Fe isotope behaviour during regional metamorphism: Example from Anshan BIFs, NE China

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An adequate understanding of the behaviour of Fe isotopes during metamorphism is crutial in using these new tracers to constrain geochemical cycling of Fe in the early part of geological history, as most Prearchean Fe-formations are metamorphosed. Here we examine this important issue by systematic investigation of Fe isotope distribution in mineral separates and bulk samples of Anshan banded-iron formations (BIFs) from NE China.

The Anshan BIFs were formed at the Archean–Proterozoic transition period (2.5 Ga), and experienced high-green schist- to low-ampiblite-facies metamorphism. The formations are composed of magnetite and quartz predominantly, with minor amounts of silicates and sulphides. Fe isotope compositions of mineral separates of magnetite and pyrite, as well as bulk samples, were measured using a Nu Plasma HR MC-ICP-MS at high-resolution mode after purification using anion exchange chromatography. The results are expressed in □ units which are deviations in parts per 10^4 from the same isotope ratios of the reference material IRMM-14. The results obtained exhibit some important features: 1) All mineral separates and bulk samples show heavy isotope enrichement relative to the standard and bulk silicate Earth; 2) The Fe isotope compositions of magnetites are very similar to those of their hosting bulk samples; 3) The Fe isotope compositions of pyrites are systematically heavier than those of corresponding magnetites separated from the same samples; 4) The Fe isotope compositions of 7 subsamples micro-drilled from different bands at cm scale for a single hand-specimen are identical within error; 4) Fe isotope compositions between samples separated by *ca.*1m distance may vary significantly.

This observation demonstrates that Fe isotopes in the BIFs studied have been largely homogenised at hand-specimen scale, but remained approximately as a close system at 1m scale during regional metamorphism at temperatures of ca.500□. This study thus provides significant new insights into Fe isotope behaviour during metamorphism. It is now necessary to extend the investigation to both lower and higher grade metamorphisms.

New considerations of ecological risk assessment for heavy metal contamination of agricultural soils

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This study introduces "Activable Rate(T_{AR})" of potentially toxic elements (PTEs, e.g. Cu, Zn, Cd, and Pb) into potential ecological risk assessment (PERA). The term of activable rate is defined as: water solution fraction + exchangeable fraction)/ overall concentration×100% in a soil sample using Tessier's sequential extraction procedure[1]], which obvously can express not only the mobility but also the bioavailbility of PTEs in the contaminated soils, and PTEs environmental toxicitis are directely depend on these properties. T_{AR} is used to replace T_r in Hakanson's mode [1, 2] of PERA, in which T_r accounts for the "sedimentological toxic factor" in the aquatic milieu ecological risk.

The contaminated soil located in Jiangsu Province, China is an irrigated paddy polluted by sewage from the smelter of the largest scale porphyry copper deposit in China. Agriculture has been damaged seriously caused by PTEs pollution, causing Cd rice to be produced.

The overall average concentrations of Cu, Zn, Cd, and Pb are 209.92mg/kg, 103.84 mg/kg, 1.37 mg/kg, and 20.34 mg/kg, respectively. the T_{AR} values Cu, Zn, Cd, and Pb is 23.00%, 10.72%, 80.78%, 14.71%, with the order Cd >> Cu > Zn > Pb. Using the modifed model, the potential ecological risk factors (*Ei*) of Cu, Zn, Cd, and Pb, are 480.76, 48.31, 838.78, and 11.11, respectively, with pollution levels of Cd >Cu >Zn>Pb.

The assessment by Geoaccumlation(I_{geo})[3] and Contamination Degree(CD)[4] approaches, based on the overall concentrations of PTEs, gives the pollution level sequence as: I_{geo}, Cu >Zn ≥ Cd > Pb and CD, Cu.>Cd >Zn >Pb.

Obviously, the new model is the diagnositic tool, especially, to sort out which PTEs should be focused for control.

[1] Tessier *et al.* (1979) *Anal Chem.* **51**, 844-850. [2] Hakanson (1980) *Water Res.* **14**, 975-1001. [3] Hu *et al.* (2006) *Environ. Geochem. & Health* **28**, 19-26. [4] Hu *et al.* (2004) *Advance Earth Scien.* **19**(Sl) 467-471.