MASTER

RADIOELEMENT STUDIES
IN THE OCEANS

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I. Bibliographic Summary - 1978

A. Reports that have been published since the last progress report:

- C00-3563-51; C00-3568-15: Bowen, V. T., 1978. Natural matrix standards. In Environment International 1: 35-39 (Pergamon Press).
- C00-3563-57: Blakemore, R. P., 1978. Effects of polychlorinated biphenyls on macromolecular synthesis by a heterotrophic marine bacterium. Applied and Environmental Microbiology 35(2): 329-336.
- C00-3563-59: Schwarzenbach, R. P. and N. S. Fisher, 1978. Rapid determination of the molecular weight distribution of total cellular fatty acids using chemical ionization mass spectrometry. J. Lipid Res. 19(1): 12-17.
- C00-3563-60: Blakemore, R. P. and C. E. Carey, 1978. Effects of polychlorinated biphenyls on macromolecular synthesis by a heterotrophic marine bacterium. Applied and Environmental Microbiology 35(2): 323-328.
- C00-3563-61; C00-2379-16: Carey, A. E. and B. W. Schroeder, 1978. Rapid sampling culture chamber. Applied and Environmental Microbiology 35(5): 976-977.
- C00-3563-64: Carey, A. E. and G. R. Harvey, 1978. Metabolism of polychlorinated biphenyls by marine bacteria. Bull. Environm. Contam. Toxicol. 20: 527-534.
- C00-3563-66: Fisher, N. S. and R. P. Schwarzenbach, 1978. Fatty acid dynamics in Thalassiosira pseudonana (bacillariophyceae): implications for physiological ecology. J. Phycol. 14(2): 143-150.
- C00-3563-69: Gavini, M. B., 1978. Radionuclide ratios in wet and dry deposition. Samples from June 1976 through December 1977. Earth and Planetary Science Letters 41: 228-232.
- C00-3563-75: Livingston, H. D., V. T. Bowen and J. C. Burke, 1977. Fallout radionuclides in Mediterranean sediments. Rapp. Comm. int. Mer Medit. 24(3): 37-40. (Formerly Report C00-3563-50).

C00-3563-77; C00-3568-20: Hardy, E. P., H. D. Livingston, J. C. Burke and H. L. Volchok, 1978. Time pattern of off-site plutonium contamination from Rocky Flats Plant by lake sediments analyses. USDOE Environmental Quarterly Report EML-342, pp. I-123 through I-146.

~~Six reprint copies of each of the above are attached to the Progress Report.~~

B. The following reports have been submitted for publication or are in press, xerox copies of each are attached:

C00-3563-47; C00-2379-10: Livingston, H. D. and V. T. Bowen. Pu and ^{137}Cs in coastal sediments. Earth and Planetary Science Letters. (In press).

C00-3563-72: Kupferman, S. L. and H. D. Livingston. A procedure for independently estimating blanks and uncertainties for measured values of ^{90}Sr and ^{137}Cs concentrations in the Atlantic Ocean. J. Marine Research (In press).

C00-3563-74: Kupferman, S. L., H. D. Livingston and V. T. Bowen. A mass balance for ^{137}Cs and ^{90}Sr in the North Atlantic Ocean. J. Marine Research (In press).

C00-3563-68; C00-2379-15: Kupferman, S. L., V. T. Bowen, H. D. Livingston and A. Aarkrog. Radioactive effluent from Windscale as a perturbation of the fallout tracer experiment in the North Atlantic Ocean. Earth and Planet. Sci. Letters (submitted).

C00-3563-79: Livingston, H. D., S. A. Casso, V. T. Bowen and J. C. Burke. Soluble and particle-associated fallout radionuclides in Mediterranean water and sediments. Presented at XXVIth Congress and Plenary Assembly of the International Commission for Scientific Exploration of the Mediterranean Sea (ICSEM), Antalya, Turkey, 24 Nov. - 2 Dec. 1978. To be published in Procés Verbaux of the meeting.

