QUANTIFICATION OF THE LARGE SCALE SUBSURFACE CIRCULATION OF THE MEDITERRANEAN BY MEANS OF TRANSIENT TRACERS

by

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Extended Abstract

We use transient tracers, which are anthropogenic substances introduced via the atmosphere into the oceans over the last few decades to derive rate information for the Levantine Intermediate Water (LIW)- and Deep Water (DW)-circulation of the Mediterranean. Our principal data base are measurements of the tracers tritium, helium-3, freons and krypton-85 as well as of carbon-14, argon-39 and the common hydrografic parameters obtained from a cruise of FS "Meteor" in Nov. - Dec. 1978. All the principal basins except the Aegean Sea have been sampled. Several stations were occupied in the vicinity of the Sicilian sill. Additional measurements in the Western Mediterranean are available from previous cruises.

Tritium data in the Eastern Mediterranean DW (Fig.1) are evaluated by means of a box model calculation applying the time dependent tritium boundary condition at the sea surface. This yields a DW turnover time of about 200 years for the Eastern Mediterranean, which corresponds to a DW formation rate of

$$4.4 \cdot 10^{12} \frac{m^3}{year} \quad (0.14 \cdot 10^{6} \frac{m^3}{sec})$$

The DW of the Herodotus Basin is about 50 years older than the average DW of the Eastern Mediterranean. These figures are in accordance with Ar-39 (Weidmann, 1982) and C-14 measurements. He-3 data (Fig. 2) show a distinct maximum in the LIW-layer. Following the maxima in this layer along an east-west direction one finds in 1978 the He-3 concentrations to be highest in the Tyrrhenian Sea. We conclude that the LIW water found in the Tyrrhenian Sea in 1978 entered the LIW layer in the source areas in about 1964-1965, i.e. during the period of the highest tritium concentrations in surface water. This conclusion is supported by freon data for the Tyrrhenian Sea station.

The corresponding east-west spreading velocity of the LIW is about

$$\frac{2400 \text{ km}}{14 \text{ years}} = 0.5 \frac{\text{cm}}{\text{sec}} .$$

It is planned to study the overflow process in the Straits of Sicily in a way similar to that reported for the Strait of Gibraltar (Roether and Weiss 1975, Schlosser 1982). Our tracer data are intended to be used in a large-scale circulation model of the whole Mediterranean Sea.

LITERATURE

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Weidmann (U.), 1982. - Ar-39 und kr-85-Messungen an Ozeanproben und ihre Bedeutung bei der Untersuchnung von Zirkulation und Mischungsprozessen im Ozean. Dissertation, Bern

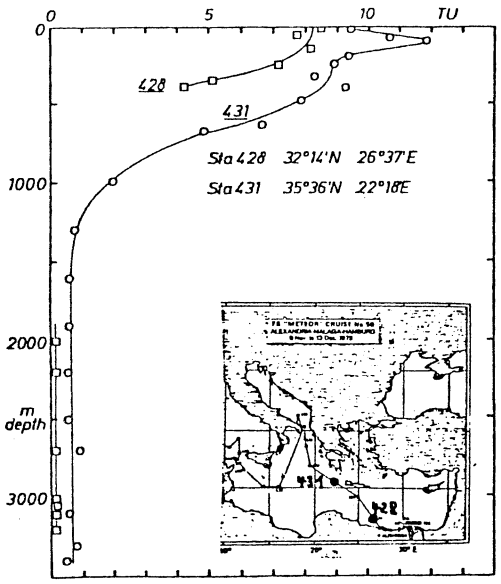

Fig. 1:Tritium concentration profiles in the Eastern Mediterranean;precision is ± 5% for surface water

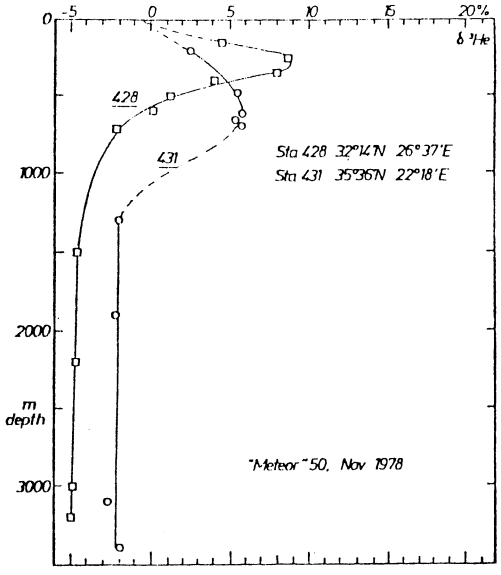

Fig.2: He-3/He-4 ratio relative to the air standard;precision is ± 3‰