Millennial/centennial-scale variations in the denitrification intensity of the OMZ in the northernmost Arabian Sea

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The Arabian Sea hosts the largest OMZ (Oxygen Minimum Zone) in the world and strong denitrification occurs throughout the entire Arabian Sea. Previous sedimentary $\delta^{15}N$ records in the Arabian Sea show the denitrification of this OMZ was strongly associated with the monsoon strength and the ventilation of intermediate waters. However, the $\delta^{15}N$ records show regionally different trends, suggesting the complex and variable dominant mechanism for the denitrification in the Arabian Sea. Here, we present new records of $\delta^{15}N$ and Br/TOC (Total Organic Carbon) from two cores at different waters on Makran margin to build high-resolution denitrification history in the northernmost Arabian Sea and discuss the controlling mechanism. The gravity core MPG10 retrieved from 2277 m spans the last 37,000 years and the other core (MPG06 from 1254 m) has higher sedimentation rate, spanning about 17,500 years. High-resolution $\delta^{15}N$ records from the two cores display large-amplitude millennial changes which well mirror climatic changes recorded in Greenland ice cores $\delta^{18}O$ and stalagmite $\delta^{18}O$. The low $\delta^{15}N$ values during Dansgaard-Oeschger (DO) stadials suggest the denitrification was inactive or weak during cold periods, while warm interstadials had increased denitrification rate. The changes in marine productivities and ventilation variations of the Antarctic Intermediate waters were mainly responsible for millennial changes in the denitrification intensity in the northern Arabian Sea. The new $\delta^{15}N$ records confirm the finding by Pichevin (2007) from the MD04-2976, showing that the increased denitrification associated with the Indian summer monsoon-driven upwelling during the early Holocene was not present in the northern Arabian Sea. The increasing denitrification from about 8 ka BP was accompanied with the increase in organic concentration in sediments. During the Holocene, the winter monsoon probably predominated over the summer monsoon in influencing marine productivity and the denitrification rate in the northernmost Arabian Sea.