Investigating the diversity and palaeobiogeography of ankylosaurian dinosaurs using tooth morphometrics

by

Emily Cross

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We acknowledge and respect the lək'ʷəŋən peoples on whose traditional territory the university stands and the Songhees, Esquimalt and W̱SÁNEĆ peoples whose historical relationships with the land continue to this day.

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Abstract

The presence of a basal cingulum, fluting, and overall size have been used to differentiate nodosaurid and ankylosaurid teeth for decades. However, the taxonomic utility of tooth morphology in ankylosaurs has not yet been quantitatively tested. Additionally, new phylogenetic hypotheses recognize four ankylosaur families (Panoplosauridae, Polacanthidae, Struthiosauridae, and Ankylosauridae), rather than the traditional nodosaurid-ankylosaurid dichotomy. Understanding ankylosaur tooth variation could better help identify taxa with ambiguous phylogenetic affinities or allow isolated teeth to test palaeoecological questions like the potential extirpation of mid Cretaceous ankylosaurids from Laramidia. I analyzed a large sample of ankylosaur teeth from the Cretaceous of Laramidia using traditional and 2D outline geometric morphometrics and investigated the utility of size and the presence or absence of a cingulum and fluting for differentiating ankylosaur teeth. Morphometric analyses show that 'nodosaurids' had the greatest variation in tooth shape and size. Panoplosauridae accounts for a large amount of 'nodosaurid' variation, whereas basal ankylosaurs, Polacanthidae, and Ankylosauridae share a similar restricted morphospace. Previously, small teeth were identified as ankylosaurid and large teeth as nodosaurid; teeth with a crown base length or height over 10 mm are only found in panoplosaurids and *Peloroplites*, traditionally considered a nodosaurid but recently recovered as a polacanthid, but smaller sizes are found in all clades. A basal cingulum and fluting are associated with Ankylosauridae and Panoplosauridae, but not with other ankylosaur families. Linear discriminant analyses could only accurately identify between 50-75% of the teeth in our sample. LDAs should therefore be used in conjunction with size and discrete traits to identify isolated teeth as panoplosaurids. As such, caution should be used when attempting to use isolated ankylosaur teeth in broader palaeoecological questions.

Table of Contents

List of Tables

List of Figures

Institutional Abbreviations

BYU – Brigham Young University Museum of Paleontology, Provo, Utah, USA

CEUM – Utah State University Eastern, Prehistoric Museum, Price, Utah, USA

CMN – Canadian Museum of Nature, Ottawa, Ontario, Canada

CPAP – Colección de Paleobiología de Antártica y Patagonia at Instituto Nacional Antártico, Chileno, Punta Arenas, Chile

DMNH – Denver Museum of Nature and Science, Denver, Colorado, USA

MLP – Museo de La Plata, La Plata, Argentina

PIN – Paleontological Institute, Russian Academy of Sciences, Moscow, Russia

ROM – Royal Ontario Museum, Toronto, Ontario, Canada

SDSNH – San Diego Natural History Museum, San Diego, USA

SMU – Southern Methodist University, Dallas, Texas, USA

TMP – Royal Tyrrell Museum of Paleontology, Drumheller, Alberta, Canada

UALVP – University of Alberta Vertebrate Paleontology, Edmonton, Alberta, Canada

UMNH – Natural History Museum of Utah, Salt Lake City, Utah, USA

ZPAL – Zoological Institute of Paleobiology, Polish Academy of Sciences, Warsaw, Poland

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Chapter 1 – Introduction

Dinosaurs continuously grew and shed teeth throughout their lives (Carpenter & Brent, 1986). Coupled with the durable nature of enamel and dentin compared to the hydroxyapatite of bones, this means that dinosaur teeth were far more likely to enter the fossil record than other skeletal or soft tissue elements. As such, signals may be present in the dental fossil record that are not present in the non-dental skeletal record and the relative abundance of teeth should may reflect the relative abundance of the species within a specific formation (Carpenter & Brent, 1986). Teeth have been used in taxonomic studies for several dinosaur clades (ex. Smith et al. 2005, Hendrickx et al, 2020), but this can present problems when tooth variation is not fully understood. Previous authors (Carpenter & Breithaupt, 1986, Coombs & Deméré, 1996) have suggested that the teeth of different ankylosaur clades can be differentiated based on tooth morphology, potentially increasing the amount of data available for understanding ankylosaur diversity and evolution through time. However, ankylosaur tooth identification through morphometrics has not been tested using modern approaches or with a large statistical sample. In this study, I use modern morphometric approaches on a dataset of over 600 tooth specimens to investigate whether ankylosaur teeth can be differentiated with morphometrics.

1.1 Ankylosaur taxonomy:

Ankylosaurs were herbivorous ornithischian dinosaurs with large body sizes often exceeding 5 metres in length (Hayashi et al, 2010). The suborder emerged in the Upper Jurassic

(Kubo, Zheng, Kubo, & Jin, 2021) and likely went extinct during the Cretaceous-Paleogene (KPg) extinction event (Carpenter & Brent, 1986). Traditionally two families are recognized and supported by several morphological traits: nodosaurids have outward protruding spines along the shoulders, a long snout, and no tail club, and ankylosaurids have a shorter snout and a tail club (W. Coombs & Maryańska, 1990). With the large body size and amount of vegetation needed for their diets, ankylosaurs are considered "keystone herbivores" and would have had a large effect on the environment they occupied (Brown et al., 2020). Ankylosaurs are the herbivores with the largest number of recovered cololites (fossilized stomach contents) allowing a clearer picture of their dietary preferences (Brown et al., 2020). The holotype of *Borealopelta markmitchelli*, a well-preserved nodosaurid specimen, was found with club moss and fern spores in its cololite, as well as primarily leaf material as opposed to twigs (Brown et al., 2020). Nodosaurids are statistically found more often in marine settings than ankylosaurs, suggesting that nodosaurids may have inhabited a larger range of paleoenvironments or displayed a preference for inhabiting coastal and/or fluvial environments (Arbour, Zanno, & Gates, 2016; Butler & Barrett, 2008).

Ankylosauria is a suborder within the larger Order Ornithischia (bird-hipped dinosaurs) and the unranked clade Thyreophora (W. Coombs & Maryańska, 1990). Thyreophora includes

Ankylosauria and Stegosauria (Figure 1). The family Nodosauridae was first proposed by Marsh (1890) but was included within Ceratopsia rather than Ankylosauria and was later moved by Marsh to Stegosauria (1895, 1896). Brown (1908) first proposed the family Ankylosauridae with the discovery of *Ankylosaurus*. While these two families were proposed at the turn of the 20th century, they were not placed as families within Ankylosauria until 1978 (Coombs, 1978). Coombs (1978) used many synapomorphies throughout the skeleton to differentiate these two families and suggested several dental features to distinguish between the families of Nodosauridae and Ankylosauridae. Ankylosaurids have small crowns relative to roots compared to nodosaurids. They have a swollen base but rarely a basal cingulum compared to nodosaurids, which have a distinct basal cingulum. Lastly, ankylosaurids have occasional complex fluting, compared to nodosaurids which have fluting running between the denticle cusps. These two families likely diverged from each other in the Upper Jurassic (W. Coombs & Maryańska, 1990).

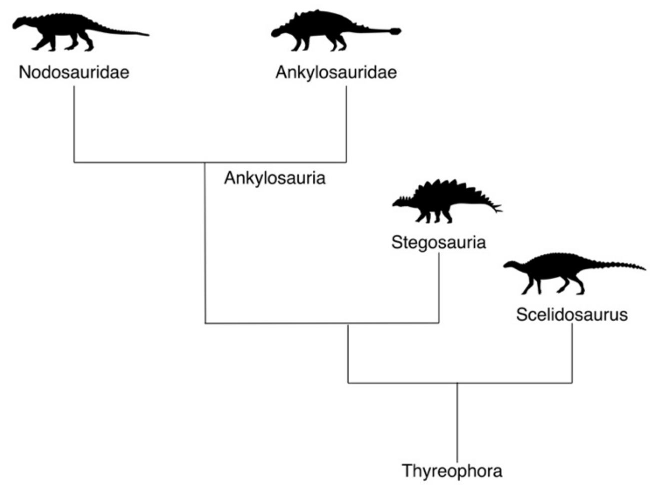

Figure 1. Simplified Coombs (1978) phylogeny. Silhouettes are from phylopic.org and are by Scott Hartman (Stegosaurus)under CC-BY 3.0, Andrew A. Farke (Euoplocephalus) under CC-BY 3.0, and Matt Dempsey (Scelidosaurus) under CC-BY 4.0.

Although most phylogenetic analyses of Ankylosauria have upheld this two-clade classification (ex. Arbour & Currie, 2016, Thompson et al., 2012), two recent studies have suggested that ankylosaur phylogenetic relationships are more complex. Soto-Acuña et al. (2021) identified a potential third clade, Parankylosauria, outside of Ankylosauridae and Nodosauridae, which contains the highly divergent *Stegouros* (Figure 2). Raven et al. (2023) recovered a paraphyletic Nodosauridae whose members are spread across three families – Polacanthidae, Panoplosauridae, and Struthiosauridae, all supported by multiple cranial and postcranial synapomorphies (Figure 3). Two dental traits are given as unambiguous synapomorphies for Struthiosauridae: sub-triangular tooth crowns and fluting on tooth crowns not extending down to the basal cingulum. No Struthiosauridae teeth

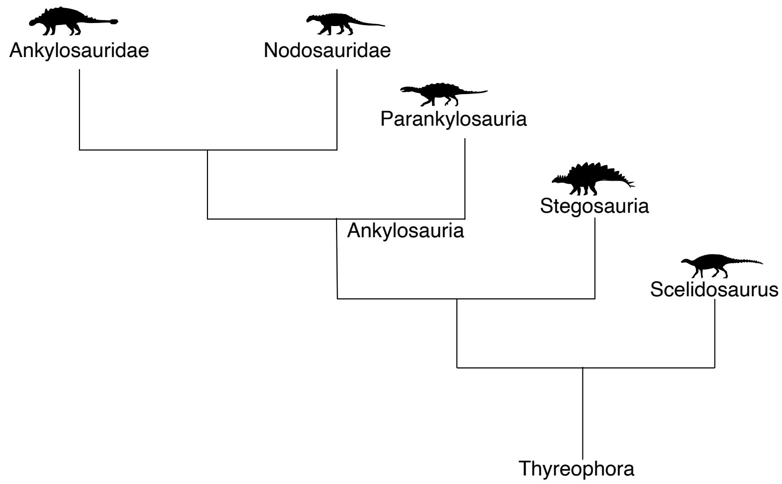

Figure 2. Soto Acuña et al. (2021) simplified phylogeny. Silhouettes are from phylopic.org and are by Scott Hartman (Stegosaurus) under CC-BY 3.0, Andrew A. Farke (Euoplocephalus) under CC-By 3.0,, Alexander Vargas (Stegouros) under CC-BY-SA 3.0 and Matt Dempsey (Scelidosaurus) under CC-BY-SA 4.0.

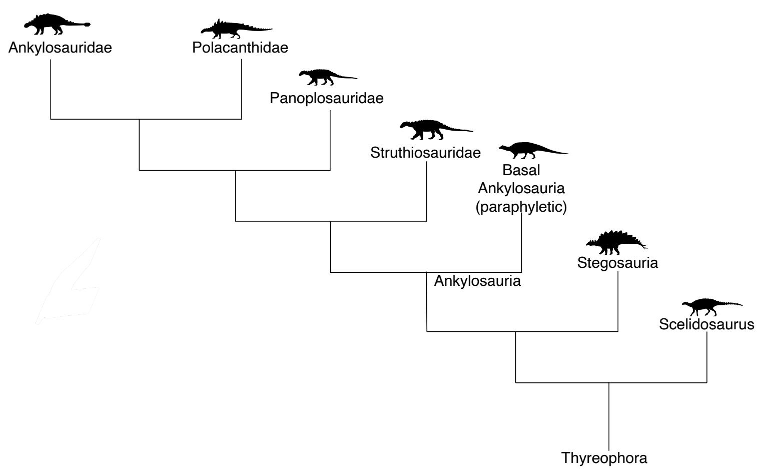

Figure 3. Simplified Raven et al. (2023) phylogeny. Silhouettes are from phylopic.org and are by Scott Hartman (Gastonia, Stegosaurus) under CC-BY 3.0, Andrew A. Farke (Euoplocephalus) under CC-BY 3.0, and Matt Dempsey (Scelidosaurus) under CC-BY-SA 4.0.

were obtained for this study, as most of these taxa are from Europe which was not a focus of this project. Notably, *Gargoyleosaurus* and *Cedarpelta* are identified as basal Ankylosauria, not falling within any of the four ankylosaur families proposed by Raven et al. (2023). This study will investigate the potential for distinguishing between Nodosauridae and Ankylosauridae, using tooth morphologies, while also considering the families proposed by Raven et al. (2023). Throughout the text, the 'traditional' nodosaurid-ankylosaurid dichotomy is referred to as the Coombs taxonomy and the revised phylogeny splitting 'nodosaurids' into Struthiosauridae, Polacanthidae, and Panoplosauridae is referred to as the Raven et al. taxonomy.

1.2 Morphometric studies

To test whether ankylosaur teeth are distinct at the family level, I used morphometrics on over 600 samples of teeth in skulls, associated teeth, and isolated teeth. There are several morphometric methodologies, however, this paper will focus on geometric morphometrics and traditional morphometrics. Within paleontology, the morphometrics of teeth has focused on sharks (Bazzi, Campione, Ahlberg, Blom, & Kear, 2021; Bazzi, Kear, Blom, Ahlberg, & Campione, 2018; Belben, Underwood, Johanson, & Twitchett, 2017) and theropod dinosaurs (Larson, 2008; Larson & Currie, 2013). These studies successfully reevaluated taxonomic relationships, differentiated between groups with similar-looking teeth, and studied diet and biodiversity. Existing morphometric methods can be applied to ankylosaur teeth and have the potential to differentiate teeth from the various ankylosaur subclades. As teeth enter the fossil record more readily than non-dental skeletal bones, they are often used in dinosaur biostratigraphy and faunal studies to indicate faunal and ecological changes (e.g. Eberth et al., 2013). For morphometric research, deformed specimens should be avoided when possible, as their measurements can skew the dataset (Hedrick, 2023). The harder enamel and dentin of teeth is less prone to ductile taphonomic distortion than bone (Schmidt et al., 2017). As such, the deformation resistance of teeth makes them an ideal feature on which to conduct morphometric research on.

A morphometric framework which distinguishes ankylosaurian subclades would A) identify the diversity of form within Ankylosauria, B) uncover the spatial and temporal distributions of ankylosaur subclades and their relationship to one another, and C) allow for a reevaluation of isolated teeth in research collections to build a broader reconstruction of ankylosaur environmental preferences.

1.3 Ankylosaur dentition:

Ankylosaur teeth are considered “primitive” compared to other ornithischians, as their structure does not change significantly from basal ornithischians, and they do not have a complex dentition compared to the modified dental batteries of hadrosaurs and ceratopsians (W. Coombs & Maryańska, 1990). Nevertheless, differences between ankylosaurian teeth have been noted in the literature since Coombs (1978) nodosaurid-ankylosaurid framework, and faunal list papers (ex. Cullen et al., 2016), museum collections, and the Paleobiology Database (PBDB) often refer isolated teeth to Nodosauridae or Ankylosauridae based on characteristics such as size and the presence/absence of a basal cingulum. Ankylosaurs have leaf-shaped teeth (Figure 4) present in the maxilla and dentary. Most derived taxa have edentulous premaxillae, but some early members retain premaxillary teeth that are also leaf-shaped. Premaxillary teeth are included in this study but are not the primary focus as so few species retained them. Figure 4 illustrates the features of an ankylosaur dentary tooth. Ankylosaur teeth generally have denticles (serrations along the edge of the tooth that would aid in leaf consumption) and sometimes have fluting (small grooves that run from the denticles down toward the tooth base). Ankylosaur teeth are not interlocking and are small relative to their skulls (W. Coombs & Maryańska, 1990). Coombs and Deméré (1996) noted that ankylosaurid teeth seem to be smaller and more numerous than nodosaurid teeth. The number of denticles varies between species and within individuals (W. Coombs & Maryańska,

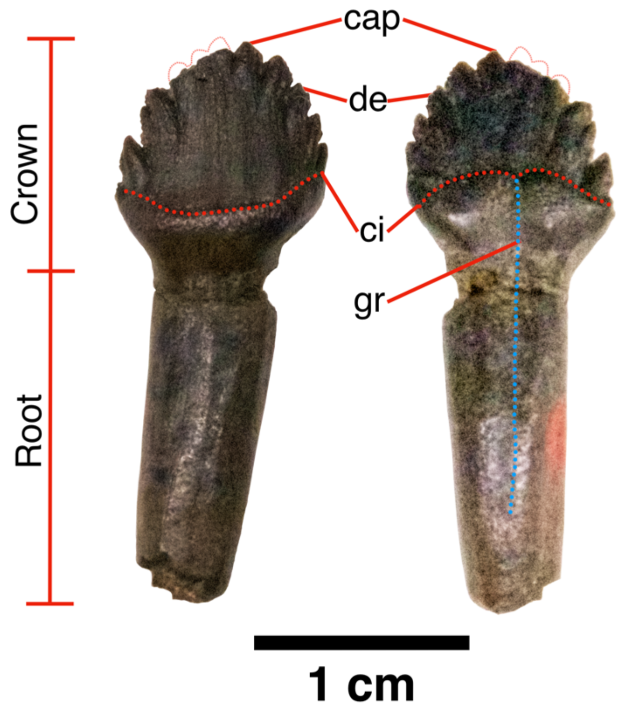

Figure 4. Edmontonia longiceps tooth (CMNFV 8531 – 7) illustrates the possible features present on an ankylosaur tooth. Red dotted line represents cingulum and blue dotted line represents groove. Abbreviations: ***cap,*** *crown apex;* ***ci,*** *cingulum;* ***de****, denticle;* ***gr****, groove.*

1990). In nodosaurids, larger teeth tend to have more denticles (W. P. Coombs & Deméré, 1996). Carpenter and Breithaupt (1986) noted that attempts to differentiate nodosaurid and ankylosaurid teeth have done so based upon the assumption that nodosaurid teeth have a basal cingulum (a ridge on the back of the tooth where the crown meets the root – see figure 4) and ankylosaurid teeth instead have a swollen base. However, teeth *in situ* in jaws have shown that this is not always the case, as not all nodosaurid teeth possess a basal cingulum and some ankylosaurid teeth do possess it (W. P. Coombs & Deméré, 1996). Morphometric research on ankylosaur teeth should include teeth *in situ* in the dentary or maxilla and isolated teeth. Teeth *in situ* in the dentary or maxilla can be reliably attributed to a specific species based on non-dental features, such as nasal passages or cranial ornamentation (Coombs, W., & Maryańska, T., 1990). Isolated teeth identifications should be reevaluated using the morphometric framework developed from *in situ* and associated teeth.

The leaf-shaped morphology present in ankylosaurs is also present in many non-ankylosaurian ornithischians and is thought to be the basal ornithischian tooth shape. Thescelosaurids, stegosaurs, and pachycephalosaurs all have a very similar tooth shape to ankylosaurs. Thescelosaurids are a family of bipedal ornithischians, stegosaurids are also thyreophorans and are generally recognized by having plates on their back, and pachycephalosaurs are the dome-headed dinosaurs. It is interesting to note that in the Cretaceous, thescelosaurids, ankylosaurs, and pachycephalosaurs were all present in the same ecosystems at the same time, and had a similar feeding height (Mallon et al., 2013).

1.4 Ankylosaur evolution throughout the Cretaceous:

The Cretaceous was a time of significant ecological change in North America, coinciding with transgressions and regressions of the Western Interior Seaway (Kauffman & Westermann, 1984). Late Jurassic dinosaur faunas dominated by sauropods, stegosaurs, and allosauroid theropods transitioned to an Early Cretaceous fauna dominated by iguanodonts, with fewer and less diverse sauropods, and no stegosaurs (Tennant et al., 2016). The Late Cretaceous saw the extirpation of sauropods until the very latest Maastrichtian, and the rise to dominance of ceratopsians, hadrosaurs, and tyrannosaurs (Benton, 2023). Ankylosaurs were present throughout the Late Jurassic to the end of the Cretaceous, but how the clades within this group changed during the Cretaceous is less clear. In North America, the earliest nodosaurids are known from the Upper Jurassic of Colorado and Wyoming (Carpenter et al., 1998, Kirkland & Carpenter 1994), and skeletal fossils are present in the Late Jurassic (Tithonian), Early Cretaceous (Barriasian, Valanginian, Aptian, Albian), and Late Cretaceous (Cenomanian, Coniacian, Santonian, Campanian, Maastrichtian). Putative nodosaurid teeth are also present throughout the Cretaceous.

Early Cretaceous North American ankylosaurids are currently only represented by *Cedarpelta*, which is sometimes recovered as a basal ankylosaurid (Arbour & Currie, 2016, Carpenter, 2001, Thompson et al., 2012) and sometimes as a nodosaurid (Vickaryous 2004). Definitive ankylosaurid body fossils are absent from the fossil record of western North America between the Cenomanian and Campanian. All North American ankylosaurids except for *Aletopelta* and *Cedarpelta* are deeply nested within a clade of Asian origin (Arbour and Currie 2016). Arbour et al. (2016) suggested that Asian ankylosaurids migrated to North America in the later Cretaceous following a potential North American ankylosaurid extirpation after the

Cenomanian, resulting in an ‘ankylosaurid gap’ similar to that proposed for sauropods by Lucas & Hunt (1989). Arbour et al. (2016) used only skeletal fossils in their dataset because of concerns about the accuracy of assigning isolated teeth to either nodosaurid or ankylosaurid ankylosaurs. However, several papers (ex. Dorr, 1985, Eaton et al., 1999, Eaton, Diem, et al., 1999, Lee, 1997, Loewen et al., 2013, Parrish, 1999, Russell, 1935, Weishampel et al., 2002 – stratigraphy updated by Krumenacker, 2010) include isolated ankylosaur teeth from the early Late Cretaceous (Cenomanian to Santonian) of North America. Investigating the morphometrics of ankylosaurid and nodosaurid teeth has the potential to test whether the “ankylosaurid gap” is a true signal indicating ankylosaurids were extirpated in North America in the early Late Cretaceous.

1.5 Objectives:

In situ and associated teeth can be reliably attributed to a single species or family. These associated teeth are used here to test differences in morphology between ankylosaurian families and between individual species. This dataset is then used to test the affinities of isolated ankylosaur teeth in order to potentially answer broader questions about ankylosaur palaeobiogeography and evolution. The primary hypotheses of this thesis are:

1. Ankylosaur teeth can be differentiated from other leaf-shaped ornithischian teeth.
2. The morphology of teeth from different ankylosaurian families (using either the Coombs or Raven et al. taxonomy) differs based on morphometric data.
3. Ankylosaurian species can be identified from isolated teeth.
4. Ankylosaurian families can be differentiated in geographically restricted formations.

Many museum collections and researchers currently classify ankylosaurid and nodosaurid isolated teeth based on features proposed by Coombs (1978), potentially skewing results if these teeth cannot be distinguished at the family level, or, alternately, reducing granularity if teeth are lumped together only as ankylosaur teeth when they are actually distinct. Determining whether the teeth of ankylosaurids and non-ankylosaurids (nodosaurids using Coombs' taxonomy; panoplosaurids, struthiosaurids, and polacanthids using Raven et al.'s taxonomy) can be reliably distinguished from each other has significant implications for several lines of inquiry. It has the potential to test the ankylosaurid extirpation hypothesis – indicating how ankylosaurs reacted to environmental change. Understanding the variation in nodosaurid tooth morphology can provide an independent line of evidence to support reclassifying Nodosauridae into the multiple families proposed by Raven et al. (2023). Palaeoecological studies often include data from palaeontological microsites and isolated dinosaur teeth Understanding which ankylosaur family an isolated tooth belongs to can help clarify whether nodosaurids inhabited a larger range of paleoenvironments or a preference for coastal environments by studying which formations they are found in, or could provide insight into dietary preferences between clades.

Chapter 2 – Methodology

Morphometrics have long been used to differentiate taxa based on the shape of a particular skeletal element (Adams, Rohlf, & Slice, 2004). Traditional morphometrics and geometric morphometrics are the primary types of morphometric analysis (Adams et al., 2004).

2.1 Materials and data collection:

I sampled teeth with known taxonomic identities based upon their association with other skeletal material or their origin from a monotaxic bonebed (Figures 5 and 6, Table 2). These teeth were used to build the training and test datasets for morphometric analyses. Taxonomic identifications were derived first from literature, and if they are not cited in literature, then by specimen cards in museum collections. I studied isolated teeth to test hypotheses of ankylosaur evolution (Table 1).

I conducted several research trips to collect the required data for the analyses. Institutions visited include the Canadian Museum of Nature, Royal Ontario Museum, Utah Museum of Natural History, Brigham Young University, Utah State University Eastern Prehistoric Museum, Denver Museum of Nature and Science, University of Alberta Lab for Vertebrate Palaeontology, and Royal Tyrrell Museum of Palaeontology. Photos provided by V. Arbour collected prior to this study were also used for digital traditional and geometric morphometric analyses. I photographed each isolated tooth in labial and lingual view, noting any important features and wear patterns. To reduce perspective and barrel lens distortion in images for digital measurements, I placed specimens in the centre of the camera view and used a high optical zoom level. I also photographed teeth *in situ* in jaws, however, depending on the stage of eruption and mounting style of the skull, often only one view of an *in situ* tooth was possible. Occasionally, there were several teeth under the same specimen number; I assigned these teeth a hyphenated arbitrary number. There is a single *Animantarx* associated tooth useable for analyses, only visible in lingual view, and Raven et al. (2023) provide two alternate classification schemes (here called Raven et al. (2023) classification B) (Figure 6), where *Animantarx* is classified as either a polacanthid or basal ankylosaur; both topologies are tested here.

Table 1. Isolated teeth summary by geologic formation

Unit	Age	Total # of teeth	# original ID ankylosaurid	# original ID nodosaurid
Belly River Group	Campanian (Eberth, 2024)	24	4	17
Cedar Mountain Fm	Late Jurassic-Cenomanian (Kirkland et al., 2016)	3		
Ruby Ranch Mbr, Cedar Mountain Fm	Aptian-Albian (Chure et al., 2010, Gulbranson et al., 2020)	3		3
Cloverly Fm	Valanginian-Cenomanian (D'Emic et al., 2019)	23		23
Dakota Fm	Cenomanian (Barclay et al., 2015)	1		
Dinosaur Park Fm	Campanian (Ramezani et al., 2022)	88	37	30
Foremost Fm	Campanian (Eberth, 2024)	7	3	1
Horseshoe Canyon Fm	Campanian-Maastrichtian (Eberth & Kamo, 2020)	2	2	
Iron Springs Fm	Santonian (Goldstrand et al., 1993)	1		
Judith River Fm	Campanian (Ramezani et al., 2022)	37	21	5
Kaiparowits Fm	Campanian (Ramezani et al., 2022)	13		
Lance Fm	Maastrichtian (Lockley et al., 2004)	1		1
Milk River Fm	Santonian (Payenberg, 2002)	8	1	1

Oldman Fm	Campanian (Eberth, 2024)	113	31	71
Scollard Fm	Maastrichtian (Eberth & Kamo, 2020)	5	1	1
St. Mary River Fm	Campanian-Maastrichtian (Campbell et al., 2019)	1		1
Straight Cliffs Fm	Turonian-Campanian (Chetnik et al., 2015)	7		
Wahweap Fm	Campanian (Beveridge et al., 2022)	4		
Wapiti Fm	Campanian-Maastrichtian (Fanti et al., 2015)	1		
Unknown Fm		15		3

Table 2. Associated teeth

Specimen number	Taxon	Coombs (1978) family	Raven et al. (2023) family	# of teeth used	Formation	Age	Type status	Teeth in situ or associated
CEUM 09173 (previously CEUM 6228)	*Animantarx ramaljonesi* (Carpenter et al, 1999)	Nodosauridae	Polacanthidae (in preferred tree) or Basal (in preferred signal tree)	1	Mussentuchit Mbr, Cedar Mountain Fm (Carpenter et al., 1999)	Cenomanian (Tucker et al., 2020)	Holotype	In situ
CEUM 12435	*Animantarx ramaljonesi*	Nodosauridae	Polacanthidae (in preferred tree) or Basal (in preferred signal tree)	0	Mussentuchit Mbr, Cedar Mountain Fm	Cenomanian (Tucker et al., 2020)		Associated
DMNH EPV 468	*Denversaurus schlessmani* (Bakker, 1988)	Nodosauridae	Panoplosauridae	1	Hell Creek Fm (Bakker, 1988)	Maastrichtian (Johnson et al., 2002)	Holotype	In situ
CMNFV 8531	*Edmontonia longiceps* (Sternberg, 1928)	Nodosauridae	Panoplosauridae	9	Horseshoe Canyon Fm	Campanian-Maastrichtian (Eberth & Kamo, 2020)	Holotype	In situ, associated
ROM 1215	*Edmontonia rugosidens* (Ryan & Evans, 2005, Russell, 1940), *Panoplosaurus longiceps* (Coombs, 1971)	Nodosauridae	Panoplosauridae	17	Dinosaur Park Fm (Mallon, 2019)	Campanian (Eberth, 2024)		In situ, associated

Specimen number	Taxon	Coombs (1978) family	Raven et al. (2023) family	# of teeth used	Formation	Age	Type status	Teeth in situ or associated
TMP 1998.098.0 001	*Edmontonia rugosidens* (Vickaryous, 2006)	Nodosauridae	Panoplosauridae	23	Dinosaur Park Fm (Vickaryous , 2006)	Campanian (Ramezani et al., 2022)		In situ
DMNH 27726	*Gargoyleosaurus parkpinorum* (Kilbourne & Carpenter, 2005)	Nodosauridae	Basal Ankylosauria	18	Morrison Fm (Kilbourne & Carpenter, 2005)	Late Jurassic (Maidment & Muxworthy, 2019)	Holotype	In situ, associated
BYU VP 50866	*Gastonia burgei*	Nodosauridae	Polacanthidae	1	Cedar Mountain Fm	Barrasian-Valanginian		Monotaxic bonebed (pers. comm. Rodney Scheetz)
CEUM 11909 (previously CEUM 5145)	*Gastonia burgei* (Kirkland, 1998), Kineer et al., 2016)	Nodosauridae	Polacanthidae	1	Yellow Cat Mbr, Cedar Mountain Fm (Kirkland, 1998, Kineer et al., 2016)	Barrasian-Valanginian (Joekal et al., 2020)	Holotype	Associated
CEUM 11910	*Gastonia burgei*	Nodosauridae	Polacanthidae	1	Yellow Cat Mbr, Cedar Mountain Fm	Barrasian-Valanginian (Joekal et al., 2020)		Monotaxic bonebed

Specimen number	Taxon	Coombs (1978) family	Raven et al. (2023) family	# of teeth used	Formation	Age	Type status	Teeth in situ or associated
CEUM 11911	*Gastonia burgei*	Nodosauridae	Polacanthidae	1	Yellow Cat Mbr, Cedar Mountain Fm	Barrasian-Valanginian (Joekal et al., 2020)		Monotaxic bonebed
CEUM 11912	*Gastonia burgei*	Nodosauridae	Polacanthidae	1	Yellow Cat Mbr, Cedar Mountain Fm	Barrasian-Valanginian (Joekal et al., 2020)		Monotaxic bonebed
CEUM 5373	*Gastonia burgei*	Nodosauridae	Polacanthidae	1	Yellow Cat Mbr, Cedar Mountain Fm	Barrasian-Valanginian (Joekal et al., 2020)		Monotaxic bonebed
DMNH 53040	*Gastonia lorriemcwhinneyae (Kineer et al., 2016)*	Nodosauridae	Polacanthidae	1	Ruby Ranch Mbr, Cedar Mountain Fm (Kineer et al., 2016)	Aptian-Albian (Chure et al., 2010, Gulbranson et al., 2022)	Paratype	Monotaxic bonebed
DMNH 50373	*Gastonia lorriemcwhinneyae*	Nodosauridae	Polacanthidae	1	Ruby Ranch Mbr, Cedar Mountain Fm	Aptian-Albian (Chure et al., 2010, Gulbranson et al., 2022)		Monotaxic bonebed

Specimen number	Taxon	Coombs (1978) family	Raven et al. (2023) family	# of teeth used	Formation	Age	Type status	Teeth in situ or associated
DMNH 50377	*Gastonia lorriemcwhinneyae*	Nodosauridae	Polacanthidae	1	Ruby Ranch Mbr, Cedar Mountain Fm	Aptian-Albian (Chure et al., 2010, Gulbranson et al., 2022)		Monotaxic bonebed
DMNH 50206	*Gastonia lorriemcwhinneyae*	Nodosauridae	Polacanthidae	2	Ruby Ranch Mbr, Cedar Mountain Fm	Aptian-Albian (Chure et al., 2010, Gulbranson et al., 2022)		In situ, associated
CMNFV 2759	*Panoplosaurus mirus* (Lambe, 1919)	Nodosauridae	Panoplosauridae	6	Dinosaur Park Fm (Lambe, 1919)	Campanian (Ramezani et al., 2022)	Holotype	Associated
CEUM 34580 (previously CEUM 26331.6)	*Pelorolites cedrimontanus* (Carpenter et al., 2008)	Nodosauridae	Polacanthidae	1	Ruby Ranch Mbr, Cedar Mountain Fm (Zanno et al., 2023)	Aptian-Albian (Chure et al., 2010, Gulbranson et al., 2022)		In situ
CMNFV 8880	*Ankylosaurus magniventris* (Arbour & Mallon, 2017)	Ankylosauridae	Ankylosauridae	2	Scollard Fm (Carpenter, 2004)	Maastrichtian (Eberth & Kamo, 2020)		Associated

Specimen number	Taxon	Coombs (1978) family	Raven et al. (2023) family	# of teeth used	Formation	Age	Type status	Teeth in situ or associated
TMP 1997.132.0001	*Anodontosaurus lambei* (Arbour & Currie, 2013)	Ankylosauridae	Ankylosauridae	6	Dinosaur Park Fm (Arbour & Currie, 2013)	Campanian (Ramezani et al., 2022)		In situ
TMP 1996.075.0001	*Anodontosaurus lambei* (Arbour & Currie, 2013)	Ankylosauridae	Ankylosauridae	12	Horseshoe Canyon Fm (Arbour & Currie, 2013)	Campanian-Maastrichtian (Eberth & Kamo, 2020)		Associated
CEUM 1264 #86	*Cedarpelta bilbeyhallorum* (Arbour & Currie, 2016, Carpenter et al., 2001)	Ankylosauridae	Basal Ankylosauria	1	Ruby Ranch Mbr, Cedar Mountain Fm (Zanno et al., 2023)	Aptian-Albian (Chure et al., 2010, Gulbranson et al., 2022)	Holotype	In situ
CMNFV 8876	*Euoplocephalus tutus* (Arbour & Currie, 2016)	Ankylosauridae	Ankylosauridae	3	Oldman Fm or Dinosaur Park Fm (Arbour & Currie, 2016)	Campanian (Eberth, 2024)		Associated
TMP 1980.016.1685	*Euoplocephalus tutus*	Ankylosauridae	Ankylosauridae	2	Dinosaur Park Fm	Campanian (Ramezani et al., 2022)		In situ

Specimen number	Taxon	Coombs (1978) family	Raven et al. (2023) family	# of teeth used	Formation	Age	Type status	Teeth in situ or associated
TMP 2017.023.0 017	tentatively *Euoplocephalus tutus*	Ankylosauridae	Ankylosauridae	4	Oldman Fm	Campanian (Eberth, 2024)		In situ
ZPAL MgD II/1	*Pinacosaurus grangeri* (Maryańska, 1977)	Ankylosauridae	Ankylosauridae	7	Djadokhta Fm (Marayańsk a, 1977)	Campanian (Dashzeveg et al., 2005)		In situ
PIN 3142/250	*Saichania chulsanensis* (Arbour et al., 2014), *Tarchia teresae* Penkalski & Tumanova, 2017, *Tarchia gigantea* Tumanova,1977	Ankylosauridae	Ankylosauridae	10	Nemegt Fm (Arbour et al., 2014)	Maastrichtian (Jerzykiewicz, 2000)		In situ
DMNH 2818	*Stegosaurus stenops* (Galton, 2011)	Stegosauridae	Stegosauridae	28	Morrison Fm (Galton, 2011)	Late Jurassic (Maidment & Muxworthy, 2019)		In situ
DMNH 136185	*Thescelosaurus neglectus*	Thescelosauridae	Thescelosauridae	12	Hell Creek Fm	Maastrichtian (Johnson et al., 2002)		In situ, associated
CMNFV 8537	*Thescelosaurus edmontonensis* (Boyd et al., 2009)	Thescelosauridae	Thescelosauridae	8	Scollard Fm (Boyd et al., 2009)	Maastrichtian (Eberth & Kamo, 2020)	Holotype	Associated

Specimen number	Taxon	Coombs (1978) family	Raven et al. (2023) family	# of teeth used	Formation	Age	Type status	Teeth in situ or associated
UALVP 00002	*Stegoceras validum* (Sullivan, 2003)	Pachycephalosauridae	Pachycephalosauridae	40	Oldman Fm (Sullivan, 2003)	Campanian (Eberth, 2024)		In situ
ROM 53579	*Pachycephalosaurus/ Dracorex* (Goodwin & Evans, 2016)	Pachycephalosauridae	Pachycephalosauridae	1	Hell Creek Fm	Maastrichtian (Johnson et al., 2002)		In situ

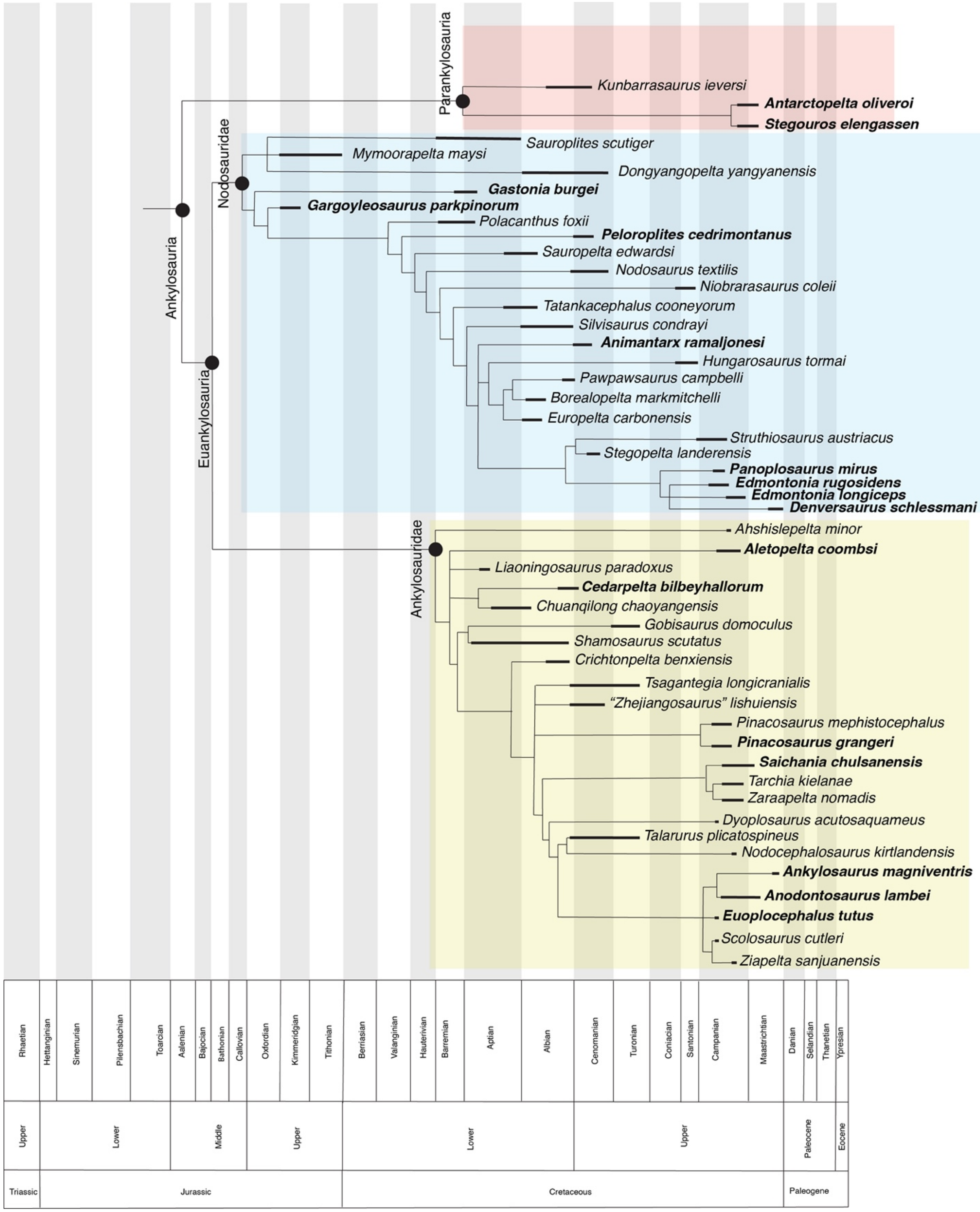

Figure 5. Phylogeny of Ankylosauria based on Coombs (1978) two-family classification method. Ankylosaurid interrelationships (yellow) from Arbour & Currie (2016), nodosauridae interrelationships (blue) from Brown et al. (2017), and relationships of parankylosaurians (red) from Soto-Acuña et al. (2021). Species in bold were investigated in this study.

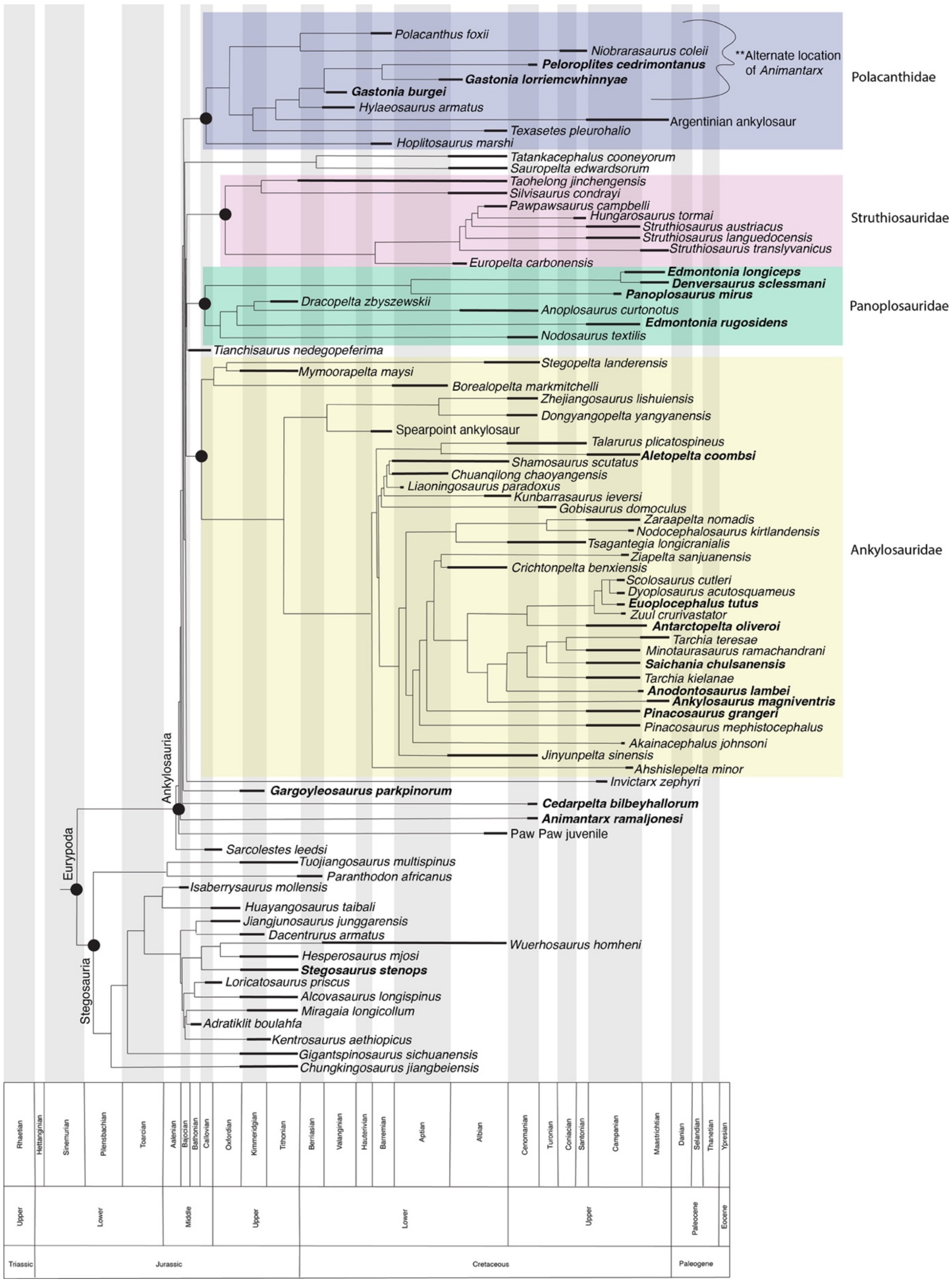

Figure 6. Phylogeny of Ankylosauria based on Raven et al. (2023) four-family classification method. Species in bold were investigated in this study.

2.2 Traditional morphometrics:

Traditional morphometrics uses datasets built from measurements such as lengths, widths, areas, or ratios. These measurements can be completed by hand, however for higher precision with small specimens, measurements are often taken from images of the specimen using quantitative image analysis software such as ImageJ (Hudgins, Currie, & Sullivan, 2022) or tpsDIGs (Marramà & Kriwet, 2017). Hudgins et al. (2022) completed traditional morphometrics on pachycephalosaur (dome-headed dinosaurs) and thescelosaurid (basal ornithischian dinosaurs) teeth, which have some similar features to the teeth of ankylosaurs and provide potential features that could be measured. Hudgins et al. (2022) measured crown height, crown base length, mid-crown length, neck length, apical length, mesial carina length, distal carina length, mesial denticle height, mesial denticle length, distal denticle height, distal denticle length, and crown angle (Figure 7). The impact of size differences must be controlled with standardization and log transformation (Marramà & Kriwet, 2017, Larson & Currie, 2013), and neither surface features (such as the basal cingulum) or curved surfaces can be included in an analysis using traditional morphometrics.

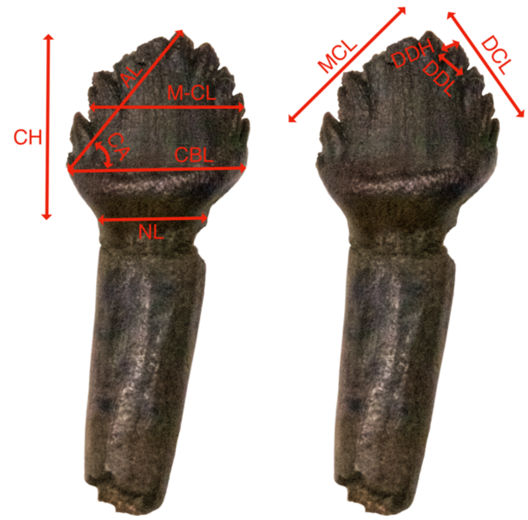

Figure 7. Edmontonia longiceps *tooth (CMNFV 8531-7). Abbreviations:* ***AL****, apical length;* ***CA****, crown angle;* ***CBL****, crown base length;* ***CH****, crown height,* ***DCL****, distal carina length,* ***DDH****, distal denticle height;* ***DDL****, distal denticle length;* ***MCL****, mesial carina length;* ***M-CL****, mid crown length;* ***NL****, neck length.*

Traditional measurements are important because the researcher can choose whether to include size as a factor of the measurements. The traditional measurements can be normalized to exclude size and study changes in shape, or the non-normalized data can be used to consider how size factors into differences between the specimens (Adams et al., 2004). Further, traditional measurements can be taken on worn or incomplete teeth. If a feature is missing or too worn to be measured, then that feature is not included, but the tooth can still be included in the analyses for the features it does possess.

I took manual measurements on isolated teeth and *in situ* teeth using digital callipers. Measurements taken include crown height (CH), crown base length (CBL), neck length (NL), apical length (AL), mesial crown length (MCL), and distal crown length (DCL). If the area to be measured was absent or too worn, I did not take a measurement. Beyond manual measurements, I also counted mesial and distal denticles on unworn teeth. Further, I noted whether the teeth have fluting, denticles, and a basal cingulum. As isolated teeth are often worn, noting the evidence of these features has potential to aid identification to family level.

I also took traditional morphometric measurements digitally using JMorph (Lelièvre & Grey, 2017). It was often difficult to maneuver the callipers in skulls. Digital measurements provided the opportunity to make sure I could collect these measurements accurately. Further, the measurements of mesial and distal denticle heights and lengths are difficult to measure manually due to their small size and these could only be measured digitally. Traditional measurements were standardized using crown base length (CBL) to reduce the effect of size on the variables.

2.3 Geometric morphometrics:

Geometric morphometrics uses digitally acquired measurements to focus on changes in shape without considering size, orientation, or position in the photograph. Two-dimensional (2D) landmark morphometrics involves selecting features that are homologous and are identifiable in all specimens, then comparing the location of those landmarks. A common workflow is to upload specimen photographs to tpsDIGs to place landmarks and complete a General Procrustes Analysis (GPA) to eliminate all factors other than the shape (such as size and rotation) (Türtscher et al., 2021). The locations of the landmark coordinates are compared to investigate differences in shape. This type of morphometrics allows for the analysis of curved edges with the use of sliding semilandmarks positioned between landmarks. 2D landmark morphometrics has some undesirable aspects for this research: it is sensitive to missing data, so worn teeth cannot be used (Marramà & Kriwet, 2017). Similarly, because a basal cingulum is not present in all teeth, it cannot be used as a landmark, despite many authors suggesting this feature is diagnostic (e.g. Carpenter and Brent 1986, Coombs and Maryanska 1990, Coombs and Deméré 1996.) Secondly, the landmarks selected ideally should be at the same topology on all specimens (Zelditch, Swiderski, & Sheets, 2004). Topology refers to the relationship between features and how they are arranged; for example, a ridge could be located in a different area relative to the other tooth features on samples of different teeth. Denticles are not ideal landmarks as they may differ in topology in ankylosaur teeth with varying numbers of denticles. The above requirements for 2D landmark analysis greatly restrict the number of landmarks able to be selected for ankylosaur teeth. The landmarks must represent the shape of the specimen if the image of the specimen was removed. The restriction on the number of landmarks means the shape created by the landmarks is only representative of the overall tooth – not the finer details like the number of denticles or denticle height, and only when the semi-landmarks are used (Fischer et al., 2022). For ankylosaur teeth to have landmarks that represent the shape, non-ideal landmarks of the most distal denticles (farthest from the crown apex) must be used.

Landmarks are graded, with 1 being optimal, 2 being suboptimal but acceptable, and 3 being biased (Zelditch et al., 2004). Type 1 landmarks are landmarks that do not need to be referenced in association with another feature (such as the intersection of several sutures) (Zelditch et al., 2004). Type 2 landmarks are landmarks that fall on an endpoint feature, such as the tip of a tooth (Zelditch et al., 2004). Finally, type 3 landmarks represent a feature that must be referred to by its relation to another feature, such as denticles farthest from the apex (Zelditch et al., 2004). Landmarks that could be used on ankylosaur teeth include the crown apex, the first mesial denticle at the base, the first distal denticle at the base, the top of the neck on the mesial side and the top of the neck on the distal side. Of those landmarks, the crown apex, the top of the neck on the mesial side, and the top of the neck on the distal side are type 2 landmarks and the first mesial denticle at the base and the first distal denticle at the base are type 2 or 3 landmarks. As the potential landmarks on ankylosaur teeth are not ideal and thus do not accurately capture the shape of the tooth, landmark geometric morphometrics was not considered a suitable analytical method for quantifying shape variation in ankylosaur teeth.

Outline geometric morphometrics involves creating a digitized outline of the shape of the object, then plotting the centroid of the object in relation to points along the curve of the outline. I created tooth outlines by using JMorph (Lelièvre & Grey, 2017). Many morphometric techniques are unable to accurately capture the shape of curved edges, however, JMorph uses a Catmull Rom spline in outline morphometrics which interprets curves between points and therefore works particularly well on shapes with curved edges (Lelièvre and Grey, 2017). Ankylosaur teeth have curved edges at the crown base and on the mesial and distal edges. To avoid error from starting point normalization, a normalized starting point was established where the base meets the root on the left side of the tooth, and all outlines were then developed clockwise. The angle of the crown is oriented differently depending on if the tooth is from the dentary or maxilla and from different sides of the skull. Each tooth image was arranged so that when the root is at the top of the image, the mesial edge is on the left side of the image. If images were not in this format, they were rotated and inverted to meet this format to reduce error. In JMorph, each tooth is calibrated by setting the length of the scale bar (Lelièvre & Grey, 2017). Following this a calibration point is chosen, which is the starting location of the outline. Images are then zoomed to view only the specimen, to ensure accuracy when creating the outline. I then set points along the edge of the specimen drawing an outline, and JMorph computes and draws the Elliptical Fourier outline. JMorph utilizes tangent-angle Fourier Transform for developing Elliptical Fourier outlines, with the modifications from Haines and Crampton (2000) to fix the potential error (Lelièvre & Grey, 2017). JMorph generates a .csv file with the Elliptical Fourier harmonic measurements for each sample. I found that the JMorph Elliptical Fourier outline file exports do not work well with the R code Momocs (Bonhomme et al., 2014), and so the non-Elliptical Fourier outlines were exported from JMorph.

JMorph exports each outline as an individual .txt file (Lelièvre et al., 2017). I wrote an R script (Appendices F and G) to combine the files into one dataset for teeth in labial view and one dataset for teeth in lingual view in a format that works for the R package Momocs (Bohomme et al., 2014). I aligned all specimens in Momocs based on the homologous outline start point where the mesial edge tooth base meets the root. I performed a quantitative analysis on the ideal number of harmonics to use for the Elliptical Fourier Transform using the function "calibrate_harmonicpower_efourier" (Bonhomme et al., 2014), resulting in 5 harmonics for labial and lingual outlines. I converted the outline data to Elliptical Fourier outline data by using "efourier(coo, nb.h)" (Bonhomme et al., 2014) where coo is the PCA data and nb.h is the number of harmonics used in the Elliptical Fourier transform.

2.4 Data analysis:

I performed a principal components analysis (PCA) on data from all analysis methods. PCA plots individual data points using the shape variables as principle component "axes," and indicates differences in shape through the separation and grouping of the data points (Zelditch et al., 2004). PCA is ideal for testing how the isolated teeth compare to the *in situ* teeth, as well as how teeth of a particular clade compare to each other. PCAs transform the variables into new ones (principal components) that do not covary – which usually leads to a significant amount of variation able to be explained by only a few variables (Zelditch et al., 2004). I used correlation (normalized variance–covariance) for the traditional morphometric PCAs, because the crown angle is in a different unit of measurement. For the rest of the analyses, the PCAs used variance-covariance. I plotted traditional morphometric PCAs in PAST. For the geometric morphometric data, I converted the Elliptical Fourier data to PCA data and plotted the PCA with the morphospace using the Momocs code "plot_PCA" (Bonhomme et al., 2014). The PCAs show if different measurements overlap in morphospaces between clades through the clustering or separation of data points. The first PCAs for each method included only data from *in situ* or associated teeth to test if the principal components (PCs) could cluster teeth according to the two taxonomic frameworks used here (Coombs (1978) and Raven et al.(2023)). If clustering occurred, unworn isolated teeth were added to the PCA to test if their family can be identified. The percent variation of each PC and the loadings of each variable contributing to the PCs representing a large amount of the variation were noted. If only a few variables contribute to the majority of the variation in PCs, a simple biplot was constructed to determine if tooth identification can occur from only a few measurements. For traditional morphometrics (both manually and digitally measured), I completed a sensitivity analysis to determine how many missing values per sample could be included in the PCA analysis without skewing the distribution.

Beyond PCAs, datasets also underwent a linear discriminant analysis (LDA) to ensure that results were statistically significant. LDA works by breaking the data from the PCA into a test dataset and a training dataset. It converts the multivariate PCA data into a one-dimensional linear dataset of features to classify the test dataset and indicates how many of each group were correctly/incorrectly identified. Leaving out one cross validation (jack-knifed) set produces the most accurate overall classification percentage. I considered tests with a classification success rate of over 75% are considered viable tests for differentiating groups of ankylosaurs. This represents a reasonable midpoint between previously published thresholds (ex. 50% in

Davis & McHorse, 2013, 90% in Marramà & Kriwet, 2017), and allowed some overlap between clades, but well-exceeded randomly assigning a specimen to arbitrary clade (10-33% depending on the morphometric analysis (Table 10)). Isolated teeth with unknown identifications that have been plotted onto successful PCAs can be classified using the LDAs with over 75% success rates. Isolated unknown teeth are classified using the LDA of the associated specimens through Bayes Theorem. This LDA classification method indicated the percentage likelihood that each isolated tooth belongs to each of the groups. Only those with over 75% confidence were considered to have their clade identified.

The dataset was also subdivided for further investigation to answer specific questions about ankylosaur biogeography and evolution. I analyzed the morphometrics of teeth associated with skulls from geological formations in Alberta (the Belly River Group, and the Dinosaur Park, Scollard, Horseshoe Canyon, Oldman, Milk River, Foremost, Wapiti, and St. Mary River formations) was also studied as they represent a large number of samples in this dataset, have some of the better stratigraphic resolution, and provide an opportunity to test the efficacy of the methods in a case study in a geographically restricted space. Additionally, I investigated the morphometrics of teeth associated with skulls from both Alberta and Montana (Lance and Hell Creek formations) as many of these formations are diagenetically related. This allows me to test the efficacy of the methods between different, yet related, units in a case study of a larger geographic space.

Table 3. Tests and rationales

Test	Explanation/rationale
All associated teeth CBL and CH size	Tests hypotheses 1 and 2; does the size of teeth differ between families

All associated teeth by Coombs (1978) classification	Tests hypotheses 1 and 2; does the shape of teeth differ between Coombs (1978) families
All associated teeth by Raven et al. (2023) classification	Tests hypotheses 1 and 2; does the shape of teeth differ between Raven et al. (2023) families
Discrete trait analysis	Tests hypothesis 2; does the presence/absence of traits differ between families
Nodosaurid associated teeth	Tests hypothesis 3; does shape differ between nodosaurid species
Ankylosaurid associated teeth	Tests hypothesis 3; does shape differ between ankylosaurid species
Associated teeth from Alberta formations	Tests hypothesis 4; can family be differentiated in a specific geographic region
Associated teeth from Alberta and Montana formations (Santonian-Maastrichtian)	Tests hypothesis 4; can family be differentiated in specific geographic regions with diagenetically related stratigraphy

I noted whether each specimen displays fluting and/or has a basal cingulum, as those have previously been suggested as traits that differentiate Ankylosauridae and Nodosauridae (Coombs 1978). Chi-squared tests were completed using the presence/absence of these features with Coombs (1978) ankylosaur families, and ankylosaur families proposed by Raven et al. (2023) to test if there was a statistically significant relationship. Chi-squared tests compared the number of specimens that have the features actually observed within the family to the number of specimens expected to display the features within each family if the features were equally dispersed between families (e.g. no correlation between family and having the feature). P-values that are smaller than the significance level rejected the null hypothesis and indicated that there is a statistically significant correlation between the presence of the feature and the family to which it belongs.

*Table 4. Summary of methods to test proposed diagnostic traits in ankylosaur teeth. Abbreviations: **AL**, apical length; **CA**, crown angle; **CBL**, crown base length; **CH**, crown height; **DCL**, distal carina length; **DD**H, distal denticle height, **DDL**, distal denticle length; **M-CL**, mid-carina length; **MCL**, mesial carina length; **MDH**, mesial denticle height; **MDL**, mesial denticle length; and **NL**, neck length.*

Feature	Proposed by	How it was tested in this study
Presence of basal cingulum	Coombs (1978) for ankylosaurs	Noting presence or absence, chi-squared test
Fluting presence/complexity	Coombs (1978) for ankylosaurs	Noting presence of fluting and whether it started from denticles and went to the base, chi-squared test
Tooth size	Coombs (1978) for ankylosaurs	Comparing size of CH and CBL in a biplot
Number of denticles	Used by Larson (2008) as denticle counts in a fixed amount of space for theropods	Taking mesial and distal denticle counts. Taken over the entire distal edge and mesial edge as ankylosaur denticle size varies from crown to base
Traditional measurements of CH, CBL, M-CL, NL, AL, MCL, DCL, MDH, MDL, DDH, DDL, CA	Hudgins et al. (2022) for use on pachycephalosaurids and thescelosaurids	Using digital calipers on the physical sample for manual measurements and using JMorph on images for digital measurements

2.5 Testing taxa of unknown affinity

Several species of ankylosaurs have contentious family identifications due to the poor or limited preservation of skeletal material that has discernable family synapomorphies. *Aletopelta*, *Antarctopelta*, and *Stegouros* are three examples that also have significant implications for interpreting ankylosaurian palaeobiogeography. I measured the CH and CBL, noted the presence/absence of traits, and produced geometric outlines from figures of teeth associated with these three species (Coombs & Deméré, 1996, Salgado & Gasparini, 2006, Soto-Acuña et al., 2021) to understand how they resolve taxonomically.

2.6 Potential Error:

Effort has been made to reduce error. For manual traditional measurements, error could be caused by the callipers being at an angle – a potential problem for the manual measurements taken from the skulls. Lelièvre and Grey (2017) estimate that the precision for digital callipers is about 0.01-0.03 mm. For digital traditional morphometric measurements, error could be caused by the line drawn to match the photographed scale not perfectly matching the length. With the scale of the images, this error should be insignificant. For the outline geometric morphometric analysis, error could be caused by the outline points not being placed in the exact position. Again, with the scale of the images, the error resulting from this should be minor. Images of SMU 73203, ZPAL MgD ii/1, and PIN 3142 were taken by Dr. Victoria Arbour, whereas all other images were taken by Emily Cross. Arnqvist and Mårtensson (1998) showed that having the images be from different people can cause different results from the use of different camera settings, etc. Some very small teeth (~1 mm) needed to be studied and imaged under a microscope. The images of these specimens are slightly lower resolution as they had to be photographed as JPEGs rather than RAW.

Chapter 3 – Results

3.1 Morphological observations

3.1.1 Nodosaurid/non-ankylosaurid teeth:

In situ and associated teeth were observed in *Animantarx, Denversaurus, Edmontonia longiceps, Edmontonia rugosidens, Gargoyleosaurus, Gastonia burgei, Gastonia lorriemcwhinneyae, Panoplosaurus,* and *Peloroplites. Animantarx* is represented by two teeth. CEUM 09173 is not fully erupted but appears to have no basal cingulum. It contains denticles and fluting running from between the denticle to the base. The flutes are not perpendicular to the base, but rather gently curve towards the center of the tooth and down to the base. CEUM 12435 is very worn yet has a distinct basal cingulum. It is missing the crown above the cingulum, so I am unable to note whether it has fluting.

Denversaurus is represented by the single tooth DMNH EPV 468, which is partially erupted and poorly preserved. Only the lingual side is visible, but there is no apparent cingulum or fluting.

The *in situ* teeth of CMNFV 8531 (*Edmontonia longiceps)* obscure the features of the adjacent teeth due to their orientation, making it difficult to take measurements. The skull contains teeth with a range of wear patterns from completely unworn to very worn. All teeth without significant wear display a clear basal cingulum. There is no consistency in the number of mesial or distal denticles through either counts or ratios and no clear trend with tooth location in the jaw. A few of the unworn teeth display fluting.

*Figure 8. Example morphologies of nodosaurid and ankylosaurid teeth associated with skulls. **A**, Gastonia burgei (BYU 50866) in labial view; **B**, Gargoyleosaurus parkpinorum (DMNH 27726-17) in labial view; **C**, Ankylosaurus magniventris (CMNFV 8880) in lingual view; **D**, Euoplocephalus tutus(CMNFV 8876-1) in lingual view; **E**, Anodontosaurus lambei (TMP 1996.075.0001-9) in lingual view; **F**, Edmontonia rugosidens (TMP 1998.098.0001 in labial view; **G**, Cedarpelta bilbeyhallorum (CEUM 1264 #86) in lingual view; **H**, Peloroplites cedrimontanus (CEUM 34580) in lingual view; **I**, Euoplocephalus tutus (TMP 2017.023.0017) in labial view. Scale bar is 1cm.*

Edmontonia rugosidens is represented by *in situ* teeth from two skulls. The teeth of ROM 1215 all have a basal cingulum, and 13 of 17 have fluting. There is a range of wear from generally unworn to worn completely down to the root. There is no consistency in the number of mesial or distal denticles through either counts or ratios and no clear trend with tooth location in the jaw. The majority of the teeth (21 of 23) from TMP 1998.098.0001 (Figure 8F) have a basal cingulum (21/23); those missing a cingulum are very worn or not erupted enough to display one. The majority of the teeth also have fluting (21/23), and again the two teeth that did not display fluting were very worn. Few teeth were unworn enough to collect accurate denticle counts. For those that were unworn on the denticle edges, there are 4-5 mesial denticles and 3-5 distal denticles, with generally the mesial edge having one more denticle than the distal edge.

Gargoyleosaurus (DMNH 27726) maxillary and premaxillary teeth have no apparent cingulum (Figure 8B). The premaxillary and maxillary teeth are very similar in size and shape. The majority of dentary teeth do not have cingulum (4/5). As a trend, the dentary teeth become smaller distally and the distal edge seems to pinch in more where base meets the root.

Gastonia burgei is represented by several teeth from monotaxic bonebeds. *Gastonia* is referred to here as nodosaurid (Kirkland 1998, Kineer et al., 2016), however, it is interesting to note that Arbour and Currie (2016) recovered *Gastonia* as ankylosaurid. BYU VP 50866 has a minor basal cingulum on the labial side. As the base meets the root, the tooth pinches in asymmetrically, with greater constriction on the mesial side. It is fluted, with flutes not continuing to the base. BYU VP 50866 (Figure 8A) has 6 mesial denticles and 5 distal denticles. CEUM 11909 has no evident cingulum or fluting. It has 10 mesial denticles and 7 distal denticles. CEUM 11910, CEUM 11911, CEUM 11912, and CEUM 5373 do not have fluting or basal cingula. CEUM 11911 has 7 mesial denticles and 6 distal denticles, and CEUM 5373 has 10 mesial denticles and 6 distal denticles.

Gastonia lorriemcwhinneyae is also represented by teeth from a monotaxic bonebed. DMNH 53040 is quite worn and not well preserved. It does not have a basal cingulum or fluting. DMNH 50373 and DMNH 50377 do not have fluting. DMNH 50377 has a cingulum, however, DMNH 50373 does not. The teeth of DMNH 50206 do not have a basal cingulum or fluting.

The majority of teeth from CMNFV 2759 (*Panoplosaurus)* have a basal cingulum (5/6) and there is variation in denticle counts for the few teeth that are unworn enough to note them. Only 1/6 teeth have some minor fluting.

The single tooth of CEUM 34580 (*Peloroplites)* is very large and triangular (Figure 8H). Preparation of the specimen has resulted in some damage to the exposed face, so some features may be diminished. The tooth has a basal cingulum and no fluting. There are 7 mesial denticles and 6 distal denticles.

3.1.2 Ankylosaurid teeth:

In situ and associated teeth were observed in *Anodontosaurus, Ankylosaurus, Cedarpelta, Euoplocephalus, Pinacosaurus,* and *Saichania.*

Ankylosaurus is represented by associated teeth with the skull of CMNFV 8880 (Figure 8C). The teeth are quite worn, with evidence of a basal cingulum, and one shows evidence of fluting.

Anodontosaurus is represented by two skulls. TMP 1997.132.0001 teeth are fluted and a have basal cingulum (6/7). None of the teeth of TMP 1996.075.0001 (Figure 8E) have a basal cingulum, but all the teeth display fluting.

The only known skull of *Cedarpelta* was initially described by Carpenter et al. (2001), where they described a maxillary tooth with specimen number CEUM 12360 (now CEUM 1264 #86). For CEUM 1264 #86 (*Cedarpelta)* Carpenter et al. (2001) noted features on the labial side of a tooth, but as of 2023, only the lingual side of a partially erupted tooth is visible (Figure 8G). There is no apparent basal cingulum. The basal width is unable to be measured due to its position in the alveolus, however crown height is noted.

Euoplocephalus is represented by several skulls. CMNFV 8876 has a basal cingulum and 5 denticles on both the mesial and distal edges (Figure 8D). Two of the three teeth display fluting. The single fully erupted tooth of TMP 1980.016.1685 has both a basal cingulum and fluting and the partially erupted tooth has fluting but no cingulum. All of the teeth of TMP 2017.023.0017 (Figure 8I) have fluting and 3/4 teeth have a basal cingulum. Several of the teeth are twisted in the alveolus to only have the mesial edge visible.

Images of juvenile *Pinacosaurus* ZPAL MgD II/1 were taken for a different study, and thus do not display the ideal magnification or lighting for this study. It appears that all of the teeth have a basal cingulum, however it is difficult to tell with the lighting. As such, these teeth are not included in the chi-squared test for basal cingulum. All the teeth have fluting. Images of *Saichania* PIN 3142/250 were also taken for a different study, and thus do not display the ideal magnification or lighting for this study. From the images, it appears all teeth possess fluting and a basal cingulum, but it is difficult to tell with the lighting. For this reason, these samples are not included in the chi squared test.

3.2 Other leaf-shaped ornithischian teeth

Stegosaur teeth share many features with ankylosaur teeth, including their leaf shape, basal cingula and fluting. I was able to sample one skull (DMNH 2818) of *Stegosaurus stenops*, and while it has many well-preserved teeth, there can be variation between individuals and should not be held as a standard for all stegosaur teeth. Like ankylosaur teeth, they also display variation of the dental features within an individual skull. There is no consistency in the number of mesial or distal denticles, or crown heights of teeth. Nearly all teeth have a prominent basal cingulum and fluting that runs from between the denticles down to the cingulum. The flutes tend to be perpendicular to the cingulum.

Thescelosauridae is represented by *Thescelosaurus neglectus* (DMNH EVP 136185) and *T. edmontonensis* (CMNFV 8537). The teeth of DMNH 136185 have no cingulum and dense fluting. The fluting runs from between the denticles to the base of the tooth, gently curving in towards the centre of the tooth. In some ankylosaur teeth, the root also pinches in where it meets the base, but this is not present in thescelosaurid teeth. Some of the roots have a defined central groove. The teeth of CMNFV 8537 teeth do not have a basal cingulum, however, the majority of teeth have fluting (7/8).

Pachycephalosaurs are represented by *Stegoceras validum* (UALVP 00002) and *Pachycephalosaurus/Dracorex* (ROM 53579). The majority of teeth in UALVP 2 do not have fluting or a basal cingulum. ROM 53579 has fluting but does not have a basal cingulum.

3.3 Tooth pathologies:

Isolated ankylosaur teeth at the ROM and TMP indicate the first evidence of split carinae on ankylosaur teeth. ROM 07767 has a split carinae on the distal edge with the main row having 4 denticles and the split row having 3. While ROM 07767 has a large wear facet on the lingual face, the rest of the tooth appears unworn. ROM 31872 has a split carinae on the distal edge with the main row having 7 denticles and the split row having 3 (Figure 9). The tooth displays moderate wear, though the denticles are still clearly discernable. ROM 31866 has a split carinae on the distal edge with the main row having 4 denticles and the split row having 3. ROM 31866 displays a wear facet on the labial face of the apex, with the carinae edges mildly worn. It is interesting to note that regardless of the number of distal denticles in the main row, the split row always consists of 3 denticles. In tyrannosaurids, the split carinae are always found on the anterior edge of the tooth (Erikson, 1995), similarly in the ankylosaur teeth, the split carinae is only noted on the distal edge. In addition to theropods, split carinae have been noted in phytosaurs and non-dinosaurian archosauriform (Beatty and Heckbert, 2009), however, there are little to no other cases of split carinae noted in ornithischian dinosaurs.

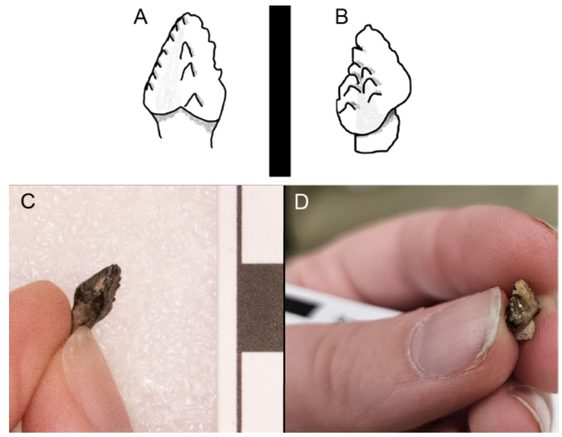

Figure 9. Illustrations of split carinae on the distal edges of ROM 31872 (A,C) and UALVP 49327 (B,D). Scale bar is 1 cm.

One specimen of an isolated "ankylosaur" tooth (TMP 1983.036.0009 - 2) displayed a unique pathology. The apex of the crown is split into two apices (Figure 10). This pathology differs from the split carinae, as it is clearly not a split in the denticle row, but the tooth crown apex itself. I propose calling this pathology "split apex".

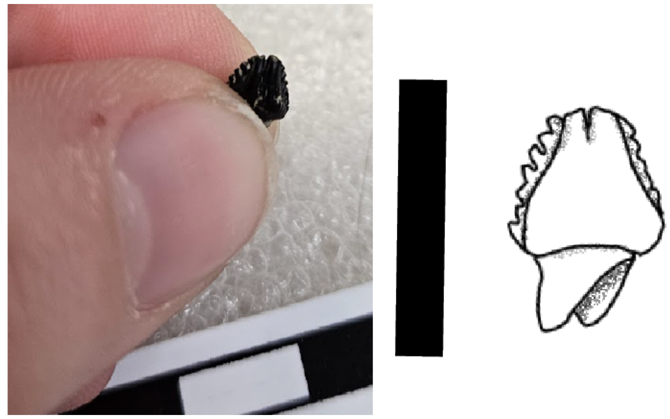

Figure 10. Illustration TMP 1983.036.0009 - 2 showing the split apex. Scale bar is 1 cm.

3.4 Differentiating leaf-shaped ornithischian teeth

I used several methods to test the hypothesis that teeth from different families of ankylosaurs can be differentiated and the hypothesis that ankylosaur teeth can be differentiated from other leaf-shaped ornithischian teeth. Teeth *in situ* or associated with skulls were studied using both manual and digital traditional measurements. I compared the CBL to the CH of the teeth using a biplot before normalizing the values to understand how size differs between families. Figure 11 shows that there is a linear

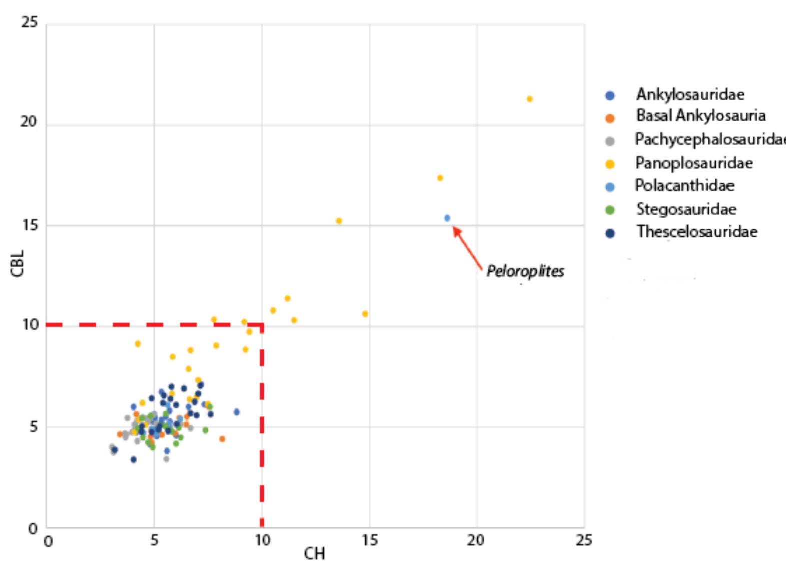

Figure 11. Tooth size using the classification scheme from Raven et al. (2023). Red line at 10mm crown base length (CBL) and crown height (CH) mark.

relationship between CBL and CH for Panoplosauridae, but not for the other families. Ankylosauridae, Thescelosauridae, Stegosauria, and Pachycephalosauria all occupy a similar morphospace. Nodosauridae, however, has a larger size distribution, plotting in the same morphospace as the other families but also reaching much larger sizes. When Nodosauridae is instead split into Panoplosauridae, Polacanthidae, and basal Ankylosauria (after Raven et al., 2023), it becomes evident that most of the large variation in size is represented by Panoplosauridae. Panoplosaurid tooth sizes plot within the cluster with Ankylosauridae and contribute to the largest samples. Basal ankylosaurs (here represented by *Gargoyleosaurus*) plot entirely in the cluster. With one exception, only Panoplosauridae plots above 10mm CBL and/or CH. Polacanthidae plots entirely in the cluster, except for one large notable outlier – *Peloroplites,* which is greater than 10mm in CBL and CH. Using the size of CBL and CH, 49 isolated teeth are here identified as nodosaurid/panoplosaurid (Table 5), with 15 of these teeth (~31% of the teeth identified by size) having a previous identification other than nodosaurid/panoplosaurid. CH and CBL size support hypothesis 2, that teeth of different ankylosaur families can be differentiated. When a tooth is larger than 10mm CH and/or CBL, it can be identified as either a nodosaurid (using Coombs taxonomy) or a panoplosaurid (using Raven et al. taxonomy). Teeth smaller than 10 mm CH and/or CBL could derive from any ankylosaur family irrespective of taxonomic framework.

Table 5. Isolated teeth identified as nodosaurid based on size.

Specimen	Original ID	ID from other analyses	New ID from size	Phys. CH	Phys. CBL	Dig. CH	Dig. CBL
CEUM 53115	Nodosaurid	Nodosaurid	Nodosaurid	13.86	15.56	14.36	15.48

Specimen	Original ID	ID from other analyses	New ID from size	Phys. CH	Phys. CBL	Dig. CH	Dig. CBL
CMNFV 1772-1	Nodosaurid	Nodosaurid	Nodosaurid	10.92	9.21	8.13	9.73
CMNFV 1772-3	Nodosaurid	Nodosaurid	Nodosaurid			6.74	10.34
CMNFV 1772a	Ankylosaurid	NA	Nodosaurid	14.49	10.62	9.5	11.42
CMNFV 2334	Ankylosaur	NA	Nodosaurid			10.43	8.95
CMNFV 59240 - 1	Nodosaurid	Ornithischia	Nodosaurid	10.26	9.91	7.58	8.93
CMNFV RDR - 9	Ankylosaur	NA	Nodosaurid				11.27
ROM 03302	Nodosaurid	NA	Nodosaurid			9.77	11.84
ROM 03516	Nodosaurid	NA	Nodosaurid				11.89
ROM 36386	Nodosaurid	NA	Nodosaurid				11.98
ROM 36388	Nodosaurid	NA	Nodosaurid				10.7
ROM 36400	Nodosaurid	NA	Nodosaurid				11.07
ROM 36413	Nodosaurid	NA	Nodosaurid				10.04
ROM 36416	Nodosaurid	NA	Nodosaurid				11.15
ROM 36417	Nodosaurid	NA	Nodosaurid				12.92
ROM 56611	Ankylosaurid	NA	Nodosaurid			9.42	10.38
ROM 58689 - 1	Ankylosaurid	NA	Nodosaurid			10.18	10.77
TMP 1985.056.0171 - 2	Nodosaurid	NA	Nodosaurid		10.11		10.7
TMP 1989.079.0008	Nodosaurid	Ornithischia	Nodosaurid	7.58	12.17	9.26	12
TMP 1989.151.0137	Ornithischia	Nodosaurid	Nodosaurid	12.53	10.61	9.61	10.59
TMP 1990.036.0081	Nodosaurid	Nodosaurid	Nodosaurid	10.43	12.78	9.66	12.9
TMP 1991.036.0171	Ankylosaurid	Nodosaurid	Nodosaurid	10.63	11.14	9.48	10.62
TMP 1991.050.0093	Ornithischia	Nodosaurid	Nodosaurid	10.48	10.84	7.38	10.45
TMP 1992.036.1178 - 3	Ankylosaurid	NA	Nodosaurid		12.46		11.94
TMP 1993.036.0364	Ankylosaurid	Nodosaurid	Nodosaurid	11.14	14.13	10.79	14.41
TMP 1994.012.0035	Nodosaurid	Ornithischia	Nodosaurid	8.86	10.84	9.16	10.35

Specimen	Original ID	ID from other analyses	New ID from size	Phys. CH	Phys. CBL	Dig. CH	Dig. CBL
TMP 1994.094.0016	Nodosaurid	Nodosaurid	Nodosaurid	12.68	12.39	10.58	12.65
TMP 1995.012.0117	Nodosaurid	Nodosaurid	Nodosaurid	10.73	10.88	9.95	11.83
TMP 1998.068.0086	Nodosaurid	NA	Nodosaurid		10.63	9.09	11.2
TMP 1998.068.0153	Ankylosaurid	NA	Nodosaurid		11.16		
TMP 1998.102.0026 - 1	Nodosaurid	Nodosaurid	Nodosaurid	9.87	11.41	9.9	11.29
TMP 1998.102.0026 - 2	Nodosaurid	NA	Nodosaurid		10.56	8.31	10.16
TMP 1998.102.0026 - 4	Nodosaurid	Nodosaurid	Nodosaurid	8.82	10.13	7.98	10.36
TMP 1998.102.0026 - 5	Nodosaurid	NA	Nodosaurid		10.76		10.74
TMP 1999.063.0019	Nodosaurid	Nodosaurid	Nodosaurid		9.77	9.11	10.05
TMP 2000.012.0024 - 1	Ornithischia	NA	Nodosaurid		10.79		10.95
TMP 2002.012.0135	Nodosaurid	NA	Nodosaurid		9.9		10.19
TMP 2005.012.0265	Nodosaurid	NA	Nodosaurid	10.14	10.3	10.18	11.12
TMP 2005.012.0279	Nodosaurid	NA	Nodosaurid		10.56		10.63
TMP 2005.012.0280	Nodosaurid	NA	Nodosaurid		10.99		11.07
TMP 2005.012.0368	Nodosaurid	NA	Nodosaurid		10.14		11.21
TMP 2005.049.0065	Ankylosaurid	NA	Nodosaurid		11.58		12.34
TMP 2005.049.0102	Nodosaurid	Ornithischia	Nodosaurid	10.04	9.33		9.44

Specimen	Original ID	ID from other analyses	New ID from size	Phys. CH	Phys. CBL	Dig. CH	Dig. CBL
TMP 2013.012.0057	Nodosaurid	Nodosaurid	Nodosaurid	13.69	11.04	11.98	11.28
TMP 2014.012.0128	Nodosaurid	Ornithischia	Nodosaurid		9.85		11.04
TMP 2023.012.0242	Nodosaurid	NA	Nodosaurid		10.59		10.88
UALVP 55390	Pachycephal osaurid	Nodosaurid	Nodosaurid	10.67	12.36	11.44	13.18
UALVP 61153	Nodosaurid	Nodosaurid	Nodosaurid		13.82		14.58
UMNH VP 7672	Ankylosaur	NA	Nodosaurid				10.96

Before normalizing the traditional measurements, I plotted PCAs of both the manual and digital traditional values to depict how size may impact the distribution of families. Within all PCAs using the Coombs (1978) phylogeny, Nodosauridae has more variation, covering the same distribution of the other families, while also extending beyond it. When plotted using the phylogeny from Raven et al. (2023), Panoplosauridae covers most of the variation displayed by 'Nodosauridae'. Size is removed as a large factor when the traditional morphometric values are standardized by dividing by the CBL and log-transforming the data. Plotting the PCAs of the Elliptical Fourier tooth outlines generally produced similar results to the traditional morphometric analyses, though with some key differences. All traditional measurements were taken on the lingual side of the tooth, if available. The straight-line measurements are the same on both sides of the tooth. Geometric morphometric methods, however, compare lingual and labial views of the teeth separately as the shape of the crown base where it meets the enamel is different on the different faces. The lingual side of the tooth tends to have a slight groove leading to a small bend upwards in the crown, where a new tooth would erupt. Given this difference, both sides are studied separately. Generally, I found that the digital traditional morphometric analyses had higher LDA classification success rates than manual traditional analyses. I also found that geometric morphometric methods were comparable in LDA classification success rates to the digital traditional analyses.

When the transformed manual and digital traditional values for teeth are plotted as a PCA, there is significant overlap between all families (Figure 12 A- B, Figure 11 A-B). However, pachycephalosaurid predentary/premaxillary teeth are an exception, as these are separated from other leaf-shaped teeth. This separation appears to be mainly driven by component 2. Plotting a PCA of families in labial and lingual views with outline geometric morphometric methods again show large variation in Nodosauridae, and very little differentiation with the other families (Figure 12 C, D). There are more lingual outlines of teeth in skulls than labial, as newly erupting teeth only expose the lingual face. Using the Raven et al. (2023) taxonomic framework, the majority of the variation shown by 'nodosaurids' is actually represented by Panoplosauridae, while Polacanthidae and basal Ankylosauria are clustered together and with Ankylosauridae (Figure 13 C, D), similar to what was observed in the traditional morphometric analyses. The alternate position of *Animantar*x as a basal ankylosaur does not significantly impact the results of the PCA of outline geometric analyses (Figure 14 A).

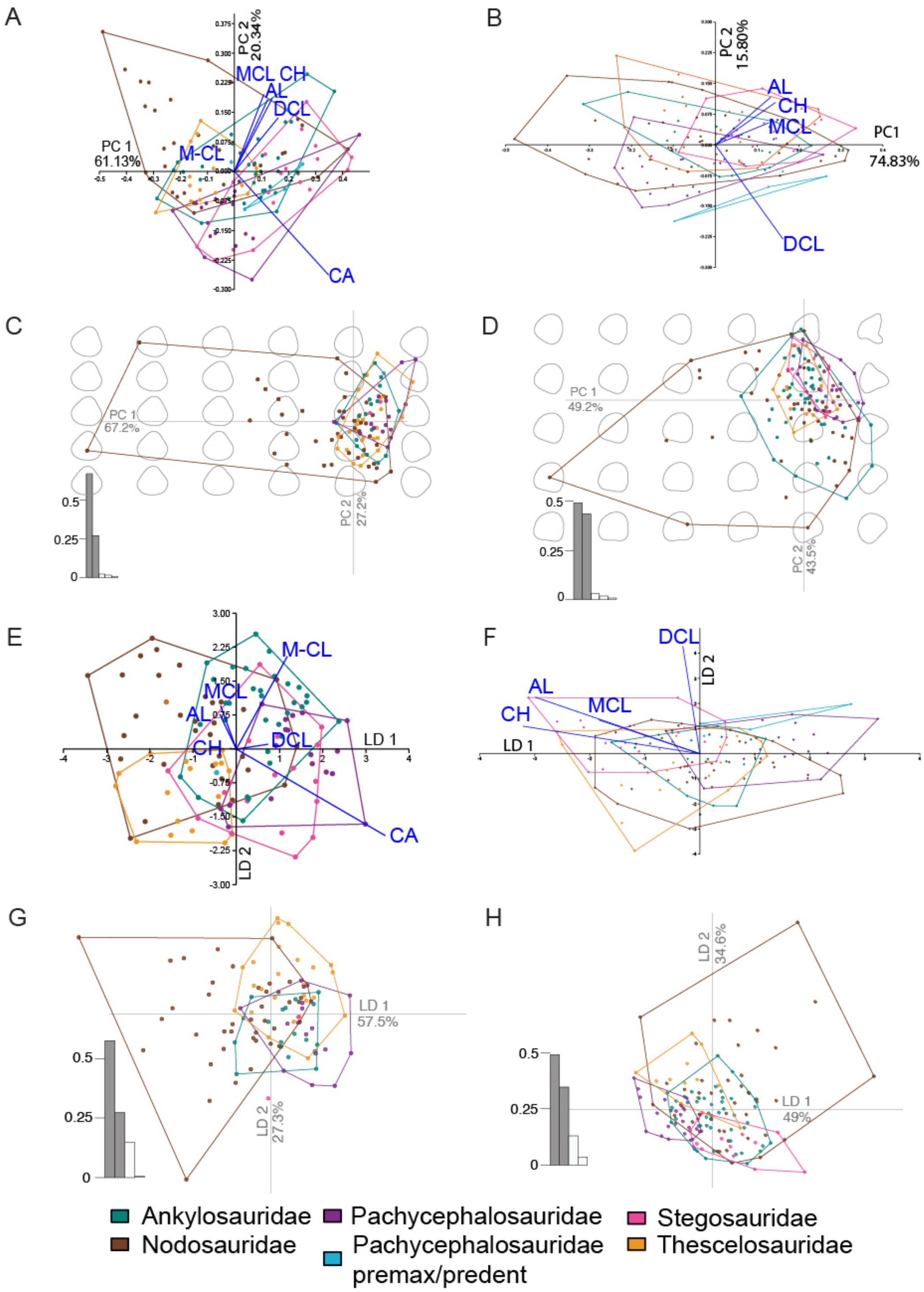

*Figure 12. Comparison of ornithischian tooth morphology using Coombs (1978) classification. Results of the principal component analyses: **A**, digital traditional analysis; **B**, manual traditional analysis; **C**, outline geometric analysis labial view; **D**, outline geometric analysis lingual view. Results of the linear discriminant analysis: **E**, digital traditional analysis; **F**, manual traditional analysis; **G**, outline geometric analysis labial view; **H**, outline geometric analysis lingual view.*

The highest LDA classification success rate for the Coombs (1978) taxonomy is of 54.03% for the digital traditional analysis (Figure 12, Table 11), making this useful for classifying ankylosaur teeth only if used with other methods. The LDAs of teeth with known identifications using the classification from Raven et al. (2023) (Ankylosauridae, Polacanthidae, Panoplosauridae, Struthiosauridae, and basal Ankylosauria) had classification success rates similar to those for the Coombs (1978) taxonomy, still falling below my set value of 75% for viable identification (Figure 13 E-H). The highest LDA classification success rate from the digital traditional analysis was 53.23% (Table 11). Raven et al. (2023) recovered *Animantarx* in two alternate positions, as a polacanthid and as a basal ankylosaur. When *Animantarx* is a polacanthid, the LDAs for outline lingual view had a classification success rate of 40.7% (Figure 13 H, Table 11) and when *Animantarx* is a basal ankylosaur; the outline lingual LDA classification success rate 40% (Figure 14 B, Table 11). Only the lingual view is given for *Animantar*x plots, as the tooth is partially erupted, with only the lingual face visible. Raven et al. (2023) classification methods are only useful when used in combination with other methods.

