I think it is one of the more successful efforts, but nevertheless few researchers are working on both sedimentary fluids and magma geochemistry. For researchers interested in subduction zones and wanting an up-to-date review and who do not have access to the original journal, the book would be a valuable aquisition. Several of the papers could be useful for graduate courses. Institutions that do not subscribe to the *Transactions of the Royal Society* should buy it. In these days of shrinking library budgets, however, I do not see many libraries purchasing it in addition to the original journal.

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Continental margins: a commemoration to M. T. Halbouty

Watkins, J. S., Feng Zhiqiang and McMillen, K. J. (editors) 1992. *Geology and Geophysics of Continental Margins*. American Association of Petroleum Geologists Memoir 53. The American Association of Petroleum Geologists, Tulsa, Oklahoma, U.S.A. 419 + xii pp. Price $82 (hardback; ISBN 0-89181-332-2); AAPG members $59.

This Memoir presents 22 papers from presentations at a conference on continental margins held at Galveston, Texas, in February 1989, to commemorate Michel T. Halbouty, the distinguished petroleum geologist. Holbouty has worked or supervised exploration in many regions, including the Gulf Coast, Alaska, southeast Asia, and the southwest Pacific, which are covered by papers in this book. His early investigations of the importance of stratigraphic traps led to the development of sequence stratigraphy, the subject of many papers in this book.

The wide-ranging title suggests a synthesis of principles governing the formation of continental margins. However, most papers in this book are instead a diverse collection of regional reviews and detailed studies of localities. There are five sections, each covering a theme that is either a geographical region or a general method. The first section, on the Chinese margin, comprises four papers. "Geological Characteristics and Petroleum Potential of Sedimentary Basins of the China Continental Shelf" by Wang Shansu and others, reviews 13 localities that are a mixture of extensional, backarc and foreland basins. It presents many figures on sediment volumes and thicknesses, and lists names of formations and traps, with information about hydrocarbon content. Many maps and cross-sections based on seismic reflection profiling are presented, but no original seismic sections. Both references are to publications by the first author. The second paper, "Geotectonic Framework of the East China Sea", by Yang Qi Lun, describes in more detail both of the basins, considered by Wang *et al.*, that are beneath this sea. Stratigraphy is reviewed, including hydrocarbon prospects, and formations are described and correlated between basins and are illustrated using original seismic sections. Changes in the evolution of these basins are related to changes in motion of Eurasia relative to the Pacific and Indian plates. The third paper, "Structure and Hydrocarbon Potential of the Para-Passive Continental Margin of the Northern South China Sea" by Feng Zhiqiang and others, does a similar job for this passive margin, including the Pearl River Mouth of Zhujiangkou basin with its large hydrocarbon reserves. Like in the previous article, formations are listed and delineated on seismic sections, stratigraphy is correlated, and tectonic evolution and hydrocarbon prospects are discussed. "Structural Evolution of the Western Pearl River Mouth Basin" by P. Edwards provides an independent summary of the stratigraphy and tectonic evolution of the same basin. It includes some high-quality seismic sections showing planar normal faults cutting basement, as well as detailed maps of the complexity of en échelon normal faulting. However, the bibliography contains only five references on the study area. The small numbers of references in some of these articles give the impression that little is published on basins offshore of China, which is not the case. A study of the Pearl River Mouth Basin by Su Daquan and others (*Basin Res.* **2**, 205–222, 1989) contains over 30 local references. There are dramatic discrepancies between different interpretations of this basin. For example, Su *et al.* concluded that most of its extension occurred during 60–35 Ma, with minor extension during 25–11 Ma. In this book, Wang *et al.* state that its extension covered 70–63 and 32–17 Ma, Edwards concludes 36–26 Ma, and Feng *et al.* prefer Mid Oligocene to Early Miocene or ~30–20 Ma. These discrepancies cannot have escaped the attention of the editors of this book. It is unfortunate that no attempt has been made to reconcile them, or to require authors to comment on them or justify their own interpretations.

