

# Methods of Estimating the Volume of Undiscovered Oil and Gas Resources

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subcrop of pre-period rocks and distribution and thickness of sediments of the period discussed.

Chapter 8, 27 pages long, titled "Exploration Techniques" discusses all the techniques used in finding, evaluating and producing offshore oil and gas pools. It covers the field of geophysical methods in considerable detail, more so than that presented in Volume 1. The sub-chapter 8.2 discusses offshore drilling rigs and typical operation during the drilling of a well from its initial to final completion as an expendable or future production well. Sub-chapter 8.3 discusses well logging. The account is presented in almost conversational form that will prove interesting reading but will not make the reader a log specialist.

Sub-chapter 8.4 treats, in some detail, production methods, the various types of production platforms, and the fields where they have been or are being installed. The section on pipelines is highly informative. The capital expenditure involved in exploration and production of oil or gas in the North Sea is discussed in terms of each barrel per day of productive capacity. A comparison of costs in the North Sea to those in the Middle East should prove informative and of interest to the reader.

Chapter 9 is of great interest because it discusses the historical events leading up to the world's most exciting exploration scene, the North Sea in the early 1970s. It began with the International Convention in 1958 which established the principles of boundaries in the North Sea. This opened the way for exploratory work, first, in the southern North Sea basin in 1962 and then in the northern basin in 1969. In the account of the latter area the authors give in detail the state of exploration prior to and following the fourth round of awards in 1972. This is followed by a description of the government's reaction to the high rate of success of exploration since 1972. This resulted in changes in legislation. The authors close the chapter with their thoughts on the future of the industry in the North Sea.

Chapter 10 submits important data on oil and gas discoveries and fields which were presented at the November 1974 conference sponsored by the Institution of Petroleum, Exploration Society of Great Britain and the American Association of Petroleum Geologists.

The data are accompanied by excellent maps and geological cross-sections through the fields.

Chapter 11 titled "Economics and Reserves" contains information of great significance. Reserves in the ground are discussed in some length, how they are calculated, their importance in decision-making by exploration companies active in the North Sea, and estimates of recoverable reserves for fields discovered to mid 1974 given at the late 1974 conference. Up to date information on price of oil and government taxation is given, followed by a discussion and columns of figures with reference to economics leading up to the ultimate topic of revenues to the government and the producers. "When production reaches 2.5 million barrels a day the yearly revenue to the exchequer will be a staggering 4,812 million dollars (£2,005 m)". The profitability of an oil field to an oil company is presented in a cash flow model of a large North Sea oil field.

In the opinion of the reviewer, the authors have achieved their aim to tell the fascinating story of the oil industry in such a way that both volumes should have a place in the libraries of non-specialists, bankers and, yes, even oil companies.

MS received February 26, 1976.

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## Methods of Estimating the Volume of Undiscovered Oil and Gas Resources

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Edited by John D. Haun  
*American Association of Petroleum Geologists, 206 p., soft cover, 1975.*  
 AAPG and SEPM members \$8.00,  
 others \$10.00

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This volume, No. 1 of the AAPG Studies in Geology series, contains 17 of the 21 papers presented at an AAPG research conference in August, 1974, at Stanford University. It was the intention that this and subsequent volumes be published as quickly as possible to disseminate the results of similar such conferences.

It is obvious from these papers that the estimation of undiscovered resources is still one of the most complex, uncertain and controversial aspects of the artistic science of petroleum geology. This book illustrates the difficulties inherent in accurately assessing a finite resource which is well hidden, if present at all. Some idea of the background behind the papers may be gained from the fact that four were prepared by geologists from the USGS, one was co-authored by a geologist from the GSC, two by major oil company geologists, the rest being from smaller organizations or from the academic community. Eighteen of the papers were by U.S. authors.

The papers by the USGS are basically a review of concepts and definitions, relating to reserves and resource evaluation. Probably the two best documented and most relevant papers are firstly, "Basic Consanguinity in Petroleum Resource Estimation" by J. W. Porter and R. G. McCrossen (published in part in CSPG Memoir No. 1), which examines world-wide accumulations in the light of a proposed basin classification; and secondly "Assessing Regional Oil and Gas Potential", by D. A. White *et al.*, (Exxon geologists) outlining probability concepts in resource estimation, based upon examples from Louisiana.

Possibly the most interesting and original paper (also the longest . . . 30 pages) was that by G. M. Kaufman *et al.*, "A Probabilistic Model of Oil and Gas Discovery". The authors present a statistical model based upon Alberta's oil and gas pools, and utilize Monte Carlo simulations to predict the size of pools discovered as the resource base is depleted.

