



BOOK REVIEWS

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Learning about rift basins

The East Greenland Rift: A Film and Workbook Training Package. Geofilms Ltd., 1991. Price £380 (exc. VAT & p&p); £28 (exc. VAT & p&p) for academic orders.

The East Greenland Rift: A Film and Workbook Training Package, is produced by Geofilms for BP Exploration. It documents the structural and stratigraphic style of one of the world's best exposed rift basins which, because of the logistical problems of undertaking field work, few of us are able to examine in person. This training package gives us a chance to experience the impressive geology of the area in four half-hour video programmes and has a strong underlying theme of basin and play fairway analysis.

The East Greenland Rift 'package' consists of two volumes. Volume I: The Workbook, is the text part of the package and contains an introduction, a programme by programme breakdown of the video and practical material in some 150 pages. Volume II: Films and Tutor Notes, comprises two videos, each containing two programmes and summary tutor notes, with answers for some of the exercises and questions posed in the programmes.

Both volumes are in a ring bound format and are well presented. The text is easy to follow and clearly divided into 'chapters' covering each of the programmes. The text is easy to read and the figures generally clear, although some of the figures lack full legends. The videos themselves are excellent and extremely well filmed. One is left in no doubt that the exposure is both excellent and large-scale. The BP geologists do an excellent job in guiding us through the geology; one wonders if they have been on an acting course! With each programme, there are ample summaries of the information provided (both in the workbook and on video), and there is a close integration between the video and workbook material. This integration is emphasized by the incorporation of comments telling the person(s) watching the video to go to specific sections and by large red stop signs at the end of each section. Personally, I found this broke the flow of the material and could be rather irritating at times.

Programme 1: Basin Development, introduces the East Greenland Rift in terms of its geographical and tectonic setting. The tectono-stratigraphic evolution of the area is presented in terms of three phases of sedimentation: late Permian carbonates, Triassic continental clastics and Jurassic submarine fans. Major vertical and lateral facies variations within these phases of sedimentation are outlined, with particular emphasis on relationships to major fault zones. In fact, tectonic control is to some degree over-emphasized at the expense of sea-level and sediment flux controls. The end of this programme relates the Mesozoic and Tertiary development of the area to the wider context of the opening of the North Atlantic.

Programme 2: Permian Carbonates, examines the varied carbonate facies developed in the late Permian. Through systematic examination of exposures and photomicrographs, facies models for restricted lagoonal and barrier carbonates, and open marine reefal carbonates are developed. The controls on the spatial and temporal distribution of the carbonates facies are addressed, but again emphasis is placed on a tectonic control without discussion of other possible causal mechanisms. Despite this, the programme presents a good overview of shallow water carbonate depositional environments. The end of the programme is devoted to an examination of the reefs and their associated flank facies as a hydrocarbon play. Aspects of the reservoir, topseal, source and migration pathway are discussed. The workbook material associated with this programme ends with a seismic exercise on the Permian of the Barents Shelf.

Programme 3: Mesozoic Clastics, is divided into two sections: The first section deals with mainly non-marine sediments of the Triassic

and the second section deals with Jurassic to Early Cretaceous marine clastics. Both sections are centred around the construction of a chronostratigraphic diagram summarizing the facies relationships across the basin. Questions are posed at frequent intervals in the programme to highlight key points in the basin evolution. Although these are intended to help the person(s) watching the video interact with the programme, the stop-start nature of the presentation is distracting. At the end of the second section, the workbook contains an exercise on the hydrocarbon potential of the Mesozoic of East Greenland. Personally, I found this programme the most difficult to follow, with a host of lithostratigraphic names and a large number of localities to remember. Some of the questions asked are difficult to answer given the data presented in the video and some of the chronostratigraphic relationships also appear difficult to construct from the exposures shown. However, summaries of the stratigraphic development and inferences as to some of the controls are presented at the end of each section.

