Paleontology, Stratigraphy, and Macroevolution
The Paleontology, Stratigraphy, and Macroevolution Research Group (PSMRG) examines the evolving relationships of Earth systems—lithosphere, hydrosphere, atmosphere and biosphere—through the full range of geologic time, including the present day. In particular, we are dedicated to understanding Earth’s history as preserved in its paleontological and stratigraphic records, and, from this, determining the ways that the physical-chemical-biological history of Earth has impacted the evolutionary trajectories and extinction histories of life.
The Earth is some 4.6 billion years old and has evolved markedly through time as a result of long-term changes to its physical dynamics and attributes, the rise of life, and contingencies such as extraterrestrial impacts and the origin of a singular species, Homo sapiens, all of which have had measurable and pronounced effects. Earth System history examines the dynamic history of the Earth and its synergistic relationship with life through the full range of geologic time. Exploring fundamental themes in the study of Earth System history, PSMRG studies the connections and interactions among changes in climate, sea level, and biology across ecosystems, whole geographic regions, and the entire globe.

The Department of Geology at the University of Cincinnati has a long and distinguished record of research in Paleozoic paleontology and sedimentary geology, the investigation of multi-scale patterns and process of diversification and extinction through time, and the processes responsible for the formation of fossil assemblages. Over the past decade, PSMRG has achieved and maintained national acclaim as one of the top ten programs in paleobiology in the United States as ranked by U.S. News and World Report. A unique aspect of UC’s program is the integration of empirical field-based study and theoretical approaches to paleobiology and sedimentary geology. The outstanding outcrops of Ordovician to Pennsylvanian age within easy reach from the University provide an unparalleled natural laboratory for study of the sedimentary geology and paleobiology of Paleozoic foreland basin and epicontinental seas. The group’s research interests also routinely carries its members around the world to investigate Earth’s geological record up close, and to directly investigate preservation, deposition and anthropogenic impacts in present-day settings. Recent additions to our faculty have extended our reach to some of the Earth’s oldest ecosystems preserved in Archean and Proterozoic rocks, as well as its youngest epochs: the Pleistocene and Anthropocene.
Paleoecology and Ecology

Paleoecology seeks to interpret the modes of life of ancient organisms and their interactions with environments and one another. Meyer has extensively examined living crinoids and coral reefs as a means of better understanding their ancient counterparts. Professors A. Miller and Meyer have long been interested in high-resolution investigation of paleoecological gradients in the famous Late Ordovician strata of the Cincinnati region. Meyer, Brett, and colleagues are engaged in a variety of paleoecological studies of Paleozoic invertebrates, including trilobites and echinoderms, to reconstruct modes of life, behavior and ecology of these extinct organisms. Studies are also focused on ancient organism interactions such as predation, parasitism and competition and their importance in the evolution of ecosystems. Professors Brooke Crowley, Josh Miller, and Yurena Yanes are actively studying environmental and dietary preferences and constraints of much more recent Pleistocene and Holocene terrestrial animals including primates and other mammals and land snails. Crowley and Yanes use stable isotopes to examine environmental gradients (e.g., temperature, aridity) in plants and animals. A. Miller is extending the gradient approach to the present-day investigation of anthropogenic influences on plant community composition along a present-day urban-to-wildland gradient in southwestern Ohio.

Taphonomy

A theme that undergirds the entire field of paleobiology is taphonomy, the study of preservational processes and biases in the geological record. PSMRG has long been interested in studies of ancient taphofacies and of modern taphonomic processes. Work by Professor Andy Czaja has examined the preservation of fossil plant material as well as preservation and biogeochemistry of ancient Precambrian microfossils. Joshua Miller has studied how the ecologies of modern mammal communities are recorded in bone accumulations and the time incorporated in such assemblages. Professor Carl Brett has developed the concept of taphofacies: suites of preservational features that aid in interpreting ancient environments and he is continuing to apply this concept to Paleozoic marine rocks. Researchers in UC’s Geology Department have also dealt extensively with modern marine environments and the potential fossil records accumulating within them; for example, Professor David Meyer has made extensive SCUBA studies of modern coral reefs; Brett is involved in on-going experimental study of fossil preservation in the Gulf of Mexico and Bahamas; Professor Arnie Miller and his students have examined the record of shell accumulations in modern lagoonal and sea grass bed environments in St. Croix, US Virgin Islands, most recently with the goal of utilizing these accumulations to diagnose anthropogenic impacts on community composition.
Biogeochemistry

