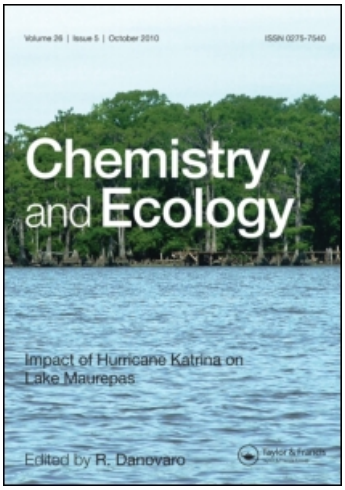

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Preliminary Caesium Data From A Cooperative Us/Ussr Monitoring Survey for Chernobyl Radioactivity in the Black Sea

William R. Curtis[a]; Jon A. Broadway[b]
[a] US Environmental Protection Agency, Office of Radiation Programs, Washington, D.C. [b] National Air and Radiation Environmental Laboratory, US Environmental Protection Agency, Montgomery, Alabama

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PRELIMINARY CAESIUM DATA FROM A COOPERATIVE US/USSR MONITORING SURVEY FOR CHERNOBYL RADIOACTIVITY IN THE BLACK SEA

WILLIAM R. CURTIS* and JON A. BROADWAY**

**US Environmental Protection Agency, Office of Radiation Programs, Washington, D.C. 20460, **US Environmental Protection Agency, National Air and Radiation Environmental Laboratory, Montgomery, Alabama 36115*

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In June 1990, scientists from the US Environmental Protection Agency's (EPA) Office of Radiation Programs (ORP), and the Woods Hole Oceanographic Institution (WHOI), travelled to Sevastopol in the Soviet Union to work with radioecologists and marine scientists from the USSR Institute of Biology of the Southern Seas (IBSS). The purpose of this cooperative programme was to conduct a monitoring survey for radioactivity in the northwestern Black Sea. Samples of sediment, surface and in-situ water, and biota were collected from fourteen stations for post-survey radionuclide analyses to determine levels of radioactivity in the Black Sea environment resulting from the Chernobyl nuclear power plant explosion and subsequent transport of radioactivity via the Dnepr and Danube rivers. This paper presents the preliminary data for caesium-137 and caesium-134 in sediment samples analyzed by the EPA/ORP. Caesium-137 was measured at four shallow (20–114 m) stations on the shelf near the mouth of the Dnepr and Danube Rivers, but was not detected in sediments from comparable depths at stations further off shore or in slope sediments at depths of 510–1288 meters. Caesium-134 was detected only in sediments from the shallow-water station nearest to the Danube River.

KEY WORDS: Chernobyl, caesium-134/137, sediments, Black Sea

INTRODUCTION

The US Environmental Protection Agency's (EPA) Office of Radiation Programs (ORP) is responsible for implementing and conducting radiation protection activities within the United States, and also provides assistance to other countries in developing emergency response and site remediation procedures. These activities include, among others: providing guidance on protective actions needed in response to nuclear accidents; measuring environmental radiation levels; and, evaluating and assessing the impact of radiation on public health.

On April 26, 1986, an explosion occurred at the Chernobyl nuclear power plant, resulting in the release of approximately 50 megacuries (MCi) of radioactivity into the environment. The estimated percentages of various radionuclides (including the longer-lived isotopes of caesium, strontium and plutonium) released from the total inventory in the reactor are shown in Table 1 (US Nuclear Regulatory Commission, 1987). The released radionuclides were widely distributed by air currents over the Soviet Union and eastern European countries (United Nations, 1988).

In response to the Chernobyl accident, the EPA/ORP conducted numerous activities to assist the international community in determining the levels of radioactive fallout, and the potential for adverse effects to mankind and the environment. In addition, the EPA/ORP initiated contacts with the Soviet Institute

Table 1 Chernobyl radionuclides released

Nuclide	*1/2-Life (days or years)*	*Estimated release (%)*	*Estimated release (MCi)**	*Estimated release (Bq)*
Np-239	2.35 d	3.0	0.102	3.78×10^{15}
Mo-99	2.8 d	2.3	2.99	1.11×10^{17}
Te-132	3.25 d	15.0	1.29	4.78×10^{16}
Xe-133	5.27 d	100.0	46.0	1.7×10^{18}
I-131	8.05 d	20.0	7.0	2.59×10^{17}
Ba-140	12.8 d	5.6	4.368	1.62×10^{17}
Ce-141	32.5 d	2.3	2.737	1.01×10^{17}
Ru-103	39.5	2.9	3.219	1.19×10^{17}
Sr-89	53.0 d	4.0	2.16	$8. \times 10^{16}$
Zr-95	65.5 d	3.2	3.808	1.41×10^{17}
Cm-242	164.0 d	3.0	0.021	7.78×10^{14}
Ce-144	284.0 d	2.8	2.408	8.92×10^{16}
Ru-106	368.0 d	2.9	1.566	5.8×10^{16}
Cs-134	2.05 y	10.0	0.51	1.89×10^{16}
Kr-85	10.77 y	100.0	0.89	3.3×10^{16}
Pu-241	13.15 y	3.0	0.138	5.11×10^{15}
Sr-90	27.95 y	4.0	0.216	$8. \times 10^{15}$
Cs-137	30.14 y	13.0	1.014	3.76×10^{16}
Pu-238	86.30 y	3.0	0.00081	$3. \times 10^{13}$
Pu-240	6,575.34 y	3.0	0.00096	3.56×10^{13}
Pu-239	24,383,56 y	3.0	0.00069	2.56×10^{13}

