

Cr isotopic evidence of enzymatic reduction of Cr(VI) catalyzed by a sulfate-reducing bacterium

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Several studies have suggested that Cr isotopic signature could be used for distinguishing between different Cr(VI) reduction pathways [1,2]. We previously showed distinct Cr isotopic fractionation behavior under aerobic versus denitrifying conditions with a single bacterial species, *Pseudomonas stutzeri* strain RCH2, even though the Cr(VI) reduction rates were comparable under those two conditions [3].

To further evaluate Cr fractionation mechanisms associated with enzymatic Cr reduction, in the current study, we used the sulfate-reducing bacterium *Desulfovibrio vulgaris* strain RCH1 isolated from DOE's Hanford 100H site. We found significant Cr(VI) reduction with lactate as the electron donor either in the presence or absence of sulfate; thus, the Cr isotopic signature was examined with and without sulfate. Under both conditions, Cr isotopic fractionation followed the same Rayleigh fractionation with an α value of 0.99806. This value is significantly smaller than the abiotic fractionation factors observed previously and is also smaller than the values from experiments with *Shewanella oneidensis* MR-1 using much lower electron donor concentrations [2], but is very similar to values from experiments with higher electron donor concentrations with either *P. stutzeri* RCH2 under aerobic conditions [3] or *S. oneidensis* MR-1 [1]. Since abiotic reduction of Cr(VI) by sulfide and Fe(II) could also have been involved in these experiments, abiotic reduction experiments with these reagents were conducted. The α values in these experiments were very different from 0.99806, implying that enzymatic reduction was dominant under the conditions tested with strain RCH1.

[1] Ellis *et al.* (2002) *Science* **295**, 260-262. [2] Sikora *et al.* (2008), *Geochim. Cosmochim. Acta* **72**, 3631-3641. [3] Han *et al.* (2012) *Appl. Environ. Microbiol.* **78**, 2462-2464.

Petrology and geochemistry of the Mesozoic potassic and sodic volcanic rocks in the Yishu deep fault zone, Shandong Province, eastern China: Petrogenesis and inferences on the evolution of the mantle sources

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Late Mesozoic potassic volcanic rocks are widespread along the Yishu deep fault zone and its both sides, but some sodic volcanic rocks are also developed in several parts of this region, especially in the interior of the fault. These rocks provide important constraints on the nature and evolution of the Late Mesozoic lithospheric mantle beneath the region. LA-ICP-MS zircon U-Pb dating yields ages of 124.0~118.7 Ma for the potassic rocks, and of 106.4~96.5 Ma for the sodic ones. Both the potassic and the sodic volcanic rocks show similar trace element features of LILE and LREE enrichment and HFSE depletion. However, the sodic volcanic rocks have lower REE (especially LREE) contents, lower Rb/Sr and La/Nb ratios, and display somewhat Pb depletions in the spidergram profiles. All the rocks have enriched Sr and Nd isotopic compositions, but the sodic volcanic rocks have slightly lower I_{Sr} ratios and higher $\epsilon_{Nd}(t)$ values with respect to the spatially coexisted potassic volcanic rocks, e. g., the I_{Sr} and $\epsilon_{Nd}(t)$ values of the coexisted sodic and potassic rocks in Tangtou basin are 0.7097~0.7100, -10.0~-11.8 and 0.7100~0.7106, -15.5~-17.0, respectively. Zircon $\epsilon_{Hf}(t)$ values of the sodic rocks are also higher than that of the potassic rocks (specially -4.2~-16.6 for the sodic rocks and -13.2~-24.3 for the potassic rocks). The elemental and isotopic systematics indicates that the potassic volcanic rocks were generated by melting of enriched lithospheric mantle which was most likely induced by hybridism of foundering lower crust of the North China Craton at mantle depths, but the magma source of the sodic volcanic rocks contain some proportions of depleted asthenosphere mantle components. Based on a synthesis of the geology and geochemistry, it is suggested that the continued extension thinned the lithosphere and induced the upwelling of asthenospheric melts which mixed with previously enriched lithospheric mantle. Decompression partial melting of the mixed mantle source produced the sodic volcanic rocks.