

A new method for *in situ* analysis of potentially toxic minerals under environmental conditions

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Introduction

To assess the risk of e.g. heavy metal contaminated soils it is an important concern to know about the chemical species of the contaminant toxic mineral. Long term dwell of heavy metals in soils can provoke certain environmental damage to the soil-system, plants and groundwater. Consequently the knowledge of the dissolution behaviour and phase transformations of these metals is very important.

Method and Materials

This study developed a new method to investigate *in situ* the changes of minerals under different environmental conditions, e.g. in soils.

PlexiglasTM polymer supports were coated with lead, zinc and copper in oxidic and sulfidic form. This method allows the direct contact of the minerals with the soil and the soil solution without losing the material. The polymer discs were inserted into soil columns under laboratory conditions. After certain time segments the supports were recovered and analysed for mineralogical phase and concentration changes.

Results and Outlook

X ray fluorescence analysis showed that the total metal concentration on the PlexiglasTM disc did not decrease significantly. In contrast to the quantitative analysis REM measurements showed optical evidence of newly formed mineral phases.

It is planned to use further nondestructive analytical methods (e.g. IR-Raman Spectrometry) to analyse the changes of minerals. This knowledge of the possible long term built, insoluble phases gives new approaches to estimate the risk of a contaminated site for its further use.

Hf-Nd isotope geochemistry of chondrites

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Knowledge of chondritic reference values for the Sm-Nd and Lu-Hf isotopic systems is essential to model planetary differentiation processes and later secular evolution of Earth and other planets. Previous studies of the Lu-Hf geochemistry of chondrites have suggested that the Nd-Hf terrestrial budget is not mass balanced, requiring the presence of a hidden reservoir within the deep Earth (Blichert-Toft & Albarède, 1997). However, to-date, Nd-Hf isotopic ratios have not been determined on the same meteorites, or even on the same sample digestion of an individual meteorite

We have re-analyzed $^{176}\text{Hf}/^{177}\text{Hf}$, $^{176}\text{Lu}/^{177}\text{Hf}$ and $^{143}\text{Nd}/^{144}\text{Nd}$ ratios of four ordinary (OC) and two carbonaceous chondrites (CC). Studied meteorites are Julesburg (L3.6), Belle Plaine (L6), Edmonson (b) (H4), MBate (L6), Allende (CV3.2) and Murchison (CM2). We have also analyzed CAI-rich and matrix separates from Allende. Hf-Nd isotopes were measured on the same sample digestion by MC-ICP-MS (VG AXIOM). In a $^{176}\text{Lu}/^{177}\text{Hf}$ vs. $^{176}\text{Hf}/^{177}\text{Hf}$ diagram, the four OC plot on the well-established 4.56 Ga eucrite isochron of Patchett & Tatsumoto (1980), indicative of derivation from material with initial isotope ratios similar to the eucrite parent body. The $^{176}\text{Lu}/^{177}\text{Hf}$ and $^{176}\text{Hf}/^{177}\text{Hf}$ ratios of OC vary from 0.0282 to 0.0361 and 0.28230 to 0.28303, respectively. In contrast, the CC from this study, including the Allende CAI-rich and matrix separates, lie off the eucrite isochron, with $^{176}\text{Lu}/^{177}\text{Hf}$ and $^{176}\text{Hf}/^{177}\text{Hf}$ ratios varying respectively from 0.0326 to 0.0365 and 0.28268 to 0.28287. In a ϵHf (4.56 Ga) vs. $^{176}\text{Lu}/^{177}\text{Hf}$ plot, a crude mixing array is defined by the CC with the Allende CAI-rich concentrate and Murchison as end members. The initial ϵHf of the CC material also correlates negatively with the Hf concentration. Since CAI have the highest Hf concentration and least radiogenic composition, this suggests that the some of the heterogeneity observed within CC material may be controlled by the presence of CAI. The measured $^{143}\text{Nd}/^{144}\text{Nd}$ in both OC and CC varies from 0.51238 to 0.51274, generally lower than the accepted planetary reference value of 0.512638. The departure of the CC material from the reference eucrite isochron might reflect either disturbance of the Lu-Hf systematic following solidification of the CC parent body or, alternatively, isotopic heterogeneity within the early solar nebula. As such, CC material may not be suitable to define Lu-Hf and, possibly, Sm-Nd terrestrial reference values; our preliminary results indicate that OC material may be a better candidate.

References

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