International Association of GeoChemistry

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INGERSON LECTURER AT THE 1st IAGC INTERNATIONAL CONFERENCE – FRANÇOIS CHABAUX

François Chabaux

The International Association for GeoChemistry (IAGC) is happy to announce that the Ingerson Lecturer for 2019 will be François Chabaux. François will be presenting his lecture at the 1st IAGC International Conference in Tomsk (Russia) in July 2019. Support for the Ingerson International Lecturer is based on a bequest by Dr. Earl Ingerson, first President of the IAGC.

François Chabaux is Professor of Geoscience and Geochemistry at the École et Observatoire des Sciences de la Terre at the University of Strasbourg (France). He is an associated researcher of the GEOTOP research center in Montréal (Canada) and a visiting scientist at the Institute of Surface-Earth System Science (ISESS) of Tianjin University (China). He is Chargé de mission (Policy Officer) at the Continental Surfaces and Interfaces department of the National Institute for Earth Sciences and Astronomy of the Centre national de la recherche scientifique (France).

For the last 25 years, François has researched the mechanisms and time constants of weathering and erosion processes in the critical zone by developing, using, and popularizing a variety of element and isotopic geochemical techniques, notably U-series nuclides. He was highly involved in the application and development of geochemical tracing approaches, including the classical radiogenic isotopes (Sr, Nd, Pb), U–Sr isotopic coupling, and the new suite of stable isotopes (Ca, B, Li) that are used to unravel the main processes involved in biogeochemical and hydrogeochemical cycles. More recently, he has investigated the nature of the water–rock interactions that control the chemical composition of waters in watersheds and aquifers by applying coupled hydrogeochemical modeling approaches. An important part of his work was carried out on the Strengbach watershed in the Vosges Mountains (France) as part of research at the Observatoire Hydro-Géochimique de l'Environnement at the Université de Strasbourg. This work contributed to making this watershed one of the current reference or emblematic sites of the French critical zone observatory network (a distributed network of research observatories around France, known as OZCAR).

François Chabaux was awarded a PhD at the University of Paris VII in 1993 on the U-series nuclides in volcanic rocks, under the supervision of Claude Allègre. He was later a research and teaching assistant at the Université Paris 7 and then at the Institut de Physique du Globe de Paris (both in France). During 1993–1994, he was a research associate at the University of Cambridge (UK). He was appointed Assistant Professor for Geochemistry at the University of Strasbourg in 1994 and Full Professor in 1998.

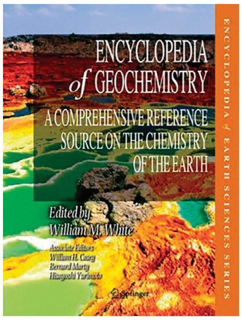
1st IAGC INTERNATIONAL CONFERENCE

Tomsk, Russia, July 21-26, 2019, wri16.com

AIG-13 APPLIED ISOTOPE GEOCHEMISTRY

WRI-16 WATER-ROCK INTERACTION

ENCYCLOPEDIA OF GEOCHEMISTRY[1]



The field of geochemistry has grown rapidly over the past few decades, driven by significant advances in new analytical techniques, theoretical calculations, laboratory experiments, and the development of geochemical databases. This impressive growth has been further accelerated by the urgent needs of almost all the Earth sciences that use geochemistry to find resources, mitigate environmental impacts, and decipher physico-chemical processes in the Earth and the solar system. The massive two-volume *Encyclopedia of Geochemistry: A Comprehensive Reference Source on the Chemistry of the Earth*, edited by William M. White, is, thus, very timely and highly relevant. It represents a comprehensive update on the 1999 version, which was edited by Clare P. Marshall and Rhodes W. Fairbridge.

