



REVIEW

## A review of “*Rocks, Fossils and Formations: Discoveries Through Time*”

Woolrych, T.R.H. (2023). *Rocks, fossils and formations: Discoveries through time*. Clayton South, Australia: CSIRO Publishing.

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The book *Rocks, Fossils and Formations: Discoveries through Time*, written by Thomas R. H. Woolrych (2023) and illustrated by Anna Madeleine Raupach, invites young readers on a 4.6 billion-year-long time travelling adventure to explore how the Australian continent came to be and the geological processes that have shaped it throughout time. I read the book through a science education lens, knowing that geoscience, the study of the solid components of the Earth and processes acting on them, is often taught out-of-field (Hobbs & Törner, 2019) to young people who are not only interested in Earth’s history but also deeply invested in combating the climate crisis. Throughout my reading, I found that the information offered would be of great interest to those with an enthusiasm for environmental science and geography, because the repeated connections made between the biosphere, atmosphere, hydrosphere and lithosphere enable readers to “better understand the continent and surrounding oceans that support our lives and lifestyles” (p. 3).

Structured in six chapters, this creative journey takes readers first to the Hadean Eon (4.6–4.0 billion years ago) explaining the physics of stardust and the conditions for building planets and moons. Readers become familiar with Earth’s structure as the process of differentiation is explained. This is important information readers can return to as they learn about the mechanics of plate tectonics in the chapters following. Readers are introduced to zircons, minerals offering clues about Earth’s venerable past.

In chapter two, readers explore the Archean Eon (4.0–2.5 billion years ago) when Earth’s crust cracked, convection currents started driving the rock cycle and the first life forms emerged. There is a focus on photosynthetic cyanobacteria and stromatolite structures, descendants of which can still be found today in Western Australia. It is in this chapter that I began travelling all over present-day Australia using Google Earth Web Version 10.0 (n.d.) to explore places such as Mount Kosciuszko, Wave Rock, Hamelin Pool, Lake Mungo and other areas of significance.

Chapter three takes readers to the Proterozoic Eon (2.5 billion to 541 million years ago) when temperatures shift, supercontinents are on the move, and the atmosphere significantly changes with the Great Oxidation Event. Readers are introduced to the principles of sedimentary geology where they learn how to read geographic structures such as cliff faces and road cuttings. The formation of metamorphic rocks is explained using a baking analogy to make abstract concepts accessible to young readers. Geological processes that make up the rock cycle are used to illustrate

how some of Australia's most important resources were deposited. The chapter concludes with a focus on the Ediacaran Period, its namesake located in South Australia, when the multicellular organism *Dickinsonia* first emerged.

The following three chapters take readers into the Phanerozoic Eon. I complemented the information and images offered with the use of the Ancient Earth Globe (Webster & Scotese, n.d.) simulation to better understand how the environment and supercontinents were changing. Chapter four focuses on the Paleozoic Era (541–252 million years ago) when the climate is warmer than it is today and life on Earth is abundant . . . until what may be the greatest mass extinction event in Earth's history! Readers learn about plate boundaries, mountain building events on the Australian continent and life at extreme temperatures. They learn how to read mud and can try a simple investigation at home by mixing "water, mud, sand and pebbles in a jar" (p. 68). Plant and animal lifeforms, such as Baragwanathia fossils found near Yea and placoderms from the Gogo Formation, are explored and their adaptations explained. Finally, readers learn about deposits of natural resources.

In chapter five, readers explore the Mesozoic Era (252–66 million years ago) and the Australian dinosaurs evolving in a cool environment. We travel to the "dinosaur triangle," a region in Queensland bordered by Winton, Richmond and Hughenden, and learn about the Wollemi pine tree, which still survives today and can be viewed in botanical gardens around the world. During the Mesozoic Era, as the supercontinent Pangea and southern land mass Gondwana broke apart, the continent of Australia could be recognised. The chapter ends with the extinction of the large dinosaurs due to the Chicxulub impact.

