# Molecular fossils and water column redox in the 1.64 Ga Barney Creek Formation and relation to local base metal mineralisation

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The 1.64 Ga Barney Creek Formation (BCF) in the McArthur Basin, northern Australia, hosts some of the world's largest stratiform Zn-Pb sulphide deposits. Currently, there are two models proposed for ore formation: syngenetic precipitation of sulphides from a metalliferous brine pool (SedEx), and early diagenetic mineralisation from hydrothermal fluids. To examine the possible contribution of SedEx processes to ZnS enrichment, we investigated inorganic and biological processes in the paleo-water column using biomarkers and iron speciation chemistry. The BCF hosts the oldest recorded clearly syngenetic biomarkers, allowing detailed paleoecological reconstructions [1]. The study yielded correlations between redox conditions and biomarkers of different phototrophic sulphur bacteria that suggest that organic matter degradation was driven by biological sulphate reduction (BSR), not aerobic heterotrophy, and that water column redox was controlled by the balance of sulphate and highly reactive Fe influx rather than organic productivity. Moreover, in sediments proximal to a large ore deposit, a ZnS-enriched horizon coincides with a transition from a fluctuating oxic/ferrous water column to sulphidic conditions followed by a return to permanently ferrous waters. The data suggests that metal and sulphate-rich fluids were emitted from the nearby Emu fault system into an anoxic and ferrous basin but not, as suggested by current SedEx models, into a sulphidic water column. The exhaled sulphate-rich brines presumably caused locally sulphidic conditions via BSR and generated a ZnS halo around the discharge zone and ore body.

[1] Brocks *et al* (2005) *Nature* **437**, 866-870