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Sediments of Lake Van – a high-resolution archive of changing climate, volcanic events and seismic activity in Eastern Anatolia for the last 500'000 yrs

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Varved sedimentary records have shown their high potential to reconstruct abrupt and global climate change within the marine realm (e.g. Cariaco Basin, Santa Barbara Basin). Continental counterparts, consisting of long and varved lacustrine records can be found in the subsurface of some deep lakes, such as Lake Van. Lake Van is a 440 m deep closed soda lake situated in a climatically sensitive semiarid and tectonically active region in Eastern Anatolia, Turkey. The ICDP project Paleovan aims to reconstruct the climatic, tectonic and volcanic history of Lake Van. Driven by an international and interdisciplinary scientific team, two sites, Ahlat Ridge (AR) and Northern Basin (NB) were drilled in summer 2010 recovering sedimentary records of 220 and 140 m, respectively. A total of 800 m of sediment-cores were opened, described and photographed in spring 2011 at the IODP core repository in Bremen. Lithologies of up to five parallel cores (multiple coring) were correlated and a composite profile was defined giving priority to core quality and continuity. Preliminary Ar/Ar dates of the core catcher yielded a basal ages of $\sim$500′000 years. Using this rough age model, geochemical measurements (every 20 cm) indicate that TOC is high in warmer periods (interglacials) and low in colder periods (glacials). These TOC fluctuations match marine isotope stages and extrapolated Holocene sedimentation rates. The 219 m long AR composite profile consists of $\sim$80 % lacustrine sediments, $\sim$10 % of volcaniclastic deposits and 10 % gaps interpreted to be coarse-grained volcaniclastic that are difficult to be recovered. The lacustrine mud, i.e. clayey silt composed of mainly clay minerals and carbonate. Based on major macroscopic sediment features eight major lacustrine sediment types ($\sim$900 layer) were differentiated and separated from the volcaniclastic deposits (300 layer). Impressive color transitions and a repetitive pattern of similar lithological successions occur throughout the record. The sub-mm thin laminated intervals as recovered from different interglacials/interstadials stand out prominently against the more banded lithologies of the remaining sections. From 168 to 189 meters below the lake floor a unit of major irregularities and accumulation of deformations were identified as a large-scale mega-event deposit. It overlies a unit of carbonate-poor diatomaceous mud and a gravel-rich unit containing fresh-water gastropods (Bithynia) and mussels. The gravel is interpreted to have been deposited under beach-like conditions and reflects the early transgressive state of the lake′s history.
The distinct and great variability of sediment types is indicative of highly and rapidly changing depositional conditions forced by lake level and other climate-driven changes and by tectonic events over the past 500'000 years. The annual laminated intervals reflect strong seasonal fluctuations in particle fluxes to the lake bottom and bottom water anoxia. The onset/cessation of theses episodically occurring laminations represent threshold crossings indicative for abrupt changes of climate (e.g. Dansgaard-Oeschger cycles) and tectonic activities. The partly varved lacustrine record enables, for the first time, to reconstruct the environmental and climate conditions captured during several glacial/interglacial cycles at a mid-latitudinal continental realm.