

Organic geochemistry of the Paleoproterozoic McArthur River (HYC) Zn/Pb deposit

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The 1.6 Ga old HYC Zn/Pb mine in Northern Australia is one of the best preserved base-metal deposit. However, the mechanisms of ore formation are still controversial. To characterise the organic matter (OM) and estimate temperatures of ore-forming fluids, we used lipid biomarkers in combination with Rock-Eval pyrolysis and stable isotope ratios of hydrogen (δD).

Results from GC-MS analyses on the lipid hydrocarbons extracted from 11 mine samples, illustrate that the maturity level of all samples is too high for preservation of polycyclic biomarkers such as hopanes and steranes. Based on the discrepancy between Tmax data on the isolated kerogen and vitrinite reflectance equivalent (Rc) values from the extracted hydrocarbons, the observed biomarkers in the ore most probably represent migrated bitumen from the surrounding sediments and do not reveal the temperature of ore deposition. Polycyclic aromatic hydrocarbons (PAHs) found in the HYC are also detected in similar distributions in the hanging wall and are thus presumably not the products of hydrothermal activity but of unknown low-temperature processes. As the bitumen in the HYC is likely migrated from surrounding unmineralized sediments, the H-isotopic composition of *n*-alkanes in the ore deposit also does not reflect the metal-bearing fluids. The source of these fluids is thus not necessarily the underlying Tawallah Group, as suggested previously [1], but remains obscure.

Based on biomarkers, we thus cannot make any statements about the temperature of the mineralising fluids, negating earlier claims for temperatures of 250 to 400°C [2] or 200°C [1]. Yet, our and previous Rock Eval data indicate that the OM in the ore body was severely altered, in ore lenses and inter-ore breccias. The data is most consistent with the flow of hot fluids with temperatures within the range of thermochemical sulphate reduction but is inconsistent with the activity of bacterial sulphate reducers.

[1] Williford *et al.* (2011), *Earth Plant. Sci. Lett.* 301(1-2), 382-392. [2] Chen *et al.* (2003), *Earth Plant. Sci. Lett.* 210(3-4), 467-479.