

Molecular characterization of a Neoproterozoic hypersaline ecosystem

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We present a detailed molecular investigation of the biotic composition and biogeochemistry of an evaporitic, hypersaline environment from the mid-Neoproterozoic (~0.8-0.7 Ga). The discovery of evaporite deposits on Mars highlights the need to understand their capacities as biological archives. Biomarkers were analyzed from evaporitic sediments of the Neoproterozoic Bitter Springs Formation, Amadeus Basin, central Australia. Due to the broad shallow nature of the Amadeus Basin and a tenuous connection with the ocean, the water was characterized by elevated salinity levels during that time. As a result, very thick (100 m to >2000 m) evaporite units were deposited [1].

We extracted biomarkers from evaporitic sediments composed of dolomite, anhydrite and/or halite. The evaporites are often composed of numerous microbial mat-like formations that exhibit roll-up structures and tearing. Full scans (gas chromatography - mass spectroscopy, GCMS) of the saturate fraction revealed high ratios of mono- and dimethyl alkanes relative to *n*-alkanes. Such patterns are typical of Precambrian and Cambrian samples and observed in a number of facies settings. An outstanding characteristic are several pseudohomologous series of both regular (to C₂₅) and irregular (to C₄₀) acyclic isoprenoids. These isoprenoids are present in high concentrations and have never before been reported in the Precambrian. The presence and relative concentrations of these compounds vary with regards to the sedimentology of the host rock. Hopanes and steranes are often present in low concentrations or are absent.

Based on these results, we present an ancient and extreme, saline environment dominated by prokaryotes – with potentially the oldest evidence of haloarchaea in the geologic record. The presence of exceptionally well preserved biomarkers in anhydrite, despite the fact that sulfate and biomarkers are thermodynamically not stable together, raises the prospect of finding biomarkers in sulfate deposits on Mars.

[1] Lindsay (1987) *Geol. Soc. of Am. Bul.* **99**, 852-865.

CO₂ sequestration in AMD affected areas: A case study

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The aim of the study was to demonstrate both sequestration of carbon dioxide and improvement of water quality in areas seriously affected by lignite mining by means of direct carbon dioxide injection in combination with industrial by-products, e.g. fly ash, and subsequent precipitation of calcite.

Treatment of AMD with fly ash is a well known technique [1–3]. However, the open pit Burghammer, received fly ashes for more than 24 years (26 10⁶ m³) just for deposition. Today the former pit is flooded with groundwater and the ash deposited is sitting at the bottom of the lake showing no reaction with the lake water.

Laboratory studies have shown that this settled fly ash can be utilized in combination with CO₂ to improve the water quality of open-pit lakes by increasing both pH and alkalinity. Hence, a general decrease of trace metal concentrations, particularly manganese, iron, and, aluminium occurred whereas concentrations of zinc, arsenic and molybdenum increased slightly.

Consequently, in a field experiment gas injection lances were installed to a sediment depth of 12 m by means of a hydraulic hammer mounted on a floating platform. From a tank with liquid CO₂ placed close to the shore of the lake CO₂ was lead to the platform with a floating pressure hose (8 bar) and from there injected into the ash body. CO₂ was applied with a pressure of 2.2 bar and 1.4 m³/h for a period of 3 months.

Continuous lake water monitoring was done during the gas injection. Drilled cores in the vicinity of the injection were used for mineralogical and geochemical investigations (TIC analyses, XRD, SEM-EDX, CL) before and after gas injection. Results indicate that calcite precipitation was on average 0.5 mass percent with maximum precipitation reaching 7.4 mass percent, while in some areas as well calcite dissolution occurred. Saturation indices of the porewater calculated with PHREEQC were confirmed by TIC-measurements.

[1] Gitari *et al.* (2006) *J Environ Sci Health A Tox Hazard Subst Environ Eng* **41**(8), 1729-1747. [2] Gitari *et al.* (2008) *Fuel* **87**(12), 2450-2462. [3] Vadpalli *et al.* (2008) *S. Afr. J. Sci.* **104**(7-8), 317-322.