Evidence of sapropel S1 formation from Holocene lacustrine sequences in Northern Dalmatia (Vrana Lake)

Dokazi formiranja sapropela S1 unutar holocenskih jezerskih sekvenci sjeverne Dalmacije (Vransko jezero)

Koraljka Bakrač, Nikolina Ilijanić, Slobodan Miko & Ozren Hasan
Hrvatski geološki institut – Croatian Geological Survey, Sachsova 2, 10 000 Zagreb, Croatia

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Sapropels are distinctive layers of organic-rich sediment commonly observed within marine sediment cores recovered from many localities throughout the Mediterranean Basin (ARIZTEGUI et al., 2000). A number of sapropel layers have been observed in marine sedimentary sequences that extend over several glacial–interglacial cycles, which suggests that the conditions under which sapropels form are linked, directly or indirectly, to Quaternary climate forcing mechanisms. The most recent (Holocene) sapropel (S1), widespread throughout the eastern Mediterranean Basin and the Adriatic, formed between ca. 9.8 and 6.8 cal kyr B.P. The wettest conditions are reported throughout the central Mediterranean region and are contemporary with enhanced rainfalls over the northern borderlands during the deposition of sapropel (organic-carbon-rich sediments) S1 in the Adriatic Sea (SIANI et al., 2010) and in the central-eastern Mediterranean Basin (ARIZTEGUI et al., 2000). However, this is a simplification, because what is termed the ‘S1 layer’ is often a complex feature, one that is difficult to detect in some places because it is susceptible to extensive oxidation, resulting in considerable thinning, or even its complete removal.

New stratigraphic data are presented from well-dated sequence in Lake Vrana near Biograd na Moru on the eastern Adriatic coast. The sequence span the uppermost Pleistocene and Holocene, but we focus here on the evidence for the time period during which sapropel S1 formed in the Mediterranean region (ca. 9.0 to 6.8 cal B.P.). The new records provide evidence of palaeoenvironmental changes on land that can be reconstructed, and which throw some light on the processes which led to the formation of S1. The evidence indicates that: (i) organic-rich sediments occurred in the lake site during the time of formation of the S1 sapropel; (ii) there is evidence of increased stratification and anoxia in the water column during the period of S1 formation; (iii) the S1 period in the study area is divisible into two sub-phases (S1a and S1b). We conclude that the key factor that initiated the formation of S1 was increased discharge of freshwater into the lake following a change post-9.0 cal B.P. to a warmer and wetter climate. Furthermore, the period of S1 formation was interrupted by a short-lived episode of comparatively cooler and drier conditions during the Early–Middle Holocene transition as in ARIZTEGUI et al., 2000. Sapropel S1 is thus subdivided into an early (S1a) and later phase (S1b), these being separated by a short-lived episode which dates to around 8.0 to 7.5 cal B.P.

Sapropel S1 is characterized in the studied core by two levels of black-gray sediments from 813 cm to 860 cm and 640 cm to 710 cm (S1a and S1b), separated by a horizon between 710 cm and 813 cm corresponding to the sapropel interruption evidenced by a short-lived period of reduced organic matter deposition (i.e. relatively low productivity and/or preservation). This is considered to reflect regional climatic cooling associated with reduced levels of precipitation that interrupted a period of generally higher precipitation. A similar subdivision of the sapropel S1 phase can be detected in a number of published stratigraphical records from sites located in various parts of the Mediterranean Basin.

From the oldest parts (zones PPVR2-I to PPVR2-IV), palynomorphs are represented by sparse taxa indicating transition from colder Pleistocene to warmer Holocene climate. From 9.6-9.3 cal BP (PPVR2-V), abundant Botryococcus (colonies) are recorded, typical of an open lake with deep water (TESTA et al., 2001) followed by Pediastrum colonies. In the next subzone PPVR2-VIa and PPVR2-VIb (ca. 8.2-7.7 cal BP), abrupt reduction of the Botryococcus algal colonies and relatively small amount of organic content is observed. At the beginning of the subzone PPVR2-Vlc (ca. 8.2-8.0 cal BP) cooling and dryness could be inferred from the increased amount of Gramineae (cereals), Ericaceae, Asteraceae and Chenopodium. This interruption is followed by wetter climate documented by decreased amount of stonic elements, while arboreal elements increase. This could be correlated with increased river inputs around the Adriatic Basin from the central Adriatic borderlands that happened around 7.5-7.0 cal BP (COMBOURIEU NEBOUT et al., 2013).
References:


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