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Response of Red Sea circulation to Holocene insolation forcing

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The Red Sea is a marginal, oligotrophic basin of the Indian Ocean located at the interface between two climate systems: the Indian Monsoon and the Mediterranean climate. Whereas on glacial-interglacial timescales, the oceanography of the Red Sea is determined by eustatic sea level changes, at times of relatively stable sea level, the oceanography of the basin is controlled by these climate systems via processes like evaporation and precipitation. Since planktonic foraminifera in the Red Sea are sensitive to the supply of nutrients in waters from the Indian Ocean, we tried to uncover fluctuations of the monsoonal and mediterranean climate systems throughout the Holocene by investigating foraminiferal faunal assemblages in two cores of the Red Sea. In order to unravel changes in past circulation patterns, foraminifer assemblage counts were supplemented by stable isotopic measurements and organic geochemical proxies. An age model of the records based on ten AMS 14-C dates indicates a close coupling of the circulation pattern with Holocene insolation change. We find in the early Holocene indications for extended and weak summer circulation conditions, which can be explained by a strong summer Monsoon. These conditions disappear in phase with the decreasing summer insolation in the early Holocene. In the Mid to Late-Holocene (3.5-2 cal. Ka BP) we observe a distinct event characterised by a change towards a foraminiferal fauna which indicates increased productivity in the Red Sea and a more pronounced winter circulation. This circulation shift towards a stronger winter surface water inflow from the Gulf of Aden into the Red Sea is consistent with increased aridity in the region causing increasing winter evaporation and deep water formation in the northern Red Sea. It is only after this arid period, that the present-day circulation pattern in the Red Sea developed.