The two volumes of the *Encyclopedia of Geochemistry* summarize the state-of-the-art advances in all the major geochemical topics. These are covered by 331 separate entries written by 308 international experts from 22 different countries. These entries are divided into three broad categories: extensive reviews of a topic; intermediate overviews of a topic; definitions and brief descriptions. Entries can range from 1 to 27 pages. The extensive reviews of fundamental and broad topics include entries such as "Earth's Continental Crust" (by Roberta L. Rudnick), "Carbonate Minerals and the CO_2–Carbonic Acid System" (by Abraham Lerman and Fred T. Mackenzie), and "Ocean Biochemical Cycling and Trace Elements" (by Hein J. W. de Baar, Steven M. A. C. van Heuven and Rob Middag). The intermediate-length overviews of more specific topics include "Subduction Zone Geochemistry" (by Terry Plank), "Inductively Coupled Plasma Mass Spectrometry" (by Maria Schonbachler), and "Paleoclimatology" (by Larry C. Peterson). The brief definitions of important terms include such items as the "Giant Impact Hypothesis" (by Hidenori Genda), the "Large-Ion Lithophile Elements" (by Catherine Chauvel and Roberta L. Rudnick), and "Geoneutrinos" (by William F. McDonough). In this latter category are brief summaries of the behaviors of naturally occurring elements and their isotopes, ranging from the lightest element in "Hydrogen" (by James G. Brophy and Arndt Schimmelmann) and "Hydrogen Isotopes" (by Arndt Schimmelmann and Peter E. Sauer) to the heaviest element in "Uranium" (by Vincent J. M. Salters), and the "Uranium Decay Series" (by Bernard Bourdon). All entries in both volumes are indexed in alphabetical order to provide readers with easy access to the topics.

The *Encyclopedia of Geochemistry* covers all the major disciplines in geochemistry and conveniently summarizes our current understanding of major geochemical reservoirs, important geological and biological processes, and the behaviors of all the naturally occurring elements and isotopes in the periodic table. Each entry provides an appropriate level of background and history, followed by a brief introduction to the essential concepts, important applications, current knowledge gaps, and areas of controversies. The main text usually ends with a brief summary, detailed bibliography, and cross-references. Although most of the entries are limited in length, they do provide a concise and overarching framework for readers.

The *Encyclopedia of Geochemistry* is an essential reference source for upper-level undergraduate and graduate students, as well as for educators and researchers. The entries provide handy introductory materials for researchers exploring new fields or for those who need to learn about a new topic. The references cited at the end of each entry provide

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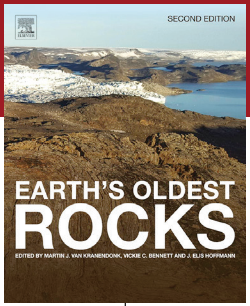
1 William M. White (ed) (2018) *Encyclopedia of Geochemistry: A Comprehensive Reference Source on the Chemistry of the Earth*, 1st ed. Springer International Publishing, 1557 pp, ISBN 978-3-319-39311-7 (Print US$499.99; €414.96); ISBN 978-3-319-39312-4 (ebook US$499.99; €474.81); ISBN 978-3-319-39313-1 (Print + ebook US$599.99; €518.96)

EARTH'S OLDEST ROCKS (2nd ED)[1]



The Earth's oldest rocks are those which formed in the time interval 3.0–4.0 billion years ago in the mid- to early Archaean Eon. Traces of anything even earlier, which would be from the Hadean (>4.0 billion years ago), are fragmental and preserved only in detrital zircon grains and in the isotopic memory of now long-extinct isotope systems. The time interval 3.0–4.0 billion years ago is a crucial stage in Earth history, for this is when the first continents formed, when life began, and was a time during which tectonic processes were quite different from modern (Phanerozoic) plate tectonics due to the different thermal state of the young Earth.

This second edition of *Earth's Oldest Rocks* (the first edition was published in 2007) is an edited volume that comprises articles written by a largely new collection of authors from those who contributed to the first edition and reflects the huge advances that have been made in the study of the earliest stages of our planet's history over the past decade. Those advances have come through the application of field studies, geochemistry and the advent of geodynamic modelling. The size of this book – 42 papers and almost 1,100 pages – is a tribute to the vigour with which this field has been pursued.

The opening section of the book succinctly explores the most recent data and ideas on the origins and earliest history of our planet. Principal themes include the use of meteorites in deriving the early history of the solar system, a discussion of the Moon-forming impact, core formation, the late veneer, and the lunar evidence for the late heavy bombardment. This is followed by a consideration of the nature of the Hadean atmosphere and oceans and the implications for the origin of life.

The next section of the book provides a series of overviews of early Earth's magmatic and tectonic processes. These provide a snapshot of mantle processes through the earliest stages of Earth history. During the Hadean, the planet was enclosed in a thick basic crust, and mantle processes were dominated by 'stagnant lid tectonics'. In the early Archaean, mantle dynamics are thought to have been dominated by plume processes, which have left their record in the subcontinental lithosphere. However, through the early to late Archaean, the komatiite and basalt record shows no evidence of a secular change in mantle processes. Models for the origin of granitoid (tonalite–trondhjemite–granodiorite, or TTG) magmas, from which the earliest continental crust formed, require the re-melting of an enriched basaltic protolith, which puzzlingly is not the most common type of Archaean basalt. In my view, this section of reviews is variable in quality. The discussion of Archaean TTGs, a field with which I am familiar, is masterful and comprehensive, yet one of the other contributions is more partisan and reflects more the views of a single laboratory.

