AGeS Student Geochronology Research 2 and Training Program Laboratory Overview

University of Arizona Fission Track Laboratory
January 8th 2019

Laboratory Facilities

The University of Arizona Fission Track Laboratory is jointly run by Prof. Barbara Carrapa and Dr. Stuart Thomson. The laboratory is set-up for fission track (FT) analysis using the external detector method. For FT counting and track length measurement the lab is equipped with two Olympus research microscopes (one BX61 and one BX51). Both microscopes include a computer-automated stage and tablet system running the FTStage software of Trevor Dumitru. We also have a full set-up for sample preparation and polishing, including a Buehler polishing machine and oven for zircon FT etching. Several computers are available for time-temperature modeling and ArcGIS. Mineral separation is possible at the University of Arizona. But, for this EarthScope initiative, this should be organized through the Arizona LaserChron Center. Alternatively, we also recommend Tucson-based geoscience service company Zirchron LLC (www.zirchron.com) who offer competitive rates for apatite and zircon mineral separation.

At the University of Arizona we are also able to offer both single grain and/or multi-aliquot apatite and zircon double- and triple-dating as part of the EarthScope student geochronology research and training program. U-Pb laser ablation ICPMS can be done at the participating Arizona LaserChron Center, and (U-Th)/He dating through the participating University of Arizona (U-Th)/He laboratory (ARHDL). These labs should be contacted separately. Of course, potential users need to take into account the additional time and costs this will involve.

Time Frame

Owing to the 4-6 weeks required for sample irradiation, and time to acquire a sample counting calibration factor, FT analysis is a drawn out analytical process requiring at least two separate lab visits. The first visit will allow the student to prepare their samples for analysis. This includes sample mounting, polishing, and etching to reveal fission tracks, and preparing samples with external mica detectors for irradiation. From our experience, for a batch of 10 to 20 samples this will take 1 to 2 weeks. Because FT etching in some zircon can take several days, we recommend additional time for conducting detrital zircon FT studies. A second visit should then be planned once the samples return from irradiation. This will involve (1) demonstration of etching of irradiated mica detectors (owing to radiation and chemical safety considerations, this has to be conducted by University of Arizona personnel); (2) an introduction to FT counting methods and techniques through counting of tracks in mica detectors; (3) acquisition of the student's own "zeta" calibration factor based on counting standard samples of known age; (4) counting tracks in the student's own samples; (5) if required, measurement of track lengths and etch pit diameters (Dpar); (6) calculation of ages; and (7) data interpretation including an introduction to inverse time-temperature modeling and/or detrital age deconvolution methods. From our experience with novice visitors, acquiring a reliable zeta calibration factor takes about 3-4 weeks. After this, dependent on the student's enthusiasm and dedication (and whether a cooling age or detrital analysis is required), 1 to 3 samples can be counted per day.

For additional double- or triple-dating using U-Pb and/or (U-Th)/He dating, please check the separate EarthScope geochronology lab overviews for the University of Arizona LaserChron Center and (U-Th)/He Lab (ARHDL).

Analytical Costs

$500 one-time training fee, $250 for each apatite or zircon FT analysis, where students can count as many grains per sample mount as they need. If multiple mounts are required for detrital zircon fission track dating, then the fee is $400 per sample for up to 3 different mounts requiring different etch times (see "Preparation for Visit" below). All fission track analyses require thermal neutron irradiation conducted at the Oregon State University Radiation Center. Current costs (June 2018) for this procedure are $900 per irradiation including packaging and shipping. Each irradiation can accommodate ~40 sample mounts, thus one irradiation is likely sufficient for most student projects. Note apatite and zircon require separate irradiations.

Preparation for Visit

For any visit, students should bring fully prepared mineral separates. To avoid additional manual picking, these should be as pure as possible. FT dating does allow some leeway in sample purity – in many cases 50% purity or better is OK, although all pyrite should be removed from any zircon separates unless the student is willing to spend visiting time manually picking grains. Note for a cooling age, 20 grains are typically counted, but owing to various factors, at least 50-100 grains should be mounted. For detrital analysis, then for statistical robustness, at least 50 to 100 counted grains are required. Owing to variable etch times for different zircon grains, several mounts may be necessary, thus a separate with hundreds to thousands of grains is preferred. For the many hours of microscope work required, we recommend any student bring along plenty of patience, a good selection of listening, and a sturdy pair of headphones!

Laboratory Personnel

Training will be conducted by either Stuart Thomson, Gilby Jepson, or Barbara Carrapa. A number of graduate students with experience of FT dating are also available to assist students with any questions.

Data Processing and Interpretation

Students will be taught how to calculate a zeta calibration factor and FT age, data reduction, statistical treatment of uncertainties and mixed ages, and track length measurement and analysis. We can also offer an introduction to inverse thermal history modeling using FT and other low temperature thermochronologic data using several software packages. PCs are available for data reduction, inverse time-temperature modeling, and age deconvolution. Unfortunately for Macophiles, Windows 7 or later is required for inverse time-temperature modeling, although BootCamp, VMware Fusion, or Parallels can be used if necessary.

Scheduling

Typically we can schedule students with a lead time of 2-3 months. We encourage prospective users to contact us beforehand to discuss any project, its feasibility, and the potential applicability of FT dating (and/or double- and triple-dating).

Contacts

Stuart Thomson (thomson@email.arizona.edu)
Barbara Carrapa (bcarrapa@email.arizona.edu)
Gilby Jepson (gjepson@email.arizona.edu)