

Introduction

This project aims to develop techniques to date past volcanic eruptions using $^{40}\text{Ar}/^{39}\text{Ar}$ dating. We mainly focus on the Camille and Lost Jim flows in Alaska as a case study for dating young volcanic rocks. The techniques developed here will be applied to other volcanic rocks in Alaska as young as 2000 years.

$^{40}\text{Ar}/^{39}\text{Ar}$ dating

$^{40}\text{Ar}/^{39}\text{Ar}$ dating is the preferable method for dating volcanic rocks. Potassium (K), a common element in rocks, contains the radioactive isotope ^{40}K which decays to ^{40}Ar with a half life of 1.25 billion years. An age can be derived from measuring the amounts of ^{40}K and ^{40}Ar . To make this measurement more precise, ^{39}K is converted to ^{39}Ar through neutron irradiation in a nuclear reactor. This enables an age determination from the $^{40}\text{Ar}/^{39}\text{Ar}$ ratio, which is more precise than measuring K and Ar separately. $^{40}\text{Ar}/^{39}\text{Ar}$ dating relies on a standard with a known age in order to calculate the age of undated rocks.

Cobb Mountain

A widely used standard for young volcanic rocks is Alder Creek sanidine (ACs) found in a rhyolitic volcanic rock on Cobb Mountain in Northern California (Fig. 1). This rock contains an abundance of sanidine crystals, a potassium-rich feldspar (Fig. 2). Part of the Geyser System in Northern California, Cobb Mountain is a well-studied volcanic system composed primarily of dacite and rhyolite.

