

EarthScope Student Geochronology Research and Training Program Laboratory Plan

Arizona State University Cosmogenic Nuclide Laboratory

March 6, 2015

Lab Description

The cosmogenic nuclide laboratory at Arizona State University (ASU) is equipped with the facilities necessary for separating and isolating the in-situ produced cosmogenic nuclides ^{10}Be and ^{26}Al from quartz grains for measurement by accelerator mass spectrometry (AMS). Equipment includes HF-handling facilities for sample etching and dissolution, an inductively coupled plasma optical emission spectrometer (ICP-OES) for pre-dissolution sample assays, pipettes, balances, MilliQ water supply, a centrifuge, laminar flow HF-safe fume hoods, hot plates, an oxidation furnace, AMS cathodes and a cathode press, and sufficient lab-ware supplies for processing multiple batches of ~15 samples. Appropriate isotope carriers and quartz standards, acid and base solutions (hexfluorosilic acid, HF, HCl, HNO₃, NH₄OH), resins for ion exchange chromatography, and Nb_(s) for oxide cathode packing are also provided. Rock crushing, milling, sieving and magnetic and feldspar separation facilities are also available through the School of Earth and Space Exploration at ASU, should students' home institutions not be equipped for the initial mineral separation steps.

Expected Time Frame

Maximum batch size is determined by the spacing of AMS standard measurements, but typically includes 12-14 samples, a standard and a blank. Students should be prepared to visit for a minimum of 2 weeks for their first batch of samples. With increased experience, students will be able to process multiple batches at different stages of the separation procedure at the same time. The ASU cosmogenic nuclide lab provides sufficient equipment to process 2-4 batches over 2-4 week time frames. AMS measurements are performed at outside AMS facilities such as the Lawrence Livermore National Laboratory Center for Accelerator Mass Spectrometry (LLNL-CAMS) and therefore are not part of the processing procedure learned by students at ASU.

The processing steps students will learn are:

- Quartz-feldspar density separation.
- Sample etching (to remove surface impurities)
- Pre-dissolution quartz purity assays
- Carrier mass addition and sample dissolution
- Ion exchange chromatography
- Sample precipitation and oxidation
- Nb mixing and cathode pressing

Analytical Costs

A one time training fee of \$350 is required. Sample processing cost is \$850 per sample, which includes all laboratory processing expenses and AMS analysis at LLNL-CAMS. The minimum batch size is 10 samples, plus a standard and blank.

Preparation for Visit

Students should communicate with Dr. Heimsath regarding their mineral separation needs well in advance of their arrival. Although ASU does host mineral separation facilities, these procedures are time consuming, and are most cost effectively accomplished prior to arrival at ASU. Students should arrive with ~100 g, 250-500 micron, non-magnetic separates. Ideally students arrive with pure quartz samples having removed most feldspar by density separation or froth floatation.

Data Processing and Interpretation

After AMS measurements are received, students will be guided through the basic stoichiometry required to convert AMS ratios to nuclide concentrations, including the proper methods for propagating analytical, blank, processing, carrier mass and nuclide half-life errors. Students will be introduced to the commonly used surface exposure age calculators used for surface clasts and depth profile sampling. Instruction in age interpretations will vary with the application, nuclide and type of geologic feature sampled.

Lab Availability

Students should schedule their visit to the ASU cosmogenic nuclide laboratory 1-2 months ahead of their intended arrival date.

Relevant laboratory contacts

All questions regarding laboratory facilities and capabilities should be directed to Dr. Arjun Heimsath (arjun.heimsath@asu.edu); 480.965.5585 (o).