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Feldspar-fluoride interactions: Examination of interfacial processes by potentiometry

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Fluoride is an essential constituent for the production and maintenance of healthy teeth and bones. However, high levels of fluoride are found to cause health hazards in many respects, requiring effective means of fluoride removal from water. Defluoridation of fluoride-rich water by naturally occurring minerals and porous materials has been addressed for many decades. Nevertheless, microscopic picture of fluoride-substrate interactions yet needs further clarification. This research is on mechanistic investigation of feldspar - fluoride surface interaction under experimental conditions that are important from the environmental view point.

Analysis of methylene blue adsorption data indicate that the specific surface area of the feldspar used for this investigation (31.2% Al, 11.6% K and 57.2% Si) is 9.79 m^2 g^{-1}. Further, variation of surface charge density, as determined through surface titrations of an aqueous feldspar suspension in two different ionic strengths, results in the point of zero charge of feldspar between pH = 3.5 and pH = 4.0.

Fluoride adsorption changes both surface and bulk properties of feldspar. The structure of crystalline feldspar was gradually changed into amorphous phase upon reaction with fluoride according to X-ray diffraction measurements. This is a rapid process reaching an apparent plateau within a 20 min stirring time and a 2.0 h equilibration time for a 10 % (w/v) fluoride/feldspar suspension. More importantly, aluminium is found to leach out during fluoride –feldspar interaction at low pH values suggesting enhanced dissolution of feldspar, although this effect is not significant at high pH values.

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