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## Data Repository

**Table DR1.** detailed X-ray fluorescence (XRF) spectrometry and instrumental neutron-activation analysis (INAA) methods and data

**Tables DR2 and DR3.** electron microprobe methods and data

**Table DR4.** paleomagnetic analysis methods and raw data

**Table DR5.** crystal-size distribution data

**Table DR6.** residence time calculations

## **SUPPLEMENTAL FILE**

### **X-Ray Fluorescence Spectrometry and Instrumental Neutron-Activation Analysis**

To characterize the rocks, 13 representative samples from the six Burney Mountain dacite domes were chipped to  $\leq 5$  mm size and altered pieces were removed by hand. Samples were analyzed for major oxide and trace elements by wavelength-dispersive X-ray fluorescence (WD-XRF) spectrometry at the GeoAnalytical Laboratory at Washington State University in Pullman, Washington using the methods of Johnson et al. (1999). Fresh rock chips (50 g) were powdered in an Al ring mill, diluted with a flux of di-lithium tetraborate ( $\text{Li}_2\text{B}_4\text{O}_7$ ) at a 2:1 ratio of flux to rock and fused into a bead at 1000 °C. After cooling, the bead was powdered, refused, and polished to provide a smooth surface for analysis of 10 major oxide and 19 trace elements on a ThermoARL Advant'XP+ sequential XRF spectrometer.

Major-oxide analysis of 20 samples collected during earlier mapping efforts in the 1980s to 1990s were ground in an Al oxide shatter box. Whole-rock major-oxide analyses were performed on pressed powder pellets by WD-XRF spectrometry at the U.S. Geological Survey Analytical Laboratory in Lakewood, Colorado (Taggart et al., 1987). Trace elements were analyzed by energy-dispersive X-ray fluorescence (ED-XRF) spectrometry at the U.S. Geological Survey in Menlo Park, California (Webb et al., 1990). Precision has been determined by repeated analysis of internal standards (Bacon and Druitt, 1988). At the levels present in most Lassen Volcanic Center area rocks, ED-XRF analyses have uncertainties at the  $1\sigma$  level of 2.1% for Ba, 11% for Rb, 0.7% for Sr, 5.3% for Y, 3.1% for Zr, and 57% for Nb.

Trace elements for a suite of 19 samples were also measured by instrumental neutron-activation analysis (INAA) at the U.S. Geological Survey in Reston, Virginia (Baedecker and McKown, 1987). Duplicate analysis of samples in both the U.S. Geological Survey and Washington State University laboratories show comparable accuracy. Table DR1 includes all major-oxide and trace-element analyses.

### **Electron Microprobe Analysis**

Major-oxide and limited trace-oxide compositions were measured on plagioclase, orthopyroxene, and clinopyroxene from polished thin sections using a wavelength-dispersive JEOL 8900 electron microprobe at the U.S. Geological Survey in Menlo Park, California. Additional electron microprobe analyses of plagioclase, orthopyroxene, and clinopyroxene cores and rims on phenocrysts from polished thin sections were done using a JEOL JXA-8230 'Super Probe' electron microprobe at Stanford University Mineral and Microchemical Analysis Facility in Stanford, California. Analyses were made using a 15-kV accelerating voltage, and a beam current of 10 nA for plagioclase with a 5  $\mu\text{m}$  beam and 15 nA for orthopyroxene and clinopyroxene with a focused beam. Count times were 30 second peak to 10 second background for all elements except Na, in which case a 10 second peak to 5 second background was used. Both Na and K were measured first to mitigate loss under the beam. Natural and synthetic silicate minerals and oxides of known composition were used as standards. Tables DR2 and DR3 include all electron microprobe data from groundmass crystals and phenocryst cores, rims, and transects.

