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Project 2.62

RADIOACTIVITY BACKGROUND AND OCEANOGRAPHIC CONDITIONS
IN THE PACIFIC PROVING GROUNDS
AT THE START OF OPERATION REDWING

(A field report based on data collected 5 April - 5
May 1956 on the M/V HORIZON and LCU 1135)

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Credit is due the crews of the M. V. HORIZON and LCU 1136 for the excellent cooperation and assistance given both scientific parties.

ABSTRACT

Background radioactivity and oceanographic conditions in the Pacific Proving Ground are of significance; in evaluating the contaminating effects of REDWING events, in the understanding of the fallout problem at sea and extrapolation to land fallout patterns. Thus, as a part of Project 2.62, a month-long study has been made of radioactivity in water, organisms, and bottom sediments, and of currents and physical character of the water over a 140,000 square mile area around Bikini Atoll.

The waters are slightly radioactive, with values of 150 to 1500 gamma counts per minute per liter (cpm/l), whereas the natural radioactive background, due to potassium-40, is about 94 cpm/l.¹ A field of maximum activity (800 to 1500 cpm/l) exists at 800 to 1200 meters depth at locations to the west of Bikini Atoll, within 150 miles of it, and between $10\frac{1}{2}^{\circ}$ and $13\frac{1}{2}^{\circ}$ N. Radioactivity is associated with particulate matter (possibly organic) at the surface only; at all other depths it is mostly in solution. Organisms collected from the upper layers and deep sea fauna captured in a trawl as deep as 2500 meters depth are about equally radioactive; the level of activity in these marine creatures is about 30 to 50 times as much per unit weight as that in equivalent weight of water. Lagoon waters and surface waters in the open sea around the lagoons are slightly more radioactive than other areas (1100 to 2100 cpm/l).

1. All values of radioactivity given in this report are gamma rays emitted per minute.

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The highest ^{level} amount of radioactivity in the area studied is on the ocean ^{& lagoon} floor in the region of CASTLE fallout. The top of one deep sea core taken 10 miles northwest of Bikini Lagoon tested 29,500 cpm/g; sediment from the northwest end of the lagoon emitted 45,000 cpm/g. Presumably both were from BRAVO event at CASTLE. Elsewhere in the lagoon, the bottom sediment generally emitted from 1500 to 4000 cpm/g compared with a usual 1000 to 3000 cpm/g in the fallout area outside the lagoon.

Sampling of bottom living organisms outside the lagoon is, so far, unsuccessful. Bottom dwelling organisms in Allinginae and Bikini Lagoons (particularly the latter) were quite radioactive. Other lagoons were not studied. The molluscs displayed the highest activity and this was outstandingly concentrated in the livers and kidneys (52,000 to 84,000 gamma cpm/g).

In the open sea area, measurements of currents verified the general circulation obtained at CROSSROADS and by Japanese cruises, but more explicit information was obtained. Meanderings and eddies dominate the flow in the latitude of Bikini; the main flow westward is located at the north side of the PPG. A large, counterclockwise-revolving eddy at Bikini is found down to depths of at least 500 meters. The current at the surface attains 0.6 to 0.7 knot speed and averages 0.3 to 0.4 knot; thence it decreases to a maximum of 0.3 knot and average of 0.15 knot at 500 meters depth.

The thickness of the wind stirred layer above the thermocline, where temperature decreases rapidly, varies from 40 meters near Bikini to 170 meters in the northwestern part of the area. The

waters are most stratified (i.e., density gradients are greatest) at depths of 50 to 175 meters, being shoalest in the southeastern part of the area, deepest in the northwestern portion, and of intermediate depth at Bikini. Water masses in the area are primarily Equatorial Pacific, North Pacific Intermediate, and West North Pacific Central.

Underwater sound propagation conditions at depths above the thermocline are good, but will become less favorable as summer progresses. Propagation in the deep water is bottom limited where depths are less than 1000 fathoms. The axis of the deep sound channel is found at 800 to 1200 meters (1.3 to 1.5 times as deep as off the U. S. West Coast).

The physical hydrography of Bikini Lagoon is similar to that obtained at CROSSROADS. Surface waters move downwind, and deep waters flow in the opposite direction to complete a cellular circulation. At the upwind end the deep waters are diverted both north and south into two secondary horizontal cells. During moderate to strong trades, water flows into the lagoon along the windward reefs and flows-out through Enyu channel and ^{flows out} at the leeward reefs and channels. With southerly and southeasterly winds most of the inflow occurs through Enyu channel.

Speed of the surface current was measured to be about 1.6% of the wind speed instead of 3% as previously found. The deep flow was apparently more variable in direction and of considerably less speed than that obtained during previous investigations. As the trade winds materially decrease, the surface

current essentially stops immediately, but the deep flow continues for some time.

It is calculated that when the east northeast trades are prevailing, water in the lagoon is completely exchanged on the average every 40 days. At times of light southerly or southeasterly winds an estimated 60 to 100 days are required. No conditions were observed during the field work in which very rapid flushing of the lagoon occurred.

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