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of life on Earth's history

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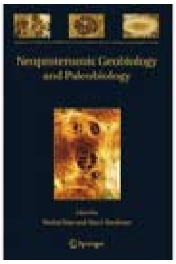

Neoproterozoic Geobiology and Paleobiology (Topics in Geobiology), Shuhai Xiao and A.J. Kaufman, eds., 2006, Springer, NY, NY, USA, 300 p., hardcover, USD 149.00, ISBN 978-1402052019.

Sir Charles Lyell's trope "the present is the key to the past" has guided innumerable studies of the Phanerozoic. The Proterozoic (2500–540 Ma), however, seems to have very different locks than the Phanerozoic, as it poses special challenges to geobiological and paleontological studies. There is no robust fossil record, which makes traditional diversity analyses, paleoecological studies, and biostratigraphic correlation difficult. Most of the fossils that are preserved represent very simple morphologies (e.g., spheres, tubes, and discs), and many of the larger, more complex fossils are only known from a few Lagerstätten with exceptional preservation. Much of our Precambrian record of life, thus, is of problematica—forms whose affinity and relationship to modern organisms is unknown and debated. In such cases as the complex morphologies preserved in the Doushantuo Formation in China, even domain-level affiliation (e.g., Bacteria versus Eukaryote) is contentious (e.g., Bailey et al., 2007; Xiao et al., 2007; Yin et al., 2007). *Neoproterozoic Geobiology and Paleobiology* is designed to explore some of the difficulties unique to studying the Neoproterozoic Era (1000–540 Ma).

The first half of the book is dedicated to the major types of eukaryotes that were thought to have existed by the end of the Neoproterozoic. First, Porter tackles the fossil record of heterotrophic eukaryotes through the Proterozoic, as heterotrophs are understudied in the Proterozoic and perhaps underrepresented in the Precambrian rock record. After a literature survey of putative heterotroph occurrences, Porter concludes that the true record of eukaryotic heterotrophs in the Precambrian might be obscured by preservational biases and our general current inability to discriminate between morphologically simple phototrophic and heterotrophic eukaryotic forms.

Chapters two, by Huntley et al., and three, by Xiao and Dong, are reports of using statistical morphometric methods to quantify the changes in the disparity of fossil forms across the Proterozoic. Chapter two presents the analysis of acritarchs, putative autotrophic phytoplankton; chapter three concerns the changes in carbonaceous compression fossils, putative macroalgae, but both types of fossils reveal similar morphological disparity trends: increases in morphospace in the early Mesoproterozoic (~1450 Ma), followed by long stasis until the late Neoproterozoic. This pattern, visible in both macro- and microscopic algae, is attributed at least in part to changes in nutrient cycling and availability through the Proterozoic.

Next the book moves further up the food chain, as chapters four and five address the fossil record of the earliest animals and their activities. First, Bottjer and Clapham examine the paleoecology of the late Neoproterozoic, studying how the community structure of the benthic marine biota seemed to change with the development of the new morphologies and ecologies of the Ediacaran fauna. Jensen et al. tackle the traces left by these earliest animals, attempting to elucidate the record of animal activities left behind in the Precambrian rock record. They first claim that many of the previous trace fossils reported in the literature are actually body fossils, as the simple morphology of these Proterozoic animals makes differentiation between the two types of fossils quite difficult. Nonetheless, while the diversity of these trace fossils might have been overstated in the past, there is still a record of the activities of Precambrian animals, a record that changes and diversifies toward the Cambrian boundary.

Next the book then turns inward, toward the genes. Erwin, in chapter six, analyzes the genetic underpinnings of body plans across a variety of organisms. By combining this information with strict phylogenetic control, Erwin is able to place constraints upon the genetic toolkits that would have been available to the urbilaterian—the last common ancestor of protostome and deuterostome animals. In turn, this provides information about what this early metazoan could, and, perhaps more importantly, could not have looked like. In chapter seven, Hedges et al. utilize the genetic sequences of these phylogenies differently for the fledgling field of molecular clock studies. This type of study uses the differences between RNA, DNA, and protein sequences across phylogenies to try to constrain the divergence times between different types of organisms. In addition to reviewing many of these studies, Hedges et al. attempt to match evolutionary timings from their molecular clock studies with observed events in the fossil record.

For the last two chapters, the book once again switches gears. Chapter eight is dedicated to a review of Neoproterozoic chemostratigraphy. As there is a paucity of geochronometrically constrained rocks in the Neoproterozoic and biostratigraphy is essentially impossible on a global scale, most researchers have turned to chemostratigraphy, augmented by lithostratigraphy, to correlate rocks. Halverson presents a composite $\delta^{13}C$ record through the Neoproterozoic, a framework on which he attempts to date and correlate several events across the globe. Finally, chapter nine presents a cautionary tale about these sorts of studies, as Corsetti and Lorentz examine Snowball Earth sections that were once correlated on the basis of their $\delta^{13}C$ and unusual lithologies,but now are revealed by radiometric dates to have been deposited hundreds of millions of years apart.

This book arose out of a Pardee Symposium at the annual meeting of the Geological Society of America in 2003. This symposium was designed as a survey of the views held by a variety of researchers in their explorations of the Neoproterozoic. Although only three of the articles in this resulting volume were papers read at the meeting, this book is similarly a collection of various views and techniques, rather than a unified synthesis of ideas. As such, it is too specific and yet too diverse to be a generalized introduction to the field of Neoproterozoic geobiology. For instance, neither Bacteria nor Archaea appear in the book's index, but these organisms are thought to compose the majority of the Earth's biota throughout the Precambrian. On the other hand, by dint of being so varied, *Neoproterozoic Geobiology and Paleontology* does provide a view of some of the unique challenges inherent in the study of the Precambrian, as well as of the excitement. After all, while the present may not be the key to the Proterozoic, it is fun trying so many different picks in our quest to open the door to understanding the Precambrian.

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Alison N. Olcott
Woods Hole Oceanographic Institute
Department of Marine Chemistry and Geochemistry
Woods Hole, Massachusetts 02543, USA
e-mail: aolcott@whoi.edu