Radioactivity levels in fish, shellfish, algae and seagrass collected from the Eastern Black Sea coast of Turkey, 1992

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Following the Chernobyl accident, radioactive contamination in the Black Sea environment of Turkey has been detected in fish, algae and shellfish (TOPCUOGLU *et al.*, 1988), (GUVEN *et al.*, 1990), (TUNCER and BAYSAL, 1990). In this study we report data obtained on radioactivity levels in fish, shellfish, algae and seagrass collected from the Eastern Black Sea coast of Turkey in 1992. For fish and shellfish, muscle and soft tissues, respectively, were sampled. The samples were dried, powdered and analyzed by a gamma spectrometer (Tennelec) coupled to a high purity Germanium detector.

The results are given in Table 1. Radioactivity was detected in all samples and varied with species and location. The measured levels of Cs-134, Cs-137 and K-40 ranged between 1-5, 5-21 and 600-3725 Bq/kg dry weight, respectively.

TABLE 1. Radioactivity levels in Selected Samples collected in 1992.

SAMPLES	Cs-134	Cs-137 (Bq/kg dry)	K-40
FISH			
Trachurus mediterraneus	1	5	605
Engraulis encrasicholus ponticus	4	13	900
Mugil saliens	2	11	653
Merlangus merlangius euxinus	4	12	965
Alosa fallax	1	7	1485
SHELLFISH			
Mytilus galloprovincialis	2	11	1840
Patella vulgata	4	10	893
Rapana thomasiana	2	9	600
ALGAE			
Ulva lactuca	5	19	2080
Enteromorpha sp.	3	13	2260
Cystoseria barbata	3	7	1130
SEAGRASS			
Zostera marina	5	21	3725

Comparison of the 1992 results with those of the our earlier study showed that the levels of radiocesium in fish, shellfish and algae have decreased considerably. For example the amounts of Cs-137 in *T. mediterraneus*, *M. saliens* and *M. galloprovincialis* were 47, 107 and 130 Bq/kg, respectively, in 1990 and only 5,11 and 11 Bq/kg in 1992. Also Cs-137 in *Enteromorpha sp.* and *C. barbata*, 35 and 27 Bq/kg in the earlier survey, had decreased to 13 and 7 Bq/kg. The highest concentrations of Cs-137 were found in *U. lactuca* and *Z. marina* while the lowest activity was detected in *T. mediterraneus* and *A. fallax*. It appears from our data that Chernobyl-derived radiocesium has diminished considerably in Turkish coastal waters during the period 1990-1992.

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Determination of gas transfer coefficients in different environments of the Mediterranean Sea using the radon deficit method

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Increasing levels of atmospheric carbon dioxide from the burning of fossil fuels and changes in land uses may result in significant climate changes in the next century. Comprehension of the mechanism governing the uptake of CO_2 in the ocean is crucial to assess the impact on climate of atmospheric CO_2 concentration changes. With regard to the evaluation of CO_2 transfer at the air-sea interface, some uncertainties over all still exist in the dependence of the gas transfer coefficients on meteoclimatic parameters.

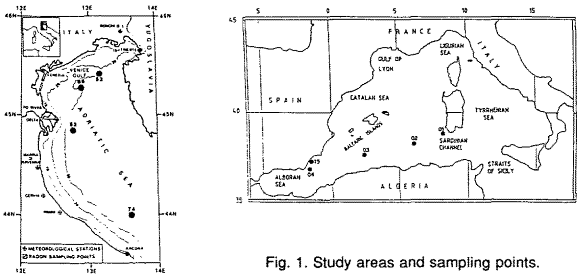

Fig. 1. Study areas and sampling points.

The disequilibrium between radon and its parent radium in the wind-mixed layer provide a widely used method for the direct calculation of the gas transfer coefficients (BROECKER and PENG, 1974). At present, a relevant number of estimations of gas exchange rates are available for the world oceans, but very few measurements have been carried out in the Mediterranean Sea.

This paper discusses the use of the radon deficit method for the calculation of gas transfer coefficients in two different Mediterranean environments: the shallow Northern Adriatic Sea and the deep Western Mediterranean between Southern Sardinia and the Gulf of Vera (Murcia, Spain) (Fig.1).

The radon deficit was estimated through the analysis of vertical profiles of radon and radium in and below the mixed layer. Five to eight samples were collected at every station. ^{222}Rn was stripped from seawater by helium carrier and adsorbed on an activated coconut charcoal cold trap. Radon was then eluted with toluene and measured directly onboard by liquid scintillation (QUEIRAZZA *et al.*, 1991). Radium analyses were performed on land on the same samples, after radon ingrowth, by the same method. The meteorological parameters were measured either onboard or by the Italian Air Force Meteorological Network in coastal stations close to the sampling points.

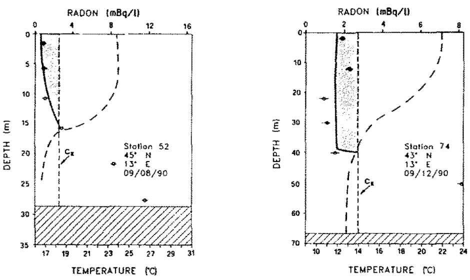

Fig.2 - Vertical profiles of ^{222}Rn (—) and temperature (---) at two stations in the Adriatic Sea. C_E=^{226}Ra concentration.

In Fig. 2 the vertical profiles of ^{222}Rn are shown for two stations in the Adriatic Sea. For this area, the calculated gas transfer coefficients range from 4 to 7 m.d-1 for wind speeds of 2-3 m.s-1. These data are in the range of those observed for other marine environments (PENG *et al.*, 1979). However, when considering the low wind speed during the period of sampling, these gas transfer coefficients appear higher than those resulting from laboratory experiments or other field surveys. Preliminary results obtained in the other study area (SW Mediterranean) in similar meteoclimatic conditions confirm that the gas transfer coefficients calculated for the Adriatic Sea are higher than those obtained for deep-sea environments. MURPHY *et al.* (1991) have shown that large differences are noted among experimental data obtained in different environments when gas transfer velocity is correlated for wind velocity. This difference is probably related to the fact that wind speed is not the best correlating parameter for gas transfer coefficients and that wave parameters have to be taken into account in order to make an accurate prediction of gas fluxes at the air-sea interface.

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