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Diagenesis of Sedimentary Sequences

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Contents

Diagenesis and Sedimentary Sequences—Introduction

The meeting on 'The Diagenesis of Sedimentary Sequences' was held in Liverpool on 30 September and 1 October 1986 under the auspices of the British Sedimentological Research Group (BSRG), a Specialist Group of the Geological Society.

The aim of the meeting was to bring together an international group of research workers on carbonate and clastic sediments, to discuss the major controls on sediment diagenesis from deposition to deep-burial. This book contains a number of the papers presented at the meeting, together with one that was offered but which the authors were unable to present. I believe that these papers are a good reflection of the proceedings of a lively and diverse meeting, attended by around 150 representatives of universities, governmental organizations and industry from nine different countries.

I leave readers to delve into the papers for themselves but would like to take this opportunity to reiterate some of the points that I raised at the meeting concerning diagenesis and the way in which it is approached.

Diagenesis is an integral part of the history of the fill of a sedimentary basin and needs to be treated as such. In order to understand the post-depositional history of a sedimentary rock or, in an industrial context, to understand the evolution of its reservoir properties, we must use information from more general geological studies. A knowledge of depositional setting, facies architecture and burial history are all invaluable in the deduction of a well-constrained diagenetic history. Similarly, quantitative diagenetic investigations may contribute information, particularly about pore-fluid evolution and temperature changes, which needs to be taken into account by those concerned with broader syntheses of basin history and hydrocarbon prospectivity.

Many published works on diagenesis and indeed most of those in this book, are concerned with the post-depositional history of a single lithological unit, or even a particular phase within a unit. As the author of a paper on the diagenetic adventures of just three ammonites (Marshall 1981) I can scarcely be too critical! Such studies concentrate attention on the interesting but perhaps atypical features of the sediment. They are undoubtedly useful in determining the local controls on diagenesis: indeed they often reveal just how complex the interaction of processes (cementation, neomorphism, compaction and dissolution) can be. However, if we only work on the small scale, it becomes difficult to determine what is typical of a sequence as a whole and indeed what is regionally rather than just locally significant.

It is extremely difficult to be objective in sampling for any geological study and this is particularly true for diagenetic investigations. Material is often only available from a restricted area of the basin (determined by outcrop pattern or on a structure that has been drilled for hydrocarbons) and our attention is automatically drawn to the 'different'. Even with careful sampling we can only ever hope to look at a minute proportion of what is there; a colleague once estimated that he was being asked to assess the reservoir potential of a North Sea reservoir unit on something like $10^{-15}\%$ of the rock in the area! We should always be aware of this! Having said that, it is interesting, and I think particularly welcome, to see that in a number of the papers in this book authors have been able to pool sufficient data to treat diagenetic evolution in a regional context.

In organizing the meeting one of the main aims was to enable specialists from different areas to talk to each other. The ways in which rocks of one type influence the diagenetic evolution of other sediments within the same sedimentary sequence are far from clear. We might, for example, expect chemical and isotopic buffering to preclude extremes of acidity, alkalinity or even geochemical values as fluids pass from one rock type to another. All too often however, in diagenetic studies, authors invoke a source, for ions, acids, fluids or whatever, from outside the rocks that they are studying. Too often, in the past, they have not considered the feasibility of reactions or the problems of mass balance or transfer.

Mudrocks are a fine example of an oft-quoted source or sink that we have yet to fully understand: they are, after all, fine-grained, and full of reactive organic and inorganic chemical species which can, through compaction, be expelled into adjacent sandstones and limestones. Several recent studies have shown that mudrocks have complex diagenetic histories and have indicated that many reaction products may stay very close to where they started. It is a shame that for a number of reasons more of the 'mudrock' papers presented at the meeting are not included in this volume.

Conduits also tend to be poorly understood by workers in our field. Faults, for example, are commonly invoked as carriers for fluids, which travel up (and occasionally down) the sedimentary pile, yet the same fractures are known to seal hydrocarbons in place. Clearly, then, we need a more integrated approach to constrain our grander conclusions. There is certainly scope for detailed,

quantitative petrographic studies of mudrocks (now possible with modern back-scatter electron microscopy) and a need for us to talk to structural geologists. Organic geochemists and thermal modellers also have a lot to offer the diagenetic investigator.

In planning the meeting and the layout of this book, to be consistent with the ideas expressed above, I have tried to avoid grouping papers on purely lithological grounds. In the book therefore the papers are, perhaps somewhat arbitrarily, arranged into three sections. The first contains a collection of papers on 'Diagenetic Processes', the second on 'Early Diagenesis' and the third on 'Regional Studies and Burial Diagenesis'; each contains papers dealing with both clastic and carbonate rocks. I hope that readers will have a look at papers that lie outside their direct field of specialization.

Finally I would like to express my thanks to all the people who have helped in the organization of the meeting and the preparation of the book. Generous financial support for the meeting was provided by grants from the Geological Society and the Royal Society, and donations from BP (London), BP Research, Britoil, Esso and Shell; the funds to enable colour printing were provided by the authors' employers, the authors themselves and by additional donations from Esso and BP. The success of the meeting was due in large part to the Liverpool postgraduates and technical staff who took the whole thing over and ran it very smoothly! (Thanks go to Steve, John, Greg, Greg, Jim, Paul and Hilary.) My gratitude, for all their work, goes to the contributors, both to the meeting and the book, as it does to the forty or so reviewers who have put so much effort into manuscripts and maintaining scientific standards. Nick Parsons of Blackwells helped ensure rapid publication and Hilary Davies prepared the index. I am especially grateful to my wife, Lesley, who has shown great patience and given enormous support, practical and moral, throughout the whole enterprise.

JIM MARSHALL
Liverpool, Easter, 1987

Reference

MARSHALL, J. D. 1981. Zoned calcites in Jurassic ammonite chambers; isotopes, trace elements and neomorphic origin. *Sedimentology*, **28**, 867–87.