Cenozoic Foreland Basins of Western Europe

Geological Society Special Publications
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MASCLE, A., PUIGDEFÀBREGAS, C., LUTERBACHER, H.P. & FERNÀNDEZ, M. (eds) 1998. *Cenozoic Foreland Basins of Western Europe*. Geological Society, London, Special Publications, **134**.

PHILLIPPE, Y., DEVILLE, E. & MASCLE, A. 1998. Thin-skin inversion tectonic of oblique basin margins: example of the western Vercors and Chartreuse subalpine massifs (SE France). *In:* MASCLE, A., PUIGDEFÀBREGAS, C., LUTERBACHER, H. P. & FERNÀNDEZ, M. (eds) *Cenozoic Foreland Basins of Western Europe*. Geological Society, London, Special Publications, **134**, 239–262.

GEOLOGICAL SOCIETY SPECIAL PUBLICATION NO. 134

Cenozoic Foreland Basins of Western Europe

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1998
Published by
The Geological Society
London

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Published by the Geological Society from:
The Geological Society Publishing House
Unit 7, Brassmill Enterprise Centre
Brassmill Lane
Bath BA1 3JN
UK
(*Orders*: Tel. 01225 445046
Fax 01225 442836)

First published 1998

British Library Cataloguing in Publication Data
A catalogue record for this book is available from the British Library.

ISBN 1-86239-015-0

Typeset by Type Study, Scarborough, UK

Printed in Great Britain by
The Alden Press, Osney Mead, Oxford, UK.

Distributors

USA
AAPG Bookstore
PO Box 979
Tulsa
OK 74101-0979
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(*Orders*: Tel. (918) 584-2555
Fax (918) 560-2652)

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Foreword

This book results from the Integrated Basin Studies Project (IBS), which ran during 1992–1995 with the support of the European Commission DGXII. Several papers have been added to the ones resulting directly from IBS, in order to offer the reader a more comprehensive overview of Western Europe's Cenozoic foreland basins. I warmly thank the authors for their much appreciated contribution.

Two other books resulting from IBS will be published in the near future by the Geological Society, completing a series of three books devoted to field studies of European Basins: one will be on the Mediterranean extensional basins within the Alpine orogen and the other will be on the Norwegian rifted margin.

A series of papers on compaction of fine-grained sediments, which was also an important theme of the IBS project, has been accepted for publication in *Marine and Petroleum Geology*.

The IBS project was born at a meeting held in Strasbourg in June 1989 on the initiative of Hubert Curien, former French Minister for Research and Technology. The meeting was aimed at defining promising new avenues of research in Geosciences. It was said that, one such avenue would be research on sedimentary basins, not only for its intrinsic scientific interest, but also because it is upstream of strategic economic activities, such as the oil and gas industry, the management of water resources and the storage of wastes. Also, most human activities take place at the surface of sedimentary basins. These activities are developing exponentially, resulting in a rapid growth of risks and environmental problems, which cannot be mastered properly without an improved knowledge of sedimentary basins at all scales, including knowledge of the physical framework of their development.

It was also mentioned at this meeting that deriving concrete applications in this research would be more effective by designing models of basins and sub-basin formation and evolution through to increasing co-operation, not only between 'geological' disciplines such as structural geology, sedimentology, geophysics and geochemistry, but also between 'geological' disciplines and 'non-geological' disciplines such as fluid and rock mechanics and thermodynamics. At this stage, numerical modelling techniques were believed to provide the necessary link to integrate these disciplines toward a quantitative earth model.

In this spirit, a panel of European researchers met several times in Brussels and designed the IBS project, which was proposed to the DGXII of the European Commission. The DGXII decided to support it after some modifications and integrated it into the Geosciences project of the Joule 2 programme. Many thanks are due to DGXII experts and executives and particularly to J. C. Imarsio and J. M. Bemtgen for having accepted this project and having helped to make it realistic and effective. IBS teams are also indebted to M. Rougeaux, Managing Director of Groupement d'Études et de Recherches en Technologie des Hydrocarbures (GERTH) who was of invaluable help in the management of the project.

The main concept of the IBS project was to create methods and techniques of modelling in which the main physical phenomena responsible for formation, development and the infilling of sedimentary basins or sub-basins are linked, starting from deep lithospheric deformation caused by the convective movements of ductile matter in the upper mantle.

Critical components of such modelling were as follows.

- The capacity to make a sound description of the mechanical linkage between deformation and near-surface deformation in order to produce the geometrical evolution of basins and sub-basins. This has to be possible in extensional and compressional tectonic contexts.
- The capacity to couple the above models with simple but realistic models of linked erosion and sedimentation processes.
- The capacity to couple the whole with a model of fine-grained sediment compaction in order to incorporate the effect of sediment loading and water escape on sediment deformation.

The final objective was to obtain practical information such as the architecture of the basin or sub-basin fill (down to the reservoir scale) and its evolution through geological time, evolution of the temperature stresses and fluid-pressure regimes.

Such methods and techniques aim also at a better design of reservoir geological models and therefore contribute to the improvement of field development planning.

