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^{14}C CYCLING AND THE OCEANS

INTRODUCTION

Furthering our understanding of how carbon is cycled within the oceans and between the ocean and the atmosphere, both in the past and present, is a critical issue today. Studies of global climate change require a better knowledge of how the ocean responds to changes in atmospheric CO_2 on short and long time scales than is currently available. Radiocarbon has proved to be an invaluable tool for studying carbon cycling. In paleoceanography, chronologies of the events recorded in sediments can be reconstructed. Currently, the incorporation of "bomb" ^{14}C into different pools of carbon can be used to track the short-term transfer of carbon from one pool to another as well as to set limits on rapid mixing rates that remained elusive prior to its production. Modeling of time-series records in surface waters will allow us to predict future changes in the carbon cycle. This special issue of *RADIOCARBON* contains papers demonstrating the power that radiocarbon studies bring to deciphering the oceans's carbon cycle.

This special issue originated in the "Carbon in the Oceans" workshop at the 15th International Radiocarbon Conference in Glasgow, Scotland. Such a unique group of talks was presented there that the decision was made to give the authors a choice of publishing either in the Proceedings (Volume 37, No. 2, 1995) or in a special "Oceans" issue. It became obvious that the issue could be dedicated to Reidar Nydal, one of the pioneers of measuring ^{14}C in the world's oceans and atmospheres, on the event of his retirement. Additional contributions have been solicited and accepted to help celebrate Reidar's career. Although it has taken some time to put together, this collection of papers provides a good sampling of the scientific questions concerning the ocean that radiocarbon can help address.

A number of papers discuss ^{14}C in the dissolved inorganic carbon (DIC) pool in the Atlantic and Pacific Oceans. Nydal and Gislefoss present an impressive 30-yr summary of atmospheric CO_2 and surface ocean DIC ^{14}C measurements. Additionally, the depth profiles they measured recently in the Nordic Seas extend the oceanographic time-series of the Geochemical Ocean Sections Study (GEOSECS) and Transient Traces in the Oceans (TTO) programs in this region, which are central to deep-water formation. Severinghaus *et al.* use $\Delta^{14}C$-DIC measurements collected along a transect in the subtropical North Atlantic Ocean to provide insight for upper ocean mixing in this dynamic region. The trio of papers by Key, Key *et al.* and Stuiver *et al.* present the first results from the Pacific program of the World Ocean Circulation Experiment (WOCE), a program that will greatly expand the database of oceanic ^{14}C measurements. Some of the important results presented in these papers are the agreement between the AMS and decay-counting techniques and the reproducibility of deep-water values over the 20-yr period from GEOSECS to WOCE. All of these papers document the increased penetration of the bomb signal into the thermocline over time, although the magnitude differs regionally.

The papers by Druffel, Ingram and Southon, and Honda use the record of $\Delta^{14}C$-DIC in the surface ocean that is preserved in calcareous organisms to study ocean mixing processes. Druffel uses the recent history of $\Delta^{14}C$ in corals from the tropical Atlantic to investigate water mass ventilation in this

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region. Ingram and Southon expand our knowledge of reservoir ages by examining ^{14}C in historic collections of shell from the eastern Pacific. Honda uses the $\Delta^{14}C$ of particulate inorganic carbon collected in sediment traps to examine surface ocean circulation and mixing in the Okhotsk and Bering Seas.

Finally, in a paper examining ^{14}C in tree rings, Damon *et al.* show that atmospheric ^{14}C values near the Arctic Circle are affected not only by regional events but by ENSO events as well.

This eclectic group of papers provides a broad sampling of the types of research ongoing in the fields of oceanography and climatology. This eclecticism is a reflection of Reidar Nydal's career for the past four decades, as is aptly described by Gislefoss in her tribute to him. The productivity and forthrightness of Professor Nydal is an inspiration to us all.

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