Studies of biogeochemistry have expanded with the hiring of Diefendorf, new research professors J. Miller and Yanes, and joint hires Czaja (Geology and Chemistry) and Crowley (Geology and Anthropology).

Crowley uses stable isotope values in plant and animal tissues to reconstruct the recent, historic, and ancient ecology of extant and extinct organisms, particularly mammals. Much of her research has been focused on quantifying ecological changes following Late Holocene extinctions and anthropogenic impacts in Madagascar. She and her students are currently developing new projects in the Dominican Republic, Trinidad and Tobago, and the Ohio River Valley.

Diefendorf and Crowley are directing the department’s brand new stable isotope facility, which will be able to analyze nitrogen, oxygen, and organic and inorganic carbon in solids and liquids. This lab will serve as a crucial teaching and training facility for students.

Czaja uses both organic geochemistry of kerogen and stable isotope geochemistry to study the Precambrian biosphere. He performs organic geochemical analyses of fossil plants and microorganisms in order to study the level of thermal alteration and composition of the fossil material. These analyses are performed using Raman spectroscopy in his new Precambrian Paleobiology Laboratory, and using nuclear magnetic resonance spectroscopy and pyrolysis gas chromatography/mass spectrometry. Czaja measures the stable iron isotope compositions of Precambrian sedimentary rocks, namely banded iron formations (BIFs), carbonates, and shales, in order to understand the evolution of Earth’s surface environment, and constraining the timing of the rise of various microbial metabolisms.

Evolutionary Paleocoeology and Paleobiogeography

Another theme that underlies much PSMRG research is evolutionary paleoecology and paleobiogeography: the stability and/or changes of ecosystems and paleogeographic regions in response to environmental perturbations on time scales ranging from years and millennia to hundreds of millions of years. In studying aspects of the Precambrian and Phanerozoic record on regional to global scales PSMRG seeks to diagnose and explain patterns of fossil occurrence, and changes of those patterns throughout the stratigraphic record.

A highly resolved stratigraphic record is key to understanding processes in Earth System history. To this end, several PSMRG researchers conduct stratigraphic research, utilizing tools such as high-resolution biostratigraphy, sequence stratigraphy (Brett) bentonite event-stratigraphy (Professor Warren Huff), and chemostratigraphy (Professors Barry Maynard and Thomas Algeo). Research on stratigraphic paleontology is directed toward the causes of periods of abrupt change as well as long interludes of effective taxonomic and ecological stasis, mass extinctions and recoveries.
Global Diversity and Extinction

SMRG has long been interested in studying large-scale patterns of biodiversity and extinction throughout the Phanerozoic Eon. Building on his earlier work on the global paleogeographic dissection of a large-scale diversification event during the Ordovician period, A. Miller was part of a group that founded The Paleobiology Database (PBDB; paleodb.org). PBDB is an online catalogue of fossil occurrences worldwide that permits the investigation of broad-scale patterns and processes of diversification and extinction throughout the history of multicellular life. A. Miller and his colleagues have sought to better calibrate the extent of diversity increases and decreases through time, and to better understand the relationship between diversification at multiple scales, ranging from the community level up to the global level.

