# Taking the temperature of the Anahim Hotspot, British Columbia


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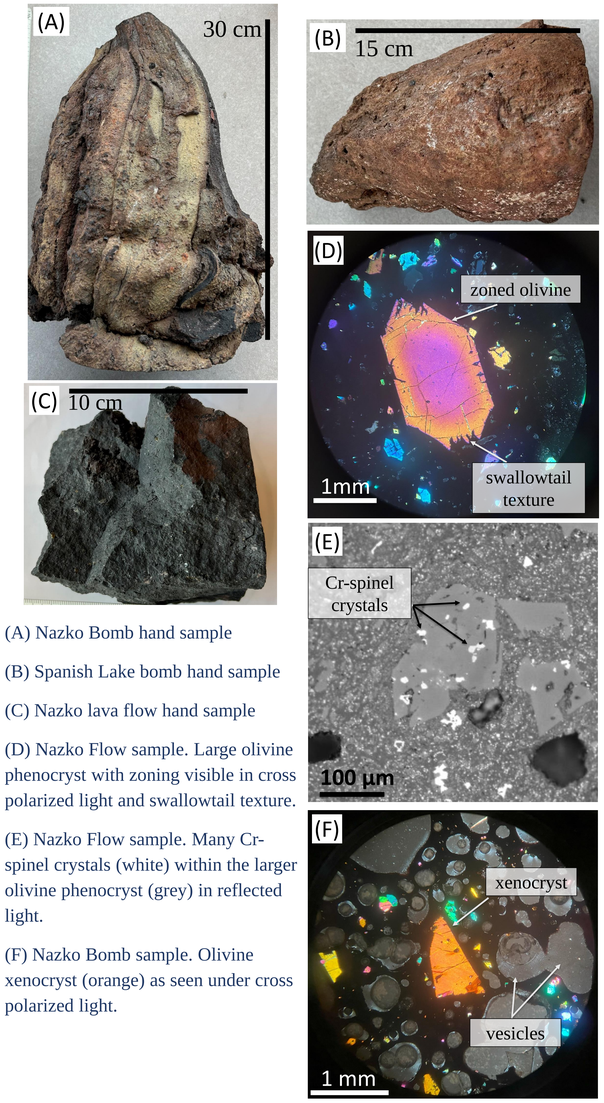
## OVERVIEW AND OBJECTIVES

- The Anahim Volcanic Belt in the Northern Cordilleran Volcanic Province of BC is thought to have formed over a fixed thermal anomaly in the mantle called the Anahim Hotspot
- Young basaltic rocks in BC from the Anahim Volcanic Belt can be sampled to test this hypothesis
- Olivine phenocrysts preserved in the lavas inform on original conditions of the mantle-derived melt that formed said lavas: temperature and water content
- Using the lava chemistry, and the refined parameter, we can determine if the lavas are of a hotspot origin

## OLIVINE IN LAVAS




(A) Nazko Bomb hand sample

(B) Spanish Lake bomb hand sample

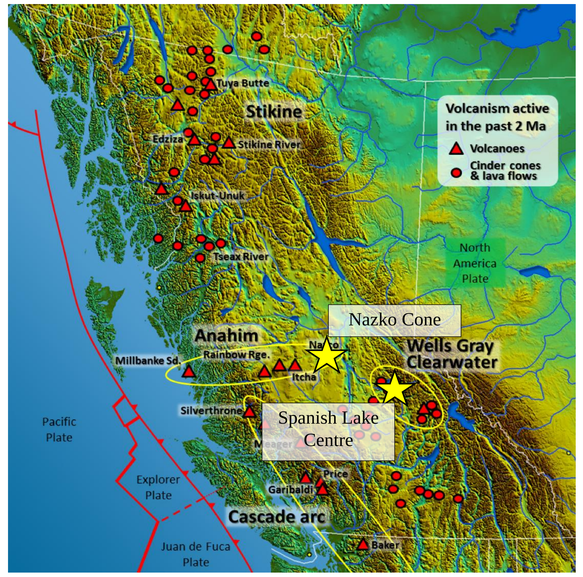
(C) Nazko lava flow hand sample

(D) Nazko Flow sample. Large olivine phenocryst with zoning visible in cross polarized light and swallowtail texture.

(E) Nazko Flow sample. Many Cr-spinel crystals (white) within the larger olivine phenocryst (grey) in reflected light.

