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Chemical evidence of water movements in the deepest part of Lake Leman (Lake Geneva)

M. Meybeck [1], P. Blanc [2], A. E. Moulherac [3] and C. Corvi [4]

[1] Laboratoire Géologie Appliquée, Université Paris 6, Place Jussieu – 75252 Paris Cédex (France)
[2] Station d'Hydrobiologie Lacustre, INRA, 75, Avenue de Corzent – 74203 Thonon-les-Bains Cédex (France)
[3] Centre de Recherches Géodynamiques, 47 Avenue de Corzent – 74203 Thonon-les-Bains Cédex
[4] Institut d'Hygiène, Laboratoire Cantonal de Chimie, Case Postale 109 – CH 1211 Genève 4 (Suisse)

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ABSTRACT

Regular surveys of bottom water chemistry (SiO_2, O_2, Fe, Mn) have been carried from 1978 to 1986 in the deepest 30 m of Lake Léman (max. depth 309 m) including interface waters sampled with a Jenkins Mortimer corer. When compared to normal chemical gradients near bottom, i.e. O_2 decrease and SiO_2 increase, three types of anomalies (lens, interface, and behaviour) have been observed on O_2 and SiO_2, the most sensitive chemical species. These anomalies were found throughout the year, in several stations of the deepest part of the lake and even along the slope of the lake basin. Major anomalies ($\Delta O_2 + 3$ to 10 mg $\cdot l^{-1}$; $\Delta SiO_2 - 1$ to 2 mg $\cdot l^{-1}$) were generally found at the sediment water interface and may extend 10–20 m above the sediment and last 10 weeks. Others marked lens anomalies could be observed for 3 to 4 months. Several mechanisms are probably responsible for this injection of surface waters along the lake slope (accumulation of turbid water on lake banks after severe windstorms; river density currents due to temperature and/or turbidity difference with lake waters). These water-inputs do not represent important volumes ($\leq 1\%$ total lake volume) but, when occuring at the interface, they ensure a sufficient oxygen level to prevent diffusion of phosphate and ammonia from pore waters when winter lake overturns do not reach bottom layers (from 1972 to 1980). Complete overturns, as observed in 1980/81, are connected with major interface anomalies (bottom O_2 moves up from 2 to 10 mg $\cdot l^{-1}$) occuring before surface mixing reaches the deepest layers.

1. Introduction

The possible intrusion of river waters into the deeper layers of lakes has been discussed since the description of sublacustrine canyons in Lake Léman and in other subalpine lakes (Forel, 1895). As stated Hutchins on (1957), "when the river is denser than any layer it will descend on the floor of the lake ..., if the river water corresponds to an intermediate density it may remain as a discrete layer in the middle of the lake", which is generally called an interflow. When river water is highly turbid