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Presentation of the 2015 Roebling Medal of the Mineralogical Society of America to Rodney C. Ewing

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Mr. President, Members of the Society, and Guests:

I am very pleased to introduce Rodney C. Ewing as the recipient of the 2015 Roebling Medal. I first met Rod when he became my post-doctoral advisor at the University of New Mexico in 1995. I have valued scientific collaborations and friendship with Rod over the years. Today, we are still working together, this time to manage the research portfolio of the Energy Frontier Research Center Materials Science of Actinides.

While he was a Ph.D. student at Stanford four decades ago, Rod began his pioneering work on the effects of ionizing radiation on crystalline materials. At that time his studies focused on oxide minerals and the crystalline-to-amorphous phase transition caused by accumulation of radiation-induced damage from the decay of incorporated uranium. Rod developed these early studies into a career-long emphasis that has given science a sophisticated understanding of the response of a broad range of minerals and ceramics to ionizing radiation. Rod determined that there is a critical dose of radiation, after which a material becomes amorphous. He showed that this critical dose is temperature dependent. Above a critical temperature, a structure recovers from radiation damage and remains crystalline despite the radiation. Rod pioneered experiments that allowed for the coupling of high-resolution transmission electron microscopy with in situ ionizing radiation. In the past decade Rod has identified crystal chemical factors in complex ceramics that can be tuned to reduce and even prevent the buildup of radiation-induced damage. These insights are of fundamental and critical importance for the design of nuclear waste forms. Rod's studies of radiation damage always remain closely tied to the geochemical and mineralogical issues of geologic disposal of nuclear waste. Rod's studies of radiation-induced damage in zircon, although partly motivated by the potential use of the phase for immobilization of excess weapons-grade plutonium, also have had major geological implications because of the importance of zircon in geochronology. Rod is now exploring the new realm of the coupling of effects of extreme environments—including extreme pressures, temperatures, and radiation doses.

Rod has been a central figure in debates concerning the best approach to dispose of nuclear waste in a geological repository in the U.S.A. and several other countries. He was active in the scientific matters of both the Waste Isolation Pilot Project (known as WIPP) and Yucca Mountain. He currently serves as the Chair of the Nuclear Waste Technical Review Board, and was appointed to this important role by President Obama. In addition to his involvement in the review processes and debates, Rod has made tremendous contributions to understanding the geochemical and mineralogical aspects of nuclear waste containment. If not for Rod Ewing, few would have realized that the corrosion of commercially generated nuclear fuels produces a suite of complex uranium minerals that are structurally and chemically identical to those in ore deposits. The importance of studying natural analogues as a guide to repository performance may have been overlooked—and we might have missed the importance of the natural reactors in Gabon, Africa. Rod published seminal papers in the 1980s and 1990s that demonstrated, usually on the basis of natural analogues, the sequence of uranyl minerals that form as spent fuel interacts with water in a geologic repository when the conditions are moist and oxidizing. Rod's research inspired groups at National Laboratories to conduct corrosion studies on surrogate and spent fuel. Those studies, done with great effort and expense over several years, confirmed Rod's predictions. Rod's work on the uranyl alteration products of spent fuel is obviously important in predicting and measuring the dissolution rates of fuel in a repository. But, he also extended these studies to develop a superior understanding of the impact of uranyl minerals on the mobility of transuranium radioisotopes in a repository environment. He coupled his work in radiation effects with geological disposal issues by studying the impact of radiation-induced amorphization on the aqueous solubility of various waste forms. Rod's extensive body of work on corrosion of glasses is also central to the issue of disposal of high-level nuclear waste, as the U.S.A. has now synthesized vast quantities of borosilicate waste glass that is loaded with radionuclides.

The Roebling Medal is for scientific eminence as represented by scientific publication of outstanding original research in mineralogy. Rod's massive body of published work includes more than 480 archival journal papers, 240 conference proceedings, and 18 book chapters. But, I would be remiss if I failed to mention that Rod has also given his time generously to many scientific committees and advisory panels, including his role in the leadership of this Society and several others. Rod is the founding editor of *Elements*, which has become hugely successful in uniting the mineralogical and geochemical research communities. I believe Rod accomplished all of the objectives he set out at the inception of his ambitious vision for *Elements*. Finally, I wish to recognize the tremendous role that Rod has played in the lives of many young scientists as a professor and mentor at the University of New Mexico for 23 years, at the University of Michigan for 17 years, and now at Stanford University. This includes directly supervising 54 graduate students and 42 post-doctoral fellows and research scientists.

President Shirey, it is my great honor and privilege to present to you the 2015 Roebling Medalist, Rodney C. Ewing.

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