Weathering rate of granite-derived soils in the subtropical China: A watershed study[$]

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In order to understand the impacts of acid precipitation on soil weathering and formation, the current study investigated the input and output as well as the balance of a number of important elements on a watershed scale. A typical forested watershed located in the southern Anhui Province, subtropical China was selected to monitor the dry and wet deposition and stream water from Feb. 2007 to Feb. 2010. The physical and chemical properties of soil and granite rock were also determined.

The results show that acid deposition is very severe in this area, including H^+ from acid rain directly and, H^+ production by nitrogen (NH_4^+-N) and sulphur (S) transformation from dry and wet precipitation. The total net input of H^+ is about 1286 to 1500 mol ha^{-1} yr^{-1}, which is an important driving force of mineral decomposition. The net annual cation (K^+, Na^+, Ca^{2+}, Mg^{2+}) discharge amounts to 2186 mol $ha^{-1}yr^{-1}$ and Si amounts to 1769 mol $ha^{-1}yr^{-1}$. By calculation, the weathering rate of granite in the studied subtropical region is about 0.65~0.72 t ha^{-1} yr^{-1}, but varying according to the environmental factors such as precipitation, temperature and rainfall acidity in different years. Correspondingly, soil formation rate is about 0.56~0.62 t ha^{-1} yr^{-1}, which equals to 0.042 ~0.054 mm yr^{-1} of soil formation, i.e. it takes about 18, 480~24, 100 years to form 1 meter deep soil cover in the subtropical China.

The weathering rate by the current study is similar to the global average of 0.66 t ha^{-1} yr^{-1}, while it is higher than that of Hubbard Brook watershed, New Hamphire, USA [1, 2]. So does the soil formation rate. The possible reasons are that this area is located in the subtropical monsoon region with high temperature and much rainfall, especially serious acid deposition which can accelerate soil weathering.

Research supported by NSFC (No. 40601040) and IFS (C/4077-1).

[1] Likens *et al.* (1977) *Biogeochemistry of a Forested Ecosystem*. Springer-Verlag, New York. [2] Wakatzuki *et al.* (1993) Soil *Sci. Plant Nutr.* **39**, 153-159.

Reduction-oxidation cyclings of clay mineral nontronite (NAu-2) and its effect on Tc immobilization

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In situ ^{99}Technetium (^{99}Tc) immobilization by Fe (II) associated with clay minerals has been studied and is a potential cost-effective method of Tc remediation at several DOE sites. The objective of this project was to study how multiple cycles of reduction-reoxidation of Fe-containing clay mineral, nontronite, affect its reactivity toward Tc (VII) reduction and and Tc (IV) reoxidation.

Fe-enriched nontronite NAu-2 was used as a model clay mineral. The project was divided into three stages: (1) NAu-2 bioreduction by *Shewanella putrefaciens* CN32 followed by 3-5 cycles of reoxidation and reduction. (2) Tc (VII) reduction by reduced NAu-2 (after various numbers of redox cycles). (3) Reoxidation of Tc (IV)-NAu-2 suspension. Our results showed that 5%-10% biogenic Fe (II) could not be reoxidized by air, suggesting that part of the Fe (II) in the NAu-2 structure was irreversibly reduced. With an increasing number of cycles, the reactivity (i.e. extent and rate) of reduced NAu-2 toward Tc (VII) reduction and immobilization decreased. These results suggest that Fe (II) speciation within the NAu-2 structure plays a significant role in controlling the reactivity of biogenic Fe (II) toward Tc (VII) reduction. Scanning electron microscopy results showed aggregation of NAu-2 particles after bioreduction, which may have caused partial irreversibility of clay-associated Fe redox cycling and may have been partially responsible for low extents of reoxidation of Tc (IV) upon its exposure to air. These results are important for our understanding of clay mineral-Tc interaction kinetics for the purpose of heavy metal remediation at DOE contaminated sites.