

The effect of selenium on fluoride – clay interactions: possible environmental health implications

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Abstract

Previous epidemiological studies have shown that dental fluorosis is endemic in the lowland, dry zone of Sri Lanka, which is considered to be an area in which excessive quantities of fluorides are present in the drinking water supplies. It has been found that kaolinitic clay forms a suitable raw material in the defluoridation of water.

It is shown that there is a noticeable effect of selenium and media pH on the reactions involved in the interaction of fluoride with clay. In this study, 1 mM fluoride solutions containing SeO_3^{2-} (selenite) concentrations of 0 mM, 0.1 mM, 0.5 mM and 1 mM were used in the reactions with kaolinitic clay. The effect of pH was monitored in the range 4 to 8. It was observed that fluoride adsorption was maximum at a pH of 5.6 without either SeO_3^{2-} or SeO_4^{2-} , the adsorption capacity being $15.2 \mu\text{mol F}^- \text{g}^{-1}$ clay. However, when the SeO_3^{2-} concentration was increased up to 0.5 mM at this optimum pH, the adsorption capacity reduced to $12.8 \mu\text{mol F}^- \text{g}^{-1}$ clay. Monitoring of the effect of SeO_4^{2-} and media pH on fluoride adsorption showed that when the SeO_4^{2-} concentration increases from zero to 0.1 mM, there is a reduction of fluoride adsorption capacity. However, when the SeO_4^{2-} concentration is further increased from 0.1 mM to 1.0 mM, there was an increase in the fluoride adsorption capacity, indicating a more consistent effect of SeO_3^{2-} on fluoride-kaolinitic clay interaction than SeO_4^{2-} .

Fluoride concentrations in drinking water supplies have a marked effect on dental health and the geochemistry of selenium appears to play an important role in the geochemical mobility of fluoride ions.