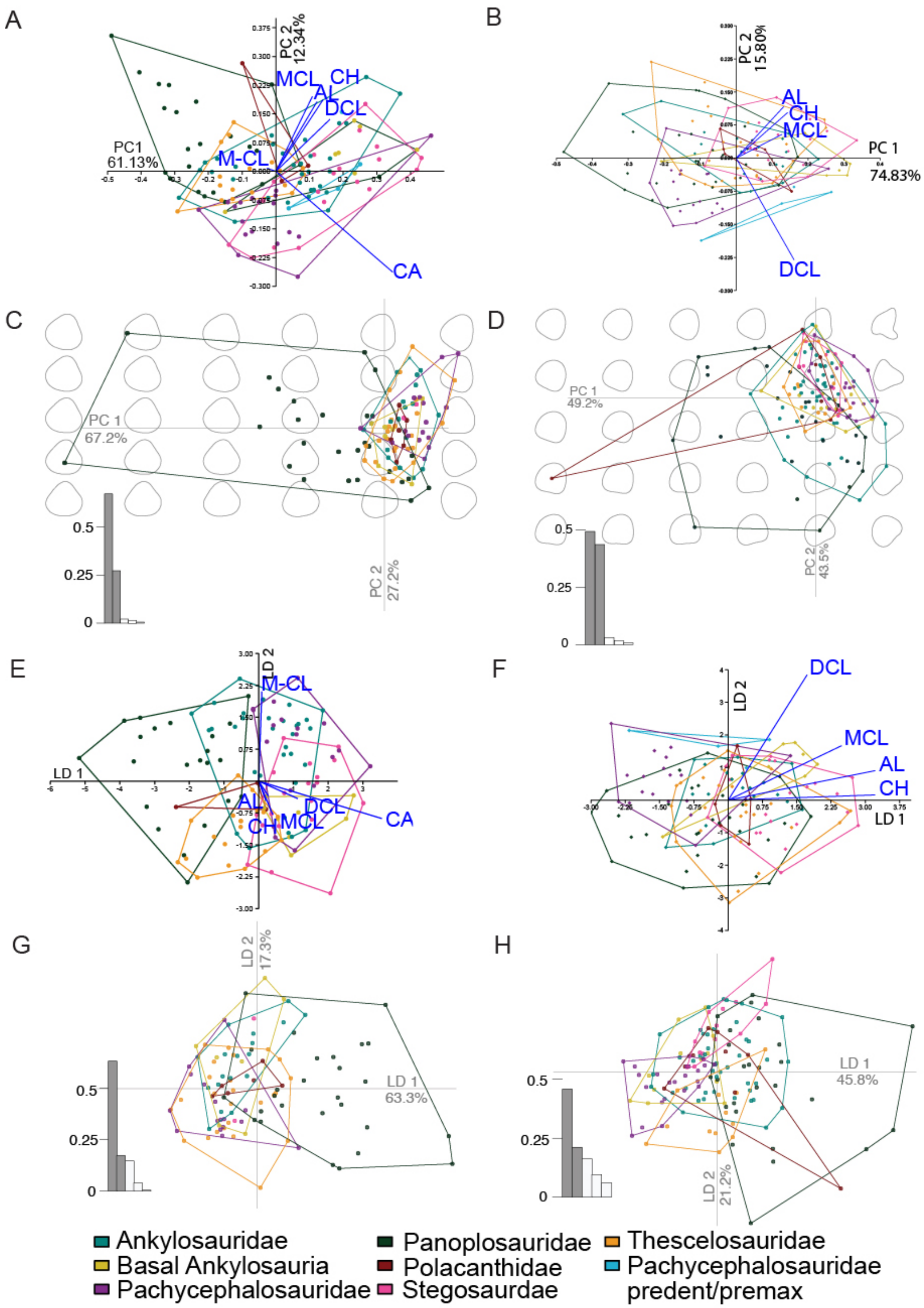

*Figure 13. Comparison of ornithischian tooth morphology using Raven et al. (2023) classification. Results from principal components analyses: **A**, digital traditional analysis; **B**, manual traditional analysis; **C**, outline geometric analysis labial view; **D**, outline geometric analysis lingual view. Results from linear discriminant analyses: **E**, digital traditional analysis; **F**, manual traditional analysis; **G**, outline geometric analysis labial view; **H**, outline geometric analysis lingual view.*

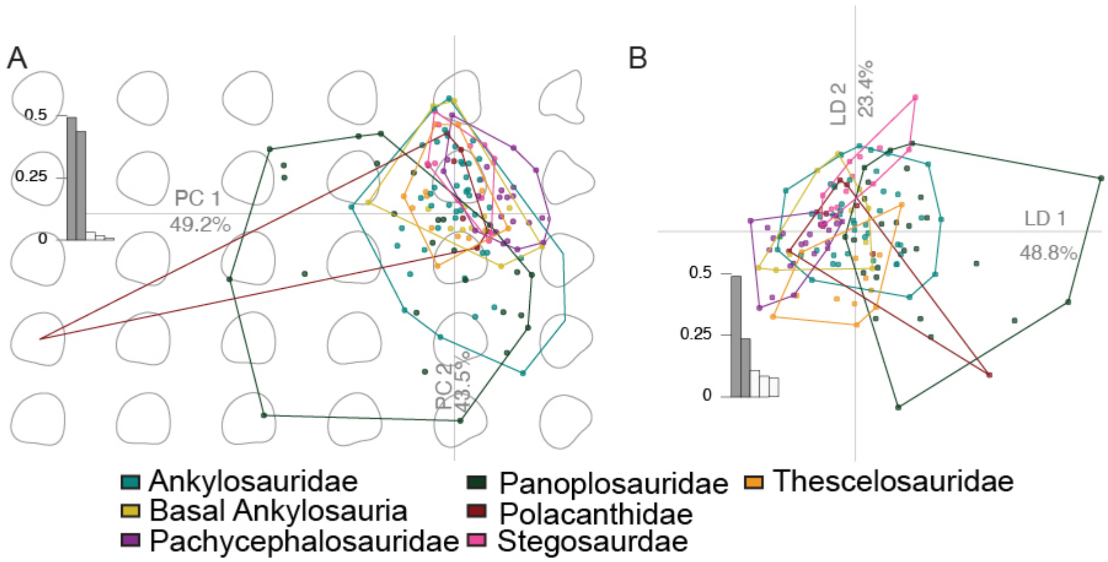

Figure 14. Comparison of ornithischian tooth morphology using Raven et al. (2023) classification B for outline geometric method in lingual view. A, PCA; B, LDA.

Chi-squared tests were used to determine if there is an association between a basal cingulum and/or fluting and ankylosaurian families using the Coombs (1978) and Raven et al. (20203) taxonomies.

Table 6. Chi-squared test for fluting using Coombs (1978) families.

Family	Observed teeth without the feature	Observed data	Expected data	$(O-E)^2/E$	Total	Proportion with fluting
Nodosaurid	57	37	47.3587786	2.26577411	94	39.36%
Ankylosaurid	10	29	19.648855	4.45033126	39	74.36%
Calculated X^2	6.71610538					
p=	0.009554605					

Table 7. Chi-squared test for basal cingulum using Coombs (1978) families.

Family	Observed teeth without the feature	Observed data	Expected data	(O-E)^2/E	Total	Proportion with cingulum
Nodosaurid	38	56	54.5343511	0.03939034	94	59.57%
Ankylosaurid	19	20	32.4885496	4.80057969	39	51.28%
Calculated X^2	4.83997003					
p=	0.027807378					

Table 8. Chi-squared test for fluting using Raven et al. (2023) classification.

Family	Observed teeth without feature	Observed data	Expected data	(O-E)^2/E	Total	Proportion with fluting
Panoplosaurid	21	35	28	1.75	56	62.50%
Polacanthid	15	1	8.5	6.61764706	17	6.25%
Basal	19	0	9.5	9.5	19	0%
Ankylosaurid	9	29	19	5.26315789	38	74.36%
Calculated X^2	23.130805					
p=	3.79255E-05					

Table 9. Chi-squared test for basal cingulum using Raven et al. (2023) classification.

Family	Observed teeth without the feature	Observed data	Expected data	(O-E)^2/E	Total	Proportion with cingulum
Panoplosaurid	9	47	31.8769231	7.174703	56	83.93%
Polacanthid	10	6	9.67692308	1.39711386	17	37.5%
Basal	18	1	10.8153846	8.9078455	19	5.26%
Ankylosaurid	18	20	21.6307692	0.12294562	38	52.63%
Calculated X^2	17.602608					
p=	0.000531152					

Fluting is significantly associated with Coomb (1978) families (p=0.0096) (Table 6). Proportionally, 74.36% of ankylosaurid teeth have fluting compared to 39.36% of nodosaurid teeth. Ankylosaurid teeth are more likely to have fluting compared to nodosaurid teeth, but this feature cannot be used alone to determine family. A basal cingulum is also somewhat associated with family (p= 0.0278) (Table 7). 51.28% of ankylosaurid teeth and 59.57% of nodosaurid teeth have a basal cingulum. Similar to fluting, the presence or absence of a basal cingulum should not be the sole trait used to assign an isolated tooth to a family but can be used in conjunction with other evidence to support an identification.

The chi-square tests using the Raven et al. (2023) classification scheme provide additional clarity on these traits. Fluting is significantly associated with families (p= 3.79×10^{-5}) (Table 8). 62.5% of panoplosaurid teeth, 6.25% of polacanthid teeth, 0% of basal ankylosaur teeth, and 74.36% of ankylosaurid teeth have fluting. Thus, if a tooth has fluting, it is most likely from a panoplosaurid or ankylosaurid. Similarly, a basal cingulum is significantly associated with families (p= 5.31×10^{-4}) (Table 9). 83.93% of panoplosaurid teeth, 37.5% of polacanthid teeth, 5.26% of basal ankylosaur teeth, and 52.63% of ankylosaurid teeth have a basal cingulum. Panoplosauridae and Ankylosauridae have a significant number of teeth with fluting and with basal cingula, and basal Ankylosauria and Polacanthidae have a significant number of teeth without either fluting or a basal cingulum.

3.5 Differentiating ankylosaur species

The PCAs of nodosaurid species show overlap between several species – notably *Edmontonia longiceps* and *Edmontonia rugosidens,* which cover a very similar morphospace in both digital and manual traditional analyses (Figure 15 A-B). The highest LDA classification success rate was 44.12% for the digital traditional analysis (Figure 15, Table 11). The outline labial view of nodosaurid teeth associated with skulls shows that much of the large variation seen in Nodosauridae and Panoplosauridae in the other geometric morphometric plots is represented by *Edmontonia,* and specifically *Edmontonia rugosidens* (Figure 15 C). Plotting teeth only associated with nodosaurid skulls in lingual view shows overlap between most nodosaurid species, with *Edmontonia longiceps* an outlying group (Figure 15 H). While there are only 3 teeth associated with *Edmontonia longiceps* – and thus not enough to indicate if it is statistically different – it is interesting to note for further analyses that they may be able to be differentiated from other nodosaurid species including *Edmontonia rugosidens*. *Peloroplites* also remains a large outlier from all other nodosaurid species. The LDA (Figure 15 H, Table 11) of lingual view nodosaurid species has a 61.4% classification success rate, however, it has a 100% success rate for classifying *Edmontonia longiceps* (keeping in mind the small sample size). While the lingual view geometric morphometric method still has an LDA success rate below 75%, it is the highest success rate for nodosaurid species, and may be useful for identifying specific species such as *Edmontonia longiceps*.

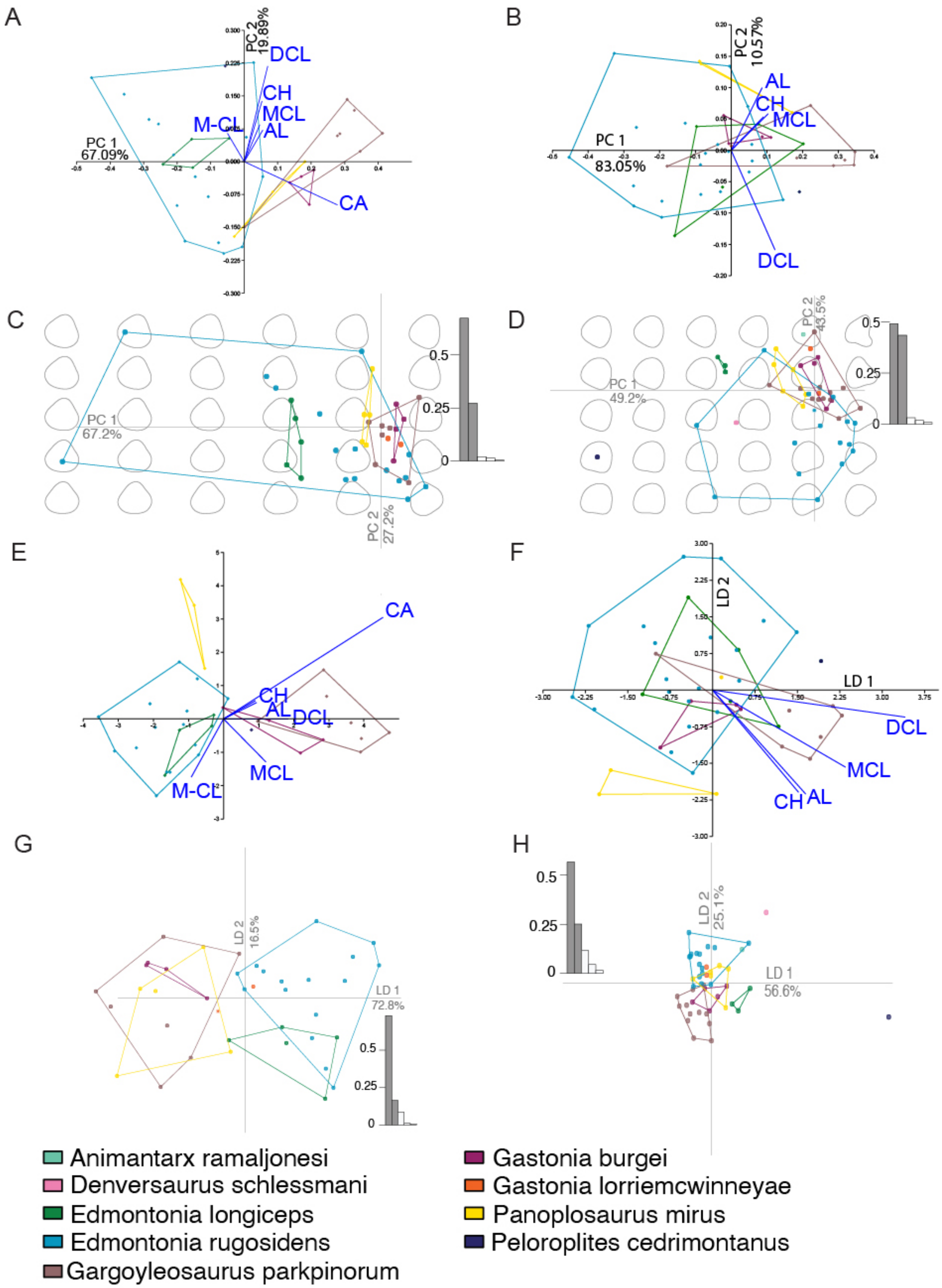

*Figure 15. Comparison of nodosaurid tooth morphology. Results of principal component analyses: **A**, digital traditional analysis; **B**, manual traditional analysis; **C**, outline geometric analysis labial view; **D**, outline geometric analysis lingual view. Results of linear discriminant analyses: **E**, digital traditional analysis; **F**, manual traditional analysis; **G**, outline geometric analysis labial view; **H**, outline geometric analysis lingual view.*

I also analyzed PCAs and LDAs of teeth associated with ankylosaurid skulls to investigate if ankylosaurid species can be differentiated. The PCAs show overlap in morphospace between species (Figure 16 A-D). There are too few outlines in labial view of ankylosaurid teeth associated with skulls to get good representation of different species (Figure 16 C, G). The highest LDA classification success rate is 59.1% for outline lingual view analysis (Figure 16, Table 11) and it may be useful when used with some of the other methods. Neither traditional morphometric method is viable for identifying ankylosaurid teeth.

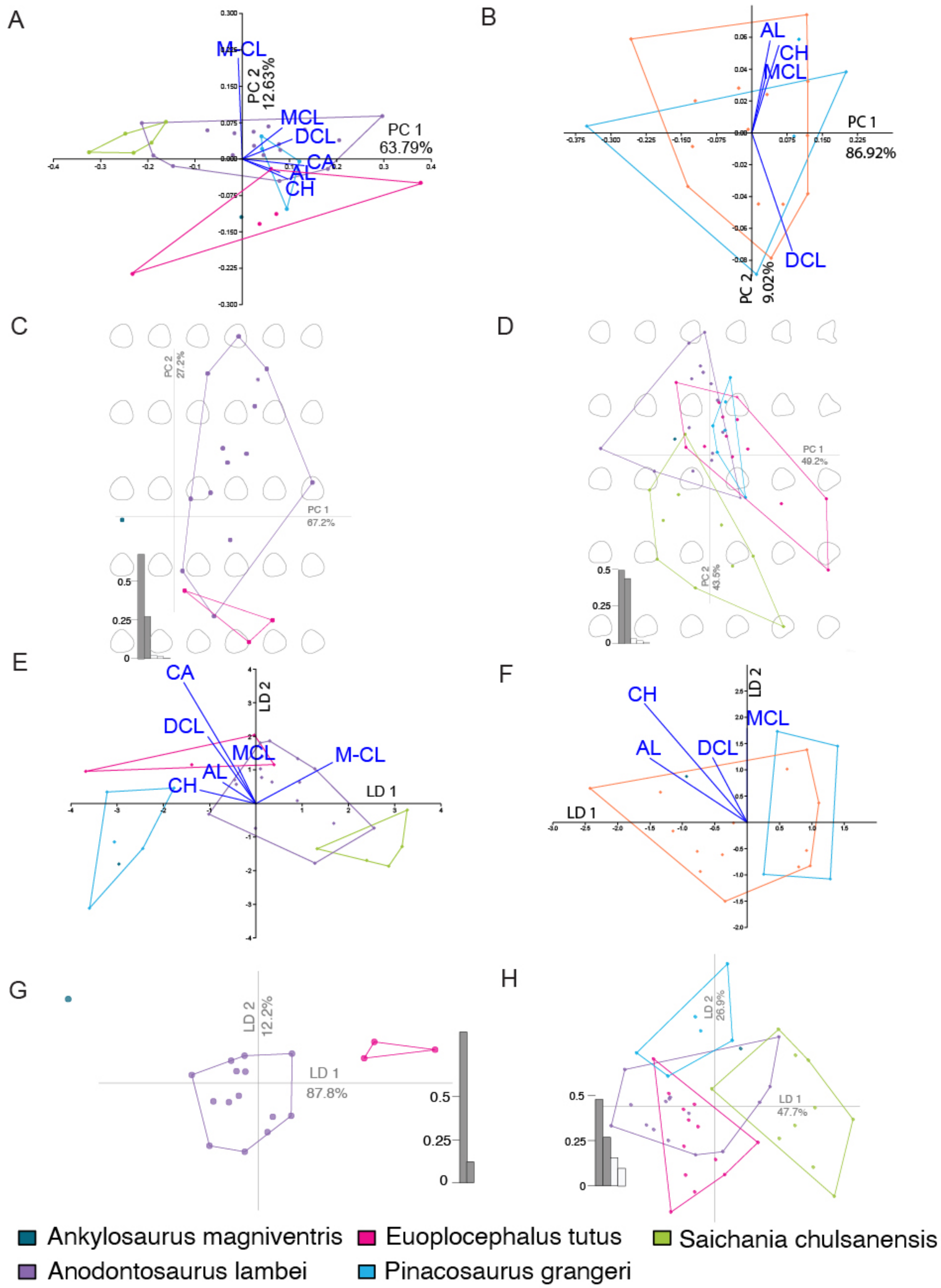

*Figure 16. Comparison of tooth morphology of ankylosaurids. Results of principal component analyses: **A**, digital traditional analysis; **B**, manual traditional analysis; **C**, outline geometric analysis labial view; **D**, outline geometric analysis lingual view; **E**, digital traditional analysis; **F**, manual traditional analysis; **G**, outline geometric analysis labial view; **H**, outline geometric analysis lingual view.*

3.6 Tooth morphology of geographically restricted formations

The PCAs of teeth from Alberta and Alberta/Montana show overlap between families towards the center of the plot, however each family has some restricted morphospace (Figure 17, 18 A-D). When only teeth from the outline method in labial view associated with skulls from formations in Alberta are plotted as a PCA, Ankylosauridae and Pachycephalosauridae are still nestled quite close, with Nodosauridae/Panoplosauridae having larger variation along PC 1 (Figure 17 C). Most LDA success rate for teeth from Alberta are in the 55-70% range, with the highest classification success rate of 67.7% percent for outline labial view analysis (Figure 17, Table 11). Classifying families of teeth from formations in Alberta in lingual view shows more overlap in ankylosaurid and nodosaurid tooth shapes than the labial view (Figure 17 C, D). All geometric morphometric methods for Alberta and Alberta/Montana formations are over 50% and may be useful for identification when used with other methods. All methods are potentially useful for identifying families when used in tandem or with other methods. All methods (traditional and geometric) have higher LDA classification success rates when used on specific geographically restricted formations than when just used on families overall. Plotting associated teeth from Alberta and Montana formations supports hypothesis 5 - when several methods are used in combination, some isolated teeth can be differentiated by family in geographically restricted formations.

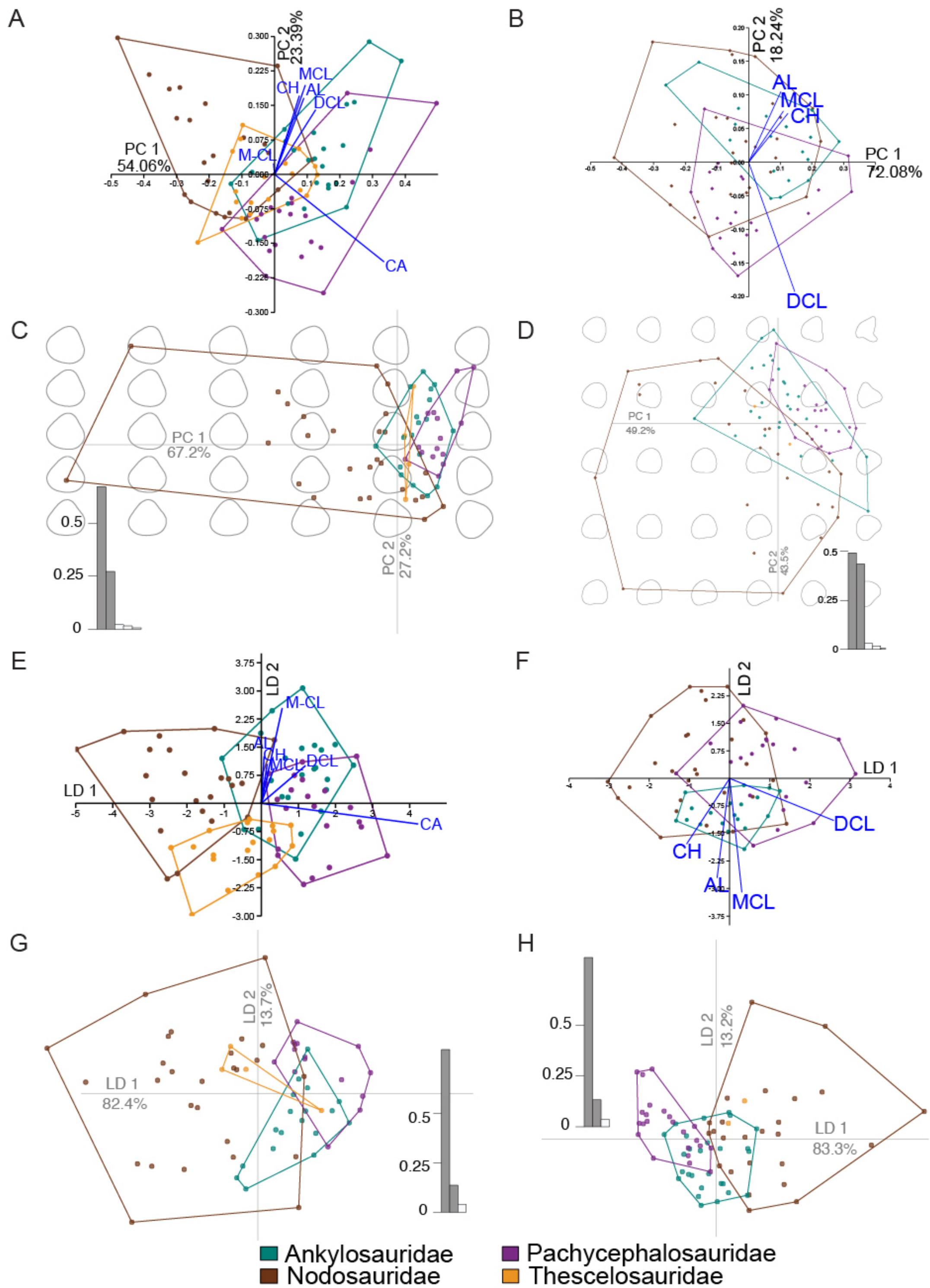

Figure 17. Comparison of associated tooth morphology from Alberta formations. Results from principal component analyses: ***A****, digital traditional analysis;* ***B****, manual traditional analysis;* ***C****, outline geometric analysis labial view;* ***D****, outline geometric analysis lingual view. LDAs:* ***E****, digital traditional analysis;* ***F****, manual traditional analysis;* ***G****, outline geometric analysis labial view;* ***H****, outline geometric analysis lingual view.*

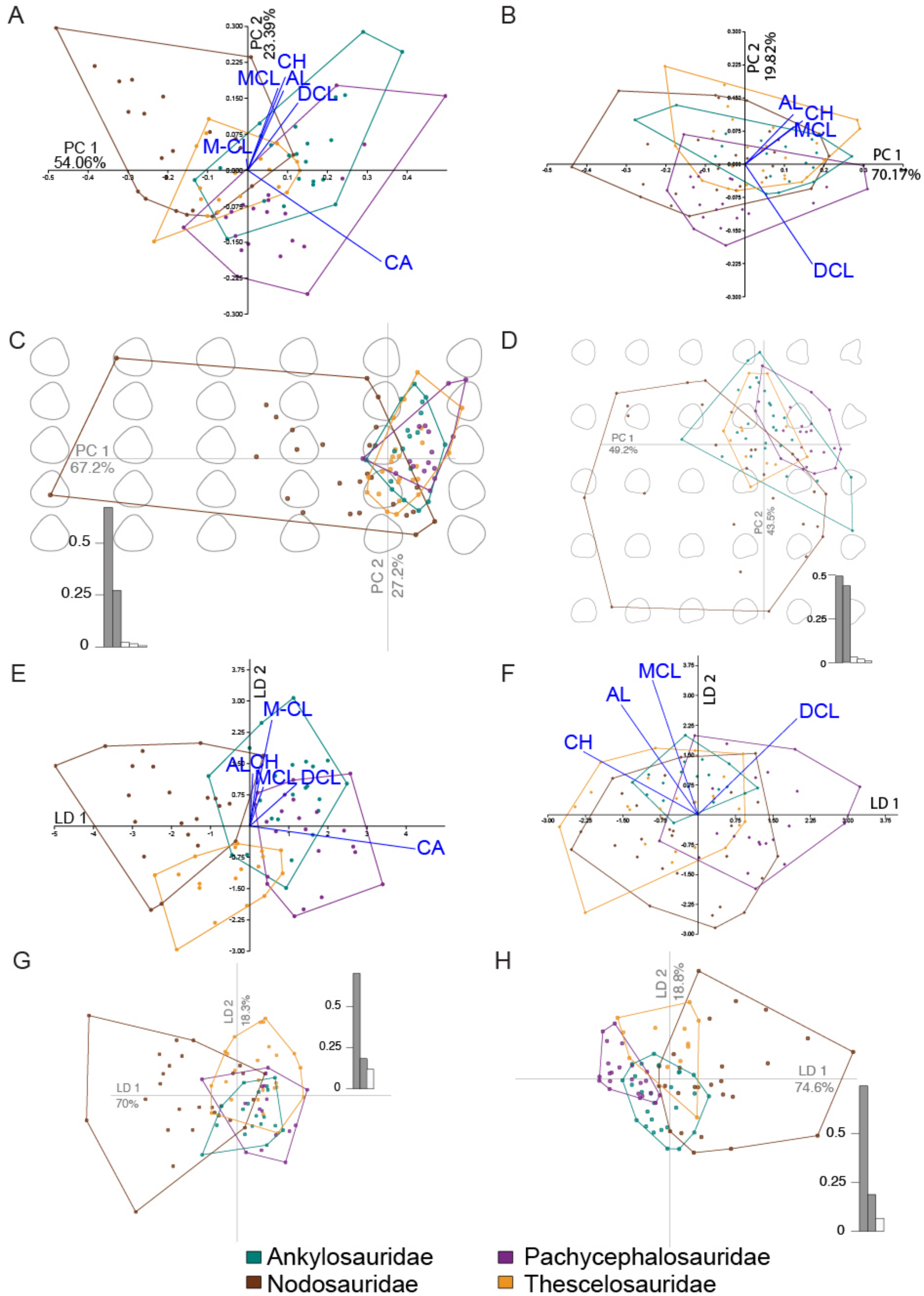

*Figure 18. Comparison of associated tooth morphology from Alberta and Montana formations. Results of principal component analyses: **A**, digital traditional analysis; **B**, manual traditional analysis; **C**, outline geometric analysis labial view; **D**, outline geometric analysis lingual view. Results of linear discriminant analyses: **E**, digital traditional analysis; **F**, manual traditional analysis; **G**, outline geometric analysis labial view; **H**, outline geometric analysis lingual view.*

3.7 Classifying isolated teeth

I sampled 137 isolated teeth from various formations and ages and attempted to classify these using geometric and traditional morphometric analyses (Figures 19 and 20). The analyses with the highest LDA classification success rates were used to compare the identifications of these isolated teeth (Table 11, Appendix B). The two analyses specifically used to identify species were only considered after family identification.

There were 14 isolated teeth (~10% of the dataset) that had consistent identifications between all analyses, where each analysis exceeds 75% likelihood for identification. All of these 14 specimens were identified as panoplosaurid. There are an additional 10 teeth that were identified with a greater than 75% likelihood in up to five of the analyses. Additionally, these samples are consistent in the identification across all analyses (e.g. UALVP 48747 had greater than 75% likelihood as an ankylosaurid from two analyses (Appendix B)). Most of these specimens were also identified as panoplosaurid (6/10). One specimen (TMP 1994.012.0035) was consistently identified as either a nodosaurid or panoplosaurid across all analyses, but never with greater than 75% likelihood (all analyses were between 55-70% range). There were 13 specimens that are consistent in their identification across all methods except 1. Of these, 7 are identified as panoplosaurid, and 6 are identified as ankylosaurid. A further 9 specimens were consistently identified across all analyses except two. Eight specimens were variably identified as nodosaurid or ankylosaurid depending on the analysis and were thus identified as Ankylosauria indet. Finally, specimens with three or more different identifications across analyses (73 specimens) are here conservatively classified as Ornithischia, since they could plausibly come from either ankylosaurs, thescelosaurs, or pachycephalosaurs.

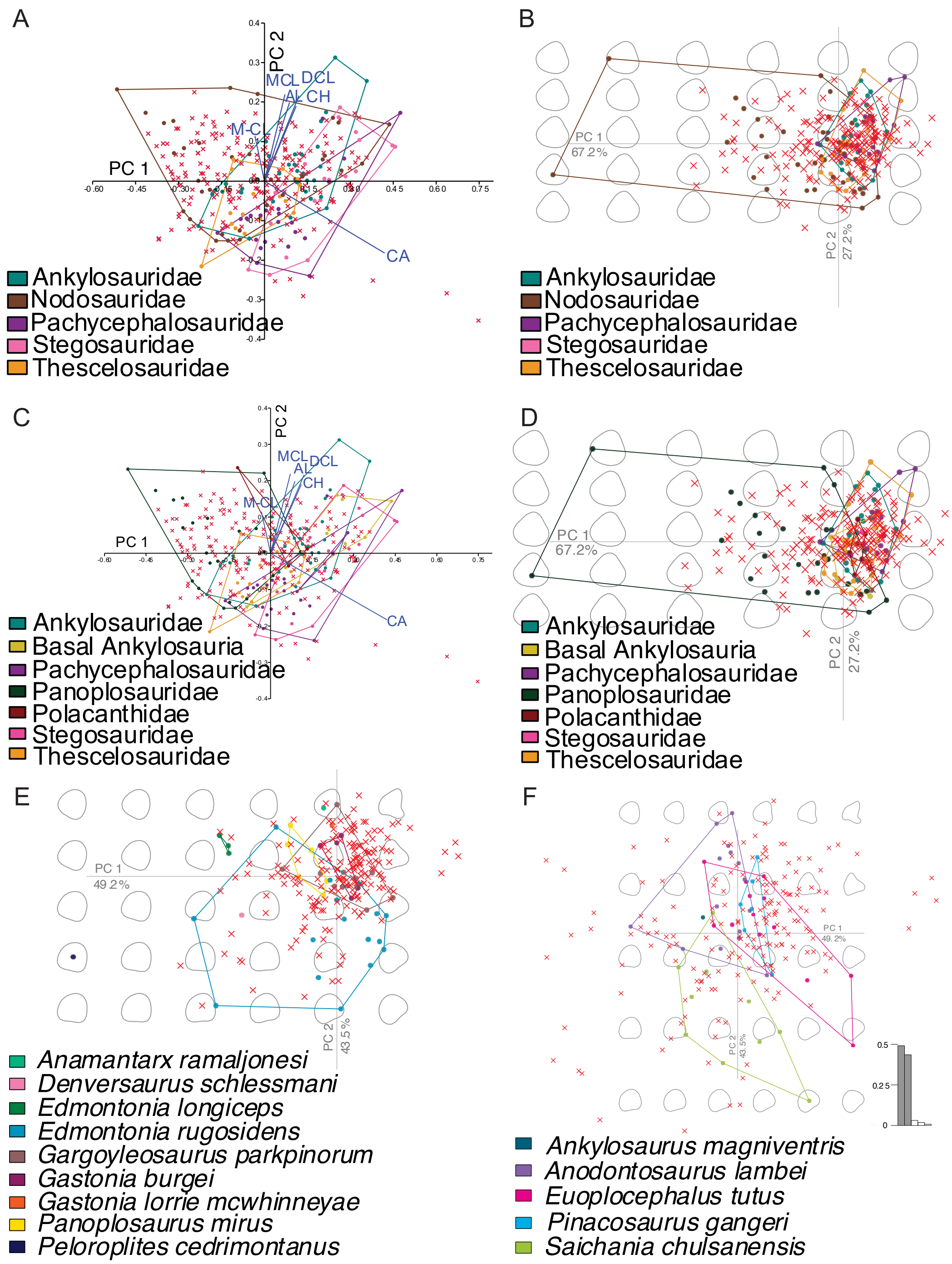

Figure 19. Isolated teeth identifications on PCAs of family and species. ***A,*** *Digital traditional analysis of Coombs (1978) families;* ***B****, Outline geometric analysis labial view of Coombs (1978) families;* ***C****, Digital traditional analysis of Raven et al. (2023) families;* ***D****, Outline geometric analysis labial view of Raven et al. (2023) families;* ***E****, Outline geometric analysis lingual view of "nodosaurid" species;* ***F****, Outline geometric analysis lingual view of ankylosaurid species.*

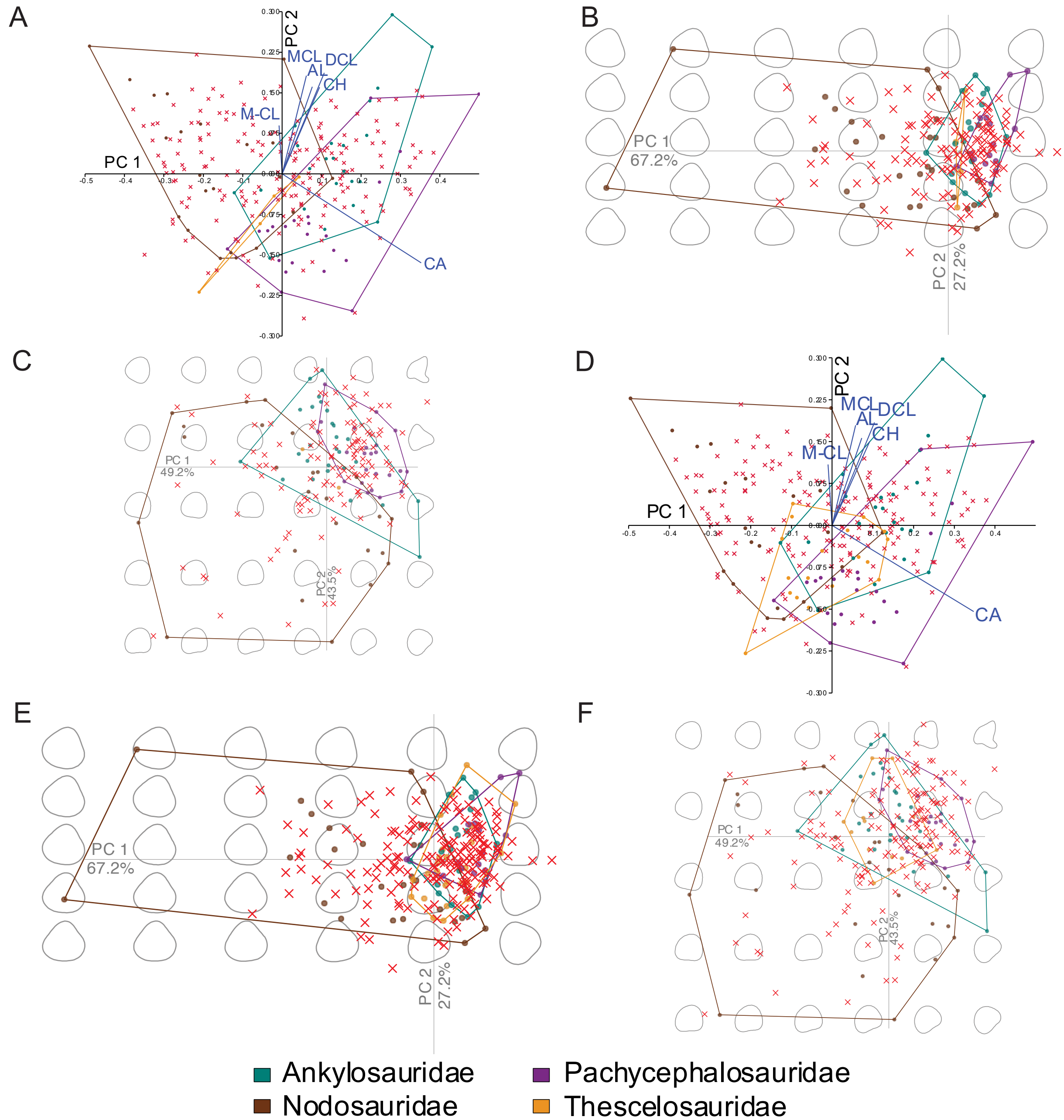

*Figure 20.Isolated teeth identification (red Xs) on PCAs of Alberta and Alberta/Montana formations. **A**, Digital traditional analysis on Alberta formations; **B**, Outline geometric analysis labial view on Alberta formations; **C**, Outline geometric analysis lingual view on Alberta formations; **D**, Digital traditional analysis on Alberta and Montana formations; **E**, Outline geometric analysis labial view on Alberta and Montana formations; **F**, Outline geometric analysis lingual view on Alberta and Montana formations.*

None of my analyses exceeded the 75% classification success rate threshold that I set as the confidence level for this study. However, many teeth had the same identification in multiple analyses with a lower classification success rate. This suggests that using several methods in conjunction could provide confidence in identifying the family of an isolated leaf-shaped tooth.

Nodosaurids and ankylosaurids had overlapping morphospace, but nodosaurids also occupy a broader region of morphospace than ankylosaurids. Isolated teeth that fall within the unique morphospace for nodosaurids can thus be more confidently identified as nodosaurids, in contrast to teeth that fall within the morphospace occupied by all ankylosaurs. As such, I was able to identify a larger number of isolated teeth as nodosaurids, and nodosaurid tooth identifications tend to have a higher classification success rate. In other words, it is easier to identify an isolated tooth as nodosaurid than it is to identify ankylosaurid teeth, or, it is easier to identify a tooth as panoplosaurid rather than ankylosaurid, polacanthid, or basal ankylosaurian, depending on the taxonomic framework being used.

There are a few specific cases where specimens have up to three different identifications, but there is general consistency between several analyses with over 75% classification likelihood. Therefore, the sample is classified as the family from the high likelihood analyses. The LDA classification of isolated teeth from the geometric methods (generated in R) provide a percent likelihood for each identification, however the LDA classifications for isolated teeth from traditional methods (generated in PAST) do not. There were five specimens that had consistent identifications over 80%, but three or more identifications that do not match that main identification, usually from the digital traditional methods. For example, CMNFV 59591-1 was classified as nodosaurid in Alberta analysis outline labial and lingual views, Alberta/Montana analysis labial view, and Coombs (1978) analysis labial view, panoplosaurid in Raven et al. (2023) labial view analysis, thescelosaurids in digital traditional Coombs (1978) analysis and digital traditional Alberta analysis, and ankylosaurid in Alberta/Montana outline lingual view analysis. Four of the analyses providing a nodosaurid/panoplosaurid identification have over 89% likelihood, therefore I consider CMNFV 59591-1 to be most likely a nodosaurid/panoplosaurid. Looking at the percentage likelihood of identifications is important, especially for those samples that have several different identifications from different analyses when developing the overall identification of an isolated tooth.

In addition to linear measurements and geometric outlines, discrete traits (fluting and the basal cingulum) are also useful for supporting the identification of isolated teeth, especially using the Raven et al. (2023) taxonomic framework. More isolated teeth can be included when using discrete traits compared to the morphometric analyses, as even incomplete and worn teeth often retain evidence of fluting or a cingulum. Appendix A shows that many of the identifications through the discrete trait analysis align with those from the traditional and geometric morphometric analyses. There are several cases where they do not align, but this does not suggest that either test is incorrect, as the features were not 100% present or absent between families (except fluting on basal Ankylosauria).

Table 10. LDA classification success rates across analyses

Method	LDA leave one out cross validation (%)	Percent correct based on groups if random (not using analysis methods)	RePCA/reLDA?
Digital traditional, Coombs (1978) classification	54.03	20.00	yes

Method	LDA leave one out cross validation (%)	Percent correct based on groups if random (not using analysis methods)	RePCA/reLDA?
Manual Traditional, Coombs (1978) classification	33.85	20.00	
Geometric outline, labial view Coombs (1978) classification	46.50	20.00	yes
Geometric outline, lingual view Coombs (1978) classification	40.70	20.00	
Digital traditional, Raven et al. (2023) classification	53.23	14.30	yes
Manual traditional, Raven et al. (2023) classification	34.62	14.30	
Geometric outline, labial view Raven et al. (2023) classification	49.00	14.30	yes
Geometric outline, lingual view Raven et al. (2023) classification	40.70	14.30	
Geometric outline, lingual view Raven et al. (2023) classification B	40.00	14.30	
Digital traditional, nodosaurid skull teeth	44.12	11.11	
Manual traditional, nodosaurid skull teeth	33.33	11.11	
Geometric outline, labial view nodosaurid skull teeth	35.10	11.11	
Geometric outline, lingual view nodosaurid skull teeth	61.40	11.11	yes
Digital traditional, ankylosaurid skull teeth	43.75	14.30	

Method	LDA leave one out cross validation (%)	Percent correct based on groups if random (not using analysis methods)	RePCA/reLDA?
Manual traditional, ankylosaurid skull teeth	31.58	33.33	
Geometric outline, labial view ankylosaurid skull teeth	88.20	33.33	
Geometric outline, lingual view ankylosaurid skull teeth	59.10	14.30	yes
Digital traditional, AB formations skull teeth	67.61	25.00	yes
Manual traditional, AB formations skull teeth	56.52	33.33	
Geometric outline, labial view AB formations skull teeth	67.70	20.00	yes
Geometric outline, lingual view AB formations skull teeth	58.40	20.00	yes
Digital traditional, AB/MT formations skull teeth	70.59	25.00	yes
Manual traditional, AB/MT formations skull teeth	45.26	33.33	
Geometric outline, labial view AB/MT formations skull teeth	59.50	25.00	yes
Geometric outline, lingual view AB/MT formations skull teeth	52.30	25.00	yes

3.9 Ankylosaurian taxa of uncertain taxonomic affinity

Aletopelta was originally identified as a nodosaurid by Coombs and Deméré (1996) but was reinterpreted as an ankylosaurid by Ford and Kirkland (2001). Arbour and Currie (2016) and

Raven et al. (2023) recovered it as a basal ankylosaurid. Coombs and Deméré (1996) figure three teeth in labial and lingual view of the SDSNH 33909 *Aletopelta* holotype. Measuring the CH and CBL of these teeth show that of the three teeth, two are above 10m in size for both CH and CBL (Table 12). The third tooth is very close to 10 mm with a CBL of 9.93mm (Table 11), and while just below the threshold, is still larger than any ankylosaurid teeth measured in this study, and falls within the greater than 9 mm plausible threshold. This indicates that *Aletopelta* is best interpreted as a nodosaurid, as originally proposed by Coombs and Deméré (1996). The SDSNH 33909 teeth all appear to possess a clear basal cingulum and minor fluting, which suggests that *Aletopelta* is likely a panoplosaurid or ankylosaurid. Finally, I plotted the outlines of the SDSNH 33909 figured teeth in labial and lingual view against the PCAs for Coombs (1978) families and Raven et al. (2023) families and conducted "reLDAs" (Figure 24). The LDA of SDSNH 33909 tooth c in lingual view identifies the tooth as panoplosaurid with 86.7% likelihood and in labial view with 74% likelihood. SDSNH 33909 teeth a and b plot as panoplosaurid in labial view and as ankylosaurid and polacanthid in lingual view; these have much lower identification likelihood values. Using Coombs (1978) families, SDSNH 33909 teeth b and c are identified as nodosaurid in both labial and lingual view, and SDSNH 33909 tooth a is identified as nodosaurid in labial view and as ankylosaurid in lingual view. Size, morphometrics, and discrete traits all strongly suggest that *Aletopelta* is a nodosaurid ankylosaur. Further, the consistent identification of SDSNH 33909 tooth c as panoplosaurid between analyses, including having a >75% likelihood identification as panoplosaurid in lingual view and 74% in labial view, suggests that *Aletopelt*a is a panoplosaurid.

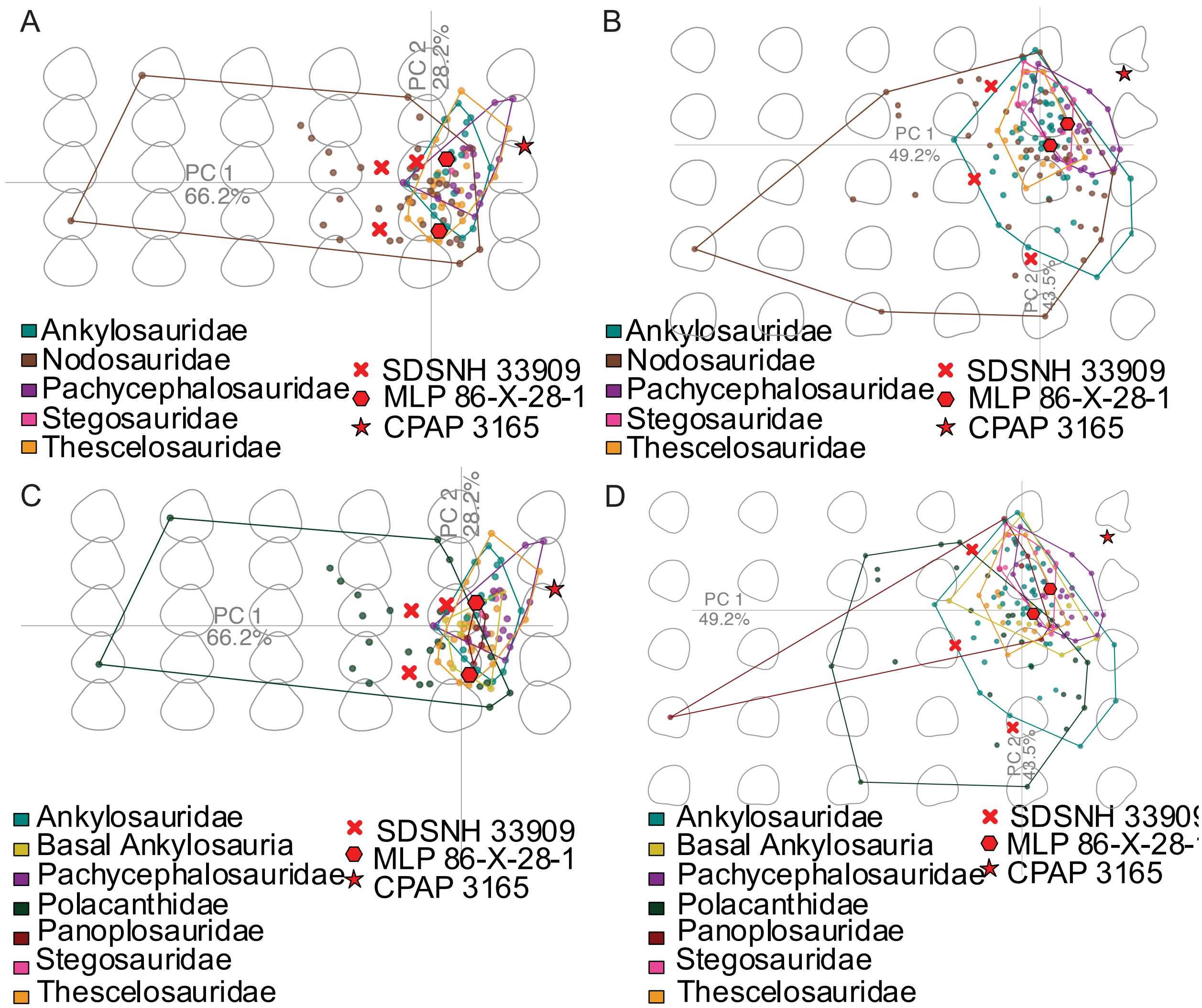

Figure 21. PCA of outline morphometrics with teeth from literature. ***A****, Coombs (1978) families in labial view;* ***B****, Coombs (1978) families in lingual view;* ***C****, Raven et al. (2023) families in labial view;* ***D****, Raven et al. (2023) families in lingual view.*

Table 11. CH and CBL of ankylosaur teeth from literature

Specimen	Sp.	CH	CBL
SDSNH 33909 – a	*Aletopelta coombsi*	9.12344294	9.93240208
SDSNH 33909 – b	*Aletopelta coombsi*	11.6891551	11.1148029
SDSNH 33909 – c	*Aletopelta coombsi*	11.5073631	11.9403924
MLP 86-X-28-1 – a	*Antarctopelta oliveroi*	8.0441458	8.78868355
MLP 86-X-28-1 – b	*Antarctopelta oliveroi*	7.17176286	7.57156831
CPAP 3165	*Stegouros elengassen*	4.96063076	5.28467851

Stegouros is a highly divergent ankylosaur recently described from Antarctica, bearing an independently evolved tail club dissimilar to ankylosaurids. Soto-Acuña et al (2021) found this taxon along with *Antarctopelta* to form the new basally-diverging clade Parankylosauria, which has yet to be tested by other researchers. *Antarctopelta,* also from Antarctica*,* has been identified as a parankylosaurian (Soto-Acuña et al., 2024, Soto-Acuña et al., 2021), basal nodosaurid (Thompson et al., 2012), indeterminate nodosaurid (Arbour & Currie, 2016), and ankylosaurid (Raven et al., 2023), and Salgado and Gasparini (2006) noted both ankylosaurid and nodosaurid features. There are no parankylosaur teeth included in my primary analysis, so it is unknown how parankylosaur teeth may plot in relation to ankylosaur families.

Soto-Acuña et al. (2021) figure a tooth from the *Stegouros* holotype (CPAP 3165). The CH and CBL of CPAP 3165 is small (Table 12), within the cluster of leaf-shaped ornithischian teeth from all families studied in this work. CPAP 3165 has very minor fluting and a basal cingulum on the labial face. Interestingly, in all of the PCA plots in lingual and labial views, *Stegouros* is completely outside of the morphospace of any of the families studied in this research (Figure 21). This is in line with its highly divergent anatomy and its phylogenetic placement outside the traditional nodosaurid-ankylosaurid dichotomy.

Salgado and Gasparini (2006) figure two teeth from *Antarctopelta* (MLP 86-X-28-1) that I analyzed using the methods in this research. The CH and CBL sizes of the two P 86-X-28-1 teeth are smaller than 10 mm (Table 12), so they cannot be confidently referred to Nodosauridae or Panoplosauridae. The teeth clearly have basal cingula and fluting, suggesting that they have a higher likelihood of being ankylosaurid or panoplosaurid than other ornithischian families, and are likely not basal ankylosaurs as none of the basal ankylosaur teeth in my dataset have fluting and only one has a basal cingulum. The *Antarctopelta* tooth outlines (in both labial and lingual views) plot in the cluster where all the ornithischian families overlap, using both the Coombs (1978) and Raven et al. (2023) taxonomic frameworks (Figure 21). In the LDAs, *Antarctopelta* resolves as an ankylosaurid, panoplosaurid, and basal ankylosaur depending on the analysis, and all identifications have <50% likelihood. Given this inconsistency, no real conclusions on *Antarctopelta* taxonomy can be drawn, however it is interesting to note that it falls within the morphospace of other ankylosaur families, unlike the teeth of the only other parankylosaurian, *Stegouros*.

Chapter 4 – Discussion

4.1 Identifying leaf-shaped ornithischian teeth

Overall, leaf-shaped ornithischian teeth are very difficult to distinguish from one another and it is difficult to make confident taxonomic identifications from isolated leaf-shaped teeth. A major takeaway from this research is that identifications of isolated leaf-shaped ornithischian teeth should be reevaluated. Previous identification methods proposed by Coombs (1978), i.e. the presence/absence of a basal cingulum, size, etc., cannot be used for identifying family as they overly simplify a range of morphologies present in ankylosaurs. This is true for both the traditional nodosaurid-ankylosaurid classification or the more recently identified ankylosaurid, panoplosaurid, polacanthid, and struthiosaurid system. For example, commonly used handbooks (e.g. Alberta Palaeontological Society, 2009), or summary literature such as (e.g. Ryan & Evans, 2005, Carpenter, 1997) note that ankylosaurid teeth are typically smaller than nodosaurid teeth, when nodosaurids clearly have teeth overlapping in size with ankylosaurids, as well as having teeth larger than ankylosaurids. Using the morphometric methods presented here, it is possible in some cases to identify panoplosaurid teeth. However, there is a large overlap in morphology for not just Ankylosauridae, and other traditional 'nodosaurid' taxa, but also for thescelosaurs, pachycephalosaurs, and stegosaurs. Any tooth unable to be resolved as Panoplosauridae, or without a consistent identification across at least three morphometric methods, should be classified as Ornithischia indet.

Hudgins et al. (2022) used traditional morphometrics to differentiate thescelosaur and pachycephalosaur teeth. However, they only used one individual of *Thescelosaurus neglectus* and one individual of *Stegoceras validum* as their dataset, not accounting for individual variation or for variation within Thescelosauridae and Pachycephalosauridae. Further, they did not include any ankylosaur teeth, which as this research has shown, overlap in morphology with thescelosaurs and pachycephalosaurs. Caution should therefore be used in using the methods from Hudgins et al. (2022) to differentiate isolated teeth given the outcomes of this research.

I recommend the following steps for identifying newly collected teeth or reassessing teeth already in collections. Noting the size of the tooth is an easy method for quickly distinguishing panoplosaurid/nodosaurid teeth from all other leaf-shaped teeth in North America, as any tooth greater than 10 mm size for CH and/or CBL can be identified as a nodosaurid/panoplosaurid. It is also likely that any teeth above 9 CBL and CH are also panoplosaurid, given that there are no teeth larger than 8.84mm CH that are not panoplosaurid (besides *Peloroplites*). Noting the presence/absence of fluting and basal cingula can then provide insight as to whether the tooth may belong to Ankylosauridae/Panoplosauridae or Polacanthidae/basal Ankylosauria. The base identification of leaf-shaped dinosaur teeth should be "Ornithischia indet." in the field given how similar the morphology is between the families, if a more specific identification is not resolved through discrete traits (cingulum/fluting) or size. Traditional and geometric morphometric methods may be employed once returning from the field to potentially resolve a more specific identification; most effective when multiple morphometric analyses are analyzed in combination. Overall, this work indicates that many leaf-shaped ornithischian teeth cannot be identified using these morphometric methods, but some can be identified to the family level.

Morphometric analyses are most effective for identifying if teeth are panoplosaurid and are rarely able to identify isolated teeth as ankylosaurid with consistency across methods. This reflects the fact that ankylosaurid teeth occupy the same morphospace as nodosaurid teeth, but nodosaurid teeth occupy a larger area of morphospace that does not fully overlap with ankylosaurids. For example, any tooth with a CBL or CH greater than 10 mm is probably a nodosaurid or panoplosaurid, but any tooth smaller could come from any ankylosaur family regardless of taxonomic framework. This has implications for the utility of teeth to test certain hypotheses of ankylosaur biogeography and evolution, such as the potential "ankylosaurid gap" in the mid Cretaceous of North America identified by Arbour et al. (2016). Given the morphometric overlap of Ankylosauridae with other clades, morphometric methods are not particularly useful for confirming an identification of Ankylosauridae. However, the analyses presented here could be used to test for the absence of ankylosaurids if only nodosaurid/panoplosaurid teeth are identified from isolated tooth samples.

This study focused on ankylosaurs from western North America (Laramidia), but ankylosaurs have a global distribution, and the variation represented by ankylosaur teeth may be greater than what was sampled in this study. For example, the parankylosaurian *Stegouros* did not plot close to other ankylosaurs sampled in my dataset. The primarily European Struthtiosauridae (using Raven et al., 2023) was not sampled as part of this project; additional geographic sampling could help resolve whether struthiosaurid teeth are distinct from other ankylosaur clades, and it would be interesting to note if they show different morphology from ankylosaurids, as the other 'nodosaurid' families do not. The Asian ankylosaurids *Saichania* and *Pinacosaurus* that were included in this study did not significantly differ from other North

American ankylosaurids, thus demonstrating a potentially similar dietary niche in geographically separated ankylosaurid species and other ornithischians with leaf-shaped teeth.

Recently, Wills et al (2024) studied a Middle Jurassic microsite in the United Kingdom and found numerous leaf-shaped teeth, including one identified as an ankylosaur, and several others as indeterminate thyreophorans. The Middle Jurassic is an important time for thyreophoran evolution, and this microsite work includes some of the oldest stegosaur and ankylosaur material. The morphometric methods explored in my research could be applied to this material, helping to potentially refine the identification of these isolated leaf-shaped ornithischian teeth and bring more clarity to the evolution of clades in Thyreophora.

Brown and Drunkenmiller (2011) describe several isolated leaf-shaped ornithischian teeth from the Prince Creek Formation of Alaska that may be better identified by the methods outlined in this work. Brown and Drunkenmiller (2011) rejected an ankylosaurian identification for these teeth because they consider that most ankylosaur taxa lack fluting that runs to the cingulum, and that ankylosaur teeth have fluting that is deep rather than wide. In comparison the teeth from the Prince Creek Formation have “vertical, shallow, and concave” flutes (Brown & Drunkenmiller, 2011). I have noted that several associated ankylosaur teeth have nearly vertical flutes that approach the cingulum (some teeth in ROM 1215, ROM 788, BYU 50866, TMP 1997.132.01, TMP 1996.075.0001, etc.) and many isolated teeth assigned to Ankylosauria prior to the work presented here. Brown and Drunkenmiller (2011) refer the teeth to Thescelosaurinae indet, but the identifications should be reevaluated, given the overlap in morphology that I have found between thescelosaurids and other ornithischians with leaf-shaped teeth including ankylosaurs. At present, no ankylosaurs have been identified from the

Prince Creek Formation, only pachycephalosaurs and thescelosaurids (Flaig et al., 2017). A more accurate identification of the microvertebrate material can provide a clearer picture of the palaeoecosystem and the palaeobiogeography of ankylosaurs.

4.2 Ankylosaur Taxonomy

The results of this study are relevant to several problems in ankylosaurian alpha taxonomy and higher-level interrelationships. Through nearly every morphometric analysis, Nodosauridae shows a larger range of variation than the other groups of leaf-shaped ornithischian teeth. Several re-evaluations of ankylosaur phylogeny, most recently Raven et al. (2023), have suggested that Nodosauridae should be split into multiple families. The chi-squared test and morphometric analyses presented in this work demonstrate that there are morphological differences within the dentition of 'nodosaurid' ankylosaurs. This research does not delve into which specific species should belong to each "nodosaurid" family but does support the hypothesis that Nodosauridae should be split into multiple clades.

When only nodosaurid species are considered, it becomes evident that much of the variation in this clade is represented by the genus *Edmontonia* – particularly *Edmontonia rugosidens*. *Edmontonia* is here represented by three skulls and two species. In comparison, *Gastonia* (represented by 13 bonebed teeth of two species) does not display the same variation observed in *Edmontonia*. The taxonomy of the closely related genera *Edmontonia* and *Panoplosaurus* is contentious (ex. Burns 2015, Carpenter, 1990), and there have been recent calls for systematic re-evaluation of *Edmontonia* and *Panoplosaurus* specimens (ex. Raven et al., 2023). *Edmontonia* has a large geographic and temporal range with respect to other ankylosaurs (Vickaryous et al., 2004). Raven et al. (2023) found *Edmontonia* to be paraphyletic and suggested that additional work is needed to resolve the phylogeny and taxonomy of species within Panoplosauridae. Specifically, they found *Edmontonia longiceps* and *Edmontonia rugosidens* as species with relative completeness in terms of known material, but as somewhat unstable in classification – indicating variation in traits between specimens identified as the same species and suggesting the need for further descriptive work. Given how much variation in Nodosauridae is covered by *Edmontonia* (ex. Figure 15), this research supports the call for the reevaluation of *Edmontonia* and *Panoplosaurus.*

The taxonomic position of *Cedarpelta* has been resolved differently in several taxonomic studies, as a basal ankylosaurid (Arbour & Currie, 2016), nodosaurid (Vickaryous et al. 2004), or basal ankylosaur (Raven et al., 2023). It is a critical taxon for understanding the evolution of ankylosaurids, because it is potentially the oldest ankylosaurid in North America, and may or may not be closely related to all other ankylosaurids found in the Campanian-Maastrichtian of North America (Arbour & Currie, 2016, Arbour et al., 2016). The single *Cedarpelta* tooth studied here was only partially erupted and thus unable to be included in the geometric morphometric outline analyses. The tooth was erupted enough, however, to measure crown height and note the presence/absence of fluting and a basal cingulum. The crown height falls within the range of overlap between nodosaurids and ankylosaurids, but it is noteworthy that this tooth is larger than most ankylosaurid and basal ankylosaur teeth, with a CH of 8.33 mm. The tooth does not have a basal cingulum or fluting, thus suggesting affinities with Polacanthidae or basal Ankylosauria rather than Panoplosauridae or Ankylosauridae. Carpenter et al. (2008) suggested that *Cedarpelta* could be a shamosaurine ankylosaurid, like *Gobisaurus* and *Shamosaurus* from

Asia, whereas the ankylosaurids in this study belong to the ankylosaurid subfamily Ankylosaurinae. *Gobisaurus* has large teeth with a CBL of 9.5mm and a CH of 11mm (Vickaryous et al., 2001), larger than what was observed for ankylosaurine ankylosaurids. The large size of *Gobisaurus* teeth suggests that shamosaurine ankylosaurid tooth size and morphology may differ from those of ankylosaurine ankylosaurids. *Gobisaurus* and *Cedarpelta* have long nodosaurid-like snouts rather than the shorter, wider snouts of ankylosaurine ankylosaurids (Vickaryous et al., 2021, Carpenter et al., 2001), and the large tooth size relative to ankylosaurids in combination with the long, narrow snout may suggest dietary convergence with nodosaurids in shamosaurine ankylosaurids. Small ankylosaurid tooth size may be more representative of ankylosaurines, with larger ankylosaurid tooth sizes in shamosaurines and basal ankylosaurids. The large tooth size of *Cedarpelta* supports either a nodosaurid or shamosaurine ankylosaurid identity.

Peloroplites was initially considered a large nodosaurid ankylosaur by Carpenter et al. (2008), but Raven et al. (2023) recovered it as a polacanthid. In the morphometric analyses and size comparisons presented here, *Peloroplites* plots far from Polacanthidae and shows similarities to Panoplosauridae. Raven et al. (2023) found four unambiguous synapomorphies for Polacanthidae and one for Panoplosauridae, but only one of the four polacanthid synapomorphies is present in *Peloroplites* because of missing data, and the sole panoplosaurid synapomorphy is also missing (rather than absent) in *Peloroplites*. As such, this only leaves one character of the scapulocoracoid (the presence of the ventral process at the posteroventral margin of the glenoid) as the feature identifying *Peloroplites* as polacanthid in Raven et al.'s (2023) dataset. The *Peloroplites* tooth is more than double the CH and CBL size of all other polacanthid specimens in my dataset. The tooth shape through both traditional morphometrics and geometric morphometrics of *Peloroplites* plots on the complete opposite side of the PC1 and LD 1 axes to the rest of Polacanthidae (ex. Figures 13 and 15). Considering only dental features, my results strongly suggest that *Peloroplites* is more likely a panoplosaurid ankylosaur, rather than a polacanthid ankylosaur. Alternatively, it is possible that *Peloroplites* evolved a specialized dentition, potentially reflecting its much larger body size compared to other polacanthids.

Aletopelta has been variously interpreted as both a nodosaurid and an ankylosaurid ankylosaur. The teeth of *Aletopelta* consistently plotted within the size and morphospace ranges for nodosaurids/panoplosaurids. The only known specimen of *Aletopelta* is sourced from marine sediments (Coombs & Deméré, 1996). Further, it is from a geographic region (California) that has little identifiable dinosaur fossil evidence (Coombs & Deméré, 1996). A nodosaurid identity for *Aletopelta* supports the previously identified positive association of nodosaurids in marine ecosystems compared to ankylosaurids (Arbour et al., 2016), supporting potential different ecological preferences between ankylosaur families. Coombs and Deméré (1996) originally proposed that the specimen that would later be named *Aletopelta* was referable to *Edmontonia*. *Aletopelta* teeth plot within the morphospace for *Edmontonia rugosidens*, supporting this hypothesis. If *Aletopelta* is *Edmontonia*, this increases the geographic range of *Edmontonia* southwards and westwards.

The two parankylosaur species investigated here, *Antarctopelta* and *Stegouros* occupied different regions of morphospace in my analyses. *Antarctopelta* plotted within the cluster of multiple leaf-shaped ornithischian families. This morphospace contains teeth from nodosaurids and ankylosaurids. Interestingly, prior to the discovery of *Stegouros* and the identification of Parankylosauria, *Antarctopelta* sometimes was recovered as a nodosaurid (Thompson et al., 2012, Arbour & Currie, 2016) and sometimes as an ankylosaurid (Raven et al., 2023, Salgado & Gasparini, 2006). *Stegouros* plotted completely outside of the occupied morphospace of any ankylosaur or leaf-shaped ornithischian family, which is potentially to be expected given its position outside of the traditional ankylosaurid/nodosaurid dichotomy. The disparate positions of parankylosaurs in the principal components analyses presented here is interesting and suggests that dental morphology was potentially more variable in parankylosaurs than other ankylosaurs

4.3 New pathologies

This research presents new tooth pathologies in ankylosaur dinosaurs. Split carinae has not been noted in other ornithischian dinosaurs, though they have been reported in saurischians (Erickson, 1995). Split carinae in theropods are thought to be caused by genetics. Here I show evidence of split carinae in isolated ankylosaur teeth. As the split carinae in ankylosaur teeth looks very similar to the split carinae in therapod teeth, it can be assumed that they are formed in a similar manner. I also report the first evidence of a split apex in Dinosauria. The discovery of the new pathology suggests future research avenues in ornithischian tooth development and the relation of these pathologies to diet.

4.4 Ankylosaur palaeoecology

This research has implications for research that relies on isolated dinosaur teeth, such as palaeoecological studies of vertebrate microsites, as well as interpretations of ankylosaur feeding ecology. Vertebrate microfossil sites amass small fossils from many animals of varying body sizes from the surrounding environment (Cullen et al., 2016). Ankylosauria is often treated as one group within microsite studies, but being able to identify if an isolated tooth is nodosaurid can provide additional information on specific ankylosaur clades. Formations in Alberta and Montana, especially the Dinosaur Park Formation of Southern Alberta, are often used in microsite palaeoecological studies, because microsites are relatively abundant, and the stratigraphy is well studied. All the traditional and geometric morphometric analyses, except for one, had LDA classification success rates between 50-75% for samples from only Alberta and samples from Alberta/Montana. These analyses therefore can be useful when used in combination to identify the family of isolated teeth from these formations.

Nodosauridae/Panoplosauridae shows the largest amount of variation in tooth morphology compared to clades of ornithischians with leaf-shaped teeth. They occupy a broader amount of morphospace for the features measured here, and they can also be much larger than other ankylosaur and ornithischian teeth. Nodosaurid/panoplosaurid teeth are not only absolutely bigger, but also proportionally bigger relative to skull size. For example, *Ankylosaurus magniventris* (CMNFV 8880) has a skull length from premaxilla to occipital condyle of 64.5cm, a skull width at the quadratojugal horns of 74.5 cm (Carpenter, 2004) and tooth CHs of ~5-7.5mm, whereas *Edmontonia rugosidens* (TMP 1998.098.0001) has a skull length of 47.7.cm and a skull width of 35.3cm (Burns, 2015, also listed as TMP 97.9.1), tooth CHs from ~7 to

23mm, in other words, crown height is 0.97% skull length in *Ankylosaurus* but 3.14% in *Edmontonia*.

This variation in Panoplosauridae suggests they may have evolved different dietary niches to ankylosaurids and the other ornithischians with leaf-shaped teeth. While nodosaurid dinosaurs occupy the same formations as ankylosaurids in North America, nodosaurid fossils are also found in formations that ankylosaurids are not – primarily coastal and marine formations (Arbour et al., 2016, Butler & Barrett, 2008). Previously, it has been hypothesized that nodosaurids may have a larger ecological niche than ankylosaurids, or preferentially chose to inhabit these environments (Arbour et al., 2016, Butler & Barrett, 2008). Some studies (ex. Mallon & Anderson, 2013) use morphometrics to show that ankylosaurids had different jaw mechanics and tooth wear than nodosaurids, while other studies (Ösi et al., 2017) suggest that different ankylosaur families have very similar jaw mechanics and tooth wear. Nodosaurids are thought to have eaten tougher plants than ankylosaurids (Ballell et al., 2023, Mallon & Anderson, 2013), and be selective or intermediate feeders (Ballell et al., 2023, Brown et al., 2020, Mallon & Anderson, 2014), with evidence of a predominantly fern diet (Brown et al., 2020). Occupying a different dietary niche could also help explain why nodosaurids/panoplosaurids are found at a higher rate in coastal/marine depositional environments (Arbour et al., 2016). Further, the possibility of nodosaurids/panoplosaurids having a different dietary niche to ankylosaurids could present an explanation for why nodosaurids remain throughout the mid Cretaceous in North America while ankylosaurids were potentially extirpated (Arbour et al., 2016). If nodosaurids/panoplosaurids were able to eat different vegetation or a wider variety of vegetation compared to ankylosaurids, they may have been less susceptible to mid Cretaceous environmental changes such as the emergence of flowering plants (Wing & Boucher, 1998), changes to precipitation and humidity (Suarez et al., 2012, Ufnar et al., 2004), climate change (Wang et al., 2013), and transgressions and regressions of sea levels (Haq, 2014).

Panoplosaurids are more likely to have fluting and a basal cingulum, whereas polacanthids and basal ankylosaurs do not. The function of the basal cingulum and fluting in dinosaur teeth in poorly studied. However, in mammals, it is suggested that the cingulum protects the neck of the tooth while chewing soft foods, protects the gums (Lucas et al., 2008), or reduces strain on the base of the tooth from a soft food diet (Anderson et al., 2009). Fluting has only been studied in spinosaurid and marine reptile teeth where it is suggested that it aids in cutting flesh and reducing the number of teeth pulled out by struggling prey (Hendrickx et al., 2019); as ankylosaurs were not carnivorous, they did not use the flutes for this function. Testing the utility of the basal cingulum and fluting in ornithischian dinosaurs could thus provide more insight into potential dietary differences between families, given that there is a significant difference in the presence/absence of the traits between families.

Geochemical analyses including ankylosaur teeth have not distinguished between families, instead grouping all teeth under Ankylosauria as a whole (ex. Cullen et al., 2022). The variation in tooth size and shape demonstrated by panoplosaurids suggests that future geochemical studies should examine the differences between ankylosaur families to better understand their role in ecosystems. Martin et al. (2022) indicated that ankylosaur families do not show differences in geochemical calcium signatures suggesting no difference in diet. However, their sample size for ankylosaurs was two and both samples were identified by them as ankylosaurid. At least one of the two teeth in their study, TMP 1998.068.0153, is an isolated tooth, also sampled in this research. Based on my analysis, it should be reclassified as a nodosaurid tooth. Thus, no conclusions on geochemistry related to ankylosaur families should be drawn from Martin et al. (2022). Given the suggested difference in feeding methods for panoplosaurids, and significant overlap in morphology between ankylosaurids and other leaf-shaped ornithischian teeth, geochemical analysis may provide an additional line of evidence for identifying the family of isolated teeth.

4.5 Limitations of this study

While this study provides an excellent basis for understanding how morphometrics can be applied to ankylosaur tooth identification, is does present several limitations. Firstly, the geometric morphometric analyses are only done in 2D. Recent morphometric research has shown that 3D morphometrics can be an even more powerful tool for studying differences in shape (Cardini, 2014). Using 2D morphometrics is not an invalid method and is certainly more cost-effective than 3D morphometrics, but it may not identify all the shape differences that 3D morphometrics could. Similarly, I did not take any crown basal widths on either the distal or mesial edge when doing traditional morphometrics. Aligning a tooth along its midline to photograph/measure the edges is quite difficult and unviable for many of the teeth *in situ* in skulls, however, it is possible that these measurements could indicate shape differences not accounted for by the methods used in this research.

There are not many ankylosaur teeth preserved within their sockets in skull, and between the skulls that do preserve teeth, there is not enough consistency of which socket they are retained within to conduct analyses only comparing teeth in the same positions in the jaw to each other. This lack of adequate fossils creates a limitation as it may be possible to differentiate ankylosaur teeth when their tooth position is considered, but many new skulls preserving multiple teeth must be discovered before this type of analysis can be completed.

There are several biases in the data based on specimen availability. There are unequal numbers of teeth associated with skulls for each family, species, time period, and formation. Specifically, there are more nodosaurid teeth associated with skulls than ankylosaurid teeth in this dataset, and there is a large bias towards teeth from Alberta. Statistical analysis methods such as the LDAs and chi-squared tests take these differences in sample size into account, but there is more variation with larger sample size. Additionally, all the stegosaur teeth and all the pachycephalosaur teeth, except for one, associated with skulls come from a single individual and thus do not represent variation between individuals. These specimens are meant to act as a test if these methods can differentiate other ornithischians with similar shaped teeth and are not the main focus of this research. Additional work should be conducted with a larger sample size of these other ornithischian groups to fully understand their variation in relationship to ankylosaur tooth morphology.

I took measurements of denticle height and width on both the mesial and distal edges of teeth when denticles were present, as well as the neck length if the neck was present/accessible. Many teeth lacked unworn denticles that could be accurately measured when the overall tooth shape was still preserved. Discarding samples that were missing denticle measurements in the traditional morphometric analysis reduced the sample size too greatly and including the missing values skewed the data, so these measurements were not used in the traditional morphometric analysis. Finally, neck length was measured on most isolated teeth, as even if the root was absent, it is possible to measure the width of where the neck meets the crown base if the bottom of the crown base is retained. However, most teeth *in situ* in skulls have the root still inside the jaw, unexposed, so it is impossible to capture an accurate neck length. With very few measurements of neck length in teeth associated with skulls, it is not possible to study how the neck length varies between groups with statistical significance.

Chapter 5 – Conclusion

Morphometric approaches presented here can identify some teeth as panoplosaurid, and occasionally as ankylosaurid, polacanthid, or other ornithischian families with leaf-shaped teeth from Laramidia. The identification techniques here presented do not align with the previous identification techniques for isolated teeth (ex. Coombs, 1978) and isolated teeth currently in collections should be reclassified.

Most of the morphospace of leaf-shaped ornithischian teeth overlaps between all families, with a small amount of distinct space belonging to each family, and a large amount of unique morphospace belonging to Panoplosauridae. There are morphological differences in shape, size, and traits of teeth in Panoplosauridae, Polacanthidae, and basal Ankylosauria, supporting the division of Nodosauridae into multiple families. A large portion of the unique morphospace of Panoplosauridae is occupied by *Edmontonia*, supporting the calls for a systematic revision of *Edmontonia.*

The techniques presented here provide insight into the taxonomy of some species of uncertain taxonomic affinity. *Cedarpelta* has a large tooth compared to most Laramidian ankylosaurs, perhaps supporting the identification of a shamosaurine ankylosaurid. *Peloroplites* has a very different tooth shape from other polacanthids and should perhaps be reassigned to Panoplosauridae. *Aletopelta* plots through all methods as a panoplosaurid, strongly indicating a nodosaurid identification. *Antarctopelta* plots in the morphospace covered by all leaf-shaped ornithischian teeth, including all ankylosaur families, which contrast the morphology of *Stegouros*, the other parankylosaurian, which plots outside of the morphospace of all

Laramidian leaf-shaped ornithischian teeth, suggesting further work should be done on parankylosaurian dentition.

Two new pathologies are noted in Ankylosauria. Split carinae, which is commonly noted in saurischians, is here first noted in Ornithischia. Split apex is defined as a new pathology separate from split carinae and is here first noted in Dinosauria.

The new identification techniques presented provide potential insight into ankylosaur dietary and environmental niches. More representative identifications of isolated teeth in microvertebrate palaeoecological studies will provide insight into paleobiogeography and ecological diversity. Difference in morphology between leaf-shaped ornithischian families, especially that of panoplosaurids, suggests future avenues of geochemical analysis to better resolve dietary and ecological niches.

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Appendix A – Identifications of isolated teeth from discrete traits

Sample Number	Previous Family ID	ID from LDAs	Possible IDs from features	Basal cingulum	Fluting
CEUM 11923	Ankylosaur	NA	Panoplosaurid/ Ankylosaurid	y	
CEUM 11924	Ankylosaur	Ornithischia	Panoplosaurid/ Ankylosaurid	y	
CEUM 12811	Nodosaurid	NA	Panoplosaurid/ Ankylosaurid	y	
CEUM 31206	Nodosaurid	NA	Panoplosaurid/ Ankylosaurid	y	
CEUM 53115	Nodosaurid	Nodosaurid/ Panoplosaurid	Panoplosaurid/ Ankylosaurid	y	
CMNFV 1131	Carnivorous dinosaur	NA	Panoplosaurid/ Ankylosaurid	y	
CMNFV 119 - 1	Nodosaurid	Ornithischia	Panoplosaurid/ Ankylosaurid	y	y
CMNFV 119 - 2	Nodosaurid	Ornithischia	Polacanthid/ Basal		
CMNFV 119 - 3	Nodosaurid	Ornithischia	Panoplosaurid/ Ankylosaurid	y	y
CMNFV 119 - 4	Nodosaurid	NA	Panoplosaurid/ Ankylosaurid	y	y
CMNFV 119 - 5	Nodosaurid	Ornithischia	Panoplosaurid/ Ankylosaurid		y
CMNFV 119 - 6	Nodosaurid	Pachycephalos aurid	Panoplosaurid/ Ankylosaurid	y	y
CMNFV 129 - 1	Ankylosaur	NA	Polacanthid/ Basal		
CMNFV 129 - 2	Ankylosaur	NA	Panoplosaurid/ Ankylosaurid	y	
CMNFV 1349	Nodosaurid	NA	Panoplosaurid/ Ankylosaurid		y
CMNFV 1772 - 1	Nodosaurid	Nodosaurid/ Panoplosaurid	Polacanthid/ Basal		

Sample Number	Previous Family ID	ID from LDAs	Possible IDs from features	Basal cingulum	Fluting
CMNFV 1772 - 2	Nodosaurid	NA	Polacanthid/ Basal		
CMNFV 1772 - 3	Nodosaurid	Nodosaurid/ Panoplosaurid	Panoplosaurid/ Ankylosaurid	y	
CMNFV 1772 - 4	Nodosaurid	NA	Panoplosaurid/ Ankylosaurid	y	
CMNFV 1772 - a	Ankylosaurid	NA	Panoplosaurid/ Ankylosaurid	y	y
CMNFV 21864	Nodosaurid	NA	Panoplosaurid/ Ankylosaurid	y	
CMNFV 2334	Ankylosaur	NA	Polacanthid/ Basal		
CMNFV 38441	Ankylosaurid	NA	Panoplosaurid/ Ankylosaurid	y	
CMNFV 38442	Ankylosaurid	Ankylosaurid	Panoplosaurid/ Ankylosaurid	y	y
CMNFV 38443	Ankylosaurid	Ornithischia	Panoplosaurid/ Ankylosaurid	y	y
CMNFV 38444	Ankylosaurid	NA	Polacanthid/ Basal		
CMNFV 38445	Ankylosaurid	Ornithischia	Panoplosaurid/ Ankylosaurid		y
CMNFV 38446	Ankylosaurid	NA	Polacanthid/ Basal		
CMNFV 38447	Ankylosaurid	Ornithischia	Polacanthid/ Basal		
CMNFV 38448	Ankylosaurid	Ornithischia	Panoplosaurid/ Ankylosaurid	y	
CMNFV 38449	Ankylosaurid	NA	Panoplosaurid/ Ankylosaurid	y	
CMNFV 59240 - 1	Nodosaurid	Ornithischia	Panoplosaurid/ Ankylosaurid	y	
CMNFV 59240 - 2	Nodosaurid	Ornithischia	Panoplosaurid/ Ankylosaurid	y	y

Sample Number	Previous Family ID	ID from LDAs	Possible IDs from features	Basal cingulum	Fluting
CMNFV 59240 - 3	Nodosaurid	NA	Panoplosaurid/ Ankylosaurid	y	
CMNFV 59431	Nodosaurid	NA	Panoplosaurid/ Ankylosaurid	y	
CMNFV 59432 - 1	Stegosauroid	NA	Panoplosaurid/ Ankylosaurid	y	
CMNFV 59432 - 2	Stegosauroid	NA	Panoplosaurid/ Ankylosaurid		
CMNFV 59459	Nodosaurid	NA	Panoplosaurid/ Ankylosaurid	y	
CMNFV 59460	Nodosaurid	NA	Panoplosaurid/ Ankylosaurid	y	
CMNFV 59480	Nodosaurid	NA	Panoplosaurid/ Ankylosaurid	y	
CMNFV 59510 - 1	Nodosaurid	NA	Panoplosaurid/ Ankylosaurid	y	y
CMNFV 59510 - 2	Nodosaurid	NA	Panoplosaurid/ Ankylosaurid	y	y
CMNFV 59534	Ankylosaurid	NA	Panoplosaurid/ Ankylosaurid	y	
CMNFV 59591 - 1	Ankylosaur	Nodosaurid/ Panoplosaurid	Panoplosaurid/ Ankylosaurid	y	y
CMNFV 59591 - 2	Ankylosaur	NA	Polacanthid/ Basal		
CMNFV 8731 - 1	Ankylosaur	NA	Panoplosaurid/ Ankylosaurid	y	
CMNFV 8731 - 2	Ankylosaur	NA	Polacanthid/ Basal		
CMNFV 8731 - 3	Ankylosaur	NA	Panoplosaurid/ Ankylosaurid	y	
CMNFV 8731 - 4	Ankylosaur	Nodosaurid/ Panoplosaurid	Panoplosaurid/ Ankylosaurid	y	y
CMNFV 973	Nodosaurid	NA	Panoplosaurid/ Ankylosaurid	y	

Sample Number	Previous Family ID	ID from LDAs	Possible IDs from features	Basal cingulum	Fluting
CMNFV CMS1921 - 1		NA	Polacanthid/ Basal		
CMNFV CMS1921 - 2		Ornithischia	Polacanthid/ Basal		
CMNFV CMS1921 - 3		Nodosaurid/ Panoplosaurid	Panoplosaurid/ Ankylosaurid	y	
CMNFV CMS1921 - 4		NA	Polacanthid/ Basal		
CMNFV CMS1921 - 5		NA	Polacanthid/ Basal		
CMNFV CMS1921 - 6		NA	Polacanthid/ Basal		
CMNFV CMS1921 - 7		Ornithischia	Panoplosaurid/ Ankylosaurid	y	
CMNFV CMS1921 - 8		NA	Polacanthid/ Basal		
CMNFV RDR - 1	Ankylosaur	Nodosaurid/ Panoplosaurid	Polacanthid/ Basal		
CMNFV RDR - 10	Ankylosaur	NA	Polacanthid/ Basal		
CMNFV RDR - 11	Ankylosaur	NA	Polacanthid/ Basal		
CMNFV RDR - 12	Ankylosaur	NA	Polacanthid/ Basal		
CMNFV RDR - 2	Ankylosaur	NA	Panoplosaurid/ Ankylosaurid	y	
CMNFV RDR - 3	Ankylosaur	NA	Panoplosaurid/ Ankylosaurid	y	
CMNFV RDR - 4	Ankylosaur	NA	Panoplosaurid/ Ankylosaurid	y	
CMNFV RDR - 5	Ankylosaur	NA	Panoplosaurid/ Ankylosaurid	y	
CMNFV RDR - 6	Ankylosaur	NA	Panoplosaurid/ Ankylosaurid	y	

Sample Number	Previous Family ID	ID from LDAs	Possible IDs from features	Basal cingulum	Fluting
CMNFV RDR - 7	Ankylosaur	NA	Panoplosaurid/ Ankylosaurid	y	
CMNFV RDR - 8	Ankylosaur	NA	Panoplosaurid/ Ankylosaurid	y	
CMNFV RDR - 9	Ankylosaur	NA	Panoplosaurid/ Ankylosaurid	y	
CMNFV UN - 1		NA	Panoplosaurid/ Ankylosaurid	y	
CMNFV UN - 2		NA	Polacanthid/ Basal		
CMNFV UN - 3		NA	Polacanthid/ Basal		
CMNFV UN - 4		NA	Panoplosaurid/ Ankylosaurid	y	
CMNFV UN - 5		Ornithischia	Panoplosaurid/ Ankylosaurid	y	
CMNFV UN - 6		NA	Polacanthid/ Basal		
CMNFV UN - 7		NA	Panoplosaurid/ Ankylosaurid	y	
CMNFV UN - 8		NA	Polacanthid/ Basal		
CMNFV UN - 9		NA	Polacanthid/ Basal		
DMNH EPV 18168 - 1	Nodosaurid	NA	Panoplosaurid/ Ankylosaurid	y	
DMNH EPV 18168 - 10	Nodosaurid	NA	Panoplosaurid/ Ankylosaurid	y	
DMNH EPV 18168 - 11	Nodosaurid	NA	Panoplosaurid/ Ankylosaurid	y	
DMNH EPV 18168 - 12	Nodosaurid	NA	Panoplosaurid/ Ankylosaurid	y	
DMNH EPV 18168 - 13	Nodosaurid	NA	Panoplosaurid/ Ankylosaurid	y	

Sample Number	Previous Family ID	ID from LDAs	Possible IDs from features	Basal cingulum	Fluting
DMNH EPV 18168 - 14	Nodosaurid	NA	Panoplosaurid/ Ankylosaurid	y	
DMNH EPV 18168 - 15	Nodosaurid	NA	Panoplosaurid/ Ankylosaurid	y	
DMNH EPV 18168 - 16	Nodosaurid	NA	Panoplosaurid/ Ankylosaurid	y	
DMNH EPV 18168 - 17	Nodosaurid	NA	Panoplosaurid/ Ankylosaurid	y	
DMNH EPV 18168 - 2	Nodosaurid	NA	Panoplosaurid/ Ankylosaurid	y	
DMNH EPV 18168 - 3	Nodosaurid	NA	Panoplosaurid/ Ankylosaurid	y	
DMNH EPV 18168 - 4	Nodosaurid	NA	Panoplosaurid/ Ankylosaurid	y	
DMNH EPV 18168 - 5	Nodosaurid	NA	Panoplosaurid/ Ankylosaurid	y	
DMNH EPV 18168 - 6	Nodosaurid	NA	Panoplosaurid/ Ankylosaurid	y	
DMNH EPV 18168 - 7	Nodosaurid	NA	Panoplosaurid/ Ankylosaurid	y	
DMNH EPV 18168 - 8	Nodosaurid	NA	Panoplosaurid/ Ankylosaurid	y	
DMNH EPV 18168 - 9	Nodosaurid	NA	Panoplosaurid/ Ankylosaurid	y	
DMNH EPV 18169 - 1	Nodosaurid	NA	Panoplosaurid/ Ankylosaurid	y	
DMNH EPV 18169 - 2	Nodosaurid	NA	Panoplosaurid/ Ankylosaurid	y	
DMNH EPV 18169 - 3	Nodosaurid	NA	Panoplosaurid/ Ankylosaurid	y	
DMNH EPV 18169 - 4	Nodosaurid	NA	Panoplosaurid/ Ankylosaurid	y	
DMNH EPV 18169 - 5	Nodosaurid	NA	Panoplosaurid/ Ankylosaurid	y	

Sample Number	Previous Family ID	ID from LDAs	Possible IDs from features	Basal cingulum	Fluting
DMNH EPV 21671	Nodosaurid	NA	Panoplosaurid/ Ankylosaurid	y	
ROM 03088	Nodosaurid	NA	Panoplosaurid/ Ankylosaurid	y	y
ROM 03287	Nodosaurid	NA	Polacanthid/ Basal		
ROM 03302	Nodosaurid	NA	Panoplosaurid/ Ankylosaurid	y	
ROM 03368	Nodosaurid	NA	Panoplosaurid/ Ankylosaurid	y	
ROM 03516	Nodosaurid	NA	Panoplosaurid/ Ankylosaurid	y	y
ROM 07763	Ankylosaurid	NA	Panoplosaurid/ Ankylosaurid	y	y
ROM 07765	Ankylosaurid	Ankylosaurid	Panoplosaurid/ Ankylosaurid	y	y
ROM 07766	Ankylosaurid	NA	Panoplosaurid/ Ankylosaurid	y	y
ROM 07767	Nodosaurid	NA	Panoplosaurid/ Ankylosaurid	y	
ROM 07768	Nodosaurid	NA	Polacanthid/ Basal		
ROM 07770	Pachycephalo saurid	Ornithischia	Panoplosaurid/ Ankylosaurid		y
ROM 07772	Nodosaurid	NA	Polacanthid/ Basal		
ROM 26346	Thescelosauri dae	NA	Panoplosaurid/ Ankylosaurid		Y
ROM 31697	Nodosaurid	NA	Panoplosaurid/ Ankylosaurid	y	
ROM 31865	Nodosaurid	NA	Polacanthid/ Basal		
ROM 31866	Ankylosaurid	Ornithischia	Panoplosaurid/ Ankylosaurid	y	y

Sample Number	Previous Family ID	ID from LDAs	Possible IDs from features	Basal cingulum	Fluting
ROM 31867	Ankylosaurid	NA	Panoplosaurid/ Ankylosaurid	y	y
ROM 31868	Ankylosaurid	NA	Panoplosaurid/ Ankylosaurid		y
ROM 31869	Ankylosaurid	NA	Panoplosaurid/ Ankylosaurid	y	y
ROM 31871	Nodosaurid	NA	Panoplosaurid/ Ankylosaurid	y	y
ROM 31872	Nodosaurid	Ornithischia	Panoplosaurid/ Ankylosaurid	y	
ROM 36385	Nodosaurid	NA	Panoplosaurid/ Ankylosaurid	y	
ROM 36386	Nodosaurid	NA	Panoplosaurid/ Ankylosaurid	y	
ROM 36387	Nodosaurid	NA	Polacanthid/ Basal		
ROM 36388	Nodosaurid	NA	Polacanthid/ Basal		
ROM 36389	Nodosaurid	NA	Panoplosaurid/ Ankylosaurid	y	
ROM 36390	Nodosaurid	NA	Polacanthid/ Basal		
ROM 36391	Nodosaurid	NA	Panoplosaurid/ Ankylosaurid	y	
ROM 36392	Nodosaurid	NA	Panoplosaurid/ Ankylosaurid	y	
ROM 36393	Nodosaurid	NA	Panoplosaurid/ Ankylosaurid	y	
ROM 36394	Nodosaurid	NA	Panoplosaurid/ Ankylosaurid	y	
ROM 36395	Nodosaurid	NA	Panoplosaurid/ Ankylosaurid	y	
ROM 36396	Nodosaurid	NA	Panoplosaurid/ Ankylosaurid	y	