Chapter six introduces readers to the Cenozoic Era (66 million years ago until the present day). During this era, readers learn about the rise of mammals and the importance of volcanoes in shaping the continent. This chapter has certainly added to my list of places to travel with both geological and cultural significance. For families visiting Victoria, the explanation of the formation of "the not-so twelve apostles" (p. 105) will be of interest. The section titled *The Secrets of Lake Mungo* explains where the earliest evidence of ceremonial burial and cremation has been preserved, offering insight into the cultural significance of the area for the Barkandji/Paakantyi, Mutthi Mutthi and Ngiyampaa peoples, the traditional custodians of the Willandra Lakes. Finally, readers are introduced to the carbon cycle and the human impact on climate change.

The book is concluded with an epilogue signalling the importance of geoscience in combating the climate crisis and resource management. The roles future geoscientists will play in space exploration and examining questions that are not yet answered will no doubt be of interest to budding geoscientists!

While reading with great interest, I found there were aspects of *Rocks, Fossils and Formations* that my science educator's lens homed in on as requiring improvement or complementary information. Although key scientific language was written in bold and a glossary of terms was offered, at times the information was too text heavy and could be complemented by further clarification. For example, page 49 uses the terms "atmosphere" and "bar" to measure pressure. These are units of measurement that need to be unpacked for young readers. In addition, key terms such as "density," "erosion" and "icehouse conditions" could be added to the glossary.

Many images complemented the text and were visually stimulating, particularly Raupach's representations of the formation and break up of supercontinents on page 94 and the present-day Australian plate on page 101. Others, however, may leave readers with unanswered questions. The representation of Bowen's Reaction Series on page 37 could use colour to represent the minerals more accurately. Olivine is represented in red when there was an opportunity to represent olivine as yellow/brownish-green. This would reflect samples that readers would encounter in nature, at museums or in classrooms. The image on page 81 depicting fossil evidence for continental drift signals the importance of *Glossopteris* yet other fossil distributions — *Lystrosaurus*, *Mesosaurus* and *Cynognathus* — that are included in the image are not explained.

Overall, *Rocks, Fossils and Formations* offers much insight into the origin and processes shaping the Australian continent in a way that would complement young readers', parents' and teachers' understanding of geoscience and Earth's systems science. The way Woolrych weaves the story of the rock cycle and plate tectonics with apt examples of rocks, minerals and fossils from geographic areas of significance is something that sets this book apart, particularly from science textbooks offered to school children where the rock cycle and plate tectonics seem to be offered as separate topics. Throughout the book there is a focus on how geoscientists use observation and modelling to understand the Earth. For instance, readers are introduced to the principles of sedimentary geology and invited to read realistic and artistic representations of geological maps, inquiry skills which can be applied as readers explore the geology of their local area. These strengths enable readers to grasp a wholistic understanding of the processes that shape the Australian continent.

Finally, this book would not only be of interest to aspiring geologists and their families, but also to teachers who have a keen interest in geology and/or for those who find themselves teaching out-of-field. The information offered in *Rocks, Fossils and Formations* can be paired with and serve to extend classroom activities that teachers use in the geoscience classroom such as modelling the rock cycle using crayons or candy and mining fruit cake. Rather than focusing on rock identification, which can be puzzling even for geologists, students might be encouraged to tell the story of a rock from the local area. This can be done by making macroscopic observations of the features of the sample and relating these to the environment in which the rock formed. The book offers ample examples of rock origin stories from all over the continent. Notably, there is a nod to the importance of Country as Tkukurpa stories are referred to and the secrets of Lake Mungo are briefly explored. Here is an opportunity for educators to pair geoscience with Indigenous innovation that has been occurring for at least 65,000 years (McNiven & Russell, 2023). As such, *Rocks, Fossils and Formations: Discoveries through Time* would make a welcome addition to teachers' personal and professional libraries.

## References

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## Author Biography

**Emily Elizabeth Rochette** is a Lecturer in Science and Chemistry Education at the Faculty of Education, The University of Melbourne. Emily has a strong interest in researching the out-of-field teaching experiences of science educators and exploring professional learning opportunities with pre- and in-service teachers.