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# Estimating sea-surface palaeotemperatures from shallow-water carbonates: the example of Mediterranean Oligocene-Miocene corals

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In general, the fossil record from shallow-water carbonates does not provide good high-resolution palaeoclimatic tracers and, with few exceptions, estimation of Cenozoic sea-water palaeotemperatures usually refers to curves derived from marine oxygen stable isotopes and from the deep sea record.

In this study, we explore the link between climate, through sea-surface temperatures of shallow-water, and the taxonomic richness of the most efficient carbonate producers, by testing variation of zooxanthellate-coral generic richness values through space and time as a proxy for relative palaeotemperatures. The approach, based on the quantitative relationship that positively correlates present-day coral taxonomic richness and prevailing mean sea-surface temperature, and underlined by the so-called "energy hypothesis", is applied to a selection of 102 Oligocene-Miocene localities of the Mediterranean region, when shallow-water carbonates were rich in scleractinian corals thriving within various depositional settings, including different reef types. Their diversity patterns, although related to a complex interplay between several environmental factors and palaeobiogeography, are in fact considered to be strongly controlled by climate variability and changes in sea-surface water temperature.

For each Oligocene-Miocene stage, generic richness values per z-coral site are firstly examined, together with variations of the Mediterranean z-coral generic pool. For better testing the method and assessing its potential application, patterns of generic rich-

ness and inferred palaeotemperatures are then compared with global palaeoclimatic curves based on marine oxygen stable isotopes data or other climate proxies, such as palaeoclimatic records from European continental floras and from fossil coral linear extension rate.

The curve obtained by the coral richness-derived palaeotemperatures shows that the numerous fluctuations through Oligocene-Miocene time correspond relatively well with the main trends in global changes of sea-water temperature especially for the entire Oligocene, the Chattian-Aquitanian boundary and the Late Miocene. Some discrepancies, however, are shown for the Middle Miocene, for which the well-known Mid-Miocene Climatic Optimum is not recorded, suggesting that regional factors, acting together with important palaeogeographical changes, exerted a strong control on the generic richness of Mediterranean z-coral communities. Moreover, from the Middle Miocene onwards to the Messinian, an increase in the temperature range of z-coral localities is clearly visible, indicating a gradual adaptation of z-coral communities to a wider temperature range, as the Mediterranean was gradually migrating northwards, outside the tropical belt.

Results of this study suggest that the potentiality of the “energy hypothesis” approach is enhanced if applied at global or regional scale, and highlight that this method can be considered a promising and reliable proxy for estimating sea-surface palaeotemperatures from reef palaeoenvironments or, in general, from shallow-water carbonates.