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Geochemical proxies for reconstructing climate variability in marginal basins: the Alboran Sea record

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High sedimentation rate sediment sections in the Alboran Sea basin (westernmost Mediterranean) have provided excellent paleoarchives for reconstructing past climate variability. The following diverse proxies have been used for such reconstruction, molecular biomarkers, stable and radiogenic isotopes, microfossil assemblages, sediment grain size, and mineral and chemical composition of marine sediments. The elemental ratios have revealed to be reliable paleoclimate proxies. Al-normalized concentrations of detrital elements have allowed to characterize the terrigenous inputs into this basin. Ti/Al, Zr/Al and Si/Al ratios have served as proxies for eolian dust input, and Mg/Al, K/Al and Rb/Al ratios have provided information on fluvial contribution. An in-depth interpretation of these terrigenous element proxies requires knowledge of the mineral composition. Redox sensitive elements have also provided a reliable reconstruction of oxygen conditions at the time of deposition, though these elements are particularly susceptible to diagenetic remobilization, and certain elements, such as U, may also be linked to organic matter, which affects bulk U concentrations. Regarding productivity, even though most of the paleoproductivity reconstructions are based on Ba proxies, the biogeochemistry of Ba is not fully understood and the mechanisms for barite precipitation in the water column are not yet known. Over the past 20,000 cal yr BP, ratios mirroring eolian input indicate a major input of dust from the end of the Last Glacial Maximum to the Oldest Dryas. Mg/Al, K/Al and Rb/Al ratios record humid conditions during the subsequent Bölling-Alleröd warm period, further supported by the decrease in the Zr/Al ratio. These ratios have also allowed a detailed reconstruction of paleoclimate conditions during the Younger Dryas and the Holocene. Ratios of redox sensitive elements such as U/Th, Zn/Al, Cu/Al, and V/Al ratios also show significant fluctuations in oxygen conditions over this time interval. Regarding productivity fluctuations, reconstructions based on Ba/Al ratios support enhanced productivity during cold periods, i.e. Heinrich event 1 and Younger Dryas. In contrast, during the Holocene the Ba/Al ratio indicates a decreasing productivity trend.