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Presentation of the 2009 Roebling Medal of the Mineralogical Society of America to Alexandra Navrotsky

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It is with great pleasure that I introduce Alexandra ("Alex") Navrotsky as recipient of the Mineralogical Society of America's highest honor, the Roebling Medal. I have known Alex for over 25 years, first as my Ph.D. advisor and mentor, and now as a friend and colleague. Alex is quite simply one of the outstanding scientists of our generation. Her research activities have centered on the thermodynamics and stability of minerals and ceramic materials. Starting as an experimentalist with a specialty in high-temperature solution calorimetry, she has since incorporated a diversity of other experimental as well as theoretical techniques to provide a global picture of the structure and bonding features responsible for the properties and phase relations of the system under study. Alex is a great synthesist of experimental and theoretical data, with the ability to understand and construct grand themes of physical behaviour ranging from the macroscopic to the nanoscale. She was one of the early "mineral physicists", defining and giving sense to that new field of study. Below, I highlight just a few of the achievements of this remarkable member of our community.

Alex's first area of major impact was quantifying order-disorder and configurational entropy in the stabilization of minerals and related materials. Her efforts in this area began with her Ph.D. studies with Ole Kleppa, at the University of Chicago, who was setting up a new experimental method to study refractory materials using high-temperature oxide melt solution calorimetry. Alex used this method to study the heats of formation, solid solution, and order-disorder properties of many compounds of the spinel family, providing a seminal advance in our understanding of the thermodynamic properties of this important group of minerals. Alex moved to Arizona State University as an assistant professor in 1969 and quickly established internationally acclaimed facilities for experimental thermochemistry. Her research on the thermodynamics of olivine-spinel transition in silicates and their analogs laid the fundamental thermodynamic framework for understanding the composition of the upper mantle from the properties of the seismic discontinuities in the Earth's transition zone. Alex's subsequent studies extended to higher pressure phases, including silicate perovskites. Her work established the existence of negative Clapeyron slopes of key perovskite-forming transitions and the atomistic basis of why they occur. The consequences of the negative Clapeyron slope for geodynamics are profound. It provides a fundamental basis for the depressing of the phase boundary in subduction zones and elevation of it in hot upwelling plumes.

Alex moved to Princeton in 1985. She helped to spearhead the effort that eventually led to the creation a NSF Center for High-Pressure Research (CHiPR). She served 11 years as a co-principal investigator (along with Charlie Prewitt, Bob Lieberman Don Weidner). Her research continued to flourish and included fundamental studies of the thermodynamics of important hydrous (and other volatile containing) high-pressure phases. During this time, Alex was elected to National Academy of Sciences.

Alex's accomplishments and interests have developed and further broadened following her move to the University of California at Davis in 1997. At Davis, she has organized a unique program, "Nanophases in the Environment, Agriculture, and Technology (NEAT)," that spans the physical and biological sciences. Her recent studies of the thermodynamic properties of nanophase materials have led to important quantification of the effects of bulk vs. surface energetics and the possibility of stabilization of different polymorphs as a function of particle size. While Alex's impact in geosciences has been profound, it must be pointed out that she has similar stature in the fields of materials science and solid-state chemistry. Given this breadth, it isn't surprising that Alex Navrotsky is now the Edward Roessler Chair in Mathematical and Physical Sciences, and is an Interdisciplinary Professor of Ceramic, Earth, and Environmental Materials Chemistry.

In closing, I should note that Alex has a highly developed sense of service toward the U.S. and international mineral science community. Her thermochemical laboratories at Arizona State, Princeton, and Davis have always been open to collaborators worldwide. She has served as Vice President and President of the Mineralogical Society of America. Alex has also led numerous workshops, conferences, symposia, and short-courses that have broken new ground in understanding the energetics, structures, and bonding in minerals and related materials. One was the 1981 Castle Hot Springs conference in Wickenburg, Arizona, that brought together geoscientists, materials scientists, physicists, and chemists (including Linus Pauling) to discuss areas of common interest. As a graduate student, I had the pleasure of attending the highly acclaimed Mineralogical Society of America short course entitled, "Microscopic to Macroscopic: Atomic Environments to Mineral Thermodynamics" organized by Alex and Susan Kieffer. This course set a new standard for understanding the atomic scale factors that control the stabilities of minerals. More recently, Jill Banfield and Alex organized another highly successful MSA short course on "Nanoparticles and the Environment." This course introduced the concepts of size-dependent properties, processes, behavior, and the implications for materials science and earth and environmental science applications. On all occasions, Alex Navrotsky has served the mineralogical community well, by encouraging younger researchers and students, and by identifying new interdisciplinary areas that should be developed for intellectual growth of the subject.

In summary, it is difficult to find a person with more impact in the mineral sciences than Alex Navrotsky. With nearly 500 published papers covering order-disorder phenomena, glasses and melts, perovskite and oxides, and nanomaterials and microporous materials, she has provided key data that has been critically important for fields ranging from geochemistry of silicate liquids and mantle phase transitions, to nanoparticles and biogeochemistry. This, combined with the continuing leadership she demonstrates in the mineral sciences and beyond, makes her all the more worthy of this award. Congratulations, Alex, on winning the Roebling Medal.