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Miocene oceanography of the Mediterranean area deduced from C-, O-, Sr-, and Nd-isotopes

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A detailed study of the isotopic composition of fossils and whole samples from a composite Oligo-Miocene pelagic sequence of the Umbria-Marche region in Italy has been made with the goal to constrain oceanographic and climatic conditions of the Mediterranean Sea during this period. Stable C and O isotope compositions of benthic and planktic foraminifera mimic global changes, supporting that these fossils have been well preserved and that the regional climate of this area was controlled by global changes in climate.

Neodymium and strontium isotope compositions of bulk carbonaceous fossils were measured and compared to those of the detrital silicate fraction of the embedding sediment. The compositions of the fossils are expected to closely relate to the former seawater composition, while the sediment would represent the hinterland. The relation between the two signals helps to evaluate oceanic circulation in the region. To broaden the spatial distribution and trace connections between different water masses, marine deposits from northern Italy and Slovenia were also investigated.

Results to date indicate a strong local influence on the εNd value and possibly a

weaker influence on the Sr isotope composition of the Mediterranean seawater during the Chattian-Aquitanian. During the Burdigalian-Serravallian a mixed seawater composition between the Atlantic and Indian Ocean water masses was registered with a stronger Indian Ocean influence in the Umbria-Marche region, while analyzes from the west (Moransengo) might reflect a strengthening Atlantic effect. The $^{87}Sr/^{86}Sr$ is still lower than that of the Miocene open ocean, probably due to erosion and influence of Sr derived from Mesozoic carbonates. The dataset also shows short-term deviations in the εNd values of the fossils coinciding with major sea-level decreases.

During the Late Serravallian-Tortonian normal open ocean Sr values were recorded, while the εNd values vary considerably. A low εNd value at 12-11 Ma could indicate inflow of water from the Atlantic Ocean, which stopped at 10 Ma due to major regression and allowed for the developement of a locally controlled water mass with εNd of −8.5. Thereafter, the εNd again approaches compositions typical for the Atlantic Ocean.