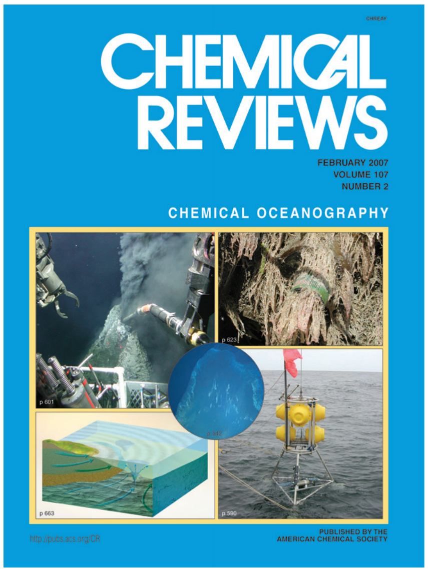
CHEMICAL REVIEWS®

Thematic Issue:
Chemical Oceanography

Guest Editors: **George W. Luther III**, University of Delaware and
Edward A. Boyle, Massachusetts Institute of Technology

Chemical Oceanography plays a central role in understanding the distribution and reactivity of chemical components within the ocean and at the earth–ocean, sediment–ocean, and atmosphere –ocean interfaces. The oceans cover approximately 70% of the earth's surface, and their average depth is about 3900 meters. The transport of materials to the center of the oceans occurs primarily via atmospheric deposition and to a lesser extent from hydrothermal vent inputs, whereas the coastal ocean is affected primarily by exchange with rivers, atmospheric processes, and groundwater exchange with coastal aquifers. Until recently, the oceanic reservoir appeared to be an expanse that could not be polluted by humans. However, as recently shown in the thematic issue on Atmospheric Chemistry in this journal (Vol. 103, No. 12), humans have altered the earth's atmosphere, so it is not surprising that the oceans have also been altered despite the one thousand year mixing time of the entire ocean.



Volume 107, Issue 2

The origin of the study of the chemistry of the oceans, frequently termed Chemical Oceanography or Marine Chemistry, can be formally traced to the three and a half year expedition of the H.M.S. *Challenger* in 1872. That research cruise collected samples and specimens to study the biology, chemistry, and geology of the water column and sediments around the globe. A major chemical finding was the constancy in the ratio of the major ions (sodium, calcium, magnesium, chloride, and sulfate) to each other throughout the oceanic water column. Since that time, Analytical Chemistry has played a fundamental role in Chemical Oceanography, as method development to determine trace elements at micromolar, nanomolar, and picomolar concentrations is required to understand the distribution and reactivity of chemical components within the ocean and at its interfaces. Reliable results at extremely low concentrations require strict sampling protocols or *in situ* techniques so that contamination of the sample does not occur. Also, the protocols for sampling of carbon and its organic compounds are normally from different for inorganic elements and compounds. For trace metals and nonmetals, proper analytical and sampling protocols were finally developed in the 1970s and have led to an improved understanding of element cycling in the ocean. Since then, technique development to determine the chemical speciation (redox state as well as specific compounds) of each element has become of paramount importance.

Physical Chemistry has always provided a conceptual framework for the description of oceanic chemistry, and many of the papers in this issue use physical chemical principles to discuss oceanic processes. For inorganic elements and compounds, the thermodynamic approach initially dominated the thinking of marine chemists. Over the last two decades, chemical kinetics and quantum mechanical approaches have enhanced our understanding of chemical transformations via reaction mechanisms at the molecular level for inorganic, organic, and biochemical reactions. In addition to studying chemical transformations via reaction mechanisms at the molecular level, Chemical Oceanography requires studying physical, geological, atmospheric, and biological processes to demonstrate how the elements and their compounds, both natural and anthropogenic, vary over a range of spatial and temporal scales. For example, much effort has been expended on the study of the uptake of chemical species by organisms, as trace amounts of an element are needed for growth but too much of an element can lead to toxicity and death.

The paper by **Millero** demonstrates the chemical complexity of the oceanic CO_2 cycle.

Morse, Arvidson, and **Lüttge** continue that topic with a thorough discussion of the thermodynamics and kinetics of $CaCO_3$ formation and dissolution.

McCollum and **Seewald** discuss the abiotic syntheses of organic compounds at deep-sea hydrothermal vents.

Coble discusses how colored dissolved organic matter (CDOM) gives the ocean its characteristic color and how it is studied via oceanic and satellite optical instrumentation.

Mopper, Stubbins, Ritchie, Bialk, and **Hatcher** describe the difficulty in getting structural information on dissolved organic matter (DOM).

McNichol and **Aluwihare** discuss the use of radiocarbon techniques to track DOM and particulate organic matter (POM) in the ocean.

Burdige reviews organic matter preservation in marine sediments.

Reeburgh discusses another greenhouse carbon gas, methane, which is produced in sediments at micromolar concentrations under zero oxygen conditions, and in the surface mixed layer under oxic conditions at (sub)nanomolar concentrations.

Rickard and **Luther** review the physical chemistry of the oceanic iron, sulfur, and iron sulfide systems.

Paytan and **McLaughlin** review the phosphorus cycle and provide details on its role in organic chemistry, biochemistry, and the formation of biogenic minerals.

Brandes, Devol, and **Deutsch** review the dynamics of the marine nitrogen cycle with emphasis on new ways to fix nitrogen and new processes leading to N_2 formation in sediments and suboxic/anoxic waters.

Reimers discusses the use of a variety of microelectrodes in the study of sediment processes.

Ding and **Seyfried** review the technological challenges in making accurate *in situ* measurements of pH and H_2 in hot hydrothermal vent fluids.

Johnson, Needoba, Riser, and **Showers** describe the need for chemical sensor networks that can measure chemical parameters.

Fitzgerald, Lamborg, and **Hammerschmidt** review the cycling of Hg in the marine environment.

Swarzenski describes how the U/Th series of radionuclides can be used as tracers for groundwater along coastal margins.

For more information about *Chemical Reviews*, go to http://pubs.acs.org/CR

ORDER TODAY! Special ACS Member Rates:

Single Thematic Issue $35 (print) / Nonmembers $45

Call toll-free 1-800-227-5558 (ask for Publications Support Services, ext. 4554)
In Washington, D.C., and outside the U.S., call 202-872-4376.
Fax order to 202-872-6325. E-mail order requests to **pss@acs.org**.
Visa / MasterCard / American Express accepted

Please include journal title, thematic issue title, volume, issue number and price; indicate credit card number and exp. date; add applicable sales tax (print only) in CA, D.C., MD, OH, IL, and 7% GST for all orders shipped to Canada.

Mail your order with payment to:
American Chemical Society,
Sales & Marketing, Attn: S.A.
1155 Sixteenth Street, NW,
Washington, D.C. 20036

Additional postage required for **air service** outside North America–$22.

Additional postage required for **surface mail** outside North America–$8.

ACS PUBLICATIONS
HIGH QUALITY. HIGH IMPACT.