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Influence of the Indian Summer Monsoon runoff on marine productivity during middle Pliocene-early Pleistocene in the northwestern Bay of Bengal

Oscar E. Romero (1), Yasmin Bokahri-Friberg (2), and Pallavi Anand (2)

(1) MARUM, Center for Marine Environmental Sciences, Univ. Bremen, Bremen, Germany (oromero@uni-bremen.de), (2) The Open University, Milton Keynes, United Kingdom

The Indian Summer Monsoon (ISM) is a conspicuous example of the interaction between solid Earth and atmospheric processes, and a key expression of low-latitude hydroclimate. Yet the pattern of variability and its main climatic controls remain elusive beyond the late Pleistocene. In this study, we present results from the core convective region of ISM precipitation in the northwest (NW) Bay of Bengal from site U1445 (17°N, 85°E), drilled during the IODP Expedition 353. Site U1445 offers the potential to track terrestrial-oceanic-atmospheric processes at a relatively high resolution, due to being proximal to one of the largest river systems (Ganges-Brahmaputra), by extracting the strong seasonal signature of the ISM rainfall and fluvial runoff. Here we present a multiproxy approach, using micropaleontological (abundance of marine and freshwater diatoms and phytoliths) and geochemical (biogenic silica, XRF-measured elements) proxies across the middle Pliocene into the early Pleistocene (4.0-2.5 Ma).

Diatoms are silica precipitating primary producers. At U1445, marine diatoms dominate the siliceous community. Generally, total diatom concentration, biogenic silica and Br/Ti tend to be higher during interglacials. In addition to the marine diatom community, the occurrence of land-derived freshwater diatoms and phytoliths (PHY, silica bodies of grass cells) reflects ISM-mediated precipitation on land, fluvial runoff and wind intensity. The strikingly positive correlation between the total diatom concentration, Br/Ti and PHY content suggests that the input of land-derived nutrients –dependent on ISM rainfall and weathering intensity variations on land– might have played an important role in driving surface water productivity in the NW Bay of Bengal for the interval 4.0-2.5 Ma. Two major increases of total diatom concentration, Br/Ti and PHY content around 3.36 Ma and 3.14 Ma are interpreted to be a two-step strengthening of the ISM runoff and marine silica productivity. These two strengthenings are well mirrored by shifts in the species-specific composition of the diatom assemblage. After 2.86 Ma, the decrease of total diatom and PHY content suggests a weakening of the ISM, before the onset of the Northern Hemisphere Glaciation. We discuss the cyclicity in our records in context with orbital parameters and the robust isotope-based age model.