Patterns of abrupt extinction and biotic change may be related to episodes of sea level, climate change, or human impacts. Thus, Brett and Algeo study the detailed sequence stratigraphic and geochemical records, in tandem with the biotic record of critical intervals to better understand the mechanisms behind periods of faunal turnover and mass extinction. Still other insights into changing environments and primary productivity may be gained by examining the organic geochemistry of sediments; the research of Professor Aaron Diefendorf utilizes biomarkers-chemical fossils in examining the record of ancient terrestrial and marine ecosystems. On a somewhat broader scale A. Miller investigates the comparative dynamics of diversification and mass extinction in ancient epi-continental seas as compared to open-ocean settings, and Algeo compares and contrasts the nature of mass extinction among regions worldwide during the largest extinction event in the history of life, at the end of the Permian Period, some 250 million years ago. Crowley has been investigating the causes and consequences of extinctions and local extirpations of terrestrial vertebrates during the Holocene.

This latter approach is but one example of the developing field of conservation paleobiology, which utilizes data on taphonomy, biogeochemistry, and isotope geochemistry of Quaternary and Holocene fossil/subfossil assemblages to provide baselines for ecological conditions prior to human impacts. Professors Crowley, J. Miller and Yanes are all conducting research at the forefront of this field.
**PSMRG Program Research Goals**

- Contribute to the understanding of preservational (taphonomic) processes which alter living organisms and communities into biased, time-averaged fossil assemblages

- Utilize the Quaternary and Anthropocene fossil and subfossil records to identify historical ecological baselines, diagnose anthropogenic impacts on natural ecosystems, and inform conservation and management efforts in modern environments.

- Develop improved conceptual models of sequence stratigraphy and their ramifications for how we understand the geologic record of past changes in biology, sea level, sedimentation, and climate, especially in ancient cratonic settings.

- Develop high-resolution temporal and stratigraphic frameworks for examining Earth and life histories; utilizing sequence and event stratigraphy coupled with refined bio-, chemo-, and magnetostratigraphy.

- Examine the geochemical history of oceans and terrestrial settings using stable isotopes, trace elements, and biomarkers for improved understanding of the origins and biogeochemical conditions of life in Earth’s diverse ecosystems through time.

- Elucidate the history of life’s biodiversity, including evolutionary radiations, mass extinctions, and recoveries, and evolutionary paleoecology in relation to changing physico-chemical conditions of marine and terrestrial environments.

**Major Research Areas:**

- Processes and biases of fossilization in the geologic record

- Ecosystem responses to environmental change

- Relationships between past and current biodiversity, paleoecology, and ecological change

- Physical and temporal relationships among rock strata

- Origin and extinction of species
Recent Funding

- (PI), Algeo, Thomas, Uranium Isotope Variations in Carbonates: Validating A New Paleoredox Proxy, National Aeronautics and Space Administration.

- (PI), Brett, Carlton, Revised Silurian Stratigraphic Correlation of the United States, U.S. Geological Survey.

- (Collaborator), Algeo, Thomas; Crowley, Brooke; Diefendorf, Aaron; Townsend-Small, Amy, Acquisition of Stable Isotope Instrumentation for Biogeochemistry Research and Teaching at the University of Cincinnati, National Science Foundation.

- (PI), Diefendorf, MRI: Acquisition of Stable Isotope Instrumentation for Biogeochemistry Research and Teaching at the University of Cincinnati, NSF.

- (Collaborator), Cameron, Guy; Fowler, Thaddeus; Huff, Warren; Jackson, Howard; Kukreti, Anant; Meyer, Helen; Rutz, Eugene, The Cincinnati Engineering Enhanced Mathematics and Science (CEEMS) Program, National Science Foundation.

- (PI), Miller, Arnold, Epicontinental Seas Versus Shallow Ocean-Facing Settings: Mass Extinction and Diversification in Two Different Worlds?, National Aeronautics and Space Administration.

- (PI), Miller, Joshua, Antlers of the Artic Refuge: Revealing Historical Caribou Calving Grounds From the Bones on the Tundra, National Geographic Society.

- (PI), Yanes, Y., Los gasteropodos terrestres de Lanzarote y Fuerteventura como indicadores paleoambientales, Spanish Ministerio de Economia y Competitividad (Mineco)
Dr. Algeo’s research specialization is sedimentary geochemistry with applications to paleoceanographic and global systems analysis. His research focus is directed along three broad themes: environmental change at the Permian/Triassic boundary, the relationship of land plant evolution to weathering rate changes and global events during the Middle to Late Devonian, and the development of trace-metal redox proxies to study paleomarine systems.

