TEPHRA SAMPLES AND ANALYSES FROM COOK INLET SOURCE VOLCANOES AND ANCHOR POINT, ALASKA

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TEPHRA SAMPLES AND ANALYSES FROM COOK INLET SOURCE VOLCANOES AND ANCHOR POINT, ALASKA

Matthew W. Loewen[1], Kristi Wallace[1], Michelle L. Coombs[1], and Katherine M. Mulliken[2]

INTRODUCTION

This report includes samples and analyses collected from source volcanoes of the Cook Inlet region, Alaska, including Hayes Volcano, Mount Spurr, Redoubt Volcano, Iliamna Volcano, Augustine Volcano, Mount Douglas, Fourpeaked Mountain, and Kaguyak Crater (fig. 1). The report also includes tephra and soil samples and analyses from a stratigraphic section examined near Anchor Point, Alaska. These samples were collected over many years during geologic investigations of the eruptive histories for these source volcanoes, and in regional studies of eruption impacts, and are compiled here to support research characterizing the composition and impacts of these volcanoes on the Cook Inlet region.

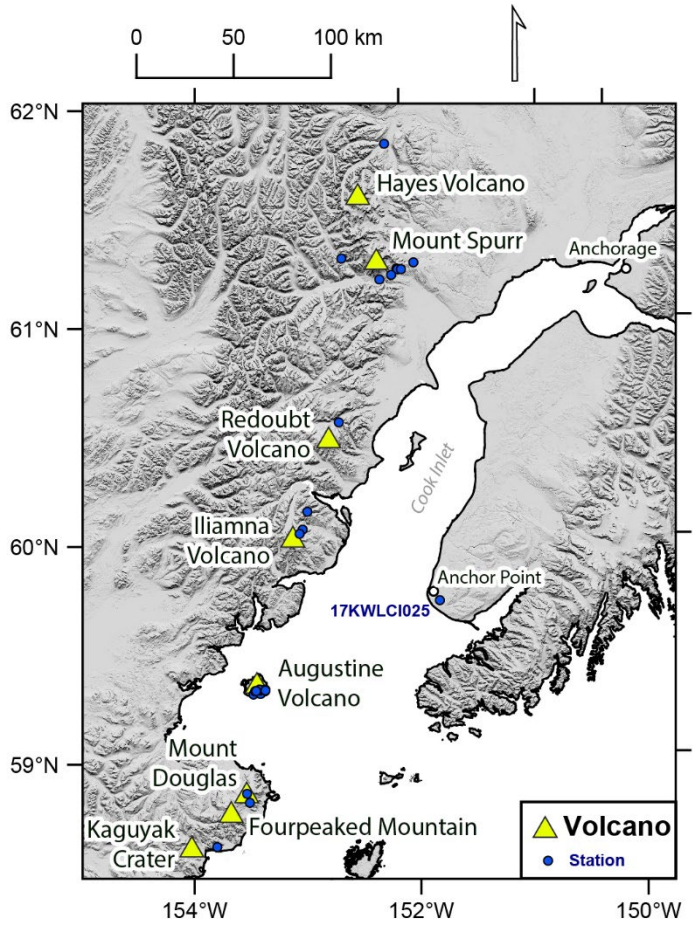

Figure 1. Overview map showing locations of the volcanoes of the Cook Inlet, Alaska. Sample stations are shown as blue dots, but only a tephra section near Anchor Point (17KWLCI025) is labeled, see figure 2 for labeled proximal volcano stations.

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Data associated with this report are available at doi.org/10.14509/31090 and are archived in the Geologic Database of Information on Volcanoes in Alaska (GeoDIVA; Cameron and others, 2022, doi.org/10.14509/geodiva). Tables include:

