

INSTRUMENTATION AVAILABLE IN THE UPRM GASI LABORATORY:

- ***Micromass IsoPrime magnetic sector isotope ratio mass spectrometer***

Stable isotope ratio mass spectrometry (SIRMS) is widely used in the physical and biological sciences, with applications ranging from environmental and chemical studies to forensic fingerprinting and medical diagnosis. Recent improvements in system performance and on-line sample generation have greatly relieved the time-consuming burden of laboratory preparation, and have made SIRMS a rapid and cost-effective method for routine isotopic analysis of a wide range of compounds.

The Micromass IsoPrime isotope ratio mass spectrometer is the heart of the GASI Lab instrumental array. The IsoPrime is a versatile small-geometry workhorse capable of determining stable isotope ratios in gases ranging in mass from H₂ to SO₂ with high precision. Analyte gases are introduced to the IsoPrime from an array of dedicated peripherals that convert a variety of substrates to a suitable gas. The gas is ionized and accelerated at high voltage through the flight tube, where a high field electromagnetic splits the ion beams on the basis of ion mass and distributes the beams to the collector array. An important upgrade to the UPRM IsoPrime is the addition of an electrostatic filter that eliminates helium gas interference from hydrogen ion beams, permitting the determination of hydrogen isotope ratios in a much greater range of materials.

- ***Micromass MultiFlow/MultiPrep sample preparation system***

Oxygen, hydrogen, and carbon isotopic ratios in natural waters and carbonate minerals provide a wealth of information about environmental conditions including source mixing, evaporation, temperatures of formation, and reactive processes. Although originally developed primarily for scientific research, many of the analytical methods have found broad practical application. For example, isotopic analysis of breath CO₂ has been identified as the most sensitive non-invasive method for detecting the presence of the ulcer-causing bacteria *Helicobacter pylori*, especially in children.

The MultiFlow/MultiPrep sample preparation systems are designed to provide maximum flexibility in the routine isotopic analysis of natural waters, carbonate minerals, and breath CO₂. Both systems employ the Gilson 222XL autosampler to completely automate the sample acquisition process, permitting unattended analysis of up to 60 samples at a time. Analyte gas can be introduced to the IsoPrime via ultrapure helium carrier gas (*MultiFlow*) or through cryogenic trapping in the IsoPrime dual inlet system (*MultiPrep*), providing a choice between cost-efficient quality analyses or maximum analytical precision. Oxygen isotope analysis of natural waters is accomplished through the standard CO₂ equilibration method, which has been adapted from the well-established laboratory technique into a fully automated process. Hydrogen isotope analysis of natural waters (also available through pyrolysis using the *Eurovector EA*) is performed by the H₂ gas equilibration method using Hokko bead catalysis, with precisions that rival off-line U- or Zn-catalysis methods at a fraction of the time and expense. Carbonate mineral analysis for carbon and oxygen isotopic ratios is done via the classic phosphoric acid dissolution method in individual sample vessels, virtually eliminating within-run sample memory effects and improving acid stability for heterogeneous samples. Breath CO₂ analysis is simple, fast and reliable at a very reasonable cost.

- ***Eurovector elemental analyzer***

The combination of elemental analysis and isotope ratio mass spectrometry (EA-IRMS) is a powerful tool in the investigation of a wide range of compounds. EA-IRMS is routinely used to determine carbon and nitrogen isotopic compositions of plant materials, soils, and many other solids that can be converted to gas species through combustion. The resulting isotopic signatures are useful for applications ranging from environmental and biological research to industrial product quality assurance and forensics.

Samples are introduced into a flash combustion chamber with a pulse of pure O₂, converting all carbon-bearing molecules to CO₂ and all nitrogen-bearing molecules to a combination of N₂ and NO_x gases. NO_x gases are then converted to pure N₂ by passing the product gas over hot Cu granules. The resulting gases are swept into the IsoPrime using ultrapure helium carrier gas. Hydrogen isotopic signatures in water can also be measured at very high precision by EA-IRMS pyrolysis with just a simple modification of the reaction chamber. Dedicated solid and liquid autosamplers permit unattended analysis of large sample batches.

The GASI Laboratory is equipped to support pre-analysis sample preparation of many different materials. In addition, the Department of Geology has a full range of geochemical and sedimentological preparation facilities that support the GASI Laboratory.