

Post-deposition diffusion of ^{137}Cs in lake sediments

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Large episodic emissions of radiocesium ^{137}Cs into the atmosphere, such as those generated by nuclear weapon testing programs in the 1960s and the Chernobyl accident in 1986, have been frequently utilized when dating lake sediments. The ongoing disaster at the reactors at Fukushima, Japan, is likely to generate a new chronological marker in sediments deposited over a large part of the region that can be recognized as subsurface peak in ^{137}Cs activities by future sedimentologists. However, the generation of a new ^{137}Cs dating horizon in lake sediment can eliminate the use of others due to significant post-depositional mobility and catchment processes as shown in this presentation. Here we show using archived sediment samples how the ^{137}Cs record within an annually varved sediment, from a lake situated about 1600 km from Chernobyl, is successively altered between 1985 to 2007 due to Chernobyl fallout and subsequent post-depositional diffusion and catchment inputs. The record reveals how Chernobyl ^{137}Cs becomes incorporated into the summer sediment in 1986 and diffuses downward in the core at a decreasing rate over time, making the marker of 1964 originally present in the core sampled three weeks before the Chernobyl accident unrecognizable two years after the accident. It is, therefore, questionable whether ^{137}Cs peaks in deep sediment can be used to recognize sediment deposited in the 1960s in regions that has received significant fallout from the accidents in Chernobyl or Fukushima.

Atomic force microscopy study of the dissolution of a calcite surface in the presence of phosphate ions

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The dissolution of calcite in the presence of phosphate solutions has been studied using Atomic Force Microscopy (AFM). The presence of phosphate in aqueous solutions is known to inhibit calcite growth [1] and has been successfully used to reduce limescale formation. In this study, solutions containing phosphate salts such as ammonium and sodium phosphate were studied in order to compare their influence on the dissolution of a calcite surface {10-14} during continuous flow in the fluid cell of an AFM.

In the presence of phosphate solutions at pH ~ 8, a significant decrease in the dissolution rate was observed. However, the etch pit density, increased for both ammonium and sodium phosphate salts, suggesting a kosmotrope hydration character of phosphate ions and therefore similar behaviour to that of fluorine ions on calcite dissolution [2]. It was also observed that the dissolving calcite surface can act as a structurally suitable substrate for calcium phosphate growth, which may prove to be an environmentally important mineral replacement reaction for remediation of phosphate rich systems.

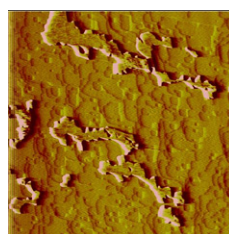


Figure 1: AFM image of calcium phosphate growth on a calcite cleavage surface. The process is limited by the release of Ca^{2+} from the dissolution of calcite.

[1] Lin & Singer (2005) *Water Research*, **39**, 4835-4843.

[2] Ruiz-Agudo *et al.* (2010) *GCA*, **74**, 1256-1267.