My adventures with x-rays in real and reciprocal space in pursuit of more and more knowledge about less and less

G.E. BROWN JR.[1,2,3]

[1]Dept. of Geological Sciences, Stanford University, Stanford, CA 94305-2115, USA
[2]Dept. of Photon Science, SLAC National Accelerator Laboratory, Menlo Park, CA 94025, USA
[3]Stanford Synchrotron Radiation Lightsource, SLAC National Accelerator Laboratory, Menlo Park, CA, USA

My love affair with x-rays began in 1965 when I took my first graduate courses in crystallography and x-ray diffraction methods at Penn State. Viewing x-ray diffraction phenomena in reciprocal space is a useful way of thinking about the interaction of x-rays with matter. I quickly embraced the study of the atomic-level details of mineral structures using x-ray diffraction methods with Jerry Gibbs. My love affair continued with the development of high-T x-ray diffraction methods to study the thermal expansion of mineral structures with Charlie Prewitt at SUNY-Stony Brook. In a natural evolution of my high-T crystallographic studies, I began melting minerals and studying the structure-property relations of silicate glasses and liquids when I moved to Stanford University in 1973. At Stanford, I experienced the beginning of the revolution in x-ray studies of matter using the extremely intense x-rays from synchrotron radiation (SR) sources such as SSRL. My first XAFS spectroscopy studies at SSRL in 1977 on Fe in silicate glasses set me on a course that I have pursued for the past 40 years, including a very fruitfull collaboration with Georges Calas and colleagues at the University of Paris VI-VII. In the mid 1980's George Parks introduced me to surface chemistry, and I introduced George to synchrotron-based XAFS spectroscopy. We began a 15-year collaboration on sorption reactions at mineral-aqueous solution interfaces, which led to the use of SR methods to determine the molecular-level speciation of heavy metal and actinide contaminants in complex environmental samples. This step led to the study of environmenal implications of engineered and natural nanoparticles with Greg Lowry and Mike Hochella. Most recently, I have worked with Stanford colleagues John Bargar and Kate Maher and a number of bright post-docs and grad students on applications of SR methods to the geochemistry of hydraulic fracturing of oil and gas shales. Learning more and more about less and less, *i.e.* about geochemical and mineralogical processes at the atomic level, has been a great adventure shared with many excellent students and post-docs throughout my career.