

Chemical and Molecular Analysis of Methanogens & SRB in Anaerobic Sediment of Lake Cadagno & Rotsee

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The Lake Cadagno and Rotsee, both mesotrophic lakes, are situated in Piora valley in Southern Switzerland and in Central Switzerland, respectively. Because of their different physical, chemical and microbiological characteristics, these two lakes were chosen to study the interaction of methanogens and sulfate-reducing bacteria as relevant contributors to the final reduction step of organic matter in lake sediments. Sediment cores were obtained in Spring 2001 at the deepest sites in Rotsee (16 m) and Lake Cadagno (21 m). The core was sliced as follows: the top 5 cm in half cm slices, deeper layers in 1 cm slices. These samples were subsequently used for DNA extraction, PCR and TGGE analysis. Additionally, POC, PON and THAA were measured. Porewater samples of gases and ions were obtained using equilibrium diffusion plates. pH, alkalinity, Na⁺, NH₄⁺, K⁺, Ca²⁺, Mg²⁺, H₂S, SO₄²⁻, Cl⁻, NO₃⁻, and CH₄ were measured. The vertical profiles of alkalinity, NH₄⁺, POC and THAA concentrations provided clues about the activity of bacteria in the sediments. The NH₄⁺ and alkalinity concentrations increased with the depth in both lakes. However, in Rotsee the increase was much higher than in Lake Cadagno. The percentage of POC content in the sediment showed a sharp decrease with depth ranging from 14% to 2% to 30 cm. The measured THAA also showed the same trend. In Rotsee, the POC decreased with depth from 7% to 5%. In Lake Cadagno, while the overall SO₄²⁻ concentration sharply decreased, the highest concentration of H₂S, 2.5 mM, was observed at 10 cm. In this case, the diffusive flux of H₂S is both upward and downward from 10 cm. In Rotsee, the concentrations of SO₄²⁻ and H₂S were in the μM range. While a decrease in SO₄²⁻ concentration was observed, there was no change in vertical profiles of H₂S. CH₄ sharply increased in both lakes to 5 mM till 40 cm. Parallel to the chemical profiles, TGGE analysis was performed to screen the population composition of the cores. Two different primer sets were used to acquire the PCR products: A109F/934b for the archaeal domain and 385GC/1387b for SRB. With predefined conditions, parallel TGGE analyses were performed. First results with archaeal PCR products indicated a shift in population composition with depth in Rotsee, whereas no changes were detectable for sulfate-reducing bacteria in Lake Cadagno and Rotsee. Analysing the present data further by sequencing and by quantifying using FISH will provide a better understanding of the interaction of methanogens and sulfate-reducing bacteria within a chemically characterized environment.

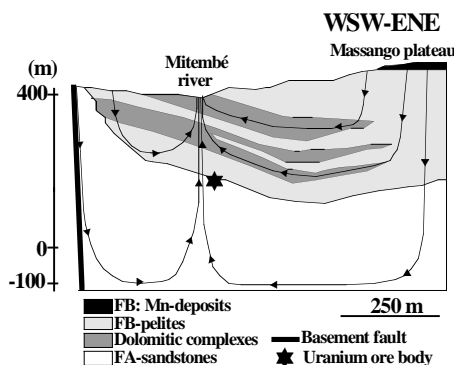
Groundwater geochemistry and dissolution processes of the Okélobondo uranium ore (Gabon)

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The Okélobondo uranium deposit (Oklo, Gabon) is located at a depth of 300 m. Groundwater samples from boreholes located at shallow depths (100-200 m) show neutral to basic pH, reducing conditions and are saturated with respect to uraninite. In contrast, deeper samples collected in the vicinity of the ore body are oxidising, slightly basic and subsaturated with respect to uraninite. A reactive transport model was used to predict the water composition.

Figure 1: Lithologic domains of the Okélobondo system.



The chemical composition of the water sampled in the upper part and in the WSW margin of the Okélobondo system can be explained in terms of the interaction of a recharge of meteoric origin with the pelites, sandstones and dolomitic complexes. The high Mn/Fe ratio and the high pH and Eh values of the water sampled in the lower part of the Okélobondo system are attributed to the interaction of the recharge with the superficial Mn-deposits (Fig. 1). Two key factors are essential for obtaining the chemistry of this water: a fast dissolution of a Mn-phase (rhodochrosite) and a slower dissolution of a Fe-phase (chlorite). This water is subsaturated in uraninite and may dissolve the ore deposit. A plume of uranium is carried downstream accounting for the uranium concentration samples in the boreholes from the shallower part of the Okélobondo system.

The reactive transport calculations were performed with the computer code RETRASO (Saaltink et al., 1998), developed under a contract with ENRESA.

References

- Saaltink, M.W., Ayora, C. and Carrera, J., 1998. A mathematical formulation for reactive transport that eliminates mineral concentrations. *Water Resources Research*, 34(7): 1649-1656.