- **Stations**: Station observations and station coordinates.
- **Layers**: Stratigraphic observations collected for one Station at Anchor Point, Alaska. Station data can be linked with the StationID column.
- **Samples**: Metadata for collected samples. Samples can be linked to the Stations or Layers data through the StationID and layer_name columns.
- **Carbon**: Radiocarbon results for a subset of samples. This table can be linked to the Samples table by the SampleID and at_num columns.
- **EPMA**: Electron probe microanalyses (EPMA) glass analyses. Most analyses are of matrix glass although a few melt inclusion analyses are included, as indicated by a suffix on the at_num and in the sample description. This table can be linked to the Samples table by the SampleID and at_num columns.
- **Laser**: Laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS) analyses of matrix glass. The table also includes the electron microprobe analyses associated with each laser analysis, and thus duplicates some information the EPMA table. This table can be linked to the Samples table by the SampleID and at_num columns.
- **GlassAvg**: Synthesizes EPMA and LA-ICP-MS analyses as a single row for each sample and uncertainties calculated from repeat sample analyses. This table can be linked to the Samples table by the SampleID and at_num columns.
- **LaserStandards**: Laser ablation secondary standard results.
- **LaserStandardSummary**: Summary statistics for laser ablation secondary standards. Unlike other tables this is not machine-readable and acts as a set of supplementary tables to the text.

DOCUMENTATION OF METHODS

Field Data

Samples included in this report were collected over eight field seasons since 2004, supporting geologic investigations on individual volcanoes and regional studies. Latitude and longitude are reported in the NAD83 datum. Locations were typically determined using various handheld GPS devices and thus are only accurate to ~10 m. The location of sample Y-3 is unknown, and a default location was entered for the source volcano (Kaguyak Crater). Station names (StationID) were assigned to sample locations and areas of general observation (fig. 2); sample names (SampleID) correspond to specific samples and include sample descriptions. Laboratory identification numbers (at_num) were assigned during laboratory processing and analysis to keep track of "child" samples.

