WiscAr Laboratory
EarthScope Geochronology Graduate Student Award Program

1. Laboratory Facilities and Operation

The Wisconsin Argon Geochronology Laboratory (WiscAr) provides opportunities for students to generate $^{40}Ar/^{39}Ar$ geo- or thermochronologic data. Primary applications include: (1) developing a chronostratigraphy for active or dormant volcanoes, (2) dating volcanic ash deposits in sedimentary basins as a means to determine rates of paleoclimatic or paleobiological change, (3) determining the thermal/cooling history of plutonic igneous or metamorphic rocks, (4) determining the timing of psuedotachylite generation along faults, (5) linking volcanic or sedimentary rocks to the geomagnetic polarity time scale. Students are encouraged to visit the lab to prepare samples for irradiation, participate in the data acquisition, and work with lab staff to understand and interpret their results. Students may also prepare mineral or groundmass separates elsewhere.

WiscAr facilities include:

- sample preparation lab (jaw crusher, hydraulic rock press, disk mill)
- mineral separation lab (heavy liquid fume hood & apparatus, Frantz isodynamic separator, ultrasonic disaggregator, Gold table)
- picking microscopes
- Cameron electron probe laboratory, which features a Hitachi S-3400N variable pressure SEM for CL and BSE applications. The SEM has a Gatan PanaCL/F cathodoluminescence detector, a ThermoElectron/NORAN System Six EDS detector and an Oxford/HKL BSE system with backscatter and forescatter detectors. The SEM is used routinely to identify and screen crystals prior to irradiation.
- MAP 215-50 single collector mass spectrometer and analytical system. This system has two chambers—each with a 5 cm diameter ZnS viewport—that are accessible to a 25 W CO_2 laser. Samples are either fused or incrementally-heated. This system is used mainly for rocks older than about 1 million years.
- Nu Instruments Noblesse 5 collector mass spectrometer and analytical system. This system comprises a single -200 cm^3 manifold with two chambers—each with a 5 cm diameter ZnS viewport—that are accessible to a 60 W CO_2 laser. This system is used mainly for small samples such as single sanidine crystals, or rocks younger than about 1 million years that contain small amounts of radiogenic argon. Samples can be incrementally-heated, or fused in a single step.

2. Time Frame

- If a sufficiently large number of samples are to be measured (more than 3 or 4), the student is strongly encouraged to visit the lab for a period of up to 2 weeks, depending on the type of rocks, to prepare samples for irradiation. For pyroclastic rocks (tuffs, bentonites, airfall deposits, etc.), it can take several days to isolate a group of one or two dozen phenocrysts from each sample. For lava flows, separating tens of milligrams of phenocryst- free groundmass from the rock can be done more rapidly such that a sample may be prepared in about a day. Coarser grained plutonic or metamorphic rocks can often be prepared relatively rapidly as a small population of K-rich minerals can be easily isolated.
- Our staff can train students in how to prepare mineral or groundmass separates for their particular samples. We also provide background materials on the fundamentals of the $^{40}Ar/^{39}Ar$ method and its applications and review these while the student is preparing his/her samples (see link to tutorials below).
- Whether the student prepares samples in our lab, or sends relatively pure mineral or groundmass separates to the lab, the samples must be irradiated prior to analysis. Once samples are sent to the nuclear reactor at the Oregon State University, it typically takes about a month for the irradiation to

take place and for the samples to 'cool' and be sent back to our lab. We let the samples 'cool' a bit longer prior to analysis, such that there is typically a delay between final preparation of samples and analysis of between 3 and 6 months depending on the number of irradiated samples already in the queue for analysis, and the reactor schedule. We strive to minimize the time between sending samples to the reactor for irradiation and their analysis, especially for student projects.

- Laser fusion or incremental heating analyses are fully automated on either of the mass spectrometer systems including measurements of system blanks and pipette gases of standards or air. It takes about one day (24 h) to generate a data set for a sample (e.g., 10-20 laser fusion dates from single sanidine phenocrysts, or a 10-15 step incremental heating analysis).

3. Cost

Students should budget $750 per sample. This will cover the cost of sample preparation if done by the student, as well as the mass spectrometer analysis. The cost is the same to acquire a laser fusion data set from a volcanic rock, or an incremental heating analysis of a lava flow groundmass or of a crystal from a plutonic or metamorphic rock. There are some reasonably-priced options for staying on or near campus during a visit: http://www.geology.wisc.edu/facilities/wiscsims/visitor_housing.html

4. Preparation for a visit

Prospective student investigators should inform the lab staff that they wish to pursue a project at least one month before visiting the lab. The lab staff will need to know what type of rocks are involved (lava flows, pyroclastic rocks or ash beds, bentonites, plutonic or metamorphic rocks), the approximate age range of the rocks, and the potassium concentrations expected in the minerals or groundmass phase to be analyzed. Tutorials on the fundamentals of radioisotopic dating and the $^{40}Ar/^{39}Ar$ method are available as powepoint files on the lab director's web page: http://geoscience.wisc.edu/geoscience/people/faculty/brad-singer/. These should be reviewed prior to arriving at the lab. It is highly desirable for the student to install and establish familiarity with the Berkeley Geochronology Center's Isoplot Add-In for Excel: http://bgc.org/isoplot_etc/isoplot.html. It is also important for students to compile all relevant metadata for their samples for inclusion in geoinformatics databases to which their data will be uploaded following publication or a negotiated embargo period.

5. Relavent Laboratory Staff

WiscAr is directed by Professor Brad Singer and managed by Dr. Brian Jicha. Singer and Jicha, along with graduate and undergraduate students who work in the lab, will train the students in all aspects of sample preparation. Singer and Jicha will work with the student on the analysis, data reduction, the propagation of uncertainties, and the interpretation of data.

6. Data reduction and interpretation - see above

7. Waiting time for lab usage

Students should contact the lab at least one month prior to beginning sample preparation. Once samples are prepared, it can take between 3 and 6 months before analyses can be completed, depending on the length of irradiation required, and the work load in lab at the time the project enters the work flow.

8. Contact

If you are interested in obtaining $^{40}Ar/^{39}Ar$ data, or would like to discuss potential collaboration, please contact:

Lab Director: Brad Singer: bsinger@geology.wisc.edu

Lab Manager: Brian Jicha: bjicha@geology.wisc.edu