Dissolution of Arsenic and Iron from Reservoir and Cap-Rocks of Geologic Carbon Dioxide Storage Sites

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Dissolution of geologically stored CO_2 in brines of saline geologic formations may lead to a change in pH and brine composition which may subsequently increase the dissolution rates of reservoir and cap rocks. Dissolution of minerals induces the release of various metals that may participate in subsequent dissolution and precipitation reactions, and that may be of concern if reacted formation fluids migrate out of the target storage zone. The objective of this study is to study the release of As and Fe, present in the reservoir and cap rocks of the Lower Tuscaloosa reservoir. XANES analysis of the samples indicated a relationship between As and Fe in these samples. To assess the potential release of As and Fe, and to measure the effect of CO_2 on their release rates, dissolution experiments were conducted with caprock and reservoir rock samples obtained at different depths. The dissolution was studied at representative conditions of the reservoir (i.e. 60 °C, 100 bars, synthetic brine of 1.4M NaCl) utlizing a small-scale flow-through system. The dissolution was conducted with deoxygenated 1.4M NaCl solution for 10 hours prior to CO_2 injection into the NaCl solution. The solution chemistry was defined pre- and post-CO_2 injection by ICP-MS analysis. Accordingly, rock samples were analyzed pre- and post-CO_2 injection by XRD and SEM. Preliminary dissolution experiments showed that upon CO_2 injection, rates of metal release increased significantly before reaching a new equilibrium (Figure 1).

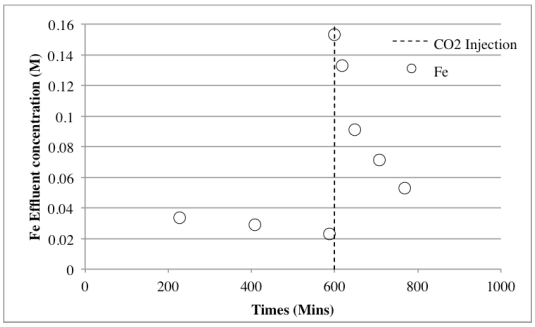

Figure 1. Effluent Fe concentration (M) with time at T=60 °C, P= 100 bar with 1.4 M NaCl. CO_2 injection after 10 hours.

Filling in the juvenile magmatic gap: evidence for continued Paleoproterozoic plate tectonics during the Great Oxidation Event

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Despite several decades of research on the growth of the continental crust, it remains unclear whether the production of juvenile continental crust has been continuous or episodic in the early Precambrian. Models for episodic crustal growth have gained traction recently through compilations of global U-Pb zircon age abundance spectra interpreted to delineate peaks and lulls in crustal growth through geologic time. One such apparent trough in zircon age abundance spectra between ~2.45 and 2.22 Ga is thought to represent a pause in crustal addition, resulting from a global shutdown of magmatic and tectonic processes [1]. The ~2.45 - 2.22 Ga magmatic shutdown model envisions a causal relationship between the cessation of tectonism and accumulation of atmospheric oxygen over the same period. Here, we present new coupled U-Pb, Hf, and O isotope data for detrital and magmatic zircon from the western Churchill Province and Trans-Hudson internides of Canada, covering an area of approximately 1.3 million km^2, that demonstrate significant juvenile crustal production during the ~230 million-year interval, and thereby argue against the magmatic shutdown hypothesis. Uninterrupted plate tectonics between ~2.45 and 2.22 Ga would have contributed to efficient burial of pyrite and organic matter and the consequent rise in atmospheric oxygen documented for this time interval.

[1] Condie *et al* 2009 *EPSL* **283**, 294-298.

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