

## GEOCHRONOLOGY OF LAKE SEDIMENTS

S.KRISHNASWAMY, D.LAL

*Tata Institute of Fundamental Research, Homi Bhabha Road, Colaba, Bombay 5, India*

and

J.M.MARTIN and M.MEYBECK

*Centre de Recherches Geodynamiques, 74, Thonon-les-Bains, France*

Received 29 March 1971

Revised version received 10 June 1971

This paper describes partially successful attempts to measure rates of sedimentation in lakes using radiometric techniques.

We show that  $^{210}\text{Pb}$  activity precipitated from the atmosphere is ideal for dating lake sediments of  $\leq 100$  yr age. In fresh waters, lead is quickly removed from solution on to particulate matter so that *unsupported*  $^{210}\text{Pb}$  activity in sediments is essentially that due to overhead fallout from the atmosphere. In three lake sediments, the atmospheric  $^{210}\text{Pb}$  activity lies between 5-50 dpm/g sediment dry weight, compared to the radium supported  $^{210}\text{Pb}$  activity of about 2 dpm/g.

$^{55}\text{Fe}$  activity has been measured in the same cores dated by the  $^{210}\text{Pb}$  method. Its activity is easily measurable in lakes and forms a method of pinpointing the sediment strata accumulated in 1963-64, the peak years of its fallout. The concentration of  $^{137}\text{Cs}$  has also been measured in a core, which however was not dated by other methods. Analogous to  $^{55}\text{Fe}$ ,  $^{137}\text{Cs}$  activity is also useful for identifying the sediment layer accumulated during 1963-64, although it seems that diffusion appreciably changes its depth distribution.

$^{32}\text{Si}$  activity has been measured in sediments from two lakes. Its activity is also measurable and promises to be useful as a dating method for sediments of  $\leq 2000$  yr age.

### 1. Introduction

The geochronology of fresh water lake sediments, besides being important in limnology, should be useful in studies of time changes in industrial pollution [1-3]. However, such studies have not yet been carried out due to non-availability of suitable radiometric methods for dating recent sediments. To date, only  $^{14}\text{C}$  dating of carbonaceous sediments [4-7] has been attempted. Otherwise, chronology has been based on qualitative (stratigraphic and palynologic) methods applicable to clay and biogenic sediments which are laminated [8-11].

In this paper, we describe results of a study of four radionuclides which are useful for deciphering the chronology of fresh water lake sediments, for the time

brackets 0-10, 0-100 and 0-2000 yr. The nuclides studies are  $^{55}\text{Fe}$  ( $t_{1/2} = 2.7$  yr),  $^{137}\text{Cs}$  ( $t_{1/2} = 30$  yr),  $^{210}\text{Pb}$  ( $t_{1/2} = 21$  yr) and  $^{32}\text{Si}$  ( $t_{1/2} \approx 500$  yr).

$^{55}\text{Fe}$  and  $^{137}\text{Cs}$  activities on the earth, in the atmosphere and in the hydrosphere, are primarily due to testing of nuclear weapons. On the other hand,  $^{210}\text{Pb}$  and  $^{32}\text{Si}$  are produced naturally in the atmosphere,  $^{210}\text{Pb}$  by the decay of  $^{222}\text{Rn}$ , a member of the  $^{238}\text{U}$  decay series ( $t_{1/2} = 3.8$  days) and  $^{32}\text{Si}$  by interactions of cosmic ray particles with atmospheric argon nuclei.

### 2. Experimental techniques

The vital statistics [5] of the lakes Lemman (alias