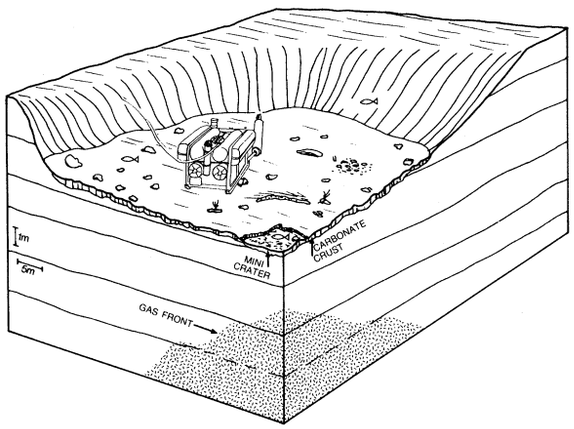

"Artist's impression of a carbonate-cement-paved pockmark. Completely paved pockmarks have to date only been observed on the plateau in Norwegian blocks 25/7 and 24/9 of the North Sea. Note ROV [remotely operated vehicle] inside pockmark." [From *Seabed Pockmarks and Seepages*]

in their formation; the authors clearly favor gas, particularly methane, as the most important fluid in the process. Besides pockmarks, the book considers a wide variety of seafloor features, all of which have the common element of being associated with some kind of seafloor seepage. Examples include mud volcanoes, hot springs, cold springs, hydrothermal vents, and volcanic emanations.

The enthusiasm of the authors for their subject comes across clearly. They are eager to have seabed pockmarks recognized as significant and to stimulate an awareness of the importance of various kinds of seabed seepages. Each of the ten chapters starts with an interesting quotation and a brief description of what's ahead. The text is generously illustrated, although a few of the acoustical records seem to have lost definition during printing and sometimes it is not possible to find locations on maps of areas discussed in the text. A reader unfamiliar with marine geochemistry and marine surveying techniques would do well to begin by examining appendixes 1 and 2. Appendix 1 discusses methane and emphasizes the complications inherent in the carbon isotopic record, although it would have been better to stress the utility of this record instead. Appendix 2 describes marine surveying techniques. A third appendix presents a series of seabed relief maps summarizing locations of pockmarks and seepages worldwide; a large line drawing might have been more effective here. A good glossary and index aid the reading population, which should include anyone interested in the science and technology of the seafloor. The book has implications for the development of offshore petroleum and mining industries and for marine pollution, radioactive waste disposal, and balancing of the global carbon cycle.

In their epilogue, the authors conclude with the following plea: "How long will we accept the strange fact that we now know more about the far side of the Moon and the surface of Mars than we know about our own dynamic planet's vitally important water-hidden surface?" Their book may help revise priorities with regard to the direction of future research.

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Metalloenzymes

The Bioinorganic Chemistry of Nickel. JACK R. LANCASTER, JR., Ed. VCH, New York, 1988. xviii, 337 pp., illus. $85.

Evidence that nickel is an essential trace element in biology has been steadily accumulating over the past 20 years. However, the diversity of its specific biological roles is only now beginning to emerge.

This is the first book devoted exclusively to the bioinorganic chemistry of nickel, and the editor has assembled a series of 14 well-written, concise papers by some of the leading experts in this extremely active area of research. The collection shows how the combination of biochemical, bioanalytical, and biophysical techniques has established the presence of nickel at the active sites of four distinct types of enzyme: urease, hydrogenase, CO dehydrogenase, and methyl coenzyme-M reductase. The authors review relevant aspects of nickel coordination chemistry, biological utilization and transport of nickel, biochemistry and enzymology of individual nickel metalloenzymes, and spectroscopic methods for investigating biological nickel centers.

How and why nature utilizes nickel to catalyze such widely different reactions as the hydrolysis of urea, the oxidation of hydrogen, the reductive desulfurization of methyl thioether, and the carbonylation of a methyl group are fascinating questions. The accounts in this book make it obvious that definitive answers are still to come. Clearly x-ray crystallographic studies of these enzymes will be essential for obtaining them. At present, information concerning the nickel centers has been pieced together through a variety of sophisticated biophysical techniques—EPR, electron spin echo, NMR, x-ray absorption, and MCD spectroscopy. Unfortunately, with the notable exception of x-ray absorption, we lack spectroscopic probes for biological Ni(II) centers. In particular, they cannot be detected by EPR, irrespective of the spin state in low-symmetry biological environments, and this presents a major impediment for detailed biophysical characterization. Techniques by which the chemically informative electronic and magnetic properties of Ni(II) centers embedded in protein matrix can be investigated will clearly be essential for further advances. What is apparent from the studies presented in this book is that the nickel coordination environment is very different in each of the known nickel metalloenzymes: octahedral coordination by O or N in urease, a mixture of S and O or N coordination in hydrogenases, and porphynoid coordination with unknown axial ligands for the F_{430} cofactor of methyl coenzyme-M reductase. The nickel environment in CO dehydrogenase is the least well characterized, but promises to be the most interesting, since the current evidence suggests some form of bimetallic FeNi active site.

This book is an extremely useful compendium of information concerning structure-function relationships in nickel metalloenzymes. As such it should be on the bookshelf of any researcher interested in bioinorganic chemistry and will surely attract the interest of a broader audience of inorganic chemists and biochemists. This book should be viewed as a progress report on a rapidly advancing field. Indeed, several significant advances are about to be reported or have occurred since the book went to press. These developments include the finding of a new biological Ni(II) porphynoid, tunichlorin, which suggests a metabolic role for nickel in marine tunicates, as well as further spectroscopic and magnetic characterization of the nickel centers in ureases, methyl coenzyme-M reductase and hydrogenases. In addition the interested reader should be referred to two excellent review articles on the microbiological and biochemical aspects of nickel enzymes that appeared in 1987 but are not cited in this book: R. P. Hausinger, *Microbiol. Rev.* **51**, 22-42, and C. T. Walsh and W. H. Orme-Johnson, *Biochemistry* **26**, 4901-4906.

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