

Rigid immobilization of antimony(V) with hydrous ferric oxide (HFO) aging

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In this study, we investigated the behavior of Sb(V) during the transformation of poorly crystalline Fe(III) oxyhydroxides (two-line ferrihydrite) with various Sb/Fe molar ratios at pH 6.0. Both XRD and Fe EXAFS analyses confirmed that goethite and hematite are the primary transformation products of the ferrihydrite in the presence of Sb(V). The crystallization kinetics showed that the transformation rate with Sb(V) was approximately the same as that of the control (without Sb(V)), which indicates that the presence of Sb(V) does not influence the transformation rate to a noticeable extent. Throughout the transformation, Sb(V) dominantly partitioned in the solid phase and no desorption of Sb(V) was observed. Furthermore, Sb EXAFS analyses suggested that Sb(V) in the solid phase is structurally incorporated into crystalline goethite and/or hematite generated by the ferrihydrite transformation. Hence, Sb(V) transfers into the thermodynamically stable solids from the metastable ferrihydrite with aging, indicating a rigid immobilization of Sb(V). These findings are valuable for making predictions on the long-term fate of Sb associated with ferrihydrite in the environments.

Keywords: ferrihydrite, XAFS, antimony

The amount of Cs adsorption to the amorphous materials in the Fukushima soil

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This study describes the amount of Cs adsorption to the amorphous materials in the soil of Fukushima Prefecture containing radioactive Cs. Although it is supposed that radioactive Cs is strongly adsorbed to clay minerals, such as mica, many amorphous materials of the volcanic-ashes origin exist in the surface of Fukushima soil. So, there is a possibility that not only clay minerals but the amorphous materials are adsorbed in radioactive Cs. In this research, the soil containing radioactive Cs was classified with elutriation, the dissolution experiment was conducted using each classified sample. In each sample, organic matter is dissolved using hydrogen peroxide and amorphous materials are dissolved using oxalic acid. After dissolving test, the mass and a dose of radiation before and after the dissolution were measured. In the sample of 8-16 micrometers, 16-32 micrometers, and 32-64 micrometers, the weight loss were 47wt% and 40wt% and 49wt%, respectively, and the reduction rate of the dose of radiation were 52%, 58%, and 52%, respectively. From this result, it became clear that there is a considerable quantity of radioactive Cs adsorption in amorphous materials and an organic matter in the fine particle of soil.

Keywords: cesium, amorphous, adsorption, soil

Modelling of Pb and Zn transport during phase transformation of monohydrocalcite: Preliminary results

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A simple model has been developed to examine Pb and Zn transport during phase transformation of monohydrocalcite. Monohydrocalcite is a nano-mineral with a diameter of ~100 nm and is metastable, being transformed to aragonite (several micrometer) in a few days. Accordingly, metals initially adsorbed on monohydrocalcite are redistributed between solution and solid during transformation, which affects metal transport. The model was made based on the results of Pb and Zn sorption experiments during transformation of monohydrocalcite (unpublished study). The model calculates changes in the concentrations of monohydrocalcite and aragonite and those of Pb and Zn sorbed to the solids and dissolved in solution with time at a given point in a water flow.

Major factors that the model considers are (i) transformation rate, (ii) change in metal distribution during transformation, (iii) change in particle size during transformation, (iv) sedimentation rate, and (v) water flow rate. The model calculations are made for the following cases: (1) with different transformation rate (e.g., retardation and inhibition) and without transformation, (2) with change in water flow rate, (3) with change in particle size of monohydrocalcite, and (4) with difference between metal redistribution mechanisms.

Metal transport is slower with transformation than without transformation because of the transformation and the subsequent sedimentation of aragonite with much larger size than monohydrocalcite. When the transformation rate is retarded, metal transport becomes faster than that with transformation, indicating important effects of transformation rate on metal transport. With slower water flow rate, metal transport is slower depending on transformation rate. The difference in particle size of hypothesized monohydrocalcite (10 and 100 nm) makes little difference when the water flow is fast. The difference in metal redistribution mechanisms (i.e., between only sorption and combination of sorption and metal precipitation) affects metal transport.

Keywords: monohydrocalcite, phase transformation, transport modelling

Nano-Minerals Formed by State-Changes: Carbon-, Rare-Earth REE- and Chlorine-Bearing Materials

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On our Earth and the Solar System bodies, nano-minerals are formed as remnants of three state-changes as follows:

1)Nano-minerals are remained at normal (room) P-T conditions among three state-changes from air, ocean liquid and solid rock systems.

2)New definition of mineral is generally solid phase in room P-T (from macro to micro-nano phases) by state-changes widely in gas-liquid-solid states.

3)Carbon-bearing nano-phases are formed at shock-wave rapid VLS conditions due to stable at high P-T conditions, which are applied for fixing high temperature carbon dioxides gas (Miura, 2007; JPO patents). Carbon-bearing solids formed at shock wave condition of volcanism(phlogopite in Shimonoseki, and crystals in Hamada and Hagi Cities; Undergrad. Thesis, Yamaguchi University, 2009).

4)Apollo lunar plagioclases with different structure and chemical compositions are explained with carbon, and REE (Eu) with Ca during impact shock-wave reactions (Miura, 2009). Impact breccias contains with high Rare-Earth REE elements and obtained at the impact breccias of the Sudbury craters (Lunar Resources NASA Rep.; Miura , 2011).

5)Chlorine-bearing nano-minerals with iron during shock-wave reactions are obtained as akaganeite in the Apollo lunar samples and artificially (Undergrad. Thesis, Yamaguchi University, 2009).

6)Nano-minerals can be formed not only water-planet Earth, but also water-less extraterrestrial Solar System due to quick and short formation of state-changes.

Keywords: Nano-minerals, Definition, State-changes, Shock-wave reaction, Carbon and Chlorine, Rare-Earth