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The lesser of two evils? Two modes of early carbonate diagenesis in sub-recent lacustrine sediments of Lake Van

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Soft, unlithified sediments recovered from modern lakes rarely offer clear evidence of diagenetic alterations. We document products of early diagenesis in the deep lacustrine setting of Lake Van. Lake Van, cored in 2010 in the frame of the ICDP PALEOVAN project, is a terminal, alkaline lake in Eastern Anatolia, Turkey. Its carbonate inventory consists of (1) primary phases: inorganic calcite and aragonite precipitating in the surface water, and low-Mg calcite ostracod valves formed at the sediment-water interface; and (2) secondary phases: aragonite encrustation of ostracod valves and organic remains and early diagenetic dolomite forming in the sediment pores. Here we focus on secondary phases.

Both types of secondary carbonate phases appear cyclically in Lake Van sediments younger than ca. 350 ka, but never together. Encrusted ostracods occur over broad intervals but are restricted to two lithologies; homogenous and banded muds, representing lake low-stands, reduced primary productivity/preservation and a well-ventilated water column. In turn, occurrence of early diagenetic dolomite is discrete but also lithology-restricted; mostly to an abrupt transition between finely laminated sediments, representing high-stands and anoxic/suboxic water column and other subsequent banded muds.

The isotopic composition of encrusted valves contrasts that of inorganic carbonates precipitating (primary phases) in the water column; heavier δ18O supports formation in bottom water, heavier δ13C is likely related to microbial activity, however, the nature of this relation is yet unclear. Encrusted valves are very common and often articulated but display different stages of opening. As ostracod valves usually disarticulate within hours to days after the animal's demise, semi-open valves suggest that the encrustation process was – in geological terms – extremely rapid.

The heavy δ18O of dolomite also suggest precipitation in the bottom water, while δ13C shows no clear systematics. Occurrence of dolomite where virtually no aragonite is present, suggests dissolution/reprecipitation processes at work.

Our unexpected finding calls for care and attention analyzing unlithified sub-recent carbonates. The facies-bound recurrence suggests that these two different early diagenetic processes are ultimately controlled by environmental factors. The ongoing study aims at revealing the mechanism of these processes.