C. The following reports were presented at various meetings and will be published; six copies of each are attached.

C00-3563-70; C00-2379-17: Carey, A. E. and V. T. Bowen. Bacteria and plutonium in marine environments. Presented at the Am. Society for Microbiology, 78th annual meeting, Las Vegas, May 1978. (Only Abstract to be published in meeting proceedings).

C00-3563-78; C00-2379-20: Schneider, D. L. and H. D. Livingston.

Detection and measurement of curium in the marine environment. Presented at the Am. Chemical Society Symposium on Analytical Methods in Oceanography, Boston, June 1978.

II. Cruise Reports

The major part of our sampling effort in 1978 was conducted as a part of an 18-month R/V KNORR Cruise, and was concentrated in two areas: Leg #6 in the areas downwind and down-current from the U. S. Pacific Test Site, and Leg #7 across the equator in the central Pacific; also in the Pacific, we worked in the Mid-Pacific Gyre region on the Scripps Institute of Oceanography ship, R/V THOMAS WASHINGTON.

A. KNORR 73, Leg #6 from Kwajalein to Kwajalein, June 18 to July 12, 1978.

This cruise was conducted in the areas downwind and down-current from the U. S. Pacific Test Site to examine the distribution and nuclide ratios of close-in fallout in the water column, sediments and in MnO₂ crusts or nodules. Eighteen stations were occupied. Attached is a chartlet* of the cruise track. Sampling at each station consisted of large volume water samples, 21-cm sediment cores, plankton tows and in situ pump collected particulates and absorbed ¹³⁷Cs and Pu (on cartridge style filters). Guyots in the area were dredged for Mn-crusts or nodules to see how the transuranics, especially, may have been immobilized by these objects. Sampling at these stations on this leg were shared between the WHOI participants and our collaborators on the cruise, Dr. V. E. Noshkin's research group at Lawrence Livermore Laboratory. At the WHOI stations (1,3,5,7,8,10,12,14 and 17) large volume water samples (60 liter) were taken at nine depths, principally above 1000 meters, stored in drums, and shipped to Woods Hole for analysis. At the Lawrence Livermore stations (2,4,6,9,11,13,15 and 16) the water was pumped into polyethylene tanks in the ship's laboratory where it was immediately processed for ¹³⁷Cs and Pu. A small filtered water sample from all large volume samples will be analyzed for primary amines for possible correlation with transuranic distributions. Plankton tows and 21-cm sediment cores were taken at each station. Plankton samples were preserved

* See Figure 1

R/V KNORR
PACIFIC 1978

FIGURE 1

for taxonomy and radionuclide analysis. Cores were extruded, sectioned, and stored for analysis at WHOI or LLL.

Dredging was attempted at stations 5,6,7 and 11. These sites were at the rim of the guyots extending in a NW direction from Rongelap, Bikini and Eniwetok Atolls. Abundant, well formed nodules and crusts were anticipated in those areas. Instead, large MnO_2 encrusted coral slabs were encountered. These proved most difficult to sample and a severe test of the equipment strength and our patience. Small sections of MnO_2 crust taken from the dredge samples, and aliquots of sediment from the 21-cm cores were finely ground and placed on various Mn enriched media in the hope of identifying Mn fixing bacteria. Other experiments were performed to determine the heterotrophic potentials of Mn-nodules and surrounding sediments by measuring the rate and amount of uptake of ^{14}C labeled glucose, glycine, casamino acids, and the amount of $^{14}Co_2$ production from these same substrates.

We had hoped to be able, on each leg of this cruise, to supplement our other samples with those collected by in-situ filtration of large volumes of water for particulates, and of in-situ chemical separation, in the flow stream, of Cs and Pu, by ion-exchange or adsorption collectors. Most unfortunately, our in-situ, stream-flow powered, large volume pumping systems developed mechanical problems which were insurmountable at sea. We still have great hope for these in-situ pumps once the mechanical problems are corrected. In lieu of this pumping system, the filtration and chemical separation experiments were performed using water taken from the ship's sub-surface uncontaminated salt water system. These results will not offer the full profile details which could have been obtained from the in-situ pumps, but we hope that sufficient information can be obtained to prove the future of these techniques.