In order to reach set goals, IBS teams used the following method:

(1) Starting from prototypes conceived mainly by a team from Vrije University in Amsterdam (S. Cloetingh *et al.*), models have been developed by using the present knowledge of the rheology of crust and sediments and by using the documentation already available on various thoroughly studied basins in different tectonic settings. At the same time a task force, under the leadership of a team from Newcastle University (A. Aplin *et al.*) undertook the revision of the knowledge on the compaction of fine-grained sediments and the modelling of the corresponding phenomena using theoretical, experimental and observational approaches.

(2) A small number of European basins, set in appropriate tectonic contexts, have been taken as natural laboratoires and carefully documented for the interaction of tectonic and sedimentation processes using extensive synthesis of seismic, well and field data.

These basins were as follows.

- Rifted basins within the Alpine orogen: the Gulf of Lions in France and the Pannonian basin in Hungary studied under the leadership of the University of Montpellier (M. Seranne *et al.*) and of the Eötvös–Lorand laboratory in Budapest (F. Horvath *et al.*).
- Foreland basins (this volume: South Pyrenean basins and the Guadalquivir basin in Spain, the molasse basin in Germany and the Barreme syncline in France studied by teams of the University of Barcelona (M. Marso *et al.*) of the Institut de Ciencas de la Terra of Barcelona (M. Fernàndez *et al.*), of the University of Tübingen (H. P. Luterbacher *et al.*), and of the ETH of Zurich (M. Ford *et al.*), associated under the leadership of the Servei Geologic of Catalunya (C. Puigdefabregas *et al.*).
- The Norwegian margins, the northern Viking Graben, the More basin, the Voring basin and the mid-Norwegian margin in Norway, studied by teams of the Norwegian universities and of the Norwegian oil companies under the leadership of Norsk Hydro (A. Nottvedt *et al.*).

IBS teams have already presented their work at four large scientific meetings within the oil industry: EAGE in Vienna (June 1994), Glasgow (June 1995), Amsterdam (June 1996) and AAPG in Nice (September 1995) and also several times to more academic audiences, in particular at the meeting of the International Lithosphere Programme in Sitges, Spain (September 1995), and at the EUG in Strasbourg (April 1995). As a consequence of the IBS programme two workshops were organized, one on the Mediterranean basins (Cergy-Pontoise, 11–13 December 1996; some of the communications have been included in this volume), and the other one on mudrocks (Geological Society, London, 28–29 January 1997).

The co-operation with industry increased during the project and finally, 21 oil companies helped in a significant way. Some, like the Norwegian oil companies were directly involved. In particular, Norsk-Hydro had the leadership of module 3 (Dynamics of the Norwegian Margins). Others contributed less directly by providing documents or helping with the interpretation.

We acknowledge this help and thank these companies which are listed below (in alphabetical order):

Amoco, BEB, BP, Coparex, DEE, EAP, Esso, INA Naftaplin, Norsk-Hydro, MOL, Mobil, ÖMV, Preussag, Repsol, RWE-DEA, Saga, Shell, Statoil, Total, VVNP, Wintershall.

In total more than 200 researchers belonging to 38 institutions and 15 countries (eight EU countries, six non-EU European countries and the USA) have participated in the IBS project. The IBS teams have been strongly connected with those of the task force: 'Origin of Sedimentary Basins' of the International Lithosphere Programme and those of the network EBRO (European Basin Research Organisation), of the 'Human Capital and Mobility' programme of the European Commission.

Through the IBS project, the DGXII of the European Commission has clearly demonstrated its capacity to create a European research environment. This capacity was enhanced by the access given to the IBS Program to a PECO program with Hungary, which resulted in the IBS program on the Pannonian basin, and by the good co-ordination with the following two institutions:

- the Research Council of Norway (NFR), thanks to which it was possible to launch the IBS-DMN program on the Dynamics of the Norwegian margins;
- the Bundesamt für Bildung und Wissenschaft of Switzerland, thanks to which it was possible to launch the IBS-ETH cooperation.

We also wish to acknowledge here the role played by these institutions and we thank them for their financial support.

The European research environment that has been created consists of academic teams who voluntarily worked on geological problems of interest to the oil industry, and who now have a solid capacity in this field. Many of these teams are now associated with the Eurobasins School, where a number of European Universities and Research Institutions cooperate, under the auspices of Academia Europea. It is my hope that IBS has given the impetus for regular co-operation in research on sedimentary basins in Europe. No doubt these teams will now work for the oil industry and other economic sectors in a more direct partnership.

B. DURAND
Project Leader of IBS
January 1998

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Acknowledgements

The editors would like to thank the following reviewers for their very significant help:

A. Artoni, D. Burbank, E. Burov, P. Cobolt, B. Colletta, E. Deville, J. L. Faure, M. Ford, D. Grangeon, P. Homewood, M. Jackson, P. Joseph, F. Lafont, I. Moretti, J. L. Mugnier, U. Norlund, Y. Philippe, Ch. Ravenne, F. Roure, M. Séguret, M. Seranne, P. Trémolières, J. Verges, E. Williams.

The following companies are also warmly thanked for supporting this volume: Total, Amoco and Saga.