Sample Number	Previous Family ID	ID from LDAs	Possible IDs from features	Basal cingulum	Fluting
ROM 36397	Nodosaurid	NA	Panoplosaurid/ Ankylosaurid	y	
ROM 36398	Nodosaurid	NA	Panoplosaurid/ Ankylosaurid	y	
ROM 36399	Nodosaurid	NA	Panoplosaurid/ Ankylosaurid	y	
ROM 36400	Nodosaurid	NA	Panoplosaurid/ Ankylosaurid	y	
ROM 36401	Nodosaurid	NA	Panoplosaurid/ Ankylosaurid	y	
ROM 36402	Nodosaurid	NA	Panoplosaurid/ Ankylosaurid	y	
ROM 36403	Nodosaurid	NA	Panoplosaurid/ Ankylosaurid	y	
ROM 36404	Nodosaurid	NA	Panoplosaurid/ Ankylosaurid	y	y
ROM 36405	Nodosaurid	NA	Polacanthid/ Basal		
ROM 36406	Nodosaurid	NA	Panoplosaurid/ Ankylosaurid	y	
ROM 36407	Nodosaurid	NA	Polacanthid/ Basal		
ROM 36408	Nodosaurid	NA	Panoplosaurid/ Ankylosaurid	y	y
ROM 36409	Nodosaurid	NA	Panoplosaurid/ Ankylosaurid	y	
ROM 36410	Nodosaurid	NA	Panoplosaurid/ Ankylosaurid	y	y
ROM 36411	Nodosaurid	NA	Panoplosaurid/ Ankylosaurid	y	y
ROM 36412	Nodosaurid	NA	Polacanthid/ Basal		
ROM 36413	Nodosaurid	NA	Panoplosaurid/ Ankylosaurid	y	

Sample Number	Previous Family ID	ID from LDAs	Possible IDs from features	Basal cingulum	Fluting
ROM 36414	Nodosaurid	NA	Panoplosaurid/ Ankylosaurid	y	
ROM 36415	Nodosaurid	NA	Polacanthid/ Basal		
ROM 36416	Nodosaurid	NA	Panoplosaurid/ Ankylosaurid	y	y
ROM 36417	Nodosaurid	NA	Panoplosaurid/ Ankylosaurid	y	y
ROM 36418	Nodosaurid	NA	Panoplosaurid/ Ankylosaurid	y	y
ROM 36419	Nodosaurid	NA	Panoplosaurid/ Ankylosaurid	y	
ROM 36420	Nodosaurid	NA	Panoplosaurid/ Ankylosaurid	y	
ROM 36421	Nodosaurid	NA	Panoplosaurid/ Ankylosaurid	y	
ROM 36422	Nodosaurid	NA	Panoplosaurid/ Ankylosaurid	y	
ROM 36423	Nodosaurid	NA	Polacanthid/ Basal		
ROM 56611	Ankylosaurid	NA	Panoplosaurid/ Ankylosaurid	y	
ROM 56620	Nodosaurid	NA	Panoplosaurid/ Ankylosaurid	y	
ROM 58144	Ankylosaurid	NA	Panoplosaurid/ Ankylosaurid	y	
ROM 58147	Pachycephalo saurid	NA	Panoplosaurid/ Ankylosaurid	y	y
ROM 58151	Ankylosaurid	NA	Panoplosaurid/ Ankylosaurid	y	
ROM 58223	Ankylosaurid	NA	Panoplosaurid/ Ankylosaurid	y	
ROM 58383	Ankylosaurid	NA	Panoplosaurid/ Ankylosaurid	y	y

Sample Number	Previous Family ID	ID from LDAs	Possible IDs from features	Basal cingulum	Fluting
ROM 58516	Ankylosaurid	NA	Polacanthid/ Basal		
ROM 58525	Ankylosaurid	NA	Panoplosaurid/ Ankylosaurid	y	y
ROM 58565 - 1	Ankylosaurid	NA	Panoplosaurid/ Ankylosaurid	y	
ROM 58565 - 2	Ankylosaurid	NA	Panoplosaurid/ Ankylosaurid	y	
ROM 58565 - 3	Ankylosaurid	NA	Panoplosaurid/ Ankylosaurid	y	
ROM 58565 - 4	Ankylosaurid	NA	Polacanthid/ Basal		
ROM 58594	Ankylosaurid	Nodosaurid/ Panoplosaurid	Panoplosaurid/ Ankylosaurid	y	
ROM 58598	Ankylosaurid	Ornithischia	Panoplosaurid/ Ankylosaurid	y	
ROM 58689 - 1	Ankylosaurid	NA	Panoplosaurid/ Ankylosaurid	y	
ROM 58689 - 2	Ankylosaurid	NA	Panoplosaurid/ Ankylosaurid	y	
ROM 58704	Ankylosaurid	NA	Panoplosaurid/ Ankylosaurid	y	
ROM 67276	Ankylosaurid	NA	Panoplosaurid/ Ankylosaurid	y	
TMP 1966.025.0015	Pachycephalo saurid	Ornithischia	Panoplosaurid/ Ankylosaurid		y
TMP 1976.006.0036	Ornithischia	Ankylosaur	Panoplosaurid/ Ankylosaurid	y	
TMP 1980.008.0026 - 1	Ankylosaurid	Nodosaurid/ Panoplosaurid	Panoplosaurid/ Ankylosaurid	y	
TMP 1980.008.0026 - 2	Ankylosaurid	Ornithischia	Panoplosaurid/ Ankylosaurid	y	y
TMP 1980.013.0046	Ankylosaurid	NA	Panoplosaurid/ Ankylosaurid		y

Sample Number	Previous Family ID	ID from LDAs	Possible IDs from features	Basal cingulum	Fluting
TMP 1980.016.0239	Ankylosaurid	NA	Panoplosaurid/ Ankylosaurid		y
TMP 1980.016.0834	Pachycephalo saurid	Ornithischia	Panoplosaurid/ Ankylosaurid		y
TMP 1980.029.0140	Pachycephalo saurid	Ankylosaur	Panoplosaurid/ Ankylosaurid	y	y
TMP 1980.029.0228	Ankylosaurid	NA	Panoplosaurid/ Ankylosaurid		y
TMP 1981.041.0014	Ankylosaurid	Ornithischia	Panoplosaurid/ Ankylosaurid	y	y
TMP 1983.036.0009 - 1	Ankylosaurid	Ankylosaurid	Panoplosaurid/ Ankylosaurid		y
TMP 1983.036.0009 - 2	Ankylosaurid	NA	Panoplosaurid/ Ankylosaurid		y
TMP 1983.036.0009 - 3	Ankylosaurid	NA	Panoplosaurid/ Ankylosaurid	y	y
TMP 1983.036.0009 - 4	Ankylosaurid	NA	Panoplosaurid/ Ankylosaurid	y	y
TMP 1983.036.0207	Nodosaurid	NA	Panoplosaurid/ Ankylosaurid	y	y
TMP 1984.091.0020	Nodosaurid	Ornithischia	Panoplosaurid/ Ankylosaurid	y	
TMP 1985.036.0121	Pachycephalo saurid	NA	Panoplosaurid/ Ankylosaurid		y
TMP 1985.056.0170 - 1	Ankylosaurid	Ornithischia	Panoplosaurid/ Ankylosaurid	y	y
TMP 1985.056.0170 - 2	Ankylosaurid	NA	Panoplosaurid/ Ankylosaurid	y	y
TMP 1985.056.0171 - 1	Nodosaurid	Nodosaurid/Pa noplosaurid	Panoplosaurid/ Ankylosaurid	y	y

Sample Number	Previous Family ID	ID from LDAs	Possible IDs from features	Basal cingulum	Fluting
TMP 1985.056.0171 - 2	Nodosaurid	NA	Panoplosaurid/ Ankylosaurid	y	y
TMP 1985.056.0171 - 3	Nodosaurid	Ornithischia	Panoplosaurid/ Ankylosaurid	y	y
TMP 1985.056.0211	Ankylosaurid	NA	Panoplosaurid/ Ankylosaurid	y	y
TMP 1985.059.0028	Pachycephalo saurid	Ornithischia	Panoplosaurid/ Ankylosaurid		y
TMP 1986.008.0084	Nodosaurid	NA	Panoplosaurid/ Ankylosaurid	y	
TMP 1986.009.0055	Nodosaurid	Ankylosaurid	Polacanthid/ Basal		
TMP 1986.023.0108	Nodosaurid	NA	Panoplosaurid/ Ankylosaurid		y
TMP 1986.095.0007	Ankylosaurid	Ornithischia	Panoplosaurid/ Ankylosaurid		y
TMP 1986.127.0005	Ankylosaurid	Ornithischia	Panoplosaurid/ Ankylosaurid		y
TMP 1986.183.0003	Nodosaurid	Ankylosaurid	Polacanthid/ Basal		
TMP 1987.029.0006	Nodosaurid	Pachycephalos aurid	Polacanthid/ Basal		
TMP 1987.036.0094	Ornithischia	Ankylosaur	Panoplosaurid/ Ankylosaurid	y	y
TMP 1987.077.0143	Ankylosaurid	NA	Panoplosaurid/ Ankylosaurid	y	y
TMP 1987.080.0010	Pachycephalo saurid	Ornithischia	Polacanthid/ Basal		
TMP 1989.069.0017	Ornithischia	Nodosaurid/ Panoplosaurid	Panoplosaurid/ Ankylosaurid	y	
TMP 1989.036.0396 - 1	Ankylosaurid	Pachycephalos aurid	Polacanthid/ Basal		

Sample Number	Previous Family ID	ID from LDAs	Possible IDs from features	Basal cingulum	Fluting
TMP 1989.036.0396 - 2	Ankylosaurid	NA	Panoplosaurid/ Ankylosaurid		y
TMP 1989.036.0396 - 3	Ankylosaurid	NA	Panoplosaurid/ Ankylosaurid		y
TMP 1989.036.0405 – 1	Ankylosaurid	NA	Panoplosaurid/ Ankylosaurid	y	y
TMP 1989.036.0405 - 2	Ankylosaurid	NA	Panoplosaurid/ Ankylosaurid	y	y
TMP 1989.036.0405 - 3	Ankylosaurid	NA	Panoplosaurid/ Ankylosaurid		y
TMP 1989.050.0002	Ornithischia	Ornithischia	Panoplosaurid/ Ankylosaurid	y	y
TMP 1989.050.0013	Ankylosaurid	Ornithischia	Panoplosaurid/ Ankylosaurid	y	
TMP 1989.050.0030	Nodosaurid	Thescelosaurid	Panoplosaurid/ Ankylosaurid	y	
TMP 1989.076.0059	Ankylosaurid	Ornithischia	Panoplosaurid/ Ankylosaurid	y	
TMP 1989.079.0008	Nodosaurid	Ornithischia	Panoplosaurid/ Ankylosaurid	y	
TMP 1989.151.0137	Ornithischia	Nodosaurid/ Panoplosaurid	Panoplosaurid/ Ankylosaurid	y	
TMP 1990.036.0081	Nodosaurid	Nodosaurid/ Panoplosaurid	Panoplosaurid/ Ankylosaurid	y	y
TMP 1990.060.0006 - 1	Ornithischia	NA	Panoplosaurid/ Ankylosaurid	y	
TMP 1990.060.0006 - 2	Ornithischia	Ornithischia	Panoplosaurid/ Ankylosaurid	y	
TMP 1990.107.0037 - 1	Ornithischia	Ornithischia	Panoplosaurid/ Ankylosaurid	y	

Sample Number	Previous Family ID	ID from LDAs	Possible IDs from features	Basal cingulum	Fluting
TMP 1990.107.0037 - 2	Ornithischia	Nodosaurid/ Panoplosaurid	Panoplosaurid/ Ankylosaurid	y	
TMP 1990.155.0007	Nodosaurid	Nodosaurid/ Panoplosaurid	Panoplosaurid/ Ankylosaurid	y	y
TMP 1991.036.0158	Ankylosaurid	Ornithischia	Polacanthid/ Basal		
TMP 1991.036.0171	Ankylosaurid	Nodosaurid/ Panoplosaurid	Panoplosaurid/ Ankylosaurid	y	
TMP 1991.036.0734	Ankylosaurid	NA	Panoplosaurid/ Ankylosaurid		y
TMP 1991.050.0093	Ornithischia	Nodosaurid/ Panoplosaurid	Polacanthid/ Basal		
TMP 1991.085.0012	Chordata	NA	Panoplosaurid/ Ankylosaurid	y	
TMP 1991.087.0072	Ornithischia	Ornithischia	Panoplosaurid/ Ankylosaurid		y
TMP 1992.036.1178 - 1	Ankylosaurid	NA	Polacanthid/Bas al		
TMP 1992.036.1178 - 2	Ankylosaurid	Ornithischia	Panoplosaurid/ Ankylosaurid	y	
TMP 1992.036.1178 - 3	Ankylosaurid	NA	Panoplosaurid/ Ankylosaurid	y	y
TMP 1993.036.0081	Ankylosaurid	NA	Panoplosaurid/ Ankylosaurid		y
TMP 1993.036.0364	Ankylosaurid	Nodosaurid/ Panoplosaurid	Panoplosaurid/ Ankylosaurid	y	y
TMP 1993.079.0065	Nodosaurid	Nodosaurid/ Panoplosaurid	Panoplosaurid/ Ankylosaurid	y	y
TMP 1994.012.0035	Nodosaurid	Ornithischia	Polacanthid/ Basal		
TMP 1994.012.0039	Nodosaurid	Ornithischia	Panoplosaurid/ Ankylosaurid	y	

Sample Number	Previous Family ID	ID from LDAs	Possible IDs from features	Basal cingulum	Fluting
TMP 1994.012.0120	Nodosaurid	Ornithischia	Panoplosaurid/ Ankylosaurid	y	y
TMP 1994.012.0565	Nodosaurid	Ornithischia	Panoplosaurid/ Ankylosaurid	y	
TMP 1994.086.0018	Nodosaurid	NA	Panoplosaurid/ Ankylosaurid	y	y
TMP 1994.092.0011	Nodosaurid	Ornithischia	Panoplosaurid/ Ankylosaurid		y
TMP 1994.094.0014 - 1	Nodosaurid	Ornithischia	Panoplosaurid/ Ankylosaurid	y	
TMP 1994.094.0014 - 2	Nodosaurid	NA	Panoplosaurid/ Ankylosaurid	y	y
TMP 1994.094.0016	Nodosaurid	Nodosaurid/ Panoplosaurid	Panoplosaurid/ Ankylosaurid	y	y
TMP 1994.097.0001	Nodosaurid	NA	Panoplosaurid/ Ankylosaurid		y
TMP 1995.012.0105	Nodosaurid	Ornithischia	Panoplosaurid/ Ankylosaurid	y	
TMP 1995.012.0117	Nodosaurid	Nodosaurid/ Panoplosaurid	Panoplosaurid/ Ankylosaurid	y	
TMP 1996.048.0018 - 1	Ankylosaur	NA	Panoplosaurid/ Ankylosaurid		y
TMP 1996.048.0018 - 2	Ankylosaur	Ornithischia	Polacanthid/ Basal		
TMP 1996.089.0002	Ornithischia	NA	Panoplosaurid/ Ankylosaurid	y	y
TMP 1997.012.0005	Ankylosaurid	NA	Panoplosaurid/ Ankylosaurid	y	y
TMP 1997.012.0042	Ankylosaurid	NA	Polacanthid/ Basal		
TMP 1997.012.0085	Nodosaurid	NA	Panoplosaurid/ Ankylosaurid	y	

Sample Number	Previous Family ID	ID from LDAs	Possible IDs from features	Basal cingulum	Fluting
TMP 1997.012.0106	Ankylosaurid	NA	Panoplosaurid/ Ankylosaurid	y	y
TMP 1998.008.0004	Ankylosaurid	NA	Panoplosaurid/ Ankylosaurid	y	y
TMP 1998.043.0004	Pachycephalo saurid	NA	Panoplosaurid/ Ankylosaurid	y	
TMP 1998.068.0086	Nodosaurid	NA	Panoplosaurid/ Ankylosaurid	y	
TMP 1998.068.0153	Ankylosaurid	NA	Panoplosaurid/ Ankylosaurid	y	y
TMP 1998.102.0026 - 1	Nodosaurid	Nodosaurid/ Panoplosaurid	Panoplosaurid/ Ankylosaurid	y	
TMP 1998.102.0026 – 2	Nodosaurid	NA	Panoplosaurid/ Ankylosaurid	y	
TMP 1998.102.0026 - 3	Nodosaurid	NA	Panoplosaurid/ Ankylosaurid	y	
TMP 1998.102.0026 - 4	Nodosaurid	Nodosaurid/ Panoplosaurid	Panoplosaurid/ Ankylosaurid	y	
TMP 1998.102.0026 - 5	Nodosaurid	NA	Panoplosaurid/ Ankylosaurid	y	
TMP 1998.102.0028 - 1	Ankylosaurid	Ornithischia	Panoplosaurid/ Ankylosaurid	y	y
TMP 1998.102.0028 - 2	Ankylosaurid	Ornithischia	Panoplosaurid/ Ankylosaurid		y
TMP 1999.055.0162	Ankylosaurid	NA	Polacanthid/ Basal		
TMP 1999.055.0290	Ankylosaurid	Ankylosaur	Panoplosaurid/ Ankylosaurid	y	y
TMP 1999.063.0019	Nodosaurid	Nodosaurid/ Panoplosaurid	Panoplosaurid/ Ankylosaurid	y	y

Sample Number	Previous Family ID	ID from LDAs	Possible IDs from features	Basal cingulum	Fluting
TMP 1999.085.0005	Ornithischia	Ornithischia	Panoplosaurid/ Ankylosaurid	y	y
TMP 2000.012.0020	Ankylosaurid	NA	Polacanthid/ Basal		
TMP 2000.012.0024 - 1	Ornithischia	NA	Panoplosaurid/ Ankylosaurid	y	y
TMP 2000.012.0024 - 2	Ornithischia	Ornithischia	Panoplosaurid/ Ankylosaurid	y	
TMP 2000.057.0027	Ornithischia	Nodosaurid/ Panoplosaurid	Panoplosaurid/ Ankylosaurid	y	
TMP 2001.012.0072	Ankylosaurid	Ornithischia	Panoplosaurid/ Ankylosaurid	y	
TMP 2001.012.0073	Ankylosaurid	NA	Polacanthid/ Basal		
TMP 2002.012.0060	Ankylosaurid	NA	Panoplosaurid/ Ankylosaurid		y
TMP 2002.012.0135	Nodosaurid	NA	Panoplosaurid/ Ankylosaurid	y	
TMP 2002.060.0001 - 1	Ankylosaurid	Ornithischia	Panoplosaurid/ Ankylosaurid		y
TMP 2002.060.0001 - 2	Ankylosaurid	Ornithischia	Panoplosaurid/ Ankylosaurid	y	
TMP 2003.012.0106	Chordata	Ornithischia	Panoplosaurid/ Ankylosaurid		y
TMP 2004.107.0003	Ankylosaur	Ornithischia	Panoplosaurid/ Ankylosaurid	y	
TMP 2004.114.0005	Ankylosaur	Ornithischia	Panoplosaurid/ Ankylosaurid	y	
TMP 2004.116.0016	Nodosaurid	Ornithischia	Panoplosaurid/ Ankylosaurid	y	y
TMP 2004.118.0012	Nodosaurid	NA	Panoplosaurid/ Ankylosaurid	y	

Sample Number	Previous Family ID	ID from LDAs	Possible IDs from features	Basal cingulum	Fluting
TMP 2005.012.0027	Ornithischia	NA	Panoplosaurid/ Ankylosaurid	y	y
TMP 2005.012.0185	Nodosaurid	NA	Panoplosaurid/ Ankylosaurid	y	y
TMP 2005.012.0233	Ankylosaur	Ornithischia	Panoplosaurid/ Ankylosaurid	y	y
TMP 2005.012.0265	Nodosaurid	NA	Panoplosaurid/ Ankylosaurid	y	y
TMP 2005.012.0279	Nodosaurid	NA	Panoplosaurid/ Ankylosaurid	y	
TMP 2005.012.0280	Nodosaurid	NA	Polacanthid/ Basal		
TMP 2005.012.0305	Nodosaurid	Nodosaurid/ Panoplosaurid	Panoplosaurid/ Ankylosaurid	y	y
TMP 2005.012.0368	Nodosaurid	NA	Panoplosaurid/ Ankylosaurid	y	
TMP 2005.012.0369	Ankylosaurid	Ornithischia	Polacanthid/ Basal		
TMP 2005.012.0384 - 1	Ankylosaurid	NA	Panoplosaurid/ Ankylosaurid		y
TMP 2005.012.0384 - 2	Ankylosaurid	NA	Panoplosaurid/ Ankylosaurid		y
TMP 2005.012.0397	Nodosaurid	NA	Panoplosaurid/ Ankylosaurid	y	
TMP 2005.012.0427	Ankylosaur	Nodosaurid	Panoplosaurid/ Ankylosaurid	y	
TMP 2005.049.0065	Ankylosaurid	NA	Panoplosaurid/ Ankylosaurid	y	y
TMP 2005.049.0102	Nodosaurid	Ornithischia	Panoplosaurid/ Ankylosaurid	y	y
TMP 2005.049.0143	Ankylosaur	NA	Panoplosaurid/ Ankylosaurid	y	y
TMP 2005.054.0007	Nodosaurid	Ornithischia	Panoplosaurid/ Ankylosaurid	y	

Sample Number	Previous Family ID	ID from LDAs	Possible IDs from features	Basal cingulum	Fluting
TMP 2006.012.0182	Ankylosaurid	Ornithischia	Panoplosaurid/ Ankylosaurid		y
TMP 2008.043.0051	Ankylosaurid	NA	Polacanthid/ Basal		
TMP 2011.047.0002	Nodosaurid	Ornithischia	Panoplosaurid/ Ankylosaurid		y
TMP 2011.047.0010	Nodosaurid	NA	Panoplosaurid/ Ankylosaurid	y	
TMP 2011.047.0079	Ankylosaurid	Ornithischia	Panoplosaurid/ Ankylosaurid	y	y
TMP 2012.012.0017	Ankylosaurid	Ornithischia	Panoplosaurid/ Ankylosaurid	y	y
TMP 2013.012.0057	Nodosaurid	Nodosaurid/ Panoplosaurid	Panoplosaurid/ Ankylosaurid	y	y
TMP 2014.012.0128	Nodosaurid	Ornithischia	Panoplosaurid/ Ankylosaurid	y	
TMP 2014.012.0134	Ankylosaurid	Ornithischia	Panoplosaurid/ Ankylosaurid	y	y
TMP 2018.012.0172	Ankylosaurid	NA	Panoplosaurid/ Ankylosaurid	y	y
TMP 2019.012.0011	Nodosaurid	NA	Panoplosaurid/ Ankylosaurid	y	y
TMP 2023.012.0023	Ankylosaurid	NA	Panoplosaurid/ Ankylosaurid		y
TMP 2023.012.0242	Nodosaurid	NA	Panoplosaurid/ Ankylosaurid	y	
UALVP 48641	Ankylosaurid	NA	Panoplosaurid/ Ankylosaurid		y
UALVP 48747	Ankylosaurid	Ankylosaurid	Polacanthid/ Basal		
UALVP 49327	Ankylosaurid	Ornithischia	Panoplosaurid/ Ankylosaurid		y
UALVP 53588 - 1	Pachycephalo saurid	NA	Panoplosaurid/ Ankylosaurid		y

Sample Number	Previous Family ID	ID from LDAs	Possible IDs from features	Basal cingulum	Fluting
UALVP 53588 - 2	Pachycephalo saurid	NA	Panoplosaurid/ Ankylosaurid		y
UALVP 53588 - 3	Pachycephalo saurid	NA	Panoplosaurid/ Ankylosaurid		y
UALVP 53588 - 4	Pachycephalo saurid	NA	Panoplosaurid/ Ankylosaurid		y
UALVP 53588 - 5	Pachycephalo saurid	NA	Polacanthid/ Basal		
UALVP 53588 - 6	Pachycephalo saurid	NA	Panoplosaurid/ Ankylosaurid	y	y
UALVP 53590	Pachycephalo saurid	Ornithischia	Polacanthid/ Basal		
UALVP 53591	Ankylosaurid	Nodosaurid/ Panoplosaurid	Panoplosaurid/ Ankylosaurid		y
UALVP 53975	Ankylosaurid	Ornithischia	Panoplosaurid/ Ankylosaurid	y	y
UALVP 55323	Ankylosaurid	NA	Panoplosaurid/ Ankylosaurid		y
UALVP 55366	Nodosaurid	Ankylosaurid	Panoplosaurid/ Ankylosaurid	y	y
UALVP 55378	Ankylosaurid	Ankylosaurid	Panoplosaurid/ Ankylosaurid	y	y
UALVP 55390	Nodosaurid	Nodosaurid/ Panoplosaurid	Panoplosaurid/ Ankylosaurid	y	y
UALVP 55621	Pachycephalo saurid	Ornithischia	Panoplosaurid/ Ankylosaurid		y
UALVP 59296	Ankylosaurid	NA	Panoplosaurid/ Ankylosaurid	y	
UALVP 61124 - 1	Nodosaurid	Nodosaurid/ Panoplosaurid	Panoplosaurid/ Ankylosaurid	y	
UALVP 61124 - 2	Nodosaurid	NA	Panoplosaurid/ Ankylosaurid	y	
UALVP 61153	Nodosaurid	Nodosaurid/ Panoplosaurid	Panoplosaurid/ Ankylosaurid	y	y

Sample Number	Previous Family ID	ID from LDAs	Possible IDs from features	Basal cingulum	Fluting
UALVP 61442	Pachycephalo saurid	NA	Polacanthid/ Basal		
UMNH VP 11638	Ankylosaur	NA	Panoplosaurid/ Ankylosaurid	y	
UMNH VP 1228	Ankylosaur	NA	Polacanthid/ Basal		
UMNH VP 1232	Ankylosaur	NA	Polacanthid/ Basal		
UMNH VP 12637	Ankylosaur	NA	Panoplosaurid/ Ankylosaurid	y	y
UMNH VP 12864	Ankylosaur	NA	Panoplosaurid/ Ankylosaurid	y	
UMNH VP 14228	Ankylosaur	NA	Panoplosaurid/ Ankylosaurid	y	
UMNH VP 14436	Ankylosaur	NA	Panoplosaurid/ Ankylosaurid	y	y
UMNH VP 14488	Ankylosaur	NA	Panoplosaurid/ Ankylosaurid	y	
UMNH VP 16221	Ankylosaur	NA	Panoplosaurid/ Ankylosaurid	y	y
UMNH VP 16874	Ankylosaur	NA	Panoplosaurid/ Ankylosaurid	y	y
UMNH VP 17418	Ankylosaur	NA	Panoplosaurid/ Ankylosaurid	y	
UMNH VP 17502	Ankylosaur	NA	Panoplosaurid/ Ankylosaurid	y	
UMNH VP 17514	Ankylosaur	NA	Panoplosaurid/ Ankylosaurid	y	
UMNH VP 17973	Ankylosaur	NA	Panoplosaurid/ Ankylosaurid	y	
UMNH VP 19037	Ankylosaur	NA	Panoplosaurid/ Ankylosaurid	y	
UMNH VP 19040	Ankylosaur	NA	Panoplosaurid/ Ankylosaurid	y	y

Sample Number	Previous Family ID	ID from LDAs	Possible IDs from features	Basal cingulum	Fluting
UMNH VP 19699	Ankylosaur	NA	Panoplosaurid/ Ankylosaurid		y
UMNH VP 19719	Ankylosaur	NA	Panoplosaurid/ Ankylosaurid	y	
UMNH VP 19720	Ankylosaur	NA	Panoplosaurid/ Ankylosaurid	y	y
UMNH VP 20599	Ankylosaur	NA	Panoplosaurid/ Ankylosaurid	y	
UMNH VP 20903	Ankylosaur	NA	Panoplosaurid/ Ankylosaurid		y
UMNH VP 24117	Ankylosaur	NA	Panoplosaurid/ Ankylosaurid	y	
UMNH VP 5609	Ankylosaur	NA	Polacanthid/ Basal		
UMNH VP 6765	Ankylosaur	NA	Panoplosaurid/ Ankylosaurid	y	
UMNH VP 7603	Ankylosaur	NA	Polacanthid/ Basal		
UMNH VP 7658	Ankylosaur	NA	Panoplosaurid/ Ankylosaurid	y	
UMNH VP 7672	Ankylosaur	NA	Panoplosaurid/ Ankylosaurid	y	

Appendix B – Comparison of isolated tooth identification by LDA methods

Appendix B-1: Isolated teeth Alberta family identifications

Specimen	Original ID	New ID	AB lingual family	Lingual likeli-hood	AB labial family	labial likeli-hood	Digital traditional AB family
CEUM 11924	Ankylosaur	Ornithischia					
TMP 2005.012.0265	Nodosaurid	Nodosaurid/ Panoplosaurid	Nodosaurid	0.7946	Nodosaurid	0.9647	Nodosaurid
UALVP 53588 - 1	Pachycephalosaurid	Ornithischia	Ankylosaurid	0.7291	Pachycephalosaurid	0.5028	Ankylosaurid
UALVP 53588 - 2	Pachycephalosaurid	Ornithischia	Ankylosaurid	0.7291	Pachycephalosaurid	0.4913	Ankylosaurid
UALVP 53588 - 3	Pachycephalosaurid	Ankylosaur	Ankylosaurid	0.7698	Nodosaurid	0.5006	Ankylosaurid
UALVP 53588 - 4	Pachycephalosaurid	Ornithischia	Ankylosaurid	0.5856	Pachycephalosaurid	0.5309	Ankylosaurid
UALVP 53588 - 6	Pachycephalosaurid	Ornithischia	Pachycephalosaurid	0.7987	Ankylosaurid	0.7178	Ankylosaurid
CEUM 53115	Nodosaurid (*Peloroplites*)	Nodosaurid/ Panoplosaurid					
CMNFV 119-1	Nodosaurid	Ornithischia	Pachycephalosaurid	0.9296			Ankylosaurid
CMNFV 119-2	Nodosaurid	Ornithischia	Pachycephalosaurid	0.6350	Ankylosaurid	0.5550	Ankylosaurid
CMNFV 119-3	Nodosaurid	Ornithischia	Ankylosaurid	0.5274	Pachycephalosaurid	0.4971	Pachycephalosaurid
CMNFV 119-5	Nodosaurid	Ornithischia	Pachycephalosaurid	0.7284	Ankylosaurid	0.5261	Pachycephalosaurid
CMNFV 119-6	Nodosaurid	Pachycephalosaurid	Pachycephalosaurid	0.9317			Pachycephalosaurid
CMNFV 1772-1	Nodosaurid (*Edmontonia*)	Nodosaurid/ Panoplosaurid	Pachycephalosaurid	0.5869	Nodosaurid	0.9283	Nodosaurid
CMNFV 1772-3	Nodosaurid (*Edmontonia*)	Nodosaurid/ Panoplosaurid	Nodosaurid	0.5947	Nodosaurid	0.9301	Nodosaurid
CMNFV 38442	Ankylosaurid	Ankylosaurid	Ankylosaurid	0.6231	Ankylosaurid	0.8281	Ankylosaurid
CMNFV 38443	Ankylosaurid	Pachycephalosaurid	Pachycephalosaurid	0.6573			Thescelosaurid
CMNFV 38445	Ankylosaurid	Ornithischia	Pachycephalosaurid	0.5634 8845	Ankylosaurid	0.6455	Ankylosaurid
CMNFV 38447	Ankylosaurid	Ornithischia	Pachycephalosaurid	0.9417	Ankylosaurid	0.8004	Pachycephalosaurid
CMNFV 38448	Ankylosaurid	Ornithischia	Pachycephalosaurid	0.8095	Ankylosaurid	0.5864	Thescelosaurid

Specimen	Original ID	New ID	AB lingual family	Lingual likeli-hood	AB labial family	labial likeli-hood	Digital traditional AB family
CMNFV 59591-1	Ankylosaur	Nodosaurid/ Panoplosaurid	Nodosaurid	0.6010	Nodosaurid	0.9279	Nodosaurid
CMNFV CMS 1921-2		Ornithischia					Thescelosaurid
CMNFV CMS 1921-3		Nodosaurid/ Panoplosaurid					Thescelosaurid
CMNFV CMS 1921-7		Pachycephalosaurid					Pachycephalosaurid
CMNFV RDR-1	Ankylosaur	Nodosaurid/ Panoplosaurid					
CMNFV UN 5		Ornithischia					Ankylosaurid
CMNFV 59240 -1	Nodosaurid	Ornithischia	Ankylosaurid	0.3479	Nodosaurid	0.9713	Thescelosaurid
CMNFV 8731-4		Nodosaurid/ Panoplosaurid	Nodosaurid	0.8752	Nodosaurid	0.7109	
CMNFV 59240 -2		Ornithischia	Nodosaurid	0.7105	Pachycephalosaurid	0.3214	Thescelosaurid
ROM 07765	Ankylosaurid	Ankylosaurid	Ankylosaurid	0.7746	Ankylosaurid	0.4871	Ankylosaurid
ROM 07770	Pachycephalosaurid	Ornithischia	Pachycephalosaurid	0.7689	Ankylosaurid	0.6413	Pachycephalosaurid
ROM 31866	Ankylosaurid	Ornithischia	Pachycephalosaurid	0.8812	Nodosaurid	0.3629	Ankylosaurid
ROM 31872	Nodosaurid	Ornithischia	Ankylosaurid	0.5336	Ankylosaurid	0.5957	Thescelosaurid
ROM 58594	Ankylosaurid	Nodosaurid/ Panoplosaurid	Nodosaurid	0.8991	Nodosaurid	0.8485	Nodosaurid
ROM 58598	Ankylosaurid	Ornithischia	Pachycephalosaurid	0.8289	Nodosaurid	0.4320	Thescelosaurid
TMP 1966.025.0015	Pachycephalosaurid (*Stegoceras*)	Ornithischia					Pachycephalosaurid
TMP 1976.006.0036	Ornithischia	Ankylosaur	Nodosaurid	0.8026	Ankylosaurid	0.5481	Nodosaurid
TMP 1980.008.0026 - 1	Ankylosaurid	Ankylosaur					Ankylosaurid
TMP 1980.008.0026 - 2	Ankylosaurid	Ornithischia					Ankylosaurid

Specimen	Original ID	New ID	AB lingual family	Lingual likeli-hood	AB labial family	labial likeli-hood	Digital traditional AB family
TMP 1980.016.0834	Pachycephalosaurid (*Stegoceras*)	Ornithischia					Ankylosaurid
TMP 1980.029.0140	Pachycephalosaurid (*Stegoceras*)	Ankylosaur					Ankylosaurid
TMP 1981.041.0014	Ankylosaurid (*Euoplocephalus*)	Ornithischia					Pachycephalosaurid
TMP 1983.036.0009 - 1	Ankylosaurid (*Euoplocephalus*)	Ankylosaurid	Ankylosaurid	0.7997	Ankylosaurid	0.6139	Ankylosaurid
TMP 1984.091.0020	Nodosaurid (*Panoplosaurus*)	Nodosaurid/ Panoplosaurid					Nodosaurid
TMP 1985.056.0170 -1	Ankylosaurid (*Euoplocephalus*)	Ankylosaurid					Ankylosaurid
TMP 1985.056.0171 - 1	Nodosaurid (*Panoplosaurus/ Edmontonia*)	Nodosaurid/ Panoplosaurid					Nodosaurid
TMP 1985.056.0171 - 3	Nodosaurid (*Panoplosaurus/ Edmontonia*)	Ankylosaur					Ankylosaurid
TMP 1985.059.0028	Pachycephalosaurid (*Stegoceras*)	Ankylosaurid					Ankylosaurid
TMP 1986.009.0055	Nodosaurid	Ankylosaurid	Ankylosaurid	0.8405	Ankylosaurid	0.5349	Ankylosaurid
TMP 1986.095.0007	Ankylosaurid	Ornithischia	Ankylosaurid	0.6112	Pachycephalosaurid	0.4760	Ankylosaurid
TMP 1986.127.0005	Ankylosaurid	Ornithischia	Pachycephalosaurid	0.8242	Ankylosaurid	0.6158	Ankylosaurid
TMP 1986.183.0003	Nodosaurid	Ankylosaurid	Ankylosaurid	0.9240	Ankylosaurid	0.5039	Ankylosaurid
TMP 1987.029.0006	Nodosaurid	Pachycephalosaurid			Pachycephalosaurid	0.8340	
TMP 1987.036.0094	Ornithischia	Ankylosaur					Ankylosaurid
TMP 1987.080.0010	Pachycephalosaurid	Ornithischia	Pachycephalosaurid	0.8604	Ankylosaurid	0.5057	Pachycephalosaurid

Specimen	Original ID	New ID	AB lingual family	Lingual likeli-hood	AB labial family	labial likeli-hood	Digital traditional AB family
TMP 1989.036.0396 - 1	Ankylosaurid (*Euoplocephalus*)	Ornithischia					Ankylosaurid
TMP 1989.050.0002	Ornithischia	Ornithischia					Ankylosaurid
TMP 1989.050.0013	Ankylosaurid	Ornithischia					Pachycephalosaurid
TMP 1989.050.0030	Nodosaurid (*Panoplosaurus*)	Ornithischia					Nodosaurid
TMP 1989.069. 0017	Ornithischia	Nodosaurid/ Panoplosaurid					
TMP 1989.076.0059	Ankylosaurid (*Euoplocephalus*)	Ornithischia	Ankylosaurid	0.6575	Pachycephalosaurid	0.6532	Pachycephalosaurid
TMP 1989.079.0008	Nodosaurid	Nodosaurid/ Panoplosaurid					Nodosaurid
TMP 1989.151.0137	Ornithischia	Nodosaurid/ Panoplosaurid	Nodosaurid	0.7098	Nodosaurid	0.9714	Nodosaurid
TMP 1990.036.0081	Nodosaurid (Panoplosaurus)	Nodosaurid/ Panoplosaurid	Nodosaurid	0.8988			Nodosaurid
TMP 1990.060.0006 - 2	Ornithischia	Ornithischia	Ankylosaurid	0.6760	Pachycephalosaurid	0.7478	Ankylosaurid
TMP 1990. 107.0037-1	Ornithischia	Ornithischia					Ankylosaurid
TMP 1990. 107.0037-2	Ornithischia	Nodosaurid/ Panoplosaurid					Nodosaurid
TMP 1990.155.0007	Nodosaurid	Nodosaurid/ Panoplosaurid	Nodosaurid	0.9030	Nodosaurid	0.9349	Nodosaurid
TMP 1991.036.158	Ankylosaurid (*Euoplocephalus*)	Ornithischia					Pachycephalosaurid
TMP 1991.036.0171	Ankylosaurid (*Ankylosaurus*)	Nodosaurid/ Panoplosaurid					Nodosaurid
TMP 1991.050.0093	Ornithischia	Nodosaurid/ Panoplosaurid					Nodosaurid
TMP 1991.087.0072	Ornithischia	Ornithischia	Pachycephalosaurid	0.5408	Pachycephalosaurid	0.8028	Nodosaurid

Specimen	Original ID	New ID	AB lingual family	Lingual likeli-hood	AB labial family	labial likeli-hood	Digital traditional AB family
TMP 1992.036.1178 - 2	Ankylosaurid	Pachycephalosaurid					Ankylosaurid
TMP 1993.036.0364	Ankylosaurid	Nodosaurid/ Panoplosaurid	Nodosaurid	0.9999	Nodosaurid	0.9983	Nodosaurid
TMP 1993.079.0065	Nodosaurid	Nodosaurid/ Panoplosaurid			Nodosaurid	0.9966	
TMP 1994.012.0035	Nodosaurid	Nodosaurid/ Panoplosaurid	Nodosaurid	0.6661	Nodosaurid	0.6053	Nodosaurid
TMP 1994.012.0039	Nodosaurid	Ornithischia	Nodosaurid	0.9266	Ankylosaurid	0.3360	Nodosaurid
TMP 1994.012.0120	Nodosaurid	Ornithischia	Pachycephalosaurid	0.7647	Pachycephalosaurid	0.5714	Nodosaurid
TMP 1994.012.0565	Nodosaurid	Ornithischia	Ankylosaurid	0.4614	Nodosaurid	0.5918	Nodosaurid
TMP 1994.092.0011	Nodosaurid	Ornithischia	Ankylosaurid	0.7804	Pachycephalosaurid	0.5111	Ankylosaurid
TMP 1994.094.0014 -1	Nodosaurid	Ornithischia	Nodosaurid	0.9158	Ankylosaurid	0.3901	Nodosaurid
TMP 1994.094.0016	Nodosaurid	Nodosaurid/ Panoplosaurid	Nodosaurid	0.9950	Nodosaurid	0.9831	Nodosaurid
TMP 1995.012.0105	Nodosaurid	Ornithischia	Ankylosaurid	0.5318	Ankylosaurid	0.4444	Nodosaurid
TMP 1995.012.0117	Nodosaurid	Nodosaurid/ Panoplosaurid					Nodosaurid
TMP 1996.048.0018 - 2	Ankylosaur	Ornithischia	Pachycephalosaurid	0.7599	Pachycephalosaurid	0.6604	Pachycephalosaurid
TMP 1998.102.0026 - 1	Nodosaurid	Nodosaurid/ Panoplosaurid	Nodosaurid	0.9978	Nodosaurid	0.9852	Nodosaurid
TMP 1998.102.0026 - 4	Nodosaurid	Nodosaurid/ Panoplosaurid	Nodosaurid	0.6218	Nodosaurid	0.9782	Nodosaurid
TMP 1998.102.0028 - 1	Ankylosaurid	Ankylosaurid	Ankylosaurid	0.5183	Ankylosaurid	0.4444	Ankylosaurid
TMP 1998.102.0028 - 2	Ankylosaurid	Ornithischia	Ankylosaurid	0.7527 35927	Pachycephalosaurid	0.4653	Ankylosaurid

Specimen	Original ID	New ID	AB lingual family	Lingual likeli-hood	AB labial family	labial likeli-hood	Digital traditional AB family
TMP 1999.055.0290	Ankylosaurid	Ankylosaur	Ankylosaurid	0.9017	Nodosaurid	0.7526	Ankylosaurid
TMP 1999.063.0019	Nodosaurid	Nodosaurid/ Panoplosaurid			Nodosaurid	0.9261	Nodosaurid
TMP 1999.085.0005	Ornithischia	Ankylosaur	Nodosaurid	0.6041	Ankylosaurid	0.4788	Ankylosaurid
TMP 2000.012.0024 - 2	Ornithischia	Ornithischia	Pachycephalosaurid	0.5290	Pachycephalosaurid	0.3831	Ankylosaurid
TMP 2000.057.0027	Ornithischia	Nodosaurid/ Panoplosaurid	Nodosaurid	0.8996	Nodosaurid	0.6144	Nodosaurid
TMP 2001.012.0072	Ankylosaurid	Ornithischia	Pachycephalosaurid	0.6852	Pachycephalosaurid	0.7833	Ankylosaurid
TMP 2002.060.0001 - 1	Ankylosaurid	Ornithischia	Ankylosaurid	0.9102	Ankylosaurid	0.4881	Ankylosaurid
TMP 2002.060.0001 - 2	Ankylosaurid	Ornithischia	Pachycephalosaurid	0.8776	Pachycephalosaurid	0.4004	Ankylosaurid
TMP 2003.012.0106	Chordata	Ankylosaur	Nodosaurid	0.5341	Ankylosaurid	0.6076	Ankylosaurid
TMP 2004.107.0003	Ankylosaur	Ornithischia	Ankylosaurid	0.7544	Thescelosauridae	0.3649	Nodosaurid
TMP 2004.114.0005	Ankylosaur	Ornithischia	Pachycephalosaurid	0.7559	Pachycephalosaurid	0.7793	Ankylosaurid
TMP 2004.116.0016	Nodosaurid	Ornithischia	Pachycephalosaurid	0.7079	Nodosaurid	0.7573	Nodosaurid
TMP 2005.012.0233	Ankylosaur	Ornithischia	Ankylosaurid	0.6702	Ankylosaurid	0.4133	Ankylosaurid
TMP 2005.012.0305	Nodosaurid	Nodosaurid/ Panoplosaurid	Nodosaurid	0.7551	Nodosaurid	0.6752	Nodosaurid
TMP 2005.012.0369	Ankylosaurid	Ornithischia	Ankylosaurid	0.8198	Ankylosaurid	0.3596	Ankylosaurid
TMP 2005.012.0427	Ankylosaur	Nodosaurid/ Panoplosaurid	Nodosaurid	0.5768	Nodosaurid	0.9457	Nodosaurid
TMP 2005.049.0102	Nodosaurid	Nodosaurid/ Panoplosaurid	Nodosaurid	0.9105	Nodosaurid	0.5653	

Specimen	Original ID	New ID	AB lingual family	Lingual likeli-hood	AB labial family	labial likeli-hood	Digital traditional AB family
TMP 2005.054.0007	Nodosaurid	Ornithischia	Ankylosaurid	0.718801871	Thescelosauridae	0.5146	Nodosaurid
TMP 2006.012.0182	Ankylosaurid	Ornithischia	Pachycephalosaurid	0.907203967	Ankylosaurid	0.6812	Ankylosaurid
TMP 2011.047.0002	Nodosaurid	Ornithischia	Nodosaurid	0.7693	Pachycephalosaurid	0.5116	Ankylosaurid
TMP 2011.047.0079	Ankylosaurid	Ornithischia	Pachycephalosaurid	0.5776	Ankylosaurid	0.7257	Ankylosaurid
TMP 2012.012.0017	Ankylosaurid	Ornithischia	Ankylosaurid	0.7434	Ankylosaurid	0.5922	Ankylosaurid
TMP 2013.012.0057	Nodosaurid	Nodosaurid	Nodosaurid	0.9991	Nodosaurid	0.9822	Nodosaurid
TMP 2014.012.0128	Nodosaurid	Ornithischia	Nodosaurid	0.9059	Thescelosauridae	0.4661	
TMP 2014.012.0134	Nodosaurid	Ankylosaurid	Pachycephalosaurid	0.7052	Ankylosaurid	0.5057	Ankylosaurid
UALVP 48747	Ankylosaurid	Ankylosaurid	Ankylosaurid	0.8397	Ankylosaurid	0.6868	Ankylosaurid
UALVP 49327	Ankylosaurid	Ornithischia	Ankylosaurid	0.6011	Nodosaurid	0.4545	Ankylosaurid
UALVP 53590	Pachycephalosaurid	Ornithischia	Pachycephalosaurid	0.7313	Pachycephalosaurid	0.5072	Ankylosaurid
UALVP 53975	Ankylosaurid (*Ankylosaurus*)	Ornithischia	Nodosaurid	0.9773	Thescelosauridae	0.4741	Ankylosaurid
UALVP 53591	Ankylosaurid	Nodosaurid/ Panoplosaurid	Nodosaurid	0.7592	Nodosaurid	0.6215	Nodosaurid
UALVP 55366	Nodosaurid	Ankylosaurid	Ankylosaurid	0.8859	Ankylosaurid	0.5161	Ankylosaurid
UALVP 55378	Ankylosaurid	Ankylosaurid	Ankylosaurid	0.7637	Ankylosaurid	0.5332	Ankylosaurid
UALVP 55390	Nodosaurid	Nodosaurid/ Panoplosaurid	Nodosaurid	0.9982	Nodosaurid	0.9661	Nodosaurid
UALVP 55621	Pachycephalosaurid	Ornithischia	Ankylosaurid	0.8085	Pachycephalosaurid	0.5868	Ankylosaurid
UALVP 61124 -1	Nodosaurid	Nodosaurid	Nodosaurid	0.6571	Nodosaurid	0.9187	Ankylosaurid
UALVP 61153	Nodosaurid	Nodosaurid/ Panoplosaurid			Nodosaurid	0.9159	

Specimen	Original ID	New ID	AB lingual family	Lingual likeli-hood	AB labial family	labial likeli-hood	Digital traditional AB family
UALVP 61442	Pachycephalosaurid	Ankylosaurid					Ankylosaurid
UMNH 11638	Ankylosaur	Ornithischia					
UMNH 1228	Ankylosaur	Ornithischia					
UMNH 12864	Ankylosaur	Ornithischia					
UMNH 14436	Ankylosaur	Ornithischia					
UMNH 17418	Ankylosaur	Ornithischia					
UMNH 17502	Ankylosaur	Ornithischia					
UMNH 19040	Ankylosaur	Ornithischia					
UMNH 19720	Ankylosaur	Ornithischia					
UMNH 20903	Ankylosaur	Ornithischia					
UMNH 5609	Ankylosaur	Ornithischia					
UMNH 7603	Ankylosaur	Ornithischia					

Appendix B-2: Isolated teeth Alberta and Montana family identifications

Specimen	Original ID	New ID	Digital traditional ABMT family	AB/MT lingual	Lingual likeli-hood	AB/MT labial family	labial likeli-hood
CEUM 11924	Ankylosaur	Ornithischia					
TMP 2005.012.0265	Nodosaurid	Nodosaurid/ Panoplosaurid	Nodosaurid	Nodosaurid	0.5653	Nodosaurid	0.9610
UALVP 53588 - 1	Pachycephalosaurid	Ornithischia	Ankylosaurid	Ankylosaurid	0.6926	Thescelosaurid	0.6748
UALVP 53588 - 2	Pachycephalosaurid	Ornithischia	Ankylosaurid	Ankylosaurid	0.6643	Pachycephalosauri d	0.4195
UALVP 53588 - 3	Pachycephalosaurid	Ankylosaur	Ankylosaurid	Ankylosaurid	0.7160	Ankylosaurid	0.4696
UALVP 53588 - 4	Pachycephalosaurid	Ornithischia	Ankylosaurid	Ankylosaurid	0.5668	Thescelosaurid	0.4383
UALVP 53588 - 6	Pachycephalosaurid	Ornithischia	Ankylosaurid	Pachycephalosaurid	0.6713	Ankylosaurid	0.6111

Specimen	Original ID	New ID	Digital traditional ABMT family	AB/MT lingual	Lingual likeli-hood	AB/MT labial family	labial likeli-hood
CEUM 53115	Nodosaurid (*Peloroplites*)	Nodosaurid/ Panoplosaurid					
CMNFV 119-1	Nodosaurid	Ornithischia	Ankylosaurid	Pachycephalosaurid	0.8577		
CMNFV 119-2	Nodosaurid	Ornithischia	Ankylosaurid	Pachycephalosaurid	0.4905	Ankylosaurid	0.4816
CMNFV 119-3	Nodosaurid	Ornithischia	Pachycephalosaurid	Ankylosaurid	0.5341	Pachycephalosauri d	0.4241
CMNFV 119-5	Nodosaurid	Ornithischia	Pachycephalosaurid	Ankylosaurid	0.4818	Thescelosaurid	0.4039
CMNFV 119-6	Nodosaurid	Pachycephalosaurid	Pachycephalosaurid	Pachycephalosaurid	0.8682		
CMNFV 1772-1	Nodosaurid (*Edmontonia*)	Nodosaurid/ Panoplosaurid	Nodosaurid	Thescelosaurid	0.3738	Nodosaurid	0.9080
CMNFV 1772-3	Nodosaurid (*Edmontonia*)	Nodosaurid/ Panoplosaurid	Nodosaurid	Thescelosaurid	0.7388	Nodosaurid	0.9286
CMNFV 38442	Ankylosaurid	Ankylosaurid	Ankylosaurid	Ankylosaurid	0.6350	Ankylosaurid	0.7944
CMNFV 38443	Ankylosaurid	Pachycephalosaurid	Thescelosaurid	Pachycephalosaurid	0.6544		
CMNFV 38445	Ankylosaurid	Ornithischia	Ankylosaurid	Ankylosaurid	0.4791	Ankylosaurid	0.5546
CMNFV 38447	Ankylosaurid	Ornithischia	Pachycephalosaurid	Pachycephalosaurid	0.8733	Ankylosaurid	0.7380
CMNFV 38448	Ankylosaurid	Ornithischia	Thescelosaurid	Pachycephalosaurid	0.6852	Thescelosaurid	0.5891
CMNFV 59591-1	Ankylosaur	Nodosaurid/ Panoplosaurid	Thescelosaurid	Ankylosaurid	0.5155	Nodosaurid	0.9179
CMNFV CMS 1921-2		Ornithischia		Pachycephalosaurid	0.5818	Thescelosaurid	0.6466
CMNFV CMS 1921-3		Nodosaurid/ Panoplosaurid		Nodosaurid	0.6818	Nodosaurid	0.8504
CMNFV CMS 1921-7		Pachycephalosaurid		Pachycephalosaurid	0.7024	Thescelosaurid	0.5917
CMNFV RDR-1	Ankylosaur	Nodosaurid/ Panoplosaurid		Nodosaurid	0.8766	Nodosaurid	0.4001
CMNFV UN 5		Ornithischia		Ankylosaurid	0.6689	Thescelosaurid	0.3620
CMNFV 59240 -1	Nodosaurid	Ornithischia	Thescelosaurid	Pachycephalosaurid	0.3133	Nodosaurid	0.9795

Specimen	Original ID	New ID	Digital traditional ABMT family	AB/MT lingual	Lingual likeli-hood	AB/MT labial family	labial likeli-hood
CMNFV 8731-4		Nodosaurid/ Panoplosaurid	Thescelosaurid	Nodosaurid	0.8336	Nodosaurid	0.5621
CMNFV 59240 -2		Ornithischia	Nodosaurid	Nodosaurid	0.6297	Thescelosaurid	0.5495
ROM 07765	Ankylosaurid	Ankylosaurid	Ankylosaurid	Ankylosaurid	0.7448	Ankylosaurid	0.4964
ROM 07770	Pachycephalosaurid	Ornithischia	Pachycephalosaurid	Pachycephalosaurid	0.5682	Ankylosaurid	0.4967
ROM 31866	Ankylosaurid	Ornithischia	Ankylosaurid	Pachycephalosaurid	0.7981	Thescelosaurid	0.4645
ROM 31872	Nodosaurid	Ornithischia	Thescelosaurid	Ankylosaurid	0.3368	Ankylosaurid	0.4625
ROM 58594	Ankylosaurid	Nodosaurid/ Panoplosaurid	Thescelosaurid	Nodosaurid	0.8433	Nodosaurid	0.7917
ROM 58598	Ankylosaurid	Ornithischia	Thescelosaurid	Thescelosaurid	0.7678	Thescelosaurid	0.6877
TMP 1966.025.0015	Pachycephalosaurid (*Stegoceras*)	Ornithischia	Pachycephalosaurid	Ankylosaurid	0.5359	Thescelosaurid	0.6799
TMP 1976.006.0036	Ornithischia	Ankylosaur	Nodosaurid	Nodosaurid	0.7567	Ankylosaurid	0.4238
TMP 1980.008.0026 - 1	Ankylosaurid	Ankylosaur	Ankylosaurid	Nodosaurid	0.9218	Nodosauridae	0.7880
TMP 1980.008.0026 - 2	Ankylosaurid	Ornithischia	Ankylosaurid	Nodosaurid	0.3457	Thescelosaurid	0.3835
TMP 1980.016.0834	Pachycephalosaurid (*Stegoceras*)	Ornithischia	Ankylosaurid	Pachycephalosaurid	0.5019	Thescelosaurid	0.4293
TMP 1980.029.0140	Pachycephalosaurid (*Stegoceras*)	Ankylosaur	Ankylosaurid	Nodosaurid	0.7894	Ankylosaurid	0.3633
TMP 1981.041.0014	Ankylosaurid (*Euoplocephalus*)	Ornithischia	Pachycephalosaurid	Pachycephalosaurid	0.5468	Thescelosaurid	0.5795
TMP 1983.036.0009 - 1	Ankylosaurid (*Euoplocephalus*)	Ankylosaurid	Ankylosaurid	Ankylosaurid	0.7367	Ankylosaurid	0.4923
TMP 1984.091.0020	Nodosaurid (*Panoplosaurus*)	Nodosaurid/ Panoplosaurid	Nodosaurid	Thescelosaurid	0.6842	Thescelosaurid	0.5209
TMP 1985.056.0170 -1	Ankylosaurid (*Euoplocephalus*)	Ankylosaurid	Ankylosaurid	Ankylosaurid	0.6097	Ankylosaurid	0.5667

Specimen	Original ID	New ID	Digital traditional ABMT family	AB/MT lingual	Lingual likeli-hood	AB/MT labial family	labial likeli-hood
TMP 1985.056.0171 - 1	Nodosaurid (*Panoplosaurus/ Edmontonia*)	Nodosaurid/ Panoplosaurid	Nodosaurid	Nodosaurid	0.6456	Nodosaurid	0.9273
TMP 1985.056.0171 - 3	Nodosaurid (*Panoplosaurus/ Edmontonia*)	Ankylosaur	Ankylosaurid	Nodosaurid	0.5214	Nodosaurid	0.6731
TMP 1985.059.0028	Pachycephalosaurid (*Stegoceras*)	Ankylosaurid	Ankylosaurid	Ankylosaurid	0.5451	Ankylosaurid	0.4502
TMP 1986.009.0055	Nodosaurid	Ankylosaurid	Ankylosaurid	Ankylosaurid	0.7761	Ankylosaurid	0.4668
TMP 1986.095.0007	Ankylosaurid	Ornithischia	Ankylosaurid	Ankylosaurid	0.5830	Pachycephalosauri d	0.3625
TMP 1986.127.0005	Ankylosaurid	Ornithischia	Ankylosaurid	Pachycephalosaurid	0.7334	Ankylosaurid	0.4886
TMP 1986.183.0003	Nodosaurid	Ankylosaurid	Ankylosaurid	Ankylosaurid	0.9123	Ankylosaurid	0.3592
TMP 1987.029.0006	Nodosaurid	Pachycephalosaurid				Pachycephalosauri d	0.6382
TMP 1987.036.0094	Ornithischia	Ankylosaur	Ankylosaurid	Ankylosaurid	0.8134	Nodosaurid	0.8611
TMP 1987.080.0010	Pachycephalosaurid	Ornithischia	Pachycephalosaurid	Pachycephalosaurid	0.7944	Ankylosaurid	0.4161
TMP 1989.036.0396 - 1	Ankylosaurid (*Euoplocephalus*)	Ornithischia	Ankylosaurid	Pachycephalosaurid	0.8035	Pachycephalosauri d	0.5261
TMP 1989.050.0002	Ornithischia	Ornithischia	Ankylosaurid	Ankylosaurid	0.4747	Pachycephalosauri d	0.4400
TMP 1989.050.0013	Ankylosaurid	Ornithischia	Pachycephalosaurid	Ankylosaurid	0.6248	Thescelosaurid	0.4495
TMP 1989.050.0030	Nodosaurid (*Panoplosaurus*)	Ornithischia	Nodosaurid	Ankylosaurid	0.4048	Thescelosaurid	0.8234
TMP 1989.069. 0017	Ornithischia	Nodosaurid/ Panoplosaurid	Nodosaurid	Nodosaurid	0.8463	Nodosaurid	0.8857
TMP 1989.076.0059	Ankylosaurid (*Euoplocephalus*)	Ornithischia	Pachycephalosaurid	Ankylosaurid	0.6890	Pachycephalosauri d	0.4083

Specimen	Original ID	New ID	Digital traditional ABMT family	AB/MT lingual	Lingual likeli-hood	AB/MT labial family	labial likeli-hood
TMP 1989.079.0008	Nodosaurid	Nodosaurid/ Panoplosaurid	Nodosaurid	Thescelosaurid	0.9884		
TMP 1989.151.0137	Ornithischia	Nodosaurid/ Panoplosaurid	Nodosaurid	Thescelosaurid	0.7906	Nodosaurid	0.9786
TMP 1990.036.0081	Nodosaurid (*Panoplosaurus*)	Nodosaurid/ Panoplosaurid	Nodosaurid	Nodosaurid	0.8044		
TMP 1990.060.0006 - 2	Ornithischia	Ornithischia	Ankylosaurid	Ankylosaurid	0.6391	Pachycephalosauri d	0.6021
TMP 1990. 107.0037-1	Ornithischia	Ornithischia	Ankylosaurid	Nodosaurid	0.7004	Thescelosaurid	0.9128
TMP 1990. 107.0037-2	Ornithischia	Nodosaurid/ Panoplosaurid	Nodosaurid	Nodosaurid	0.7004	Nodosaurid	0.8619
TMP 1990.155.0007	Nodosaurid	Nodosaurid/ Panoplosaurid	Nodosaurid	Nodosaurid	0.8768	Nodosaurid	0.9071
TMP 1991.036.158	Ankylosaurid (*Euoplocephalus*)	Ornithischia	Pachycephalosaurid	Ankylosaurid	0.8465	Thescelosaurid	0.3494
TMP 1991.036.0171	Ankylosaurid (*Ankylosaurus*)	Nodosaurid/ Panoplosaurid	Nodosaurid	Nodosaurid	0.8194	Nodosaurid	0.9954
TMP 1991.050.0093	Ornithischia	Nodosaurid/ Panoplosaurid	Nodosaurid	Nodosaurid	0.9493	Nodosaurid	0.8804
TMP 1991.087.0072	Ornithischia	Ornithischia	Nodosaurid	Pachycephalosaurid	0.4207	Thescelosaurid	0.5470
TMP 1992.036.1178 - 2	Ankylosaurid	Pachycephalosaurid	Pachycephalosaurid	Ankylosaurid	0.7129	Pachycephalosauri d	0.4580
TMP 1993.036.0364	Ankylosaurid	Nodosaurid/ Panoplosaurid	Nodosaurid	Nodosaurid	0.9999	Nodosaurid	0.9992
TMP 1993.079.0065	Nodosaurid	Nodosaurid/ Panoplosaurid				Nodosaurid	0.9962
TMP 1994.012.0035	Nodosaurid	Nodosaurid/ Panoplosaurid	Nodosaurid	Nodosaurid	0.6951	Nodosaurid	0.5836
TMP 1994.012.0039	Nodosaurid	Ornithischia	Nodosaurid	Nodosaurid	0.8210	Thescelosaurid	0.6652
TMP 1994.012.0120	Nodosaurid	Ornithischia	Nodosaurid	Pachycephalosaurid	0.4742	Thescelosaurid	0.5806

Specimen	Original ID	New ID	Digital traditional ABMT family	AB/MT lingual	Lingual likeli-hood	AB/MT labial family	labial likeli-hood
TMP 1994.012.0565	Nodosaurid	Ornithischia	Nodosaurid	Ankylosaurid	0.4317	Nodosaurid	0.4120
TMP 1994.092.0011	Nodosaurid	Ornithischia	Ankylosaurid	Ankylosaurid	0.7828	Thescelosaurid	0.3955
TMP 1994.094.0014 -1	Nodosaurid	Ornithischia	Nodosaurid	Thescelosaurid	0.8061	Thescelosaurid	0.7445
TMP 1994.094.0016	Nodosaurid	Nodosaurid/ Panoplosaurid	Nodosaurid	Nodosaurid	0.9724	Nodosaurid	0.9887
TMP 1995.012.0105	Nodosaurid	Ornithischia	Nodosaurid	Ankylosaurid	0.4353	Thescelosaurid	0.4024
TMP 1995.012.0117	Nodosaurid	Nodosaurid/ Panoplosaurid	Nodosaurid	Nodosaurid	0.9913	Nodosaurid	0.9799
TMP 1996.048.0018 - 2	Ankylosaur	Ornithischia	Pachycephalosaurid	Pachycephalosaurid	0.7318	Thescelosaurid	0.5174
TMP 1998.102.0026 - 1	Nodosaurid	Nodosaurid/ Panoplosaurid	Nodosaurid	Nodosaurid	0.9979	Nodosaurid	0.9870
TMP 1998.102.0026 - 4	Nodosaurid	Nodosaurid/ Panoplosaurid	Nodosaurid	Thescelosaurid	0.6715	Nodosaurid	0.9733
TMP 1998.102.0028 - 1	Ankylosaurid	Ankylosaurid	Ankylosaurid	Ankylosaurid	0.5940	Ankylosaurid	0.4741
TMP 1998.102.0028 - 2	Ankylosaurid	Ornithischia	Ankylosaurid	Ankylosaurid	0.7397	Thescelosaurid	0.3575
TMP 1999.055.0290	Ankylosaurid	Ankylosaur	Ankylosaurid	Ankylosaurid	0.8919	Nodosaurid	0.6161
TMP 1999.063.0019	Nodosaurid	Nodosaurid/ Panoplosaurid	Nodosaurid			Nodosaurid	0.9333
TMP 1999.085.0005	Ornithischia	Ankylosaur	Ankylosaurid	Nodosaurid	0.4375	Ankylosaurid	0.3384
TMP 2000.012.0024 - 2	Ornithischia	Ornithischia	Ankylosaurid	Thescelosaurid	0.3818	Thescelosaurid	0.8320
TMP 2000.057.0027	Ornithischia	Nodosaurid/ Panoplosaurid	Nodosaurid	Thescelosaurid	0.4366	Nodosaurid	0.5079
TMP 2001.012.0072	Ankylosaurid	Ornithischia	Ankylosaurid	Pachycephalosaurid	0.6075	Thescelosaurid	0.4480

Specimen	Original ID	New ID	Digital traditional ABMT family	AB/MT lingual	Lingual likeli-hood	AB/MT labial family	labial likeli-hood
TMP 2002.060.0001 - 1	Ankylosaurid	Ornithischia	Ankylosaurid	Nodosaurid	0.9089	Thescelosaurid	0.4697
TMP 2002.060.0001 - 2	Ankylosaurid	Ornithischia	Ankylosaurid	Pachycephalosaurid	0.7396	Thescelosaurid	0.4938
TMP 2003.012.0106	Chordata	Ankylosaur	Ankylosaurid	Nodosaurid	0.5136	Ankylosaurid	0.5170
TMP 2004.107.0003	Ankylosaur	Ornithischia	Nodosaurid	Ankylosaurid	0.7015	Thescelosaurid	0.8294
TMP 2004.114.0005	Ankylosaur	Ornithischia	Ankylosaurid	Pachycephalosaurid	0.6967	Thescelosaurid	0.6755
TMP 2004.116.0016	Nodosaurid	Ornithischia	Nodosaurid	Pachycephalosaurid	0.5498	Nodosauri	0.4540
TMP 2005.012.0233	Ankylosaur	Ornithischia	Ankylosaurid	Ankylosaurid	0.5699	Thescelosaurid	0.4678
TMP 2005.012.0305	Nodosaurid	Nodosaurid/ Panoplosaurid	Nodosaurid	Nodosaurid	0.7198	Nodosaurid	0.6484
TMP 2005.012.0369	Ankylosaurid	Ornithischia	Ankylosaurid	Ankylosaurid	0.8211	Thescelosaurid	0.5071
TMP 2005.012.0427	Ankylosaur	Nodosaurid/ Panoplosaurid	Nodosaurid	Thescelosaurid	0.4532	Nodosaurid	0.8997
TMP 2005.049.0102	Nodosaurid	Nodosaurid/ Panoplosaurid		Nodosaurid	0.9009	Thescelosaurid	0.5776
TMP 2005.054.0007	Nodosaurid	Ornithischia	Nodosaurid	Ankylosaurid	0.4372	Thescelosaurid	0.7935
TMP 2006.012.0182	Ankylosaurid	Ornithischia	Ankylosaurid	Pachycephalosaurid	0.7933	Ankylosaurid	0.6037
TMP 2011.047.0002	Nodosaurid	Ornithischia	Ankylosaurid	Nodosaurid	0.7296	Thescelosaurid	0.6552
TMP 2011.047.0079	Ankylosaurid	Ornithischia	Ankylosaurid	Pachycephalosaurid	0.4460	Ankylosaurid	0.7066
TMP 2012.012.0017	Ankylosaurid	Ornithischia	Ankylosaurid	Ankylosaurid	0.7459	Thescelosaurid	0.4423
TMP 2013.012.0057	Nodosaurid	Nodosaurid	Nodosaurid	Nodosaurid	0.9990	Nodosaurid	0.9843

Specimen	Original ID	New ID	Digital traditional ABMT family	AB/MT lingual	Lingual likeli-hood	AB/MT labial family	labial likeli-hood
TMP 2014.012.0128	Nodosaurid	Ornithischia		Nodosaurid	0.6616	Thescelosaurid	0.6030
TMP 2014.012.0134	Nodosaurid	Ankylosaurid	Ankylosaurid	Pachycephalosaurid	0.6148	Ankylosaurid	0.4046
UALVP 48747	Ankylosaurid	Ankylosaurid	Ankylosaurid	Ankylosaurid	0.8236	Ankylosaurid	0.6067
UALVP 49327	Ankylosaurid	Ornithischia	Ankylosaurid	Ankylosaurid	0.5975	Nodosauri	0.3477
UALVP 53590	Pachycephalosaurid	Ornithischia	Ankylosaurid	Pachycephalosaurid	0.6306	Pachycephalosauri d	0.3533
UALVP 53975	Ankylosaurid (*Ankylosaurus*)	Ornithischia	Ankylosaurid	Nodosaurid	0.9735	Thescelosaurid	0.6867
UALVP 53591	Ankylosaurid	Nodosaurid/ Panoplosaurid	Nodosaurid	Nodosaurid	0.5874	Nodosaurid	0.6867
UALVP 55366	Nodosaurid	Ankylosaurid	Ankylosaurid	Ankylosaurid	0.8910	Ankylosaurid	0.3911
UALVP 55378	Ankylosaurid	Ankylosaurid	Ankylosaurid	Ankylosaurid	0.7822	Ankylosaurid	0.4136
UALVP 55390	Nodosaurid	Nodosaurid/ Panoplosaurid	Nodosaurid	Nodosaurid	0.9965	Nodosaurid	0.9799
UALVP 55621	Pachycephalosaurid	Ornithischia	Ankylosaurid	Ankylosaurid	0.7555	Pachycephalosauri d	0.4703
UALVP 61124 -1	Nodosaurid	Nodosaurid	Ankylosaurid	Nodosaurid	0.6459	Nodosaurid	0.9098
UALVP 61153	Nodosaurid	Nodosaurid/ Panoplosaurid				Nodosaurid	0.9238
UALVP 61442	Pachycephalosaurid	Ankylosaurid	Ankylosaurid	Ankylosaurid	0.5851	Ankylosaurid	0.6495
UMNH 11638	Ankylosaur	Ornithischia					
UMNH 1228	Ankylosaur	Ornithischia					
UMNH 12864	Ankylosaur	Ornithischia					
UMNH 14436	Ankylosaur	Ornithischia					
UMNH 17418	Ankylosaur	Ornithischia					
UMNH 17502	Ankylosaur	Ornithischia					
UMNH 19040	Ankylosaur	Ornithischia					

Specimen	Original ID	New ID	Digital traditional ABMT family	AB/MT lingual	Lingual likeli-hood	AB/MT labial family	labial likeli-hood
UMNH 19720	Ankylosaur	Ornithischia					
UMNH 20903	Ankylosaur	Ornithischia					
UMNH 5609	Ankylosaur	Ornithischia					
UMNH 7603	Ankylosaur	Ornithischia					

Appendix B – 3: Isolated teeth Coombs (1978) family identifications

Specimen	Original ID	New ID	labial family	labial family likelihood	Digital traditional family
CEUM 11924	Ankylosaur	Ornithischia			
TMP 2005.012.0265	Nodosaurid	Nodosaurid/Panoplosaurid	Nodosaurid	0.9514	Nodosaurid
UALVP 53588 - 1	Pachycephalosaurid	Ornithischia	Thescelosaurid	0.5602	Pachycephalosaurid
UALVP 53588 - 2	Pachycephalosaurid	Ornithischia	Pachycephalosaurid	0.3149	Ankylosaurid
UALVP 53588 - 3	Pachycephalosaurid	Ankylosaur	Nodosaurid	0.4884	Pachycephalosaurid
UALVP 53588 - 4	Pachycephalosaurid	Ornithischia	Thescelosaurid	0.3174	Ankylosaurid
UALVP 53588 - 6	Pachycephalosaurid	Ornithischia	Ankylosaurid	0.3957	Ankylosaurid
CEUM 53115	Nodosaurid (*Peloroplites*)	Nodosaurid/Panoplosaurid	Nodosaurid	0.7418	Nodosaurid
CMNFV 119-1	Nodosaurid	Ornithischia			Ankylosaurid
CMNFV 119-2	Nodosaurid	Ornithischia	Ankylosaurid	0.3904	Ankylosaurid
CMNFV 119-3	Nodosaurid	Ornithischia	Pachycephalosaurid	0.3575	Stegosaurid
CMNFV 119-5	Nodosaurid	Ornithischia	Nodosaurid	0.4136	Ankylosaurid
CMNFV 119-6	Nodosaurid	Pachycephalosaurid			Stegosaurid
CMNFV 1772-1	Nodosaurid (*Edmontonia*)	Nodosaurid/Panoplosaurid	Nodosaurid	0.9103	Nodosaurid
CMNFV 1772-3	Nodosaurid (*Edmontonia*)	Nodosaurid/Panoplosaurid	Nodosaurid	0.8889	Nodosaurid
CMNFV 38442	Ankylosaurid	Ankylosaurid	Ankylosaurid	0.5768	Stegosaurid

Specimen	Original ID	New ID	labial family	labial family likelihood	Digital traditional family
CMNFV 38443	Ankylosaurid	Pachycephalosaurid			Pachycephalosaurid
CMNFV 38445	Ankylosaurid	Ornithischia	Ankylosaurid	0.4056	Stegosaurid
CMNFV 38447	Ankylosaurid	Ornithischia	Ankylosaurid	0.5531	Stegosaurid
CMNFV 38448	Ankylosaurid	Ornithischia	Thescelosaurid	0.5018	Pachycephalosaurid
CMNFV 59591-1	Ankylosaur	Nodosaurid/Panoplosaurid	Nodosaurid	0.8978	Thescelosaurid
CMNFV CMS 1921-2		Ornithischia			Ankylosaurid
CMNFV CMS 1921-3		Nodosaurid/Panoplosaurid	Nodosaurid	0.8304	Thescelosaurid
CMNFV CMS 1921-7		Pachycephalosaurid			Pachycephalosaurid
CMNFV RDR-1	Ankylosaur	Nodosaurid/Panoplosaurid	Nodosaurid	0.5643	
CMNFV UN 5		Ornithischia	Thescelosaurid	0.5415	Ankylosaurid
CMNFV 59240 -1	Nodosaurid	Ornithischia	Nodosaurid	0.9699	Nodosaurid
CMNFV 8731-4		Nodosaurid/Panoplosaurid	Nodosaurid	0.7444	Thescelosaurid
CMNFV 59240 -2		Ornithischia	Thescelosaurid	0.4060	Pachycephalosaurid
ROM 07765	Ankylosaurid	Ankylosaurid	Nodosaurid	0.7444	Ankylosaurid
ROM 07770	Pachycephalosaurid	Ornithischia	Ankylosaurid	0.4333	Stegosaurid
ROM 31866	Ankylosaurid	Ornithischia	Nodosaurid	0.4100	Pachycephalosaurid
ROM 31872	Nodosaurid	Ornithischia	Ankylosaurid	0.3757	Thescelosaurid
ROM 58594	Ankylosaurid	Nodosaurid/Panoplosaurid	Nodosaurid	0.8640	Nodosaurid
ROM 58598	Ankylosaurid	Ornithischia	Thescelosaurid	0.4764	Thescelosaurid
TMP 1966.025.0015	Pachycephalosaurid (*Stegoceras*)	Ornithischia	Thescelosaurid	0.5750	Pachycephalosaurid
TMP 1976.006.0036	Ornithischia	Ankylosaur	Nodosaurid	0.4644	Nodosaurid
TMP 1980.008.0026 - 1	Ankylosaurid	Ankylosaur	Nodosaurid	0.7724	Ankylosaurid
TMP 1980.008.0026 - 2	Ankylosaurid	Ornithischia	Nodosaurid	0.4454	Ankylosaurid
TMP 1980.016.0834	Pachycephalosaurid (*Stegoceras*)	Ornithischia	Thescelosaurid	0.3555	Ankylosaurid
TMP 1980.029.0140	Pachycephalosaurid (*Stegoceras*)	Ankylosaur	Nodosaurid	0.3794	Ankylosaurid
TMP 1981.041.0014	Ankylosaurid (*Euoplocephalus*)	Ornithischia	Thescelosaurid	0.4147	Pachycephalosaurid

Specimen	Original ID	New ID	labial family	labial family likelihood	Digital traditional family
TMP 1983.036.0009 - 1	Ankylosaurid (*Euoplocephalus*)	Ankylosaurid	Ankylosaurid	0.3413	Stegosaurid
TMP 1984.091.0020	Nodosaurid (*Panoplosaurus*)	Nodosaurid/Panoplosaurid	Nodosaurid	0.5869	Nodosaurid
TMP 1985.056.0170 -1	Ankylosaurid (*Euoplocephalus*)	Ankylosaurid	Nodosaurid	0.4354	Ankylosaurid
TMP 1985.056.0171 - 1	Nodosaurid (*Panoplosaurus/Edmontonia*)	Nodosaurid/Panoplosaurid	Nodosaurid	0.8625	Nodosaurid
TMP 1985.056.0171 - 3	Nodosaurid (*Panoplosaurus/Edmontonia*)	Ankylosaur	Nodosaurid	0.7207	Ankylosaurid
TMP 1985.059.0028	Pachycephalosaurid (*Stegoceras*)	Ankylosaurid	Nodosaurid	0.4167	Ankylosaurid
TMP 1986.009.0055	Nodosaurid	Ankylosaurid	Ankylosaurid	0.3570	Ankylosaurid
TMP 1986.095.0007	Ankylosaurid	Ornithischia	Pachycephalosaurid	0.2772	Ankylosaurid
TMP 1986.127.0005	Ankylosaurid	Ornithischia	Nodosaurid	0.3539	Ankylosaurid
TMP 1986.183.0003	Nodosaurid	Ankylosaurid	Nodosaurid	0.3498	Ankylosaurid
TMP 1987.029.0006	Nodosaurid	Pachycephalosaurid	Pachycephalosaurid	0.6003	
TMP 1987.036.0094	Ornithischia	Ankylosaur	Nodosaurid	0.8867	Ankylosaurid
TMP 1987.080.0010	Pachycephalosaurid	Ornithischia	Ankylosaurid	0.3364	Ankylosaurid
TMP 1989.036.0396 - 1	Ankylosaurid (*Euoplocephalus*)	Ornithischia	Pachycephalosaurid	0.4499	Ankylosaurid
TMP 1989.050.0002	Ornithischia	Ornithischia	Pachycephalosaurid	0.3626	Ankylosaurid
TMP 1989.050.0013	Ankylosaurid	Ornithischia	Nodosaurid	0.3468	Pachycephalosaurid
TMP 1989.050.0030	Nodosaurid (*Panoplosaurus*)	Ornithischia	Thescelosaurid	0.6922	Nodosaurid
TMP 1989.069. 0017	Ornithischia	Nodosaurid/Panoplosaurid	Nodosaurid	0.8087	Nodosaurid
TMP 1989.076.0059	Ankylosaurid (*Euoplocephalus*)	Ornithischia	Pachycephalosaurid	0.3593	Pachycephalosaurid
TMP 1989.079.0008	Nodosaurid	Nodosaurid/Panoplosaurid			Nodosaurid
TMP 1989.151.0137	Ornithischia	Nodosaurid/Panoplosaurid	Nodosaurid	0.9247	Nodosaurid
TMP 1990.036.0081	Nodosaurid (*Panoplosaurus*)	Nodosaurid/Panoplosaurid			Nodosaurid
TMP 1990.060.0006 - 2	Ornithischia	Ornithischia	Pachycephalosaurid	0.5514	Ankylosaurid
TMP 1990. 107.0037-1	Ornithischia	Ornithischia	Thescelosaurid	0.8523	Pachycephalosaurid
TMP 1990. 107.0037-2	Ornithischia	Nodosaurid/Panoplosaurid	Nodosaurid	0.7620	Nodosaurid
TMP 1990.155.0007	Nodosaurid	Nodosaurid/Panoplosaurid	Nodosaurid	0.8957	Nodosaurid

Specimen	Original ID	New ID	labial family	labial family likelihood	Digital traditional family
TMP 1991.036.158	Ankylosaurid (*Euoplocephalus*)	Ornithischia	Nodosaurid	0.3467	Pachycephalosaurid
TMP 1991.036.0171	Ankylosaurid (*Ankylosaurus*)	Nodosaurid/Panoplosaurid	Nodosaurid	0.9789	Ankylosaurid
TMP 1991.050.0093	Ornithischia	Nodosaurid/Panoplosaurid	Nodosaurid	0.7866	Nodosaurid
TMP 1991.087.0072	Ornithischia	Ornithischia	Thescelosaurid	0.5149	Ankylosaurid
TMP 1992.036.1178 - 2	Ankylosaurid	Pachycephalosaurid	Pachycephalosaurid	0.3783	Pachycephalosaurid
TMP 1993.036.0364	Ankylosaurid	Nodosaurid/Panoplosaurid	Nodosaurid	0.9934	Nodosaurid
TMP 1993.079.0065	Nodosaurid	Nodosaurid/Panoplosaurid	Nodosaurid	0.9701	
TMP 1994.012.0035	Nodosaurid	Nodosaurid/Panoplosaurid	Nodosaurid	0.6812	Nodosaurid
TMP 1994.012.0039	Nodosaurid	Ornithischia	Thescelosaurid	0.5243	Nodosaurid
TMP 1994.012.0120	Nodosaurid	Ornithischia	Thescelosaurid	0.4626	Nodosaurid
TMP 1994.012.0565	Nodosaurid	Ornithischia	Nodosaurid	0.7146	Ankylosaurid
TMP 1994.092.0011	Nodosaurid	Ornithischia	Thescelosaurid	0.3020	
TMP 1994.094.0014 -1	Nodosaurid	Ornithischia	Thescelosaurid	0.5229	Nodosaurid
TMP 1994.094.0016	Nodosaurid	Nodosaurid/Panoplosaurid	Nodosaurid	0.9511	Nodosaurid
TMP 1995.012.0105	Nodosaurid	Ornithischia	Nodosaurid	0.4563	Nodosaurid
TMP 1995.012.0117	Nodosaurid	Nodosaurid/Panoplosaurid	Nodosaurid	0.9546	Nodosaurid
TMP 1996.048.0018 - 2	Ankylosaur	Ornithischia	Thescelosaurid	0.4623	Pachycephalosaurid
TMP 1998.102.0026 - 1	Nodosaurid	Nodosaurid/Panoplosaurid	Nodosaurid	0.9313	Nodosaurid
TMP 1998.102.0026 - 4	Nodosaurid	Nodosaurid/Panoplosaurid	Nodosaurid	0.9134	Nodosaurid
TMP 1998.102.0028 - 1	Ankylosaurid	Ankylosaurid	Ankylosaurid	0.3947	Ankylosaurid
TMP 1998.102.0028 - 2	Ankylosaurid	Ornithischia	Thescelosaurid	0.2745	Ankylosaurid
TMP 1999.055.0290	Ankylosaurid	Ankylosaur	Nodosaurid	0.7344	Ankylosaurid
TMP 1999.063.0019	Nodosaurid	Nodosaurid/Panoplosaurid	Nodosaurid	0.9419	Nodosaurid
TMP 1999.085.0005	Ornithischia	Ankylosaur	Nodosaurid	0.3955	Ankylosaurid
TMP 2000.012.0024 - 2	Ornithischia	Ornithischia	Thescelosaurid	0.7248	Nodosaurid
TMP 2000.057.0027	Ornithischia	Nodosaurid/Panoplosaurid	Nodosaurid	0.7513	Nodosaurid

Specimen	Original ID	New ID	labial family	labial family likelihood	Digital traditional family
TMP 2001.012.0072	Ankylosaurid	Ornithischia	Thescelosaurid	0.4094	Ankylosaurid
TMP 2002.060.0001 - 1	Ankylosaurid	Ornithischia	Thescelosaurid	0.3551	Ankylosaurid
TMP 2002.060.0001 - 2	Ankylosaurid	Ornithischia	Thescelosaurid	0.3747	Ankylosaurid
TMP 2003.012.0106	Chordata	Ankylosaur	Ankylosaurid	0.4192	Ankylosaurid
TMP 2004.107.0003	Ankylosaur	Ornithischia	Thescelosaurid	0.6400	Nodosaurid
TMP 2004.114.0005	Ankylosaur	Ornithischia	Thescelosaurid	0.6255	Ankylosaurid
TMP 2004.116.0016	Nodosaurid	Ornithischia	Nodosaurid	0.5887	Nodosaurid
TMP 2005.012.0233	Ankylosaur	Ornithischia	Thescelosaurid	0.3370	Ankylosaurid
TMP 2005.012.0305	Nodosaurid	Nodosaurid/Panoplosaurid	Nodosaurid	0.6539	Nodosaurid
TMP 2005.012.0369	Ankylosaurid	Ornithischia	Nodosaurid	0.3469	Ankylosaurid
TMP 2005.012.0427	Ankylosaur	Nodosaurid/Panoplosaurid	Nodosaurid	0.9358	Nodosaurid
TMP 2005.049.0102	Nodosaurid	Nodosaurid/Panoplosaurid	Nodosaurid	0.4788	
TMP 2005.054.0007	Nodosaurid	Ornithischia	Thescelosaurid	0.6067	Nodosaurid
TMP 2006.012.0182	Ankylosaurid	Ornithischia	Ankylosaurid	0.4532	Ankylosaurid
TMP 2011.047.0002	Nodosaurid	Ornithischia	Thescelosaurid	0.4867	Ankylosaurid
TMP 2011.047.0079	Ankylosaurid	Ornithischia	Ankylosaurid	0.5863	Ankylosaurid
TMP 2012.012.0017	Ankylosaurid	Ornithischia	Nodosaurid	0.3712	Ankylosaurid
TMP 2013.012.0057	Nodosaurid	Nodosaurid	Nodosaurid	0.9801	Nodosaurid
TMP 2014.012.0128	Nodosaurid	Ornithischia	Nodosaurid	0.4918	
TMP 2014.012.0134	Nodosaurid	Ankylosaurid	Ankylosaurid	0.3576	Ankylosaurid
UALVP 48747	Ankylosaurid	Ankylosaurid	Ankylosaurid	0.4404	Ankylosaurid
UALVP 49327	Ankylosaurid	Ornithischia	Nodosaurid	0.5554	Pachycephalosaurid
UALVP 53590	Pachycephalosaurid	Ornithischia	Pachycephalosaurid	0.2974	Pachycephalosaurid
UALVP 53975	Ankylosaurid (*Ankylosaurus*)	Ornithischia	Thescelosaurid	0.5520	Ankylosaurid
UALVP 53591	Ankylosaurid	Nodosaurid/Panoplosaurid	Nodosaurid	0.5594	Nodosaurid
UALVP 55366	Nodosaurid	Ankylosaurid	Ankylosaurid	0.3180	Ankylosaurid

Specimen	Original ID	New ID	labial family	labial family likelihood	Digital traditional family
UALVP 55378	Ankylosaurid	Ankylosaurid	Ankylosaurid	0.3426	Ankylosaurid
UALVP 55390	Nodosaurid	Nodosaurid/Panoplosaurid	Nodosaurid	0.9597	Nodosaurid
UALVP 55621	Pachycephalosaurid	Ornithischia	Pachycephalosaurid	0.3887	Ankylosaurid
UALVP 61124 -1	Nodosaurid	Nodosaurid	Nodosaurid	0.8531	Pachycephalosaurid
UALVP 61153	Nodosaurid	Nodosaurid/Panoplosaurid	Nodosaurid	0.9088	
UALVP 61442	Pachycephalosaurid	Ankylosaurid	Ankylosaurid	0.4541	Ankylosaurid
UMNH 11638	Ankylosaur	Ornithischia			
UMNH 1228	Ankylosaur	Ornithischia			Pachycephalosaurid
UMNH 12864	Ankylosaur	Ornithischia			Thescelosaurid
UMNH 14436	Ankylosaur	Ornithischia			Pachycephalosaurid
UMNH 17418	Ankylosaur	Ornithischia			
UMNH 17502	Ankylosaur	Ornithischia			Pachycephalosaurid
UMNH 19040	Ankylosaur	Ornithischia			Thescelosaurid
UMNH 19720	Ankylosaur	Ornithischia			Stegosaurid
UMNH 20903	Ankylosaur	Ornithischia			Thescelosaurid
UMNH 5609	Ankylosaur	Ornithischia			Stegosaurid
UMNH 7603	Ankylosaur	Ornithischia			Stegosaurid

Appendix B – 4: Isolated teeth Raven et al. (2023) family identifications

Specimen	Original ID	New ID	Raven et al. Labial family	Raven et al. labial likelihood	Digital traditional Raven et al. family
CEUM 11924	Ankylosaur	Ornithischia			
TMP 2005.012.0265	Nodosaurid	Nodosaurid/Panoplosaurid	Panoplosaurid	0.9434	Panoplosaurid
UALVP 53588 - 1	Pachycephalosaurid	Ornithischia	Thescelosaurid	0.5808	Pachycephalosaurid

Specimen	Original ID	New ID	Raven et al. Labial family	Raven et al. labial likelihood	Digital traditional Raven et al. family
UALVP 53588 - 2	Pachycephalosaurid	Ornithischia	Pachycephalosaurid	0.3333	Ankylosaurid
UALVP 53588 - 3	Pachycephalosaurid	Ankylosaur	Ankylosaurid	0.3926	Ankylosaurid
UALVP 53588 - 4	Pachycephalosaurid	Ornithischia	Thescelosaurid	0.3401	Ankylosaurid
UALVP 53588 - 6	Pachycephalosaurid	Ornithischia	Ankylosaurid	0.3482	Basal
CEUM 53115	Nodosaurid (*Peloroplites*)	Nodosaurid/Panoplosaurid	Panoplosaurid	0.8665	Panoplosaurid
CMNFV 119-1	Nodosaurid	Ornithischia			Basal
CMNFV 119-2	Nodosaurid	Ornithischia	Ankylosaurid	0.3715	Basal
CMNFV 119-3	Nodosaurid	Ornithischia	Pachycephalosaurid	0.3763	Basal
CMNFV 119-5	Nodosaurid	Ornithischia	Ankylosaurid	0.3530	Basal
CMNFV 119-6	Nodosaurid	Pachycephalosaurid			Stegosaurid
CMNFV 1772-1	Nodosaurid (*Edmontonia*)	Nodosaurid/Panoplosaurid	Panoplosaurid	0.8806	Panoplosaurid
CMNFV 1772-3	Nodosaurid (*Edmontonia*)	Nodosaurid/Panoplosaurid	Panoplosaurid	0.9459	Panoplosaurid
CMNFV 38442	Ankylosaurid	Ankylosaurid	Ankylosaurid	0.6220	Basal
CMNFV 38443	Ankylosaurid	Pachycephalosaurid			Pachycephalosaurid
CMNFV 38445	Ankylosaurid	Ornithischia	Ankylosaurid	0.3719	Basal
CMNFV 38447	Ankylosaurid	Ornithischia	Ankylosaurid	0.5584	Stegosaurid
CMNFV 38448	Ankylosaurid	Ornithischia	Thescelosaurid	0.3829	Pachycephalosaurid
CMNFV 59591-1	Ankylosaur	Nodosaurid/Panoplosaurid	Panoplosaurid	0.9034	Thescelosaurid
CMNFV CMS 1921-2		Ornithischia	Thescelosaurid	0.5996	Ankylosaurid
CMNFV CMS 1921-3		Nodosaurid/Panoplosaurid	Panoplosaurid	0.8503	Thescelosaurid
CMNFV CMS 1921-7		Pachycephalosaurid	Thescelosaurid	0.4873	Pachycephalosaurid
CMNFV RDR-1	Ankylosaur	Nodosaurid/Panoplosaurid	Panoplosaurid	0.4193	
CMNFV UN 5		Ornithischia	Thescelosaurid	0.3009	Ankylosaurid
CMNFV 59240 -1	Nodosaurid	Ornithischia	Panoplosaurid	0.9656	Thescelosaurid
CMNFV 8731-4		Nodosaurid/Panoplosaurid	Panoplosaurid	0.5177	Thescelosaurid
CMNFV 59240 -2		Ornithischia	Thescelosaurid	0.4633	Panoplosaurid

