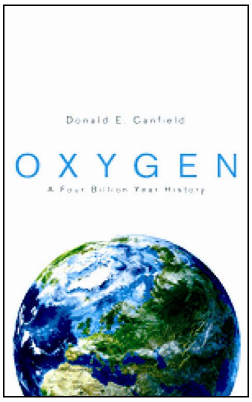

Oxygen: A Four Billion Year History. Donald E. Canfield, Princeton University Press, 41 William Street, Princeton, New Jersey 08540, USA. 2014. XV + 196 pp. Price: £19.95/US$ 27.95. ISBN 978-0-691-14502-0.

Splitting of water molecule releasing free molecular oxygen during photosynthesis is perhaps the most important reaction that fundamentally changed the surface of the Earth and made it a unique planet in the Universe. This simple reaction whose products are life and oxygen, articulates the intertwined nature of life and oxygen on Earth's surface. The fascinating story of co-evolution of life and oxygen is unfolded in a subtle yet a defining style in this book by Donald E. Canfield (eminent Ecologist, Biogeochemist and Professor of Ecology at the University of Southern Denmark and Director of the Nordic Center for Earth Evolution), published as a part of Science Essentials series by Princeton University Press. The topic covered by book has enthused many geologists, geochemists and palaeontologists of several generations. Canfield has not only narrated the latest ideas based on very sophisticated database, but has also described the tales on the origin of thought processes and the researchers behind them. Such a narration has made this book eminently readable. Another facet of this book is the comprehension of interplay among the various factors such as geology, biology and chemistry that influenced the oxygen growth. It is often difficult to write on interdisciplinary topics, because of the possibility of an unintentional prejudice towards a particular speciality, thereby losing focus. Canfield has dealt with vast geological times, interactions among life, geochemistry and Earth's surface with ease and elegance, perhaps owing to his scientific journey.

The book is organized in a chronological order of Earth's history, which also depicts the oxygen evolution from low to high. In the first chapter Canfield sets the premise for the odyssey of oxygen evolution by pondering on many fortuitous conditions that made planet Earth habitable. He demarcates the three tenets of life – energy, chemical components and water, and their interaction to sustain the abundance of life on Earth. Following this he discusses life before oxygen and narrates the tale of methanogens, sulphate-reducing and iron-oxidizing bacteria that would have been flourishing ~3.5 Ga of Earth's history. In the succeeding two chapters, oxygenic photosynthesis and its mechanisms are explored in-depth. These two chapters are not only educative, but also fascinate readers about the marvels of nature's most efficient laboratory as put forth by Jan Ingenhouz as early as in the 17th century. In the fifth chapter, Canfield discusses the processes that control the oxygen concentration in the Earth's atmosphere, where in the roles of oxidation of pyrite and organic matter as major sinks have been discussed at length. However, the role of tectonics as a controlling factor is not fully explored.

The early history of oxygen evolution has been dealt in chapters 6 and 7 from biological and geological perspectives. The discussion on the timing of initiation of oxygenic photosynthesis is quite elaborate and up-to-date. The geological evidences for early evolution of oxygen are mainly restricted to detrital uraninites and pyrites and hop onto the sulphur isotope evidences. This chapter could have been more comprehensive; but considering Canfield's focus on biological backdrop to the whole story, it is adequate. In chapter 8, the Great Oxidation Event (GOE) that took place during the Paleoproterozoic is discussed. Again he has taken a cue from the sulphur isotope geochemistry to pin down the GOE. Further, Mo concentration and its linkage to possible whiffs of oxygen prior to GOE are discussed. The topic of GOE is such a stimulating one, that a review paper appeared in *Nature*[1] almost coinciding with the publication of this book, suggesting that GOE is actually Great Oxidation Transition[1] (GOT), rather than an event. Canfield did not elaborate on the causes for GOE and appears to have attributed it to the interplay between initiation of oxygenic photosynthesis and various sinks of oxygen. The historical tales, scientific heroes in this line of research and hot debates surrounding this topic are all covered in full length. In chapters 10 and 11, the history of oxygen evolution during the remaining period of the Proterozoic has been presented with emphasis on the sulphidic ocean (also known as Canfield Ocean) during the Mesoproterozoic and the linkage between increase in oxygen level and animal evolution during the Neoproterozoic. In chapter 12, the Phanerozoic part of oxygen evolution history is presented. Given the author's direct involvement with this part of the research during his doctoral research at Yale University, the topic is covered comprehensively, recognizing the variations in oxygen concentrations during this young phase of Earth's history. In the Epilogue, Canfield summarizes existing evidences for a possible model for evolution of oxygen during Earth's history. During the writing of this book he presumes that another book on this topic would be inevitable 30 years down the lane given the gaps in the knowledge of understanding the oxygen evolution history – a question that bothers many geologists and geochemists. He has pointed out many research areas where new evidence can be gathered and knowledge on oxygen evolution history improved. Most importantly, once the question of timing of GOE is more or less settled, the future research may focus on the causal processes. This book helps not only the students for getting exposed to the fascinating field of oxygen evolution, but also helps researchers who have made significant inroads, as it serves as a source of up-to-date information on the topic. The end notes and references are useful. I strongly recommend this book to be in all libraries and to all interested in the origin and evolution of oxygen, which is so special to our Earth. The book would be of value for many years to come.

1. Lyons, T. W., Reinhard, C. T. and Planavsky, N. J., *Nature*, 2014, **506**, 307–315.

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