



Center for Accelerator Mass Spectrometry
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Lab Description

The Center for Accelerator Mass Spectrometry at Lawrence Livermore National Laboratory (cams.llnl.gov) has a long history of facilitating student-lead projects, and leading the development and application of AMS analyses to Earth-system problems and the evolution of Earth's landscape.

We have existing capabilities for AMS-based measurements of the following cosmogenic radionuclides: ^7Be , ^{10}Be , ^{14}C , ^{26}Al , ^{36}Cl , $^{35}\text{Cl}/^{37}\text{Cl}$, and ^{129}I , centered around a $\sim 10,000\text{ ft}^2$ facility which houses three accelerator-based systems. CAMS distinguishes between cosmogenic nuclides (^7Be , ^{10}Be , ^{26}Al , ^{36}Cl , in situ ^{14}C) and the more traditional application of radiocarbon to geochronology and carbon cycle work. The former is referred to as GeoCAMS, and the latter as Natural Carbon, but the distinction is informal and flexible.

Our facilities include a chemistry laboratory for the complete preparation of samples for radiocarbon analysis, where we frequently host visitors learning to prepare their own samples. Because of the additional complexity and use of strong acids, sample preparation facilities for GeoCAMS nuclides are not available to visitors, but we encourage students interested in those analyses who do not have access to a sample prep lab to contact us to discuss possible alternatives. Methods development proposals can, in general, be easily accommodated due to the presence of multiple ion-sources on the main FN accelerator, which allows for analysis of stable isotope beams without affecting other (simultaneous) AMS activities.

Expected time frame

The duration of visits will be specific to the project objectives and will depend on the number and type of samples and the isotope to be analyzed. Students bringing fully prepared cosmogenic nuclide targets may visit for a week or less, while visits to the natural carbon sample prep lab are usually one to two weeks in duration. In general, batches of 10-15 carbonaceous macrofossils (e.g., shells, wood) can be accomplished in a few days, while preparation of bone samples or multiple batches may require two weeks or longer.

Observation of the AMS system and data collection software during the analysis of samples is an important part of the visit, whether or not the samples running are the student's own. Natural carbon runs occur weekly, while GeoCAMS runs are scheduled monthly (^{10}Be) or quarterly (^{26}Al , ^{36}Cl), depending on sample demand; for these isotopes, the visit will be coordinated with the run schedule.

Analytical costs

CAMS' analytical costs are based on per-sample AMS charges, and vary slightly from year to year; currently they range from \$258-\$487 for radiocarbon samples, and \$225-\$728 for GeoCAMS samples. Note that the radiocarbon charge includes both sample preparation and AMS analysis, while the GeoCAMS charge is for the AMS analysis only.

Preparation for visit

For radiocarbon, sample preparation facilities exist for the chemical pretreatment and conversion of carbonaceous materials to graphite for subsequent AMS analysis. We do not have a dedicated sieving and microscope laboratory, so it is highly preferred that macrofossils or charcoal are isolated or picked at the student's home lab. The choice of material that will best provide the desired information can vary greatly with geologic setting, available material, and project goals, and we're happy to discuss sample selection ahead of the visit. We strongly discourage "bulk" dates unless the geology and depositional environment preclude macrofossil dating, or the scientific question being posed can be answered with bulk dates.

As for any lab submitting radiocarbon samples for the first time, students preparing samples in a lab space that does not routinely send radiocarbon samples to CAMS will need to check their lab for tracer ^{14}C contamination prior to bringing samples to our sample prep lab. A swipe kit and instructions for effective swiping will be provided and the cost of initial swipes is borne by CAMS, but 3-4 weeks should be allowed for the swipes to be taken and measured before the visit.

Students in residence will be afforded office space and wireless internet access while visiting CAMS, and will be encouraged to interact with CAMS post-docs and staff and other visitors.

Data Processing and Interpretation

While observing the AMS analysis of samples, students will also be introduced to the procedures for reducing the raw AMS data to isotope ratios, using CAMS' in-house software, including any observations made during the run and assessment of the international standards measured alongside the samples. Students will be guided through the parts of the official CAMS report for the nuclide they are working with, so that they understand the calculations involved in the final age or isotope ratio, and how to take advantage of the additional information included (e.g., stable isotope values, associated blanks and monitor materials, stable isotope currents, etc.).

Expected Lab Availability

Visits for preparation of natural carbon samples can usually be scheduled with 1-2 months' notice; visits for GeoCAMS isotopes will be coordinated with the run schedule, but for ^{10}Be or ^{26}Al can usually also be scheduled within 2-3 months.

Making Connections

At CAMS we value a spirit of scientific inquiry and a desire to better understand the world around us from every perspective. We welcome visitors of every racial, religious, ethnic, sexual, and gender identity. Please be in touch!