

## Updates on Large-Volume, High-Pressure Research at GSECARS Beamlines, Advanced Photon Source

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The development of synchrotron-based large-volume high pressure (LVP) techniques for studying earth-related materials under extreme pressure and temperature (PT) conditions has been an ongoing effort at the GeoSoilEnviroCARS (GSECARS) of the Advanced Photon Source (APS). Over the years, these developmental efforts have enabled us to conduct coordinated studies on earth materials in both the solid and liquid states under high PT conditions. In this presentation we will show, with the following examples, how state-of-the-art techniques were applied in our recent scientific studies: (1) High PT ultrasonic velocity measurements, (2) Rheological properties of earth materials at high pressure and high temperature, using the deformation DIA (D-DIA), (3) Acoustic emission recording coupled with the D-DIA for monitoring ductile vs. brittle behavior and reaction progress in rock deformation studies, (4) High pressure three-dimensional imaging of composite materials using the high-pressure X-ray tomographic microscope (HPXTM), and (5) Structure studies of non-crystalline materials using a Paris-Edinburgh Press (PEP) combined with a multi-channel collimator (MCC). These techniques have the potential to provide the community with a complete suite of tools for structure, density, elasticity and viscosity measurements of earth materials.