

Introduction to special section: Maurice Ewing Symposium on Applications of Trace Substance Measurements to Oceanographic Problems

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On October 16-20, 1995, a Maurice Ewing Symposium on Applications of Trace Substance Measurements to Oceanographic Problems was held at Biosphere 2 in Oracle, Arizona. The objectives of this symposium were (1) to review the status of tracer methodology for oceanographic research (technological advances and progress in applications), (2) to evaluate the potential of the individual tracers for regional and global studies of water mass formation and circulation in the ocean, and (3) to outline the role of tracers in calibration and improvement of global circulation models.

Trace substances of natural and anthropogenic origin have been used to study circulation and mixing in the ocean for roughly the past 4 decades. In such studies the penetration and subsequent spreading of anthropogenic trace substances released to the ocean are observed and evaluated in terms of flow paths and mean transit and residence times of specific water masses. These studies are basically regional or global dye experiments. Additionally, the radioactive character of several natural tracers is used to determine the mean residence times of deep waters.

The tracer methodology was developed in the late 1950s when techniques for sensitive measurement of rare isotopes became available and anthropogenically released tracers reached significant levels in the environment. Classical examples of these activities were the development of the techniques for measurement of radiocarbon and tritium by Libby [1980] and the subsequent transfer of these methods to oceanographic studies. Since that time, considerable effort has been concentrated on the development of technological and methodological aspects of tracers as part of chemical and physical oceanography. In several global and regional surveys the potential of a broad variety of tracers for studies of ocean circulation was investigated and documented. The largest of these programs were the Geochemical Ocean Sections Study (GEOSECS), Transient Tracers in the Ocean (TTO) (North Atlantic Studies (NAS) and Tropical Atlantic Studies (TAS)), and South

Atlantic Ventilation Experiment (SAVE) programs. More recently, several tracers were included as one element of the World Ocean Circulation Experiment (WOCE) Hydrographic Program, and this program has produced, for the first time, a truly global survey of these tracers with sufficient spatial resolution.

The symposium was attended by about 60 scientists who presented lectures and posters on recent tracer work, new measurement techniques, reviews of applications of tracers to oceanographic problems, and recent work on incorporation of tracers into ocean circulation models. As a result of this symposium, 15 papers have been prepared for publication in *Journal of Geophysical Research-Oceans*. These papers are a mixture of new material and reviews and cover the following topics: (1) thermocline ventilation by Jenkins; (2) deep and bottom water formation and circulation by Broecker et al., Smythe-Wright and Boswell, and Rhein et al.; (3) intermediate water circulation by Lupton; (4) use of tracers in models to investigate circulation and mixing by England and Holloway and Heinze et al.; (5) tracer input functions by Mensch et al.; (6) gas exchange by Asher and Wanninkhof; (7) new measurement techniques by Bulsiewicz et al.; (8) purposeful tracers; (9) use of transient tracers to study carbon dioxide uptake by the oceans; and (10) tracer ages.

The papers will be published in two groups as special sections of *Journal of Geophysical Research-Oceans*. This issue contains 10 papers, and a subsequent issue will contain the remaining 5 papers. All of the papers will be bound together in a combined reprint that will be available upon request from the editors of this special section.

References

Libby, W. V., *Radiocarbon and Tritium*, vol. 1, Willard F. Libby Collected Papers, edited by R. Berger and L. M. Libby, Geo Science Analytical, Santa Monica, Calif., 1980.

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