The second section includes six papers on Southwest Pacific and Eastern Indian Ocean Margins. In "Tectonic History, Sedimentation, and Changes in Relative Sea Level: Chatham Rise, New Zealand", R.H. Herzer and R. A. Wood investigate this ~500 m deep continental submarine plateau that is east of the South Island of New Zealand, using seismic reflection and drilling. Before Cretaceous time, this region formed part of a landmass between the South Island and West Antarctica. Cretaceous rifting south of the Chatham Rise aborted, and the breakup of New Zealand from Antarctica occurred farther south. This paper discusses the subsequent evolution of this region, which is now part of the Pacific plate, including sedimentation as it has gradually subsided, and volcanism. B.W. Davy addresses "The Influence of Subducting Plate Buoyancy on Subduction of the Hikurangi–Chatham Plateau beneath the North Island, New Zealand". This study region is north of the Chatham Rise. Although called a plateau, its bathymetry is up to 4000 m. Gravity and seismic information constrain crustal thickness to ~10 km, suggesting that it probably comprises unusually thick oceanic crust formed at an anomalously hot spreading centre. P. R. King and G. P. Thrasher, cover "Post-Eocene Development of the Taranaki Basin, New Zealand". This Cretaceous passive margin has been affected by Tertiary shortening. M. S. Marlow, N. F. Exon and S. V. Dadisman investigate "Hydrocarbon Potential and Gold Mineralization in the New Ireland Basin". They use seismic reflection and other methods to constrain the structure and evolution of this basin, which at present is situated in the extreme southwestern part of the Pacific plate. They suggest a new interpretation of the Tertiary evolution of this remote and complex region. D. W. Scholl and R. H. Herzer investigate the "Geology and Resource of the Southern Tonga Platform". Although natural oil seeps exist in Tonga, the source beds have not been identified, and the hydrocarbon potential is unlikely to be significant. Finally, R. G. Matson and G. F. Moore discuss "Structural Influences on Neogene Subsidence in the Central Sumatra Fore-arc Basin". Oblique convergence of the Indian and Eurasian plates is locally accommodated in part by subduction of the Indian plate and in part by right-lateral faults onshore on Sumatra, which strike subparallel to the surface trace of the Benioff zone. The Tertiary evolution of the fore-arc basin, between Sumatra and the surface trace of this Benioff zone, is extremely complex.

The third section, on African and Mediterranean margins, is a real mixture. A. Bosellini examines "The Continental Margins of Somalia". He presents a great deal of well log and other information concerning the parts of these margins that are exposed onshore, which I believe is not published elsewhere, along with a new fit of the initial positions of Africa, Madagascar, India and Arabia. M. F. Coffin and P. D. Rabinowicz present a great deal of seismic and other information concerning "The Mesozoic East African and Madagascan Conjugate Continental Margins". M. Sarti and others discuss the "Basin Geometry and Architecture of a Tethyan Passive Margin, Southern Alps, Italy". Extensional basins formed in northern Italy in Mesozoic time at the southern passive margin of the Tethys ocean. These authors present a lot of interpretation of these basins, based on what appears to be little solid information. Finally, J. S. Holik and P. D. Rabinowicz discuss the "Structural and Tectonic Evolution of Oceanic Lithosphere Within the Jurassic Quiet Zone, Offshore of Morocco". This locality has been affected in Tertiary time by the Canary Islands upwelling mantle plume.

The fourth section covers sea level and seismic stratigraphic studies. K. J. McMillen and P. O'Sullivan discuss "Tectonic and Eustatic Controls on Paleogene Sequence Stratigraphy: Beaufort Sea, Alaska and Canada". This major petroleum province comprises a Mesozoic passive margin that has been affected by Tertiary shortening. Its interpretation is complicated by the fact that stratigraphy has been defined independently in its Alaskan and Canadian parts. M. Ito and F. Masuda discuss "The Evolution of Mesozoic–Cenozoic Sedimentary Basins Along the Japanese Continental Margin". They attempt to isolate effects of eustatic sea-level variations from tectonic effects. "Upper-Cretaceous Stratigraphy and Relative Sea-level Changes, Gulf Coastal Plain of Eastern and Central Alabama", by D. T. King and M. C. Skotnicki, a synthesis of many years of work, is an excellent introduction to the stratigraphy of this region, with numerous references to detailed studies in regional journals. A. H. Bouma and others

