AGeS Geochronology Research and Training Program Laboratory Plan

Center for Fallout Radionuclide Analytics (FRNA) at Dartmouth College

Point of contact: Joshua Landis (joshua.d.landis@dartmouth.edu)

Research Scientist Joshua Landis
atmospheric deposition, soil processes

Professor Carl Renshaw (carl.e.renshaw@dartmouth.edu
fluvial geomorphology

Professor Marisa Palucis (marisa.c.palucis@dartmouth.edu)
hillslope processes

Lab Description

Our research uses short-lived radionuclide (SLR) and fallout radionuclide (FRN) chronometers to investigate modern environmental changes over annual to centennial timescales. Our methods span biogeochemical cycles, from atmospheric deposition, soil processes, fluvial transport and lacustrine deposition, to hillslope processes. Applications include reconstruction of conventional (lake, peat) environmental archives; fate, transport and ecosystem cycling of contaminants including mercury (Hg), time and length scales of fluvial sediment transport, and erosion in Arctic landscapes. Students are encouraged to contact any of our PIs for the research venue most-closely aligned with their interests.

Measurements for the SLR and FRN chronometers are performed in the FRNA lab by gamma spectroscopy, which allows us to employ ^{7}Be:^{210}Pb, ^{241}Am bomb-pulse, ^{228}Th:^{228}Ra methods, as well as classical ^{210}Pb methods, all with concurrent measurements. More information is available on our website. We operate 6 Mirion broad-energy germanium (BEGe) gamma detectors, which are optimized for large-volume environmental samples and simultaneous measurement of both low-energy (^{210}Pb, ^{241}Am) and higher-energy (^{7}Be, ^{228}Ra) gamma photopeaks. Small-volume experimental and lake sediment samples may be counted in our Mirion Well-Type 3523 detector. To achieve necessary analytical precision, we count individual samples for up to 7 days, pending needs of individual projects.

Some methods require preconcentration and/or wet chemistry for sample preparation, and these are accommodated in our associated Materials Characterization Laboratory, which is fully equipped with capital instrumentation including ICPOES for measurement of, e.g., yield tracers in chemical separations of FRNs, and direct mercury analyzer (DMA) for Hg measurement in solids, atomic fluorescence Hg analyzer for Hg in liquids, Spex 8000M ball mill, Spex 8530 shatterbox, Wiley mill, as well as fume hoods, freezer-dryer, drying ovens, muffle furnace, centrifuge, analytical balances, etc.

Anticipated Visit Duration

Gamma analysis requires multi-day counts for most samples, and most data sets require weeks to months of dedicated counting time. Consequently, visits may be scheduled either prior to sampling to focus on experimental design, or following analysis to focus on results and interpretation.

Typical visits to the facility are suited to 1-2 days for discussion of the following: (1) visitor's research application and experimental design, (2) sample collection and preparation, (3) data reduction to understand the analytical process and uncertainty propagation, (4) environmental systematics of the radionuclides as they apply to research applications, (5) interpretation of gamma data that is reported by the lab, (6) interpretation of project results if available at the time of visit. Students may visit the lab both pre- and post-analysis if this suits their budget and availability.

Visit Preparation

Researchers interested in submitting samples for analysis should contact us 2-3 months prior to their intended visit time, and prior to any sampling, to ensure that their experimental design is aligned with both FRN environmental systematics and age model assumptions, and that sufficient instrument time can be made available within the appropriate timeframe.

It's a unique logistical challenge that our measurements are time-sensitive. For example, for high-precision ^{7}Be:^{210}Pb chronometry of soils and lake sediments, samples should be prepared for analysis within two weeks of collection due to the ^{7}Be low abundance and short half-life (54 days). This requires close collaboration with the lab to ensure that we have room in the queue at the appropriate time.

Our ability to host AGeS students is subject to instrument availability. Please contact us prior to AGeS proposal submission to ensure adequate instrument time can be made available during the requested timeframe.

Analytical Cost

Sample analysis typically costs $89/sample if prepared and packed by the student. Sample preparation is easy with routine lab facilities, so we typically require that this is done at the student's institution. Note that sample size and geometry is critical to ensure accurate results by gamma spectroscopy, so please contact us prior to sample collection for details and instructions. We must provide you with the necessary sample petri dishes used for analysis.

We have resources to accommodate sample preparation and chemical procedures at FRNA if necessary facilities are not available at the student's home institution – in this case please inquire for sample pricing.

For all general inquires please contact joshua.d.landis@dartmouth.edu