Amongst the 12 included papers is information on the tectonic setting of the offshore and onshore Santa Maria Basin, the San Simeon/Hosgri fault system, and the distribution and nature of seismicity within the region. You will find offshore seismic data provided by Steritz & Luyendyk and Cummings & Johnson, information about correlating marine terraces by Rockwell *et al.*, so-called stress determinations from fault-slip data by Vittori *et al.*, and an investigation of the seismicity by Dehlinger & Bolt. My personal favourites include a review of the seismotectonic framework by Clark *et al.*, and several excellent papers on using marine terraces and other geomorphic/stratigraphic features as strain gauges (e.g. Hanson *et al.*, Lettis *et al.*, Nitchman & Slemmons, Hanson & Lettis, Hall *et al.*, and another Lettis *et al.*); these papers are accompanied by 5 excellent (and very large) geological maps included in envelopes at the front and back of the volume. The strain gauge data—which tells us about uplift/subsidence rates, fault-slip rates and earthquake recurrence intervals—show that some structures do appear to show deformation rates that agree with predictions of long-term deformation derived from space-based geodesy: others clearly do not and appear to be dead, but not gone.

This is exciting material! Despite the 1987 vintage of the work, and the concentration on geomorphic and Quaternary–Holocene stratigraphic data rather than structural geology, the information was a breath of fresh air to me, and provided insights into the growth of geological structures that many structural geologist may not be accustomed to. Through examination of deformed marine terraces and other geomorphic features, the authors provide real data on the rates of Quaternary–Holocene regional deformation and the growth of faults and folds: marvellous stuff!

Overall, I found most of this book to be gripping and very worthy of a place on the shelf of any structural geologist. I will proudly carry this one into the coffee room to astound my sedimentologist colleagues and those who work on the Quaternary; colleagues who may previously have thought that structural geologists only look at old and undeforming rocks.

Basins of the Rio Grande Rift: Structure, Stratigraphy and Tectonic Setting. Keller, G. R. and Cather, S. M. (editors) 1994. Geol. Soc. Am. Spec. Paper **291**. Price: $72.50 (soft back; ISBN: 0-8137-2291-8).

This volume arose from a series of papers presented at a symposium of the 1991 joint meeting of the Rocky Mountain and South-Central sections of the Geological Society of America. The volume highlights the view that the basins of the Rio Grande Rift are part of a late Cenozoic intra-continental rift which differs from the Kenya, Baikal and Rhine rifts in that (1) it is well-exposed due to incised modern drainage; (2) petroleum exploration has spawned a number of seismic reflection profiles; (3) the geology is constrained by a number of radiometric dates. The volume contains 19 papers and deals with all the basins comprising the rift, with coverage of the geology from Colorado, through New Mexico to Texas; an area of about 400,000 km^2: an extensive and welcome data-base indeed!

Although the volume concentrates on a single geographical area, it contains many sections that will be of interest to readers of this Journal. Chapin & Cather describe the tectonic setting of the whole rift. They suggest that rotation about a Euler Pole to the north of the rift explains both the increase in purported values of extension from north to south and the kinematics of so-called accommodation zones between individual sub-basins that appear to lie on small circles relative to the Euler Pole. A section on the 'accommodation zones' shows that their geometry and kinematics are poorly-constrained, a situation which may tempt structural geologists with an interest in such structures to get their boots on and go and have a look at them! Also, an intriguing section which investigates the rift's uplift history through studies of the palaeoelevations of flora preserved in Eocene Lake Beds should be of interest to geodynamicists with botanical interests. Seismic reflection profiles allowing speculation concerning the deep structure of the rift are provided in papers by Kluth & Schaftenaar, Russel & Snelson and Barrow & Keller. These speculations fuel the long-standing debate concerning the existence of listric normal fault geometries and low-angle detachments in rifts: some people can see them, some cannot! With the clear presentations of the actual seismic lines, the reader can join in and have a go at interpreting the enigmatic seismic data. Schneider & Keller and Adams & Keller use a variety of geophysical data to examine the lithospheric structure of the rift. Lewis & Baldridge use models of flexural deformation for the footwalls of rift-bounding faults to suggest that some contractional structures previously attributed to Laramide compression may have formed during the Cenozoic extension. Harrison examines the orientations of faults and stress axes for one basin within the rift. Beck & Chapin suggest that Proterozoic structural trends have been reactivated during the growth of Phanerozoic structures. Salyards *et al.* present palaeomagnetic data which show that the Rio Grande Rift is not rotating as a whole, as previously thought, but consists of a number of smaller counter-clockwise rotating blocks. Mack *et al.* use magnetostratigraphy to examine the stratigraphic variations across faults in the rift. May *et al.* present apatite fission-track data and show that rapid uplift occurs in the footwall of the rift-bounding faults whilst slower uplift occurs on the hanging-wall dip-slopes. Collins & Raney investigate Quaternary fault movements within the rift. The volume also contains many other sedimentological and stratigraphical data which will interest structural geologists who enjoy brief respites from deformed rocks!

