Report COO-3563-56

RADIOELEMENT STUDIES IN THE OCEANS

Progress Report
for Period January 1, 1976—December 31, 1976

Vaughan T. Bowen

Woods Hole Oceanographic Institution
Woods Hole, Massachusetts 02543

EP

Prepared for
THE U. S. ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION
UNDER CONTRACT NO. E(11-1)-3563.00

DISCLAIMER

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A. Bibliographic Summary:

1. Six reprints of each of the following reports, published since our last progress report, are enclosed.

COO-3563-33; COO-3568-12: H. D. Livingston and V. T. Bowen, 1976. Contrasts between the marine and freshwater biological interactions of plutonium and americium. U. S. Energy Research and Development Administration, HASL Environmental Quarterly, HASL-315, pp. I-157 – I-172.

COO-3563-34; COO-2379-07: V. T. Bowen, H. D. Livingston and J. C. Burke, 1976. Distributions of transuranium nuclides in sediment and biota of the North Atlantic Ocean. In Transuranium Nuclides in the Environment, pp. 107-120. (IAEA, Vienna).

COO-3563-36: H. D. Livingston and V. T. Bowen, 1976. Americium in the marine environment -- relationships to plutonium. In Environmental Toxicity of Aquatic Radionuclides: Models and Mechanisms, pp. 107-130. Ann Arbor Science Publishers, Inc., Morton W. Miller and J. Newell Stannard, Editors.

COO-3563-37; COO-2379-06: L. D. Labeyrie, H. D. Livingston and V. T. Bowen, 1976. Comparison of the distributions in marine sediments of the fall-out derived nuclides ^{55}Fe and $^{239,240}Pu$: a new approach to the chemistry of the environmental radionuclides. In Transuranium Nuclides in the Environment, pp. 121-137.

COO-3563-38: S. L. Kupferman and V. T. Bowen, 1976. Comparison of ^{137}Cs concentrations measured after in situ absorption with those determined by bulk water analyses or calculated from ^{90}Sr analyses. Limn. & Oceanogr. 21(3): 467-473.

COO-3563-39: L. B. Graham, A. D. Colburn and J. C. Burke, 1976. A new, simple method for gently collecting planktonic protozoa. Limn. & Oceanogr. 21(2): 336-341.

COO-3563-46: Nicholas S. Fisher, 1976. North Sea phytoplankton. Nature 259: 160.

COO-3563-52: G. R. Harvey and W. G. Steinhauer, 1976. Transport pathways of polychlorinated biphenyls in Atlantic water. J. Marine Res. 34(4): 561-575.

2. The following reports have been published as shown; but since no reprints have been provided, six Xerox copies are enclosed.

COO-3563-24: V. T. Bowen et al, 1975. Report of working group on transuranic elements. In Reference Methods for Marine Radioactive Studies II. (IAEA, Vienna), Technical Report Series 169: 5-31.

COO-3563-40; COO-2379-08: V. T. Bowen, 1976. Distributions of transuranic nuclides in the oceans; possibilities for their cycling. In International Union of Geodesy and Geophysics Proces-Verbaux No. 14. IAPSO XVI General Assembly at Grenoble, France, August-September 1975, pp. 143-144 (Abstract).

3. The following reports, of which we enclose six preprints each, were presented at various meetings and will be published:

COO-3563-47; COO-2379-10: H. D. Livingston and V. T. Bowen. Plutonium and cesium-137 distribution patterns in coastal sediments of the Northwest Atlantic Ocean. Presented at the Symposium on Environmental Chemistry and Cycling Processes, Augusta, Georgia, 28-30 April 1976. To be published.

COO-3563-50: H. D. Livingston, V. T. Bowen and J. C. Burke. Fallout radionuclides in Mediterranean sediments. XXVth Congress and Pleanary Assembly of the International Commission of the Mediterranean Sea, Split, Yugoslavia, 25-30 October 1976. To be published.