* Decay corrected to May 6, 1986
Source: US Nuclear Regulatory Commission (NRC), 1987, Table 6.1
Note: This is a modified version of NRC Table 6.1. The data are presented here for general information only. The data for caesium-134 and caesium-137 are highlighted. The reader may wish to compare the caesium data in this Table with the data in Tables 3 and 4.

of Biology of the Southern Seas (IBSS) and proposed a cooperative study to determine the levels of Chernobyl radioactivity in the Black Sea due to transport by the Dnepr and Danube River systems and deposition by fallout. The relative proximity (approximately 380 miles/480 km, see Figure 1) of the Black Sea to Chernobyl provided a unique opportunity to study the effects from a radiation accident upon a marine ecosystem. Information obtained from this study would be directly applicable to EPA/ORP responsibilities in the event of a similar nuclear accident occurring in the United States. A proposal for a cooperative study between EPA/ORP and the IBSS, entitled "*Transport, Partitioning, and Effects of Radioactivity Releases in a Marine Ecosystem*" was submitted to and subsequently approved by the US-USSR Joint Committee for Cooperation in the Field of Environmental Protection. In January 1990, a three-year cooperative project was initiated. Activities for the first year included: cooperative bioeffects studies to identify suitable test organisms, and to develop standardized testing protocols for determining sublethal effects in aquatic organisms from radiation exposure; exchanging information to develop standard procedures for determining sorption distribution coefficients (K_d) in sediments in order to calculate potential sediment transport rates for radionuclides; a monitoring survey for Chernobyl radioactivity in the Black Sea; and intercalibration and intercomparison measurements of radioactivity in Black Sea sediment, water and biota samples.

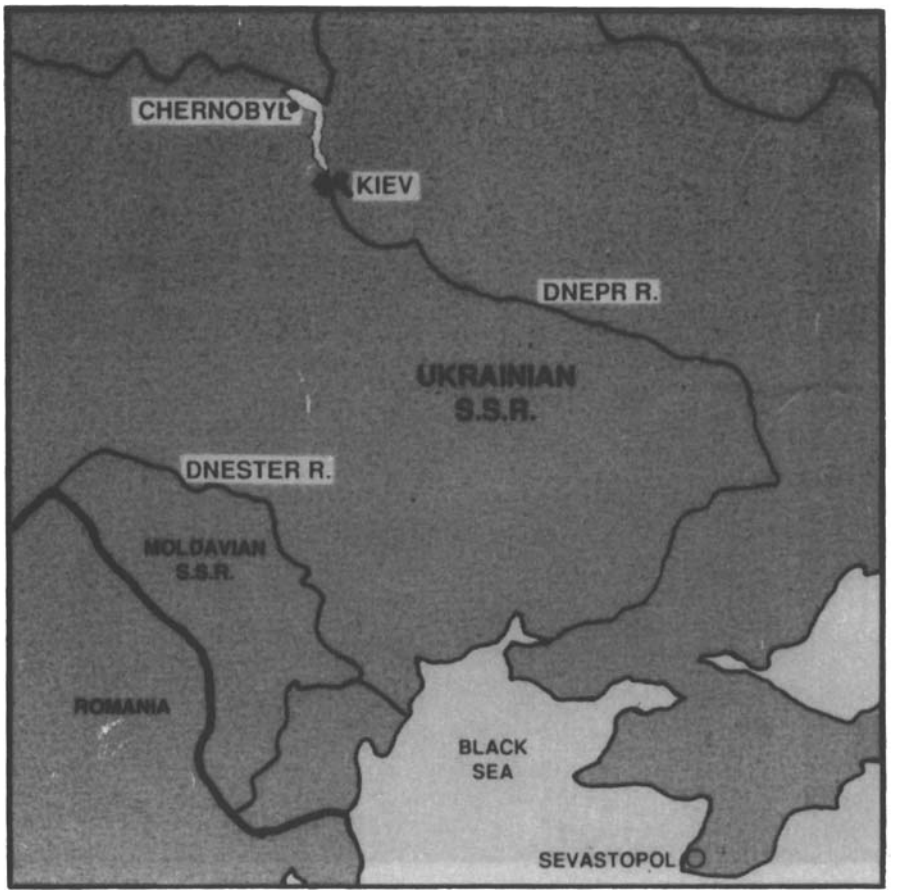

Figure 1 Proximity of Chernobyl to the Black Sea

BLACK SEA SURVEY

As stated previously, the Black Sea affords a unique opportunity to study radiation effects in a marine environment – not only because of its proximity to Chernobyl, but also because of its exposure to the radioactive fallout cloud that passed over the northwest portion of the Sea on May 1, 1986 (Buessler, 1987).