Specimen	Original ID	New ID	Raven et al. Labial family	Raven et al. labial likelihood	Digital traditional Raven et al. family
ROM 07765	Ankylosaurid	Ankylosaurid	Ankylosaurid	0.4045	Ankylosaurid
ROM 07770	Pachycephalosaurid	Ornithischia	Ankylosaurid	0.4118	Stegosaurid
ROM 31866	Ankylosaurid	Ornithischia	Thescelosaurid	0.3984	Ankylosaurid
ROM 31872	Nodosaurid	Ornithischia	Ankylosaurid	0.3842	Polacanthid
ROM 58594	Ankylosaurid	Nodosaurid/Panoplosaurid	Panoplosaurid	0.6953	Polacanthid
ROM 58598	Ankylosaurid	Ornithischia	Thescelosaurid	0.5494	Thescelosaurid
TMP 1966.025.0015	Pachycephalosaurid (*Stegoceras*)	Ornithischia	Thescelosaurid	0.5626	Pachycephalosaurid
TMP 1976.006.0036	Ornithischia	Ankylosaur	Ankylosaurid	0.3378	Panoplosaurid
TMP 1980.008.0026 - 1	Ankylosaurid	Ankylosaur	Panoplosaurid	0.7912	Ankylosaurid
TMP 1980.008.0026 - 2	Ankylosaurid	Ornithischia	Thescelosaurid	0.3634	Ankylosaurid
TMP 1980.016.0834	Pachycephalosaurid (*Stegoceras*)	Ornithischia	Thescelosaurid	0.2746	Basal
TMP 1980.029.0140	Pachycephalosaurid (*Stegoceras*)	Ankylosaur	Ankylosaurid	0.2942	Ankylosaurid
TMP 1981.041.0014	Ankylosaurid (*Euoplocephalus*)	Ornithischia	Thescelosaurid	0.4833	Pachycephalosaurid
TMP 1983.036.0009 - 1	Ankylosaurid (*Euoplocephalus*)	Ankylosaurid	Ankylosaurid	0.3772	Polacanthid
TMP 1984.091.0020	Nodosaurid (*Panoplosaurus*)	Nodosaurid/Panoplosaurid	Panoplosaurid	0.5335	Panoplosaurid
TMP 1985.056.0170 -1	Ankylosaurid (*Euoplocephalus)*	Ankylosaurid	Ankylosaurid	0.4023	Ankylosaurid
TMP 1985.056.0171 - 1	Nodosaurid (*Panoplosaurus/Edmontonia*)	Nodosaurid/Panoplosaurid	Panoplosaurid	0.9075	Panoplosaurid
TMP 1985.056.0171 - 3	Nodosaurid (*Panoplosaurus/Edmontonia*)	Ankylosaur	Panoplosaurid	0.6419	Ankylosaurid
TMP 1985.059.0028	Pachycephalosaurid (*Stegoceras*)	Ankylosaurid	Ankylosaurid	0.3649	Ankylosaurid
TMP 1986.009.0055	Nodosaurid	Ankylosaurid	Thescelosaurid	0.3358	Ankylosaurid
TMP 1986.095.0007	Ankylosaurid	Ornithischia	Pachycephalosaurid	0.2523	Ankylosaurid
TMP 1986.127.0005	Ankylosaurid	Ornithischia	Ankylosaurid	0.3672	Ankylosaurid
TMP 1986.183.0003	Nodosaurid	Ankylosaurid	Ankylosaurid	0.2970	Ankylosaurid
TMP 1987.029.0006	Nodosaurid	Pachycephalosaurid	Pachycephalosaurid	0.6084	
TMP 1987.036.0094	Ornithischia	Ankylosaur	Panoplosaurid	0.8001	Ankylosaurid
TMP 1987.080.0010	Pachycephalosaurid	Ornithischia	Ankylosaurid	0.3617	Pachycephalosaurid

Specimen	Original ID	New ID	Raven et al. Labial family	Raven et al. labial likelihood	Digital traditional Raven et al. family
TMP 1989.036.0396 - 1	Ankylosaurid (*Euoplocephalus*)	Ornithischia	Pachycephalosaurid	0.4509	Ankylosaurid
TMP 1989.050.0002	Ornithischia	Ornithischia	Pachycephalosaurid	0.3964	Ankylosaurid
TMP 1989.050.0013	Ankylosaurid	Ornithischia	Thescelosaurid	0.3799	Ankylosaurid
TMP 1989.050.0030	Nodosaurid (*Panoplosaurus*)	Ornithischia	Thescelosaurid	0.7328	Ankylosaurid
TMP 1989.069. 0017	Ornithischia	Nodosaurid/Panoplosaurid	Panoplosaurid	0.9011	Panoplosaurid
TMP 1989.076.0059	Ankylosaurid (*Euoplocephalus*)	Ornithischia	Pachycephalosaurid	0.3554	Stegosaurid
TMP 1989.079.0008	Nodosaurid	Nodosaurid/Panoplosaurid			Panoplosaurid
TMP 1989.151.0137	Ornithischia	Nodosaurid/Panoplosaurid	Panoplosaurid	0.9805	Panoplosaurid
TMP 1990.036.0081	Nodosaurid (*Panoplosaurus*)	Nodosaurid/Panoplosaurid			Panoplosaurid
TMP 1990.060.0006 - 2	Ornithischia	Ornithischia	Thescelosaurid	0.4309	Ankylosaurid
TMP 1990. 107.0037-1	Ornithischia	Ornithischia	Thescelosaurid	0.8238	Pachycephalosaurid
TMP 1990. 107.0037-2	Ornithischia	Nodosaurid/Panoplosaurid	Panoplosaurid	0.8809	Panoplosaurid
TMP 1990.155.0007	Nodosaurid	Nodosaurid/Panoplosaurid	Panoplosaurid	0.8999	Panoplosauridae
TMP 1991.036.158	Ankylosaurid (*Euoplocephalus*)	Ornithischia	Thescelosaurid	0.3201	Pachycephalosaurid
TMP 1991.036.0171	Ankylosaurid (*Ankylosaurus*)	Nodosaurid/Panoplosaurid	Panoplosaurid	0.9961	Panoplosaurid
TMP 1991.050.0093	Ornithischia	Nodosaurid/Panoplosaurid	Panoplosaurid	0.9112	Panoplosaurid
TMP 1991.087.0072	Ornithischia	Ornithischia	Thescelosaurid	0.5268	Panoplosaurid
TMP 1992.036.1178 - 2	Ankylosaurid	Pachycephalosaurid	Pachycephalosaurid	0.4186	Pachycephalosaurid
TMP 1993.036.0364	Ankylosaurid	Nodosaurid/Panoplosaurid	Panoplosaurid	0.9993	Panoplosaurid
TMP 1993.079.0065	Nodosaurid	Nodosaurid/Panoplosaurid	Panoplosaurid	0.9965	
TMP 1994.012.0035	Nodosaurid	Nodosaurid/Panoplosaurid	Panoplosaurid	0.6809	Panoplosaurid
TMP 1994.012.0039	Nodosaurid	Ornithischia	Thescelosaurid	0.5825	Panoplosaurid
TMP 1994.012.0120	Nodosaurid	Ornithischia	Thescelosaurid	0.5193	Panoplosaurid
TMP 1994.012.0565	Nodosaurid	Ornithischia	Panoplosaurid	0.3858	Panoplosaurid
TMP 1994.092.0011	Nodosaurid	Ornithischia	Thescelosaurid	0.2915	
TMP 1994.094.0014 -1	Nodosaurid	Ornithischia	Thescelosaurid	0.5965	Panoplosaurid

Specimen	Original ID	New ID	Raven et al. Labial family	Raven et al. labial likelihood	Digital traditional Raven et al. family
TMP 1994.094.0016	Nodosaurid	Nodosaurid/Panoplosaurid	Panoplosaurid	0.9920	Panoplosaurid
TMP 1995.012.0105	Nodosaurid	Ornithischia	Thescelosaurid	0.2970	Panoplosaurid
TMP 1995.012.0117	Nodosaurid	Nodosaurid/Panoplosaurid	Panoplosaurid	0.9619	Panoplosaurid
TMP 1996.048.0018 - 2	Ankylosaur	Ornithischia	Thescelosaurid	0.4435	Pachycephalosaurid
TMP 1998.102.0026 - 1	Nodosaurid	Nodosaurid/Panoplosaurid	Panoplosaurid	0.9921	Panoplosaurid
TMP 1998.102.0026 - 4	Nodosaurid	Nodosaurid/Panoplosaurid	Panoplosaurid	0.9769	Panoplosaurid
TMP 1998.102.0028 - 1	Ankylosaurid	Ankylosaurid	Ankylosaurid	0.3665	Basal
TMP 1998.102.0028 - 2	Ankylosaurid	Ornithischia	Thescelosaurid	0.2681	Ankylosaurid
TMP 1999.055.0290	Ankylosaurid	Ankylosaur	Panoplosaurid	0.4905	Ankylosaurid
TMP 1999.063.0019	Nodosaurid	Nodosaurid/Panoplosaurid	Panoplosaurid	0.9339	Panoplosaurid
TMP 1999.085.0005	Ornithischia	Ankylosaur	Ankylosaurid	0.2775	Ankylosaurid
TMP 2000.012.0024 - 2	Ornithischia	Ornithischia	Thescelosaurid	0.7464	Ankylosaurid
TMP 2000.057.0027	Ornithischia	Nodosaurid/Panoplosaurid	Panoplosaurid	0.4281	Panoplosaurid
TMP 2001.012.0072	Ankylosaurid	Ornithischia	Thescelosaurid	0.4033	Ankylosaurid
TMP 2002.060.0001 - 1	Ankylosaurid	Ornithischia	Thescelosaurid	0.3688	Ankylosaurid
TMP 2002.060.0001 - 2	Ankylosaurid	Ornithischia	thescelosaurid	0.4070	Ankylosaurid
TMP 2003.012.0106	Chordata	Ankylosaur	Ankylosaurid	0.4502	Ankylosaurid
TMP 2004.107.0003	Ankylosaur	Ornithischia	Thescelosaurid	0.6972	Panoplosaurid
TMP 2004.114.0005	Ankylosaur	Ornithischia	Thescelosaurid	0.5909	Ankylosaurid
TMP 2004.116.0016	Nodosaurid	Ornithischia	Panoplosaurid	0.4057	Panoplosaurid
TMP 2005.012.0233	Ankylosaur	Ornithischia	Thescelosaurid	0.3730	Ankylosaurid
TMP 2005.012.0305	Nodosaurid	Nodosaurid/Panoplosaurid	Panoplosaurid	0.7112	Panoplosaurid
TMP 2005.012.0369	Ankylosaurid	Ornithischia	Thescelosaurid	0.3982	Ankylosaurid
TMP 2005.012.0427	Ankylosaur	Nodosaurid/Panoplosaurid	Panoplosaurid	0.7087	Panoplosaurid
TMP 2005.049.0102	Nodosaurid	Nodosaurid/Panoplosaurid	Thescelosaurid	0.4548	
TMP 2005.054.0007	Nodosaurid	Ornithischia	Thescelosaurid	0.6832	Panoplosaurid

Specimen	Original ID	New ID	Raven et al. Labial family	Raven et al. labial likelihood	Digital traditional Raven et al. family
TMP 2006.012.0182	Ankylosaurid	Ornithischia	Ankylosaurid	0.4811	Basal
TMP 2011.047.0002	Nodosaurid	Ornithischia	Thescelosaurid	0.5482	Ankylosaurid
TMP 2011.047.0079	Ankylosaurid	Ornithischia	Ankylosaurid	0.5984	Ankylosaurid
TMP 2012.012.0017	Ankylosaurid	Ornithischia	Thescelosaurid	0.3589	Ankylosaurid
TMP 2013.012.0057	Nodosaurid	Nodosaurid	Panoplosaurid	0.9655	Panoplosaurid
TMP 2014.012.0128	Nodosaurid	Ornithischia	Thescelosaurid	0.4398	
TMP 2014.012.0134	Nodosaurid	Ankylosaurid	Ankylosaurid	0.3431	Ankylosaurid
UALVP 48747	Ankylosaurid	Ankylosaurid	Ankylosaurid	0.4862	Ankylosaurid
UALVP 49327	Ankylosaurid	Ornithischia	Panoplosaurid	0.2864	Ankylosaurid
UALVP 53590	Pachycephalosaurid	Ornithischia	Basal	0.2445	Pachycephalosaurid
UALVP 53975	Ankylosaurid (*Ankylosaurus*)	Ornithischia	Thescelosaurid	0.5708	Ankylosaurid
UALVP 53591	Ankylosaurid	Nodosaurid/Panoplosaurid	Panoplosaurid	0.5215	Panoplosaurid
UALVP 55366	Nodosaurid	Ankylosaurid	Ankylosaurid	0.3372	Ankylosaurid
UALVP 55378	Ankylosaurid	Ankylosaurid	Ankylosaurid	0.3649	Ankylosaurid
UALVP 55390	Nodosaurid	Nodosaurid/Panoplosaurid	Panoplosaurid	0.9891	Panoplosaurid
UALVP 55621	Pachycephalosaurid	Ornithischia	Pachycephalosaurid	0.4228	Ankylosaurid
UALVP 61124 -1	Nodosaurid	Nodosaurid	Panoplosaurid	0.8964	Ankylosaurid
UALVP 61153	Nodosaurid	Nodosaurid/Panoplosaurid	Panoplosaurid	0.9621	
UALVP 61442	Pachycephalosaurid	Ankylosaurid	Ankylosaurid	0.5111	Basal
UMNH 11638	Ankylosaur	Ornithischia	Thescelosaurid	0.4127	
UMNH 1228	Ankylosaur	Ornithischia	Thescelosaurid	0.3458	Basal
UMNH 12864	Ankylosaur	Ornithischia	Thescelosaurid	0.7404	Thescelosaurid
UMNH 14436	Ankylosaur	Ornithischia	Thescelosaurid	0.3655	Pachycephalosaurid
UMNH 17418	Ankylosaur	Ornithischia			
UMNH 17502	Ankylosaur	Ornithischia	Pachycephalosaurid	0.3873	Basal
UMNH 19040	Ankylosaur	Ornithischia	Thescelosaurid	0.5310	Basal

Specimen	Original ID	New ID	Raven et al. Labial family	Raven et al. labial likelihood	Digital traditional Raven et al. family
UMNH 19720	Ankylosaur	Ornithischia	Thescelosaurid	0.5094	Stegosaurid
UMNH 20903	Ankylosaur	Ornithischia	Panoplosaurid	0.7220	Thescelosaurid
UMNH 5609	Ankylosaur	Ornithischia			Stegosaurid
UMNH 7603	Ankylosaur	Ornithischia			Stegosaurid

Appendix B – 5: Isolated tooth ankylosaurid and nodosaurid species identifications

Specimen	Original ID	New ID	Nodosaurid lingual species	Nodosaurid lingual likelihood	Ankylosaurid lingual species	Ankylosaurid lingual likelihood
CEUM 11924	Ankylosaur	Ornithischia	*Denversaurus*	0.6799	*Saichania*	0.9249
TMP 2005.012.0265	Nodosaurid	Nodosaurid/ Panoplosaurid	*Panoplosaurus*	0.2849	*Ankylosaurus*	0.7495
UALVP 53588 - 1	Pachycephalosaurid	Ornithischia	*Edmontonia rugosidens*	0.4330	*Euoplocephalus*	0.9385
UALVP 53588 - 2	Pachycephalosaurid	Ornithischia	*Gastonia burgei*	0.4484	*Euoplocephalus*	0.7760
UALVP 53588 - 3	Pachycephalosaurid	Ankylosaur	*Panoplosaurus*	0.3804	*Euoplocephalus*	0.6076
UALVP 53588 - 4	Pachycephalosaurid	Ornithischia	*Gastonia burgei*	0.4370	*Euoplocephalus*	0.8878
UALVP 53588 - 6	Pachycephalosaurid	Ornithischia	*Gargoyleosaurus*	0.9685	*Pinacosaurus*	0.7779
CEUM 53115	Nodosaurid (*Peloroplites*)	Nodosaurid/ Panoplosaurid	*Edmontonia longiceps*	0.9999	*Saichainia*	0.9965
CMNFV 119-1	Nodosaurid	Ornithischia	*Gargoyleosaurus*	0.9900	*Pinacosaurus*	0.9916
CMNFV 119-2	Nodosaurid	Ornithischia	*Gargoyleosaurus*	0.8847	*Pinacosaurus*	0.9241
CMNFV 119-3	Nodosaurid	Ornithischia	*Edmontonia rugosidens*	0.5624	*Anodontosaurus*	0.5646
CMNFV 119-5	Nodosaurid	Ornithischia	*Gargoyleosaurus*	0.8927	*Pinacosaurus*	0.7188
CMNFV 119-6	Nodosaurid	Pachycephalosaurid	*Gargoyleosaurus*	0.9669	*Pinacosaurus*	0.7417
CMNFV 1772-1	Nodosaurid (*Edmontonia*)	Nodosaurid/ Panoplosaurid	*Edmontonia longiceps*	0.6816	*Saichania*	0.9466

Specimen	Original ID	New ID	Nodosaurid lingual species	Nodosaurid lingual likelihood	Ankylosaurid lingual species	Ankylosaurid lingual likelihood
CMNFV 1772-3	Nodosaurid (*Edmontonia*)	Nodosaurid/ Panoplosaurid	*Edmontonia rugosidens*	0.9977	*Saichania*	0.9981
CMNFV 38442	Ankylosaurid	Ankylosaurid	*Panoplosaurus*	0.6538	*Anodontosaurus*	0.9615
CMNFV 38443	Ankylosaurid	Pachycephalosaurid	*Gastonia burgei*	0.6801	*Euoplocephalus*	0.9305
CMNFV 38445	Ankylosaurid	Ornithischia	*Gargoyleosaurus*	0.8743	*Anodontosaurus*	0.7478
CMNFV 38447	Ankylosaurid	Ornithischia	*Gargoyleosaurus*	0.9915	*Pinacosaurus*	0.9970
CMNFV 38448	Ankylosaurid	Ornithischia	*Gargoyleosaurus*	0.9394	*Pinacosaurus*	0.8733
CMNFV 59591-1	Ankylosaur	Nodosaurid/ Panoplosaurid	*Anamantarx*	0.9893	*Anodontosaurus*	0.7373
CMNFV CMS 1921-2		Ornithischia	*Gargoyleosaurus*	0.9970	*pinacosaurus*	0.9440
CMNFV CMS 1921-3		Nodosaurid/ Panoplosaurid	*Edmontonia rugosidens*	0.8196	*Saichania*	0.8627
CMNFV CMS 1921-7		Pachycephalosaurid	*Gastonia burgei*	0.5785	*Euoplocephalus*	0.9581
CMNFV RDR-1	Ankylosaur	Nodosaurid/ Panoplosaurid	*Edmontonia rugosidens*	0.9849	*Saichania*	0.9952
CMNFV UN 5		Ornithischia	*Edmontonia rugosidens*	0.8663	*Euoplocephalus*	0.4918
CMNFV 59240 -1	Nodosaurid	Ornithischia	*Edmontonia longiceps*	0.8490	*Anodontosaurus*	0.6624
CMNFV 8731-4		Nodosaurid/ Panoplosaurid	*Edmontonia rugosidens*	0.6072	*Saichania*	0.7290
CMNFV 59240 -2		Ornithischia	*Edmontonia rugosidens*	0.9641	*Saichania*	0.8920
ROM 07765	Ankylosaurid	Ankylosaurid	*Gastonia burgei*	0.2887	*Euoplocephalus*	0.7283
ROM 07770	Pachycephalosaurid	Ornithischia	*Gargoyleosaurus*	0.9643	*Saichania*	0.8340
ROM 31866	Ankylosaurid	Ornithischia	*Gargoyleosaurus*	0.9269	*Saichania*	0.9181
ROM 31872	Nodosaurid	Ornithischia	*Gargoyleosaurus*	0.3666	*Anodontosaurus*	0.7725
ROM 58594	Ankylosaurid	Nodosaurid/ Panoplosaurid	*Panoplosaurus*	0.7737	*Anodontosaurus*	0.6500
ROM 58598	Ankylosaurid	Ornithischia	*Gargoyleosaurus*	0.8410	*Saichania*	0.4870

Specimen	Original ID	New ID	Nodosaurid lingual species	Nodosaurid lingual likelihood	Ankylosaurid lingual species	Ankylosaurid lingual likelihood
TMP 1966.025.0015	Pachycephalosaurid (*Stegoceras*)	Ornithischia	*Edmontonia rugosidens*	0.7703	*Pinacosaurus*	0.6933
TMP 1976.006.0036	Ornithischia	Ankylosaur	*Panoplosaurus*	0.7526	*Saichania*	0.5434
TMP 1980.008.0026 - 1	Ankylosaurid	Ankylosaur	*Panoplosaurus*	0.8921	*Saichania*	0.7884
TMP 1980.008.0026 - 2	Ankylosaurid	Ornithischia	*Panoplosaurus*	0.3857	*Saichania*	0.8009
TMP 1980.016.0834	Pachycephalosaurid (*Stegoceras*)	Ornithischia	*Gargoyleosaurus*	0.7979	*Pinacosaurus*	0.4177
TMP 1980.029.0140	Pachycephalosaurid (*Stegoceras*)	Ankylosaur	*Gastonia lorriemcwhinneyae*	0.5816	*Euoplocephalus*	0.8137
TMP 1981.041.0014	Ankylosaurid (*Euoplocephalus*)	Ornithischia	*Gastonia burgei*	0.7200	*Euoplocephalus*	0.8206
TMP 1983.036.0009 - 1	Ankylosaurid (*Euoplocephalus*)	Ankylosaurid	*Panoplosaurus*	0.5590	*Anodontosaurus*	0.8626
TMP 1984.091.0020	Nodosaurid (*Panoplosaurus*)	Nodosaurid/ Panoplosaurid	*Gargoyleosaurus*	0.9528	*Saichania*	0.6976
TMP 1985.056.0170 -1	Ankylosaurid (*Euoplocephalus)*	Ankylosaurid	*Gargoyleosaurus*	0.8370	*Anodontosaurus*	0.5104
TMP 1985.056.0171 - 1	Nodosaurid (*Panoplosaurus/ Edmontonia*)	Nodosaurid/ Panoplosaurid	*Edmontonia rugosidens*	0.4578	*Saichania*	0.7757
TMP 1985.056.0171 - 3	Nodosaurid (*Panoplosaurus/ Edmontonia*)	Ankylosaur	*Gastonia burgei*	0.5429	*Anodontosaurus*	0.8034
TMP 1985.059.0028	Pachycephalosaurid (*Stegoceras*)	Ankylosaurid	*Edmontonia rugosidens*	0.9794	*Pinacosaurus*	0.6045
TMP 1986.009.0055	Nodosaurid	Ankylosaurid	*Panoplosaurus*	0.6214	*Anodontosaurus*	0.6945
TMP 1986.095.0007	Ankylosaurid	Ornithischia	*Gastonia burgei*	0.4712	*Anodontosaurus*	0.8844
TMP 1986.127.0005	Ankylosaurid	Ornithischia	*Gargoyleosaurus*	0.8873	*Pinacosaurus*	0.5739
TMP 1986.183.0003	Nodosaurid	Ankylosaurid	*Panoplosaurus*	0.6033	*Anodontosaurus*	0.7527
TMP 1987.029.0006	Nodosaurid	Pachycephalosaurid				

Specimen	Original ID	New ID	Nodosaurid lingual species	Nodosaurid lingual likelihood	Ankylosaurid lingual species	Ankylosaurid lingual likelihood
TMP 1987.036.0094	Ornithischia	Ankylosaur	*Panoplosaurus*	0.5266	*Euoplocephalus*	0.8740
TMP 1987.080.0010	Pachycephalosaurid	Ornithischia	*Gargoyleosaurus*	0.8533	*Pinacosaurus*	0.5243
TMP 1989.036.0396 - 1	Ankylosaurid (*Euoplocephalus*)	Ornithischia	*Gargoyleosaurus*	0.8392	*Euoplocephalus*	0.7652
TMP 1989.050.0002	Ornithischia	Ornithischia	*Edmontonia rugosidens*	0.8711	*Euoplocephalus*	0.4186
TMP 1989.050.0013	Ankylosaurid	Ornithischia	*Edmontonia rugosidens*	0.7774	*Euoplocephalus*	0.8012
TMP 1989.050.0030	Nodosaurid (*Panoplosaurus*)	Ornithischia	*Edmontonia rugosidens*	0.5135	*Saichania*	0.5278
TMP 1989.069. 0017	Ornithischia	Nodosaurid/ Panoplosaurid	*Edmontonia rugosidens*	0.9774	*Saichania*	0.9689
TMP 1989.076.0059	Ankylosaurid (*Euoplocephalus*)	Ornithischia	*Gastonia lorriemcwhinneyae*	0.2902	*Euoplocephalus*	0.7673
TMP 1989.079.0008	Nodosaurid	Nodosaurid/ Panoplosaurid	*Edmontonia longiceps*	0.9964	*Anodontosaurus*	0.5576
TMP 1989.151.0137	Ornithischia	Nodosaurid/ Panoplosaurid	*Edmontonia longiceps*	0.9988	*Saichania*	0.8690
TMP 1990.036.0081	Nodosaurid (*Panoplosaurus*)	Nodosaurid/ Panoplosaurid	*Edmontonia longiceps*	0.6722	*Saichania*	0.9943
TMP 1990.060.0006 - 2	Ornithischia	Ornithischia	*Panoplosaurus*	0.3989	*Euoplocephalus*	0.9478
TMP 1990. 107.0037-1	Ornithischia	Ornithischia	*Gastonia burgei*	0.5496	*Euoplocephalus*	0.5004
TMP 1990. 107.0037-2	Ornithischia	Nodosaurid/ Panoplosaurid	*Panoplosaurus*	0.4109	*Saichania*	0.4261
TMP 1990.155.0007	Nodosaurid	Nodosaurid/ Panoplosaurid	*Edmontonia rugosidens*	0.7506	*Saichania*	0.9953
TMP 1991.036.158	Ankylosaurid (*Euoplocephalus*)	Ornithischia	*Gastonia lorriemcwhinneyae*	0.6053	*Euoplocephalus*	0.8708
TMP 1991.036.0171	Ankylosaurid (*Ankylosaurus)*	Nodosaurid/ Panoplosaurid	*Edmontonia longiceps*	0.8598	*Saichania*	0.9765
TMP 1991.050.0093	Ornithischia	Nodosaurid/ Panoplosaurid			*Saichania*	0.9239

Specimen	Original ID	New ID	Nodosaurid lingual species	Nodosaurid lingual likelihood	Ankylosaurid lingual species	Ankylosaurid lingual likelihood
TMP 1991.087.0072	Ornithischia	Ornithischia	*Edmontonia rugosidens*	0.8942	*Anodontosaurus*	0.4202
TMP 1992.036.1178 - 2	Ankylosaurid	Pachycephalosaurid	*Edmontonia rugosidens*	0.8802	*Euoplocephalus*	0.9730
TMP 1993.036.0364	Ankylosaurid	Nodosaurid/ Panoplosaurid	*Denversaurus*	0.9934	*Saichania*	1.0000
TMP 1993.079.0065	Nodosaurid	Nodosaurid/ Panoplosaurid				
TMP 1994.012.0035	Nodosaurid	Nodosaurid/ Panoplosaurid	*Edmontonia rugosidens*	0.4307	*Saichania*	0.8536
TMP 1994.012.0039	Nodosaurid	Ornithischia	*Panoplosaurus*	0.5477	*Saichania*	0.8951
TMP 1994.012.0120	Nodosaurid	Ornithischia	*Gargoyleosaurus*	0.9102	*Saichania*	0.9222
TMP 1994.012.0565	Nodosaurid	Ornithischia	*Edmontonia rugosidens*	0.6059	*Saichania*	0.7504
TMP 1994.092.0011	Nodosaurid	Ornithischia	*Gastonia burgei*	0.4182	*Anodontosaurus*	0.6936
TMP 1994.094.0014 -1	Nodosaurid	Ornithischia	*Gargoyleosaurus*	0.5544	*Anodontosaurus*	0.6355
TMP 1994.094.0016	Nodosaurid	Nodosaurid/ Panoplosaurid	*Edmontonia longiceps*	0.8644	*Saichania*	0.9995
TMP 1995.012.0105	Nodosaurid	Ornithischia	*Panoplosaurus*	0.5928	*Anodontosaurus*	0.9001
TMP 1995.012.0117	Nodosaurid	Nodosaurid/ Panoplosaurid	*Edmontonia rugosidens*	0.8699	*Saichania*	0.9987
TMP 1996.048.0018 - 2	Ankylosaur	Ornithischia	*Gastonia burgei*	0.5105	*Euoplocephalus*	0.9562
TMP 1998.102.0026 - 1	Nodosaurid	Nodosaurid/ Panoplosaurid	*Edmontonia rugosidens*	0.9990	*Saichania*	0.9997
TMP 1998.102.0026 - 4	Nodosaurid	Nodosaurid/ Panoplosaurid	*Edmontonia longiceps*	0.8819	*Saichania*	0.7451
TMP 1998.102.0028 - 1	Ankylosaurid	Ankylosaurid	*Gargoyleosaurus*	0.7530	*Pinacosaurus*	0.6914
TMP 1998.102.0028 - 2	Ankylosaurid	Ornithischia	*Gastonia burgei*	0.4483	*Anodontosaurus*	0.8116
TMP 1999.055.0290	Ankylosaurid	Ankylosaur	*Gastonia lorriemcwhinneyae*	0.5732	*Euoplocephalus*	0.9050

Specimen	Original ID	New ID	Nodosaurid lingual species	Nodosaurid lingual likelihood	Ankylosaurid lingual species	Ankylosaurid lingual likelihood
TMP 1999.063.0019	Nodosaurid	Nodosaurid/ Panoplosaurid				
TMP 1999.085.0005	Ornithischia	Ankylosaur	*Panoplosaurus*	0.7821	*Anodontosaurus*	0.9915
TMP 2000.012.0024 - 2	Ornithischia	Ornithischia	*Panoplosaurus*	0.3519	*Euoplocephalus*	0.4788
TMP 2000.057.0027	Ornithischia	Nodosaurid/ Panoplosaurid	*Gargoyleosaurus*	0.4504	*Anodontosaurus*	0.9151
TMP 2001.012.0072	Ankylosaurid	Ornithischia	*Gargoyleosaurus*	0.7665	*Anodontosaurus*	0.4588
TMP 2002.060.0001 - 1	Ankylosaurid	Ornithischia	*Panoplosaurus*	0.6003	*Euoplocephahlus*	0.8124
TMP 2002.060.0001 - 2	Ankylosaurid	Ornithischia	*Gargoyleosaurus*	0.7490	*Pinacosaurus*	0.3634
TMP 2003.012.0106	Chordata	Ankylosaur	*Edmontonia rugosidens*	0.7605	*Euoplocephalus*	0.3347
TMP 2004.107.0003	Ankylosaur	Ornithischia	*Panoplosaurus*	0.6270	*Euoplocephalus*	0.9155
TMP 2004.114.0005	Ankylosaur	Ornithischia	*Gastonia burgei*	0.5481	*Euoplocephalus*	0.4942
TMP 2004.116.0016	Nodosaurid	Ornithischia	*Gargoyleosaurus*	0.4799	*Anodontosaurus*	0.5301
TMP 2005.012.0233	Ankylosaur	Ornithischia	*Gastonia lorriemcwhinneyae*	0.3484	*Euoplocephalus*	0.8676
TMP 2005.012.0305	Nodosaurid	Nodosaurid/ Panoplosaurid	*Edmontonia rugosidens*	0.8339	*Anodontosaurus*	0.6945
TMP 2005.012.0369	Ankylosaurid	Ornithischia	*Panoplosaurus*	0.3963	*Euoplocephalus*	0.8666
TMP 2005.012.0427	Ankylosaur	Nodosaurid/ Panoplosaurid	*Gastonia burgei*	0.4276	*Anodontosaurus*	0.6924
TMP 2005.049.0102	Nodosaurid	Nodosaurid/ Panoplosaurid	*Edmontonia rugosidens*	0.9837	*Saichania*	0.9129
TMP 2005.054.0007	Nodosaurid	Ornithischia	*Edmontonia rugosidens*	0.2946	*Euoplocephalus*	0.7462
TMP 2006.012.0182	Ankylosaurid	Ornithischia	*Gargoyleosaurus*	0.9974	*Pinacosaurus*	0.9962
TMP 2011.047.0002	Nodosaurid	Ornithischia	*Edmontonia rugosidens*	0.4571	*Saichania*	0.6653
TMP 2011.047.0079	Ankylosaurid	Ornithischia	*Gargoyleosaurus*	0.8436	*Pinacosaurus*	0.9279
TMP 2012.012.0017	Ankylosaurid	Ornithischia	*Gastonia burgei*	0.3591	*Anodontosaurus*	0.8818

Specimen	Original ID	New ID	Nodosaurid lingual species	Nodosaurid lingual likelihood	Ankylosaurid lingual species	Ankylosaurid lingual likelihood
TMP 2013.012.0057	Nodosaurid	Nodosaurid	*Edmontonia rugosidens*	0.9877	*Ankylosaurus*	0.7102
TMP 2014.012.0128	Nodosaurid	Ornithischia	*Edmontonia rugosidens*	0.5270	*Saichania*	0.9986
TMP 2014.012.0134	Nodosaurid	Ankylosaurid	*Gargoyleosaurus*	0.7769	*Anodontosaurus*	0.5832
UALVP 48747	Ankylosaurid	Ankylosaurid	*Gastonia burgei*	0.5224	*Euoplocephalus*	0.8913
UALVP 49327	Ankylosaurid	Ornithischia	*Edmontonia rugosidens*	0.8088	*Anodontosaurus*	0.4562
UALVP 53590	Pachycephalosaurid	Ornithischia	*Gargoyleosaurus*	0.8568	*Anodontosaurus*	0.4552
UALVP 53975	Ankylosaurid (*Ankylosaurus*)	Ornithischia	*Edmontonia rugosidens*	0.7871	*Saichania*	0.9679
UALVP 53591	Ankylosaurid	Nodosaurid/ Panoplosaurid	*Panoplosaurus*	0.6825	*Anodontosaurus*	0.5151
UALVP 55366	Nodosaurid	Ankylosaurid	*Edmontonia rugosidens*	0.5949	*Euoplocephalus*	0.9106
UALVP 55378	Ankylosaurid	Ankylosaurid	*Edmontonia rugosidens*	0.5071	*Euoplocephalus*	0.9504
UALVP 55390	Nodosaurid	Nodosaurid/ Panoplosaurid	*Denversaurus*	0.9269	*Saichania*	0.9987
UALVP 55621	Pachycephalosaurid	Ornithischia	*Panoplosaurus*	0.5217	*Anodontosaurus*	0.8870
UALVP 61124 -1	Nodosaurid	Nodosaurid	*Edmontonia rugosidens*	0.9563	*Saichania*	0.5887
UALVP 61153	Nodosaurid	Nodosaurid/ Panoplosaurid				
UALVP 61442	Pachycephalosaurid	Ankylosaurid	*Gastonia burgei*	0.6451	*Anodontosaurus*	0.7878
UMNH 11638	Ankylosaur	Ornithischia	*Gargoyleosaurus*	0.7212	*Saichania*	0.8639
UMNH 1228	Ankylosaur	Ornithischia	*Gargoyleosaurus*	0.9166	*Pinacosaurus*	0.7998
UMNH 12864	Ankylosaur	Ornithischia	*Panoplosaurus*	0.8765	*Anodontosaurus*	0.9073
UMNH 14436	Ankylosaur	Ornithischia	*Gargoyleosaurus*	0.9181	*Pinacosaurus*	0.7027
UMNH 17418	Ankylosaur	Ornithischia	*Gastonia burgei*	0.5210	*Euoplocephalus*	0.9525
UMNH 17502	Ankylosaur	Ornithischia	*Gargoyleosaurus*	0.9070	*Pinacosaurus*	0.7790
UMNH 19040	Ankylosaur	Ornithischia	*Gastonia burgei*	0.6886	*Euoplocephalus*	0.9882

Specimen	Original ID	New ID	Nodosaurid lingual species	Nodosaurid lingual likelihood	Ankylosaurid lingual species	Ankylosaurid lingual likelihood
UMNH 19720	Ankylosaur	Ornithischia	*Gastonia lorriemcwhinneyae*	0.3738	*Euoplocephalus*	0.9759
UMNH 20903	Ankylosaur	Ornithischia	*Edmontonia rugosidens*	0.4746	*Saichania*	0.7558
UMNH 5609	Ankylosaur	Ornithischia	*Gargoyleosaurus*	0.4956	*Euoplocephalus*	0.9663
UMNH 7603	Ankylosaur	Ornithischia	*Gastonia burgei*	0.6134	*Euoplocephalus*	0.9870

Appendix C – Standardized/log-transformed manual traditional measurements

Red cells with -3 values represent absent measurements

Sample Number	CH	NL	AL	MCL	DCL
CEUM 11923	-3	-3	-3	-3	-3
CEUM 11924	-3	-3	-3	-3	-3
CEUM 12435	-3	-3	-3	-3	-3
CEUM 53115	-0.04976	-0.2270	0.0004340	-0.06021	-0.08938
CEUM 82583	-0.01928	-3	0.06940	0.05727	-0.05096
CEUM 82585	-0.04788	-3	-0.1225	-0.1406	-0.3572
CEUM 82586	-3	-3	-3	-3	-3
CEUM 82588	0.04083	-3	0.02528	0.01161	-0.09741
CEUM 82590	-0.1864	-3	-0.08639	-0.09759	-0.2163
CEUM 82592	-0.0009324	-3	0.04389	-0.08030	-0.2050
CEUM 82594	-0.03069	-0.1639	-0.04281	-0.1192	-0.1942
CEUM 82595	0.01631	-3	0.009765	-0.07758	-0.1857
CMNFV 1131	-3	-3	-3	-3	-3
CMNFV 119 - 1	-3	-3	-3	-3	-3
CMNFV 119 - 2	0.07143	-3	0.05389	0.02843	0.02480
CMNFV 119 - 3	0.02754	-3	0.05305	-0.002176	-0.06471
CMNFV 119 - 4	-3	-3	-3	-3	-3
CMNFV 119 - 5	0.08687	-3	0.04344	0.02164	-3
CMNFV 119 - 6	0.02035	-3	0.03606	-0.04479	-0.1302
CMNFV 129 - 1	-3	-3	-3	-3	-3
CMNFV 129 - 2	-3	-3	-3	-3	-3
CMNFV 1349	-0.02007	-3	-0.007802	-0.02712	-0.1833
CMNFV 1772 - 1	0.07433	-3	0.09071	-0.02031	-0.2009
CMNFV 1772 - 2	-3	-3	-3	-3	-3
CMNFV 1772 - 3	-3	-3	-3	-3	-3
CMNFV 1772 - 4	-3	-3	-3	-3	-3
CMNFV 1772 - a	0.1353	-0.1187	0.07839	-0.009901	-0.1123
CMNFV 21864	-3	-3	-3	-3	-3
CMNFV 2334	-3	-3	-3	-3	-3
CMNFV 38441	-3	-3	-3	-3	-3
CMNFV 38442	0.04598	-0.2148	0.091924	0.07273	0.05775
CMNFV 38443	-0.001216	-3	0.001256	-0.04923	-0.3648
CMNFV 38444	-3	-3	-3	-3	-3
CMNFV 38445	-3	-3	-3	-3	-3

Sample Number	CH	NL	AL	MCL	DCL
CMNFV 38446	-3	-3	-3	-3	-3
CMNFV 38447	-3	-3	-3	-3	-3
CMNFV 38448	-3	-3	-3	-3	-3
CMNFV 38449	-3	-3	-3	-3	-3
CMNFV 59240 - 1	0.01549	-3	-0.01790	-0.06310	-0.1610
CMNFV 59240 - 2	-0.06168	-3	-0.01008	-3	-0.1437
CMNFV 59240 - 3	-3	-3	-3	-3	-3
CMNFV 59431	-0.005081	-3	0.03043	-0.02014	-0.1383
CMNFV 59432 - 1	-0.03771	-3	0.01332	-0.05968	-0.1309
CMNFV 59432 - 2	-3	-3	-3	-3	-3
CMNFV 59459	-3	-3	-3	-3	-3
CMNFV 59460	-3	-3	-3	-3	-3
CMNFV 59480	-3	-3	-3	-3	-3
CMNFV 59510 - 1	-3	-3	-3	-3	-3
CMNFV 59510 - 2	0.01864	-3	0.009127	-0.06825	-0.2134
CMNFV 59534	-3	-3	-3	-3	-3
CMNFV 59591 - 1	-3	-3	-3	-3	-3
CMNFV 59591 - 2	-3	-3	-3	-3	-3
CMNFV 8537 - 1	-3	-3	-3	-3	-3
CMNFV 8537 - 2	-3	-3	-3	-3	-3
CMNFV 8537 - 3	-3	-3	-3	-3	-3
CMNFV 8537 - 4	-3	-3	-3	-3	-3
CMNFV 8537 - 5	-3	-3	-3	-3	-3
CMNFV 8537 - 6	-3	-3	-3	-3	-3
CMNFV 8537 - 7	-3	-3	-3	-3	-3
CMNFV 8537 - 8	-3	-3	-3	-3	-3
CMNFV 8731 - 1	-3	-3	-3	-3	-3
CMNFV 8731 - 2	-3	-3	-3	-3	-3
CMNFV 8731 - 3	-3	-3	-3	-3	-3
CMNFV 8731 - 4	0.008966	-3	0.0004341	-0.1026	-0.1312
CMNFV 973	-3	-3	-3	-3	-3
CMNFV CMS1921 - 1	-3	-3	-3	-3	-3
CMNFV CMS1921 - 2	-0.09388	-0.1822	0.01418	-0.01119	-0.1837
CMNFV CMS1921 - 3	-0.003470	-0.1973	0.01618	-0.07527	-0.1314
CMNFV CMS1921 - 4	-3	-3	-3	-3	-3
CMNFV CMS1921 - 5	-3	-3	-3	-3	-3
CMNFV CMS1921 - 6	-3	-3	-3	-3	-3
CMNFV CMS1921 - 7	-3	-3	-3	-3	-3

Sample Number	CH	NL	AL	MCL	DCL
CMNFV CMS1921 - 8	-3	-3	-3	-3	-3
CMNFV 8531 - 1	0.1289	-3	0.1144	0.08021	-3
CMNFV 8531 - 2	-3	-3	-3	-3	-3
CMNFV 8531 - 3	0.01560	-3	-0.06772	-0.08561	-0.2538
CMNFV 8531 - 4	-0.05372	-3	-0.1499	-0.2019	-0.1481
CMNFV 8531 - 5	-3	-3	-3	-3	-3
CMNFV 8531 - 6	-3	-3	-3	-3	-3
CMNFV 8531 - 7	0.09061	-0.2089	0.1069	0.03520	-0.03939
CMNFV 8531 - 8	0.04493	-3	0.02859	0.02364	-0.1484
CMNFV 8531 - 9	-0.03433	-3	-0.01457	-0.1029	-0.1197
CMNFV 8880 - 1	0.09324	-0.1186904	0.1063	0.01031	-0.09494
CMNFV 8880 - 2	-3	-3	-3	-3	-3
CMNFV 2759 - 1	0.04143	-0.2395	0.04321	-0.1086	-0.3120
CMNFV 2759 - 2	-3	-3	-3	-3	-3
CMNFV 2759 - 3	-3	-3	-3	-3	-3
CMNFV 2759 - 4	-3	-3	-3	-3	-3
CMNFV 2759 - 5	0.1260	-3	0.1381	-0.02002	-0.09228
CMNFV 2759 - 6	0.02670	-3	0.02054	-0.07189	-0.3229
CMNFV 8876 - 1	-0.02959	-0.3273	-0.0009175	-0.04206	-0.066553
CMNFV 8876 - 2	-3	-3	-3	-3	-3
CMNFV 8876 - 3	-3	-3	-3	-3	-3
CMNFV RDR - 1	-0.05356	-3	0.01135	-0.04735	-0.1061
CMNFV RDR - 10	-3	-3	-3	-3	-3
CMNFV RDR - 11	-3	-3	-3	-3	-3
CMNFV RDR - 12	-3	-3	-3	-3	-3
CMNFV RDR - 2	-3	-3	-3	-3	-3
CMNFV RDR - 3	-3	-3	-3	-3	-3
CMNFV RDR - 4	-3	-3	-3	-3	-3
CMNFV RDR - 5	-3	-3	-3	-3	-3
CMNFV RDR - 6	-3	-3	-3	-3	-3
ROM 1215 - 1	-0.1260	-0.1351	-0.1205	-0.2437	-0.2710
ROM 1215 - 2	0.02412	-0.1559	-0.01822	-0.06716	-0.1622
ROM 1215 - 3	-0.08612	-0.1843	-0.05115	-0.2460	-0.3345
ROM 1215 - 4	-3	-3	-3	-3	-3
ROM 1215 - 5	-0.2308	-0.2705	-0.1383	-0.3300	-0.4074
ROM 1215 - 6	-3	-0.2299	-3	-3	-3
ROM 1215 - 7	-0.06433	-0.1538	-0.1048	-0.2329	-0.2053
ROM 1215 - 8	0.04243	-0.01665	0.1111	-0.07655	-0.1702

Sample Number	CH	NL	AL	MCL	DCL
ROM 1215 - 9	-0.05323	-0.08859	-0.03806	-0.09534	-0.2686
ROM 1215 - 10	-0.005460	-0.1560	-0.03197	-0.1560	-0.1860
ROM 1215 - 11	-3	-0.2272	-3	-3	-3
ROM 1215 - 12	-0.09147	-0.2583	0.006951	-0.08405	-0.1875
ROM 1215 - 13	-3	-0.2096	-3	-3	-3
ROM 1215 - 14	-0.1311	-0.3918	-0.08069	-0.1336	-0.4781
ROM 1215 - 15	-3	-3	-3	-3	-3
ROM 1215 - 16	-0.1369	-0.2009	-0.1461	-0.1507	-0.1927
ROM 1215 - 17	-0.1582	-0.2166	-0.1818	-0.1804	-0.2562
TMP 2017.23.17 - 1	-3	-3	-3	-3	-3
TMP 2017.23.17 - 2	-3	-3	-3	-3	-3
TMP 2017.23.17 - 3	-3	-3	-3	-3	-3
TMP 2017.23.17 - 4	-3	-3	-3	-3	-3
CMNFV RDR - 7	-3	-3	-3	-3	-3
CMNFV RDR - 8	-3	-3	-3	-3	-3
CMNFV RDR - 9	-3	-3	-3	-3	-3
CMNFV UN - 1	-3	-3	-3	-3	-3
CMNFV UN - 2	-3	-3	-3	-3	-3
CMNFV UN - 3	-3	-3	-3	-3	-3
CMNFV UN - 4	-3	-3	-3	-3	-3
CMNFV UN - 5	0.03170	-3	0.04235	-0.06171	0.02519
CMNFV UN - 6	-3	-3	-3	-3	-3
CMNFV UN - 7	-3	-3	-3	-3	-3
CMNFV UN - 8	-3	-3	-3	-3	-3
CMNFV UN - 9	-3	-3	-3	-3	-3
DMNH EPV 18168 - 1	-0.1606	-0.1512	-3	-3	-3
DMNH EPV 18168 - 10	0.06828	-0.1011	0.002266	-0.1258	-0.2350
DMNH EPV 18168 - 11	0.009289	-0.06981	0.02011	-0.004816	-0.1309
DMNH EPV 18168 - 12	0.01404	-0.1824	0.02002	-0.03257	-0.2494
DMNH EPV 18168 - 13	0.01527	-0.2142	-0.07539	-0.1447	-0.1771
DMNH EPV 18168 - 14	-0.01147	-0.1681	-0.03698	-0.1038	-0.2820
DMNH EPV 18168 - 15	0.06305	-0.1160	0.03522	-0.02492	-0.06009
DMNH EPV 18168 - 16	0.1282	-0.1814	0.002003	-0.04773	-0.06657
DMNH EPV 18168 - 17	0.04433	-0.1251	-0.0003238	-0.07821	-0.2350
DMNH EPV 18168 - 2	0.01005	-0.1735	0.01005	-0.03962	-0.1974
DMNH EPV 18168 - 3	-3	-0.2097	-3	-3	-3
DMNH EPV 18168 - 4	-0.06077	-0.2057	-0.02909	-0.1112	-0.1611
DMNH EPV 18168 - 5	-0.03419	-0.1800	-0.005046	-0.07685	-0.1274

Sample Number	CH	NL	AL	MCL	DCL
DMNH EPV 18168 - 6	0.02869	-0.2010	-0.01140	-0.008414	-0.1340
DMNH EPV 18168 - 7	0.05050	-0.1737	0.02149	-0.04051	-0.2373
DMNH EPV 18168 - 8	-0.08351	-0.1368	-0.06711	-0.1471	-0.1912
DMNH EPV 18168 - 9	-0.03784	-0.2140	-0.06402	-0.08123	-0.1854
DMNH EPV 18169 - 1	-3	-0.1733	-3	-3	-3
ROM 788 - 1	-3	-0.1618	-3	-3	-3
ROM 788 - 2	-3	-0.3689	-3	-3	-3
ROM 788 - 3	-3	-0.2480	-3	-3	-3
ROM 788 - 4	-0.07653	-3	-3	-3	-3
ROM 788 - 5	-0.1568	-3	-0.08072	-0.1166	-0.4002
ROM 788 - 6	-3	-3	-3	-3	-3
ROM 788 - 7	-3	-3	-3	-3	-3
ROM 788 - 8	-3	-3	-3	-3	-3
DMNH EPV 18169 - 2	-0.1469	-3	-3	-3	-3
DMNH EPV 18169 - 3	0.02497	-0.2280	-0.002851	-0.1567	-0.1696
DMNH EPV 18169 - 4	-3	-0.1763	-3	-3	-3
DMNH EPV 18169 - 5	-0.05033	-0.1283	-3	-3	-3
DMNH EPV 21671	-0.08875	-0.1352	-0.07634	-0.2018	-0.2146
PIN 3142 - 1	-3	-3	-3	-3	-3
PIN 3142 - 10	-3	-3	-3	-3	-3
PIN 3142 - 2	-3	-3	-3	-3	-3
PIN 3142 - 3	-3	-3	-3	-3	-3
PIN 3142 - 4	-3	-3	-3	-3	-3
PIN 3142 - 5	-3	-3	-3	-3	-3
PIN 3142 - 6	-3	-3	-3	-3	-3
PIN 3142 - 7	-3	-3	-3	-3	-3
PIN 3142 - 8	-3	-3	-3	-3	-3
PIN 3142 - 9	-3	-3	-3	-3	-3
ROM 03088	-3	-3	-3	-3	-3
ROM 03287	-3	-3	-3	-3	-3
ROM 03302	-3	-3	-3	-3	-3
ROM 03368	-3	-3	-3	-3	-3
ROM 03516	-3	-3	-3	-3	-3
ROM 07763	-3	-0.1875	-3	-3	-3
ROM 07765	0.03301	-3	0.04918	-0.03662	-0.2351
ROM 07766	-3	-3	-3	-3	-3
ROM 07767	0.02732	-0.1580	0.02358	-0.06964	-0.1171
ROM 07768	-3	-3	-3	-3	-3

Sample Number	CH	NL	AL	MCL	DCL
ROM 07770	-0.001922	-0.2376	0.05414	0.01658	-0.03462
ROM 07772	-3	-3	-3	-3	-3
ROM 26346	0.1110	-0.1971	0.08130	-0.03025	-0.05358
ROM 31697	-3	-3	-3	-3	-3
ROM 31865	-3	-3	-3	-3	-3
ROM 31866	-0.04018	-0.1960	0.01341	-0.03858	-0.1173
ROM 31867	-0.0004141	-0.2491	-0.06139	-0.1176	-0.2034
ROM 31868	-3	-3	-3	-3	-3
ROM 31869	-3	-3	-3	-3	-3
ROM 31871	-3	-3	-3	-3	-3
ROM 31872	0.005400	-0.2718	0.0004341	-0.1034	-0.1313
ROM 36385	-3	-3	-3	-3	-3
ROM 36386	-3	-3	-3	-3	-3
ROM 36387	-3	-3	-3	-3	-3
ROM 36388	-3	-3	-3	-3	-3
ROM 36389	-3	-3	-3	-3	-3
ROM 36390	-3	-3	-3	-3	-3
ROM 36391	-3	-3	-3	-3	-3
ROM 36392	-3	-3	-3	-3	-3
ROM 36393	-3	-3	-3	-3	-3
ROM 67921	-0.1310	-3	0.08398	0.038121	-0.1051
ROM 67939	0.03343	-0.2069	0.05373	-0.04984	-0.3176
ROM 67946	-3	-3	-3	-3	-3
ROM 67947	-3	-3	-3	-3	-3
ROM 67948	-3	-3	-3	-3	-3
ROM 36548	-0.01199	-0.08628	-0.01304	-0.04584	-0.3032
ROM 36394	-3	-3	-3	-3	-3
ROM 36395	-3	-3	-3	-3	-3
ROM 36396	-3	-3	-3	-3	-3
ROM 53579	-3	-3	-3	-3	-3
ROM 36397	-3	-3	-3	-3	-3
ROM 36398	-3	-3	-3	-3	-3
ROM 36399	-3	-3	-3	-3	-3
ROM 36400	-3	-3	-3	-3	-3
ROM 36401	-3	-3	-3	-3	-3
ROM 36402	0.003589	-3	0.02119	-0.09142	-0.1750
ROM 36403	-3	-3	-3	-3	-3
ROM 36404	-3	-3	-3	-3	-3

Sample Number	CH	NL	AL	MCL	DCL
ROM 36405	-3	-3	-3	-3	-3
ROM 36406	-3	-3	-3	-3	-3
ROM 36407	-3	-3	-3	-3	-3
ROM 36408	-3	-3	-3	-3	-3
ROM 36409	0.008419	-0.2010	0.02056	-0.02539	-0.2420
ROM 36410	-3	-3	-3	-3	-3
ROM 36411	-3	-3	-3	-3	-3
ROM 36412	-0.04462	-0.2436	-0.06342	-0.1442	-0.1594
ROM 36413	-3	-3	-3	-3	-3
ROM 36414	-3	-3	-3	-3	-3
ROM 36415	-3	-3	-3	-3	-3
ROM 36416	-3	-3	-3	-3	-3
ROM 36417	-3	-3	-3	-3	-3
ROM 36418	0.02389	-3	0.04169	-0.09405	-0.2400
ROM 36419	-3	-3	-3	-3	-3
ROM 36420	-3	-3	-3	-3	-3
ROM 36421	-3	-3	-3	-3	-3
ROM 36422	-3	-3	-3	-3	-3
ROM 36423	-3	-3	-3	-3	-3
ROM 56611	-3	-3	-3	-3	-3
ROM 56620	-3	-3	-3	-3	-3
BYU VP 50866	0.03970	-0.05964	0.03315	-0.09558	-0.2087
ROM 58144	-0.04797	-0.1927	0.01010	-0.09598	-0.2270
ROM 58147	-0.03600	-0.2521	-0.001088	-0.04183	-0.1338
CEUM 11912	-3	-3	-3	-3	-3
CEUM 11911	0.03063	-0.2384	-0.008251	-0.06984	-0.1708
CEUM 11910	-3	-3	-3	-3	-3
CEUM 11909	0.06491	-0.1988	0.04591	0.01226	-0.1079
CEUM 5373	0.04812	-0.1924	0.04080	0.0004341	-0.1226
CEUM 31206	-3	-3	-3	-3	-3
CEUM 12811	-3	-3	-3	-3	-3
ROM 58151	-3	-3	-3	-3	-3
ROM 58223	-0.1366	-0.1705	-0.04184	-0.1430	-0.1774
ROM 58383	-0.05169	-0.2211	0.003696	-0.06386	-0.3928
ROM 58516	-3	-3	-3	-3	-3
ROM 58525	-3	-3	-3	-3	-3
ROM 58565 - 1	-3	-3	-3	-3	-3
ROM 58565 - 2	-3	-3	-3	-3	-3

Sample Number	CH	NL	AL	MCL	DCL
ROM 58565 - 3	-0.05729	-0.09726	0.04884	-0.07049	-0.2931
ROM 58565 - 4	-3	-3	-3	-3	-3
CEUM 09173	0.04844	-0.1885	0.06097	0.02738	0.01265
ROM 58594	-0.008302	-0.2029	0.03059	-0.03928	-0.1113
CEUM 1264 #86	-3	-3	-3	-3	-3
CEUM 34580	0.04844	-0.1885	0.06097	0.02738	0.01265
DMNH EPV 468	0.1674	-3	-3	-0.03418	-3
DMNH EPV 27726 - 1	0.1677	-0.02297	0.09402	-3	-3
DMNH EPV 27726 - 2	-3	-3	-3	-3	-3
DMNH EPV 27726 - 3	-3	-3	-3	-3	-3
DMNH EPV 27726 - 4	0.08831	-3	0.1552	0.06414	-3
DMNH EPV 27726 - 5	0.08671	-3	0.1452	0.08955	-0.07520
DMNH EPV 27726 - 6	0.1786	-0.08753	0.1599	0.08349	0.05753
DMNH EPV 27726 - 7	-3	-3	-3	-3	-3
DMNH EPV 27726 - 8	-3	-3	-3	-3	-3
DMNH EPV 27726 - 9	-3	-3	-3	-3	-3
DMNH EPV 27726 - 10	-0.06527	-3	-0.08671	-0.1731	-0.2438
DMNH EPV 27726 - 11	-0.06557	-0.1163	-3	-3	-3
DMNH EPV 27726 - 12	-0.07195	-0.1475	-3	-3	-3
DMNH EPV 27726 - 13	-0.02462	-0.1760	-0.1348	-3	-3
DMNH EPV 27726 - 14	0.1432	-3	0.1361	0.1149	0.06899
DMNH EPV 27726 - 15	0.03014	-3	-3	-3	-3
DMNH EPV 27726 - 16	0.1420	-3	0.1501	0.07415	0.05206
DMNH EPV 27726 - 17	0.06423	-0.1288	0.1032	0.01429	-0.02956
DMNH EPV 27726 - 18	0.1025	-0.1406	0.1274	0.08121	0.03883
DMNH EPV 53040	-0.002871	-0.1746	-0.001216	-0.04190	-0.1625
DMNH EVP 136185 - 1	0.01119	-0.1620	0.01589	-0.04548	-0.2538
DMNH EVP 136185 - 2	-0.03052	-0.1648	-0.04091	-0.05494	-0.4549
DMNH EVP 136185 - 3	-0.06366	-0.2714	-0.02500	-0.10780	-0.1329
DMNH EVP 136185 - 4	0.01189	-0.1850	0.03281	-0.01071	-0.07259
DMNH EVP 136185 - 5	0.02694	-0.2098	0.04323	-0.04803	-0.06512
DMNH EVP 136185 - 6	-0.07508	-0.1839	-0.05058	-0.1454	-0.1878
DMNH EVP 136185 - 7	0.06986	-0.1904	0.1008	0.03712	-0.04034
DMNH EVP 136185 - 8	0.08641	-0.1616	0.01905	-0.003812	-0.03860
DMNH EVP 136185 - 9	-0.07810	-0.1804	-0.06974	-0.1338	-0.2932
DMNH EVP 136185 - 10	-0.005006	-0.1899	0.02154	-0.04813	-0.1132
DMNH EVP 136185 - 11	0.04232	-0.1512	-0.02281	-0.08979	-0.09701
DMNH EVP 136185 - 12	0.07808	-0.2032	0.03410	-0.04085	-0.1044

Sample Number	CH	NL	AL	MCL	DCL
DMNH EPV 136185 - 13	0.03591	-0.1588	0.01532	-0.01561	-0.3302
DMNH EPV 136185 - 14	-0.04474	-0.2166	0.01476	-0.09515	-0.1105
DMNH EPV 136185 - 15	0.01259	-0.2668	0.04853	0.02002	-0.03403
DMNH EPV 136185 - 16	-0.03725	-0.1773	-0.04372	-0.08834	-0.1183
DMNH EPV 136185 - 17	0.02020	-0.1793	-0.03897	-0.1165	-0.1699
DMNH EPV 136185 - 18	0.1147	-3	0.06473	0.03975	-0.08462
DMNH EPV 136185 - 19	0.06689	-0.1490	-0.01170	-0.1841	-0.2616
DMNH EPV 136185 - 20	0.2107	-0.1634	0.1626	0.02106	-0.04222
DMNH EPV 136185 - 21	-0.003904	-3	-3	-3	-3
DMNH EPV 136185 - 22	0.17638	-3	0.1956	0.03751	-0.05954
DMNH EPV 136185 - 23	0.05382	-0.2307	0.1181	-0.07418	-0.1715
DMNH EPV 136185 - 24	0.04324	-0.3312	0.01129	-0.09288	-0.1805
DMNH EPV 136185 - 25	0.01161	-3	0.05529	-0.05588	-0.1516
DMNH EPV 136185 - 26	0.03455	-0.08502	0.05936	-0.06165	-0.1524
DMNH EPV 136185 - 27	-0.04992	-0.08900	0.03580	0.02018	-0.2827
DMNH EVP 2818 - 1	0.07994	-3	0.2348	-0.05562	-0.1666
DMNH EPV 2818 - 2	-0.01260	-0.2285	0.1357	-0.01640	-0.07446
DMNH EPV 2818 - 3	0.1917	-0.1896	0.1917	0.004020	-0.03033
DMNH EPV 2818 - 4	0.09497	-3	0.09953	0.03340	0.01355
DMNH EPV 2818 - 5	0.1016	-0.3064439	0.03492	-0.05262	-0.1317
DMNH EPV 2818 - 6	0.07883	-3	0.1091	0.05297	-0.01710
DMNH EPV 2818 - 7	-3	-3	-3	-3	-3
DMNH EPV 2818 - 8	0.1180	-0.1244	-3	-3	-3
DMNH EPV 2818 - 9	0.01769	-3	0.02714	-0.09029	-3
DMNH EPV 2818 - 10	0.1236	-0.07561	0.07328	-0.05559	-0.1581
DMNH EPV 2818 - 11	0.1957	-3	0.2103	0.09097	0.02680
DMNH EPV 2818 - 12	0.09275	-0.2479	0.06291	-0.1083	-0.2306
DMNH EPV 2818 - 13	0.1369	-0.2993	0.1482	0.09177	-0.04298
DMNH EPV 2818 - 14	0.07370	-3	0.07062	-0.02189	-0.1497
DMNH EPV 2818 - 15	0.1209	-0.1406	0.1110	-0.04303	-0.1040
DMNH EPV 2818 - 16	0.09415	-0.2396	0.1231	-0.01938	-0.05838
DMNH EPV 2818 - 17	0.1147	-0.2931	0.1927	0.05469	-0.08583
DMNH EPV 2818 - 18	0.1220	-0.1972	0.1391	0.06067	-0.05251
DMNH EPV 2818 - 19	-3	-0.1795	-3	-3	-3
DMNH EPV 2818 - 20	-0.01612	-0.1778	-0.002442	-0.1526	-0.1609
DMNH EPV 2818 - 21	0.09256	-0.2337	0.05226	-0.09637	-0.1228
DMNH EPV 2818 - 22	-3	-0.2214	-3	-3	-3
DMNH EPV 2818 - 23	-3	-3	-3	-3	-3

Sample Number	CH	NL	AL	MCL	DCL
DMNH EPV 2818 - 24	-0.01444	-3	0.06522	-0.01697	-0.06146
DMNH EPV 2818 - 26	0.06465	-3	0.07821	-0.07813	-0.1147
DMNH EPV 2818 - 27	-0.01045	-3	0.03510	0.01775	-0.1366
DMNH EPV 2818 - 28	0.01950	-3	0.03843	-0.01800	-0.05084
ROM 58598	0.0004341	-0.1443	0.0668	0.04747	-0.06305
ROM 58689 - 1	-3	-3	-3	-3	-3
ROM 58689 - 2	-0.02926	-0.2458	-0.01154	-0.07229	-0.1516
ROM 58704	-3	-3	-3	-3	-3
ROM 67276	-3	-3	-3	-3	-3
ROM 69382	-3	-3	-3	-3	-3
SMU 73203	-3	-3	-3	-3	-3
TMP 1966.025.0015	0.02808	-0.2095	0.04899	-0.009186	-0.07299
TMP 1976.006.0036	0.06632	-0.2580	0.06178	0.005074	-0.09000
TMP 1980.008.0026 - 1	0.02683	-0.2052	0.09210	0.01586	-0.1545
TMP 1980.008.0026 - 2	-0.04393	-0.2379	0.04164	0.01444	-0.1259
TMP 1980.013.0046	-0.09718	-0.1164	0.01582	-0.09474	-0.1807
TMP 1980.016.0239	-0.02069	-0.2651	0.02591	-0.07289	-0.1639
TMP 1980.016.0834	0.1370	-3	0.1232	0.02362	-0.02187
TMP 1980.016.1685 - 1	0.1106	-3	0.1283	0.07456	-0.004236
TMP 1980.016.1685 - 2	0.05234	-0.3396	0.04716	0.03994	-0.06439
TMP 1980.029.0140	-0.03153	-0.2433	0.03322	-0.03680	-0.1192
TMP 1980.029.0228	-0.02444	-0.2482	-0.004429	-0.04851	-0.1108
TMP 1981.041.0014	-0.06224	-3	0.002732	-0.04145	-0.2036
TMP 1983.036.0009 - 1	-0.01342	-0.2826	0.04495	0.02042	-0.07781
TMP 1983.036.0009 - 2	-0.01541	-0.2451	0.05783	0.03530	-0.1226
TMP 1983.036.0009 - 3	0.07019	-3	0.1143	0.04362	0.03439
TMP 1983.036.0009 - 4	0.008510	-0.2798	0.01818	-0.04942	-0.06704
DMNH EPV 50377	-3	-0.1305	-3	-3	-3
DMNH EPV 50373	0.01186	-3	-3	-3	-3
DMNH EVP 50206 - 1	-3	-0.1157	-3	-3	-3
DMNH EVP 50206 - 2	-3	-3	-3	-3	-3
DMNH EPV 50206 - 3	-3	-0.1913	-3	-3	-3
DMNH EPV 50206 - 4	-3	-0.2504	-3	-3	-3
TMP 1983.036.0207	-0.08411	-0.2554	-0.03566	-0.04815	-0.2122
TMP 1984.091.0020	-0.01706	-0.2395	-0.002146	-0.06766	-0.2696
TMP 1985.036.0121	-3	-0.2155	-3	-3	-3
TMP 1985.056.0170 - 1	-0.003506	-0.2591	0.03727	-0.005093	-0.03639
TMP 1985.056.0170 - 2	-0.05169	-0.2979	-0.009350	-0.05085	-0.1206

Sample Number	CH	NL	AL	MCL	DCL
TMP 1985.056.0171 - 1	-0.02641	-0.2500	0.05525	-0.02888	-0.1686
TMP 1985.056.0171 - 2	-3	-0.2652	-3	-3	-3
TMP 1985.056.0171 - 3	0.04910	-0.1685	0.03434	-0.06728	-0.1436
TMP 1985.056.0211	0.04675	-0.2380	0.05816	-0.02426	-0.08038
TMP 1985.059.0028	-0.008361	-0.2548	0.05234	0.04060	-0.01583
TMP 1986.008.0084	0.01155	-0.2028	0.04269	-0.05307	-0.1500
TMP 1986.009.0055	0.1263	-0.2117	0.08329	0.02658	-0.03299
TMP 1986.023.0108	0.02541	-0.2175	0.06273	-0.02276	-0.04294
TMP 1986.095.0007	-0.003900	-0.2429	0.06818	0.03523	-0.01897
TMP 1986.127.0005	-0.008462	-3	0.02758	-0.04867	-0.1249
TMP 1986.183.0003	0.02320	-0.2781	0.03416	-0.02070	-0.07279
TMP 1987.029.0006	-3	-0.2291	-3	-3	-3
TMP 1987.036.0094	0.05160	-0.2600	0.02325	-0.08197	-0.2514
TMP 1987.077.0143	0.03494	-0.2666	0.02790	-0.1098	-0.2579
TMP 1987.080.0010	-0.009154	-0.2256	0.02126	-0.05693	-0.09068
TMP 1989.069.0017	-0.09938	-0.1761	-0.05101	-0.06690	-0.2048
TMP 1989.036.0396 - 1	-0.008222	-0.1985	-0.02835	-0.06288	-0.08318
TMP 1989.036.0396 - 2	-0.08051	-0.2702	-0.01581	-0.1331	-0.2518
TMP 1989.036.0396 - 3	-0.09982	-0.2090	0.003864	-0.06046	-0.1665
TMP 1989.036.0405 - 1	0.06846	-0.2524	-0.01400	-3	-3
TMP 1989.036.0405 - 2	-3	-3	-3	-3	-3
TMP 1989.036.0405 - 3	-0.01454	-0.3361	-0.04899	-0.1197	-0.1431
TMP 1989.050.0002	-0.06871	-0.2130	0.0004341	-0.05769	-0.1914
TMP 1989.050.0013	0.002860	-0.2091	0.01164	-0.09840	-0.1911
TMP 1989.050.0030	-0.04342	-0.1990	0.03836	-0.009411	-0.1734
TMP 1989.076.0059	0.01768	-0.2955	0.02880	-0.1443	-0.1593
TMP 1989.079.0008	-0.2049	-0.2736	-0.06858	-0.1038	-0.1640
TMP 1989.151.0137	0.07260	-0.2081	0.04692	0.01333	-0.05861
TMP 1990.036.0081	-0.08771	-0.3174	-0.06267	-0.08771	-0.1282
TMP 1990.060.0006 - 1	-0.01476	-0.2356	0.001145	-0.04845	-0.07639
TMP 1990.060.0006 - 2	0.004636	-0.2275	0.03100	-0.05584	-0.07425
TMP 1990.107.0037 - 1	0.06404	-0.1418	0.05971	0.02674	-0.1855
TMP 1990.107.0037 - 2	-3	-0.2046	-3	-3	-3
TMP 1990.155.0007	-0.006943	-0.2064	0.01526	0.006788	-0.1391
TMP 1991.036.0158	-0.02850	-0.3159	-0.01685	-0.06035	-0.09563
TMP 1991.036.0171	-0.01990	-0.1919	0.01986	-0.009812	-0.1103
TMP 1991.036.0734	-0.04843	-0.2780	-0.02004	-0.1044	-0.1894
TMP 1991.050.0093	-0.01422	-0.2308	-0.08365	-0.1352	-0.1270

Sample Number	CH	NL	AL	MCL	DCL
TMP 1991.085.0012	0.06168	-0.2400	0.05154	-0.01423	-0.2118
TMP 1991.087.0072	-0.1085	-0.1525	-0.03774	-0.1068	-0.1515
TMP 1992.036.0313 - 1	-3	-3	-3	-3	-3
TMP 1992.036.0313 - 2	-3	-3	-3	-3	-3
TMP 1992.036.1178 - 1	0.002065	-0.2274	-0.01707	-0.07041	-0.09413
TMP 1992.036.1178 - 2	-0.04427	-0.2638	-0.05441	-0.04227	-0.1428
TMP 1992.036.1178 - 3	-3	-0.2362	-3	-3	-3
TMP 1993.036.0081	-0.02766	-0.2550	0.01776	-0.02693	-0.1303
TMP 1993.036.0364	-0.1027	-0.2124	-0.03874	-0.05693	-0.1263
TMP 1993.079.0065	-3	-0.1884	-3	-3	-3
TMP 1994.012.0035	-0.08706	-0.2753	-0.04067	-0.08026	-0.1324
TMP 1994.012.0039	0.005001	-0.1877	0.04304	0.03463	-0.2030
TMP 1994.012.0120	-0.09482	-0.2226	-0.01961	-3	-3
TMP 1994.012.0565	0.02115	-0.1877	-0.01700	-0.1173	-0.2120
TMP 1994.086.0018	0.009819	-0.2313	-0.04415	-0.07765	-0.2012
TMP 1994.092.0011	0.04107	-0.2275	0.05279	0.01998	-0.03487
TMP 1994.094.0014 - 1	0.05334	-0.1920	0.01260	-3	-0.1212
TMP 1994.094.0014 - 2	-3	-0.2645	-3	-3	-3
TMP 1994.094.0016	0.01047	-0.2225	-0.02628	-0.1358	-0.1692
TMP 1994.097.0001	-0.02715	-0.2498	-0.001930	0.01890	-0.09695
TMP 1995.012.0105	0.02305	-0.1894	0.01750	-0.005409	-0.07090
TMP 1995.012.0117	-0.005589	-0.2577	0.009901	-0.05932	-0.1384
TMP 1996.048.0018 - 1	-0.09770	-0.2492	-0.01584	-0.1217	-0.1300
TMP 1996.048.0018 - 2	-0.1318	-0.2892	-0.05433	-0.1860	-0.1990
TMP 1996.075.0001 - 1	0.03748	-0.3415	0.04172	-0.04777	-0.05386
TMP 1996.075.0001 - 10	0.09777	-0.2825	0.09432	0.001292	-0.06430
TMP 1996.075.0001 - 11	-0.01126	-0.2115	0.07672	-0.03178	-0.1675
TMP 1996.075.0001 - 12	-0.01439	-0.2704	0.04905	-0.05432	-0.08977
TMP 1996.075.0001 - 2	-3	-0.2365	-3	-3	-3
TMP 1996.075.0001 - 3	0.1146	-3	0.1260	-0.0005060	-0.09239
TMP 1996.075.0001 - 4	0.02854	-3	0.05847	0.01937	-0.1227
TMP 1996.075.0001 - 5	-3	-3	-3	-3	-3
TMP 1996.075.0001 - 6	0.07806	-3	0.08462	-0.01567	-0.04210
TMP 1996.075.0001 - 7	-0.007306	-0.2588	0.06156	-0.03231	-0.1367
TMP 1996.075.0001 - 8	-3	-0.2745	-3	-3	-3
TMP 1996.075.0001 - 9	0.0004341	-0.3054	0.008544	-0.03847	-0.05085
TMP 1996.089.0002	0.06127	-0.2360	0.08266	-0.01941	-0.1019
TMP 1997.012.0005	-0.004557	-0.1378	0.05311	-0.04512	-0.1031

Sample Number	CH	NL	AL	MCL	DCL
TMP 1997.012.0042	-3	-0.2112	-3	-3	-3
TMP 1997.012.0085	0.05791	-0.2369	0.02908	-0.05224	-0.1248
TMP 1997.012.0106	0.01771	-0.2234	0.08180	0.02161	0.01048
TMP 1997.132.0001 - 1	0.04554	-3	0.05555	0.01821	-0.01720
TMP 1997.132.0001 - 2	-0.09793	-0.2636	-0.01061	-0.06592	-0.3628
TMP 1997.132.0001 - 3	-0.02032	-0.2698	0.05931	-3	-0.1340
TMP 1997.132.0001 - 4	-3	-3	-3	-3	-3
TMP 1997.132.0001 - 5	-0.01540	-3	-0.03584	-0.02003	-0.2408
TMP 1997.132.0001 - 6	-0.07930	-3	0.009151	-0.04156	-0.2187
TMP 1997.132.0001 - 7	-0.08416	-3	-0.01640	-0.05868	-0.2115
TMP 1998.008.0004	0.05744	-0.2241	0.09726	-0.06434	-0.1659
TMP 1998.043.0004	0.02811	-0.2539	-0.004862	-0.07581	-0.1510
TMP 1998.068.0086	-3	-0.2355	-3	-3	-3
TMP 1998.068.0153	-3	-0.2248	-3	-3	-3
TMP 1998.098.0001 - 1	-3	-0.1639	-3	-3	-3
TMP 1998.098.0001 - 10	-0.06965	-0.1854	-0.02134	-0.07927	-0.1180
TMP 1998.098.0001 - 11	-3	-3	-3	-3	-3
TMP 1998.098.0001 - 12	-3	-0.1797	-3	-3	-3
TMP 1998.098.0001 - 13	0.001760	-0.1810	0.002201	-0.09970	-0.1830
TMP 1998.098.0001 - 14	-3	-0.2289	-3	-3	-3
TMP 1998.098.0001 - 15	-3	-0.2153	-3	-3	-3
TMP 1998.098.0001 - 16	-3	-0.1983	-3	-3	-3
TMP 1998.098.0001 - 17	-3	-0.2061	-3	-3	-3
TMP 1998.098.0001 - 18	-3	-3	-3	-3	-3
TMP 1998.098.0001 - 19	-3	-3	-3	-3	-3
TMP 1998.098.0001 - 2	-3	-0.1993	-3	-3	-3
TMP 1998.098.0001 - 20	-3	-0.2913	-3	-3	-3
TMP 1998.098.0001 - 21	0.1055	-3	0.08321	0.07514	-3
TMP 1998.098.0001 - 22	-0.04387	-3	-0.06206	-0.1377	-0.1505
TMP 1998.098.0001 - 23	-3	-3	-3	-3	-3
TMP 1998.098.0001 - 3	0.15783	-0.2171	-0.01228	-0.06522	-0.01406
TMP 1998.098.0001 - 4	-3	-0.2290	-3	-3	-3
TMP 1998.098.0001 - 5	-3	-0.1798	-3	-3	-3
TMP 1998.098.0001 - 6	0.02201	-0.2346	0.05865	-0.001829	-0.2651
TMP 1998.098.0001 - 7	0.09073	-0.1829	0.008136	-0.05473	-0.1331
TMP 1998.098.0001 - 8	0.03144	-0.2342	0.01028	-0.03019	-0.1090
TMP 1998.098.0001 - 9	-0.05214	-0.1425	0.02637	-0.004705	-0.09500
TMP 1998.102.0026 - 1	-0.06247	-0.1701	0.02805	-0.01191	-0.2592

Sample Number	CH	NL	AL	MCL	DCL
TMP 1998.102.0026 - 2	-3	-0.2067	-3	-3	-3
TMP 1998.102.0026 - 3	-3	-0.2159	-3	-3	-3
TMP 1998.102.0026 - 4	-0.05964	-0.1276	-0.08496	-0.1276	-0.1815
TMP 1998.102.0026 - 5	-3	-1.1801	-3	-3	-3
TMP 1998.102.0028 - 1	0.1052	-0.1468	0.07710	0.02004	-0.03964
TMP 1998.102.0028 - 2	0.06067	-0.2289	0.06863	0.03417	0.01585
TMP 1999.055.0162	0.03270	-0.2649	0.02813	0.007726	-0.09311
TMP 1999.055.0290	-0.07395	-0.2039	-0.03588	-0.01564	-0.1270
TMP 1999.063.0019	-3	-0.1677	-3	-3	-3
TMP 1999.085.0005	0.03793	-0.1948	0.05154	0.02218	-0.05270
TMP 2000.012.0020	-0.004220	-3	0.04323	0.008299	-0.09786
TMP 2000.012.0024 - 1	-3	-0.1879	-3	-3	-3
TMP 2000.012.0024 - 2	-0.06259	-0.2140	0.001654	-0.09484	-0.1448
TMP 2000.057.0027	-0.007600	-0.2213	0.01751	-0.02624	-0.09488
TMP 2001.012.0072	-0.03964	-0.2326	0.01712	0.01466	-0.1115
TMP 2001.012.0073	-3	-0.2026	-3	-3	-3
TMP 2002.012.0060	-3	-0.1018	-3	-3	-3
TMP 2002.012.0135	-3	-0.1444	-3	-3	-3
TMP 2002.060.0001 - 1	0.01278	-0.2504	0.03975	0.03150	-0.1205
TMP 2002.060.0001 - 2	0.0004341	-3	0.03430	-0.04956	-0.1675
TMP 2003.012.0106	-0.06491	-0.2566	0.02976	-0.07739	-0.08850
TMP 2004.107.0003	-0.05066	-0.1765	0.04487	-0.002410	-0.2781
TMP 2004.114.0005	0.003733	-0.1266	0.02380	-0.02867	-0.1389
TMP 2004.116.0016	-0.02870	-0.2024	-0.01026	-0.05390	-0.2519
TMP 2004.118.0012	-3	-0.2055	-3	-3	-3
TMP 2005.012.0027	-3	-0.2271	-3	-3	-3
TMP 2005.012.0185	-3	-0.1418	-3	-3	-3
TMP 2005.012.0233	0.02031	-0.2200	0.007994	-0.06433	-0.1088
TMP 2005.012.0265	-0.006358	-0.2046	0.06345	-0.005077	-0.02830
TMP 2005.012.0279	-3	-0.1657	-3	-3	-3
TMP 2005.012.0280	-3	-0.1946	-3	-3	-3
TMP 2005.012.0305	-0.06541	-0.2637	-0.04380	-0.1363	-0.1645
TMP 2005.012.0368	-3	-0.1878	-3	-3	-3
TMP 2005.012.0369	-0.01307	-0.2186	0.06302	-0.06299	-0.2456
TMP 2005.012.0384 - 1	0.007440	-0.2543	-3	-3	-3
TMP 2005.012.0384 - 2	-3	-0.2863	-3	-3	-3
TMP 2005.012.0397	-3	-0.16271	-3	-3	-3
TMP 2005.012.0427	-0.07204	-0.2291	-0.01411	-0.05222	-0.1964

Sample Number	CH	NL	AL	MCL	DCL
TMP 2005.049.0065	-3	-0.1660	-3	-3	-3
TMP 2005.049.0102	0.03225	-0.2489	0.03139	-0.09082	-0.2598
TMP 2005.049.0143	-3	-0.2238	-3	-3	-3
TMP 2005.054.0007	0.005343	-0.2158	0.02503	-0.01849	-0.2698
TMP 2006.012.0182	0.06677	-0.2556	0.06478	-0.03487	-0.002659
TMP 2008.043.0051	-3	-3	-3	-3	-3
TMP 2011.047.0002	0.05897	-0.1672	0.06312	0.06312	0.009879
TMP 2011.047.0010	-3	-0.1178	-3	-3	-3
TMP 2011.047.0079	0.08388	-0.2788	0.06393	0.03607	-3
TMP 2012.012.0017	0.05360	-0.1678	0.07954	-0.04014	-0.003457
TMP 2013.012.0057	0.09378	-0.1808	0.08157	0.03005	-0.14254
TMP 2014.012.0128	-3	-0.1976	-3	-3	-3
TMP 2014.012.0134	0.09785	-0.2505	0.09387	-3	-3
TMP 2018.012.0172	-3	-0.2239	-3	-3	-3
TMP 2019.012.0011	-0.03402	-0.1255	0.02113	-0.004898	-0.1098
TMP 2023.012.0023	-3	-0.2616	-3	-3	-3
TMP 2023.012.0242	-3	-0.1994	-3	-3	-3
UALVP 00002 - 1	-3	-0.1340	-3	-3	-3
UALVP 00002 - 10	-3	-3	-3	-3	-3
UALVP 00002 - 11	-0.1212	-0.1366	-0.04273	-0.08250	-0.1137
UALVP 00002 - 12	-0.2086	-0.1881	-0.07977	-0.1134	-0.1110
UALVP 00002 - 13	-0.1480	-3	-0.03766	-0.05915	-0.2042
UALVP 00002 - 14	-3	-3	-3	-3	-3
UALVP 00002 - 15	-0.1926	-3	0.002253	-0.06857	-0.1955
UALVP 00002 - 16	-3	-3	-3	-3	-3
UALVP 00002 - 17	-0.06409	-3	-0.04215	-0.1185	-0.3002
UALVP 00002 - 18	-3	-3	-3	-3	-3
UALVP 00002 - 19	-3	-3	-3	-3	-3
UALVP 00002 - 2	-3	-0.1279	-3	-3	-3
UALVP 00002 - 20	-3	-0.0774	-3	-3	-3
UALVP 00002 - 21	-0.06186	-0.1645	-0.1125	-0.1448	-0.0770
UALVP 00002 - 22	-3	-0.08789	-3	-3	-3
UALVP 00002 - 23	-3	-0.1037	-3	-3	-3
UALVP 00002 - 24	0.09132	-0.1442	0.05795	-0.001254	0.01125
UALVP 00002 - 25	0.1238	-3	0.1281	0.07974	0.02959
UALVP 00002 - 26	-3	-0.02094	-3	-3	-3
UALVP 00002 - 27	-3	-0.09164	-3	-3	-3
UALVP 00002 - 28	-0.04999	-0.2061	-0.1480	-0.1583	-0.1258

Sample Number	CH	NL	AL	MCL	DCL
UALVP 00002 - 29	-3	-0.1548	-3	-3	-3
UALVP 00002 - 3	-0.1300	-0.1888	-0.06139	-0.1464	-0.03302
UALVP 00002 - 30	-0.07887	-0.1289	-0.02516	-0.1331	-0.06540
UALVP 00002 - 31	-0.03214	-0.1885	-0.03414	-0.1022	-0.1503
UALVP 00002 - 32	-3	-0.2453	-3	-3	-3
UALVP 00002 - 33	-0.1068	-3	-0.07165	-0.1357	-0.1895
UALVP 00002 - 34	-0.1083	-0.2431	-0.04575	-0.1464	-0.2112
UALVP 00002 - 35	-3	-3	-3	-3	-3
UALVP 00002 - 36	-0.16202	-0.1867	-0.07031	-0.1817	-0.2211
UALVP 00002 - 37	-3	-3	-3	-3	-3
UALVP 00002 - 38	-3	-0.1018	-3	-3	-3
UALVP 00002 - 39	-0.002494	-0.1122	-0.03926	-0.1250	-0.1463
UALVP 00002 - 4	0.03892	-0.1070	0.03259	-0.003510	0.02057
UALVP 00002 - 40	-0.06267	-0.09095	-0.1288	-0.1457	-0.1524
UALVP 00002 - 5	0.1176	-0.08345	0.1042	0.06827	0.07715
UALVP 00002 - 6	-0.02337	-0.1466	-0.04458	-0.1199	-0.05864
UALVP 00002 - 7	-0.08075	-3	-0.08286	-0.1238	-0.1157
UALVP 00002 - 8	-0.04227	-3	-0.01597	-0.1428	-0.07327
UALVP 00002 - 9	-3	-3	-3	-3	-3
UALVP 48641	-3	-3	-3	-3	-3
UALVP 48747	0.01664	-0.2073	-3	-3	-3
UALVP 49327	-0.005532	-0.2476	-0.02814	-0.05571	-0.1228
UALVP 53588 - 1	0.02774	-0.2610	0.07265	0.01306	-0.2518
UALVP 53588 - 2	0.06325	-0.2707	0.03196	-0.05906	-0.09014
UALVP 53588 - 3	-0.07991	-0.2365	0.01426	-0.1233	-0.1635
UALVP 53588 - 4	0.02104	-0.2869	-0.002955	0.007135	-0.04024
UALVP 53588 - 5	-3	-0.2872	-3	-3	-3
UALVP 53588 - 6	0.11022	-0.1646	0.1276	0.08664	0.06417
UALVP 53590	0.1485	-0.1042	0.1076	-0.009208	0.02701
UALVP 53591	-0.04865	-0.1823	-0.009589	-0.09416	-0.1976
UALVP 53975	-0.09709	-3	-0.05267	-0.07288	-0.1647
UALVP 55323	-0.07444	-0.2383	-0.02286	-0.1241	-0.1400
UALVP 55366	-0.06111	-0.2596	-0.01550	-0.03393	-0.1143
UALVP 55378	-0.07985	-0.2030	0.021697	-0.006556	-0.1905
UALVP 55390	-0.06335	-0.1754	-0.07740	-0.07950	-0.1707
UALVP 55621	0.02100	-0.2562	-0.01023	-0.03010	-0.1410
UALVP 59296	-3	-3	-3	-3	-3
UALVP 61124 - 1	-0.08662	-0.2565	-0.04750	-0.1231	-0.1452

Sample Number	CH	NL	AL	MCL	DCL
UALVP 61124 - 2	0.01731	-0.2381	0.04547	0.02031	-0.08327
UALVP 61153	-3	-0.2254	-3	-3	-3
UALVP 61442	0.04497	-0.1873	0.1003	-3	-3
UMNH VP 11638	-0.08787	-3	0.07974	-0.009747	-0.1094
UMNH VP 1228	0.1034	-0.23320	0.09387	-0.0005599	-0.07177
UMNH VP 1232	-3	-3	-3	-3	-3
UMNH VP 12637	0.006304	-3	-0.02491	-0.05017	-0.1633
UMNH VP 12864	0.07068	-0.1959	0.05012	-0.05775	-0.1818
UMNH VP 14228	-3	-3	-3	-3	-3
UMNH VP 14436	0.01674	-0.1965	-0.002198	-0.05550	-0.05950
UMNH VP 14488	-0.06344	-0.1678	-0.05309	-0.09443	-0.2139
UMNH VP 16221	-0.02131	-0.1859	-0.03261	-0.1286	-0.1106
UMNH VP 16874	-0.08009	-0.2245	-0.02913	-0.1015	-0.2177
UMNH VP 17418	-3	-3	-3	-3	-3
UMNH VP 17502	0.03329	-0.1732	0.07696	0.01238	-0.1192
UMNH VP 17514	-3	-3	-3	-3	-3
UMNH VP 17973	-0.02956	-0.1887	-0.02657	-0.04798	-0.1037
UMNH VP 19037	-3	-3	-3	-3	-3
UMNH VP 19040	0.05004	-3	0.02857	0.008192	-0.1850
UMNH VP 19699	0.02093	-0.1789	0.01251	-0.07172	-0.08857
UMNH VP 19719	-3	-3	-3	-3	-3
UMNH VP 19720	0.002786	-3	0.02451	-0.05347	-0.1997
UMNH VP 20599	-0.005634	-3	0.03081	-0.006994	-0.3207
UMNH VP 20903	-0.06901	-3	-0.04598	-0.05977	-0.09663
UMNH VP 24117	-3	-3	-3	-3	-3
UMNH VP 5609	-3	-3	-3	-3	-3
UMNH VP 6765	-3	-3	-3	-3	-3
UMNH VP 7603	-3	-3	-3	-3	-3
UMNH VP 7658	-0.02603	-3	0.01927	0.04318	-0.05275
UMNH VP 7672	-3	-3	-3	-3	-3
ZPAL MgD II/1-1	-3	-3	-3	-3	-3
ZPAL MgD II/1-2	-3	-3	-3	-3	-3
ZPAL MgD II/1-3	-3	-3	-3	-3	-3
ZPAL MgD II/1-4	-3	-3	-3	-3	-3
ZPAL MgD II/1-5	-3	-3	-3	-3	-3
ZPAL MgD II/1-6	-3	-3	-3	-3	-3
ZPAL MgD II/1-7	-3	-3	-3	-3	-3

Appendix D - standardized/log transformed digital traditional morphometric measurements

