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BOOK REVIEWS

ATLAS OF THE TEXTURAL PATTERNS OF BASALTS AND THEIR GENETIC SIGNIFICANCE. By S. S. Augustithis. Elsevier Scientific Publishing Company, Amsterdam, 1978. x + 323 pages. $73.95.

This book is divided into two sections, 100 pages of text and 202 pages of figures—mostly photomicrographs. The quality of printing of the book and especially the reproduction of the 500 photomicrographs is very good. This collection of photomicrographs displays many of the interesting textures found in basaltic rocks. Although the general theme of the book is concerned with basalt textures, nearly half of the text is a discussion of the origin of igneous rocks. The concepts developed are of basalts originating by fusion of a gabbroic lower crust, and intermediate and silicic rocks by varying degrees of sediment assimilation and metasomatism by basaltic magma.

Three chapters (about 20 pages) are concerned with the nature of xenoliths found in basalts. The last ten chapters (about 30 pages) cover a variety of topics from trace elements to volcanic rock series. The half of the text which deals with textures reflects many of the author's personal ideas and interpretations. Many petrologists will find these ideas contrary to current concepts on the nature of silicate melts and crystallization from these melts. Most of the references cited are prior to 1972. The author uses a complex terminology which is not defined in the text or in the AGI Glossary of Geology. Such terms as collomorph, tecoblast, nematoblast, velonoblast, interleptonic, topo-tectically, and synisotropization are often confusing and probably unnecessary. "Animated" terms such as invasion, autocatharsis, and digestion are frequently used in textural descriptions.

Several debatable aspects of the author's treatment of textures are:

(1) Crystals which deviate from a closed, euhedral form do not necessarily indicate corrosion. Many skeletal growth forms have been documented as resulting from rapid growth rates. Groundmass included in these skeletal crystals has not resulted from invasion, nor does it represent post-groundmass crystal growth of the skeletal crystal.

(2) Two minerals may commonly grow together, either because of mutual nucleation sites or coupled growth. Intergrowths do not require "invasion" of one crystal by another.

(3) Colloidal structures in plagioclase do not represent the effects of hydrous colloids prior to crystallization of the basaltic magma. These structures in palagonite are clearly related to hydration of basaltic glass after solidification.

(4) Radial segmentation of augite in basalt may relate to defects and strain produced during growth from the melt, and not necessarily to explosive volcanism, magmatic collisions, or post-solidification deformation.

(5) The author suggests that apatite can occur as inclusions in all mafic phases and thus crystallizes early; however, many studies, both petrographic and geochemical, have shown that apatite must be a late crystallizing phase.

(6) Granophyric quartz in residual patches within basalt is completely consistent with experimentally determined phase relationships in basaltic systems and does not require metasomatism.

Kinetics are not used for the interpretation of textures in spite of the classical acceptance of this approach. Cooling rates, growth rates, nucleation rates, and diffusion rates, along with the physiochemical variables which affect these rates, are completely ignored. In the past ten years very significant advances, in both theoretical and experimental areas, have been made in our knowledge of the kinetic controls on textures (for reviews see Kirkpatrick, 1975; Lofgren, 1978). The author chose not to use a systematic, observational approach, nor one based on the kinetic processes which can be used to interpret textures.

References

Kirkpatrick, R. J. (1975) Crystal growth from the melt: a review. *Am. Mineral., 60,* 798–814.

Lofgren, G. (in press) Experimental studies on the dynamic crystallization of silicate melts. In R. B. Hargraves, Ed., *Physics of Magmatic Processes.* Princeton University Press, Princeton, New Jersey.

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SUGGESTIONS TO AUTHORS OF THE REPORTS OF THE UNITED STATES GEOLOGICAL SURVEY, 6th Edition. Edited by Elna E. Bishop, Edwin B. Eckel, and others. U. S. Government Printing Office, Washington, D. C., 1978. 273 pages. $6.25.

It is 20 years since the previous edition of this classic appeared. It and its predecessors (1st edition, 1909) have provided a guide through the pitfalls and perils of manuscript preparation and publication not only to successive generations of Survey authors but also to geologists throughout the world. Thus the appearance of a new edition is an event to be applauded by writers, reviewers, and editors. Its format and content follow quite closely those of the 5th edition but have been revised and updated in many places. Short sections are included on petrologic terminology, chemical terminology, and mineralogic terminology and description. I would urge all contributors to *The American Mineralogist* to obtain a copy of this book, to read it carefully, and to use the procedures recommended therein.

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THE PHYSICAL CHEMISTRY AND MINERALOGY OF SOILS. VOL. II: SOILS IN PLACE. By C. E. Marshall. Wiley, New York, 1977. xiii + 313 pages. $25.00.

Chapter 1, "Pedology in Relation to Physicochemical and Mineralogical Processes," gives a historical perspective, beginning with

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Dokuchaev's work on soil-forming factors (climate, vegetation, topography, parent material, and time) and soil horizonation (anisotropic character along a line more or less at right angles to the surface). Heterogeneity of solid phases—amorphous *vs.* crystalline, and variability of gas and liquid compositions are mentioned. For example, how the presence or absence of $CaCO_3$ has a drastic effect on pH and the calcium hydroxide potential is set forth. Effect of past regimes of climate and vegetation are mentioned, but the continual influence of influx of new parent material by fluvial and eolian processes is not mentioned.

