

Presentation of the 2023 Roebling Medal of the Mineralogical Society of America to Georges Calas

GORDON E. BROWN, JR.^{1,*}

¹D.W. Kirby Professor Emeritus, Department of Earth & Planetary Sciences, Stanford-Doerr School of Sustainability, Stanford University, Stanford, California 94305-2115, U.S.A.

President Jeff Post, Vice President Donna Whitney, Councilors, Past Roebling Medalists, Members and Fellows of the Mineralogical Society of America, and Guests:

I'm delighted to introduce my good friend Georges Calas, recipient of the 2023 Roebling Medal. This medal is "*the highest award of the Mineralogical Society of America for scientific eminence as represented primarily by scientific publication of outstanding original research in mineralogy.*" Georges's 40+ year career in mineralogy and inorganic geochemistry has resulted in over 320 publications in peer-reviewed journals and monographs that cover topics ranging from structure/property relationships of silicate glasses and melts and environmental geochemistry/mineralogy to radiation damage in minerals and glasses and nuclear waste management. Most recently, Georges has focused on mineral resources and their sustainable development. Georges played a lead role in four different thematic issues of *Elements Magazine*—three in 2006 and one in 2017—devoted to these subject areas. This body of work serves as an extraordinary example of the use of a multidisciplinary approach to address the complexity of Earth materials and the chemical reactions they undergo in Earth-surface environments.

Georges Calas is one of the very best mineralogists in the world as well as a pioneer in the application of various types of molecular-level spectroscopy to mineralogical and low-temperature geochemical problems. He has become a leader of and an ambassador for the mineral sciences worldwide. For example, in 2016, he was awarded a Doctor Honoris Causa Degree from the National University of Kazakhstan, Almaty, for his tireless efforts to help educate scientists in developing countries about the societal impacts of the mineral sciences.

It has been my great pleasure to watch Georges broaden his research horizons over the years into interdisciplinary areas, such as materials science and molecular environmental science. Throughout his scientific career, Georges has carried out research at the interface between mineralogy and geochemistry that has had an enormous impact in both fields, as indicated by his numerous international honors, including most recently the 2022 International Mineralogical Association Medal of Excellence in Mineralogical Sciences.

I have known Georges since 1982, when we met at the Fall Meeting of the American Geophysical Union in San Francisco, California. He presented an outstanding talk on the use of synchrotron radiation-based X-ray absorption fine structure (XAFS) spectroscopy to determine the local coordination environments

of iron in silicate glasses. This presentation signaled the mineralogical and geochemical worlds that Georges Calas was a rising young star doing pioneering work only two years past his Ph.D. degree in 1980 with Claude Allegre at the University of Paris 6. Over the past 40 years, Georges and I have collaborated on a number of research projects and have published several dozen papers in peer-reviewed journals together with our students and other collaborators. Portions of our collaborative work are highlighted in a 100-page issue of *Geochemical Perspectives* entitled "Mineral-Aqueous Solution Interfaces and Their Impact on the Environment," published in 2012 by the European Association of Geochemistry. Our collaborations have allowed me to see Georges in action as a professor, mentor, and researcher at one of the leading universities in the world. The impact and very high quality of his research, mentoring, and teaching have been exceptional.

Georges was the first geochemist/mineralogist in Europe to utilize synchrotron radiation methods to tackle a variety of problems involving complex Earth materials and the processes that form and modify them. He has since become one of the world leaders in the applications of synchrotron radiation to Earth materials of all types. His Ph.D. research involved a UV-vis spectroscopic study of the molecular-level speciation (oxidation state and local structural environment) of uranium in silicate glasses prepared under different oxygen fugacity conditions. This seminal study brought immediate attention to Georges within the geochemistry and mineralogy communities and led to his classic UV-vis, EPR, Mössbauer, and XAFS studies of transition metal environments in silicate glasses with his long-time research partner Prof. Jacqueline Petiau, in the historic Laboratoire de Minéralogie-Cristallographie de Paris (LMCP).

