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Significance of Winter Monsoon and ventilation changes in the Arabian Sea during the Late Quaternary: implication for denitrification and nitrous oxide emission

L. Pichevin (1,4), E. Bard (1), P. Martinez (2) and Tara S. Ivanochko (3)

(1) CEREGE, Europôle de l'Arbois BP 80, 13545 Aix en Provence Cedex 4, France (2) Université Bordeaux I - Département de Géologie et Océanographie, UMR-CNRS 5805, 33405 Talence Cedex, France (3) Department of Earth and Ocean Sciences, University of British Columbia, 6339 Stores Road,Vancouver, BC, Canada (4) now at School of Geosciences, Grant Institute, University of Edinburgh, West Main Road, EH10 3JW, Edinburgh, UK (lpichevi@staffmail.ed.ac.uk / +44 131 668 3184 / +44 131 650 8505)

Variations in Summer Monsoon-related productivity have been hitherto regarded as the main driver for changes in basin-wide oxygen deficiency and water column denitrification in the Arabian Sea (AS). Modern sea water profiles of oxygen, nitrate deficit and Nitrogen isotopes yet reveal the spatial decoupling of summer time productivity and denitrification maxima in the AS and raise the possibility that winter Monsoon (WM) and/or ventilation play a crucial role for modulating denitrification in the North eastern AS, today and through the past.

New, high resolution, 50 kyr-records of δ^{15}N from the Pakistan margin are compared to five other denitrification records spread from the South western to North eastern AS. This regional comparison unveils the persistence of east-west heterogeneities in denitrification intensity (sedimentary δ^{15}N signals) across millennial scale climate shifts, the last Termination and, intriguingly, throughout the Holocene epoch. The AS Oxygen Minimum Zone experienced east-west swings across Termination I and over the last 10 kyr. Probable causes are (1) combined changes in WM-induced productivity and ventilation due to millennial scale variations in Antarctic Intermediate Water formation as well as (2) postglacial reorganization of intermediate circulation in the North eastern AS following sea level rise.

While denitrification in world's OMZ, including the western AS, gradually declined following the deglacial maximum (10-9 kyr BP), our North eastern AS records clearly witness increasing denitrification from 8kyr BP which probably contributed to the simultaneous atmospheric N_2O rise. This arguably impacted the Holocene climate through sustained marine nitrogen loss and nitrous oxide production.