Red cells with -3 values represent absent measurements

Sample Number	CH	M-CL	NL	AL	MCL	DCL	MDH	MDL	DDH	DDL	CA
CEUM 11923	-3	-0.107	-0.211	-3	-3	-3	-1.34	-1.34	-1.36	-1.06	-3
CEUM 11924	-0.089	-0.2446	-0.235	-0.0568	-3	-3	-3	-3	-3	-3	0.644
CEUM 12435	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
CEUM 53115	-0.03214	-0.1783	-0.212	0.009860	-0.05926	-0.08135	-0.979	-0.979	-1.20	-0.917	0.5522
CEUM 82583	0.04085	-0.1006	-3	0.04904	0.04904	-0.01184	-0.9026	-0.9026	-0.9594	-0.8035	0.8954
CEUM 82585	-0.1385	-0.07545	-0.1738	-0.09303	-0.1482	-0.3088	-1.3195	-1.3195	-1.1540	-1.1390	0.6714
CEUM 82586	-0.08340	-0.2841	-3	-3	-3	-3	-3	-3	-3	-3	-3
CEUM 82588	-0.02693	-0.1754	-3	0.02343	0.01709	-0.06040	-0.9479	-0.9479	-0.9516	-0.9160	0.6776
CEUM 82590	-0.1684	-0.1135	-3	-0.09052	-0.1268	-0.2057	-0.9990	-0.9990	-1.1407	-0.8427	0.7579
CEUM 82592	0.03028	-0.1691	-0.1915	-0.001585	-0.03743	-0.2064	-1.0065	-1.0065	-0.9930	-0.8434	0.9011
CEUM 82594	-0.1466	-0.1680	-0.1808	-0.1066	-0.1421	-0.1649	-1.3216	-1.3216	-1.4219	-1.1125	1.08688
CEUM 82595	-0.03141	-0.1582	-0.1730	-0.01839	-0.09157	-0.1823	-1.1692	-1.1692	-3	-3	0.7024
CMNFV 1131	-3	-3	-0.1907	-3	-3	-3	-3	-3	-3	-3	-3
CMNFV 119 - 1	0.008601	-0.1268	-0.2397	0.07418	0.001463	-0.03947	-3	-3	-3	-3	1.1867
CMNFV 119 - 2	0.04487	-0.0969	-0.2959	0.1147	0.03220	-0.007074	-0.9000	-0.8996	-1.1277	-1.08680	1.1845
CMNFV 119 - 3	0.02874	-0.1246	-0.2967	0.02939	-0.01300	-0.05999	-0.8231	-0.8568	-0.7961	-0.7428	0.9911
CMNFV 119 - 4	-0.07533	-0.2226	-0.3159	-3	-3	-3	-3	-3	-3	-3	-3
CMNFV 119 - 5	-0.04498	-0.1288	-0.2282	0.03672	-0.02493	-0.09901	-1.2536	-1.0072	-3	-3	1.09951

Sample Number	CH	M-CL	NL	AL	MCL	DCL	MDH	MDL	DDH	DDL	CA
CMNFV 119 - 6	0.04865	-0.1118	-3	-0.007245	-0.06340	-0.09163	-1.3835	-0.9458	-0.9808	-0.8086	1.03282
CMNFV 129 - 1	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
CMNFV 129 - 2	-0.02343	-0.1153	-0.2032	-0.003315	-0.08099	-0.2072	-1.1271	-0.8890	-3	-3	0.7019
CMNFV 1349	-0.09910	-0.09422	-0.3937	0.01046	-0.02611	-0.09229	-1.09617	-0.8336	-1.2065	-1.00823	0.9646
CMNFV 1772 - 1	-0.07750	-0.07062	-0.1772	0.03636	0.01962	-0.1799	-1.1959	-0.9548	-3	-3	0.6609
CMNFV 1772 - 2	-0.1398	-0.2036	-0.1877	-3	-3	-3	-3	-3	-3	-3	-3
CMNFV 1772 - 3	-0.1852	-0.1141	-0.1923	-0.09022	-0.1354	-0.1769	-3	-3	-3	-3	0.6702
CMNFV 1772 - 4	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
CMNFV 1772 - a	-0.07942	-0.02539	-0.1561	-0.009946	-0.06638	-0.1722	-1.0793	-1.1027	-0.7972	-0.8899	0.6325
CMNFV 21864	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
CMNFV 2334	0.06683	0.02310	-0.1673	-3	-3	-3	-3	-3	-3	-3	-3
CMNFV 38441	-0.1543	-0.1437	-0.2236	-3	-3	-3	-3	-3	-3	-3	-3
CMNFV 38442	0.09256	-0.1567	-0.2381	0.07253	0.02319	-0.02623	-0.7314	-0.7839	-0.8379	-0.6070	1.0827
CMNFV 38443	-0.08613	-0.1082	-0.2303	0.01602	-0.01391	-0.2949	-1.03403	-0.9249	-1.0636	-0.9802	0.9359
CMNFV 38444	-0.2899	-3	-0.2960	-3	-3	-3	-3	-3	-3	-3	-3
CMNFV 38445	0.1288	-0.1045	-0.2111	0.1316	0.07540	0.04472	-3	-3	-3	-3	1.1390
CMNFV 38446	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
CMNFV 38447	0.04477	-0.1457	-0.2344	0.07883	-0.02355	-0.05856	-3	-3	-3	-3	1.1895
CMNFV 38448	0.02452	-0.2714	-0.2142	0.06901	-0.04881	-0.05778	-3	-3	-3	-3	1.1136
CMNFV 38449	0.04869	-0.1057	-0.2704	0.05105	0.01172	-0.1194	-3	-3	-3	-3	1.018
CMNFV 59240 - 1	-0.07067	-0.1235	-0.2366	-0.02149	-0.05715	-0.2242	-3	-3	-3	-3	0.7713
CMNFV 59240 - 2	-0.1331	-0.0959	-0.2902	-0.1099	-0.1664	-0.1994	-3	-3	-1.2387	-0.9733	0.7302
CMNFV 59240 - 3	-3	-3	-0.2498	-3	-3	-3	-3	-3	-3	-3	-3

Sample Number	CH	M-CL	NL	AL	MCL	DCL	MDH	MDL	DDH	DDL	CA
CMNFV 59431	-0.07778	-0.05610	-0.2525	-0.01761	-0.09947	-0.2837	-1.1410	-0.8132	-1.3391	-0.9391	1.0218
CMNFV 59432 - 1	-0.1038	-0.1763	-0.2832	-0.05933	-0.1788	-0.3063	-0.9277	-0.9621	-3	-3	0.7877
CMNFV 59432 - 2	-3	-3	-0.1644	-3	-3	-3	-3	-3	-3	-3	-3
CMNFV 59459	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
CMNFV 59460	-0.2220	-0.08920	-0.1850	-3	-3	-3	-3	-3	-3	-3	-3
CMNFV 59480	-0.1748	-0.009131	-0.1721	-0.04263	-0.1576	-0.1734	-3	-3	-3	-3	0.6878
CMNFV 59510 - 1	-0.2040	-0.2596	-0.1781	-0.03059	-0.1018	-0.1662	-1.1843	-1.0386	-1.2501	-1.1271	0.8636
CMNFV 59510 - 2	-0.1040	-0.09904	-0.2399	0.008241	-0.02327	-0.2273	-3	-3	-0.9243	-0.7511	0.8196
CMNFV 59534	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
CMNFV 59591 - 1	0.004382	-0.1916	-0.3087	-0.1039	-0.2414	-0.2765	-1.2619	-1.1648	-3	-3	0.7935
CMNFV 59591 - 2	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
CMNFV 8537 - 1	-0.1596	-0.2781	-0.2371	-0.08347	-0.1359	-0.3153	-1.3261	-1.1394	-1.2994	-1.2507	0.7754
CMNFV 8537 - 2	-0.1690	-0.2239	-0.1522	-3	-3	-3	-3	-3	-3	-3	-3
CMNFV 8537 - 3	-0.1030	-0.2460	-0.1833	-3	-3	-3	-3	-3	-3	-3	-3
CMNFV 8537 - 4	-3	-3	-0.1118	-3	-3	-3	-3	-3	-3	-3	-3
CMNFV 8537 - 5	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
CMNFV 8537 - 6	-0.07426	-0.1241	-0.1993	-0.05219	-0.07608	-0.1945	-3	-3	-3	-3	0.8743
CMNFV 8537 - 7	-0.06644	-0.1765	-0.1775	0.002495	-0.02876	-0.1572	-3	-3	-1.0619	-1.0540	0.8791
CMNFV 8537 - 8	-0.001643	-0.14607	-0.2879	0.008646	-0.03257	-0.1180	-1.2712	-1.2712	-1.2712	-0.8861	0.9203
CMNFV 8731 - 1	-0.06303	-0.1155	-0.1728	-3	-3	-3	-3	-3	-3	-3	-3
CMNFV 8731 - 2	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
CMNFV 8731 - 3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
CMNFV 8731 - 4	-0.04881	-0.2227	-0.2464	-0.07357	-0.1216	-0.1985	-1.1301	-0.9797	-3	-3	0.7555

Sample Number	CH	M-CL	NL	AL	MCL	DCL	MDH	MDL	DDH	DDL	CA
CMNFV 973	-0.059564	-0.15723	-0.2334	-3	-3	-3	-3	-3	-3	-3	-3
CMNFV CMS1921 - 1	-3	-3	-0.21838	-3	-3	-3	-3	-3	-3	-3	-3
CMNFV CMS1921 - 2	-0.1212	-0.1115	-1.2444	-0.006482	-0.04633	-0.1390	-0.9426	-1.1759	-1.2174	-0.9379	0.8394
CMNFV CMS1921 - 3	-0.07660	-0.1186	-0.2119	-0.06747	-0.1045	-0.1323	-0.8119	-0.8220	-0.7411	-0.7189	0.8181
CMNFV CMS1921 - 4	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
CMNFV CMS1921 - 5	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
CMNFV CMS1921 - 6	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
CMNFV CMS1921 - 7	-0.1299	-0.1068	-0.3002	-0.05573	-0.1257	-0.3106	-3	-3	-3	-3	1.05758
CMNFV CMS1921 - 8	-0.1211	-0.1009	-0.2350	-0.03838	-0.08042	-0.14709	-1.1498	-1.1430	-1.4184	-0.9712	0.7564
CMNFV 8531 - 1	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
CMNFV 8531 - 2	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
CMNFV 8531 - 3	0.04862	-0.1372	-0.1746	0.02975	-0.05425	-0.1939	-3	-3	-3	-3	0.6506
CMNFV 8531 - 4	-0.01095	-0.2491	-0.2303	-0.05106	-0.15353	-3	-1.1091	-1.0082	-3	-3	0.7241
CMNFV 8531 - 5	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
CMNFV 8531 - 6	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
CMNFV 8531 - 7	-0.01315	-0.07964	-0.1888	0.004429	-0.07431	-0.09492	-0.9839	-0.9127	-0.9796	-0.9237	0.7784
CMNFV 8531 - 8	-0.04697	-0.09016	-0.2328	0.02071	-0.01951	-0.2621	-1.0757	-0.8519	-1.1351	-1.04170	0.5966
CMNFV 8531 - 9	-0.1228	-0.1011	-0.1875	-0.04087	-0.08858	-0.1290	-0.9936	-0.9249	-0.9009	-0.8535	0.6970
CMNFV 8880 - 1	0.07931	-0.1754	-0.1840	0.04166	-0.07107	-0.1244	-1.1090	-0.9698	-0.9632	-0.6147	0.9297
CMNFV 8880 - 2	-0.06966	-0.2154	-0.1703	-3	-3	-3	-3	-3	-3	-3	-3
CMNFV 2759 - 1	0.01910	-0.1380	-0.2328	0.009199	-0.1187	-0.1833	-1.2285	-0.9551	-1.1448	-0.8870	0.9331
CMNFV 2759 - 2	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3

Sample Number	CH	M-CL	NL	AL	MCL	DCL	MDH	MDL	DDH	DDL	CA
CMNFV 2759 - 3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
CMNFV 2759 - 4	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
CMNFV 2759 - 5	0.08526	-0.1606	-3	0.1084	-0.1225	-0.1291	-3	-3	-3	-3	0.9887
CMNFV 2759 - 6	-0.07833	-0.2952	-3	-0.0006671	-0.1624	-0.2470	-1.1999	-1.0175	-1.2557	-1.0923	0.8234
CMNFV 8876 - 1	0.03902	-0.09510	-0.3104	0.01739	-0.02631	-0.07923	-1.0043	-0.8953	-3	-3	1.0223
CMNFV 8876 - 2	0.04743	-0.1578	-3	0.03496	-0.05713	-0.1374	-1.2206	-0.9304	-3	-3	1.0650
CMNFV 8876 - 3	-0.03266	-0.1904	-3	-0.01453	-0.09413	-0.1117	-3	-3	-0.9805	-1.0481	1.0139
CMNFV RDR - 1	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
CMNFV RDR - 10	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
CMNFV RDR - 11	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
CMNFV RDR - 12	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
CMNFV RDR - 2	-0.06505	-0.2006	-0.1722	-3	-3	-3	-3	-3	-3	-3	-3
CMNFV RDR - 3	0.03608	-0.1824	-3	-3	-3	-3	-3	-3	-3	-3	-3
CMNFV RDR - 4	-0.02677	-0.1079	-0.2526	0.03938	-0.005357	-0.2746	-1.1939	-0.8963	-3	-3	0.7192
CMNFV RDR - 5	-0.1041	-0.1052	-0.1715	-0.03947	-0.1748	-0.1901	-3	-3	-3	-3	0.6892
CMNFV RDR - 6	-0.0968	-0.1714	-0.2007	0.02090	-0.004836	-0.1778	-3	-3	-3	-3	0.6793
ROM 1215 - 1	-3	-3	-0.1446	-3	-3	-3	-3	-3	-3	-3	-3
ROM 1215 - 2	-0.04622	-0.04339	-0.1364	-3	-3	-3	-3	-3	-3	-3	-3
ROM 1215 - 3	-0.05926	-0.2392	-0.1215	-0.03047	-0.1499	-0.3021	-1.1754	-0.9465	-3	-3	0.7962
ROM 1215 - 4	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
ROM 1215 - 5	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
ROM 1215 - 6	-3	-3	-0.1864	-3	-3	-3	-3	-3	-3	-3	-3
ROM 1215 - 7	-0.06538	-0.07286	-0.1367	0.01389	-0.07612	-0.3585	-1.0813	-0.8115	-3	-3	0.8975
ROM 1215 - 8	-0.09799	-0.1262	-0.1361	0.017078	-0.08698	-0.3672	-3	-3	-3	-3	0.8369

Sample Number	CH	M-CL	NL	AL	MCL	DCL	MDH	MDL	DDH	DDL	CA
ROM 1215 - 9	-0.1458	-0.06656	-0.1438	-0.003771	-0.06574	-0.3646	-1.0564	-1.0184	-3	-3	0.7304
ROM 1215 - 10	0.03067	-0.1805	-0.1656	0.05837	-0.04520	-0.2012	-0.8562	-0.8108	-0.9348	-0.8708	0.8730
ROM 1215 - 11	-0.1463	-3	-0.1436	-3	-3	-3	-3	-3	-3	-3	-3
ROM 1215 - 12	-0.01823	-0.1922	-0.1283	0.02451	-0.06634	-0.2750	-0.8426	-0.8509	-3	-3	0.7314
ROM 1215 - 13	-3	-3	-0.2064	-3	-3	-3	-3	-3	-3	-3	-3
ROM 1215 - 14	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
ROM 1215 - 15	-3	-3	-0.2550	-3	-3	-3	-0.9055	-0.8421	-3	-3	-3
ROM 1215 - 16	-0.1604	-0.1049	-0.1656	-0.07409	-0.1221	-0.2064	-0.9083	-0.8842	-1.2582	-0.9167	0.6841
ROM 1215 - 17	-0.3331	-0.1870	-0.1973	-3	-3	-3	-3	-3	-3	-3	-3
TMP 2017.23.17 - 1	0.06926	-0.1130	-3	0.1021	0.03958	-3	-0.8569	-0.9221	-3	-3	1.0523
TMP 2017.23.17 - 2	-0.09933	-0.1086	-3	0.01738	-0.04760	-3	-3	-3	-3	-3	0.8557
TMP 2017.23.17 - 3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
TMP 2017.23.17 - 4	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
CMNFV RDR - 7	-3	-3	-0.1727	-3	-3	-3	-3	-3	-3	-3	-3
CMNFV RDR - 8	-3	-3	-0.2053	-3	-3	-3	-3	-3	-3	-3	-3
CMNFV RDR - 9	-3	-3	-0.2098	-3	-3	-3	-3	-3	-3	-3	-3
CMNFV UN - 1	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
CMNFV UN - 2	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
CMNFV UN - 3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
CMNFV UN - 4	-0.1060	-0.1543	-3	-0.1240	-0.1609	-0.2194	-1.0552	-0.9214	-1.3749	-0.8808	0.7092
CMNFV UN - 5	-0.04146	-0.04146	-0.2486	0.01733	-0.07928	-0.1249	-1.0850	-1.0397	-1.0397	-0.8268	1.0160
CMNFV UN - 6	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3

Sample Number	CH	M-CL	NL	AL	MCL	DCL	MDH	MDL	DDH	DDL	CA
CMNFV UN - 7	-0.09052	-0.1264	-0.2057	-3	-3	-3	-0.9225	-0.7569	-1.0083	-0.8393	-3
CMNFV UN - 8	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
CMNFV UN - 9	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
DMNH EPV 18168 - 1	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
DMNH EPV 18168 - 10	-0.02469	-0.2578	-0.1691	-0.06889	-0.1403	-0.2009	-3	-3	-3	-3	0.7903
DMNH EPV 18168 - 11	0.09971	-0.1608	-0.1179	0.005474	-0.06595	-0.07276	-3	-3	-3	-3	0.9639
DMNH EPV 18168 - 12	-3	-3	-0.2075	-3	-3	-3	-3	-3	-3	-3	-3
DMNH EPV 18168 - 13	-0.002850	-0.2264	-3	-3	-3	-3	-3	-3	-3	-3	-3
DMNH EPV 18168 - 14	-3	-3	-0.2114	-3	-3	-3	-3	-3	-3	-3	-3
DMNH EPV 18168 - 15	-0.02929	-0.1340	-0.1462	-0.0003032	-0.02069	-0.07940	-3	-3	-3	-3	0.9473
DMNH EPV 18168 - 16	-0.006711	-0.1619	-0.2180	-0.001143	-0.04257	-0.1770	-3	-3	-3	-3	0.9314
DMNH EPV 18168 - 17	-0.1210	-0.2135	-0.1785	-0.01600	-0.06849	-0.2160	-3	-3	-3	-3	0.8724
DMNH EPV 18168 - 2	-0.05281	-0.1355	-0.1663	-0.006210	-3	-3	-3	-3	-3	-3	0.8820
DMNH EPV 18168 - 3	-3	-3	-0.2101	-3	-3	-3	-3	-3	-3	-3	-3
DMNH EPV 18168 - 4	-0.005951	-0.1132	-0.2183	-3	-3	-3	-3	-3	-3	-3	-3
DMNH EPV 18168 - 5	-0.01328	-0.1876	-0.2519	-3	-3	-3	-3	-3	-3	-3	-3
DMNH EPV 18168 - 6	-0.1497	-0.2596	-0.1866	-3	-3	-3	-3	-3	-3	-3	-3
DMNH EPV 18168 - 7	0.005678	-0.1106	-0.1882	-0.0007401	-0.04527	-0.2360	-3	-3	-3	-3	0.7517
DMNH EPV 18168 - 8	-0.1634	-0.2204	-0.1593	-3	-3	-3	-3	-3	-3	-3	-3
DMNH EPV 18168 - 9	-0.04074	-0.1582	-0.2475	-0.1192	-0.1632	-0.1865	-3	-3	-3	-3	0.8099
DMNH EPV 18169 - 1	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
ROM 788 - 1	-3	-3	-0.1939	-3	-3	-3	-3	-3	-3	-3	-3
ROM 788 - 2	-3	-3	-0.1935	-3	-3	-3	-3	-3	-3	-3	-3
ROM 788 - 3	-0.05182	-0.1766	-3	-3	-3	-3	-3	-3	-3	-3	-3
ROM 788 - 4	-0.03588	-0.1350	-0.1854	-3	-3	-3	-3	-3	-3	-3	-3

Sample Number	CH	M-CL	NL	AL	MCL	DCL	MDH	MDL	DDH	DDL	CA
ROM 788 - 5	-0.1718	-0.1348	-3	-3	-3	-3	-3	-3	-3	-3	-3
ROM 788 - 6	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
ROM 788 - 7	0.04889	-0.1721	-0.2136	-3	-3	-3	-3	-3	-3	-3	-3
ROM 788 - 8	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
DMNH EPV 18169 - 2	-0.02493	-3	-0.3198	-3	-3	-3	-3	-3	-3	-3	-3
DMNH EPV 18169 - 3	0.02032	-0.1344	-0.2643	-0.01645	-0.1075	-0.2365	-3	-3	-3	-3	0.7203
DMNH EPV 18169 - 4	-3	-3	-0.1757	-3	-3	-3	-3	-3	-3	-3	-3
DMNH EPV 18169 - 5	-3	-3	-0.1388	-3	-3	-3	-3	-3	-3	-3	-3
DMNH EPV 21671	-0.1274	-0.2404	-0.1687	-3	-3	-3	-3	-3	-3	-3	-3
PIN 3142 - 1	-0.1274	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
PIN 3142 - 10	-0.1206	-0.02539	-3	0.01610	-3	-3	-3	-3	-1.0885	-0.9672	0.9691
PIN 3142 - 2	0.03193	-0.04814	-3	-0.1126	-0.2173	-0.1647	-3	-3	-1.1426	-0.8892	0.7482
PIN 3142 - 3	-0.1080	-0.05052	-3	-0.07046	-3	-3	-3	-3	-3	-3	0.8366
PIN 3142 - 4	-0.1281	-0.03425	-3	-0.01063	-3	-3	-3	-3	-3	-3	0.7305
PIN 3142 - 5	-0.09175	-0.03492	-3	-3	-3	-3	-3	-3	-3	-3	-3
PIN 3142 - 6	-0.1199	-0.02462	-3	-0.01305	-0.07689	-0.2178	-3	-3	-3	-3	0.7743
PIN 3142 - 7	-0.0958	-0.05131	-3	0.03250	-0.08350	-0.2353	-1.0412	-0.8461	-1.1995	-0.9352	0.7750
PIN 3142 - 8	-0.08420	0.01365	-3	0.01178	-0.06125	-0.2152	-3	-3	-3	-3	0.8720
PIN 3142 - 9	-0.05106	-0.03773	-3	0.001086	-0.01214	-0.2657	-1.0328	-0.8559	-1.1728	-0.9497	0.8065
ROM 03088	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
ROM 03287	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
ROM 03302	-0.08293	-0.1459	-3	-3	-3	-3	-3	-3	-3	-3	-3
ROM 03368	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
ROM 03516	-3	-3	-0.2244	-3	-3	-3	-3	-3	-3	-3	-3
ROM 07763	-0.09326	-0.09417	-0.2046	-3	-3	-3	-3	-3	-3	-3	-3

Sample Number	CH	M-CL	NL	AL	MCL	DCL	MDH	MDL	DDH	DDL	CA
ROM 07765	-0.0003853	-0.05076	-0.2406	0.04696	-0.08826	-0.1404	-0.9495	-0.8024	-0.8884	-0.7580	1.0587
ROM 07766	-3	-3	-0.2298	-3	-3	-3	-3	-3	-3	-3	-3
ROM 07767	-0.03145	-0.1232	-0.1620	0.03338	-0.01089	-0.09012	-0.8125	-0.7226	-1.01769	-0.7734	0.8855
ROM 07768	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
ROM 07770	0.03915	-0.1918	-0.2323	0.04066	-0.04757	-0.07915	-3	-3	-3	-3	1.0815
ROM 07772	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
ROM 26346	0.07471	-0.1587	-0.1824	0.07472	-0.03509	-0.05887	-1.0252	-0.9621	-1.1562	-0.8144	1.16836
ROM 31697	-0.1072	-3	-0.2815	-3	-3	-3	-3	-3	-3	-3	-3
ROM 31865	-3	-3	-0.2367	-3	-3	-3	-3	-3	-3	-3	-3
ROM 31866	-0.03564	-0.07763	-0.2203	0.03442	-0.05865	-0.2379	-1.0174	-0.7303	-1.0410	-0.8326	0.9726
ROM 31867	-0.02570	-0.1374	-0.2698	0.009094	-0.05950	-0.1992	-0.8535	-0.8351	-3	-3	0.9566
ROM 31868	0.07550	-0.1440	-0.2386	0.02791	-0.1368	-0.1382	-3	-3	-0.8494	-0.8723	1.1487
ROM 31869	-3	-3	-0.2568	-3	-3	-3	-3	-3	-3	-3	-3
ROM 31871	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
ROM 31872	0.03774	-0.1627	-0.2569	-0.02893	-0.05215	-0.1077	-1.2084	-0.9109	-1.1876	-0.9503	0.9289
ROM 36385	-0.09596	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
ROM 36386	-3	-3	-0.1998	-3	-3	-3	-3	-3	-3	-3	-3
ROM 36387	-0.2440	-0.1150	-3	-3	-3	-3	-3	-3	-3	-3	-3
ROM 36388	-3	-3	-0.2118	-3	-3	-3	-3	-3	-3	-3	-3
ROM 36389	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
ROM 36390	-3	-3	-0.1975	-3	-3	-3	-3	-3	-3	-3	-3
ROM 36391	-3	-3	-0.2391	-3	-3	-3	-3	-3	-3	-3	-3
ROM 36392	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
ROM 36393	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3

Sample Number	CH	M-CL	NL	AL	MCL	DCL	MDH	MDL	DDH	DDL	CA
ROM 67921	-0.1246	-0.1155	-3	0.02929	0.004243	-0.1236	-0.9572	-0.6411	-0.8528	-0.8162	0.8606
ROM 67939	0.001746	-0.1794	-0.2167	0.05358	-0.06776	-0.2189	-1.1149	-0.7915	-0.8254	-0.7380	1.1838
ROM 67946	-0.01304	-0.1410	-3	-3	-3	-3	-3	-3	-3	-3	-3
ROM 67947	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
ROM 67948	0.1144	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
ROM 36548	-3	-0.03731	-0.1143	-3	-3	-3	-3	-3	-3	-3	-3
ROM 36394	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
ROM 36395	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
ROM 36396	-0.1739	-0.08045	-0.1126	-0.1139	-0.1495	-0.1792	-1.1371	-1.1372	-3	-3	0.6766
ROM 53579	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
ROM 36397	-3	-3	-0.1963	-3	-3	-3	-3	-3	-3	-3	-3
ROM 36398	-3	-3	-0.2211	-3	-3	-3	-3	-3	-3	-3	-3
ROM 36399	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
ROM 36400	-3	-3	-0.2226	-3	-3	-3	-3	-3	-3	-3	-3
ROM 36401	-3	-3	-0.2632	-3	-3	-3	-3	-3	-3	-3	-3
ROM 36402	-0.1572	-0.09637	-0.2211	-3	-3	-3	-3	-3	-3	-3	-3
ROM 36403	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
ROM 36404	-0.09346	-0.09288	-0.19768	-3	-3	-3	-3	-3	-3	-3	-3
ROM 36405	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
ROM 36406	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
ROM 36407	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
ROM 36408	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
ROM 36409	-3	-3	-0.2207	-3	-3	-3	-3	-3	-3	-3	-3
ROM 36410	-0.1069	-0.2352	-0.2082	-3	-3	-3	-3	-3	-3	-3	-3
ROM 36411	-0.07979	-0.1377	-0.1956	-3	-3	-3	-3	-3	-3	-3	-3

Sample Number	CH	M-CL	NL	AL	MCL	DCL	MDH	MDL	DDH	DDL	CA
ROM 36412	-0.05198	-0.1337	-0.2335	-0.014236	-0.07844	-0.1562	-1.0194	-0.9400	-1.2049	-1.0885	0.7540
ROM 36413	-3	-3	-0.2758	-3	-3	-3	-3	-3	-3	-3	-3
ROM 36414	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
ROM 36415	-3	-3	-0.1675	-3	-3	-3	-3	-3	-3	-3	-3
ROM 36416	-3	-3	-0.2492	-3	-3	-3	-3	-3	-3	-3	-3
ROM 36417	-3	-3	-0.2372	-3	-3	-3	-3	-3	-3	-3	-3
ROM 36418	-0.1947	-3	-0.2910	-3	-3	-3	-3	-3	-3	-3	-3
ROM 36419	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
ROM 36420	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
ROM 36421	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
ROM 36422	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
ROM 36423	0.05548	-0.1637	-0.1530	-0.004797	-0.1165	-0.3924	-3	-3	-3	-3	0.8324
ROM 56611	-0.04167	-0.1499	-0.1359	-0.05523	-0.1045	-0.2093	-3	-3	-3	-3	0.6781
ROM 56620	-3	-3	-0.2164	-3	-3	-3	-3	-3	-3	-3	-3
BYU VP 50866	0.05877	-0.1030	-0.07738	0.01615	-0.08316	-0.1843	-1.0756	-1.0756	-0.9740	-1.0135	0.9798
ROM 58144	-0.07322	-0.1299	-0.2061	-0.03268	-0.1373	-0.2167	-0.9538	-0.7255	-0.8760	-0.8265	0.6856
ROM 58147	-0.1190	-0.04282	-0.2615	0.01612	-0.04536	-0.1312	-1.1159	-0.9874	-1.0778	-0.9384	0.9655
CEUM 11912	-3	-0.1201	-0.1911	-3	-3	-3	-3	-3	-3	-3	-3
CEUM 11911	-0.003107	-0.1351	-0.1560	0.01517	-0.05398	-0.1861	-3	-3	-3	-3	1.0463
CEUM 11910	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
CEUM 11909	0.04034	-0.1440	-0.1779	0.06408	0.01845	-0.1558	-1.2451	-1.2451	-1.2451	-1.1184	1.0217
CEUM 5373	-0.02211	-0.1951	-0.2038	0.03894	0.00408	-0.1262	-1.0375	-1.0375	-1.05800	-0.9163	0.9833
CEUM 31206	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
CEUM 12811	-0.1494	-0.1435	-0.1893	-3	-3	-3	-3	-3	-3	-3	-3

Sample Number	CH	M-CL	NL	AL	MCL	DCL	MDH	MDL	DDH	DDL	CA
ROM 58151	-0.1361	-3	-0.1484	-3	-3	-3	-3	-3	-3	-3	-3
ROM 58223	-0.1221	-0.1767	-0.2058	-0.02783	-0.03141	-0.1514	-1.4391	-1.0160	-3	-3	0.8197
ROM 58383	-0.05832	-0.2433	-0.2551	-3	-3	-3	-3	-3	-3	-3	-3
ROM 58516	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
ROM 58525	-0.1454	-0.1503	-0.1474	-0.03648	-0.08278	-0.2256	-3	-3	-3	-3	0.8306
ROM 58565 - 1	-0.1007	-0.2084	-0.1686	-0.03536	-0.1252	-0.3062	-3	-3	-3	-3	0.9122
ROM 58565 - 2	-0.1229	-0.1801	-0.1735	-3	-3	-3	-3	-3	-3	-3	-3
ROM 58565 - 3	0.003930	-0.1047	-0.1381	0.05387	0.01015	-0.1723	-0.9066	-0.8104	-0.7511	-0.6160	0.8668
ROM 58565 - 4	-3	-3	-0.2908	-3	-3	-3	-3	-3	-3	-3	-3
CEUM 09173	-0.03583	-0.09442	-3	-3	-3	-3	-0.7502	-0.7502	-0.8337	-0.8586	-3
ROM 58594	0.01383	-0.1393	-0.2027	0.02591	-0.02149	-0.08819	-0.8474	-0.8373	-0.8339	-0.7665	0.7714
CEUM 1264 #86	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
CEUM 34580	0.08366	-0.1296	-3	0.08366	0.009374	-0.01101	-0.8613	-0.8613	-0.9423	-0.8315	0.6872
DMNH EPV 468	0.1768	-0.2150	-3	-3	-3	-3	-0.6746	-0.6746	-3	-3	0.8296
DMNH EPV 27726 - 1	0.2660	-0.1715	-0.06384	0.1580	-3	-3	-3	-3	-3	-3	1.2213
DMNH EPV 27726 - 2	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
DMNH EPV 27726 - 3	0.06041	-0.1492	-3	0.07527	0.032879	0.01745	-3	-3	-3	-3	1.1926
DMNH EPV 27726 - 4	0.003126	-0.1446	-3	0.0004340	-3	-3	-3	-3	-3	-3	1.0936
DMNH EPV 27726 - 5	0.1023	-0.1492	-0.1051	0.1406	0.09352	-0.009815	-3	-3	-3	-3	1.05265
DMNH EPV 27726 - 6	0.09451	-0.1314	-3	0.05765	-3	-3	-1.1027	-1.1027	-1.3720	-1.3394	-3
DMNH EPV 27726 - 7	0.1471	-0.07692	-3	0.1793	-3	-3	-3	-3	-3	-3	1.2661
DMNH EPV 27726 - 8	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3

Sample Number	CH	M-CL	NL	AL	MCL	DCL	MDH	MDL	DDH	DDL	CA
DMNH EPV 27726 - 9	0.1476	-0.09813	-3	0.1340	0.1045	0.04615	-1.1142	-1.1142	-3	-3	1.2465
DMNH EPV 27726 - 10	-0.1319	-0.1633	-3	-0.08160	-0.1165	-0.1840	-1.3429	-1.3429	-3	-3	0.8845
DMNH EPV 27726 - 11	-3	-0.2474	-0.1637	-3	-3	-3	-3	-3	-3	-3	-3
DMNH EPV 27726 - 12	-0.1344	-0.1357	-0.1448	-0.1461	-3	-3	-3	-3	-3	-3	-3
DMNH EPV 27726 - 13	-0.06331	-0.2268	-0.2018	-0.05711	-3	-3	-3	-3	-3	-3	1.0178
DMNH EPV 27726 - 14	0.1035	-0.1857	-3	0.1100	-3	-3	-3	-3	-3	-3	1.1375
DMNH EPV 27726 - 15	0.02820	-0.1721	-3	0.1207	0.006130	-0.04485	-3	-3	-3	-3	1.1325
DMNH EPV 27726 - 16	0.06584	-0.1485	-3	0.1951	0.08716	-0.0257	-3	-3	-3	-3	1.0782
DMNH EPV 27726 - 17	0.05348	-0.1826	-0.1591	0.08533	0.02739	-0.03086	-1.0085	-1.0085	-1.0601	-0.9697	1.0599
DMNH EPV 27726 - 18	0.07189	-0.1967	-0.2042	0.06179	0.02186	-0.03810	-3	-3	-3	-3	1.0533
DMNH EPV 53040	0.03881	-3	-0.1418	-3	-3	-3	-3	-3	-3	-3	-3
DMNH EVP 136185 - 1	0.02386	-0.1551	-0.1617	0.02138	-0.01010	-0.2268	-1.1459	-1.1459	-1.2969	-1.0708	0.7869
DMNH EVP 136185 - 2	-3	-3	-0.1461	-3	-3	-3	-3	-3	-3	-3	-3
DMNH EVP 136185 - 3	-0.03550	-0.1750	-0.1959	0.05495	-0.005046	-0.09343	-1.1547	-1.1547	-1.1547	-1.0831	1.0154
DMNH EVP 136185 - 4	-0.03612	-0.2467	-0.1878	0.03704	-0.06353	-0.1840	-3	-3	-3	-3	0.7665
DMNH EVP 136185 - 5	0.01035	-0.1842	-0.2012	0.07250	-0.01064	-0.1136	-1.0813	-1.0813	-1.2715	-1.1038	0.9410
DMNH EVP 136185 - 6	-0.1399	-0.2377	-0.1846	-3	-3	-3	-3	-3	-3	-3	-3
DMNH EVP 136185 - 7	0.004714	-0.2187	-0.1988	0.04033	-0.0007967	-0.1651	-1.1702	-1.1702	-1.3760	-1.2183	0.7689
DMNH EVP 136185 - 8	-3	-3	-0.1536	-3	-3	-3	-3	-3	-3	-3	-3
DMNH EVP 136185 - 9	-3	-3	-0.1862	-3	-3	-3	-3	-3	-3	-3	-3
DMNH EVP 136185 - 10	-0.08064	-0.2393	-0.1936	-0.05665	-0.1086	-0.1824	-1.37576	-1.3758	-1.3917	-1.0003	0.8267
DMNH EVP 136185 - 11	-0.1192	-0.1273	-0.1496	-0.0339	-0.09839	-0.2300	-1.1992	-1.1992	-1.3511	-1.0951	0.8672

Sample Number	CH	M-CL	NL	AL	MCL	DCL	MDH	MDL	DDH	DDL	CA
DMNH EVP 136185 - 12	-0.08238	-0.2091	-0.1857	-0.01851	-0.09298	-0.1983	-1.2816	-1.2816	-1.1588	-1.1499	0.8177
DMNH EPV 136185 - 13	-3	-3	-0.1662	-3	-3	-3	-3	-3	-3	-3	-3
DMNH EPV 136185 - 14	-0.05553	-0.1767	-0.1198	0.04226	-0.03638	-0.1419	-1.2041	-1.2041	-1.1521	-1.1283	0.9888
DMNH EPV 136185 - 15	-0.006725	-0.1943	-0.1449	0.03127	-0.02216	-0.05638	-1.2862	-1.2862	-1.2344	-1.1083	0.9958
DMNH EPV 136185 - 16	-0.06170	-0.2758	-0.1220	-3	-3	-3	-3	-3	-3	-3	-3
DMNH EPV 136185 - 17	-0.04527	-0.2234	-0.1572	-0.02468	-0.1771	-0.1938	-1.1764	-1.1764	-1.3343	-1.1282	0.8771
DMNH EPV 136185 - 18	0.1304	-0.1618	-0.2522	0.06467	-3	-0.1112	-3	-3	-3	-3	0.9149
DMNH EPV 136185 - 19	0.07003	-0.1513	-0.1481	-0.04114	-0.1701	-0.2079	-3	-3	-3	-3	0.9188
DMNH EPV 136185 - 20	0.09539	-0.1042	-0.1510	0.04947	-3	-0.08021	-3	-3	-3	-3	0.9867
DMNH EPV 136185 - 21	0.04071651	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
DMNH EPV 136185 - 22	0.07027	-0.1169	-3	-3	-3	-3	-3	-3	-3	-3	-3
DMNH EPV 136185 - 23	0.02888	-0.2274	-0.1038	0.02045	-0.03000	-0.1790	-3	-3	-3	-3	0.9548
DMNH EPV 136185 - 24	0.01897	-0.2378	-3	-3	-3	-0.2591	-3	-3	-3	-3	-3
DMNH EPV 136185 - 25	0.06960	-0.1979	-3	0.0004340	-0.1070	-0.1721	-3	-3	-3	-3	1.0150
DMNH EPV 136185 - 26	0.07782	-0.06155	-0.2207	0.07567	-3	-0.02876	-3	-3	-3	-3	1.2583
DMNH EPV 136185 - 27	-0.08861	-0.2061	-0.1633	-0.02489	-3	-3	-3	-3	-3	-3	0.9723
DMNH EVP 2818 - 1	-0.1193	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
DMNH EPV 2818 - 2	-0.08866	-0.1297	-0.3544	-0.1276	-0.1946	-0.2311	-3	-3	-3	-3	0.9458

Sample Number	CH	M-CL	NL	AL	MCL	DCL	MDH	MDL	DDH	DDL	CA
DMNH EPV 2818 - 3	0.08955	-0.2373	-0.2541	0.09517	-0.01099	-0.1096	-3	-3	-3	-3	1.09015
DMNH EPV 2818 - 4	0.08839	-3	-3	0.09628	-3	-3	-3	-3	-3	-3	-3
DMNH EPV 2818 - 5	0.1222	-0.3036	-0.2656	0.08859	-3	-3	-3	-3	-3	-3	-3
DMNH EPV 2818 - 6	0.1354	-0.08451	-0.1825	0.1143	0.06372	-0.01486	-3	-3	-3	-3	1.1491
DMNH EPV 2818 - 7	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
DMNH EPV 2818 - 8	0.1413	-3	-0.1338	-3	-3	-3	-3	-3	-3	-3	-3
DMNH EPV 2818 - 9	0.06416	-3	-0.2078	0.01769	-0.06395	-3	-1.0854	-1.0855	-3	-3	1.0588
DMNH EPV 2818 - 10	0.039118	-3	-0.2160	-3	-3	-3	-3	-3	-3	-3	-3
DMNH EPV 2818 - 11	0.08494	-0.05248	-3	0.1706	0.07054	-0.01807	-1.1304	-1.1304	-1.1556	-1.3483	1.08648
DMNH EPV 2818 - 12	-0.008080	-0.1611	-0.25098	-0.01756	-0.10880	-0.2056	-3	-3	-3	-3	0.9634
DMNH EPV 2818 - 13	0.1829	-0.2158	-0.2158	0.1870	0.06216	-0.004071	-1.2152	-1.2152	-3	-3	1.0469
DMNH EPV 2818 - 14	0.1023	-0.1612	-0.2951	0.06411	-0.05739	-0.07335	-1.2274	-1.2274	-3	-3	1.0031
DMNH EPV 2818 - 15	0.01808	-0.1607	-0.2593	-0.05432	-0.1707	-0.2038	-1.1922	-1.1922	-1.3330	-1.2492	1.1175
DMNH EPV 2818 - 16	0.1574	-0.04414	-0.3435	0.08468	0.01665	-0.003717	-3	-3	-3	-3	1.17203
DMNH EPV 2818 - 17	0.1622	-0.1069	-0.2776	0.1051	0.04347	0.03498	-3	-3	-3	-3	1.2737
DMNH EPV 2818 - 18	0.1627	-0.2533	-0.2101	0.1547	0.05345	0.03684	-0.9100	-0.9100	-3	-3	1.2591
DMNH EPV 2818 - 19	0.1552	-0.1041	-0.1141	-3	-3	-3	-3	-3	-3	-3	-3
DMNH EPV 2818 - 20	-0.05386	-0.09352	-0.2872	-0.06909	-0.1711	-0.1952	-3	-3	-3	-3	1.0602
DMNH EPV 2818 - 21	0.07367	-0.1670	-0.2641	0.06449	-0.1184	-0.1255	-1.1472	-1.1472	-1.1867	-1.1867	1.0727
DMNH EPV 2818 - 22	-0.06848	-0.1137	-0.2531	-0.1229	-0.2057	-0.2156	-3	-3	-3	-3	1.0203
DMNH EPV 2818 - 23	0.08809	-0.1309	-0.1936	0.08366	-0.02057	-0.07096	-0.9978	-0.9978	-3	-3	1.1548
DMNH EPV 2818 - 24	0.04604	-0.06338	-3	0.09066	-0.008874	-0.02702	-3	-3	-3	-3	1.1957

Sample Number	CH	M-CL	NL	AL	MCL	DCL	MDH	MDL	DDH	DDL	CA
DMNH EPV 2818 - 26	0.06092	-0.1799	-0.2283	0.09081	-0.03185	-0.09019	-1.2995	-1.2995	-3	-3	1.0827
DMNH EPV 2818 - 27	-0.002461	-0.1083	-3	0.02566	-0.05708	-0.08427	-1.1851	-1.1851	-3	-3	1.1057
DMNH EPV 2818 - 28	-0.06051	-0.1098	-0.3316	0.01120	-0.04553	-0.1169	-1.0421	-1.0421	-1.0336	-1.3383	0.9572
ROM 58598	-0.01139	-0.2131	-0.1757	0.05844	0.03557	-0.09796	-1.1359	-0.8379	-1.1738	-0.9313	0.7597
ROM 58689 - 1	-0.02401	-0.1724	-0.3112	-3	-3	-3	-0.9247	-0.7672	-0.9985	-0.8617	-3
ROM 58689 - 2	-0.09137	-0.2838	-0.2308	-0.07671	-0.1417	-0.1740	-0.9447	-0.8455	-1.0667	-0.7925	0.8380
ROM 58704	-3	-3	-0.1245	-3	-3	-3	-3	-3	-3	-3	-3
ROM 67276	-0.1106	-0.1576	-0.2227	-3	-3	-3	-3	-3	-3	-3	-3
ROM 69382	-0.1257	-0.07984	-0.1683	-0.09086	-0.2313	-0.3182	-3	-3	-3	-3	0.6352
SMU 73203	-3	-3	-3	-3	-3	-3	-0.8470	-0.8963	-3	-3	-3
TMP 1966.025.0015	0.003389	-0.05764	-0.2088	0.04456	-0.01159	-0.0005553	-3	-3	-3	-3	1.1516
TMP 1976.006.0036	0.05037	-0.0514	-0.1487	0.09234	-0.001898	-0.05270	-1.0418	-0.7563	-0.9877	-0.6803	0.8125
TMP 1980.008.0026 - 1	0.02610	-0.05652	-0.2151	0.08715	0.02146	-0.1636	-1.0908	-0.8016	-1.0186	-0.7224	0.9610
TMP 1980.008.0026 - 2	-0.01793	-0.02982	-0.2176	0.05079	0.03706	-0.06888	-0.7812	-0.8393	-0.8592	-0.7678	0.7945
TMP 1980.013.0046	-0.03912	-0.03078	-0.26042	0.01925	-0.04978	-0.1293	-1.0621	-1.0849	-0.8877	-0.8543	0.8293
TMP 1980.016.0239	0.03124	-0.06100	-0.2489	0.04840	0.005104	-0.01778	-0.9531	-0.6626	-0.9704	-0.6374	1.0985
TMP 1980.016.0834	0.03428	-0.1667	-0.2849	0.1161	0.04749	-0.01538	-3	-3	-3	-3	1.1704
TMP 1980.016.1685 - 1	0.03832	-0.2057	-3	0.08419	0.01022	-0.06534	-3	-3	-3	-3	0.9599
TMP 1980.016.1685 - 2	0.1653	-0.1610	-3	0.2017	0.1842	0.0506	-3	-3	-3	-3	1.1202
TMP 1980.029.0140	-0.04246	-0.06070	-0.2697	0.005033	-0.03571	-0.08911	-1.0919	-0.8498	-1.0136	-0.8553	0.9571

Sample Number	CH	M-CL	NL	AL	MCL	DCL	MDH	MDL	DDH	DDL	CA
TMP 1980.029.0228	-0.09010	-0.07720	-0.2554	-0.03701	-0.06313	-0.1128	-1.0393	-0.9247	-1.0249	-0.7227	0.8999
TMP 1981.041.0014	-0.04827	-0.02567	-3	-0.01441	-0.02081	-0.08313	-0.8248	-0.6780	-0.8680	-0.6892	0.9550
TMP 1983.036.0009 - 1	0.09951	-0.05121	-0.3045	0.07017	0.001303	-0.1424	-0.9309	-0.6916	-1.0124	-0.7816	0.9974
TMP 1983.036.0009 - 2	0.006849	-0.05738	-0.2323	-0.01771	-0.02967	-0.06295	-1.0622	-1.0622	-1.0439	-0.9776	1.0244
TMP 1983.036.0009 - 3	0.03372	-0.05749	-0.4400	0.08742	0.05650	0.02849	-1.1167	-0.8572	-1.0185	-0.8779	1.1135
TMP 1983.036.0009 - 4	-0.03765	-0.01724	-0.2602	0.007665	-0.05078	-0.1159	-3	-3	-0.7509	-0.6114	1.0368
DMNH EPV 50377	-3	-3	-0.1474	-3	-3	-3	-3	-3	-3	-3	-3
DMNH EPV 50373	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
DMNH EVP 50206 - 1	-3	-3	-0.06976	-3	-3	-3	-3	-3	-3	-3	-3
DMNH EVP 50206 - 2	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
DMNH EPV 50206 - 3	-3	-3	-0.1892	-3	-3	-3	-3	-3	-3	-3	-3
DMNH EPV 50206 - 4	-3	-3	-0.2476	-3	-3	-3	-3	-3	-3	-3	-3
TMP 1983.036.0207	-0.07675	-0.1241	-0.2293	-0.02179	-0.06253	-0.1669	-0.8569	-0.6272	-0.8615	-0.7551	0.8045
TMP 1984.091.0020	-0.06848	-0.04995	-0.2178	0.004345	-0.03125	-0.1388	-3	-3	-3	-3	0.6430
TMP 1985.036.0121	0.07360	-0.06130	-0.2517	0.1197	0.08468	0.01864	-1.1920	-1.0419	-1.0518	-0.8240	1.0901
TMP 1985.056.0170 - 1	-0.01114	-0.06644	-0.2227	0.07927	-0.002019	-0.09902	-0.9585	-0.9511	-3	-3	1.0483
TMP 1985.056.0170 - 2	-0.07570	-0.07570	-0.3031	0.00486	-0.04909	-0.1384	-3	-3	-3	-3	0.8960
TMP 1985.056.0171 - 1	-0.01310	-0.007092	-0.2509	0.03623	-0.04327	-0.1392	-1.0196	-0.8040	-1.0544	-0.8109	0.7223
TMP 1985.056.0171 - 2	-3	-3	-0.2600	-3	-3	-3	-3	-3	-3	-3	-3
TMP 1985.056.0171 - 3	-0.001886	-0.02826	-0.2041	0.02626	-0.04463	-0.07520	-3	-3	-3	-3	0.8407
TMP 1985.056.0211	-0.002859	-0.04537	-0.2384	0.05435	0.01017	-0.06209	-0.9004	-0.7126	-0.8068	-0.6800	0.9502

Sample Number	CH	M-CL	NL	AL	MCL	DCL	MDH	MDL	DDH	DDL	CA
TMP 1985.059.0028	0.01023	-0.03448	-0.2178	0.02633	0.007993	0.005739	-1.0964	-0.7886	-1.1577	-0.9065	1.0327
TMP 1986.008.0084	-0.008400	-0.1161	-0.1919	0.06122	-0.03094	-0.1006	-0.9605	-0.7857	-0.9365	-0.7502	0.8536
TMP 1986.009.0055	0.08774	-0.04842	-0.2228	0.1207	-0.01436	-0.03152	-0.8954	-0.8157	-1.0869	-0.6859	1.0096
TMP 1986.023.0108	0.01457	-0.03238	-0.2337	0.02419	-0.09925	-0.1390	-3	-3	-3	-3	0.9169
TMP 1986.095.0007	0.05484	-0.04822	-0.2588	0.09981	0.01221	0.006360	-1.0782	-0.8585	-1.0583	-0.7267	1.0607
TMP 1986.127.0005	-0.03783	-0.05046	-0.2062	0.03334	-0.04863	-0.08078	-1.0590	-0.8602	-1.1409	-0.8908	0.9831
TMP 1986.183.0003	0.02262	-0.06415	-0.2416	0.05846	0.03041	-0.05937	-0.9950	-0.8763	-3	-3	0.9375
TMP 1987.029.0006	-3	-3	-0.3303	-3	-3	-3	-3	-3	-3	-3	-3
TMP 1987.036.0094	-0.04821	0.035989	-0.1854	0.1037	0.007547	-0.1836	-3	-3	-3	-3	0.8465
TMP 1987.077.0143	-0.01666	-0.05511	-0.2560	0.03788	-0.04985	-0.08465	-3	-3	-3	-3	1.0509
TMP 1987.080.0010	-0.1275	-0.1254	-0.2374	0.002003	-0.08819	-0.1972	-1.4291	-0.9972	-3	-3	1.0275
TMP 1989.069.0017	-0.1047	-0.03040	-0.1750	-0.06151	-0.1099	-0.1462	-1.1083	-0.7738	-0.9966	-0.7452	0.6625
TMP 1989.036.0396 - 1	-0.08166	-0.06272	-0.1895	0.06762	-0.06148	-0.1083	-3	-3	-3	-3	1.1237
TMP 1989.036.0396 - 2	-0.07485	-0.02090	-0.2582	-0.02003	-0.05738	-0.1319	-3	-3	-3	-3	0.9642
TMP 1989.036.0396 - 3	0.03411	-0.004720	-0.1814	0.03647	-0.02870	-0.08938	-3	-3	-3	-3	0.9907
TMP 1989.036.0405 - 1	-0.03219	-0.09051	-0.2332	0.003045	-0.1025	-0.1960	-3	-3	-3	-3	1.0308
TMP 1989.036.0405 - 2	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
TMP 1989.036.0405 - 3	-0.03805	-0.04047	-0.2379	0.04982	-0.08295	-0.05195	-0.8532	-0.6411	-0.8747	-0.7807	0.9511
TMP 1989.050.0002	-0.06465	-0.004292	-0.2543	-0.01879	-0.08707	-0.08298	-0.9490	-0.9611	-3	-3	0.8892
TMP 1989.050.0013	-0.06165	-0.02450	-0.2020	-0.02038	-0.06801	-0.1288	-3	-3	-3	-3	0.9334
TMP 1989.050.0030	-0.05797	-0.07746	-0.2207	0.03439	-0.004930	-0.1511	-3	-3	-3	-3	0.8049
TMP 1989.076.0059	0.01399	-0.1013	-0.2866	0.06038	-0.01594	-0.1455	-3	-3	-3	-3	1.1485

Sample Number	CH	M-CL	NL	AL	MCL	DCL	MDH	MDL	DDH	DDL	CA
TMP 1989.079.0008	-0.1120	-0.07478	-0.2497	-0.05134	-0.08214	-0.1658	-3	-3	-3	-3	0.5899
TMP 1989.151.0137	-0.04169	-0.05545	-0.2339	0.06855	0.008149	-0.02617	-3	-3	-3	-3	0.7212
TMP 1990.036.0081	-0.12503	-0.03457	-0.2824	-0.06203	-0.08271	-0.1246	-0.9957	-0.7837	-0.8976	-0.6935	0.5676
TMP 1990.060.0006 - 1	-0.03526	-0.06137	-0.2175	0.04607	-0.03368	-0.1000	-3	-3	-3	-3	0.9083
TMP 1990.060.0006 - 2	0.05952	-0.06129	-0.2944	0.1061	0.03259	-0.01958	-3	-3	-3	-3	1.1647
TMP 1990.107.0037 - 1	0.04093	-0.01395	-0.1458	0.1047	0.02339	-0.2320	-3	-3	-3	-3	0.8914
TMP 1990.107.0037 - 2	-0.1414	-0.06332	-0.2553	-0.02182	-0.05448	-0.2140	-3	-3	-3	-3	0.6200
TMP 1990.155.0007	-0.01618	-0.01665	-0.1814	0.02934	-0.0530	-0.09433	-1.1621	-1.0038	-3	-3	0.7147
TMP 1991.036.0158	-0.07133	-0.02219	-0.3627	-0.04134	-0.1053	-0.1482	-1.1558	-0.9303	-3	-3	0.9302
TMP 1991.036.0171	-0.04883	0.01529	-0.1598	0.0428	-0.008648	-0.08408	-3	-3	-3	-3	0.6714
TMP 1991.036.0734	-0.03259	-0.02204	-0.2610	0.008832	-0.08693	-0.1622	-0.8927	-0.9039	-3	-3	0.9079
TMP 1991.050.0093	-0.1504	-0.04274	-0.1859	-0.06389	-0.09121	-0.1630	-3	-3	-0.9659	-0.7180	0.6273
TMP 1991.085.0012	-0.01909	-0.03700	-0.2230	0.07176	0.004464	-0.1141	-3	-3	-3	-3	0.7503
TMP 1991.087.0072	-0.06448	-0.0358	-0.1632	-0.04878	-0.1178	-0.2021	-3	-3	-3	-3	0.7747
TMP 1992.036.0313 - 1	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
TMP 1992.036.0313 - 2	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
TMP 1992.036.1178 - 1	-0.06386	-0.03767	-0.2361	-0.009775	-0.04278	-0.05849	-0.9652	-0.7626	-0.8101	-0.6922	0.9882
TMP 1992.036.1178 - 2	-0.1238	-0.007170	-0.2837	-0.04453	-0.06352	-0.2031	-0.8914	-0.6479	-0.9858	-0.6670	0.8668
TMP 1992.036.1178 - 3	-3	-3	-0.2748	-3	-3	-3	-3	-3	-3	-3	-3
TMP 1993.036.0081	-0.04450	-0.1179	-0.2500	0.04306	0.009437	-0.07420	-0.9888	-0.9559	-1.0318	-0.8859	0.9058
TMP 1993.036.0364	-0.1251	-0.04624	-0.1844	-0.04191	-0.08625	-0.1066	-3	-3	-3	-3	0.5332
TMP 1993.079.0065	-3	-3	-0.1779	-3	-3	-3	-3	-3	-3	-3	-3
TMP 1994.012.0035	-0.0525	-0.04318	-0.2507	0.04350	-0.03765	-0.1267	-3	-3	-3	-3	0.6531

Sample Number	CH	M-CL	NL	AL	MCL	DCL	MDH	MDL	DDH	DDL	CA
TMP 1994.012.0039	-0.05119	-0.1024	-0.2002	0.05264	0.02188	-0.1362	-0.7888	-0.6784	-0.8085	-0.6685	0.6962
TMP 1994.012.0120	-0.2052	-0.08066	-0.2292	-0.01013	-0.07902	-0.1616	-3	-3	-3	-3	0.6535
TMP 1994.012.0565	-0.002527	-0.004314	-0.1564	0.02788	-0.06165	-0.1693	-3	-3	-3	-3	0.7681
TMP 1994.086.0018	-0.02623	-0.05099	-0.2048	0.01817	-0.007395	-0.1342	-1.1966	-1.0028	-1.1485	-0.7749	0.8114
TMP 1994.092. 0011	0.05026	-0.01026	-0.2372	0.1089	0.01684	-0.1217	-1.0254	-0.6994	-0.8833	-0.8092	1.0085
TMP 1994.094.0014 - 1	-0.04027	-0.08760	-0.2044	0.03765	-0.02384	-0.1531	-3	-3	-3	-3	0.6767
TMP 1994.094.0014 - 2	-0.1793	-0.06105	-0.2790	-0.05749	-0.09831	-0.1852	-3	-3	-3	-3	0.9411
TMP 1994.094.0016	-0.07708	-0.08578	-0.1787	-0.01209	-0.06297	-0.1434	-3	-3	-3	-3	0.5593
TMP 1994.097.0001	-0.05662	-0.07440	-0.2678	0.006502	-0.04206	-0.1035	-1.0254	-0.8220	-0.9721	-0.6767	0.9901
TMP 1995.012.0105	-0.004974	-0.05139	-0.1711	0.05197	-0.003492	-0.1147	-3	-3	-3	-3	0.6900
TMP 1995.012.0117	-0.07464	-0.05881	-0.2735	-0.01563	-0.07247	-0.2234	-3	-3	-3	-3	0.6558
TMP 1996.048.0018 - 1	-0.09681	-0.1252	-0.2312	-0.01937	-0.06090	-0.1057	-0.9565	-0.8092	-1.0645	-0.7083	1.0156
TMP 1996.048.0018 - 2	-0.08913	-0.1230	-0.3015	-0.07786	-0.1284	-0.2021	-1.2284	-0.8394	-0.9543	-0.7958	1.1625
TMP 1996.075.0001 - 1	0.05125	-0.01259	-0.2540	0.06695	-0.005597	-0.02421	-1.0192	-0.7531	-1.0192	-0.7630	1.0547
TMP 1996.075.0001 - 10	0.08727	-0.05490	-0.2442	0.1200	0.07138	0.01407	-0.9109	-0.9402	-0.7940	-0.8335	1.0383
TMP 1996.075.0001 - 11	-0.07065	-0.05506	-0.2975	0.07457	-0.01325	-0.1105	-0.9723	-0.7572	-0.8952	-0.8178	1.0266
TMP 1996.075.0001 - 12	-0.05606	-0.06129	-0.2211	0.08933	-0.01918	-0.07520	-3	-3	-3	-3	1.0770
TMP 1996.075.0001 - 2	-0.1481	-0.06460	-0.2481	-0.04740	-0.1089	-0.2138	-3	-3	-3	-3	0.9333
TMP 1996.075.0001 - 3	0.1179	-0.09168	-3	0.1437	0.05695	-0.06020	-0.9774	-0.6921	-3	-3	1.0268
TMP 1996.075.0001 - 4	-0.002005	-0.06133	-0.3059	0.06859	0.03472	-0.07462	-1.0895	-0.7862	-1.0248	-0.7392	1.0097

Sample Number	CH	M-CL	NL	AL	MCL	DCL	MDH	MDL	DDH	DDL	CA
TMP 1996.075.0001 - 5	-0.05894	-0.007200	-0.3894	-0.01672	-0.06967	-0.1533	-1.0450	-0.8643	-3	-3	0.9763
TMP 1996.075.0001 - 6	0.06747	-0.03342	-0.2867	0.1372	-0.1226	-0.2296	-1.0315	-0.7502	-3	-3	1.1473
TMP 1996.075.0001 - 7	0.01697	-0.02327	-0.2262	0.009217	-0.002235	-0.09659	-3	-3	-3	-3	0.9831
TMP 1996.075.0001 - 8	-3	-3	-0.2197	-3	-3	-3	-3	-3	-3	-3	-3
TMP 1996.075.0001 - 9	-0.007085	-0.07687	-0.3031	0.04838	-0.02410	-0.05516	-1.01224	-0.7891	-1.1357	-0.8865	0.9907
TMP 1996.089.0002	-0.001513	-0.09880	-0.2536	0.09544	-0.009389	-0.2298	-1.1300	-0.8146	-1.1388	-0.7628	0.9184
TMP 1997.012.0005	-0.04152	-0.03929	-0.1885	0.03807	-0.03266	-0.07893	-1.1017	-0.7140	-0.9217	-0.7742	0.9042
TMP 1997.012.0042	-0.01564	-0.03001	-0.2211	0.02551	-0.01862	-0.07537	-1.1227	-0.7380	-3	-3	0.9291
TMP 1997.012.0085	0.06478	-0.0003372	-0.2273	0.06940	-0.07057	-0.11455	-3	-3	-3	-3	0.9699
TMP 1997.012.0106	-0.008157	-0.09506	-0.2308	0.07372	0.01396	-0.03571	-3	-3	-0.9202	-0.7546	0.9325
TMP 1997.132.0001 - 1	0.1863	0.006418	-3	0.1970	0.1126	0.06016	-3	-3	-3	-3	1.0164
TMP 1997.132.0001 - 2	0.003466	-0.02655	-3	0.06793	-0.01821	-0.07878	-3	-3	-3	-3	0.8830
TMP 1997.132.0001 - 3	0.01363	-0.04826	-3	0.03037	-0.1010	-0.2393	-3	-3	-3	-3	0.8547
TMP 1997.132.0001 - 4	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
TMP 1997.132.0001 - 5	0.002000	-0.08514	-3	0.02853	0.02037	-0.1138	-3	-3	-3	-3	0.9016
TMP 1997.132.0001 - 6	0.01948	0.005045	-3	-0.002356	-0.06122	-0.06660	-3	-3	-3	-3	1.0588
TMP 1997.132.0001 - 7	-0.1020	-0.01461	-3	-0.05066	-0.04563	-0.1941	-0.9503	-0.8395	-3	-3	0.8050
TMP 1998.008.0004	0.07363	-0.03862	-0.2288	0.09205	0.02009	-0.09925	-3	-3	-3	-3	0.9161
TMP 1998.043.0004	-0.01543	-0.03429	-0.3024	0.02843	-0.04322	-0.1133	-0.9994	-0.7157	-3	-3	0.9091
TMP 1998.068.0086	-0.09012	-0.03047	-0.2652	-0.01575	-0.09443	-0.1455	-3	-3	-3	-3	0.6069
TMP 1998.068.0153	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
TMP 1998.098.0001 - 1	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3

Sample Number	CH	M-CL	NL	AL	MCL	DCL	MDH	MDL	DDH	DDL	CA
TMP 1998.098.0001 - 10	-0.1204	-0.03642	-0.1922	-0.07378	-0.1089	-0.1451	-3	-3	-3	-3	0.7302 3
TMP 1998.098.0001 - 11	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
TMP 1998.098.0001 - 12	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
TMP 1998.098.0001 - 13	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
TMP 1998.098.0001 - 14	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
TMP 1998.098.0001 - 15	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
TMP 1998.098.0001 - 16	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
TMP 1998.098.0001 - 17	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
TMP 1998.098.0001 - 18	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
TMP 1998.098.0001 - 19	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
TMP 1998.098.0001 - 2	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
TMP 1998.098.0001 - 20	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
TMP 1998.098.0001 - 21	-0.04867	-0.04803	-3	0.008897	-0.02751	-0.1515	-0.9262	- 0.9027	-3	-3	0.5346
TMP 1998.098.0001 - 22	0.01914	0.02521	-3	0.001902	-0.05827	-0.1164	-3	-3	-3	-3	0.8500
TMP 1998.098.0001 - 23	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
TMP 1998.098.0001 - 3	0.1443	-0.0456	-0.2806	0.08843	-0.05615	0.006513	-0.7908	- 0.7146	-3	-3	0.7892
TMP 1998.098.0001 - 4	-3	-3	-0.1758	-3	-3	-3	-3	-3	-3	-3	-3
TMP 1998.098.0001 - 5	-3	-3	-0.1822	-3	-3	-3	-3	-3	-3	-3	-3
TMP 1998.098.0001 - 6	-0.06113	-0.04650	-0.2261	0.02507	-0.01813	-0.2221	-3	-3	-3	-3	0.6304

Sample Number	CH	M-CL	NL	AL	MCL	DCL	MDH	MDL	DDH	DDL	CA
TMP 1998.098.0001 - 7	0.02259	-0.01018	-0.2491	-0.02291	-0.1259	-0.1131	-3	-3	-3	-3	0.4597
TMP 1998.098.0001 - 8	0.02363	-0.05884	-0.2413	-0.01050	-0.07890	-0.1239	-3	-3	-3	-3	0.3368
TMP 1998.098.0001 - 9	-0.006864	-0.01232	-0.1716	0.02379	-0.008028	-0.1997	-3	-3	-3	-3	0.5696
TMP 1998.102.0026 - 1	-0.05656	0.006918	-0.1633	0.02436	-0.02898	-0.08089	-0.9284	-0.7200	-0.8620	-0.7022	0.6668
TMP 1998.102.0026 - 2	-0.08676	-0.02734	-0.1987	0.003837	-0.03515	-0.2068	-3	-3	-3	-3	0.5606
TMP 1998.102.0026 - 3	-3	-3	-0.2078	-3	-3	-3	-3	-3	-3	-3	-3
TMP 1998.102.0026 - 4	-0.1128	-0.06644	-0.1249	-0.08034	-0.1227	-0.1568	-3	-3	-3	-3	0.6438
TMP 1998.102.0026 - 5	-3	-3	-0.1953	-3	-3	-3	-3	-3	-3	-3	-3
TMP 1998.102.0028 - 1	0.05047	-0.1223	-0.1816	0.1002	-0.004814	-0.02462	-0.8144	-0.5960	-0.7923	-0.6627	1.0616
TMP 1998.102.0028 - 2	0.08528	-0.01096	-0.2239	0.1201	0.04745	-0.01289	-3	-3	-3	-3	1.0563
TMP 1999.055.0162	-0.05549	-0.04060	-0.2848	-0.005876	-0.1125	-0.1746	-3	-3	-3	-3	0.9697
TMP 1999.055.0290	-0.01782	-0.05602	-0.1930	0.06485	-0.003711	-0.08769	-3	-3	-3	-3	0.8845
TMP 1999.063.0019	-0.04217	-0.003904	-0.1852	0.02437	-0.02353	-0.2021	-3	-3	-3	-3	0.6990
TMP 1999.085.0005	0.02698	0.004492	-0.1760	0.05405	-0.0007322	-0.09491	-1.0164	-0.7624	-0.9049	-0.7268	0.8888
TMP 2000.012.0020	-0.007466	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
TMP 2000.012.0024 - 1	-3	-3	-0.1930	-3	-3	-3	-3	-3	-3	-3	-3
TMP 2000.012.0024 - 2	-0.01561	-0.04892	-0.21471	0.04256	-0.003217	-0.1685	-3	-3	-3	-3	0.8261
TMP 2000.057.0027	-0.02078	-0.04844	-0.2232	0.04087	-0.03674	-0.09504	-3	-3	-3	-3	0.7299
TMP 2001.012.0072	0.003898	-0.06818	-0.2131	0.06270	-0.005695	-0.1317	-3	-3	-3	-3	1.0307
TMP 2001.012.0073	-3	-3	-0.1882	-3	-3	-3	-3	-3	-3	-3	-3
TMP 2002.012.0060	-3	-3	-0.2401	-3	-3	-3	-3	-3	-3	-3	-3
TMP 2002.012.0135	-3	-3	-0.1731	-3	-3	-3	-3	-3	-3	-3	-3
TMP 2002.060.0001 - 1	0.01030	0.01208	-0.2603	0.06131	-0.03060	-0.1722	-3	-3	-3	-3	1.0446
TMP 2002.060.0001 - 2	-0.1080	-0.08124	-0.1963	-0.01044	-0.07780	-0.1545	-3	-3	-3	-3	0.8523
TMP 2003.012.0106	-0.07782	-0.09148	-0.2796	0.005320	-0.04935	-0.0880	-0.9124	-0.7394	-1.0867	-0.7242	0.9236

Sample Number	CH	M-CL	NL	AL	MCL	DCL	MDH	MDL	DDH	DDL	CA
TMP 2004.107.0003	-0.05964	-0.05074	-0.2083	0.04445	0.003684	-0.2446	-3	-3	-3	-3	0.6834
TMP 2004.114.0005	-0.002198	-0.02200	-0.1685	0.09796	-0.02200	-0.1016	-3	-3	-3	-3	0.9766
TMP 2004.116.0016	-0.1425	-0.06116	-0.2085	0.01972	-0.03710	-0.1875	-0.9668	-0.6026	-1.0304	-0.5957	0.7120
TMP 2004.118.0012	-3	-3	-0.2110	-3	-3	-3	-3	-3	-3	-3	-3
TMP 2005.012.0027	-3	-3	-0.2322	-3	-3	-3	-3	-3	-3	-3	-3
TMP 2005.012.0185	-3	-3	-0.1892	-3	-3	-3	-3	-3	-3	-3	-3
TMP 2005.012.0233	-0.05403	-0.03360	-0.2518	0.05032	-0.08051	-0.1230	-0.9932	-0.8412	-1.0459	-0.8130	0.9662
TMP 2005.012.0265	-0.03788	-0.09133	-0.2657	0.05050	-0.009830	-0.1030	-1.1317	-0.8283	-0.8904	-0.7155	0.6117
TMP 2005.012.0279	-3	-3	-0.1679	-3	-3	-3	-3	-3	-3	-3	-3
TMP 2005.012.0280	-3	-3	-0.17898	-3	-3	-3	-3	-3	-3	-3	-3
TMP 2005.012.0305	-0.1013	-0.01838	-0.2478	-0.02452	-0.1140	-0.2004	-0.9939	-0.6775	-1.1591	-0.8004	0.6133
TMP 2005.012.0368	-3	-3	-0.2267	-3	-3	-3	-3	-3	-3	-3	-3
TMP 2005.012.0369	0.04053	-0.009371	-0.2081	0.06419	-0.04196	-0.1439	-0.8877	-0.8133	-0.9479	-0.6787	0.9017
TMP 2005.012.0384 - 1	-3	-3	0.03754	-3	-3	-3	-3	-3	-3	-3	-3
TMP 2005.012.0384 - 2	-3	-3	-0.2659	-3	-3	-3	-3	-3	-3	-3	-3
TMP 2005.012.0397	-3	-3	-0.1576	-3	-3	-3	-3	-3	-3	-3	-3
TMP 2005.012.0427	-0.03677	-0.0774	-0.2362	0.01812	-0.07141	-0.1609	-3	-3	-3	-3	0.6685
TMP 2005.049.0065	-3	-3	-0.1838	-3	-3	-3	-3	-3	-3	-3	-3
TMP 2005.049.0102	-3	-3	-0.1868	-3	-3	-3	-3	-3	-3	-3	-3
TMP 2005.049.0143	-3	-3	-0.2343	-3	-3	-3	-3	-3	-3	-3	-3
TMP 2005.054.0007	-0.1146	-0.04214	-0.2738	-0.006284	-0.06413	-0.2504	-3	-3	-3	-3	0.6455
TMP 2006.012.0182	0.02536	-0.06719	-0.2443	0.07193	0.05894	-0.008716	-0.9429	-0.7486	-3	-3	1.0747
TMP 2008.043.0051	-3	-3	-0.1691	-3	-3	-3	-3	-3	-3	-3	-3

Sample Number	CH	M-CL	NL	AL	MCL	DCL	MDH	MDL	DDH	DDL	CA
TMP 2011.047.0002	0.01766	-0.04554	-0.2049	0.07538	0.04693	-0.0001723	-0.9757	-0.7419	-0.9700	-0.8029	0.9433
TMP 2011.047.0010	-3	-3	-0.1354	-3	-3	-3	-3	-3	-3	-3	-3
TMP 2011.047.0079	0.005355	-0.1194	-0.2936	0.07526	0.001258	-0.10873	-1.1828	-0.8980	-3	-3	1.0316
TMP 2012.012.0017	0.06237	-0.008065	-0.17544	0.1011	0.03143	-0.07002	-3	-3	-3	-3	0.9649
TMP 2013.012.0057	0.02656	-0.04280	-0.1824	0.08031	0.005025	-0.09849	-1.0144	-0.7077	-1.1274	-0.7382	0.5971
TMP 2014.012.0128	-3	-3	-0.2201	-3	-3	-3	-3	-3	-3	-3	-3
TMP 2014.012.0134	0.06518	-0.04805	-0.2703	0.1014	0.003415	-0.07213	-3	-3	-3	-3	1.1769
TMP 2018.012.0172	-3	-3	-0.2054	-3	-3	-3	-3	-3	-3	-3	-3
TMP 2019.012.0011	-0.08908	-0.03798	-0.2193	0.03757	-0.06901	-0.09989	-0.8270	-0.8051	-0.9950	-0.6549	0.8809
TMP 2023.012.0023	-3	-3	-0.2538	-3	-3	-3	-3	-3	-3	-3	-3
TMP 2023.012.0242	-3	-3	-0.1940	-3	-3	-3	-3	-3	-3	-3	-3
UALVP 00002 - 1	-3	-3	-0.1341	-3	-3	-3	-3	-3	-3	-3	-3
UALVP 00002 - 10	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
UALVP 00002 - 11	-0.09869	-0.00809	-0.2038	-0.1083	-0.1386	-0.2553	-3	-3	-3	-3	0.8319
UALVP 00002 - 12	-0.1622	-0.007571	-0.2240	-0.06909	-0.2187	-0.1883	-3	-3	-3	-3	0.9873
UALVP 00002 - 13	-0.08328	-0.03941	-3	-0.0517	-0.1131	-0.1691	-3	-3	-3	-3	0.9128
UALVP 00002 - 14	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
UALVP 00002 - 15	-0.06117	-0.01860	-0.2152	-0.04622	-0.1437	-0.2139	-3	-3	-3	-3	0.8866
UALVP 00002 - 16	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
UALVP 00002 - 17	-0.09068	-0.006737	-3	-0.05783	-0.1209	-0.1850	-3	-3	-3	-3	0.9086
UALVP 00002 - 18	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
UALVP 00002 - 19	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
UALVP 00002 - 2	-3	-3	-0.1037	-3	-3	-3	-3	-3	-3	-3	-3
UALVP 00002 - 20	-3	-3	-0.1636	-3	-3	-3	-3	-3	-3	-3	-3
UALVP 00002 - 21	-0.05116	-0.03615	-0.1933	-0.0867	-0.1798	-0.1823	-3	-3	-3	-3	0.9824

Sample Number	CH	M-CL	NL	AL	MCL	DCL	MDH	MDL	DDH	DDL	CA
UALVP 00002 - 22	-3	-3	-0.1137	-3	-3	-3	-3	-3	-3	-3	-3
UALVP 00002 - 23	-3	-3	-0.1067	-3	-3	-3	-3	-3	-3	-3	-3
UALVP 00002 - 24	0.1303	-0.1483	-0.02477	0.1850	0.1392	-0.1471	-3	-3	-3	-3	1.0283
UALVP 00002 - 25	0.2126	-0.09446	-0.1172	0.2256	0.1452	-0.05226	-3	-3	-3	-3	1.2743
UALVP 00002 - 26	-3	-3	-0.1652	-3	-3	-3	-3	-3	-3	-3	-3
UALVP 00002 - 27	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
UALVP 00002 - 28	-0.07236	-0.03731	-0.1339	-0.09813	-0.1197	-0.2487	-3	-3	-3	-3	0.9824
UALVP 00002 - 29	-3	-3	-0.1409	-3	-3	-3	-3	-3	-3	-3	-3
UALVP 00002 - 3	-0.05124	-0.2030	-0.1251	-0.03922	-0.08946	-0.09233	-3	-3	-3	-3	1.0215
UALVP 00002 - 30	-0.07738	-0.03475	-0.1370	-0.02302	-0.08510	-0.1642	-3	-3	-3	-3	0.9588
UALVP 00002 - 31	-0.09135	-0.03670	-0.2032	-0.06372	-0.1132	-0.1896	-3	-3	-3	-3	1.0687
UALVP 00002 - 32	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
UALVP 00002 - 33	-0.09963	-0.07347	-0.09500	-0.06474	-0.1067	-0.09036	-3	-3	-3	-3	1.0669
UALVP 00002 - 34	-0.1116	-0.08950	-0.1375	-0.03016	-0.04323	-0.1663	-3	-3	-3	-3	1.1093
UALVP 00002 - 35	-3	-3	-0.0993	-3	-3	-3	-3	-3	-3	-3	-3
UALVP 00002 - 36	-0.009750	-0.08372	-0.1037	-0.1037	-0.04966	-0.2040	-3	-3	-3	-3	0.9384
UALVP 00002 - 37	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
UALVP 00002 - 38	-3	-3	-0.2264	-3	-3	-3	-3	-3	-3	-3	-3
UALVP 00002 - 39	-0.1204	-0.09961	-0.1305	-0.1092	-0.1685	-0.1204	-3	-3	-3	-3	1.1533
UALVP 00002 - 4	-0.007991	-0.1311	-0.1145	0.05670	-0.08302	0.02870	-3	-3	-3	-3	1.1036
UALVP 00002 - 40	-0.08074	-0.06837	-0.2510	-0.04592	-0.1171	-0.2531	-3	-3	-3	-3	0.9544
UALVP 00002 - 5	0.08010	-0.1655	-0.1100	0.1118	-0.03731	0.01368	-3	-3	-3	-3	1.1222
UALVP 00002 - 6	-0.05004	-0.1879	-3	-0.007025	-0.09167	-0.1189	-3	-3	-3	-3	0.9741
UALVP 00002 - 7	-0.1023	-0.2179	-3	-0.04337	-0.06278	-0.09514	-3	-3	-3	-3	0.9787
UALVP 00002 - 8	-0.06671	-0.2060	-3	-0.005185	-0.07994	-0.09160	-3	-3	-3	-3	0.9651
UALVP 00002 - 9	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
UALVP 48641	-3	-3	-0.3209	-3	-3	-3	-3	-3	-3	-3	-3

Sample Number	CH	M-CL	NL	AL	MCL	DCL	MDH	MDL	DDH	DDL	CA
UALVP 48747	-0.03400	-0.01553	-0.1955	0.02745	-0.08286	-0.1928	-3	-3	-3	-3	0.9185
UALVP 49327	-0.01921	-0.02144	-0.2117	0.01990	-0.05973	-0.2455	-3	-3	-3	-3	0.9516
UALVP 53588 - 1	-0.04564	-0.03837	-0.2746	0.02215	0.00453	-0.2730	-3	-3	-3	-3	0.8585
UALVP 53588 - 2	0.003500	-0.02709	-0.3535	0.05979	-0.007850	-0.03592	-3	-3	-3	-3	1.1159
UALVP 53588 - 3	-0.01929	-0.03752	-0.2261	0.01430	-0.05233	-0.1924	-1.1921	-1.0068	-1.1180	-0.8502	0.9429
UALVP 53588 - 4	0.003077	-0.002225	-0.2670	0.02198	0.006576	-0.06424	-3	-3	-3	-3	1.0156
UALVP 53588 - 5	-0.01679	-0.06777	-0.2914	-0.03185	-0.06986	-0.1364	-3	-3	-3	-3	1.0158
UALVP 53588 - 6	0.07349	-0.08631	-0.1694	0.1427	0.09186	0.06956	-1.3007	-0.9857	-1.1597	-0.9681	1.1267
UALVP 53590	0.08148	-0.05372	-0.1517	0.1170	-0.03033	0.02316	-3	-3	-3	-3	1.2133
UALVP 53591	-0.07515	-0.04647	-0.1988	-0.002999	-0.04484	-0.2367	-1.2169	-0.7964	-3	-3	0.6398
UALVP 53975	-0.09230	0.03250	-3	0.02650	-0.01200	-0.1130	-0.9974	-0.8306	-0.8075	-0.7288	0.7852
UALVP 55323	-0.111	-0.00253	-0.2512	0.01068	-0.008543	-0.2013	-3	-3	-3	-3	0.8001
UALVP 55366	-0.01957	-0.04944	-0.2298	0.04276	-0.01587	-0.07618	-3	-3	-3	-3	1.0293
UALVP 55378	-0.03015	-0.0165 1	-0.3744	0.03926	0.02728	-0.1262	-3	-3	-0.8180	-0.7302	0.9703
UALVP 55390	-0.06099	0.001740	-0.1970	-0.02498	-0.07360	-0.1738	-3	-3	-0.9315	-0.8404	0.5022
UALVP 55621	0.02857	-0.03886	-0.2494	0.03451	-0.01988	-0.05386	-0.9764	-0.8442	-0.9567	-0.7275	0.9502
UALVP 59296	-3	-3	-0.2146	-3	-3	-3	-3	-3	-3	-3	-3
UALVP 61124 - 1	-0.05311	-0.04712	-0.2415	0.007489	-0.1173	-0.08367	-3	-3	-3	-3	0.8779
UALVP 61124 - 2	-0.01972	-0.04487	-0.2611	0.05355	0.01721	-0.2462	-3	-3	-3	-3	0.5927
UALVP 61153	-3	-3	-0.2280	-3	-3	-3	-3	-3	-3	-3	-3
UALVP 61442	0.01008	-0.05940	-0.2414	0.07598	0.001320	-0.06349	-3	-3	-3	-3	1.0157
UMNH VP 11638	-0.11310	-0.2044	-0.1894	0.05668	-3	-3	-3	-3	-3	-3	0.6887
UMNH VP 1228	0.02556	-0.2732	-0.1632	0.05198	0.004396	-0.002561	-1.0779	-1.0779	-1.2012	-0.81059	1.1632
UMNH VP 1232	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3

Sample Number	CH	M-CL	NL	AL	MCL	DCL	MDH	MDL	DDH	DDL	CA
UMNH VP 12637	-0.1827	-0.1146	-0.2098	-0.1196	-0.1733	-0.2787	-3	-3	-1.0082	-0.9006	0.6332
UMNH VP 12864	-0.02702	-0.1995	-0.1916	-0.04072	-0.07853	-0.1867	-1.2712	-1.2712	-1.3348	-0.8548	0.7985
UMNH VP 14228	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
UMNH VP 14436	-0.07001	-0.1372	-0.1801	0.005055	-0.09014	-0.1149	-1.1319	-1.1319	-1.2150	-0.9332	1.0423
UMNH VP 14488	-0.1511	-0.2079	-0.2811	-0.08369	-0.1651	-0.1839	-1.0908	-1.0908	-0.8887	-0.9848	1.1410
UMNH VP 16221	-0.1038	-0.01894	-0.1924	-0.08787	-0.1829	-0.2179	-1.0537	-1.0537	-0.9373	-0.7916	0.7632
UMNH VP 16874	-0.1834	-0.05899	-0.2080	-3	-3	-3	-3	-3	-3	-3	-3
UMNH VP 17418	-0.1872	-0.3267	-3	-0.09443	-0.1528	-3	-1.0740	-1.0740	-3	-3	1.4122
UMNH VP 17502	-0.02565	-0.1444	-0.2196	0.05548	0.01736	-0.006526	-0.9391	-0.9391	-0.8409	-0.8656	1.1733
UMNH VP 17514	-3	-0.1425	-3	-3	-3	-3	-0.9549	-0.9549	-0.8415	-0.8070	-3
UMNH VP 17973	-0.09511	-0.1615	-0.2014	-0.03860	-0.04415	-0.08271	-1.0965	-1.0965	-1.0965	-1.0376	1.1119
UMNH VP 19037	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
UMNH VP 19040	-0.07986	-0.1766	-0.2578	0.023823	-0.02302	-0.2085	-1.0343	-1.0343	-0.9204	-0.8913	1.0715
UMNH VP 19699	-0.06644	-0.2359	-0.1637	0.01829	-0.06011	-0.1856	-0.9921	-0.9921	-1.0924	-1.1156	1.3470
UMNH VP 19719	-3	-3	-0.1363	-3	-3	-3	-3	-3	-3	-3	-3
UMNH VP 19720	0.03716	-0.1502	-3	0.04710	-0.01347	-0.1368	-0.8260	-0.8260	-0.7504	-0.6540	1.1471
UMNH VP 20599	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
UMNH VP 20903	-0.08421	-0.2096	-0.2227	-0.03491	-0.07972	-0.09597	-1.1983	-1.1983	-1.1216	-0.9223	0.7832
UMNH VP 24117	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
UMNH VP 5609	-0.003290	-0.2349	-0.2413	0.04615	-0.03833	-0.1485	-0.9503	-0.9503	-1.21589	-1.1083	1.5964

Sample Number	CH	M-CL	NL	AL	MCL	DCL	MDH	MDL	DDH	DDL	CA
UMNH VP 6765	-0.07831	-0.1457	-0.1904	-3	-3	-3	-3	-3	-3	-3	-3
UMNH VP 7603	0.0004340	-0.3165	-3	0.0004340	-0.06913	-0.08841	-0.8264	-0.8264	-1.1245	-0.8264	1.7099
UMNH VP 7658	0.094305	-0.1194	-3	-3	-3	-3	-3	-3	-3	-3	-3
UMNH VP 7672	-3	-3	-0.2609	-3	-3	-3	-3	-3	-3	-3	-3
ZPAL MgD II/1-1	-3	-0.1004	-0.1221	0.002715	-0.04962	-0.06708	-1.0964	-0.9874	-1.0103	-0.9127	0.9900
ZPAL MgD II/1-2	-0.08065	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
ZPAL MgD II/1-3	-3	-0.08330	-0.1657	0.04151	-0.02818	-0.05618	-0.9413	-0.7319	-1.1023	-0.7665	0.9914
ZPAL MgD II/1-4	-0.08143	-0.06480	-0.1959	0.04549	-0.05447	-0.05169	-0.9078	-0.8129	-1.0473	-0.7351	1.0599
ZPAL MgD II/1-5	0.03805	-0.08001	-3	0.05805	-0.007230	-0.05822	-0.8627	-0.6446	-1.0162	-0.7044	1.0743
ZPAL MgD II/1-6	-0.01155	-0.03141	-0.1099	0.03450	-0.02219	-0.07787	-3	-3	-0.7842	-0.7564	1.0151
ZPAL MgD II/1-7	-0.005911	-0.1864	-0.014324	0.04093	-0.03288	-0.07229	-1.0051	-0.9110	-1.0451	-0.8885	1.0924

Appendix E – Raw data

Appendix E – 1: Specimen original identifications, geologic units, and age

Sample Number	Coombs (1978) family or other higher taxonomic original ID	Raven et al. (2023) family	Taxon	Unit	Age citation	Age
BYU VP 50866	Nodosauridae	Polacanthidae	*Gastonia burgei*	Cedar Mountain Fm	Joeckel et al., 2020	Barrasian-Valanginian (125-120)
CEUM 09173	Nodosauridae	Polacanthidae or basal ankylosaur	*Anamantarx rameljonesi*	Cedar Mountain Formation, Mussentuchit member	Tucker et al., 2020	Cenomanian (98-96)
CEUM 11909	Nodosauridae	Polacanthidae	*Gastonia burgei*	Cedar Mountain Fm, Yellow Cat member	Joeckel et al., 2020	Barrasian-Valanginian (139-134)
CEUM 11910	Nodosauridae	Polacanthidae	*Gastonia burgei*	Cedar Mountain Fm, Yellow Cat member	Joeckel et al., 2020	Barrasian-Valanginian (139-134)
CEUM 11911	Nodosauridae	Polacanthidae	*Gastonia burgei*	Cedar Mountain Fm, Yellow Cat member	Joeckel et al., 2020	Barrasian-Valanginian (139-134)
CEUM 11912	Nodosauridae	Polacanthidae	*Gastonia burgei*	Cedar Mountain Fm, Yellow Cat member	Joeckel et al., 2020	Barrasian-Valanginian (139-134)
CEUM 11923	Ankylosaur			Cedar Mountain Fm	Kirkland et al., 2016	Late Jurassic-Cenomanian
CEUM 11924	Ankylosaur			Cedar Mountain Fm	Kirkland et al., 2016	Late Jurassic-Cenomanian
CEUM 12435	Nodosauridae	Polacanthidae or Basal ankylosaur	*Anamantarx rameljonesi*	Cedar Mountain Formation,	Tucker et al., 2020	Cenomanian (98-96)

Sample Number	Coombs (1978) family or other higher taxonomic original ID	Raven et al. (2023) family	Taxon	Unit	Age citation	Age
				Mussentuchit member		
CEUM 1264 #86	Ankylosauridae	Basal ankylosaur	*Cedarpelta bilbeyhallorum*	Cedar Mountain Fm, Ruby Ranch member	Chure et al., 2010, Gulbranson et al., 2020	Aptian-Albian (123.66-104.46)
CEUM 12811	Nodosauridae	Polacanthidae	*Peloroplites cedrimontanus*	Cedar Mountain Fm, Ruby Ranch member	Chure et al., 2010, Gulbranson et al., 2020	Aptian-Albian (123.66-104.46)
CEUM 31206	Nodosauridae	Polacanthidae	*Peloroplites cedrimontanus*	Cedar Mountain Fm, Ruby Ranch member	Chure et al., 2010, Gulbranson et al., 2020	Aptian-Albian (123.66-104.46)
CEUM 34580	Nodosauridae	Polacanthidae	*Peloroplites cedrimontanus*	Cedar Mountain Fm, Ruby Ranch member	Chure et al., 2010, Gulbranson et al., 2020	Aptian-Albian (123.66-104.46)
CEUM 53115	Nodosauridae	Polacanthidae	*Peloroplites cedrimontanus*	Cedar Mountain Fm, Ruby Ranch member	Chure et al., 2010, Gulbranson et al., 2020	Aptian-Albian (123.66-104.46)
CEUM 5373	Nodosauridae	Polacanthidae	*Gastonia burgei*	Cedar Mountain Fm, Yellow Cat member	Joeckel et al., 2020	Barrasian-Valanginian (139-134)
CMNFV 1131	Carnivorous dinosaur?			Oldman Fm	Eberth, 2024	Campanian (78-77)
CMNFV 119 - 1	Nodosauridae		*Paleoscincus*	Oldman Fm	Eberth, 2024	Campanian (78-77)
CMNFV 119 - 2	Nodosauridae		*Paleoscincus*	Oldman Fm	Eberth, 2024	Campanian (78-77)

