

Book Reviews

The Diatoms: Applications for the Environmental and Earth Sciences

Editors: Stoermer, E.F. and Smol, J.P.

Publisher: 2001 Cambridge University Press, Cambridge, UK; 469 pp., 85 figs., 10 tables; £ 29,95, Paperback; ISBN 0-521-00412-8

The first era in diatom research was based on taxonomy and systematology. In the late 1960s, scientists' attention was more drawn to environmental problems. It was found that numerous diatom species are sensitive to environmental factors like pH, nitrogen and phosphorus loads, salinity, light and temperature. In the introduction of the book, the editors point out that the book does not deal with the biology and taxonomy of these microscopic algae, but focuses instead on the applications and uses of diatoms as indicators of ecosystem changes. Today's diatom research is based on autecological studies and the derived information is transformed to statistically based functions. Biological indices were developed from huge data sets for monitoring past, present and future impacts of human activity or natural processes on marine and freshwater environments.

Even though the book is divided into six major parts, the main point of diatom research can be simplified and reduced to two sections concerning scientific questions on water quality and climate change caused either by human activities or long-term global processes that influence freshwater and marine systems.

Most of the chapters in the book deal with rivers and lakes. This explains why diatom-based applications play an important role in freshwater management policies to ensure future water supply. Stevenson and Pan (chapter 2) show the application of diverse indices, like the diatom index of biotic integrity (IBI) and the diatom tolerance index (DTI), for example, in evaluating the water quality of river and stream ecosystems. Fritz, Cumming, Gasse and Laird (chapter 3) present tools for reconstructing hydrologic and climatic changes in saline lakes. The contribution of Schelske (chapter 4) focuses on the question concerning whether biochemical silica depletion in the water column is due to increasing phosphorus concentrations in the Laurentian Great Lakes. Battarbee, Charles, Dixit and Renberg (chapter 5) provide an historical review on diatom-based indices and an overview of today's statistically based applications on lake surface-water acidification. Hall and Smol (chapter 6) reconstruct diatom inferred phosphorus levels to quantify lake eutrophication. All the approaches shown in chapters 3, 5, and 6 have in common the method of comparing diatom assemblages from recent surface lake sediments with diatom assemblages of sediment cores. Measurements of present lake water chemistry parameters were taken to determine the optimum for the ecological factor for specific species to reconstruct the same ecological variable in the historical lake chemistry. To use linear regression indices, it was necessary to group diatoms into diverse categories of the ecological factor (e.g. pH classification system by Hustedt). However, this has led to difficulties. Different classes are found in the literature for the same taxon. With the beginning of the 1990s, multivariate non-linear statistical methods were developed, like the weighted-averaging method, which assumes that the relative abundance of a dia-

tom species is at its highest at a given pH value. The use of calibration data-sets (SWAP and PIRLA project) containing chemical and physical parameters from each softwater lake produce more realistic error estimates of taxon responses to limnological conditions.

The next chapters are concerned with the enormous research field of global climate change documented by water-level changes. Bradbury (chapter 7) differentiates in the introduction between 'long-term' and 'short-term' changes. From the geological viewpoint, basic processes like continental drift, tectonics and volcanism, orbital relations between the earth and sun and the earth's rotation are causes for long-term processes which influence climate and biologic environment change over thousands and even millions of years. Cycles of eustatic sea level changes are reconstructed from the Early Miocene to the Quaternary by separating marine from non-marine diatom species. Wolin and Duthie (chapter 8) describe Holocene diatom stratigraphy from four habitat categories of the North American Great Lakes. Diatom inferred water depth is also calculated in this chapter using weighted averaging and multiple regression models. The next three chapters of the book include diatom research sites with almost no human impact. The examined lakes are highly sensitive to climatic changes, and the limiting growth factors for diatoms are certainly temperature and the exposure to light. The extreme aquatic environment conditions above the alpine treeline, the Arctic Circle and the Antarctic are described by Lotter, Pienitz and Schmidt (chapter 9), Douglas and Smol (chapter 10) and Spaulding and McKnight (chapter 11). Johansen (chapter 12) found that aerial diatoms are possibly UV-radiation resistant. If so, diatom species of desert and polar regions could be used as indicators for increasing levels of UV-radiation.