investigate "Late Neogene Louisiana Continental Margin Construction". They identify the types of structures, including submarine canyons, which form in this region in response to sea-level variations. R. G. Mann, W. R. Bryant and P. D. Rabinowitz discuss "Seismic Facies Interpretation of the Northern Green Canyon Area, Gulf of Mexico". Much of the structure of this study area, which is also south of Louisiana, also seems to have developed in response to sea-level variations. G. H. Lee and others discuss the "Origin and Evolution of the Keathley Canyon, Northwestern Gulf of Mexico". This area, offshore of Texas, can be compared with the nearby study area of the previous paper. The final paper in this section, "An Analysis of the Implicit Assumptions of the Methodology of Seismic Sequence Stratigraphy" by J. A. Thorne, examines over 20 assumptions in this methodology. Some are common sense assumptions in the absence of better information, such as regarding all sediment flux as flowing in the same direction or regarding each seismic reflector as a time line. The most fundamental assumptions relate to the extent of isostatic compensation of sedimentation and/or erosion of a basin's surroundings, processes that are ignored in many analyses that infer global sea-level variations, including some in this book. It is obvious that unless one knows precisely what isostatic compensation occurred at each stage during the formation of a basin, one cannot know at what absolute level deposition occurred, and one thus cannot quantify absolute sea level variations. This thought-provoking article should be particularly useful in encouraging advanced students to think carefully about assumptions behind standard methods.

The final section consists of a single paper, the fourth by P. D. Rabinowitz, which reviews "Ocean Drilling on Passive Continental Margins", discussing the contribution of Ocean Drilling Project Legs 100–126 from 1985 to 1989. Five of these legs had major objectives relevant to passive margins: 103 (northwest of Spain), 104 (west of Norway), 107 (the Tyrrhenian Sea), and 122 and 123 (northwest of Australia). Leg 104 is of particular interest: drilling just east of the transition to oceanic crust penetrated ~1 km into a sequence of Paleogene lava flows associated with the Iceland upwelling mantle plume. These had previously been interpreted by some as sediments on account of their strong seaward-dipping seismic reflections.

Despite some lapses, this book contains a great deal of high-quality science. The contents include many papers on regions that are very remote, unfamiliar and interesting, plus others on familiar regions that are near the conference venue. Most papers are well-presented and provide excellent introductions to the subject matter. The studies of gold mineralization in the SW Pacific and on Cretaceous stratigraphy of the Gulf of Mexico coast are particularly good examples. However, there is no logical reason why such diverse papers should be in the same book. Only one paper addresses general principles, the discussion of assumptions implicit in sequence stratigraphy.

There are several overall problems with this book. First, notwithstanding the linkage of its subject matter with the career of M. T. Halbouty, it is difficult to justify any general book on continental margins that includes so little on the passive margins of western Europe and nothing on the Atlantic margins of North America. Second, there is the 3 year lead time between the 1989 conference and publication in 1992. Many papers address regions where much has been published in the meantime. No attempt has been made to update references with publications since 1989. Third, there is a striking lack of co-ordination between some papers. Apart from the three incompatible interpretations of the South China Sea, several opportunities to derive results of general relevance were lost. For instance, the Taranaki basin and the Beaufort Sea are both passive margins that have subsequently been affected by shortening. Rather than presenting two review articles, it may have been more useful to examine general problems of resolving the development of structures that have formed during two or more phases of tectonic activity. Several studies examined adjacent localities using different methods, particularly around the Gulf of Mexico. Something could have been written on how these methods can be combined in overall interpretations. Some important general methods for studying offshore areas, such as side-scan sonar, do not feature anywhere in the book. Finally, despite the title, there has been no attempt to address the physics of processes at continental margins, for example governing faulting or turbidity currents in submarine canyons. As an example, some people have suggested that escapes of methane from beneath the sea floor, possibly triggered by these currents, may have dramatic effects, on both local structure and human activity. Many otherwise inexplicable effects in regions such as the passive margin of the southeastern U.S.A. (the so-called 'Bermuda triangle') can potentially be explained by this process. For instance, gas escaping into seawater would reduce its density, thus reducing buoyancy forces and causing ships to sink. Mud volcanoes above gas leaks may be mistaken for permanent islands, causing ships and aircraft to navigate incorrectly. Confirmation by reputable specialists that such processes are physically feasible would have widespread implications, not least by drawing attention to a significant natural hazard that has previously gone unrecognized, and debunking explanations that involve the paranormal.

