

EarthScope Student Geochronology Research and Training Program Laboratory Overview

CU Boulder (U-Th)/He Laboratory 02/07/17

Lab Description

The University of Colorado Boulder (U-Th)/He laboratory includes all of the facilities required to prepare and analyze minerals for (U-Th)/He thermochronology. Equipment includes two binocular microscopes with transmitted light and polarizing filters, a calibrated digital camera for sample characterization and preparation, an ASI Alphachron He extraction and analysis line, a Finnigan Element2 ICP-MS for measuring radioactive parent nuclides, and a clean lab for the wet chemistry required to prepare samples for ICP-MS analysis. The lab can measure (U-Th)/He on a variety of minerals, although visitors should discuss analyzing non-standard minerals (anything besides apatite or zircon) with us before writing grants. In the CU Boulder lab a sample is defined as 3 to 5 single-grain analyses, depending on the mineral and the goals of the study. For additional information, go to:

http://www.colorado.edu/GeolSci/thermochronology/CU_Thermochronology/Home.html

Expected Time Frame

Students should expect to spend a minimum of one week visiting our lab for preparation and analysis of a minimum of 5 samples. For analysis of 10-15 samples, a two week visit should be scheduled. Each sample can take anywhere from 2-8 hours to prepare depending on its size and quality, and the speed and experience of the user. The first step of analysis (He measurement) can accommodate 25 single-grains, which typically consists of 22 unknowns and 3 standards. Because He analysis is automated, once a batch of samples is ready, the visiting student can run them in parallel with additional sample preparation. Due to restrictions on clean lab use, students will not participate in the dissolution of their samples, or in analyzing them for parent nuclide concentrations. Those steps will be handled by lab staff, and are covered in the per sample fee.

The basic steps that the student will learn and perform during and after the visit are as follows:

- Identify appropriate minerals using a binocular microscope.
- Measure and characterize single grain samples.
- Load single grains into metal packets.
- Load samples into the ultra-high vacuum He analysis line.
- Prepare the line for analysis by running standards and background measurements.
- Set up an automated run table to analyze samples.
- Check sample status during analysis.
- Reduce data and calculate total He abundances.
- Unload samples from the machine to prepare them for U, Th, and Sm analysis.
- Use He, U, Th, and Sm data to calculate (U-Th)/He dates for their grains.
- Interpret and/or model data.

Analytical Costs

Our typical lab rates are a \$350 training fee, and an additional \$65 for each apatite analysis (we typically recommend 5 individual grain analyses per basement sample = \$325/sample) and \$100 for each zircon analysis (we typically recommend 3 individual grain analyses per basement

sample = \$300/sample). Students interested in working on detrital samples should consider analyzing at least 8-10 individual grains per sample for both apatite and zircon. It may be possible to negotiate analytical costs for EarthScope graduate student geochronology projects depending on the individual project requirements, resources, and timeframes, so please don't hesitate to contact CU lab staff for more information if you are interested in using He dating in a project. Our prices include all consumables and supplies, use of equipment, training, and preliminary data reduction. In addition, CU staff will aid in the interpretation of the total data. Students interested in running minerals besides apatite and zircon should first contact the CU Boulder lab to discuss costs.

Preparation for Visit

Students should arrive at CU Boulder with pure mineral separates. Rocks need to be crushed, pulverized, and run through hydrodynamic, heavy liquid, and magnetic separation steps so that they are left with a dense, non-magnetic fraction, preferably a vial of apatite and/or zircon. Students who do not have access to mineral separation facilities should contact GeoSep Services (<http://www.geoseps.com/>), a commercial outfit that the CU Boulder lab regularly works with. Mineral separation can take substantial time, and students should make sure to check with GeoSep prior to scheduling a lab visit.

Relevant Laboratory Staff

The CU Boulder Thermochronology Lab is directed by Professor Becky Flowers and managed by Dr. James Metcalf. Following project planning with Flowers and Metcalf, Metcalf will primarily coordinate student visits, and will direct their training, sample preparation, analysis, and data reduction. Metcalf will perform all of the necessary wet chemistry and ICP-MS analysis. Flowers and Metcalf will be engaged in data interpretation."

Data Processing and Interpretation

While in the lab students will learn how to process and reduce all of the data they have collected. This includes calculation of alpha-ejection factors, raw He dates, corrected He dates, and the propagation of uncertainties. In addition, students will be shown the basics of how to use a thermal modeling program to better understand the significance of their results. Flowers and Metcalf will continue to be available to consult with the students through email and/or videoconferencing until they are satisfied that they understand the results.

Expected Lab Availability

In most situations, students may schedule time in the CU He lab with 1-2 months lead time.

Contacts

If you are interested in acquiring (U-Th)/He data in our lab, or would like to discuss potential collaborations, please contact either:

Rebecca Flowers: rebecca.flowers@colorado.edu

James Metcalf: james.metcalf@colorado.edu