## **$^{40}\text{Ar}/^{39}\text{Ar}$ Radiometric Dating**

Samples were collected from three of the dacite domes for  $^{40}\text{Ar}/^{39}\text{Ar}$  radiometric dating. Each sample was crushed in a roller mill, washed in an ultrasonic bath, and sieved to the 250–355  $\mu\text{m}$  size fraction. Approximately 150 mg of fresh groundmass was separated using a LB-1 Barrier Frantz magnetic separator and handpicked to remove undesirable phases (e.g., phenocrysts, glass shards, and altered groundmass). Groundmass separates were packaged in Cu foil along with Bodie Hills sanidine monitor minerals ( $9.797 \pm 0.003$  Ma, equivalent to Fish Canyon sanidine at  $28.100 \pm 0.015$  Ma; Fleck and Calvert, 2016), and enclosed in quartz vials wrapped in 0.5 mm thick Cd foil to shield samples from thermal neutrons during irradiation. Samples were irradiated for 1 h in the central thimble of the U.S. Geological Survey TRIGA reactor in Denver, Colorado at a power level of 1 MW (Dalrymple et al., 1981). The reactor vessel was rotated continuously and oscillated vertically during irradiation to minimize vertical and lateral neutron flux gradients.

Argon isotopic measurements were conducted at the U.S. Geological Survey in Menlo Park, California, using a MAP216 single-collector mass spectrometer with a Baur-Signer source and a Johnston MM1 electron multiplier. Argon was extracted from Bodie Hills fluence monitor sanidines in a single heating step (*i.e.*, total fusion) using a New Wave  $\text{CO}_2$  laser, whereas Ar was extracted from groundmass separates of unknown age in 7–10 temperature steps (typically spanning 550–1450  $^{\circ}\text{C}$ ) using a Mo shielded custom resistance furnace with a Mo crucible. Extracted Ar was exposed to a 4 A tungsten filament,  $-150$   $^{\circ}\text{C}$  cold finger, and two SAES St-175 getters (one at 300  $^{\circ}\text{C}$ , one at room temperature) to remove active gases. Prior to measurement, samples were degassed at 500  $^{\circ}\text{C}$  until troublesome gases (e.g., water, nitrogen, and hydrocarbons as measured by a Granville-Phillips 835 VQM) were reduced to acceptable levels. Instrumental mass discrimination was calculated by repeated measurement of air, assuming atmospheric  $^{40}\text{Ar}/^{36}\text{Ar} = 298.56 \pm 0.31$  (Lee et al., 2006). Ages were calculated using the decay constants of Steiger and Jäger (1977). Uncertainties are reported at  $2\sigma$  unless otherwise stated and include propagated uncertainties in counting statistics and J-values. Table 1 includes all relevant data for the  $^{40}\text{Ar}/^{39}\text{Ar}$  analyses.

## **Paleomagnetic Analysis**

Paleomagnetic samples were collected, processed, and interpreted from seven sites using standard protocols (McElhinny, 1973). Eight 10 cm long cores were drilled at each site using a portable, hand-held, gasoline-powered, water-cooled, diamond-coring drill, and were oriented in the field using a sun compass. A 2.5 cm long specimen from each core was measured using a cryogenic magnetometer. All specimens were subjected to alternating-field demagnetization to remove secondary components of magnetization. An isothermal remanent magnetization resulting from nearby lightning strikes was a significant secondary magnetization source for these topographically high-standing sites. The mean characteristic direction of remanent magnetization for four sites was calculated using line fits of data on vector-component diagrams, which were averaged using conventional Fisher statistics. Some specimens failed to reveal their characteristic remanent magnetization through alternating-field demagnetization and instead were fit with great-circle planes matching their progressive cleaning behavior. As a result, three sites were calculated using a mixture of lines and planes. Most sites have mean directions with 95% confidence limits between 1 and 3 $^{\circ}$ . Table DR4 includes the raw data for the paleomagnetic analyses.

