DISTINGUISHED GEOLOGIC CAREER AWARD (MGPV DIVISION)

Presented to
Frederick A. Frey

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Citation by J Michael Rhodes

I have known, and admired the work of, Fred Frey, the 2014 recipient of the Geological Society of America's Distinguished Career Award in Petrology, Mineralogy and Geochemistry for over 40 years.

Formally trained in chemistry, Fred rapidly established a reputation as a leading geochemist, making some of the earliest contributions to our understanding of trace element geochemistry of the rare-earth elements in a wide variety of rocks. This new approach to geochemistry used Radiochemical Neutron Activation Analysis (RNAA), an extremely painstaking technique that undoubtedly honed his uncompromising insistence on the importance of the highest quality geochemical data.

Later, Fred, among others, introduced Instrumental Neutron Activation Analysis to geochemistry, contributing to the instrumental revolution that, including X-Ray Fluorescence Analysis and Isotope Dilution Analysis, that improved data quality for both major and trace element analyses. Fred was a pioneer in this revolution, making possible quantitative trace element modeling of magmatic processes.

Early in his career, Fred realized that to understand the dynamics of the earth's mantle and melting processes within it, he needed, first, to study mantle rocks and mantle-derived magmas in different tectonic environments and, second, to integrate trace element geochemistry with field and volcanological studies, and with petrology, mineralogy, and isotopic analyses. His extensive, and highly cited, publication list (211 to date) shows that he has been extremely successful in both these goals, and his collaborators include a veritable "Who's Who" in geology, petrology, volcanology and geochemistry.

Significant contributions to the Geoscience Community have included working on numerous committees, co-convening several Geological Society of America Penrose Conferences and AGU Chapman Conferences and yeoman service as Associate Editor of Geochemica Cosmochemica Acta for over twenty years. In 1998 he became President-Elect of the Volcanology, Geochemistry and Petrology Section of the American Geophysical Union, and President between 2000 and 2002. At MIT, Fred has trained 32 students. Almost all have gone on to successful careers in the Geosciences.

In summary, Fred Frey has had an outstanding, highly productive and sustained career over 48 years. His publications cover an exceedingly wide range of topics, almost all in highly rated journals. Many are "classics" that have been highly influential in modern geochemistry. In recognition of his outstanding research contributions he received the prestigious AGU Bowen Award in 1986, was elected a Fellow of the American Geophysical Union (AGU) in 1996, and was elected Fellow of the Geochemical Society and the European Association of Geochemistry in 2000. In my opinion Fred belongs amongst the greats of modern geochemisty and the Geological Society of America's Distinguished Career Award in Petrology, Mineralogy and Geochemistry is a fitting tribute to his remarkable career.

Response by Frederick A. Frey

"Thank You" to MGPV, Mike and most importantly to my students; there is no doubt that without their research skills and motivation to succeed, I would not be here.

A Distinguished Career Award leads me to reflect on forks in the road. Undergraduate School: MIT or Wisconsin? In 1956 MIT students chanted "$1500 tuition is Too Damn Much." The Wisconsin $50 tuition made the choice easy. Why Chemical Engineering? A difficult major, but a BS Chem Eng led to job opportunities At Hercules Chemical Company, I supervised a technician who knew more than I did; an uncomfortable situation. Graduate School: Harvard Business School or Chemistry at Wisconsin? I chose the latter. Assistant Professor Larry Haskin had developed a radiochemical technique for determining the abundance of rare-earth elements (REE). Larry asked me "Would you be interested in determining the REE content of deep-seated rocks"? I had no clue what "deep- seated rocks" meant, but replied "sure". I analyzed peridotites (deep-seated rocks). While discussing my results, Larry said, "one of us must learn **geology**." Next semester a course in Igneous Petrology initiated my association with the Department of Geosciences.

After a thesis defense in 1966, I was surprised that two universities were interested in hiring a geochemist. Frank Press, recently appointed Chair of the Geology and Geophysics at MIT, was building a new department. A superb opportunity, but I recall that Frank said "I was a full professor by age 31; no reason you cannot do the same." Did he realize that I was already 28?

What research paths to follow? Trace Element Geochemistry was not a well-established field, and I was often asked "how can you ignore 99% of the rock". I sent letters to igneous petrologists who might be interested in collaborative research. A positive reply came from Dave Green, who had mineral separates from the Lizard peridotite; I was eager to analyze them for REE. Our jointly authored papers are my most cited publications. We continued to study peridotite massifs. Stimulated by John Dickey's thesis research on the Ronda Peridotite, students M. Obata and J. Suen identified systematics to the layering and compositional variation. Then study of the layered Horoman Peridotite showed us that to understand mantle processes our km-scale sampling had to be supplemented by cm-scale sampling using a portable rock drill followed by ion-probe analyses of clinopyroxene in the facility supervised by Nobu Shimizu.

I realized that accurate compositional data are not useful if the sample analyzed was inappropriate for solving the problem being addressed. In our studies of mantle xenoliths we found that the absence of field constraints hindered our understanding. As part of my thesis I determined REE abundances in MORB. The results, depletion in the most incompatible elements, were surprising. Bill Bryan and Geoff Thompson at WHOI and I used MORB obtained by DSDP to understand the geochemical characteristics of the igneous

oceanic crust. Studies of drill core from Hawaiian volcanoes were stimulated by M. Garcia and a long term collaboration with Dave Clague has led to 15 papers focused on Hawaiian lavas. Discussions with Mike Rhodes, and use of his XRF facility, have been stimulating to many aspects of our research. Our studies of Andean volcanoes in Chile resulted from Lopez-Escobar, my only student with 3 MIT degrees. Our efforts on basalt forming the Eastern Indian Ocean seafloor began with a 1988 ODP cruise to the Ninetyeast Ridge, when as shipboard scientists Dominique Weis and I realized that we had complementary geochemical skills. My experience in major and trace element geochemistry combined with her expertise in radiogenic isotopic ratios has led to 30 papers.

In closing I have enjoyed my career because understanding evolution of the earth requires people with diverse expertise working together towards a common goal. It is fun and my career continues.