OSU ARGON GEOCHRONOLOGY LABORATORY

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Overview: The OSU Argon Geochronology Laboratory (http://geochronology.coas.oregonstate.edu) at Oregon State University (OSU) has employed the K/Ar and 40Ar/39Ar dating methods since 1969, with a focus on volcanism in the terrestrial environments to improve the geochronology of ocean crust, island arc, subduction zone, continental, and ocean island volcanism, large igneous provinces and flood basalts, lunar rocks, hydrothermal minerals and clays, and much more. Our user-base is ever-growing and ranges from students, post-docs and collaborators at OSU to a high number of clients and collaborators throughout the U.S. and internationally. Over the decades, we have continued to upgrade our facility, starting out with a Reynolds-design mass spectrometer to determine the ages of Apollo mission lunar rocks, followed by an AEI MS-10, an MAP215-50, and now two ARGUS-VI multi-collector mass spectrometers. Compared to our research on the MAP215-50 from 1991-2013, using the ARGUS-VI instrumentation provides a quantum leap forward in precision, accuracy and throughput of measurements. With two ARGUS-VI instruments online, we now have a throughput of ~70,000 analyses/year on ~1,300 samples from ~130 projects. Each ARGUS-VI is outfitted with a 25-watt CO_2 laser with scan head technology to carry our total fusion and incremental heating experiments, while the argon gas cleaning is carried out on ~300 cc extraction lines outfitted with various getters, turbo and ion pumps. One of our main specialties is groundmass dating of submarine basalts that have experienced mild to moderate hydrothermal and seawater alteration.

New Research Avenues: Using multi-collector noble gas mass spectrometry allows us to carry out incremental heating experiments with greater resolution, precision and detail, for example **(i)** to better resolve primary age signals in small groundmass samples (5-20 mg for samples younger than 5 Ma; and less than 5 mg for older samples), **(ii)** to measure small amounts of very fine-grained terrigenous sediment fractions to use as paleoproxies for sediment transport and climate change, **(iii)** to analyze extremely small fragments of Precambrian metamorphic rocks, minerals and mineral inclusions, **(iv)** to date ultra-low-potassium lavas from large oceanic igneous provinces, boninite island arc series, and ocean crust tholeiites with increased accuracy and precision in order to unravel their temporal evolution and world-wide environmental impacts, **(v)** to date single sanidine crystals or fragments using incremental heating techniques that are 100 ka or younger, with some samples as young as a few thousands to tens of thousands of years and thus overlapping the radiocarbon method, and **(vi)** to analyze low-potassium clinopyroxene minerals.

Preparations and Expected Time Frame: Sample preparation, in particular, altered submarine basalt samples is labor extensive and requires the full attention of the visiting student. Visiting students will receive intense training in mineral separation. Samples will be QA/QC-ed by the technical staff and the PI in the lab, before samples are ready for packaging and irradiation. Analysis of the samples is similarly labor extensive and requires the full attention of the visiting student as well. Again, we will train students intensely, as we encourage each student to partake in all steps of the process, in order to gain full insights in the analytical process, the pitfalls, understand the best approaches to interpreting the analytical results, and get comfortable in assigning meaningful geological ages. A typical time frame for the entire process is 6-10 months, because samples need to be irradiated (and cool down) after sample preparation and before analyses. Often, we ask students to visit our lab over two periods, one to prepare samples; the second to carry out the analyses. As a rule of thumb, we estimate that 10 samples require about 3 to 4 weeks of mineral separation including training; and 2 weeks for the measurements.

Analytical Costs: For students the fee is $500/sample for incremental heating (up to 30 steps) of a sample or for doing total fusions of single crystals (up to 30 single crystals). For incremental heating of 5 single crystals it is $1000/sample (up to 12 steps per single crystal).