There were other important considerations for conducting a survey in the northwest Black Sea. First, Chernobyl is located on the Pripyat River, a major tributary of the Dnepr River which flows through the Ukraine and into the northwestern portion of the Black Sea. Secondly, the Danube River (which also drains into the northwestern Black Sea) flows through and between portions of Austria, Bulgaria, Cszechoslovakia, Hungary, and Romania. These countries were also subjected to radioactive fallout from the Chernobyl accident (United Nations, 1988) (Goldman and Anspaugh, 1987). In addition, the Woods Hole Oceanographic Institution had previously established a successful, cooperative working relationship with the IBSS in Sevastopol and had conducted monitoring activities in the Black Sea during 1987 and 1988. Buessler (1987) has reported on radioactive measurements

made in the central Black Sea. The WHOI/IBSS survey experience and the data obtained, would therefore be of value to the EPA/ORP during its cooperative survey with the IBSS in June 1990.

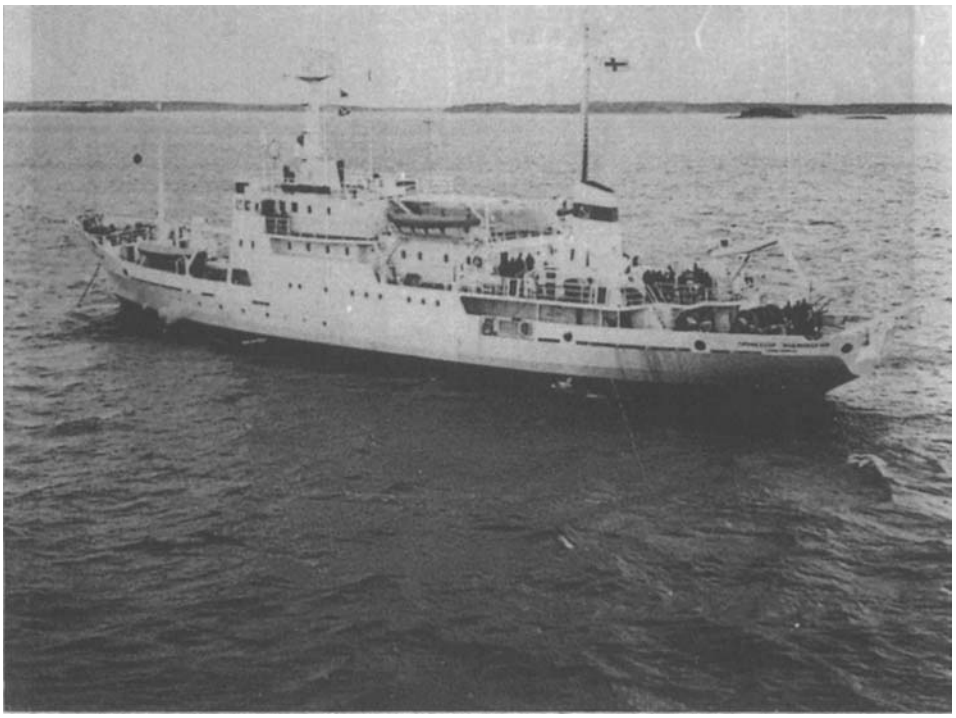

Figure 2 The R/V *Professor Vodyanitsky*

The cooperative survey was conducted from the well-equipped USSR survey vessel *R/V Professor Vodyanitsky* provided by the IBSS (Figure 2). Samples of water, sediment and biota were collected from fourteen stations in the northwestern Black Sea (Figure 3). Station coordinates, water depths, and the types of samples collected at each station are given in Table 2. The locations of the sampling stations were selected to compare concentrations of Chernobyl radioactivity in shallow and deeper waters that may have been transported to the Black Sea via the Dnepr and Danube Rivers. Participating scientists were from the IBSS in Sevastopol, the EPA/ORP in Washington, D.C., the EPA/ORP National Air and Radiation Environmental Laboratory (NAREL) in Montgomery, Alabama, and the WHOI Department of Chemistry in Woods Hole, Massachusetts.

Water sampling was conducted by WHOI to determine the concentrations and distributions of caesium-134, caesium-137 and strontium-90 in the water column near the region of major freshwater inflows in the northwestern Black Sea. These three radionuclides are being used as tracers of water circulation processes.

