**EarthScope Student Geochronology Research and Training Program Laboratory Overview**

**University of Michigan Thermochronology Lab**
**12/4/2019**

### *Lab Description*

The University of Michigan Thermochronology Lab was established in 2013, and provides facilities for the preparation and analysis of a variety of accessory minerals for (U-Th)/He Thermochronology. The lab is equipped with facilities for sample preparation and grain picking, including rock cutting and crushing labs, a Frantz isodynamic magnetic separator, fume hood space for heavy liquid separation, and a separate microscopy lab with digital cameras. Sample helium analysis is conducted on an ASI Alphachron Helium Instrument consisting of a fully automated diode laser extraction system and quadrupole mass spectrometer. A diffusion cell permits the undertaking of diffusion experiments. Any interest in analysing grains other than apatite or zircon should be discussed with the lab prior to writing a grant. For additional information on the University of Michigan Thermochronology Lab, you can refer to our website at: https://sites.lsa.umich.edu/thermochronology-lab/

### *Expected Time Frame*

Students should expect to spend a minimum of one week visiting the lab for grain selection, packaging, and analysis of bedrock samples. Additional time should be planned if rock crushing and mineral separation are to be completed at Michigan, or if the proposed research involves the analysis of detrital samples. The student will gain a solid background in all steps of sample preparation and (U-Th)/He analysis.

The basic steps that the student will learn and perform during and after the visit are as follows:
- Rock crushing and sieving.
- Removal of organics, clays and carbonates.
- Magnetic separation.
- Heavy liquid mineral separation.
- Identification of appropriate minerals using a binocular microscope.
- Measure and characterize single grain samples.
- Load grains into metal packets.
- Load samples into the Alphachron's ultra-high vacuum helium analysis line.
- Prepare the Alphachron for analysis by running background measurements.
- Set up an automated run to analyse samples and standards.
- Check sample status during analysis.
- Reduce data and calculate total helium abundances.
- Unload samples from the Alphachron.
- Use He, U, Th and Sm data to calculate (U-Th)/He dates.
- Interpret and/or model data.

### *Costs Associated with Visit*

Students should budget $300 for each 4-grain bedrock apatite sample and $350 for each 3-grain bedrock zircon sample. The cost to run additional grains is $40/grain for apatite and $80/grain for zircon. Please contact the lab to discuss customized rates for large-n (>20 grain) detrital thermochronology samples, or for costs associated with the analysis of phases other than apatite or zircon. An additional fee of $60/sample will be assessed for any rock crushing or mineral separation that needs to be completed at Michigan. These prices include all

consumables and supplies, use of equipment, and training. There are several low-cost short-term housing options in the area, please contact the lab to discuss housing budgets.

### Preparation for Visit
Students should arrive at the University of Michigan with the samples agreed upon with the lab. Prior to sample collection, students should have discussed the most suitable sampling target in their field area for sampling and have received instruction on sample collection. Appointments for visiting the lab as well as housing accommodations should be made several weeks in advance. Note that ICP-MS analysis is currently outsourced and final results are typically available 1-2 months after samples are analysed in the lab.

### Relevant Laboratory Staff
The University of Michigan Thermochronology Lab is directed by Professors Nathan Niemi and Marin Clark and managed by Amanda Maslyn. Following project planning with the lab, Amanda will provide training in sample preparation, analysis, and data reduction. Niemi or Clark will be engaged in development of a sampling plan for the proposed research, oversee data analysis, and provide advice on data interpretation and thermal modelling.

### Data Processing and Interpretation
While in the lab, students will learn how to process and reduce all of the collected data. This includes calculation of alpha-ejection factors, raw He age dates, corrected He age dates, and the propagation of uncertainties. In addition, students will be shown the basics of how to use a thermal modelling program to better understand the significance of their results. Lab staff 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
In most situations, students may schedule time in the University of Michigan Thermochronology Lab with 1-2 months lead time.

### Contacts
If you are interested in acquiring (U-Th)/He data in our lab, or would like to discuss potential collaborations, please contact either:

Nathan Niemi: naniemi@umich.edu
Amanda Maslyn: afcarey@umich.edu
Marin Clark: marinkc@umich.edu