



MEDICAL MINERALOGY AND GEOCHEMISTRY²

As stated in chapter 1, "Despite its importance, the area of Medical Mineralogy and Geochemistry has received limited attention by scientists, administrators, and the public". This book brings to light numerous and sometimes remarkable links that exist between geological materials and processes and the health of man and animals. Through a comprehensive synthesis and interpretation of recent research on toxicity mechanisms and biophysical parameters controlling element distribution in Earth

materials and the environment, the reviews in this book bridge gaps in the geomedical discourse and may eventually contribute to better diagnostic and prevention strategies for a number of environmental and other diseases.

Sponsored by the Mineralogical Society of America, the Geochemical Society and the United States Department of Energy, the book is excellently produced. Its 10 chapters are based on a short course held at the United States Geological Survey in California in December 2006. The chapters were written by some 30 researchers, active in toxicology, environmental medicine, biochemistry or geochemistry.

In chapter 1, "The Emergent Field of Medical Mineralogy and Geochemistry", Sahai et al. present a brief overview of this highly interdisciplinary subject area. In chapter 2, "Toxicological Geochemistry of Earth Materials", Plumlee et al. show how mineralogical characterization can facilitate the interpretation of epidemiological data; this task, in my opinion, forms one of the key objectives of medical mineralogy and geochemistry. The authors also show that fibre dimension alone is not enough to assess the potential toxicity of asbestos, and they indicate that additional information (e.g. surface area, solubility in lung fluid, trace metal and trace organic contents, surface charge at physiological pH, surface reactivity) is still needed. Plumlee et al. advocate for greater use of modern techniques, such as X-ray absorption spectroscopy and Raman microspectroscopy, to understand how fibres and their contained metals contribute to chronic bioreactivity *in vivo*. This chapter provides a concise summary of various aspects of the book's central theme, which is the health effects arising from our interaction with Earth materials and processes.

In chapter 3, "Metal Speciation and Its Role in Bioaccessibility and Bioavailability", Reeder et al. write authoritatively, using language that is crisp, simple, and intelligible. Nevertheless, I find the distinction between 'bioavailability' and 'bioaccessibility' a bit blurred, although the authors refrain from recommending a preferred usage and clearly indicate the potential for confusion. On page 71, under 'Role of Metal Speciation', the first example discussed is arsenic, giving the misleading impression that the metalloid arsenic is a metal. The authors point to several aspects of 'arsenic behaviour in health studies' that are still imperfectly understood. I wonder whether examples of the health effects of arsenic in African groundwater systems, such as in the aquifers of the African Rift Valley, could have been included for a more holistic appraisal.

Perl and Moalem present a highly readable synthesis in chapter 4 of what is known about Alzheimer's disease and similar disorders. They present cogent evidence for the environmental etiology of amyotrophic lateral sclerosis/parkinsonism-dementia complex neurodegeneration, though remaining somewhat speculative in some of their conclusions.

In chapter 5, Schramm et al. consider the potential role of soil in the transmission of prion diseases, fatal neurodegenerative disorders affecting a variety of mammalian species. Chronic wasting disease and scrapie

are the only transmissible spongiform encephalopathies that appear to be environmentally transmitted. The authors describe many known aspects of etiology, but also indicate that there is still a lot to be researched, such as the relationship of cell death to protein conversion and levels of infectivity in soils contaminated naturally with prions.

In chapter 6, "Interaction of Iron and Calcium Minerals in Coals and Their Roles in Coal Dust-Induced Health and Environmental Problems", Huang et al. show that the interaction of pyrite and calcite, two important minerals in coal, may contribute to the development of coal workers' pneumoconiosis through oxidative stress mechanisms. The language is highly technical, with terminologies specific to medicine and biochemistry. Since there is no glossary, geologists and others from the non-biomedical sciences might, at times, lose the thread of the discourse. But the narrative is well referenced, and those wanting to learn more will know exactly where to find such information.

In chapter 7, "Mineral-Induced Formation of Reactive Oxygen Species", Schoonen et al. provide a list of abbreviations and explanations of selected terms, which will no doubt be helpful to readers from non-medical and non-biochemical science backgrounds.

In chapter 8, entitled "Nature of the Calcium Phosphate Crystals and Cellular, Structural and Physical Chemical Mechanisms in Their Formation", Glimcher provides a detailed synthesis of current understanding of the structure, composition and mineralization process in bone formation. The reference list reveals an amazing volume of contributions from collaborative research carried out in the author's own laboratory.

The development of biomaterials for orthopaedic and dental implants with improved properties and durability is critical to dealing with aging populations. In chapter 9, "Silicate Biomaterials for Orthopaedic and Dental Implants", Ceruti and Sahai show how geochemists and mineralogists can make significant contributions to the field of tissue engineering for implants by collaborating with scientists in biomedical engineering, molecular biology and genetics, and by learning their tools. The development of new biotechnological devices relies largely on the capacity of materials scientists to adapt their concepts and techniques to the living world. In chapter 10, "Living Cells in Oxide Glasses", Livage and Coradin examine recent efforts to take advantage of the biological activities of living cells to design functional materials such as biosensors.

Emphasis on recent findings is a strength of this book. The many areas referred to as "still imperfectly understood" will provide immense scope for the next generation of geochemists and toxicologists. About 70% of references post-date the year 2000. Inter-chapter citations and cross referencing are easy to follow, since chapter references are located at the end of each chapter. The reproduction in black and white of originally coloured prints has caused some loss of detail, leading to reduced comprehension of a few figures and diagrams (e.g. Chapter 2, Fig. 9; Chapter 4, Fig. 3; Chapter 5, Figs. 2, 3 and 5; Chapter 7, Fig. 12). Although the text contains a handful of 'typos', none results in loss of meaning.

Written by a diverse group of researchers, the book suffers from the use of specialized terminology and from a few cases of inconsistent formatting. For example, in chapter 4, there are sub-heading breaks, unlike in the other chapters. Many of the examples are from study populations in developed regions of the world, where, ironically, human interactions with geological materials (and processes) are far less than in Africa and other developing regions. However, this is understandable, in view of the general paucity of high-quality data on such interactions in developing regions. I believe that when such data become available, they will help remove some of the gaps in our knowledge of the toxicological geochemistry of Earth materials, as revealed in this book.

This book will appeal to a wide audience comprising researchers in environmental and public health, postgraduate students in almost any branch of the natural and biomedical sciences, as well as anyone interested in the behaviour of Earth materials in the natural world. I do highly recommend this book.

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² Sahai N, Schoonen MAA, editors (2006) Reviews in Mineralogy & Geochemistry 64, Mineralogical Society of America, 3635 Concorde Pkwy Ste 500, Chantilly, VA 20151-1125, United States, ISBN 978-0-939950-76-6; US\$40; 25% discount for MSA members