

THE CHEMICAL EVOLUTION OF THE ATMOSPHERE AND OCEANS

HEINRICH D. HOLLAND

PRINCETON SERIES IN GEOCHEMISTRY



The Chemical Evolution Of The Atmosphere And Oceans Princeton Series In Geochemistry

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The Chemical Evolution Of The Atmosphere And Oceans Princeton Series In Geochemistry:

The Chemical Evolution of the Atmosphere and Oceans Heinrich D. Holland, 1984-07-21 In this first full scale attempt to reconstruct the chemical evolution of the Earth's atmosphere and oceans Heinrich Holland assembles data from a wide spectrum of fields to trace the history of the ocean atmosphere system A pioneer in an increasingly important area of scholarship he presents a comprehensive treatment of knowledge on this subject provides an extensive bibliography and outlines problems and approaches for further research The first four chapters deal with the turbulent first half billion years of Earth history The next four chapters devoted largely to the Earth from 3.9 to 0.6 by b p demonstrate that changes in the atmosphere and oceans during this period were not dramatic The last chapter of the book deals with the Phanerozoic Eon although the isotopic composition of sulfur and strontium in seawater varied greatly during this period of Earth history the chemical composition of seawater did not

From Suns to Life: A Chronological Approach to the History of Life on Earth Muriel Gargaud, Philippe Claeys, Purificación López-García, Hervé Martin, Thierry Montmerle, Robert Pascal, Jacques Reisse, 2007-07-05 This review emerged from several interdisciplinary meetings and schools gathering a group of astronomers geologists biologists and chemists attempting to share their specialized knowledge around a common question how did life emerge on Earth Their ultimate goal was to provide some kind of answer as a prerequisite to an even more demanding question is life universal The resulting state of the art articles were written by twenty five scientists telling a not so linear story but on the contrary highlighting problems gaps and controversies Needless to say this approach yielded no definitive answers to both questions However by adopting a chronological approach to the question of the emergence of life on Earth the only place where we know for sure that life exists it was possible to break down this question into several sub topics that can be addressed by the different disciplines The main chapters of this review present the formation and evolution of the solar system 3 the building of a habitable planet 4 prebiotic chemistry biochemistry and the emergence of life 5 the environmental context of the early Earth 6 and the ancient fossil record and early evolution 7 The concluding chapter 9 provides the highlights of the review and presents the different points of view about the universality of life Two pedagogical chapters are included one on chronometers 2 another in the form of a frieze 8 which summarizes in graphical form the present state of knowledge about the chronology of the emergence of life on Earth before the Cambrian explosion

Environmental and Resources Geochemistry of Earth System Naotatsu Shikazono, 2015-01-05 The Earth system consists of subsystems that include the atmosphere hydrosphere water geosphere rocks minerals biosphere and humans In order to understand these subsystems and their interactions it is essential to clarify the mass transfer mechanism geochemical cycle and influence of human activity on the natural environment This book presents fundamental theories thermodynamics kinetics mass balance model coupling models such as the kinetics fluid flow model the box model and others concerning mechanisms in weathering formation of hydrothermal ore deposits hydrothermal alteration formation of groundwater quality

and the seawater system The interaction between fluids atmosphere water and solid phases rocks minerals occurs both in low temperature and also in high temperature systems This book considers the complex low temperature cycle with the high temperature cycle a combination that has not been dealt with in previous books concerning Earth systems Humanity is a small part of the biosphere however human activities greatly influence Earth s surface environments atmosphere hydrosphere biosphere soils rocks Thus the influences of humans on other subsystems particularly mass transfer in the deep underground geologic environment composed of host rocks and groundwater are discussed in relation to high level nuclear waste geologic disposal and CO₂ underground sequestration topics that have not been included in other books on environmental science

