

## **EarthScope 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 UIUC 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  $^4\text{He}$ . A Nikon SMZ-18 stereo microscope with accompanying imaging software is used for grain selection and preparation for  $^4\text{He}$  analysis. Dr. Guenther, 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***

Students should allocate at least one week's time for visiting the HAL and analyzing a minimum of 5 samples (assuming 3-5 aliquots of apatite and zircon per sample). This 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. These are included at no additional cost to users. 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. Dr. Guenther will train and assist students in this aliquot selection and stereoscope use.

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. Guenther 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. Guenther 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 5 single apatite grain aliquots per basement sample (\$320/sample) and 3 single zircon grain analyses per basement sample (\$246/sample). These prices include all consumables and supplies, use of equipment, training, and

preliminary data reduction. In addition, Dr. Guentner will aid in the interpretation of the data. Additional minerals (i.e. Fe-oxides) can be run at the HAL as well, but students should contact Guentner first in order to negotiate rates.

### ***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. Guentner 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. Guentner to assess the suitability of these techniques, rock types, and objectives.

### ***Relevant Laboratory Staff***

The HAL is directed by Professor William Guentner and he will be in charge of assisting the visiting students and directing their training, sample preparation, analysis, data reduction, and data interpretation. He is also responsible for the wet chemistry lab methods and ICP-MS analysis. Dr. Guentner is in the process of searching for a laboratory technician to assume some of these responsibilities. However, because he is currently (as of Feb. 2017) the sole staff person in the lab, students should note that his ability to accept new projects may be limited. Please contact him first to discuss availability.

### ***Contacts***

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

William Guentner: [wrg@illinois.edu](mailto:wrg@illinois.edu)