A speleothem record of changes in tropical convection in the Indian Ocean during the last glacial period

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Socotra Island, Yemen, is located at 12°N, 53°E in the western Indian Ocean. Rain falls on the island primarily during the late spring/early summer when the inter-tropical convergence zone passes over the island on its annual northward migration. A second, weaker wet season occurs during the early winter as the ITCZ returns south. Total annual rainfall, based on vegetation types, is estimated to be between 400 and 600 mm/y (Miller et al, 1996). Because of its location, rainfall on the island should be sensitive to changes in the tropical hydrological cycle. Our previous work has shown that the $\delta^{18}O$ values of speleothem calcite record changes in rainfall intensity in this region (Neff et al., 2001; Burns et al., in press).

A 1.73 m stalagmite, M1-2, was recovered from Moomi Cave I on the eastern side of Socotra. A series of 14 Th^{230}/U ages show that the sample was deposited between 42.8 and 54.6 kyBP. The Th^{230}/U ages are in stratigraphic order and provide an excellent age model for the sample. Oxygen and carbon isotope ratios were measured on more than 850 samples taken at 2mm intervals, for an average time resolution of less than14 years. The $\delta^{18}O$ values range from -1.5‰ +1.3‰ on the VPDB scale. The observed variation is interpreted to be due to changes in the intensity of convection associated with the ITCZ. Lower $\delta^{18}O$ values indicate greater rainfall/convection and enhanced Indian Ocean monsoon. When inverted and plotted versus age, the running average of $\delta^{18}O$ values show a pattern of millennial-scale variation that is strikingly similar to changes in $\delta^{18}O$ found in Greenland ice cores (Fig. 1). Warm (less negative $\delta^{18}O$) interstadial events 9, 10, 11,12, 13 and 14 in the ice cores are all well resolved and appear as wet (more negative $\delta^{18}O$) events in the stalagmite. Varying age offset between the two datasets is likely due to age model problems in the ice core.

Sampling at 1 mm intervals, ~7 year resolution, over the transition into interstadial 11 (end of Heinrich event 5) first show an increase to the most positive $\delta^{18}O$ values, +1.3‰, in the

record before a rapid decrease to values of around -1‰. The change occurs in approximately 35 years, similar to the time span of temperature change for this event found in Greenland ice. Our record is a further indication of very close coupling of climate variation between high and low northern latitudes, even on decadal timescales.

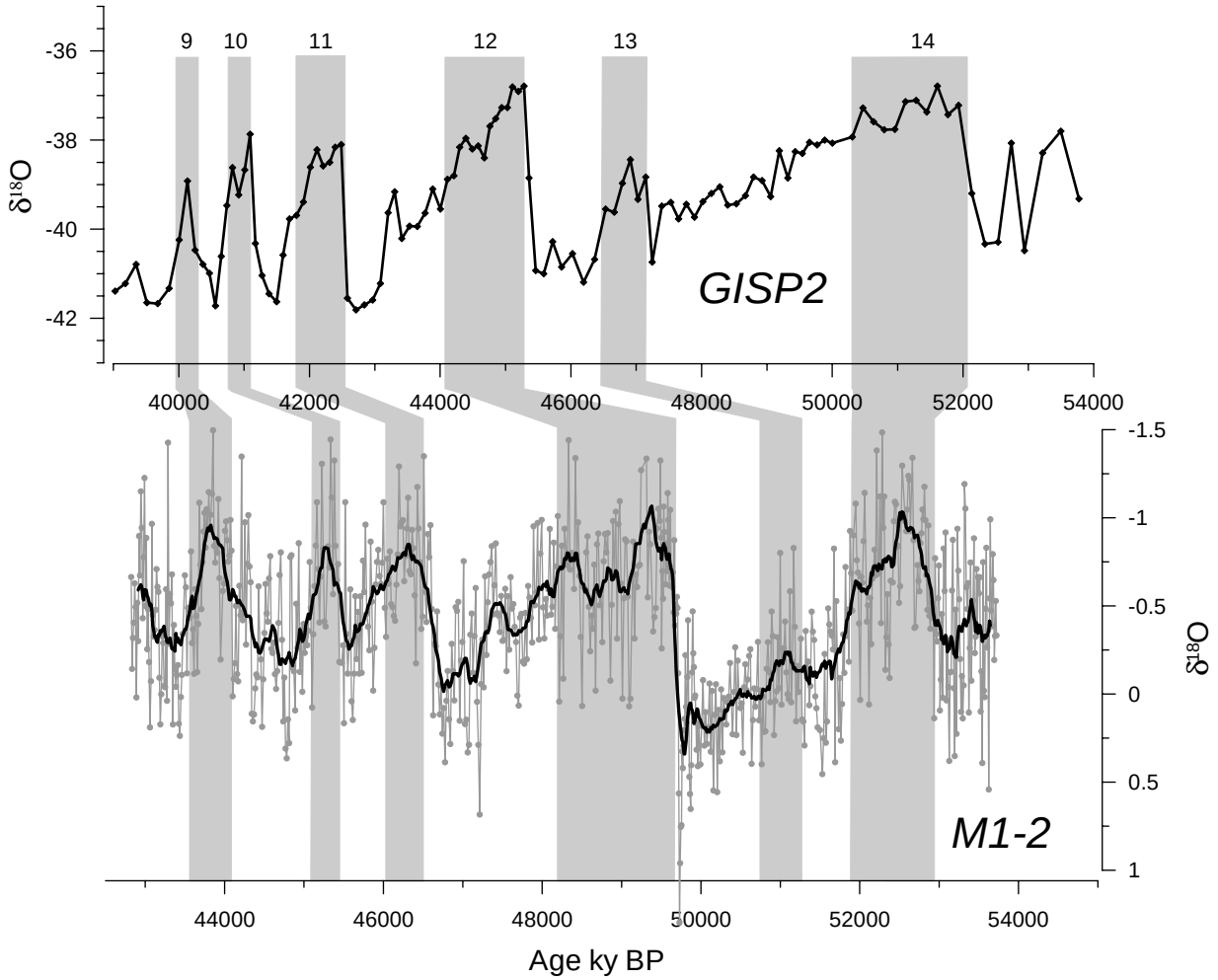

Figure 1. Oxygen isotopic records from the GISP2 ice core, upper panel, and stalagmite M1-2, lower panel, on independent chronologies. The dark line in the M1-2 record is the 17 point running average. Interstadial events 9, 10, 11, 12, 13, and 14 are highlighted in grey.