Dr. Brett’s research lies at the interface between paleontology and sedimentary geology. Brett is pursuing studies relating regional and global changes in sea level, climate, and the carbon cycle to episodes of biotic change (bioevents) and extinction, and time-specific sedimentary facies. He is especially involved in establishing regional and global patterns of Paleozoic sequence stratigraphy and relating them to prolonged intervals of relative biotic stability—which he termed “coordinated stasis”, and episodes of abrupt change. He also maintains active research in taphonomy, including comparative fossil preservation and modern experimental approaches, designed to test the concept of taphofacies. He is pursuing studies of ancient organism interactions, including organism-substrate relationships and the mid Paleozoic predator revolution, and has interests in the paleobiology of marine invertebrates, especially echinoderms and arthropods. Dr. Brett has spent four decades researching the paleontology and stratigraphy of the mid Paleozoic strata of eastern North America and is a member of the international Subcommissions on Stratigraphy of the Ordovician (SOS), Silurian (SSS), and Devonian (SDS); he is presently Vice Chair of SDS.
**Brooke Crowley (Departments of Geology and Anthropology): Assistant Professor of Geology and Anthropology**

Dr. Crowley uses stable isotope biogeochemistry to answer a variety of questions about modern and extinct mammal communities. Her main research interests include extinction, environmental and ecological consequences of human impacts, habitat transformation and conservation. Dr. Crowley’s current projects revolve around using stable isotope biogeochemistry to detect ecological differences among modern and extinct communities of mammals. Currently, she examines the effects of habitat and dietary differences on the isotopic signatures in modern species. She then uses these isotopic patterns in modern individuals to understand dietary niches and habitats for animals in the past.

**Theresa Culley (Department of Biology): Professor, Biological Sciences**

Dr. Cullry studies plant population biology and genetics, including ecogenomics; speciation in plants, including integrative taxonomy in the plant genus Camassia; evolution of breeding systems, especially cleistogamy in violets and dioecy in Hawaiian taxa; ecological and genetic effects of habitat fragmentation; ecophysiological ecology; evolution of invasiveness; airborne pollution effects on plants.


Andrew Czaja (Departments of Geology and Chemistry): Assistant Professor of Geology and Chemistry

Dr. Czaja’s overall interests are the origin and early evolution of life on Earth and the possibility of life elsewhere in the universe. He approaches these fields through the study of Precambrian fossil microorganisms (microfossils) and organic and isotopic biogeochemistry. His specific areas of interest include the diversity and evolution of Precambrian microfossils (particularly those of the Archean Eon, >2.5 billion years ago); the search for geochemical evidence of past terrestrial life and past or present extraterrestrial life; and understanding the geochemical alteration of fossil organic matter and inorganic aspects of permineralization. Dr. Czaja has field sites in Western Australia, South Africa, and Ontario, Canada. He also studies the ancient biogeochemical redox cycling of iron through iron isotope analyses of ancient sedimentary rocks, including banded and granular iron formations. For this work, Dr. Czaja collaborates with Drs. Clark Johnson, Brian Beard, and Eric Roden, members of the Wisconsin Astrobiology Research Consortium, one of the lead teams of the NASA Astrobiology Institute.

Aaron Diefendorf (Department of Geology): Assistant Professor, Geology

Dr. Diefendorf’s research aims to contribute to our understanding of future global change by examining changes in ancient climate, ecology, and the carbon cycle from the Cretaceous to the Holocene by using organic and stable isotope biogeochemical tools. His interests are focused on reconstructing changes in paleoecology, paleoenvironment, and paleoclimate using organic and stable isotope biogeochemical tools. His current research is developing tools to reconstruct changes in terrestrial paleoecology and paleoclimate using fossil chemicals (biomarkers) specific for various plant taxa. These plant-specific biomarkers are produced in plant leaves and are preserved in Quaternary terrestrial and aquatic sediments. Changes in the type and abundance of biomarkers provide clues to paleoecological change and their carbon and hydrogen isotope ratios provide powerful information on the paleoenvironment. Research field areas include Wyoming, Tennessee, Florida, North and South Carolina, Georgia, California, and Ireland.


