

Acceptance of the Mineralogical Society of America Award for 1986

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Dear Friends and Colleagues, President Paul Barton, Jerry:

I am deeply grateful for the honor you have bestowed on me in selecting me as the recipient of the 1986 MSA Award. In Cuba the radio programs from the countryside often gave news reports in the form of songs such as the “Guantanamera.” I thought that maybe I should follow my Cuban tradition today, but alas, with the lack of a guitar and because I figured you will have enough trouble with my accent, I decided against it.

Looking at the impressive list of previous recipients, my hopes are that I can indeed measure up to the high standards that they have set. While I find that preparing an acceptance speech is more torturous than the usual GSA talk (and I know hearing one is even worse!), there is one compensatory note, namely the chance to thank the many people that have contributed to my career.

In contrast to many recent recipients, I did not start early in life with mineralogy on my mind! My dreams of early childhood in Cuba were to become a soccer star. Well, Castro changed all of that in a hurry. Our coming to the U.S. as Cuban refugees was very tough on my parents. Although they could have gone to Spain or Venezuela, like many of their friends, where life would have been much easier, my parents decided that a U.S. education for their children outweighed the hardships. I am deeply grateful for that. Of course, my parents played a key role very early on in my life by making sure that the directions and priorities were set correctly. It is thanks to their insistence that I went to Gonzaga High School, a Jesuit high school in Washington, D.C. At Gonzaga, I learned not only the patterns of scholarship but also Christian principles, which have guided me throughout the rest of my life. Gonzaga has been without a doubt the most important educational institution in my life. It was there that I became obsessed with mathematics, a love that led me to go to Princeton for my undergraduate degree.

During my freshman year at Princeton, the next critical step occurred when, at a geology department open house, I had the good fortune to meet Dick Holland. Dick opened up fascinating geochemical vistas to me, which were broadened by a summer with Moto Sato at the U.S. Geological Survey. It is my hope that we can expose many of the young chemists and physicists today to Earth sciences early and thereby enlist them in our field. This is especially important in the grand new era of high technology and quantification that we are experiencing now.

I found geology to be both humbling and exhilarating—



humbling because of its grand complexity and exhilarating because there are so many conceptual unknowns. The rest of my undergraduate years at Princeton, I profited enormously from Dick’s amazingly agile mind, very careful scholarship, and tenacious inquisitiveness. Our research resulted in a paper in *Science* on the Primordial Oil Slick. Dick’s panic at my Cuban-style GSA presentation of this work led him to tell me to stick to the script or the world’s experts in the audience would intellectually vivisect me! I still have problems with keeping to the script, but my sins are redeemed today as I am closely sticking to these notes.

A full-time career in geochemistry and mineralogy was not still in my plans, however, as I left Princeton to go to Harvard for a Ph.D. in chemical physics. A year later, Dick arrived at Harvard, and I began to get the hint from Upstairs. My collaboration with Dick Holland and with Steve Richardson ultimately led to several chapters in my Ph.D. thesis, which was a hodge-podge of quantum mechanics, molecular mechanics, and geochemistry. It was at Harvard that my interests in geochemical and mineralogical kinetics began. My thesis, in fact, included the work with Steve, which I would later expand using the term geospeedometry (much to Dick’s chagrin at the use of Greek and Anglo-Saxon roots simultaneously).

It was at this point that I had to decide on whether to make a full-time career in Earth sciences. There was an inner tug of war, with one side of me pulling toward the much safer and simpler shores of theoretical chemistry

and the other toward the much more complex but exciting area of geochemistry. Fortunately for me I chose to go to Penn State as an assistant professor. Penn State was marvelous for my geochemical and mineralogical development. The huge variety of faculty and students and the extensive experimental equipment were fantastic. Upon my arrival, I found myself immediately collaborating with Wayne Burnham on the thermodynamics of silicate melts (and using his lab for crystal growth and diffusion experiments later), with Hu Barnes on the thermodynamics of hydrothermal solutions and with Will White on the kinetics of dissolution and radioactive waste disposal. This was followed by collaborations with Derrill Kerrick on metamorphic kinetics of dehydration and decarbonation reactions, with Hiroshi Ohmoto on the kinetics of sulfur-isotope exchange, and with Carlo Pantano and Eric Cross (both at the Materials Research Laboratory) on experimental determinations of diffusion in garnets (SIMS) and on the polarization behavior of olivines. Of course, these works required excellent graduate students, and I am very grateful to have had these. I cannot thank Penn State enough.

My interest in developing the kinetic theory of minerals had led me on many occasions to interact with a previous recipient of the MSA Award, Robert Berner. Bob's elegant insights into kinetics and geochemistry have always been keenly received by the mathematician in me, and we embarked on many discussions on diagenesis, mineral dissolution and growth, and low-temperature geochemistry. Our collaboration has led recently to the development of the CO₂ geochemical model (BLAG), the product of many wine-catalyzed summer days with both Bob Berner and Bob Garrels. I am fortunate to have Bob not only as a close friend but also now as a colleague at Yale.

During these same years, I ran across an ex-Penn State, Jerry Gibbs. I remember the first time that I heard Jerry give a talk on quantum mechanics (specifically on extended Hückel theory) as a GSA meeting. Given my background in this topic, I felt curious as to how the audience would react. Well, it was skeptic to say the least! But Jerry persisted and has been the lone star in motivating mineralogists to enter this promising field. At the same time, my general interests in kinetics kept leading me to formulate a theory based on fundamental atomic processes. Jerry's research pointed a way to carry out just that. An exceedingly fruitful collaboration ensued that continues as I speak. We are excited about the wealth of applications of quantum mechanics to mineralogy, petrology, and, of course, kinetics. It is indeed a pleasure to have the chance to work with Jerry to expand this field.

Finally, I would like to thank the biggest kinetic force in my life, namely my wife, Evelyn. We all need to be reminded of the important things in life—especially when one is cursing at the computer at 3 A.M.!—and Evelyn has always done just that, most precious of all by her wonderfully humorous look at life. Evelyn has served the dual role of handing out a sobering amount of humility (after all, how important is the growth-rate law of plagioclase crystals when the kids need to go on a Scout-sponsored parent-son camping trip!) and yet appreciating the importance of my work—at least to me—enough to encourage and support me very unselfishly through all these years.

I am lucky indeed to have had Evelyn, my parents, and so many exceptional scientists as collaborators and friends. They as much as I share in this award. It is so nice to be rewarded for having so much fun! In closing, I want to thank you all again for the honor of receiving the Mineralogical Society of America Award for 1986.