Biogeochemical Cycling and Climatic Evolution During the Last 22,000 Years in the Indian Sector of Southern Ocean

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Southern Ocean provides an excellent archive of past climatic variability and global biogeochemical cycling. Proxy records of trace elements and isotopes in two AMS ^{14}C-dated sediment cores representing two distinct oceanographic regimes (Sub-Antarctic Front and Polar Front Zone) within the Indian sector of Southern Ocean were studied for the past ~22 kyr BP. Records of multiple proxies like stable isotopes, organic carbon, biogenic silica, trace metals like Fe, Ba and U along with magnetic and sedimentological parameters revealed significant changes in the biogeochemical cycling in this region with the regional and global implications.

Stable oxygen isotope records of planktic foraminifers like *G. bulloides* and *N. pachyderma* suggest an early warming event immediately after 19 kyr BP, with the largest shift starting around 16 kyr BP. The records reveal that the typical Northern Hemisphere deglacial events are absent and the deglacial warming is synchronous with the Antarctic temperature changes as reflected in ice core records. The ice-rafted detritus (IRD) in both the cores reveal that the IRDs increased dramatically during the early deglaciation and are nearly absent during the Holocene. Timing of the ice rafting events clearly imply that the onset of the deglacial warming and ice rafting commenced as early as 18.5 kyr BP and peaked around 16 kyr BP.

Proxy reconstructions using biogenic silica, carbonate, organic carbon as well as trace metal proxies suggest a closely interlinked biogeochemical processes and climatic evolution in this part of the Southern Ocean. Increased opal productivity during the last glacial maximum (LGM) even at 44°S (core site north of the Polar Front), indicates an equatorward migration of the Polar Front. Calcite productivity shows opposite trend and was low/ absent during the LGM and increased substantially during the late deglaciation and Holocene. Records of Fe concentration fluctuate similar to other terrigenous records, where as the Ba profile indicate a close relationship with the productivity records. Since the accumulation of authigenic U in marine sediment mainly depends on the degree of anoxia and the amount of export flux of metabolizable organic material, its variability is expected to reveal past changes oceanic anoxia. The U records reveals two major highs at 20-22 kyr BP and 12-14 kyr BP, supporting increased bottom water anoxia during these periods. The biogeochemical implications of the multiple proxy records examined here thus improve the current understanding and may challenge the existing paradigms in the Southern Ocean.