ARTHUR L. DAY MEDAL

Presented to
John M. Eiler

John M. Eiler
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Citation by Kenneth A. Farley

It is a great pleasure for me to cite John Eiler as he is recognized with the Day Medal of the Geological Society of America. Simply put John is a remarkably creative scientist whose work has answered critical scientific questions and launched an entirely new branch of geochemistry. I'm fortunate to be able to say that John is a good friend and colleague — we have shared lab space for the last decade — and I have much enjoyed watching his career blossom from starting postdoc to preeminent scientist.

John's early work developing both laser fluorination and ion probe methods for oxygen isotope measurement of volcanic rocks and phenocrysts brought clarity to the long-standing question of the role of deeply subducted materials in the genesis of ocean island basalts. His survey of olivine phenocrysts in plume-related lavas and his detailed work on the Hawaiian islands showed unambiguously that some, but not all, hotspot lavas carry the "smoking gun" oxygen isotope signature of alteration at the Earth's surface. In some cases this signature reflects shallow-level contamination from the surrounding hydrothermally-altered volcanic pile, but in others the data demand a volumetrically-substantial component of subducted oceanic crust or sediments in the plume source region. The latter conclusion is of great importance because it provides critical insights to the origin of mantle plumes and settles a question to which decades of previous work using elemental and radiogenic isotope data had failed to bring closure.

A few years ago John started to move in an entirely different direction. While the fathers of stable isotope geochemistry like Harold Urey made passing reference to the importance of how isotopes distribute themselves *within* molecules, essentially all of stable isotope geochemistry over the last few decades has been concerned with the *bulk composition* of a sample. In a textbook example of thinking out of the box, Eiler focused his attention on the idea that the stable isotope *distribution* within the molecule carries extraordinarily useful information, and demonstrated that existing mass spectrometers were capable of reading this information back. His first foray into the field — the analysis of "clumping" of ^{13}C and ^{18}O in CO_2 and also in carbonate minerals — is in my opinion the single most important discovery in any area of geochemistry in the last decade. This work has led to the "clumped isotope thermometer" for calcium carbonate, a methodology that allows determination of mineral formation temperature without concern for the O isotope composition of the water from which the carbonate precipitated (indeed that composition comes out as a byproduct of the measurement). This is a revolutionary methodology — a true game-changer — and has already been applied to questions as diverse as the body temperature of dinosaurs, the paleo-elevation of the Bolivian Altiplano, and seawater temperatures in deep geologic time.

Not satisfied by this remarkable new technique, Eiler has now embarked on the study of the "isotopic anatomy" (the internal distribution of stable isotopes) in organic molecules. Given their diverse compositions and formation mechanisms, and their key role in many processes of interest in geochemistry, biology, chemistry, and even biomedicine, application of these methods to organic molecules has the potential to be an extremely rich new field of research.

We recognize members of our community with awards like the Day Medal because they remind us of why we all commit so much of ourselves to our work. The message to take away from John's work is this: even in a field that is more than 75 years old, there can be breakout discoveries that surprise, thrill and motivate all of us.

Response by John M. Eiler

Thank you, Ken, for your kind and thoughtful citation. We should all have friends willing to fly across the country to say kind things about us in public.

I am greatly humbled and honored to receive the Arthur Day medal. Not least because of the close personal and scientific connections I feel to many of its past recipients: Harold Urey is the wellspring of almost everything I've done. Al Nier designed the mass spectrometers that are the foundation of most of my career. I've now spent half my life in work and friendship with various Caltech colleagues who are previous Day medal recipients – including my postdoctoral advisors Sam Epstein, Ed Stolper and Ken. And a dozen more former Day medalists have been important colleagues and scientific collaborators or sparring partners at various parts of my career. It is a beautiful thing to spend your life guided by brilliant, interesting people.

It is customary for the medalist to give a short account of his or her career, though I have to say mine has not been guided by any obvious theme or path. Frankly, it hasn't made a great deal of sense even to me. I was drawn into geology at Beloit college by the Pied Piper figure of Hank Woodard and the opportunities it offered for fishing. I moved to the University of Iowa to chase a girlfriend, who improbably agreed to marry me a number of years later, and is with us now with us as the beautiful woman in the front of the room. There, I concentrated on metamorphic petrology and geochemistry because Tom Foster and Mark Reagan are interesting, thoughtful fellows and their labs are in the basement and therefore stays cool in the summer.

My first introduction to the world of isotope geochemistry came during my Ph.D. training at the University of Wisconsin, in my home town of Madison. I owe much to my advisors there: John Valley taught me the meaning of a good measurement and the importance of technical innovations in geochemistry. Lukas Baumgartner introduced me to the world of deep, mathematically based analyses of geochemical and petrologic problems. I can't say I really have much of a head for this area, but you can't fault him for trying!

My move to Caltech as a postdoc opened my eyes to many areas of science and introduced me to a community of broad, critical thinkers who have taught me most of what I think about being a natural scientist. I spent the first few years of my time there

using stable isotopes to study the origin and evolution of basalt – something enabled by laser based techniques of oxygen isotope analysis, recently developed at Carnegie and Wisconsin.

After transitioning into my present role as a faculty member at Caltech, my career has wandered in a way that could seem unhinged to an outsider – from igneous rocks to martian minerals to molecular hydrogen in the earth's atmosphere. The biggest step in my career has been the decision to explore isotopic clumping or ordering in natural materials. This idea grew from several things: A close reading of Harold Urey's papers in the chemical physics of molecular hydrogen, written in the 1930's. The example of the great Sam Epstein, who's own career was marked by free exploration of previously unmeasured things. And my realization that common gas source mass spectrometers should be easily converted to measure multiply substituted molecular gases. Beyond that, I can't say I gave the whole issue much thought, other than to find it inspiring that so little was known about these ubiquitous, diverse and peculiar isotopic creatures. An irrational choice, but as they say: sometimes it is better to be lucky than good.

I'ld like to close by expressing my deep gratitude to the people of the GSA for maintaining the traditions of the Arthur Day medal, which honors the memory of a great experimental petrologist, geochemist and leader in the earth sciences. Finally, my thanks to all of you for coming to participate in the medal award ceremony.