Treatise on Geochemistry, 2013-10-19 This extensively updated new edition of the widely acclaimed Treatise on Geochemistry has increased its coverage beyond the wide range of geochemical subject areas in the first edition with five new volumes which include the history of the atmosphere geochemistry of mineral deposits archaeology and anthropology organic geochemistry and analytical geochemistry In addition the original Volume 1 on Meteorites Comets and Planets was expanded into two separate volumes dealing with meteorites and planets respectively These additions increased the number of volumes in the Treatise from 9 to 15 with the index appendices volume remaining as the last volume Volume 16 Each of the original volumes was scrutinized by the appropriate volume editors with respect to necessary revisions as well as additions and deletions As a result 27% were republished without major changes 66% were revised and 126 new chapters were added In a many faceted field such as Geochemistry explaining and understanding how one sub field relates to another is key Instructors will find the complete overviews with extensive cross referencing useful additions to their course packs and students will benefit from the contextual organization of the subject matter Six new volumes added and 66% updated from 1st edition The Editors of this work have taken every measure to include the many suggestions received from readers and ensure comprehensiveness of coverage and added value in this 2nd edition The esteemed Board of Volume Editors and Editors in Chief worked cohesively to ensure a uniform and consistent approach to the content which is an amazing accomplishment for a 15 volume work 16 volumes including index volume

Uranium-series Geochemistry Bernard Bourdon, Gideon M. Henderson, Craig C. Lundstrom, Simon Turner, 2018-12-17 Volume 52 of Reviews in Mineralogy and Geochemistry updates our knowledge of U series geochemistry offer an opportunity for non specialists to understand its basic principles and give us a view of the future of this active field of research In this volume for the first time all the methods for determining the uranium and thorium decay chain nuclides in Earth materials are discussed It was prepared in advance of a two day short course April 3-4 2003 on U series geochemistry jointly sponsored by GS and MSA and presented in Paris France prior to the joint EGS AGU EUG meeting in Nice

Reading the Archive of Earth's Oxygenation Victor Melezhik, Anthony R. Prave, Eero J. Hanski, Anthony E. Fallick, Aivo Lepland, Lee R. Kump, Harald Strauss, 2012-09-28 Earth s present day environments are the outcome of a 4.5 billion year period of evolution reflecting the interaction of global scale

geological and biological processes Punctuating that evolution were several extraordinary events and episodes that perturbed the entire Earth system and led to the creation of new environmental conditions sometimes even to fundamental changes in how planet Earth operated Volume 3 Global Events and the Fennoscandian Arctic Russia Drilling Earth Project represents another kind of illustrated journey through the early Palaeoproterozoic provided by syntheses reviews and summaries of the current state of our understanding of a series of global events that resulted in a fundamental change of the Earth System from an anoxic to an oxic state The book discusses traces of life possible causes for the Huronian age glaciations addresses radical changes in carbon sulphur and phosphorus cycles during the Palaeoproterozoic and provides a comprehensive description and a rich photo documentation of the early Palaeoproterozoic supergiant petrified oil field Terrestrial environments are characterised through a critical review of available data on weathered and calichified surfaces and travertine deposits Potential implementation of Ca Mg Sr Fe Mo U and Re Os isotope systems for deciphering Palaeoproterozoic seawater chemistry and a change in the redox state of water and sedimentary columns are discussed The volume considers in detail the definition of the oxic atmosphere possible causes for the oxygen rise and considers the oxidation of terrestrial environment not as a single event but a slow motion process lasting over hundreds of millions of years Finally the book provides a roadmap as to how the FAR DEEP cores may facilitate future interesting science and provide a new foundation for education in earth science community Welcome to the illustrative journey through one of the most exciting periods of planet Earth

