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Sedimentology, tephrostratigraphy, and chronology of the DEEP site sediment record, Lake Ohrid (Albania, FYROM)

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Lake Ohrid, located on the Balkan Peninsula, is one of the very few lakes in the world that provides a continuous and high-resolution record of environmental change of >1.3 Ma. The sedimentary archive was drilled in spring 2013 within the scope of the International Continental Scientific Drilling Program (ICDP) and the Scientific Collaboration on Past Speciation Conditions in Lake Ohrid (SCOPSCO) project in order to investigate local and regional geological and paleoclimatic processes, as well as triggers of evolutionary patterns and endemic biodiversity.

The continuous composite profile (584 m) of the main drill site DEEP was logged (XRF, MSCL) and subsampled for biogeochemical (TIC, TOC, TN, TS) and sedimentological (grain size) analyses. The lithology of the DEEP site indicates that the history of Lake Ohrid can roughly be separated into two parts, with the older section between 584 and 450 m depth being characterised by a sedimentary facies indicating shallow water conditions, which is likely younger than ca. 1.9 Ma. In the lowermost few meters of the succession gravels and pebbles hampered a deeper drilling penetration and indicate that fluvial conditions existed during the onset of lake formation. Together with geotectonic, seismic, and biological information, the data imply that the Ohrid basin formed by transtension during the Miocene, opened during the Pliocene and Pleistocene, and that the lake established between 1.9 and 1.3 Ma ago. The sediments of the younger part (< 450 m sediment depth) indicate that deeper water conditions established in Lake Ohrid after 1.3 Ma ago. Since then, biogeochemical proxy data respond to global glacial/interglacial variability, with warm periods being characterized by high TIC and TOC concentrations and cold periods by negligible TIC and low TOC contents, respectively.

To date, 56 tephra horizons have been identified in the upper 450 m of the DEEP site sequence and are subject of ongoing investigations aimed at identifying their specific volcanic sources and equivalent known tephra by using geochemical fingerprinting of glass fragments. This was already successfully approved for tephra horizons in the upper 247.8 m of the sequence, obtaining important chronological information from 11 well dated tephra layers. These tephrochronological constraints were complemented by ages obtained from tuning the consistent pattern of the biogeochemical proxy data to orbital parameters in order to develop an age depth model for the last 637 kyr. This dating approach for the upper part will be further extended for the lower sequence below 247.8 m and combined with paleomagnetic information. The Brunhes/Matuyama boundary and the Jaramillo subchron are evident in the DEEP site sequence and will be further confined by higher resolution paleomagnetic measurements. The high-resolution data will also enable the reconstruction of the dynamic of the Earth′s Magnetic Field during polarity transitions. This mulit-method dating approach will provide a robust chronology of the core, which is the backbone to fulfil the major aims of the SCOPSCO project.