Book Reviews

*Edinburgh Rock, the Geology of Lothian* by Euan N. K. Clarkson & Brian G. J. Upton. Dunedin Academic Press, Edinburgh. 239 pp. ISBN 1-903765-39-0, £19.95.

The authors have produced a semi-popular account of the geological history of Edinburgh and the Lothians, defined as the area north of the Southern Uplands and eastwards from the Bathgate Hills. They extended this area a short distance into the Scottish Borders, to include the world-famous Hutton’s unconformity at Siccar Point. The book should be understandable by anyone who has completed a first-year university geology degree course, as well as more knowledgeable amateur geologists. Overall the book is generally well-produced and copiously illustrated. However, the colour balance of a few photographs, particularly Figures 7.1, 8.3 and 10.8, is seriously awry. The book’s handy A5 size and robust cover mean that it can be used in the field as a complement to the Edinburgh Geological Society’s excursion guide to the same area (McAdam & Clarkson 1996).

The first three chapters form an introduction to the book and provide an explanation of important geological concepts, which will assist amateur geologists. Chapter 1 briefly describes the topography of the region, together with the principal rock types and their importance to the history and economic development of the region. Chapter 2 begins by explaining the origin of the various rock types of the Lothians, going on to describe the tectonic, magmatic and climatic processes that have affected them. The remainder of the chapter gives a brief résumé of the geological history of the area. This is followed, in Chapter 3, by a guide to the diverse collection of plants and vertebrate animals that can be found within the Upper Palaeozoic strata of the Lothians.

Chapters 4 and 5 are devoted to the Lower Palaeozoic rocks of southern and central Scotland. Chapter 4 contains a very brief summary of the geology of the Southern Uplands. Chapter 5 describes the geology of the Silurian inliers of the Pentland Hills, and in particular the North Esk inlier. The latter has yielded a large assemblage of invertebrate faunas, on which Professor Clarkson is the unrivalled expert.

Chapters 6 and 7 focus on the latest Silurian to early Devonian Old Red Sandstone strata of the Lanark Group. The subordinate sedimentary rocks are described in Chapter 6, while Chapter 7 deals, in detail, with the intercalated volcanic rocks of the Pentland Hills Volcanic Formation. This volcanic formation has now been subdivided into 13 members. The authors have, however, neglected to mention that some uncertainty remains regarding the age relationships between some of the members. In particular, it is possible that the Fairmilehead, Braid Hills and Blackford Hill members, which are separated from the remainder of the Pentland Hills Volcanic Formation by a major fault which runs close to the line of the Edinburgh city by-pass, may be equivalent in age to the upper part of that succession, rather than being younger than the sequence exposed in the Pentland Hills. However, by way of compensation, the wide variety of volcanic textures preserved within the Pentland Hills Volcanic Formation are described in considerable detail, although the well-developed flow banding present in the rhyolite lavas of the Caerketton Member on the west side of Castlelaw Hill and on Caerketton Crags probably should also have been mentioned.

Chapters 8 and 9 deal with sandstone-dominated sedimentary rocks of the Stratheden (Late Devonian) and Inverclyde (earliest Carboniferous) groups which unconformably overlie the Pentland Hills Volcanic Formation. The first of these chapters describes the East Lothian coastal succession from Cove to Pease Bay and the Kinnesswood Formation rocks of the western Pentland Hills. Unfortunately, the presence of Stratheden Group rocks at Pease Bay, defined as those strata below the lowest cornstone bed within the exposed sequence, has been overlooked by the authors. Chapter 9 discusses the Inverclyde Group rocks of Edinburgh city comprising the red sandstones of the Kinnesswood Formation and the cementstone-bearing mudstones and siltstones of the Ballagan Formation.

As befitting their importance, the remaining Carboniferous rocks of the Lothians are allocated a full six chapters, forming almost half of the book. Chapter 10 chronicles the early Carboniferous volcanic and intrusive activity of the Edinburgh area, while Chapter 11 focuses on similar rocks of East Lothian. Understandably, Arthur’s Seat takes pride of place and the account reflects Professor Upton’s intimate knowledge of the geology of this royal park. The volcanic succession, as well as the successive generations of vents and sills which formed during the building of the Arthur’s Seat volcano, are described in some detail. The illustrations include several excellent views of which the aerial photograph of Arthur’s Seat, which runs across two pages (pp 94 and 95), is the most impressive. Chapters 10 and 11 also include several photographs illustrating the range of volcanic rocks and xenoliths that can be found in exposure.

