

Sedimentary Responses to Forced Regressions

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Sedimentary Responses to Forced Regressions

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Preface

An increasing number of studies in recent years have demonstrated that significant progradation of shallow marine systems occurs under conditions of base-level fall. These new data are forcing many sedimentary geologists to critically re-evaluate many aspects of sequence stratigraphy relating to erosion and deposition during base-level (lake - or relative sea-level) fall, and the intrinsic link made between stratal geometries and base-level change. For the first time, this volume brings together a collection of articles that focus solely on forced regressions, providing a more complete picture of the development, formation, variability and preservation of the surfaces and deposits generated during base-level fall.

There were three main stimuli for bringing this volume to fruition. The first was interest expressed in the stratigraphic surfaces and stratal units developed during base-level fall, and the processes responsible for their formation and preservation. The second was the controversy concerning the position of the sequence boundary with respect to forced regressive deposits, and suggestions that sediments deposited during base-level fall should be incorporated within a fourth systems tract. The third objective was to provide a discussion forum dedicated to new ideas and data that could address the conceptual and practical problems related to the recognition and differentiation of the stratal surfaces and units generated during forced regression from those formed during base-level rise. Thus, the volume was conceived to try and resolve controversial issues, but more importantly aimed to emphasize the significant progress being made in understanding sedimentary responses to forced regression, and the important implications of these findings have for the understanding and interpretation of the rock record.

The volume comprises three natural groups of papers. The first group contains two papers that give an overview of the main concepts, models and practical issues related to deposition during base-level fall and provide important background for those readers unfamiliar with the subject. The second uses mainly sedimentological and geometrical criteria to identify forced regressive deposits and infer base-level changes. This group of papers contains an article from northern Greenland, two studies of Triassic and Jurassic strata from northern Europe, and a collection of three articles from the Late Cretaceous Western Interior Seaway of North America. The latter complement the first overview paper that also presents and utilizes data from the Western Interior Seaway. The third group begins with an exploration of forced regressive deposits in active tectonic settings. The main thrust of papers in this section focuses on the Late Pliocene–Recent where biostratigraphic and radiometric dating allows direct comparison of the stratigraphic units and the bounding surfaces formed against a well-constrained high-frequency, high-amplitude glacio-eustatic signal once the subsidence/uplift history of an area is known. It is in these settings that sequence stratigraphic concepts and models related to base-level fall can be most rigorously tested.

In an attempt to provide coherence between the wide range of geological settings and age of the strata discussed in this volume, authors were requested to address at least one of seven important issues related to forced regressions: (i) criteria for the recognition of forced regressive deposits and for their differentiation from strata formed during base-level rise, (ii) the expressions of the bounding surfaces to forced regressive strata and their variability, (iii) changes to facies and facies stacking patterns during forced regression, (iv) controls on the preservation potential of the surfaces and strata formed during base-level fall, (v) along strike and down-dip variability in forced regressive deposits as a function of differences in relative sea-level change, physiography and sediment supply, (vi) the placement of the 'main' or 'master' sequence boundary with respect to forced regressive deposits and (vii) implications for existing sequence stratigraphic models and concepts.

Collectively, the articles in this volume clearly show that sediments deposited during base-level fall can play a significant role in the outbuilding of continental margins and in the progradation of depositional systems in general. They provide an important discussion of the practical issues related to the recognition of key stratal surfaces and sediments formed during forced regression both outcrop and subsurface datasets. Significantly, many of the papers challenge the notion that there is a simple relationship between stratal geometry and base-level change, and provide important insights as to why the importance of sediments formed during forced regression has often been overlooked in the past. The reasons for this oversight appear to be due to practical problems related

to the recognition of strata deposited during forced regression, apparently resulting from the formation/preservation of non-diagnostic stratal geometries, combined with the effects of postdepositional tilting, deformation and incorrect choice of datum. The results of the studies published here will be of interest to all geologists attempting to understand the relationship between changes in base-level and stratigraphy, and to all who use sequence stratigraphy as a method of stratigraphic correlation and interpretation at outcrop and in the subsurface.

As with any volume, the generous donation of time and financial help from many sources is essential. In this regard, we would like to thank Elf Aquitaine, Esso Exploration & Production UK Ltd, BP Exploration Operating Company Ltd and Norsk Hydro for their generous financial support, and to the Geological Society and the British Sedimentological Research Group for their invaluable logistical and financial contribution. At the University of Manchester we thank Marina Raven for secretarial help, past PhD students including Fiona Burns, Matt Docherty, Pierre Eliet, Matt Hall, Lesley McMurray, Andrew Quallington and Andrew Thurlow for their superb help in organising the original conference, and Dave Owens for his special projection skills. Finally, it would have been impossible to compile this volume without the invaluable contribution of time and effort by the referees, to whom we wish to extend sincere thanks on behalf of ourselves and the authors herein. They are: Bruce Ainsworth, Hubert Arnaud, William Fitchen, Bob Carter, Francesco Chiocci, Richard Collier, Trevor Elliott, Evan Franseen, Bruce Fouke, Mark Harris, Bruce Hart, William Helland-Hansen, Francisco Hernández-Molina, John Howell, Peter Johannessen, Steve Johnson, Tim Naish, David Piper, Philip Playford, Guy Plint, Andy Pulham, Ian Sharp, Don Swift, Kevin Taylor, Maurice Tucker, Tjeerd van Andel, Dave Waltham and several others who wished to remain anonymous. Cath Hunt, Ian Sharp and Mike Young are thanked for carefully reading through various edited versions of some of the papers included here. At the Geological Society we would thank Angharad Hills and Andrew Morton for their editorial assistance and advice.

We dedicate this volume to the memory of our friend and colleague, Marina Raven, who assisted with the organization of the conference and who sadly passed away during the preparation of this volume.

*D. Hunt
R. L. Gawthorpe*