Lab Dedication Highlights

On September 21, 2000, the Eugene N. Cameron Electron Microprobe Laboratory was dedicated along with the new Rare Gas Geochronology and Radiogenic Isotope laboratories. Following an open house and unveiling of a plaque that dedicates the Eugene N. Cameron Electron Microprobe Laboratory, attendees gathered in the L.R. Laudon Lecture Hall to hear Professor John Valley speak about Eugene N. Cameron and his contributions to the department, and Professors Brad Singer and Clark Johnson describe the Rare Gas Geochronology and Radiogenic Isotope laboratories. Those who stayed the full afternoon were rewarded with a supper buffet in the Geology Museum atrium. A synopsis of the lab descriptions of John Fournelle and John Valley, Brad Singer, and Clark Johnson follows.

Eugene N. Cameron Electron Microprobe Lab

The University of Wisconsin's first Electron Microprobe Lab came into existence in 1966 when Gene Cameron took the initiative to make a successful application for funds to the National Science Foundation. Raymond Castaing had invented this research instrument at the University of Paris in 1951, and by 1956 the first commercial electron microprobe (Cameca) was available. Gene Cameron had developed the science of reflected light microscopy to study ore minerals and pushed this technique to its limits. He was well aware of the additional power of the microprobe to provide precise, micron-scale chemical data on the specimens that he and his students were studying-from the Bushveld, Stillwater and other layered complexes.

In 1966, with $50,000 from WARF and $50,000 from NSF, Gene acquired an Applied Research Laboratories (ARL) "EMX" electron microprobe. Soon thereafter Everett Glover was employed to run the probe lab, which he did until retiring in 1992. The probe was located at 917 University Avenue, and remained in operation until December 1980. Scores of students learned how to use this unautomated (i.e. hand cranked spectrometers) electron microprobe. Some of the first samples returned from the moon by the Apollo missions between 1969-71 were analyzed here.

photo: Geology Dept. archive

Gene Cameron, left, and Everett Glover in the first probe lab, 1967.

By 1978, the limitations of the first generation electron microprobes were obvious, and Gene Cameron procured funding (with the assistance of Professor Charlie Guidotti) for an automated ARL-SEMQ (Scanning Electron Microprobe Quantometer). The new machine was purchased for ~$300,000 of NSF and UW funds and installed in Weeks Hall in February 1981. A new generation of probers cut their teeth on this nine-spectrometer instrument.

By 1990, the SEMQ was showing its age. Given that there was new interest in a state-of-the-art electron microprobe that could combine high quality imaging (BSE, CL, x-ray maps) with spot quantitative analyses, John Valley procured funding from NSF ($320,000), UW ($290,000), and AMOCO ($8,000) to purchase our third electron microprobe. The new microprobe, a Cameca SX51, was installed in September 1993 and was dedicated by Gene Cameron in late 1993. Associate Scientist John Fournelle has managed the probe lab since 1992. This microprobe is used by several dozen researchers every year for a wide variety of research projects.

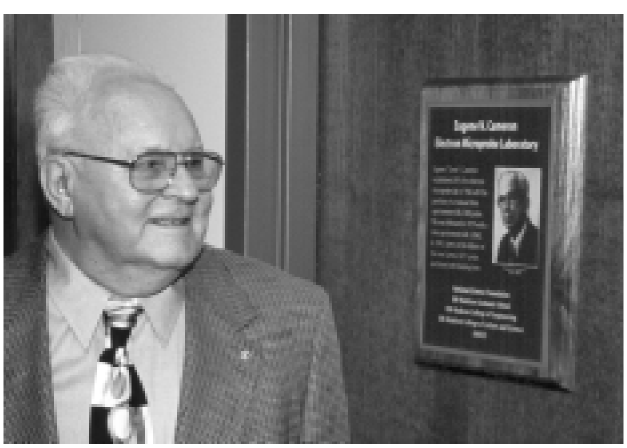

photo: Carl Bowser

Harry Abendroth (MA 53) unveils the plaque on the door of the new probe lab, September 2000. Harry worked with Gene Cameron in the Bushveld Complex as a graduate student in 1952.

Rare Gas Geochronology Laboratory

Under the supervision of Assistant Professor Brad Singer, construction of the laboratory began in 1999 and operations were established in May, 2000 thanks to generous contributions from Lewis G. Weeks, Albert W. and Alice M. Weeks, Dr. Henry F. Nelson, Shell Oil Company, Exxon Company, The National Science Foundation, and the UW-Madison Graduate School. The laboratory houses an ultra-sensitive Mass Analyser Products 215-50 rare gas mass spectrometer, automated 25 Watt infra-red CO_2 laser probe to degas single-crystal samples for $^{40}Ar/^{39}Ar$ analysis, two all-metal resistance furnaces for argon and helium analysis, a custom fabricated stainless steel ultra-high vacuum system for gas extraction and purification, and computer hardware and software designed in-house to automate the entire analytical system. Precise measurements are made routinely on sub-femtogram quantities of argon released from individual sub-milligram crystals of sanidine or mica using the laser, or via incremental-heating of 100 milligram packets of basalt in the resistance furnace. Dr. Singer's research focuses mainly on the development of $^{40}Ar/^{39}Ar$ dating methods and their application to several problems where understanding the timing of volcanism, both effusive and explosive, are vital to understanding Earth processes. These include evolution of composite volcanoes and volcanic fields in subduction zones, evaluation of the behavior of the geomagnetic field over the past five million years through precise dating of basaltic lava flow sequences, constraining the timing of climate changes or trends in the Pleistocene.

photo courtesy Brad Singer

Professor Brad Singer in the Rare Gas Geochronology Lab.

