

cases leading me to reassess my own interpretation of common fault phenomena.

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The Ramberg Volume

Talbot, C. J. (editor) 1988. *Geological Kinematics and Dynamics*. University of Uppsala Bulletin of the Geological Institutions, Uppsala, Sweden. 193 pp. Price 155 SKr (ca £17).

This volume contains papers from a 1987 conference held in Uppsala in honour of Hans Ramberg, on the occasion of his 70th birthday. Ramberg's brilliant research in petrology and structural geology has always circumvented conventions, and this volume does too, in three respects. It was published, not by a mainstream, international journal (as it well could have been), but by Ramberg's home institute, the University of Uppsala. One opens the volume and who should be author of the first paper but Ramberg himself! Compounding these novelties, my copy arrived with a loose-leaf Table of Contents and Preface (which I have now resourcefully taped inside the front cover). Editor C. Talbot explains in his Preface that the decision to publish in the local bulletin was taken "with the agreement of the authors . . . [and] . . . on the assumption that important work will surface however obscure the source". The papers are indeed important, so I will use this space to help them "surface", by listing the authors and their subjects so readers may write for reprints or perhaps order the whole volume. At the prices shown above, the volume is a bargain, compared with special issues from commercial publishers. Some readers may discover the Uppsala bulletin in their own libraries; it is circulated to six or seven hundred institutions internationally.

Ramberg (University of Uppsala) leads the first section, *Theory*, with the first description I have seen of the energy principles that govern the competition between independent processes in deforming bodies, with examples from buckle folding and nappe spreading. W. S. Fyfe (University of Western Ontario) reviews what we know of geochemical fluxes from the solid earth into the biosphere and concludes that such fluxes can be important on a human time scale and need to be better understood. P. H. Reitan (State University of New York at Buffalo) considers the problem of heat supply in orogenic/metamorphic belts and concludes that a significant contribution from strain heating is indicated. M. B. Bayly (Rensselaer Polytechnic Institute) propagates an idea from Ramberg about the direction-dependence of chemical potential in stressed solids, and manages to define shear stress in terms of a gradient in chemical potential with respect to orientation. J. Huang and D. Turcotte (Cornell University) describe a self-similar mechanical model for an earthquake source region which, when stressed to failure in their computer, yields shock sequences similar to natural seismic sequences. O. Stephansson (Luleå University) surveys available bedrock stress measurements in Scandinavia and concludes that a horizontal component due to ridge-push may be present. J.-P. Poirier (Institut de Physique du Globe, Paris) reviews several kinds of analog studies currently in use by students of rock deformation, noting their usefulness and limitations and giving advice for new work.

In section two, entitled *Fabric Studies*, B. Ildefonse and A. Fernandez (Université Claude Bernard-Lyon I, Université Clermont-Ferrand II) describe simple shear experiments with high concentrations of elongate rigid particles in a flowing matrix. Interaction between the particles is found to slow down their rotation, and to promote a metastable preferred orientation in the shear direction. A. Fernandez discusses the theory of strain-induced preferred orientation of elongate rigid objects, and presents strain maps obtained from feldspar orientations in a granite pluton. W. Schwerdtner, J. van Berkel and J. Torrance (University of Toronto; Free University, Amsterdam; Heath Steel Mines, Newcastle, New Brunswick) describe shape fabric patterns in naturally deformed nodular anhydrite and wrestle with the problem of determining strain history from total strain measurements. P. Hudleston and J. Tabor (University of Minnesota, Minneapolis) conclude the section by describing folded calcite veins and using features of vein morphology and strain analysis to build a tight case for buckle folding with inner-arc collapse by volume-loss.

In the next section on *Numerical Model Studies*, H. Schmeling

(University of Uppsala) describes computer models of buoyancy tectonics driven by various combinations of thermal and compositional density inversions, helping to define conditions under which single or multiple cycles of overturn occur. J. van Berkel (Free University, Amsterdam) follows with a two-dimensional finite-element calculation of the strain field in a diapiric ridge and its overburden, and finds the results in general agreement with the results of other computer models and centrifuge experiments.

