

APS 6BM-B Beamline: A Dedicated Large Volume High Pressure Facility for Mineral Properties Research in Earth and Planetary Science

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APS 6BM-B Beamline was established in 2015 at Argonne National Laboratory as a partial reincarnation of NSLS X17B2 Beamline, a renowned innovative world leader in large volume high pressure research using synchrotron-based techniques. It is supported by NSF/COMPRES and is dedicated to materials property research in earth and planetary sciences, especially rock and mineral physics. 6BM-B's standard high pressure setup includes a 250-ton hydraulic press equipped with a D-DIA module and a Rotational Drickamer Apparatus from Yale University, covering a pressure range from crust to lower mantle. In addition to straight forward phase transition and equation of state studies based on X-ray diffraction, this beamline is uniquely designed to investigate the rheological properties of minerals and rocks. It probes the materials structure information using energy dispersive X-ray powder diffraction (ED-XPD) in the energy range of 20-100 keV. With a 10-element solid state Ge array detector in a circular geometry for ED-XPD data collection, stress can be measured in real time. Sample strain and strain rate are obtained by direct radiographic imaging using a CCD camera and scintillating YAG crystals. Together it allows rapid exploration of stress-strain relationships under various conditions, ideal for studies of steady state and dynamic deformation process. 6BM-B is also equipped with a newly developed ultrasonic sound velocity measurement system DIASCoPE (Directly integrated acoustic system combined with pressure experiments) that is a few orders of magnitude faster than current technique. Synchronization of DIASCoPE with other available techniques at the beamline has opened the door to simultaneous measurement of materials properties at mHz and MHz frequencies. In this presentation, detailed technical features and capabilities of 6BM-B will be showcased with the illustration of most recent scientific progress of our user community. New techniques and new science for 6BM-B's future will be discussed.