Radiogenic Isotope Laboratory

http://www.geology.wisc.edu/~unstable/

The laboratory is under the direction of Professor Clark Johnson, and is also overseen by associate scientist Dr. Brian Beard. Initially established in room 375 in 1988, the laboratory underwent significant expansion in 2000, adding a new laboratory in room 372 and a new mass spectrometer. This expansion was funded by the Department of Geology and Geophysics Lewis G. Weeks Fund, the UW-Madison Graduate School, NSF, and NASA. Collectively, the instrumentation, equipment, and laboratory spaces have a replacement value of approximately $2,000,000.

The laboratory houses a HEPA-filtered clean chemistry lab in several sub-rooms of room 375, and is divided into a heavy element area, and a first transition metal area, which has minimal metal components and extra HEPA filtered work areas. Chemical separation of ultra-small amounts (microgram to nanogram quantities of trace elements require blank levels in the picogram range, which necessitates clean work environments and distillation of all reagents. Extensive power and air conditioning, clean-air supply, and exhaust systems that are separate from the main building systems are required for this environment. Isotopic (mass) analysis of processed samples is accomplished in the room 372 laboratory. Instrumentation in the lab includes the original mass spectrometer (purchased in 1988), a thermal ionization mass spectrometer (TIMS) that is well suited to mass analysis of elements that have moderate ionization potentials, such as the well-known long-lived radioactive isotope systems ^{87}Rb-^{87}Sr, ^{147}Sm-^{143}Nd, ^{232}Th-^{208}Pb, ^{235}U-^{207}Pb, and ^{238}U-^{206}Pb that have been used for several decades in Earth science research. Isotopic ratios may be generally measured to a precision of +/- 0.002 % on the TIMS instrument, which is often required for tracing mass fluxes between major reservoirs of the Earth, or high-precision geochronology. The new instrumentation, a multi-collector inductively- coupled plasma mass spectrometer (MC-ICP-MS) offers an unprecedented

photo: Clark Johnson

Dr. Brian Beard in the Rare Gas Geochronology Lab.

Nita Sahai

meet the **NEW FACULTY**

We wish to introduce our newest faculty member, Dr. Nita Sahai, who joined us in August 2000. She was born in Jodhpur, India, and received a major in geology and a minor in chemistry from St. Xavier's College in Bombay, India. She received her PhD in geochemistry at Johns Hopkins University, after which she took a one-year post-doctoral position at Arizona State University, followed by a two-year NSF post-doctoral fellowship with Prof. Jack Tossell at the University of Maryland, College Park. Her fundamental research interests are in the areas of biomineralization and biomimetic materials synthesis, including how silica is precipitated from water by diatoms and radiolaria, the interaction of proteins and inorganic ions leading to bone-apatite growth in vertebrate animals, and the precipitation of clay minerals as mediated by organic compounds exuded by organisms.

She is also involved in aqueous environmental geochemistry with a focus on the adsorption of toxic metals on mineral surfaces. Her research attempts to understand the fundamental reaction mechanisms of biogeochemical import, and could also have useful biomedical and industrial applications. To undertake the intensive quantitative calculations of the potential chemical pathways involved in the processes described above, Nita has assembled an impressive parallel-processing array of PCs, and has also built a "wet-chemistry" laboratory for experimental work. She is building collaborations with the chemistry department and with the water chemistry program at UW. Nita is excited to have already formed a research group consisting of three graduate students, and encourages students to think in an indisciplinary manner to face the research challenges of the future.

(See Nita's faculty report on page 58.)

(Radiogenic Isotope Laboratory, continued)

opportunity for high precision (+/- 0.002 %) isotopic measurements of high-ionization potential elements that are extremely difficult or impossible to analyze by other means.

Major advances will now be possible in isotope systems such as ^{176}Lu-^{176}Hf and ^{187}Re-^{187}Os, which promise to provide important new insights into crust-mantle evolution, the short-lived 238U-230Th system, which promises new advances in understanding magma chamber systems of "active" volcanoes, and studies of mass-dependent isotopic fractionation of the first transition metals such as Cr, Fe, Ni, Cu, and Zn, which are becoming increasingly important in low-temperature geochemistry and geomicrobiology.

Because of stringent power, air quality, humidity, temperature, and exhaust requirements for the lab, the room 372 laboratory also has systems that are separate from the main building system.

Current research underway includes collaborative work with a number of research groups in the department, as well as other institutions, including: Isotope geochemistry of the first transition metals, which initially focuses on the metabolically important element Fe, and includes both field- and laboratory-based research into the mechanisms and extent of isotopic fractionation in inorganic, abiologic, and biologic systems; this new and analytically difficult work has important implications for tracing the origin and evolution of life on Earth and other planetary bodies. In addition to a major effort from our own group, departmental collaborations include work with the research groups of Professors Banfield, Bahr, Carroll, and Tikoff.