AGeS Student Geochronology Research and Training Program Laboratory Overview

University of Illinois at Urbana-Champaign (U-Th)/He Laboratory

Lab Description

The Helium Analysis Laboratory (HAL) at the University of Illinois contains an ultra-high-vacuum, noble gas extraction and analysis line built by Santa Cruz Laser Microfurnace. Key features of this line include: a) a diode laser, b) fully automated operation with LabView source code, c) cryogenic purification trap, d) calibrated standard and gas spiking system, and e) a Pfeiffer gas source quadrupole mass spectrometer. The system is capable of obtaining blank levels of .1 fmol ^{4}He. A Nikon SMZ-18 stereo microscope with accompanying imaging software is used for grain selection and preparation for ^{4}He analysis. Dr. Guenthner, along with other faculty members in the Dept. of Geology, also maintains a Thermo iCAP Q quadrupole ICP-MS. The iCAP is frequently and routinely used for trace element isotope dilution analysis, with a self-aspirating low-flow PFA nebulizer, an all-PFA sample introduction system, and an ESI autosampler.

Expected Time Frame

The expected time frame varies based upon the number of samples that a student wants to run. We recommend contacting us directly to help decide on a feasible number of samples, and the appropriate number of single grain aliquots per sample that best suits your project. For some context though, in one week's time a student can expect to run ~50 individual zircon grains or ~100 individual apatite grains. The HAL recommends a minimum of 3-5 single grain aliquots of apatite and zircon per sample. These estimates of total grain numbers will include an additional set of standards of known age (typically Durango apatite or Fish Canyon Tuff zircon) of approximately one per 5-8 unknowns.

Initial grain screening for aliquots is a critical component of (U-Th)/He analysis and requires hands-on training for users to properly identify high-quality candidate grains in stereoscope, and develop manual skills to manipulate the micrometer-scale crystals and carrier Nb-tubes. Running samples at HAL is most efficient if the student can prepare grains at their home institution prior to their visit. Dr. Guenthner can facilitate the sample preparation process via zoom instruction, supply recommendations, and providing Nb-tubes to the student. However, if students have no previous experience with grain selection and preparation and/or would prefer to perform their sample preparation at HAL, Dr. Guenthner will train and assist students in this aliquot selection and stereoscope use at Illinois. Please allocate ~1 week of additional time for this process if required.

Visiting students will be expected to run their own samples for degassing on the noble gas line. This develops a new set of lab skills and eliminates some of the potential "black-box" nature of thermochronologic data analysis. Again, Dr. Guenthner will train new users on the line and be on-call to assist should any issues crop out while using the instrumentation. Completing all of the necessary tasks to obtain a (U-Th)/He date can be difficult to achieve in a single visit as learning the necessary tasks for grain dissolution, spiking, and ICP-MS analysis are time intensive. Moreover, safety and cleanliness concerns with respect to wet chemistry spikes and acids are such that these tasks are best completed by experienced individuals to avoid accidents and cross-contamination of

spikes and samples. Dr. Josh Smith, research scientist in the department of Earth Science & Environmental Change at Illinois, will therefore take the lead in performing the wet chemistry methods, although the students are welcome to observe this process if interested.

Analytical Costs

The HAL's rates are assessed at $64 for each apatite analysis and $82 for each zircon analysis. We recommend *at least* 3-5 single apatite grain aliquots per basement sample 3-5 single zircon grain analyses per basement sample. Please note that depending on the project (e.g. detrital samples, samples with exploitable date-eU trends) more aliquots might be recommended. Students should discuss with Dr. Guenthner the appropriate number while they are preparing their AGeS submissions. These prices include all consumables and supplies, use of equipment, training, and preliminary data reduction. In addition, Dr. Guenthner will aid in the interpretation of the data.

Preparation for Visit

Prior to their visit, students should have already obtained mineral separates. A number of commercial mineral separation services exist. If the student does not have access to the equipment necessary to conduct mineral separation methods (crushing, pulverizing, and run through hydrodynamic, heavy liquid, and magnetic separation), they should contact Dr. Guenthner for some suggested companies. Students should also note that not all rock samples provide apatite or zircon in sufficient quantity or quality for useful (U-Th)/He dating. As such, students are encouraged to contact Dr. Guenthner to assess the suitability of these techniques, rock types, and objectives.

Relevant Laboratory Staff

The HAL is directed by Professor William Guenthner and managed by Dr. Josh Smith. Both Dr. Guenthner and Dr. Smith will be in charge of assisting the visiting students and directing their training, sample preparation, analysis, data reduction, and data interpretation. They will also be responsible for the wet chemistry lab methods and ICP-MS analysis.

Contacts

If you are interested in visiting the HAL, or would like to discuss potential collaborations, please contact:

William Guenthner: wrg@illinois.edu
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