MASTER

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GEOCHEMICAL STUDIES OF CONTINENTAL WATERS

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Annual Report
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During the past year the following research has been accomplished:

1) Gas exchange rate program. As has been outlined in our previous reports and in several publications (Broecker, 1965; Broecker et al., 1967; Broecker and Peng, 1971), we are endeavoring to develop the radon method for the determination of gas exchange in natural waters. Our efforts we feel have been very successful. During the past year the following progress was made.

(a) Our 200-liter radon stripping device was thoroughly tested on the Antipode Expedition of the GEOSECS group off Samoa in the South Pacific. About 100 extractions were carried out in a manner designed to test every phase of the new procedure. We were pleased to find that the system runs smoothly and turns out excellent results. A report on this work will be completed when the Ra^{226} determinations on the water samples returned from the expedition have been completed. A more permanent version of this system is under construction for use on the forthcoming GEOSECS traverses. The present system will be used for a detailed study of the gas exchange rate for the North Pacific to be carried out over a 6 week period, Dec. 5 to Jan 12 aboard the Canadian Coast Guard ship VANCOUVER.

(b) The first stage of the program of laboratory studies on the relationship between the gas exchange rates of radon, CO_2 , O_2 , He, ... is near completion. Tsung-Hung Peng will complete his Ph.D. thesis on this topic by late spring. His thesis will be included as part of the final report for this program.

(c) Our cooperative program with the Canadian Fisheries Research Board group at Winnipeg has produced some important results. By spiking Lake 227 in the Kenora environmental studies area with Ra^{226} we have been able to obtain gas exchange rates for this artificially eutrophied water body. The results will be submitted as a report to Science. A preprint of this paper is included in this report (Appendix A). A more lengthy paper discussing in detail the Ra^{226} - Rn^{222} experiment is in preparation. It will be included in the final report. *Kenora*

Two limnocorrals are currently in operation in the Kenora area. Their purpose is to determine whether gas exchange rates for a lake can be measured within a small area (5 m^2) isolated from the surrounding water by a floating curtain which extends into the thermocline of the lake. One of the corrals is located in Lake 227 and the other in a second lake (not artificially eutrophied) which was spiked with Ra^{226} last August. Results from these experiments should be available by mid-spring. They will be included in the final report.

2) Urban water program. Because of the reduction in funding (through the cost of living increase and the increase in Columbia overhead) the scope of our program had to be reduced. We were unable to begin the Sr^{90} and Cs^{137} program outlined in the proposal. We did, however, forge ahead in our attempt to come to grips with the factors influencing the major ion chemistry of urban waters. We think that we can explain the origin of the majority of the chloride ion present and have also demonstrated how this tracer can be harnessed to yield valuable information regarding the residence time of rain water in urban ground water systems. A report on this subject was given at the Urban Water Quality Workshop, Syracuse University, and appears as Appendix B. *Revised*

Our major effort during the past year has gone into understanding the distribution of SO_4 ion in surface waters and ground waters in the New York City area. We have shown that the source of this sulfate must be SO_2 released during combustion. Roughly one quarter of all the sulfur released in this way must end up in the local water. Our conclusion is based on the fact that the SO_4 content of surface waters shows a very regular decrease (half each 8 miles) away from the City center. The distribution is independent of rock type and of local population density. We have shown that this S does not reach the ground in significant amounts via rain and snow. We also feel we can demonstrate that it does not come via

impacting aerosols. We are currently exploring the possibility that SO_2 diffuses into the soils and is there oxidized by microorganisms. A major paper on this problem is in preparation and will be available for the final report.

References Cited

- An application of natural radon to problems in ocean circulation (1965), Wallace S. Broecker, in: Symposium on Diffusion in Oceans and Fresh Waters, Lamont Geological Observatory (1964), Palisades, N.Y., 116-145.
- Radium-226 and radon-222: Concentration in Atlantic and Pacific Oceans (1967), W. S. Broecker, Y. H. Li, J. Cromwell, Science 158, 1307-1310.
- The vertical distribution of radon in the BOMEX area (1971), W. S. Broecker and T.-H. Peng, Earth Planet. Sci. Letters 11, 99-108.