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Acceptance of the Mineralogical Society of America Award for 1985

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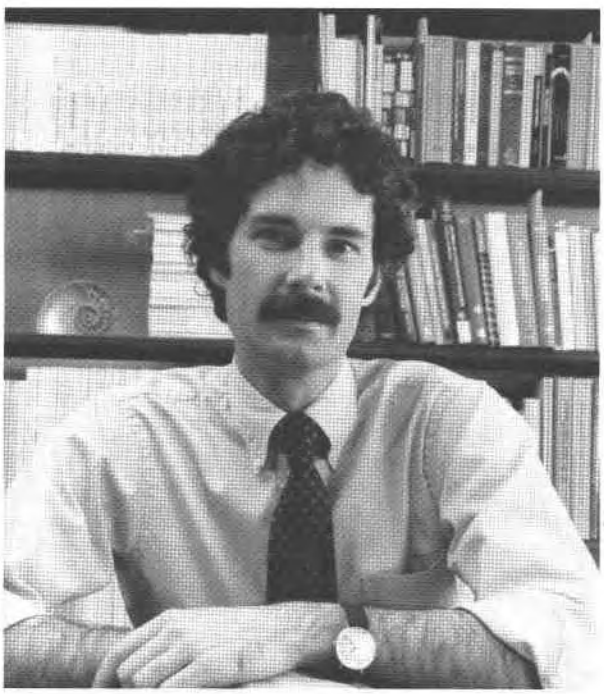
Hans, Doug, Members, Fellows, and Friends:



I am at once delighted and humbled by this honor. Delighted because there is no higher reward in research than to have friends and colleagues find your work interesting and useful. Humbled because no matter how interesting or useful that work, it is only a small part of the Society's many research activities that are no less important than mine.

I want to begin by briefly describing how I got here and take advantage of the uncommon opportunity to publicly express gratitude to some of those who have helped me along the way. Both my parents were trained as chemists; perhaps there was a genetic imperative that led me eventually to chemical petrology: More importantly, they encouraged me to be independent, to develop wide-ranging interests, and to be a careful and tireless observer. My sister Phyllis introduced me to geology, and happy memories of our rummaging about in the dirt for fossil and mineral specimens led me a decade later through numerous diversions to an undergraduate geology major at Stanford University.

My last year at Stanford I redetermined the nepheline-kalsilite miscibility gap in Bill Luth's Bomb Lab. The satisfaction of seeing 100 data points fit by equations with 6 adjustable Margules parameters was immense. Those years were the beginning of a revolution in petrology—the routine application of thermodynamic models to experimental data and of thermodynamic calculations to problems of petrogenesis—and I found myself, unknowingly at the time, in the middle of it. I am grateful to Bill for seeing where the future was more clearly than I and insisting that I continue graduate study with the person who introduced these equations to petrologists, J. B. Thompson.

My four years as a graduate student at Harvard were blessed by exposure to many remarkable people. I was part of a cohort of exceptional students that included two past winners of this award, two winners of the Geochemical Society's Clarke Medal, two winners of the Paleontological Society's Schuchert Award, and others whose work is equally as deserving of such recognition—a lively and stimulating group whose pace, in some ways, I'm still trying to keep up with. The years in Cambridge were especially enriched by my friendship with Tim Grove; our intense enthusiasms for things as diverse as the Gassetts schist, first and second derivatives of G-X curves, and pioneering *in vivo* crystallographic studies of *Blatta germanica* formed the foundations of my continued enjoyment of the discovery and fellowship of research. More importantly, I had the double good fortune to be taught petrology by the two Thompsons. From Alan I learned to link experimental data to natural mineral assemblages through numerical equations. Jim left me two legacies. One was purely technical, an understanding of chemical thermodynamics and of the necessity of seeing rocks simultaneously as assemblages of minerals with certain chemical compositions, as phase diagrams, and as systems of algebraic expressions. The other, less tangible, was his repeated demonstration that problems could be solved with an elegant style that I certainly would never claim to have mastered but that I never tire of trying to emulate.

After graduation from Harvard, I spent two years at the Geophysical Laboratory luxuriating in the unfettered pursuit of a various lines of research. The Lab's laissez-faire atmosphere rewarded me with the idea that was to become central to most of my research in subsequent years. One afternoon in a comfortable haze induced by grinding starting materials under ethanol, the vision of a ternary reciprocal exchange diagram involving Fe-Mg garnet and biotite danced in my head. The diagram shows that at constant bulk composition the compositions of the minerals de-

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pend on their relative proportions. As I pondered this seemingly mundane result, I realized that extensive quantities are related to proportions of phases in interesting and unexplored ways. This unpredicted moment eventually led to the proposal that impure carbonate rocks may be metamorphosed not only through their absorption of heat but also through their infiltration by aqueous fluids. I am delighted that Doug Rumble can serve as my citationist because our collaborative research integrating isotope geochemistry and petrology, founded on a warm friendship begun at the Geophysical Lab, later unequivocally confirmed that proposal.

After the Geophysical Laboratory, I taught for seven years at Arizona State University where the relations between intensive quantities and proportions of minerals formed the basis for studies of reaction mechanisms, element mobility, and the relative importance of buffering and infiltration during the formation of metamorphic rocks. Although I now hang my hat at Johns Hopkins University and am delighted to do so—it is a double pleasure to have this award bestowed on me by a colleague and an office next-door neighbor—most of the work that is cited for this honor was conducted at A.S.U. My seven years in Arizona were very productive, and I warmly thank all my former associates for their support.

No list of friends, mentors and advisers is complete without my wife Margaret whose love, encouragement, and indulgence have brought me here as surely as any of my purely scientific collaborations.

By emphasizing an individual's achievement, awards may fail to recognize that these achievements would not be possible without less heralded efforts. I want to briefly pay tribute to a few of these. Most of my research has been based on samples collected from a metamorphic terrane in south-central Maine that has served over the years as a remarkable natural laboratory for the study of metamorphic process. All my work has followed directly from structural, stratigraphic, and metamorphic studies of the area first systematically conducted by Phil Osberg. Quantitative characterization of metamorphic fluid-rock interaction relies on laboratory calibrations of mineral-fluid equilibria. None of my studies of impure carbonate rocks would have been possible without the experimental phase-equilibria data that George Skippen, Dave Hewitt, and Derrill Kerrick, among others, have provided over the years. Much of my analytical treatment of metamorphism is couched in terms of reaction progress. My applications of the reaction-progress variable to metamorphic petrology show the influence of pioneering studies by Hal Helgeson. These people have made my work possible and therefore share in its recognition.

I cannot resist the temptation to conclude with a number of miscellaneous comments. First, your honoring me today demonstrates that individual research is not a hopeless anachronism; useful contributions in geology traditionally have been and will continue to be made by individual efforts. Second, along with the presentation of the Roebling Medal to Professor Turner, it's gratifying to see the value of field studies reaffirmed. Because this award honors an area and style of research as much as an individual, I invite all of you who spend summers in the field to share with me recognition for the importance of this work. Finally, when I began by saying that I was both delighted and humbled by this award, I neglected to say I was also a little unnerved. This award is not just a show of approbation but also an expression of expectation of future efforts. The expectations of friends, teachers, and mentors are not taken lightly. I promise to rise with great enthusiasm to the challenge of not disappointing these expectations. Thank you very much.