

AGeS³ - Advancing Geochronology Science, Spaces, and Systems Laboratory Profile

US Geological Survey – Denver Radiogenic Isotope Lab

Laboratory Description

The USGS Denver Radiogenic Isotope Laboratory is the current incarnation of isotope laboratories operating since the 1960s under the Branch of Isotope Geology. DRIL is a cooperatively-funded mass spectrometry laboratory located on the Denver Federal Center campus in Denver, Colorado. The lab specializes in radiogenic isotope studies that contribute to projects nationwide and internationally in collaboration with scientists from GECSC, G3SC and other USGS Science Centers, as well as with colleagues from other Federal Agencies and academic institutions. The laboratory supports U-Th series geochronology applied to hydrogenic minerals (carbonates, sulfates, silicates), analyzed by thermal ionization mass spectrometry.

Laboratory facilities available for use include a rock sawing and polishing laboratory, sample prep laboratory for drilling or crushing powdered samples in low dust environment, a HEPA-filtered class 10,000, metal-free clean laboratory with HEPA-filtered laminar flow workbenches, exhausting laminar flow hoods and dry down spaces for column chemistry separation of U and Th, and a mass spec laboratory with HEPA filtered sample loading bench. DRIL staff maintain a Thermo-Finnigan Triton TIMS and conduct U-Th series dating by peak jumping using a single secondary ion multiplier ion counter with RPQ filter. DRIL utilizes and in-house mixed ²²⁹Th-²³³U-²³⁶U spike calibrated using gravimetric solutions. Lab performance is monitored by frequent measurement of an in-house secular equilibrium (Schwartzwalder uraninite) and coral (Acropora coral, 120 ka) dating standard as well as measurement of NIST SRM 4321B U isotope standard.

Expected Time Frame

Depending on the number of samples and how much of the procedure the student wishes to actively participate in, we suggest a visit duration of 2 to 4 weeks to complete a “small” project. If sample drilling is done before the student arrives, a visit of 2 weeks is sufficient to prepare one round of ~18 samples in the clean lab and analyze at least one set of 10 samples on the TIMS. If the student wants to do all sample preparation at USGS DRIL, be present for all the mass spectrometry and/or analyze more than 18 samples, more time and/or multiple visits will be necessary.

The following list shows approximately how much time each step in the procedure requires:

Drilling (1 day)

- Collect sample powders using milling machine or mortar and pestle

Chemical preparation (5 days per set of 18 samples)

- Spike with mixed U-Th tracer
- Dissolve powders

- Dissolve secondary mineral phases (e.g., silicate detritus in carbonates)
- Column chemistry
- Column chemistry

TIMS analysis (5 days per set of 8-10 samples)

- Measure U and Th isotopes

Data reduction (1-2 hours per sample set)

- Reduce data with in-house R script, calculate U-series ages using Isoplot or IsoplotR

Analytical Costs

Students should budget a basic charge of \$1000 per analysis (one sample age). However, we will work with investigators to recover sufficient funds to cover costs while not discouraging the visitors from doing enough analyses to solve the problem, regardless of number of analyses.

Preparation for Visit

The best (but not mandatory!) ways to prepare for a visit:

1. Determine U and Th concentrations for samples at home institution or through other collaborations to screen for most successful candidates for dating.
2. Drill powders ahead of time. Typical sample sizes range from 20-200 mg depending on concentrations, approximate age, sample type and study goals. We will assist in deciding optimal sample sizes for each project.

Additional Lab Capabilities

In addition to U-Th series geochronology, USGS DRIL routinely conducts isotope tracer analyses by multi-collector TIMS for minerals, waters, and whole rock samples for Sr, Nd, and Pb. DRIL also owns and maintains an IsotopX Phoenix TIMS with ATONA Faraday amplifiers. CA-ID-TIMS U-Pb dating of zircons is currently under development in the laboratory.

Laboratory Staff

The Denver Radiogenic Isotope Lab is cooperatively run by a number of principal investigators, post-docs, and support staff:

Adam Hudson (ahudson@usgs.gov): Research Geologist (Principal Investigator), GECSC

Hannah Tompkins (htompkins@usgs.gov): Geologist (Lab Manager), GECSC

Richard Moscati (rmoscati@usgs.gov): Research Geologist (Principal Investigator), G3SC

Ryan Frazer (rfrazer@usgs.gov): Research Geologist (Postdoctoral Fellow), GECSC

Neil Griffis (ngriffis@usgs.gov): Research Geologist (Postdoctoral Fellow), G3SC

Miriam Primus (mprimus@usgs.gov): Geologist (USGS Intern), GECSC

James Paces (jbpaces@usgs.gov): Research Geologist (Emeritus), GECSC

Leonid Neymark (lneymark@usgs.gov): Research Chemist (Emeritus), G3SC

Wayne Premo (wpremo@usgs.gov): Geologist (Emeritus), GECSC

Data Processing and Interpretation

Measured isotope ratio data are processed and reduced using an in-house R script to correct for spike and blank contributions, propagate uncertainties, and transform data into ratios necessary for U-Th series dating calculations. Script output is suitable for U-Th series age calculations using Excel-based program Isoplot or in R using IsoplotR. IsoplotR is also available as an online GUI, which is useful for student training to calculate ages, perform detrital Th corrections, calculate isochrons and plot data.

Expected Lab Availability

Students and advisors should contact the laboratory at least 3-6 months in advance and develop a research plan prior to submission of proposals. As a USGS lab, DRIL serves needs of internal federally funded projects first. Availability for collaboration is subject to current workload and staff availability.

Contact Information

If you are interested in pursuing a collaboration for U-Th series dating with DRIL please contact:

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