Sample Number	Coombs (1978) family or other higher taxonomic original ID	Raven et al. (2023) family	Taxon	Unit	Age citation	Age
CMNFV 119 - 3	Nodosauridae		*Paleoscincus*	Oldman Fm	Eberth, 2024	Campanian (78-77)
CMNFV 119 - 4	Nodosauridae		*Paleoscincus*	Oldman Fm	Eberth, 2024	Campanian (78-77)
CMNFV 119 - 5	Nodosauridae		*Paleoscincus*	Oldman Fm	Eberth, 2024	Campanian (78-77)
CMNFV 119 - 6	Nodosauridae		*Paleoscincus*	Oldman Fm	Eberth, 2024	Campanian (78-77)
CMNFV 129 - 1	Ankylosaur			Oldman Fm	Eberth, 2024	Campanian (78-77)
CMNFV 129 - 2	Ankylosaur			Oldman Fm	Eberth, 2024	Campanian (78-77)
CMNFV 1349	Nodosauridae		*Palaeoscincus asper*			
CMNFV 1772 - 1	Nodosauridae	Panoplosauridae	*Edmontonia/ Panoplosaurus*	Belly River Group	Eberth, 2024	Campanian
CMNFV 1772 - 2	Nodosauridae	Panoplosauridae	*Edmontonia/ panoplosaurus*	Belly River Group	Eberth, 2024	Campanian
CMNFV 1772 - 3	Nodosauridae	Panoplosauridae	*Edmontonia/ Panoplosaurus*	Belly River Group	Eberth, 2024	Campanian
CMNFV 1772 - 4	Nodosauridae	Panoplosauridae	*Edmontonia/ Panoplosaurus*	Belly River Group	Eberth, 2024	Campanian
CMNFV 1772 - a	Ankylosauridae	Ankylosauridae	*Euoplocephalus tutus*	Belly River Group	Eberth, 2024	Campanian
CMNFV 21864	Nodosauridae	Panoplosauridae	*Edmontonia*	St. Mary River Fm	Campbell et al., 2019	Campanian-Maastrichtian
CMNFV 2334	Ankylosaur			Belly River Group	Eberth, 2024	Campanian
CMNFV 2759 - 1	Nodosauridae	Panoplosauridae	*Panoplosaurus mirus*	Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
CMNFV 2759 - 2	Nodosauridae	Panoplosauridae	*Panoplosaurus mirus*	Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
CMNFV 2759 - 3	Nodosauridae	Panoplosauridae	*Panoplosaurus mirus*	Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)

Sample Number	Coombs (1978) family or other higher taxonomic original ID	Raven et al. (2023) family	Taxon	Unit	Age citation	Age
CMNFV 2759 - 4	Nodosauridae	Panoplosauridae	*Panoplosaurus mirus*	Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
CMNFV 2759 - 5	Nodosauridae	Panoplosauridae	*Panoplosaurus mirus*	Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
CMNFV 2759 - 6	Nodosauridae	Panoplosauridae	*Panoplosaurus mirus*	Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
CMNFV 38441	Ankylosauridae			Oldman Fm	Eberth, 2024	Campanian (78-77)
CMNFV 38442	Ankylosauridae			Oldman Fm	Eberth, 2024	Campanian (78-77)
CMNFV 38443	Ankylosauridae			Oldman Fm	Eberth, 2024	Campanian (78-77)
CMNFV 38444	Ankylosauridae			Oldman Fm	Eberth, 2024	Campanian (78-77)
CMNFV 38445	Ankylosauridae			Oldman Fm	Eberth, 2024	Campanian (78-77)
CMNFV 38446	Ankylosauridae			Oldman Fm	Eberth, 2024	Campanian (78-77)
CMNFV 38447	Ankylosauridae			Oldman Fm	Eberth, 2024	Campanian (78-77)
CMNFV 38448	Ankylosauridae			Oldman Fm	Eberth, 2024	Campanian (78-77)
CMNFV 38449	Ankylosauridae			Oldman Fm	Eberth, 2024	Campanian (78-77)
CMNFV 59240 - 1	Nodosauridae			Belly River Group	Eberth, 2024	Campanian
CMNFV 59240 - 2	Nodosauridae			Belly River Group	Eberth, 2024	Campanian
CMNFV 59240 - 3	Nodosauridae			Belly River Group	Eberth, 2024	Campanian
CMNFV 59431	Nodosauridae		*Palaeoscincus asper*	Belly River Group	Eberth, 2024	Campanian

Sample Number	Coombs (1978) family or other higher taxonomic original ID	Raven et al. (2023) family	Taxon	Unit	Age citation	Age
CMNFV 59432 - 1	Stegosauroid			Belly River Group	Eberth, 2024	Campanian
CMNFV 59432 - 2	Stegosauroid			Belly River Group	Eberth, 2024	Campanian
CMNFV 59459	Nodosauridae		*Palaeoscincus asper*	Belly River Group	Eberth, 2024	Campanian
CMNFV 59460	Nodosauridae		*Palaeoscincus costatus*	Belly River Group	Eberth, 2024	Campanian
CMNFV 59480	Nodosauridae		*Palaeoscincus costatus*	Belly River Group	Eberth, 2024	Campanian
CMNFV 59510 - 1	Nodosauridae		*Palaeoscincus asper*	Belly River Group	Eberth, 2024	Campanian
CMNFV 59510 - 2	Nodosauridae		*Palaeoscincus asper*	Belly River Group	Eberth, 2024	Campanian
CMNFV 59534	Ankylosauridae	Ankylosauridae	*Euoplocephalus*	Belly River Group	Eberth, 2024	Campanian
CMNFV 59591 - 1	Ankylosaur			Foremost Fm	Eberth, 2024	Campanian (80-78)
CMNFV 59591 - 2	Ankylosaur			Foremost Fm	Eberth, 2024	Campanian (80-78)
CMNFV 8531 - 1	Nodosauridae	Panoplosauridae	*Edmontonia longiceps*	Horseshoe Canyon Fm	Eberth & Kamo, 2020	Campanian-Maastrichtian (73.1-68)
CMNFV 8531 - 2	Nodosauridae	Panoplosauridae	*Edmontonia longiceps*	Horseshoe Canyon Fm	Eberth & Kamo, 2020	Campanian-Maastrichtian (73.1-68)
CMNFV 8531 - 3	Nodosauridae	Panoplosauridae	*Edmontonia longiceps*	Horseshoe Canyon Fm	Eberth & Kamo, 2020	Campanian-Maastrichtian (73.1-68)
CMNFV 8531 - 4	Nodosauridae	Panoplosauridae	*Edmontonia longiceps*	Horseshoe Canyon Fm	Eberth & Kamo, 2020	Campanian-Maastrichtian (73.1-68)
CMNFV 8531 - 5	Nodosauridae	Panoplosauridae	*Edmontonia longiceps*	Horseshoe Canyon Fm	Eberth & Kamo, 2020	Campanian-Maastrichtian (73.1-68)
CMNFV 8531 - 6	Nodosauridae	Panoplosauridae	*Edmontonia longiceps*	Horseshoe Canyon Fm	Eberth & Kamo, 2020	Campanian-Maastrichtian (73.1-68)

Sample Number	Coombs (1978) family or other higher taxonomic original ID	Raven et al. (2023) family	Taxon	Unit	Age citation	Age
CMNFV 8531 - 7	Nodosauridae	Panoplosauridae	*Edmontonia longiceps*	Horseshoe Canyon Fm	Eberth & Kamo, 2020	Campanian-Maastrichtian (73.1-68)
CMNFV 8531 - 8	Nodosauridae	Panoplosauridae	*Edmontonia longiceps*	Horseshoe Canyon Fm	Eberth & Kamo, 2020	Campanian-Maastrichtian (73.1-68)
CMNFV 8531 - 9	Nodosauridae	Panoplosauridae	*Edmontonia longiceps*	Horseshoe Canyon Fm	Eberth & Kamo, 2020	Campanian-Maastrichtian (73.1-68)
CMNFV 8537 - 1	Thescelosauridae	Thescelosauridae	*Thescelosaurus edmontonensis*	Scollard Fm	Eberth & Kamo, 2020	Maastrichtian (66.88-66.043)
CMNFV 8537 - 2	Thescelosauridae	Thescelosauridae	*Thescelosaurus edmontonensis*	Scollard Fm	Eberth & Kamo, 2020	Maastrichtian (66.88-66.043)
CMNFV 8537 - 3	Thescelosauridae	Thescelosauridae	*Thescelosaurus edmontonensis*	Scollard Fm	Eberth & Kamo, 2020	Maastrichtian (66.88-66.043)
CMNFV 8537 - 4	Thescelosauridae	Thescelosauridae	*Thescelosaurus edmontonensis*	Scollard Fm	Eberth & Kamo, 2020	Maastrichtian (66.88-66.043)
CMNFV 8537 - 5	Thescelosauridae	Thescelosauridae	*Thescelosaurus edmontonensis*	Scollard Fm	Eberth & Kamo, 2020	Maastrichtian (66.88-66.043)
CMNFV 8537 - 6	Thescelosauridae	Thescelosauridae	*Thescelosaurus edmontonensis*	Scollard Fm	Eberth & Kamo, 2020	Maastrichtian (66.88-66.043)
CMNFV 8537 - 7	Thescelosauridae	Thescelosauridae	*Thescelosaurus edmontonensis*	Scollard Fm	Eberth & Kamo, 2020	Maastrichtian (66.88-66.043)
CMNFV 8537 - 8	Thescelosauridae	Thescelosauridae	*Thescelosaurus edmontonensis*	Scollard Fm	Eberth & Kamo, 2020	Maastrichtian (66.88-66.043)
CMNFV 8731 - 1	Ankylosaur			Milk River Fm	Payenberg et al., 2002	Santonian
CMNFV 8731 - 2	Ankylosaur			Milk River Fm	Payenberg et al., 2002	Santonian
CMNFV 8731 - 3	Ankylosaur			Milk River Fm	Payenberg et al., 2002	Santonian
CMNFV 8731 - 4	Ankylosaur			Milk River Fm	Payenberg et al., 2002	Santonian
CMNFV 8876 - 1	Ankylosauridae	Ankylosauridae	*Euoplocephalus tutus*	Oldman Fm	Eberth, 2024	Campanian (78-77)

Sample Number	Coombs (1978) family or other higher taxonomic original ID	Raven et al. (2023) family	Taxon	Unit	Age citation	Age
CMNFV 8876 - 2	Ankylosauridae	Ankylosauridae	*Euoplocephalus tutus*	Oldman Fm	Eberth, 2024	Campanian (78-77)
CMNFV 8876 - 3	Ankylosauridae	Ankylosauridae	*Euoplocephalus tutus*	Oldman Fm	Eberth, 2024	Campanian (78-77)
CMNFV 8880 - 1	Ankylosauridae	Ankylosauridae	*Ankylosaurus magniventris*	Scollard Fm	Eberth & Kamo, 2020	Maastrichtian (66.88-66.043)
CMNFV 8880 - 2	Ankylosauridae	Ankylosauridae	*Ankylosaurus magniventris*	Scollard Fm	Eberth & Kamo, 2020	Maastrichtian (66.88-66.043)
CMNFV 973	Nodosauridae		*Palaeoscincus costatus*	Belly River Group	Eberth, 2024	Campanian
CMNFV CMS1921 - 1						
CMNFV CMS1921 - 2						
CMNFV CMS1921 - 3						
CMNFV CMS1921 - 4						
CMNFV CMS1921 - 5						
CMNFV CMS1921 - 6						
CMNFV CMS1921 - 7						
CMNFV CMS1921 - 8						
CMNFV RDR - 1	Ankylosaur					
CMNFV RDR - 10	Ankylosaur					
CMNFV RDR - 11	Ankylosaur					

Sample Number	Coombs (1978) family or other higher taxonomic original ID	Raven et al. (2023) family	Taxon	Unit	Age citation	Age
CMNFV RDR - 12	Ankylosaur					
CMNFV RDR - 2	Ankylosaur					
CMNFV RDR - 3	Ankylosaur					
CMNFV RDR - 4	Ankylosaur					
CMNFV RDR - 5	Ankylosaur					
CMNFV RDR - 6	Ankylosaur					
CMNFV RDR - 7	Ankylosaur					
CMNFV RDR - 8	Ankylosaur					
CMNFV RDR - 9	Ankylosaur					
CMNFV UN - 1						
CMNFV UN - 2						
CMNFV UN - 3						
CMNFV UN - 4						
CMNFV UN - 5						
CMNFV UN - 6						
CMNFV UN - 7						

Sample Number	Coombs (1978) family or other higher taxonomic original ID	Raven et al. (2023) family	Taxon	Unit	Age citation	Age
CMNFV UN - 8						
CMNFV UN - 9						
DMNH EPV 53040	Nodosauridae	Polacanthidae	paratype *Gastonia lorriemcwhimeyae*	Cedar Mountain Fm, Ruby Ranch member	Chure et al., 2010, Gulbranson et al., 2020	Aptian-Albian (123.66-104.46)
DMNH EPV 136185 - 13	Thescelosaur	Thescelosauridae	*Thescelosaurus neglectus*	Hell Creek Fm	Johnson, Nichols, & Hartman 2002	Maastrichtian (70-66 Ma)
DMNH EPV 136185 - 14	Thescelosaur	Thescelosauridae	*Thescelosaurus neglectus*	Hell Creek Fm	Johnson, Nichols, & Hartman 2002	Maastrichtian (70-66 Ma)
DMNH EPV 136185 - 15	Thescelosaur	Thescelosauridae	*Thescelosaurus neglectus*	Hell Creek Fm	Johnson, Nichols, & Hartman 2002	Maastrichtian (70-66 Ma)
DMNH EPV 136185 - 16	Thescelosaur	Thescelosauridae	*Thescelosaurus neglectus*	Hell Creek Fm	Johnson, Nichols, & Hartman 2002	Maastrichtian (70-66 Ma)
DMNH EPV 136185 - 17	Thescelosaur	Thescelosauridae	*Thescelosaurus neglectus*	Hell Creek Fm	Johnson, Nichols, & Hartman 2002	Maastrichtian (70-66 Ma)
DMNH EPV 136185 - 18	Thescelosaur	Thescelosauridae	*Thescelosaurus neglectus*	Hell Creek Fm	Johnson, Nichols, & Hartman 2002	Maastrichtian (70-66 Ma)
DMNH EPV 136185 - 19	Thescelosaur	Thescelosauridae	*Thescelosaurus neglectus*	Hell Creek Fm	Johnson, Nichols, & Hartman 2002	Maastrichtian (70-66 Ma)
DMNH EPV 136185 - 20	Thescelosaur	Thescelosauridae	*Thescelosaurus neglectus*	Hell Creek Fm	Johnson, Nichols, & Hartman 2002	Maastrichtian (70-66 Ma)
DMNH EPV 136185 - 21	Thescelosaur	Thescelosauridae	*Thescelosaurus neglectus*	Hell Creek Fm	Johnson, Nichols, & Hartman 2002	Maastrichtian (70-66 Ma)
DMNH EPV 136185 - 22	Thescelosaur	Thescelosauridae	*Thescelosaurus neglectus*	Hell Creek Fm	Johnson, Nichols, & Hartman 2002	Maastrichtian (70-66 Ma)
DMNH EPV 136185 - 23	Thescelosaur	Thescelosauridae	*Thescelosaurus neglectus*	Hell Creek Fm	Johnson, Nichols, & Hartman 2002	Maastrichtian (70-66 Ma)
DMNH EPV 136185 - 24	Thescelosaur	Thescelosauridae	*Thescelosaurus neglectus*	Hell Creek Fm	Johnson, Nichols, & Hartman 2002	Maastrichtian (70-66 Ma)

Sample Number	Coombs (1978) family or other higher taxonomic original ID	Raven et al. (2023) family	Taxon	Unit	Age citation	Age
DMNH EPV 136185 - 25	Thescelosaur	Thescelosauridae	*Thescelosaurus neglectus*	Hell Creek Fm	Johnson, Nichols, & Hartman 2002	Maastrichtian (70-66 Ma)
DMNH EPV 136185 - 26	Thescelosaur	Thescelosauridae	*Thescelosaurus neglectus*	Hell Creek Fm	Johnson, Nichols, & Hartman 2002	Maastrichtian (70-66 Ma)
DMNH EPV 136185 - 27	Thescelosaur	Thescelosauridae	*Thescelosaurus neglectus*	Hell Creek Fm	Johnson, Nichols, & Hartman 2002	Maastrichtian (70-66 Ma)
DMNH EPV 18168 - 1	Nodosauridae			Cloverly Fm	D'Emic et al., 2019	Valanginian-Cenomanian (140-98)
DMNH EPV 18168 - 10	Nodosauridae			Cloverly Fm	D'Emic et al., 2019	Valanginian-Cenomanian (140-98)
DMNH EPV 18168 - 11	Nodosauridae			Cloverly Fm	D'Emic et al., 2019	Valanginian-Cenomanian (140-98)
DMNH EPV 18168 - 12	Nodosauridae			Cloverly Fm	D'Emic et al., 2019	Valanginian-Cenomanian (140-98)
DMNH EPV 18168 - 13	Nodosauridae			Cloverly Fm	D'Emic et al., 2019	Valanginian-Cenomanian (140-98)
DMNH EPV 18168 - 14	Nodosauridae			Cloverly Fm	D'Emic et al., 2019	Valanginian-Cenomanian (140-98)
DMNH EPV 18168 - 15	Nodosauridae			Cloverly Fm	D'Emic et al., 2019	Valanginian-Cenomanian (140-98)
DMNH EPV 18168 - 16	Nodosauridae			Cloverly Fm	D'Emic et al., 2019	Valanginian-Cenomanian (140-98)
DMNH EPV 18168 - 17	Nodosauridae			Cloverly Fm	D'Emic et al., 2019	Valanginian-Cenomanian (140-98)
DMNH EPV 18168 - 2	Nodosauridae			Cloverly Fm	D'Emic et al., 2019	Valanginian-Cenomanian (140-98)
DMNH EPV 18168 - 3	Nodosauridae			Cloverly Fm	D'Emic et al., 2019	Valanginian-Cenomanian (140-98)
DMNH EPV 18168 - 4	Nodosauridae			Cloverly Fm	D'Emic et al., 2019	Valanginian-Cenomanian (140-98)
DMNH EPV 18168 - 5	Nodosauridae			Cloverly Fm	D'Emic et al., 2019	Valanginian-Cenomanian (140-98)

Sample Number	Coombs (1978) family or other higher taxonomic original ID	Raven et al. (2023) family	Taxon	Unit	Age citation	Age
DMNH EPV 18168 - 6	Nodosauridae			Cloverly Fm	D'Emic et al., 2019	Valanginian-Cenomanian (140-98)
DMNH EPV 18168 - 7	Nodosauridae			Cloverly Fm	D'Emic et al., 2019	Valenginian-Cenomanian (140-98)
DMNH EPV 18168 - 8	Nodosauridae			Cloverly Fm	D'Emic et al., 2019	Valanginian-Cenomanian (140-98)
DMNH EPV 18168 - 9	Nodosauridae			Cloverly Fm	D'Emic et al., 2019	Valanginian-Cenomanian (140-98)
DMNH EPV 18169 - 1	Nodosauridae			Cloverly Fm	D'Emic et al., 2019	Valanginian-Cenomanian (140-98)
DMNH EPV 18169 - 2	Nodosauridae			Cloverly Fm	D'Emic et al., 2019	Valanginian-Cenomanian (140-98)
DMNH EPV 18169 - 3	Nodosauridae			Cloverly Fm	D'Emic et al., 2019	Valanginian-Cenomanian (140-98)
DMNH EPV 18169 - 4	Nodosauridae			Cloverly Fm	D'Emic et al., 2019	Valanginian-Cenomanian (140-98)
DMNH EPV 18169 - 5	Nodosauridae			Cloverly Fm	D'Emic et al., 2019	Valanginian-Cenomanian (140-98)
DMNH EPV 21671	Nodosauridae			Cloverly Fm	D'Emic et al., 2019	Valanginian-Cenomanian (140-98)
DMNH EPV 27726 - 1	Nodosauridae	Basal ankylosaur	*Gargoyleosaurus parkpinorum*	Morrison Fm	Maidment & Muxworthy, 2019	Late Jurassic: Kimmeridgian-Tithonian (156-147)
DMNH EPV 27726 - 10	Nodosauridae	Basal ankylosaur	*Gargoyleosaurus parkpinorum*	Morrison Fm	Maidment & Muxworthy, 2019	Late Jurassic: Kimmeridgian-Tithonian (156-147)
DMNH EPV 27726 - 11	Nodosauridae	Basal ankylosaur	*Gargoyleosaurus parkpinorum*	Morrison Fm	Maidment & Muxworthy, 2019	Late Jurassic: Kimmeridgian-Tithonian (156-147)
DMNH EPV 27726 - 12	Nodosauridae	Basal ankylosaur	*Gargoyleosaurus parkpinorum*	Morrison Fm	Maidment & Muxworthy, 2019	Late Jurassic: Kimmeridgian-Tithonian (156-147)

Sample Number	Coombs (1978) family or other higher taxonomic original ID	Raven et al. (2023) family	Taxon	Unit	Age citation	Age
DMNH EPV 27726 - 13	Nodosauridae	Basal ankylosaur	*Gargoyleosaurus parkpinorum*	Morrison Fm	Maidment & Muxworthy, 2019	Late Jurassic: Kimmeridgian-Tithonian (156-147)
DMNH EPV 27726 - 14	Nodosauridae	Basal ankylosaur	*Gargoyleosaurus parkpinorum*	Morrison Fm	Maidment & Muxworthy, 2019	Late Jurassic: Kimmeridgian-Tithonian (156-147)
DMNH EPV 27726 - 15	Nodosauridae	Basal ankylosaur	*Gargoyleosaurus parkpinorum*	Morrison Fm	Maidment & Muxworthy, 2019	Late Jurassic: Kimmeridgian-Tithonian (156-147)
DMNH EPV 27726 - 16	Nodosauridae	Basal ankylosaur	*Gargoyleosaurus parkpinorum*	Morrison Fm	Maidment & Muxworthy, 2019	Late Jurassic: Kimmeridgian-Tithonian (156-147)
DMNH EPV 27726 - 17	Nodosauridae	Basal ankylosaur	*Gargoyleosaurus parkpinorum*	Morrison Fm	Maidment & Muxworthy, 2019	Late Jurassic: Kimmeridgian-Tithonian (156-147)
DMNH EPV 27726 - 18	Nodosauridae	Basal ankylosaur	*Gargoyleosaurus parkpinorum*	Morrison Fm	Maidment & Muxworthy, 2019	Late Jurassic: Kimmeridgian-Tithonian (156-147)
DMNH EPV 27726 - 2	Nodosauridae	Basal ankylosaur	*Gargoyleosaurus parkpinorum*	Morrison Fm	Maidment & Muxworthy, 2019	Late Jurassic: Kimmeridgian-Tithonian (156-147)
DMNH EPV 27726 - 3	Nodosauridae	Basal ankylosaur	*Gargoyleosaurus parkpinorum*	Morrison Fm	Maidment & Muxworthy, 2019	Late Jurassic: Kimmeridgian-Tithonian (156-147)
DMNH EPV 27726 - 4	Nodosauridae	Basal ankylosaur	*Gargoyleosaurus parkpinorum*	Morrison Fm	Maidment & Muxworthy, 2019	Late Jurassic: Kimmeridgian-Tithonian (156-147)
DMNH EPV 27726 - 5	Nodosauridae	Basal ankylosaur	*Gargoyleosaurus parkpinorum*	Morrison Fm	Maidment & Muxworthy, 2019	Late Jurassic: Kimmeridgian-Tithonian (156-147)
DMNH EPV 27726 - 6	Nodosauridae	Basal ankylosaur	*Gargoyleosaurus parkpinorum*	Morrison Fm	Maidment & Muxworthy, 2019	Late Jurassic: Kimmeridgian-Tithonian (156-147)

Sample Number	Coombs (1978) family or other higher taxonomic original ID	Raven et al. (2023) family	Taxon	Unit	Age citation	Age
DMNH EPV 27726 - 7	Nodosauridae	Basal ankylosaur	*Gargoyleosaurus parkpinorum*	Morrison Fm	Maidment & Muxworthy, 2019	Late Jurassic: Kimmeridgian-Tithonian (156-147)
DMNH EPV 27726 - 8	Nodosauridae	Basal ankylosaur	*Gargoyleosaurus parkpinorum*	Morrison Fm	Maidment & Muxworthy, 2019	Late Jurassic: Kimmeridgian-Tithonian (156-147)
DMNH EPV 27726 - 9	Nodosauridae	Basal ankylosaur	*Gargoyleosaurus parkpinorum*	Morrison Fm	Maidment & Muxworthy, 2019	Late Jurassic: Kimmeridgian-Tithonian (156-147)
DMNH EPV 2818 - 10	Stegosaurus	Stegosauridae	*Stegosaurus stenops*	Morrison Fm	Maidment & Muxworthy, 2019	Late Jurassic: Kimmeridgian-Tithonian (156-147)
DMNH EPV 2818 - 11	Stegosaurus	Stegosauridae	*Stegosaurus stenops*	Morrison Fm	Maidment & Muxworthy, 2019	Late Jurassic: Kimmeridgian-Tithonian (156-147)
DMNH EPV 2818 - 12	Stegosaurus	Stegosauridae	*Stegosaurus stenops*	Morrison Fm	Maidment & Muxworthy, 2019	Late Jurassic: Kimmeridgian-Tithonian (156-147)
DMNH EPV 2818 - 13	Stegosaurus	Stegosauridae	*Stegosaurus stenops*	Morrison Fm	Maidment & Muxworthy, 2019	Late Jurassic: Kimmeridgian-Tithonian (156-147)
DMNH EPV 2818 - 14	Stegosaurus	Stegosauridae	*Stegosaurus stenops*	Morrison Fm	Maidment & Muxworthy, 2019	Late Jurassic: Kimmeridgian-Tithonian (156-147)
DMNH EPV 2818 - 15	Stegosaurus	Stegosauridae	*Stegosaurus stenops*	Morrison Fm	Maidment & Muxworthy, 2019	Late Jurassic: Kimmeridgian-Tithonian (156-147)
DMNH EPV 2818 - 16	Stegosaurus	Stegosauridae	*Stegosaurus stenops*	Morrison Fm	Maidment & Muxworthy, 2019	Late Jurassic: Kimmeridgian-Tithonian (156-147)
DMNH EPV 2818 - 17	Stegosaurus	Stegosauridae	*Stegosaurus stenops*	Morrison Fm	Maidment & Muxworthy, 2019	Late Jurassic: Kimmeridgian-Tithonian (156-147)

Sample Number	Coombs (1978) family or other higher taxonomic original ID	Raven et al. (2023) family	Taxon	Unit	Age citation	Age
DMNH EPV 2818 - 18	Stegosaurus	Stegosauridae	*Stegosaurus stenops*	Morrison Fm	Maidment & Muxworthy, 2019	Late Jurassic: Kimmeridgian-Tithonian (156-147)
DMNH EPV 2818 - 19	Stegosaurus	Stegosauridae	*Stegosaurus stenops*	Morrison Fm	Maidment & Muxworthy, 2019	Late Jurassic: Kimmeridgian-Tithonian (156-147)
DMNH EPV 2818 - 2	Stegosaurus	Stegosauridae	*Stegosaurus stenops*	Morrison Fm	Maidment & Muxworthy, 2019	Late Jurassic: Kimmeridgian-Tithonian (156-147)
DMNH EPV 2818 - 20	Stegosaurus	Stegosauridae	*Stegosaurus stenops*	Morrison Fm	Maidment & Muxworthy, 2019	Late Jurassic: Kimmeridgian-Tithonian (156-147)
DMNH EPV 2818 - 21	Stegosaurus	Stegosauridae	*Stegosaurus stenops*	Morrison Fm	Maidment & Muxworthy, 2019	Late Jurassic: Kimmeridgian-Tithonian (156-147)
DMNH EPV 2818 - 22	Stegosaurus	Stegosauridae	*Stegosaurus stenops*	Morrison Fm	Maidment & Muxworthy, 2019	Late Jurassic: Kimmeridgian-Tithonian (156-147)
DMNH EPV 2818 - 23	Stegosaurus	Stegosauridae	*Stegosaurus stenops*	Morrison Fm	Maidment & Muxworthy, 2019	Late Jurassic: Kimmeridgian-Tithonian (156-147)
DMNH EPV 2818 - 24	Stegosaurus	Stegosauridae	*Stegosaurus stenops*	Morrison Fm	Maidment & Muxworthy, 2019	Late Jurassic: Kimmeridgian-Tithonian (156-147)
DMNH EPV 2818 - 25	Stegosaurus	Stegosauridae	*Stegosaurus stenops*	Morrison Fm	Maidment & Muxworthy, 2019	Late Jurassic: Kimmeridgian-Tithonian (156-147)
DMNH EPV 2818 - 26	Stegosaurus	Stegosauridae	*Stegosaurus stenops*	Morrison Fm	Maidment & Muxworthy, 2019	Late Jurassic: Kimmeridgian-Tithonian (156-147)
DMNH EPV 2818 - 27	Stegosaurus	Stegosauridae	*Stegosaurus stenops*	Morrison Fm	Maidment & Muxworthy, 2019	Late Jurassic: Kimmeridgian-Tithonian (156-147)

Sample Number	Coombs (1978) family or other higher taxonomic original ID	Raven et al. (2023) family	Taxon	Unit	Age citation	Age
DMNH EPV 2818 - 28	Stegosaurus	Stegosauridae	*Stegosaurus stenops*	Morrison Fm	Maidment & Muxworthy, 2019	Late Jurassic: Kimmeridgian-Tithonian (156-147)
DMNH EPV 2818 - 3	Stegosaurus	Stegosauridae	*Stegosaurus stenops*	Morrison Fm	Maidment & Muxworthy, 2019	Late Jurassic: Kimmeridgian-Tithonian (156-147)
DMNH EPV 2818 - 4	Stegosaurus	Stegosauridae	*Stegosaurus stenops*	Morrison Fm	Maidment & Muxworthy, 2019	Late Jurassic: Kimmeridgian-Tithonian (156-147)
DMNH EPV 2818 - 5	Stegosaurus	Stegosauridae	*Stegosaurus stenops*	Morrison Fm	Maidment & Muxworthy, 2019	Late Jurassic: Kimmeridgian-Tithonian (156-147)
DMNH EPV 2818 - 6	Stegosaurus	Stegosauridae	*Stegosaurus stenops*	Morrison Fm	Maidment & Muxworthy, 2019	Late Jurassic: Kimmeridgian-Tithonian (156-147)
DMNH EPV 2818 - 7	Stegosaurus	Stegosauridae	*Stegosaurus stenops*	Morrison Fm	Maidment & Muxworthy, 2019	Late Jurassic: Kimmeridgian-Tithonian (156-147)
DMNH EPV 2818 - 8	Stegosaurus	Stegosauridae	*Stegosaurus stenops*	Morrison Fm	Maidment & Muxworthy, 2019	Late Jurassic: Kimmeridgian-Tithonian (156-147)
DMNH EPV 2818 - 9	Stegosaurus	Stegosauridae	*Stegosaurus stenops*	Morrison Fm	Maidment & Muxworthy, 2019	Late Jurassic: Kimmeridgian-Tithonian (156-147)
DMNH EPV 468	Nodosauridae	Panoplosauridae	*Denversaurus schlessmani*	Hell Creek Fm	Johnson, Nichols, & Hartman 2002	Maastrichtian (70-66 Ma)
DMNH EPV 50206 - 3	Nodosauridae	Polacanthidae	*Gastonia lorriemcwhinneyae*	Cedar Mountain Fm, Ruby Ranch member	Chure et al., 2010, Gulbranson et al., 2020	Aptian-Albian (123.66-104.46)
DMNH EPV 50206 - 4	Nodosauridae	Polacanthidae	*Gastonia lorriemcwhinneyae*	Cedar Mountain Fm,	Chure et al., 2010, Gulbranson et al., 2020	Aptian-Albian (123.66-104.46)

Sample Number	Coombs (1978) family or other higher taxonomic original ID	Raven et al. (2023) family	Taxon	Unit	Age citation	Age
				Ruby Ranch member		
DMNH EPV 50373	Nodosauridae	Polacanthidae	*Gastonia lorriemcwhinneyae*	Cedar Mountain Fm, Ruby Ranch member	Chure et al., 2010, Gulbranson et al., 2020	Aptian-Albian (123.66-104.46)
DMNH EPV 50377	Nodosauridae	Polacanthidae	*Gastonia lorriemcwhinneyae*	Cedar Mountain Fm, Ruby Ranch member	Chure et al., 2010, Gulbranson et al., 2020	Aptian-Albian (123.66-104.46)
DMNH EVP 136185 - 1	Thescelosaur	Thescelosauridae	*Thescelosaurus neglectus*	Hell Creek Fm	Johnson, Nichols, & Hartman 2002	Maastrichtian (70-66 Ma)
DMNH EVP 136185 - 10	Thescelosaur	Thescelosauridae	*Thescelosaurus neglectus*	Hell Creek Fm	Johnson, Nichols, & Hartman 2002	Maastrichtian (70-66 Ma)
DMNH EVP 136185 - 11	Thescleosaur	Thescelosauridae	*Thescelosaurus neglectus*	Hell Creek Fm	Johnson, Nichols, & Hartman 2002	Maastrichtian (70-66 Ma)
DMNH EVP 136185 - 12	Thescelosaur	Thescelosauridae	*Thescelosaurus neglectus*	Hell Creek Fm	Johnson, Nichols, & Hartman 2002	Maastrichtian (70-66 Ma)
DMNH EVP 136185 - 2	Thescelosaur	Thescelosauridae	*Thescelosaurus neglectus*	Hell Creek Fm	Johnson, Nichols, & Hartman 2002	Maastrichtian (70-66 Ma)
DMNH EVP 136185 - 3	Thescelosaur	Thescelosauridae	*Thescelosaurus neglectus*	Hell Creek Fm	Johnson, Nichols, & Hartman 2002	Maastrichtian (70-66 Ma)
DMNH EVP 136185 - 4	Thescelosaur	Thescelosauridae	*Thescelosaurus neglectus*	Hell Creek Fm	Johnson, Nichols, & Hartman 2002	Maastrichtian (70-66 Ma)
DMNH EVP 136185 - 5	Thescelosaur	Thescelosauridae	*Thescelosaurus neglectus*	Hell Creek Fm	Johnson, Nichols, & Hartman 2002	Maastrichtian (70-66 Ma)
DMNH EVP 136185 - 6	Thescelosaur	Thescelosauridae	*Thescelosaurus neglectus*	Hell Creek Fm	Johnson, Nichols, & Hartman 2002	Maastrichtian (70-66 Ma)
DMNH EVP 136185 - 7	Thescelosaur	Thescelosauridae	*Thescelosaurus neglectus*	Hell Creek Fm	Johnson, Nichols, & Hartman 2002	Maastrichtian (70-66 Ma)
DMNH EVP 136185 - 8	Thescelosaur	Thescelosauridae	*Thescelosaurus neglectus*	Hell Creek Fm	Johnson, Nichols, & Hartman 2002	Maastrichtian (70-66 Ma)

Sample Number	Coombs (1978) family or other higher taxonomic original ID	Raven et al. (2023) family	Taxon	Unit	Age citation	Age
DMNH EVP 136185 - 9	Thescelosaur	Thescelosauridae	*Thescelosaurus neglectus*	Hell Creek Fm	Johnson, Nichols, & Hartman 2002	Maastrichtian (70-66 Ma)
DMNH EVP 2818 - 1	Stegosaurus	Stegosauridae	*Stegosaurus stenops*	Morrison Fm	Maidment & Muxworthy, 2019	Late Jurassic: Kimmeridgian-Tithonian (156-147)
DMNH EVP 50206 - 1	Nodosauridae	Polacanthidae	*Gastonia lorriemcwhinneyae*	Cedar Mountain Fm, Ruby Ranch member	Chure et al., 2010, Gulbranson et al., 2020	Aptian-Albian (123.66-104.46)
DMNH EVP 50206 - 2	Nodosauridae	Polacanthidae	*Gastonia lorriemcwhinneyae*	Cedar Mountain Fm, Ruby Ranch member	Chure et al., 2010, Gulbranson et al., 2020	Aptian-Albian (123.66-104.46)
PIN 3142/250 - 1	Ankylosauridae	Ankylosauridae	*Saichania chulsanensis*	Nemegt Fm	Jerzykiewicz, 2000	Upper Campanian-Lower Maastrichtian
PIN 3142/250 - 10	Ankylosauridae	Ankylosauridae	*Saichania chulsanensis*	Nemegt Fm	Jerzykiewicz, 2000	Upper Campanian-Lower Maastrichtian
PIN 3142/250 - 2	Ankylosauridae	Ankylosauridae	*Saichania chulsanensis*	Nemegt Fm	Jerzykiewicz, 2000	Upper Campanian-Lower Maastrichtian
PIN 3142/250 - 3	Ankylosauridae	Ankylosauridae	*Saichania chulsanensis*	Nemegt Fm	Jerzykiewicz, 2000	Upper Campanian-Lower Maastrichtian
PIN 3142/250 - 4	Ankylosauridae	Ankylosauridae	*Saichania chulsanensis*	Nemegt Fm	Jerzykiewicz, 2000	Upper Campanian-Lower Maastrichtian
PIN 3142/250 - 5	Ankylosauridae	Ankylosauridae	*Saichania chulsanensis*	Nemegt Fm	Jerzykiewicz, 2000	Upper Campanian-Lower Maastrichtian
PIN 3142/250 - 6	Ankylosauridae	Ankylosauridae	*Saichania chulsanensis*	Nemegt Fm	Jerzykiewicz, 2000	Upper Campanian-Lower Maastrichtian
PIN 3142/250 - 7	Ankylosauridae	Ankylosauridae	*Saichania chulsanensis*	Nemegt Fm	Jerzykiewicz, 2000	Upper Campanian-Lower Maastrichtian
PIN 3142/250 - 8	Ankylosauridae	Ankylosauridae	*Saichania chulsanensis*	Nemegt Fm	Jerzykiewicz, 2000	Upper Campanian-Lower Maastrichtian
PIN 3142/250 - 9	Ankylosauridae	Ankylosauridae	*Saichania chulsanensis*	Nemegt Fm	Jerzykiewicz, 2000	Upper Campanian-Lower Maastrichtian

Sample Number	Coombs (1978) family or other higher taxonomic original ID	Raven et al. (2023) family	Taxon	Unit	Age citation	Age
ROM 03088	Nodosauridae					
ROM 03287	Nodosauridae			Oldman Fm	Eberth, 2024	Campanian (78-77)
ROM 03302	Nodosauridae			Oldman Fm	Eberth, 2024	Campanian (78-77)
ROM 03368	Nodosauridae			Oldman Fm	Eberth, 2024	Campanian (78-77)
ROM 03516	Nodosauridae			Oldman Fm	Eberth, 2024	Campanian (78-77)
ROM 07763	Ankylosauridae			Oldman Fm	Eberth, 2024	Campanian (78-77)
ROM 07765	Ankylosauridae			Oldman Fm	Eberth, 2024	Campanian (78-77)
ROM 07766	Ankylosauridae			Oldman Fm	Eberth, 2024	Campanian (78-77)
ROM 07767	Nodosauridae			Oldman Fm	Eberth, 2024	Campanian (78-77)
ROM 07768	Nodosauridae			Oldman Fm	Eberth, 2024	Campanian (78-77)
ROM 07770	Pachycephalosaurid ae	Pachycephalosaur idae	*Stegoceras validum?*	Oldman Fm	Eberth, 2024	Campanian (78-77)
ROM 07772	Nodosauridae					
ROM 1215 - 1	Nodosauridae	Panoplosauridae	*Edmontonia rugosidens*	Dinosaur Park Fm (Mallon, 2019)	Ramezani et al., 2022	Campanian (76.5-74.4)
ROM 1215 - 10	Nodosauridae	Panoplosauridae	*Edmontonia rugosidens*	Dinosaur Park Fm (Mallon, 2019)	Ramezani et al., 2022	Campanian (76.5-74.4)
ROM 1215 - 11	Nodosauridae	Panoplosauridae	*Edmontonia rugosidens*	Dinosaur Park Fm (Mallon, 2019)	Ramezani et al., 2022	Campanian (76.5-74.4)
ROM 1215 - 12	Nodosauridae	Panoplosauridae	*Edmontonia rugosidens*	Dinosaur Park Fm (Mallon, 2019)	Ramezani et al., 2022	Campanian (76.5-74.4)
ROM 1215 - 13	Nodosauridae	Panoplosauridae	*Edmontonia rugosidens*	Dinosaur Park Fm (Mallon, 2019)	Ramezani et al., 2022	Campanian (76.5-74.4)

Sample Number	Coombs (1978) family or other higher taxonomic original ID	Raven et al. (2023) family	Taxon	Unit	Age citation	Age
ROM 1215 - 14	Nodosauridae	Panoplosauridae	*Edmontonia rugosidens*	Dinosaur Park Fm (Mallon, 2019)	Ramezani et al., 2022	Campanian (76.5-74.4)
ROM 1215 - 15	Nodosauridae	Panoplosauridae	*Edmontonia rugosidens*	Dinosaur Park Fm (Mallon, 2019)	Ramezani et al., 2022	Campanian (76.5-74.4)
ROM 1215 - 16	Nodosauridae	Panoplosauridae	*Edmontonia rugosidens*	Dinosaur Park Fm (Mallon, 2019)	Ramezani et al., 2022	Campanian (76.5-74.4)
ROM 1215 - 17	Nodosauridae	Panoplosauridae	*Edmontonia rugosidens*	Dinosaur Park Fm (Mallon, 2019)	Ramezani et al., 2022	Campanian (76.5-74.4)
ROM 1215 - 2	Nodosauridae	Panoplosauridae	*Edmontonia rugosidens*	Dinosaur Park Fm (Mallon, 2019)	Ramezani et al., 2022	Campanian (76.5-74.4)
ROM 1215 - 3	Nodosauridae	Panoplosauridae	*Edmontonia rugosidens*	Dinosaur Park Fm (Mallon, 2019)	Ramezani et al., 2022	Campanian (76.5-74.4)
ROM 1215 - 4	Nodosauridae	Panoplosauridae	*Edmontonia rugosidens*	Dinosaur Park Fm (Mallon, 2019)	Ramezani et al., 2022	Campanian (76.5-74.4)
ROM 1215 - 5	Nodosauridae	Panoplosauridae	*Edmontonia rugosidens*	Dinosaur Park Fm (Mallon, 2019)	Ramezani et al., 2022	Campanian (76.5-74.4)
ROM 1215 - 6	Nodosauridae	Panoplosauridae	*Edmontonia rugosidens*	Dinosaur Park Fm (Mallon, 2019)	Ramezani et al., 2022	Campanian (76.5-74.4)
ROM 1215 - 7	Nodosauridae	Panoplosauridae	*Edmontonia rugosidens*	Dinosaur Park Fm (Mallon, 2019)	Ramezani et al., 2022	Campanian (76.5-74.4)
ROM 1215 - 8	Nodosauridae	Panoplosauridae	*Edmontonia rugosidens*	Dinosaur Park Fm (Mallon, 2019)	Ramezani et al., 2022	Campanian (76.5-74.4)

Sample Number	Coombs (1978) family or other higher taxonomic original ID	Raven et al. (2023) family	Taxon	Unit	Age citation	Age
ROM 1215 - 9	Nodosauridae	Panoplosauridae	*Edmontonia rugosidens*	Dinosaur Park Fm (Mallon, 2019)	Ramezani et al., 2022	Campanian (76.5-74.4)
ROM 26346	Thescelosauridae	Thescelosauridae	*Thescelosaurus*	Scollard Fm	Eberth & Kamo, 2020	Maastrichtian (66.88-66.043)
ROM 31697	Nodosauridae			Lance Fm	Lockley et al., 2004	Maastrichtian (69-66)
ROM 31865	Nodosauridae			Oldman Fm	Eberth, 2024	Campanian (78-77)
ROM 31866	Ankylosauridae			Oldman Fm	Eberth, 2024	Campanian (78-77)
ROM 31867	Ankylosauridae			Oldman Fm	Eberth, 2024	Campanian (78-77)
ROM 31868	Ankylosauridae			Oldman Fm	Eberth, 2024	Campanian (78-77)
ROM 31869	Ankylosauridae			Oldman Fm	Eberth, 2024	Campanian (78-77)
ROM 31871	Nodosauridae			Oldman Fm	Eberth, 2024	Campanian (78-77)
ROM 31872	Nodosauridae			Oldman Fm	Eberth, 2024	Campanian (78-77)
ROM 36385	Nodosauridae			Oldman Fm	Eberth, 2024	Campanian (78-77)
ROM 36386	Nodosauridae			Oldman Fm	Eberth, 2024	Campanian (78-77)
ROM 36387	Nodosauridae			Oldman Fm	Eberth, 2024	Campanian (78-77)
ROM 36388	Nodosauridae			Oldman Fm	Eberth, 2024	Campanian (78-77)
ROM 36389	Nodosauridae			Oldman Fm	Eberth, 2024	Campanian (78-77)
ROM 36390	Nodosauridae			Oldman Fm	Eberth, 2024	Campanian (78-77)
ROM 36391	Nodosauridae			Oldman Fm	Eberth, 2024	Campanian (78-77)
ROM 36392	Nodosauridae			Oldman Fm	Eberth, 2024	Campanian (78-77)
ROM 36393	Nodosauridae			Oldman Fm	Eberth, 2024	Campanian (78-77)
ROM 36394	Nodosauridae			Oldman Fm	Eberth, 2024	Campanian (78-77)
ROM 36395	Nodosauridae			Oldman Fm	Eberth, 2024	Campanian (78-77)
ROM 36396	Nodosauridae			Oldman Fm	Eberth, 2024	Campanian (78-77)
ROM 36397	Nodosauridae			Oldman Fm	Eberth, 2024	Campanian (78-77)

Sample Number	Coombs (1978) family or other higher taxonomic original ID	Raven et al. (2023) family	Taxon	Unit	Age citation	Age
ROM 36398	Nodosauridae			Oldman Fm	Eberth, 2024	Campanian (78-77)
ROM 36399	Nodosauridae			Oldman Fm	Eberth, 2024	Campanian (78-77)
ROM 36400	Nodosauridae			Oldman Fm	Eberth, 2024	Campanian (78-77)
ROM 36401	Nodosauridae			Oldman Fm	Eberth, 2024	Campanian (78-77)
ROM 36402	Nodosauridae			Oldman Fm	Eberth, 2024	Campanian (78-77)
ROM 36403	Nodosauridae			Oldman Fm	Eberth, 2024	Campanian (78-77)
ROM 36404	Nodosauridae			Oldman Fm	Eberth, 2024	Campanian (78-77)
ROM 36405	Nodosauridae			Oldman Fm	Eberth, 2024	Campanian (78-77)
ROM 36406	Nodosauridae			Oldman Fm	Eberth, 2024	Campanian (78-77)
ROM 36407	Nodosauridae			Oldman Fm	Eberth, 2024	Campanian (78-77)
ROM 36408	Nodosauridae			Oldman Fm	Eberth, 2024	Campanian (78-77)
ROM 36409	Nodosauridae			Oldman Fm	Eberth, 2024	Campanian (78-77)
ROM 36410	Nodosauridae			Oldman Fm	Eberth, 2024	Campanian (78-77)
ROM 36411	Nodosauridae			Oldman Fm	Eberth, 2024	Campanian (78-77)
ROM 36412	Nodosauridae			Oldman Fm	Eberth, 2024	Campanian (78-77)
ROM 36413	Nodosauridae			Oldman Fm	Eberth, 2024	Campanian (78-77)
ROM 36414	Nodosauridae			Oldman Fm	Eberth, 2024	Campanian (78-77)
ROM 36415	Nodosauridae			Oldman Fm	Eberth, 2024	Campanian (78-77)
ROM 36416	Nodosauridae			Oldman Fm	Eberth, 2024	Campanian (78-77)
ROM 36417	Nodosauridae			Oldman Fm	Eberth, 2024	Campanian (78-77)
ROM 36418	Nodosauridae			Oldman Fm	Eberth, 2024	Campanian (78-77)
ROM 36419	Nodosauridae			Oldman Fm	Eberth, 2024	Campanian (78-77)
ROM 36420	Nodosauridae			Oldman Fm	Eberth, 2024	Campanian (78-77)
ROM 36421	Nodosauridae			Oldman Fm	Eberth, 2024	Campanian (78-77)
ROM 36422	Nodosauridae			Oldman Fm	Eberth, 2024	Campanian (78-77)

Sample Number	Coombs (1978) family or other higher taxonomic original ID	Raven et al. (2023) family	Taxon	Unit	Age citation	Age
ROM 36423	Nodosauridae			Oldman Fm	Eberth, 2024	Campanian (78-77)
ROM 53579	Pachycephalosaurid ae	Pachycephalosaur idae	*Pachycephalosaurus wyomingensis*	Hell Creek Fm	Johnson, Nichols, & Hartman 2002	Maastrichtian (70-66 Ma)
ROM 56611	Ankylosauridae			Milk River Fm	Payenberg et al., 2002	Santonian
ROM 56620	Nodosauridae			Milk River Fm	Payenberg et al., 2002	Santonian
ROM 58144	Ankylosauridae			Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
ROM 58147	Pachycephalosaurid ae	Pachycephalosaur idae	*Stegoceras validum?*	Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
ROM 58151	Ankylosauridae			Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
ROM 58223	Ankylosauridae			Oldman Fm	Eberth, 2024	Campanian (78-77)
ROM 58383	Ankylosauridae			Foremost Fm	Eberth, 2024	Campanian (80-78)
ROM 58516	Ankylosauridae			Oldman Fm	Eberth, 2024	Campanian (78-77)
ROM 58525	Ankylosauridae			Oldman Fm	Eberth, 2024	Campanian (78-77)
ROM 58565 - 1	Ankylosauridae			Oldman Fm	Eberth, 2024	Campanian (78-77)
ROM 58565 - 2	Ankylosauridae			Oldman Fm	Eberth, 2024	Campanian (78-77)
ROM 58565 - 3	Ankylosauridae			Oldman Fm	Eberth, 2024	Campanian (78-77)
ROM 58565 - 4	Ankylosauridae			Oldman Fm	Eberth, 2024	Campanian (78-77)
ROM 58594	Ankylosauridae			Oldman Fm	Eberth, 2024	Campanian (78-77)
ROM 58598	Ankylosauridae			Oldman Fm	Eberth, 2024	Campanian (78-77)
ROM 58689 - 1	Ankylosauridae			Oldman Fm	Eberth, 2024	Campanian (78-77)
ROM 58689 - 2	Ankylosauridae			Oldman Fm	Eberth, 2024	Campanian (78-77)
ROM 58704	Ankylosauridae			Oldman Fm	Eberth, 2024	Campanian (78-77)

Sample Number	Coombs (1978) family or other higher taxonomic original ID	Raven et al. (2023) family	Taxon	Unit	Age citation	Age
ROM 67276	Ankylosauridae			Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
ROM 788 - 1	Ankylosauridae	Ankylosauridae	*Euplocephalus tutus*	Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
ROM 788 - 2	Ankylosauridae	Ankylosauridae	*Euplocephalus tutus*	Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
ROM 788 - 3	Ankylosauridae	Ankylosauridae	*Euplocephalus tutus*	Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
ROM 788 - 4	Ankylosauridae	Ankylosauridae	*Euplocephalus tutus*	Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
ROM 788 - 5	Ankylosauridae	Ankylosauridae	*Euplocephalus tutus*	Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
ROM 788 - 6	Ankylosauridae	Ankylosauridae	*Euplocephalus tutus*	Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
ROM 788 - 7	Ankylosauridae	Ankylosauridae	*Euplocephalus tutus*	Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
ROM 788 - 8	Ankylosauridae	Ankylosauridae	*Euoplocephalus tutus*	Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
SMU 73203	Nodosauridae	Struthiosauridae	*Pawpawsaurus campbelli*	Pawpaw Formation		
TMP 1966.025.0015	Pachycephalosauridae	Pachycephalosauridae	*Stegoceras*	Judith River Fm	Ramezani et al., 2022	Campanian (78.7-75.26)
TMP 1976.006.0036	Ornithischia			Foremost Fm	Eberth, 2024	Campanian (80-78)
TMP 1980.008.0026 - 1	Ankylosauridae	Ankylosauridae		Judith River Fm	Ramezani et al., 2022	Campanian (78.7-75.26)
TMP 1980.008.0026 - 2	Ankylosauridae	Ankylosauridae		Judith River Fm	Ramezani et al., 2022	Campanian (78.7-75.26)

Sample Number	Coombs (1978) family or other higher taxonomic original ID	Raven et al. (2023) family	Taxon	Unit	Age citation	Age
TMP 1980.013.0046	Ankylosauridae	Ankylosauridae		Foremost Fm	Eberth, 2024	Campanian (80-78)
TMP 1980.016.0239	Ankylosauridae	Ankylosauridae	*Euoplocephalus*	Judith River Fm	Ramezani et al., 2022	Campanian (78.7-75.26)
TMP 1980.016.0834	Pachycephalosauridae	Pachycephalosauridae	*Stegoceras*	Judith River Fm	Ramezani et al., 2022	Campanian (78.7-75.26)
TMP 1980.016.1685 - 1	Ankylosauridae	Ankylosauridae	*Euoplocephalus*	Judith River Fm	Ramezani et al., 2022	Campanian (78.7-75.26)
TMP 1980.016.1685 - 2	Ankylosauridae	Ankylosauridae	*Euoplocephalus*	Judith River Fm	Ramezani et al., 2022	Campanian (78.7-75.26)
TMP 1980.029.0140	Pachycephalosauridae	Pachycephalosauridae	*Stegoceras*	Judith River Fm	Ramezani et al., 2022	Campanian (78.7-75.26)
TMP 1980.029.0228	Ankylosauridae	Ankylosauridae		Judith River Fm	Ramezani et al., 2022	Campanian (78.7-75.26)
TMP 1981.041.0014	Ankylosauridae	Ankylosauridae	*Euoplocephalus*	Judith River Fm	Ramezani et al., 2022	Campanian (78.7-75.26)
TMP 1983.036.0009 - 1	Ankylosauridae	Ankylosauridae	*Euoplocephalus*	Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
TMP 1983.036.0009 - 2	Ankylosauridae	Ankylosauridae	*Euoplocephalus*	Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
TMP 1983.036.0009 - 3	Ankylosauridae	Ankylosauridae	*Euoplocephalus*	Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)

Sample Number	Coombs (1978) family or other higher taxonomic original ID	Raven et al. (2023) family	Taxon	Unit	Age citation	Age
TMP 1983.036.0009 - 4	Ankylosauridae	Ankylosauridae	*Euoplocephalus*	Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
TMP 1983.036.0207	Nodosauridae		*Panoplosaurus*	Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
TMP 1984.091.0020	Nodosauridae	Panoplosauridae	*Panoplosaurus*	Judith River Fm	Ramezani et al., 2022	Campanian (78.7-75.26)
TMP 1985.036.0121	Pachycephalosauridae	Pachycephalosauridae		Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
TMP 1985.056.0170 - 1	Ankylosauridae	Ankylosauridae	*Euoplocephalus*	Judith River Fm	Ramezani et al., 2022	Campanian (78.7-75.26)
TMP 1985.056.0170 - 2	Ankylosauridae	Ankylosauridae	*Euoplocephalus*	Judith River Fm	Ramezani et al., 2022	Campanian (78.7-75.26)
TMP 1985.056.0171 - 1	Nodosauridae	Panoplosauridae	*Panoplosaurus/ Edmontonia*	Judith River Fm	Ramezani et al., 2022	Campanian (78.7-75.26)
TMP 1985.056.0171 - 2	Nodosauridae	Panoplosauridae	*Panoplosaurus/ Edmontonia*	Judith River Fm	Ramezani et al., 2022	Campanian (78.7-75.26)
TMP 1985.056.0171 - 3	Nodosauridae	Panoplosauridae	*Panoplosaurus/ Edmontonia*	Judith River Fm	Ramezani et al., 2022	Campanian (78.7-75.26)
TMP 1985.056.0211	Ankylosauridae	Ankylosauridae	*Euoplocephalus*	Judith River Fm	Ramezani et al., 2022	Campanian (78.7-75.26)
TMP 1985.059.0028	Pachycephalosauridae	Pachycephalosauridae	*Stegoceras*	Judith River Fm	Ramezani et al., 2022	Campanian (78.7-75.26)

Sample Number	Coombs (1978) family or other higher taxonomic original ID	Raven et al. (2023) family	Taxon	Unit	Age citation	Age
TMP 1986.008.0084	Nodosauridae			Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
TMP 1986.009.0055	Nodosauridae			Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
TMP 1986.023.0108	Nodosauridae			Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
TMP 1986.095.0007	Ankylosauridae	Ankylosauridae	*Euoplocephalus*	Horseshoe Canyon Fm	Eberth & Kamo, 2020	Campanian-Maastrictian (73.1-68)
TMP 1986.127.0005	Ankylosauridae	Ankylosauridae	*Euoplocephalus*	Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
TMP 1986.183.0003	Nodosauridae			Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
TMP 1987.029.0006	Nodosauridae			Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
TMP 1987.036.0094	Ornithischia			Judith River Fm	Ramezani et al., 2022	Campanian (78.7-75.26)
TMP 1987.077.0143	Ankylosauridae	Ankylosauridae		Oldman Fm	Eberth, 2024	Campanian (78-77)
TMP 1987.080.0010	Pachycephalosauridae	Pachycephalosauridae	*Pachycephalosaurus*	Oldman Fm	Eberth, 2024	Campanian (78-77)
TMP 1989.069.0017	Ornithischia			Judith River Fm	Ramezani et al., 2022	Campanian (78.7-75.26)

Sample Number	Coombs (1978) family or other higher taxonomic original ID	Raven et al. (2023) family	Taxon	Unit	Age citation	Age
TMP 1989.036.0396 - 1	Ankylosauridae	Ankylosauridae	*Euoplocephalus*	Judith River Fm	Ramezani et al., 2022	Campanian (78.7-75.26)
TMP 1989.036.0396 - 2	Ankylosauridae	Ankylosauridae	*Euoplocephalus*	Judith River Fm	Ramezani et al., 2022	Campanian (78.7-75.26)
TMP 1989.036.0396 - 3	Ankylosauridae	Ankylosauridae	*Euoplocephalus*	Judith River Fm	Ramezani et al., 2022	Campanian (78.7-75.26)
TMP 1989.036.0405 - 1	Ankylosauridae	Ankylosauridae	*Euoplocephalus*	Judith River Fm	Ramezani et al., 2022	Campanian (78.7-75.26)
TMP 1989.036.0405 - 2	Ankylosauridae	Ankylosauridae	*Euoplocephalus*	Judith River Fm	Ramezani et al., 2022	Campanian (78.7-75.26)
TMP 1989.036.0405 - 3	Ankylosauridae	Ankylosauridae	*Euoplocephalus*	Judith River Fm	Ramezani et al., 2022	Campanian (78.7-75.26)
TMP 1989.050.0002	Ornithischia			Judith River Fm	Ramezani et al., 2022	Campanian (78.7-75.26)
TMP 1989.050.0013	Ankylosauridae	Ankylosauridae		Judith River Fm	Ramezani et al., 2022	Campanian (78.7-75.26)
TMP 1989.050.0030	Nodosauridae	Panoplosauridae	*Panoplosaurus*	Judith River Fm	Ramezani et al., 2022	Campanian (78.7-75.26)
TMP 1989.076.0059	Ankylosauridae	Ankylosauridae	*Euoplocephalus*	Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
TMP 1989.079.0008	Nodosauridae			Oldman Fm	Eberth, 2024	Campanian (78-77)

Sample Number	Coombs (1978) family or other higher taxonomic original ID	Raven et al. (2023) family	Taxon	Unit	Age citation	Age
TMP 1989.151.0137	Ornithischia			Oldman Fm	Eberth, 2024	Campanian (78-77)
TMP 1990.036.0081	Nodosauridae	Panoplosauridae	*Panoplosaurus*	Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
TMP 1990.060.0006 - 1	Ornithischia			Milk River Fm	Payenberg et al., 2002	Santonian
TMP 1990.060.0006 - 2	Ornithischia			Milk River Fm	Payenberg et al., 2002	Santonian
TMP 1990.107.0037 - 1	Ornithischia			Judith River Fm	Ramezani et al., 2022	Campanian (78.7-75.26)
TMP 1990.107.0037 - 2	Ornithischia			Judith River Fm	Ramezani et al., 2022	Campanian (78.7-75.26)
TMP 1990.155.0007	Nodosauridae			Foremost Fm	Eberth, 2024	Campanian (80-78)
TMP 1991.036.0158	Ankylosauridae	Ankylosauridae	*Euoplocephalus*	Judith River Fm	Ramezani et al., 2022	Campanian (78.7-75.26)
TMP 1991.036.0171	Ankylosauridae	Ankylosauridae	*Ankylosaurus*	Judith River Fm	Ramezani et al., 2022	Campanian (78.7-75.26)
TMP 1991.036.0734	Ankylosauridae	Ankylosauridae	*Euoplocephalus*	Judith River Fm	Ramezani et al., 2022	Campanian (78.7-75.26)
TMP 1991.050.0093	Ornithischia			Judith River Fm	Ramezani et al., 2022	Campanian (78.7-75.26)

Sample Number	Coombs (1978) family or other higher taxonomic original ID	Raven et al. (2023) family	Taxon	Unit	Age citation	Age
TMP 1991.085.0012	Chordata			Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
TMP 1991.087.0072	Ornithischia			Scollard Fm	Eberth & Kamo, 2020	Maastrichtian (66.88-66.043)
TMP 1992.036.0313 - 1	Nodosauridae			Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
TMP 1992.036.0313 - 2	Nodosauridae			Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
TMP 1992.036.1178 - 1	Ankylosauridae	Ankylosauridae		Judith River Fm	Ramezani et al., 2022	Campanian (78.7-75.26)
TMP 1992.036.1178 - 2	Ankylosauridae	Ankylosauridae		Judith River Fm	Ramezani et al., 2022	Campanian (78.7-75.26)
TMP 1992.036.1178 - 3	Ankylosauridae	Ankylosauridae		Judith River Fm	Ramezani et al., 2022	Campanian (78.7-75.26)
TMP 1993.036.0081	Ankylosauridae	Ankylosauridae		Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
TMP 1993.036.0364	Ankylosauridae	Ankylosauridae		Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
TMP 1993.079.0065	Nodosauridae			Oldman Fm	Eberth, 2024	Campanian (78-77)
TMP 1994.012.0035	Nodosauridae			Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)

Sample Number	Coombs (1978) family or other higher taxonomic original ID	Raven et al. (2023) family	Taxon	Unit	Age citation	Age
TMP 1994.012.0039	Nodosauridae			Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
TMP 1994.012.0120	Nodosauridae			Oldman Fm	Eberth, 2024	Campanian (78-77)
TMP 1994.012.0565	Nodosauridae			Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
TMP 1994.086.0018	Nodosauridae			Scollard Fm	Eberth & Kamo, 2020	Maastrichtian (66.88-66.043)
TMP 1994.092.0011	Nodosauridae			Oldman Fm	Eberth, 2024	Campanian (78-77)
TMP 1994.094.0014 - 1	Nodosauridae			Oldman Fm	Eberth, 2024	Campanian (78-77)
TMP 1994.094.0014 - 2	Nodosauridae			Oldman Fm	Eberth, 2024	Campanian (78-77)
TMP 1994.094.0016	Nodosauridae			Oldman Fm	Eberth, 2024	Campanian (78-77)
TMP 1994.097.0001	Nodosauridae			Oldman Fm	Eberth, 2024	Campanian (78-77)
TMP 1995.012.0105	Nodosauridae			Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
TMP 1995.012.0117	Nodosauridae			Judith River Fm	Ramezani et al., 2022	Campanian (78.7-75.26)

Sample Number	Coombs (1978) family or other higher taxonomic original ID	Raven et al. (2023) family	Taxon	Unit	Age citation	Age
TMP 1996.048.0018 - 1	Ankylosaur			Oldman Fm	Eberth, 2024	Campanian (78-77)
TMP 1996.048.0018 - 2	Ankylosaur			Oldman Fm	Eberth, 2024	Campanian (78-77)
TMP 1996.075.0001 - 1	Ankylosauridae	Ankylosauridae	*Anodontosaurus lambei*	Horseshoe Canyon Fm	Eberth & Kamo, 2020	Campanian-Maastrictian (73.1-68)
TMP 1996.075.0001 - 10	Ankylosauridae	Ankylosauridae	*Anodontosaurus lambei*	Horseshoe Canyon Fm	Eberth & Kamo, 2020	Campanian-Maastrictian (73.1-68)
TMP 1996.075.0001 - 11	Ankylosauridae	Ankylosauridae	*Anodontosaurus lambei*	Horseshoe Canyon Fm	Eberth & Kamo, 2020	Campanian-Maastrictian (73.1-68)
TMP 1996.075.0001 - 12	Ankylosauridae	Ankylosauridae	*Anodontosaurus lambei*	Horseshoe Canyon Fm	Eberth & Kamo, 2020	Campanian-Maastrictian (73.1-68)
TMP 1996.075.0001 - 2	Ankylosauridae	Ankylosauridae	*Anodontosaurus lambei*	Horseshoe Canyon Fm	Eberth & Kamo, 2020	Campanian-Maastrictian (73.1-68)
TMP 1996.075.0001 - 3	Ankylosauridae	Ankylosauridae	*Anodontosaurus lambei*	Horseshoe Canyon Fm	Eberth & Kamo, 2020	Campanian-Maastrictian (73.1-68)
TMP 1996.075.0001 - 4	Ankylosauridae	Ankylosauridae	*Anodontosaurus lambei*	Horseshoe Canyon Fm	Eberth & Kamo, 2020	Campanian-Maastrictian (73.1-68)
TMP 1996.075.0001 - 5	Ankylosauridae	Ankylosauridae	*Anodontosaurus lambei*	Horseshoe Canyon Fm	Eberth & Kamo, 2020	Campanian-Maastrictian (73.1-68)
TMP 1996.075.0001 - 6	Ankylosauridae	Ankylosauridae	*Anodontosaurus lambei*	Horseshoe Canyon Fm	Eberth & Kamo, 2020	Campanian-Maastrictian (73.1-68)

Sample Number	Coombs (1978) family or other higher taxonomic original ID	Raven et al. (2023) family	Taxon	Unit	Age citation	Age
TMP 1996.075.0001 - 7	Ankylosauridae	Ankylosauridae	*Anodontosaurus lambei*	Horseshoe Canyon Fm	Eberth & Kamo, 2020	Campanian-Maastrictian (73.1-68)
TMP 1996.075.0001 - 8	Ankylosauridae	Ankylosauridae	*Anodontosaurus lambei*	Horseshoe Canyon Fm	Eberth & Kamo, 2020	Campanian-Maastrictian (73.1-68)
TMP 1996.075.0001 - 9	Ankylosauridae	Ankylosauridae	*Anodontosaurus lambei*	Horseshoe Canyon Fm	Eberth & Kamo, 2020	Campanian-Maastrictian (73.1-68)
TMP 1996.089.0002	Ornithischia			Scollard Fm	Eberth & Kamo, 2020	Maastrichtian (66.88-66.043)
TMP 1997.012.0005	Ankylosauridae	Ankylosauridae		Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
TMP 1997.012.0042	Ankylosauridae	Ankylosauridae	*Euoplocephalus*	Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
TMP 1997.012.0085	Nodosauridae			Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
TMP 1997.012.0106	Ankylosauridae	Ankylosauridae	*Euoplocephalus*	Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
TMP 1997.132.0001 - 1	Ankylosauridae	Ankylosauridae	*Anodontosaurus lambei*	Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
TMP 1997.132.0001 - 2	Ankylosauridae	Ankylosauridae	*Anodontosaurus lambei*	Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
TMP 1997.132.0001 - 3	Ankylosauridae	Ankylosauridae	*Anodontosaurus lambei*	Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)

Sample Number	Coombs (1978) family or other higher taxonomic original ID	Raven et al. (2023) family	Taxon	Unit	Age citation	Age
TMP 1997.132.0001 - 4	Ankylosauridae	Ankylosauridae	*Anodontosaurus lambei*	Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
TMP 1997.132.0001 - 5	Ankylosauridae	Ankylosauridae	*Anodontosaurus lambei*	Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
TMP 1997.132.0001 - 6	Ankylosauridae	Ankylosauridae	*Anodontosaurus lambei*	Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
TMP 1997.132.0001 - 7	Ankylosauridae	Ankylosauridae	*Anodontosaurus lambei*	Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
TMP 1998.008.0004	Ankylosauridae	Ankylosauridae		Scollard Fm	Eberth & Kamo, 2020	Maastrichtian (66.88-66.043)
TMP 1998.043.0004	Pachycephalosauridae	Pachycephalosauridae		Oldman Fm	Eberth, 2024	Campanian (78-77)
TMP 1998.068.0086	Nodosauridae			Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
TMP 1998.068.0153	Ankylosauridae	Ankylosauridae		Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
TMP 1998.098.0001 - 1	Nodosauridae	Panoplosauridae	*Edmontonia rugosidens*	Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
TMP 1998.098.0001 - 10	Nodosauridae	Panoplosauridae	*Edmontonia rugosidens*	Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
TMP 1998.098.0001 - 11	Nodosauridae	Panoplosauridae	*Edmontonia rugosidens*	Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)

Sample Number	Coombs (1978) family or other higher taxonomic original ID	Raven et al. (2023) family	Taxon	Unit	Age citation	Age
TMP 1998.098.000 1 - 12	Nodosauridae	Panoplosauridae	*Edmontonia rugosidens*	Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
TMP 1998.098.000 1 - 13	Nodosauridae	Panoplosauridae	*Edmontonia rugosidens*	Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
TMP 1998.098.000 1 - 14	Nodosauridae	Panoplosauridae	*Edmontonia rugosidens*	Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
TMP 1998.098.000 1 - 15	Nodosauridae	Panoplosauridae	*Edmontonia rugosidens*	Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
TMP 1998.098.000 1 - 16	Nodosauridae	Panoplosauridae	*Edmontonia rugosidens*	Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
TMP 1998.098.000 1 - 17	Nodosauridae	Panoplosauridae	*Edmontonia rugosidens*	Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
TMP 1998.098.000 1 - 18	Nodosauridae	Panoplosauridae	*Edmontonia rugosidens*	Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
TMP 1998.098.000 1 - 19	Nodosauridae	Panoplosauridae	*Edmontonia rugosidens*	Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
TMP 1998.098.000 1 - 2	Nodosauridae	Panoplosauridae	*Edmontonia rugosidens*	Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
TMP 1998.098.000 1 - 20	Nodosauridae	Panoplosauridae	*Edmontonia rugosidens*	Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
TMP 1998.098.000 1 - 21	Nodosauridae	Panoplosauridae	*Edmontonia rugosidens*	Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)

Sample Number	Coombs (1978) family or other higher taxonomic original ID	Raven et al. (2023) family	Taxon	Unit	Age citation	Age
TMP 1998.098.0001 - 22	Nodosauridae	Panoplosauridae	*Edmontonia rugosidens*	Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
TMP 1998.098.0001 - 23	Nodosauridae	Panoplosauridae	*Edmontonia rugosidens*	Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
TMP 1998.098.0001 - 3	Nodosauridae	Panoplosauridae	*Edmontonia rugosidens*	Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
TMP 1998.098.0001 - 4	Nodosauridae	Panoplosauridae	*Edmontonia rugosidens*	Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
TMP 1998.098.0001 - 5	Nodosauridae	Panoplosauridae	*Edmontonia rugosidens*	Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
TMP 1998.098.0001 - 6	Nodosauridae	Panoplosauridae	*Edmontonia rugosidens*	Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
TMP 1998.098.0001 - 7	Nodosauridae	Panoplosauridae	*Edmontonia rugosidens*	Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
TMP 1998.098.0001 - 8	Nodosauridae	Panoplosauridae	*Edmontonia rugosidens*	Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
TMP 1998.098.0001 - 9	Nodosauridae	Panoplosauridae	*Edmontonia rugosidens*	Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
TMP 1998.102.0026 - 1	Nodosauridae			Oldman Fm	Eberth, 2024	Campanian (78-77)
TMP 1998.102.0026 - 2	Nodosauridae			Oldman Fm	Eberth, 2024	Campanian (78-77)

Sample Number	Coombs (1978) family or other higher taxonomic original ID	Raven et al. (2023) family	Taxon	Unit	Age citation	Age
TMP 1998.102.0026 - 3	Nodosauridae			Oldman Fm	Eberth, 2024	Campanian (78-77)
TMP 1998.102.0026 - 4	Nodosauridae			Oldman Fm	Eberth, 2024	Campanian (78-77)
TMP 1998.102.0026 - 5	Nodosauridae			Oldman Fm	Eberth, 2024	Campanian (78-77)
TMP 1998.102.0028 - 1	Ankylosauridae	Ankylosauridae		Oldman Fm	Eberth, 2024	Campanian (78-77)
TMP 1998.102.0028 - 2	Ankylosauridae	Ankylosauridae		Oldman Fm	Eberth, 2024	Campanian (78-77)
TMP 1999.055.0162	Ankylosauridae	Ankylosauridae	*Euoplocephalus*	Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
TMP 1999.055.0290	Ankylosauridae	Ankylosauridae		Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
TMP 1999.063.0019	Nodosauridae			Oldman Fm	Eberth, 2024	Campanian (78-77)
TMP 1999.085.0005	Ornithischia			Oldman Fm	Eberth, 2024	Campanian (78-77)
TMP 2000.012.0020	Ankylosauridae	Ankylosauridae		Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
TMP 2000.012.0024 - 1	Ornithischia			Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)

Sample Number	Coombs (1978) family or other higher taxonomic original ID	Raven et al. (2023) family	Taxon	Unit	Age citation	Age
TMP 2000.012.0024 - 2	Ornithischia			Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
TMP 2000.057.0027	Ornithischia			Oldman Fm	Eberth, 2024	Campanian (78-77)
TMP 2001.012.0072	Ankylosauridae	Ankylosauridae		Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
TMP 2001.012.0073	Ankylosauridae	Ankylosauridae		Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
TMP 2002.012.0060	Ankylosauridae	Ankylosauridae		Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
TMP 2002.012.0135	Nodosauridae			Belly River Group	Eberth, 2024	Campanian
TMP 2002.060.0001 - 1	Ankylosauridae	Ankylosauridae		Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
TMP 2002.060.0001 - 2	Ankylosauridae	Ankylosauridae		Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
TMP 2003.012.0106	Chordata			Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
TMP 2004.107.0003	Ankylosaur			Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
TMP 2004.114.0005	Ankylosaur			Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)

Sample Number	Coombs (1978) family or other higher taxonomic original ID	Raven et al. (2023) family	Taxon	Unit	Age citation	Age
TMP 2004.116.0016	Nodosauridae			Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
TMP 2004.118.0012	Nodosauridae			Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
TMP 2005.012.0027	Ornithischia			Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
TMP 2005.012.0185	Nodosauridae			Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
TMP 2005.012.0233	Ankylosaur			Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
TMP 2005.012.0265	Nodosauridae			Oldman Fm	Eberth, 2024	Campanian (78-77)
TMP 2005.012.0279	Nodosauridae			Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
TMP 2005.012.0280	Nodosauridae			Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
TMP 2005.012.0305	Nodosauridae			Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
TMP 2005.012.0368	Nodosauridae			Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
TMP 2005.012.0369	Ankylosauridae	Ankylosauridae		Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)

Sample Number	Coombs (1978) family or other higher taxonomic original ID	Raven et al. (2023) family	Taxon	Unit	Age citation	Age
TMP 2005.012.038 4 - 1	Ankylosauridae	Ankylosauridae		Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
TMP 2005.012.038 4 - 2	Ankylosauridae	Ankylosauridae		Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
TMP 2005.012.039 7	Nodosauridae			Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
TMP 2005.012.042 7	Ankylosaur			Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
TMP 2005.049.006 5	Ankylosauridae	Ankylosauridae		Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
TMP 2005.049.010 2	Nodosauridae			Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
TMP 2005.049.014 3	Ankylosaur			Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
TMP 2005.054.000 7	Nodosauridae			Oldman Fm	Eberth, 2024	Campanian (78-77)
TMP 2006.012.018 2	Ankylosauridae	Ankylosauridae		Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
TMP 2008.043.005 1	Ankylosauridae	Ankylosauridae		Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
TMP 2011.047.000 2	Nodosauridae			Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)

Sample Number	Coombs (1978) family or other higher taxonomic original ID	Raven et al. (2023) family	Taxon	Unit	Age citation	Age
TMP 2011.047.0010	Nodosauridae			Oldman Fm	Eberth, 2024	Campanian (78-77)
TMP 2011.047.0079	Ankylosauridae	Ankylosauridae		Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
TMP 2012.012.0017	Ankylosauridae	Ankylosauridae		Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
TMP 2013.012.0057	Nodosauridae			Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
TMP 2014.012.0128	Nodosauridae			Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
TMP 2014.012.0134	Ankylosauridae	Ankylosauridae		Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
TMP 2017.023.0017 - 1	Ankylosauridae	Ankylosauridae	*Euoplocephalus tutus*	Oldman Fm (upper muddy unit)	Eberth, 2024	Campanian (78-77)
TMP 2017.023.0017 - 2	Ankylosauridae	Ankylosauridae	*Euoplocephalus tutus*	Oldman Fm (upper muddy unit)	Eberth, 2024	Campanian (78-77)
TMP 2017.023.0017 - 3	Ankylosauridae	Ankylosauridae	*Euoplocephalus tutus*	Oldman Fm (upper muddy unit)	Eberth, 2024	Campanian (78-77)
TMP 2017.023.0017 - 4	Ankylosauridae	Ankylosauridae	*Euoplocephalus tutus*	Oldman Fm (upper muddy unit)	Eberth, 2024	Campanian (78-77)
TMP 2018.012.0172	Ankylosauridae	Ankylosauridae		Belly River Group	Eberth, 2024	Campanian

Sample Number	Coombs (1978) family or other higher taxonomic original ID	Raven et al. (2023) family	Taxon	Unit	Age citation	Age
TMP 2019.012.0011	Nodosauridae			Belly River Group	Eberth, 2024	Campanian
TMP 2023.012.0023	Ankylosauridae	Ankylosauridae		Belly River Group	Eberth, 2024	Campanian
TMP 2023.012.0242	Nodosauridae			Belly River Group	Eberth, 2024	Campanian
UALVP 00002 - 1	Pachycephalosauridae	Pachycephalosauridae	*Stegoceras validum*	Oldman Fm	Eberth, 2024	Campanian (78-77)
UALVP 00002 - 10	Pachycephalosauridae	Pachycephalosauridae	*Stegoceras validum*	Oldman Fm	Eberth, 2024	Campanian (78-77)
UALVP 00002 - 11	Pachycephalosauridae	Pachycephalosauridae	*Stegoceras validum*	Oldman Fm	Eberth, 2024	Campanian (78-77)
UALVP 00002 - 12	Pachycephalosauridae	Pachycephalosauridae	*Stegoceras validum*	Oldman Fm	Eberth, 2024	Campanian (78-77)
UALVP 00002 - 13	Pachycephalosauridae	Pachycephalosauridae	*Stegoceras validum*	Oldman Fm	Eberth, 2024	Campanian (78-77)
UALVP 00002 - 14	Pachycephalosauridae	Pachycephalosauridae	*Stegoceras validum*	Oldman Fm	Eberth, 2024	Campanian (78-77)
UALVP 00002 - 15	Pachycephalosauridae	Pachycephalosauridae	*Stegoceras validum*	Oldman Fm	Eberth, 2024	Campanian (78-77)
UALVP 00002 - 16	Pachycephalosauridae	Pachycephalosauridae	*Stegoceras validum*	Oldman Fm	Eberth, 2024	Campanian (78-77)
UALVP 00002 - 17	Pachycephalosauridae	Pachycephalosauridae	*Stegoceras validum*	Oldman Fm	Eberth, 2024	Campanian (78-77)
UALVP 00002 - 18	Pachycephalosauridae	Pachycephalosauridae	*Stegoceras validum*	Oldman Fm	Eberth, 2024	Campanian (78-77)
UALVP 00002 - 19	Pachycephalosauridae	Pachycephalosauridae	*Stegoceras validum*	Oldman Fm	Eberth, 2024	Campanian (78-77)
UALVP 00002 - 2	Pachycephalosauridae	Pachycephalosauridae	*Stegoceras validum*	Oldman Fm	Eberth, 2024	Campanian (78-77)

Sample Number	Coombs (1978) family or other higher taxonomic original ID	Raven et al. (2023) family	Taxon	Unit	Age citation	Age
UALVP 00002 - 20	Pachycephalosaurid ae	Pachycephalosaur idae	*Stegoceras validum*	Oldman Fm	Eberth, 2024	Campanian (78-77)
UALVP 00002 - 21	Pachycephalosaurid ae	Pachycephalosaur idae	*Stegoceras validum*	Oldman Fm	Eberth, 2024	Campanian (78-77)
UALVP 00002 - 22	Pachycephalosaurid ae	Pachycephalosaur idae	*Stegoceras validum*	Oldman Fm	Eberth, 2024	Campanian (78-77)
UALVP 00002 - 23	Pachycephalosaurid ae	Pachycephalosaur idae	*Stegoceras validum*	Oldman Fm	Eberth, 2024	Campanian (78-77)
UALVP 00002 - 24	Pachycephalosaurid ae	Pachycephalosaur idae	*Stegoceras validum*	Oldman Fm	Eberth, 2024	Campanian (78-77)
UALVP 00002 - 25	Pachycephalosaurid ae	Pachycephalosaur idae	*Stegoceras validum*	Oldman Fm	Eberth, 2024	Campanian (78-77)
UALVP 00002 - 26	Pachycephalosaurid ae	Pachycephalosaur idae	*Stegoceras validum*	Oldman Fm	Eberth, 2024	Campanian (78-77)
UALVP 00002 - 27	Pachycephalosaurid ae	Pachycephalosaur idae	*Stegoceras validum*	Oldman Fm	Eberth, 2024	Campanian (78-77)
UALVP 00002 - 28	Pachycephalosaurid ae	Pachycephalosaur idae	*Stegoceras validum*	Oldman Fm	Eberth, 2024	Campanian (78-77)
UALVP 00002 - 29	Pachycephalosaurid ae	Pachycephalosaur idae	*Stegoceras validum*	Oldman Fm	Eberth, 2024	Campanian (78-77)
UALVP 00002 - 3	Pachycephalosaurid ae	Pachycephalosaur idae	*Stegoceras validum*	Oldman Fm	Eberth, 2024	Campanian (78-77)
UALVP 00002 - 30	Pachycephalosaurid ae	Pachycephalosaur idae	*Stegoceras validum*	Oldman Fm	Eberth, 2024	Campanian (78-77)
UALVP 00002 - 31	Pachycephalosaurid ae	Pachycephalosaur idae	*Stegoceras validum*	Oldman Fm	Eberth, 2024	Campanian (78-77)
UALVP 00002 - 32	Pachycephalosaurid ae	Pachycephalosaur idae	*Stegoceras validum*	Oldman Fm	Eberth, 2024	Campanian (78-77)
UALVP 00002 - 33	Pachycephalosaurid ae	Pachycephalosaur idae	*Stegoceras validum*	Oldman Fm	Eberth, 2024	Campanian (78-77)
UALVP 00002 - 34	Pachycephalosaurid ae	Pachycephalosaur idae	*Stegoceras validum*	Oldman Fm	Eberth, 2024	Campanian (78-77)

Sample Number	Coombs (1978) family or other higher taxonomic original ID	Raven et al. (2023) family	Taxon	Unit	Age citation	Age
UALVP 00002 - 35	Pachycephalosaurid ae	Pachycephalosaur idae	*Stegoceras validum*	Oldman Fm	Eberth, 2024	Campanian (78-77)
UALVP 00002 - 36	Pachycephalosaurid ae	Pachycephalosaur idae	*Stegoceras validum*	Oldman Fm	Eberth, 2024	Campanian (78-77)
UALVP 00002 - 37	Pachycephalosaurid ae	Pachycephalosaur idae	*Stegoceras validum*	Oldman Fm	Eberth, 2024	Campanian (78-77)
UALVP 00002 - 38	Pachycephalosaurid ae	Pachycephalosaur idae	*Stegoceras validum*	Oldman Fm	Eberth, 2024	Campanian (78-77)
UALVP 00002 - 39	Pachycephalosaurid ae	Pachycephalosaur idae	*Stegoceras validum*	Oldman Fm	Eberth, 2024	Campanian (78-77)
UALVP 00002 - 4	Pachycephalosaurid ae	Pachycephalosaur idae	*Stegoceras validum*	Oldman Fm	Eberth, 2024	Campanian (78-77)
UALVP 00002 - 40	Pachycephalosaurid ae	Pachycephalosaur idae	*Stegoceras validum*	Oldman Fm	Eberth, 2024	Campanian (78-77)
UALVP 00002 - 5	Pachycephalosaurid ae	Pachycephalosaur idae	*Stegoceras validum*	Oldman Fm	Eberth, 2024	Campanian (78-77)
UALVP 00002 - 6	Pachycephalosaurid ae	Pachycephalosaur idae	*Stegoceras validum*	Oldman Fm	Eberth, 2024	Campanian (78-77)
UALVP 00002 - 7	Pachycephalosaurid ae	Pachycephalosaur idae	*Stegoceras validum*	Oldman Fm	Eberth, 2024	Campanian (78-77)
UALVP 00002 - 8	Pachycephalosaurid ae	Pachycephalosaur idae	*Stegoceras validum*	Oldman Fm	Eberth, 2024	Campanian (78-77)
UALVP 00002 - 9	Pachycephalosaurid ae	Pachycephalosaur idae	*Stegoceras validum*	Oldman Fm	Eberth, 2024	Campanian (78-77)
UALVP 48641	Ankylosauridae	Ankylosauridae		Horseshoe Canyon Fm	Eberth & Kamo, 2020	Campanian-Maastrictian (73.1-68)
UALVP 48747	Ankylosauridae	Ankylosauridae		Wapiti Fm		Campanian-Maastrichtian (80-66)
UALVP 49327	Ankylosauridae	Ankylosauridae	*Ankylosaurus sp.*	Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
UALVP 53588 - 1	Pachycephalosaurid ae	Pachycephalosaur idae	*Stegoceras*	Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)

Sample Number	Coombs (1978) family or other higher taxonomic original ID	Raven et al. (2023) family	Taxon	Unit	Age citation	Age
UALVP 53588 - 2	Pachycephalosauridae	Pachycephalosauridae	*Stegoceras*	Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
UALVP 53588 - 3	Pachycephalosauridae	Pachycephalosauridae	*Stegoceras*	Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
UALVP 53588 - 4	Pachycephalosauridae	Pachycephalosauridae	*Stegoceras*	Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
UALVP 53588 - 5	Pachycephalosauridae	Pachycephalosauridae	*Stegoceras*	Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
UALVP 53588 - 6	Pachycephalosauridae	Pachycephalosauridae	*Stegoceras*	Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
UALVP 53590	Pachycephalosauridae	Pachycephalosauridae	*Stegoceras*	Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
UALVP 53591	Ankylosauridae	Ankylosauridae		Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
UALVP 53975	Ankylosauridae	Ankylosauridae	*Ankylosaurus sp.*	Foremost Fm	Eberth, 2024	Campanian (80-78)
UALVP 55323	Ankylosauridae	Ankylosauridae	*Ankylosaurus sp.*	Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
UALVP 55366	Nodosauridae			Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
UALVP 55378	Ankylosauridae	Ankylosauridae	*Ankylosaurus sp.*	Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
UALVP 55390	Nodosauridae			Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
UALVP 55621	Pachycephalosauridae	Pachycephalosauridae		Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
UALVP 59296	Ankylosauridae	Ankylosauridae	*Ankylosaurus sp.*	Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
UALVP 61124 - 1	Nodosauridae			Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
UALVP 61124 - 2	Nodosauridae			Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
UALVP 61153	Nodosauridae			Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)

Sample Number	Coombs (1978) family or other higher taxonomic original ID	Raven et al. (2023) family	Taxon	Unit	Age citation	Age
UALVP 61442	Pachycephalosaurid ae	Pachycephalosaur idae		Dinosaur Park Fm	Ramezani et al., 2022	Campanian (76.5-74.4)
UMNH VP 11638	Ankylosaur			Dakota Fm	Barclay et al., 2015	Cenomanian
UMNH VP 1228	Ankylosaur			Kaiparowits Fm	Ramezani et al., 2022	Campanian (77.3-74.9)
UMNH VP 1232	Ankylosaur			Cedar Mountain Fm	Kirkland et al., 2016	Late Jurassic-Cenomanian
UMNH VP 12637	Ankylosaur			Kaiparowits Fm	Ramezani et al., 2022	Campanian (77.3-74.9)
UMNH VP 12864	Ankylosaur			Kaiparowits Fm	Ramezani et al., 2022	Campanian (77.3-74.9)
UMNH VP 14228	Ankylosaur			Straight Cliffs Fm	Chentnik et al., 2015	Turonian - Campanian
UMNH VP 14436	Ankylosaur			Kaiparowits Fm	Ramezani et al., 2022	Campanian (77.3-74.9)
UMNH VP 14488	Ankylosaur			Kaiparowits Fm	Ramezani et al., 2022	Campanian (77.3-74.9)
UMNH VP 16221	Ankylosaur			Kaiparowits Fm	Ramezani et al., 2022	Campanian (77.3-74.9)
UMNH VP 16874	Ankylosaur			Kaiparowits Fm	Ramezani et al., 2022	Campanian (77.3-74.9)
UMNH VP 17418	Ankylosaur			Straight Cliffs Fm	Chentnik et al., 2015	Turonian - Campanian
UMNH VP 17502	Ankylosaur			Straight Cliffs Fm	Chentnik et al., 2015	Turonian - Campanian
UMNH VP 17514	Ankylosaur			Kaiparowits Fm	Ramezani et al., 2022	Campanian (77.3-74.9)
UMNH VP 17973	Ankylosaur			Wahweap Fm	Beveridge et al., 2022	Campanian (82.17-77.29)
UMNH VP 19037	Ankylosaur			Kaiparowits Fm	Ramezani et al., 2022	Campanian (77.3-74.9)

Sample Number	Coombs (1978) family or other higher taxonomic original ID	Raven et al. (2023) family	Taxon	Unit	Age citation	Age
UMNH VP 19040	Ankylosaur			Kaiparowits Fm	Ramezani et al., 2022	Campanian (77.3-74.9)
UMNH VP 19699	Ankylosaur			Straight Cliffs Fm	Chentnik et al., 2015	Turonian - Campanian
UMNH VP 19719	Ankylosaur			Straight Cliffs Fm	Chentnik et al., 2015	Turonian - Campanian
UMNH VP 19720	Ankylosaur			Straight Cliffs Fm	Chentnik et al., 2015	Turonian - Campanian
UMNH VP 20599	Ankylosaur			Kaiparowits Fm	Ramezani et al., 2022	Campanian (77.3-74.9)
UMNH VP 20903	Ankylosaur			Kaiparowits Fm	Ramezani et al., 2022	Campanian (77.3-74.9)
UMNH VP 24117	Ankylosaur			Iron Springs		Santonian
UMNH VP 5609	Ankylosaur			Kaiparowits Fm	Ramezani et al., 2022	Campanian (77.3-74.9)
UMNH VP 6765	Ankylosaur			Wahweap Fm	Beveridge et al., 2022	Campanian (82.17-77.29)
UMNH VP 7603	Ankylosaur			Wahweap Fm	Beveridge et al., 2022	Campanian (82.17-77.29)
UMNH VP 7658	Ankylosaur			Wahweap Fm	Beveridge et al., 2022	Campanian (82.17-77.29)
UMNH VP 7672	Ankylosaur			Straight Cliffs Fm	Chentnik et al., 2015	Turonian - Campanian
ZPAL MgD ii/1-1	Ankylosauridae	Ankylosauridae	*Pinacosaurus grangeri*	Djadokhta Formation	Dashzeveg et al., 2005	Campanian
ZPAL MgD ii/1-2	Ankylosauridae	Ankylosauridae	*Pinacosaurus grangeri*	Djadokhta Formation	Dashzeveg et al., 2005	Campanian
ZPAL MgD ii/1-3	Ankylosauridae	Ankylosauridae	*Pinacosaurus grangeri*	Djadokhta Formation	Dashzeveg et al., 2005	Campanian
ZPAL MgD ii/1-4	Ankylosauridae	Ankylosauridae	*Pinacosaurus grangeri*	Djadokhta Formation	Dashzeveg et al., 2005	Campanian

Sample Number	Coombs (1978) family or other higher taxonomic original ID	Raven et al. (2023) family	Taxon	Unit	Age citation	Age
ZPAL MgD ii/1-5	Ankylosauridae	Ankylosauridae	*Pinacosaurus grangeri*	Djadokhta Formation	Dashzeveg et al., 2005	Campanian
ZPAL MgD ii/1-6	Ankylosauridae	Ankylosauridae	*Pinacosaurus grangeri*	Djadokhta Formation	Dashzeveg et al., 2005	Campanian
ZPAL MgD ii/1-7	Ankylosauridae	Ankylosauridae	*Pinacosaurus grangeri*	Djadokhta Formation	Dashzeveg et al., 2005	Campanian

