

F.R. Siegel

Environmental Geochemistry of Potentially Toxic Metals

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# **Environmental Geochemistry of Potentially Toxic Metals**

With 40 Figures and 33 Tables



**Springer**

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## Preface

Contamination of the earth's ecosystems by potentially toxic metals/metalloids is a global problem. It will likely grow with our planet's increasing populations and their requirements for natural resources (e.g., water, food, energy, waste-disposal sites) and metals-based goods. The health impacts of pollution from the ingestion of heavy metals/metalloids via respiration, food, and drinking water are most often long-term and manifest themselves in many ways. These include, for example, diminution of mental acuity, loss of motor control, critical organ dysfunction, cancer, chronic illnesses and concomitant suffering, incapacitation, and finally death. The incidence and geographic distribution of disease (epidemiology) has been well-documented historically and in modern times for toxic metals-triggered diseases in humans, animals and vegetation.

The role of the environmental geochemist and colleagues in environmental sciences is to scientifically evaluate how to manage metals/metalloids at sources or *in-situ* so as to alleviate or eliminate their negative health impacts on living populations. This is initiated by identifying sources and by developing models of the physical, chemical and biological controls on mobilization, interaction, deposition and accumulation of potentially toxic metals/metalloids in source systems and earth ecosystems. From this knowledge base, environmental scientists (e.g., geologists, chemists, biologists, environmental engineers, physicists/meteorologists) work together to develop

concepts and technological methodologies to preserve global ecosystems. Their concerted efforts are equally focussed on devising strategems to remediate ecosystems still carrying heavy metals/metalloids pollutant burdens from ancient and modern societies.

This book brings an appreciation of the complexity involved in studies on potentially toxic metals to scientists who investigate chemical/biochemical metals pollution problems in the earth's vast array of living environments. This is done in initial chapters that focus on heavy metals/metalloids and their roles as essential elements and as pollutants, identify metals' sources, characterize metals' mobility/immobility in environmental media, and establish their pathways, geochemical cycles and bioaccumulation in ecosystems. Subsequent chapters deal with defining contamination values and processes that can affect them through time, and with assessing ecosystems' health statuses via various indicator media and their chemical analysis under proper protocols. The final chapters of the book discuss remediation/alleviation strategies and environmentally-reasoned decision-making to keep earth systems sustainable.

Frederic R. Siegel  
Washington, D.C.  
April, 2001

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## Dedication

To dedicate this book is to acknowledge many sources of support that kept me on an even keel when writing it, provided me with insight as to what should be emphasized in it, and allowed me access to knowledge garnered during research projects worldwide. Thus, I dedicate this book first to my wife, Felisa, my daughters, Gabriela (spouse Morris Benveniste) and Galia, and my grandchildren, Naomi, Coby and Noa. I dedicate this book also to the myriad of undergraduate and graduate students from many parts of the world I have had in classes and with whom I worked on M.S. thesis and Ph.D. dissertation research projects. Their questions and discussions in and out of the classroom were important in formulating what should go into the manuscript. Finally, I dedicate this book to the broad spectrum of scientists working on environmental problems whose published research expanded my own fields of knowledge and contributed to the breadth of the book.

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