Geophysical Research Abstracts
Vol. 13, EGU2011-8191, 2011
EGU General Assembly 2011

Environmental and biogeochemical changes in Lake Tswaing, South Africa, during the last 84 ka BP

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Lake Tswaing is a small crater lake located approximately 40 km northwest of Pretoria, South Africa, at an altitude of 1045 m above sea level. The lake formed in an impact crater by the inflow of groundwater and precipitation. At present Lake Tswaing is a highly saline and anoxic environment partly due to enhanced evaporation during the dry winter months. The sediments from Lake Tswaing provide the longest continuous record of paleoenvironmental change from the southern African subcontinent (Kristen et al., 2007, and references cited therein). Recently, we traced the modern carbon cycle in the crater environment based on stable carbon isotope analyses on bulk organic matter and certain characteristic biomarkers, and found indications for methanotrophic activity in the lake (Kristen et al., 2010). For a comprehensive understanding of the climatic influence on the evolution of the lake environment and its biogeochemistry and for insights into the adaption of the lake organisms to the extreme and changing environmental conditions during the last 84 ka BP, the organic matter in a 35 m long sediment core from Lake Tswaing was investigated by several geochemical methods.
Lipid biomarkers, i.e. organism-specific chemical compounds, and their stable carbon and hydrogen isotopic signatures provided information about the dominant organisms and the environmental conditions in Lake Tswaing. The total organic carbon (TOC) content varied strongly throughout the core ranging from 0.3% up to 9.8% TOC. Hydrogen isotopic composition of plant-derived n-alkanes indicated that low TOC contents corresponded to dry climatic conditions which reduced the allochthonous input and the productivity in the lake. In general, algae and bacteria were the predominating organisms in Lake Tswaing. Both groups showed strong variations and a temporal succession in response to changing nutrient conditions in the lake during specific intervals; e.g., dinoflagellates were most prominent in the time before 66 ka BP followed by a period with higher bacterial activity. Alkenone-producing algae appeared between 37 and 31 ka BP and showed strong shifts in their abundance which is possibly related to salinity effects. The occurrence of specific biomarkers strongly depleted in 13C pointed to the occurrence of methanotrophic/methylotrophic organisms during certain periods.

References

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