Bacteria and their relevance during formation and preservation of sapropels

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Ongoing biological modification by metabolically active, unique bacteria

Up to 217,000 year-old sapropels and intermediate layers harbor unknown, metabolically active chemoorganotrophic bacteria and archaea. Sapropels exhibit higher cell numbers, higher activities of hydrolytic exoenzymes and higher anaerobic glucose degradation rates than the carbon-lean intermediate layers. This vertical pattern of metabolic activities suggests that the microbial carbon substrates originate from the sapropel layers themselves. Based on the analysis of 16S rRNA gene sequences, the majority of bacteria in sapropels belong to so-far-uncultured green nonsulfur bacteria and constitute up to 70% of total microbial biomass. In addition, Crenarchaeota were found in the microbial assemblage. Since both groups represent only a minor fraction of microbial biomass at the sediment surface, these previously unknown prokaryotes seem to be adapted to sapropels where they apparently still alter the subfossil organic matter.

Subfossil bacterial remains

Isorenieratene and its derivatives have been used as indicators for past anoxia of Mediterranean bottom waters. However, we found isorenieratene also in carbon-lean intermediate layers which were deposited under oxic conditions. Using a highly sensitive method, we could furthermore detect fossil 16S rRNA gene sequences of green sulfur bacteria not only in sapropels but also in the intermediate layers. Based on the vertical distribution of different sequences in the sediments, at least one type of green sulfur bacteria appears to be allochthonous and may have reached the deep-sea sediments via input from rivers or coastal lagoons, rather than representing a pelagic form which thrived in the chemocline of a stratified water column. During formation of at least some of the sapropels, an alleged anoxia of Eastern Mediterranean bottom waters therefore may not have reached the euphotic zone.

References

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Migmatitic geochronology and geochemistry – a key to understanding the exhumation of the Madan dome (Bulgaria)

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The high-grade metamorphic rocks exposed at the area of Madan dome are part of the lower plate of the late Alpine Central Rhodopian core complex, exhumed at Eocene time (Ivanov et al., 2000). This study links U-Pb ages of accessory minerals and geochemistry of anatectic melts, generated in the dome core, with Alpine structural evolution of the dome.

High-precise U-Pb analyses of single zircon grains from orthogneissic mesosome, filled with thin millimeter scale leucosome, discordant leucosome and metric scale anatectic granite body usually show inheritance of lead components, post crystallization lead loss and yield a Variscan age of the protolith (310.7 ± 4.6 Ma). Newly formed zircon from a discordant leucosome give an age of 37.08 ± 0.38 Ma. The U-Pb analyses of single monazites revealed the age of their crystallization from anatectic melt at 37.8 ± 1.5Ma.

The leucosomes have near a minimum melt composition for the major elements. The elements occurring as trace constituents in felsic phases (Rb, Ba and Sr) have concentrations similar to those of model equilibrium melts. The incompatible elements (REE, Hf, Zr, Y, Th, Sc, Nb, Ta) occurring as essential structural components in accessory phases or as trace constituents of mafic minerals show a positive correlation with Fe+Mg+Ti; this demonstrates a residence in refractory phases and low mobility during melting. LREE and Zr concentrations in some leucosomes coincide with those calculated for low temperature felsic peraluminous equilibrium melts. Leucosome samples with higher REE contents have negative Eu anomalies, whereas those with low total REE have positive Eu anomalies, which indicate that feldspar fractionation was important in their petrogenesis. Migmatic geochemistry corroborates an assumption of low temperature melting and fast melts extraction that corresponds with rapid exhumation tectonic regime. This fact is confirmed by the narrow time bracket between peak of the metamorphism (37 Ma, > 600°C), core complex cooling (35 Ma at 300°C) and volcanic activity (32 Ma).

References

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