

University of Alaska Fairbanks Geochronology Facility EarthScope Student Geochronology Laboratory Education Plan

1) Laboratory Facilities Available

This facility has been in operation since 1972 as a K-Ar dating laboratory and since 1989 as a $^{40}\text{Ar}/^{39}\text{Ar}$ facility. The laboratory has facilities for sample preparation, including a fully equipped rock crushing room, Frantz magnetic separators, heavy liquids (sodium polytungstate), and binocular hand-picking scopes. The primary spectrometer is a VG3600, installed in 1994, which is connected 'on-line' to a Coherent 6-watt laser-heating system and to a Modifications, Ltd. resistance-style furnace; both with a low-blank extraction line. This system came on line in May 1994 and is used to do single-step fusions and step-heating experiments on single mineral crystals and small-multicrystal aliquots. The spectrometer is fully computer controlled, and the laser and furnace systems are fully automated. We have upgraded the VG3600 electronics in 2004. This allows for improved signal to noise ratio and increased stability and sensitivity. We have implemented an automated single-grain fusion procedure using a specially designed cooper tray that holds up to 121 single grains. We have implemented MDD software acquired from UCLA for diffusion experiments on K-feldspar samples. We use a hand held Niton xl3t hand held X-ray fluorometer (XRF) to confirm mineral identification and purity for all K-feldspar work.

2) Student Time Frame

$^{40}\text{Ar}/^{39}\text{Ar}$ dating involves both sample preparation and irradiation before dating analysis can occur. In house sampling preparation by our staff goes quickly (>~10 samples a day from rock to mineral separate), but students should plan on ~4 samples a day with direction and assistance from a lab tech. Irradiation time turnaround is about six weeks depending on the age of the sample. We only send out irradiations about ~6 times a year so please contact us with both the general age of your samples (*older or younger than Oligocene? Which affects irradiation time*) and the number of samples to receive a more refined time line.

Hence we recommend students optimize their time at UAF by preparing their samples and sending us their mineral separate and a fist size of piece of rock material (if possible) in case further mineral separation is needed by our staff. We can coordinate a timeline for mineral separate shipments with our irradiation schedule. If there is a limited amount of sample material (i.e. drill cores), we can perform the mineral separation in totality. Once at UAF the students will receive further training and opportunities to perform mineral separations on their own samples or other samples we are working on.

The student will be involved with all aspects of analysis of their sample: sample preparation, degassing, mass spectrometer operation, data reduction, figure-data table preparation, and interpretation.

3) A standard step-heat of a mineral separate is \$700. Due to increased mass spectrometer time detrital work costs (~100 single grain fusions) are \$1700 and K-Feldspar diffusion experiments on the resistance furnace are \$1700. We will work with students to optimize the number-type of analyses to fit their research goals and can custom design a heating schedule to get more data produced for a given budget.

4) Student Preparation

Students must understand the limitations of different geochronological techniques for different research goals. The student is encouraged to contact us and explain their research goals and possible sample material in details so we can best meet their research needs. Sample material and pure mineral separation is key for successful $^{40}\text{Ar}/^{39}\text{Ar}$ dating analysis and we encourage the student to communicate with us on all stages of this aspect of their work-regardless if they are separating the sample here or elsewhere. Before the student arrives, we will assign both general reference material on $^{40}\text{Ar}/^{39}\text{Ar}$ dating and in particular $^{40}\text{Ar}/^{39}\text{Ar}$ dating application papers on their region of research focus. Once the student arrives at UAF additional training in mineral separation, radiation-laser safety, and mass spectrometry will be given.

5) Laboratory Staff

Dr. Jeff Benowitz is a Research Assistant Professor who manages the UAF geochronology facility. Dr. Paul Layer, Professor of Geophysics and Dean of the College of Natural Science and Mathematics, ran the lab for over 20 years and now participates in all aspects of operation, data analysis, and mentoring. Both Dr. Benowitz and Dr. Layer will be involved with student mentoring and lab operation. We also have at least one student lab assistant on staff at all times.

6) Data Reduction and Analysis

Data is collected and reduced using an integration of the VG3600 IonVantage software and in-house Visual Basic programs for spectrometer control and data analysis. All data is exported in Excel spreadsheets that can be plotted in ISOPLOT (Ludwig, 2003) or plotted using our in house reduction software and CorellDraw. We will work with and assist all students with data reduction, table and figure production for publication and interpretation. We archive all data produced at the UAF geochronology facility and store samples that are not returned to users. All data is produced exported in an archive-able format for archiving at other data repositories.

7) Scheduling

Please contact us to obtain our irradiation schedule and to discuss a time line for sample preparation and scheduling a visit for analysis. The more information we know about graduation deadlines, upcoming presentations the more helpful we can be with scheduling.

8) Contact

Contact Dr. Jeff Benowitz (jbenowitz@alaska.edu) if you would like to discuss if $^{40}\text{Ar}/^{39}\text{Ar}$ is appropriate for your research goals and to initiate collaborations.