COO-3563-51; COO-3568-15: V. T. Bowen. Natural matrix standards. Presented at the International Committee for Radionuclide Metrology, Working Group on Low-Level Measurement Techniques, Paris, France, 4-6 October 1976. To be published.

4. The following reports, of which we enclose six preprints each, have been submitted for publication:

COO-3563-44: N. S. Fisher. On the differential sensitivity of estuarine and open-ocean diatoms to exotic chemical stress. Accepted for publication in American Naturalist.

COO-3563-45: J. A. Pechenik and N. S. Fisher. Ingestion and assimilation of three species of phytoplankton by larvae of the gastropod Nassarius obsoletus. Submitted to Limn. & Oceanogr. 1976. Is now being revised.

COO-3563-55: F. R. Hess. Use of radio-controlled miniature aircraft for marine atmosphere sampling. Accepted for publication in Marine Chemistry.

5. Six copies each of the following miscellaneous papers are enclosed:

COO-3563-53; COO-2379-12: V. T. Bowen, 1976. Non-USA disposal of radioactive waste in the oceans: past and ongoing. Testimony presented to Subcommittee on Energy and the Environment, Washington, D. C., 26-27 July 1976.

COO-3563-54: F. R. Hess, 1976. Stream-powered, large volume deep ocean sampler. Disclosure of invention.

B. Sample Collection

In the yar 1976 we were involved in two major cruises, one in the Mediterranean and Atlantic off the Iberian Peninsula, the other in the North Sea and northeastern Atlantic to Iceland.

a) On KNORR Cruise 54, leg V we were chiefly interested in the sediments and water masses of the western-most Mediterranean, the Mediterranean outflow water and the sediments beneath it. This was a cooperative cruise between our research team, that of Dr. W. Roether of University of Heidelberg, Germany and that of Dr. S. Kupferman, University of Delaware; we also made space and samples available for people from the IAEA Laboratory for Marine Radioactivity, Monaco, to be used in their studies of chemical pollution of the Mediterranean.

The work done on this cruise, directly related to the present ERDA contract, fell into three classes:

1. Collection of large-volume water samples for analysis of fallout nuclides, especially plutonium and americium.
2. Collection of large-volume sediment cores for analysisof fallout nuclides, especially plutonium and americium.
3. Collection of plankton samples for analysis of fallout nuclides, especially plutonium and americium, as well as for studies of distribution and abundance of Foraminifera and Acantharia. Also physiological and morphological studies.

Appended is a chartlet showing the cruise track and the sampling locations. In all the following samples were collected:

1. Large-volume water stations (surface to bottom)	12
2. Surface water stations	2
3. 21-cm gravity cores	19

4. Plankton tows (3/4m #10 net, oblique)	23
5. Niskin samples for trace metals in seawater	12
6. In-situ Cs-137 sampling profiles	5
7. Surface samples for Cs-137	6
8. Hydrographic stations - Nansen bottles, temperature and salinity at each Large-volume station + O_2	12
9. CTD lowerings for each hydrographic station and between stations	39
10. Nephelometer lowerings	39

The water, sediment, and plankton samples for analysis of plutonium and americium will take a long time -- the measurements are slow and we have a large backlog of samples awaiting analysis. When the data are available, they will be reported in our usual fashion.

The plankton samples to be studied for taxonomic and distributional information will take even longer; typically, years elapse between sample collection and final publication of the data.

Other Programs:

A. At most of the L. V. Stations, samples were taken in very close-spaced profiles, for tritium, krypton-85, and radon measurements by Dr. W. Roether'sgroup at Heidelberg. Analysis of these stations is currently underway.

B. Samples of a variety of kinds were taken by people from IAEA Laboratory for Marine Radioactivity at Monaco, to be used for analysis of chemical pollutants, both organic and toxic trace elements. IAEA paid for all parts of this program except ship time.

C. At five hydrostations a group from the University of Delaware sampled for in situ Cs-137. Six surface samples for this same program were taken, towing the samplers while underway.

The program was generally completed with great success, the ship performed well and the scientific parties worked well together.

