

EarthScope Student Geochronology Research and Training Program Laboratory Plan

University of Vermont, Cosmogenic Nuclide Laboratory, February 6, 2017

Lab Overview

The cosmogenic nuclide laboratory at University of Vermont (UVM) is equipped with all of the facilities required to separate and isolate both *in situ* and meteoric cosmogenic ^{10}Be from soils, rock, and sediment for measurement by accelerator mass spectrometry (AMS). We can also process samples for ^{26}Al , produce low blank carrier, and test quartz purity.

For meteoric samples, equipment includes HF- and Perchloric- handling facilities, Pt crucibles, MilliQ water supply, balances, hot plates, pipettes, laminar-flow HF-safe fume hoods, ovens, a fluxing stand, a torch, Pt-tipped tongs, plastic forceps and rods, a centrifuge, tubes, beakers, and sufficient labware supplies for processing 14 samples each week along with an associated blank and an internal quality control standard.

For *in situ* samples, equipment includes HF- and Perchloric- handling facilities, teflon labware, MilliQ water supply, balances, hot plates, pipettes, laminar-flow HF-safe fume hoods, ovens, a centrifuge, tubes, beakers, and sufficient labware supplies for processing 10 samples each week along with an associated blank and internal quality control standard.

Appropriate stable isotope carriers (^9Be and ^{27}Al), acid and base solutions, and Nb for oxide cathode packing are also provided. Rock crushing, milling, sieving and magnetic and density separation facilities are also available, should students' home institutions not be equipped for the initial mineral separation steps.

Realistic Time Frame

Each batch of samples takes a work week of processing time once it has been prepared (sample material powdered for meteoric ^{10}Be , pure quartz made and purity quantified for *in situ* ^{10}Be and ^{26}Al). For quartz preparation, allocate at least three to four full weeks depending on the number of samples. For safety reasons, we do not work weekends. We train visitors so that by the third batch of samples, they are working independently (with continued oversight from a PhD-level supervisor). AMS measurements are performed at outside AMS facilities including Lawrence Livermore National Laboratory Center for Accelerator Mass Spectrometry (LLNL-CAMS) and Purdue Rare Isotope Measurement (PRIME) Laboratory. Students can arrange to visit these labs in order to learn measurement techniques.

For *in situ* sample preparation, the processing steps students will learn are:

- Magnetic separation
- Sample etching to purify quartz
- Pre-dissolution quartz purity testing
- Carrier mass addition and sample dissolution
- Ion exchange chromatography
- Sample precipitation a

For meteoric sample preparation, the processing steps students will learn are:

- Sample powdering
- Massing and carrier addition
- Fluxing

- Purification
- Column chemistry
- Yield testing
- Sample precipitation

Costs

Current costs, incremented yearly are: \$350 per sample including training and supervision for *in situ* ^{10}Be and ^{26}Al , and \$290 for meteoric ^{10}Be . For *in situ*, we work in batches of 10 samples, plus a standard and blank. For meteoric, we work in batches of 14 samples, plus a standard and blank. Please plan on bringing samples in increments of 10 or 14, respectively, since we strongly prefer not process partial batches. Costs for AMS measurements are additional and need to be arranged for by the student with the AMS laboratory. We can provide contact information for pricing and sample submission.

Preparation for Visit

Students should communicate with the lab regarding their mineral separation needs well in advance of their arrival. Although UVM does have full rock preparation and mineral separation facilities, these procedures are time consuming, and if possible are best done prior to arrival at Vermont.

There are abundant resources in Burlington for visitors, including an airport (BTV), numerous options for accommodation (including some that are walking distance from campus), and options for free shuttles. There is more visitor information available on our visitor page, <http://www.uvm.edu/cosmolab/?Page=visitors.html>.

Lab Staff

Students will work primarily with Dr. Lee Corbett, who is a post-doc associated in part with the laboratory.

Data Reduction and Interpretation

After AMS measurements are received, students will be guided through the basic calculations required to convert AMS ratios to nuclide concentrations, including the proper methods for propagating 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 and waiting time

Students should schedule their visit to the UVM cosmogenic nuclide laboratory at least four months ahead of their target arrival date. We often book visitor slots many months into the future and cannot guarantee that there will be space available unless it is booked ahead.

Relevant laboratory contacts

All questions regarding laboratory facilities and capabilities should be directed to both Dr. Paul Bierman (pbierman@uvm.edu) and Dr. Lee Corbett (lbcorbett@gmail.com).