Appendix E – 2: Specimen information and discrete trait observations

Specimen	Dentary or maxillary?	Isolated or associated?	Labial photo?	Lingual photo?	Basal cingulum?	Fluting?	Denticles?	Root?
BYU VP 50866		i, monotaxic bonebed	y	y	y	y	y	y
CEUM 09173	dentary	a		y	y		y	y
CEUM 11909		a	y	y			y	y
CEUM 11910		i, monotaxic bonebed	y	y			y	y
CEUM 11911		i, monotaxic bonebed	y	y			y	y
CEUM 11912		i, monotaxic bonebed	y	y			y	y
CEUM 11923		i	y	y	y		y	y
CEUM 11924		i	y	y	y			
CEUM 12435		a	y	y	y			y
CEUM 1264 #86	maxillary	a		y			y	
CEUM 12811		i	y	y	y			y
CEUM 31206		i	y	y	y			
CEUM 34580	maxillary	a		y	y		y	y
CEUM 53115		i	y	y	y		y	y
CEUM 5373		i, monotaxic bonebed	y	y			y	y
CMNFV 1131		i	y	y	y			
CMNFV 119 - 1		i	y	y	y	y		
CMNFV 119 - 2		i	y	y			y	
CMNFV 119 - 3		i	y	y	y	y	y	
CMNFV 119 - 4		i	y	y	y	y	y	
CMNFV 119 - 5		i	y	y		y	y	
CMNFV 119 - 6		i	y	y	y	y	y	
CMNFV 129 - 1		i	y	y				

Specimen	Dentary or maxillary?	Isolated or associated?	Labial photo?	Lingual photo?	Basal cingulum?	Fluting?	Denticles?	Root?
CMNFV 129 - 2		i	y	y	y		y	y
CMNFV 1349		i	y	y		y	y	
CMNFV 1772 - 1		i	y	y			y	
CMNFV 1772 - 2		i	y	y				
CMNFV 1772 - 3		i	y	y	y		y	
CMNFV 1772 - 4		i	y	y	y		y	
CMNFV 1772 - a		i	y	y	y	y	y	y
CMNFV 21864		i	y	y	y			
CMNFV 2334		i	y	y				
CMNFV 2759 - 1	maxillary	a	y	y	y	y	y	y
CMNFV 2759 - 2	maxillary	a	y	y	y			
CMNFV 2759 - 3	dentary	a	y	y	y			y
CMNFV 2759 - 4	dentary	a	y	y	y			y
CMNFV 2759 - 5	maxillary	a	y	y	y		y	
CMNFV 2759 - 6	maxillary?	a	y	y			y	
CMNFV 38441		i	y	y	y			y
CMNFV 38442		i	y	y	y	y	y	y
CMNFV 38443		i	y	y	y	y	y	
CMNFV 38444		i	y	y				y
CMNFV 38445		i	y	y		y	y	y
CMNFV 38446		i	y	y				
CMNFV 38447		i	y	y			y	
CMNFV 38448		i	y	y	y			y
CMNFV 38449		i	y	y	y			
CMNFV 59240 - 1		i	y	y	y		y	
CMNFV 59240 - 2		i	y	y	y	y	y	

Specimen	Dentary or maxillary?	Isolated or associated?	Labial photo?	Lingual photo?	Basal cingulum?	Fluting?	Denticles?	Root?
CMNFV 59240 - 3		i	y	y	y			
CMNFV 59431		i	y	y	y		y	
CMNFV 59432 - 1		i	y	y	y		y	
CMNFV 59432 - 2		i	y	y				y
CMNFV 59459		i	y	y	y			
CMNFV 59460		i	y	y	y			
CMNFV 59480		i	y	y	y			
CMNFV 59510 - 1		i	y	y	y	y	y	
CMNFV 59510 - 2		i	y	y	y	y	y	
CMNFV 59534		i	y	y	y			
CMNFV 59591 - 1		i	y	y	y	y		
CMNFV 59591 - 2		i	y	y				
CMNFV 8531 - 1	maxillary	a	y				y	
CMNFV 8531 - 2	maxillary	a	y				y	
CMNFV 8531 - 3	maxillary	a	y		y		y	
CMNFV 8531 - 4	maxillary	a	y		y		y	
CMNFV 8531 - 5	maxillary	a	y				y	
CMNFV 8531 - 6	dentary	a	y				y	
CMNFV 8531 - 7	maxillary	a	y	y	y	y	y	y
CMNFV 8531 - 8	maxillary	a	y	y	y		y	
CMNFV 8531 - 9	dentary	a	y	y	y	y	y	
CMNFV 8537 - 1	listed as dentary, but I say maxillary	a	y	y		y	y	y
CMNFV 8537 - 2	listed as dentary, but I say maxillary	a	y	y			y	y

Specimen	Dentary or maxillary?	Isolated or associated?	Labial photo?	Lingual photo?	Basal cingulum?	Fluting?	Denticles?	Root?
CMNFV 8537 - 3	listed as dentary, but I say maxillary	a	y	y		y	y	y
CMNFV 8537 - 4	listed as dentary, but I say maxillary	a	y	y		y	y	y
CMNFV 8537 - 5	listed as dentary, but I say maxillary	a	y	y		y		y
CMNFV 8537 - 6	listed as dentary, but I say maxillary	a	y	y		y	y	
CMNFV 8537 - 7	listed as dentary, but I say maxillary	a	y	y		y	y	
CMNFV 8537 - 8	listed as dentary, but I say maxillary	a	y	y		y	y	
CMNFV 8731 - 1		i	y	y	y			
CMNFV 8731 - 2		i	y	y				
CMNFV 8731 - 3		i	y	y	y			
CMNFV 8731 - 4		i	y	y	y	y	y	
CMNFV 8876 - 1	maxillary	a	y	y	y			y
CMNFV 8876 - 2	dentary	a	y	y		y	y	
CMNFV 8876 - 3	dentary	a	y	y		y	y	
CMNFV 8880 - 1	dentary?	a	y	y	y	y	y	y
CMNFV 8880 - 2	maxillary?	a	y	y	y		y	y
CMNFV 973		i	y	y	y			
CMNFV CMS1921 - 1		i	y	y				
CMNFV CMS1921 - 2		i	y	y			y	y
CMNFV CMS1921 - 3		i	y	y	y		y	y

Specimen	Dentary or maxillary?	Isolated or associated?	Labial photo?	Lingual photo?	Basal cingulum?	Fluting?	Denticles?	Root?
CMNFV CMS1921 - 4		i	y	y				
CMNFV CMS1921 - 5		i	y	y				
CMNFV CMS1921 - 6		i	y	y				y
CMNFV CMS1921 - 7		i	y	y	y			
CMNFV CMS1921 - 8		i	y	y				
CMNFV RDR - 1		i	y	y			y	
CMNFV RDR - 10		i	y	y				
CMNFV RDR - 11		i	y	y				
CMNFV RDR - 12		i	y	y				
CMNFV RDR - 2		i	y	y	y			y
CMNFV RDR - 3		i	y	y	y		y	
CMNFV RDR - 4		i	y	y	y		y	
CMNFV RDR - 5		i	y	y	y			
CMNFV RDR - 6		i	y	y	y			
CMNFV RDR - 7		i	y	y	y			
CMNFV RDR - 8		i	y	y	y			
CMNFV RDR - 9		i	y	y	y			y
CMNFV UN - 1		i	y	y	y			
CMNFV UN - 2		i	y	y				
CMNFV UN - 3		i	y	y				
CMNFV UN - 4		i	y	y	y		y	
CMNFV UN - 5		i	y	y	y		y	
CMNFV UN - 6		i	y	y				
CMNFV UN - 7		i	y	y	y			
CMNFV UN - 8		i	y	y				
CMNFV UN - 9		i	y	y				

Specimen	Dentary or maxillary?	Isolated or associated?	Labial photo?	Lingual photo?	Basal cingulum?	Fluting?	Denticles?	Root?
DMNH EPV 53040		i, monotaxic bonebed	y	y			y	y
DMNH EPV 136185 - 13		a	y	y		y	y	y
DMNH EPV 136185 - 14	dentary	a	y	y		y	y	y
DMNH EPV 136185 - 15	dentary	a	y	y		y	y	y
DMNH EPV 136185 - 16	dentary	a	y	y		y	y	y
DMNH EPV 136185 - 17	dentary	a	y	y		y	y	y
DMNH EPV 136185 - 18	maxillary	a	y			y	y	
DMNH EPV 136185 - 19	maxillary	a	y			y	y	y
DMNH EPV 136185 - 20	maxillary	a	y			y	y	y
DMNH EPV 136185 - 21	maxillary	a	y			y	y	
DMNH EPV 136185 - 22	maxillary	a	y			y	y	y
DMNH EPV 136185 - 23	maxillary	a	y			y	y	y
DMNH EPV 136185 - 24	maxillary	a	y			y	y	y
DMNH EPV 136185 - 25	maxillary	a	y			y	y	
DMNH EPV 136185 - 26	maxillary	a	y			y	y	y
DMNH EPV 136185 - 27	maxillary	a	y			y	y	y
DMNH EPV 18168 - 1		i	y	y	y		y	
DMNH EPV 18168 - 10		i	y	y	y			

Specimen	Dentary or maxillary?	Isolated or associated?	Labial photo?	Lingual photo?	Basal cingulum?	Fluting?	Denticles?	Root?
DMNH EPV 18168 - 11		i	y	y	y			
DMNH EPV 18168 - 12		i	y	y	y			
DMNH EPV 18168 - 13		i	y	y	y			
DMNH EPV 18168 - 14		i	y	y	y		y	
DMNH EPV 18168 - 15		i	y	y	y			
DMNH EPV 18168 - 16		i	y	y	y			
DMNH EPV 18168 - 17		i	y	y	y			
DMNH EPV 18168 - 2		i	y	y	y			
DMNH EPV 18168 - 3		i	y	y	y			
DMNH EPV 18168 - 4		i	y	y	y		y	
DMNH EPV 18168 - 5		i	y	y	y			
DMNH EPV 18168 - 6		i	y	y	y			
DMNH EPV 18168 - 7		i	y	y	y			
DMNH EPV 18168 - 8		i	y	y	y			
DMNH EPV 18168 - 9		i	y	y	y			
DMNH EPV 18169 - 1		i	y	y	y			
DMNH EPV 18169 - 2		i	y	y	y		y	
DMNH EPV 18169 - 3		i	y	y	y		y	
DMNH EPV 18169 - 4		i	y	y	y		y	
DMNH EPV 18169 - 5		i	y	y	y			
DMNH EPV 21671		i	y	y	y		y	
DMNH EPV 27726 - 1	maxillary	a	y	y				y
DMNH EPV 27726 - 10	dentary	a	y	y	y		y	
DMNH EPV 27726 - 11	dentary	a	y	y			y	y
DMNH EPV 27726 - 12	dentary	a	y	y				y
DMNH EPV 27726 - 13	dentary	a		y				y

Specimen	Dentary or maxillary?	Isolated or associated?	Labial photo?	Lingual photo?	Basal cingulum?	Fluting?	Denticles?	Root?
DMNH EPV 27726 - 14	dentary or predentary	a	y	y			y	
DMNH EPV 27726 - 15	dentary or predentary	a	y	y			y	
DMNH EPV 27726 - 16	dentary or predentary	a	y	y			y	
DMNH EPV 27726 - 17		a	y	y			y	y
DMNH EPV 27726 - 18		a	y	y			y	y
DMNH EPV 27726 - 2	maxillary	a		y			y	
DMNH EPV 27726 - 3	maxillary	a		y			y	
DMNH EPV 27726 - 4	maxillary	a		y			y	
DMNH EPV 27726 - 5	premaxillary	a		y			y	
DMNH EPV 27726 - 6	premaxillary	a	y	y			y	y
DMNH EPV 27726 - 7	premaxillary	a		y				
DMNH EPV 27726 - 8	premaxillary	a		y				
DMNH EPV 27726 - 9	dentary	a		y			y	
DMNH EPV 2818 - 10	maxillary	a		y	y	y	y	y
DMNH EPV 2818 - 11	maxillary	a		y	y	y	y	
DMNH EPV 2818 - 12	maxillary	a		y	y	y	y	
DMNH EPV 2818 - 13	maxillary	a		y	y	y	y	
DMNH EPV 2818 - 14	maxillary	a		y	y	y	y	
DMNH EPV 2818 - 15	maxillary	a		y	y	y	y	
DMNH EPV 2818 - 16	maxillary	a		y	y	y	y	
DMNH EPV 2818 - 17	maxillary	a		y	y	y	y	
DMNH EPV 2818 - 18	maxillary	a		y	y	y	y	
DMNH EPV 2818 - 19	maxillary	a		y	y	y	y	
DMNH EPV 2818 - 2	maxillary	a	y		y		y	
DMNH EPV 2818 - 20	dentary	a		y	y	y	y	

Specimen	Dentary or maxillary?	Isolated or associated?	Labial photo?	Lingual photo?	Basal cingulum?	Fluting?	Denticles?	Root?
DMNH EPV 2818 - 21	dentary	a		y	y	y	y	
DMNH EPV 2818 - 22	dentary	a		y	y	y	y	
DMNH EPV 2818 - 23	dentary	a		y	y	y	y	
DMNH EPV 2818 - 24	dentary	a		y	y	y	y	
DMNH EPV 2818 - 25	dentary	a		y	y	y	y	
DMNH EPV 2818 - 26	dentary	a		y	y	y	y	
DMNH EPV 2818 - 27	dentary	a		y	y	y	y	
DMNH EPV 2818 - 28	dentary	a		y	y	y	y	
DMNH EPV 2818 - 3	maxillary	a	y		y		y	
DMNH EPV 2818 - 4	maxillary	a		y	y	y	y	
DMNH EPV 2818 - 5	maxillary	a		y	y	y	y	
DMNH EPV 2818 - 6	maxillary	a		y	y	y	y	
DMNH EPV 2818 - 7	maxillary	a		y	y	y	y	
DMNH EPV 2818 - 8	maxillary	a		y	y	y	y	
DMNH EPV 2818 - 9	maxillary	a		y	y	y	y	
DMNH EPV 468	maxillary	a		y			y	
DMNH EPV 50206 - 3	maxillary	a	y	y			y	y
DMNH EPV 50206 - 4	maxillary	a	y	y			y	y
DMNH EPV 50373		i, monotaxic bonebed	y	y			y	
DMNH EPV 50377		i, monotaxic bonebed	y	y	y		y	y
DMNH EVP 136185 - 1		a	y	y		y	y	y
DMNH EVP 136185 - 10		a	y	y		y	y	y
DMNH EVP 136185 - 11		a	y	y		y	y	y
DMNH EVP 136185 - 12		a	y	y		y	y	y

Specimen	Dentary or maxillary?	Isolated or associated?	Labial photo?	Lingual photo?	Basal cingulum?	Fluting?	Denticles?	Root?
DMNH EVP 136185 - 2		a	y	y		y	y	y
DMNH EVP 136185 - 3		a	y	y		y	y	y
DMNH EVP 136185 - 4		a	y	y	y	y	y	y
DMNH EVP 136185 - 5		a	y	y		y	y	y
DMNH EVP 136185 - 6		a	y	y	y	y	y	y
DMNH EVP 136185 - 7		a	y	y		y	y	y
DMNH EVP 136185 - 8		a	y	y		y	y	y
DMNH EVP 136185 - 9		a	y	y		y	y	y
DMNH EVP 2818 - 1	maxillary	a	y		y			
DMNH EVP 50206 - 1	maxillary	a	y	y			y	y
DMNH EVP 50206 - 2	maxillary	a	y	y			y	
PIN 3142/250 - 1	maxillary	a	y	y	y? hard to tell in picture	y? hard to tell in picture	y	
PIN 3142/250 - 10	maxillary	a	y		y? hard to tell in picture	n? hard to tell in picture	y	
PIN 3142/250 - 2	maxillary	a	y	y	y? hard to tell in picture	y? hard to tell in picture	y	
PIN 3142/250 - 3	maxillary	a	y	y	y? hard to tell in picture	y? hard to tell in picture	y	
PIN 3142/250 - 4	maxillary	a	y	y	y? hard to tell in picture	y? hard to tell in picture	y	
PIN 3142/250 - 5	maxillary	a	y		y? hard to tell in picture	n? hard to tell in picture	y	
PIN 3142/250 - 6	maxillary	a	y		y? hard to tell in picture	n? hard to tell in picture	y	

Specimen	Dentary or maxillary?	Isolated or associated?	Labial photo?	Lingual photo?	Basal cingulum?	Fluting?	Denticles?	Root?
PIN 3142/250 - 7	maxillary	a	y		y? hard to tell in picture	n? hard to tell in picture	y	
PIN 3142/250 - 8	maxillary	a	y		y? hard to tell in picture	n? hard to tell in picture	y	
PIN 3142/250 - 9	maxillary	a	y		y? hard to tell in picture	n? hard to tell in picture	y	
ROM 03088		i	y	y	y	y	y	
ROM 03287		i	y	y				
ROM 03302		i	y	y	y			
ROM 03368		i	y	y	y			
ROM 03516		i	y	y	y	y	y	
ROM 07763		i	y	y	y	y	y	y
ROM 07765		i	y	y	y	y	y	
ROM 07766		i	y	y	y	y		
ROM 07767		i	y	y	y		y	y
ROM 07768		i	y	y				
ROM 07770		I	y	y		y	y	y
ROM 07772		i	y	y				
ROM 1215 - 1	maxillary	a	y	y	y	y	y	y
ROM 1215 - 10	maxillary	a	y	y	y	y	y	y
ROM 1215 - 11	maxillary	a	y	y	y	y		
ROM 1215 - 12	maxillary	a	y	y	y	y	y	y
ROM 1215 - 13	maxillary	a	y	y	y			y
ROM 1215 - 14	maxillary	a	y	y	y	y	y	y
ROM 1215 - 15	maxillary	a	y	y	y	y	y	
ROM 1215 - 16	maxillary	a	y	y	y	y	y	y

Specimen	Dentary or maxillary?	Isolated or associated?	Labial photo?	Lingual photo?	Basal cingulum?	Fluting?	Denticles?	Root?
ROM 1215 - 17	dentary	a	y	y	y	y	y	y
ROM 1215 - 2	maxillary	a	y	y	y	y	y	y
ROM 1215 - 3	maxillary	a	y	y	y	y	y	y
ROM 1215 - 4	maxillary	a	y	y	y			
ROM 1215 - 5	maxillary	a	y	y	y	y	y	y
ROM 1215 - 6	maxillary	a	y	y	y			y
ROM 1215 - 7	maxillary	a	y	y	y	y	y	y
ROM 1215 - 8	maxillary	a	y	y	y	y	y	y
ROM 1215 - 9	maxillary	a	y	y	y		y	y
ROM 26346		I	y	y		Y	Y	Y
ROM 31697		i	y	y	y			
ROM 31865		i	y	y			y	
ROM 31866		i	y	y	y	y	y	y
ROM 31867		i	y	y	y	y	y	y
ROM 31868		i	y	y		y		
ROM 31869		i	y	y	y	y		
ROM 31871		i	y	y	y	y	y	
ROM 31872		i	y	y	y		y	y
ROM 36385		i	y	y	y			
ROM 36386		i	y	y	y			
ROM 36387		i	y	y				
ROM 36388		i	y	y				
ROM 36389		i	y	y	y			
ROM 36390		i	y	y				
ROM 36391		i	y	y	y			
ROM 36392		i	y	y	y			

Specimen	Dentary or maxillary?	Isolated or associated?	Labial photo?	Lingual photo?	Basal cingulum?	Fluting?	Denticles?	Root?
ROM 36393		i	y	y	y			
ROM 36394		i	y	y	y			
ROM 36395		i	y	y	y			
ROM 36396		i	y	y	y		y	
ROM 36397		i	y	y	y			
ROM 36398		i	y	y	y			
ROM 36399		i	y	y	y		y	
ROM 36400		i	y	y	y			
ROM 36401		i	y	y	y			
ROM 36402		i	y	y	y		y	
ROM 36403		i	y	y	y			
ROM 36404		i	y	y	y	y	y	
ROM 36405		i	y	y				
ROM 36406		i	y	y	y			
ROM 36407		i	y	y				
ROM 36408		i	y	y	y	y	y	
ROM 36409		i	y	y	y		y	y
ROM 36410		i	y	y	y	y	y	y
ROM 36411		i	y	y	y	y	y	y
ROM 36412		i	y	y			y	y
ROM 36413		i	y	y	y		y	
ROM 36414		i	y	y	y			
ROM 36415		i	y	y				
ROM 36416		i	y	y	y	y	y	
ROM 36417		i	y	y	y	y	y	
ROM 36418		i	y	y	y	y	y	

Specimen	Dentary or maxillary?	Isolated or associated?	Labial photo?	Lingual photo?	Basal cingulum?	Fluting?	Denticles?	Root?
ROM 36419		i	y	y	y			
ROM 36420		i	y	y	y			
ROM 36421		i	y	y	y			
ROM 36422		i	y	y	y			
ROM 36423		i	y	y			y	
ROM 53579	maxillary	a	y			y	y	
ROM 56611		i	y	y	y		y	
ROM 56620		i	y	y	y		y	y
ROM 58144		i	y	y	y		y	y
ROM 58147		I	y	y	y	y	y	y
ROM 58151		i	y	y	y		y	
ROM 58223		i	y	y	y		y	y
ROM 58383		i	y	y	y	y	y	y
ROM 58516		i	y	y				
ROM 58525		i	y	y	y	y		
ROM 58565 - 1		i	y	y	y		y	
ROM 58565 - 2		i	y	y	y			
ROM 58565 - 3		i	y	y	y		y	y
ROM 58565 - 4		i	y	y				
ROM 58594		i	y	y	y		y	y
ROM 58598		i	y	y	y		y	y
ROM 58689 - 1		i	y	y	y			
ROM 58689 - 2		i	y	y	y		y	y
ROM 58704		i	y	y	y			
ROM 67276		i	y	y	y			
ROM 788 - 1	maxillary	a		y				y

Specimen	Dentary or maxillary?	Isolated or associated?	Labial photo?	Lingual photo?	Basal cingulum?	Fluting?	Denticles?	Root?
ROM 788 - 2	maxillary	a		y	y		y	y
ROM 788 - 3	maxillary	a		y	y			y
ROM 788 - 4	maxillary	a		y	y		y	
ROM 788 - 5	maxillary	a		y	y		y	
ROM 788 - 6	maxillary	a		y	y		y	
ROM 788 - 7	maxillary	a		y	y	y	y	
ROM 788 - 8	maxillary	a		y	y	y	y	
SMU 73203	maxillary	a	y	y	y		y	y
TMP 1966.025.0015		i	y	y		y	y	y
TMP 1976.006.0036		i	y	y	y		y	y
TMP 1980.008.0026 - 1		i	y	y	y		y	y
TMP 1980.008.0026 - 2		i	y	y	y	y	y	y
TMP 1980.013.0046		i	y	y		y	y	y
TMP 1980.016.0239		i	y	y		y	y	y
TMP 1980.016.0834		i	y	y		y	y	
TMP 1980.016.1685 - 1	dentary	a		y		y	y	
TMP 1980.016.1685 - 2	dentary	a	y		y	y	y	y
TMP 1980.029.0140		i	y	y	y	y	y	y
TMP 1980.029.0228		i	y	y		y	y	y
TMP 1981.041.0014		i	y	y	y	y	y	
TMP 1983.036.0009 - 1		i	y	y		y	y	y
TMP 1983.036.0009 - 2		i	y	y		y	y	y
TMP 1983.036.0009 - 3		i	y	y	y	y	y	
TMP 1983.036.0009 - 4		i	y	y	y	y	y	y
TMP 1983.036.0207		i	y	y	y	y	y	y
TMP 1984.091.0020		i	y	y	y		y	y

Specimen	Dentary or maxillary?	Isolated or associated?	Labial photo?	Lingual photo?	Basal cingulum?	Fluting?	Denticles?	Root?
TMP 1985.036.0121		i	y	y		y	y	y
TMP 1985.056.0170 - 1		i	y	y	y	y	y	y
TMP 1985.056.0170 - 2		i	y	y	y	y	y	y
TMP 1985.056.0171 - 1		i	y	y	y	y	y	y
TMP 1985.056.0171 - 2		i	y	y	y	y	y	y
TMP 1985.056.0171 - 3		i	y	y	y	y	y	y
TMP 1985.056.0211		i	y	y	y	y	y	y
TMP 1985.059.0028		i	y	y		y	y	y
TMP 1986.008.0084		i	y	y	y		y	y
TMP 1986.009.0055		i	y	y			y	y
TMP 1986.023.0108		i	y	y		y	y	y
TMP 1986.095.0007		i	y	y		y	y	y
TMP 1986.127.0005		i	y	y		y	y	
TMP 1986.183.0003		i	y	y			y	y
TMP 1987.029.0006		i	y	y			y	y
TMP 1987.036.0094		i	y	y	y	y	y	y
TMP 1987.077.0143		i	y	y	y	y	y	y
TMP 1987.080.0010		i	y	y			y	y
TMP 1989.069.0017		i	y	y	y		y	y
TMP 1989.036.0396 - 1		i	y	y			y	y
TMP 1989.036.0396 - 2		i	y	y		y	y	y
TMP 1989.036.0396 - 3		i	y	y		y	y	y
TMP 1989.036.0405 - 1		i	y	y	y	y	y	y
TMP 1989.036.0405 - 2		i	y	y	y	y	y	
TMP 1989.036.0405 - 3		i	y	y		y	y	y
TMP 1989.050.0002		i	y	y	y	y	y	y

Specimen	Dentary or maxillary?	Isolated or associated?	Labial photo?	Lingual photo?	Basal cingulum?	Fluting?	Denticles?	Root?
TMP 1989.050.0013		i	y	y	y			y
TMP 1989.050.0030		i	y	y	y		y	y
TMP 1989.076.0059		i	y	y	y		y	y
TMP 1989.079.0008		i		y	y		y	y
TMP 1989.151.0137		i	y	y	y		y	y
TMP 1990.036.0081		i	y	y	y	y	y	y
TMP 1990.060.0006 - 1		i	y	y	y		y	y
TMP 1990.060.0006 - 2		i	y	y	y		y	y
TMP 1990.107.0037 - 1		i	y	y	y		y	y
TMP 1990.107.0037 - 2		i	y	y	y		y	y
TMP 1990.155.0007		i	y	y	y	y	y	y
TMP 1991.036.0158		i	y	y			y	y
TMP 1991.036.0171		i	y	y	y		y	y
TMP 1991.036.0734		i	y	y		y	y	y
TMP 1991.050.0093		i	y	y			y	y
TMP 1991.085.0012		i	y	y	y		y	y
TMP 1991.087.0072		i	y	y		y	y	y
TMP 1992.036.0313 - 1	dentary	a	y	y	y	y	y	
TMP 1992.036.0313 - 2	dentary	a		y			y	
TMP 1992.036.1178 - 1		i	y	y			y	y
TMP 1992.036.1178 - 2		i	y	y	y		y	y
TMP 1992.036.1178 - 3		i	y	y	y	y	y	y
TMP 1993.036.0081		i	y	y		y	y	y
TMP 1993.036.0364		i	y	y	y	y	y	y
TMP 1993.079.0065		i	y	y	y	y	y	y
TMP 1994.012.0035		i	y	y			y	y

Specimen	Dentary or maxillary?	Isolated or associated?	Labial photo?	Lingual photo?	Basal cingulum?	Fluting?	Denticles?	Root?
TMP 1994.012.0039		i	y	y	y		y	y
TMP 1994.012.0120		i	y	y	y	y	y	y
TMP 1994.012.0565		i	y	y	y		y	y
TMP 1994.086.0018		i	y	y	y	y	y	y
TMP 1994.092.0011		i	y	y		y	y	y
TMP 1994.094.0014 - 1		i	y	y	y		y	y
TMP 1994.094.0014 - 2		i	y	y	y	y	y	y
TMP 1994.094.0016		i	y	y	y	y	y	y
TMP 1994.097.0001		i	y	y		y	y	y
TMP 1995.012.0105		i	y	y	y		y	y
TMP 1995.012.0117		i	y	y	y		y	y
TMP 1996.048.0018 - 1		i	y	y		y	y	y
TMP 1996.048.0018 - 2		i	y	y			y	y
TMP 1996.075.0001 - 1		a	y	y		y	y	y
TMP 1996.075.0001 - 10		a	y	y		y	y	y
TMP 1996.075.0001 - 11		a	y	y		y	y	y
TMP 1996.075.0001 - 12		a	y	y		y	y	y
TMP 1996.075.0001 - 2		a	y	y		y	y	y
TMP 1996.075.0001 - 3		a	y	y		y	y	
TMP 1996.075.0001 - 4		a	y	y		y	y	
TMP 1996.075.0001 - 5		a	y	y		y	y	
TMP 1996.075.0001 - 6		a	y	y		y	y	
TMP 1996.075.0001 - 7		a	y	y		y	y	y
TMP 1996.075.0001 - 8		a	y	y		y	y	y
TMP 1996.075.0001 - 9		a	y	y		y	y	y

Specimen	Dentary or maxillary?	Isolated or associated?	Labial photo?	Lingual photo?	Basal cingulum?	Fluting?	Denticles?	Root?
TMP 1996.089.0002		i	y	y	y	y	y	y
TMP 1997.012.0005		i	y	y	y	y	y	y
TMP 1997.012.0042		i	y	y			y	y
TMP 1997.012.0085		i	y	y	y		y	y
TMP 1997.012.0106		i	y	y	y	y	y	y
TMP 1997.132.0001 - 1	maxilla	a		y	y	y	y	
TMP 1997.132.0001 - 2	maxilla	a	y	y	y	y	y	y
TMP 1997.132.0001 - 3	maxilla	a		y			y	y
TMP 1997.132.0001 - 4	maxilla	a		y	y	y	y	
TMP 1997.132.0001 - 5	maxilla	a		y	y	y	y	
TMP 1997.132.0001 - 6	maxilla	a		y	y	y	y	
TMP 1997.132.0001 - 7	maxilla	a		y	y	y	y	
TMP 1998.008.0004		i	y	y	y	y	y	y
TMP 1998.043.0004		i	y	y	y		y	y
TMP 1998.068.0086		i	y	y	y		y	y
TMP 1998.068.0153		i	y	y	y	y	y	y
TMP 1998.098.0001 - 1	maxilla	a	y	y	y	y	y	y
TMP 1998.098.0001 - 10	dentary	a	y	y	y	y	y	y
TMP 1998.098.0001 - 11	dentary	a	y	y				y
TMP 1998.098.0001 - 12	maxilla	a	y		y	y	y	y
TMP 1998.098.0001 - 13	maxilla	a	y		y	y	y	y
TMP 1998.098.0001 - 14	maxilla	a	y		y	y	y	y
TMP 1998.098.0001 - 15	maxilla	a	y		y	y	y	y

Specimen	Dentary or maxillary?	Isolated or associated?	Labial photo?	Lingual photo?	Basal cingulum?	Fluting?	Denticles?	Root?
TMP 1998.098.0001 - 16	maxilla	a	y		y	y	y	y
TMP 1998.098.0001 - 17	maxilla	a	y		y	y	y	y
TMP 1998.098.0001 - 18	maxilla	a	y		y			
TMP 1998.098.0001 - 19	maxilla	a	y		y	y		
TMP 1998.098.0001 - 2	maxilla	a	y	y	y	y	y	y
TMP 1998.098.0001 - 20	maxilla	a	y		y	y	y	y
TMP 1998.098.0001 - 21	dentary	a		y	y	y	y	
TMP 1998.098.0001 - 22	maxilla	a		y	y	y	y	y
TMP 1998.098.0001 - 23	maxilla	a		y		y		
TMP 1998.098.0001 - 3	maxilla	a	y	y	y	y	y	y
TMP 1998.098.0001 - 4	maxilla	a	y	y	y	y	y	y
TMP 1998.098.0001 - 5	maxilla	a	y	y	y	y	y	y
TMP 1998.098.0001 - 6	maxilla	a	y	y	y	y	y	y
TMP 1998.098.0001 - 7	dentary	a	y	y	y	y	y	y
TMP 1998.098.0001 - 8	dentary	a	y	y	y	y	y	y
TMP 1998.098.0001 - 9	dentary	a	y	y	y	y	y	y
TMP 1998.102.0026 - 1		i	y	y	y		y	y
TMP 1998.102.0026 - 2		i	y	y	y		y	y
TMP 1998.102.0026 - 3		i	y	y	y		y	y
TMP 1998.102.0026 - 4		i	y	y	y		y	y
TMP 1998.102.0026 - 5		i	y	y	y			y
TMP 1998.102.0028 - 1		i	y	y	y	y	y	y

Specimen	Dentary or maxillary?	Isolated or associated?	Labial photo?	Lingual photo?	Basal cingulum?	Fluting?	Denticles?	Root?
TMP 1998.102.0028 - 2		i	y	y		y	y	y
TMP 1999.055.0162		i	y	y			y	y
TMP 1999.055.0290		i	y	y	y	y	y	y
TMP 1999.063.0019		i	y	y	y	y	y	y
TMP 1999.085.0005		i	y	y	y	y	y	y
TMP 2000.012.0020		i	y	y			y	
TMP 2000.012.0024 - 1		i	y	y	y	y	y	y
TMP 2000.012.0024 - 2		i	y	y	y		y	y
TMP 2000.057.0027		i	y	y	y		y	y
TMP 2001.012.0072		i	y	y	y		y	y
TMP 2001.012.0073		i	y	y			y	y
TMP 2002.012.0060		i	y	y		y	y	y
TMP 2002.012.0135		i	y	y	y		y	y
TMP 2002.060.0001 - 1		i	y	y		y	y	y
TMP 2002.060.0001 - 2		i	y	y	y		y	
TMP 2003.012.0106		i	y	y		y	y	y
TMP 2004.107.0003		i	y	y	y		y	y
TMP 2004.114.0005		i	y	y	y		y	y
TMP 2004.116.0016		i	y	y	y	y	y	y
TMP 2004.118.0012		i	y	y	y		y	y
TMP 2005.012.0027		i	y	y	y	y	y	y
TMP 2005.012.0185		i	y	y	y	y	y	y
TMP 2005.012.0233		i	y	y	y	y	y	y
TMP 2005.012.0265		i	y	y	y	y	y	y
TMP 2005.012.0279		i	y	y	y		y	y
TMP 2005.012.0280		i	y	y			y	y

Specimen	Dentary or maxillary?	Isolated or associated?	Labial photo?	Lingual photo?	Basal cingulum?	Fluting?	Denticles?	Root?
TMP 2005.012.0305		i	y	y	y	y	y	y
TMP 2005.012.0368		i	y	y	y		y	y
TMP 2005.012.0369		i	y	y			y	y
TMP 2005.012.0384 - 1		i	y	y		y		y
TMP 2005.012.0384 - 2		i	y	y		y	y	y
TMP 2005.012.0397		i	y	y	y		y	y
TMP 2005.012.0427		i	y	y	y		y	y
TMP 2005.049.0065		i	y	y	y	y	y	y
TMP 2005.049.0102		i	y	y	y	y	y	y
TMP 2005.049.0143		i	y	y	y	y	y	y
TMP 2005.054.0007		i	y	y	y		y	y
TMP 2006.012.0182		i	y	y		y	y	y
TMP 2008.043.0051		i	y	y			y	
TMP 2011.047.0002		i	y	y		y	y	y
TMP 2011.047.0010		i	y	y	y		y	y
TMP 2011.047.0079		i	y	y	y	y	y	y
TMP 2012.012.0017		i	y	y	y	y	y	y
TMP 2013.012.0057		i	y	y	y	y	y	y
TMP 2014.012.0128		i	y	y	y		y	y
TMP 2014.012.0134		i	y	y	y	y	y	y
TMP 2017.023.0017 - 1	maxillary	a		y	y	y	y	
TMP 2017.023.0017 - 2	maxillary	a		y	y	y		
TMP 2017.023.0017 - 3	maxillary	a		y	y	y	y	
TMP 2017.023.0017 - 4	maxillary	a		y		y	y	
TMP 2018.012.0172		i	y	y	y	y	y	y
TMP 2019.012.0011		i	y	y	y	y	y	y

Specimen	Dentary or maxillary?	Isolated or associated?	Labial photo?	Lingual photo?	Basal cingulum?	Fluting?	Denticles?	Root?
TMP 2023.012.0023		i	y	y		y	y	y
TMP 2023.012.0242		i	y	y	y		y	y
UALVP 00002 - 1	dentary	a	y	y			y	y
UALVP 00002 - 10	maxillary	a	y	y		y	y	
UALVP 00002 - 11	maxillary	a	y	y		y	y	y
UALVP 00002 - 12	maxillary	a	y	y		y	y	y
UALVP 00002 - 13	maxillary	a	y	y			y	
UALVP 00002 - 14	maxillary	a	y	y		y	y	
UALVP 00002 - 15	maxillary	a	y	y		y	y	
UALVP 00002 - 16	maxillary	a	y	y			y	
UALVP 00002 - 17	maxillary	a	y	y			y	
UALVP 00002 - 18	maxillary	a	y	y			y	
UALVP 00002 - 19	maxillary	a	y	y			y	
UALVP 00002 - 2	dentary	a	y	y			y	y
UALVP 00002 - 20	maxillary	a	y	y			y	y
UALVP 00002 - 21	maxillary	a	y	y			y	y
UALVP 00002 - 22	premaxilla	a	y	y		y	y	y
UALVP 00002 - 23	premaxilla	a	y	y			y	y
UALVP 00002 - 24	premaxilla	a	y	y			y	y
UALVP 00002 - 25	maxillary	a	y	y			y	
UALVP 00002 - 26	maxillary	a	y	y			y	y
UALVP 00002 - 27	maxillary	a	y	y			y	y
UALVP 00002 - 28	maxillary	a	y	y			y	y
UALVP 00002 - 29	maxillary	a	y	y			y	y
UALVP 00002 - 3	predentary	a	y	y			y	y
UALVP 00002 - 30	maxillary	a	y	y			y	y

Specimen	Dentary or maxillary?	Isolated or associated?	Labial photo?	Lingual photo?	Basal cingulum?	Fluting?	Denticles?	Root?
UALVP 00002 - 31	maxillary	a	y	y			y	y
UALVP 00002 - 32	maxillary	a	y	y			y	y
UALVP 00002 - 33	maxillary	a	y	y			y	
UALVP 00002 - 34	maxillary	a	y	y			y	y
UALVP 00002 - 35	maxillary	a	y	y			y	
UALVP 00002 - 36	maxillary	a	y	y			y	y
UALVP 00002 - 37	maxillary	a	y	y			y	
UALVP 00002 - 38	maxillary	a	y	y			y	y
UALVP 00002 - 39	maxillary	a	y	y			y	y
UALVP 00002 - 4	predentary	a	y	y			y	y
UALVP 00002 - 40	maxillary	a	y	y			y	y
UALVP 00002 - 5	predentary	a	y	y			y	y
UALVP 00002 - 6	dentary	a	y	y			y	y
UALVP 00002 - 7	dentary	a		y			y	
UALVP 00002 - 8	dentary	a	y	y			y	
UALVP 00002 - 9	predentary	a	y	y			y	
UALVP 48641		i	y	y		y	y	
UALVP 48747		i	y	y				y
UALVP 49327		i	y	y		y	y	y
UALVP 53588 - 1		i	y	y		y	y	y
UALVP 53588 - 2		i	y	y		y	y	y
UALVP 53588 - 3		i	y	y		y	y	y
UALVP 53588 - 4		i	y	y		y	y	y
UALVP 53588 - 5		i	y	y				y
UALVP 53588 - 6		i	y	y	y	y	y	y
UALVP 53590		i	y	y			y	y

Specimen	Dentary or maxillary?	Isolated or associated?	Labial photo?	Lingual photo?	Basal cingulum?	Fluting?	Denticles?	Root?
UALVP 53591		i	y	y		y	y	y
UALVP 53975		i	y	y	y	y	y	
UALVP 55323		i	y	y		y	y	y
UALVP 55366		i	y	y	y	y	y	y
UALVP 55378		i	y	y	y	y	y	y
UALVP 55390		i	y	y	y	y	y	y
UALVP 55621		i	y	y		y	y	y
UALVP 59296		i	y	y	y		y	
UALVP 61124 - 1		i	y	y	y		y	y
UALVP 61124 - 2		i	y	y	y		y	y
UALVP 61153		i	y	y	y	y	y	y
UALVP 61442		i	y	y			y	y
UMNH VP 11638		i	y	y	y		y	
UMNH VP 1228		i	y	y			y	y
UMNH VP 1232		i	y					
UMNH VP 12637		i	y	y	y	y	y	
UMNH VP 12864		i	y	y	y		y	y
UMNH VP 14228		i	y	y	y			
UMNH VP 14436		i	y	y	y	y	y	y
UMNH VP 14488		i	y	y	y		y	y
UMNH VP 16221		i	y	y	y	y	y	y
UMNH VP 16874		i	y	y	y	y	y	y
UMNH VP 17418		i	y	y	y		y	y
UMNH VP 17502		i	y	y	y		y	y
UMNH VP 17514		i	y	y	y		y	
UMNH VP 17973		i	y	y	y		y	y

Specimen	Dentary or maxillary?	Isolated or associated?	Labial photo?	Lingual photo?	Basal cingulum?	Fluting?	Denticles?	Root?
UMNH VP 19037		i	y	y	y			
UMNH VP 19040		i	y	y	y	y	y	
UMNH VP 19699		i	y	y		y	y	y
UMNH VP 19719		i	y	y	y			
UMNH VP 19720		i	y	y	y	y	y	
UMNH VP 20599		i	y	y	y		y	
UMNH VP 20903		i	y	y		y	y	
UMNH VP 24117		i	y	y	y			
UMNH VP 5609		i	y	y			y	y
UMNH VP 6765		i	y	y	y			
UMNH VP 7603		i	y	y			y	
UMNH VP 7658		i	y	y	y		y	
UMNH VP 7672		i	y	y	y		y	
ZPAL MgD II/1-1	dentary	a	y	y	y? only labial side	y, labial	y	y
ZPAL MgD II/1-2	dentary	a	y	y	y? only labial side	y, labial	y	y
ZPAL MgD II/1-3	dentary	a	y	y	y? only labial side	y, labial	y	y
ZPAL MgD II/1-4	dentary	a	y	y	y? only labial side	y, labial	y	y
ZPAL MgD II/1-5	dentary	a	y	y	y? only labial side	y, labial	y	y
ZPAL MgD II/1-6	dentary	a	y	y	y? only labial side	y, labial	y	y
ZPAL MgD II/1-7	dentary	a	y		y? hard to tell in picture		y	y

Appendix E – 3: Manual traditional raw measurements

Sample Number	CH	CBL	NL	AL	MCL	DCL	MDC	DDC
BYU VP 50866	6.01	5.49	4.78	5.92	4.4	3.39	6	5
CEUM 09173	5.39	5.75		6.2	5.58	4.1	3	5
CEUM 11909	6.3	5.43	3.43	6.03	5.58	4.23	10	7
CEUM 11910								
CEUM 11911	5.95	5.55	3.2	5.44	4.72	3.74	7	6
CEUM 11912								
CEUM 11923								
CEUM 11924								
CEUM 12435								
CEUM 1264 #86	8.13							
CEUM 12811								
CEUM 31206								
CEUM 34580	16.04	14.36	9.29	16.51	15.28	14.77	7	6
CEUM 53115	13.86	15.56	9.21	15.56	13.53	12.65	7	6
CEUM 5373	5.38	4.82	3.09	5.29	4.82	3.63	10	6
CMNFV 1131								
CMNFV 119 - 1								
CMNFV 119 - 2	5.3	4.5		5.09	4.8	4.76	7	8
CMNFV 119 - 3	7.1	6.67		7.53	6.63	5.74	6	5
CMNFV 119 - 4								
CMNFV 119 - 5	6.09	4.99		5.51	5.24		6	
CMNFV 119 - 6	6.24	5.96		6.47	5.37	4.41	7	3
CMNFV 129 - 1								
CMNFV 129 - 2							4	4
CMNFV 1349	5.58	5.85		5.74	5.49	3.83	7	7
CMNFV 1772 - 1	10.92	9.21		11.34	8.78	5.79	4	2

Sample Number	CH	CBL	NL	AL	MCL	DCL	MDC	DDC
CMNFV 1772 - 2								
CMNFV 1772 - 3								
CMNFV 1772 - 4								
CMNFV 1772 - a	14.49	10.62	8.07	12.71	10.37	8.19	6	3
CMNFV 21864								
CMNFV 2334								
CMNFV 2759 - 1	7.32	6.66	3.83	7.35	5.18	3.24	4	3
CMNFV 2759 - 2								
CMNFV 2759 - 3								
CMNFV 2759 - 4								
CMNFV 2759 - 5	8.12	6.08		8.35	5.8	4.91	4	4
CMNFV 2759 - 6	8.51	8.01		8.39	6.78	3.8	8	
CMNFV 38441								
CMNFV 38442	5.82	5.24	3.19	6.47	6.19	5.98	5	5
CMNFV 38443	5.25	5.27		5.28	4.7	2.27	7	4
CMNFV 38444								
CMNFV 38445								
CMNFV 38446								
CMNFV 38447								
CMNFV 38448								
CMNFV 38449								
CMNFV 59240 - 1	10.26	9.91		9.5	8.56	6.83	3	3
CMNFV 59240 - 2	7.6	8.77		8.56		6.29		3
CMNFV 59240 - 3								
CMNFV 59431	4.69	4.75		5.09	4.53	3.45	5	5
CMNFV 59432 - 1	7.29	7.96		8.2	6.93	5.88	6	4
CMNFV 59432 - 2								

Sample Number	CH	CBL	NL	AL	MCL	DCL	MDC	DDC
CMNFV 59459								
CMNFV 59460								
CMNFV 59480								
CMNFV 59510 - 1								
CMNFV 59510 - 2	8.76	8.4		8.57	7.17	5.13	5	3
CMNFV 59534								
CMNFV 59591 - 1								
CMNFV 59591 - 2								
CMNFV 8531 - 1	11.59	8.62		11.21	10.36		6	
CMNFV 8531 - 2								
CMNFV 8531 - 3	9.9	9.56		8.17	7.84	5.32	5	3
CMNFV 8531 - 4	8.95	10.14		7.17	6.36	7.2		
CMNFV 8531 - 5								
CMNFV 8531 - 6								
CMNFV 8531 - 7	11.51	9.35	5.77	11.95	10.13	8.53	5	5
CMNFV 8531 - 8	11.9	10.74		11.46	11.33	7.62	7	2
CMNFV 8531 - 9	9.23	10		9.66	7.88	7.58	5	3
CMNFV 8537 - 1							8	8
CMNFV 8537 - 2								
CMNFV 8537 - 3								
CMNFV 8537 - 4								
CMNFV 8537 - 5								
CMNFV 8537 - 6								
CMNFV 8537 - 7								
CMNFV 8537 - 8								
CMNFV 8731 - 1								
CMNFV 8731 - 2								

Sample Number	CH	CBL	NL	AL	MCL	DCL	MDC	DDC
CMNFV 8731 - 3								
CMNFV 8731 - 4	8.73	8.56		8.56	6.75	6.32	3	2
CMNFV 8876 - 1	6	6.43	3.02	6.41	5.83	5.51	6	5
CMNFV 8876 - 2								
CMNFV 8876 - 3								
CMNFV 8880 - 1	7.53	6.08	4.62	7.76	6.22	4.88	5	3
CMNFV 8880 - 2								
CMNFV 973								
CMNFV CMS1921 - 1								
CMNFV CMS1921 - 2	7	8.7	5.71	8.98	8.47	5.69	9	4
CMNFV CMS1921 - 3	8.85	8.93	5.66	9.26	7.5	6.59	5	3
CMNFV CMS1921 - 4								
CMNFV CMS1921 - 5								
CMNFV CMS1921 - 6								
CMNFV CMS1921 - 7								
CMNFV CMS1921 - 8								
CMNFV RDR - 1	7.62	8.63		8.85	7.73	6.75	7	5
CMNFV RDR - 10								
CMNFV RDR - 11								
CMNFV RDR - 12								
CMNFV RDR - 2								
CMNFV RDR - 3								
CMNFV RDR - 4								
CMNFV RDR - 5								
CMNFV RDR - 6								
CMNFV RDR - 7								
CMNFV RDR - 8								

Sample Number	CH	CBL	NL	AL	MCL	DCL	MDC	DDC
CMNFV RDR - 9								
CMNFV UN - 1								
CMNFV UN - 2								
CMNFV UN - 3								
CMNFV UN - 4								
CMNFV UN - 5	6.04	5.62		6.19	4.87	5.95	8	5
CMNFV UN - 6								
CMNFV UN - 7								
CMNFV UN - 8								
CMNFV UN - 9								
DMNH EPV 53040	5.23	5.27	3.52	5.25	4.78	3.62		3
DMNH EPV 136185 - 13	7.77	7.16	4.96	7.41	6.9	3.34		
DMNH EPV 136185 - 14	4.83	5.36	3.25	5.54	4.3	4.15	7	6
DMNH EPV 136185 - 15	5.79	5.63	3.04	6.29	5.89	5.2	6	6
DMNH EPV 136185 - 16	5.4	5.89	3.91	5.32	4.8	4.48		
DMNH EPV 136185 - 17	6.51	6.22	4.11	5.68	4.75	4.2	7	7
DMNH EPV 136185 - 18	7.82	6.01		6.97	6.58	4.94		6
DMNH EPV 136185 - 19	6.76	5.8	4.11	5.64	3.79	3.17		
DMNH EPV 136185 - 20	8.67	5.34	3.66	7.76	5.6	4.84		
DMNH EPV 136185 - 21	5.97	6.03						
DMNH EPV 136185 - 22	6.39	4.26		6.68	4.64	3.71		
DMNH EPV 136185 - 23	5.01	4.43	2.6	5.81	3.73	2.98		
DMNH EPV 136185 - 24	4.79	4.34	2.02	4.45	3.5	2.86		
DMNH EPV 136185 - 25	4.72	4.6		5.22	4.04	3.24	5	4
DMNH EPV 136185 - 26	3.57	3.3	2.71	3.78	2.86	2.32		
DMNH EPV 136185 - 27	3.25	3.65	2.97	3.96	3.82	1.9		
DMNH EPV 18168 - 1	5.47	7.93	5.59					

Sample Number	CH	CBL	NL	AL	MCL	DCL	MDC	DDC
DMNH EPV 18168 - 10	8.29	7.09	5.61	7.12	5.3	4.12		
DMNH EPV 18168 - 11	5.94	5.82	4.95	6.09	5.75	4.3		
DMNH EPV 18168 - 12	6.48	6.28	4.12	6.57	5.82	3.53		
DMNH EPV 18168 - 13	6.84	6.61	4.03	5.55	4.73	4.39		
DMNH EPV 18168 - 14	6.83	7.02	4.76	6.44	5.52	3.66		
DMNH EPV 18168 - 15	6.92	5.99	4.58	6.49	5.65	5.21		
DMNH EPV 18168 - 16	7.41	5.52	3.63	5.54	4.94	4.73		
DMNH EPV 18168 - 17	6.34	5.73	4.29	5.72	4.78	3.33		
DMNH EPV 18168 - 2	6.84	6.69	4.48	6.84	6.1	4.24		
DMNH EPV 18168 - 3		7.84	4.83					
DMNH EPV 18168 - 4	5.28	6.08	3.78	5.68	4.7	4.19		
DMNH EPV 18168 - 5	6.62	7.17	4.73	7.08	6	5.34		
DMNH EPV 18168 - 6	7.93	7.43	4.67	7.23	7.28	5.45		
DMNH EPV 18168 - 7	8.35	7.44	4.98	7.81	6.77	4.3		
DMNH EPV 18168 - 8	6.23	7.56	5.51	6.47	5.38	4.86		
DMNH EPV 18168 - 9	6.83	7.46	4.55	6.43	6.18	4.86		
DMNH EPV 18169 - 1		8.27	5.54					
DMNH EPV 18169 - 2	5.29	7.43						
DMNH EPV 18169 - 3	9.82	9.28	5.48	9.21	6.46	6.27		
DMNH EPV 18169 - 4		7.83	5.21					
DMNH EPV 18169 - 5	7.17	8.06	5.99					
DMNH EPV 21671	7.58	9.31	6.81	7.8	5.84	5.67		
DMNH EPV 27726 - 1	6.72	4.57	4.33	5.67				
DMNH EPV 27726 - 10	4.77	5.55		4.54	3.72	3.16	5	
DMNH EPV 27726 - 11	4.26	4.96	3.79					
DMNH EPV 27726 - 12	3.69	4.36	3.1					
DMNH EPV 27726 - 13	3.7	3.92	2.61	2.87				

Sample Number	CH	CBL	NL	AL	MCL	DCL	MDC	DDC
DMNH EPV 27726 - 14	6.17	4.44		6.07	5.78	5.2		
DMNH EPV 27726 - 15	5.44	5.08						
DMNH EPV 27726 - 16	6.36	4.59		6.48	5.44	5.17		
DMNH EPV 27726 - 17	6.07	5.24	3.89	6.64	5.41	4.89	7	8
DMNH EPV 27726 - 18	7.11	5.62	4.06	7.53	6.77	6.14		
DMNH EPV 27726 - 2	3.48				3.89			
DMNH EPV 27726 - 3	5.13							
DMNH EPV 27726 - 4	4.8	3.92		5.6	4.54		5	
DMNH EPV 27726 - 5	6.1	5		6.98	6.14	4.2		
DMNH EPV 27726 - 6	8.79	5.83	4.76	8.42	7.06	6.65	>10	>10
DMNH EPV 27726 - 7	6.24							
DMNH EPV 27726 - 8	6.84			6.44	4.98		8	
DMNH EPV 27726 - 9	6.48				5.82		7	
DMNH EPV 2818 - 10	6.03	4.54	3.81	5.37	3.99	3.15		
DMNH EPV 2818 - 11	6.76	4.31		6.99	5.31	4.58	9	7
DMNH EPV 2818 - 12	6.47	5.23	2.95	6.04	4.07	3.07		
DMNH EPV 2818 - 13	7.19	5.25	2.63	7.38	6.48	4.75		
DMNH EPV 2818 - 14	7.08	5.98		7.03	5.68	4.23	9	
DMNH EPV 2818 - 15	6.23	4.72	3.41	6.09	4.27	3.71	8	7
DMNH EPV 2818 - 16	6.95	5.6	3.22	7.43	5.35	4.89		
DMNH EPV 2818 - 17	6.35	4.88	2.48	7.6	5.53	4		
DMNH EPV 2818 - 18	6.22	4.7	2.98	6.47	5.4	4.16		
DMNH EPV 2818 - 19		3.77	2.49					
DMNH EPV 2818 - 2	4.59	4.73	2.79	6.46	4.55	3.98		
DMNH EPV 2818 - 20	4.37	4.54	3.01	4.51	3.19	3.13		
DMNH EPV 2818 - 21	5.75	4.65	2.71	5.24	3.72	3.5	7	7
DMNH EPV 2818 - 22		4.97	2.98					

Sample Number	CH	CBL	NL	AL	MCL	DCL	MDC	DDC
DMNH EPV 2818 - 23	5.99			6.37	4.72		8	
DMNH EPV 2818 - 24	5.16	5.34		6.2	5.13	4.63		9
DMNH EPV 2818 - 25		5.09	3.09					
DMNH EPV 2818 - 26	5.67	4.89		5.85	4.08	3.75	8	
DMNH EPV 2818 - 27	5.51	5.65		6.12	5.88	4.12		
DMNH EPV 2818 - 28	6.28	6.01		6.56	5.76	5.34	8	7
DMNH EPV 2818 - 3	7.49	4.82	3.11	7.49	4.86	4.49		
DMNH EPV 2818 - 4	5.67	4.56		5.73	4.92	4.7		
DMNH EPV 2818 - 5	7.02	5.56	2.74	6.02	4.92	4.1		
DMNH EPV 2818 - 6	4.84	4.04		5.19	4.56	3.88		
DMNH EPV 2818 - 7	5.86		3.72					
DMNH EPV 2818 - 8	4.72	3.6	2.7					
DMNH EPV 2818 - 9	5.9	5.67		6.03	4.6			
DMNH EPV 468	9.58	6.52			6.02		4	
DMNH EPV 50206 - 3		6.94	4.46					
DMNH EPV 50206 - 4		4.69	2.63					
DMNH EPV 50373	5.77	5.62						
DMNH EPV 50377		5.68	4.2					
DMNH EVP 136185 - 1	7.35	7.17	4.93	7.43	6.45	3.99	10	5
DMNH EVP 136185 - 10	6.34	6.42	4.14	6.74	5.74	4.94	6	6
DMNH EVP 136185 - 11	7.39	6.71	4.73	6.36	5.45	5.36	8	7
DMNH EVP 136185 - 12	8.3	6.94	4.34	7.5	6.31	5.45	9	7
DMNH EVP 136185 - 2	6.76	7.26	4.96	6.6	6.39	2.54	9	5
DMNH EVP 136185 - 3	5.15	5.97	3.19	5.63	4.65	4.39	9	6
DMNH EVP 136185 - 4	7.29	7.1	4.63	7.65	6.92	6	9	10
DMNH EVP 136185 - 5	5.23	4.92	3.03	5.43	4.4	4.23	6	5
DMNH EVP 136185 - 6	5.68	6.76	4.42	6.01	4.83	4.38	6	5

Sample Number	CH	CBL	NL	AL	MCL	DCL	MDC	DDC
DMNH EVP 136185 - 7	7.98	6.8	4.38	8.57	7.4	6.19	7	9
DMNH EVP 136185 - 8	7.51	6.16	4.24	6.43	6.1	5.63		
DMNH EVP 136185 - 9	5.14	6.16	4.06	5.24	4.52	3.13		
DMNH EVP 2818 - 1	4.36	3.63		6.23	3.19	2.47		
DMNH EVP 50206 - 1		6.64	5.08					
DMNH EVP 50206 - 2		6.98						
PIN 3142/250 - 1								
PIN 3142/250 - 10								
PIN 3142/250 - 2								
PIN 3142/250 - 3								
PIN 3142/250 - 4								
PIN 3142/250 - 5								
PIN 3142/250 - 6								
PIN 3142/250 - 7							7	5
PIN 3142/250 - 8								
PIN 3142/250 - 9							10	5
ROM 03088								
ROM 03287								
ROM 03302								
ROM 03368								
ROM 03516								
ROM 07763		6	3.89					
ROM 07765	5.53	5.13		5.74	4.71	2.98	5	4
ROM 07766								
ROM 07767	6.99	6.57	4.56	6.93	5.59	5.01	6	4
ROM 07768								
ROM 07770	5.51	5.54	3.2	6.27	5.75	5.11	8	6

Sample Number	CH	CBL	NL	AL	MCL	DCL	MDC	DDC
ROM 07772								
ROM 1215 - 1	3.87	5.18	3.79	3.92	2.95	2.77		
ROM 1215 - 10	6.58	6.67	4.65	6.19	4.65	4.34	6	4
ROM 1215 - 11		8.08	4.78					
ROM 1215 - 12	6.95	8.59	4.73	8.72	7.07	5.57	6	4
ROM 1215 - 13		8.65	5.33					
ROM 1215 - 14	6.97	9.44	3.82	7.83	6.93	3.13	7	4
ROM 1215 - 15								
ROM 1215 - 16	6.71	9.21	5.79	6.57	6.5	5.9	6	5
ROM 1215 - 17	6.43	9.27	5.62	6.09	6.11	5.13	9	5
ROM 1215 - 2	5.27	4.99	3.48	4.78	4.27	3.43		
ROM 1215 - 3	5.48	6.69	4.37	5.94	3.79	3.09	4	3
ROM 1215 - 4								
ROM 1215 - 5	5.38	9.17	4.91	6.66	4.28	3.58		
ROM 1215 - 6		9.27	5.45					
ROM 1215 - 7	4.72	5.48	3.84	4.3	3.2	3.41		
ROM 1215 - 8	5.42	4.92	4.73	6.35	4.12	3.32	5	3
ROM 1215 - 9	5.62	6.36	5.18	5.82	5.1	3.42	7	3
ROM 26346	5.29	4.1	2.6	4.94	3.82	3.62	5	5
ROM 31697								
ROM 31865								
ROM 31866	5.4	5.93	3.77	6.11	5.42	4.52	8	4
ROM 31867	5.11	5.12	2.88	4.44	3.9	3.2	5	4
ROM 31868								
ROM 31869								
ROM 31871								
ROM 31872	7.03	6.95	3.71	6.95	5.47	5.13	7	7

Sample Number	CH	CBL	NL	AL	MCL	DCL	MDC	DDC
ROM 36385								
ROM 36386								
ROM 36387								
ROM 36388								
ROM 36389								
ROM 36390								
ROM 36391								
ROM 36392								
ROM 36393								
ROM 36394								
ROM 36395								
ROM 36396								
ROM 36397								
ROM 36398								
ROM 36399								
ROM 36400								
ROM 36401								
ROM 36402	9.66	9.59		10.06	7.76	6.4	6	6
ROM 36403								
ROM 36404								
ROM 36405								
ROM 36406								
ROM 36407								
ROM 36408								
ROM 36409	9.87	9.69	6.09	10.15	9.13	5.54		3
ROM 36410								
ROM 36411								

Sample Number	CH	CBL	NL	AL	MCL	DCL	MDC	DDC
ROM 36412	7.31	8.11	4.62	7	5.81	5.61	5	5
ROM 36413								
ROM 36414								
ROM 36415								
ROM 36416								
ROM 36417								
ROM 36418	8.36	7.92		8.71	6.37	4.55		
ROM 36419								
ROM 36420								
ROM 36421								
ROM 36422								
ROM 36423								
ROM 53579								
ROM 56611								
ROM 56620								
ROM 58144	7.54	8.43	5.4	8.62	6.75	4.99	6	3
ROM 58147	5.25	5.71	3.19	5.69	5.18	4.19	7	6
ROM 58151								
ROM 58223	4.79	6.57	4.43	5.96	4.72	4.36	5	4
ROM 58383	4.7	5.3	3.18	5.34	4.57	2.14	5	3
ROM 58516								
ROM 58525								
ROM 58565 - 1								
ROM 58565 - 2								
ROM 58565 - 3	5.34	6.1	4.87	6.82	5.18	3.1	4	3
ROM 58565 - 4								
ROM 58594	8.85	9.03	5.65	9.68	8.24	6.98	7	5

Sample Number	CH	CBL	NL	AL	MCL	DCL	MDC	DDC
ROM 58598	7.86	7.86	5.63	9.16	8.76	6.79	8	4
ROM 58689 - 1							6	4
ROM 58689 - 2	7.2	7.71	4.37	7.5	6.52	5.43	4	3
ROM 58704								
ROM 67276								
ROM 788 - 1		6.12	4.21					
ROM 788 - 2		6.68	2.85					
ROM 788 - 3		5.87	3.31					
ROM 788 - 4	4.43	5.29						
ROM 788 - 5	4.12	5.92		4.91	4.52	2.35	5	3
ROM 788 - 6	4.73							
ROM 788 - 7	4.82					2.99		3
ROM 788 - 8								
SMU 73203								
TMP 1966.025.0015	4.86	4.56	2.81	5.1	4.46	3.85		
TMP 1976.006.0036	8.66	7.44	4.1	8.57	7.52	6.04	4	3
TMP 1980.008.0026 - 1	8.81	8.29	5.16	10.24	8.59	5.8	5	3
TMP 1980.008.0026 - 2	7.43	8.23	4.75	9.05	8.5	6.15	9	6
TMP 1980.013.0046	5.31	6.65	5.08	6.89	5.34	4.38	4	3
TMP 1980.016.0239	4.41	4.63	2.51	4.91	3.91	3.17		
TMP 1980.016.0834	5.74	4.19		5.56	4.42	3.98		
TMP 1980.016.1685 - 1	6.02	4.67		6.27	5.54	4.62		
TMP 1980.016.1685 - 2	6.74	5.98	2.73	6.66	6.55	5.15		
TMP 1980.029.0140	4.97	5.35	3.05	5.77	4.91	4.06	6	4
TMP 1980.029.0228	5.93	6.28	3.54	6.21	5.61	4.86	6	4
TMP 1981.041.0014	4.89	5.65		5.68	5.13	3.53		
TMP 1983.036.0009 - 1	4.93	5.09	2.65	5.64	5.33	4.25	5	3

Sample Number	CH	CBL	NL	AL	MCL	DCL	MDC	DDC
TMP 1983.036.0009 - 2	4.84	5.02	2.85	5.73	5.44	3.78	6	6
TMP 1983.036.0009 - 3	5.05	4.3		5.59	4.75	4.65	6	6
TMP 1983.036.0009 - 4	4.88	4.79	2.51	4.99	4.27	4.1	6	3
TMP 1983.036.0207	5.67	6.89	3.82	6.34	6.16	4.22	4	4
TMP 1984.091.0020	9.72	10.12	5.82	10.06	8.65	5.43		
TMP 1985.036.0121		4.82	2.93					
TMP 1985.056.0170 - 1	5.48	5.53	3.04	6.02	5.46	5.08	5	4
TMP 1985.056.0170 - 2	5.17	5.83	2.93	5.7	5.18	4.41	5	4
TMP 1985.056.0171 - 1	7.05	7.5	4.21	8.51	7.01	5.08	4	4
TMP 1985.056.0171 - 2		10.11	5.48					
TMP 1985.056.0171 - 3	8.67	7.75	5.25	8.38	6.63	5.56		
TMP 1985.056.0211	5.63	5.06	2.92	5.78	4.78	4.2	5	4
TMP 1985.059.0028	5.86	5.98	3.32	6.74	6.56	5.76	7	5
TMP 1986.008.0084	6.72	6.55	4.1	7.22	5.79	4.63	6	4
TMP 1986.009.0055	6.67	4.99	3.06	6.04	5.3	4.62	6	5
TMP 1986.023.0108	5.9	5.57	3.37	6.43	5.28	5.04	5	5
TMP 1986.095.0007	4.98	5.03	2.87	5.88	5.45	4.81	7	5
TMP 1986.127.0005	5.31	5.42		5.77	4.84	4.06	6	6
TMP 1986.183.0003	6.65	6.31	3.32	6.82	6.01	5.33	6	4
TMP 1987.029.0006		2.19	1.29					
TMP 1987.036.0094	9.17	8.15	4.47	8.59	6.74	4.56	7	4
TMP 1987.077.0143	4.97	4.59	2.48	4.89	3.56	2.53		
TMP 1987.080.0010	5.37	5.49	3.26	5.76	4.81	4.45	7	7
TMP 1989.069.0017	7.46	9.39	6.25	8.34	8.04	5.85	5	4
TMP 1989.036.0396 - 1	3.97	4.05	2.56	3.79	3.5	3.34		
TMP 1989.036.0396 - 2	4.29	5.17	2.77	4.98	3.8	2.89		
TMP 1989.036.0396 - 3	4	5.04	3.11	5.08	4.38	3.43		

Sample Number	CH	CBL	NL	AL	MCL	DCL	MDC	DDC
TMP 1989.036.0405 - 1	5.72	4.89	2.73	4.73				
TMP 1989.036.0405 - 2		5.21						
TMP 1989.036.0405 - 3	6.55	6.78	3.12	6.05	5.14	4.87	6	5
TMP 1989.050.0002	5.44	6.38	3.9	6.38	5.58	4.1		
TMP 1989.050.0013	5.38	5.35	3.3	5.49	4.26	3.44	6	4
TMP 1989.050.0030	5.64	6.24	3.94	6.81	6.1	0.18		
TMP 1989.076.0059	3.85	3.7	1.87	3.95	2.65	2.56		
TMP 1989.079.0008	7.58	12.17	6.47	10.38	9.57	8.33		
TMP 1989.151.0137	12.53	10.61	6.56	11.81	10.93	9.26	8	5
TMP 1990.036.0081	10.43	12.78	6.14	11.05	10.43	9.5	5	4
TMP 1990.060.0006 - 1	5.89	6.1	3.54	6.11	5.45	5.11		
TMP 1990.060.0006 - 2	4.15	4.11	2.43	4.41	3.61	3.46		
TMP 1990.107.0037 - 1	7.04	6.08	4.38	6.97	6.46	3.96	7	3
TMP 1990.107.0037 - 2		8.84	5.51					
TMP 1990.155.0007	9.33	9.49	5.89	9.82	9.63	6.88	9	6
TMP 1991.036.0158	5.51	5.89	2.84	5.66	5.12	4.72	8	6
TMP 1991.036.0171	10.63	11.14	7.15	11.65	10.88	8.63		
TMP 1991.036.0734	5.62	6.29	3.31	6	4.94	4.06		
TMP 1991.050.0093	10.48	10.84	6.36	8.93	7.93	8.08		
TMP 1991.085.0012	8.66	7.52	4.32	8.46	7.27	4.61		
TMP 1991.087.0072	5.08	6.53	4.59	5.98	5.1	4.6	5	5
TMP 1992.036.0313 - 1		7.7						
TMP 1992.036.0313 - 2								
TMP 1992.036.1178 - 1	5.33	5.31	3.14	5.1	4.51	4.27	5	4
TMP 1992.036.1178 - 2	4.33	4.8	2.61	4.23	4.35	3.45		
TMP 1992.036.1178 - 3		12.46	7.22					
TMP 1993.036.0081	5.98	6.38	3.54	6.64	5.99	4.72	6	5

Sample Number	CH	CBL	NL	AL	MCL	DCL	MDC	DDC
TMP 1993.036.0364	11.14	14.13	8.65	12.91	12.38	10.55	4	3
TMP 1993.079.0065		9.66	6.25					
TMP 1994.012.0035	8.86	10.84	5.74	9.86	9	7.98		
TMP 1994.012.0039	7.64	7.56	4.9	8.34	8.18	4.73	5	2
TMP 1994.012.0120	7.29	9.08	5.43	8.67				
TMP 1994.012.0565	7.72	7.36	4.77	7.07	5.61	4.51		
TMP 1994.086.0018	7.01	6.86	4.02	6.19	5.73	4.31	8	6
TMP 1994.092.0011	5.48	4.99	2.95	5.63	5.22	4.6	6	6
TMP 1994.094.0014 - 1	9.93	8.79	5.64	9.04		6.64		
TMP 1994.094.0014 - 2		5.84	3.17					
TMP 1994.094.0016	12.68	12.39	7.41	11.65	9.05	8.38	4	3
TMP 1994.097.0001	5.18	5.52	3.1	5.49	5.76	4.41	5	5
TMP 1995.012.0105	9.45	8.97	5.79	9.33	8.85	7.61		
TMP 1995.012.0117	10.73	10.88	6	11.12	9.48	7.9		
TMP 1996.048.0018 - 1	3.9	4.89	2.75	4.71	3.69	3.62	6	6
TMP 1996.048.0018 - 2	2.3	3.12	1.6	2.75	2.03	1.97		
TMP 1996.075.0001 - 1	6.11	5.61	2.55	6.17	5.02	4.95	6	5
TMP 1996.075.0001 - 10	6.32	5.05	2.63	6.27	5.06	4.35	6	5
TMP 1996.075.0001 - 11	4.76	4.89	3	5.83	4.54	3.32	4	3
TMP 1996.075.0001 - 12	4.89	5.06	2.71	5.66	4.46	4.11	5	4
TMP 1996.075.0001 - 2		3.92	2.27					
TMP 1996.075.0001 - 3	6.01	4.62		6.17	4.61	3.73	4	4
TMP 1996.075.0001 - 4	5.74	5.38		6.15	5.62	4.05		
TMP 1996.075.0001 - 5		5.09						
TMP 1996.075.0001 - 6	5.25	4.39		5.33	4.23	3.98		
TMP 1996.075.0001 - 7	5	5.09	2.8	5.86	4.72	3.71	5	3
TMP 1996.075.0001 - 8		5.41	2.87					

Sample Number	CH	CBL	NL	AL	MCL	DCL	MDC	DDC
TMP 1996.075.0001 - 9	5.83	5.83	2.88	5.94	5.33	5.18	6	6
TMP 1996.089.0002	7.72	6.71	3.89	8.11	6.41	5.3	6	5
TMP 1997.012.0005	6.05	6.12	4.45	6.91	5.51	4.82		
TMP 1997.012.0042		5.75	3.53					
TMP 1997.012.0085	6.69	5.86	3.39	6.26	5.19	4.39		
TMP 1997.012.0106	6.66	6.4	3.82	7.72	6.72	6.55		
TMP 1997.132.0001 - 1	5.57	5.02		5.7	5.23	4.82		
TMP 1997.132.0001 - 2	4.44	5.57	3.03	5.43	4.78	2.41	6	4
TMP 1997.132.0001 - 3	5.51	5.78	3.1	6.62		4.24		
TMP 1997.132.0001 - 4		6.74						
TMP 1997.132.0001 - 5	5.65	5.86		5.39	5.59	3.36	8	3
TMP 1997.132.0001 - 6	4.51	5.42		5.53	4.92	3.27		1
TMP 1997.132.0001 - 7	5.62	6.83		6.57	5.96	4.19	6	4
TMP 1998.008.0004	6.66	5.84	3.48	7.3	5.03	3.98	6	4
TMP 1998.043.0004	6.15	5.77	3.21	5.7	4.84	4.07	5	4
TMP 1998.068.0086		10.63	6.17					
TMP 1998.068.0153		11.16	6.64					
TMP 1998.098.0001 - 1		10.18	6.97					
TMP 1998.098.0001 - 10	7.3	8.58	5.59	8.16	7.14	6.53	4	3
TMP 1998.098.0001 - 11			4.9					
TMP 1998.098.0001 - 12		9.21	6.08					
TMP 1998.098.0001 - 13	9.83	9.8	6.45	9.84	7.78	6.42		
TMP 1998.098.0001 - 14		9.01	5.31					
TMP 1998.098.0001 - 15		9.16	5.57					
TMP 1998.098.0001 - 16		10.88	6.88					
TMP 1998.098.0001 - 17		11.64	7.23					
TMP 1998.098.0001 - 18								

Sample Number	CH	CBL	NL	AL	MCL	DCL	MDC	DDC
TMP 1998.098.0001 - 19								
TMP 1998.098.0001 - 2		11.41	7.2					
TMP 1998.098.0001 - 20		13.64	6.96					
TMP 1998.098.0001 - 21	16	12.56		15.2	14.92			
TMP 1998.098.0001 - 22	10.23	11.33		9.81	8.24	8	4	3
TMP 1998.098.0001 - 23								
TMP 1998.098.0001 - 3	14.43	10.04	6.08	9.75	8.63	9.71		4
TMP 1998.098.0001 - 4		12.27	7.23					
TMP 1998.098.0001 - 5		9.44	6.23					
TMP 1998.098.0001 - 6	10.1	9.61	5.59	10.99	9.56	5.21	4	3
TMP 1998.098.0001 - 7	16.5	13.4	8.78	13.64	11.8	9.85		5
TMP 1998.098.0001 - 8	14.5	13.5	7.86	13.81	12.58	10.49		5
TMP 1998.098.0001 - 9	9.78	11.04	7.94	11.72	10.91	8.86	5	4
TMP 1998.102.0026 - 1	9.87	11.41	7.7	12.16	11.09	6.27	5	4
TMP 1998.102.0026 - 2		10.56	6.55					
TMP 1998.102.0026 - 3		9.98	6.06					
TMP 1998.102.0026 - 4	8.82	10.13	7.54	8.32	7.54	6.66	5	3
TMP 1998.102.0026 - 5		10.76	0.7					
TMP 1998.102.0028 - 1	6.06	4.76	3.39	5.68	4.98	4.34	4	4
TMP 1998.102.0028 - 2	5.4	4.7	2.77	5.5	5.08	4.87		5
TMP 1999.055.0162	5.72	5.31	2.88	5.66	5.4	4.28		
TMP 1999.055.0290	5.56	6.6	4.12	6.07	6.36	4.92		
TMP 1999.063.0019		9.77	6.63					
TMP 1999.085.0005	7.85	7.2	4.59	8.1	7.57	6.37	6	4
TMP 2000.012.0020	6.49	6.56		7.24	6.68	5.23		
TMP 2000.012.0024 - 1		10.79	6.99					
TMP 2000.012.0024 - 2	6.14	7.1	4.33	7.12	5.7	5.08		

Sample Number	CH	CBL	NL	AL	MCL	DCL	MDC	DDC
TMP 2000.057.0027	8.56	8.72	5.23	9.07	8.2	7		
TMP 2001.012.0072	4.65	5.1	2.98	5.3	5.27	3.94		
TMP 2001.012.0073		6.26	3.92					
TMP 2002.012.0060		6.62	5.23					
TMP 2002.012.0135		9.9	7.09					
TMP 2002.060.0001 - 1	4.99	4.85	2.72	5.31	5.21	3.67	7	5
TMP 2002.060.0001 - 2	5.42	5.42		5.86	4.83	3.68		
TMP 2003.012.0106	5.29	6.15	3.4	6.58	5.14	5.01	6	5
TMP 2004.107.0003	5.44	6.12	4.07	6.78	6.08	3.22		
TMP 2004.114.0005	5.28	5.24	3.91	5.53	4.9	3.8		
TMP 2004.116.0016	6.91	7.39	4.63	7.21	6.52	4.13		
TMP 2004.118.0012		6.56	4.08					
TMP 2005.012.0027		9.48	5.61					
TMP 2005.012.0185		8.3	5.98					
TMP 2005.012.0233	5.36	5.12	3.08	5.21	4.41	3.98	5	5
TMP 2005.012.0265	10.14	10.3	6.42	11.91	10.17	9.64	6	3
TMP 2005.012.0279		10.56	7.2					
TMP 2005.012.0280		10.99	7.01					
TMP 2005.012.0305	8.42	9.8	5.33	8.85	7.15	6.7	4	4
TMP 2005.012.0368		10.14	6.57					
TMP 2005.012.0369	5.06	5.22	3.15	6.03	4.51	2.96	5	4
TMP 2005.012.0384 - 1	4.37	4.3	2.39					
TMP 2005.012.0384 - 2		6.14	3.17					
TMP 2005.012.0397		7.72	5.3					
TMP 2005.012.0427	7.7	9.1	5.36	8.8	8.06	5.78		
TMP 2005.049.0065		11.58	7.89					
TMP 2005.049.0102	10.04	9.33	5.25	10.02	7.56	5.12		

Sample Number	CH	CBL	NL	AL	MCL	DCL	MDC	DDC
TMP 2005.049.0143		5.92	3.53					
TMP 2005.054.0007	7.11	7.03	4.27	7.44	6.73	3.77		
TMP 2006.012.0182	6.56	5.63	3.12	6.53	5.19	5.59	7	3
TMP 2008.043.0051								
TMP 2011.047.0002	8.32	7.27	4.94	8.4	8.4	7.43	7	5
TMP 2011.047.0010		8.3	6.32					
TMP 2011.047.0079	6.23	5.14	2.7	5.95	5.58			
TMP 2012.012.0017	6.33	5.6	3.8	6.72	5.1	5.55		6
TMP 2013.012.0057	13.69	11.04	7.27	13.31	11.82	7.94	6	3
TMP 2014.012.0128		9.85	6.24					
TMP 2014.012.0134	5.47	4.37	2.45	5.42				
TMP 2017.023.0017 - 1	4.2						5	
TMP 2017.023.0017 - 2	4.3							
TMP 2017.023.0017 - 3	5.91						5	
TMP 2017.023.0017 - 4							5	
TMP 2018.012.0172		9.46	5.64					
TMP 2019.012.0011	6.05	6.55	4.9	6.87	6.47	5.08	5	3
TMP 2023.012.0023		5.16	2.82					
TMP 2023.012.0242		10.59	6.68					
UALVP 00002 - 1		4.99	3.66					
UALVP 00002 - 10		4.78						
UALVP 00002 - 11	3.43	4.54	3.31	4.11	3.75	3.49		
UALVP 00002 - 12	2.89	4.68	3.03	3.89	3.6	3.62		
UALVP 00002 - 13	3.21	4.52		4.14	3.94	2.82	10	7
UALVP 00002 - 14		4.95						
UALVP 00002 - 15	3.05	4.76		4.78	4.06	3.03		
UALVP 00002 - 16		4.7						

Sample Number	CH	CBL	NL	AL	MCL	DCL	MDC	DDC
UALVP 00002 - 17	4.24	4.92		4.46	3.74	2.46		
UALVP 00002 - 18								
UALVP 00002 - 19		4.7						
UALVP 00002 - 2		4.92	3.66					
UALVP 00002 - 20		5.05	4.22					
UALVP 00002 - 21	4.08	4.71	3.22	3.63	3.37	3.94		
UALVP 00002 - 22		3.42	2.79					
UALVP 00002 - 23		4.45	3.5					
UALVP 00002 - 24	6.35	5.15	3.69	5.88	5.13	5.28		
UALVP 00002 - 25	4.97	3.74		5.02	4.49	4		10
UALVP 00002 - 26		4.16	3.96					
UALVP 00002 - 27		4.34	3.51					
UALVP 00002 - 28	4.3	4.83	3	3.43	3.35	3.61		
UALVP 00002 - 29		4.82	3.37					
UALVP 00002 - 3	3.79	5.12	3.31	4.44	3.65	4.74		
UALVP 00002 - 30	3.49	4.19	3.11	3.95	3.08	3.6		
UALVP 00002 - 31	4.36	4.7	3.04	4.34	3.71	3.32		
UALVP 00002 - 32		4.97	2.82					
UALVP 00002 - 33	4.03	5.16		4.37	3.77	3.33		
UALVP 00002 - 34	3.93	5.05	2.88	4.54	3.6	3.1		
UALVP 00002 - 35		4.99						
UALVP 00002 - 36	3.61	5.25	3.41	4.46	3.45	3.15		
UALVP 00002 - 37		4.9						
UALVP 00002 - 38		4.38	3.46					
UALVP 00002 - 39	4.43	4.46	3.44	4.07	3.34	3.18		
UALVP 00002 - 4	4.83	4.42	3.45	4.76	4.38	4.63	11	8
UALVP 00002 - 40	3.96	4.58	3.71	3.4	3.27	3.22		

Sample Number	CH	CBL	NL	AL	MCL	DCL	MDC	DDC
UALVP 00002 - 5	5.96	4.55	3.75	5.78	5.32	5.43	12	
UALVP 00002 - 6	4.61	4.87	3.47	4.39	3.69	4.25		
UALVP 00002 - 7	4.13	4.98		4.11	3.74	3.81	10	
UALVP 00002 - 8	4.64	5.12		4.93	3.68	4.32		
UALVP 00002 - 9	4.59							
UALVP 48641		5.65						
UALVP 48747	4.91	4.73	2.93					
UALVP 49327	6.5	6.59	3.72	6.17	5.79	4.96	5	5
UALVP 53588 - 1	5.41	5.08	2.78	6	5.23	2.84	6	3
UALVP 53588 - 2	4.6	3.98	2.13	4.28	3.47	3.23		
UALVP 53588 - 3	4.62	5.56	3.22	5.74	4.18	3.81	6	4
UALVP 53588 - 4	5.39	5.14	2.65	5.1	5.22	4.68		
UALVP 53588 - 5		4.93	2.54					
UALVP 53588 - 6	5.86	4.55	3.11	6.1	5.55	5.27		
UALVP 53590	5.12	3.64	2.86	4.66	3.56	3.87	6	7
UALVP 53591	7.43	8.32	5.46	8.13	6.69	5.27	4	3
UALVP 53975	7.14	8.94		7.91	7.55	6.11	8	3
UALVP 55323	4.99	5.93	3.42	5.62	4.45	4.29	6	5
UALVP 55366	4.33	4.99	2.74	4.81	4.61	3.83	6	3
UALVP 55378	3.64	4.38	2.74	4.6	4.31	2.82	6	3
UALVP 55390	10.67	12.36	8.24	10.33	10.28	8.33	6	4
UALVP 55621	6.48	6.18	3.42	6.03	5.76	4.46	6	4
UALVP 59296		7.74						
UALVP 61124 - 1	6.57	8.03	4.44	7.19	6.04	5.74	5	5
UALVP 61124 - 2	8.65	8.32	4.8	9.23	8.71	6.86		
UALVP 61153		13.82	8.21					
UALVP 61442	4.92	4.44	2.88	5.59				

Sample Number	CH	CBL	NL	AL	MCL	DCL	MDC	DDC
UMNH VP 11638	5.98	7.33		8.8	7.16	5.69	7	5
UMNH VP 1228	5.54	4.37	2.55	5.42	4.36	3.7	5	5
UMNH VP 1232								
UMNH VP 12637	8.93	8.81		8.31	7.84	6.04	8	5
UMNH VP 12864	8.43	7.17	4.56	8.04	6.27	4.71	6	4
UMNH VP 14228								
UMNH VP 14436	5.15	4.96	3.15	4.93	4.36	4.32	7	5
UMNH VP 14488	2.9	3.36	2.28	2.97	2.7	2.05	6	3
UMNH VP 16221	8.17	8.59	5.59	7.96	6.38	6.65	6	4
UMNH VP 16874	3.53	4.25	2.53	3.97	3.36	2.57	6	5
UMNH VP 17418								
UMNH VP 17502	4.25	3.94	2.64	4.7	4.05	2.99	6	3
UMNH VP 17514								
UMNH VP 17973	4.33	4.64	3	4.36	4.15	3.65	8	7
UMNH VP 19037								
UMNH VP 19040	4.35	3.88		4.14	3.95	2.53	5	3
UMNH VP 19699	2.6	2.48	1.64	2.55	2.1	2.02	6	6
UMNH VP 19719								
UMNH VP 19720	3.7	3.68		3.89	3.25	2.32	4	2
UMNH VP 20599	6.39	6.48		6.95	6.37	3.09	7	3
UMNH VP 20903	6.97	8.18		7.35	7.12	6.54	8	5
UMNH VP 24117								
UMNH VP 5609								
UMNH VP 6765								
UMNH VP 7603							4	3
UMNH VP 7658	3.18	3.38		3.53	3.73	2.99		5
UMNH VP 7672								

Sample Number	CH	CBL	NL	AL	MCL	DCL	MDC	DDC
ZPAL MgD II/1-1							5	6
ZPAL MgD II/1-2							4	5
ZPAL MgD II/1-3							4	4
ZPAL MgD II/1-4							4	4
ZPAL MgD II/1-5							4	4
ZPAL MgD II/1-6							4	4
ZPAL MgD II/1-7							4	4

Appendix E – 4: Digital traditional raw measurements

Sample Number	CH	CBL	M-CL	NL	AL	MCL	DCL	MDH	MDL	DDH	DDL	CA
BYU VP 50866	6.2	5.42	4.27	4.53	5.62	4.47	3.54	0.45	0.75	0.57	0.52	51.73
CEUM 09173	5.62	6.11	4.91					1.08	1.14	0.89	0.84	
CEUM 11909	5.69	5.19	3.72	3.44	6.01	5.41	3.62	0.29	0.41	0.29	0.39	54.55
CEUM 11910	5.41			2.85								
CEUM 11911	4.88	4.92	3.6	3.43	5.09	4.34	3.2					54.73
CEUM 11912		5.07	3.84	3.26								
CEUM 11923		9.99	7.79	6.14				0.45	0.7	0.43	0.87	
CEUM 11924	8.81	10.84	6.16	6.3	9.5							47.8
CEUM 12435												
CEUM 1264 #86	8.49									1.42	1.92	
CEUM 12811	9.45	13.35	9.58	8.62								
CEUM 31206												
CEUM 34580	18.62	15.37	11.39		18.62	15.69	14.97	2.1	1.86	1.74	2.25	74.78
CEUM 53115	14.36	15.48	10.25	9.49	15.82	13.49	12.82	1.61	1.96	0.96	1.86	55.19
CEUM 5373	4.5	4.74	3.02	2.96	5.18	4.78	3.54	0.43	0.58	0.41	0.57	45.61
CMNFV 1131		11.42		7.35								
CMNFV 119 - 1	4.29	4.21	3.14	2.42	4.99	4.22	3.84					64.71

Sample Number	CH	CBL	M-CL	NL	AL	MCL	DCL	MDH	MDL	DDH	DDL	CA
CMNFV 119 - 2	4.52	4.08	3.26	2.06	5.31	4.39	4.01	0.51	0.51	0.3	0.33	62.4
CMNFV 119 - 3	6.65	6.23	4.67	3.14	6.66	6.04	5.42	0.93	0.86	0.99	1.12	61.03
CMNFV 119 - 4	5.66	6.74	4.03	3.25								
CMNFV 119 - 5	4.44	4.93	3.66	2.91	5.36	4.65	3.92	0.27	0.48			61.99
CMNFV 119 - 6	6.37	5.7	4.4		5.6	4.92	4.61	0.23	0.64	0.59	0.88	61.47
CMNFV 129 - 1												
CMNFV 129 - 2	9.9	10.46	8.01	6.54	10.37	8.67	6.48	0.77	1.34			52.64
CMNFV 1349	4.42	5.56	4.47	2.24	5.69	5.23	4.49	0.44	0.81	0.34	0.54	51.24
CMNFV 1772 - 1	8.13	9.73	8.26	6.46	10.57	10.17	6.42	0.61	1.07			44.56
CMNFV 1772 - 2	6.5	8.98	5.61	5.82								
CMNFV 1772 - 3	6.74	10.34	7.94	6.63	8.39	7.56	6.87					48.38
CMNFV 1772 - 4												
CMNFV 1772 - a	9.5	11.42	10.76	7.96	11.15	9.79	7.67	0.94	0.89	1.81	1.46	48.99
CMNFV 21864												
CMNFV 2334	10.43	8.95	9.43	6.08								
CMNFV 2759 - 1	6.65	6.37	4.63	3.72	6.5	4.84	4.17	0.37	0.7	0.45	0.82	54.6
CMNFV 2759 - 2												
CMNFV 2759 - 3												
CMNFV 2759 - 4												
CMNFV 2759 - 5	7.49	6.16	4.25		7.9	4.64	4.57					60.02
CMNFV 2759 - 6	6.58	7.89	3.99		7.87	5.42	4.46	0.49	0.75	0.43	0.63	52.53
CMNFV 38441	4.06	5.8	4.16	3.46								
CMNFV 38442	6.43	5.2	3.62	3	6.14	5.48	4.89	0.96	0.85	0.75	1.28	62.91
CMNFV 38443	4.03	4.92	3.83	2.89	5.1	4.76	2.49	0.45	0.58	0.42	0.51	42.44
CMNFV 38444	2.14	4.18		2.11								
CMNFV 38445	6.13	4.56	3.58	2.8	6.17	5.42	5.05					62.8
CMNFV 38446												

Sample Number	CH	CBL	M-CL	NL	AL	MCL	DCL	MDH	MDL	DDH	DDL	CA
CMNFV 38447	4.53	4.09	2.92	2.38	4.9	3.87	3.57					63.27
CMNFV 38448	4.63	4.38	2.34	2.67	5.13	3.91	3.83					56.89
CMNFV 38449	5.51	4.93	3.86	2.64	5.54	5.06	3.74					51.38
CMNFV 59240 - 1	7.58	8.93	6.71	5.17	8.49	7.82	5.32					52.73
CMNFV 59240 - 2	6.35	8.64	6.92	4.42	6.7	5.88	5.45			0.49	0.91	46.41
CMNFV 59240 - 3		9.74		5.47								
CMNFV 59431	4.1	4.91	4.31	2.74	4.71	3.9	2.55	0.35	0.75	0.22	0.56	51.62
CMNFV 59432 - 1	6.11	7.77	5.17	4.04	6.77	5.14	3.83	0.91	0.84			47.65
CMNFV 59432 - 2		6.01		4.11								
CMNFV 59459												
CMNFV 59460	4.94	8.25	6.71	5.38								
CMNFV 59480	6.43	9.63	9.42	6.47	8.72	6.69	6.45					46.92
CMNFV 59510 - 1	4.07	6.52	3.58	4.32	6.07	5.15	4.44	0.42	0.59	0.36	0.48	47.62
CMNFV 59510 - 2	6.06	7.71	6.13	4.43	7.85	7.3	4.56			0.91	1.36	50.88
CMNFV 59534			5.3	8.35	6.69	4.65						
CMNFV 59591 - 1	8.83	8.75	5.62	4.29	6.88	5.01	4.62	0.47	0.59			54.38
CMNFV 59591 - 2												
CMNFV 8531 - 1												
CMNFV 8531 - 2												
CMNFV 8531 - 3	11.51	10.3	7.5	6.88	11.02	9.08	6.58					46.06
CMNFV 8531 - 4	10.53	10.81	6.08	6.35	9.6	7.58		0.83	1.05			57.26
CMNFV 8531 - 5												
CMNFV 8531 - 6												
CMNFV 8531 - 7	9.43	9.73	8.09	6.29	9.82	8.19	7.81	1	1.18	1.01	1.15	58.4
CMNFV 8531 - 8	9.18	10.24	8.31	5.98	10.73	9.78	5.59	0.85	1.43	0.74	0.92	40.44
CMNFV 8531 - 9	7.79	10.35	8.19	6.71	9.41	8.43	7.68	1.04	1.22	1.29	1.44	51.51
CMNFV 8537 - 1	4.64	6.71	3.53	3.88	5.53	4.9	3.24	0.31	0.48	0.33	0.37	40