(F) Nazko Bomb sample. Olivine xenocryst (orange) as seen under cross polarized light.

## STUDY LOCATIONS

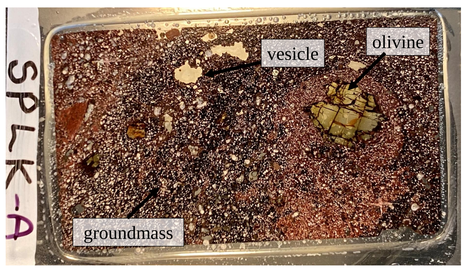



**Above:** Map showing young volcanoes in BC. Study locations showing Nazko Cone (Anahim Volcanic belt) and Spanish Lake Centre (Wells Gray Clearwater) Figure modified from Earle and Panchuk (2015).

## HOW DOES OLIVINE MEASURE TEMPERATURE?

- Samples from three British Columbia Neogene lavas were cut into two thin (30 µm) sections and two thick (200 µm) sections each
- Ideal olivine phenocrysts in thick sections (>100 µm with several Cr-spinel grain inclusions >10 µm) were selected using a reflected light microscope and their coordinates were saved using an x-y coordinate system
- Analysis for major elements was performed by Electron Microprobe at the University of Alberta.

**Right**: Thin section of Spanish Lake olivine phyric basaltic lava. A large olivine crystal (>4 mm) is present within the groundmass making this an ideal sample for use with the LA-ICP-MS.




- Analysis for major and some trace elements was performed by laser ablation-inductively coupled plasma-mass spectrometry (LA-ICP-MS) on sample SPLK-A. Data reduction was completed at UVic using the lolite™(V4.8) software package (Paton et al., 2010)
- Major element and trace element results were used with multiple geothermometers to calculate melt parameters: temperature of melt, water content, and redox state
- Chemical data in olivines are used to derive the temperature they crystallized at

## ACKNOWLEDGEMENTS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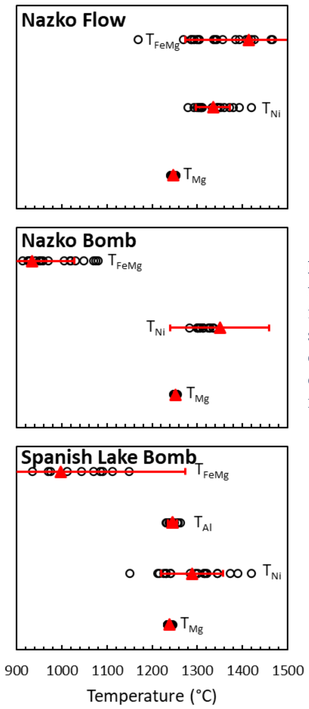
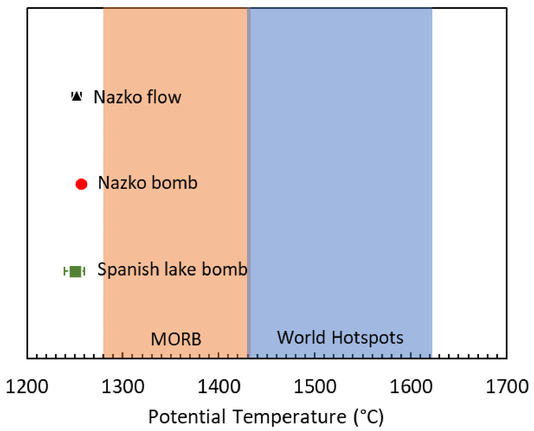
## TEMPERATURES IN OLIVINES




**Left**: Comparison of lava temperatures calculated from the four thermometers used for this study on each sample. $T_{Al}$ was only used for the Spanish Lake center. $T_{Al}$ ,$T_{Mg}$, and $T_{Ni}$ are the most robust thermometers.

## SO HOW HOT IS THE ANAHIM HOTSPOT?




**Above**: Calculated mantle potential temperatures of each sample showing that they are significantly colder than world hotspots and mid ocean ridge basalt (MORB).

- Conclusion: the Anahim Hotspot is not very hot at all!
- The lavas are likely not of a hotspot origin

## THE NEXT STEPS

- Collect LA-ICP-MS data from all samples to apply the $T_{Al}$ thermometer to all three samples
- Gather data and calculate mantle potential temperatures for other young volcanoes in BC