AGeS Student Geochronology Research and Training Program Laboratory Profile

University of Arizona Fission Track Laboratory
January 11th 2024

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 apatite and zircon fission track (FT) analysis using the external detector method. For FT counting and apatite 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 are also fully equipped 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. While mineral separation is possible at the University of Arizona, owing to priority given to internal users, we recommend conducting any mineral separations through 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 which from our past experience hosting AGeS awardees will require an intensive 4-5 week visit to complete sample analysis on 8-10 samples. Once we receive the mineral separates, we do sample preparation on behalf of any visitors, including mounting, polishing, and etching to reveal fission tracks, and prepare samples with external mica detectors for irradiation ourselves before any visit. If any visitor is interested in this process, we can take them through the preparation process during any visit. Any laboratory visit should be scheduled after the samples return from irradiation. A laboratory visit will involve an introduction to FT counting methods and techniques through (1) initial counting of tracks in irradiated mica detectors; (2) acquisition of the student's own "zeta" calibration factor based on counting 8 to 10 standard samples of known age; (3) then counting tracks and dating the student's own samples; (4) if required, measurement of track lengths and etch pit diameters (Dpar); (5) calculation of ages; and (6) data interpretation including an introduction to inverse time-temperature modeling and/or detrital age deconvolution methods. Previous AGeS visitors have typically taken about 2-3 weeks to acquiring a reliable zeta calibration factor. After this, about 1 to 2 samples can be counted per day. A typical visit should be planned for 4 to 5 weeks for 8-10 FT cooling age sample analyses.

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, $300 for each apatite or zircon FT analysis, where students can count as many grains per sample mount as needed. If multiple mounts are required for detrital zircon fission track dating, then the fee is $500 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 (2023) for this procedure are $1200 per irradiation including packaging and shipping. Each irradiation can accommodate ~40 sample mounts, thus one irradiation will be sufficient for any student project. Note apatite and zircon require different, separate irradiations.

Preparation for Visit

For any visit, students should send fully prepared mineral separates at least 3 to 4 months before any planned visit to allow sufficient time for sample preparation and 4-6 week sample irradiation time. To avoid additional manual picking, any supplied mineral separates should be as pure as possible. FT dating does allow some leeway in sample separate mineral purity – in many cases 50% purity or better is OK. For zircon FT, pyrite can affect the etching process, thus needs to be removed from any zircon separate before mounting. Note for a cooling age, 20 grains are typically counted, but owing to various factors, at least 50 grains are generally mounted. For detrital analysis, then for statistical robustness, we recommend counting at least 50 grains per sample. 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, and a good selection of listening.

Laboratory Personnel

Training will be conducted by Dr. Stuart Thomson, who has over 30 years' experience in counting fission tracks. A number of graduate students with experience of FT dating are also usually 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. Note a Windows PC is required for inverse time-temperature modeling using the modeling software HeFTy. The alternative modeling software QTQt runs on both Mac and PC.

Scheduling

Typically we can schedule students with a lead time of 3-4 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).

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