

Mass-independent fractionation of Cr isotopes during photo-oxidation of Cr(III) in solution

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The photo-oxidation of chromium is one of the potential pathways for the conversion of innocuous trivalent chromium to carcinogenic and soluble hexavalent chromium in the environment [1]. This oxidation mechanism may have taken place after open air disposal of chromium ore processing residues in the environment. In this study, mass-independent fractionation of chromium isotopes associated with the photo-oxidation of trivalent chromium was investigated as a potential tracer for this reaction in the environment. Two main mechanisms have been proposed for producing mass-independent fractionation among chromium isotopes : kinetic magnetic isotope effect [2] and nuclear field shift effect [3].

Aqueous trivalent chromium was exposed to a 1000 W xenon lamp mimicking solar light radiation and this produced a photo-oxidation of Cr(III). The newly formed hexavalent chromium and the remaining trivalent chromium were separated using ion-exchange chromatography. Their isotopic composition, corrected from mass-dependent fractionation, were analyzed with high precision by thermal ionization mass spectrometry. The Cr isotope data show resolvable MIF between the Cr(III) and Cr(VI) in the irradiated solution once equilibrium was reached. The Cr isotope pattern is consistent with a nuclear field shift effect, which means this effect could be used as an environmental tracer. The occurrence of magnetic isotope effect versus nuclear field shift effect was also investigated by testing various reaction times and pH parameters during the experiments.

[1] Dai, Changyuan, Liu, Lan & Deng (2010), *Environmental Science and Technology* 44, 6959-6964.

[2] Buchachenko (2001), *Journal of Physical Chemistry* 44, 9995-1001.

[3] Schauble (2007), *Geochimica et Cosmochimica Acta* 71, 2170-2189.