Other papers including those by such authors as H. D. Hedberg, M. T. Halbouty, K. O. Emery and L. G. Weeks deal with a diversity of concepts relating to basin evaluation, entrapment factors, computer simulation studies and deep ocean sediments. Editor J. D. Haun has provided a good introductory summary paper.

The volume is suitably indexed under author, subject, and keyword, and is attractively bound in soft cover.

Conferences, especially of this type, have many inherent limitations which make the original objectives difficult to achieve. It is therefore understandable that expediency and confidentiality result in only minor input from the major oil companies and little originality in many of the papers. Many of the authors have merely reiterated old ideas and some touch only on the peripheral aspects of the conference theme.

However, despite such shortcomings, this volume is definitely a good buy, and recommended reading for any geologist who is concerned about the state of the art/science for which geologists as a group are receiving much justifiable criticism. Mineral geologists may find some of the concepts adaptable. In addition, this book should be recommended reading for the layman, government official and politician or anyone concerned about today's or tomorrow's energy supplies.

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## **Belize Shelf - Carbonate Sediments, Clastic Sedimentology, and Ecology**

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Edited by K. F. Wantland and W. C. Pusey III  
*American Association of Petroleum Geologists, Studies in Geology No. 2. 599 p., soft cover, 1975.*  
 SEPM and AAPG members \$15.00,  
 Others \$19.00.

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In 1960, having completed the herculean task of describing the modern carbonate sediments on the Great Bahama Bank, E. G. Purdy turned his attention to the Belize (British Honduras) continental shelf, a contrasting, reef-dominated area of both terrigenous-clastic and carbonate sedimentation. Over the next six years he, and a team of graduate students from Rice University, studied the sedimentology of this complex. The result was nine Ph.D. dissertations focused on various aspects of sedimentation, carbonate diagenesis and benthic organism ecology. Time and circumstance have mitigated against publication of all but two of these studies, and now, at last, the rest are combined between the pages of this volume.

The book contains nine papers; a succinct, well-written overview of the regional shelf attributes by Purdy and the two editors, seven papers on the Belize shelf proper and one paper on the aeolianites of the northeastern Yucatan Peninsula.

Sedimentation on different parts of the Belize shelf are detailed in three papers. The shallow northern shelf studied by Pusey, although reminiscent of Florida Bay, Shark Bay and parts of the Great Bahama Bank, is veneered with fine grained terrigenous clastic as well as carbonate sediments. Of particular interest are the two large mud banks at the entrance to Chetumal Bay, thought to result from the interplay of tidal currents and waves as opposed to binding and trapping by sea grasses.

The documentation of carbonate sediments in lagoons, on beaches and on tidal flats around the large island Ambergris Cay by Ebanks is another addition to the growing literature on this topic. An important, and at the same time disturbing conclusion resulting from analysis of coastal mangrove swamps along the landward margin of the shelf by High, is that the sediments in this zone have no consistent relationship to environment of deposition. Perhaps the most significant contribution does not come from any one of these papers alone, but rather from the consistent picture of sedimentation during the Holocene transgression, obtained by all three workers from analysis of many soft-sediment cores.

Clay minerals, which comprise a significant part of lagoon sediments throughout, are thought by Scott to be detrital in origin and to reflect drainage from intensively leached, geologically varied terrane versus karsted carbonate terrane. Interestingly, she also feels that dispersal patterns of the clay minerals reflect, in part, the different settling tendencies of the various clays.

Pleistocene carbonates are treated in two studies, one on the reef to shelf to mudbank transition on Ambergris Cay (Tebbutt) and one on the aeolianites of the Northeast Yucatan platform north of Belize (Ward). These studies confirm the now well-documented diagenetic processes that occur in the subaerial vadose zone and contain interesting information on recrystallization of aragonite skeletons (to aragonite) and diagenesis related to plant roots, paleoexposure horizons and calcrete.

Microfauna in the Holocene shelf sediments are described in two solid studies, one on the ecology of benthic foraminifera (Wantland) and the other on the taxonomy of ostracods (Teeter) and both convincingly illustrate the value of examining microfauna together with sediments.

This volume, along with earlier published studies on the shelf interior lime muds (Matthews, *Jour. Sed. Petrology*, 1969; Scholle and Kling, *Jour. Sed. Petrology*, 1972); the morphology and fauna of some shallow reefs (Stoddart, *Atoll. Res. Bull.*, 1962, 1963) and the role of inherited topography in reef distribution and sedimentation (Purdy, *SEPM Spec. Publ.* 18, 1974) combine to yield one of the most complete analyses of a modern reef