Overall, a nice volume to have on the shelf, with many insights into the development of rift zones. I am sure those working around the Rio Grande, or those studying rifts will wish to own a copy of this volume, but I am sure many may simply wish to order it for their library.

The approach adopted in these two volumes from the Geological Society of America is that of applying old techniques to new rocks. This approach—an approach that is, in my view, not encouraged by funding constraints in my own country—appears to me to have produced some very exciting new results and important insights into fundamental earth processes. I am pleased that the Geological Society of America provides encouragement, in the form of such volumes, to workers engaged in basic data collection.

London, U.K. *Gerald P. Roberts*

Model collection

Modern Developments in Structural Interpretation, Validation and Modelling. Buchanan, P. G. & Nieuwland, D. A. (editors) 1996. Geol. Soc. Spec. Publ. **99**. Price: £70 (£36 for members of the Geological Society).

This Geological Society special publication provides a comprehensive review of the latest developments and techniques available in structural interpretation, cross-section validation and modelling techniques. The volume is of modest size (370 pages in length) containing 23 articles organised into six chapters on the basis of methods and techniques used. After an introduction, the chapters cover, in order: (1) Seismic Interpretation; (2) Palinspastic reconstruction and forward modelling; (3) Fault populations and geometric analyses; (4) Analogue modelling; (5) Mathematical modelling, and finally, (6) Regional analysis and remote sensing. It is inevitable, however, that there is a large degree of overlap between individual chapters and that most authors have combined more than one technique to achieve their goals. Most people, I feel, will dip into this volume (as I did) to concentrate on those chapters and techniques that are relevant to their interests rather than reading the entire volume from cover to cover.

This special publication begins with *Seismic Interpretation* (Chapter 1). In their excellent introduction, the editors point out that the single most important technique that has enabled significant advances in structural interpretation is 3D seismic. Access to 2D and 3D seismic for structural interpretation is becoming widely available in academia. It is appropriate that the first chapter of this Special Publication focuses on some of the pitfalls of using seismic interpretations for validating 3D fault geometries. The first contributor to Chapter 1 outlines the advantages of integrating gravity and magnetic data for validating seismic processing and interpretation. The next paper deals with estimating the density of faults below the limit of seismic resolution by analysing the fractal or power-law scaling of fault displacements. The last contributor in Chapter 1 focuses on quantifying the variety and complexity of ductile strain associated with faults. This paper provides a number of examples in which significant fault-related ductile strain can be demonstrated. These authors show that fault-related ductile strains can occur on all scales and can vary both laterally and vertically.

Chapter 2, *Palinspastic Reconstructions and Forward Modelling*, contains the largest number of contributors to this volume. The chapter

begins with a discussion on the application and limitations of cross-section validation techniques to hydrocarbon exploration and production. Guidelines on how to plan a cross-section validation project, and what datasets to include in such a project, are described. A similar contribution, as a case history, describes a strategy for the restoration of inverted basins.

It is encouraging that many of the contributors in this chapter have paid careful attention to the limitations as well as to the benefits of cross-section validation techniques. One of the main themes running through many of the articles is the intended use of the restored cross-section. The main uses fall into two broad categories, namely, to validate cross-sections by evaluating, and possibly modifying, the structural interpretation and/or to determine and illustrate the (most likely) geometric evolution. The common approach to a section that does not balance would be to change the interpretation and/or restoration algorithm to make the section balance. One point to emerge from this chapter is that in areas of complex geology, or where there is heterogeneous stretching or shear, conventional 2D section restoration may not actually be a suitable technique if the intended use is to modify the structural or seismic interpretation.

The main limitation with conventional cross-section restoration is that restoration is a 2D process that assumes plane strain deformation (that is, there is no movement into or out of the plane of cross-section). This assumption is robust as long as the section is in the direction of material transport and that ductile strain is homogeneous. Examples in Chapter 2 illustrate situations where the 2D plane strain assumption may be invalid (e.g. in areas that have undergone inversion or where there is complex salt tectonics). In such structurally complex areas, the 2D restoration technique may only be useful for identifying grossly invalid interpretations or to determine and illustrate the most likely geometric and kinematic evolution. One conclusion to be drawn from these studies, as pointed out by some of the authors, is that there is an urgent need for 3D restoration techniques in areas of complex structural geometries. Detailed research to characterise and understand the 3D kinematic analysis and evolution of complex areas is required in order to develop 3D restoration techniques. Bearing this in mind, I was a little disappointed to find that there were only three contributions to Chapter 3, *Fault Populations and Kinematic Analyses*. Understanding the 3D kinematic evolution of fault systems is a key part to unravelling the structural evolution of an area. Kinematic analyses can establish whether an individual fault has developed as an isolated structure or has formed by the linkage of segments or by the breaching of relay structures. This chapter provides some excellent examples, based on field observations and seismic interpretations, which underline the importance of understanding the kinematic evolution of fault systems. Unravelling the 3D kinematic evolution of faults depends upon understanding the likely cause(s) of displacement variations on fault surfaces. The authors in this Chapter (and some in Chapter 1) illustrate that displacement analysis techniques is an alternative structural analysis method for testing the validity of 3D fault geometries.

