Vibracore Sampling in the Broken Group Islands

by Seonaid Duffield, Iain McKechnie, Denis St. Claire, and Duncan McLaren

Introduction

Vibracoring is a geological sampling technology designed to obtain large-volume cores from a variety of sediments. The technology has utility in coastal archaeology particularly for recovering stratigraphically intact sediments and zooarchaeological data from deep coastal archaeological sites. The efficacy of vibracore technology was initially tested in a large shell midden site on the Central Coast of BC with the support of the Hakai Institute and Dr. Duncan McLaren's Hakai Ancient Landscapes Archaeology Project (Duffield 2017). In the summer of 2017, the UVic archaeological field school in Barkley Sound supported a smaller vibracoring project in the Broken Group Islands in Tseshaht First Nation territory on western Vancouver Island (Duffield 2018). This article provides a short overview of how we applied this technology at two sites in the Broken Group Islands to evaluate the efficacy of this sampling method for generating zooarchaeological and chronological data from deep coastal shell middens.

The vibracore unit used in these projects is manufactured by Wink Vibracore Ltd (Richmond, BC). The unit consists of a Honda motor, drill head, flex cable, drill rod, drill bit and "gin pole" assembly (Figure 1).

To collect a core sample, sonic vibrations are transferred from the motor through the flex cable to the drill head. The drill head vibrates at a high frequency (7,000 to 12,000 acoustic vibrations per minute), which causes sediments in contact with the drill rod to mobilize. The weight of the assembled unit coupled with the sonic vibrations, allow it to sink into the ground and recover a sediment sample in a clear plastic core sample tube fitted inside the threaded drill rods (Figure 2 and https://youtu.be/Oe4fNHEXGzw). Drill rods can be threaded together to achieve total depth of 7.6 m.

The drill rod size used for this project accommodates a 7.5 cm diameter sample tube. The length of the rods and sample tubes are 152.4 cm (5 feet) in length and required five extensions for this project. Deploying the unit in

Figure 1. Right: Vibracoring at Kakmakimilh (Photo: Iain McKechnie). Left: Keith Island 1 profile drawing, GSC core photograph, radiocarbon sample locations and date ranges (cal BP) and description of core stratigraphy.

Figure 2. Tseshaht Beach Keeper, Cody Gus transporting a successfully recovered vibracore sample tube from Kakmakimilh (Photo: Iain McKechnie).

the field requires some considerations for transport as the unit is bulky and weighs approximately 135 kg (~300 lbs.).

Once the desired depth is achieved, cores are extracted using a winch system (the "gin pole" assembly) that hoists the corestring from the ground. This is achieved by replacing the drill head with a "hoisting cap" (threaded cap with an eyelet). The gin pole is set up over the embedded sample; the gin pole wire is attached to the hoisting cap and winched out of the ground one-rod section at a time. The "ball controller" stops the sample from slipping back into the ground while removing or "breaking" the core rod sections from the corestring (Wink Vibracore Ltd n.d.). The recovered samples are stratigraphically intact as the sediments are not churned up during collection (Duffield 2017).

A small working area is cleared of vegetation to facilitate safety while a three-person team operates the machine. It is additionally important to have a level working area close to the core location to enable the threading and un-threading of heavy rod sections. The vibracore is an ideal method for efficient and minimally invasive recovery of deep archaeological samples and an excellent alternative to conventional excavation as it only leaves a 7.5 cm diameter hole in the ground.

Vibracoring in the Broken Group Islands

Following discussion with Tseshaht First Nation council members and staff, we opted to collect vibracore samples from two ancient Tseshaht settlements and reserve locations (Figure 3) in the Broken Group Islands (Tl'ihuuw'a, Nettle Island, DfSh-5, 305T and Kakmakimilh, Keith Island, DfSh-17, 306T). The sampling fieldwork was part of the Keith Island Archaeological Project and the University of Victoria field school in Barkley Sound, co-directed by Iain McKechnie and Denis St. Claire. The Broken Group Islands are monitored by the Tseshaht Beach Keepers as part of a partnership agreement between Tseshaht First Nation and Pacific Rim National Park Reserve.

Over two and a half days, the vibracore team recovered a total of five core samples from deep shell midden ridges and house terraces. The deepest core was recovered from the height of the prominent shell midden ridge at Tl'ihuuw'a (Nettle Island), 527.5 cm below surface. A total of 14.62 meters of coring recovered a total of 8.04 meters of sediment, indicating an overall compaction rate of 55% with variation between cores ranging from 49-78% (Duffield 2018:16). Post-field analysis included assistance from Dr. Randy Enkin from the Geological Survey of Canada's core-logging facility at the Institute of Ocean Sciences (Sidney). This lab provided measures of magnetic susceptibility (SI E-5), density (g/cm3), and a high-resolution image of the entire length of the core in one continuous photo. Scanned cores were split lengthwise, preserving the stratigraphy and integrity of the core section (Figure 1 shows an example of the stratigraphy, profile and radiocarbon date for a Kakmakimilh sample).

