

BOOK REVIEW

KNAUST, D. & BROMLEY, R. (eds). 2012. *Trace Fossils as Indicators of Sedimentary Environments*. Developments in Sedimentology, vol. 64. 924pp. Elsevier. Price £120.00. ISBN 978 0 444 53813 0. doi:10.1017/S0016756813001118

Dirk Knaust and Richard Bromley have compiled a comprehensive and diverse review of all aspects of the current understanding of trace fossils and their distributions. At over 900 pages in length, divided into 28 chapters produced by over 80 world-leading authors and co-authors, this book represents a thorough and wide-ranging text that provides both an introduction to, and a detailed review of the current understanding of the study and applications of trace fossils (ichnology). One of the key strengths and attractions of the book is that it draws on the expertise of leaders in their individual fields to contribute concise chapters that summarize the state of the art in these fields. The book is divided into three main sections: the first focuses upon concepts and methods in ichnology; the second on detailed analysis and descriptions of the trace fossils encountered in important depositional environments; and the third on the industrial applications of trace fossils to hydrocarbon and aquifer reservoir quality assessment.

The first section of the book contains chapters which clearly summarize important themes that provide the foundations of the study of ichnology. The opening chapter on the history of ichnology (Baucon *et al.*) is interesting, and provides some insights that are all-too-rarely encountered and appreciated in other texts and journals. Other important contributions to this section include chapters on ichnotaxonomy (Rindsberg *et al.*), ichnofacies (MacEachern *et al.*), ichnofabric (Ekdale *et al.*) and sequence stratigraphy (MacEachern *et al.*), all of which provide coherent and concise modern summaries. These chapters will be of use to students and anyone seeking a clear introduction to the study and description of trace fossils. In addition to these helpful reviews, other papers in this section provide new approaches and methodologies, examples of original research and new ideas. Personal highlights from this section include the proposal of a new objective, feature-based scheme for the classification of the 585 valid ichnogenera (including burrows, borings, trackways and trails; Knaust), and a nicely illustrated chapter outlining the linkages between physical and chemical conditions, behaviour and burrow morphology in modern shallow marine settings (Dashtgard & Gingras).

The second (and longest) section is where I think this book really stands out from other ichnological texts: by providing detailed reviews of the conditions, processes, settings and ichnology of 16 major depositional environments. In contrast with other ichnological texts, this book does not attempt to provide a detailed photographic atlas of trace fossils, extensive descriptions of commonly occurring trace fossils or thoughts on the evolutionary trends of trace fossils through geological time. Instead, the environments and trace fossils of each of the selected depositional settings is described by different groups of specialists who draw on their collective experience working on field and/or subsurface examples from these depositional environments. This makes the text an important reference for anyone wishing to use trace fossils as a tool in sedimentology and facies analysis. A further

strength of this text is that it not only includes the traditional fields of clastic-dominated environments, but also includes chapters describing trace fossils from deep and shallow marine carbonates, and mixed lithology settings. Broad depositional environments are also divided into small sub-environments (e.g. shallow marine settings are divided into five sub-environments and continental settings into four sub-environments), in order to provide very detailed descriptions of individual settings. I was pleased to find that this book provides in-depth reviews of depositional environments which may lack equally detailed treatment elsewhere, for example glacial settings (Netto *et al.*) and the continental slope (Hubbard *et al.*). Other depositional environments that have been well documented elsewhere are strongly represented by well-illustrated, concise chapters (e.g. lacustrine settings: Scott *et al.*; and deep sea fans: Uchman & Wetzel). Most chapters contain useful summary diagrams of the trace fossil distributions across the environment in question. Individually these chapters represent useful additions to the literature, containing a good balance between summaries of current understanding and personal research examples, observations and insights. The high-quality illustrations, colour figures, diagrams and extensive reference lists provide effective and useful summaries of each depositional setting. These chapters will be of value to anyone who is trying to engage more closely with the ichnology of particular depositional settings, including advanced students, researchers and professional sedimentologists and ichnologists.

Lastly, this book contains a comparatively short section that reviews the industrial impacts of ichnology, by examining the impacts of bioturbation on porosity and permeability (Gingras *et al.*), and specifically the impacts of burrow systems on carbonate aquifers (Cunningham *et al.*). While some may be disappointed that this section is comparatively brief, these are emerging fields of research. By including this section this book again stands out by providing an overview of the current methods, techniques and potential applications of trace fossils to reservoir characterization.

As the applications of trace fossils are becoming ever more appreciated, this book represents a timely and valuable addition to the literature. The editors deserve congratulating for their ambition to start, and the motivation to complete this major multi-author work, as well as for their attention to detail in ensuring the high quality and consistency between all chapters. I expect that this text will be widely used as a key reference by a wide range of readers. These may include anyone either wanting an introduction to trace fossils, or those using ichnology as a tool in topics such as facies analysis and stratigraphy. While students and non-experts are likely to be drawn to the introductory chapters and review sections, it is to be recommended to more experienced workers and professionals who will be attracted by detailed sections that include original research data, methodologies and personal insights. Because of the focus on the integration between environment and trace fossils, the readership of this book should also extend from ichnologists to palaeobiologists and sedimentologists.

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