contribute significantly to knowledge of the structure, composition or physical properties in particular places: in short, the work that any national Geological Survey should concern itself with. I see no convincing evidence that more general problems in geodynamics are best answered by information along an artificially straight line, designed to go through many different countries (the cynic would say, in order to raise both money and the political temperature). I would be surprised to find anyone who thought that a seismic line aimed at revealing insights into the recent and active evolution of the Mediterranean would be best sited from Genoa to Tunis: the real reason for its location is that it is a prolongation of a line 3000 km farther north in Scandinavia. The last chapter in the book, entitled *Geodynamics of Europe*, contains sections headed 'How does geology work?' and 'What drives tectonic processes?' I have to say that, in my opinion, the EGT does not contribute significantly to these general questions, nor was it ever likely to: they are much more likely to be addressed by focused, smaller projects in carefully chosen geographical locations (not necessarily in Europe) that have nothing to do with political borders and almost certainly don't lie along straight lines.

This publication will therefore appeal strongly to those who want to know about the lithosphere in particular parts of Europe. Those who seek more fundamental insights into continental tectonics and evolution will not find them here. My own view is that the EGT whole is no more than the sum of its parts: some of which are provocative and original, and others of which are not.

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Global Positioning System

Hofmann-Wellenhof, B., Lichtenegger, H. and Collins, J. 1992. *GPS Theory and Practice.* Springer, Vienna. 326 pp. Price 550 Austrian Schillings, DM 79.00 (softback).

In so far as structural geology is concerned with measuring the deformation of rocks, GPS is one of the most powerful tools of structural geology. Admittedly the use of GPS is restricted to motions of the Earth's surface, and to geologically tiny time intervals, yet no one with an interest in tectonics can afford, any longer, to be ignorant of the results of GPS work. At the heart of the study of tectonics is the need to understand the dynamics of the manifold tectonic processes whose kinematics are often adequately described already. Frequently, the ability to discriminate between competing tectonic hypotheses lies in a knowledge of the velocity field in a deforming region. The techniques of structural geology and earthquake seismology are reasonably good at providing measures of strain and strain rate, but they are incapable of yielding information on rotation, and thus on the full velocity field unless assumptions are made in addition to the measurements. Palaeomagnetic data can provide supplementary information on rotations, but very rarely on when, or how rapidly, such rotations occurred. There is a need, therefore, for a tool that allows one to measure the full displacement field in a deforming region, and geodesy provides such a tool.

Several studies of crustal deformation were carried out using the techniques of conventional geodesy (triangulation plus trilateration or triangulation alone) but such studies relied usually upon the reoccupation of geodetic networks established on surveying rather than tectonic criteria. The rapid rise of precise positioning using satellite geodesy, and in particular the availability of portable receivers of the Global Positioning Systems (GPS) has provided the opportunity for Earth Scientists to design their own networks for tectonic purposes, and to carry out the fieldwork at an accessible cost. Measurements of baseline lengths are repeatable to one part in 10^7, or better, so that in a region that is straining at $3 \times 10^{-15} s^{-1}$, or faster, the signal exceeds the noise in a few years. Better still, several high quality old terrestrial surveys exist, so the timescale can be extended back by decades or even a century.

For these reasons, it is likely that many readers of this journal may wish, some time soon, to come to grips with the results of GPS studies. To do this they will probably wish to dip into some authoritative text on geodesy and GPS. There are already several very good such texts, of which the book under review is one. Each text aims at as broad an audience as is possible within the constraints of a reasonable length and adequate depth of coverage of fundamentals.

Unfortunately, the potential range of readers is vast and Earth Scientists occupy a fairly small fraction of this range. Engineers, navigators, surveyors and even, perhaps, lawyers use GPS in greater numbers. Thus Earth Scientists are in a minority, even though they have been involved in GPS since its inception, and still provide part of the driving force towards the achievement of the highest precision GPS measurements. It's likely, then, that most readers of these pages will, if they are considering purchasing a GPS text for themselves, or a library, be swayed in that choice more by the degree to which the texts differ in their presentation of material relevant to the Earth Scientist than by variation in the (high) quality of presentation.

The book under review begins with chapters on the origins of GPS, and an overview of the way the system works, then chapters on reference systems, satellite orbits, the satellite signal and the quantities that can be measured using GPS. A chapter on The Survey itself follows, which is full of good advice, of a general sort. The observables you obtain from a survey are not, of course, the quantity of interest—baseline vectors—but are apparent distances to the satellites or (in geodetic practice) the phase of the signal. Considerable post-processing of data is required before the observables can be converted into the quantities of interest. Roughly one-third of the book is devoted to this processing. The book ends with a list of the application of GPS, and speculations about its future.

