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High Speed X-ray imaging for the study of liquids behavior at high pressure and temperature

Eglantine Boulard (1,2), Andrew King (2), Nicolas Guignot (2), Jean-Philippe Perrillat (3), Yann Le Godec (1), Pablo Garcia Del Real (3), Alisha Clark (4), Guillaume Morard (1), Jean-Pierre Deslandes (2), and Jean-Paul Itié (2)

(1) CNRS, IMPMC, France (eglantine.boulard@upmc.fr), (2) Synchrotron Soleil, France, (3) Université Claude Bernard Lyon, France, (4) Northwestern University, USA

In situ characterization of materials under conditions of high pressure and high temperature (HP-HT) are of great interest in planetary and materials sciences as well as physics and chemistry. Upon the last decade, many efforts have focused on the development of in situ three dimensional (3D) tomographic imaging at HP-HT, which enable nondestructive investigations of heterogeneous structures of materials [e.g. Wang et al. 2005, Philippe et al. 2016]. X-ray imaging is one of the most powerful tools for investigating the behavior and properties of liquids (i.e. viscosity, surface tension on a liquid-liquid interface or immiscibility of liquids). A critical parameter for the accurate characterization of these properties in liquids is the time resolution (e.g. acquisition time) at which changes can be observed, detected and/or measured [e.g. Kono et al 2015]. We have implemented high speed X-ray tomography at HP-HT on the Psiché Beamline at Soleil Synchrotron (France). Using pink beam through a Paris-Edinburgh Press, we were able to increase the speed by 100 compared to the current state of art (i.e. from 15 min to < 10 s). In complementary, high speed 3D tomography can be integrated with combined angle- and energy-dispersive structural analysis and refinement acquisitions [CAESAR, Wang et al. 2004], offering the possibility to study material/liquids structures at the micro and atomic scales. Here, we will present first measurements of silicate melt propagation through a solid silicate matrix at HP-HT and discuss its applications in Earth sciences as well as further developments for higher speed acquisition (< 1s) in the near future on Psiché Beamline.