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Macquarie University-Australian Synchrotron D-DIA apparatus

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The recent development of the deformation-DIA (D-DIA) cubic-cell multi-anvil apparatus permits dynamic experiments investigating the rheological properties (measuring stress and strain) of materials at high pressures and temperatures, previously unattainable in deformation apparatus.

A D-DIA apparatus is currently being commissioned on the XAS beamline at the Australian Synchrotron. The system consists of a four post frame with a 250-ton hydraulic cylinder pressurising the D-DIA module. Pressure control in the main- and differential rams is via an EPICS PID control loop where pressure is monitored by pressure transducers and varied by stepper-motor driven pressure generators. The sample is heated via a graphite resistance furnace. Temperature is monitored by a Pt-Rh or W-Re thermocouple and controlled via a Eurotherm PID controller. Positioning in the beam is achieved by mounting the press on an ADC X-Y-Z-rotation stage, the whole assembly weighing >3 tons. A particular constraint of operating the D-DIA apparatus at the AS is that it must be completely removable from the XAS Hutch C end station. The system has been modularised to facilitate convenient movement.

The MQ-AS D-DIA system is capable of exerting hydrostatic pressures of ~10 GPa and temperatures to ~1600 K. When commissioning is complete the apparatus will be capable of radiographic imaging and energy dispersive or angle dispersive XRD. Initial experiments will investigate metal-silicate migration and the rheology of mantle mineral assemblages.

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