Introduction to Geochemistry Kula C. Misra, 2012-05-21 INTRODUCTION TO Geochemistry This book is intended to serve as a text for an introductory course in geochemistry for undergraduate graduate students with at least an elementary level background in earth sciences chemistry and mathematics The text containing 83 tables and 181 figures covers a wide variety of topics ranging from atomic structure to chemical and isotopic equilibria to modern biogeochemical cycles which are divided into four interrelated parts Crystal Chemistry Chemical Reactions and biochemical reactions involving bacteria Isotope Geochemistry radiogenic and stable isotopes and The Earth Supersystem which includes discussions pertinent to the evolution of the solid Earth the atmosphere and the hydrosphere In keeping with the modern trend in the field of geochemistry the book emphasizes computational techniques by developing appropriate mathematical relations solving a variety of problems to illustrate application of the mathematical relations and leaving a set of questions at the end of each chapter to be solved by students However so as not to interrupt the flow of the text involved chemical concepts and mathematical derivations are separated in the form of boxes Supplementary materials are packaged into ten appendixes that include a standard state 298 15 K 1 bar thermodynamic data table and a listing of answers to selected chapter end questions

Evolution of Primary Producers in the Sea Paul Falkowski, Andrew H. Knoll, 2011-08-31 Evolution of Primary Producers in the Sea reference examines how photosynthesis evolved on Earth and how phytoplankton evolved through time ultimately to permit the evolution of complex life including human beings The first of its kind this book

provides thorough coverage of key topics with contributions by leading experts in biophysics evolutionary biology micropaleontology marine ecology and biogeochemistry This exciting new book is of interest not only to students and researchers in marine science but also to evolutionary biologists and ecologists interested in understanding the origins and diversification of life Evolution of Primary Producers in the Sea offers these students and researchers an understanding of the molecular evolution phylogeny fossil record and environmental processes that collectively permits us to comprehend the rise of phytoplankton and their impact on Earth s ecology and biogeochemistry It is certain to become the first and best word on this exhilarating topic Discusses the evolution of phytoplankton in the world s oceans as the first living organisms and the first and basic producers in the earths food chain Includes the latest developments in the evolution and ecology of marine phytoplankton specifically with additional information on marine ecosystems and biogeochemical cycles The only book to consider of the evolution of phytoplankton and its role in molecular evolution biogeochemistry paleontology and oceanographic aspects Written at a level suitable for related reading use in courses on the Evolution of the Biosphere Ecological and Biological oceanography and marine biology and Biodiversity

On Gaia Toby Tyrrell, 2013-07-21 A critical examination of James Lovelock s controversial Gaia hypothesis One of the enduring questions about our planet is how it has remained continuously habitable over vast stretches of geological time despite the fact that its atmosphere and climate are potentially unstable James Lovelock s Gaia hypothesis posits that life itself has intervened in the regulation of the planetary environment in order to keep it stable and favorable for life First proposed in the 1970s Lovelock s hypothesis remains highly controversial and continues to provoke fierce debate On Gaia undertakes the first in depth investigation of the arguments put forward by Lovelock and others and concludes that the evidence doesn t stack up in support of Gaia Toby Tyrrell draws on the latest findings in fields as diverse as climate science oceanography atmospheric science geology ecology and evolutionary biology He takes readers to obscure corners of the natural world from southern Africa where ancient rocks reveal that icebergs were once present near the equator to mimics of cleaner fish on Indonesian reefs to blind fish deep in Mexican caves Tyrrell weaves these and many other intriguing observations into a comprehensive analysis of the major assertions and lines of argument underpinning Gaia and finds that it is not a credible picture of how life and Earth interact On Gaia reflects on the scientific evidence indicating that life and environment mutually affect each other and proposes that feedbacks on Earth do not provide robust protection against the environment becoming uninhabitable or against poor stewardship by us

Marine Clastic Sedimentology Jeremy K. Leggett, 2012-12-06 Tarquin Teale a sedimentology stratigraphy postgraduate student at the Royal School of Mines was killed in a road accident south of Rome on 17 October 1985 Premature death is a form of tragedy which can make havoc of the ordered progress which we try to impose on our lives As parents relatives and friends we all know this and yet somehow when it touches our own world there is no consolation to be found anywhere In Tarquin s case the enormity of the loss felt by those of us who knew him can barely be expressed in words Tarquin had

everything which we aspire to His fellow graduate students envied his dramatic progress in research We his advisors in appreciating this progress marvelled at how refreshingly rare it was to see such precocious talent combined with such a caring modest and well balanced personality He was destined for the highest honours in geoscience and there is no doubt that he would have lived a life had he been granted the chance which would have spread colour intellectual insight and goodness

