

Hydrochemical and stable isotopic assessment of water quality and its variations in rice-growing areas in East China

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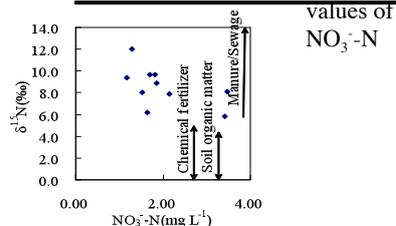
Nitrate contamination of surface-water and groundwater is a common occurrence worldwide. In drinking water, nitrate in excess of 10 mg N/L may be toxic for infants and may be responsible for increases in stomach cancer for other. The nitrogen-stable isotopic composition of nitrate has been extensively used for the identification of nitrogen sources and transformation pathways in hydrologic studies. The West Lake is a typical shallow lake located in Hangzhou city, China. East of the West Lake is on the verge of the downtown, the other three sides are surrounded by small hills. The West Lake has been in the risk of eutrophication and ecosystem degradation. Here, we have analyzed the dissolved anions in the West Lake, with the immediate goals of describing water quality and identifying the sources of nitrate in the West Lake.

All the samples were taken in the West Lake on April 4, 2012. The average pH value of water was 6.95, and all samples was weakly acidic. The average DO concentration of the surface water was 7.43 mg L⁻¹. The surface water was aerobic. The average BOD₅ and COD_{Cr} concentration of the samples was 3.0 mg L⁻¹ and 13.5 mg L⁻¹, respectively. Low BOD values and COD values reflect low burden of organic pollution in the West Lake. TP concentrations remained at a low level, was 0.075 mg L⁻¹ concentrations was low and was 0.29 mg L⁻¹. NO₃⁻-N concentration in the samples was higher than NH₄⁺-N concentrations, was 1.66mg L⁻¹. The average TN concentration was 2.48 mg L⁻¹. It was found that 75% of the surface water samples in the West Lake had higher TN concentration than the statutory limit (1.5 mg L⁻¹) for surface water (GB3838-2002). TN was the major contaminant. The δ¹⁵N_{NO3} values for the samples from the West Lake ranged from 5.8‰ to 12.0‰. It was probable that the sources of NO₃⁻-N were rainfall, manure applied to land, and agricultural fertilizer.

Table1: Water quality of the West Lake and the Environmental guideline of national quality standards for surface waters, China (GB3838-2002) (mg L⁻¹).

	Concentration/Ave.	Standard deviation	GB3838-2002/IV
DO	7.43	0.42	3.0
pH	6.95	0.04	≥ 6-9
BOD ₅	3.0	1.0	≤ 6.0
COD _{Cr}	13.5	5.1	≤ 30.0
TP	0.075	0.02	≤ 0.1
TN	2.48	0.47	≤ 1.5
NO ₃ ⁻ -N	1.66	0.29	≤ 10.0
NH ₄ ⁺ -N	0.29	0.23	≤ 1.5

Figure1: δ¹⁵N_{NO3}⁻ versus concentrations.



Halogen partitioning behavior at Earth's mantle conditions

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Halogens have, because of their incompatibility, the potential to act as key tracers of volatile transport processes in the Earth's mantle. Combining Mid Ocean Ridge Basalt (MORB) [1] and Ocean Island Basalt (OIB) [2] bulk halogen concentrations with experimentally determined halogen partition coefficients (this study) allows us to investigate the halogen content and variance in different mantle reservoirs.

As starting material, we used a primitive mantle composition simplified to four components (CaO, MgO, Al₂O₃ and SiO₂), to which defined small amounts of halogens (~0.2 wt%) were added. Partition experiments were performed for 5 h at 1.0 to 2.5 GPa and 1500-1600°C.

Samples contain forsterite grains or a mixture of forsterite and orthopyroxene grains with a side length of up to 150 μm embedded in a MORB-like melt. Euhedral crystal shapes and the fact that no halogen concentration gradients are detectable within the crystals or melt indicate that experiments were performed at equilibrium conditions.

In all experiments, compatibilities of Br, Cl and F are ordered with $D_{Br}^{mineral/melt} < D_{Cl}^{mineral/melt} < D_{F}^{mineral/melt}$; e.g. $D_{Br}^{fo/melt}$ was determined to 0.128 at 1600°C ($D_{Cl}^{fo/melt} = 0.202$, $D_{F}^{fo/melt} = 0.259$; Uncertainties: ~20%). Our data combined with results of recent studies [3,4] show that fluorine and chlorine partitioning into forsterite increases by about two orders of magnitude between 1300°C and 1600°C and does not show a pressure dependence. Chlorine partitioning into orthopyroxene shows a similar temperature effect ($D_{Cl}^{opx/melt} = 0.905(81)$ at 1600°C and 2.3 GPa) but decreases significantly with increasing pressure.

By using natural bulk Cl concentrations in basalt [1,2] and assuming accumulated fractional melting [5], we are able to estimate bulk Cl concentrations of MORB (3-5 μg/g) and OIB (25-50 μg/g) source regions. Data suggest that the MORB source region is 80-95% more depleted in chlorine relative to the OIB source region.

- [1] Ruzie *et al.* (2012) **V31A-2762**, AGU Fall Meeting. [2] Kendrick *et al.* (2012) *Geology* **40**, 1075-1078. [3] Beyer *et al.* (2011) *EPSL* **337-338**, 1-9. [4] Dalou *et al.* (2012) *CMP* **163**, 591-609. [5] Shaw (1970) *Geochim Cosmochim Acta* **34**, 237-243.