

Gas exchange at the air - sea interface in the Mediterranean Area

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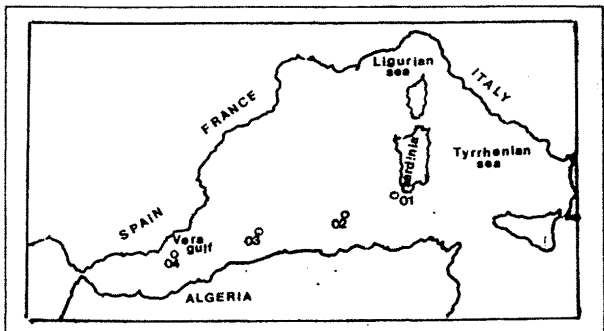
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To elucidate the mechanisms governing the air-sea fluxes of CO₂ under different meteorological conditions ENEA (Ente Nazionale per le Nuove Tecnologie, l'Energia e l'Ambiente), ENEL (Ente Nazionale per l'Energia Elettrica) and CISE (Centro Informazioni Studi Esperienze) have carried out an experimental study in the Western Mediterranean sea.

The study is to be considered as preliminary to a large study that ENEA, ENEL and CISE will carry out in the frame of the CEC MAST II Program, Mediterranean targeted project. The experimental activity was carried out on July-August 1991 during the cruise of the oceanographic R/V *Bannock* of the Italian National Research Council. The studied area was localized along the way between Sardinia Island (Italy) and Vera Gulf (Spain) (Fig.1).



Study area and sampling points

Gas exchange process was investigated by the radon deficiency method and by direct evaluation of the net CO₂ flux across the air-sea interface. The driving force for CO₂ gas transfer has been characterized in terms of the difference between the CO₂ partial pressure in the surface sea water and in the overlying atmosphere ($\Delta p\text{CO}_2$) (TAKAHASHI *et al.*, 1983).

CO₂ was determined by gaschromatography after sampling in air at 10 m above the sea surface. Inorganic carbon species were determined in water by pH and total alkalinity measurements (GRAN, 1952). In addition dissolved CO₂ in sea water was determined by gaschromatography after gas purging from water by means of CO₂-free air.

The gas exchange coefficients, expressed in terms of the piston velocity, estimated on the basis of the radon deficiency method were evaluated (BROECKER and PENG, 1974). The method and results of the piston velocity calculations based on the vertical distribution of ²²²Rn in the mixed layer are reported in another separated paper presented at this Congress (BONIFORTI *et al.*).

Meteorological parameters (air and water temperature, pressure, humidity, wind speed and direction etc.) sea water parameters (total alkalinity, pH, free dissolved CO₂) and air CO₂ concentrations were measured in order to provide data sets useful in developing and evaluating gas transfer models.

Moreover, a total number of 12 water samples were collected from the investigated area and analyzed for ¹⁴C. Radiocarbon analysis was performed by benzene synthesis method (TAMERS, 1975) and very low background liquid scintillation counting (LKB Wallac Qantulus 1220). The obtain data will be useful to estimate water masses mixing in the Western Mediterranean sea.

Field activity permitted to experiment on board large volume (200 l) water samplers and to evaluate CO₂ extraction efficiency from such large devices.

REFERENCES

- BONIFORTI R., DELFANTI R., MARTINOTTI W., PAPUCCI C., QUEIRAZZA G. and ROVERI M.- Determination of gas transfert coefficients in different environment of the Mediterranean sea using the radon deficit method.
- BROECKER W.S. and PENG T.H., 1974.- Gas exchange rates between air and sea. *Tellus* XXVI, 1-2, 21-35.
- GRAN G., 1952.- Determination of the equivalence point in potentiometric titration. II International Congress of Analytical Chemistry, 77, 661-671.
- TAKAHASHI T., CHIPMAN D. and SMETHIE W., 1983.- Technical report DOE/ER/60000-T1.
- TAMERS M.A., 1975.- Chemical yield estimation of the benzene synthesis for radiocarbon dating. *International Journal of Applied Radiation and Isotopes*, 26, 676-682.