Imaging melt processes in planetary deep interiors: new techniques in tomographic imaging at extreme conditions.

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Over the past decade, X-ray computed tomography has increasingly been used in Earth Science to provide detailed, quantitative 3-D information on textures in complex, multi-phase geological materials. On-going advances in both instrumentation and analytical techniques have led to a marked improvement in the resolution of tomographic data, allowing techniques to be applied to new areas of research, including constraining textural development in complex, partially molten systems. For example, we have recently used nano-resolution tomography of run products from high-pressure/temperature deformation experiments to constrain mechanisms for the formation of Fe-rich cores in rocky bodies in the early solar system. However, results from this study highlight a significant limitation in traditional high-pressure studies: characterisation of quench experiments only provides a snap shot of textural development. Our work demonstrates the key role which deformation plays is enabling segregation of core-forming melts, but cannot provide key data on the segregation velocities of melt once it is mobilized. As such, we are unable to determine the timescales under which deformation-aided percolation might form a planetary core, and therefore unable to test the feasibility of this process.

Using the recently-developed rotational-tomography Paris-Edinburgh cell (rotoPEC), a novel apparatus which can be used to conduct *in-situ* tomographic imaging experiments under simultaneous high-pressure/temperature conditions (up to 15 GPa and 2000K), we have obtained the first data on melt mobility under the extreme conditions of planetary interiors. We will describe how the rotoPEC can be used for various *in-situ* CT studies and present results from recent experiments at both Diamond Light Source (I12) on mobility of core-forming melts in the deep Earth and ESRF (ID27) on mobility of basaltic magma which demonstrate the capacity of this device for provide unparalleled information on textural development in complex materials at extreme conditions.

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