Biogenic REEs nano particle formation and its mobilty in environments

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Geochemical behaviors of rare earth elements (REEs of La, Ce, Pr, Nd, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu) are important to understand the migration of trivalent actinides and fission genic REEs from nuclear power plants and high level radioactive waste. When REEs migrates in environemnts, their chemical states may change by the interaction with inorganic and organic materials. Many researchers have studied the interaction of REEs with organic materials. However, the biotransformation of REEs have not fully understood. We have conducted the research on the interaction of REEs with microorganisms.

The adsorbed REEs on the cell surface changed the chemical states to the REEs-phosphate precipitates by the reaction with phosphate ions released from inside the yeast cells. Using the single gene deletion mutant yeast strains, genes concerned with phosphate transport contribute to uranium tolerance, suggesting that REE- and U(VI)-phosphate precipitations are resulted from the expression of yeast by the adsorption of REE and U(VI). Recently, we found that the nanoparticles formation of Ce(III)-phosphate on the cell surface delays the oxidation of Ce(III) to Ce(IV) by Mn oxides in the mixtures of microorganisms and Mn oxides.

Microorganisms may response to REE. We found distinct organic molecules released from Mn oxidizing fungus, which complexed selectively with tetra valent elements including Ce and Th. This complexiation results in the transformation of immobile tetra valent element to mobile one. When microorganisms expose to the solution containing nano particles of Ce oxides, the exudates released by microorganisms were adsorbed onto the nanoparticles, resulting in the enhance of the mobility of nanoparticles of Ce oxides.

These findings indicate that microorganisms affect geochemical behavior of REEs.