

## **LOW MOLECULAR WEIGHT ORGANIC ACIDS IN DEEP TERRESTRIAL SYSTEMS**

Andrea VIETH, Kai MANGELSDORF and Brian HORSFIELD

*GFZ Geoforschungszentrum Potsdam, Section Organic Geochemistry, Telegrafenberg, D-14473 Potsdam; vieth@gfz-potsdam.de.*

With the increasing research on the “Deep Biosphere”, the question arises where the carbon source for microbial life is derived from. It is well-known that microorganisms can use acetate and other low-molecular weight organic compounds as carbon source to produce methane. Heating experiments with kerogen and humic acids resulted in the release of low molecular weight mono- and dicarboxylic acids (Kawamura and Kaplan, 1987). Mono-carboxylic acids were also present in oil-formation waters leading to the interpretation that they are precursors of natural gas (Carothers and Kharaka, 1978). The focus of our research was on the potential of different lithologies to release low molecular weight organic acids that can be used as carbon source to feed the Deep Biosphere and/or as precursors of thermogenic gas production.

Samples of immature to mature coals and source rocks but also lithologies with low organic carbon content adjacent to organic carbon rich layers were extracted with water for 48 h using Soxhlet apparatus. The water extracts were analysed by ion chromatography.

The extraction of coals from New Zealand with water resulted in the release of low molecular weight organic acids like formate, acetate and oxalate as well as varying amounts of chloride and sulphate. These compounds have already been described to be extractable from low-rank coals with water in a Soxhlet apparatus (Bou-Raad *et al.*, 2000). They found that the amount of oxalate released was negatively correlated to the rank of the coal samples. Our results do not show this correlation for oxalate, but we observed lower amounts of formate and acetate released from coal samples with higher rank and higher total organic carbon (TOC) content (Figure 1). Pyrolysis of coals led to high amounts of acetate, formate and acetate but low amounts of these compounds have already been detected after washing the coal samples (Quyn *et al.*, 2002). This indicates that low rank coals can provide low molecular weight organic acids which may decarboxylate to yield hydrocarbons or be consumed by microorganisms.

Aside from coal samples, it became obvious that sands and silts adjacent to lignite and coal layers also release organic compounds to the water phase, although in low concentrations. The amount of released organic compounds from these lithologies decreases with decreasing

TOC content of the samples and distance from the organic carbon rich layers. The presence of intact phospholipids in the carrier lithologies (Mangelsdorf *et al.*, this volume) indeed proves the presence of living microorganisms.

Our first results therefore support the hypothesis of lignite and organic carbon rich sediments feeding adjacent carrier lithologies in the Deep Biosphere. Interestingly, silts and sands with low organic carbon content also have the potential to feed living microorganisms by releasing low molecular weight organic compounds, but in lower concentrations.

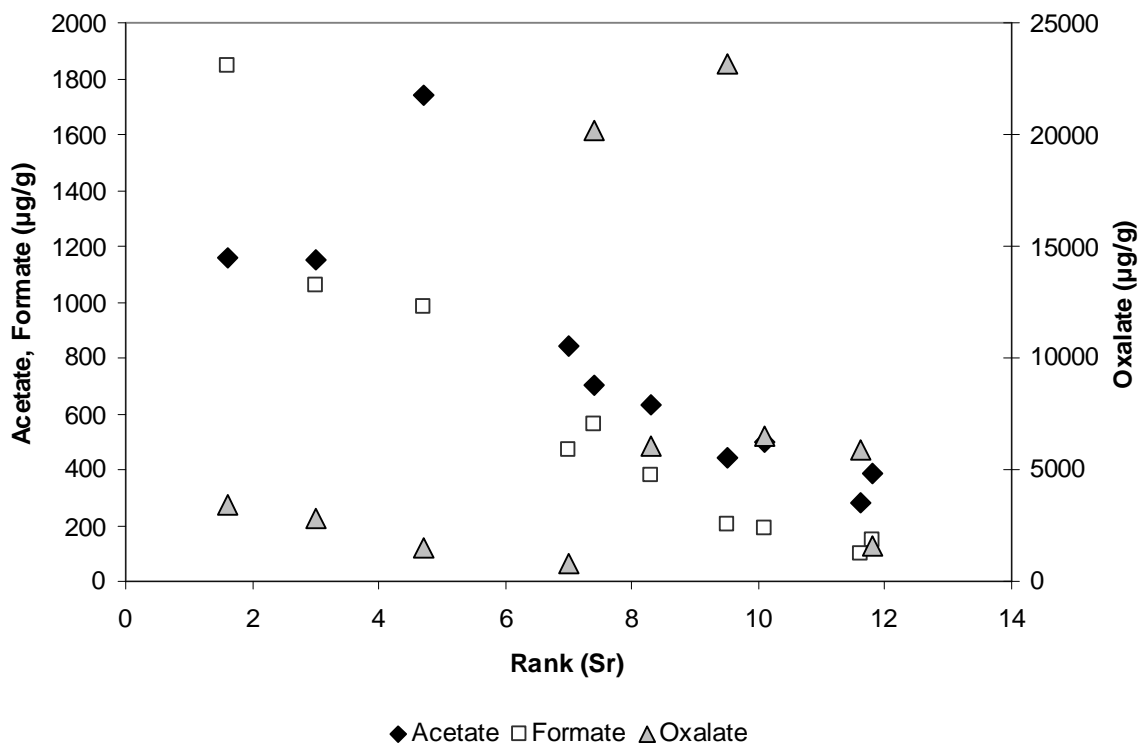


Figure 1. Amounts of acetate, formate and oxalate ( $\mu\text{g/g}$ ) released from New Zealand coals of different maturity in contact with water.

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