As shown in Table 2, water samples were collected at stations 2, 3, 4, 5, 6, 7, 8, and 9. Samples from shallow water (depths to 114 metres) stations were obtained by using a floating pump to pass surface water through caesium absorbers located on

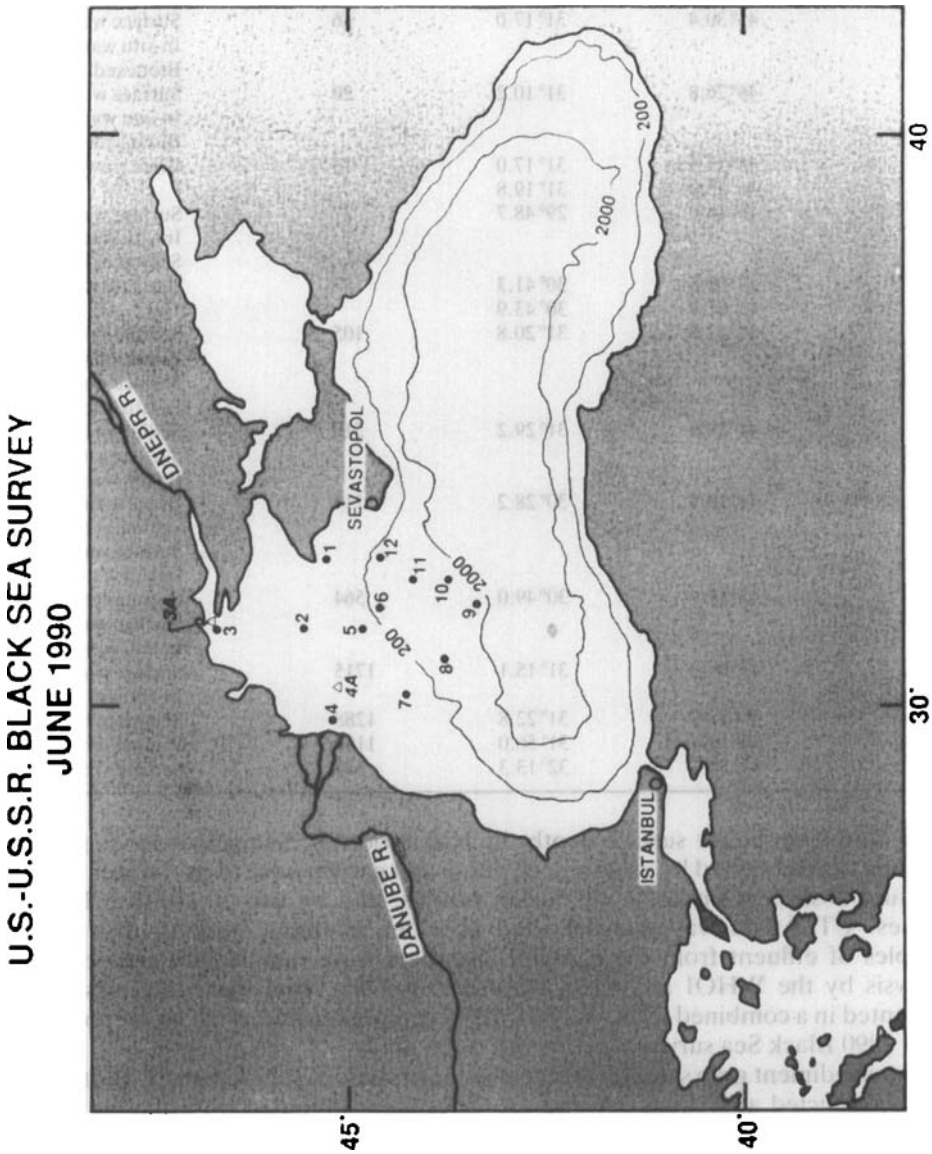

Figure 3 Sampling station locations, Black Sea survey

Table 2 Station locations/samples collected.

Station no.	*Latitude (N)*	*Longitude (E)*	*Water depth (m)*	*Type of sampling*
1	45° 12.0	32° 42.6	75	Biota/sediment grab
2	45° 30.4	31° 17.0	46	Surface water
				In-situ water
				Biota/sediment grab
3	46° 26.8	31° 10.2	20	Surface water
				In-situ water
				Biota/sediment grab
3A	46° 27.5	31° 17.0	15	Biota trawl
	46° 28.0	31° 19.8		" "
4	45° 14.0	29° 48.7	27	Surface water
				In-situ water
				Sediment boxcore
4A	45° 00.5	30° 41.3	53	Biota trawl
	45° 01.4	30° 43.9		" "
5	44° 42.5	31° 20.8	105	Sediment boxcore
				Biota/sediment grab
				Surface water
				In-situ water
6	44° 38.9	31° 29.2	510	Sediment boxcore
				Surface water
				In-situ water
7	44° 10.8	30° 28.2	114	Biota/sediment grab
				Sediment boxcore
				Surface water
				In-situ water
8	43° 57.9	30° 49.0	564	Sediment boxcore
				Surface water
				In-situ water
9	43° 40.0	31° 15.1	1715	Surface water
				In-situ water
10	43° 58.9	31° 22.8	1288	Sediment boxcore
11	44° 32.4	31° 56.0	1109	Sediment boxcore
12	44° 54.1	32° 13.3	335	Sediment boxcore