Following these introductory papers, the major part of this volume is given over to reviews of areas where Hadean and early Archaean rocks are preserved. There is a particularly helpful review of the claims and counterclaims made for the nature of the Hadean Earth from the study of the famous detrital zircons from the Jack Hills in western Australia. The current consensus indicates that some of these grains are as old as 4.37 Ga and that they crystallised from a granitoid melt derived from an early mafic crust at 4.4–4.5 Ga. Their subsequent alteration supports the view that there was water on Earth prior to 4.2 Ga. Subsequent papers review the geology of regions where the very oldest rocks are preserved. These include the Yilgarn Craton (western Australia) where rocks formed at 3.73 Ga but where the oldest detrital zircons are 4.37 Ga; the North China Craton where the oldest rocks are 3.8 Ga old and there are detrital zircons 4.0 Ga old; the 3.9–3.6 Ga Itsaq Gneisses (west Greenland); and the 4.03–3.9 Ga Acasta Gneisses (northern Canada), which also contain hints of older crust from 4.2 Ga. This section also includes an important review of the age of the Nuvvuagittuq Greenstone Belt (NE Superior Province of Canada) where there are disputed claims for rocks formed at 4.3 Ga, potentially making this region the only known Hadean crust. Granite–greenstone belt terrains, with their record of surface processes, are also an important source of information about the early Earth, although there are only two regions from the early Archaean where they are well-exposed, little deformed, and of low-metamorphic grade. These are the 3.53–2.83 Ga Pilbara Craton (western Australia) and the 3.55–3.20 Ga Barberton Greenstone Belt of the Kapvaal Craton (South Africa). Previously, models for the evolution of these two very well-studied regions of similar geology have invoked radically different tectonic processes, and it is pleasing to read that new models are converging. Less well-known areas of early Archaean geology are described in the final part of this regional review section, including terrains from the USA, India, the Fennoscandian Shield, the Ukraine Shield, Zimbabwe and Antarctica.

The final section of papers is on early life. Three very useful review papers cover the significance of carbonaceous matter in understanding early life processes, the implications of the chert and carbonate isotope records, and the formation and palaeo-environmental significance of Archaean cherts. This is followed by regional case studies from localities where early life has been reported: Isua in west Greenland, the Pilbara Craton in Australia, and Barberton in South Africa.

Predictably, even though this volume is published in 2019, the subject does not stand still. There are now new data for Hadean (4.1 Ga) detrital zircons from sediments in the Barberton Greenstone Belt in South Africa. Claims for stromatolites at Isua as critical evidence for life on Earth at 3.7 Ga are now being seriously questioned. And evidence for life on Earth at 3.95 Ga in the Saglek region of northern Labrador (not reported in this volume) is now disputed.

This volume is a valuable and up-to-date summary of our current knowledge of the early Earth. And yet for me there is one contribution missing – a synthesis of our knowledge to date. To what extent are these Hadean remnants representative of our planet in Hadean times, both in terms of relative volume and the processes they record? Similarly, for the early Archaean. Could these be fragments of a much larger former crustal volume that is now destroyed or are they indicative of small volumes of emerging continents? A review of crustal growth processes and some further inferences about the nature of tectonic processes on the early Earth would have been a welcome addition.

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1 Van Krandendonk M, Bennet V, Hoffmann E (eds) *Earth's Oldest Rocks*, 2nd Edition (2018), Elsevier, 1112 pp, eBook ISBN: 9780444639028 (US$191.25/€202.30), Paperback ISBN: 9780444639011 (US$191.25/€181.90

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comprehensive reviews and make excellent further reading. Many of the encyclopedia's entries are also valuable resources for undergraduate geochemistry classes. They make ideal reading materials for students who are interested in more in-depth knowledge. For example, the "Magmatic Process Modelling" entry (by Mark Ghiorso) is well-suited to form complementary material to lectures on trace element geochemistry. The entries also make perfect reading assignments for graduate seminar classes, because they provide sufficient background for students to read more research-based articles. For instance, the "Geochronology and Radiogenic Isotopes" entry (by Jeff Vervoort) succinctly explains the fundamentals of isotope dating methods and paves the way for students to understand the applications of different geochronometers to constrain the timing of all manner of processes.

The *Encyclopedia of Geochemistry* is a comprehensive and must-have reference source for anyone interested in the geochemistry of planet Earth.

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