Dissolved trace metals in Ligurian, Tyrrhenian, Ionian and East Atlantic deep-waters

Rifaat G.M. HANNA

Sydney Water Board, Scientific Services, WEST RYDE **(Australia)**

This work has been done during the 15th geochemical and geophysical Scientific Cruise (April-June 1984) aboard R/V*"AKADEMIK PETROVSKI"*, and the participation of the author within the IOC/UNESCO programme "X.4 - Ocean and its resources". A total of 78 surface and bottom water samples were collected from the open mid-eastern Atlantic Ocean (35°- 36°N and 12°-14°W), Ligurian, Tyrrhenian, Ionian and Maltese Seas (33°-44°N and 8°-28°E) with two stations in front of Genova and Monaco; Eight sampling stations from the Atlantic Ocean and twenty five stations from the Mediterranean Sea. The trace metals Cu, Zn, Pb, Cd, Ni, Co, Cr together with Mn, Fe, Li, Sr were determined in water samples.

Water samples were collected with pre-treated polycarbonate samplers. The sampling, processing and analysis were performed under strict clean conditions. The seawater samples were acidified with "suprapur" HNO_3 (1:1) and stored at 0°C in 0.5 - 2L acid-leached quartz bottles on board the ship, until measurement in onshore laboratories. No filtration of samples was performed because of the low amount of particles in open Mediterranean waters and due to the potential of contamination. A "Hitachi 180-70" double beam polarised Zeeman atomic absorption spectrophotometer was used to analyse the metals. All methods applied are described in detailed elsewhere (HANNA, 1985).

Details of the analytical results will be presented in the oral and/or the poster sessions at the congress, together with the exact location and the total depth of the sampling stations. This study showed that the concentration ($\mu g\ L^{-1}$) ranges and the grand averages from surface and bottom of all stations (together with ± standard deviation) were 0.08-0.05 (0.063 ± 0.1), 0.06-0.18 (0.086 ± 0.02) for Mn; .26-.45 (0.33 ± 0.6); .25 - 1.44 (.42 ± .12) for Fe; 0.11 - 0.14 (0.124 ± 0.01), 0.11 - .14 (0.124 ± 0.01) for Li; 3.7 - 4.8 (4.1 ± .2), 3.8 - 4.8 (4 ± .11) for Sr; 0.05 - 0.1 7 (0.093 ± 0.05), 0.05 - 0.1 7 (0.093 ± 0.05), 0.05 - 0.1 7 (0.11 ± 0.03) for Cu; 0.05 - 0.15 (0.08 ± 0.015), 0.04 - 0.11 (0.12 ± 0.06) for Zn; 0.3 - 0.6 (0.49 ± 0.1), 0.4 - 0.6 (0.5 ± 0.05) for Pb; 0.03 - 0.09 (0.075 ± 0.01), 0.07 - 0.1 (0.087± 0.01) for Cd; 0.26 - 0.36 (0.3 ± 0.02), 0.2 - 0.7 (0.36 ± 0.03) for Ni; 0.6 - 0.9 (0.76 ± 0.1), 0.6 - 0.9 (0.8 ± 0.04) for Co and 0.01 - 0.06 (0.06 ± 0.01), 0.04 - 0.1 (0.07 ± 0.01) for Cr (the values for surface and bottom respectively for each element).

The elements concentration of the open Mediterranean sea water samples are close to oceanic results gathered under similar conditions (except for Cd and Pb). These results indicate that a serious metal pollution problem does not exist in the open Mediterranean sea water so far at that time.

The elements Li, Sr, Pb, Co, Cr had bottom/surface ratio of the concentration values one and Mn, Fe, Zn, Ni had up to 1.4 values and Cu the only element which had a ratio of 1.9. This study show that the shap of the Mediterranean profiles differ from other findings in the open ocean (e.g. Pacific and Indian Oceans) by two main features. Firstly, no increase with depth, secondly, in average, much lower concentrations have been found in bottom waters of the Mediterranean than in Pacific or Indian Ocean bottom waters. (BOYLE *et al.*, 1975, 76; DANIELSSON, 1980; WESTERLUND OHMAN, 1991). I believe that these characteristics are mainly caused by the special hydrochemical conditions and biogeochemical processes prevailing in the Mediterranean Sea, (low nutrients and vertical mixing). These results indicate that little biological oxidation occurs in Mediterranean deep waters. Moreover, due to the low primary production, the processes of thermalhaline vertical convections (STOMMEL, 1972) and the relatively high turnover rate of the deep water do not allow enrichment comparable to those measured in Pacific waters. This assumption does not implicit that a biologically mediated transport from surface waters does not occur for these elements in Mediterranean. I suggest, and are supported by other authors (KREMLING & PETERSEN, 1981) and model calculations (TOPPING, 1974), that the overall analytical precision has to be much better than 5% to identify biologically mediated variations of trace metals in Mediterranean waters.

The overall mean concentrations of all elements determined in this study fit in very well with data reported by other authors (UNEP, 1985) for the world oceans. This supports the conclusions already made by BERNHARD (1978), KREMLING and PETERSEN (1981) that trace metal concentrations in seawater of the open Mediterranean do not seem to be much different from other oceans. I do hope that my data serve as a useful help for establishing the actual baseline concentrations in the Mediterranean sea environment.

Acknowledgments:

This work was supported by the IOC/UNESCO grant to the author to participate in the 15th Cruise of R/V *"AKADEMIK PETROVSKI"* and the visit to Moscow State University to undertake this work, Contract No. SC/RP 206076.5. Thanks are also due to professor U.K. BURLINE, Dr. U.N. GORSKY and Ms. T.G. SOKOVI of Moscow State University for their great help in the sampling and analysis of the samples.

REFERENCES

BERNHARD M., 1978.- Heavy Metals and chlorinated hydrocarbons in the Mediterranean. *Ocean Management* 3: pp. 253-313.

BOYLE E.A., SCLATER F.X. and EDMOND J.M., 1976.- On the Marine Geochemistry of Cd. *Nature*, 263: pp. 42-44.

BOYLE E.A., SCLATER F.X. and EDMOND J.M., 1977.- The Distribution of Dissolved Cu in the Pacific. *Earth Plan. Sci. Lett.* 37: pp. 38-54.

DANIELSSON L.G., 1980.- Cd, Co, Cu, Fe, Pb, Ni and Zn in Indian Ocean water. *Mar. Chem.* 8: pp. 199-215.

HANNA R.G.M., 1985.- Report on the 15th Scientific Cruise of R/V*"AKADEMIK PETROVSKI"* in the Mediterranean Sea, UNESCO, Paris, 12 p.

KREMLING K.X. and PETERSEN H., 1981.- The Distribution of Zn, Cd, Cu, Mn and Fe in waters of the open Mediterranean Sea. *Meteor Forsch.-Ergebnisse*, 23: pp. 5-14.

STOMMEL H., 1972.- Deep Winter-time Convection in the Western Mediterranean Sea. In: A.L. Gordon (Ed.), *Stud. Phys. Oceanogr. New York*, 2: pp. 207-218.

TOPPING G., 1974.- The movement of heavy metals in a marine ecosystem. *Int. Counc. Expl. Sea*, E31: pp. 1-7.

UNEP, 1985.- Report on the state of Pollution of the Mediterranean Sea. Athens: UNEP/IG. 56/Inf. 4.

WESTERLUND S.X. and OHMAN P., 1991.- Fe in the Water Column of Weddell Sea. *Mar. Chem.*, 35: pp. 199-217.