Metal Ions and the Route to Life Wolfgang Nitschke, Simon Duval, 2025-08-28 Volume 28 entitled Metal Ions and the Route to Life of the series Metal Ions in Life Sciences advocates for the prime importance of the recognition of metal ions and metal bearing minerals in the transition from inanimate matter to first life on our planet Unlike the relatively unreactive organic molecules the traditional protagonists of orthodox origin of life hypotheses metals and minerals are natural catalysts abundantly present in the majority of settings on the early Earth considered as conducive to bringing forth life In these palaeogeochemical settings they may have catalyzed the anabolic conversions of inorganic precursor molecules into organics and may have converted redox disequilibria between environmental reductants and oxidants into the ordering i.e. the lowering of entropy of first living entities Far fetched Yet this is precisely what metal ions do in life today An unlikely coalition of biology biochemistry and bioenergetics and physics thermodynamics and condensed matter physics is growingly questioning the plausibility of the orthodox hypotheses while putting metal ions and minerals centre stage in their scenarios In this volume 29 internationally renowned experts from fields as diverse as microbiology biochemistry astrobiology electrochemistry ecology mineralogy geology and geochemistry shine light from their individual angles on this topic bringing home metal ions primordial importance to extant life presenting minerals with tantalizing reactivities appearing as look-alikes of life's processes and sketching out plausible metal ion based scenarios for life's emergence on planet Earth Metal Ions and the Route to Life provides the empirical groundwork to interested researchers and the general public for revisiting their preconceived ideas about the origin of life and for appreciating the absolute indispensability of metal ions in life now just as at its beginnings

Iron Geochemistry: An Isotopic Perspective Clark Johnson, Brian Beard, Stefan Weyer, 2020-01-09 This book provides a comprehensive summary of research to date in the field of stable iron isotope geochemistry Since research began in this field 20 years ago the field has grown to become one of the major research fields in non traditional stable isotope geochemistry This book reviews all aspects of the field from low temperature to high temperature processes biological processes and cosmochemical processes It provides a detailed history and state of the art summary about analytical methods to determine Fe isotope ratios and discusses analytical and sample prospects

Revolutions that Made the Earth Tim Lenton, Andrew Watson, 2013-04-11 The Earth that sustains us today was born out of a few remarkable near catastrophic revolutions started by biological innovations and marked by global environmental consequences The revolutions have certain features in common such as an increase in complexity energy utilization and information processing by life This book describes these revolutions showing the fundamental interdependence of the evolution of life and its non

living environment We would not exist unless these upheavals had led eventually to successful outcomes meaning that after each one at length a new stable world emerged The current planet reshaping activities of our species may be the start of another great Earth system revolution but there is no guarantee that this one will be successful The book explains what a successful transition through it might look like if we are wise enough to steer such a course This book places humanity in context as part of the Earth system using a new scientific synthesis to illustrate our debt to the deep past and our potential for the future

Organic Geochemistry Michael H. Engel, Stephen A. Macko, 2013-11-11 As this is the first general textbook for the field published in over twenty years the editors have taken great care to make sure coverage is comprehensive Diagenesis of organic matter kerogens exploration for fossil fuels and many other subjects are discussed in detail to provide faculty and students with a thorough introduction to organic geochemistry

An Introduction to the Chemistry of the Sea Michael E. Q. Pilson, 2013 An engaging introduction to marine chemistry and the ocean's geochemical interactions with the solid earth and atmosphere for students of oceanography