Programme 4: Half Grabens, introduces the geometry of half graben and the relationships between basin structure and the sedimentary fill. The programme starts with an outline of the structure of the half graben in Wollaston Forland through the use of a series of traverses across the area. This section illustrates some of the variation both across the half graben and longitudinally along the basin. In general the panoramic views are clear, but in some cases more annotation on the video would help in relating the commentary to the views. The cross-sectional geometry of the half graben is summarized in relation to planar and listric fault geometries from sandbox models. This section of the programme ends with a review of the along-strike changes in the half graben geometry as one moves from a major fault segment towards a terrace (transfer zone). The second part of the programme documents the variation in the syn-rift sediments through examination of a number of exposures situated progressively further away from the border fault zone. This section is summarized by the development of a facies model for turbidite deposition in rift basins and construction of simple cross-sections illustrating the stacking patterns of the sedimentary systems. Programme 4 also includes two exercises based on seismic lines from the North Viking graben and Jeanne d'Arc basin.

In summary, this is a well produced package which I would strongly recommend. The material could be used at different levels of experience and in a wide range of basin analysis, structural, sedimentological and energy resources courses. It is reasonably priced (especially for academics) considering the amount of material that is contained within the package. It is certainly much cheaper than going to East Greenland. However, there is nothing like seeing those field relationships for yourself!

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Understanding more about the Earth

Brown, G., Hawkesworth, C. and Wilson, C. (editors) 1992. *Understanding the Earth: A New Synthesis.* Cambridge University Press, U.K. Price £70.00 (hardback), £24.95 (softback) (\$44.95 softback).

This is an important book, likely to be regarded as a classic for years to come. However, readers and students expecting simply an updated version of the original '*Understanding the Earth*', published in 1971, may well be disappointed. The original book was designed as a reader to support the Open University Foundation Course, then in its infancy. I have a copy of the second edition, published in 1972 following the phenomenal success of the first. It contains 27 short, readable chapters, with an average length of 13 pages, and starting with a basic account of rocks and minerals. I bought it as a first year undergraduate, and found it a useful and accessible aid to my course at

that level—a book to dip into whenever I was writing an essay. Like the original, the new *Understanding the Earth* has been written by a cast of famous earth scientists—for the most part leaders in their fields. The scope is also similar—the whole range of the subject but with a distinctly hard-rock and geophysics bias. Structural geology, for example, is seen entirely through the eyes of geophysicists, and there is very little on low temperature geochemistry. But there the resemblance ends, for the new book is really a final year or even postgraduate reader, and only the brightest and most persistent first years are likely to get much out of the majority of chapters. Although it deceptively occupies a similar amount of shelf space as the original, the new book is in fact about twice as long, with more words on each page, and well over 500 pages. Each chapter is in essence an up-to-the-minute review of a particular field, starting with a very brief introduction to the basic underlying principles of that area of study—principles which comprise the whole of some first year texts of similar lengths! This makes for a very dense style in many chapters—the whole of metamorphism in 25 pages from Alan Thompson, for example!

The 25 chapters in the book are grouped into eight sections, each with an introduction by the editors. These sections comprise: The interior of the earth, its origin, and the solar system; magma generation, geological time, and the origin of the continents; plate tectonics, ore deposits and metamorphism; structure and deformation of the continental lithosphere and the formation of sedimentary basins; sedimentology; sequence stratigraphy, lithospheric stress and sea level change; palaeontology and evolution; and palaeoclimatology and volcanic hazards. At first sight some of these groupings seem a trifle idiosyncratic, but in fact they work pretty well. Linking sequence stratigraphy (by Chris Wilson) to intraplate stress (by Sierd Cloetingh) gives an interesting perspective on global and sea level change for example. I enjoyed reading the three chapters on crustal deformation, by Simon Klemperer and Carolyn Peddy, Philip England and Tony Watts, even if the structural geologist's perspective was missing. Other highlights for me were Steve Spark's superb account of magma generation, Keith O'Nions's succinct summary of crustal evolution, Mike Russell's comprehensive summary of hydrothermal ore deposits, and Simon Conway-Morris's nicely illustrated account of Precambrian life. I also at last found out the difference between a sequence and a parasequence!

So who should have a copy of *'Understanding the Earth'* on their shelves? Every university lecturer, for a start—I learnt something new from virtually every chapter, and this book is the first I reach for if stumped by a question in a second or third year tutorial. Undergraduates will find it useful for second and third year courses. The subject matter is mostly too detailed for bedtime reading, or the coffee table, however.

