Sr–Nd isotopic characteristics of river sediments in the Tibetan Plateau

WEIHUA WU[1,3]*, JIEDONG YANG[2], SHIJIN XU[3], HONGWEI YIN[3], HUAYU LU[1] AND KAIJUN ZHANG[3]

[1]School of Geographic and Oceanographic Sciences, Nanjing University, Nanjing 210093, China (*correspondence: wuwh@nju.edu.cn)

[2]Center of Modern Analysis Nanjing University, Nanjing 210093, China

[3]State key Laboratory for Mineral Deposits Research, School of Earth Sciences and Engineering, Nanjing University, Nanjing 210093, China

Introduction

Sr–Nd isotopic characteristics of different terranes in the Tibetan Plateau can be used to identify the attribute of tectonic units, reveal the geochemical heterogeneity of plateau lithosphere and the difference of evolution process of terranes. At present, isotope geochemical studies in the Tibetan Plateau mainly focus on granites, granulites and volcanic rocks. In this study, we provided a new perspective by using river sediments to reveal the isotopic characteristics and tectonic affinities of various terranes in the Tibetan Plateau.

Sr-Nd isotopic characteristics

We collected 40 river sediment samples in different terranes of the Tibetan Plateau and measured their Sr–Nd isotopic compositions. Three isotopic regions can be identified: (A) The Qilian Terrane and Himalaya Terrane. They have more negative ε_{Nd} (0) values (from -14.3 to -11.8 and from -20.64 to -13.26, respectively) and high $^{87}Sr/^{86}Sr$ values (from 0.719674 to 0.738818 and from 0.721020 to 0.824959, respectively), reflecting old and mature continental crust origin of these two terranes; (B) The southern Lhasa terrane. It is more radiogenic in ε_{Nd} (0) values (from -8.82 to -3.8) and low in $^{87}Sr/^{86}Sr$ values (from 0.711504 to 0.719489), implying the combined impact of the Neo–Tethys mantle and Himalaya old continental crust; and (C) other terranes. They have $^{87}Sr/^{86}Sr$ and ε_{Nd} (0) values between the above two.

Tectonic implications

Sr–Nd isotopic compositions of the Qilian Terrane are very close to those in the Yangtze Craton and are clearly different from the North China Craton, indicating that the Qilian Terrane was probably separated from the Yangtze Craton. Sr–Nd isotopic characteristics of the Songpan–Ganzi Terrane are similar to the Yangtze Craton and are remarkably different than the North China Craton, eastern Kunlun–Qaidam and the central Qiangtang metamorphic belt, implying that the provenance of the huge flysch complex of the Songpan–Ganzi Terrane may be the Yangtze Craton.

In situ biostimulation of U(VI) reduction and immobilization using emulsified vegetable oil

W.-M. WU[1]*, D. WATSON[2], T. MEHLHORN[2], J. EARLES[2], M. BOYANOV[3], T. GIHRING[2], C. SCHADT[2], K. LOWE[2], J. PHILLIPS[2], K. KEMNER[3], B. SPALDING[2], C.S. CRIDDLE[1], P. JARDINE[2] AND S. BROOKS[2]

[1]Stanford University, Stanford, CA94305, USA (*correspondence: billwu@stanford.edu)

[2]Environmental Sciences Division, Oak Ridge National Laboratory, Oak Ridge, TN 37831, USA

[3]Biosciences Division, Argonne National Laboratory, Argonne, IL60439, USA

A field test was conducted in Area 2 of the DOE Oak Ridge Field Research Facility to reduce U (VI) using an emulsified vegetable oil (EVO) product containing 60% oil. Groundwater contained 5-6 μM U; 1.0-1.2 mM sulfate; 0.2-1.5 mM nitrate; 2.5-4.0 mM Ca^{2+}; with a pH of ~6.8. The hydrologic conditions were characterized by conducting a Br^- tracer test. Diluted EVO solution (20%) was then injected. The distribution of EVO injected and biogeochemical process was monitored through analysis of aqueous samples and surged samples of aquifer solids. A large fraction of the oil injected was trapped or adsorbed in the subsurface.

The geochemistry was monitored over one year period. After oil injection, the sequential bioreduction of nitrate, Mn (IV), Fe (III) and sulfate occurred. Acetate was an intermediate in the oil degradation. U (VI) reduction was observed after 2-4 weeks of the oil injection and U concentrations were reduced to below 0.126 μM (EPA MCL) at several well locations during the initial 100 days. The U concentration in groundwater seeps flowing into Bear Creek was decreased by >80% within a four month period and remained at less than 50% of original level after >365 days, indicating that the U migration was reduced substantially. Dissolved methane concentration increased after the oil injection, indicating the enhancement of methanogenic activity. After the oil was consumed, rebound of U in groundwater was observed together with the rebound of sulfate concentrations as acetate concentrations approached below detection limits. Rebound of U in downgradient wells were slow as the oil was sequentially consumed in upgradient locations. U (VI) reduction to U (IV) *in situ* during the field tests was confirmed by XANES analysis. The change of U valence in sediment samples corresponded with the changes in groundwater geochemistry. Known U (VI)-and Fe (III)-reducing bacteria and a diversity of sulfate-reducing bacteria were stimulated after the oil injection.