deck, and from below surface depths by Niskin bottles. Samples from deep water stations were obtained by using a deck pump and garden hose to pass water through caesium absorbers on deck, by Niskin bottles, and by use of 140-litre Bodman bottles. CTD data was also collected at water sampling stations. Twenty-litre samples of effluent from the caesium absorbers were retained for radiochemical analysis by the WHOI and IBSS laboratories. Data from these analyses will be presented in a combined EPA, WHOI, IBSS comprehensive, final data report of the June 1990 Black Sea survey.

Biota/sediment grab samples were collected at stations 1, 2, 3, 5 and 7. Biota trawls were conducted at stations 3A and 4A. Specimens obtained from the biota grabs included various small crustaceans, tunicates, polychaete worms, and molluscs (primarily mussels). The biota trawls yielded an abundance of *Sprattus* spp. fish, a few *Odontegadus* spp. fish, and four *Squalus* spp. sharks. A few polychaete and nematode worms were also collected in some of the shallow-water sediment boxcore samples. The biota samples are being analyzed for radionuclides by the EPA/ORP/NAREL and IBSS laboratories. Species identification of the biota samples is being accomplished by IBSS marine biologists.

Sediment samples were obtained from stations 4, 5, 6, 7, 8, 10, 11, and 12. These

station locations were chosen to determine the levels of Chernobyl radioactivity reaching the northwestern Black Sea via the Dnepr and Danube River systems. Also, during pre-survey planning, the sediment stations were approximately aligned (e.g. 3-2-5-9, 4-5-6-11, 4-7-8-9, and 12-11-10-9) to allow a comparison and evaluation of radionuclide transport from the shallower to deeper water environments.

Collection of Sediments

Sediments were ordinarily collected with a Gray O'Hare box corer (Figure 4) that had a 25 cm wide, 25 cm long, and 50 cm high sample box capacity. This easy-to-use, simplified coring device worked equally well in shallow and deeper waters, providing a relatively undisturbed sample when sediment consistency allowed for penetration as the corer hit the bottom. In these conditions, the size of sediment sample retrieved closely approximated the size of the sample box.

