

BOOK REVIEWS

Structures in tectonic context

Suppe, J. 1985. *Principles of Structural Geology*. Prentice Hall, New Jersey. 537 pp. Price: hardcover £48.00.

About two or three English-language text books of structural geology are published every year. Of those that are comprehensive in scope, aimed at undergraduates and have appeared in the last decade, perhaps two, *An Outline of Structural Geology* (1976) by Hobbs, Means and Williams, and *Foundations of Structural Geology* (1983) by Park, have gained very wide acceptance. I believe that Suppe's *Principles of Structural Geology* possesses the potential to join that list because not only does it cover most (but not all) classes of structure but it also contains original ideas and insights. In addition, sufficient tectonics is included and integrated with structural geology for the reader to be able to appreciate deformation products and processes in their broader context. But for its high price (£48.00) it would probably be on most students' essential reading lists. The publishers should consider producing a cheap soft-back version; perhaps concurrently with a second edition, which Suppe hints will be forthcoming.

The thirteen chapters of *Principles of Structural Geology* are collected into four parts: I. Introduction. II. Principles of Deformation, III. Classes of Structure and IV. Regional Structural Geology. The heart of the book is part III, "Classes of Structure," which comprises 247 of the total 537 pages, including the 30 taken up by the appendix, references and an unusually comprehensive index. A pleasing aspect of the chapters in part III is the way in which after describing each class of structure, Suppe employs the deformation principles given in part II to interpret them. From some, largely older texts, one gains the impression that once the author had 'got through' such fundamentals he heaved a sigh of relief.

Some elementary knowledge of plate tectonic theory is assumed in chapter 1, "Introduction to the Deformation of the Lithosphere". This assumption permits the author to knit together a selection of topics concerned with the morphology, properties and behaviour of large crustal units, both active and inactive. Chapter 2, "The Geometry of Map-Scale Structures" commences with relatively short but workman-like accounts of recording structural observations and plotting 'stereographic' projections, but most of it is devoted to the technique of balanced section construction; the first time I have seen the axioms and practicalities set out in a text book.

"Strain and Stress", the theme of chapter 3, that opens part III will be familiar to many geologists trained after 1955 and hence it contains few surprises. The principal processes that enable rocks to flow are treated in chapter 4 "Deformation Mechanisms", which is succeeded by a masterful account of "Fracture and Brittle Behaviour" in Chapter 5. Suppe makes especially effective use of Mohr stress diagrams to explain relationships. Interestingly, in fig. 5.5, the entire range of failure between tensile and Coulomb fracture behaviour is referred to as transitional tensile behaviour, although there is a normal component of extension only across some of the fractures in the group. This definition of transitional tensile behaviour would not appeal to all workers but it possesses the merit of highlighting the conclusion that the effective least principal stress is tensile during the initiation of all fractures in the range. It is noteworthy, however, that in chapters 6 and 7, the author reverts to more customary usage, and includes only those fractures across which the effective normal stress is negative in the transitional tensile category. The statement (p. 170) "most joints are probably tensile or transitional tensile fractures" is an inference with which I agree completely.

The theme of 'Joints' is continued in chapter 6, the first of Part III. In my view, it is easily the best account in a text book of these enigmatic but universal structures since the publication in 1966 of Price's *Fault and Joint Development in Brittle and Semi-Brittle rock*. Especially rewarding is the section on the origin of joints from the perspective of crustal stress conditions. Suppe predicts that consideration of *in situ* stress measurements will in the future become more important in this context.

Before dealing with "Faults" in chapter 8, the structural aspects of magmatic, mud and salt intrusions and extrusions are considered in chapter 7. Emphasis in chapter 8 is given to faulting mechanisms and recent modifications to Anderson's classic theory of faulting. Chapter 9 "Folds", is largely a straightforward exposition of necessary material

that is now common to most structural texts. Nevertheless, the section on fault-related folds, particularly fault-bend folds, presents a view that is generally underemphasized or considered only in the context of thin-skinned thrust belts. Boudins are briefly described in this chapter rather than with foliations or lineations as is customary. Boudins formed under high-grade conditions are called *inverse folds*, a term new to me. Chapter 10, "Fabrics", which discusses both penetrative and non-penetrative foliations, also contains some unusual nomenclature; *fanning* and *antifanning* are employed to describe convergent and divergent axial plane foliations, respectively. Part III concludes with a short account in chapter 11 of "Impact Structures". Suppe makes the thought provoking point, that if the average rate at which continents are lowered by denudation is 0.1 mm/year, then a crater 1 km in diameter and depth will be removed in only ten million years. Hence many impact structures older than about the medial Miocene are likely to be difficult to detect.

Section IV, which is devoted to 'Regional Structural Geology' comprises two chapters, 12 "Appalachians" and 13, "North American Cordillera". The choice of these two regions presumably reflects the author's judgement about the nationalities of the majority of his readers, but despite the concentration on United States and Canadian tectonic provinces those resident elsewhere will gain much of general interest from these two chapters. In many structural texts and courses, regional structural geology is a topic less favoured than, say, deformation processes. Suppe provides an excellent and succinct justification for its inclusion. His words are worth quoting in full (p. 416):

"Regional structural geology is a subject quite different in flavour from the rest of structural geology because it is first of all concerned with unique historical events and only secondarily with general classes of deformational processes. The goal of workers in regional structural geology is primarily to decipher the history and the associated present structural geometry and prior paleogeographies of some area of our planet. Regional structural geology also leads to important insights into the underlying physical processes and recurring historical themes that are repeated in space and time among the various mountain belts of the world."

In common with all good text books the enthusiasms of the author are clear from his choice of topics and it is difficult to quarrel with those of Suppe. There are, however, some surprising omissions of classes of structure. For example, mullions, chocolate tablet structure, shear bands and quartz rods are not discussed. Furthermore, some topics, such as the significance of stretching lineations, syntaxial and antitaxial growth fibres, the crack-seal mechanism of vein development and shear zones characterized by en échelon veins and/or a local secondary foliation are treated cursorily, or in much less depth than I would have expected.

A useful study hint of the author is the recommendation that those who are revising for an examination should read the index as a way of providing a check-list of topics that should be understood. I confess that after twenty years of teaching, this worthwhile idea came to me as a fresh one. A more conventional aspect of Suppe's book is the inclusion of exercises at the end of each chapter. Most worthy: do readers ever attempt to solve them? Two facets of the book which all students should attempt to emulate are the directness of Suppe's prose style and the clarity of his line drawings.

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Kinematic interpretations of structures

Nicolas, A. 1984. *Principes de Tectonique*. Masson, Paris. 200 pp. Price: softcover 101 FF.

To date, French students have no abundant literature on structural geology in their own language. Nicolas' book dedicated to the kinematics of structures within deformed rocks is now at their disposal.

After very basic considerations about stress and strain, the theory of discontinuous deformation and the mechanism of continuous deformation are briefly presented in the first three chapters. The following chapters present and interpret various types of structures within deformed rocks: the discontinuities of the brittle field (faults, joints,