Geophysical Research Abstracts
Vol. 16, EGU2014-6610, 2014
EGU General Assembly 2014

Conditions of S1 Sapropel deposition in the eastern Levantine Sea inferred from high-resolution geochemical analysis

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Holocene sediment in the Levantine Sea is characterized by the presence of organic-rich Sapropel layer (S1) that was formed by a drastic decrease of labile organic matter decomposition under oxygen-depleted conditions. It was demonstrated that reduced oxygen supply to bottom waters was a precondition of sapropel formations, and fresh water inputs played a key role. To study the relationship between bottom water oxygenation and surface water freshening, we performed major, minor and trace element analyses by combining XRF and ICP-MS measurements as well as stable isotope analyses on surface dwelling planktonic foraminifer Globigerinoides ruber of core MD04-2722 (33°10'N, 33°50'E, 1780 m water depth) from the east Levantine Sea. The water depth of core location is close to an upper limit of anoxic layer during S1 formation (1800 m).

Based on 14C dates and δ18O of G. ruber, Ba/Al (indicator of export production), Br/Cl (organic matter content) and Mn (oxidised S1 upper limit), the S1 deposition of core MD04-2722 was estimated to have occurred at 11 to 6.5 cal ka BP. Redox-sensitive U/Al and Mo/Al suggest that the bottom water oxygen depletion started as early as $\sim$12 cal ka BP in concert with surface freshening indicated by decreasing G. ruber δ18O values. Some elemental ratios (V/Al, Fe/Al, As/Al and high resolution Fe/Ti and V/Ti) present a prominent decrease at 8 cal ka BP, a sign of bottom water re-oxygenation. Benthic foraminiferal abundance of core MD04-2722 supports the oxygenation conditions inferred from geochemistry.

Our estimate about the onset of oxygen depletion at 12 cal ka BP is consistent with changes in benthic foraminiferal δ13C values in the South Aegean and the Levantine Sea, and U-Th dates of authigenic carbonates that was formed under suboxic conditions on the Nile deep-sea fan. We propose that the organisation of circulation in the Eastern Levantine Sea was initiated at $\sim$ 12 ka in relation to surface water freshening. The observed re-oxygenation event at 8 ka at 1780 m reinforces the idea that the re-ventilation expanded in the Eastern Levantine Sea at water depth of 890 to 2300m. Possible mechanisms of this event will be discussed using compilation of existing data.