

Mobility of ^{137}Cs in freshwater system using Mass Balance and Diffusion Studies

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Introduction

Cesium-137 is one of the most-widely used tracers for soil erosion and sedimentation studies. Its strikingly contrasting geochemical behaviour in fresh and salt water is of fundamental importance for its effective use as tracer and chronometer. Activity of ^{137}Cs in recent sedimentary record provides two globally-observed time markers (1963-peak & 1952-first appearance). To understand the factors that cause ^{137}Cs mobility in sediment porewater, a series of laboratory experiments were conducted to investigate its diffusion under different chemical conditions (oxic/anoxic and soft/hard water) in conjunction with a mass balance study in a lake in SE Michigan, USA.

Discussion of Results

We report the following: i) the fraction of ^{137}Cs desorbed from solid to liquid was the highest in oxic soft water (SW) compared to oxic hard water (HW), with the sequence: anoxic SW > oxic SW > anoxic HW > oxic HW, implying that chemistry of the porewater has direct bearing on ^{137}Cs diffusion.; ii) the fraction of anoxic sediment-sorbed ^{137}Cs exchanged with water containing a suite of ions follows the order: $\text{NH}_4^+ > \text{Mn}^{2+} > \text{K}^+ > \text{Mg}^{2+} \approx \text{Ca}^{2+} > \text{Na}^+ > \text{Sr}^{2+}$; iii) the diffusion flux of ^{137}Cs is ~ 8% of the total input flux to Lake St. Clair; and iv) The variations in partitioning of ^{137}Cs between solid and liquid phases is a function of water chemistry. A synthesis of reported ^{137}Cs diffusion and its implication to soil erosion studies will be presented.