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フェリハイドライト・ナノ粒子の生成・溶解・移動・Pu吸着
Formation, dissolution, migration and Pu-sorption of ferrihydrite nanoparticles

月村 勝宏 [1*], 鈴木 正哉 [1], 鈴木 庸平 [2], 村上 隆 [2]
Katsuhiro Tsukimura[1*], Masaya Suzuki[1], Yohey Suzuki[2], Takashi Murakami[2]

[1] 産業技術総合研究所, [2] 東京大学
[1]AIST, [2]The University of Tokyo

This paper describes the behavior of Pu and ferrihydrite nanoparticles in the Lake Karachai area. The Pu in the Lake Karachai area is sorbed to colloidal ferrihydrite and moves with the ferrihydrite in the groundwater. The Pu is incorporated in the inner part of ferrihydrite because the partition coefficients of Pu between solution and ferrihydrite have a wide variation. The ferrihydrite is formed from Fe(III), which is supplied through the dissolution of Fe(II) from metallic iron in Lake Karachai and iron-bearing minerals in rock and the oxidation of the Fe(II) by oxygen or nitrate. The formation of hematite or goethite, which is more stable than ferrihydrite, decrease the concentration of ferrihydrite. When the supply of Fe(III) exceeds the formation of hematite or goethite, the concentration increases, and when the supply of Fe(III) is less than the formation of hematite or goethite, the concentration decreases. The formation rate of hematite or goethite is proportional to the concentration of ferrihydrite nano-particles, the formation rate decreases by more than one order of magnitude in groundwater because of the present of trace amount of dissolved silica. The migration of ferrihydrite nano-particles depends on the concentration and the size of nanoparticles, and the pH of the groundwater. When the concentration of nano-particles exceeds the critical aggregation concentration (around 10-3 mol Fe /L), the nano-particles aggregate and precipitate. Large nano-particles are trapped in the dimples of fractures or filtrated in constrictions. When the size of ferrihydrite nano-particles is 70 nm, which is the same as that in the Lake Karachai area, the 99 % of the particles are trapped in a dimple of 3 mm. The gravity also significantly affects the downward movement of nano-particles. The ferrihydrite nano-particles with the diameter of 70 nm move downward with the velocity of 0.12 m/year, which is significant because the assessment period of radioactive nuclear wastes is more than 10,000 years.

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