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ID-1-P-3381 The removal of fluoride from the aqueous solutions using calcium-based minerals

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Fluoride in water is a contaminant that could harmfully affect the human hard tissues by reconfiguring the biological apatite minerals. Since fluoride could be present in groundwater in high concentrations because of both geological and industrial reasons, diverse methods have been devised to remove the problematic contaminant. In this presentation, the fluoride removal by calcium-based minerals is displayed. Calcite (calcium carbonate) and brushite (dicalcium phosphate dihydrate) were used in the form of single crystals for the atomic force microscopy (AFM). The microscopic observation was complemented by the analysis of the solid phases by X-ray diffraction. In addition, the kinetics of the fluoride removal was monitored by measuring the fluoride concentration in the aqueous solutions. The fluoride removal was through the process of dissolution-and-recrystallization, through which the calcite and brushite were transformed into fluorite and fluorapatite, respectively. AFM was especially useful to understand the surface phenomena during the transformation. The dissolution could be easily discerned by the pit formation of calcite and brushite, and the recrystallized precipitation was also found on the surfaces of the single crystals. In addition, the interference caused by organic compounds on the fluoride uptake was studied, which had practical implications during the wastewater treatment. By combining the AFM and bulk experiments, the organic interference could be understood in terms of the changes in the boundary layers on the crystal surfaces. Especially, the AFM observation on the evolution of the dissolution pits indicated the alterations in the diffusion of calcium and fluoride ions through the boundary layers. The current study could have broad implications in the wastewater treatment as well as biomedical mineralization.