Geochemical comparison of Late Pliocene sapropels from the Vrica land section and ODP Sites 964 and 974

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The post-Miocene sedimentary record of the Mediterranean Sea records evidence of global climate variations characterized by a cyclicity of ~21kyr and induced by fluctuations in the orbital precessional cycle (e.g. Emeis et al., 1996). Sapropels are the expression of such climate changes. Their widespread occurrence allows reconstruction of the paleoceanographic processes involved in organic matter production and preservation, their variability through time and space, and evaluation of the relative importance of local factors. We studied two insolation cycles (i-cycle 178 and i-cycle 180) from the Vrica Section (Calabria, Italy) and ODP Sites 964 and 974. The Vrica Section is a paleomargin sequence characterized by high sedimentation rates at the edge of the Ionian Basin. In contrast, Sites 964 (middle of the Ionian Basin) and 974 (central Tyrrhenian Basin) represent open sea settings.

Methods and results

We analyzed a variety of geochemical proxies including contents of organic carbon and nitrogen, trace element compositions, C and N isotopic contents of bulk organic matter, and alkenone and *n*-alkane biomarker molecules. The Vrica section because of its high sedimentation rates allows observation of much finer details within the sedimentary sequence than either of the deep-sea Sites. At Vrica in fact we identified the presence of two interruptions and a pre-sapropel for i-cycle 178 and of two sub-units within i-cycle 180.

Conclusions

The comparison of the same sapropel sequences between multiple sites is particularly useful to understanding the major processes involved in sapropel deposition and the tuning operated by local factors. In particular, increased productivity at the sea surface, anoxia at the sea bottom, increased continental runoff and higher rates of nitrogen fixation (Struck et al., 2001) seem to be involved in sapropel deposition. The investigation of sites from different sub-basins is especially interesting in the evaluation of the synchroneity and strength of the global signal controlling sapropel events.

References

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High-K magmas from the French Massif Central: crust-mantle interaction during the Hercynian orogeny.

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The occurrence of highly potassic magmatism in active orogens is well documented. However, the nature of its source and the evolution of magmas during ascent is still debated and it remains to be shown whether such magmas can help trace mantle processes beneath orogenic areas. To better elucidate the interaction between high-K magmas and the crust, we analyzed so-far poorly characterized lamprophyres from mid to deep crustal levels of the eroded Hercynian orogen of the French Massif Central.

$^{40}Ar/^{39}Ar$ dates obtained on biotite-rich minettes from the Cevennes located externally during orogeny and amphibole-rich spessartites from Auvergne located more centrally show that these high-K magmas were emplaced between 325 Ma and 310 Ma, during the late orogenic extensional phase and the late phase of granitic magmatism. Zoned biotites, calcic amphiboles and K-feldspars are the key minerals in these "calc-alkaline" lamprophyres. Although mechanical interaction between the lamprophyres and the surrounding granites is evident in the field, major and trace element compositions demonstrate that contamination was limited, and that biotite and/or amphibole were the only minerals to crystallize at depth. This suggests that the highly LREE-enriched lamprophyres represent early liquids from a metasomatized mantle source rich in either mica or amphibole and located at depths shallower than the garnet stability field, presumably the lithospheric mantle. Sr isotopes further indicate the mantle source was enriched during the Hercynian subduction, possibly with fluids with a sediment-like signature. Highly unradiogenic Nd and Hf isotope compositions require a time-integrated much older, perhaps Pan-african, reservoir.

These results show that in the present case (1) high-K volcanic rocks experienced only limited crustal interaction, suggesting rapid ascent through the crust, and thus may be representative of their mantle source; (2) shallow lithospheric mantle was melted during the late stages of orogeny; (3) the geochemistry is dominated by ancient and/or recent metasomatism. Because high-K orogenic magmatism appears chemically homogeneous in mountain belts through time, these conclusions may apply more generally thus throwing light on the key "mature" state of the orogenic process to be recognized in past orogens.