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DAVIDOF VOLCANO SAMPLES AND ANALYSES

Matthew W. Loewen[1], Hannah Dietterich[1], and Hannah Rosenkrans[1]

INTRODUCTION

This report includes samples and analyses collected in the western Aleutian Islands in 2021 by Alaska Volcano Observatory (AVO) geologists Hannah Dietterich and Matt Loewen. The primary target of this sampling was Davidof volcano, a partially submerged 5 km-diameter caldera located in the Rat Islands (fig. 1). Subaerial exposures include Davidof, Khvostof, Lopy, and Pyramid islands. The only prior published work on Davidof volcano was part of the U.S. Geological Survey's post World War II geologic reconnaissance of the Aleutian Islands (Nelson and others, 1959). Nelson and others (1959) only indicate two samples from Davidof volcano that were analyzed petrographically, but prior to this data release no quantitative data for Davidof volcano have been available.

This report also includes samples collected during 2021 from the western shore of Little Sitkin Volcano, as well as new electron microprobe analyses from samples previously collected in 2005 and 2015 from Little Sitkin Volcano and 2015 from Segula Volcano.

Data associated with this report are available at doi.org/10.14509/31084 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:

- **Definitions**: Descriptions (i.e., units, methods) for all columns in other data tables.
- **Stations**: Station observations and station coordinates.
- **Layers**: Stratigraphic observations collected at a subset of stations. 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.
- **WholeRock**: Bulk whole rock major and trace element analyses. This table can be linked to the Samples table by the SampleID and at_num columns.
- **EPMA**: Electron microprobe 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.

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- **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 Laser 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.

