

Geochemistry of Marine Humic Compounds

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Foreword

Some 90 years ago, the first information on the occurrence of dissolved organic matter in sea water was published. For 50 years after that revelation, little progress was made in identifying these dissolved “yellow substances.” In the 1950s and 1960s, a few chemical oceanographers identified some specific dissolved organic compounds, but few of these pioneers fully appreciated their significance in terms of biological interactions, metal chelation, or interactions with sedimentary material.

When Mohammed Rashid began his work on marine humic compounds in the mid-1960s, he was one of only five scientists who had specifically designed their studies toward understanding the nature of these complex materials. Over the next decade, Dr. Rashid directed his research toward characterization of humic and fulvic compounds in the marine environment, the influence of humic substances on the growth of marine phytoplankton, the role of organic matter in complexing metals in sea water and marine sediments, the interaction between humic substances and clay minerals in marine environments, and the influence of organic matter on the geotechnical properties of marine sediments. As if the many papers produced from these scientific investigations were not sufficient, Dr. Rashid turned his attention to the geochemistry of hydrocarbons found in ancient and modern marine sediments. He viewed the maturation of hydrocarbons from the perspective of a continuum of diagenetic processes acting on the original organic matter in the sediments. Dr. Rashid also turned his attention to contemporary environmental concerns with special regard to the importance of organic matter in transporting pollutants or the degradation of natural organic matter and processed hydrocarbons in the marine environment.

A few years ago when Dr. Rashid considered the need for a comprehensive text to review the geochemistry of marine organic matter, I could not think of a more qualified scientist to write such a book. In this final product, one can see that Dr. Rashid’s work is well represented. That is as it would be, even had the book been written by another. Certainly few could have attempted to cover the broad scope of this subject, from soil humic compounds to dissolved organic matter in sea water to hydrocarbons in marine sediments. Furthermore, Dr. Rashid has reviewed the field with an appreciation that can come only from one who has struggled with the difficulties of analyzing and characterizing the enormous range of organic substances found in the ocean. Dr. Rashid has included examples of an-

alytical data that students as well as experienced researchers will find useful as a reference compendium. He has also included many illustrations derived from original research in a variety of specialized fields that help the reader to understand both the theoretical and empirical reactions of organic matter in a variety of environmental conditions.

Completion of the tasks of compiling the published information, synthesizing coherent chapters, and indexing this book has been especially difficult for Dr. Rashid, who became seriously ill during the past two years. He completed final revisions to the manuscript only days before he submitted to open heart surgery.

It is my great pleasure to join Dr. Rashid in the sincere hope that this book will be of service to the growing number of individuals studying the geochemistry of marine organic matter, and that it will in some measure spur our progress in understanding and quantifying this complex field.

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Preface

The high rate of primary production and the massive amount of organic matter that enters marine sedimentary deposits makes the oceans one of the largest reservoirs of organic carbon. Humic compounds constitute the predominant form of organic matter present in sea water and recent sediments. The products of their diagenesis are also common in ancient sediments. Humic compounds are strikingly ubiquitous in the biosphere, extremely complex in composition, and capable of many interactions in nature. There are hardly any geochemical reactions in the marine environments that are not influenced by these compounds. Some forms survive the ravages of geological time, while others yield a variety of economically important products through diversified diagenetic transformations. These compounds thus play a significant role in the geochemical history of soils and sediments. Despite their wide occurrence and significant contributions to geological and geochemical reactions, many marine and earth scientists are either unfamiliar with these compounds or have failed to recognize their full impact. After years of neglect, this situation is being remedied, as is evident from an increasing number of publications during the last 10 to 15 years outlining the chemical nature and geochemical significance of humic compounds. However, large gaps still persist in our knowledge and understanding of these naturally occurring organic compounds. This book is an attempt to provide an insight into the origin, distribution, and reactions of marine humic compounds and to point out the scope of research for future investigations.

In view of the rapid advances in the field of marine geochemistry, a critical review, resynthesis, and reevaluation of the existing information was considered pertinent. It is essential to make organic geochemistry an effective tool in solving many paleoceanographic and marine geological problems that are not easily solved by conventional methods. The origin and distribution of organic compounds, the process of humification, physico-chemical properties of humic compounds, and their reactions with metals and minerals are reviewed particularly with respect to the geological and geochemical implications of these reactions. Besides these topics, there are some discussions on the diagenetic transformations of humic compounds. Some attention has also been focused on the contemporary environmental and ecological problems. It is my earnest hope that the book will serve as a reference to both the new and experienced scientists in the field of marine geochemistry. It is further hoped that geologists,

soil scientists, water chemists, limnologists, ecologists, marine biologists, and scientists in related disciplines will be equally benefited by this book. At present, no suitable textbook on marine organic geochemistry is available for advanced students. The contents of this book will be of interest to them as well.

I am extremely grateful to the Management Committee of the Atlantic Geoscience Centre, Geological Survey of Canada, for providing me with an opportunity to write this book and all the necessary facilities to complete the task. My sincere thanks are also due to a number of my colleagues for valuable comments and criticisms on various parts of the manuscript. I am particularly grateful to D.E. Buckley, S.R.V. Durvasula, H. Kodama, M.K. Mahendrappa, A. Nissenbaum, A. Prakash, M. Schnitzer, and G. Vilks for their reviews of different chapters. My thanks are due to Cecilia Middleton for typing the initial manuscript, Art Cosgrove for drafting the illustrations, Joyce Wiley for editing, Kevin Robertson for his general assistance, and the staff of the BIO Library for their help in literature search. I am deeply indebted and grateful to Bill LeBlanc for his sustained and valuable help, without which my progress with this book would have been slow. Last but not the least, my deepest thanks go to my wife, Rashida, who provided immense encouragement and showed a great deal of patience throughout.

M.A. RASHID

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