PSMRG Faculty
**WARREN HUFF (Department of Geology):**
Professor, Geology

Dr. Huff’s training and expertise involve study of the mineralogy and geochemistry of clay. His focus has been on topics ranging from the mineralogy and geochemistry of Paleozoic K-bentonites and their application to the solution of tectonomagmatic and regional stratigraphic problems to Quaternary clays in glacial environments. Much of Dr. Huff’s research deals with the study of K-bentonites, which are the remains of explosively erupted volcanic ash layers. These layers are now altered largely to clay minerals although some original volcanic crystals remain. He studies both types of minerals to learn about the nature of the source volcanoes, many of which are over 400 million years old, as well as the natural processes by which the volcanic ash layers have been buried in the earth and altered to their present form.

**J. BARRY MAYNARD (Department of Geology);**
Professor, Geology

Dr. Maynard’s research career has focused on the chemistry of metals at the Earth’s surface, with principal focus in recent years on Mn, Fe, Cu and Pb. Systems studied include Mn-Fe ore bodies, constructed wetlands treating mine drainage, slope stability problems, and corrosion scales in drinking water systems.

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Arnold I. Miller  
(Department of Geology):  
Professor, Geology

Dr. Arnie Miller’s research aims to understand biodiversity throughout geological time and in the present day. Currently, the central focus of his work is the interpretation of major changes in global biodiversity during the history of life, including brief intervals of time when global biodiversity dramatically decreased (mass extinctions) or increased (radiations). Dr. Miller’s other interests are: analyses of shells accumulating on present-day seafloors both to better understand the formation of ancient fossil assemblages and to help diagnose recent, anthropogenic changes in coastal environments; the numerical modeling of the formation of fossil assemblages; and distributions of ancient communities of marine organisms in association with environmental gradients. Recently, he has also begun collaborating with colleagues in the Departments of Biology and Geography in an investigation of the effects of urbanization on the distribution and abundance of plant species in urban-to-rural settings.


Joshua Miller (Department of Geology): Research Assistant Professor, Geology

Dr. Josh Miller studies naturally occurring bone accumulations on landscape surfaces (death assemblages) to recover high-quality historical population and geographic-use data on modern mammal communities. Bones survive on landscape surfaces from decades (in tropical regions) to millennia (in Arctic latitudes), providing historical ecological data that are otherwise unavailable for most ecosystems. Dr. Miller works closely with ecologists, wildlife managers, and conservation biologists to incorporate the methods and time-scales offered by conservation paleobiology into fundamental and applied wildlife research, and to inform public policy. Dr. Miller is also recalibrating our understanding of the ecological quality of fossil records and studying changes in mammalian ecology during the Quaternary and Holocene. Current field sites include the Arctic National Wildlife Refuge (AK), Yellowstone National Park (WY), Denali National Park (AK), Isle Royale National Park (MI), the Wind River Mountains (WY), Amboseli National Park (Kenya), and Ellesmere Island (Canada).

Kenneth Petren (Department of Biology): Professor, Biological Sciences

Dr. Petren's lab uses a broad range of approaches to understand speciation, population divergence, dispersal and species interactions in natural populations of vertebrates. Major research contributions are in the field of comparative landscape genetics, where molecular markers (like those used in forensics) are used to trace or ancestry and population history, and in the field of behavioral mechanisms of ecological interactions, where invasive species are used as model systems. Research areas include evolution and adaptive radiation of Darwin's finches and the dynamics and consequences of lizard invasions. The Petren lab combines molecular genetic techniques, laboratory experiments of behavior, and manipulative field experiments to understand population divergence and ecological species interactions. Field research is conducted on the remote islands of the Galápagos archipelago, South America, the tropical Pacific, the southeastern USA, and right here in Cincinnati, Ohio. For more information, Dr. Petren is part of the growing Integrative Behavior group within Biological Sciences.

