Nitrate sources and nitrogen biogeochemical processes in the Feng River in West China inferred from the nitrogen and oxygen dual isotope measurements of nitrate

Jianhui Zhia,*, Aizhong Dingb, Shurong Zhangb

aCollege of Environmental & Resource Sciences, Shanxi University, Taiyuan 030006, China, Tel. +86 1 345 346 9108; email: zhijianhui@126.com
bCollege of Water Sciences, Beijing Normal University, Beijing 100875, China, Tel. +86 1058805051; email: ading@bnu.edu.cn (A. Ding), Tel. +86 1 371 894 6182; email: srzhang@bnu.edu.cn (S. Zhang)

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ABSTRACT

A portion of the nitrogen from watersheds entering river networks, which degrades river water quality and causes subsequent eutrophication of the downstream river. Identifying the source of nitrate in rivers is the primary method of controlling excessive nitrogen input into rivers. In this paper, nitrate sources in the Feng River were inferred from nitrate dual isotopes (δ¹⁵N\text{nitrate} and δ¹⁸O\text{nitrate}) combined with the water quality data, and nitrogen biogeochemical processes were further explored. The results indicated that NO₃⁻/CO₃⁻-N is the dominant form of nitrogen in the Feng River system. The annual average content of nitrate was 3.21 mg/L, representing approximately 83% of the total nitrogen content. In September of 2012, the δ¹⁵N\text{nitrate} and δ¹⁸O\text{nitrate} values suggested that the atmospheric deposition and soil organic nitrogen were the main sources of nitrate in the upstream region, and that the atmospheric deposition, chemical fertilizers, sewage, and manure inputs were the sources in the downstream region, with average contribution ratios of 68.4, 19, and 12.6%, respectively. In December of 2011, the δ¹⁵N\text{nitrate} and δ¹⁸O\text{nitrate} values suggested that the nitrate upstream was mainly derived from soil organic nitrogen and that the nitrate downstream was derived mainly from sewage and manure inputs, with a contribution ratio of 68%. The δ¹⁸O\text{nitrate} data indicated that most of the nitrate from microbial nitrification could make a remarkable contribution to the Feng River system. The variations in the isotopic nitrate values suggested that denitrification enriched the heavier isotopes of nitrate in the upstream and midstream Feng River in the summer. The isotopic characteristics of the phytoplankton uptake of nitrogen were obvious in the downstream Feng River in April 2012. Nitrogen biogeochemical processes of the Feng River water system are the results of a mixture of denitrification and phytoplankton uptake and other processes.

Keywords: Nitrate sources; Nitrogen and oxygen dual isotopes; Nitrogen biogeochemical processes; Denitrification; Feng River

*Corresponding author.

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