Chapter 12 describes the sedimentary rocks of the Strathclyde Group. Unfortunately, this chapter does include a number of errors and omissions. In particular, the Gullane and Aberlady formations are not described here; the economically important sandstones of western Edinburgh are mentioned only in the later Building Stones chapter; and the Wardie Shale, with its exceptionally well-preserved invertebrate fauna, is...
wrongly assigned to the West Lothian Oil-Shale Formation. However, the lithology and depositional environment of the West Lothian Oil-Shale Formation, which includes the economically important oil shales, the non-marine Burdiehouse Limestone and the scientifically important East Kirkton fauna, are well described. The reference on page 140 to the disused limestone workings at Ferniehill, Hyvots Bank and Moredun should be transferred to Chapter 13, as these workings were in the Hurlet (locally known as the Gilmerton) Limestone. The collapse of these disused limestone workings has, in recent years, resulted in several properties having to be abandoned. Chapter 13 deals with the geology of the Clackmannan Group. Although largely non-marine, this group contains significant marine limestone beds, in particular the Lower and Upper Limestone formations which in places are erroneously referred to as ‘Groups’. The reference to possible glacial striae on page 156 of Chapter 13 clearly belongs in Chapter 17, beside Figure 17.3. Chapter 14 describes the Coal Measures sedimentary sequence and includes a depiction of a coal-swamp forest. In Chapter 15, the authors clearly differentiate between the older Carboniferous alkali-dolerite sills of, for example, Corstorphine Hill and Salisbury Crags, from the younger quartz-dolerite intrusions. The latter include a suite of numerous dykes as well as the much larger Midland Valley Sill.

Chapter 16 contains a brief account of the geological history of the Lothians from the end of the Carboniferous until the Pleistocene, a span of nearly 300 million years – even though there is no sedimentary record of this period in the region. The Pleistocene ice ages and their legacy are described in Chapter 17. This chapter emphasizes the numerous landscape features formed during deglaciation, rather than the Pleistocene deposits themselves. It should be noted that the view illustrated in Figure 17.8 is taken from the South Bridge, not George IV Bridge as stated in the caption. The chapter on the building stones of Edinburgh is interesting, but would have benefited from a reference to McMillan et al. (1999), who covered the subject in far greater detail. A short epilogue completes the book.

There is a very select bibliography, which could have been at least doubled in size. The Index of Place Names is exhaustive, but contains one or two ‘howlers’, such as ‘Blackhall Hill’ (some entries refer to Blackhall, others to Blackford Hill) and ‘Craigcook Loch’ (for Craigcrook Loch). Finally there is an Index of Geologists.

Overall, this is a good book. But it could have been improved by a more consistent and rigorous application of the new lithostratigraphic framework for the Devonian and Carboniferous, and by a little more attention to detail.

References

McADAM, A.D. & CLARKSON, E.N.K. 1996. Lothian Geology. An Excursion Guide, 2nd edn. Edinburgh

McMillan, A.A., Gillanders, R.J. & Fairhurst, J.A. 1999. Building Stones of Edinburgh. 2nd edn. Edinburgh Geological Society and Scottish Academic Press, Edinburgh.

Agates – Treasures of the Earth by R. Pabian, with B. Jackson, P. Tandy & J. Cromartie. Natural History Museum, London, 2006. ISBN 0-565-09195-6. £16.99.

This little hardback book is intended to provide an overview of the geology, origins, history and occurrence of agate.

Although there are a number of excellent books and online guides to agates from particular areas, this book is unusual, and very welcome, in that it provides at least a brief glimpse of agates from a wide range of the world’s most significant localities, at a not-prohibitive price.

The descriptive and historical sections are mostly good, and a good range of fine agates are illustrated, although in a small book such as this, it is easy to feel that some localities have been under-represented (e.g. Germany, Australia, and even our own fabulous Ardinnie Quarry, which is represented by just a single specimen).

There are also sections dealing with the terminology and genesis of agates. In general, these are much less successful than the descriptive parts. The terminology sections get a bit bogged down in places, attempting to distinguish ‘formal’ from ‘informal’ agate names and terminology to little useful effect.

The book also struggles a bit in attempting to get to grips with the genesis of agates, and omits mention of some good recent work. There are a surprising number of geological and other errors (e.g. tholeiitic basalt described as an ultrabasic rock, rhyolite said to contain no free silica, including Mull and Skye in ‘the Small Isles’, anhydrite misspelt as anhydrate, among others). There is a tendency to allow undue space to some ideas that perhaps do not deserve it (e.g. fossil plants as silica sources in agate-bearing lavas).

