Extensive N-loss from permeable Wadden Sea sediments due to aerobic denitrification

H. GAO, A. KHALILI, D. DE BEER, G. LAVIK AND M.M.M. KUYPERS*

Max Planck Institute for Marine Microbiology, 28359 Bremen, Germany
(*correspondence: mkuypers@mpi-bremen.de)

The role of permeable sediments in the oceanic N-budget is poorly understood. In this study, nitrogen (N) loss rates were determined in permeable sediments of the Wadden Sea using a combination of stable N isotopes, microsensor measurements and model simulation approaches. Results indicate that permeable Janssand sediments are characterized by some of the highest denitrification rates in the marine environment. Moreover, several lines of evidence showed that denitrification occured under oxic conditions. N loss rates generally showed little temporal and spatial variation (207 ± 30 µmol m^{-2} h^{-1}) over the three field campaigns conducted in autumn 2006 and spring and summer 2007. Utilizing an extensive time series of nutrient concentrations and current velocities obtained from a continuous monitoring station, NO_x^- flux into the sediment was modeled over a full annual cycle. Modeled NO_x^- fluxes were sufficiently high to support the experimentally derived N-loss rates. Combining the measured rates with the modeled results, an annual N-removal rate of 745 ± 109 mmol N m^{-2} y^{-1} was estimated for permeable sediments of the Wadden Sea. This rate agrees well with previous N loss estimates for the Wadden Sea based on N budget calculations. Our results indicate that permeable sediments, accounting for 58- 70 % of the continental shelf area, are an important N-sink and their contribution to the global N-loss budget should be reevaluated.

Applications of laser microprobe analysis for silicon and oxygen isotopes (Fujian, China)

J.F. GAO AND T.P. DING

The Key Laboratory of Metallogeny and Mineral Assessment, Institute of Mineral Resources; Chinese Academy of Geological Sciences, Beijing 100037, China.
(correspondence: tony_and_mary@126.com)

The O and Si isotope compositions of minerals from the miarolitic cavity granite and pegmatite in Yunxiao county, Fujian province are measured by using conventional method and laser probe analytic method for determining their material sources and forming conditions. The results are listed in the Table 1.

Sample	$\delta^{18}O_{V\text{-}SMOW}$ (‰)			$\delta^{30}Si_{NBS\text{-}28}$ (‰)		
	Q	Fs	Gar *	Q	Fs	Gar*
Gr-01	7.6	6.4		-0.1	-0.1	
Gr-02	8.0	5.6		-0.3	0.0	
Peg-01	7.7	6.3	3.3, 3.3	-0.2	-0.2	-1.8, -1.9
Peg-02	7.4	5.6	3.1, 3.6	-0.5	-0.3	-1.8, -2.2
Peg-03	7.7	6.0	3.4	-0.4	0.2	-2.0

Table 1 : The results of oxygen and silicon isotope compositions
*minerals were analyzed by using laser probe isotope analytic method. Q-quartz; Fs-feldspar; Gar-garnet.

The O and Si isotope compositions of quartz and feldspar from the pegmatite are very similar to those of the granite, indicating that they have the same magma source.

From the oxygen isotope fractionation between quartz and feldspar, a temperature of 461°C is obtained for the granite, indicating that the granite may be subjected some extend of water-rock interaction after crystallization. This is consistent with the extensive development of pegmatite miarolitic cavity in granite. From the oxygen isotope fractionation between quartz and feldspar, a temperature range between 505°C and 532°C is obtained for pegmatite, indicating that fluid temperature was more than 500°C when the pegmatite was formed.

The silicon and oxygen isotopic ratios of garnet were both significantly lower than those of coexisting quartz and feldspar in miarolitic cavity, indicating that parallel silicon and oxygen isotopic fractionations are present between garnet and quartz (and feldspar), although the extent of silicon isotopic fractionation is smaller that those of oxygen isotope fractionation.