AGeS
Laboratory Overview

University of Massachusetts Ultrachron (Microprobe Dating) Laboratory
12/02/24

Lab Description

The University of Massachusetts Electron Microprobe Facility includes three electron microprobes, a scanning electron microscope, high-vacuum carbon/aluminum/gold coating, thin section polishing/finishing, a confocal micro-Raman system, and microscopy facilities. High-resolution full- compositional mapping is done on a five-spectrometer Cameca SX-100 microprobe. Dating (monazite, xenotime, thorite, etc.) is done on the "Cameca SX-Ultrachron" microprobe, optimized for high spatial resolution trace element analysis. Dating is carried out in-situ in polished thin sections. The laboratory specializes in constraining metamorphic reactions or deformation events by relating monazite growth or alteration events to interpretable fabrics and metamorphic assemblages.

Expected Time Frame

Monazite/xenotime dating is carried out in three steps: 1) Full-section compositional mapping to locate all accessory phases and to place accessory grains into microstructural and petrologic context; 2) high-resolution grain mapping to characterize compositional domains within monazite/xenotime grains; 3) Quantitative major and trace element analysis of monazite compositional domains (for dating) using the SX-Ultrachron microprobe. Compositional mapping is best carried out weeks to months in advance of dating in order to allow time for image analysis and interpretation and for establishing the dating strategy. This is crucial in maximizing both efficiency and potential geochronologic significance. Polished sections are typically shipped to UMass for mapping, but students can participate in the mapping effort if desired. Image processing and analysis can be done at UMass or at the home institution. Detailed processing instructions are provided. Dating typically involves one or more days per thin section but depends critically on the goals and of the project, and the number and complexity of target grains in each section.

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

- This section imaging and photography.
- Full thin-section compositional mapping.
- Simultaneous processing of accessory mineral maps.
- Image processing: integrating high-resolution mapping with full section mapping.
- Developing a hypothesis-based strategy for quantitative analysis/dating.
- Setting analysis locations on the Ultrachron microprobe
- Post-analysis imaging of analyzed grains.
- Data reduction, interpretation, presentation.

Analytical Costs

Costs are based on hourly usage, but the following are typical charges:

Full-thin-section compositional maps ~$115.00/thin section
High-resolution grain mapping ~ $150.00 - $300.00/thin section (10-20 grains
Ultrachron dating ~ 600.00-1000.00 per sample

Thus, full analysis costs are typically on the order of $1200.00 per polished section. Careful microstructural analysis typically results in 2 or 3 thin sections with well exposed and interpretable microstructures or reactions for which monazite dates can provide important constraints on tectonic histories.

Preparation for Visit

As noted, compositional mapping is best carried out weeks to months in advance of dating. Mapping can be done in an outside laboratory, but we recommend that students interact with laboratory staff concerning mapping requirements and protocol. For Ultrachron dating analysis, students should send polished sections in advance for aluminum coating and loading in the Ultrachron probe. Pumping, stabilization, standardization and reference standard analysis can take up to 12 hours. Students should arrive at UMass Amherst with high resolution maps and full-section maps in both printed and digital form.

Relevant Laboratory Staff

The UMass Ultrachron Facility is directed by Dr. Michael Jercinovic in collaboration with Michael Williams. Drs. Jercinovic or Williams will carry out machine stabilization and calibration before analytical visits.

Data Processing and Interpretation

While in the lab students will learn how to process, reduce, and display microprobe geochronologic data as well as error analysis techniques. Proprietary laboratory software for data reduction and presentation will be provided to all student visitors for use at their home institution. Drs. Jercinovic and Williams will continue to be available to consult with the students through email and/or videoconferencing in order to evaluate and interpret results.

Expected Lab Availability

In most situations, students may schedule time in the Electron Microprobe Facility with 1-2 months lead time.

Contacts

If you are interested in electron microprobe geochronologic data in the UMass Lab, or would like to discuss potential collaborations, please contact either:

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