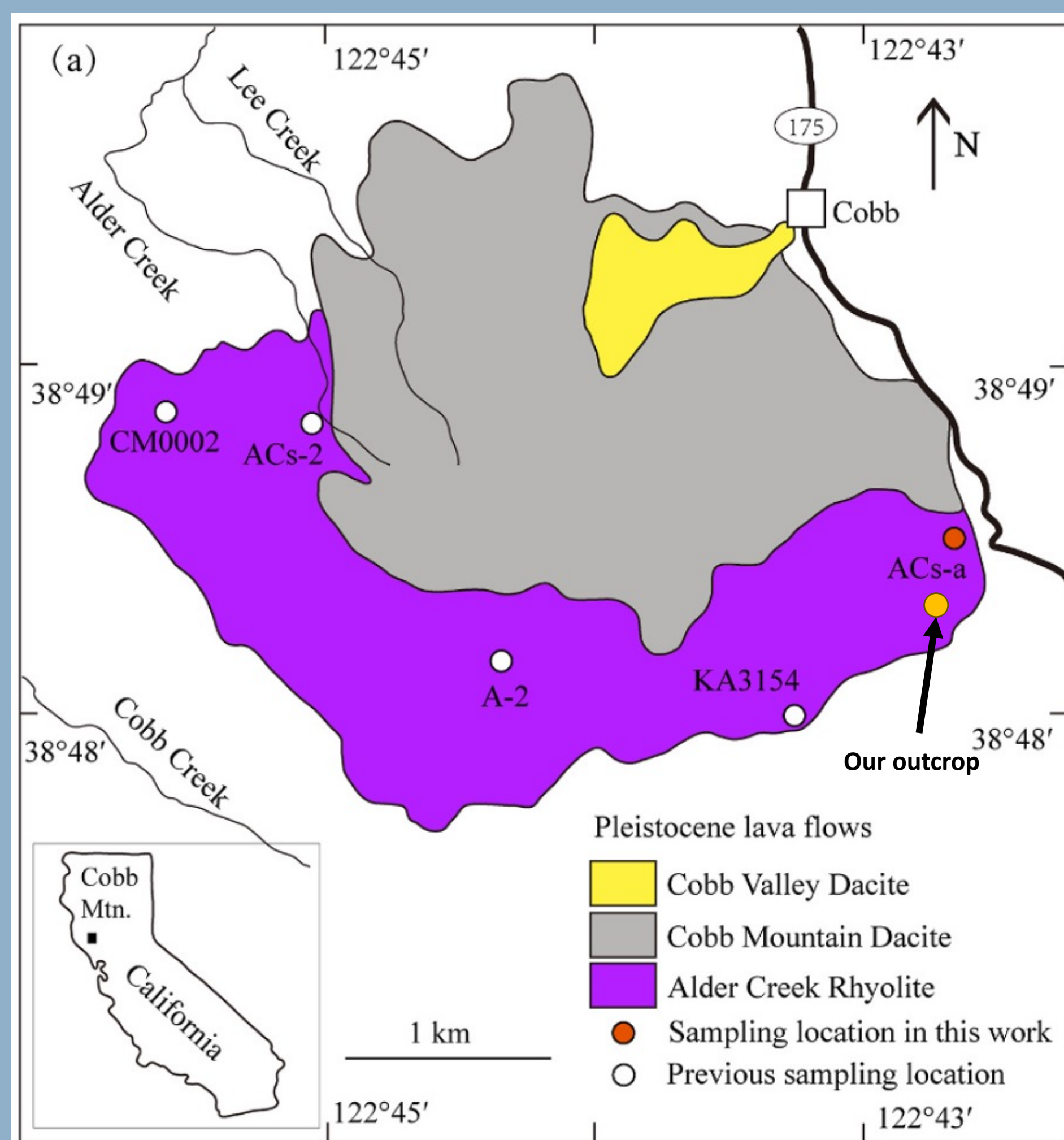


Figure 1: Geologic Map of Cobb Mountain in Northern California showing previous sampling locations, modified from Wang et al. (2023). Our outcrop is indicated by an orange dot.

Field Work

We traveled to Northern California in late February 2024 to sample the Alder Creek rhyolite. Most of the past sampling locations were not publicly accessible, so we had to scout the area for a suitable sampling location. We identified an outcrop from which we collected ~220 lbs of unweathered hand samples with large sanidine crystals (Fig. 2) and shipped them to UAF (Fig.3). This material will be crushed and sanidine crystals will be extracted to provide standard material for this project as well as for future $^{40}\text{Ar}/^{39}\text{Ar}$ analyses of other young volcanic rocks.



Figure 2: Hand sample of Alder Creek Rhyolite showing large feldspar crystals, which are used as a standard for $^{40}\text{Ar}/^{39}\text{Ar}$ dating.



Figure 3: The authors at the outcrop (A); some of the rock samples collected from this outcrop (B); samples shipped to UAF (C).

Literature

Marcucci, E. C., Hamilton, C. W., & Herrick, R. R. (2017). Remote sensing evidence of lava-ground ice interactions associated with the Lost Jim Lava Flow, Seward Peninsula, Alaska. *Bulletin of Volcanology*, 79, 1-18.

Mukasa, S. B., A. V. Andronikov, and C. M. Hall (2007). The $^{40}\text{Ar}/^{39}\text{Ar}$ chronology and eruption rates of Cenozoic volcanism in the eastern Bering Sea Volcanic Province, Alaska. *J. Geophys. Res.*, 112, B06207, doi:10.1029/2006JB004452.

Wang, Y., Wang, F., Shi, W., Yang, L., & Wu, L. (2023). Alder creek sanidine (ACs-a): New sampling and intercalibration for quaternary $^{40}\text{Ar}/^{39}\text{Ar}$ age monitoring. *Applied Geochemistry*, 152, 105629.

Camille and Lost Jim Lava Flows

The rocks we will date for this project come from the Camille and Lost Jim lava flows on the Seward Peninsula (Fig. 4). Most of the volcanic activity in the area is young, which makes it challenging to date. A previous attempt to date these flows in 2006 was unsuccessful. However, with new samples and improved methods, we aim to obtain an accurate eruption date of the two flows. Camille is the older flow and is partially covered by Lost Jim, providing a test for our method.

