Analogue and Numerical Modelling of Crustal-Scale Processes

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Analogue and Numerical Modelling of Crustal-Scale Processes

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Preface

As Earth's crust is the most accessible part of our planet, a wealth of information on its structure and composition is available from geological observations and geophysical measurements. Its shape and composition today are, however, the result of processes occurring at different scales in time and space, rendering study of the crust a complex and challenging undertaking. Field observations and seismic data, for example, confront us with the present day structures and must, for an in-depth understanding of their origin, be reconciled with the processes of deformation that created them. Reconstructing these processes in the past is commonly hindered by lack of continuous outcrop, limited depth resolution and little to no constraints on time. Analogue and numerical models may help improve our understanding of crustal-scale processes through their ability to simulate the birth and evolution of deformational structures at different scales. In this context, the link between theory and observations makes modelling a fundamental tool for the study of processes that alter the Earth's crust.

This volume presents new analogue and numerical model studies of natural processes contributing to the state of the Earth's crust. It shows the insights offered by models over a broad range of tectonic problems, in all cases carefully documenting the model approach used. By 'model' we mean an approximation of a physical process that will help further our understanding of the process itself, the measurable or observable structures that result from it, and the parameters that control it. Models allow us to set the boundary conditions, study the effects of parameter variations and perform sensitivity analyses. By their nature, they are, however, always a simplification of reality. As the words imply, an analogue model represents a scaled analogue of a natural structure, scaling not only the dimensions, but also the forces and material (for example, sand or clay) properties. A numerical model is a mathematical description of the natural situation, whereby aspects of processes are chosen that are of interest and can also feasibly be captured in equations. Both modelling techniques allow us to generate hypotheses regarding crustal-scale processes that can be tested against the results of field observations and geophysical studies.

The volume is divided into five sections:

- *Analogue and numerical sandbox models* tests the reproducibility of models between different laboratories and the suitability of different numerical solution methods for reproducing sandbox results.
- *Models of orogenic processes* describes processes influencing styles of orogenic deformation at convergent plate margins.
- *Models of sedimentary basins* discusses different aspects of extension, inversion and hydrocarbon migration within extensionally-formed sedimentary basins.
- *Models of surface processes and deformation* focuses on links between crustal-scale deformation and erosion processes at the Earth's surface.
- *Models of faults and fluid flow* discusses faults, important for short-term seismicity and their long-term effects on crustal strength, and fluid flow, which is crucial for oil reservoir studies.

The origin of this volume lies in GeoMod2004, an international meeting on analogue and numerical modelling of geological processes, held in Switzerland in June 2004. We would like to thank our co-organizers, Giovanni Bertotti and Paolo Ruffo, and all the participants of GeoMod2004, who provided the stimulus for editing this volume. Sixteen of the 23 papers in this book were presented or initiated at this conference. We thank the Geological Society Publishing House and especially Angharad Hills, Staff Editor, Helen Floyd-Walker, Production Editor, and Bob Holdsworth, Society Books Editor, for all their help in the publication of this book.

Susanne Buiter
& Guido Schreurs

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