Princeton University

Honors Faculty Members
Receiving Emeritus Status

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The biographical sketches were written by colleagues
in the departments of those honored.

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Faculty Members Receiving Emeritus Status

Michael Leslie Bender

Michael Leslie Bender retires July 1, 2014, after 17 years at Princeton.

After earning his B.S. at Carnegie Mellon University and Ph.D. at Columbia University, Michael taught at the University of Rhode Island for 25 years. A professor of geosciences at Princeton since 1997, he is a geochemist who measures the concentrations and isotopic ratios of important chemicals in the ocean, the atmosphere, deep sea sediments, and ice cores. With these measurements, Michael has made fundamental discoveries regarding the global-scale chemical cycles, especially involving biologically active elements, as they occur today and in past times of different climate.

Current generations of Earth and environmental scientists most commonly associate Michael with his pioneering work on the concentrations and isotopic compositions of diverse gases trapped in glacial ice. His first efforts in this area were on the isotopic composition of diatomic oxygen (O_2) in Antarctic and Greenland ice cores. Michael's measurements through the lengths of these ice cores revealed the response of the global biosphere to Earth's orbital changes over the last 400,000 years and provided the first direct approach for dating ice. The measurements allowed Michael to put Antarctic and Greenland ice cores records on a common time scale, revealing that the abrupt warming at the end of the last ice age occurred in Antarctica before Greenland and that the two regions subsequently alternated in their warming toward interglacial climate. This and other of Michael's discoveries persist as key constraints in current efforts to explain the ice age cycles that dominate the climate history of the last three million years.

More recently, Michael has brought to fruition his long-term effort to measure the ratio of oxygen to nitrogen trapped in ice,

providing a still more accurate dating of ice cores. He has also measured the isotopic compositions of nitrogen and argon in ice, which have applications ranging from identifying past periods of extremely rapid climate change to providing robust age estimates for the world's oldest ice. In truth, Michael has played a central role in the development of nearly all of the current activities on ice core gases and almost singlehandedly trained the field's most prominent researchers.

One of the pioneers in environmental geochemistry, Michael had a hand in launching a broad range of currently active areas of investigation. In his early career, he made seminal contributions to the chemistry of marine sediments, especially the interaction of sediment particles with the surrounding pore-waters. His measurements demonstrated that dissolved chemicals in pore-waters are consumed by microbes in a sequence corresponding to the amount of chemical energy released during their reaction, giving rise to one of the primary organizing principles of modern environmental chemistry. He also provided evidence for biological reactions before biologists believed that there were organisms capable of carrying them out. To understand the relative roles of continental inputs and hydrothermal vents in controlling seawater chemistry, Michael made measurements of the metals found at extremely low concentrations in seawater, now known as "trace metals," planting the seeds for the subsequent discovery that these metals limit the growth of phytoplankton in vast expanses of the open ocean. Michael was one of the first researchers to apply uranium radioactivity to date ancient coral deposits in order to reconstruct past sea level changes. He was also an early innovator in measuring the elemental and isotopic composition of marine limestone fossils, now an established approach in the study of ancient oceans. In ongoing work on fossil corals, Michael has returned to this approach in order to understand how and why fundamental aspects of seawater chemistry have changed over the last 200 million years of Earth history.

At Princeton, Michael developed an intensive program measuring the oxygen concentration in modern air. His lab was one of

the first two to achieve the needed precision to capture the minute (0.01%) seasonal cycle in atmospheric oxygen driven by plant growth and decay. He also measured the equally subtle year-on-year decline in atmospheric oxygen content that results from fossil fuel burning, which allowed him to determine the relative roles of the ocean and the land in absorbing fossil fuel carbon dioxide.

Over the last decade, Michael has developed ship-based instruments that continuously measure dissolved gases in surface seawater, quantifying photosynthesis and respiration in ocean waters without requiring the vessel to stop to take samples. Recently, in a feat of analytical ingenuity, he developed an instrument that continuously measures the carbon content of ocean surface waters to better than 0.03%. These capabilities are allowing oceanographers to map and quantify the ocean's productivity in high resolution, with the ultimate goal of achieving a mechanistic understanding of the biological fertility of the ocean at local, regional, and global scales.

Among those with whom he has had significant scientific interaction, Michael has earned the deepest respect, even a degree of awe, both for the strength of his intellect and for his unflagging commitment to scientific rigor and personal integrity. An informatively common situation with Michael is the following: As a coauthor of a study, he works intensively with the first author to strengthen the evidence, arguments, and presentation, only to pull himself from the authorship list in the eleventh hour, with the explanation that he did not contribute adequately. Michael is endowed with a startling mental acuity, which reveals itself most amusingly in his ability to interject on-the-spot calculations into the most casual conversation. In these and other ways, he has unintentionally endowed generations of prominent Earth and environmental scientists with a nagging sense of unworthiness. At the same time, Michael is innately self-effacing. He shuns honors and has been known to chastise those who nominate him for awards. He declined the offer of a named professorship so that it could flow to a junior colleague.

Coming to Princeton in the latter half of his career, Michael has worked tirelessly for the benefit of the University and the

Department of Geosciences. It is hard to overstate the thoroughness and thoughtfulness with which he approached every aspect of his service, from the development of undergraduate courses and the direction of the graduate program to the recruitment of new faculty members. While Michael regrets the loss of some collegial interaction that his retirement entails, he is excited to have more time for research, and we are thankful that we will continue to have the benefit of his remarkable intellect, deep perspective, and personal generosity for some time to come.