The book is well laid out, the mathematics is reasonable clearly presented and the references are up-to-date. Good though it is, I suspect this is not the book for an Earth Scientist. The book by Leick (1990) covers, in significantly more depth than the present one, several aspects of GPS that are valuable for the interested geologist. First, there are many more illustrations, which aid greatly in the presentation of concepts that are second nature to a surveyor but may be unfamiliar to others. In addition there is a separate chapter on the combination of GPS and terrestrial data, which is central to the use of GPS in tectonic studies, though not of great interest to other users. The two chapters on the geoid and reference systems are very clear and help drive home the important point that even when you have two time-separated, arbitrarily precise sets of GPS co-ordinators, you still have a way to go before you can determine deformation.

Leick also provides appendices on linear algebra and some of the essential statistics. To follow either of these books completely requires some trigonometry, some matrix algebra, and the tolerance of a notation involving Greek symbols. A former associate editor of *Journal of Structural Geology* assures me that such notation can constitute a barrier to understanding in otherwise well-disposed structural geologists. To him I would say two things: first if you can't use Greek symbols in a geodesy book, I don't know where you can: any Greek geodesist will tell you that geodesy is the second oldest profession, and began in Greece. Secondly, if Greek symbols turn you off, Smith (1988) has achieved the seemingly impossible task of writing a book on geodesy without equations; it even covers GPS.

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Leick, A. 1990. *GPS Satellite Surveying.* Wiley-Interscience, New York.

Smith, J. R. 1988. *Basic Geodesy, An Introduction to the History and Concepts of Modern Geodesy Without Mathematics.* Landmark Enterprises, Rancho Cordora, California.

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Deep-water rocks

Pickering, K. T., Hiscott, R. N. and Hein, F. J. 1989. *Deep Marine Environments—Clastic Sedimentation and Tectonics.* Unwin Hyman, London, U.K. Price £75 (hardback); £29.95 (paperback).

This well written book is a useful reference text, and will be a valuable addition to the shelves of many geologists. It is well referenced, richly illustrated with modern examples, and could be useful as a source text for specialist undergraduate courses in global tectonics or sedimentology. The balance of the book is clearly sedimentological, but it provides a perspective on ancient environments for more specialized structural researchers; who, in the course of their work, would have become aware of the material in the final section on plate tectonics and sedimentation. The approach of the book is original and welcome: it describes the sedimentary processes and products from different plate-tectonic environments. One use for this book is to assist field geologists identify the likely tectonic setting and field relationships of deep-water rocks. Destructive or oblique-slip margins, in particular, can juxtapose rocks from a wide-range of plate-tectonic settings. This book presents a wide repertoire of sedimentological models, and data from a range of modern settings, to suggest how they might relate. Structural geologists working on deep marine rocks should be aware of this information. The book has an accent on siliciclastic sediments, but is applicable to carbonate and more mixed environments.

A history of the investigation of deep-marine environments forms the first chapter. The remainder of the book is divided into three parts. The first part considers sediment transport and deposition in deep water, deep-water facies and depositional processes. The nature and products of high-density, bouma-type and low-density turbidity currents; debris flows; contour currents and sediment-slides, are all considered in Chapter 2. This chapter provides a useful review of sediment gravity flows in particular. In Chapter 3, which is particularly applicable to anyone wishing to describe deep-water sedimentary rocks in the field, the reader is introduced to a comprehensive facies classification scheme, which is illustrated with photographs, and referenced, to facilitate comparisons. The final chapter introduces many of the controls on sedimentation: variations in the CCD and sediment supply, sea-level changes and the importance of glaciations and ridge-volumes and intraplate stresses. It ends with a brief account of the effect of oceanic circulation patterns and the identification of, and possible significance of, changes in bed thickness and grain-size. These topics are not dealt with in any depth, and cover topics which are outside the scope of most field structural studies.

The second part of the book describes slope aprons (and continental slopes in particular), submarine canyons and valleys, submarine fans, sheet sedimentation on the abyssal plains and in trenches, and contourites. There is considerable information in this section which gives the reader a good impression of what sediments from these various settings are like, which makes this section useful reading. Chapter 5 describes many types of passive and active continental margins, including the effects of sea-level change and slope failure. Chapter 6 concentrates on the origin of modern submarine canyons, but does mention some ancient examples. The processes operating in, and nature of, modern fans are described more fully in the next chapter, together with some ancient examples of submarine fan deposits. This is followed by an account of modern abyssal plains (probably too short), trench and fore-arc/back-arc basin floors and a description of some ancient sheet systems. The final chapter on contourites concentrates on modern examples, because of the scarcity of reliable examples in the geological literature. They are included because of their palaeoceanographic significance, and since continental rise successions influenced by contour-current or bottom-current processes lack good reservoir rocks.