## REFERENCES CITED

- Bacon, C.R., and Druitt, T.H., 1988, Compositional evolution of the zoned calcalkaline magma chamber of Mount Mazama, Crater Lake, Oregon: *Contributions to Mineralogy and Petrology*, v. 98, p. 224–256, <https://doi.org/10.1007/BF00402114>.
- Baedecker, P.A., and McKown, D.M., 1987, Instrumental neutron activation analysis of geochemical samples: U.S. Geological Survey Bulletin 1770, 14 p.
- Cashman, K.V., 1988, Crystallization of Mount St. Helens 1980–1986 dacite: A quantitative textural approach: *Bulletin of Volcanology*, v. 50, p. 194–209, <https://doi.org/10.1007/BF01079682>.
- Cashman, K.V., 1992, Groundmass crystallization of Mount St. Helens dacite, 1980–1986: A tool for interpreting shallow magmatic processes: *Contributions to Mineralogy and Petrology*, v. 109, p. 431–449, <https://doi.org/10.1007/BF00306547>.
- Dalrymple, G.B., Alexander, E.C., Jr., Lanphere, M.A., and Kraker, G.P., 1981, Irradiation of samples for  $^{40}\text{Ar}/^{39}\text{Ar}$  dating using the Geological Survey TRIGA reactor: U.S. Geological Survey Professional Paper 1176, 55 p, <https://doi.org/10.3133/pp1176>.
- Fleck, R.J., and Calvert, A.T., 2016, Intercalibration of  $^{40}\text{Ar}/^{39}\text{Ar}$  mineral standards with Bodie Hills sanidine [abs.]: Geological Society of America Annual Meeting 2016, Denver, Colorado, USA.
- Higgins, M.D., 1996, Crystal size distributions and other quantitative textural measurements in lavas and tuffs from Egmont volcano (Mt. Taranaki), New Zealand: *Bulletin of Volcanology*, v. 58, p. 194–204, <https://doi.org/10.1007/s004450050135>.
- Higgins, M.D., 2000, Measurement of crystal size distributions: *American Mineralogist*, v. 85, p. 1,105–1,116, 10.2138/am-2000-8-901.
- Higgins, M.D., 2002, A crystal-size distribution study of the Kiglapait layered mafic intrusion, Labrador, Canada: Evidence for textural coarsening: *Contributions to Mineralogy and Petrology*, v. 144, p. 314–330, <https://doi.org/10.1007/s00410-002-0399-9>.
- Johnson, D.M., Hooper, P.R., and Conrey, R.M., 1999, XRF analysis of rocks and minerals for major and trace elements on a single low dilution Li-tetraborate fused bead: JCPDS-International Centre for Diffraction Data, p. 843–867.
- Lee, J.-Y., Marti, K., Severinghaus, J.P., Kawamura, K., Yoo, H.-S., Lee, J.B., and Kim, J.S., 2006, A redetermination of the isotopic abundances of atmospheric Ar: *Geochimica et Cosmochimica Acta*, v. 70, p. 4507–4512, <https://doi.org/10.1016/j.gca.2006.06.1563>.
- McElhinny, M.W., 1973, *Paleomagnetism and Plate Tectonics*: Cambridge, United Kingdom, University Press, 368 p.
- Steiger, R.H., and Jäger, E., 1977, Subcommittee on geochronology: Convention on the use of decay constants in the geo- and cosmochemistry: *Earth and Planetary Science Letters*, v. 36, p. 359–362, [https://doi.org/10.1016/0012-821X\(77\)90060-7](https://doi.org/10.1016/0012-821X(77)90060-7).
- Taggart, J.E., Jr., Lindsey, J.R., Scott, B.A., Vivit, D.V., Bartel, A.J., and Stewart, K.C., 1987, Analysis of geologic materials by wavelength-dispersive X-ray fluorescence spectrometry: U.S. Geological Survey Bulletin 1770, 19 p.
- Webb, P.C., Potts, P.J., and Watson, J.S., 1990, Trace element analysis of geochemical reference samples by energy dispersive X-ray fluorescence spectrometry: *Geostandards Newsletter*, v. 14, p. 361–372, <https://doi.org/10.1111/j.1751-908X.1990.tb00077.x>.
- Witter, M., Furman, T., La Femina, P., and Feinman, M., 2016, Understanding magmatic processes at Telica volcano, Nicaragua: Crystal size distribution and textural analysis: *The American Mineralogist*, v. 101, p. 1052–1060, <https://doi.org/10.2138/am-2016-5379>.