There was, however, one flaw that is proving more and more serious: We arranged to lease, with operator, a Geosecs CTD from one GEOSECS Operations Group at SIO, at a cost of about $6,000 for the leg. From the very start this arrangement was unsatisfactory. The operator sent was not familiar with the gear; the gear was not accompanied by a spare-parts kit; no real effort was made to get things ready for business before the vessel sailed. As a result, we were not able to use the CTD, nor the nephelometer with which it was married, until several days out. It was not available in the Mediterranean to search for the shallow high-suspensoid current at all -- and this was our most serious need for it.

Then to cap all, we are still, <u>eleven months</u> later, without any data from the CTD traces. The operator refused to leave read-out copies behind him, and so far neither letters, phone calls, nor hold-up of the final payment on the lease contract, have sufficed to get a response from Dr. Bainbridge. Naturally we will never, ourselves, try to use GOG services again, and we urge that ERDA funds not again be committed to such a losing gamble.

b). On KNORR Cruise 54, Leg VI we were interested to work in North Sea (in association with the International FLEX experiment -- relating to the development of the spring plankton bloom), the Norwegian Sea and a traverse to Iceland collecting samples to replace those missed on the 1975 KNORR cruise in this area.

The work done on this cruise, directly related to one present ERDA contract, fell into three classes:

1. Collection of large volume seawater samples for analyses of fallout and nuclear fuel reprocessing produced nuclides -- especially transuranics.
2. Collection of large diameter sediment cores for the same purpose.
3. Collection of plankton samples for the same purpose plus for studies of distribution and abundance of Foraminifera and Acantharia.

The attached chartlet shows, in very small scale, the cruise track of KNORR 54 Leg VI. In all, we obtained, for our program, the following samples:

1. Large Volume Water Samples, surface to bottom, on 13 stations - 142 55-liter drums, in all.
2. Plankton Tows - 35.
3. Sphincter Cores - 21-cm diameter - 23 for sediment distribution of fallout nuclides.
4. Box Cores - 13 for sediment distributions of fallout nuclides.
5. A large amount of associated hydrographic, current meter, biological and sedimentological data.

Some of the samples collected in the North Sea, and others collected along the north and western coasts of Scotland are of high relevance to study of the distribution of radioactive waste effluent from the Windscale plant in the Irish Sea. A report of analyses of some of these samples has been prepared for early submission to Nature(London).

We are very interested, also, to have found that the Pu:Cs ratios in shallow-water cores from the North Sea show the same sort of evidence of upward migration of Pu that we have seen in similar cores from the eastern coast, of the U. S. As soon as a few more of these cores have been analyzed, these confirming data will be prepared for publication.

