A micro-tomography Transmission X-ray Microscope for *in situ* Geoscience Applications

Andrew M. Kiss[1], Adam D. Jew[1,2], Anna L. Harrison[1,2], Katharine Maher[2], Yijin Liu[1], Piero Pianetta[1], Gordon E. Brown[1,2], and John Bargar[1]

[1]Stanford Synchrotron Radiation Lightsource, SLAC National Accelerator Laboratory, Menlo Park, CA, 94025, USA
[2]Department of Geological Sciences, Stanford University, Stanford, CA 94305, USA

Abstract
Understanding the microstructure of different geoscience samples, such as shale and sandstone, is relevant for a range of applications such as hydraulic fracturing and carbon dioxide sequestration. How the morphology evolves when put under realistic conditions is not well understood and requires an instrument with the capability to image the 3D structure quickly and with submicron resolution. The development of a micron-scale transmission X-ray microscope (micro-CT) here at the Stanford Synchrotron Radiation Lightsource has been driven by the need to image these samples under realistic conditions with a high spatial and temporal resolution. The current microscope is capable of performing continuous scan tomography in tens of seconds with submicron pixel resolution. Combining the high brilliance X-ray source with a high sensitivity detector, the exposure time for each image can be minimized, providing fast data collection. Preliminary results with the micro-CT have shown promising imaging data with both shale and sandstone samples. With these high quality images, the microstructure of the sample can be analyzed to study different transport phenomena such as fluid permeability. The development of an elevated temperature and pressure environmental chamber is ongoing in order to investigate morphology and permeability changes in the structure while the sample is under conditions representative of subsurface geological reservoirs.