In recognition of the very high quality of his science as well as his significant contributions to the LMCP and the University of Paris 6 and 7, Georges served as Deputy Director of the LMCP from 1997 to 2008 and is Distinguished Professor (Exceptional Class) of Earth Sciences at the University of Paris 6 (University Pierre et Marie Curie). The quality of Georges's science has also led to his being awarded two prestigious prizes by the French Academy of Sciences—the Carrière prize in Mineralogy in 1988 and the Yvan Peyches Grand Award in Materials Science in 2002. He was also awarded the Leon Bertrand Award in Applied Earth Sciences in 2006 by the Société Géologique de France. In 2006, Georges was elected as a senior member in the Institut Universitaire de France (inaugural Chair of Mineralogy), which is a major honor for French academics. In addition to these French national awards, Georges was honored by the Mineralogical Society of America by being elected Fellow in 1989 and by being selected

* E-mail: gordon.brown@stanford.edu

in 1999 for the Best Paper Award in *American Mineralogist*. The Stanford University School of Earth Sciences also honored Georges by naming him the Alan Cox Visiting Professor in 1992. In 2009, Georges was elected Geochemistry Fellow of the Geochemical Society and the European Association of Geochemistry. In 2011, he was elected to membership in Academia Europaea and also received the Schlumberger Medal of the Mineralogical Society of Great Britain and Ireland for his seminal work in mineralogy and inorganic geochemistry. Georges was elected Foreign Fellow of the Royal Society of Canada in 2014, another major honor that highlights his excellent international scientific reputation. As mentioned earlier, Georges received the 2022 IMA Medal of Excellence in Mineralogical Sciences. In addition, Georges has presented more than 130 invited talks and plenary lectures since 1982 at international scientific meetings in disciplines ranging from mineralogy and geochemistry to materials science and glass science. In addition, he has been an outstanding mentor of over 40 Ph.D. students and post-docs during his tenure as a professor at the University of Paris 6 and 7. His impact on these students, post-docs, and collaborators from France and other countries has been enormous, based on my own observations over the past 40 years.

Georges has been very active in many Earth Science organizations, including the IMA and service on IMA Commissions, and as a convener of sessions at a number of scientific meetings. His record of service to professional Earth Science societies is second to none, as shown by the long list of his activities in these societies. Most recently, Georges has become heavily involved in mineral resources and their sustainable development, having been elected to the annual chair “Sustainable Development” in the College de France, Paris. In this role, Georges organized a

highly successful international symposium at the College de France, Paris, in June 2015 on “*Mineral Resources and Sustainable Development: Transformations to Prepare for the Future*,” which I attended. He also served as co-convener with me and my former student Bradford Mills in December 2017 of a Stanford University Symposium on “*Mineral Resources and Their Sustainable Development*,” which attracted more than 100 participants from around the world. Most recently, Georges has served on the Technical Advisory Group “Stained Glasses,” Notre Dame de Paris reconstruction project.

Georges Calas’ work in the areas of mineralogy and geochemistry described above has changed the way we think about disordered Earth materials and the processes that form them. It has also shown us how Earth materials, in concert with microbial organisms, can sequester and, in some cases, transform toxic elements in highly complex, anthropogenically perturbed environments, thus limiting (or enhancing) their dispersal at Earth’s surface. The impact of Georges Calas’s work extends far beyond the borders of France and Europe and is comparable to the very best inorganic geochemical and mineralogical work being carried out in the world today. In looking through the list of 81 Roebling Medals awarded since 1937, I was surprised to see that only one French scientist, Raimond Castaing, was awarded the Roebling Medal in 1977 for his development of the electron microprobe. We now have two Roebling Medalists from France. Without question, Georges Calas is one of the most outstanding French and European mineralogists of his generation. He is an excellent choice for one of the highest honors in mineralogy, given his outstanding record of innovative and pioneering research in the mineral sciences.

President Post, I am honored to present Professor Georges Calas for the 2023 Roebling Medal.