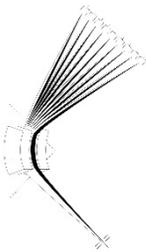


EarthScope Awards for Geochronology Student (AGeS) Research Program

Training Program Laboratory Overview - MIT Isotope Lab

Lab Description

The MIT isotope lab specializes in high-precision U-Pb geochronology and thermochronology of accessory minerals (zircon, baddeleyite, monazite, titanite, rutile, perovskite, and apatite) through the ID-TIMS method. The lab facilities are designed to efficiently process geochronologic samples from targeted mineral separation to acquisition of high precision U-Pb dates. We successfully extract accessory minerals from samples as small as drill cuttings to as large as tens of kilograms. If necessary, the mineral separates can be mounted, polished and imaged by backscatter electron and/or cathodoluminescence on the JEOL-JXA-733 Superprobe for detailed characterization. Selected zircon grains or grain fragments are pre-treated by a thermal annealing and acid leaching procedure modified after the CA-TIMS method of Mattinson (2005). We employ the EARTHTIME mixed U-Pb tracers and analytical protocols for high interlaboratory reproducibility. Individual grains are dissolved in high-pressure digestion vessels, and Pb and U are separated using miniature anion exchange columns with total Pb procedural blanks of 0.3 pg or lower. U and Pb isotopic measurements are made using either the ISOTOPX X62 or VG Sector 54 thermal ionization mass spectrometer, both equipped with multiple Faraday detectors and Daly photomultiplier ion-counting systems (For further details see Ramezani et al., 2011 and Burgess et al., 2014).

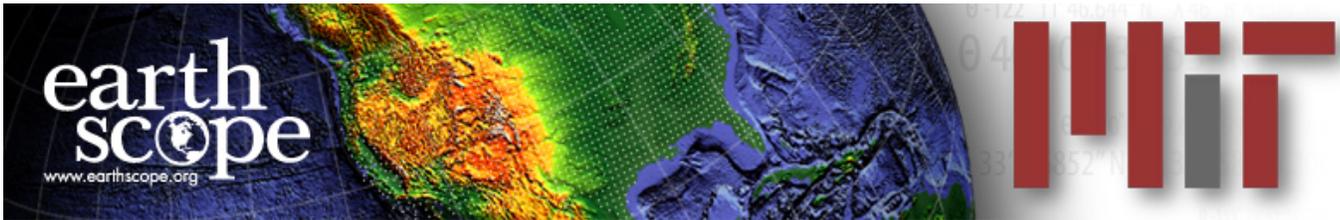


Expected Time Frame

Depending on the scope and scale of the project, we suggest a visit duration of 2 to 6 weeks. Duration will also depend on the student's level of experience. More time and/or multiple visits might be necessary for those visitors who wish to actively participate in mineral separation, mass spectrometry and data processing at MIT. Time can be significantly reduced if these steps are carried out before or after student's visit. The following list shows approximate time required for each step in the procedure:

Rock Crushing and Mineral Separation (1-2 days per sample)

- Coarse crushing using a sledge hammer or hydraulic press and pulverization by Shatterbox®
- High-density liquid separation



- Magnetic separation

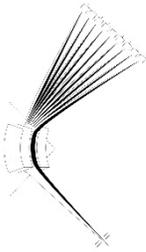
Grain Selection, Mount Preparation and Imaging (2 days)

- Make an epoxy mount with up to 300 grains
- Image grains on electron microprobe
- Process images and select individual grains for geochronology

High-temperature Annealing for Zircon (2½ days)

Dissolution and Column Chemistry (1 week)

- Load grains into Teflon microcapsules
- Chemical Abrasion: Leach in HF overnight for 12 hours (for zircon only)
- Rinse, flux and reload into microcapsules, spike with tracer (1 day)
- Dissolve grains in digestion vessels in an oven (2 days)
- Prepare for column chemistry (chemical conversion, setup and clean columns)
- Column Chemistry (1 day)



Mass Spectrometry (ca. 3-5 hours per grain)

- Load purified U and Pb from samples onto single filaments
- Load filaments into Mass spectrometer, pump down overnight
- Measure U and Pb isotopes

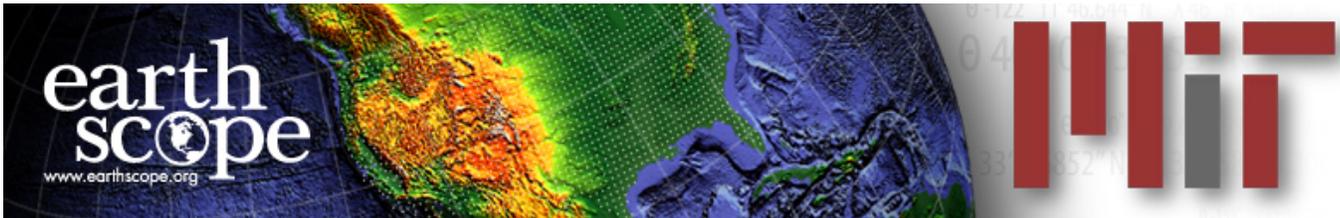
Analytical Costs

Analytical costs are difficult to assess when training students. Our approach is to work with investigators to secure sufficient funds to cover the costs while not discouraging the visitors from doing too few analyses to save budget. The number of analyses required is highly dependent on the sample and project. Some samples may be done with as few as four analyses while others may take 20 or more. Our basic charge is \$2000/sample and that would include 4-8 analyses, plus the cost of mineral separation. Our primary goal, however, is always to solve the problem, regardless of the number of analyses that can be afforded.

Preparation for Visit

Interested students should contact the Isotope Lab staff (see below) in order to:

1. Develop a suitable project with a practical time table in line with the goals of the EarthScope AGeS Program
2. Discuss sample collection and advance preparations, if necessary
3. Prepare a research proposal, including a timeline and budget, for submission to the AGeS Program

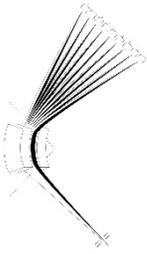


4. Obtain a letter of support from the Isotope Lab to accompany their proposal

Upon approval, the final project/visit schedule will be determined in coordination with the awardee.

Additional Lab Capabilities

In addition to high precision U-Pb geochronology, the MIT Isotope Lab is fully equipped to measure Sr, Nd, and Pb isotopes in minerals and whole rocks. Trace element and Hf isotopic analyses of dissolved minerals can also be done in conjunction with other facilities on the MIT campus. If you are interested in any of these analyses to complement the U-Pb work, please contact us and we can discuss the additional time and costs these analyses entail. Have special requests for analysis? Contact us!



Laboratory Staff

The Bowring Lab at MIT is a user-operated facility maintained by research staff, postdoctoral associates and graduate students. Research scientist Jahan Ramezani oversees the routine operation of the facility and is responsible for working with and training of visiting students. Collaboration with MIT faculty and researchers is highly encouraged.

Data Processing and Interpretation

Visiting students are encouraged to participate in all aspects of U-Pb geochronology, including mass spectrometric measurements, data reduction and interpretation. If not allowed due to time constraints, however, the lab staff will assist in the completion of these final steps after the student departs MIT. We will happily provide assistance and guidance up to the completion of the project and publication of its results.

Expected Lab Availability

In most situations, students will be able to schedule a visit to the MIT Isotope Lab two months in advance.

Contact Information

If you are interested in pursuing a research project at MIT and would like to discuss potential collaborations, please contact:

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(617) 253-1384