We were pleased to be able to make the joint scientific effort with the Lawrence Livermore Laboratory. They were of great help in planning the cruise, and in arranging shipping and travel, as well as in providing needed equipment and supplies. By sharing the sampling effort we were able to reduce the overall effort of each individual, but increase the total output of the cruise. We are looking forward to the analytical results which will not only be of great interest in themselves, but will supplement data obtained in GEOSECS 5 years ago. This will also be an excellent opportunity for intercalibration of our analytical techniques.

B. KNORR 73, Leg #7, Kwajalein to Pago Pago, American Samoa, July 18-August 17, 1978.

On this cruise, principally to follow up and increase detail on Geosecs stations, the major sampling effort was concentrated on water from the surface to 750 meters where transuranic concentration maxima are located. At eight of the eleven stations* ten large volume water samples were taken between these depths. At the remaining three stations seven large volume water samples were taken between 0 and 750 meters and three samples in the deeper waters. At two of these stations chemical separations were done on surface water for Cs and Pu by pumping approximately 1000 gallons of water through prepared cartridges. Five eight-inch diameter tripod cores and three one-hour plankton tows were also taken.

This cruise included a variety of scientific work and proved to be an opportunity for data exchange between members of the scientific party. We were able to have nutrient analyses (silicate, nitrate, nitrite and phosphate) done on water from all of our stations by means of a shipboard auto analyzer. Dr. N. B. Price furnished information on particulates in the water at our stations, and as on the previous cruise, water from our samples was filtered and frozen for primary amine analyses in Woods Hole. All of these data should greatly aid in our interpretation of nuclide concentration profiles for water and sediments at these stations.

* See Figure 2

R/V Thomas Washington

Mariana II

3 Aug - 2 Sep 1978

FIGURE 3

C. R/V THOMAS WASHINGTON (Scripps Institute of Oceanography), Cruise Mariana II,
Honolulu to Honolulu, in the Mid-Pacific Gyre region.

In August we took part in this multi-program cruise sponsored by Sandia Laboratories, Albuquerque, New Mexico with Dr. Kenneth Smith of Scripps Institute of Oceanography as Chief Scientist. Ours was one of seven participating groups. Sampling was concentrated in the work area 30° - 31° N latitude, 158° W longitude, about 600 miles north of Hawaii.

Our work consisted of water, sediment and biota collections and the testing of a new instrument for continuous recording of conductivity, temperature and depth (CTD). Six shallow large-volume water stations were taken,* two along the track (24° N and 27° N) to the work area, three in the vicinity of 30° N and one at 31° N. At each station, ten depths were sampled between the surface and 750 meters to further characterize the tongue of high Pu water discussed in last year's Progress Report (pp. 49-53). Aliquots from selected depths were preserved for subsequent bacterial measurements.

We also collected for radionuclide analyses sediment samples from six different box cores taken in the main work area. Two of the participating groups provided us with deep-sea amphipods and we collected the fauna from two of the many glass fishing floats netted during the cruise.

In addition, we tested for the first time our new, internally-recording CTD of the type developed at the University of Washington. In this internally-recording mode, conducting wire between the CTD and the vessel is eliminated and the instrument can thus be used with any hydrographic winch. Aside from the testing and calibration of the unit, repetitive and detailed near-bottom profiles of temperature and conductivity were taken at two stations to study benthic circulation.

* See Figure 3

D. Other Sample Collecting

The collection of herring from local river-runs was continued this year much the same as in the last few years. A few short cruises were made to round out sampling of bottom feeding fish and invertebrates. Special emphasis was placed on spawning fish which were obtained for studies of Pu uptake in milt and roe.

III. Abstracts of Reports Published or in Press

On the following pages, for the convenience of readers too hurried to consult the appended reprints and preprints, we have included the Abstracts of those reports.

Abstracts, Reprints & Preprints removed