Resolving Late Pleistocene Volcanic History in the Aleutian Arc by Means of High Precision $^{40}$Ar/$^{39}$Ar Geochronology

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The $^{40}$Ar/$^{39}$Ar geochronometer has become an important tool in the field of volcanology. Age determinations with uncertainties of better than 5-10% at the 95% confidence level can now be obtained via furnace incremental-heating methods on groundmass separated from arc lavas as young as 20 ka (e.g., Singer et al., 2000). This represents better than an order of magnitude improvement in temporal resolution over classical K-Ar dating. Thanks to automated analytical systems, the eruptive chronology of an individual arc volcano can be established through geologic mapping, supported by a large number of $^{40}$Ar/$^{39}$Ar analyses (e.g., Singer et al., 1997). $^{40}$Ar/$^{39}$Ar dating can thus reveal not only the long term evolution of a volcano, but also distinguish the timing of punctuations such as caldera collapse, major pyroclastic activity, introduction of new magma into the reservoir system, or periods of repose or erosion. Such precise time-volume-composition data is essential to reconstructing the physical structure and dynamics of subvolcanic plumbing systems. Moreover, quantitative modeling of magmatic processes is critically dependent on knowing the timing and duration of specific volcanic sequences within large volcanoes (e.g., Hawkesworth et al., 2000). Beyond delineating the temporal evolution of a volcano, $^{40}$Ar/$^{39}$Ar dating allows for a meaningful appreciation of the record of glacial erosion of lava flow sequences. The $^{40}$Ar/$^{39}$Ar method can also provide the precise age control required when investigating geomagnetic field behavior, including paleosecular variation and reversals.

Despite these advances, surprisingly little $^{40}$Ar/$^{39}$Ar dating has been carried out in the Aleutians. Forty two K-Ar and only three $^{40}$Ar/$^{39}$Ar ages (e.g., Layer, 1997) have been published from igneous rocks, mainly intrusions, along the Aleutian Island arc. The Eocene to Pliocene history of the arc is poorly understood, however, it also could be explored using $^{40}$Ar/$^{39}$Ar dating. We have acquired new $^{40}$Ar/$^{39}$Ar ages from 14 Latest Pleistocene lavas at Seguam, Shishaldin, and Kanaga volcanoes in the Aleutians. Incremental-heating experiments require 6-8 hours of analytical time including 3 hot system blanks and 4-10 heating steps from 650$^\circ$ to 1400$^\circ$C. None of the 35 experiments conducted yielded isochrons showing evidence of excess argon. The results indicate that for lavas younger than 100 ka containing less than 1.0% K$_2$O, experiments from 3-4 subsamples combine to yield plateau ages with uncertainties of less than 10 kyr, and samples with greater than 2.0% K$_2$O can yield uncertainties of less than 1 kyr. Levels of radiogenic argon extracted during experiments on postglacial (<15 ka) samples or those with <0.5% K$_2$O proved impossible to measure.

Five of the fourteen new $^{40}$Ar/$^{39}$Ar ages were determined from subaerial lavas at Seguam Island, Alaska (Figure 1). Seguam is a Pleistocene-Recent shield volcano with multiple eruptive centers comprising a bimodal suite of tholeiitic, low-K basalt/basaltic andesite and dacite and rhyolite with up to 71% SiO$_2$. Historical activity in 1977 and 1993 included basaltic ash and lava eruptions. The new $^{40}$Ar/$^{39}$Ar ages indicate that K-Ar chronology of Singer et al. (1992)
overestimated the duration of volcanic activity preserved by several hundred thousand years. Further $^{40}$Ar/$^{39}$Ar dating could constrain the timing of caldera collapse and associated explosive rhyolitic volcanism on the eastern part of the island. We plan to use the $^{40}$Ar/$^{39}$Ar results in conjunction with major and trace element and U-Th isotope disequilibria data to gain a clearer picture of the mechanisms and timescales over which crystallization, mixing, and explosive build-up of volatiles have occurred repeatedly over the past ~100 kyrs at Seguam.

**Figure 1.** Geologic map of Seguam Island (after Singer et al., 1992) with locations of dated samples. The age spectra were generated via furnace incremental-heating of multiple subsamples of each lava.

**REFERENCES**


