Uptake Mechanisms of Eu(III) by Hydroxyapatite: A Potential Backfill Material for Trivalent Minor Actinides

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The permeable reactive barrier (PRB) technique has attracted increasing attention for the in situ remediation of contaminated groundwater. Herein, the macroscopic uptake behaviors and microscopic speciation of Eu(III) on hydroxyapatite (HAP) were studied by using theoretical modeling, batch experiments, powder X-ray diffraction (PXRD) fitting and X-ray absorption spectroscopy (XAS). For the batch experiments, nearly all dissolved Eu(III) in solution was removed within an extremely short reaction time of 5 min. In addition, the thermodynamic calculations, PXRD and XAS analysis confirmed the formation of $EuPO_4 \cdot H_2O$(s) phase via the dissolution-precipitation mechanism. The detailed comparison of the present experimental findings and related HAP-metal systems suggested that the relative contribution of precipitation to the total Eu(III) removal increased with decreasing P:Eu ratio. These findings demonstrated the feasibility of using HAP-based PRBs for the in situ purification of groundwater containing trivalent lanthanide/actinides, e.g., Eu(III), ^{241}Am(III) and ^{244}Cm(III).

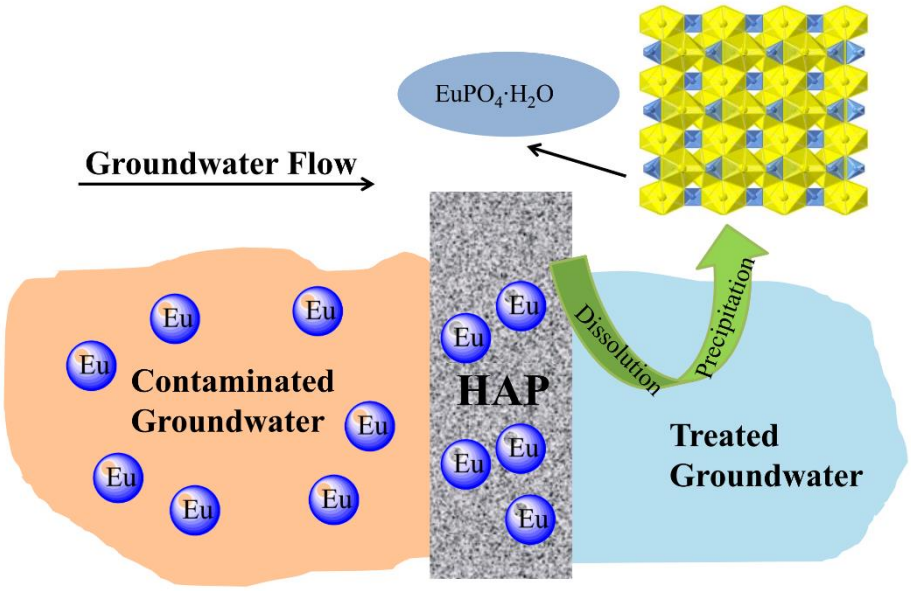

Fig.1. uptake mechanisms of Eu(III) by HAP