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Deoxygenation dynamics in the Eastern Mediterranean Sea and implications for water mass configuration during Holocene sapropel S1 formation

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Sapropels are the sedimentological record of repetitive anoxic events in the Eastern Mediterranean Sea. The youngest event sapropel S1 occurred in the early Holocene, between ~10-6 ka BP. Here we present geochemical and benthic foraminifera fauna assemblage data of two new sediment cores from the coast of Israel. EZ17G5 and ME0318 were taken at 1200 and 1430 m water depths in March 2017 and 2018, respectively. Total organic carbon, Ba/Al and V/Al were measured on both cores. Additionally, diversity and oxygen indices were calculated based on the benthic foraminifera fauna. While TOC and Ba/Al indicate that the sapropel conditions lasted from ~6.6-9.8 and ~6.6-9.3 ka BP, the faunal indices imply a gradual onset of S1 from oxic to suboxic to anoxic conditions over a period of several hundred years with anoxic conditions confined to the interval between 9.5 and 8.8 ka BP. The 8.2 ka cooling event was more pronounced in ME0318 whereas in EZ17G5 it seems that oxygenation gradually increased from ~7.8 to 6.5 ka BP.

The findings are compatible and support a new model of water mass configuration during sapropel formation. As a result of a survey of sediment cores from across the Eastern Mediterranean, it was shown that the waters above 500 m showed similar thermohaline circulation to the modern Eastern Mediterranean albeit probably with a slower water flow rate. The waters below 1800 m were anoxic throughout S1 and showed no interruption, which has been interpreted as being due to stagnation. By contrast, there was an intermediate water mass (SIW) which showed partial reventilation at the 8.2 ka event as well as slow ventilation during S1b. For the generation of partial ventilation at intermediate water depths, we propose water mass formation and advection as the possible process.

Using this four layer model, the properties of this sapropel intermediate water mass was examined. Commonly, sapropels are defined by TOC and/or Ba/Al ratios but our results imply that benthic foraminifera reveal the changing oxygen status of this water mass, which was also shown using V/Al as a redox sensitive trace metal. Determining the changing oxygen status of the overlying water body is important as modern oxygen minimum zones are spreading. Knowing the dynamics and oceanographic processes of past anoxic events will help to understand the development in the future.