

Reading the Archive of Earth's Oxygenation

Volume 1: The Palaeoproterozoic of Fennoscandia as Context for the Fennoscandian Arctic Russia -
Drilling Early Earth Project

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Preface to Volume 1

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. One of the earliest and arguably the greatest of these events was a substantial increase (orders of magnitude) in the atmospheric oxygen abundance, sometimes referred to as the Great Oxidation Event. Given our present knowledge, this oxygenation of the terrestrial atmosphere and the surface ocean, during the Palaeoproterozoic Era between 2.4 and 2.0 billion years ago, irreversibly changed the course of Earth's evolution. Understanding why and how it happened and what its consequences were are among the most challenging problems in Earth sciences.

The three-volume treatise entitled “Reading the Archive of Earth's Oxygenation” (1) provides a comprehensive review of the Palaeoproterozoic Eon with an emphasis on the Fennoscandian Shield geology; (2) serves as an initial report of the preliminary analysis of one of the finest lithological and geochemical archives of early Palaeoproterozoic Earth history, created under the auspices of the International Continental Scientific Drilling Programme (ICDP); (3) synthesises the current state of our understanding of aspects of early Palaeoproterozoic events coincident with and likely related to Earth's progressive oxygenation with an emphasis on still-unresolved problems that are ripe for and to be addressed by future research. Combining this information in three coherent volumes offers an unprecedented cohesive and comprehensive elucidation of the Great Oxidation Event and related global upheavals that eventually led to the emergence of the modern aerobic Earth System.

The format of these books centres on high-quality photo-documentation of Fennoscandian Arctic Russia – Drilling Early Earth Project (FAR-DEEP) cores and natural exposures of the Palaeoproterozoic rocks of the Fennoscandian Shield. The photos are linked to geochemical data sets, summary figures and maps, and time-slice reconstructions of basinal and palaeoenvironmental settings that document the response of the Earth system to the Great Oxidation Event. The emphasis on a thorough, well-illustrated characterisation of rocks reflects the importance of sedimentary and volcanic structures that form a basis for interpreting ancient depositional environments, and chemical, physical and biological processes operating on Earth's surface. Most of the structural features are sufficiently complex as to challenge the description by other than a visual representation, and high-quality photographs are themselves a primary resource for presenting essential information. Although nothing can replace the wealth of information that a geologist can obtain from examining an outcrop first hand, the utility of photographs offers the next best source of data for assessing and evaluating palaeoenvironmental reconstructions. This three-volume treatise will, thus, act as an information source and guide to other researchers and help them identify and interpret such features elsewhere, and will serve as an illustrated guidebook to the Precambrian for geology students.

Finally, the three-volume treatise provides a link to the FAR-DEEP core collection archived at the Geological Survey of Norway. These drillcores are a unique resource that can be used to help solve the outstanding problems in understanding the causes and consequences of the multiple processes associated with the progressive oxygenation of terrestrial environments. It is anticipated that the well-archived core will provide the geological foundation for future research aimed at testing and generating new ideas about the Palaeoproterozoic Earth. The three-volume treatise will be of interest to researchers involved directly in studying this hallmark period in Earth history, as well as professionals and students interested in Earth System evolution in general.

Volume 1: “The Palaeoproterozoic of Fennoscandia as Context for the Fennoscandian Arctic Russia – Drilling Earth Project” describes the implementation of the FAR-DEEP drilling project in Arctic Russia. It summarises the knowledge of more than 50 years of largely Russian-led fieldwork, information hitherto virtually unavailable in the West, and provides geological description of drilling areas with an exhaustive illustration of rocks by high-quality, representative photographs. The volume offers a comprehensive review and rich photo-illustration of palaeotectonic, palaeogeographic and magmatic evolution of the Fennoscandian Shield in the early Palaeoproterozoic and links the evolution of the shield to the emergence of an aerobic Earth system. The volume unfolds the event-based Fennoscandian chronostratigraphy and discusses the chronology of the Palaeoproterozoic global events as the basis for a new subdivision of Palaeoproterozoic time.

Welcome to the illustrative journey through one of the most exciting periods of planet Earth!