

Radioactivity Levels in Marine Algae from the Black Sea and Marmara Sea

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The accident at Tchernobyl nuclear power station on 26 April 1986 has been the subject of radionuclide contamination surveys in algae (Güven et al., 1990), fish, (Topcuoğlu et al., 1988) and sediments (Buesseler et al., 1987) of the Black Sea. In this work the algae were collected from the Turkish coasts of the Black Sea in 1989 and Marmara Sea during 1981-1989 and their gamma isotopic analysis was made using γ -ray spectrometry (Canberra, S 85). The gross beta radioactivities of the samples were also measured with a gas-flow proportional counter.

Table 1

| Algae | Location | date | Bq/g ⁻¹ , dry weight | | |
|----------------------------|-----------|------|---------------------------------|-------------------|-----------------|
| | | | ¹³⁴ Cs | ¹³⁷ Cs | ⁴⁰ K |
| <i>Cheetamorphe linum</i> | Şile | (1) | nd | 0.010±0.006 | 1.476±0.216 |
| <i>C. linum</i> | Sinop | (1) | nd | 0.011±0.005 | 2.525±0.268 |
| <i>Ulva rigida</i> | Şile | (1) | <0.005 | 0.011±0.006 | 0.749±0.210 |
| <i>U. rigida</i> | Amaş | (2) | nd | 0.006±0.003 | 0.541±0.228 |
| <i>U. rigida</i> | Araklı | (2) | nd | 0.007±0.004 | 0.537±0.230 |
| <i>U. lactuca</i> | Sinop | (1) | nd | 0.005 | 1.021±0.622 |
| <i>Cystoseira barbata</i> | İgneada | (1) | <0.005 | 0.015±0.009 | 0.901±0.175 |
| <i>C. barbata</i> | Beşikdüzü | (2) | <0.005 | 0.015±0.009 | 0.340±0.203 |
| <i>C. barbata</i> | Çayeli | (2) | nd | 0.015±0.007 | 0.430±0.126 |
| <i>C. barbata</i> | Sarp | (2) | nd | 0.007±0.003 | 1.579±1.379 |
| <i>Ceramium rubrum</i> | Şile | (1) | nd | 0.006±0.004 | 0.817±0.209 |
| <i>C. rubrum</i> | Sinop | (1) | nd | 0.012±0.007 | 0.906±0.301 |
| <i>Phyllophora nervosa</i> | Şile | (1) | nd | 0.009±0.005 | 0.597±0.149 |

Collection date: (1) Jun. 1989, (2) Jul. 1989, Counting date: Aug.-Dec. 1989, Feb. 1990

The ¹³⁷Cs levels found in the algae samples collected from regions of the Black Sea in 1989 are given in Table 1. As can be seen, ¹³⁷Cs was detected in some of the samples but ¹³⁴Cs was only detected in *Ulva rigida* and *Cystoseira barbata*.

Table 2

| Algae | Location | date | Radionuclide concentration Bq/g ⁻¹ , dry weight | | | |
|----------------------------|----------|---------------|--|-------------------|-------------------|-----------------|
| | | | ¹⁰⁶ Ru | ¹³⁴ Cs | ¹³⁷ Cs | ⁴⁰ K |
| <i>Ulva lactuca</i> | (1) | a) 25.9.1987 | <0.010 | <0.005 | 0.011±0.003 | 0.620±0.077 |
| | | b) 1.4.1988 | | | | |
| <i>Corallina granifera</i> | (2) | a) 10.10.1987 | <0.010 | nd | nd | 0.110±0.038 |
| | | b) 17.10.1988 | | | | |

Collection sites: (1) Çanakkale, (2) Gelibolu, a) Collection date, b) Counting date, nd: not detected.

Radioactivity in the algae collected from the region of the Marmara Sea is shown in Table 2. Of the algae collected from Çanakkale in 1987, ¹³⁴Cs and ¹³⁷Cs activities were detected in *Ulva lactuca*. ¹³⁷Cs alone was detected in *Cystoseira barbata*, *Padina pavonia* and *Ceramium rubrum* collected in 1989. ¹³⁷Cs was also found in *Codium fragile* collected from Çanakkale in 1983 and 1987, but not in 1989. ¹⁰⁶Ru activity was detected at the <0.010 level in *U. lactuca* and *Corallina granifera*. Total β -activities were found to be between 0.163-1.392 Bq/g.