To summarize, this book contains many individual articles that will interest many people. However, I was disappointed by the overall lack of focus. With more careful planning, and with greater emphasis on general principles, much more could have been made of this subject.

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Photos in petroleum geology

Foster, N. H. and Beaumont, E. A. (compilers) 1992. *Photogeology and Photogeomorphology*. American Association of Petroleum Geologists Treatise of Petroleum Geology Reprint Series, No. 18. The American Association of Petroleum Geologists, Tulsa, Oklahoma, U.S.A. 555 pp. Price $36 (hardcover); $25 (softcover).

The AAPG Treatise of Petroleum Geology Reprint Series aims to bring together the acknowledged landmark papers, from a specific field of petroleum geology, within one volume (or set of volumes). This recent addition to the Reprint Series, covering photogeology and photogeomorphology, presents a total of 39 papers which are subdivided (as indicated) into the following five sections: General Methods (10 papers); Photogeologic Measurement Techniques (four papers); Application to Petroleum Exploration (five papers); Fracture Identification (four papers); and Photogeomorphology (16 papers).

The basic methodology of photogeological interpretation is covered comprehensively within the General Methods section. Of the 10 papers which comprise this section, eight were published prior to 1965, perhaps reflecting the increased proportion of offshore exploration since the late 1950s and corresponding reduction in widespread use of aerial photographs in exploration programs. Several papers within this first section deal with the detailed relationships between drainage pattern and subsurface structure in relatively flat-lying areas, providing a good insight into the potential accuracy of photogeological interpretation in estimation of dip magnitudes, stratigraphic thicknesses and basic structural geometry. An account of Alaskan North Slope field mapping and photogeology, carried out by the USGS in the late 1940s, is an excellent example of the value of photogeological interpretation in guiding early 1950s exploration success in this region.

Detailed expansion of dip and stratigraphic thickness estimation is provided in the four papers which comprise the second section on Photogeologic Measurement Techniques. The basis for dip estimation is explained in great detail in three of these papers, with specific attention to differentiating between subvertical and vertical dips.

The section on Applications to Petroleum Exploration comprises six papers, including five from the 1940s, which cite several examples of the use of photogeological interpretation from North America. The surge of photogeological interpretation during this era is emphasized by the fact that in 1947 approximately 110,000 sq. miles of the Rocky Mountains were interpreted by photogeological methods, and in 1954 approximately 500,000 sq. miles of photogeological interpretation were completed worldwide. Examples of exploration work from W. Canada, including descriptions from the Interior Plains, Rocky Mountain Foothills and Eastern Rocky Mountains provide a good contrast to the approach used in the Gulf Coast where the identification of subtle surface geomorphological anomalies was the basis for prediction of subsurface structure location.

Interpretation of joint and fracture systems is covered in the section on Fracture Identification. Prediction of reservoir fracture geometry to maximize the efficiency of field development planning may be constrained by knowledge of surface fracture systems; the possible link between surface lineaments apparent on aerial photographs and reservoir structure is discussed in the first of four papers within this section. The remaining three papers describe the results of photogeological fracture analysis, in effect lineament analysis, based on align-