Groundwater composition in the Cannington region, Australia: Mixing, water-rock interaction and applications to mineral exploration

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The Cannington Ag-Pb-Zn deposit is located ~170 km southeast of Mount Isa in Queensland. The Proterozoic basement is unconformably overlain by 8-70 m of variably weathered Cretaceous sedimentary rocks of the Great Australian Basin (GAB). This cover includes a basal sandstone, a sequence of mudstonse and siltstones, and, locally, a fossiliferous limestone unit.

Groundwater samples were collected from 24 bores over a ~50 x 100 km area, plus one from a seep in the underground mine. Alkalinity, pH, electrical conductivity, temperature, dissolved oxygen and Eh were determined in the field. The samples were prepared and analysed for major dissolved species, trace elements and stable isotopes of O, H, C and S.

The groundwaters are fresh to brackish (total dissolved solids = 670 to 2120 mg/L), circum-neutral to alkaline (pH = 6.6 to 8.4) and warm (T = 27 to 48 °C). Two sub-groups are recognised representing groundwaters (1) from the fractured Proterozoic bedrock (FPB) and (2) from porous and fractured aquifers of the GAB. The FPB groundwaters tend to be brackish, cool and Na-Cl^- dominated, whereas the GAB grondwaters typically are fresher, warmer and Na-HCO_3^- dominated. A third sub-group of intermediate composition represents *mixing* between these two end-member waters. A number of trace element distributions as well as the stable isotopes suggest *interaction* between groundwater and minerals in the Proterozoic basement and the Mesozoic aquifer(s). Elevated F^- concentrations delineate the western margin of the Eromanga basin and appear to be controlled by fluorite solubility. Ore element (e.g., Pb, Zn) concentrations are low due to the stability of solid phases under the prevailing Eh-pH conditions and adsorption onto Fe-oxyhydroxides. Several elements/isotopes reflect interaction with the *mineralisation* itself and are potential hydrogeochemical tracers for exploration through cover here.