The book finishes with a little section on collecting agates, but this seems a bit unsure of its audience and, in attempting to cover the situation in very diverse countries, ends up being somewhat vague, and not terribly useful.

The colour photographs are mostly good, but sometimes the captions do not give specimen sizes, or lack locality data. References are patchily dealt with, and some mentioned in the text are not given in the list at the back.

This book has a very similar title to Harry Macpherson’s 1989 softback book Agates, also published by the Natural History Museum (NHM). I hope that the new book is not viewed by the NHM publications department as a substitute for the older one. Despite being a
slightly out of date, the older book remains a more comprehensive, authoritative, not to mention cheaper, source of information on Scottish agates. It would be good to see a new updated edition dealing with recent Scottish agate finds. Although they overlap, the books complement one another.

In summary, I’d recommend this new book to those who like agate. Despite some significant geological shortcomings, it is an interesting and attractive little book. There are other colour books dealing with similar ranges of agate material, but these are much more costly, and not widely available. It is perhaps rather expensive for the content, but it does provide an unusually broad descriptive overview of agates from a wide range of localities.

John Faithfull
Hunterian Museum

Regional Geophysics of South-east England (CD) by J. Busby, A. Walker & K. Rollin; Regional Geophysics of Southern Scotland and Northern England (CD) by G. Kimbell, R. Carruthers, A. Walker & J. Williamson. 2006. British Geological Survey. Regional Geophysical CDs: the first two of a series of four. £25 each.

This series of CDs provides an interactive regional overview to the subsurface geological structure of Britain based on gravity and magnetic data. They represent an innovative step forward by the British Geological Survey to take the user or customer beyond the traditional map and cross-sections based on surface observations with insights into the three-dimensional subsurface structure of the country. The CD-ROMs are designed to be used with Internet Explorer® on a Windows-based PC, but much of the content can be viewed using other browsers or computer platforms, although some of the functionality may be impaired. Some known problems (relatively minor, fortunately) that might be encountered using other browsers are listed in the Help section of the CDs, with suggested work-arounds.

The first thing to say is that there is an enormous amount of information on the subsurface geological structure of the UK in these CDs. It is based primarily on data from the national gravity and aeromagnetic surveys, to which almost all appropriate modelling and interpretation methodologies have been applied in order to inform the user. In each of the four subareas of Britain, the CDs contain: an account of the regional geology, a reference suite of geophysical maps (images using a wide range of presentation methods, such as oblique illumination and shaded-relief); information on the data sources, including rock physical properties and seismic reflection and refraction results; data analysis, including lineament identification, deconvolution for source depth and anomaly review, again accompanied by images; modelling comprising 2.5D crustal sections and 3D models; and a reference list. This content list is not exhaustive and varies from one CD to another, and I would recommend you to take a look at the contents list to make sure the CDs have what you want. Nevertheless, they contain an enormous amount of information, and at a very reasonable price.

It would be easy to get drowned in this enormous amount of information – it’s a personal thing, but I find navigating documents on screen rather difficult, especially when the ability to flick backwards and forwards between ‘pages’ would help with their comparison and understanding. CDs can vary enormously in their user-friendliness. Thank goodness these CDs are very well organized, indexed and have easy-to-navigate menus. Moreover, it is possible to print hard copy of everything on the CD if you need it for more permanent reference. The balance of text to images is good – just enough text to explain the data sources, processing, analysis and modelling, with more lengthy preliminary interpretation and discussion sections – and the material is pitched at a useful level, roughly mid-years undergraduate I would say.

One of the most interesting sections is a compilation of information on the physical rock properties of the area, specifically density and magnetic susceptibility. As it happens, one of the CDs reviewed is for SE England, where much of the interest is in the geophysical signature of the deeply buried basement rocks, and there are few samples from basement on which to measure physical properties. Nevertheless, these compilations were essential for the modelling presented later and will be valuable to those who want to construct their own crustal structure models from gravity and magnetic data. I also found the maps of the residual anomalies from the upward continued gravity and magnetic fields very instructive to compare with the surface geology for a better insight into shallow crustal structure. Access to the raw anomaly data would provide hours of excellent class material for undergraduates.

All of the background information on data and analysis, although important in its own right, underpins the section on crustal models. The crustal models are really upper crustal models, dealing with the top 15 km of the crust. The 2D joint modelling of gravity and magnetic anomalies is carried out along selected profiles across important features in the anomaly field and 3D modelling tackles selected areas of particular geological interest. For example, on the SE England CD are the results of a comprehensive 3D modelling project on the Wash granites, and on the southern Scotland and northern England CD, of the Southern Upland granites. The model interpretations are suitably tentative but sound enough to give the user some confidence in the possibilities.

