XA0300411 IAEA-CN-80/35P

STABLE ISOTOPES, $\delta^{18}O$ AND $\delta^{2}H$, IN THE STUDY OF WATER BALANCE OF LAKE MASSOKO, TANZANIA: INVESTIGATION OF THE EXCHANGE BETWEEN LAKE AND UNDERGROUND WATER

L. BERGONZINI, E. GIBERT, A.WINCKEL
Laboratoire d'Hydrologie et de Géochimie Isotopique,
Université Paris-Sud, Orsay, France

The stable oxygen and deuterium isotope compositions of a lake depend upon its water balance. Therefore the balance equations of stable isotopes, which imply calculation of the composition of evaporating moisture δ_E, provide information for assessing the water balance. In most cases, this approach is used to investigate the relationships between lakes and groundwater.

Lake Massoko (8°20'S, 33°45'E, 870 m.a.s.l.) is a freshwater maar-lake without surface outlet. The lake surface and its runoff area cover 0.38 and 0.55 km^2 respectively. In contrast with the mean annual rainfall in the other parts of south Tanzania (1000-1200 mm y^{-1}), the presence of Lake Malawi to the South, and the high ranges to the North (Mounts Poroto, Rungwe and Livingstone) imply local climatic features. Air masses overloaded with humidity bypassing Lake Malawi are submitted, especially in April, to ascending currents, producing rainfalls up to 2450 mm y^{-1} over Massoko area. Because of the evaporation rate from the lake's surface (around 2100 mm y^{-1}) and without taking into account the runoff from the drainage basin, hydrological balance is positive and imply underground lost.

One of most difficult points in the establishment of the isotope balances is the calculation of the composition of the evaporated water (δ_E), which requires an estimation of the isotopic composition of the water vapour in the atmosphere over the lake (δ_{Atm}). Without direct measurements, two ways can be used for the determination of the vapour composition (i) equilibrium with precipitation and reconstitution from them, or (ii) calculation from the balances of a terminal lake of the region. Both approaches are presented and compared, but only the second one allows physical solutions. δ_{Atm} determined from Lake Rukwa hydrological and isotope balances has been used to calculate values for δ_E over Lake Massoko. The estimation of δ_{Atm} obtained from Lake Rukwa budgets presents a deuterium excess higher than the values obtained from precipitation. This fact appears in good agreement with local rivers composition.

However, the hydrological and isotope balances of Lake Massoko gives evidence of important groundwater input and output, overimposed to relationships with groundwater circulation at a regional scale. Water lost by infiltration has been estimated at about 60% of the total lost and inflow from the basin assessed at around 40% of the input. This point indicates that Lake Massoko did not directly amplified the climatic fluctuations, and that its level is maintained by groundwater. In such a scheme, at odds with many lake of East Africa, the sediment preservation is optimised as confirmed by a continuous sedimentary sequence core in the lake in 1996* and having registered more than 35 ky B.P. of environmental history. Sedimentation rate fluctuation over this period are presented and compared with other limnological sequences.

* EC Programme RUKWA: "Investigations of the sediments of Lake Rukwa (Tanzania): a clue for reconstructing the south equatorial climate during the last 130,000 years" (DG XII: Environment, Area I - Global Change).