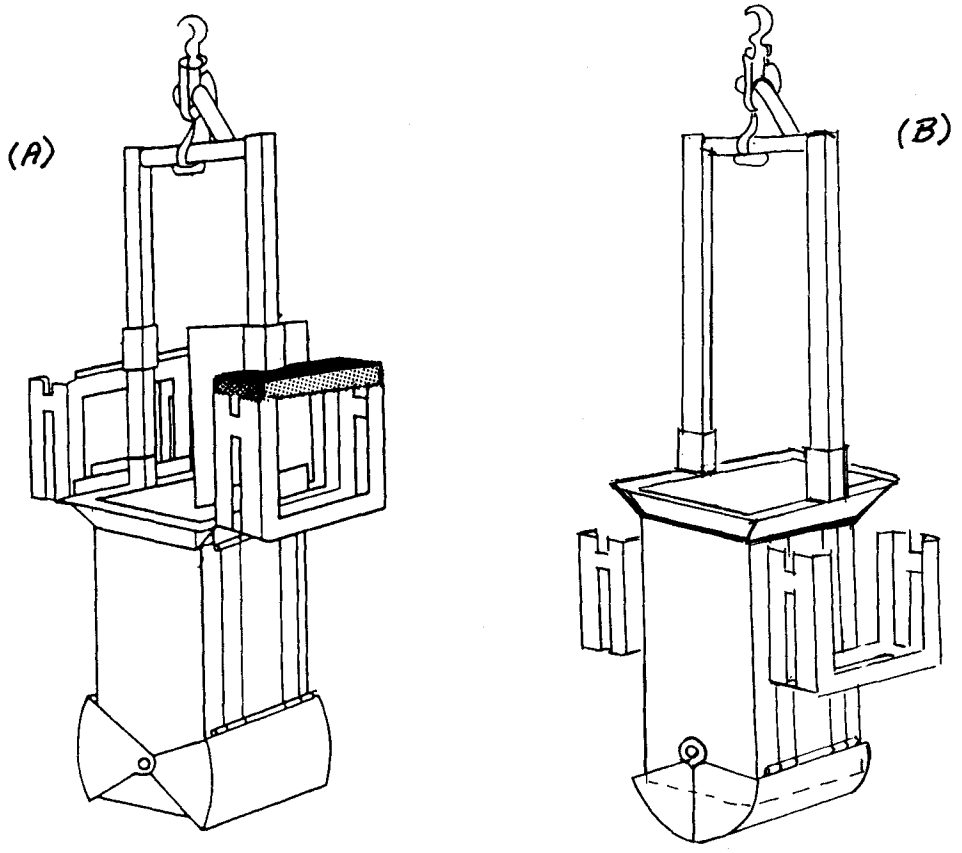

Figure 4 Gray O'Hare sediment box coring sampler (A) Open position (B) Closed position.

Attempts to use this corer at stations 2 and 3 were unsuccessful, however, due to the extremely high percentage of mussel shells on the bottom. At those locations, standard-type (Van Veen and/or Smith-McIntyre) "clam-dredge" grabs had to be deployed to obtain bottom samples.

Two boxcores were collected at the other sediment sampling stations and, upon retrieval, a total of eight subcores were obtained and sub-samples taken by intruding clear three or five-inch diameter plastic core liners into the top of the box corer. The five-inch diameter subcores were used to obtain samples for post-survey radionuclide analyses. The three-inch diameter subcores were for other measurements and analyses. At each sediment sampling station (where a relatively undisturbed boxcore sediment sampled had been obtained), a total of eight subcores were obtained. The eight subcores were designated for analysis as follows: one for on board ship measurement of Eh and pH; one for grain size distribution and mineral composition analyses by EPA/ORP and the US Army Corps of Engineers (COE); two for K_d determinations by the US Department of Energy's (DOE) Brookhaven National Laboratory (BNL); one for heavy metals by the EPA Environmental Research Laboratory in Athens, Georgia (ERL-A); and three for radionuclides by EPA/ORP/NAREL, WHOI, and IBSS laboratories. Preliminary results for the analyses of subcores by DOE/BNL, and by EPA/ERL-A are given in Fuhrmann et al. (1991) and Neiheisel et al. (1992).

Each subcore was capped before its removal from the Gray O'Hare corer, and then washed, labelled, sealed with waterproof tape and stored upright for subsequent on board or post-survey analysis. Additionally, the subcores designated for K_d analysis were stored upright in the ship's freezer immediately after collection, capping and labelling. The K_d subcores were also carried back to the US frozen, in containers filled with dry ice. The dry ice was refurbished every few hours during the return trip, to ensure that the subcores remained solidly frozen until reaching the DOE/BNL in New York. The subcores obtained for grain size, mineral composition and heavy metals analyses remained upright and intact while stored during the survey and subsequent transport to the specific analytical laboratories. The five-inch diameter subcores to be analyzed for radioactivity were carefully segmented into either one centimetre (0-1, 1-2, 2-3, 3-4, 4-5) or five centimetre (5-10, 10-15) layers within approximately one-hour after collection. The segmented samples from these five-inch subcores were then stored in appropriately labelled containers for transport after the survey.

The data presented in the following section of this paper are the result of EPA/NAREL gamma spectroscopy analysis of Black Sea sediment samples for caesium-137 and caesium-134. Sample preparation procedures, counting equipment and procedures used, minimal detectable levels, and quality assurance procedures are detailed in the EPA/NAREL Radiochemistry Procedures Manual (EPA, 1984).

PRELIMINARY RADIOANALYTICAL DATA

Tables 3 and 4 show the data for caesium-137 and -134 in sediment samples collected during the June 1990 Black Sea survey. Sample sizes, counting times, and counting dates are also provided. All reported activities were corrected to 6 May 1986. Samples were analyzed by gamma spectroscopy, using Nuclear Data multichannel analyzers connected to lithium-drifted germanium detectors.

The relatively undisturbed sediment subcores from stations 4-8 and 10-12 were

Table 3 Caesium-137 in sediment subcores, Black Sea survey.

