

AAPG MEMOIR 57

CARBONATE SEQUENCE STRATIGRAPHY

RECENT DEVELOPMENTS AND APPLICATIONS



Edited by
Robert G. Loucks and J. Frederick Sarg

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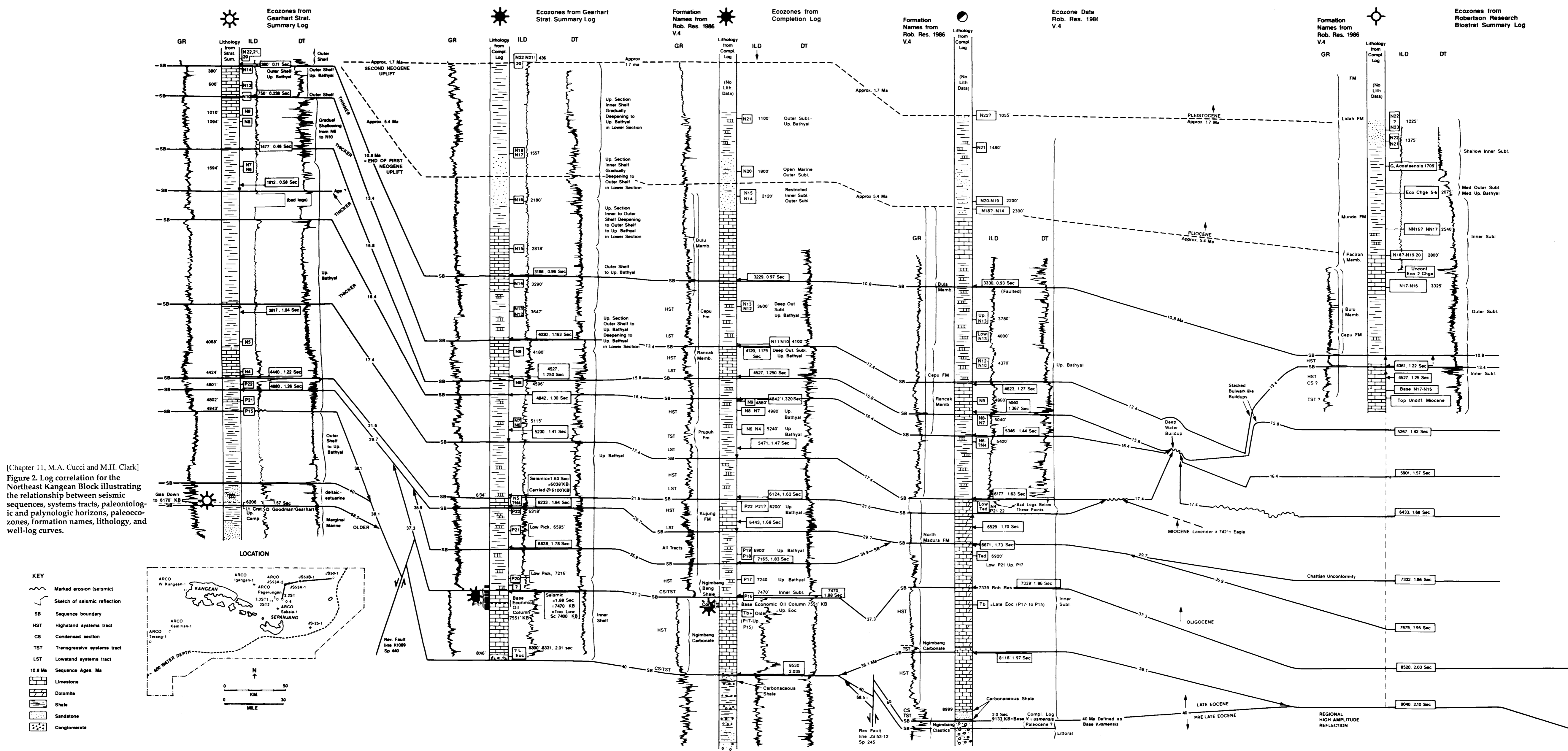
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[Chapter 11, M.A. Cucci and M.H. Clark]
 Figure 2. Log correlation for the Northeast Kangean Block illustrating the relationship between seismic sequences, systems tracts, paleontologic and palynologic horizons, paleoecozones, formation names, lithology, and well-log curves.

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Dust jacket photo: View of the Sassolungo (Langkofel) Group of peaks, western Dolomites, northern Italy. The high-standing light-colored peaks are formed by Triassic dolomite. The darker rocks in the foreground are basinal volcanic and carbonate turbidites and mudstones of the Triassic La Valle (Wengen) and San Cassiano (Cassian) formations. The photograph was taken from Col Rodella looking south. (Photograph by K. Biddle).

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About the Editors



Robert G. Loucks received his B.A. degree from the University of New York at Binghamton in 1967 and his Ph.D. degree from the University of Texas at Austin in 1976. Before joining ARCO Exploration and Production Technology in 1983, he had already gained 15 years of research and exploration experience with Texaco, Texas Bureau of Economic Geology, Mobil, and Cities Service. He is presently a Research Advisor in ARCO's Reservoir Geology Group in Plano, Texas. His overall research interests include carbonate sequence stratigraphy, carbonate depositional systems, and carbonate and clastic diagenesis. Presently his research is concentrating on applying sequence stratigraphy to reservoir development, understanding rock fabric control on porosity and permeability, and reservoir heterogeneity in paleocave reservoir systems.