References:


YURENA YANES (Department of Geology), Assistant Professor, Geology

Dr. Yanes’ research interests are primarily focused on the multidisciplinary study of modern and fossil land snail assemblages. She integrates disparate data from manifold disciplines, including isotope geochemistry, taxonomy, taphonomy, paleoecology, morphometrics and amino acid dating. These data are used jointly to reconstruct changes in past environmental and ecological conditions, to evaluate the quality and fidelity of the fossil record, and to better understand organism–environment interactions. Understanding how organisms have responded to ecological, environmental and anthropogenic variations is critical to comprehend present diversity and anticipate future outcomes (i.e., the past is the key to the future). Her main field research areas are low–latitude oceanic islands such as the Canary Archipelago and the Bahamas. Tropical islands exhibit outstanding land snail diversity in both space and time, and appear to be especially sensitive to human impact and global change. Ultimately, her research aims to help to protect terrestrial malacoфаunas, which are declining in an alarming rate.


**Recent PSMRG Masters Theses**

- Anne Lagomarcino 2011: “The relationship between genus richness and geographic area in Late Cretaceous marine biotas”
- Nadeesha Koraledara 2011 “Chemical, mineralogical and textural properties of the Kope Formation mudstones: how they affect its durability”
- Nathan Marshall 2012: “Silt in the upper ordovician kope formation (Ohio, Indiana, Kentucky): the enlightening wildcard”
- Thomas Schramm 2012: “Sequence Stratigraphy of the Late Ordovician (Katian), Maysvillian Stage of the Cincinnati Arch, Indiana, Kentucky, and Ohio, U.S.A”
- Jeffrey Hannon 2012: “Microendolithic structures from the Fort Payne formation (lower Mississippian), Kentucky and Tennessee: implications for the paleoenvironment of carbonate mudmounds”
- Zach Mergenthal 2012: “Preliminary investigation of N-alkanes and alkenones in East Greenland lacustrine sediment: implications for possible Holocene climate reconstructions”
- Tanya del Valle 2013: “Comparative Growth Rates of the Extinct Coral Montastrea nancyi: A Dominant Framework Builder in the Pleistocene (MIS 5e) Reefs of Curacao, Netherland Antilles”
- Sharmila Giri 2013: “Modern plant-derived terpenoids in an upper Michigan River basin and implications for studying ancient terpenoids”
Recent PSMRG Masters Theses

Nicholas Sullivan 2013: “Refinements to the depositional history of Lower Silurian Strata in the northeastern United States by means of conodont biostratigraphy, d13C chemostratigraphy, sequence stratigraphy, and magnetic susceptibility”

Recent PSMRG PHD Dissertations

Michael Desantis 2011: “Anatomy of Middle Devonian faunal turnover in eastern North America: implications for global bioevents at the Eifelian-Givetian stage boundary”

Brian Nicklen 2011: “Establishing a tephrochronologic framework for the middle permian (Guadalupian) type area and adjacent portions of the Delaware basin and northwestern shelf, west Texas and southeastern New Mexico, USA”

James Zambito 2011: “The Late Middle Devonian (Givetian) global taghanic biocrisis in its type region (Northern Appalachian Basin): geologically rapid faunal transitions driven by global and local (Distinguished Doctoral Dissertation Award, College of Arts and Sciences)

Zhenzhu Wan 2012: “Stable carbon and nitrogen isotopic studies of Devonian land plants - an indicator of paleoclimate and paleoenvironmental changes”

Sarah Kolbe 2013: “Forest ecosystem response to environmental pressures along an urban-to-wildland gradient in southwestern Ohio”

Research Laboratories

Luminescence Dating Laboratory

Full sample preparation facilities for luminescence dating are available in the Department of Geology. These include: sieving equipment; heavy liquid separation facilities; and acid treatment equipment. A Riso Automated TL/IRSL/Blue OSL Dating System DA-15C/D will be used to make the OSL measurements. A Daybreak alpha counter is also available and will be used to help determine the concentrations of radioisotopes in sediment to help calculate dose rates. The laboratory also has an Ortex MicroNOMAD portable spectroscopy system with NaI detectors and an InSpector 1000 high-performance digital hand-held spectrometer for field dose rate determination.

