Chemical Geology (Isotope Geoscience Section), 94 (1992) 173–181
Elsevier Science Publishers B.V., Amsterdam

^{210}Pb, ^{226}Ra and ^{32}Si in Pavin lake (Massif Central, France)

J-M. Martin[a], M. Meybeck[a,1], V.N. Nijampurkar[b] and B.L.K. Somayajulu[b]

[a]*Institut de Biogéochimie Marine, Unité Associée au CNRS No. 386, 1 rue Maurice Arnoux, F-92120 Montrouge, France*
[b]*Physical Research Laboratory, Ahmedabad 380 009, India*

(Received May 21, 1991; revised and accepted October 11, 1991)

ABSTRACT

Martin, J-M., Meybeck, M., Nijampurkar, V.N. and Somayajulu, B.L.K., 1992. ^{210}Pb, ^{226}Ra and ^{32}Si in Pavin lake (Massif Central, France). Chem. Geol. (Isot. Geosci. Sect.), 94: 173–181.

Measurements of cosmogenic ^{32}Si and the U-decay series' nuclides ^{210}Pb and ^{226}Ra in waters and sediments of lake Pavin are reported. Both ^{210}Pb and ^{226}Ra are enriched in the anoxic deep waters compared to the oxic surface waters, respectively by a factor of 4 and 10, whereas ^{32}Si is depleted by a factor of ~2. Redox conditions in the lake appear to have no marked effect on the ^{32}Si. Using a steady-state box model it is shown that the deep-water ^{32}Si concentration is controlled by the underground lacustrine springs. The residence times of ^{210}Pb, ^{32}Si and ^{226}Ra are ~1, ~10 and ~80 a, respectively. In the case of ^{32}Si, where more data are available, the assessed inventory data from the overhead atmospheric fallout and that measured in the sediments agree very well as expected. The ^{210}Pb- and ^{32}Si-based deposition rates during the past ~100 a ranged from 0.8 to 1.9 mm a^{-1}, earlier these were a factor of ~3–5 faster. The geochemistry of ^{32}Si and ^{210}Pb in lake Pavin in many ways resembles that in the ocean, only the time scales of the processes involved are faster.

1. Introduction

In view of the vastness of the oceans and the complexity of marine processes an alternative approach to understand the aqueous biogeochemical processes would be through study of small and well-defined ecosystems. Indeed Volchok et al. (1970) did take such an approach: they studied a crater lake to understand oceanic fallout. A number of earlier works too realised the value of studying geochemical processes in lakes, well defined with respect to their sources and sinks (Lerman, 1978). It is well known that lake sediments are ideal for storing records of short-lived phenomena (Krishnaswami and Lal, 1978).

Due to its geochemical and morphological characteristics, Pavin lake in the Massif Central, France, appears to be ideally suited for such studies (Martin, 1985). It is located in a remote area far from industrial sources. Due to its forested watershed, the lake sediments are basically biogenic, consisting of ~90% diatomous substance with negligible detrital materials. From a chemical point of view the lake is characterised by the presence of two stratified layers, the upper oxic layer (mixolimnion) which is affected only during winter by mixing and the deeper and totally anoxic layer (monimolimnion) which has steady-state conditions (Meybeck et al., 1975). The present investigation, using the U-decay series' nuclide ^{210}Pb (half-life = 22.3 a) and cosmogenic ^{32}Si (= 140 a; see Somayajulu et al., 1987, 1991), is intended to determine the accumulation rates of the lake sediments as well as to understand the aqueous geochemistry of Pb and Si

[1]*On leave at*: Laboratoire de Géologie Appliquée, Université Pierre et Marie Curie, 4 place Jussieu, F-75230 Paris Cedex 05, France.