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Seismic stratigraphic evolution of Lake Van, Eastern Turkey: An integration of seismic, hydroacoustic, and drilling data

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Lake Van in Eastern Anatolia (Turkey) is the fourth largest terminal lake in the world with a surface area of 3,574 km^2, a volume of 607 km^3, a maximum depth of 450 m, and a maximal length of 130 km WSW-ENE. Over 1500 km of multi-channel seismic reflection profiles in combination with ICDP drilling and bathymetric data from Lake Van, eastern Turkey, allow to reconstruct stratigraphic evolution of the lake basin. Three major basins (Tatvan, Deveboynu and the Northern basin) are separated from each other by Ahlat and Northern ridges. The sedimentary history of the lake was subdivided into 19 distinct phases reflecting major environmental and depositional changes. Five major regressive and fourteen transgressive phases have been identified. Five lake lowstands have been dated as follows: (Phase 1) ∼580 ka; (Phase 5) ∼ 355-341 ka; (Phase 7) ∼ 320-210 ka; (Phase 12) ∼ 170-140 ka; and (Phase 18) ∼ 30-16 ka. Estimated paleolake levels (below present lake level) at the end of each phase are; 610 m for Phase 1, 560 m for Phase 5, 470 m for Phase 7, 310 m for Phase 12, and 210 m for Phase 18. The sediment infill history of Lake Van over the ∼580 ka is characterized five types of sedimentary facies. (a) Uniform 'well-stratified' lacustrine deposits (alternating organic muds and fine grained turbidites and tephra) formed under quiescent lake level conditions characterize the deeper parts of the basin. (b) Chaotic 'mass-transport' deposits characteristics of the southern parts of the lake have likely resulted from mass-transport process possibly triggered by ongoing tectonic activity along the lake margins. (c) Oblique or complex-oblique shaped 'deltaic' deposits have formed on the eastern/southeastern shelf and slope areas most likely due to accumulation of large volumes of clastic material derived from adjacent rivers. (d) Non-uniform 'fluvial' deposits characterizing the shelves are interpreted to have mainly deposited by fluvial processes when the shelf was subaerially exposed. (e) Chaotic 'volcaniclastic' deposits that fill local basins (Northern basin) are probably due to volcanic mass flows such as pyroclastic flows. In summary, our data show that sedimentation in the basins was mainly controlled by tectonic, climatic, and volcanic factors. The effect of climate was more pronounced in sedimentary phases rather than other factors as suggested by repeated patterns of lake level fluctuations. Such lake level fluctuations which reflected in clinoforms in seismic data are also documented as morphological features (channels, terraces) in bathymetric data.