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Book Review

CHEMICAL BIOMARKERS IN AQUATIC ECOSYSTEMS: By T. Bianchi and E. Canuel. (2011) Princeton University Press. 392 pp. List price US $95.00; Kindle available. ISBN: 978-0691134147.

The book *Chemical Biomarkers in Aquatic Ecosystems* by T. Bianchi and E. Canuel describes organic matter as it relates to globally important processes in biogeochemistry. Chemical biomarkers, or biomarker molecules, are defined here as compounds that characterize certain biotic sources and selectively retain their source information, even after stages of decomposition and diagenesis. Biomarkers, for the most part, are organic molecules and are used to gain insight into many aspects of the modern and ancient Earth system. The information from biomarkers can be applied to a broad range of overlapping studies including areas ranging from fossil fuels, evolution of life on Earth, and microbial chemotaxonomy, to the cycling of carbon, nutrients, and energy. In their book, Bianchi and Canuel demonstrate the utility of organic molecules as tracers of processes occurring in aquatic ecosystems, both modern and ancient, especially where combined with isotopic analysis of those biomarkers.

The authors' approach for the core of the book is to focus on classes of biomarkers, describing the structure, biochemical synthesis, analysis, and reactivity of each class, followed by a selection of relevant applications to aquatic systems. These systems include lakes, rivers, estuaries, oceans, and, where appropriate, paleoenvironments. A major focus in the book is the biochemical synthesis of biomarker molecules. This discussion begins in the first chapter, which covers broadly the major biochemical pathways, and is followed up by a more detailed look at biochemical pathways relevant to particular classes of chemical biomarkers. There is also a chapter on stable (^{18}O, ^{2}H, ^{13}C, ^{15}N, and ^{34}S) and radioactive (^{14}C) isotopes in organic matter. These data can add significantly to studies of carbon cycling, paleoclimate, and ecological relationships, especially where applied to specific biomarker molecules. A chapter on analytical technology, and the role it has played in the study and understanding of chemical biomarkers exposes the reader to both the classical tools as well as the emerging technologies that are being used in the field today. While most of the book (Chapters 5–13) is focused on naturally occurring biomarkers, the final chapter discusses anthropogenic biomarkers, including various emerging contaminants, and how the sources of these compounds can be apportioned using the same organic and isotopic biogeochemical approach that has proven so fruitful for naturally occurring compounds. The scholarship is excellent and the references cited are an appropriate cross section of the field, providing an excellent introduction for graduate level study. The authors suggest a background in introductory level organic and inorganic chemistry is required for this book; however, I also think that some coursework in biochemistry would also be very helpful to potential readers.

Chemical Biomarkers in Aquatic Ecosystems is a significant contribution to the field of organic biogeochemistry. As the authors themselves point out, most of the books on this topic are edited volumes, and therefore lack the focus to be useful textbooks. Other books could serve as textbooks for organic geochemistry focused on sediments and petroleum (e.g., *Organic Geochemistry* by Killops and Killops or *The Biomarker Guide* by Peters, Walters, and Moldowan) or more generally marine biogeochemistry (e.g., *Marine Biogeochemistry* by Libes); however, the focus of *Chemical Biomarkers in Aquatic Ecosystems* is more appropriate to understanding the cycling of organic matter in modern aquatic systems and the application of organic and isotopic biomarkers to understanding (paleo)environmental processes. *Chemical Biomarkers in Aquatic Ecosystems* bridges the gap between the "traditional" fields of organic geochemistry and aquatic biogeochemistry. The combined discussions of both the biochemical formation of the biomarkers, as well as of their utility as process indicators is of particular importance and almost unique to this book. Thus, the reader will be able to understand the biogeochemical basis for the use of these compounds as biomarkers, rather than taking their applicability on faith. This alone is a significant difference between this book and all others, and puts *Chemical Biomarkers in Aquatic Systems* in a class of its own.

This book provides basic knowledge of the cycling of organic matter in aquatic ecosystems, as it is critical to these systems, and of the potential use these tracers to reconstruct ecosystem processes on a variety of timescales. This information will be useful to students and researchers in a broad array of aquatic sciences, including the fields of oceanography and limnology, aquatic ecology, biogeochemistry, environmental science, paleoclimate, and (paleo)environmental change.

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