

Evolution of the groundwater geochemistry in sulphide-rich mine tailings remediated by applying soil cover, Kristineberg, northern Sweden

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At the Kristineberg mine in northern Sweden, sulphide-rich tailings were remediated in 1996 by applying till covers. The sulphides were isolated from the atmosphere to prevent oxidation. This was realized either by covering the tailings with till in combination with a raised groundwater level, thereby saturating the tailings with water, or by covering with compacted clayey till overlain by till (dry cover). During and after 1998, 14 groundwater pipes were installed in the tailings impoundment to study the effects of the remediation. Sampling has been performed on 32 occasions during a period of more than 3 years, and the samples were analysed for major elements and metals, anions, pH, redox and conductivity. The results show that the groundwater characteristics vary considerably in the impoundment, even under the same type of cover. The pH is generally increasing and redox is generally decreasing across the studied impoundment, where some areas showed quicker changes than others. The main source reaction of the pollution thus seems to have slowed down. Only As could be released at some locations, possibly as a result of an increased pH. Before the remediation, metals released by sulphide oxidation were partly secondarily retained in the tailings below the oxidation front. Such metals, mainly Fe, S, Mg and Zn, have been remobilised by a first washout as a result of the raised groundwater level. A second washout by the clean groundwater from the western till slope, combined with the slowing down of the acid-producing reactions should lead to significant and general decreases in the observed concentrations throughout 2004-2005. However, iron precipitations occur in some places, creating a secondary acidification, and resulting in a secondary buffering.

Iron Isotopes in Human Blood

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Introduction

The study of natural isotopic variation for heavy elements has had a significant influence in many research fields such as biology, planetary, earth, and environmental sciences (Anber et al., 2000, Beard et al., 1999, Brantrey et al., Zhu et al., 2001). Because Fe has a relative mass difference that is likely to be sufficient to record biologically-induced isotopic fractionation. In this study, precise Fe isotopes for several geochemical and biological materials have been measured by means of multiple collection-inductively coupled plasma-mass spectrometry (MC-ICPMS).

Isotopic Analysis and Results

Precise and accurate isotopic analysis of Fe could be achieved by (a) reduction of polyatomic interference by utilising a desolvating nebulizer, (b) external correction of mass discrimination effect using Ni, and (c) chemical separation technique for Fe from complex organic compounds using 4-methyl-2-pentanone. The resultant precisions (internal precision or repeatability) of the measurements for both the $^{56}\text{Fe}/^{54}\text{Fe}$ and $^{57}\text{Fe}/^{54}\text{Fe}$ ratios were better than 0.01% for solution samples at the 95% confidence level. Using the present technique, the $^{56}\text{Fe}/^{54}\text{Fe}$ and $^{57}\text{Fe}/^{54}\text{Fe}$ ratios for human red blood cells were measured. The resulted Fe isotopic ratios for human red blood cells were approximately 0.17% per mass lighter than those for IRMM-014 reference material.

It was recognized that ferrous Fe was lighter than ferric Fe in aqueous solutions (Johnson et al., 2002), and generally vegetables and animals absorb ferrous Fe. This indicates lighter iron isotopic composition of human red blood cells can be caused by oxidation-reduction in food chain (Zhu et al., 2002).

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