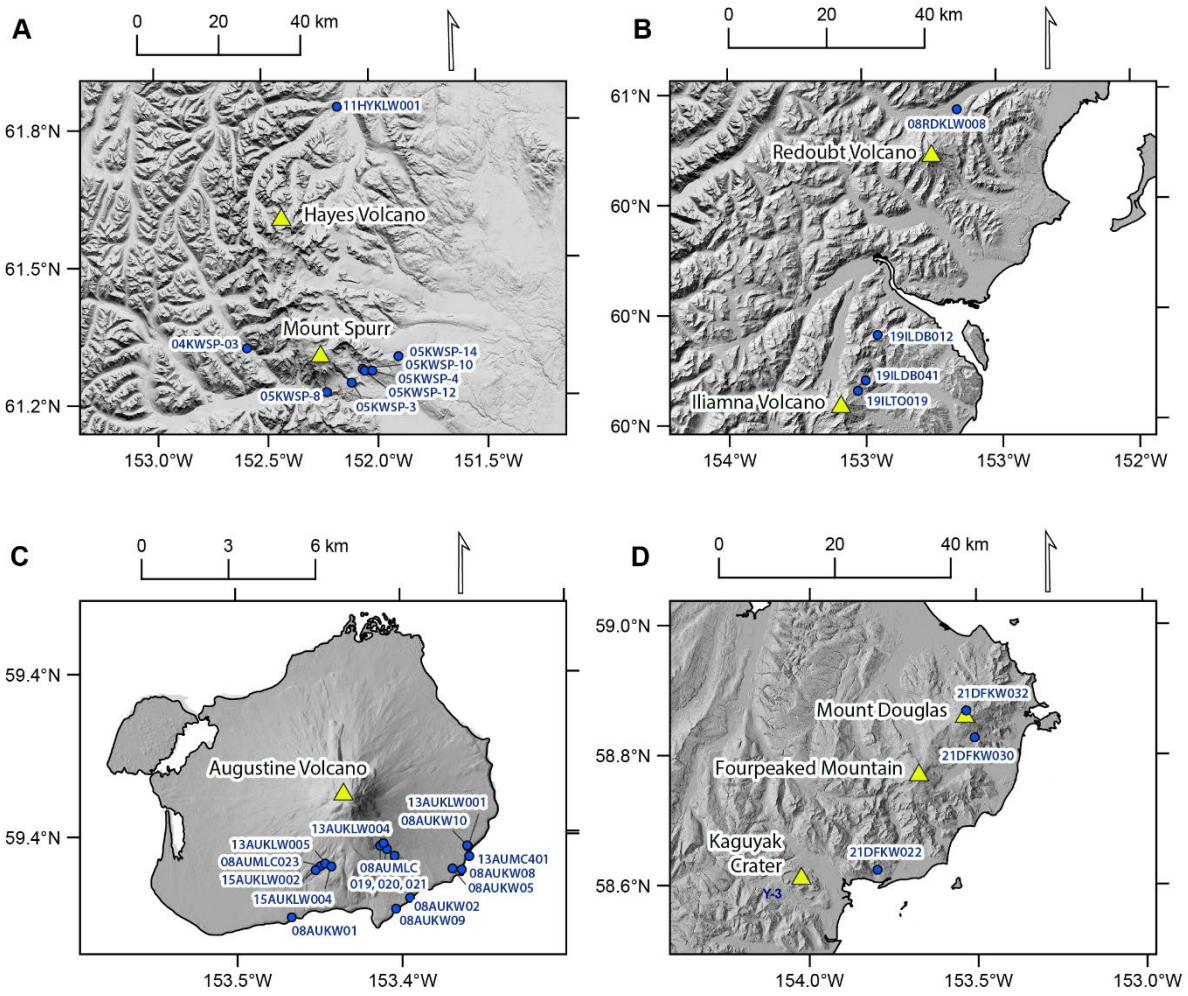

Figure 2. Detail maps of proximal volcano sample stations. **(A)** Hayes Volcano and Mount Spurr, **(B)** Redoubt and Iliamna volcanoes, **(C)** Augustine Volcano, and **(D)** Mount Douglas, Fourpeaked Mountain, and Kaguyak Crater.

Radiocarbon Analyses

Peat samples from station 17KWLCI025 were analyzed at the University of Georgia Center for Applied Isotope Studies (CAIS) by Accelerator Mass Spectrometry (AMS) to determine carbon (C) isotope ^{14}C radiocarbon ages. Samples were dried at room temperature within six weeks of collection in the field then submitted to CAIS where they were treated with 1N HCl at 80 ˚C for one hour to remove carbonate material and washed with deionized water before drying at 60 ˚C. Dried samples were combusted at 900 ˚C in an evacuated sealed quartz ampoule in the presence of copper oxide (CuO). Graphite $^{14}C/^{13}C$ ratios were measured with a 0.5 MeV accelerator mass spectrometer with isotope ratios compared to Oxalic Acid II (NBS SRM 4990C). Ratios of $^{13}C/^{12}C$ were measured separately using a stable isotope ratio mass spectrometer and are reported as $\delta^{13}C$ relative to Pee Dee Belemnite (PDB). Reported uncalibrated ages (AgeInterpreted) are given in radiocarbon years before 1950 using a ^{14}C half-life of 5,568 years. Calibration calculated used the R-package "Bchron" (Haslett and Parnell, 2008).

Electron Microprobe Analyses

Tephra samples were mounted in epoxy and polished for electron microprobe analysis in the Alaska Tephra Laboratory at the U.S. Geological Survey in Anchorage Alaska. Analyses were performed at the University of Alaska Fairbanks Advanced Instrumentation Laboratory on a JEOL JXA 8530F instrument. Detailed methodology and analysis of accuracy and precision can be found in Loewen and others (2023).

Laser Ablation Analyses

After electron microprobe analysis, a subset of suitably glassy tephras were analyzed by LA-ICP-MS at the Oregon State University W.M. Keck Collaboratory for Plasma Spectrometry using Photo Machines Analyte G2 193 nm ArF Excimer Laser coupled to a Thermoscientific X Series 2 (2018) or iCAP RQ (2022) ICP-MS. Ablation was performed with a 50 µm (2018) or 30 µm (2012) spot, 4.8 J/cm^2 (2018) or 6.3 J/cm^2 (2022) beam energy, and 7 Hz pulse rate for ~25 seconds. Prior to analysis the carbon coat was removed with light polishing, and analysis locations were pre-ablated with four pulses of a 110-µm-diameter beam. Concentrations were determined using in-house reduction software written in Visual Basic and described in Loewen and Kent (2012), using GSE-1G as a calibration standard and using the silicon (Si) isotope ^{29}Si—as independently constrained by electron microprobe analysis—as an internal standard. Secondary standards included GSD-1G, NIST-612, BHVO-2G, BCR-2G, and ATHO-G.

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