Acta Geologica Polonica, Vol. 64 (2014), No. 3, pp. 351–352
DOI: 10.2478/agp-2014-0018

BOOK REVIEW

Gąsiewicz, A. and Słowakiewicz, M. 2013. Palaeozoic climate cycles: their evolutionary and sedimentological impact.

Geological Society Special Publication, **376**, 1–586. The Geological Society London.

The causes of historical climate changes are a continuing subject of heated discussions, in which political and economical aspects often dominate over the climatological facts. Although it seems indisputable that the discussed changes are a reality, the basic controversy concerns the influence of human activity on their magnitude. Geologists have entered into the discussion relatively late, but they have clearly widened the range of the discussion by the addition of climate changes recorded in various Phanerozoic successions. The present book perfectly fits in the mainstream of this discussion.

The attractive book title, suggesting analysis of climate throughout the Palaeozoic, does not correspond very accurately to its content. In fact, the book focuses on the climatic changes only of the Late Palaeozoic, particularly those which occurred during the last 100 Ma of the Carboniferous and the Permian. This was really a very specific period of Earth's history; comprising a geographically extensive and long-lasting glaciation followed by a time of dry and hot climate. Simultaneously, geotectonical processes led to numerous changes of continent configurations and sea level, and finally to the greatest mass extinction in Phanerozoic history. There are numerous and readily recognizable indirect indications of Earth's climate changes in the stratigraphic record of the interval under discussion.

The book came about from the palaeoclimatic session held at the European Geosiences Union General Assembly Conference in Vienna (2011) and includes 22 papers. As usual, in the case of such sets of papers, their correspondence with the main subject of the book is variable. In a few cases, the main subject of the paper is strictly sedimentological, stratigraphical or regional, and any climatic aspects seem to have been added as an afterthought. However, such papers are the exception, and most of the papers concentrate largely on discussion of past climate changes.

All of the papers are grouped formally in five chapters but they can actually be classified into three main topics: general remarks on the Late Palaeozoic climate, stratigraphy and palaeogeography; Carboniferous case studies; and Permian case studies. Incidentally, the book editors were not particularly attached to the chapter subdivision, because the chapter titles are presented only on the contents page, and not in the text.

The choice of the four papers that open the book is very sound and the papers are particularly informative. **H. Wofner** analysed climate changes and their sedimentological record in the Carboniferous–Permian time interval. This is a very competent synthesis of recent knowledge of the development of the Carboniferous–Permian glaciation and it provides a brief description of the key world sections, an excellent starting point for further reading of regional case studies. Extremely interesting in the context of present-day discussion is the final conclusion that the variations in CO_2 concentrations are not a very convincing cause of global temperature changes. As it proved in the case of the Quaternary glaciation, "rising temperature preceded the increase of atmospheric CO_2". According to this author, the causes of climatic changes are evidently more complex and were caused by "...forces emanating from our galaxy (cosmic ray influx, magnetic intensity, gravitational vectors) and their variation over the course of a galactic year (the time for the solar system to orbit the core of the galaxy)".

X. Wang and an assembly of Chinese and Japanese authors summarized the state of knowledge of the Carboniferous of South China. They presented a description of evolving brachiopod, fusulinacean and conodont assemblages in Chinese sections in the context of climate change. Although the paper could be assigned to the group of papers where the climatic context is of secondary importance, the article is an extremely useful synthesis of modern knowledge of the Chinese Carboniferous.

Similarly synthetic in character is the paper by **Zubin-Stathopoulos *et al.*** on the Pennsylvanian–Permian carbonates in the north-west part of Pangea. The general subject of their observations is the very broad interval starting from the Serpukchovian (upper part of the Mississippian) and ending in the latest Permian in the classical region of east-central British Columbia. Microfacies analysis enabled warm and cold cli-

matic zones to be distinguished and to be assigned to the changing palaeogeographies.

The last of the papers included in the basic chapter is dedicated to a summary of the Zechstein magnetostratigraphy. **M. Szurlies** showed that the duration of the Zechstein (max. 3.5 Ma) was shorter than hitherto accepted and that the Permian/Triassic boundary was located within the continental deposits of the lowermost Buntsandstein. This conclusion had been proposed earlier by some Polish stratigraphers, and it was satisfactory that this hypothesis was now confirmed by magnetostratigraphic data.

The second basic set of articles is connected with the Carboniferous and the Pennsylvanian/Permian boundary interval, i.e. with the time of the great Gondwana Glaciation. In continental sections the recognition of climatic changes is difficult and therefore it is not surprising that most of the investigations are concentrated on eustatically controlled sedimentary cyclicity resulting from changes in volume of the southern continental ice sheet. Direct consideration of climate variations appears almost by accident in this chapter, and at times this gives the impression that climatic conclusions were added at the request of the reviewers or editors. Nevertheless, there are at least two papers, which describe very precise methodological tools. The first one (**U. Gebhardt** and **M. Hiete**) is devoted to the Carboniferous of the Saale Basin (Germany) and proposes an interesting procedure for distinguishing between auto- and allocyclicity in continental red beds of the Variscan intermontane basin (Pennsylvanian). The second one (**M. Waksmundzka**) is an example of the application of sequence stratigraphy in the correlation of Carboniferous sections between eastern Poland and western Europe, with innovative conclusions on the continuity of sedimentation. Neither paper concentrates on climate issues but they are both very interesting methodological contributions to stratigraphy.

The last set of the papers is the most extensive and concentrates on Permian topics. They include direct climate-related interpretations based on geochemical analysis and provide quantitive data of specific climatic components. The best example is the analysis of carbon and oxygen stable isotopes in samples from brachiopod shells by **J.K. Nielsen *et al.***, which enabled recognition of seasonal climate changes in two different geographical zones, represented by Spitsbergen (20ºN–45ºN during the Permian) and Central Poland (Kajetanów – 30º farther to the south). Equally interesting is **H. Kiersnowski's** paper, with the reconstruction of wind directions, dependent on climatic fluctuations during the Permian in western Poland. This is a very elegant example of the application of pure sedimentological data to the interpretation of past climates. Another example of such climatic implications drawn from sedimentological observations is the interpretation by **G. Czapowski** and **H. Tomassi-Morawiec** of the bromine content in salt, the key supposition being the connection of this indicator with variations in climate humidity.

This part of the book is very well integrated and the component papers have been carefully selected. This most probably results from the personal interest of the book editors, **A. Gąsiewicz** and **M. Słowakiewicz**, whose scientific activity is focused on the widely interpreted geology of the Southern European Permian Basin. Their joint article, in the final part of the book, is devoted to the nature of hydrocarbons in the Zechstein Main Dolomite of Poland. In contrast to the older hypothesis on the Carboniferous source of the hydrocarbons, they argued that the majority of the hydrocarbons derived from *in situ* organic matter.

The quoted examples, although selected slightly tendentiously, confirm the general impression after reading the book that strict climatic considerations constitute the addenda rather than the basic conclusions. However, this does not reduce the importance of this valuable and useful book. It is especially worthwhile for all geologists who investigate Late Palaeozoic successions. In conclusion, this excellent set of case studies can be thoroughly recommended and it needs to be in all institutional libraries.

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