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Acceptance of the 2024 Roebling Medal of the Mineralogical Society of America

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Ladies and Gentlemen, Colleagues and Friends:

It is with great humbleness and appreciation that I receive the 2024 Roebling Medal from the Mineralogical Society of America. It is a special pleasure to have it bestowed on me by my long-time mentor, colleague, and friend, Alexandra Navrotsky. It is equally wonderful to be here with many friends and colleagues. I thank you all for your support.

I am grateful for this opportunity to acknowledge and thank all those who provided me with the foundation and, indeed, inspiration throughout my career. Looking at all the previous recipients of the Roebling Medal, I am awestruck to be included among them. Reflecting on my past, I realize how fortunate I have been to be in the right place at the right time.

I grew up in Blacksburg, Virginia. My parents, Robert D. Ross and Mary H. Ross, both scientists, encouraged me to explore and question the natural world through books and field trips. My academic journey started as an undergraduate at Virginia Tech (V.P.I. at that time) in the late 1970s, which, unbeknownst to me at the time, was a powerhouse in mineralogy and petrology. G.V. ("Jerry") Gibbs (Roebling Medalist, 1987) revealed the world of crystal symmetry and its mathematical basis through his challenging course in crystallography. Jerry employed me in the summers while I was an undergraduate, and I learned about the beauty of crystal structures by building ball-and-spoke models. I also explored topics in quantum chemistry by finding papers for Jerry in the library and learned how to program an HP-65. Jerry had an outstanding group of graduate students, postdocs, and visiting scholars working with him and I learned much from them. Every day was new and fun, and it could not have been better training for my future career.

I pursued a computational M.S. thesis at the University of British Columbia with Pat Meagher using ab initio quantum chemistry to explore the flexibility of the $H_6Si_2O_7$ molecule under simulated pressure. Hugh Greenwood and Tom Brown introduced me to the world of thermodynamics, phase equilibria, and self-consistency analyses. These laid important foundations when I moved to ASU in 1981 for my Ph.D. to work with Alexandra Navrotsky (Roebling Medalist, 2009). It was a vibrant time at ASU with an incredible group of graduate students, postdocs, and visiting international scholars, including Masaki Akaogi, Michael Carpenter, Ekhard Salje, and many others. Fortuitously, Susan Kieffer was at the USGS in Flagstaff, and my Ph.D. thesis evolved into an interdisciplinary project exploring the thermodynamic properties of high-pressure phases using a combination

of calorimetry, spectroscopy, Kieffer lattice vibrational models, and phase equilibria. Alex also gave me the freedom to explore the periodic table, again laying another essential cornerstone in my career. I was fortunate to spend a summer at Los Alamos National Laboratory, where I realized the potential of using neutron scattering methods to explore Earth materials, foreshadowing a topic I would return to later in my career.

After ASU, I moved to Stony Brook to work with Charlie Prewitt (Roebling Medalist, 2003). Again, I was in the right place at the right time, witnessing the installation of the first multi-anvil press in the United States! Charlie, Bob Liebermann, and Don Weidner laid the groundwork for this extraordinary event, which was the birth of Mineral Physics in the United States. I was amidst a fantastic group of international students, postdocs, and visiting scholars, including Ross Angel. Each day brought new discoveries as I gained hands-on experience doing synthesis and phase equilibria experiments. Bob Liebermann later became President of COMPRES where I met so many scientists in the early stages of *their* careers, many of whom are here today.

A year later, Ross and I moved to Washington, D.C., when Charlie Prewitt accepted the Directorship of the Geophysical Laboratory. Here, I worked closely with Bob Hazen (Roebling Medalist, 2016) and Larry Finger, who patiently taught me about the wonder of high-pressure single-crystal X-ray diffraction. I was able to study high-pressure silicate phases in situ at high pressure using a diamond-anvil cell. At this time, the first high-temperature Y-Ba-Cu-O superconductor was discovered, and I was part of the Carnegie team that determined its crystal

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structure. These were exciting times indeed.

A major opportunity came in 1988 when we moved to University College London. G.D. ("David") Price led a powerful team of computational mineral physicists at UCL. I enjoyed regular meetings between UCL, Cambridge, and Oxford and was able to reconnect with colleagues I had met earlier in my career. It was a time when mineralogists were discovering applications using neutrons at the ISIS facility at Rutherford Appleton Laboratory. I also spent many summers using the multi-anvil presses at the Bayerisches Geoinstitut (BGI) in Bayreuth, Germany. The cornerstones laid earlier in my career in crystallography, high-pressure research, spectroscopy, calorimetry, computational modeling, and phase equilibria studies allowed me to explore many new topics while at UCL, including the stabilities and high-pressure behavior of pyroxenes, carbonates, hydrous magnesium silicates, perovskites, and many others.

I returned full circle to Blacksburg in 2000, followed by a decade of exploring the details of perovskite structures at high pressure, which resulted in a predictive model for their high-pressure behavior based on bond-valence theory. These studies were made possible by Ross's advances in developing crystallographic software for high-pressure research. I reunited with my original mentor, Jerry Gibbs, now as a colleague, to calculate electron densities of Earth materials, revealing insights into their chemical bonding, crystal chemistry, and properties. I also rejoined Alex, who was at UC Davis, and Brian Woodfield at BYU on an interdisciplinary project exploring the hydration layers of metal-oxide nanoparticles. The insights from inelastic neutron spectroscopy revealed the important role that water adsorbed on surfaces of nanoparticles has on their stability. Both Alexander ("Sasha") Kolesnikov and Luke Daemen opened the doors of the closely knit community of neutron spectroscopy to an outsider—a geologist rather than a physicist by training and a female! My journey of using neutrons to explore the lattice dynamics of Earth materials, metal-organic frameworks, and sulfides continues to this day, performing experiments at the Spallation Neutron Source of Oak Ridge National Laboratory.

As this narrative comes to a close, I share with you several themes that have been present throughout my career. The first is the importance of mentorship: mentors who share knowledge and wisdom; who support you through professional and personal "ups and downs." I therefore urge all of you to keep the field of mineralogy vibrant by helping to mentor and develop a diverse future generation of mineralogists. The second theme is that I have been fortunate to explore new topics driven by curiosity rather than solely by funding. In many cases, an oddball discovery is the one that is the most important, even though it might not be immediately relevant. The third theme is that each day should bring you a new nugget of knowledge and discovery. It might come from a conversation, movie, book, article, documentary, or just tinkering in the lab.

Finally, I want to reflect on the future of mineralogy in the face of challenging times. In 1921, Edward Kraus (*American Mineralogist*, 6:23–34) addressed this topic. He made points that are relevant today, including the importance of mineralogy in pure and applied science and various branches of industry. He noted that problems of fundamental significance requiring a comprehensive knowledge of crystallography and mineralogy are many and that applications of the methods and facts of our science are constantly increasing. This is especially true today and in the coming decades, where mineralogists will be at the forefront of solving problems relevant to energy, resources, and stewardship of our planet. We must be flexible and prepared to embrace the challenges ahead. Finally, as noted by Kraus, friendly cooperation among members of an organization such as the Mineralogical Society of America is critical to advance the field of mineralogy and to ensure that it continues to thrive in the future.