Station number	*Subcore segment (cm)*	*Sample size (g dry)*	*Counting date*	*Activity (pCi/g dry)*	*Activity (Bq)*	*2-Sigma error (%)*
3	Sample # 1	508.0	12/14/90	0.11	0.004	±10
Grab	Sample # 2	458.0	12/14/90	0.05	0.002	±41
	Sample # 3	458.0	12/16/90	0.05	0.002	±41
4	0–1	15.1	12/17/90	7.21	0.267	±4
Subcore	1–2	31.0	12/17/90	8.97	0.332	±2
	1–2*	31.0	12/18/90	8.74	0.324	±4
	2–3	31.1	12/17/90	9.40	0.348	±3
	3–4	37.2	12/17/90	4.87	0.180	±3
	4–5	34.7	12/17/90	2.41	0.089	±5
	5–10	310.0	8/25/90	1.34	0.050	±3
	10–15	300.0	8/16/90	0.94	0.035	±6
5 Grab	Sample # 1	403.0	12/14/90	0.07	0.003	± 27
5	0–1	28.7	12/17/90	1.01	0.037	±10
Subcore	1–2	27.5	12/16/90	1.07	0.040	±9
	2–3	33.4	12/16/90	0.68	0.025	±17
	3–4	38.9	12/16/90	0.29	0.011	±19
	4–5	33.7	12/14/90	0.23	0.009	±23
	4–5	33.7	12/14/90	0.23	0.009	±23
	5–10	277.0	8/23/90	ND		
	10–15	227.0	8/25/90	ND		
7	0–1	28.8	12/17/90	1.20	0.044	±9
Subcore	1–2	29.6	12/18/90	0.90	0.033	±12
	2–3	28.6	12/18/90	0.44	0.016	±16
	3–4	28.2	12/18/90	0.20	0.007	±43
	4–5	24.4	12/18/90	0.12	0.004	±48
	5–10	224.0	8/26/90	0.07	0.003	±43
	10–15	243.0	8/26/90	ND		
Kiev	Moss sample	95.0	8/10/90	602.1	22.3	±1

Notes: ND = Non Detectable. MDL at NAREL for caesium is 0.025 pCig^{-1} or 0.0009 Bq.
Decay corrected to 6 May 1986. All sample counting times = 1000 minutes.
Cs-137 not detected in any subcore segments from stations 1, 2, 6, 8, 10, 11 or 12.
*Duplicate analysis for the 1–2 cm segment of station 4.
Grab = disturbed sample; subcore = undisturbed sample.

Table 4 Caesium-134 activity in sediment subcores, Black Sea survey.

Station number	*Subcore segment (cm)*	*Sample size (g dry)*	*Counting date*	*Activity (pCi/g dry)*	*Activity (Bq)*	*2-Sigma error (%)*
4	0–1	15.1	12/17/90	ND		
Subcore	1–2	31.0	12/17/90	2.74	0.101	±19
	1–2*	31.0	12/18/90	2.84	0.105	±21
	2–3	31.1	12/17/90	3.45	0.128	±13
	3–4	37.2	12/17/90	1.11	0.041	±23
	4–5	34.7	12/17/90	ND		
	5–10	310.0	8/25/90	ND		
	10–15	300.0	8/16/90	ND		
Kiev	Moss Sample	95.0	8/10/90	285.8	10.585	±1

Notes: ND = Non Detectable
MDL at NAREL for caesium is 0.025 pCi g^{-1} or 0.0009 Bq.
Caesium-134 not detected in any subcore segments or grab samples from stations 1, 2, 3, 5, 6, 7, 8, 10, 11 or 12.
All sample counting times = 1000 minutes.
*Duplicate samples were analyzed for the 1–2 cm. segment.

analyzed in 1 cm segments from the surface to a depth of 5 cm, and in 5 to 10 and 10 to 15 cm increments. For stations 1–3, and 5, where the sample obtained was disturbed, analyses were performed on an aliquot of the total sample.

Cs-137 was detected in grab samples from stations 3 and 5, and in subcores from stations 4, 5 and 7. Cs-134 was detected in the subcore from station 4 only. Neither Cs-137 nor -134 was detected in any of the sediment samples collected from stations 1, 2, 6, 8, 10, 11 or 12. The minimum detectable level (MDL) for both caesium isotopes at NAREl is 0.025 pCi g^{-1} (0.0009 Bq).

Where Cs-137 activity was detectable, it is reported in Table 3 by station number and increment range for undisturbed subcore samples, and by station number only for the disturbed samples. Table 4 contains the data for detectable caesium-134 activity. Decay-corrected Cs-137 and -134 activity from a moss sample collected at the edge of the Kiev water reservoir in early June 1990 is included in Tables 3 and 4 for comparison with caesium measured in Black Sea sediment samples. Complete results of radiochemistry analyses for specific radionuclides conducted by NAREL, and all WHOI and IBSS analytical data will be included in a subsequent report.

Table 5 provides a comparison of caesium-137 activity in the Black Sea samples with caesium-137 activity measured in sediment samples from other marine environments. The data from locations other than the Black Sea were obtained from monitoring surveys for radioactivity (see references in the Table) at previously-used US ocean disposal sites for packaged (containerized) low-level radioactive waste (LLW) materials. These data are for radionuclides in marine sediments near waste containers, disposed in deeper waters many years ago, and are provided for information and comparison purposes only. In contrast, the Black Sea data represent caesium distributed from the Dnepr and Danube River Basins and atmospheric fallout from the Chernobyl accident into comparatively shallow marine waters.

Table 5 Activity of caesium-137 in Black Sea sediments compared with caesium-137 detected in sediments from other marine monitoring surveys.