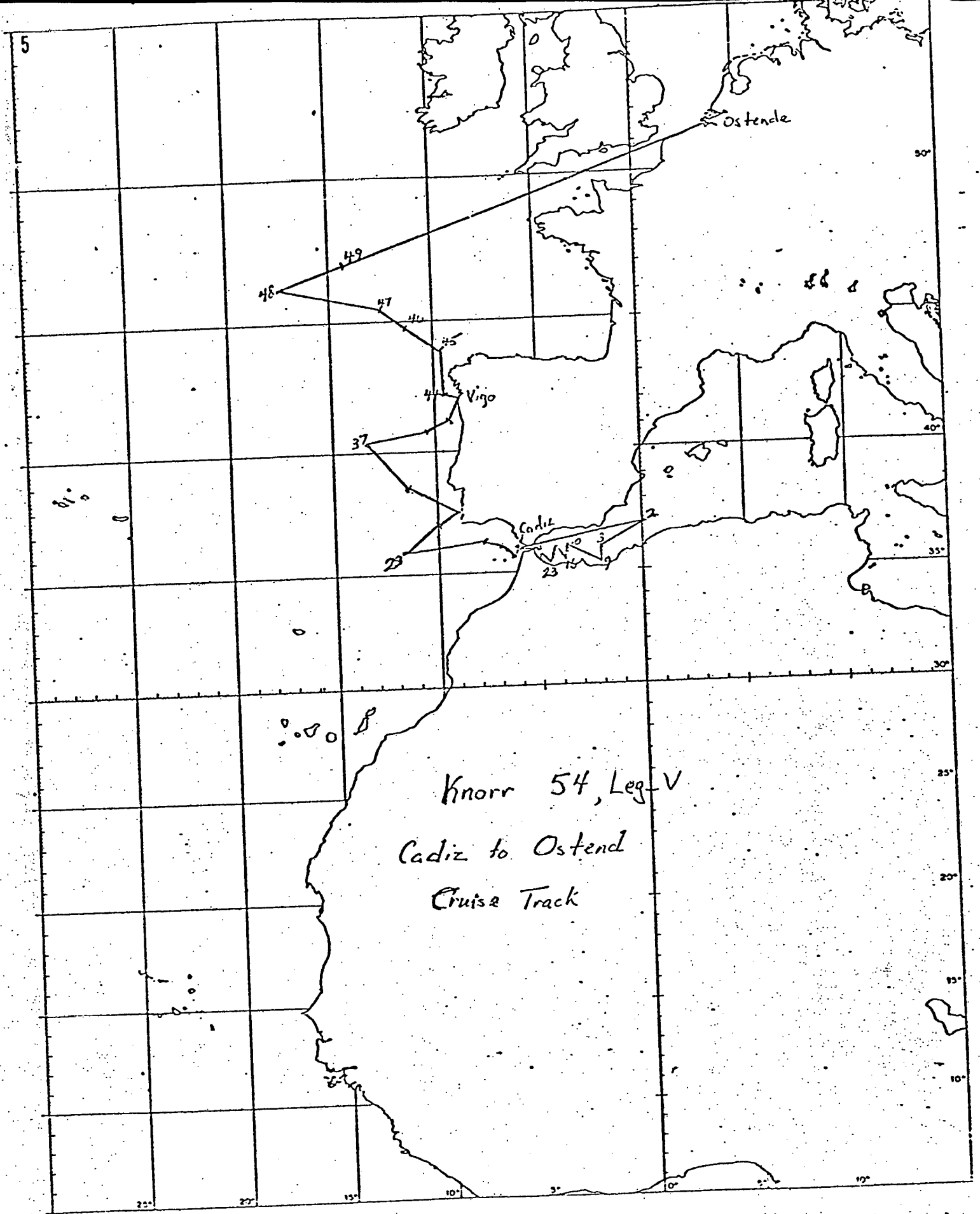
Other Sampling:

As in previous years a good deal of time, diplomacy, and some ship money have gone into sampling in local waters. Pursuing our interest in the inventories and distributions of transuranics in sediments, and in the passage of these nuclides, from fallout, along marine food chains most of this work has involved sediment coring or dredging, a collection of algae, invertebrates or fish for radiochemical analysis. Some effort has also been put into the collection of algae or microorganisms to be used in laboratory experiments of uptake of transuranium nuclides, as well as into obtaining clean seawater or sediment to be used as substrates in such experiments.

C. Scientific Results

Last year we tried, as an experiment, supplementing the listing of all of the reports that have been published or completed in the past year (see part A. Bibliographic Summary) by presenting here, in numerical order, all the abstracts of these reports. It would be an exaggeration to claim that we received a flood of favorable feed-back from this experiment; on the other hand, all the feed-back we did receive -- from readers within the Institution -- was favorable. Consequently, we are following last year's practice again, in the hope that some of the Abstracts will prove so engagingly cryptic as to draw a few readers to look at the full texts, which are appended to this report. Unfortunately no Abstracts were written for Reports COO-3563-24, -44, -46, -53, and -54.