The final section of papers is entitled *Material Model Studies*. G. Peltzer (Institut de Physique du Globe, Paris) describes indentation tectonics experiments carried out using an enormous centrifuge and samples with a free surface for lateral extrusion of fault wedges. Toward the end of experiments, shortening is found to be accommodated by about 30% vertical thickening and 70% lateral extrusion. P. Davy and P. Cobbold (Université de Rennes) describe non-centrifuge experiments otherwise broadly similar to those of Peltzer, but with varying degrees of lateral confinement at the relatively free lateral surface, resulting in varying ratios of thickening to lateral extrusion. Serial lateral extrusion of fault wedges, observed in the experiments of Peltzer, is not observed here. Cobbold and Davy review geological and geophysical data bearing on the tectonic history of Central Asian over the past 50 Ma and make comparisons with features of their indentation models. J.-C. Soula, G. Bessiere and G. Herail (Université Paul Sabatier, Toulouse; Université de Toulouse-Le Mirail) describe the structural behaviour of physical models consisting of a rigid or ductile basement material overlain by a more brittle cover layer, with pre-existing faults built into the basement in some of the experiments. The behaviour of the cover over these reactivated basement structures is related to the behaviour of the Bierzo basin, Spain. N. Mancktelow (ETH-Zentrum, Zurich) ends with a detailed account of rheological measurements on paraffin waxes, with attention to such inconvenient but important features as variation in properties between different batches of the same wax. Paraffin waxes appear to be useful analogs for geological materials that exhibit a power-law relationship between stress and strain-rate.

The volume may be obtained from the distributors: Almquist and Wiksell International, Box 638, S-10128 Stockholm, Sweden.

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Geology of the North Atlantic and Europe in words and pictures

Ziegler, P. A. 1988. *Evolution of the Arctic-North Atlantic and the Western Tethys*. AAPG Memoir 43. AAPG, Tulsa, Oklahoma, U.S.A. 198 pp. Price \$48 (\$58 to non-members), carriage extra.

When we were students, my friend, Len Pile, and I used to quip about writing the definitive stratigraphic textbook, to be called *The Geology of the World*, as an antidote to our interminable stratigraphy lectures. Well, Len, if you're reading this I have some bad news—we've been pipped to the post by Peter Ziegler.

This is a much slimmer volume than its title would suggest, for the whole later Silurian to Recent development of the Arctic, Atlantic and European mega-region has been compressed (if that is an appropriate term) into less than 200 pages, supplemented by 30 superbly printed palaeogeographic maps and stratigraphic columns in plate form, in a separate part of the Memoir. Len and I would never have succeeded anyway; this Ziegler/Shell compilation is clearly the product not only of one of the few geological minds capable of synthesizing such an enormous amount of information, but also of what must be the most extensive collection of data available for the region. In this memoir, Ziegler cites some 1200 references to supplement Shell's not inconsiderable in-house database.

The text is organized into 10 chapters, nine of which deal with the whole area for some stated time interval. Within each chapter this vast geographical area is discussed, basin by basin, although there is no obvious consistency in the choice and extent of the basins under discussion from chapter to chapter. This is understandable given the extent of the database which has been winnowed down, but it does mean that if you want to follow the evolution of any particular basin from Palaeozoic through to Tertiary times you often have to search

through the whole text to find what you want. Mercifully, the North Sea is an exception to this rule. Chapter 10, entitled *Thoughts and speculations on geodynamic processes*, acts as a synthesis and is a pleasant blend of simplified summaries of plate movements together with a discussion on modern tectonic processes for basin formation and deformation.

The plates are magnificent full-colour productions, crammed with detail and interest. Twenty-one palaeogeographic maps cover 400 million years of sedimentation patterns and tectonic events of a block of the Earth's crust almost 7000 km², centred on Scandinavia, although of course continents come and go with time through the field of view (Africa is my particular favourite). These are supplemented by 74 tectonostratigraphic columns in nine plates, covering first the Palaeozoic and then the Mesozoic–Tertiary development of the major basins of the Atlantic–European region. The columns are linked in fence diagram form to ease comparison through or between basins. All the plates are colour-coded: the columns to indicate depositional environment and lithology and the maps to show the nature of basin sedimentation and tectonic stability.

