Tritium isotope profiles in the Eastern Mediterranean

by

G. CORTECCI,* P. NOTO** and E. OZTURGUT***

**Laboratorio di Geologia Nucleare, Università di Pisa (Italie)*
***Istituto Internazionale per le Richerche Geotermiche, Pisa (Italie)*
****Saclant ASW Research Centre, La Spezia (Italie)*

Abstract

The surface tritium distributions in the Eastern Mediterranean are not uniform, with 8 to 19 tritium units, as the highest values are observed in the Ionian and Crete seas. In some profiles the tritium decreases not monotonically with depth. By means of the radioactive decay law and the calculated exponential decrease of tritium in the Levantine basin we estimate the westward component of the Levantine flow speed of about 1 cm/s.

Résumé

La distribution superficielle du tritium en Méditerranée de l'est n'est pas uniforme et montre des valeurs comprises entre 8 et 19 unités tritium; les valeurs plus élevées ont été observées en mer Ionienne et en mer de Crête. On a observé que dans quelques profils en mer Ionienne le tritium ne diminue pas constamment avec la profondeur. Nous avons évalué approximativement, par la loi de la décadence radioactive et par la diminution exponentielle du tritium dans le bassin Levantin, la composante ouest de la vitesse de l'eau Levantine (1 cm/s) entre le bassin Levantin et le canal de Sicile.

***

Introduction

In the winter of 1974, SACLANT Research Centre (La Spezia, Italy) conductes a survey in the Eastern Mediterranean and in the Levantine basin to study the Levantine water formation. At selected hydrographic stations water samples for tritium and oxygen measurements were collected with a rosette sampler. The main purpose of the tritium measurements concerns the possibility of using them to evaluate the time taken by the Levantine flow to go from the sinking area to the Strait of Sicily. Furthermore, these values make possible a comparison of present-day tritium distribution in the eastern (this work) and western [CORTECCI *et al.*, 1974 *a* and 1974 *b*] Mediterranean with those of ÖSTLUND [1969] for samples collected in 1965, after the 1961-1962 fusion bomb tests.

Experimental

The tritium measurements were made by means of the method described by CAMERON [1967]. As a first step in the analysis, the water sample were distilled. Of the distillate, 250 ml was enriched by electrolysis until 8-9 ml remained. The enriched sample (5 ml) was reduced by hot magnesium metal to hydrogen, which was then converted with ethylene on a Pd-Asbestos catalyst to ethane; this was introduced into a low level proportional counter filled to a pressure of 1.9 atm of the sample. The tritium concentrations are reported as tritium units (TU), the number of tritium atoms for 10^{18} hydrogen atoms. The accuracy of the measurements is about ± 0.7 TU.

The Winkler method was used in the dissolved oxygen measurements.

Rapp. Comm. int. Mer Médit., **23**, 7, pp. 85-86 (1976).

Results and discussion

The tritium profile in the Strait of Sicily shows a mean surface and subsurface content of about 8.5 TU, which is very close to that measured in the south and central Tyrrhenian basin [CORTECCI *et al.*, 1974*a* and 1974*b*] and mark out the less saline surface flow of more " Atlantic " water; furthermore, it shows an intermediate layer 150 m in thickness with 12 TU advected there probably from the Ionian sea and, finally, a deeper layer with 9.3 TU, a maximum of salinity and the lowest oxygen content, representing the outflowing Levantine water.

The profiles made in the South Ionian sea show higher subsurface tritium contents, with values rancing between 14 and 19 TU.

The tritium contents measured by ÖSTLUND [1969] in Mediterranean and Aegean surface waters collected in 1965 are about 60 per cent higher than those observed at present. This is in good agreement with the radioactive decay of tritium from 1965 to 1974. At present, the samples from the Sea of Crete show high surface tritium concentrations with average 14.5 TU. This must be a residue of the tritium rich waters discharged through the Dardanelles from the Black sea.

The surface and subsurface contents observed in the Levantine basin are slightly higher (8.5 — 10 TU) than those measured in the Strait of Sicily and in the Tyrrhenian sea (8-9 TU).

In the sinking regions (Levantine basin and Sea of Crete) the tritium, salinity and oxygen contents of water masses are very uniform with depth and show very close positive correlations. By means of the radioactive decay law and the calculated exponential decrease of tritium in the Levantine area after the concentration peak due to the 1961-1962 fusion bomb tests, we estimate a westwards component of the Levantine flow spead of about 1 cm/s.

References

CAMERON (J.F.), 1967. — Survey of systems for concentration and low background counting of tritium in water. *Radioactive dating and methods in low-level counting*. IAEA, Vienna.

CORTECCI (G.), MOLCARD (R.) & NOTO (P.), 1974*a*. — Isotopic analysis of the deep structure in the Tyrrhenian sea. *Nature*, **250**, pp. 134-136.

CORTECCI (G.), NOTO (P.) & MOLCARD (R.), 1974*b*. — Tritium and sulfate-oxygen isotopes in the Mediterranean sea : some profiles in the low Tyrrhenian basin. *Boll. Geof. Teor. Appl. (in press)*.

ÖSTLUND (H.G.), 1969. — Expedition Odysseus '65 : tritium and radiocarbon in the Mediterranean and Black seas. *Technical Report*, Rosenstiel School of Marine and Atmospheric Science, University of Miami.