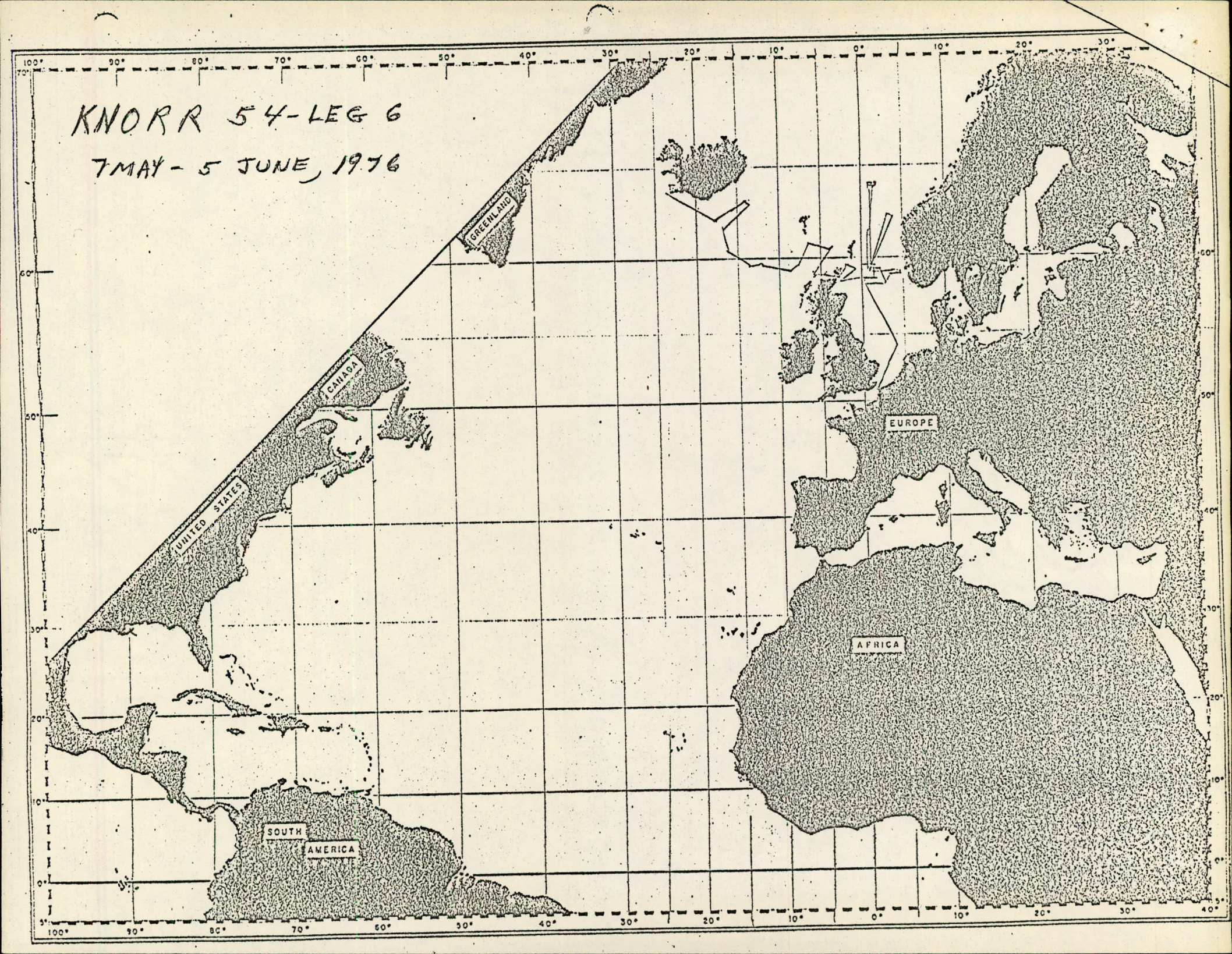
Reprints + Preprints Removed



Knorr 54, Leg V

Cadiz to Ostend

Cruise Track


KNORR 54-LEG 6
7 MAY - 5 JUNE, 1976
GREENLAND
CANADA
UNITED STATES
EUROPE
AFRICA
SOUTH AMERICA