AGeS Student Geochronology Research and Training Program Laboratory Overview
UC Santa Barbara LASS-ICPMS Lab
12/02/2024

Lab Description

The University of California, Santa Barbara LASS (Laser Ablation Split Stream ICP-MS) facility is capable of

- simultaneously measuring in-situ U-Th/Pb dates and either trace elements (e.g. Li, Ti, Zr, Sr, Y, REE, Hf, etc.) or complementary isotope tracers (e.g. Li, Lu-Yb-Hf, Sm-Nd, Rb-Sr, etc.) on relatively small volumes of material.
- Measurement of in-situ Rb/Sr, Lu/Hf, K/Ca dates via LA-QQQ-ICP-MS
- Rapid high-resolution elemental and isotopic imaging via LA-TOF-ICP-MS

We routinely analyze a range of accessory minerals and have well-characterized reference zircon, monazite, xenotime, titanite, rutile, calcite, garnet, allanite, baddeleyite, uraninite, thorite, and apatite.

Instrumentation

2x Elemental Scientific Lasers 193 nm excimer lasers with Two-Volume3 ablation cells,
Nu Plasma HR MC-ICP-MS,
Nu Plasma P3D MC-ICP-MS,
Nu instruments Vitesse TOF-ICP-MS,
Agilent 8900 triple quadrupole ICP-MS,
(see here for more information: www.petrochronology.com).

The facility is staffed by full-time senior development engineer Dr. Andrew Kylander-Clark.

Expected Time Frame

Students should expect to spend a minimum of one week visiting our lab for data collection and interpretation. Students can expect to analyze 3 – 5 samples / day. However, the actual time taken to analyze a sample depends on several factors, including the number of spots required (routine is 120 spots for a detrital sample and 40-50 spots for igneous/metamorphic samples), the quality of the preparatory imaging (see below) and the speed and experience of the user.

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

- Identify appropriate minerals using a binocular and/or petrographic microscope (if not already completed prior to the visit).
- Mount and image minerals using appropriate optical/x-ray techniques (if not already completed prior to visit).
- Tune instrument and run standards
- Set up run to analyze samples.
- Check sample status during analysis.
- Reduce data, calculate isotopic ratios, ages and elemental abundances.
- Interpret data.

Analytical Costs

Students should budget $2396/day for U-Th/Pb analyses only or $3188/day for LASS analyses. As noted above analysis time varies considerably, but for budgetary purposes students can expect to analyze a minimum of 5 samples/day. Detailed costs can be viewed here https://www.petrochronology.com/Analysis-Types/User-Fees. These prices include all

consumables, supplies, and training related to use of LASS facility. They do not include use of mineral separation or electron beam facilities at UCSB.

Preparation for Visit

Students should arrive at UCSB with uncoated standard width (≤27mm wide) polished thin sections and/or grains mounted in polished 1" (or 25mm) epoxy resin discs. Locations of all grains should be marked on an electronic image of the mount or thin section that is 1-4X the size of a page. Each grain in thin section should have a second location image that is zoomed in to show just the grain of interest and the immediately surrounding grains; this is absolutely necessary for monazite because it looks very 'ordinary' in reflected light, but generally not necessary for zircon, titanite, and rutile because of their distinct reflected-light signature. Zircon grains should be imaged with CL; for planning purposes, a typical spot size is 20-40 microns. Monazite grains should be imaged with x-rays; good choices include Y, Ca, Nd, Si, Th, U; for planning purposes, a typical spot size is 7-10 microns. Titanite and rutile grains should be imaged with BSE and/or x-rays (e.g., Zr, Al, Th, U). More information on sample preparation is available here: https://www.petrochronology.com/Prepare/sample-preparation.

Students who do not have access to mineral separation facilities should contact either a commercial vendor. By prior arrangement, it may also be possible to use the mineral separation facilities and mounting/polishing facilities at UCSB. However, students should arrive at least 48hrs prior to their scheduled instrument time to allow sufficient time for sample preparation.

Students who do not have access to electron imaging facilities may use the electron-beam instrumentation housed at UCSB. This facility consists of a new Cameca SX100 electron probe microanalyser (EPMA) with five WDS spectrometers, EDS, and CL detectors and a FEI FEG-source scanning electron microscope (SEM) with EBSD, EDS, BSE, and CL detectors. The x-ray facility is staffed by a full-time senior development engineer, Dr. Gareth Seward (seward@geol.ucsb.edu). Potential users should contact Cottle (cottle@geol.ucsb.edu) or Seward to arrange analytical time well in advance of their visit. Information on costs etc. can be found here: https://sites.google.com/site/semgeolucsb/. Use of the SEM/EPMA facility is not covered by costs associated with the ICP lab.

Relevant Laboratory Staff

The UCSB LASS Lab is directed by Professors John Cottle (cottle@geol.ucsb.edu) and Bradley Hacker (hacker@geol.ucsb.edu) and managed by Dr. Andrew Kylander-Clark (kylander@geol.ucsb.edu). Cottle, Kylander-Clark and a UCSB graduate student assistant will be primarily in charge of the visiting students, and will direct their training, sample preparation, analysis, data reduction, and data interpretation.

Data Processing and Interpretation

While in the lab students will be learn how to process and reduce all of the data they have collected. This includes calculation of isotopic ratios and ages, trace element concentrations and the propagation of uncertainties. Cottle and Kylander-Clark 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

We are normally able to accommodate users within 6 - 8 weeks. Potential users should consult our lab calendar (https://www.petrochronology.com/Visit/Schedule) to check availability. Please ignore any names in parentheses – these refer to graduate student 'lab helpers' assigned to that day.