How will we see *'Understanding the Earth'* in the year 2000—will it stand the test of time? In several areas, it will be seen as a definitive statement of the 'state of the art' in 1992. Otherwise, it may seem a little dated by the lack of attention to environmental geology, apart from palaeontology and volcanic hazards—no engineering geology, oceanography, waste disposal or geological microbiology, for example. Indeed, there is less than in the original, where chapters on nuclear explosions and seismology, resources and the environment, and the Mohole and geopolitics were ahead of their time. But as a whole-earth text book, at this level, it would be hard to surpass and the editors, including the late Geoff Brown are certainly to be congratulated for a difficult task well executed.

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Visiting impacts

Hodge, P. (1994). *Meteorite Craters and Impact Structures of the Earth*. Cambridge University Press, U.K. 124 pp. (ISBN 0-521-36092-7). Price £25.00 (\$49.95).

Although many of us may be near-saturated with discussion of the impact theory of dinosaur extinction, the collision of the comet

P/Shoemaker-Levy 9 into Jupiter in July, 1994 has revitalized or initiated public interest in encounters between objects in the solar system. The appearance of Hodge's book at this time might therefore be considered auspicious. This volume is basically a traveller's guide to all (or nearly all) of the certain and probable meteorite impact structures that have been recognized to date on the Earth's surface.

After a very brief introduction (4 pages), the remaining 7 chapters describe 139 impact structures to be found in the United States, Canada, Latin America, Australia, Europe, Africa and Asia. For each locality, there is a summary table giving location (latitude and longitude), diameter, age and condition of exposure. This is followed by a short account, in which is given a synopsis of the history, geology and features to be seen, in some cases accompanied by anecdotal details. The accessibility of each crater is then described in one or two short statements, and this is followed by one or more references where interested readers can dig in deeper. Most crater descriptions are accompanied by one or more photographs.

The information presented is accurate, as far as I can tell. Hodge has taken much of the data from previously published compendia, but has supplemented this with details from the more recent literature. Among the things I checked were the scepticism regarding the impact origin of the Bee Bluff structure in West Texas, and the roster of African craters, both of which are reported correctly (the recently discovered, 70 km diameter Morokweng structure of South Africa, the 20 km Highbury structure of Zimbabwe, and the 11 km Aorounga structure of Chad are not included, but news of these is only just published or about to be published).

The jacket blurb says that this book will be of interest to geologists and astronomers, but to me it seems more aimed at the scientifically-aware lay public. Researchers and those with a serious interest in impact processes will be disappointed by the skimpy introduction, lack of detailed maps, and generally low scientific level of the writing. There is not much of interest for most structural geologists. Some of the anecdotes and trivia are, however, entertaining. A large pallasite evidently was uncovered by hogs burrowing under a barbed wire fence at Haviland, Kansas. Millions of people have unknowingly visited the 8 km diameter Des Plains structure, which underlies Chicago's O'Hare Airport, one of the world's busiest. Locally quarried impact breccias were used to construct St. George's church at Nordlingen (Ries structure, Germany) and a 16th century castle at Rochechouart, France.

Hodge attempts to direct us, as tourists, to each of the crater localities, in many cases providing rudimentary road maps. In a large number of cases, however, there is little or nothing to see upon arrival because the structures are either buried, deeply eroded, or completely covered with vegetation. For a few examples, Hodge chooses to illustrate this with photos, such as of a ploughed field (Haviland, Kansas), of a dip in the road, and of a barn near the crater centre (Holleford, Ontario). Trail guides or route logs are provided for some of the well known, easily accessible impact structures, such as Meteor Crater, Arizona; Brent, Ontario; Sudbury, Ontario; Ries, Germany; and Wolfe Creek, Western Australia. However, for other craters we are given only general directions to the sites, rather than detailed instructions on how to get to specific localities where evidence of impact origin can be examined. This would have made the book much more useful.

The book contains some careless misspellings, typographical errors, and editorial oversights: "diapere", p. 71; "spinafex", p. 63; "The target rocks are basalts and sedimentary.", p. 113. There is a word, line, or section missing between pp. 101 and 102. I could nowhere find a caption for the colour jacket photo of multiple depressions in some desert. I would have considered it essential to have included a world map of numbered crater locations, keyed to the entry for each structure.

I will be able to use Hodge's book as a summary of basic information about specific impact structures (at least until such time as a substantial number of new sites are discovered), but not as a source from which to prepare university-level lectures, or as a detailed guide to explore any of the 139 impact sites described. This book is ideal for the amateur geologist, meteoriticist, or astronomer, with a passionate interest for exploring the effects of interplanetary collisions, however imperfectly they may be preserved.

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