Natural Gamma-emmiters in the Marine Environment Aegean and Ionian Sea - Greece

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The natural radioactivity regime in the Aegean and Ionian Sea (Greece) is summarised with respect to marine abiotic material and biota. The terrigenous actinides ^{238}U, ^{226}Ra, ^{232}Th, etc., as well as ^{40}K are considered as major contributors to the background gamma-radiation in the marine ecosystems, since artificial gamma-emitters comprise a minor fraction to the total mass of radionuclides in the Aegean and Ionian Sea (FLOROU *et al.*, 1990). The dispersion of the natural radioactivity in the different environmental materials examined is described as follows (see also Fig. 1):

Sea water
From the derived results it is noteworthy that ^{226}Ra presents elevated concentrations if compared with other Mediterranean regions (BOJANOVSKI *et al.*, 1982), while the activities of the actinides in sea water seem to follow the pattern $^{238}U > ^{228}Ra = ^{226}Ra > ^{228}Th \geq ^{232}Th$.

Sediment
The observed values in sediments from a wide network around the Greek peninsula and the Aegean Archipelagos vary greatly. The geological origin of the region considered has an apparent influence on the measured concentrations. Thus the areas of volcanic origin show elevated activities either of actinides and potassium-40. Concerning the actinides, the general pattern for sediments is $^{232}Th = ^{228}Ra > ^{238}U = ^{226}Ra$.

Algae
Algae in general show a selective bioaccumulation of ^{234}Th besides that of ^{40}K. The general pattern of activities concerning the three major groups is:

^{234}Th:	*brown algae 2 red algae >> green algae*
^{228}Th and ^{40}K:	*brown algae > red algae = green algae*

while the concentrations follow the trend $^{234}Th = ^{40}K >> ^{228}Th = ^{228}Ra$. The much higher concentrations of ^{234}Th compared with those of ^{223}Th can be explained by the build up of the supporting parent ^{238}U, which shows higher concentrations in sea water than either ^{228}Th and its precursor ^{228}Ra. In this case one must take into account the bioavailability of the different chemical forms of Th in sea water.

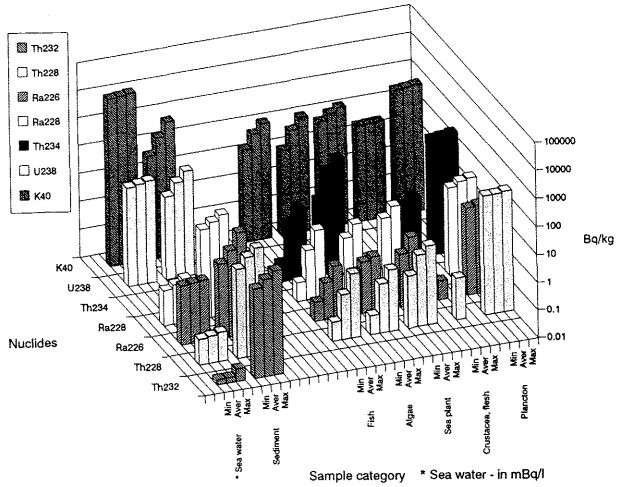
Sea plant
The distribution of the detected actinides in the various parts of *Posidonia oceanica* seems to follow the general pattern: *juuenile (leaves) = shoot > adult leaves*. Concerning the detected nuclides, ^{223}Ra and ^{223}Th show higher specific activities than ^{226}Ra. As the plant has a close relation with the sea bed, this can be explained by the pattern observed in sediments mentioned above, taking also into account the selective bioaccumulation of the more bioavailable chemical forms of the radionuclides considered.

Zooplancton
Thorium is selectively bioaccumulated by zooplankton as can be concluded not only from the higher concentrations of ^{234}Th and ^{228}Th in comparison with ^{226}Ra and ^{223}Ra, but also from the fact that the activity of ^{228}Th has not grown in from its precursor ^{228}Ra since it shows minor activities. Nevertheless, it is interesting that zooplancton shows higher concentrations of Th and Ra isotopes in general, if compared with algae, sea plant, benthic crustacea and fish.

Benthic crustacea
Benthic crustacea bioaccumulate the isotopes of Th in exoskeleton rather than in flesh where ^{40}K shows the higher concentrations. The concentrations of Ra are in the same range for both tissues. In comparison with the other taxa considered, the benthic crustacea measured show the highest concentrations of 40K and the lowest concentrations of the detected actinides.

Fish
Concerning the fish of different habitats one notes that pelagic fish show higher concentrations of Th than those in demersal species. Sediment also does not seem to affect the concentrations of actinides in the plaice (*Arnoglossus laterna*) which, by eating benthic organisms, ingests the sediment adhering to them.

Fig. 1.- Natural radioactivity in marine abiotic material and biota from Aegean and Ionian Sea (Greece). Results of ERL measurements during the period 1984-1990.



This study is based on the data derived from the monitoring program of the ERL in connection with the GIRMED activities.

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The Radiological Exposure of the EC Population from Radioactivity in the Mediterranean Sea Project MARINA-MED

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The Commission of the European Communities has started a project called MARINA-MED to study the radiological exposure of the population of the European community from radioactivity in Mediterranean waters.

At this aim a working party has been set up, firstly to prepare a review of the disposal of liquid radioactive effluents directly or indirectly into the Mediterranean sea, secondly to develop a more detailed model of dispersion in the Mediterranean sea based on the work carried out for project MARINA on North European waters, thirdly to evaluate the quantities, distribution and end-uses of marine products, and finally to assess the exposure of public.

To achieve these goals four subgroups have been established, covering respectively :
- sources of radioactivity in the Mediterranean sea;
- environmental measurements and critical group dose assessments;
- quantities and utilization of marine products;
- collective dose assessment.

The following sources of radioactivity will be taken into account :
- discharges from all civil nuclear sites up to the end of 1990 ;
- fallout from weapons testing ;
- natural radionuclides ;
- Chernobyl deposition.

Regarding environmental measurements all available monitoring data will be collected. These data will also serve top test the revised Mediterranean marine dispersion model.

As regard the survey of the quantities and utilization of marine products, consideration shall be given to where the products originate, where they go and what fraction is consumed in individual Member States. From these data an assessment of individual doses to critical groups of the population will be made.
Finally a collective dose assessment will be made for the Member States.

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