

# Earthlike Planets: Surfaces of Mercury, Venus, Earth, Moon, Mars

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## Economic Geology and Geotectonics

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Edited by D.H. Tarling  
*Halsted Press, 213 p., 1981.*  
 \$54.95

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*Economic Geology and Geotectonics* presents the views of the "British School" on the impact of global plate tectonics in the area of economic mineral deposits genesis and mineral exploration strategy. It is aimed both at professionals responsible for the planning and evaluation of exploration programs, and at senior undergraduate and postgraduate students. The book consists of contributions by eight authors including J.P.N. Badman, R.J. Bailey, R.D. Beckinsale, J.R. Cann, G.A.L. Johnson, A.H.G. Mitchell, R. Stoneley and D.H. Tarling. Lest the usual North American view that economic geology is synonymous with the geology of metallic mineral deposits prevail, be advised that four of the nine chapters are concerned with petroleum geology and coal. There are two overview chapters: one introduces the book with a succinct review of plate tectonics and the other is a concluding chapter on paleoclimatological considerations. The remaining three chapters cover ore deposits of the ocean crust, ore deposits associated with subduction zones and ore deposits in sedimentary rocks.

The three chapters dealing with petroleum (Bailey and Stoneley) contain much material normally found in texts on petroleum geology. Source rocks, cap and reservoir rocks, traps and processes of entrapment, the effects of heating on maturation and the evolution of sedimentary basins receive attention. Plate tectonics is woven into this discussion as a basis from which to study the evolution and structural development of petroleum-bearing basins. Whether the discussions of petroleum geology are presented in satisfactory depth and breadth will probably depend on the background of individual readers. As a demonstration that plate tectonics provide an additional tool to evaluate the petroleum potential of sedimentary basins, these chapters are highly successful.

The chapter on coal (Johnson) is developed in a comparable manner to those on petroleum. Coal geology as such receives some attention while the main emphasis is on the paleogeographic set-

ting of the major coal fields of the world and the part played by plate tectonics in their evolution.

Metallic mineral deposits are covered in three chapters dealing with ore deposits of the ocean crust, ores in subduction zones and metal deposits in sediments. The discussion on ocean crust ore deposits (Cann) first considers processes during the formation and evolution of ocean crust and then reviews mineralization in ophiolites and ocean floor sulphide deposits of the type found in Red Sea brine pools. The discussion is brief and deposits are not described in much detail. Rather, attention focuses on those aspects of ocean floor deposits which are readily explained by plate tectonic mechanisms but whose origin is otherwise obscure.

Ore deposits associated with subduction (Beckinsale and Mitchell) consider familiar ore types such as porphyry coppers and Kuroko ore in terms of four major tectonic settings: magmatic arcs, back-arc magmatic belts, outer-arc magmatic belts and foreland fold-thrust belts. The authors conclude that relationships between plate convergence, magma generation and metal concentrations are obscure, and do not at present, provide the best assessment of mineralization potential.

Ores in sediments (Badham) is one of the longer chapters in the book. It covers placer deposits, iron formations, red-bed copper deposits and sediment host zinc-lead deposits. The discussion provides a balanced and up-to-date review of the principal genetic arguments relevant to each deposit type, and examines geotectonic implications in some detail. It is concluded that a relationship between geotectonics and mineralization always exists but it may be too general to help the explorationist.

Whether the book will be seen by explorationists as of direct value to their immediate problems is somewhat problematical. What *Economic Geology and Geotectonics* does do, and in a highly competent fashion, is present an assessment of the impact of plate tectonics on concepts of mineral deposit genesis. As a reference or supplement to courses on ore deposits for senior undergraduate or graduate students, the book is strongly recommended. As the principal text for the typical North American senior undergraduate course in mineral deposits, the main theme is too specialized and the assumed background is too extensive.

MS received September 16, 1981.

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## Earthlike Planets: Surfaces of Mercury, Venus, Earth, Moon, Mars

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By Bruce Murray, Michael C. Malin and Ronald Greeley  
*W.H. Freeman and Company,*  
*387 p., 1981*  
 \$24.95 US Hardcover, \$14.95 US Paper

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In the past decade the volume of information upon other planets and moons of the Solar System has increased by many times. Summary books are appearing at an increasing rate including, most recently, texts in comparative planetology written from the earth scientists' viewpoint rather than that of the astronomers! This is the newest of them, by three leading planetologists trained in geology. Their bias is made plain, for the Moon is always described as a planet, which it is in the sense that it belongs to the same class of large, differentiated rocky objects as Mercury, Venus, Earth and Mars.

The book is in four parts, beginning with a review of planetary origins that emphasises hot, heterogeneous accretion concepts, plus summaries of main features of the designated planets. These contain unnecessary repetition. A second part summarises exogene and endogene processes that mould the surfaces. The exogene chapter covers impact cratering, mass waste, eolian and fluvial activity; periglacial activity is a glaring omission and there is a general lack of explanatory reference to terrestrial examples of eolian and fluvial forms. By contrast, the endogene chapter is amply referenced to Earth. It covers plate tectonics, volcanic landforms, extensional and compressional structures.