Cosmogenic Nuclide Laboratories

The Department of Geology has facilities to prepare sediment and rock samples for Be-10 and Al-26 cosmogenic nuclides surface exposure dating and erosion studies. The laboratories include a rock crushing laboratory; heavy liquid a separation laboratory; and a chemistry laboratory that has ultrasonic baths, hot rollers for leaching sediment and rock, columns for cation and anion exchange, HF and perchloric acid hoods for acid work, and hoods for target loading.
Quaternary Sediment and Coring Laboratory

This laboratory integrates field and laboratory equipment for taking and analyzing sediment cores, principally glacial lake cores. Included in this laboratory is a Coulter counter grain size analyzer; a Strato-box marine geophysical sonar core for seismic profiling of subsurface sediments; a high-resolution imaging microscope; a custom, high-resolution sediment core photography frame; a magnetic susceptibility instrument; a muffle furnace and a low-temperature oven for drying samples; and two dedicated microcomputers. There are two coring units: a Limestone piston coring system with a stainless steel extractable core, and a “Bolivian” piston coring unit with a clear polycarbonate tube. Lakes cores are taken from a pontoon raft equipped with a coring tower and a mechanically-powered winch supported by a Zodiac and a Boston Whaler.

Organic Geochemistry Laboratory

The Department of Geology Organic Geochemistry Laboratory is equipped to process modern and ancient soils, plants, sediments, and rocks. The laboratory has general organic geochemistry equipment including a Beckman Coulter centrifuge, Mettler Toledo balance, Mettler Toledo pH meter, water purification system, drying ovens, large muffle furnace, refrigerator, freezer, glassware, and lipid standards. For lipid preparation, the laboratory has a Dionex ASE 350 solvent extraction system, a TurboVap LV for solvent evaporation, nitrogen blow-down stations, and other lipid preparation equipment. The laboratory houses an Agilent 7890A gas chromatograph (GC) with autosampler, multimode and cool on-column injector, a two-way splitter, a flame ionization detector, and an Agilent 5975C quadrupole mass spectrometer (MSD) for the identification and quantification of organic matter. The GC/MSD is equipped with the NIST 2008 and Wiley Spectral libraries and a data analysis workstation.

Stable Isotope Facility for Biogeochemical Research

The Department of Geology is currently seeking funding for a stable isotope ratio mass spectrometry (IRMS) facility. This facility would include the ability to measure stable isotope ratios of carbon, nitrogen, hydrogen, and oxygen. This lab would include a Thermo Delta Advantage IRMS and peripheral devices to measure carbon and nitrogen isotopes in organic matter (e.g., soils, lake sediments, plant and animal tissues), carbon and hydrogen isotopes of biomarkers, oxygen and hydrogen isotopes of waters, carbon and oxygen isotopes of carbon dioxide in air, carbon and oxygen isotopes of carbonates (e.g., shells, lake marls), and nitrogen isotopes of nitrates.

Biogeochemistry Laboratory

The Department of Geology biogeochemistry facility is set up for the analysis of dissolved organic carbon and nitrogen in waters with a Shimadzu TOC/TN analyzer, the analysis of carbon and nitrogen concentrations of organic matter in various substrates (e.g., soils, lake and marine sediments) with a Thermo Flash Elemental Analyzer, the analysis of carbon dioxide, methane, and nitrous oxide gases with a Shimadzu gas chromatograph, and the analysis of dissolved inorganic nitrogen with a Biotage spectrophotometer.
**X-ray Laboratory**

This laboratory, located in the Department of Geology, is equipped for two principal modes of X-ray analysis: diffraction (XRD) and fluorescence (XRF). The Department has the services of a full-time staff person for the maintenance and operation of this facility. The XRF unit is a Rigaku 3070 wavelength dispersive system that was purchased in 1987. Instruments such as the Rigaku ZSX Primus II Sequential Wavelength-Dispersive XRF Spectrometer and the Rigaku XRD Ultima IV X-Ray Diffraction System combine great accuracy and sensitivity with ease of operation. The Ultima IV is a high-quality X-ray diffractometer system that is easy to use, highly accurate, and has the versatility to meet all of our teaching and research needs in X-ray diffraction. XRF systems like the ZXS Primus II spectrometer provide the ability to process very small samples and to include a wide range of elements.