J. Frederick "Rick" Sarg has accumulated 18 years of petroleum exploration and production experience in research and operational assignments with major oil companies and as an Independent Consultant. Rick earned B.S. and M.S. degrees in geology from the University of Pittsburgh, Pittsburgh, Pennsylvania, and in 1976 he obtained his Ph.D. in geology from the University of Wisconsin, Madison. He was employed by Mobil in 1976, and then joined Exxon that same year. At Exxon, he became a member of the exploration research group that developed seismic/sequence stratigraphic concepts and techniques, and from 1985 to 1988 he was Supervisor of the Carbonate Group at Exxon Production Research Company. From 1990 to 1992 Rick operated as an Independent Consultant. Since 1992, he has been with Mobil Technology Center.

Rick Sarg has worldwide experience in integrated seismic-well-outcrop interpretation of siliciclastic and carbonate sequences. His emphasis has been on seismic stratigraphy, carbonate sequences, outcrop documentation of seismic-scale sequences, and Permian basin geology. Rick has authored and co-authored 15 papers on carbonate sedimentology and stratigraphy. He has prepared, coordinated, and presented seismic and sequence stratigraphy seminars to industry for 13 years. Rick is a member of AAPG, SEPM, GSA,

PBS-SEPM, and WTGS. From 1985 to 1993 he served as an Associate Editor of the *AAPG Bulletin*. He was an AAPG Distinguished Lecturer in 1988–89. Currently he is a member of the Ocean Drilling Program, Sediments and Geochemical Processes Panel.

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FOREWORD

This volume derives from the Research Symposium on Carbonate Sequence Stratigraphy presented at the 1991 national convention of the American Association of Petroleum Geologists. Selected papers from other technical meetings also are included. In formulating and compiling the papers for this volume, the coeditors recognized a need to bring together in one volume a representative cross section of current research in carbonate sequence stratigraphy. This volume is meant to be a "snapshot in time" of one of the fastest growing areas of stratigraphic research and application. We hope it will provide a stimulus for future research and for more successful application. Critical field observations, improvements in seismic resolution, and imaginative computer modeling are likely to make important future contributions to carbonate sequence stratigraphy. If this publication begins to generate new ideas and interdisciplinary discussion and debate, we will consider it to have accomplished its purpose.

The chapters in this volume clearly show the diverse response of carbonate platforms to subsidence, relative changes in sea level, and the related changes in environment and sediment supply. Some illustrate the similarities in geometry and accommodation response with siliciclastic sequences, and many demonstrate the unique responses carbonates show to tectonic subsidence, sea-level changes, and environmental fluctuations. The present volume covers a number of important topics in the area of carbonate sequence stratigraphy. These include: (1) conceptual models for interpretation; (2) the sedimentologic process-response of carbonate platforms to changing sea levels; (3) large-scale stratal patterns of second- and third-order sequences; and (4) small-scale, high-frequency cycle stacking patterns.

The chapters are grouped into three sections. The first describes sequence concepts and sedimentologic principles that permit and constrain interpretation. Handford and Loucks present conceptual models for interpreting carbonate sequences in a variety of depositional settings. Greenlee and Lehmann apply large-scale second-order sequence ideas to placing hydrocarbon-productive carbonate buildups in a stratigraphic framework, and Zempolich documents the platform response to long-term sea-level rises. Grammer et al. and Brown and Loucks describe the process/response of high-angle platforms to sea-level fluctuations.

The second section includes six chapters that describe seismic sequence-scale case studies involving both seismic and outcrop interpretations. The chapters of this section are grouped according to geologic age, from oldest to youngest, beginning with two chapters on the Devonian of the Canning basin (Southgate et al. and Holmes and Christie-Blick). These are followed

by chapters interpreting: (1) the Upper Pennsylvanian stratigraphy of the Permian basin (Waite); (2) the drowning successions of a Mesozoic and a Tertiary platform (Erlich et al.); and (3) the Neogene reefs of Indonesia (Saller et al.) and the East Java Sea (Cucci and Clark).

The final section presents eight examples of high-frequency, meter-scale cycle deposition and stacking patterns. Montañez and Osleger describe parasequence stacking patterns from Cambrian platforms of the Great Basin, Nevada. Reid and Dorobek interpret parasequence sets in the context of larger scale second- and third-order sequences in the Mississippian of the western interior of the United States. Goldhammer et al. describe the high-frequency stratigraphy of an isolated, Triassic age platform in the Dolomites of northern Italy. Pomar describes the high-resolution stratigraphy of the Upper Miocene reefs on Mallorca, Spain, and compares outcrop geometry's to seismic progradational patterns. Franseen et al. qualify relative changes in sea level in similar Miocene cycles of southeast Spain. Four chapters from the Permian basin document the high-resolution cycle architecture of Upper Permian strata (Sonnenfeld and Cross), compare the internal characteristics of small-scale cycles to a Holocene shoal complex (Harris et al.), and interpret the diagenetic history related to cycle development (Hovorka et al. and Mutti and Simo).

The coeditors of this volume are very grateful for the authors' enterprise in the undertaking and for their patience in reworking their papers. We also appreciate the considerable interest by the AAPG-SEPM membership, whose large attendance at the 1991 Symposium and poster sessions indicates the importance the whole area of sequence stratigraphy has to petroleum exploration and development.

Robert G. Loucks
J. Frederick "Rick" Sarg