In our earlier study of radionuclides in the algae of the Black Sea, it was found that contamination due to Tchernobyl was present and it gradually diminished until 1988 (Güven et al., 1990). Comparison of the results from the earlier work with those of the present study showed that radionuclide contamination of the algae diminished over time. The highest contamination appeared at İgneada, İnebolu-Sinop and Sarp on the coasts of the Black Sea.

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Radiocesium Levels in Algae, Shellfish and Sediment Samples collected from the Eastern Mediterranean Coast of Turkey

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Radioactive contamination from the Tchernobyl accident in the marine environment of Turkey has been detected in fish (Topcuoğlu et al., 1987), algae (Güven et al., 1990) and shellfish (Bulut et al., in press). In this study we report the data obtained on the radioactivity levels in algae, shellfish and sediments collected from eastern Mediterranean coasts of Turkey in 1989.

The algae samples were collected from Akkuyu, Yumurtalık, Botaş and Karataş. *Patella* sp. were collected in Akkuyu. The sediment samples were taken with a Beckman type dredge from approximately a 10 m depth in the Akkuyu area. The samples were dried and analysed by a β -ray Canberra S-85 4 K MCA spectrometer coupled to a high purity Germanium detector (Ortec GMX).

Table 1

| Sample | Location | | Bq/g ⁻¹ , dry weight | | |
|-----------------------------------|------------|-----|---------------------------------|-------------------|-----------------|
| | | | ¹³⁴ Cs | ¹³⁷ Cs | ⁴⁰ K |
| ALGAE | | | | | |
| <i>Cystoseira crinita</i> | Akkuyu | (1) | nd | nd | 1.198±0.169 |
| <i>C. fimbriata</i> | Akkuyu | (1) | nd | 0.0021±0.0018 | 0.879±0.174 |
| <i>Padina pavonia</i> | Akkuyu | (1) | nd | 0.0019±0.0018 | 0.701±0.125 |
| <i>Jania rubens</i> | Akkuyu | (1) | nd | 0.0024±0.0020 | 0.166±0.077 |
| <i>Halopteris</i> sp. | Akkuyu | (1) | nd | 0.0016±0.0015 | 0.471±0.116 |
| <i>Dictyota dichotoma</i> | Akkuyu | (1) | nd | 0.0022±0.0019 | 1.272±0.136 |
| <i>Cladostephus verticillatus</i> | Akkuyu | (1) | nd | nd | 0.967±0.237 |
| <i>Padina pavonia</i> | Yumurtalık | (2) | nd | nd | - |
| <i>Jania rubens</i> | Yumurtalık | (2) | nd | nd | - |
| <i>Sargassum hornshuchii</i> | Yumurtalık | (2) | nd | 0.0032±0.0026 | - |
| <i>S. hornshuchii</i> | Botaş | (2) | nd | nd | - |
| <i>S. hornshuchii</i> | Karataş | (2) | nd | nd | - |
| <i>S. linea</i> | Karataş | (2) | nd | 0.0025±0.0021 | - |
| SHELLFISH | | | | | |
| <i>Patella</i> sp. (soft part) | Akkuyu | (1) | nd | 0.0020±0.0018 | 0.061±0.006 |
| <i>Patella</i> sp. (shell) | Akkuyu | (1) | nd | 0.0019±0.0018 | 0.061±0.006 |
| SEDIMENT | | | | | |
| Sample 1 | Akkuyu | (1) | nd | 0.0025±0.0021 | 0.241±0.044 |
| Sample 2 | Akkuyu | (1) | nd | 0.0020±0.0017 | 0.290±0.145 |

(1) Collection date July 1989, Counted date Sept. 1989

(2) Collection date June 1989, Counted date Feb. 1990

nd: not detected

The results are given in Table 1. They indicate that ¹³⁴Cs activity was not detected. ¹³⁷Cs was found in the sampler in varying amounts, i.e. in very low or non-detectable levels.

Comparison of the results with those of the earlier study showed that the amounts of ¹³⁷Cs in *Cystoseira fimbriata* and *Jania rubens* were 0.0047 and 0.0039 Bq/g respectively in 1984 but diminished to 0.0021 and 0.0024 Bq/g. At the same time, the amounts of ¹³⁷Cs in sediments collected from Akkuyu were negligible in 1984 and 1989 (Çaem, 1986). On the other hand, the ¹³⁷Cs activity levels are also in the same range in Antalya sediments collected in 1986 before and after Tchernobyl accident (unpublished data).

These results indicate that the effect of the Tchernobyl accident was not apparent in the Mediterranean coasts of Turkey.

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