

Halite sedimentology and petrography in the Dead Sea basin as an indicator for paleoenvironment and paleoclimate

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Halite precipitated in the Dead Sea basin during the last three interglacials and represents extremely arid periods when the lake level dropped, possibly below 400m bmsl. The halite is divided into two main types: Large transparent preferential oriented crystals that formed on the lake-bed and small non-oriented crystals that formed on the lake-atmosphere boundary and accumulated on the lake floor. Small crystals tend to form due to relatively high evaporation rate, while large crystals form in lower rates of evaporation and may indicate a limnological structure of a mixed water column. These two types of halite occur at different frequencies and time intervals varying in thickness from a few mm up to tens of centimeters. The mud in between the halite layers or crystals is usually associated with the large-crystal salt type where also mud is found between the halite crystals. Nevertheless, at some specific locations alternations between small-crystal halite and mud is observed.

The thick large crystal layers probably represent the slowest rate of lake level drop (assuming a relatively deep lake) and the crystals are often transparent and contain almost no fluid inclusions, suggesting a very slow growth of the crystals. Assuming that large crystals can grow on the lake floor only when the water column is mixed and the absence of small crystals during these periods may suggest that the temperatures during summer weren't relatively warm, keeping the water column mixed. Alternatively, the degree of saturation of halite may have decreases to below saturation under the higher temperatures of the summer.

The most extreme climatic conditions are represented by the thick small-crystal halite layers that usually include rafts that are associated with high supersaturation of halite and evaporation. These layers do not contain any detrital material beside a few faint layers of some detritus with slightly larger crystals of halite. Frequent alternations (~0.5-1cm of each layer) between the two halite types may represent milder conditions and seem to be seasonal.

An unusual occurrence of halite is alternations between very fine crystals of halite (up to 2 cm thickness) and detritus (~1 mm thick) representing sharp transitions between wet and very dry conditions. These alternations occur at a few places only during MIS 5e and mainly around the pebbles layer that was deposited towards the end of MIS5e. The most frequent and thickest sections of the small-crystal halite with less large-crystal halite mark the beginning of the precipitation of halite at the current and last interglacials.

The structure of the halite and relationship with the mud layers, together with the absence of evidence of halite dissolution, suggests a relatively deep-water body where floods did not mix the whole water column and reduce the degree of saturation of halite. However, the thick sections of halite suggest significant lake level drops, with the most extensive one of at least 300m occurring during MIS 5e.