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In-situ Capabilities for Computed Microtomography at SEES Facilities at the APS

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The microtomography facility at the GSECARS 13-BM-D bending magnet beamline at the Advanced Photon Source has a number of in-situ cells for conducting experiments over a wide temperature and pressure range. Imaging can be done in 3 beam modes:

- Monochromatic beam for differential absorption contrast, for example at the iodine and cesium K edges.
- Pink beam reflected from a Pt mirror with absorbers for tailored broad energy bandwidth. This results in high speed imaging and good contrast. The mirror angle can be adjusted to change the high-energy cutoff, and can be bent to either produce a vertically focused beam or a defocused beam with a large vertical height.
- White beam for very high energy imaging.

In-situ cells available for users include:

- Mjolnir triaxial cell optimized for 3 mm rock cores with confining pressures up to 50 MPa and axial loads to 600 MPa.
- Modified Mjolnir optimized for granular media with low confining pressures and axial loads using a stepper motor micrometer and low force load cell.
- Heitt Mjolnir cell for 10 mm diameter rock core at up to 300C and 30 MPa. (currently being fabricated)
- High-temperature granular media cell for studies up to 150 C.
- Low-temperature granular media cell for studies down to -120 C.

The system has a very flexible sample stage that readily accommodates a wide variety of user-provided sample environments. These have included a cell based on the Mjolnir design with acoustic velocity and emission transducers, large-sample triaxial systems for granular media, and flow-through high-temperature cells for dissolution and precipitation studies.

We have an active program in studying diamond inclusions using microtomography at 13-BM-D to locate the inclusions in 3-D, followed by x-ray diffraction to identify the inclusions. We can switch between tomography and diffraction modes in less than 1 minute without entering the hutch.

We are also planning to enhance the SEES APS 6-BM station to be able to tomography in these in-situ cells, as well as future larger cells weighing up to 100 kg. This will include the capability for in-situ energy-dispersive diffraction to measure the stress state of the sample.