

Interactive comment on “Sensitivity of Red Sea circulation to sea level and insolation forcing during the last interglacial” by G. Trommer et al.

G. Trommer et al.

gabi.trommer@gmx.de

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We would like to thank referee #2 for the thorough review of our manuscript. We have addressed the comments in detail below.

The referee is right that the interpretation of the proxy data in the Red Sea is not straightforward. To ensure a valid interpretation of the foraminifera data, all assemblage data has been compared by principal component analysis (PCA) with the modern surface data set of Siccha et al. 2009 (described on page 1200, line 26-28 and 1204, line 24-28, shown in Fig. 4). This analysis allows us to define periods of Red Sea oceanic conditions analogues to the present day by overlapping surface and core samples (Fig. 4a). Non-analogue periods are MIS 6 and large parts of MIS 5e and 5d, where *G. glutinata* and *G. tenella* are present (page 1205, line 2-12, Fig. 4b). Periods

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analogue to the present day are highlighted in Fig. 5 and we state clearly on page 1205, line 10-12 and 23-24 that absolute reconstructed values of chlorophyll a outside these analogue periods are not reliable.

The “fundamentally comparable conditions” in Siccha et al. 2009 are not to be misunderstood as general climate conditions but as oceanographic conditions in the Red Sea. The circulation conditions and salinity in the Red Sea are in particular dependent of sea level, which regulates the water exchange with the Indian Ocean (Rohling et al. 1998, Siddall et al. 2003, Biton et al. 2008). At sea levels of 100 m below present day, salinity exceeds 50 (Siddall et al. 2003, Biton et al. 2008) being above the survival threshold of all planktic foraminifera (Hemleben et al. 1989). Only at sea levels higher than 55 – 50 m below the present, planktic foraminifera species in the Red Sea seem to be no longer affected by increased salinity (Trommer et al. 2010) and therefore count as analogue to present day conditions. This is shown by our PCA results (Fig. 4) and is highlighted in the transfer function results (Fig. 5).

The TEX86 provides the only available method to reconstruct SST in the Red Sea at present. The alkenone index UK'37 cannot be applied because haptophyte algae only occur in the most northern part of the Red Sea and alkenones are not present in the sediments investigated here. The stable oxygen isotopes of planktic foraminifera in the Red Sea have been extensively shown to be very strongly dominated by sea level and are useless for SST reconstructions in the Red Sea (Hemleben et al. 1996, Rohling et al. 1998, 2004, 2008a, b, 2009; Siddall et al., 2003, 2004, 2006). There are multiple calibration studies showing that TEX86 correlates best with SST in a variety of environments (Schouten et al. 2002, Powers et al. 2004, Wuchter et al. 2004, Schouten et al. 2007, Kim et al. 2008, Trommer et al. 2009). In the Red Sea study of Trommer et al. (2009) it was shown that SST could explain the observed Crenarchaeota membrane lipid composition and that TEX86 did not correlate with salinity, nutrients, diagenetic effects and deep water temperature. Based on these papers, it seems reasonable to use TEX86 as SST proxy in the northern Red Sea for KL23 (Fig. 9).

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The correctly mentioned mixed TEX86 signal from advection of the open ocean population in the southern and central Red Sea requires careful interpretation of the TEX86 signal of the central Red Sea core KL9, which we provide in the discussion on pages 1209-1210. During the glacial when exchange with the open ocean was extremely limited due to low sea level, we assume the TEX86 signal in KL9 to be a pure 'Red Sea' signal and hence applied the Red Sea calibration (Trommer et al. 2009) (page 1209, line 7-21, Fig. 9). After sea level rise, advection and mixing of the two populations would have taken place. We estimated the potential mixing relationship by assuming a constant SST offset between the northern and central Red Sea core (which is 3° C at present) (page 1209-1210). Based on this assumption, we get a meaningful estimate of central Red Sea SSTs during the last interglacial (Fig. 9). We note that Biton et al. (2010) recently modelled this mixing scenario in the central Red Sea for the Holocene and found them to be in agreement with northern Red Sea SST reconstructions.

Concerning the BIT index the referee is right that on first sight, one would expect a peak during MIS 5.5, associated with increased rainfall and increased river discharge. But since the Red Sea surroundings are and were rather dry during the glacial MIS 6 (see – for example – the major aeolian dust peak in Termination II in Rohling et al., 2008b Paleooceanography), with consequently expected absence of any vegetation, no/little soil may have been available to be washed out with the onset of increased precipitation of MIS 5.5. We suggest that with this onset of precipitation, vegetation could start to develop resulting in soil formation, building up significant amounts of soil. Only when the vegetation cover declined again with decreasing precipitation, seasonally significant rainfalls were able to wash out the now available soil into the Red Sea basin, causing the elevated BIT (page 1211, line 12-15). The significance of the finding is the evidence for vegetation cover during MIS 5.5 in the Red Sea region. We will clarify this paragraph and improve the discussion.

Minor issues: We will check the figures and adapt the labels. We will change the depths and ages on page 1200 line 7-8. We will modify the first paragraph on page

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1203. The “aplanktonic zones” are nevertheless results that have to be mentioned at the beginning of the results section, so that the reader is able to follow the records. We will delete the first sentence of section 3.4 on page 1206, since we agree with the referee on the misleading context.

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