Chapters 4 and 5 deal with analogue and mathematical modelling of geological structures, respectively. The first contribution in Chapter 4 describes the recent advances and limitations of scaled physical models, whilst the second describes sandbox models of thrust tectonics with multiple detachment levels. The mathematical models presented in Chapter 5 range from the finite-element modelling of shear bands to the modelling of localised deformation during crustal extension. Chapter 6, *Regional Analysis and Remote Sensing*, contains two regional studies that demonstrate the added value of integrating techniques to obtain a detailed stratigraphic and structural interpretation of an area.

Finally, a note on the presentation of this volume. I was a little disappointed by the quality of reproduction of some of the diagrams. Detail in some of the seismic cross-sections and contour diagrams is almost totally obscured by an extremely high level of contrast. This is unfortunate not only because the diagrams illustrate key points described in the text but also because the rest of this volume is produced to a very high standard (not withstanding the fact that the publication number on the spine is different to that on the front cover). I understand from the publishers that this volume will be reprinted and that all diagrams will be reproduced. Despite these minor shortcomings, I am certain that this Special Publication will be regarded as a valuable source of techniques for structural interpretation and validation of fault geometries. I can certainly recommend this volume as an essential, and indeed, a worthwhile purchase, for academic and industry structural geologists alike.

Hundleby, Lincs, U.K. *P. G. Bretan*

Something in the basement?

Richard W. Ojakangas, Albert B. Dickas and John C. Green (editors) 1995. *Basement Tectonics 10: Proceedings of the Tenth International Conference on Basement Tectonics held in Duluth, Minnesota, USA, August 1992.* Kluwer Academic Publishers, Netherlands. Price: £135.00 (hardback).

Deformed continental lithosphere is characterised by a broad and diffuse regions in which fault—and shear-zone—bounded blocks partition strains into a series of complex displacements, internal strains and rotations in response to far-field plate tectonic stresses. This behaviour reflects the weakness of continental lithosphere and also important lateral strength variations that occur due to the presence of pre-existing structures in the continental crust such as old faults and shear zones. These long-lived zones of weakness tend repeatedly to reactivate, accommodating successive crustal strains, often in preference to the formation of new zones of displacement. This architecture of inheritance is very long lived since buoyant continental crust is not normally subducted. Basement tectonics is important to a wide range of Earth Scientists because reactivation of pre-existing structures is known to strongly influence the form and location of mountain belts, sedimentary basins, intraplate seismicity, mineralisation sites, fluid/magma migration pathways and shallow groundwater movements.

This book is one of a continuing series of volumes composing papers and abstracts arising from international meetings that are held every few years in the USA and other countries. The conferences aim to bring together Earth Scientists from several disciplines to present work under the general basement theme. In his useful introduction, Patrick Barosh points out that the history of basement tectonics is closely linked to the recognition of 'lineaments'. An appreciation of these linear features arose from the classic work of Hobbs (1901, 1904) who was undoubtedly influenced by earlier studies by Kjerulf, Daubree and, inevitably, Charles Lapworth. As with plate tectonics, the increasing recognition of basement lineaments during the rest of the twentieth century arose from the application of increasingly improved topographic, geological, geophysical and, most recently, satellite mapping methods. Yet many of us still see the whole lineament analysis as unscientific and vague, akin to some kind of glorified reading of the tea-leaves, looking for patterns where none exist. However, our improved understanding of both continental tectonics and the growth of fracture populations in rocks at different scales suggest that these views need changing.

The book is subdivided into four sections: Part I. Rifting—Midcontinent Rifts; Part II. Basement Control on Younger Structures; Part III. Shear Zones; and Part IV. Abstracts. The Contents list 39 papers and 16 abstracts, with topics understandably somewhat biased towards studies in North America given the conference location and list of participants, but work from other regions including Scandinavia, Africa, South America, Asia and Europe is also included. A broad range of geological and geophysical disciplines is represented, including structural geology, stratigraphy, hydrocarbon geology, geochemistry, aeromagnetic studies, seismic profiling and economic geology. It all sounds great, but the end result is a bit of a disappointment. There are two main reasons for this: (i) Too many 'papers' are little more than extended abstracts covering two or three pages without any accompanying diagrams to help locate the reader. (ii) Too many papers are much too focused on their study material, often presenting a rather parochial view. As a result, the general reader will gain less information about basement tectonic processes than they might reasonably expect from such a book. As a newcomer to the region, I found the first part of the volume concerning the North American midcontinent rifts of Proterozoic age to be quite informative and interesting. Elsewhere, there are useful reviews of North American basement tectonic fabrics (Baars *et al.*), together with stimulating papers on recurrent faulting in Montana (Nelson) and reactivated transpressional shear zones in the Superior Province (Hudleston & Bauer). Although the editing is generally satisfactory, I found that some papers could have done with a good deal of pruning. Conversely, some abstracts are tantalisingly interesting—what a pity they never appeared as full papers! Reproduction of diagrams and maps is generally good, but too many papers lack sufficient diagrams.

All in all, then, this volume presents a somewhat unfocused collection of works that will probably only appeal to hard-core aficionados of