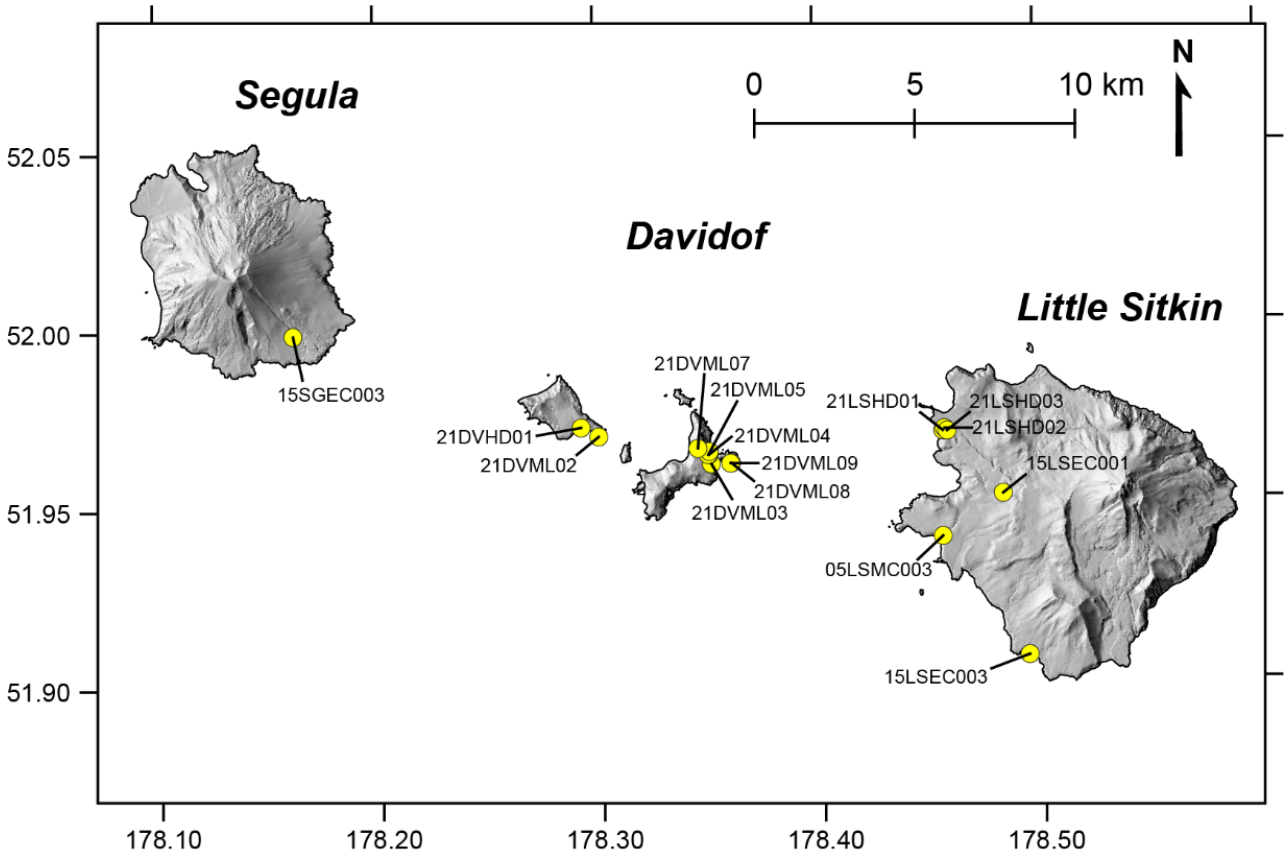

Figure 1. Location of sample stations in the central Rat Islands of the Western Aleutians, Alaska. Basemap is an IFSAR-derived hillshade.

DOCUMENTATION OF METHODS

Field Data

Geologists collected samples during helicopter- and boat-supported fieldwork in May 2021 and recorded locations using GPS-enabled iPad mini 5 tablets in with the StraboSpot

field app (Walker and others, 2019; www.strabospot.org/). Latitude and longitude are reported in the WGS84 datum. Station names (StationID) were assigned to sample locations and areas of general observation; sample names (SampleID) correspond to specific samples and include sample descriptions. Laboratory id numbers (at_num) were assigned during laboratory processing and analysis to keep track of "daughter" samples.

Radiocarbon Analyses

Soil samples were analyzed at the University of Georgia Center for Applied Isotope Studies (CAIS) by Accelerator Mass Spectrometry (AMS) to determine ^{14}C radiocarbon ages. Bulk soil samples were dried at room temperature within 6 weeks of collection in the field. Samples were then submitted to CAIS where humic acid separation and analysis was performed using the following method: root material and other organics were partially removed by sieving through 125 µm nylon mesh. The resulting soil was then treated with 1N hydrochloric acid at 80 ˚C for 1 hour to remove carbonates after which the samples were treated with a solution of 0.5M $Na_4P_2O_7$ and 0.1M NaOH at room temperature over 24 hours for humic acid extraction. Samples were then precipitated and centrifuged with concentrated hydrochloric acid. Finally, samples were rinsed with Milli_Q water and dried at 105 ˚C overnight. Dried samples were combusted at 900 ˚C in an evacuated sealed quartz ampoule in the presence of 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 5568 years.

Whole Rock Analyses

Bulk lava and tephra samples were crushed to ~1-cm pieces, sonicated, and dried before submittal to the Washington State University Peter Hooper GeoAnalytical Laboratory for X-ray fluorescence (XRF) and solution Inductively Coupled Plasma-Mass Spectrometry (ICP-MS) analysis. Procedures used followed Johnson and others (1999) and technical notes posted at environment.wsu.edu/facilities/geoanalytical-lab/technical-notes/. Detailed analysis and discussion of major and trace element uncertainty for samples submitted by AVO to this lab are provided in Nye and others (2018), which demonstrated 2s precision of <0.5 rel.% for major oxides (1.2% for FeOT) and 4 rel.% for most trace elements.

Electron Microprobe Analyses

Tephra samples were mounted in epoxy and polished for electron microprobe analysis at the University of Alaska Fairbanks Advanced Instrumentation Lab 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 Thermo Scientific iCAP-RQ ICP-MS. Ablation was performed at a 30 µm spot at 6.3 J/cm^2 beam energy and 7 hz for ~25 seconds. Prior to analysis carbon coat was removed 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 ^{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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