

Biomarker and stable carbon isotope analyses of sedimentary organic matter from Lake Tswaing: Evidence for deglacial wetness and early Holocene drought from South Africa

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ABSTRACT

The 1.13-km-wide crater Tswaing (25°24'30" S, 28°04'59" E) is located approximately 40 km northwest of Pretoria at an altitude of 1045 m above sea level. The crater was formed in granitic bedrock by a meteorite impact. Sediments from Lake Tswaing document hydrological changes in southern Africa over the last 200 Ka. In this study we investigate modern plant and lake water as well as modern and ancient sediment samples from the Tswaing Crater in South Africa using biomarker and stable carbon isotope analyses on bulk OM and specific biomarker compounds. The characteristic molecular markers for higher land plants (predominantly C₃-type deciduous angiosperms) in Lake Tswaing are long-chain *n*-alkanes (*n*-C₂₇₋₃₃), *n*-alkanols (*n*-C₂₈₊₃₀), stigmaterol, β-sitosterol, β-amyrin, α-amyrin and lupeol. The C₁₇ *n*-alkane, tetrahymanol, gammaceran-3-one and C₂₉ sterols dominate autochthonously produced OM. By comparing carbon isotope signatures of bulk OM and the characteristic biomarkers, we trace the modern carbon cycle in the crater environment and find indications for methanogenic activity in the lake from isotopically depleted moretene. A comparative study of core sediments reveals changes in the terrestrial (C₃ vs. C₄) and aquatic bioproductivity and allows insights into the variability of the carbon cycle under the influence of changing climatic conditions for the time from the end of the last glacial (Termination I) to the late Holocene, c. 14,000–2,000 calibrated years before present (yr BP). The most pronounced changes occur in the aquatic realm at c. 10,000 yr BP and 7,500 yr BP when our results imply climate swings from more humid to more arid and to gradually more humid conditions again, which can be related to a shift in the position of the Inter-Tropical Convergence Zone or to changes in the tropical atmosphere-ocean interaction.

Key words: Lake Tswaing, biomarkers, stable carbon isotopes, carbon cycle, bioproductivity, climate conditions