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Presentation of the Mineralogical Society of America Award for 2002 to John M. Eiler

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President Ewing, members of the Society, and guests:

John Eiler grew up in the Midwest and got his start in geology at Beloit College and the University of Iowa where he studied high-grade metamorphic rocks with Henry Woodard and Tom Foster. Tom's letter of recommendation said simply, John is the best of 450 geology majors I have taught. How refreshingly clear and accurate! I first got to know John, the summer before he started graduate school at the University of Wisconsin. He was van driver for an Adirondack field trip after the1989 IMA meeting in Washington, D.C. My first impression has been lasting. John was equally cheerful arguing arcane points in metamorphic petrology as he was changing a flat tire. In fact, he can do both at the same time!

This versatility has become the hallmark of John's stable isotope research: the formulation of new theory and hands-on development of new analytical technology to test the resultant hypotheses. John's research is also distinguished by the ease with which he moves among different research communities, and his good taste in problems. I will describe just some of John's research, there is much more.

John will also receive the Macelwane Award this year at the San Francisco AGU meeting. Ed Stolper is the presenter and I am sure he will elaborate on some of John's other achievements (see: EOS, Feb. 4, 2003, p. 39–40).

As a graduate student in Madison, John made major contributions to formerly intractable questions relating to the mechanisms of stable isotope exchange in minerals. This was a wonderful time. I sometimes wondered if I was the student, learning more from John than he from me. John was motivated by the fact that stable isotopes satisfy all of the requirements predicted for good geothermometry except one; they seldom gave the right answer. John recognized that previous models of stable isotope exchange among minerals are not realistic and he formulated a new theoretical basis for inter-mineral exchange. John's Fast Grain Boundary diffusion model is the most comprehensive available. It is the first to properly consider mass-balance in multiphase systems. In other words, it works for real rocks. And it is still the state-of-the-art today, 10 years after publication.

John was not content to only theorize. He devised tests for the Fast Grain Boundary model at a time when such predictions were largely untestable. To do this required oxygen isotope analysis at the scale of an electron probe beam spot. But in situ isotope measurements required an ion microprobe and in 1990, ion probes were not capable of the precision necessary for useful oxygen isotope analyses on Earth. John and I used to sit around and ponder all the interesting things we would analyze if only we could. This has dramatically changed now: sample sizes are one million times smaller (ng vs. mg), precision by ion probe is 100 times better, and 0.1‰ is within reach. John's thesis helped pioneer these improvements. His work on ion probe matrix effects and data reduction made theoretical progress in a formerly empirical area. It became possible to analyze mineral grain boundaries, and to make core to rim traverses. It has now been shown that many minerals are isotopically zoned or heterogeneous. No wonder thermometry has failed so often! John predicted stable isotope zoning, he was the first to demonstrate its existence in nature, and he has told us what it means. As a consequence, we have new tools that enable us to properly interpret multiple events in the complex thermal and fluid history of a rock. With careful modeling, one can construct tests to predict which samples or portions of samples preserve interpretable information, and which are compromised. In one leap, this made accurate stable isotope thermometry viable and moved beyond the snapshot model.

After Wisconsin, John went to the California Institute of Technology as a post-doc to work with Ed Stolper and Sam Epstein. He turned from metamorphism and embraced the mantle. John took to basalt quickly, and was soon designing experiments and bringing olivine to Madison for analysis. It was commonly accepted that nothing new would come from oxygen isotope studies in the mantle, but John did not accept this. In the words of one letter writer, "John Eiler entered the field of mantle geochemistry like a monkey with a machine gun." I think that was a good thing. In two short years, John demonstrated new approaches for oxygen isotope analysis in ocean island basalts using a laser. His high quality data swept aside previous studies. He established correlations where none were expected. And he published a seminal series of papers that reinterpreted the end-member mantle reservoirs. He discovered that the mantle is far more homogeneous in $\delta^{18}O$ than previously thought. This was surprising given ongoing recycling of crustal material into the mantle. However, there are important anomalies. While EM1 is like normal mantle, EM2 contains a significant component of subducted sediment. This is not seen in the radiogenic data. A different letter writer said, "John Eiler revitalized the field of mantle geochemistry by providing a powerful new tracer".

John is now on the faculty at Caltech and his new ideas continue to amaze me. He has built a lab full of prototype equipment, and he has an active group that is working on everything from the mantle of the Earth to the atmosphere of Mars. His promising studies of D/H in atmospheric H_2 have required a new type of stable isotope mass-spectrometer and may become the baseline for evaluating the effects of hydrogen-fueled transportation. I would love to go on, but time grows short.

In conclusion, it is an honor and a pleasure to present John Eiler, this year's recipient of the Mineralogical Society of America Award.