Arizona LaserChron Center (www.laserchron.org)

EarthScope Geochronology Graduate Student Award Program

1. Laboratory Facilities and Operation

The Arizona LaserChron Center (ALC) provides opportunities for students to generate U-Th-Pb geochronologic and Hf isotopic information utilizing Laser-Ablation ICP Mass Spectrometry (LA-ICPMS). Primary applications include (1) U-Th-Pb and Hf analyses of detrital and magmatic zircon, (2) U-Th-Pb analyses of titanite, apatite, and monazite, and (3) U-Th-Pb and Hf isotopic analyses of baddeleyite. Researchers are required to come to the lab to generate their data so that they learn the theory and methods of U-Pb geochronology and Hf isotope geochemistry, and are familiar with the strengths and weaknesses of their data. Students are able to come to the lab for sample processing, or to bring mineral separates prepared elsewhere.

ALC facilities include:

-- sample preparation lab (rock crusher, roller mill, Wilfley table, ultrasonic disaggregator)

-- mineral separation lab (heavy liquids, Frantz isodynamic separator, Wig-L-Bug)

-- picking microscopes, mounting materials, and mineral standards for preparing mounts

-- SEM laboratory for sample imaging/analysis, which includes a Hitachi 3400N (for SE and BSE imaging), Gatan Chroma2 CL system (for color CL images), and Oxford EDS & EBSD system (for mineral characterization).

-- Nu HR multicollector ICPMS, with expanded collector block for measurement of Hf-Lu-Yb isotopes and of U-Th-Pb (using either Faraday collectors or ion counters). This instrument is used for U-Th-Pb geochronology and for Hf isotope analysis.

-- Thermo Element2 single-collector ICPMS, with enhanced sensitivity interface. This instrument is used for U-Th-Pb geochronology and for trace element and rare-earth element analyses.

-- Two Photon Machines Analyte G2 excimer lasers.

For most applications, our two mass spectrometers are operated independently in order to generate large data sets (~300 analyses for detrital studies, ~50 analyses for magmatic studies) for U-Th-Pb ages, but Hf isotope data only on targeted age groups. We are also able to operate in split-stream mode for applications where U-Th-Pb and Hf data are needed for every grain, or if high spatial resolution is needed for small/complex grains.

2. Time Frame: The timeline for a typical study is as follows:

-- mineral separates (hopefully of high purity) are sent to ALC at least two weeks prior to a session for mount preparation and initial imaging.

-- researchers arrive and are introduced to lab personnel, facilities, and methods. For the first visit, students are asked to arrive a day or two early so they can participate in preparing and imaging mounts. Background information is provided on basic theory of the U-Th-Pb and Hf isotope systems and on mass spectrometry.

-- Training and data acquisition begin when samples and students are ready. A "minder" is present continuously to monitor instrument operation and data quality for at least the first few hours. Once the operator is comfortable with data acquisition, the minder checks on instrument performance and data quality on an hourly basis.

-- U-Pb ages are generated at a rate of ~100 analyses per hour, whereas Hf measurements are conducted at rate of 20 per hour. We encourage several students to come as a group in order to be able to run day and night. While data are acquired (in fully automated mode for most applications), students are able to evaluate data quality, reduce data, make data tables and plots, and discuss their interpretations. All data are reduced, with final tables/plots prepared and interpretations refined, prior to the end of a visit.

-- following a visit, researchers are encouraged to work with ALC personnel to prepare data and interpretations for publication.

3. Costs: Students should budget:

-- $100 for BSE/CL imaging of sample prior to analysis.

-- $400 to determine U-Th-Pb ages for a detrital zircon sample. An average of ~300 ages will be determined per sample, depending on the number of age groups present. For example, ~100 analyses will be conducted on a sample with only one age group, whereas ~600 will be conducted on a sample with 8 age groups.

-- $200 per sample to determine U-Th-Pb ages for magmatic zircon, titanite, apatite, baddeleyite, and monazite.

-- $300 to determine Hf isotope data for a typical sample.

-- $300 per sample for extraction of minerals of interest. This cost can be reduced if students participate in processing the samples.

Note that ALC provides a travel subsidy of up to $200 per day for students to visit the lab. This covers most travel costs for most visitors. See “Student Support” link at www.lasercrhon.org.

4. Activities prior to a visit. This is highly variable, depending on the student’s prior expertise, facilities available at the home institution, and types of analysis to be conducted. End-members are that a student can bring a rock sample and complete all steps at the ALC, or that a student can bring mounted/imaged samples and conduct only the isotope analyses at the ALC.

5. Staff members who oversee training and operation include: Mark Pecha (PhD student), Alex Pullen (post-doc), Jacob Favela (PhD student), Intan Yokelson (MS student), Nicky Giesler (MS student), and Chelsi White (MS student). Students will work with G. Gehrels on data interpretation and preparation of materials for publication.

6. Data reduction and interpretation – see above.

7. Waiting time for lab usage: We generally schedule visits within 2 months of first contact. This can be reduced for short or high-priority visits. An up-to-date lab schedule can be viewed from the “NU Schedule“ link at www.laserchron.org.

8. Contacts:

Lab Manager: Mark Pecha (mpecha@email.arizona.edu, 520-419-8934)

Lab Director: George Gehrels (ggehrels@email.arizona.edu, 520-349-4702)