Sample Number	CH	CBL	M-CL	NL	AL	MCL	DCL	MDH	MDL	DDH	DDL	CA
CMNFV 8537 - 2	4.54	6.71	4	4.72								
CMNFV 8537 - 3	4.38	5.56	3.15	3.64								
CMNFV 8537 - 4		5.22		4.03								
CMNFV 8537 - 5												
CMNFV 8537 - 6	4.79	5.69	4.27	3.59	5.04	4.77	3.63					42.6
CMNFV 8537 - 7	5.4	6.3	4.19	4.18	6.33	5.89	4.38			0.54	0.55	47.69
CMNFV 8537 - 8	6.25	6.28	4.48	3.23	6.4	5.82	4.78	0.33	0.33	0.33	0.81	52.26
CMNFV 8731 - 1	7.11	8.23	6.3	5.52								
CMNFV 8731 - 2												
CMNFV 8731 - 3												
CMNFV 8731 - 4	7.57	8.48	5.07	4.8	7.15	6.4	5.36	0.62	0.88			48.29
CMNFV 8876 - 1	6.58	6.02	4.83	2.94	6.26	5.66	5.01	0.59	0.76			63.37
CMNFV 8876 - 2	5.65	5.07	3.52		5.49	4.44	3.69	0.3	0.59			58.88
CMNFV 8876 - 3	4.92	5.31	3.42		5.13	4.27	4.1			0.55	0.47	54.82
CMNFV 8880 - 1	7.34	6.12	4.08	4	6.73	5.19	4.59	0.47	0.65	0.66	1.48	52.05
CMNFV 8880 - 2	5.36	6.3	3.83	4.25								
CMNFV 973	8.63	9.91	6.89	5.78								
CMNFV CMS1921 - 1		9.97		6.02								
CMNFV CMS1921 - 2	6.21	8.22	6.35	0.46	8.09	7.38	5.96	0.93	0.54	0.49	0.94	56.79
CMNFV CMS1921 - 3	7.05	8.42	6.4	5.16	7.2	6.61	6.2	1.29	1.26	1.52	1.6	55.38
CMNFV CMS1921 - 4												
CMNFV CMS1921 - 5												
CMNFV CMS1921 - 6												
CMNFV CMS1921 - 7	3.11	4.2	3.28	2.1	3.69	3.14	2.05					47.95
CMNFV CMS1921 - 8	6.71	8.88	7.03	5.16	8.12	7.37	6.32	0.62	0.63	0.33	0.94	50.67
CMNFV RDR - 1												
CMNFV RDR - 10												

Sample Number	CH	CBL	M-CL	NL	AL	MCL	DCL	MDH	MDL	DDH	DDL	CA
CMNFV RDR - 11												
CMNFV RDR - 12												
CMNFV RDR - 2	6.26	7.28	4.58	4.89								
CMNFV RDR - 3	7.48	6.89	4.52									
CMNFV RDR - 4	8.5	9.05	7.05	5.05	9.9	8.93	4.8	0.57	1.14			47.4
CMNFV RDR - 5	7.78	9.9	7.76	6.66	9.03	6.61	6.38					48.39
CMNFV RDR - 6	7.28	9.11	6.13	5.73	9.55	9	6.04					43.52
CMNFV RDR - 7		9.57		6.42								
CMNFV RDR - 8		9.69		6.03								
CMNFV RDR - 9		11.27		6.94								
CMNFV UN - 1												
CMNFV UN - 2												
CMNFV UN - 3												
CMNFV UN - 4	6.65	8.5	5.95		6.38	5.86	5.12	0.74	1.01	0.35	1.11	43.51
CMNFV UN - 5	5.03	5.54	5.03	3.12	5.76	4.61	4.15	0.45	0.5	0.5	0.82	57.48
CMNFV UN - 6												
CMNFV UN - 7	6.43	7.93	5.92	4.93				0.94	1.38	0.77	1.14	
CMNFV UN - 8												
CMNFV UN - 9												
DMNH EPV 53040	5.08	4.65		3.35								
DMNH EPV 136185 - 13		6.99		4.76								
DMNH EPV 136185 - 14	4.43	5.04	3.35	3.82	5.55	4.63	3.63	0.31	0.33	0.35	0.37	49.11
DMNH EPV 136185 - 15	6.01	6.11	3.9	4.37	6.56	5.8	5.36	0.31	0.45	0.35	0.47	60.51
DMNH EPV 136185 - 16	5.39	6.22	3.29	4.69								
DMNH EPV 136185 - 17	5.76	6.4	3.82	4.45	6.04	4.25	4.09	0.42	0.51	0.29	0.47	48.22
DMNH EPV 136185 - 18	7.61	5.64	3.88	3.15	6.54		4.36					46.36
DMNH EPV 136185 - 19	6.68	5.69	4.01	4.04	5.17	3.84	3.52					47.19

Sample Number	CH	CBL	M-CL	NL	AL	MCL	DCL	MDH	MDL	DDH	DDL	CA
DMNH EPV 136185 - 20	6.97	5.6	4.4	3.95	6.27		4.65					54.3
DMNH EPV 136185 - 21	6.88	6.27										
DMNH EPV 136185 - 22	5.65	4.81	3.67									
DMNH EPV 136185 - 23	5.2	4.87	2.88	3.83	5.1	4.54	3.22					43.88
DMNH EPV 136185 - 24	5.26	5.04	2.91				2.77					
DMNH EPV 136185 - 25	6.04	5.15	3.26		5.15	4.02	3.46					53.31
DMNH EPV 136185 - 26	4.04	3.38	2.93	2.03	4.02		3.16					61.27
DMNH EPV 136185 - 27	3.16	3.88	2.41	2.66	3.66							36.4
DMNH EPV 18168 - 1												
DMNH EPV 18168 - 10	6.71	7.11	3.92	4.81	6.06	5.14	4.47					43.86
DMNH EPV 18168 - 11	7.53	5.99	4.13	4.56	6.06	5.14	5.06					55.12
DMNH EPV 18168 - 12		6.25		3.87								
DMNH EPV 18168 - 13	6.58	6.63	3.93									
DMNH EPV 18168 - 14		6.91		4.24								
DMNH EPV 18168 - 15	5.5	5.89	4.32	4.2	5.88	5.61	4.9					52.16
DMNH EPV 18168 - 16	5.42	5.51	3.79	3.33	5.49	4.99	3.66					47.05
DMNH EPV 18168 - 17	4.27	5.65	3.45	3.74	5.44	4.82	3.43					42.11
DMNH EPV 18168 - 2	5.82	6.58	4.81	4.48	6.48							50.14
DMNH EPV 18168 - 3		7.67		4.72								
DMNH EPV 18168 - 4	6.07	6.16	4.74	3.72								
DMNH EPV 18168 - 5	7.16	7.39	4.79	4.13								
DMNH EPV 18168 - 6	5.27	7.45	4.09	4.84								
DMNH EPV 18168 - 7	7.49	7.4	5.73	4.79	7.38	6.66	4.29					41.77
DMNH EPV 18168 - 8	5.36	7.82	4.7	5.41								
DMNH EPV 18168 - 9	6.83	7.51	5.21	4.24	5.7	5.15	4.88					48.47
DMNH EPV 18169 - 1				5.49								
DMNH EPV 18169 - 2	6.81	7.22		3.45								

Sample Number	CH	CBL	M-CL	NL	AL	MCL	DCL	MDH	MDL	DDH	DDL	CA
DMNH EPV 18169 - 3	9.6	9.17	6.72	4.98	8.82	7.15	5.31					48.15
DMNH EPV 18169 - 4		7.49		4.99								
DMNH EPV 18169 - 5		7.65		5.55								
DMNH EPV 21671	7.15	9.6	5.51	6.5								
DMNH EPV 27726 - 1	8.17	4.43	2.98	3.82	6.37							73.74
DMNH EPV 27726 - 10	4.15	5.63	3.86		4.66	4.3	3.68	0.25	0.45			43.15
DMNH EPV 27726 - 11		5.49	3.1	3.76								
DMNH EPV 27726 - 12	3.4	4.64	3.39	3.32	3.31							
DMNH EPV 27726 - 13	4.17	4.83	2.86	3.03	4.23							50.32
DMNH EPV 27726 - 14	5.96	4.7	3.06		6.05							64.5
DMNH EPV 27726 - 15	4.84	4.54	3.05		5.99	4.6	4.09					61.6
DMNH EPV 27726 - 16	5.36	4.61	3.27		7.22	5.63	4.34					55.19
DMNH EPV 27726 - 17	6.17	5.46	3.58	3.78	6.64	5.81	5.08	0.53	0.69	0.47	0.58	62.67
DMNH EPV 27726 - 18	6.52	5.53	3.51	3.45	6.37	5.81	5.06					62.52
DMNH EPV 27726 - 2												
DMNH EPV 27726 - 3	4.88	4.25	3.01		5.05	4.58	4.42					66.21
DMNH EPV 27726 - 4	4.85	4.82	3.45		4.82							59.79
DMNH EPV 27726 - 5	6.5	5.14	3.64	4.03	7.1	6.37	5.02					58.02
DMNH EPV 27726 - 6	7.49	6.03	4.45		6.88			0.47	0.26	0.25	0.27	
DMNH EPV 27726 - 7	5.58	3.98	3.33		6.01							73.44
DMNH EPV 27726 - 8	7.66											
DMNH EPV 27726 - 9	5.18	3.69	2.94		5.02	4.69	4.1	0.28	0.5			65.09
DMNH EPV 2818 - 10	5.51	5.04		3.06								
DMNH EPV 2818 - 11	5.82	4.79	4.24		7.09	5.63	4.59	0.35	0.16	0.33	0.21	58.45
DMNH EPV 2818 - 12	5.55	5.66	3.9	3.17	5.43	4.4	3.52					52.02
DMNH EPV 2818 - 13	7.37	4.84	2.94	2.94	7.44	5.58	4.79	0.29	0.35			53.92
DMNH EPV 2818 - 14	7.6	6.01	4.14	3.04	6.96	5.26	5.07	0.35	0.23			60.53

Sample Number	CH	CBL	M-CL	NL	AL	MCL	DCL	MDH	MDL	DDH	DDL	CA
DMNH EPV 2818 - 15	5.27	5.06	3.49	2.78	4.46	3.41	3.16	0.32	0.2	0.23	0.28	66.31
DMNH EPV 2818 - 16	6.03	4.2	3.79	1.9	5.1	4.36	4.16					62.41
DMNH EPV 2818 - 17	5.43	3.74	2.92	1.97	4.76	4.13	4.05					70.23
DMNH EPV 2818 - 18	5.48	3.77	2.1	2.32	5.38	4.26	4.1	0.46	0.36			68.46
DMNH EPV 2818 - 19	4	2.8	2.2	2.15								
DMNH EPV 2818 - 2	4.43	5.44	4.03	2.4	4.05	3.47	3.19					48.01
DMNH EPV 2818 - 20	4.35	4.93	3.97	2.54	4.2	3.32	3.14					56.62
DMNH EPV 2818 - 21	5.73	4.84	3.29	2.63	5.61	3.68	3.62	0.34	0.28	0.31	0.31	57.22
DMNH EPV 2818 - 22	4.24	4.97	3.82	2.77	3.74	3.09	3.02					52.08
DMNH EPV 2818 - 23	4.92	4.02	2.97	2.57	4.87	3.83	3.41	0.4	0.26			57.41
DMNH EPV 2818 - 24	4.71	4.24	3.66		5.22	4.15	3.98					66.54
DMNH EPV 2818 - 25		4.87	3.85	2.97						0.21	0.15	47.76
DMNH EPV 2818 - 26	5.61	4.88	3.22	2.88	6.01	4.53	3.96	0.24	0.34			59.03
DMNH EPV 2818 - 27	4.48	4.51	3.51		4.78	3.95	3.71	0.29	0.17			57.53
DMNH EPV 2818 - 28	4.84	5.57	4.32	2.59	5.71	5.01	4.25	0.5	0.26	0.51	0.25	50.47
DMNH EPV 2818 - 3	6.14	5	2.89	2.78	6.22	4.87	3.88					61.53
DMNH EPV 2818 - 4	5.45	4.45			5.55							
DMNH EPV 2818 - 5	6.7	5.06	2.51	2.74	6.2							
DMNH EPV 2818 - 6	5.91	4.33	3.56	2.84	5.63	5.01	4.18					61.04
DMNH EPV 2818 - 7	5.34			2.86								
DMNH EPV 2818 - 8	6.24	4.51		3.31								
DMNH EPV 2818 - 9	5.71	4.93		3.05	5.13	4.25		0.4	0.25			56.45
DMNH EPV 468	9.13	6.08	3.7					1.28	1.23			41.06
DMNH EPV 50206 - 3		6.86		4.43								
DMNH EPV 50206 - 4		4.5		2.54								
DMNH EPV 50373		5.26										
DMNH EPV 50377		5.47		3.89								

Sample Number	CH	CBL	M-CL	NL	AL	MCL	DCL	MDH	MDL	DDH	DDL	CA
DMNH EVP 136185 - 1	7.04	6.67	4.66	4.59	7	6.51	3.95	0.47	0.57	0.33	0.56	40.83
DMNH EVP 136185 - 10	5.45	6.57	3.78	4.2	5.76	5.11	4.31	0.27	0.49	0.26	0.65	44.08
DMNH EVP 136185 - 11	4.88	6.43	4.79	4.55	5.94	5.12	3.78	0.4	0.69	0.28	0.51	47.36
DMNH EVP 136185 - 12	5.8	7.02	4.33	4.57	6.72	5.66	4.44	0.36	0.42	0.48	0.49	46.13
DMNH EVP 136185 - 2		7.15		5.1								
DMNH EVP 136185 - 3	4.4	4.78	3.19	3.04	5.42	4.72	3.85	0.33	0.59	0.33	0.39	49.52
DMNH EVP 136185 - 4	6.37	6.93	3.92	4.49	7.54	5.98	4.53					40.47
DMNH EVP 136185 - 5	4.87	4.76	3.11	2.99	5.62	4.64	3.66	0.39	0.45	0.25	0.37	41.55
DMNH EVP 136185 - 6	5	6.91	3.99	4.51								
DMNH EVP 136185 - 7	7.13	7.06	4.26	4.46	7.74	7.04	4.82	0.47	0.5	0.29	0.42	41.46
DMNH EVP 136185 - 8		6.09		4.27								
DMNH EVP 136185 - 9		6.12		3.98								
DMNH EVP 2818 - 1	2.61	3.44										
DMNH EVP 50206 - 1		6.56		5.58								
DMNH EVP 50206 - 2	5.45			4.63								
PIN 3142/250 - 1	6.71	8.87										
PIN 3142/250 - 10	6.14	5.71	5.38		5.92					0.46	0.61	53.18
PIN 3142/250 - 2	6.69	8.59	7.68		6.62	5.2	5.87			0.61	1.1	48.1
PIN 3142/250 - 3	5.77	7.76	6.9		6.59							53.26
PIN 3142/250 - 4	6.42	7.94	7.33		7.74							42.68
PIN 3142/250 - 5	6.1	8.05	7.42									
PIN 3142/250 - 6	6.28	7.84	7.4		7.6	6.56	4.74					46.62
PIN 3142/250 - 7	6.22	7.56	6.71		8.14	6.23	4.39	0.68	1.07	0.47	0.87	45.03
PIN 3142/250 - 8	6.03	6.79	7		6.97	5.89	4.13					50.56
PIN 3142/250 - 9	5.34	6.65	6.09		6.66	6.46	3.6	0.61	0.92	0.44	0.74	42.59
ROM 03088												
ROM 03287												

Sample Number	CH	CBL	M-CL	NL	AL	MCL	DCL	MDH	MDL	DDH	DDL	CA
ROM 03302	9.77	11.84	8.45									
ROM 03368												
ROM 03516		11.89		7.08								
ROM 07763	4.77	5.92	4.76	3.69								
ROM 07765	5.29	5.3	4.71	3.04	5.9	4.32	3.83	0.59	0.83	0.68	0.92	60.66
ROM 07766		4.71		2.77								
ROM 07767	5.77	6.21	4.67	4.27	6.7	6.05	5.04	0.95	1.17	0.59	1.04	47.7
ROM 07768												
ROM 07770	5.74	5.25	3.37	3.07	5.76	4.7	4.37					63.34
ROM 07772												
ROM 1215 - 1		4.82		3.45								
ROM 1215 - 10	6.98	6.51	4.29	4.44	7.44	5.86	4.09	0.9	1	0.75	0.87	48.59
ROM 1215 - 11	4.87	6.83		4.9								
ROM 1215 - 12	7.05	7.36	4.72	5.47	7.78	6.31	3.9	1.05	1.03			39.65
ROM 1215 - 13		7.41		4.6								
ROM 1215 - 14												
ROM 1215 - 15		6.65		3.69				0.82	0.95			
ROM 1215 - 16	5.86	8.49	6.66	5.79	7.15	6.4	5.27	1.04	1.1	0.46	1.02	41.01
ROM 1215 - 17	4.24	9.15	5.94	5.8								
ROM 1215 - 2	4.58	5.1	4.61	3.72								
ROM 1215 - 3	5.83	6.68	3.85	5.05	6.23	4.73	3.33	0.44	0.75			41.84
ROM 1215 - 4												
ROM 1215 - 5		7.71										
ROM 1215 - 6		8.77		5.7								
ROM 1215 - 7	4.09	4.76	4.02	3.47	4.91	3.99	2.08	0.39	0.73			37.59
ROM 1215 - 8	4.28	5.37	4.01	3.92	5.58	4.39	2.3					36.88
ROM 1215 - 9	4.44	6.22	5.33	4.46	6.16	5.34	2.68	0.54	0.59			33.43

Sample Number	CH	CBL	M-CL	NL	AL	MCL	DCL	MDH	MDL	DDH	DDL	CA
ROM 26346	4.83	4.07	2.82	2.67	4.83	3.75	3.55	0.38	0.44	0.28	0.62	59.97
ROM 31697	5.68	7.28		3.8								
ROM 31865		6.03		3.49								
ROM 31866	5.42	5.89	4.92	3.54	6.37	5.14	3.4	0.56	1.09	0.53	0.86	55.3
ROM 31867	4.67	4.96	3.61	2.66	5.06	4.32	3.13	0.69	0.72			44.88
ROM 31868	4.91	4.13	2.96	2.38	4.4	3.01	3			0.58	0.55	58.16
ROM 31869		3.8		2.1								
ROM 31871												
ROM 31872	7.16	6.57	4.51	3.63	6.14	5.82	5.12	0.4	0.8	0.42	0.73	55.77
ROM 36385	6.47	8.08										
ROM 36386		11.98		7.55								
ROM 36387	5.68	9.98	7.65									
ROM 36388		10.7		6.56								
ROM 36389												
ROM 36390		8.76		5.55								
ROM 36391		9.26		5.33								
ROM 36392	7.49			5.94								
ROM 36393												
ROM 36394												
ROM 36395												
ROM 36396	5.86	8.76	7.27	6.75	6.73	6.2	5.79	0.63	0.63			41.59
ROM 36397		8.5		5.4								
ROM 36398		7.7		4.62								
ROM 36399												
ROM 36400		11.07		6.62								
ROM 36401		8.21		4.47								
ROM 36402	6.71	9.65	7.72	5.79								

Sample Number	CH	CBL	M-CL	NL	AL	MCL	DCL	MDH	MDL	DDH	DDL	CA
ROM 36403												
ROM 36404	7.49	9.3	7.5	5.89								
ROM 36405												
ROM 36406												
ROM 36407												
ROM 36408												
ROM 36409		9.54		5.73								
ROM 36410	6.91	8.85	5.14	5.47								
ROM 36411	6.4	7.7	5.6	4.9								
ROM 36412	6.93	7.82	5.74	4.56	7.56	6.52	5.45	0.74	0.89	0.48	0.63	44.38
ROM 36413		10.04		5.31								
ROM 36414				5.19								
ROM 36415		8.38		5.69								
ROM 36416		11.15		6.27								
ROM 36417		12.92		7.47								
ROM 36418	5.07	7.95		4.06								
ROM 36419												
ROM 36420												
ROM 36421												
ROM 36422												
ROM 36423	6.63	5.84	4	4.1	5.77	4.46	2.36					39.7
ROM 53579												
ROM 56611	9.42	10.38	7.34	7.58	9.13	8.15	6.4					49.45
ROM 56620		6.1		3.7								
ROM 58144	7.35	8.71	6.45	5.41	8.07	6.34	5.28	0.96	1.63	1.15	1.29	42.22
ROM 58147	4.32	5.69	5.15	3.11	5.9	5.12	4.2	0.43	0.58	0.47	0.65	52.55
ROM 58151	5	6.85		4.86								

Sample Number	CH	CBL	M-CL	NL	AL	MCL	DCL	MDH	MDL	DDH	DDL	CA
ROM 58223	4.9	6.5	4.32	4.04	6.09	6.04	4.58	0.23	0.62			42.91
ROM 58383	4.55	5.21	2.97	2.89								
ROM 58516												
ROM 58525	4.38	6.13	4.33	4.36	5.63	5.06	3.64					41.5
ROM 58565 - 1	4	5.05	3.12	3.42	4.65	3.78	2.49					41.25
ROM 58565 - 2	5.99	7.96	5.25	5.33								
ROM 58565 - 3	6.23	6.18	4.85	4.49	6.99	6.32	4.15	0.76	0.95	1.09	1.49	45.47
ROM 58565 - 4		5.5		2.81								
ROM 58594	9.21	8.93	6.47	5.59	9.47	8.49	7.28	1.26	1.29	1.3	1.52	52.75
ROM 58598	7.96	8.18	5	5.45	9.35	8.87	6.52	0.59	1.18	0.54	0.95	47.03
ROM 58689 - 1	10.18	10.77	7.23	5.25				1.27	1.83	1.07	1.47	
ROM 58689 - 2	6.11	7.55	3.92	4.43	6.32	5.44	5.05	0.85	1.07	0.64	1.21	51.99
ROM 58704		7.99		5.99								
ROM 67276	7.2	9.3	6.46	5.56								
ROM 788 - 1		6.48		4.14								
ROM 788 - 2		6.13		3.92								
ROM 788 - 3	5	5.64	3.75									
ROM 788 - 4	5.04	5.48	4.01	3.57								
ROM 788 - 5	4.04	6.01	4.4									
ROM 788 - 6	4.92											
ROM 788 - 7	5.11	4.57	3.07	2.79								
ROM 788 - 8												
SMU 73203		5.24						0.74	0.66			
TMP 1966.025.0015	4.42	4.39	3.84	2.71	4.86	4.27	4.38					62.24
TMP 1976.006.0036	8.37	7.46	6.62	5.29	9.22	7.42	6.6	0.67	1.3	0.76	1.55	48.44
TMP 1980.008.0026 - 1	9.4	8.86	7.77	5.39	10.82	9.3	6.07	0.71	1.39	0.84	1.67	80.98
TMP 1980.008.0026 - 2	7.4	7.72	7.2	4.67	8.67	8.4	6.58	1.27	1.11	1.06	1.31	48.09

Sample Number	CH	CBL	M-CL	NL	AL	MCL	DCL	MDH	MDL	DDH	DDL	CA
TMP 1980.013.0046	6.18	6.77	6.3	3.71	7.07	6.03	5.02	0.58	0.55	0.87	0.94	45.69
TMP 1980.016.0239	4.96	4.62	4.01	2.6	5.16	4.67	4.43	0.51	1	0.49	1.06	57.96
TMP 1980.016.0834	4.53	4.19	2.85	2.17	5.47	4.67	4.04					62.03
TMP 1980.016.1685 - 1	5.74	5.26	3.27		6.38	5.38	4.52					47.96
TMP 1980.016.1685 - 2	5.6	3.83	2.64		6.09	5.85	4.3					50.51
TMP 1980.029.0140	5.1	5.63	4.89	3.02	5.69	5.18	4.58	0.45	0.79	0.54	0.78	51
TMP 1980.029.0228	5.3	6.53	5.46	3.62	5.99	5.64	5.03	0.59	0.77	0.61	1.23	51.85
TMP 1981.041.0014	5.05	5.65	5.32		5.46	5.38	4.66	0.84	1.18	0.76	1.15	50.93
TMP 1983.036.0009 - 1	6.27	4.99	4.43	2.47	5.86	5	3.59	0.58	1.01	0.48	0.82	49.6
TMP 1983.036.0009 - 2	5.45	5.37	4.7	3.14	5.15	5.01	4.64	0.46	0.46	0.48	0.56	56.8
TMP 1983.036.0009 - 3	5.01	4.64	4.06	1.68	5.67	5.28	4.95	0.35	0.64	0.44	0.61	60.26
TMP 1983.036.0009 - 4	4.36	4.76	4.57	2.61	4.84	4.23	3.64			0.84	1.16	51.81
TMP 1983.036.0207	5.7	6.81	5.11	4.01	6.47	5.89	4.63	0.94	1.6	0.93	1.19	43.41
TMP 1984.091.0020	8.48	9.94	8.85	6.01	10.03	9.24	7.21					43.68
TMP 1985.036.0121	5.8	4.9	4.25	2.74	6.45	5.95	5.11	0.31	0.44	0.43	0.73	60.3
TMP 1985.056.0170 - 1	5.18	5.32	4.56	3.18	6.38	5.29	4.23	0.58	0.59			59.46
TMP 1985.056.0170 - 2	4.9	5.84	4.9	2.9	5.9	5.21	4.24					45.96
TMP 1985.056.0171 - 1	7.89	8.14	8	4.56	8.84	7.36	5.9	0.77	1.27	0.71	1.25	42.94
TMP 1985.056.0171 - 2		10.7		5.87								
TMP 1985.056.0171 - 3	7.46	7.5	7.02	4.68	7.96	6.76	6.3					51.96
TMP 1985.056.0211	5.25	5.29	4.76	3.05	5.99	5.41	4.58	0.66	1.02	0.82	1.1	47.17
TMP 1985.059.0028	5.82	5.69	5.25	3.44	6.04	5.79	5.76	0.45	0.92	0.39	0.7	61.34
TMP 1986.008.0084	6.32	6.45	4.93	4.14	7.42	6	5.11	0.7	1.05	0.74	1.14	46.04
TMP 1986.009.0055	6.2	5.07	4.53	3.03	6.69	4.9	4.71	0.64	0.77	0.41	1.04	51.83
TMP 1986.023.0108	6.24	6.04	5.6	3.52	6.38	4.8	4.38					49.88
TMP 1986.095.0007	5.77	5.09	4.55	2.8	6.4	5.23	5.16	0.42	0.7	0.44	0.95	58.53
TMP 1986.127.0005	4.88	5.33	4.74	3.31	5.75	4.76	4.42	0.46	0.73	0.38	0.68	51.26

Sample Number	CH	CBL	M-CL	NL	AL	MCL	DCL	MDH	MDL	DDH	DDL	CA
TMP 1986.183.0003	6.62	6.29	5.42	3.6	7.19	6.74	5.48	0.63	0.83			54.46
TMP 1987.029.0006		2.53		1.18								
TMP 1987.036.0094	6.49	7.26	7.88	4.73	9.21	7.38	4.75					50.98
TMP 1987.077.0143	4.48	4.66	4.1	2.58	5.08	4.15	3.83					52.39
TMP 1987.080.0010	4.11	5.52	4.13	3.19	5.54	4.5	3.5	0.2	0.55			58.8
TMP 1989.069.0017	7.55	9.62	8.96	6.42	8.34	7.46	6.86	0.74	1.61	0.96	1.72	44.22
TMP 1989.036.0396 - 1	3.36	4.06	3.51	2.62	4.74	3.52	3.16					53.98
TMP 1989.036.0396 - 2	4.38	5.21	4.96	2.87	4.97	4.56	3.84					47.97
TMP 1989.036.0396 - 3	5.49	5.08	5.02	3.34	5.52	4.75	4.13					49.72
TMP 1989.036.0405 - 1	4.61	4.97	4.03	2.9	5	3.92	3.16					53.35
TMP 1989.036.0405 - 2		5.2										
TMP 1989.036.0405 - 3	5.39	5.89	5.36	3.4	6.6	4.86	5.22	0.82	1.34	0.78	0.97	52.62
TMP 1989.050.0002	5.56	6.46	6.39	3.59	6.18	5.28	5.33	0.72	0.7			50.047
TMP 1989.050.0013	4.81	5.55	5.24	3.48	5.29	4.74	4.12					47.6
TMP 1989.050.0030	5.69	6.51	5.44	3.91	7.04	6.43	4.59					41.54
TMP 1989.076.0059	3.9	3.78	2.99	1.95	4.34	3.64	2.7					53.21
TMP 1989.079.0008	9.26	12	10.09	6.74	10.65	9.92	8.18					46.66
TMP 1989.151.0137	9.61	10.59	9.31	6.17	12.39	10.78	9.96					55.72
TMP 1990.036.0081	9.66	12.9	11.9	6.72	11.17	10.65	9.67	1.29	2.11	1.62	2.6	47.65
TMP 1990.060.0006 - 1	5.48	5.95	5.16	3.6	6.61	5.5	4.72					48.17
TMP 1990.060.0006 - 2	4.32	3.77	3.27	1.91	4.81	4.06	3.6					55.08
TMP 1990.107.0037 - 1	6.06	5.52	5.34	3.94	7.02	5.82	3.23					42.98
TMP 1990.107.0037 - 2	6.49	9	7.77	4.99	8.55	7.93	5.49					37.48
TMP 1990.155.0007	9.22	9.58	9.21	6.3	10.24	8.47	7.7	0.65	0.94			49.66
TMP 1991.036.0158	5.17	6.1	5.79	2.64	5.54	4.78	4.33	0.42	0.71			51.94
TMP 1991.036.0171	9.48	10.62	10.99	7.34	11.71	10.4	8.74					49.82
TMP 1991.036.0734	5.69	6.14	5.83	3.36	6.26	5.02	4.22	0.78	0.76			49.66

Sample Number	CH	CBL	M-CL	NL	AL	MCL	DCL	MDH	MDL	DDH	DDL	CA
TMP 1991.050.0093	7.38	10.45	9.46	6.8	9.01	8.46	7.17			1.12	1.99	44.29
TMP 1991.085.0012	7.17	7.5	6.88	4.48	8.84	7.57	5.76					42.2
TMP 1991.087.0072	5.7	6.62	6.09	4.54	5.91	5.04	4.15					39.4
TMP 1992.036.0313 - 1		10.26										
TMP 1992.036.0313 - 2												
TMP 1992.036.1178 - 1	4.82	5.59	5.12	3.24	5.46	5.06	4.88	0.6	0.96	0.86	1.13	54.4
TMP 1992.036.1178 - 2	3.89	5.18	5.09	2.69	4.67	4.47	3.24	0.66	1.16	0.53	1.11	38.11
TMP 1992.036.1178 - 3		11.94		6.33								
TMP 1993.036.0081	5.59	6.2	4.72	3.48	6.84	6.33	5.22	0.63	0.68	0.57	0.8	49.91
TMP 1993.036.0364	10.79	14.41	12.94	9.41	13.07	11.8	11.26					49.18
TMP 1993.079.0065		9.82		6.51								
TMP 1994.012.0035	9.16	10.35	9.36	5.8	11.43	9.48	7.72					46.55
TMP 1994.012.0039	7.36	8.29	6.54	5.22	9.35	8.71	6.05	1.34	1.73	1.28	1.77	41.18
TMP 1994.012.0120	5.95	9.56	7.93	5.63	9.33	7.96	6.58					43.04
TMP 1994.012.0565	7.3	7.35	7.27	5.12	7.83	6.37	4.97					43.08
TMP 1994.086.0018	6.31	6.71	5.96	4.18	6.99	6.59	4.92	0.42	0.66	0.47	1.12	43.46
TMP 1994.092.0011	5.53	4.93	4.81	2.85	6.33	5.12	3.72	0.46	0.98	0.64	0.76	50.27
TMP 1994.094.0014 - 1	8.03	8.82	7.2	5.5	9.61	8.34	6.19					41.89
TMP 1994.094.0014 - 2	3.7	5.6	4.86	2.94	4.9	4.46	3.65					48.89
TMP 1994.094.0016	10.58	12.65	10.37	8.37	12.29	10.93	9.08					45.84
TMP 1994.097.0001	4.98	5.68	4.78	3.06	5.76	5.15	4.47	0.53	0.85	0.6	1.19	55.51
TMP 1995.012.0105	8.77	8.88	7.88	5.98	10	8.8	6.81					43.48
TMP 1995.012.0117	9.95	11.83	10.32	6.29	11.4	10	7.06					53.54
TMP 1996.048.0018 - 1	3.94	4.93	3.69	2.89	4.71	4.28	3.86	0.54	0.76	0.42	0.96	51.1
TMP 1996.048.0018 - 2	2.66	3.27	2.46	1.63	2.73	2.43	2.05	0.19	0.47	0.36	0.52	47.54
TMP 1996.075.0001 - 1	5.7	5.07	4.92	2.82	5.91	5	4.79	0.48	0.89	0.48	0.87	57.5
TMP 1996.075.0001 - 10	6.12	5.01	4.41	2.85	6.6	5.9	5.17	0.61	0.57	0.8	0.73	54.72

Sample Number	CH	CBL	M-CL	NL	AL	MCL	DCL	MDH	MDL	DDH	DDL	CA
TMP 1996.075.0001 - 11	4.1	4.83	4.25	2.43	5.73	4.68	3.74	0.51	0.84	0.61	0.73	51.35
TMP 1996.075.0001 - 12	4.17	4.75	4.12	2.85	5.83	4.54	3.99					56.71
TMP 1996.075.0001 - 2	3.06	4.31	3.71	2.43	3.86	3.35	2.63					36.96
TMP 1996.075.0001 - 3	6.03	4.6	3.72		6.4	5.24	4	0.48	0.93			48.92
TMP 1996.075.0001 - 4	5.32	5.35	4.64	2.64	6.26	5.79	4.5	0.43	0.87	0.5	0.97	54.71
TMP 1996.075.0001 - 5	4.5	5.16	5.07	2.1	4.96	4.39	3.62	0.46	0.7			48.85
TMP 1996.075.0001 - 6	4.82	4.13	3.82	2.13	5.66	3.11	2.43	0.38	0.73			57.98
TMP 1996.075.0001 - 7	5.08	4.89	4.63	2.9	4.99	4.86	3.91					47.03
TMP 1996.075.0001 - 8		5.25		3.16								
TMP 1996.075.0001 - 9	5.72	5.82	4.87	2.89	6.5	5.5	5.12	0.56	0.94	0.42	0.75	56.96
TMP 1996.089.0002	6.67	6.7	5.33	3.73	8.34	6.55	3.94	0.49	1.02	0.48	1.15	55.52
TMP 1997.012.0005	5.81	6.4	5.84	4.14	6.98	5.93	5.33	0.5	1.23	0.76	1.07	51.32
TMP 1997.012.0042	5.83	6.05	5.64	3.63	6.41	5.79	5.08	0.45	1.1			51.38
TMP 1997.012.0085	6.53	5.63	5.62	3.33	6.6	4.78	4.32					52.52
TMP 1997.012.0106	6.5	6.63	5.32	3.89	7.85	6.84	6.1			0.79	1.16	56.75
TMP 1997.132.0001 - 1	8.84	5.76	5.84		9.06	7.46	6.61					59.81
TMP 1997.132.0001 - 2	7.18	7.13	6.7		8.33	6.83	5.94					54.45
TMP 1997.132.0001 - 3	5.34	5.18	4.63		5.55	4.1	2.98					37.07
TMP 1997.132.0001 - 4		4.89										
TMP 1997.132.0001 - 5	5.55	5.53	4.54		5.9	5.79	4.25					44.08
TMP 1997.132.0001 - 6	4.89	4.68	4.73		4.65	4.06	4.01					53.58
TMP 1997.132.0001 - 7	5.33	6.75	6.52		6	6.07	4.31	0.75	0.97			43.08
TMP 1998.008.0004	7.15	6.04	5.52	3.56	7.46	6.32	4.8					49.79
TMP 1998.043.0004	5.64	5.85	5.4	2.91	6.24	5.29	4.5	0.58	1.12			47.45
TMP 1998.068.0086	9.09	11.2	10.43	6.07	10.79	9	8					45.29
TMP 1998.068.0153												
TMP 1998.098.0001 - 1		11.27										

Sample Number	CH	CBL	M-CL	NL	AL	MCL	DCL	MDH	MDL	DDH	DDL	CA
TMP 1998.098.0001 - 10	6.69	8.84	8.12	5.67	7.45	6.87	6.32					47.49
TMP 1998.098.0001 - 11												
TMP 1998.098.0001 - 12												
TMP 1998.098.0001 - 13												
TMP 1998.098.0001 - 14												
TMP 1998.098.0001 - 15												
TMP 1998.098.0001 - 16												
TMP 1998.098.0001 - 17												
TMP 1998.098.0001 - 18												
TMP 1998.098.0001 - 19												
TMP 1998.098.0001 - 2		11.62										
TMP 1998.098.0001 - 20												
TMP 1998.098.0001 - 21	13.6	15.23	13.62		15.53	14.28	10.73	1.79	1.89			52.14
TMP 1998.098.0001 - 22	9.24	8.85	9.37		8.88	7.73	6.76					62.64
TMP 1998.098.0001 - 23												
TMP 1998.098.0001 - 3	14.81	10.63	9.56	5.56	13.02	9.33	10.78	1.71	2.04			65.42
TMP 1998.098.0001 - 4		11.68		7.78								
TMP 1998.098.0001 - 5		10.04		6.59								
TMP 1998.098.0001 - 6	7.87	9.07	8.14	5.38	9.6	8.69	5.43					38.72
TMP 1998.098.0001 - 7	18.28	17.37	16.95	9.77	16.46	12.98	13.37					50.04
TMP 1998.098.0001 - 8	22.47	21.3	18.58	12.2	20.77	17.74	15.99					46.24
TMP 1998.098.0001 - 9	11.2	11.39	11.06	7.66	12.02	11.17	7.18					42.27
TMP 1998.102.0026 - 1	9.9	11.29	11.46	7.74	11.93	10.55	9.36	1.32	2.14	1.54	2.23	52.41
TMP 1998.102.0026 - 2	8.31	10.16	9.53	6.42	10.24	9.36	6.3					36.93
TMP 1998.102.0026 - 3		9.44		5.84								
TMP 1998.102.0026 - 4	7.98	10.36	8.88	7.76	8.6	7.8	7.21					45.61
TMP 1998.102.0026 - 5		10.74		6.84								

Sample Number	CH	CBL	M-CL	NL	AL	MCL	DCL	MDH	MDL	DDH	DDL	CA
TMP 1998.102.0028 - 1	5.6	4.99	3.76	3.28	6.28	4.93	4.71	0.76	1.26	0.8	1.08	57.5
TMP 1998.102.0028 - 2	5.63	4.63	4.51	2.76	6.1	5.16	4.49					52.7
TMP 1999.055.0162	4.87	5.54	5.04	2.87	5.46	4.27	3.7					51.66
TMP 1999.055.0290	6.05	6.31	5.54	4.04	7.32	6.25	5.15					48.36
TMP 1999.063.0019	9.11	10.05	9.95	6.55	10.62	9.51	6.3					50.25
TMP 1999.085.0005	7.92	7.45	7.52	4.96	8.43	7.43	5.98	0.71	1.28	0.92	1.39	57.67
TMP 2000.012.0020	6.53	6.65										
TMP 2000.012.0024 - 1		10.95		7.01								
TMP 2000.012.0024 - 2	6.9	7.16	6.39	4.36	7.89	7.1	4.85					47.97
TMP 2000.057.0027	8.58	9.01	8.05	5.38	9.89	8.27	7.23					48.37
TMP 2001.012.0072	5.03	4.99	4.26	3.05	5.76	4.92	3.68					53.55
TMP 2001.012.0073		6.18		4								
TMP 2002.012.0060		6.53		3.75								
TMP 2002.012.0135		10.19		6.83								
TMP 2002.060.0001 - 1	4.89	4.78	4.91	2.62	5.5	4.45	3.21					52.97
TMP 2002.060.0001 - 2	4.72	6.06	5.02	3.85	5.91	5.06	4.24					43.12
TMP 2003.012.0106	5.16	6.18	5	3.24	6.25	5.51	5.04	0.75	1.12	0.5	1.16	51.82
TMP 2004.107.0003	5.79	6.65	5.91	4.11	7.36	6.7	3.78					32.07
TMP 2004.114.0005	4.93	4.96	4.71	3.36	6.21	4.71	3.92					46.99
TMP 2004.116.0016	5.38	7.48	6.49	4.62	7.82	6.86	4.85	0.8	1.86	0.69	1.89	38.53
TMP 2004.118.0012		6.35		3.9								
TMP 2005.012.0027		9.54		5.58								
TMP 2005.012.0185		9.12		5.89								
TMP 2005.012.0233	4.56	5.17	4.78	2.89	5.8	4.29	3.89	0.52	0.74	0.46	0.79	47.82
TMP 2005.012.0265	10.18	11.12	9	6.02	12.48	10.86	8.76	0.81	1.64	1.42	2.13	45.47
TMP 2005.012.0279		10.63		7.21								
TMP 2005.012.0280		11.07		7.32								

Sample Number	CH	CBL	M-CL	NL	AL	MCL	DCL	MDH	MDL	DDH	DDL	CA
TMP 2005.012.0305	7.64	9.66	9.25	5.45	9.12	7.42	6.08	0.97	2.02	0.66	1.52	39.64
TMP 2005.012.0368		11.21		6.64								
TMP 2005.012.0369	5.89	5.37	5.25	3.32	6.22	4.87	3.85	0.69	0.82	0.6	1.12	42.82
TMP 2005.012.0384 - 1		2.24		2.44								
TMP 2005.012.0384 - 2		5.84		3.16								
TMP 2005.012.0397		7.76		5.39								
TMP 2005.012.0427	8.6	9.37	7.83	5.43	9.76	7.94	6.46					43.67
TMP 2005.049.0065		12.34		8.07								
TMP 2005.049.0102		9.44		6.13								
TMP 2005.049.0143		6.22		3.62								
TMP 2005.054.0007	5.99	7.81	7.08	4.15	7.69	6.73	4.38					34.52
TMP 2006.012.0182	6.09	5.75	4.92	3.27	6.78	6.58	5.63	0.65	1.02			68.29
TMP 2008.043.0051		4.73		3.2								
TMP 2011.047.0002	7.45	7.16	6.44	4.46	8.51	7.97	7.15	0.75	1.29	0.76	1.12	62.83
TMP 2011.047.0010		8.63		6.31								
TMP 2011.047.0079	5.32	5.26	3.99	2.67	6.25	5.27	4.09	0.34	0.66			56.57
TMP 2012.012.0017	6.54	5.67	5.56	3.78	7.15	6.09	4.82					52.29
TMP 2013.012.0057	11.98	11.28	10.21	7.4	13.56	11.4	8.98	1.08	2.2	0.83	2.05	44.6
TMP 2014.012.0128		11.04		6.64								
TMP 2014.012.0134	5.05	4.35	3.89	2.33	5.49	4.38	3.68					65.37
TMP 2017.023.0017 - 1	4.84	4.13	3.18		5.22	4.52		0.57	0.49			46.58
TMP 2017.023.0017 - 2	3.79	4.77	3.71		4.96	4.27						34.21
TMP 2017.023.0017 - 3												
TMP 2017.023.0017 - 4	5.66											
TMP 2018.012.0172		9.66		6.01								
TMP 2019.012.0011	5.28	6.49	5.94	3.91	7.07	5.53	5.15	0.96	1.01	0.65	1.43	49.33
TMP 2023.012.0023		5.05		2.81								

Sample Number	CH	CBL	M-CL	NL	AL	MCL	DCL	MDH	MDL	DDH	DDL	CA
TMP 2023.012.0242		10.88		6.95								
UALVP 00002 - 1		5.4		3.96								
UALVP 00002 - 10		4.54										
UALVP 00002 - 11	4.09	5.14	5.04	3.21	4	3.73	2.85					34.9
UALVP 00002 - 12	3.76	5.47	5.37	3.26	4.66	3.3	3.54					53.12
UALVP 00002 - 13	4.51	5.47	4.99		4.85	4.21	3.7					44.74
UALVP 00002 - 14		5.33										
UALVP 00002 - 15	4.85	5.59	5.35	3.4	5.02	4.01	3.41					43.05
UALVP 00002 - 16		5.56										
UALVP 00002 - 17	4.45	5.49	5.4		4.8	4.15	3.58					44.48
UALVP 00002 - 18												
UALVP 00002 - 19		5.33										
UALVP 00002 - 2		5.39		4.24								
UALVP 00002 - 20		5.43		3.72								
UALVP 00002 - 21	4.83	5.44	5	3.48	4.45	3.59	3.57					52.23
UALVP 00002 - 22		3.5		2.69								
UALVP 00002 - 23		4.34		3.39								
UALVP 00002 - 24	6.69	4.96	3.52	4.68	7.59	6.83	3.53					52.94
UALVP 00002 - 25	5.56	3.41	2.74	2.6	5.73	4.76	3.02					64.12
UALVP 00002 - 26		4.6		3.14								
UALVP 00002 - 27		4.26										
UALVP 00002 - 28	4.16	4.92	4.51	3.61	3.92	3.73	2.77					47.25
UALVP 00002 - 29		4.46		3.22								
UALVP 00002 - 3	4.98	5.61	3.51	4.2	5.12	4.56	4.53					58.94
UALVP 00002 - 30	3.97	4.75	4.38	3.46	4.5	3.9	3.25					43.2
UALVP 00002 - 31	3.65	4.51	4.14	2.82	3.89	3.47	2.91					52.83
UALVP 00002 - 32		4.84										

Sample Number	CH	CBL	M-CL	NL	AL	MCL	DCL	MDH	MDL	DDH	DDL	CA
UALVP 00002 - 33	3.7	4.66	3.93	3.74	4.01	3.64	3.78					54.36
UALVP 00002 - 34	3.63	4.7	3.82	3.42	4.38	4.25	3.2					60.45
UALVP 00002 - 35		4.38		3.48								
UALVP 00002 - 36	4.21	4.31	3.55	3.39	3.39	3.84	2.69					37.4
UALVP 00002 - 37		3.92										
UALVP 00002 - 38		4.37		2.59								
UALVP 00002 - 39	3.05	4.03	3.2	2.98	3.13	2.73	3.05					57.36
UALVP 00002 - 4	5.1	5.2	3.84	3.99	5.92	4.29	5.55					66
UALVP 00002 - 40	3.11	3.75	3.2	2.1	3.37	2.86	2.09					33.76
UALVP 00002 - 5	6.2	5.16	3.52	4	6.67	4.73	5.32					68.37
UALVP 00002 - 6	4.7	5.28	3.42		5.19	4.27	4.01					49.74
UALVP 00002 - 7	4.19	5.31	3.21		4.8	4.59	4.26					50.56
UALVP 00002 - 8	4.66	5.44	3.38		5.37	4.52	4.4					50.19
UALVP 00002 - 9												
UALVP 48641		5.35		2.55								
UALVP 48747	4.6	4.98	4.8	3.17	5.3	4.11	3.19					41.27
UALVP 49327	5.83	6.1	5.8	3.74	6.38	5.31	3.46					54.56
UALVP 53588 - 1	4.73	5.26	4.81	2.79	5.53	5.31	2.8					37.97
UALVP 53588 - 2	4.26	4.23	3.97	1.87	4.85	4.15	3.89					55.23
UALVP 53588 - 3	5.59	5.85	5.36	3.47	6.04	5.18	3.75	0.37	0.57	0.44	0.82	51.29
UALVP 53588 - 4	4.94	4.91	4.88	2.65	5.16	4.98	4.23					50.89
UALVP 53588 - 5	4.69	4.88	4.17	2.49	4.53	4.15	3.56					50.61
UALVP 53588 - 6	5.55	4.69	3.84	3.17	6.51	5.79	5.5	0.23	0.48	0.32	0.5	62.79
UALVP 53590	4.93	4.09	3.61	2.88	5.35	3.81	4.31					66.84
UALVP 53591	7.46	8.88	7.97	5.61	8.81	8	5.14	0.53	1.41			38.74
UALVP 53975	6	7.43	8		7.89	7.22	5.72	0.74	1.09	1.15	1.38	45.3
UALVP 55323	4.53	5.86	5.82	3.28	6	5.74	3.68					36.98

Sample Number	CH	CBL	M-CL	NL	AL	MCL	DCL	MDH	MDL	DDH	DDL	CA
UALVP 55366	4.66	4.88	4.35	2.87	5.38	4.7	4.09					52.2
UALVP 55378	4.38	4.7	4.52	1.98	5.14	5	3.51			0.71	0.87	43.89
UALVP 55390	11.44	13.18	13.22	8.36	12.43	11.11	8.82			1.53	1.89	41.88
UALVP 55621	6.53	6.12	5.59	3.44	6.62	5.84	5.4	0.64	0.87	0.67	1.14	54.56
UALVP 59296		7.7		4.69								
UALVP 61124 - 1	6.47	7.32	6.56	4.19	7.44	5.58	6.03					55.26
UALVP 61124 - 2	7.99	8.37	7.54	4.58	9.46	8.7	4.74					32.76
UALVP 61153		14.58		8.61								
UALVP 61442	5	4.89	4.26	2.8	5.82	4.9	4.22					50.7
UMNH VP 11638	5.95	7.73	4.82	4.99	8.80							37.74
UMNH VP 1228	4.62	4.36	2.32	2.99	4.91	4.4	4.33	0.36	0.8	0.27	0.67	63.48
UMNH VP 1232												
UMNH VP 12637	5.94	9.06	6.95	5.58	6.87	6.07	4.76			0.88	1.13	38.93
UMNH VP 12864	6.43	6.85	4.32	4.4	6.23	5.71	4.45	0.36	0.58	0.31	0.95	43.07
UMNH VP 14228												
UMNH VP 14436	3.97	4.67	3.4	3.08	4.72	3.79	3.58	0.34	0.46	0.28	0.54	51.47
UMNH VP 14488	2.2	3.12	1.93	1.63	2.57	2.13	2.04	0.25	0.48	0.4	0.32	43.17
UMNH VP 16221	6.66	8.47	8.1	5.43	6.91	5.55	5.12	0.74	1.15	0.97	1.36	49.09
UMNH VP 16874	2.71	4.14	3.61	2.56								
UMNH VP 17418	1.09	1.68	0.79		1.35	1.18		0.14	0.25			43.4
UMNH VP 17502	3.55	3.77	2.7	2.27	4.28	3.92	3.71	0.43	0.33	0.54	0.51	56.19
UMNH VP 17514		7.55	5.43					0.83	1.02	1.08	1.17	
UMNH VP 17973	3.45	4.3	2.96	2.7	3.93	3.88	3.55	0.34	0.39	0.34	0.39	55.63
UMNH VP 19037												
UMNH VP 19040	3	3.61	2.4	1.99	3.81	3.42	2.23	0.33	0.46	0.43	0.46	42.56
UMNH VP 19699	2.04	2.38	1.38	1.63	2.48	2.07	1.55	0.24	0.32	0.19	0.18	52.91
UMNH VP 19719		5.29		3.86								

Sample Number	CH	CBL	M-CL	NL	AL	MCL	DCL	MDH	MDL	DDH	DDL	CA
UMNH VP 19720	3.45	3.17	2.24		3.53	3.07	2.31	0.47	0.67	0.56	0.7	44.48
UMNH VP 20599		6.37										
UMNH VP 20903	6.73	8.18	5.04	4.89	7.54	6.8	6.55	0.51	0.89	0.61	0.97	49.65
UMNH VP 24117												
UMNH VP 5609	1.16	1.17	0.68	0.67	1.3	1.07	0.83	0.13	0.12	0.07	0.09	46.19
UMNH VP 6765	8.34	10	7.14	6.44								
UMNH VP 7603	0.81	0.81	0.39		0.81	0.69	0.66	0.12	0.16	0.06	0.12	41.53
UMNH VP 7658	2.93	2.36	1.79									
UMNH VP 7672		10.96		6								
ZPAL MgD II/1-1	4.72	5.69	4.51	3.4	5.72	5.07	4.87	0.45	0.58	0.55	0.69	55.6
ZPAL MgD II/1-2	5.21											
ZPAL MgD II/1-3	4.67	5.64	4.65	3.17	6.2	5.28	4.95	0.64	1.04	0.44	0.96	55.29
ZPAL MgD II/1-4	5.78	5.3	4.56	2.9	5.88	4.67	4.7	0.65	0.81	0.47	0.97	60.84
ZPAL MgD II/1-5	5	5.14	4.27		5.87	5.05	4.49	0.7	1.16	0.49	1.01	60.98
ZPAL MgD II/1-6	5.43	5.51	5.12	3.97	5.96	5.23	4.6			0.9	0.96	57.05
ZPAL MgD II/1-7	4.54	4.6	2.99	2.89	5.05	4.26	3.89	0.45	0.56	0.41	0.59	56.9

Appendix F – R code lingual view script

```
setwd("/Users/Emily/Desktop/raw outlines/lingual")

library(readxl)

library(tidyverse)

library(Momocs)

library(shapes)

library(ade4)


list.files() ->lingual_outline ##groups all of the files together

import_txt(lingual_outline) ->lingual_outlines ##imports all the txt files in the list as their
outline files


read_csv("/Users/Emily/Desktop/raw outlines/lingual_outlines.csv") -> lingual_fac #makes the
dataframe of identifying facts


Out(lingual_outlines, fac = dplyr::tibble(lingual_fac)) -> lingual_outlines.coo ##turning the file
list to a coo

coo_close(lingual_outlines.coo) ->lingual_outlines.coo #closing outlines


class(lingual_outlines.coo) ## test it's a coo now


panel(lingual_outlines.coo) #panel showing all of outlines
stack(lingual_outlines.coo)


##flip upside-down outlines
coo_flipx(lingual_outlines.coo[20])-> lingual_outlines.coo[20]
coo_plot(lingual_outlines.coo[20])
```

```
coo_flipy(lingual_outlines.coo[20])-> lingual_outlines.coo[20]
coo_plot(lingual_outlines.coo[20])

coo_flipx(lingual_outlines.coo[74])-> lingual_outlines.coo[74]
coo_plot(lingual_outlines.coo[74])
coo_flipy(lingual_outlines.coo[74])-> lingual_outlines.coo[74]
coo_plot(lingual_outlines.coo[74])

coo_flipx(lingual_outlines.coo[75])-> lingual_outlines.coo[75]
coo_plot(lingual_outlines.coo[75])
coo_flipy(lingual_outlines.coo[75])-> lingual_outlines.coo[75]
coo_plot(lingual_outlines.coo[75])

coo_flipx(lingual_outlines.coo[76])-> lingual_outlines.coo[76]
coo_plot(lingual_outlines.coo[76])
coo_flipy(lingual_outlines.coo[76])-> lingual_outlines.coo[76]
coo_plot(lingual_outlines.coo[76])

coo_flipx(lingual_outlines.coo[77])-> lingual_outlines.coo[77]
coo_plot(lingual_outlines.coo[77])
coo_flipy(lingual_outlines.coo[77])-> lingual_outlines.coo[77]
coo_plot(lingual_outlines.coo[77])

coo_flipx(lingual_outlines.coo[78])-> lingual_outlines.coo[78]
coo_plot(lingual_outlines.coo[78])
coo_flipy(lingual_outlines.coo[78])-> lingual_outlines.coo[78]
coo_plot(lingual_outlines.coo[78])


coo_flipx(lingual_outlines.coo[79])-> lingual_outlines.coo[79]
coo_plot(lingual_outlines.coo[79])
coo_flipy(lingual_outlines.coo[79])-> lingual_outlines.coo[79]
coo_plot(lingual_outlines.coo[79])

coo_flipx(lingual_outlines.coo[80])-> lingual_outlines.coo[80]
coo_plot(lingual_outlines.coo[80])
coo_flipy(lingual_outlines.coo[80])-> lingual_outlines.coo[80]
coo_plot(lingual_outlines.coo[80])

coo_flipx(lingual_outlines.coo[81])-> lingual_outlines.coo[81]
coo_plot(lingual_outlines.coo[81])
coo_flipy(lingual_outlines.coo[81])-> lingual_outlines.coo[81]
coo_plot(lingual_outlines.coo[81])
```

```
coo_flipx(lingual_outlines.coo[82])-> lingual_outlines.coo[82]
coo_plot(lingual_outlines.coo[82])
coo_flipy(lingual_outlines.coo[82])-> lingual_outlines.coo[82]
coo_plot(lingual_outlines.coo[82])

coo_flipx(lingual_outlines.coo[83])-> lingual_outlines.coo[83]
coo_plot(lingual_outlines.coo[83])
coo_flipy(lingual_outlines.coo[83])-> lingual_outlines.coo[83]
coo_plot(lingual_outlines.coo[83])

coo_flipx(lingual_outlines.coo[84])-> lingual_outlines.coo[84]
coo_plot(lingual_outlines.coo[84])
coo_flipy(lingual_outlines.coo[84])-> lingual_outlines.coo[84]
coo_plot(lingual_outlines.coo[84])

coo_flipx(lingual_outlines.coo[121])-> lingual_outlines.coo[121]
coo_plot(lingual_outlines.coo[121])
coo_flipy(lingual_outlines.coo[121])-> lingual_outlines.coo[121]
coo_plot(lingual_outlines.coo[121])

coo_flipx(lingual_outlines.coo[122])-> lingual_outlines.coo[122]
coo_plot(lingual_outlines.coo[122])
coo_flipy(lingual_outlines.coo[122])-> lingual_outlines.coo[122]
coo_plot(lingual_outlines.coo[122])

coo_plot(lingual_outlines.coo[123])
coo_rotate(lingual_outlines.coo[123], 90)-> lingual_outlines.coo[123]
coo_flipx(lingual_outlines.coo[123])-> lingual_outlines.coo[123]
coo_plot(lingual_outlines.coo[123])

coo_rotate(lingual_outlines.coo[124], 90)-> lingual_outlines.coo[124]
coo_plot(lingual_outlines.coo[124])

coo_flipx(lingual_outlines.coo[125])-> lingual_outlines.coo[125]
coo_plot(lingual_outlines.coo[125])
coo_flipy(lingual_outlines.coo[125])-> lingual_outlines.coo[125]
coo_plot(lingual_outlines.coo[125])

coo_flipx(lingual_outlines.coo[126])-> lingual_outlines.coo[126]
coo_plot(lingual_outlines.coo[126])
coo_flipy(lingual_outlines.coo[126])-> lingual_outlines.coo[126]
coo_plot(lingual_outlines.coo[126])

coo_flipx(lingual_outlines.coo[127])-> lingual_outlines.coo[127]
```

```
coo_plot(lingual_outlines.coo[127])
coo_flipy(lingual_outlines.coo[127])-> lingual_outlines.coo[127]
coo_plot(lingual_outlines.coo[127])

coo_flipx(lingual_outlines.coo[128])-> lingual_outlines.coo[128]
coo_plot(lingual_outlines.coo[128])
coo_flipy(lingual_outlines.coo[128])-> lingual_outlines.coo[128]
coo_plot(lingual_outlines.coo[128])

coo_flipx(lingual_outlines.coo[129])-> lingual_outlines.coo[129]
coo_plot(lingual_outlines.coo[129])
coo_flipy(lingual_outlines.coo[129])-> lingual_outlines.coo[129]
coo_plot(lingual_outlines.coo[129])

coo_flipx(lingual_outlines.coo[130])-> lingual_outlines.coo[130]
coo_plot(lingual_outlines.coo[130])
coo_flipy(lingual_outlines.coo[130])-> lingual_outlines.coo[130]
coo_plot(lingual_outlines.coo[130])

coo_flipx(lingual_outlines.coo[131])-> lingual_outlines.coo[131]
coo_plot(lingual_outlines.coo[131])
coo_flipy(lingual_outlines.coo[131])-> lingual_outlines.coo[131]
coo_plot(lingual_outlines.coo[131])
coo_likely_anticlockwise(lingual_outlines.coo[131])

coo_flipx(lingual_outlines.coo[223])-> lingual_outlines.coo[223]
coo_plot(lingual_outlines.coo[223])
coo_rev(lingual_outlines.coo[223])-> lingual_outlines.coo[223]
coo_likely_anticlockwise(lingual_outlines.coo[223])

coo_flipy(lingual_outlines.coo[263])-> lingual_outlines.coo[263]
coo_plot(lingual_outlines.coo[263])
coo_rev(lingual_outlines.coo[263])-> lingual_outlines.coo[263]
coo_likely_anticlockwise(lingual_outlines.coo[263])

coo_flipx(lingual_outlines.coo[275])-> lingual_outlines.coo[275]
coo_plot(lingual_outlines.coo[275])
coo_flipy(lingual_outlines.coo[275])-> lingual_outlines.coo[275]
coo_plot(lingual_outlines.coo[275])

coo_flipx(lingual_outlines.coo[305])-> lingual_outlines.coo[305]
coo_plot(lingual_outlines.coo[305])
coo_flipy(lingual_outlines.coo[305])-> lingual_outlines.coo[305]
coo_plot(lingual_outlines.coo[305])
```

```
coo_flipx(lingual_outlines.coo[312])-> lingual_outlines.coo[312]
coo_plot(lingual_outlines.coo[312])
coo_rev(lingual_outlines.coo[312])-> lingual_outlines.coo[312]
coo_likely_anticlockwise(lingual_outlines.coo[312])

coo_flipx(lingual_outlines.coo[17])-> lingual_outlines.coo[17]
coo_plot(lingual_outlines.coo[17])
coo_flipy(lingual_outlines.coo[17])-> lingual_outlines.coo[17]
coo_plot(lingual_outlines.coo[17])

stack(lingual_outlines.coo)
pile(lingual_outlines.coo)


## calculate the harmonic power needed
calibrate_harmonicpower_efourier(lingual_outlines.coo)

##Elliptical fourier transform
Lingual_outlinesF <- efourier(lingual_outlines.coo, nb.h = 5, norm = FALSE)
class(Lingual_outlinesF)


Lingef309 <- efourier(lingual_outlines.coo[309], nb.h = 5) ##plot individual fourier shapes
efiL <- efourier_i(Lingef309)
plot(efiL)


Lingef313 <- efourier(lingual_outlines.coo[313], nb.h = 5) ##plot individual fourier shapes
efiL13 <- efourier_i(Lingef313)
plot(efiL13)

Lingef312 <- efourier(lingual_outlines.coo[312], nb.h = 5) ##plot individual fourier shapes
efiL12 <- efourier_i(Lingef312)
plot(efiL12)

Lingef305 <- efourier(lingual_outlines.coo[305], nb.h = 5) ##plot individual fourier shapes
efiL5 <- efourier_i(Lingef305)
plot(efiL5)

Lingef14 <- efourier(lingual_outlines.coo[14], nb.h = 5) ##plot individual fourier shapes
efiL14 <- efourier_i(Lingef14)
plot(efiL14)
```

```
Lingef15 <- efourier(lingual_outlines.coo[15], nb.h = 5) ##plot individual fourier shapes
efiL15 <- efourier_i(Lingef15)
plot(efiL15)

Lingef201 <- efourier(lingual_outlines.coo[201], nb.h = 5) ##plot individual fourier shapes
efiL201 <- efourier_i(Lingef201)
plot(efiL201)

Lingef228 <- efourier(lingual_outlines.coo[228], nb.h = 5) ##plot individual fourier shapes
efiL228 <- efourier_i(Lingef228)
plot(efiL228)

filter(lingual_outlines.coo, Isolated == "a" ) -> LingF

LingualFF <- efourier(LingF, nb.h = 5,norm = FALSE)
class(LingF)

hcontrib(Lingual_outlinesF) ##plot shows how the harmonics contribute to the morphospace
shapes

filter(Lingual_outlinesF, Isolated == "a" ) -> LingF ###only associated specimens

##performing PCA on all teeth data
LingualOutP <- PCA(Lingual_outlinesF)
LingualOutP
plot(LingualOutP)

filter(LingualOutP, Age!= "Unknown" ) -> LingualOutP ##taking out the samples with unknown
values

##ploting all teeth age
plot_PCA(
 LingualOutP,
 ~Age,
 points = TRUE,
 center_origin = FALSE,
 zoom = 0.9, ##how zoomed in the plot, change depending on what I'm looking at
 morphospace = FALSE,
 eigen = TRUE,
 chull = TRUE,
 labelpoints = FALSE,
 title = "Morphology of teeth through Stages (Lingual)"

 )
```

```
LingualOutP.1<- LDA(LingualOutP, ~Age)
LingualOutP.1
plot_LDA(
 LingualOutP.1,
 title = "LDA of all teeth through time (lingual)",
)

#performing PCA on associated tooth filtered data
LingualAs <- PCA(LingualFF)
LingualAs
plot(LingualAs)

##plotting associated teeth family
plot_PCA(
 LingualAs,
 ~Family,
 points = TRUE,
 center_origin = FALSE,
 zoom = 0.9,
 morphospace = TRUE,
 eigen = TRUE,
 chull = TRUE,
 title = "Morphology of teeth associated with skulls (lingual)"
 )

LingualAs.1<- LDA(LingualAs, ~Family)
LingualAs.1
plot_LDA(
 LingualAs.1,
 title = "LDA of teeth associated with skulls (lingual)",
)

##plotting Raven et al family
plot_PCA(
 LingualAs,
 ~Raven_family,
 points = TRUE,
 center_origin = FALSE,
 zoom = 0.9,
 morphospace = TRUE,
 eigen = TRUE,
 chull = TRUE,
 title = "Morphology of teeth associated with skull using
```

```
  Raven et al. classification (lingual)"
)

LingualAs.2<- LDA(LingualAs, ~Raven_family)
LingualAs.2
plot_LDA(
  LingualAs.2,
  title = "LDA of teeth associated with skulls using
  Raven et al. classification (lingual)",
)

##Just plotting nodosaurid species
filter(LingualAs, Isolated == "a", Family == "Nodosauridae" ) -> LingFN ###only associated
specimens
plot_PCA(
  LingFN,
  ~Sp,
  title = "Morphology of nodosaurid teeth asscociated with skulls (lingual)",
  points = TRUE,
  center_origin = FALSE,
  zoom = 0.7,
  morphospace = TRUE,
  eigen = TRUE,
  chull = TRUE
)

LingFN.1<- LDA(LingFN, ~Sp)
LingFN.1
plot_LDA(
  LingFN.1,
  title = "LDA of teeth associated with nodosaurid skulls (lingual)",
)

###fitting isolated teeth to nodosaurid PCA/LDA
filter(lingual_outlines.coo, Sp == "Unknown") ->lingPN
lingPN <- efourier(lingPN, nb.h = 5, norm=FALSE)


lingNfinal <- rePCA(LingFN, lingPN)
plot_PCA(lingNfinal)

plot_PCA(
  LingFN,
  ~Sp,
```

```
  title = "Morphology of nodosaurid skull teeth with isolated teeth (lingual)",
  points = TRUE,
  center_origin = FALSE,
  zoom = 0.9,
  morphospace = TRUE,
  eigen = FALSE,
  chull = TRUE
)

points(lingNfinal$x[,1:2], col="red", pch=4)

##Classifying the teeth with unknown family using the scheme from nodosaurid LDA!
reLDA(lingNfinal, LingFN.1) -> lingNfinal.L
lingNfinal.L
as.data.frame(lingNfinal.L) -> lingNDF
write_csv(lingNDF,"/Users/Emily/Desktop/raw outlines/lingual_unknown_nodo.csv")
as.data.frame(lingNfinal$fac)->lingNSL
write_csv(lingNSL,"/Users/Emily/Desktop/raw outlines/lingual_nodo_speclist.csv")


##Just plotting ankylosaurid species
filter(LingualAs, Isolated == "a", Family == "Ankylosauridae" ) -> LingFA ###only associated
specimens
plot_PCA(
  LingFA,
  ~Sp,
  title = "Morphology of ankylosaurid teeth associated with skulls (lingual)",
  points = TRUE,
  center_origin = FALSE,
  zoom = 0.9,
  morphospace = TRUE,
  eigen = TRUE,
  chull = TRUE
)

LingFA.1<- LDA(LingFA, ~Sp)
LingFA.1
plot_LDA(
  LingFA.1,
  title = "LDA of teeth associated with ankylosaurid skulls (lingual)",
)

filter(lingual_outlines.coo, Family == "Unknown") ->lingAnFam
lingAnFam <- efourier(lingAnFam, nb.h = 5, norm=FALSE)
```

```
lingAnFam <- rePCA(LingFA, lingAnFam)
plot_PCA(lingAnFam)

plot_PCA(
 LingFA,
 ~Sp,
 title = "Morphology of ankylosaurid teeth associated with skulls (lingual)",
 points = TRUE,
 center_origin = FALSE,
 zoom = 0.9,
 morphospace = TRUE,
 eigen = TRUE,
 chull = TRUE
)

points(lingAnFam$x[,1:2], col="red", pch=4)

##Classifying the teeth with unknown family using the scheme from ankylosaurid LDA!
reLDA(lingAnFam, LingFA.1) -> lingAnFam.L
lingAnFam.L
as.data.frame(lingAnFam.L) -> lingAnFamDF
write_csv(lingAnFamDF,"/Users/Emily/Desktop/raw outlines/lingual_unknown_anky.csv")
as.data.frame(lingAnFam$fac)->lingAnSL
write_csv(lingAnSL,"/Users/Emily/Desktop/raw outlines/lingual_unknown_anky_speclist.csv")


##Just plotting skull teeth by Alberta Fm
filter(LingualAs, Isolated == "a", Fm %in% c("Belly River Group","Dinosaur Park Fm","Horseshoe
Canyon Fm","Oldman Fm", "Scollard Fm")) -> LingFFm ###only associated specimens
plot_PCA(
 LingFFm,
 ~Family,
 title = "Morphology of teeth associated with skulls in Alberta Formations (lingual)",
 points = TRUE,
 center_origin = FALSE,
 zoom = 0.9,
 morphospace = TRUE,
 eigen = TRUE,
 chull = TRUE
)

##AB FM LDA
```

```
LingFFm.1<- LDA(LingFFm, ~Family)
LingFFm.1
plot_LDA(
  LingFFm.1,
  title = "LDA of Morphology of teeth associated with skulls in Alberta Formations (lingual)",
)

###fitting isolated teeth to AB formation PCA/LDA
filter(lingual_outlines.coo, Family == "Unknown",Fm %in% c("Belly River Group","Dinosaur Park Fm","Scollard Fm","Horseshoe Canyon Fm","Oldman Fm", "Milk River Fm", "Foremost Fm", "Wapiti Fm", "St. Mary River Fm")) ->lingPunk ### trying to get isolated teeth to plot  onto the existing AB form plot
lingPunk <- efourier(lingPunk, nb.h = 5, norm=FALSE)


lingoutfinal <- rePCA(LingFFm, lingPunk)
plot_PCA(lingoutfinal)

plot_PCA(
  LingFFm,
  ~Family,
  title = "Morphology of teeth asscociated with skulls in
  Alberta Formations with
  isolated teeth (lingual)",
  points = TRUE,
  center_origin = FALSE,
  zoom = 0.9,
  morphospace = TRUE,
  eigen = FALSE,
  chull = TRUE
)

points(lingoutfinal$x[,1:2], col="red", pch=4)

##Classifying the teeth with unknown family using the scheme from AB formations LDA!
reLDA(lingoutfinal, LingFFm.1) -> lingoutfinal.L
lingoutfinal.L
as.data.frame(lingoutfinal.L) -> lingoutfDF
write_csv(lingoutfDF,"/Users/Emily/Desktop/raw outlines/lingual_unknown_AB_Form.csv")
as.data.frame(lingoutfinal$fac)->lingoutfSL
write_csv(lingoutfSL,"/Users/Emily/Desktop/raw outlines/lingual_unknown_AB_Form_speclist.csv")

##Just plotting skull teeth by Alberta/Montana Fm
```

```
filter(LingualAs, Isolated == "a", Fm %in% c("Belly River Group","Dinosaur Park Fm","Horseshoe Canyon Fm","Oldman Fm", "Scollard Fm", "Hell Creek Fm")) -> LingFAMFm ###only associated specimens
plot_PCA(
  LingFAMFm,
  ~Family,
  title = "Morphology of teeth asscociated with skulls in
  Alberta/Montana Formations (lingual)",
  points = TRUE,
  center_origin = FALSE,
  zoom = 0.9,
  morphospace = TRUE,
  eigen = TRUE,
  chull = TRUE
)


##ABMT FM LDA
LingFAMFm.1<- LDA(LingFAMFm, ~Family)
LingFAMFm.1
plot_LDA(
  LingFAMFm.1,
  title = "LDA of Morphology of teeth asscociated
  with skulls in Alberta/Montana
  Formations (lingual)",
)

###fitting isolated teeth to ABMT from PCA/LDA
filter(lingual_outlines.coo, Family == "Unknown",Fm %in% c("Belly River Group","Dinosaur Park Fm","Scollard Fm","Horseshoe Canyon Fm","Oldman Fm", "Milk River Fm", "Foremost Fm", "Wapiti Fm", "St. Mary River Fm", "Unknown", "Lance Fm", "Cloverly Fm", "Hell Creek Fm", "Judith River Fm")) ->lingPunkAM ### trying to get isolated teeth to plot  onto the existing AB form plot
lingPunkAM <- efourier(lingPunkAM, nb.h = 5, norm=FALSE)


lingoutfinalAM <- rePCA(LingFAMFm, lingPunkAM)
plot_PCA(lingoutfinalAM)

plot_PCA(
  LingFAMFm,
  ~Family,
  title = "Morphology of teeth asscociated with skulls in
  Alberta/Montana Formations with
```

```
  isolated teeth (lingual)",
  points = TRUE,
  center_origin = FALSE,
  zoom = 0.9,
  morphospace = TRUE,
  eigen = FALSE,
  chull = TRUE
)

points(lingoutfinalAM$x[,1:2], col="red", pch=4)

##Classifying the teeth with unknown family using the scheme from AB/MT formations LDA!
reLDA(lingoutfinalAM, LingFAMFm.1) -> lingoutfinalAM.L
lingoutfinalAM.L
as.data.frame(lingoutfinalAM.L) -> lingoutfDFAM
write_csv(lingoutfDFAM,"/Users/Emily/Desktop/raw
outlines/lingual_unknown_ABMT_Form.csv")
as.data.frame(lingoutfinalAM$fac)->lingoutfSLAM
write_csv(lingoutfSLAM,"/Users/Emily/Desktop/raw
outlines/lingual_unknown_ABMT_Form_speclist.csv")


##plotting epochs
plot_PCA(
  LingualOutP,
  ~Epoch,
  points = TRUE,
  center_origin = FALSE,
  zoom = 0.9,
  morphospace = TRUE,
  eigen = TRUE,
  chull = TRUE,
  labelpoints = FALSE,
  title = "Morphology of teeth through Epochs (lingual)"
)

LingualOutP.1<- LDA(LingualOutP, ~Epoch)
LingualOutP.1
plot_LDA(
  LingualOutP.1,
  title = "LDA of all teeth through Epochs (lingual)",
)

##plotting important time groups
```

```
plot_PCA(
 LingualOutP,
 ~Time,
 points = TRUE,
 center_origin = FALSE,
 zoom = 0.9,
 morphospace = TRUE,
 eigen = TRUE,
 chull = TRUE,
 labelpoints = FALSE,
 title = "Morphology of teeth thruogh time (lingual)"
)

LingualOutP.1<- LDA(LingualOutP, ~Time)
LingualOutP.1
plot_LDA(
 LingualOutP.1,
 title = "LDA of all teeth through time (lingual)",
)

filter(LingualAs, Raven_family_b!= "Unknown" ) -> LingualAs

##plotting Raven et al. family with animantarx as basal
plot_PCA(
 LingualAs,
 ~Raven_family_b,
 points = TRUE,
 center_origin = FALSE,
 zoom = 0.9,
 morphospace = TRUE,
 eigen = TRUE,
 chull = TRUE,
 title = "Morpholgy of teeth associated with skull using
 Raven et al. classification (lingual)"
)

LingualAs.6<- LDA(LingualAs, ~Raven_family_b)
LingualAs.6
plot_LDA(
 LingualAs.6,
 title = "LDA of teeth associated with skulls using
 Raven et al. classification b (lingual)")

##how shape contributes to PCs
```

```
PCcontrib(LingualAs,nax = 1:6)
PCcontrib(LingualOutP, nax= 1:2)
```

Appendix G – R code labial view script

```
setwd("/Users/Emily/Desktop/raw outlines/labial")

library(readxl)

library(tidyverse)


library(Momocs)

library(shapes)

library(ade4)

list.files() ->labial_outline ##groups all of the files together

import_txt(labial_outline) ->labial_outlines ##imports all the txt files in the list as their outline files

read_csv("/Users/Emily/Desktop/raw outlines/labial_outlines.csv") -> labial_fac #makes the dataframe of identifying facts

## need to close the outlines to do fourier
Out(labial_outlines, fac = dplyr::tibble(labial_fac)) -> labial_outlines.coo ##turning the file list to a coo

class(labial_outlines.coo) ## test it's a coo now

panel(labial_outlines.coo) # do the panel showing all of outlines

stack(labial_outlines.coo)

##flip upside-down outlines
coo_flipx(labial_outlines.coo[105])-> labial_outlines.coo[105]
coo_plot(labial_outlines.coo[105])
coo_flipy(labial_outlines.coo[105])-> labial_outlines.coo[105]
coo_plot(labial_outlines.coo[105])

coo_flipx(labial_outlines.coo[255])-> labial_outlines.coo[255]
```

```
coo_plot(labial_outlines.coo[255])
coo_flipy(labial_outlines.coo[255])-> labial_outlines.coo[255]
coo_plot(labial_outlines.coo[255])

coo_flipx(labial_outlines.coo[104])-> labial_outlines.coo[104]
coo_plot(labial_outlines.coo[104])
coo_flipy(labial_outlines.coo[104])-> labial_outlines.coo[104]
coo_plot(labial_outlines.coo[104])

coo_flipx(labial_outlines.coo[176])-> labial_outlines.coo[176]
coo_plot(labial_outlines.coo[176])
coo_flipy(labial_outlines.coo[176])-> labial_outlines.coo[176]
coo_plot(labial_outlines.coo[176])

stack(labial_outlines.coo)
pile(labial_outlines.coo)

coo_center(labial_outlines.coo) ->centlaboutcoo ##centring all outlines
stack(centlaboutcoo) ##stacking all outlines by centre

## aligns outlines along their x axis
coo_alignxax(labial_outlines.coo) -> labial_outline_align
stack(labial_outline_align)

##calculate the harmonic power needed
calibrate_harmonicpower_efourier(labial_outlines.coo)

#elliptical fourier transform
Labial_outlinesF <- efourier(labial_outlines.coo, nb.h = 5, norm = FALSE)
class(Labial_outlinesF)

filter(labial_outlines.coo, Isolated == "a" ) -> LabF


LabialFF <- efourier(LabF, nb.h = 5,norm = FALSE)
class(Labial_outlinesF)


hcontrib(Labial_outlinesF) ##plot shows how the harmonics contribute to the morphospace shapes



filter(Labial_outlinesF, Isolated == "a" ) -> LabF ###only associated specimens
```

```
##performing PCA on all teeth data
LabialOutP <- PCA(Labial_outlinesF)
LabialOutP
plot(LabialOutP)

filter(LabialOutP, Age!= "Unknown" ) -> LabialOutP ##taking out the samples with unknown
values

##ploting all teeth age
plot_PCA(
  LabialOutP,
  ~Age,
  title = "Tooth morphology through time (Labial)",
  points = TRUE,
  center_origin = FALSE,
  zoom = 1, ##how zoomed in the plot, change depending on what I'm looking at
  morphospace = FALSE,
  eigen = TRUE,
  chull = TRUE,
)

##AGE LDA
LabialOut.1<- LDA(LabialOutP, ~Age)
LabialOut.1
plot_LDA(
  LabialOut.1,
  title = "LDA of teeth associated with skulls (Labial)",
)

#performing PCA on associated tooth filtered data
LabialAs <- PCA(LabialFF)
LabialAs
plot(LabialAs)

filter(LabialAs, Age!= "Unknown" ) -> LabialAs ##taking out the samples with unknown values

##plotting associated teeth family
plot_PCA(
  LabialAs,
  ~Family,
  points = TRUE,
  title = "Morphology of teeth associated with skulls (Labial)",
```

```
  center_origin = FALSE,
  zoom = 0.9,
  morphospace = TRUE,
  eigen = TRUE,
  chull = TRUE,
  )

##FAMILIES LDA
LabialAs.1<- LDA(LabialAs, ~Family)
LabialAs.1
plot_LDA(
  LabialAs.1,
  title = "LDA of teeth associated with skulls (Labial)",
  )

filter(labial_outlines.coo, Family == "Unknown") ->labPFam
labPFam <- efourier(labPFam, nb.h = 5, norm=FALSE)

labfam <- rePCA(LabialAs, labPFam)
plot_PCA(labfam)

plot_PCA(
  LabialAs,
  ~Family,
  title = "Morphology of teeth asscociated with skulls
with isolated teeth (Labial)",
  points = TRUE,
  center_origin = FALSE,
  zoom = 0.9,
  morphospace = TRUE,
  eigen = FALSE,
  chull = TRUE
)

points(labfam$x[,1:2], col="red", pch=4)

##Classifying the teeth with unknown family using the scheme from AB formations LDA!
reLDA(labfam, LabialAs.1) -> labfam.L
labfam.L
as.data.frame(labfam.L) -> labfamDF
write_csv(labfamDF,"/Users/Emily/Desktop/raw outlines/labial_unknown_fam.csv")
as.data.frame(labfam$fac)->laboutfSL
write_csv(laboutfSL,"/Users/Emily/Desktop/raw outlines/labial_unknown_fam_speclist.csv")
```

```
filter(LabialAs, Raven_family!= "Unknown") -> LabialAs ##taking out the samples with unknown values

##plotting Raven et al family
plot_PCA(
  LabialAs,
  ~Raven_family,
  title = "Morphology of teeth asscociated with skulls
using Raven et al. classification (Labial)",
  points = TRUE,
  center_origin = FALSE,
  zoom = 0.9,
  morphospace = TRUE,
  eigen = TRUE,
  chull = TRUE
)

##RAVEN ET AL LDA
LabialAs.2<- LDA(LabialAs, ~Raven_family)
LabialAs.2
plot_LDA(
  LabialAs.2,
  title = "LDA of teeth associated with skulls
using Raven et al. taxonomy (Labial)",
)

filter(labial_outlines.coo, Family == "Unknown") ->labRFam ### get isolated teeth to plot  onto the existing raven family plot
labRFam <- efourier(labRFam, nb.h = 5, norm=FALSE)

labRfam <- rePCA(LabialAs, labRFam)
plot_PCA(labRfam)

plot_PCA(
  LabialAs,
  ~Raven_family,
  title = "Morphology of teeth asscociated with skulls with
isolated teeth using Raven et al taxonomy (Labial)",
  points = TRUE,
  center_origin = FALSE,
  zoom = 0.9,
  morphospace = TRUE,
  eigen = FALSE,
```

```
  chull = TRUE
)

points(labRfam$x[,1:2], col="red", pch=4)

##Classifying the teeth with unknown family using the scheme from Raven et al. LDA!
reLDA(labRfam, LabialAs.2) -> labRfam.L
labRfam.L
as.data.frame(labRfam.L) -> labfamRDF
write_csv(labfamRDF,"/Users/Emily/Desktop/raw outlines/labial_unknown_raven_fam.csv")
as.data.frame(labRfam$fac)->laboutfRSL
write_csv(laboutfRSL,"/Users/Emily/Desktop/raw
outlines/labial_unknown_reaven_fam_speclist.csv")

##Just plotting nodosaurid species
filter(LabialAs, Isolated == "a", Family == "Nodosauridae" ) -> LabFN ###only associated
specimens
plot_PCA(
  LabFN,
  ~Sp,
  title = "Morphology of nodosaurid teeth asscociated with skulls (Labial)",
  points = TRUE,
  center_origin = FALSE,
  zoom = 0.9,
  morphospace = TRUE,
  eigen = TRUE,
  chull = TRUE
)

##nodosaurid LDA
LabFN.1<- LDA(LabFN, ~Sp)
LabFN.1
plot_LDA(
  LabFN.1,
  title = "LDA of Morphology of teeth asscociated
with skulls in Alberta Formations (Labial)",
)

##Just plotting ankylosaurid species
filter(LabialAs, Isolated == "a", Family == "Ankylosauridae" ) -> LabFA ###only associated
specimens
plot_PCA(
  LabFA,
  ~Sp,
```

```
  title = "Morphology of ankylosaurid teeth associated with skulls (Labial)",
  points = TRUE,
  center_origin = FALSE,
  zoom = 0.9,
  morphospace = TRUE,
  eigen = TRUE,
  chull = TRUE
)

##Ankyosaurid LDA
LabFA.1<- LDA(LabFA, ~Sp)
LabFA.1
plot_LDA(
  LabFA.1,
  title = "LDA of Morphology of teeth associated with ankylosaurid skulls (Labial)",
)

##Just plotting skull teeth by Alberta Fm
filter(LabialAs, Isolated == "a", Fm %in% c("Belly River Group","Dinosaur Park Fm","Horseshoe
Canyon Fm","Oldman Fm", "Scollard Fm")) -> LabFAFm ###only associated specimens
plot_PCA(
  LabFAFm,
  ~Family,
  title = "Morphology of teeth associated with skulls in
Alberta Formations (Labial)",
  points = TRUE,
  center_origin = FALSE,
  zoom = 0.9,
  morphospace = TRUE,
  eigen = TRUE,
  chull = TRUE
)

##AB Fm LDA
LabFAFm.1<- LDA(LabFAFm, ~Family)
LabFAFm.1
plot_LDA(
  LabFAFm.1,
  title = "LDA of Morphology of teeth asscociated
with skulls in Alberta Formations (Labial)",
)

filter(labial_outlines.coo, Family == "Unknown",Fm %in% c("Belly River Group","Dinosaur Park
Fm","Scollard Fm","Horseshoe Canyon Fm","Oldman Fm", "Milk River Fm", "Foremost Fm",
```

```
"Wapiti Fm", "St. Mary River Fm") ) ->labPunkAt ### trying to get isolated teeth to plot  onto
the existing AB form plot
labPunkAt <- efourier(labPunkAt, nb.h = 5, norm=FALSE)


laboutfinalAt <- rePCA(LabFAFm, labPunkAt)
plot_PCA(laboutfinalAt)

plot_PCA(
  LabFAFm,
  ~Family,
  title = "Morphology of teeth asscociated with skulls in Alberta
  Formations with isolated teeth (Labial)",
  points = TRUE,
  center_origin = FALSE,
  zoom = 0.9,
  morphospace = TRUE,
  eigen = FALSE,
  chull = TRUE
)

points(laboutfinalAt$x[,1:2], col="red", pch=4)

##Classifying the teeth with unknown family using the scheme from AB/MT formations LDA!
reLDA(laboutfinalAt, LabFAFm.1) -> laboutfinalAt.L
laboutfinalAt.L
as.data.frame(laboutfinalAt.L) -> laboutfAtDF
write_csv(laboutfAtDF,"/Users/Emily/Desktop/raw outlines/labial_unknown_AB_Form.csv")
as.data.frame(laboutfinalAt$fac)->laboutfAtSL
write_csv(laboutfAtSL,"/Users/Emily/Desktop/raw
outlines/labial_unknown_AB_Form_speclist.csv")

##Just plotting skull teeth by Alberta/Montana Fms
filter(LabialAs, Isolated == "a", Fm %in% c("Belly River Group","Dinosaur Park Fm","Horseshoe
Canyon Fm","Oldman Fm", "Scollard Fm", "Hell Creek Fm")) -> LabFAMFm ###only associated
specimens
plot_PCA(
  LabFAMFm,
  ~Family,
  title = "Morphology of teeth associated with skulls in
Alberta and Montana Formations (Labial)",
  points = TRUE,
  center_origin = FALSE,
  zoom = 0.9,
```

```
  morphospace = TRUE,
  eigen = TRUE,
  chull = TRUE
)

##AB/MT FM LDA
LabFAMFm.1<- LDA(LabFAMFm, ~Family)
LabFAMFm.1
plot_LDA(
  LabFAMFm.1,
  title = "LDA of Morphology of teeth asscociated
with skulls in Alberta/Montana
Formations (Labial)",
)

filter(labial_outlines.coo, Family == "Unknown",Fm %in% c("Belly River Group","Dinosaur Park Fm","Scollard Fm","Horseshoe Canyon Fm","Oldman Fm", "Milk River Fm", "Foremost Fm", "Wapiti Fm", "St. Mary River Fm", "Lance Fm", "Hell Creek Fm", "Cloverly Fm", "Judith River Fm", "Unknown") ) ->labPunkMt ### trying to get isolated teeth to plot  onto the existing ABMT form plot
labPunkMt <- efourier(labPunkMt, nb.h = 5, norm=FALSE)

laboutfinalMt <- rePCA(LabFAMFm, labPunkMt)
plot_PCA(laboutfinalMt)

plot_PCA(
  LabFAMFm,
  ~Family,
  title = "Morphology of teeth asscociated with skulls in Alberta/Montana
  Formations with isolated teeth (Labial)",
  points = TRUE,
  center_origin = FALSE,
  zoom = 0.9,
  morphospace = TRUE,
  eigen = FALSE,
  chull = TRUE
)

points(laboutfinalMt$x[,1:2], col="red", pch=4)

##Classifying the teeth with unknown family using the scheme from AB/MT formations LDA!
reLDA(laboutfinalMt, LabFAMFm.1) -> laboutfinalMt.L
laboutfinalMt.L
as.data.frame(laboutfinalMt.L) -> laboutfMtDF
```

```
write_csv(laboutfMtDF,"/Users/Emily/Desktop/raw
outlines/labial_unknown_ABMT_Form.csv")
as.data.frame(laboutfinalMt$fac)->laboutfMtSL
write_csv(laboutfMtSL,"/Users/Emily/Desktop/raw
outlines/labial_unknown_ABMT_Form_speclist.csv")

## plotting epochs
plot_PCA(
  LabialOutP,
  ~Epoch,
  title = "Tooth morphology through Epochs (Labial)",
  points = TRUE,
  center_origin = FALSE,
  zoom = 1,
  morphospace = TRUE,
  eigen = TRUE,
  chull = TRUE,
)

##Epoch LDA
LabialOut.1<- LDA(LabialOutP, ~Epoch) ##
LabialOut.1
plot_LDA(
  LabialOut.1,
  title = "Morphology of teeth through Epochs (Labial)",
)

##ploting all teeth age (important time groups)
plot_PCA(
  LabialOutP,
  ~Time,
  title = "Tooth morphology through time",
  points = TRUE,
  center_origin = FALSE,
  zoom = 1,
  morphospace = TRUE,
  eigen = TRUE,
  chull = TRUE,
)

##AGE important time LDA
LabialOut.1<- LDA(LabialOutP, ~Time)
LabialOut.1
plot_LDA(
```

```
  LabialOut.1,
  title = "LDA of teeth through time",
)

PCcontrib(LabialOutP,nax = 1:2) ##contribution of PCs to shape description
```