The third part outlines stratigraphic and morphologic histories of the surfaces of the Moon, Mercury and Mars. Discussion is quite detailed and controversial matters are fairly dealt with, but this part seems premature. The histories rest upon a few lunar dates calibrating cratering flux rates there, and the assumption that lunar results apply elsewhere. More attention to analysis of morphology and distribution and less to highly inferential histories would seem appropriate, given the present state of knowledge. Perhaps some planetologists are repeating the Davisian error in the history of geomorphology - "assume the process-form rela-

tionship and deduce the history from it". The final chapter of comparisons strongly favours a 'Late Heavy Bombardment' phase at ~ 3.8 to 4.0 gy in the inner planets. This is controversial. Deposition of basaltic plains (maria) succeeded this phase on Mercury, Moon and Mars in the authors' view. Climate cycles and changes on planets with atmospheres are considered; the treatment of causes of glaciations is trite.

The book is very well illustrated with good quality reproductions of satellite images, mosaics and air photographs, plus appropriate original or reproduced line diagrams.

Much of my criticism follows from the authors' intent to write a book without equations, formulae or analytic exposition, for the general interest reader and as a supplementary in undergraduate planetology courses. We have no main text for undergraduate, geological planetology courses! Here, the lack of formal exposition severely limits the treatment of most important matters (models of origin, cratering flux rates, etc.), induces repetition and some rather dogmatic statements.

A second weakness is inescapable. The book is out of date as a consequence of the recent pace of satellite exploration, although it cites references from 1979. The exciting Galilean satellites of Jupiter can be covered in only a few appended pictures. The orbiter radar map of Venus, constituting almost all that is known of that surface at present, is too recent for analysis here. The halt in U.S., planetary explorations for the next few years gives Western specialists the chance to catch up and write major analytical texts in comparative planetology, rather than hasty supplementaries. That being said, this book is the best overview currently on the market and is very reasonably priced.

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## Moraines and Varves

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Edited by C. Schluchter  
A.A. Balkema, Rotterdam 441 p., 1979  
(99 Main Street, Salem NH 03079, U.S.A.)  
\$45.00 U.S.

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*Moraines and Varves* is a collection of papers presented at the 1978 meeting of "INQUA Commission on Genesis and Lithology of Quaternary Deposits" which was held in Switzerland. It consists of approximately 40 contributions varying from 4 to 33 (average about 10) pages which cover subjects as diverse as till provenance investigations in areas of alpine glaciation, rock glacier deposits, dispersal of debris by modern glaciers, till stratigraphy, laminated Holocene lacustrine sediments and sedimentology of a tidal lake. The editor is to be commended for using a two word title for a package this diverse.

The book is truly an international collection of papers with authors from 17 countries. Most papers are in English (4 are in German and 1 in French). In one or two the writing is a little difficult to follow but when one considers that English is the first language of less than 1/3 of the authors, the writers have handled the language very well. There is some inconsistency in type face and illustration style from paper to paper because author prepared materials have been extensively used. However the overall quality of the book is good and the editor and his reviewers have obviously put a lot of effort into preparing this book.

The volume is divided into three parts. The first part, *Geology and Genesis of Moraines*, covers aspects of sedimentation and sedimentology of glacial deposits (mainly till), formation and recognition of till landforms, provenance of till, transportation of material by ice and genetic interpretations of till stratigraphy. One criticism is that many papers do not provide textural data or adequately describe the glacial sediments which are discussed. The second part, *Varves and Glaciolacustrine Sedimentation*, contained only four papers which were germane to varves (classical sense) or glaciolacustrine sedimentation. The others were concerned with rhythmical laminations in Holocene lake sediments which are considered to be annual in cycle and sedimentation in nonglacial water bodies such as the Black Sea and Lake Biwa.

The third section, *Contributions Related to the Field Excursion*, includes a summary paper on the Quaternary History of Switzerland, a discussion on formation of Alpine moraine complexes in Switzerland and two papers on deformation structures in glaciolacustrine sediments.

There is considerable variation in subject, detail of treatment, use of data and overall quality from paper to paper. Several papers, such as, "Weichselian till stratigraphy in central South-Norway" by K. Garnes and "Sedimentology of a tidal lake, Pitt Lake, British Columbia" by G.M. Ashley are comprehensive reports which probably should have been published as separate monographs. Others, such as "Analysis of pre-pleistocene glacial rocks: aims and problems" by M.J. Hambrey and W.B. Harland and "Paleogeography of Lake Biwa, Japan - and deep drilling site investigations in ancient lakes" by S. Horie are little more than descriptions of projects and hence should not have been included in this volume of scientific papers. Some such as "Origin and composition of clastic varves" by M. Sturm, consider sedimentation from a broad theoretical point of view whereas others such as "Moraines on the northern slopes and foothills of the Macgillycuddy's Reeks, south-west Ireland" by W.P. Warren, consist mainly of qualitative descriptive information for a very small area.

Several of the papers are excellent and many are good. The ten papers mentioned below are what I considered to be the best but a reader with different biases and interests would have little difficulty choosing other papers for this list.

"Sedimentation by valley glaciers; a model and genetic classification" by G.S. Boulton and N. Eyles, is easy to read, presents a logical classification and provides fairly comprehensive interpretations of complex glacial stratigraphy. It does however suffer from a lack of concrete data. "Composition and dispersal of debris by modern glaciers, Bylot Island, Canada" by R.N.W. DiLabio and W.W. Shiels, presents plenty of data on the composition and variation of tills and shows how compositional data can be used in interpreting the history of ice movement and the nature of glacial processes. "The problems of waterlain tills" by A. Dreimanis, is a good and concise review. It clearly outlines the problems in determining the precise origin of glacial sediments and provides concrete suggestions on further research. "The origin of preconsolidated and normally consolidated tills in eastern Wisconsin, U.S.A." by D.M. Mickelson, L.J. Acomb and T.B. Edil, contains a detailed presentation of the data on which hypotheses are based