**Spectral Gamma Ray Core Logger**

A Core Lab SGL custom-built spectral gamma core-logging instrument is located in the Department of Geology. It generates total API, 40K, 232Th, and 238U data; a bulk density feature allows corrections for non-uniform core diameter.

**Ohio Valley Archaeology Laboratory**

This laboratory is located in the Department of Anthropology and is equipped to conduct particle size analysis of unconsolidated Quaternary sediments, extract bulk soil organic matter from core samples, and extract bone collagen and hair protein for stable isotope analyses. In addition to standard chemicals for acid-base-acid pretreatments and equipment such as analytical balances and glassware, the laboratory has a magnetic susceptibility meter with high-resolution probes, two proton magnetometers, single junction ion selective electrode for fluoride dating of bone, two petrographic microscopes, ten binocular microscopes, and a digital microscope for photo-microscopy. The laboratory also has a computer workstation for data analysis and GIS.

**Court Archaeological Research Facility**

This field laboratory is currently under construction at the University of Cincinnati’s Center for Field Studies. The new laboratory will be used for the processing artifacts, Quaternary invertebrate, vertebrate, and plant remains, and sediments from drill cores and excavation. The laboratory will have a fume hood, basic laboratory equipment, 3-d image scanners, a digital microscope, a computer workstation for analysis and data management, and a dedicated curation room for core, sediment, ecofact, artifact, and archival records. The laboratory will also have a laboratory smart classroom.
PALEOETHNOBOTANICAL LABORATORY

This facility is located in the Department of Biological Sciences and is equipped to process and analyze archaeological plant materials using light and electron microscopy. Equipment includes a phase contrast compound microscope, various binocular light microscopes with digital imaging capabilities, a fume hood and computer workstations configured for image processing, data analysis and GIS applications. Over 3000 plant reference specimens from North America, Central America and Northern India are housed in the laboratory.

GIS AND REMOTE SENSING LABORATORIES

Three state-of-the-art GIS and remote sensing research and teaching laboratories located in the Department of Geography with high performance computing and environmental monitoring capabilities supporting the processing and analysis of multi-spectral, hyper-spectral, radar, and lidar imagery and the development of geographic information systems and networks.

HUMAN EVOLUTIONARY LOCOMOTOR LABORATORY

The Department of Anthropology Human Evolutionary Locomotor Laboratory examines human gait performance and hominin evolutionary anatomy through experimental biomechanics and modeling. The lab is equipped with an eight camera Vicon MX T10 motion capture system, two force platforms (AMTI BP 400600 and Bertec 4060-07-1000), a Basler piA640-210gm high speed digital video camera and a Smooth Power treadmill.

CLAY MINERALOGY LABORATORY

The study of clay minerals requires a variety of sample preparation methods including high- and low-speed centrifugation, high- and low-temperature treatment, ethylene glycol saturation, ultrasonic disaggregation, and treatment with a variety of toxic chemicals. All of these facilities are available in the clay mineralogy laboratory along with high-speed grinding and crushing equipment. The lab is located adjacent to the XRD and XRF laboratories for easy access to those analytical facilities.
Key Field Areas

The PSMRG has active research in the above regions

Research Opportunities

Doctoral Graduate Support
The PSMRG and the Department of Geology provides a range of financial support opportunities for graduate students, including research and teaching assistantships, fellowships, tuition waivers and grants for research expenses.

Graduate Students
Prospective students are advised to contact individual members of PSMRG about opportunities for graduate study and research.

Weekly Seminar
The PSMRG holds a weekly seminar for its members to present current research and for invited speakers. This is hosted by the Department of Geology.
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