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.

Rob Westaway

Durham, U.K.

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-

ment of vegetation types, stream segments and soil tones, and the possible relationship of these surface lineament patterns to subsurface structure.

The concluding section covers Photogeomorphology. Of the 16 papers, seven have been published since 1974 making this the most recent section of the volume. The main themes are regional landform analysis and the uses of aerial photographs in all aspects of geomorphological analysis, broadening in scope as far as use to planners, engineers and landscape architects in site development projects. Drainage pattern description and classification is a recurring topic within this section. Several papers evaluate the surface expression of deep hydrocarbon accumulations, perhaps the most thorough of these concluding that in the Central Rocky Mountains, surface expression of such deep structures are "subtle, inconclusive or absent". This general conclusion contrasts with specific examples from Nevada and the Anadarko Basin of good correspondence of surface features and subsurface hydrocarbon accumulations.

Taken as a whole, this set of papers provides a comprehensive overview of photogeological analytical techniques which will be of potentially high value to geologists faced with the future challenge of exploring onshore frontier basins in remote locations, where aerial photographs may form a key data set alongside satellite images and field-based studies. While there is little in this volume that many structural geologists will find gripping, there are numerous specific examples of the value of recognizing subtle geomorphological variations in flat-lying areas, which in the absence of seismic data, are frequently the only clue to predicting near-surface structure. Those papers dealing with fracture analysis and possible surface expression of deep structure in thrust systems largely predate recent developments in understanding the evolution of fault and fracture arrays, joint systems and three-dimensional thrust system geometry. As a result, many of the structural geological statements within these papers are a little oversimplified. These are minor points; the strength of the volume is in the detailed descriptions of photogeological methodology and analysis developed during the 1940s and 1950s. At $25 *Photogeology and Photogeomorphology* is good value and should be consulted frequently by all geologists embarking on photogeological interpretation projects.

S. J. Matthews

Uxbridge, U.K.

Map projections: all you need to know

Maling, D. H. 1992. *Coordinate Systems and Map Projections* (2nd edn). Pergamon Press, Oxford, U.K. 476 pp. Price £72.50; $145 (hardcover).

The geological map is the most concise method of conveying information in the geosciences. We spend much of our professional life working with such maps, but how much attention do we pay to the geographic base on which they are constructed? I suspect that many geoscientists compile carefully collected data on base maps using a photocopier to correct the scale. Whilst this might not create a problem for small areas, errors, distortion and incompatibilities can occur if the base map crosses national boundaries or has a large latitudinal extent. In certain branches of the science (e.g. geodetic surveys, marine geophysics, tectonics, remote sensing) an exact knowledge of the map projection used or the assumed geometry of the spheroid is essential. D. H. Maling's book, *Coordinate Systems and Map Projections* provides a comprehensive account of this field. This is a second edition of a work the publishers describe as "the definitive English work on map projection". I can certainly accept their claim. The book is comprehensive and all the relevant mathematical formulae for over 40 projections are given. The author has often deliberately omitted details of their derivations, simply confining himself to describing the underlying theory and presenting the result. I welcome this approach and find that it works well—all most people need is the basic equation. There is a comprehensive reference list for those who are interested in reading further. The problem of writing efficient algorithms for processing the necessary transformations is also discussed. The book is well illustrated, but as 1 page of text can refer to many diagrams readers will find themselves often having to turn several pages to follow the arguments. However, the cross-referencing is good and the relevant page numbers of figures in other chapters are given.

Chapter 1 deals with the figure of the Earth and the reference systems used in surveying and mapping. This includes precise definitions of the spheroid and the geoid, tabulated estimates of the spheroid and discussion of errors in the spherical approximation. It is interesting to note that the divisions between national sectors in the North Sea are based on the spherical approximation. This could lead to errors in the order of hundreds of metres in the absolute positioning of these boundaries. Chapters 2 and 3 deal with coordinate reference systems on the plane and on the sphere. These give a concise review of Euclidean and non-Euclidean trigonometry. Chapter 4 discusses the geometry of the spheroid and deals with the important topic of accurate estimate of arc distance upon the spheroidal surface. A subject that is exciting considerable interest as long base-line GPS surveys are now being used to estimate inter- and intra-plate motions. Chapters 5–7 deal with the basic problems of projecting a spherical body onto a planar piece of paper. The various underlying assumptions that must be made, i.e. equal area, equal angular, equidistance, etc., and their relative strengths and weaknesses are discussed. Chapter 7 deals with the classification of families of projections (there are about 400 described!) and is really only of interest to the geographer doing research in this area. Chapters 8–10 describe how to construct, compute and derive map projections. Manual and automated methods are described. However, the present price of computing power means that manual methods are more of historic interest, or only apply in the preparation of large base maps without access to a suitable plotter. I found Chapters 11 and 12, which deal with the choice of suitable projections most interesting. Such problems as how to produce a base map for the Andes or the eastern seaboard of the Pacific with the minimum distortion of both area and angles are discussed. It may not be generally realized, but a Mercator projection of the Andes can lead to areal distortions in the order of 400% along the chain. Chapters 13–15 deal with deliberately distorted maps, navigation charts and surveying. Chapter 16 describes perhaps the most important projection, the equal area Transverse Mercator Projection of both the spherical and spheroidal earth in great detail. Chapters 17 and 18 deal with the distortions inherent in collecting remotely sensed images where a satellite in an oblique orbit scans a spheroidal surface. The problems of finding a suitable projection so that data derived from such images can be compared with that derived from other maps, or can be incorporated into GIS systems are also dealt with. This last point is discussed in more detail in Chapter 19. The appendices give the algebraic expressions for the coordinates and particular scales of most important map projections (Appendix I), projection coordinates for Briesemeister's projection for use with Chapter 9 (Appendix II) and the full equations to determine position, convergence and local scale factors on a Transverse Mercator projection of the spheroid (Appendix III).

This is a useful reference book for workers in the Earth Sciences. It is too comprehensive and too slanted towards the needs of cartographers to be suitable for recommendation to students. However, if your work involves preparing synoptic small-scale maps of large areas and you wish to select the optimum projection, geodetic surveying or the integration of several different projections into a GIS system, then this is the book for you.

P. D. Ryan

Galway, Ireland

Visiting England and Wales

Duff, P. McL. and Smith, A. J. (editors). 1992. *Geology of England and Wales*. The Geological Society, London. 651 pp. Price £75 (hardback); £34 (softback).

How many of us have been acutely embarrassed when asked by overseas visitors for a text covering the geology of the British Isles? We have been able to suggest that there is an excellent book describing the geology of Scotland (Craig 1991), but that the best that can be offered for England and Wales are rather generalized student texts (e.g. Anderton *et al.* 1979) or the 13 British Regional Geology series (BRG) books. Excellent though many of the latter may be, they fail to give a