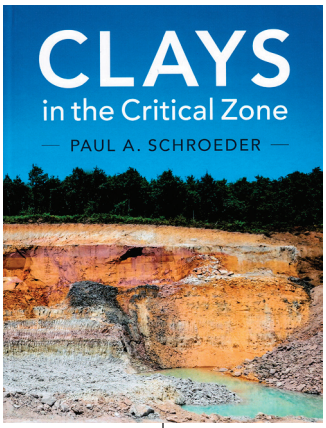
CLAYS IN THE CRITICAL ZONE[1]



The central importance of clays and clay minerals to our understanding of very many of the processes in, and functions of, the recently conceptualised "critical zone" is indisputable. The 2018 book *Clays in the Critical Zone* by Paul Schroeder is a timely contribution that, if you are not already swayed, will convince you of this fact. Mainly aimed at students, the book is divided into five parts and makes frequent use of an engaging conversational style, along with analogies and anecdotes to assist with its pedagogic aims. Paul is well known for his online teaching resources, and this book is an outgrowth of a course he teaches on clay mineralogy. No surprise, then, that there is also a useful online link (http://clay.uga.edu/CCZ/) to copies of all the figures from the book, as well as some spreadsheets that teachers and students alike will find a most useful resource.

The opening two chapters of the book are both quite short. Between them they provide concise introductions to the definitions of "clay", "clay mineral", and "clay size", along with the classification of clay minerals, the concept of "the critical zone" and the historical, political and human context to the development of the broad field of clay science. Emphasis is placed on the concept of the critical zone, not as a rebranding but as a recognition that the complexity of its defining components and processes requires its investigation to be undertaken by an integrated cross-disciplinary approach. Additionally, the case is made for a new approach to clay/soil mineralogy data management by way of example of the difficulty of rational analysis of previous research on hydroxy-interlayered clay minerals, as expounded by Carolyn Olson in her talk at Euroclay 2015 (Olson 2015). This is a point well worth reiterating, and I firmly believe that, as a basic first step, we must wholeheartedly subscribe to improve clay mineralogical data management if we are to get a firm grasp on the comparative ability that the networked study of the critical zone both offers and requires. My only disappointment in these opening chapters was the introduction to the various crystal chemical concepts, which are key to understanding the classification that is applied to clay minerals. The pathway through this material (to be fair, all of which is there) is rapid and, in parts, staccato. I think this could, unfortunately, leave it somewhat foggy for newcomers to the field.

The next chapter (Chapter 3) is a hefty one. It constitutes over one-third of the book and is devoted to the arsenal of diffraction, spectroscopic and thermal instrumental methods that are most commonly employed in the characterisation of clays and clay minerals. Emphasis is placed on the multi-technique approach to clay mineral characterisation, and students of the critical zone will find this chapter provides a series of very nicely paced and progressed introductions to many of the methods that they may need to understand before they delve into more specialised texts. I did wonder if the long and detailed explanation of junction probabilities, which is required to understand modelling of oriented diffraction patterns of mixed-layered clay minerals, is something that could have been dealt with in a shorter format using judicious citations to other, more detailed, texts on the topic. Chemistry is next up, and this chapter (Chapter 4) provides a good overview of a variety of geochemical concepts that help to understand how and why clays form where they do, including a walkthrough of the construction of a phase diagram. My only comments on the chemistry chapter are that the presentation of ion exchange seemed to me overly complex in parts, and some readers may also have wished for more coverage of the biological dimensions of clays in the critical zone.

Chapter 5 on critical zone clay sequences was the chapter I was most looking forward to and is, in my view, the most important part of the book. It begins with an introduction to the approaches that are used to evaluate change and rates of change when examining weathering and clay mineral distributions in the critical zone. The application of these approaches within the framework of various sequences – chosen to isolate the influence of one major soil-forming factor, including litho-, bio-, chrono-, climo-, and toposequences – is illustrated with detailed examples for all but the climosequences. Students and researchers alike will find this chapter a very useful compilation of examples that mainly detail the integration of chemical and X-ray diffraction data. I was, however, expecting some final synthesis that, among other things, might point the way forward in terms of how we may more readily compare and contrast such examples in the future, as part of the network of effort that is required to advance our understanding of the critical zone: but there was none.

In summary, this book is a very useful addition to the subject of the critical zone, weathering and soils. All students will wish to consult it. The aim is set out in the preface: "[T]o emphasize the importance of clay minerals in the context of this complex 'thing' we call the Critical Zone." It certainly achieves that aim with a wide and impressive coverage of the key topics.

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REFERENCE

Olson C (2015) The search for soil hydroxy-interlayered vermiculites: a case for data stewardship. Programme and Abstracts Volume, Euroclay 2015, Edinburgh, UK. Mineralogical Society, p 355

1 Schroeder PA (2018) Clays in the Critical Zone. Cambridge University Press, 252 pp, ISBN (print) 9781107136670; ISBN (e-book) 9781108691857