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# An interdisciplinary approach to reconstructing hydrologically controlled terrestrial habitat dynamics during MIS 5 from sediments of Lake Ohrid (Albania, Macedonia)

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We investigated sediments from a piston core (site Co1202) in the northeastern part of Lake Ohrid (Macedonia, Albania) that cover the period from 136 to 97 ka, i.e. most of marine isotope stage (MIS) 5 including Termination II and the peak warm period of MIS 5e (Eemian).
The aim of the study was to reconstruct climatically controlled changes in the terrestrial habitat by combining data from elemental, lipid biomarker (alkyl lipids, glycerol dialkyl glycerol tetraethers/GDGTs) and compound-specific carbon isotope analyses with pollen data.
Comparison of biomarker data from sediments and modern materials shows a close similarity between the average biomarker composition of sediments and soils. This is confirmed by statistical analyses, implying that a dominant proportion of the sedimentary alkyl lipids derives from soils while aquatic sources (macrophytes, phytoplankton) can be ruled out as a major source. The carbonate record of the Co1202 sediments and the GDGT-based proxy for lake surface water temperature (TEX86) closely follow climatic trends as they are known from the North Atlantic realm, including marine isotope sub-stage 5d and short-term climate events such as cold events C25, C24 and C23. By contrast, proxies based on alkyl lipid composition reveal an entirely different pattern. Episodes of slow, continuous change are disrupted by abrupt shifts. This suggests a threshold-controlled system, with supply of organic matter from specific sources being increased or suppressed by a sudden change of supply pathways. Such a mechanism is provided by lake level change that includes rapid flooding or exposure of extensive tectonic terraces in the vicinity of site Co1202 as documented by geophysical surveys. Both flooding and exposure change the areas that certain habitats occupy in the catchment of the site, e.g., the proportions of vegetation and soils on the surrounding mountain slopes relative to that on low-lying terrace surfaces. Several such abrupt changes can be seen in the biomarker records, with a particularly severe lake level drop and erosion of soil organic matter culminating in the deposition of a sand layer at 112 ka. Notably, the pollen record does not reflect the longer-term climatic deterioration of MIS 5d nor the short-term cold events to the same extent as the elemental and biomarker data. However, assuming that a substantial proportion of the pollen is delivered towards the site as part of the soil fraction, higher soil erosion rates during exposure or flooding will have increased the supply of pollen from vegetation previously established on the terraces and, thus, likely compensated for the change in the wider vegetation cover, in particular, the recession of forest vegetation on the mountain slopes during drier periods.
Our results illustrate the complexity of habitat dynamics in the Ohrid Basin, with the vegetation and soil organic matter pools developing at different speeds while lake level change further modifies habitat composition as well as organic matter supply. The results also demonstrate that organic-geochemical and palynological data combined can improve our understanding of local habitat modification and, in turn, highlight the importance of local habitat with regard to the interpretation of paleo-environmental records.