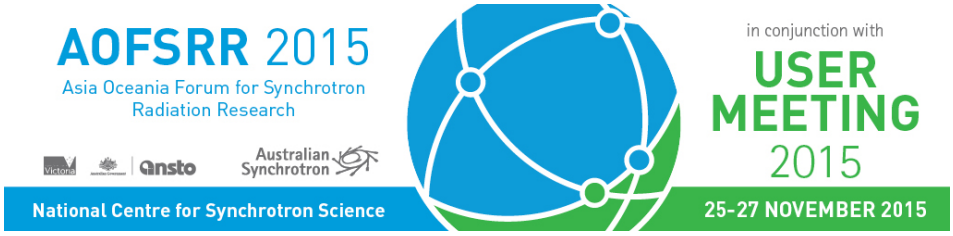

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From molecules to minerals: Resolving fast mineral formation processes in aquatic systems using energy dispersive XAS

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While the formation and transformation of many minerals has been relatively well studied empirically at a macromolecular scale, the precise mechanisms by which minerals form and transform at the molecular level remain poorly described. Time-resolved X-ray absorption spectroscopy (XAS) allows observation of changes in the local coordination environment of molecules involved in the very early stages of mineral formation in aquatic systems, and thus has the potential to provide detailed information on the mechanisms involved. We attempted to use energy dispersive XAS at the ODE beamline of the Synchrotron SOLEIL to study the formation of strontium carbonate and iron oxyhydroxide minerals. Employing a Quantum ULTRA detector and a Biologic XFM stopped-flow device permitted time resolution as short as 50 µs, thereby offering the possibility to observe the very first steps in the mineral formation process. Despite numerous technical difficulties, we were able to collect high quality XAS data (including EXAFS) at very short timescales for both mineral systems. While the technical issues meant that the data collected were not able to provide unequivocal evidence for particular mechanisms, our results provide several new insights into the processes that govern mineral formation in aquatic systems and confirm the potential for this technique to be used on such systems in future.

Keywords

iron, strontium, mineral formation, kinetics, energy dispersive XAS

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