These colour plates, which readers may have seen as slides at Ziegler's conference papers over recent years, form the centrepiece of this memoir. In them the data are clear and succinctly presented, albeit in a generalized form, and each plate must represent hundreds of hours of painstaking correlation and synthesis. They reward careful study with new or more complete ideas, and on their own make this book a must for those whose work includes regional tectonic modelling and plate movement analysis for post-Caledonian Europe.

The text is much more disappointing. Here, by and large, brevity does not mean elegance, but more usually reduces the geology to one-line comparisons of areas with unfamiliar names in a style which I find difficult to follow and impossible to comprehend. Obviously, this type of overview of such a wide subject area means that there is little room for detail, but the text demands real hard work from the reader to grasp the essential nature of each basin. For me, there is a yawning chasm between the amount of geological data which oozes out of the plates and that which can be prised out of the text. The text is, however, liberally illustrated with colour diagrams which offer both relief and information.

Readers will naturally turn to basins and systems with which they are familiar, and will find there brief but accurate statements of the geology. For most of us, many of the basins covered in this memoir are unfamiliar, so I earnestly hope those areas are accurate too. Throughout the text, I would like to have seen a little more detail to support my hopes. For example, we are told (p. 37) that in Bjørnøya, "wrench-induced basin inversion occurred during the Sakmarian". How do we know?

I am sure the answer to my question is to be found in the reference list, which is extensive and up-to-date, considering the book was actually written in late 1986. This list alone is worth having. The index, by contrast, is very poor. If ever a book needed a good index this was it, and at times I found myself wondering if the real index had been inadvertently left out. The one that is included was written for computer indexing purposes and falls far short of being a useful guide to the contents. You will have to go searching for subject matter that interests you.

All in all, this is a valuable résumé of a vast chunk of geological knowledge—a snip at \$60. Institutions should have a library copy and interested individuals will find a great deal of thought-provoking ideas and information here, like I did. I can promise each reader that they will find something they did not know, as well as something to disagree

with, in this memoir. I have learned much from it already, not least that it is almost impossible to review!

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Structural geology for beginners

Park, R. G. 1989. *Foundations of Structural Geology* (2nd edn). Blackie, Glasgow. Price £12.95 (paperback), £30 (hardback).

"This highly regarded textbook is specifically tailored to the requirements of students at the early stages of their studies . . . The second edition has been carefully revised, and now contains new sections on extensional settings, strike-slip tectonics, collage (?) tectonics, the use and interpretation of stereograms and elementary geological map analysis."

For once the publisher's 'blurb' is a fair description of the second edition of this excellent little book. There is indeed, a new introductory chapter on *Basic concepts* which defines and explains bedding, formation, unconformities, etc., the geometry of planes and lines, and then in two pages attempts the "elementary geological map analysis" referred to. An Appendix similarly attempts to introduce the stereographic projection, which will certainly help the uninitiated to understand the stereographic representations in various diagrams. Otherwise, these new sections do not greatly enhance the book.

The other principal additions are the useful sections on extensional and strike-slip faulting and on the Makran complex. The sections on Central Asia and the Caledonian of Britain have also been up-dated. These revisions involve new diagrams which unfortunately are not compatible in style with the others, nor are they generally of the same high quality of draftsmanship as those of the first edition, with their excellent use of a second colour.

Indeed some of the original diagrams have had their second colour removed and in two instances the printer has accidentally omitted it. The photographs were never a strong point and although the opportunity has been taken to replace the worst, the almost indecipherable pictures of slickensides and cleavage refraction remain.

Unfortunately, this juggling of diagrams and photographs has led to erroneous references in both text and captions (pp. 19, 24, 133 and 135) and no reference to the new photographs in fig. 10.11. Three mistakes I spotted in the first edition that may cause confusion to students have not been rectified (equation 8.3: p. 63 shear and normal stress wrongly attributed; caption to fig. 6.11); I hope there are no more.

Although I think it is a pity that the chance was not taken to update the book further (e.g. *C-S* fabrics, shear criteria) and that more attention was not given to the points raised above, this still remains an invaluable text for the beginner in structural geology. It is clearly set out, concise and as comprehensive as you can expect at this length (148 pp.). At the moment, its only competitor in the U.K. at this price is McClay's superb *The Mapping of Geological Structures* (Open University Press, £7.95) which achieves far more at the small-scale but lacks, of course, the large-scale treatment.

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