In summary, we have here, in effect, regional geophysical atlases, including the data, their analysis and possible interpretation. This leads me back to navigating through the vast amount of information that is contained within the CDs. I think the navigation in this case is about as good as it can be, but, personally, I would still rather be looking at a book. The CDs will be an essential information source for any project in British
Gravity and Magnetic Anomaly Maps of the British Isles and Adjacent Continental Shelf and Margin compiled by staff of the British Geological Survey. 2006. Nine maps in each set at scale 1:1 000 000, plus a compilation map at scale 1:3 000 000 (maps are also available individually). ISBN 0751834599 and 0751834602. £50 for one map set, or £90 for both map sets.

Beautifully presented in two handy map packs, these products represent the culmination of ten years of data compilation. They extend the coverage of the previous editions of gravity and magnetic anomaly maps of the British Isles published by the British Geological Survey (BGS), and are drafted in the Universal Transverse Mercator grid system, thus minimizing geometric distortion across the area. Whilst the 1:1 000 000 maps are colour-filled contour maps, the 1:3 000 000 compilation is a colour shaded-relief image, illuminated from the north. This latter is the kind of map that would adorn the office, corridor or laboratory wall if a flat version rather than a folded version is available for framing.

Details of data sources, data processing and presentation are provided with each map. The data, from several sources, have been merged and gridded at 1 km intervals before contouring. The magnetic data are presented as total field magnetic anomalies at 10 nT (nanotesla) contour interval, and the gravity data as Bouguer anomalies onshore and Free-Air anomalies offshore at 2 mGal (milligal) contour interval. An advance on previous BGS maps is the inclusion of satellite-derived gravity data from Scripps Institute of Oceanography in some offshore areas, and a Geological Survey of Canada magnetic data compilation in the more distal marine parts. Otherwise the data are BGS data or bought-in surveys from commerce, academia and government departments. It is appreciated that merging all these data sets is not trivial. In all there is full map coverage from 48°N to 66°N and from 12°W to 6°E. The maps graphically reveal the differences in the gravity and magnetic fields over continents and oceans.

I have just a couple of quibbles with the overall presentation of the maps: it would have been helpful to have the continental shelf break drawn in, in addition to the coastline, for general location purposes; and there is a ‘typo’ where the thumbnail grey shaded-relief magnetic anomaly map is called a gravity map. Never mind, these are great maps to look at.

There are a number of approaches to the use and interpretation of gravity and magnetic anomaly data. As maps, the data might be used simply for inspirational purposes and find their way onto the office, corridor or laboratory wall. Also as maps they reveal geological trends and the distribution of shallow and deep basement rocks at a resolution appropriate to the map scale. Tectonic terrains are discernible by their gravity and magnetic contour patterns. The qualitative description of the features of such maps is an essential precursor to more advanced interpretation. In this regard, it is important to use these new maps in conjunction with the insets and notes on data coverage because, although the data were gridded at 1 km intervals before contouring, this does not overcome the lack of short wavelength information in data sets originally collected or delivered at, say, 5 km intervals. The inclusion with the maps of what is, in effect, metadata, is an indication of the thoughtfulness with which they have been prepared.

The vast majority of potential field data interpretations will incorporate numerical modelling, in two or three dimensions, for which a wide range of inverse and forward methods exist for gravity and magnetic data. The shorter wavelength components of the anomalous fields yield crustal structure models, whereas the longer wavelength components in gravity data also contain information on the extent and mechanism of isostatic compensation on a regional scale. Frequently, modelling is done in a more-or-less integrated way with seismic interpretation. Whatever the aims and objectives might be, the original gravity and magnetic data will be needed as digital profiles or gridded values in order to permit the modelling approach. So, whilst contour maps are indeed inspirational, reveal trends and point to the potential for data modelling, most geophysicists will want access to the digital data behind the maps.

The new BGS maps are the best gravity and magnetic anomaly maps available for the British Isles and adjacent continental shelf and margin. They are rigorously prepared and beautifully presented. For both geophysical teaching and research purposes in academia, for a range of commercial ventures, such as hydrocarbon and mineral exploration, and, perhaps, for planning and environmental purposes (although higher resolution images of smaller areas would be more appropriate here) their study and interpretation will be an essential first step.

Roger Scrutton
University of Edinburgh