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High-resolution reconstruction of abrupt climate change during DO8 and H4 in the Arabian Sea: grain-size analysis and end-member modelling as a tool to distinguish wind-blown dust and Indus River sediments

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Climate in and around the Arabian Sea is dominated by complex interactions between summer and winter monsoonal winds. Variations in the monsoon intensity have been demonstrated to be linked to precessional cycles, but also to variability on sub-Milankovitch scale frequencies. Previous studies have shown that these millennial-scale changes are related to the Dansgaard-Oeschger cycles and Heinrich events observed in the northern hemisphere, but the control and process characterising those variations remain unknown.

Here we explore a set of typical millenial-scale variations during the last glacial period using the grain-size distributions of terrigenous sediments as a paleoclimatic indicator. This high-resolution ($\sim$1 sample/ka) study was performed on sediments from core SO130 289KL, which was retrieved from the Indus Fan, and provides evidence of abrupt changes in sedimentation between 35.4 and 41.1 ka. Terrigenous material is mainly supplied by the Indus River, as well as from various sources by winds. Grain-size analysis, combined with end-member modelling, permits to infer provenance and dispersals patterns of the particles without detailed assumptions about the geological settings. It is observed that from 39.9 to 38.4 kyr BP (equivalent to Heinrich event 4)

the sediments are dominated by relatively coarse-grained wind-blown dust, which is followed by an abrupt switch (equivalent to Dansgaard-Oeschger event 8) to dominance of fine-grained fluvial-derived mud, and a gradual decline of fine-grained material from 36.5 to 36 kyr BP. Considering the sea-level variations, the drying out of the Persian Gulf could have contributed a new source of sediments, present only during H4. The increase in TOC content in the sediments is concomitant with the increase of fluvial material delivered by the Indus, during the relatively warm DO8. Hence, the higher discharge, implying higher precipitation in the source area of the sediments, most likely triggers the enhancement of production and preservation of organic material in the oxygen minimum zone (OMZ) off the Indus Delta. The study of grain size thus permits to assert a strong atmospheric teleconnection between the monsoonal climate on the Pakistan margin and the northern hemisphere DO cycles and Heinrichs events.