Extreme geochemical environments in mound springs of the Great Artesian Basin, Australia

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The travertine Mound Springs of the Great Artesian Basin (GAB) form iconic features in arid central Australia, containing rare relcit species endemic to different spring groups. The springs discharge along major fault lines which extend to great depths in the lithosphere. A long history of discharge into organic-rich soils has caused a build up of sulfidic soil materials, in some cases with Cr-reducible S concentrations >40 wt. %. Soil acidification has recently been documented in some springs as a consequence of sulfide oxidation initiated by decreasing spring flow rates. Rare oxyhydroxysulfate mineral efflorescence assemblages (*inter alia* natrojarosite, sideronatrite, metavoltine, ferrinatrite and jurbanite) have formed under extremely acidic (pH<1) conditions in these arid zone environments.

Simple batch aqueous dissolution experiments have shown that a range of contaminants are present and mobile in the acid sulfate soils at spring discharge points. The results for the sulfuric soil materials, showed that dissolved acidity was often extremely high (> 200 meq l^{-1}), with SO_4/Cl ratios up to 100 and high concentrations of dissolved metal and metalloid contaminants including Al, As, Fe, Tl and V, typically well above trigger values for ecosystem protection.

Sulfur ($\delta^{34}S$) isotope ratios were very light and much lower than the source groundwater (> -40‰ difference) consistent with bacterial sulfate reduction, and soil profiles displayed a more negative trend with depth. Iron isotopes also displayed large differences within some profiles, with the largest difference immediately above the oxidation front (> 0.9 ‰) indicating large isotope fractionation during the oxidation processes.

A conceptual model is presented linking regional groundwater flow systems to deep crustal structures and the formation of low temperature extreme environments in surficial discharge zones.