The three chapters comprising the final part of the book describe sedimentation on evolving and mature passive margins, active convergent margins and oblique-slip continental margins. This section concentrates on briefly reviewing the tectonic context of sedimentary basins, and is the least useful in the book. Although difficult, some review of which sedimentological characteristics distinguish these environments would have been useful. To describe sedimentary basins in their plate tectonic context is not the same as a discussion of how sedimentation is controlled by tectonic processes. This question may be a difficult one. Different environments affect provenance and facies geometries. However the answer may be 'not much!'; but no reply is given in this book. Lacking this sort of overview, sedimentological and tectonic processes remain poorly integrated, despite this being one of the claims on the fly leaf. What is presented is more of a compilation than a critique or review. The specialist structural geologist will learn little new about tectonics from this section, although it would be useful to third-year undergraduates wishing to read a short account about these regions. The chapter on passive margins concentrates on reviewing the Atlantic margins and northern North Sea, but includes a Tethyan example of a Jurassic passive margin from the Italian Alps. The next chapter considers fore-arcs, back-arc/marginal basins and marine foreland basins. After describing the variation of trench-fill sediments, fore-arc and trench-slope basins, a brief account of back-arc basin sedimentation is included. The section on accretionary environments is continued with short accounts of the modern North Fiji basin, Lesser Antilles, Middle America, and Peruvian marine and north-west Pacific; and concluded by a mention of the Chugach Terrane and Shimanto Belt, with the Timor-Taminbar and south-west Pyrenean foreland basins as examples of deep marine foreland basins in a continent–continent collision zone. The final chapter on oblique-slip continental margin basins uses modern examples from the Andaman Sea, Hikurangi Trough and California, and ancient examples from the Pyrenees and Britain/Newfoundland, to illustrate oblique tectonics. This final chapter is probably the least satisfactory of the three: it lacks significant discussion of pull-apart basins, and concentrates too heavily on a review of regional tectonics.

On balance there is much useful material in this book for undergraduates, postgraduates and specialist researchers. Almost every illustration in the book is clear and useful, despite having a variety of styles and sources. The text is clearly written, and given the length of the book and quantity of illustrations, covers subjects in as much depth as possible. The paperback edition is securely bound, and represents good value.

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Caribbean tectonics

Mann, P., Draper, G. and Lewis, J. F. (editors) 1992. *Geologic and Tectonic Development of the North America–Caribbean Plate Boundary in Hispaniola.* Geological Society of America Special Paper 262. 401 pp. + five plates in slipcase. Price $98.75.

Reading through this Special Paper is like taking a semester seminar in the geology of Hispaniola. (Unfortunately it took me that long to finish this review!) The book includes 18 substantial papers, maps as both page-sized sketches and folded plates (but no colored maps), satellite and aerial images, stratigraphic columns, fossil lists, and many other extras. The main authors are the editors and their students. Coworkers Fred Nagle, James Joyce, Jim Pindell, Stevè Kesler, Terry Edgar, Marge Winslow, Bill McCann and W. A. van den Bold contribute nine papers partly or completely.

The first two papers, by the editors, give an overview of Hispaniola's place in the Caribbean tectonic framework, and discuss the island's metamorphic core. Serious attempts are made to sort, classify and describe all the diverse tectonic and stratigraphic elements that make up Hispanola. Some of these do not seem to agree with each other, but largely the conflicts seem to be problems of usage and vocabulary. The metamorphic belts and structures of northern and central/southern Hispaniola are related to each other, and to the geologic development of a deep-sea trench and island-arc rocks of a subduction zone. This is done well and should serve as a model for other plate boundaries. As ever, the more work is done, the more complicated are the models and explanations.

Joyce describes high-pressure metamorphism near the north coast of the island, relating metamorphism to collision with the Bahamas Platform. Metamorphic ages show that collision began in the Late Cretaceous and ended in the early Tertiary. Detailed structural analysis supports the metamorphic evidence. Draper and Nagle, and Pindell and Draper, review and extend their work in the Puerto Plata area and elsewhere on the north coast, begun by Nagle years ago in his work in the Hess Caribbean Project. This is a structurally complex, poorly exposed area of melange and diapiric movement. Many loose ends still remain, but the concepts of serpentinite protrusion and diapirism have given us a good model to follow. The recognition of serpentinite conglomerates, sedimentary deposits of largely serpentine composition, allows the understanding of several difficult regions. Local stratigraphic names impede quick comprehension, but there is no other way to present the topic.

Two papers by John Lewis and coworkers present detailed petrography, petrology and geochemistry of the metamorphic Duarte Complex, and stratigraphy of Cretaceous (Tireo) volcanic rocks in the same region. They suggest an early island-arc or seamount environment, with Cretaceous volcanism as part of an extensional episode.

Steven Kesler and coworkers have four papers on tonalite and other igneous rocks focusing on K/Ar ages related to arc and plate models, two Late Cretaceous volcanic units (Maimon and Los Ranchos), and an epithermal gold deposit (Pueblo Viejo) in a maar/diatreme complex. The volcanic units represent contemporaneous seamount and