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The orbital control of the sea level and past climatic changes in the Gulf of Lions (off south of France) from 133 kyr to 400 kyr

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A multidisciplinary study involving micropaleontological and geochemical tools was carried out in borehole PRGL 1-4 (Promess1) drilled in the upper slope of the Gulf of Lions with the aim of reconstructing the impact of climate changes on surface and bottom waters between 133 and 400 Kyr. Benthic foraminifer species were grouped by R-mode principal components analysis. We obtained 3 factors that accounted for changes from mesotrophic to eutrophic and oxygenated to dysoxic situations. During warm stages, characterized by high percentatges of planktic foraminifer species G. inflata and G. ruber, benthic communities were preferentially mesotrophic owing to the low supply of organic matter from the river and mixed layer as a consequence of sea level increase and the subsequent separation of Rhône river mouth. We compared our micropaleontological results with C/N ratio in organic matter (considered a proxy of the source of organic matter), % calcium carbonate (% $CaCO_3$), δ18O Gobigerina bulloides and % trace elements (Al, Ca, Fe, K, Sr). Our proxies recorded past climatic variability both at millennial-scale and at astronomical-scale. In order to study the relationship between the periodicities that explained most of the variance we used power spectral and cross coherence estimation by Welch method. Our results showed that astronomical parameters mainly controlled both ventilation and sea level changes in the Gulf of Lions. The precession cycle was the most significant regarding ventilation of intermediate waters enhancing the intensity of northwesterly winds at precession maxima. It turned benthic fauna to oxygenated and favored mixed layer productivity. Moreover sediment composition changed from carbonated-detrital to silicate-related. On the other hand, obliquity and eccentricity chiefly controlled sea level variability through continental ice sheet covering. The increase of riverin input during lowstands increased detrital calcium carbonate in sediment in addition to benthic eutrophic fauna. During highstands, the assemblages were dominated by warm planktic foraminifer fauna in the mixed layer and mesotrophic benthic foraminifer species on the bottom. Furthermore, as consequence of mouth river separation a change from detrital to biogenic calcium carbonate was also recorded.