

for small mine evaluation, including the reminder to check the location of lease pegs with respect to the orebody, a result of past sad experiences! Australian (B.M.R.) standard map symbols are reproduced plus basic geometrical formulae useful in surveying together with data for Engineering Geology; parameters for hydrogeology; geophysical quantities and some basic safety information. This is an essential book for Australasian geologists, but the amount of useful and sometimes hard-to-find data presented make it of interest to others.

T. LIVERTON

Boulter, C. A. *Four Dimensional Analysis of Geological Maps: Techniques of Interpretation*. Chichester and New York (John Wiley and Sons), 1989. xxiv + 296 pp. Price (paperback) £14.95.

This book introduces the science of interpretation of geological maps in terms of the three spatial dimensions plus time—the fourth dimension.

The book consists of twelve chapters, together with two appendices which deal with stereographic and related projections and with geological symbols. A comprehensive index is provided.

Chapter 1 outlines the philosophy behind the book in terms of presenting and understanding geological maps not only as depicting the spatial distribution of rock types on 2D maps but as also carrying fundamental information on the 3D geometry of an area as well as depicting time relationships—the fourth dimension. Chapter 2 introduces base maps used for geological mapping, the topographic map and discusses, albeit briefly, the problems of reliability of the geological information recorded on them, i.e. limitation of outcrop, limitations of scale, mapping style (reconnaissance or detail) and time spent mapping an area. Chapter 3 discusses two-dimensional presentation of 3D geology. Fundamental relationships of strike, dip, attitudes of lines, planes and apparent dips are presented. Chapter 4 deals with geology at the earth's surface and introduces outcrop and exposure, widths of outcrop, the effects of topography, the rule of V's, three-point problems and simple cross-section construction. The problems of structure contouring real data are discussed.

Chapter 5 on remote sensing adds an extremely useful and important dimension to the book by introducing the concepts of aerial photograph interpretation and the uses of other forms of remote sensing imagery (these too often are scantily dealt with in UK undergraduate courses, and

students do not often use aerial photographs when mapping in the field in the UK). More examples of aerial photographs of deformed terrains and perhaps also examples of colour aerial photographs would strengthen this chapter. Chapter 6 introduces the fourth dimension into the analysis—chronology. Emphasis is placed upon stratigraphic concepts, stratigraphic principles, and upon stratigraphic information contained in maps. Only this chapter contains two references for further reading (except for chapter 12 where references for report writing styles are given). Chapter 7 briefly introduces the basics of geological deformation—displacement, rotation, strain and volume change, whereas Chapter 8 discusses the geometric features of continuous deformation—principally folding in more detail. Emphasis is placed not only on description of fold style but also upon thinking about folds in 3 dimensions; a three dimensional classification of folds is given. Minor structures and outcrop features are discussed as aids to interpreting geological structures and map patterns. Unfortunately in this chapter there is only a brief mention of the effects of topography on the outcrop patterns of folded strata, both single phase deformation and polyphase deformation. Many more examples here would be extremely useful for students working in polyphase terrains.

Perhaps the most useful chapter in this book is chapter 9, Discontinuous deformation—Faults. This introduces some of the more modern concepts of faulting and fault patterns, particularly emphasizing separation and displacement across fault surfaces. It is this chapter which could well do with a comprehensive reference list so that the reader could go beyond the basic features given in this book.

Chapter 10 discusses the forms and map expressions of igneous and metamorphic rocks. Fundamental features of these regions are somewhat briefly treated. More examples of real map patterns would be useful here. Chapter 11 presents the fundamentals of unconformity surfaces and stratigraphic nomenclature associated to them. Chapter 12 presents a synthesis of map interpretation and how to present the results of the analysis in a report (references to report writing are given at the end of the chapter).

The book, although well presented, does have shortcomings in that in the reviewer's opinion it never quite tackles the fourth dimension. The timing and sequencing of geological events is not sufficiently emphasized—for example in Chapter 12 the construction of synoptic progressive evolution diagrams for the development of the geological history of an area is not given emphasis. The book

could also be strengthened by placing more emphasis on cross-section construction and for some terrains, balanced section construction.

One of the other serious limitations of the book, to my mind, is the lack of chapter references and a general reference list. True, the sources of many diagrams are acknowledged at the front of the book but many readers will want references to the original papers for the ideas and the diagrams in a more accessible form than given in this text. This could be achieved by having either reference lists at the end of each chapter, or by a comprehensive reference list at the back of the book. Many of the new ideas on tectonics and faulting are introduced in this book but the reader will have a hard time determining the appropriate references just from the figure acknowledgements.

Despite the shortcomings the book is a welcome addition to texts on map interpretation particularly in the fact that the more modern concepts of structural geology are introduced and in that aerial photographs and remote sensing are discussed. The book is primarily written as an undergraduate text with a strong structural geology bias. The text is well written and the illustrations are clear and well presented. The size of the book is 20 cm × 27 cm, single column, allowing good reproduction of diagrams and aerial photograph stereo pairs. Despite the limitations mentioned above, the book will be very useful for students and academics alike. It compares very favourably with other books on map interpretation and unlike them has a strong emphasis on modern 3D structural geometry.

K. R. McCLAY

Radhakrishna, B. P., Ramakrishnan, M. and Mahabaleswar, B., eds. *Granulites of South India*. Bangalore (Geological Society of India: Memoir 17), 1990. xxiv + 502 pp.

This memoir, subtitled the Pichamuthu volume, is published in honour of Professor C. S. Picha-

muthu on his 90th birthday. In addition to a tribute to him by the senior editor, the book presents reprints of 48 papers, divided into seven main sections, each section being prefaced by editors' comments. The classic paper by Thomas Holland on the charnockite series leads off, though here and in most of the papers there are substantial sections omitted, represented by * * * *. Papers by Pichamuthu, Howie, Subramaniam and Rajagopalam are included, together with the more recent contributions by Weaver, Friend, Sen and Bhattacharya, and Newton. The majority of the papers were distributed in a wide variety of journals, and in collecting them together in the style of the Benchmark series published by Van Nostrand Reinhold, the editors have done a considerable service.

R. A. HOWIE

Subbarao, K. V., ed. *Deccan Flood Basalts*. Bangalore (Geological Survey of India: Memoir 10), 1988. xxii + 393 pp, 22 maps, 1 geological map (1:1 000 000).

Memoir 10 is the result of an eight-day field workshop held in Bombay-Poona, and includes a reconnaissance map of the Deccan Basalt Group. The vast majority of the chapters, of which there are twenty-six, involve Indian scientists. A published inaugural address by K. G. Cox is followed by chapters covering all aspects of the geology of the Deccan including $^{40}\text{Ar}/^{39}\text{Ar}$ ages, mantle xenoliths, seismic profiling, zeolites, gravity, intertrap units and many papers on the basaltic units. The memoir provides useful background information for researchers into flood volcanism and would hopefully be included in most libraries on campuses with an active volcanology-geochemistry group.

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