Samples were transported to the University of Victoria where sediments

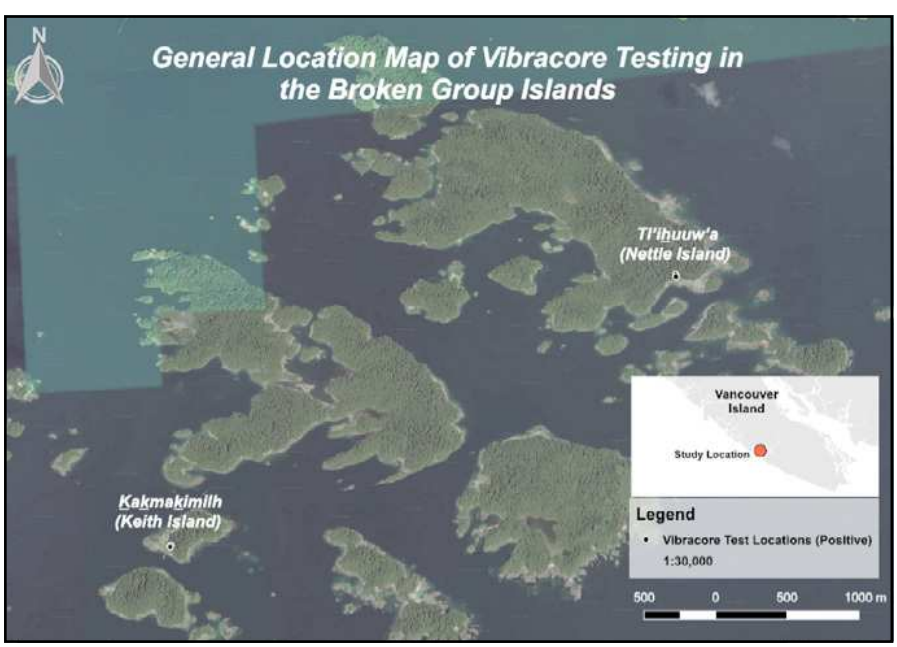

Figure 3. Overview map showing the locations of vibracore tests on Tl'ihuuw'a (305T, Nettle Island) and Kakmakimilh (306T Keith Island) within the Broken Group Islands (Base map: Google satellite imagery).

from the split cores were sorted in 5 cm increments, wet-screened through ¼-inch and 2 mm nested screens, dried, and picked for all vertebrate remains. Zooarchaeological identification was achieved by the first author with the guidance of specialist Rebecca Wigen at the UVic zooarchaeological laboratory. A total of 1,308 vertebrate specimens were identified from within a total volume of approximately 21 litres of core sediments from vibracores at Tl'ihuuw'a and 898 from Kakmakimilh with the vast majority of identified specimens being fish (95.6%), followed by mammals (3.0%) and birds (1.2%). While these assemblages demonstrate Indigenous use of a wide range of marine resources, Pacific herring (Clupea pallasii) and northern anchovy (Engraulis mordax) were the two most proportionally abundant fish species recovered from both sites, which is consistent with other fine screened assemblages in Barkley Sound as well as other assemblages from these same sites (McKechnie 2005, 2014, McKechnie et al. 2019).

Five small artifacts were recovered from two different cores at Tl'ihuuw'a including 4 fragments of bone tools and one green chert debitage flake (Figure 4). Given the total volume of examined core sediments, the estimated number of artifacts per cubic meter (~250 artifacts per cubic metre) is considerably higher than conventional excavations conducted in the region (McMillan and St. Claire 2005:45, 2012:35). However, no artifacts were recovered from vibracores samples from Kakmakimilh despite a similar examined volume indicating variability in artifact recovery in small volumes.

Figure 4. Photo of green chert debitage recovered from Tl'ihuuw'a using Dino-lite digital microscope (Photo: Angela Dyck).

We obtained eight radiocarbon dates from the A.E. Lalonde AMS Laboratory at the University of Ottawa on charcoal recovered from the cores. Results showed vibracore-sampled deposits at Tl'ihuuw'a dated as early as 2,700 cal BP and ranged from 1,182 -505 cal BP from two areas of a shell midden ridge at Kakmakimilh. The majority of dates show stratigraphic integrity and have accumulation rates between 20-45 cm per century (Duffield 2018:16).

Conclusions

Vibracore technology was successful at quickly recovering stratigraphically intact sequences of zooarchaeological data, charcoal, and artifacts from multiple locations within deep shell midden deposits in Tseshaht territory dating to the late Holocene. This coring methodology combines and improves on the use of bucket auger sampling and percussion coring (Cannon 2000; Martindale et al. 2009) which disturbs and compacts sediments to a greater degree. The expense and logistical support required to acquire and complete this project is considerable but this coring methodology holds promise for more adequately sampling deep and complex shell midden deposits across the coast more broadly.

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