

# <sup>137</sup>Cs AS A TOOL FOR WATER MASSES DYNAMICS IN THE WESTERN MEDITERRANEAN SEA

Leonardo Torricelli , Roberta Delfanti \* and Carlo Papucci

ENEA Marine Environment Research Centre P.O. Box 224 I-19100 La Spezia, Italy - roberta.delfanti@santateresa.enea.it

## Abstract

<sup>137</sup>Cs measurements were conducted in the western Mediterranean Sea in order to examine the relationship between its distribution and water masses circulation. From the results this correlation is clearly evidenced. The minimum concentration in the Algero-Provençal basin seems to identify the horizontal and vertical extent of the Tyrrhenian Deep Water (TDW).

*Keywords : Radionuclides, Western Mediterranean, Hydrology.*

It is well known that <sup>137</sup>Cs is a useful long term radiotracer for water mass transport in the Mediterranean Sea [1]. Its major sources are fallout from nuclear weapon testing in the early 1960s and the Chernobyl accident in 1986 that produced a marked input in the Eastern Mediterranean, re-distributed in the water column and transferred to the Western Mediterranean in the intermediate waters flowing through the Sicily Straits [2]. This work presents the <sup>137</sup>Cs distribution in the water column in the western Mediterranean basin and discusses its relationships with convection processes and thermohaline circulation.

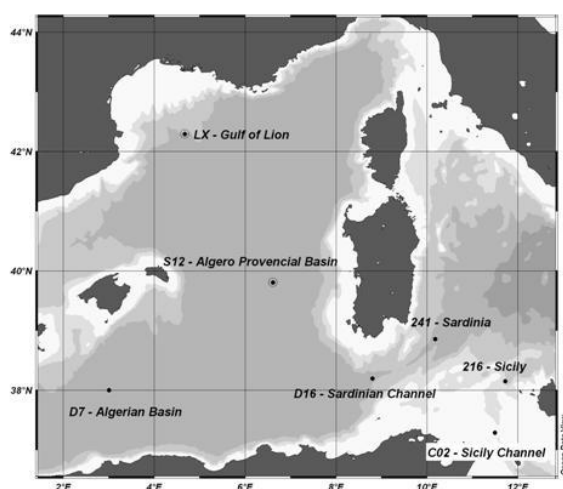


Fig. 1. Sampling stations in the western Mediterranean sea, May 2005.

Sea water samples were collected in seven station (Fig 1) during a sampling campaign in the western Mediterranean sea in May 2005. <sup>137</sup>Cs was pre-concentrated on board by AMP method and measured in laboratory by gamma spectrometry with high purity germanium detectors.

Figure 2 shows the vertical profiles of <sup>137</sup>Cs in the study area. A relative maximum is present in the salinity maximum of the LIW with concentration ranging from 3.3 mBq/l in the Sicily Straits (St.C02) to 1.7 mBq/l in the Gulf of Lions (St. LX). This decrease is due to the LIW mixing with adjacent water masses during its spread along the basin.

The <sup>137</sup>Cs profiles reach a minimum (1-1.5 mBq/l) at depths around 1000-2000 m. The concentrations in the minimum, furthermore, are lowest close to the Sardinian coast (St. 241) and increase farther to west. According to Rhein [3] the variation and range of water mass properties in this layer can be explained as a mixture between deep water from the Tyrrhenian (TDW) and the Western Mediterranean Deep Water (WMDW).

The deep water below 2000 m in the Algero-Provençal basin (St S12) and in the Algerian basin (St. D7) shows an increase in Cs Activity (2.1-2.4 mBq/l). This is a clear signal of the new WMDW formed by deep convection in the Gulf of Lions during the winter 2004-2005 [4] that rapidly spread to the central part of the western Mediterranean.

The <sup>137</sup>Cs distribution in the water column has a clear relationship with the water masses in all basins. In particular the minimum values at mid depth seem to be a tool to identify the horizontal and vertical extend of the

TDW in the Algero-Provençal basin.

The sigma - theta characteristic of the TDW, infact, do not allow one to detect its presence in the Algero-Provençal basin, because its features could also be a local mixing product [5].

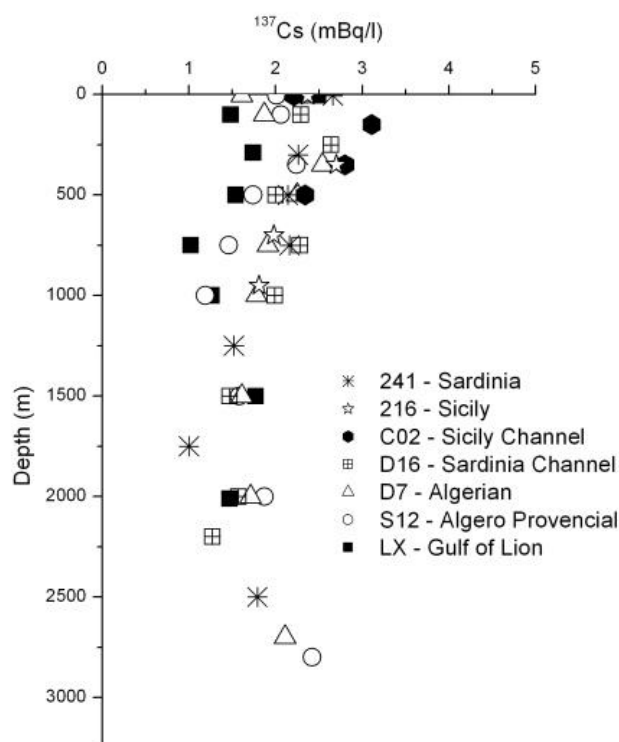


Fig. 2. <sup>137</sup>Cs vertical profiles in the seven stations

## References

- 1 - Sanchez-Cabeza J.A., Ortega M., Merino J. and Masque P., 2002. Long-term box modelling of Cs-137 in the Mediterranean Sea. *J. Marine Syst.* 33: 457-472.
- 2 - Papucci C. and Delfanti R., 1999. <sup>137</sup>Caesium distribution in the eastern Mediterranean Sea: recent changes and future trends. *Sci. Total Environ.*, 238: 67-75
- 3 - Rhein M., Send U., Klein B. and Krahnemann G., 1999. Interbasin deep water exchange in the western Mediterranean. *J. Geophys. Res.*, 104 (C10): 23495-23508.
- 4 - Schroeder K., Gasparini G. P., Tangherlini M. and Astraldi M., 2006. Deep and Intermediate Water in the Western Mediterranean under the influence of the Eastern Mediterranean Transient. *Geophys. Res. Lett.*, 33, L21607, doi:10.1029/2006GL027121.
- 5 - Astraldi M. and G. P. Gasparini, 1992. The seasonal characteristics of the circulation in the North Mediterranean basin and their relationship with the atmospheric-climatic conditions, *J. Geophys. Res.*, 97 (C6): 9531-9540.