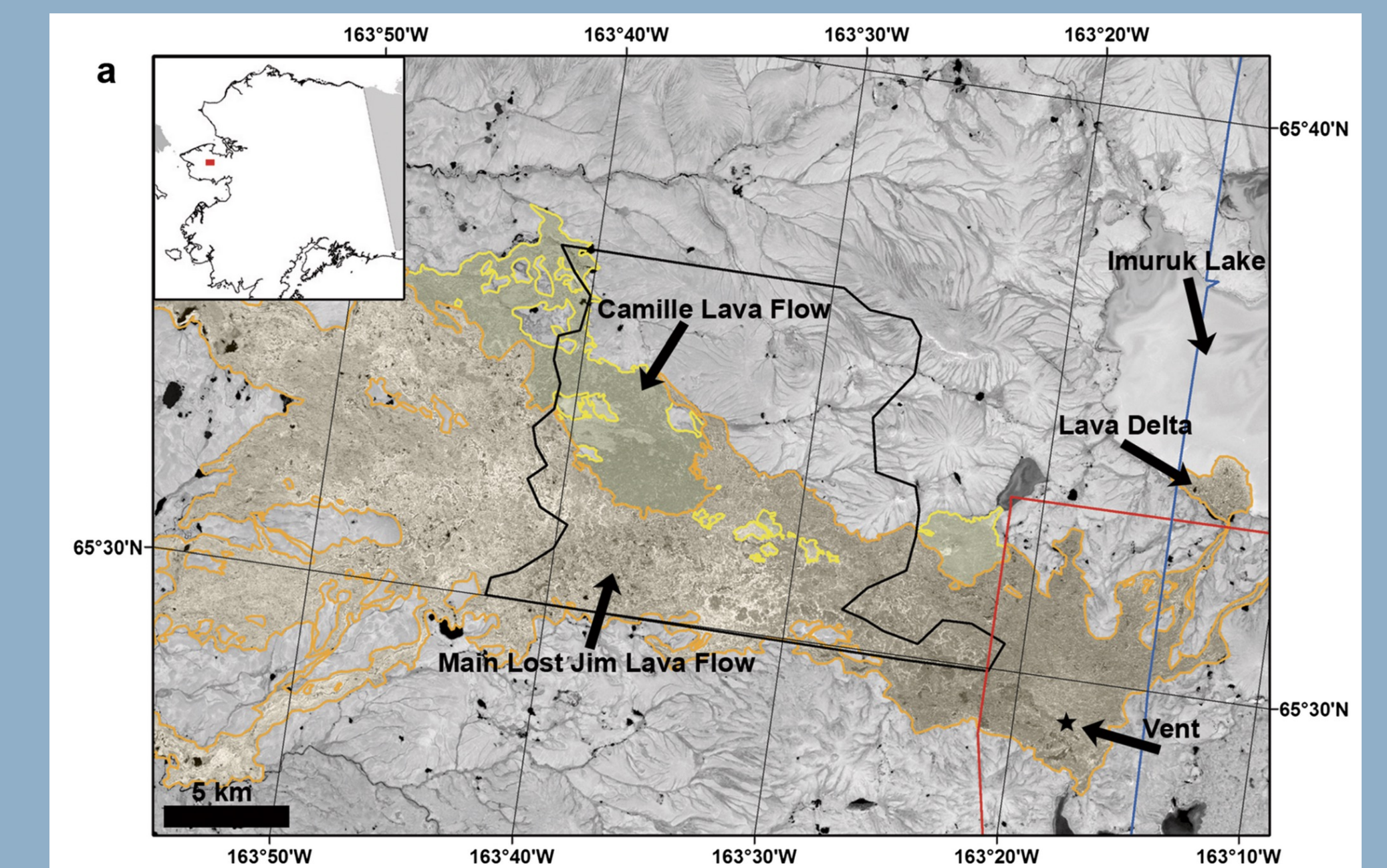


Figure 4: Map of the Camille and Lost Jim Lava Flows, from Marcucci et al. (2017).

Future Work

- Process Alder Creek samples to extract sanidine crystals
- Process Camille and Lost Jim samples
- Prepare all samples for irradiation
- Characterize samples for their chemical composition
- Date 20 samples each from Camille and Lost Jim
- Reduce Data and calculate ages



Figure 5: The authors processing rock samples collected from Cobb Mountain.

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