Location	*Reference*	*Activity range (pCi/g dry)*	*Activity range (Bq)*
Massachusetts Bay LLW Disposal Site	Curtis and Mardis, 1984	0.03 to 0.12	0.001 to 0.004
Atlantic 2880 m LLW Disposal Site	Dyer, 1976	< 0.1 to 4.8	< 0.004 to 0.178
Farallon Islands 900 m LLW Disposal Site	Dyer, 1976	0.0 to 0.11	0.0 to 0.004
Frallon Islands 1700 m LLW Disposal Site	Noshkin *et al.*, 1978	0.009 to 0.137	0.0003 to 0.005
Black Sea (Subcores from Stations 4, 5, 7)	This Paper	0.07 to 9.40	0.003 to 0.348

Notes: Activity reported is for upper 15 cm segments of sediment cores only.

DISCUSSION

As reported in Table 3, detectable levels of caesium-137 were observed in the sediment subcores and grab samples from stations 3, 4, 5, and 7. Caesium-134 activity was detected only in the sediment samples collected from station 4. The

sediment samples from stations 3 and 4 were collected in shallow water (20 and 27 metres depth, respectively) near the Dnepr and Danube Rivers. Samples from stations 5 and 7 were obtained further offshore on the Black Sea shelf, and in deeper water (105 and 114 metres depth, respectively).

The highest levels of activity for caesium-137 (9.40 pCi g^{-1}) (0.348 Bq) and caesium-134 (3.45 pCi g^{-1}) (0.128 Bq) were observed in the upper segments (layers) of the subcore samples from station 4. From these highest activity levels at station 4, the level of caesium-137 decreases easterly to a maximum of 1.07 pCi g^{-1} (0.40 Bq) at station 5. The caesium-137 activity also decreases in a southerly direction from station 4 to a maximum of 1.20 pCi g^{-1} (0.044 Bq) at station 7. The levels of activity for both caesium-137 and caesium-134 decrease with depth in each of the subcores obtained from stations 4, 5 and 7.

The highest ratio of caesium-134 to caesium-137 observed in the 2–3 cm segment of the subcore from station 4 is 0.37. That ratio is only slightly reduced from the 0.47 ratio observed for caesium isotopes in the green moss samples collected from the Kiev reservoir (see Tables 3 and 4), and the 0.5 ratio for Chernobyl caesium reported by Buessler (Buessler *et al.*, 1991).

CONCLUSIONS

The caesium-137, -134 analytical results presented in this report are preliminary data only. Considerable speculation can be made as to how much of the caesium measured in the Black Sea is a result of the Chernobyl accident, and subsequent transportation of nuclides through environmental pathways. As the data in this report suggests, and as would be expected, elevated levels of what is apparently Chernobyl caesium are observed in the upper three to four centimetres of coastal Black Sea sediment samples. The data in this paper alone will not provide a definitive answer; additional data and analyses are needed. The EPA/ORP is continuing its work to identify Chernobyl radionuclides in the environment, and to assess environmental impacts. Future studies will attempt to trace caesium-137 and -134, and other nuclides from the reactor to the Black Sea by making measurements in the Kiev Reservoir, the Dnepr and Danube Rivers, and at additional locations in the Black Sea itself. Data from these monitoring studies will be provided in subsequent reports provided jointly by the EPA/ORP, the IBSS and the WHOI.

Previous post-Chernobyl monitoring studies in the Black Sea, as described in Buessler (1987) and Buessler *et al.* (1991) focused primarily on identifying radionuclides in the water column and measuring their levels of activity. The June 1990 cooperative study, described briefly in this paper, provided the first comprehensive focus on measuring Chernobyl radioactivity in all components of the Black Sea environment – including biota, sediments and water. In Buessler and Livingston (1991) it is noted that the preliminary analytical data from the 1990 survey suggest that approximately two-thirds of the total caesium-137 observed in the sediments originated from Chernobyl. The sediments and biota of the northwest Black Sea shelf environment are, however, subject to severe industrial waste deposition and contamination from the Danube and Dnepr River systems. To assess Chernobyl's impact accurately on this environment, periodic and well-designed monitoring surveys should continue to acquire meaningful data.

In this respect, a source already exists for such information. The IBSS has for years conducted an extensive monitoring programme for various pollutants in the Black

Sea to assess environmental conditions and has a broad-based data bank of environmental pollution information. Thus, the EPA/ORP intends to continue studies with IBSS to: examine the pre- and post-Chernobyl database; to acquire additional Black Sea data as needed; monitor the Kiev Reservoir, the Dnepr and Danube Rivers, also as needed; and to apply the existing or acquired data to appropriate radionuclide transport and risk assessment models. The overall EPA/ORP purpose in conducting these studies is to provide the information needed for emergency response to any future nuclear accident scenarios.

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