Hydrocarbon Habitat in Rift Basins

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Preface

This book provides an overview of the geology and hydrocarbon habitat or rift basins in a variety of geographic settings and of diverse geological ages. It stems from the boom in rift basin exploration which occurred throughout the 1980s, from recognition early in the decade that lacustrine shales can be excellent source rocks, and from some notable exploration successes. This exploration activity led to a substantial increase in the available subsurface data which, in turn, fuelled a rapid expansion in the understanding of rift basin geology, a topic which remains at the forefront of geological research for both academic and petroleum industry workers.

The book brings together studies from workers of different disciplines and backgrounds who are actively studying rift basins of different geological ages and diverse geographic settings. The intention of the volume is to present a broad spectrum of topics related to rift basin geology and its impact on hydrocarbon habitat. The papers span the entire range from theoretical models through outcrop studies to case studies of productive and non-productive rift basins.

In the first section of the book, there are five papers which are concerned with the tectonic and structural development of rift basins. The first of these, by Morley, reviews the major developments in structural geology over the previous decade, a time during which ideas about rift structure changed radically. New concepts evolved that prompted a major re-evaluation of many other aspects of rift geology such as sedimentation patterns and stratigraphic evolution. Kusznir *et al.* then present models based on observed fault geometries which can be used to constrain several structural attributes of rifts including basin geometry, fault spacing and polarity and extension magnitude. The three other papers in the first section discuss specific examples of structural style. Roberts & Gawthorpe demonstrate how differing styles of deformation within the Gulf of Corinth rift significantly affect diagnenesis over relatively short distances. Bosworth integrates outcrop and drilling data into a model which demonstrates that the Gulf of Suez is one of the most highly strained, failed continental rifts and is therefore an important link between low-strain failed rifts and successful ocean basins. In the last paper in the section, Platt presents an interpretation of the structure and tectonic development of the North Sea based on deep penetration seismic data.

Stratigraphic development and reservoir distribution are the topics covered by the five papers in the second section of the book. In the first of these, Lambiase & Bosworth present a model for the response of sedimentation patterns and resultant stratigraphy to evolving structural geometry and topography. This is followed by an analysis of stratigraphic response to structurally-controlled basin geometries at several scales, and its effect on reservoir distribution, in the Jeanne d'Arc basin, Canada by Driscoll & Hogg. Collier & Gawthorpe then discuss the relationship between tectonics, drainage and sedimentation in the tectonically active basins of central Greece and comment on the implications for syn-rift reservoir geometries. The fourth paper, by Scholz, uses seismic stratigraphy to interpret the stratigraphic development of the Ruhuhu delta in Lake Malawi and then discusses the implications for hydrocarbon exploration. In the final paper of the section, Smith describes the architecture of Early Cretaceous syn-rift lacustrine turbidites in the offshore of Gabon.

Two papers on source rocks and geochemistry form the third section of the book. The lead paper is by Katz who presents a survey of rift basin source rocks and discusses their distribution, the factors controlling their deposition, distribution and quality and their geochemical attributes. The survey includes oil- and gas-prone source rocks and restricted marine as well as lacustrine examples. In the other paper, Williams *et al.* describe the characteristics of lacustrine source rocks in Southeast Asia. They define several features which are common to Palaeogene and Cretaceous rift basins which range geographically from China to Indonesia.

The fourth, and final, section of the book is devoted to case studies of productive and non-productive rift basins. Banks *et al.* lead off the section with a discussion of the Karoo (Permo–Triassic) rift basins of the Luangwa Valley, Zambia. Their analysis of the structural and stratigraphic history indicates untested hydrocarbon potential in the currently non-productive basins. Kreuser expands the discussion of East African rift basins to include the Permian to Jurassic basins of Tanzania, Mozambique, Zimbabwe, Madagascar and Ethiopia. He describes several phases in their tectonic and

stratigraphic evolution and recognizes considerable variation in their hydrocarbon potential based on source rock properties. The very productive Songliao Basin of China is described by Li. Four evolutionary stages have contributed to the formation of the supergiant Daqing oilfield which had produced 8.2 billion barrels by the end of 1992. In the final paper, Williams & Eubank discuss hydrocarbon habitat in the Central Sumatra Basin, Indonesia. Tectonics, stratigraphic history, climate and migration efficiency have all contributed to the formation of numerous oilfields which total 25 billion barrels of proven reserves.

Collectively the various papers on models and case studies in this book lead the reader to the inescapable conclusion that each rift basin is a unique geological entity, yet that all are variations on a common theme. The models illustrate the major progress that has been made recently towards defining that theme and in recognizing the variations on it. The case studies clearly demonstrate that it is often those variations which determine the hydrocarbon habitat of a specific rift basin. Future research and continued hydrocarbon exploration in rift basins will further refine the models, define more clearly the general characteristics of all rifts, better delineate the range of possible variations on the common theme and refine and improve exploration strategies.

This volume is an outgrowth of the 1993 Bath Conference which was sponsored by the Petroleum Group of the Geological Society. The meeting was the first of the Bath Conferences to turn its attention beyond the borders of Britain and to adopt an international theme. It was Richard Hardman of Amerada Hess, whilst Chairman of the Petroleum Group, who proposed the theme of the conference and it is he who deserves much of the credit for its success.

Bandar Seri Begawan J. J. Lambiase
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