The ion concentration in estuarine environments is extremely variable. In contrast to lakes, estuaries are a more open system for both freshwater input from rivers and from land drainage and input by the open sea. Estuaries are also influenced by tidal range, climate sea-level oscillations, tectonism and isostasy. In former as well as in present times, estuaries are at a high risk of eutrophication due to human settlements. Denys and de Wolf (chapter 13) focus on the study of paleo-coastal processes. Snoeijs (chapter 14) states that the Baltic Sea, a brackish body of water, is one of the most polluted seas on earth. In the last 100 years, the trophic status has changed from oligotrophic to mesotrophic. Sullivan (chapter 15) reviews the applied diatom studies on anthropogenic eutrophication and the response of benthic diatom assemblages in coastal areas. Cooper (chapter 16) focuses on postglacial Holocene anthropogenic influences on water quality and changes in land-use. Sancetta (Chapter 17) presents studies on fossil marine diatoms from Pleistocene sediments and emphasizes the difficulties to interpret ecological requirements of ancient species.

Other applications in the fields of archaeology, oil and gas exploration, and forensic science topics like the toxicity of diatoms, diatoms as markers of atmospheric transport and the industrial use of fossil diatoms are presented by Juggins and Cameron (chapter 18), Krebs (chapter 19), Peabody (chapter 20), Fryxell and Villac (chapter 21), Harper (chapter 22), and Harwood (chapter 23).

The enormously widespread application of diatoms all over the world as indicators for environmental changes in aquatic biotopes is impressively demonstrated through this book. It is recommendable for all scientists, especially for students involved in environmental research. Even though the editors point out

that the book does not deal with biology and taxonomy on diatoms, many of the authors of the specific chapters demand more autecological data on diatom species. Despite the enormous number of citations in the book and the glossary, presented in the appendix, it would have been particularly desirable if questions on the autecology of diatom taxa and molecular tools would have been dealt with as well. However, these might be topics for another excellent future publication.

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Book Reviews

Permeable Barriers for Groundwater Remediation

Authors: Gavaskar, A.R., Gupta, N., Sass, B.M., Janosy, R.J. and O'Sullivan, D.

Publisher: 1998 Battelle Press, Columbus, Ohio, USA; 176 pages, 4 Appendices with reference lists, 41 figures, 13 tables and keyword index; \$ 44.95, Hardcover; ISBN: 1-57477-036-5

The authors present a comprehensive design guidance for construction and monitoring of permeable and chemical reactive barriers for in situ remediation of chlorinated organic compounds contaminated groundwater by metallic iron, iron sulfides and pyrite. After a decade of positive reactive barrier experiences at different contaminated sites, this North American born technology has found acceptance by US and Canadian authorities. Despite these experiences with chemical reactive barriers, collections within Europe have only been gathered at some small-scale test sites. The literature cited in the book unfortunately includes only English language literature up to 1997.

Chapter 1: Problem and technology descriptions, brief discussions of the abiotic chemical and electrochemical reductive chlorocarbon degradation reactions at the metal surface, biological mediated reactions, current status of iron barrier field applications and the status of efforts of the U.S. EPA to provide regulatory guidance for the use of the barriers.

Chapter 2: Requirements of site characterization data concerning groundwater flow system characteristics, organic and inorganic composition of the groundwater inclusive analytical methods.

Chapter 3: Survey about the different kinds of reactive media the barriers may be built up with. Reactivity, stability, availability, cost, hydraulic performance and environmental compatibility are addressed.

Chapter 4: Parameters for conducting treatability testing at bench scale to find out the suitable reactive media for the given groundwater and groundwater contaminant composition.

Chapter 5 and Appendix B: Different parameters are given which have strong influences on the permeable barrier and funnel design and -location, especially hydrogeologic and geochemical modeling.

Chapter 6: The emplacement techniques for different barrier and funnel installation design are introduced.

Chapter 7 and Appendix A: Ensuring that the plume is adequately captured and treated is of outstanding importance for every groundwater sanitation measure. This task requires adequacy of monitoring the groundwater quality, especially downstream to the barrier. Different possibilities for adequate positioning of the monitoring well system are shown. Sampling techniques are important parts within the monitoring measures. Traditional sampling methods involving purging several casing or pore volumes of groundwater prior to collection or any sampling method of drawing groundwater quickly, should be avoided. The adequate monitoring technique requirements inclusive geochemical modeling should be condensed in the 'Quality Assurance Project Plan' before any monitoring measures are done. Meanwhile, important simple monitoring devices placed into monitoring wells for in situ monitoring have not been mentioned. Passive samplers (examples are the so called ceramic dosimeters, gaisafe passive samplers and tape detectors) monitoring frights and different other parameters of contaminants, reductants and microbes without causing any disturbances of the groundwater aquifer have unfortunately not been mentioned within this chapter. But this seems to me to be the only substantial point of criticism.

Chapter 8: How to calculate permeable barrier economics.

Chapter 9: Methodologic recapitulation of all steps necessary for designing and implementing permeable barriers from preliminary assessments to barrier emplacement.

This book should be of interest to all parties involved in the field of groundwater restoration.

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