

Preface

Applications of concepts and methods of physics and chemistry to geology resulted in the field of *Isotope Geochemistry* which has revolutionized our understanding of our Earth system and our environment. When isotope techniques applied to understanding environmental changes that have taken place in the anthropocene, the resultant field can be defined as *Environmental Isotope Geochemistry*. The applications of isotopes as tracers and chronometers have permeated not only every sub-branch of geosciences, but also archaeology, anthropology and environmental forensics.

Over the past three to four decades major developments in instrumentation have resulted in high precision and sensitivity in the measurement of a large number of radioactive and stable isotopes that are widely utilized as powerful tools in earth and environmental science. These developments have opened-up new areas of research, resulting in even widening and deepening knowledge of geochemical processes and new discoveries.

The purpose of this two-set volume is to bring together the more recent applications of a much larger number of radioactive and stable isotopes in earth and environmental science, compared to the previous efforts (detailed in Chap. 1), which is necessitated by the rapid developments in the field from the broad expansion of elements studied now and novel applications that have emerged. In this first most-comprehensive edited volume, the 40 chapters that follow cover applications of 115 isotopes from $Z = 1$ to $Z = 95$ (hydrogen to americium; radioactive isotopes of 30 elements, stable isotopes of 27 elements, and both radioactive and stable nuclides of 9 elements) as environmental tracers and chronometers. The topics covered in this Handbook include: the cycling, transport and scavenging of atmospheric constituents; the biogeochemical cycling of inorganic and organic substances in aqueous systems; redox processes; the sources, fate, and transport of organic and inorganic pollutants in the environment; material transport in various Earth's sub-systems (viz., lithosphere, hydrosphere, atmosphere and biosphere); weathering and erosion studies; effective surface exposure ages; sediment dynamics; the chronology of inorganic and organic substances; reconstruction of paleoclimate and paleoenvironment; water mass mixing; tracing both the production and origin of food; tracing the sources of pollutant metals in the human body; archaeology; and anthropology. We anticipate that this handbook will serve as an excellent resource for veteran researchers, graduate students, applied scientists in environmental companies, and regulators in public agencies, reviewing many tried and tested techniques as well as presenting state of the art advances in *Environmental Isotope Geochemistry*.

The field of *Environmental Isotope Geochemistry* is so vast that it is not possible to cover every aspect of this field. The audience in this field includes atmospheric scientists, geologists, hydrologists, oceanographers, limnologists, glaciologists, geochemists, biogeochemists, soil scientists, radiation and health physicists and it is our hope that we have included in-depth chapters in this Handbook that are relevant to everyone of this group.

This idea of editing this handbook was conceived in 2008 and the proposal was submitted to the publisher in 2009 during my sabbatical leave as a *Plummer Visiting Research Fellow* at St. Anne's College, University of Oxford. I owe a special thanks to Don Porcelli for inviting me to Oxford and for the countless discussions we have had during my pleasant stay there. An advisory committee comprised of the following scientists was formed to advise the editor in selecting topics and authors: Per Andersson (Sweden), Joel Blum (USA), Thure Cerling (USA), Brian Gulson (Australia), Kastsumi Hirose (Japan), Gi-Hoon Hong (South Korea), Carol Kendall (USA), Devendra Lal (USA), Don Porcelli (UK), R. Ramesh (India), Henry Schwarcz (Canada), Peter Swarzenski (USA), and Jing Zhang (China). I would like to thank the Editorial Advisory Board members for thoughtful suggestions at various stages of this Handbook. I would like to specially thank Carol Kendall, Gi-Hoon Hong, Henry Schwarcz and Peter Swarzenski for suggesting some key chapters for inclusion in this Handbook that enhanced the overall breadth of coverage. S. Krishnaswami has been very helpful in looking through the original list of topics and came forth with many good suggestions to improve the content of this handbook. My association with him over the past 28 years (first as one of my early advisors in graduate school at the Physical Research Laboratory (PRL), in Ahmedabad, India) has been very enjoyable. I thank student assistant Vineeth Mohan of my department for his editorial assistance with the manuscripts. We thank all of the 82 external reviewers who gave up their time for reviewing all the manuscripts. Finally, I am deeply indebted to all the authors for their relentless efforts in collectively producing a thorough comprehensive two-set volume of articles with breadth and depth for a variety of audiences and their efforts will be highly appreciated by students of yesterday, today and tomorrow.

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