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Lake Level Changes of Lake Van over the Last 400 ka: Evidence from Deltas in Seismic Reflection Data and ICDP Drilling

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Lake Van is located on the East Anatolian Plateau of Turkey, which is a key area to obtain long-term regional paleoclimate records. This study is based on the correlation of seismic reflection data acquired by IFM-GEOMAR in 2004 and the borehole stratigraphic information obtained from two sites drilled by International Continental Scientific Drilling Program (ICDP) Paleovan Project in 2010. The drilled sites (Northern Basin and Ahlat Ridge) are located at the water depths of 245 m and 357 m, where drill holes reached to depths of 145.5 m and 220 m below the lake floor, respectively. Physical core properties were measured by the Geotek Multi Sensor Core Logging (MSCL) equipment at the onshore lab of the drilling campaign. Correlation between the seismic and MSCL data was based mainly on matching the two data sets of the tephra layers that were characterized by high reflection amplitudes and the high magnetic susceptibility values. Stratigraphic correlation between the two sites was done using the magnetic susceptibility profiles. Seismic reflections representing the different tephra layers were then traced over the basin. A tentative age model was constructed based on AMS ^{14}C dates, tephra correlation and varve counting. It was then tuned with the isotope stages using the δ^{18}O and δ^{13}C isotope data, and used to date the seismic reflections.

The seismic lines extending from the north towards the 460 m deep Tatvan Basin in the south reveal a stack of at least five deltas that developed over the past 400 ka cal BP. According to the age model these deltas developed during the cold periods. The minimum lake level occurred at about 350 ka cal BP (MIS-10) when the lake level was about 550 m below the present lake level. Considering possible crustal subsidence due to sediment and water loading and sediment compaction, the water level at the time would have been 400-350 m below the present level. Another delta formed at 200 m below the present lake level during the Last Glacial Maximum. The other deltas at 160 m 235 m, 300 m and 490 m below the present lake level (without the subsidence correction) are dated 125-95, 166-142, 195-169 and 270-234 ka cal BP, respectively. Estimated dates have an error approximately 10 ka due to uncertainties in estimating the ages of seismic reflectors and isotope stage boundaries. From the seismic stratigraphic analysis, it can be concluded that interglacial epochs have lower sedimentation rate than the glacial epochs. This was mainly due to the high rate of physical weathering, low lake levels and abundant mass-flow events during glacial epochs. During high lake levels, mainly laminated and banded sediments were deposited, whereas glacial epochs with low lake levels are characterized by grey homogenous muds and turbidite sedimentation. The turbidites commonly range in thickness from a few cm to a few meters, and are characterized by a sharp basal boundary, overlain by a sandy bed that passes upward into graded and laminated clayey silt and a homogeneous mud layer.