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Paleoenvironmental Changes In Lake Van During the Late Glacial-Holocene

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Lake Van is the fourth largest terminal lake and the largest soda lake in the world (volume 607 km^3, area 3,570 km^2, and maximum depth 461 m). The pH of its waters is 9.81 and salinity is about ‰ 22. It is located in the Eastern Anatolian High Plateau in Turkey, with the present lake level located at 1649 m. This region has a continental climate influenced by the Siberian High Pressure, North Atlantic and Mid-Latitude Subtropical systems. Its varved sediments with high sedimentation rate (0.5-0.7 m/ka) provide a continuous record of climatic conditions for Quaternary period.

Multi-proxy analyses, including inorganic XRF Core Scanner elemental, total organic (TOC) and inorganic carbon (TIC), stable carbon and oxygen isotopes of bulk carbonate, and XRD mineralogical analysis, were carried out in the upper part of the 144 m-long composite stratigraphic section recovered by the ICDP-PaleoVan Project in the Northern Basin. The age model was constructed using AMS C-14 analysis and tephra ages from previous studies. The main purpose was to study the paleo-environmental changes during the last glacial-interglacial cycle covering the last 25 ka in the Lake Van region.

The studied composite stratigraphic section consists of five lithological types: a) banded and/or laminated clayey silt, b) homogeneous clayey silt, c) tephra, d) graded sand-silt (turbidite-homogenite), and e) deformed lacustrine sediments and tephra layers (i.e., slide and slump deposits). The time interval between 12.5 and 6.5 ka calBP (Younger Dryas, YD - early Holocene) consists mainly of banded and laminated sediments with tephra intercalations, whereas the interval between 25 and -14.5 ka cal BP sediments are predominatly of graded sand-silt (mass transport deposits) with tephra and homogeneous clayey silt interbeds. The multi-proxy analyses were mainly conducted on the banded and laminated clayey silt and homogeneous clayey silt layers that are authoctonous lake sediments. There is a strong covariance between δ^{18}O and δ^{13}C values of the bulk carbonates (r>0.88), which demonstrates that the lake remained as a closed basin in general. The TOC and TIC values are higher during the Holocene and Younger Dryas (TOC>2.5 wt% and TIC>3 wt%) than those during the late glacial (TOC <2 wt%) and TIC <3 wt%). There is a weak positive correlation between TOC and TIC for the Holocene (r=0.37), and a weak negative correlation for the late glacial and YD sediments (r=-0.22). The highest TOC values (>4 wt%) are observed during 9-6.5, 5.7 and 5-4 ka calBP. Significant positive correlations between TOC, TIC, δ^{18}O and δ^{13}C values during these periods suggest high TOC and TIC values are related to high organic productivity, probably associated with low water levels in the lake. High amplitude oscillations (7 ‰) in δ^{18}O, and δ^{13}C values during 14-13 ka calBP and late Holocene (5 ka BP-present) suggest lake level oscillations and associated changes in the lake's organic productivity. The lowest δ^{18}O values (< ‰ -4) are observed at 4-2, 17-14, 21.3 and 27-26 ka calBP, which probably correspond to relatively high lake levels.