

^{224}Ra : ^{228}Th disequilibrium in coastal sediments: Implications for the transfer across the sediment-water interface

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We utilized $^{224}\text{Ra}/^{228}\text{Th}$ disequilibrium in the sediment to investigate the processes that regulate dissolved transfer across the sediment-water interface. Depth profiles of dissolved and surface-bound ^{224}Ra and ^{228}Th in the upper 0-20 cm sediment were measured using a delayed coincidence counter during a cruise to the Yangtze estuary from 15 to 24 August 2011. Along with ^{224}Ra and ^{228}Th , depth profiles of ^{234}Th were collected to determine the bioturbation rate in the sediment. At most study sites, a marked deficit of ^{224}Ra relative to ^{228}Th was observed in the upper 0-10 cm sediment. In contrast, ^{224}Ra was in excess with respect to ^{228}Th in the upper 0-5 cm sediment at the river mouth, possibly due to redistribution of ^{224}Ra from the mid-salinity region. By modeling the ^{224}Ra profiles in the sediment using the general diagenetic equation, we demonstrated that in most cases molecular diffusion and bioturbation together can account for only ~20-30% of the measured flux of ^{224}Ra . We concluded that other mechanisms, especially irrigation, must be invoked to explain the remnant 70% of the observed deviation of ^{224}Ra relative to ^{228}Th in the sediment. On the basis of the $^{224}\text{Ra}/^{228}\text{Th}$ disequilibrium in the sediment, we proposed an invaginated interface model to quantify the transfer rate of other dissolved species across the sediment-water interface. We have utilized the invaginated interface model to determine the benthic consumption rate of dissolved O_2 . The result reveals that O_2 consumption is an important loss term of dissolved O_2 in the Yangtze estuary and must be considered as one of the mechanisms that lead to hypoxia in this area.

The effect of zinc, nickel and cobalt on fluoride removal by low cost materials: Zeolite and calcite

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Spent Pot Lining (SPL) is a by-product of the electrolytic process in the smelting of aluminium. Historical disposal of SPL from the Hydro Aluminium smelter at Kurri Kurri, NSW, Australia has rendered the nearby groundwater contaminated as high as 2000 mg/L fluoride, which is far beyond the drinking water limitation of 1.5 mg/L. The excessive intake of fluoride, however, can lead to fluorosis. Since SPL leachate is in fact a complex chemical cocktail which also contains other contaminants like metal ions, it is necessary to understand how these chemicals will behave during the defluoridation process. This research aims to determine the effect of zinc, nickel, cobalt on the fluoride removal by zeolite and calcite. For this purpose, a range of "free-drift" kinetic tests have been conducted.

The tests were carried out at 20°C and a stirring rate of 200 rpm with $150\mu\text{m}$ zeolite or calcite. The initial concentration of synthetic fluoride solution was about 200 mg/L, which reflected the "average" concentration of fluoride contamination in groundwater at the Hydro Aluminium site. The fluoride solution was spiked with known amounts of either Zn, Ni or Co. Fluoride concentrations & pH were measured every 10 seconds using the respective ion-selective electrodes and spot checked by ion chromatography (IC). Selected samples were sent for ICPMS analysis for total metals.

Results show that the presence of metals can enhance the fluoride adsorption by zeolite with fluoride removal generally increasing with metal concentration. The best fluoride adsorption occurs with the addition of 100 mg/L Ni^{2+} . It exhibits an approximately 20% higher percentage adsorption than the blank (no metals). As for the calcite, the sample with Zn^{2+} exhibit the highest fluoride removal of around 90%, while the samples with the addition of Co^{2+} and Ni^{2+} are found to inhibit defluoridation compared with the blank. The kinetic study indicates that the experimental data are well fitted by the pseudo-second order kinetics model and Hill logistic model, with the latter resulting in a better fit overall.