U.S. Geological Survey Professional Paper, 1984

Deep-Sea Sediments, 2010-12-22 During the past few decades deep sea research benefited greatly from a number of newly developed highly sophisticated exploration techniques and comprehensive datasets thanks to the immense industrial interest in deep sea sediments The book *Deep Sea Sediments* focuses on the sedimentary processes operating within the various modern and ancient deep sea environments The individual chapters track the way of sedimentary particles from continental erosion or production in the marine realm to transport into the deep sea to final deposition on the sea floor The sedimentary processes cover several types of sediment gravity flow and contour currents pelagic settling and hemipelagic advection planktic and benthic bioproductivity and volcanoclastic sedimentation In addition the relationships between depositional environment and endobenthic organisms as well as early diagenetic processes at and within the deep sea floor are dealt with Facies models of the wide range of depositional products hold the key for a process related interpretation of ancient deposits Changes in sea water chemistry major innovations in organism evolution and changes in external controls on sedimentation and productivity are discussed in the context of overarching trends in ocean history Deep sea sediments are not only of interest because of the numerous interacting processes involved in their formation but they represent also a nearly inexhaustible archive of long term climatic changes Consequently the book also includes an introduction to the climatic interpretation of the various proxies that reveal global changes during the Mesozoic greenhouse and Neogene icehouse conditions In order to address the specific interest of the oil and gas industry in deep water sediments the investigation techniques that are applied in this context and the methods to predict both the occurrences and the characteristics of hydrocarbon reservoirs are included as well Examines the rapidly evolving field of deep sea sedimentary research Focuses on sedimentary and diagenetic processes with theory and case histories Covers the climate record hydrocarbon reservoirs and other topics of interest Features a multimedia component with colour versions of figures

Astrobiology: Future Perspectives P. Ehrenfreund, 2004-07-14 Astrobiology a new exciting interdisciplinary research field seeks to unravel the origin and evolution of life wherever it might exist in the Universe The current view of the origin of life on Earth is that it is strongly connected to the origin and evolution of our planet and indeed of the Universe as a whole We are fortunate to be living in an era where centuries of speculation about the two ancient and fundamental problems the origin of life and its prevalence in the Universe are being replaced by experimental science The subject of Astrobiology can be approached from many different perspectives This book is focused on abiogenic organic matter from the viewpoint of astronomy and planetary science and considers its potential relevance to the origins of life on Earth and elsewhere Guided by the review papers in this book the concluding chapter aims to identify key questions to motivate future research and stimulate astrobiological applications of current and future research facilities and space missions Today s rich array of new spacecraft telescopes and dedicated scientists promises a steady flow of discoveries and insights that will ultimately lead us to the answers we seek

The Emerald Planet David Beerling, 2017-05-12 Plants have profoundly moulded the Earth s climate and the evolutionary trajectory of life Far from being silent witnesses to the passage of time plants are dynamic components of our world shaping the environment throughout history as much as that environment has shaped them In *The Emerald Planet* David Beerling puts plants centre stage revealing the crucial role they have played in driving global changes in the environment in recording hidden facets of Earth s history and in helping us to predict its future His account draws together evidence from fossil plants from experiments with their living counterparts and from computer models of the Earth System to illuminate the history of our planet and its biodiversity This new approach reveals how plummeting carbon dioxide levels removed a barrier to the evolution of the leaf how plants played a starring role in pushing oxygen levels upwards allowing spectacular giant insects to thrive in the Carboniferous and it strengthens fascinating and contentious fossil evidence for an ancient hole in the ozone layer Along the way Beerling introduces a lively cast of pioneering scientists from Victorian times onwards whose discoveries provided the crucial background to these and the other puzzles This understanding of our planet s past sheds a sobering light on our own climate changing activities and offers clues to what our climatic and ecological futures might look like There could be no more important time to take a close look at plants and to understand the history of the world through the stories they tell Oxford Landmark Science books are must read classics of modern science writing which have crystallized big ideas and shaped the way we think

Initial Reports of the Deep Sea Drilling Project Scripps Institution of Oceanography, 1969

The Chemical Evolution Of The Atmosphere And Oceans Princeton Series In Geochemistry Book Review: Unveiling the Power of Words

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