Chapter 2, "Early Stages of Rock Weathering," considers alteration of rock minerals to secondary products, as particularly affected by climate. The Garrels and Christ type stability diagram is introduced. In an author-by-author review, specific effects of humus, temperature, and character of the rock are considered. Volcanic glass is contrasted to more solid rocks. Free energy changes and chemical potentials are introduced, mainly for gibbsite and kaolinite systems. The extreme slowness of reaction of many minerals in water is pointed out as a limitation of the usefulness of thermodynamics in defining soils "in place." The illustration of the interesting concept of weathering mean (Fig. 6) unfortunately has lost all reference to its source (Tamura *et al.*).

Chapter 3, "Hydrothermal Synthesis of Minerals in Relation to Pedology," examines trends of mineral change at elevated temperatures and pressures, as clues to what ultimately may happen in soils. Later in the chapter the effect of Al-complex formers on kaolin-type synthesis at room temperature is reviewed.

Chapter 4, "The Chemical Expression of Climatic Factors," considers the chemical potential of soil water as affected by soil dryness and temperature. As the vapor pressure of water in soils changes, the direction of mineral transformation reactions may be reversed. Particle size, valence change, complexation, and peptization are considered in relation mainly to podzols. Humus character and distribution in grassland soils is mentioned.

Chapter 5, "Quantitative Aspects of Soil Profiles," presents a summary of Missouri soil solution analyses in reference to thermodynamic stability diagrams, showing "kaolinite stability" in mainly beidellitic clay soils. Suggested experimentation that is needed for understanding of the results is outlined. Index mineral frequency (suites of heavy specific gravity minerals such as zircon, tourmaline, *etc.*) is reviewed. Use of quartz as a weathering index is discussed, although no mention of eolian additions of quartz is made. Studies with the assumption that certain elements are immobile are reviewed. Translocation of clay is exemplified by profile diagrams. Iler's findings of variation in quartz solubility with grain size is detailed. The filter-bed mechanism for clay accumulation in the B horizon is described.

Chapter 6 evaluates the pedological factors listed in Chapter 1. Chapter 7 addresses physical descriptions of soil profiles. Chapter 8 reviews mineralogical analyses, from laterite (gibbsitic) to phyllosilicate-dominated profiles, with emphasis on carbonate rock weathering. Chapter 9 reviews elemental analyses of the mineral and the organic portions of the soil. Chapter 10 returns to ionic properties of soils (with more on the Missouri soil data, extending Chapter 5).

Finally, Chapter 11, "Obstacles and Vistas," addresses the complexities of soils and opportunities for further study, particularly with the present array of improved tools of basic physics and chemistry.

This book is a scholarly effort to describe soils from a physical-chemistry and mineralogical point of view. It partially represents the "state of the art," and certainly the author's views and experiences; however, it is too complex and uneven in level of treatment for a class textbook. It will, nonetheless, serve as a valuable reference for graduate students and instructors.

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PALEOCURRENTS AND BASIN ANALYSIS, Second Edition. By P. E. Potter and F. J. Pettijohn. Springer-Verlag, Berlin, New York, 1977. 425 pages. $25.70.

Considerable attention was paid during the 1950's to field-oriented studies involving the interpretation of paleocurrents and sedimentary structures. Potter and Pettijohn provided leadership in this research area during that period. Sedimentologists and stratigraphers found useful their first edition (1963) on this subject, which synthesized directional properties of sediments and their application to basin analysis. I believe that the updated second edition is also a valuable reference volume, and it should be well received by student and researcher alike.

The present *Paleocurrents and Basin Analysis* follows the first-edition format but, in addition, provides a supplement and annotated references at the end of each of the original ten chapters. These supplement sections are interesting in that they record and discuss recent developments. As might be expected in an evolving field, there have been some changes in direction of study during the thirteen years that have elapsed since the publication of original volume. The present phase, which follows the spectacular period of growth from the late 1940's to early 1960's, is characterized by consolidation, synthesis, and formulation of classifications—a rather classic evolution. The published record continues to mushroom, while the number of descriptive papers on sedimentary structures is clearly on the decline. Cross-bedding and ripple-mark analyses have become about as commonplace as turbidite investigations. Particle orientation, earlier used primarily in the study of sand and gravel deposits, now also is readily applied to fossil-rich strata, carbonates, volcaniclastic deposits, and loess. In reading this update, one has the impression that no particularly spectacular progress has been made in the mapping of paleocurrent flow on the basis of linear structures in turbidites and glacial deposits.

In this new edition, attention is called to the increased interest in deformational features such as dish structures, although few experimental studies are being conducted on dewatering phenomena. There has been some clarification of the relationship between the position of a discrete sedimentary body in a basin, its depositional environment, and its shape and internal organization, but here again no spectacular breakthroughs are apparent. Studies of the areal variation of scalar properties resulting from sediment transport are now applied to a broader range of environments, including airborn dust and ash falls, arenites and rudites, and muds and mudstones; particularly useful is a listing in Chapter 8 of some of the more important recent publications in these areas.

Sedimentology continues to involve more sophisticated data analysis, and the authors call attention to methodology and to uses of statistical techniques and tools that facilitate data collection and processing. As might be expected, however, the major change of approach in the study of sedimentary basins, both modern and ancient, has been brought about by the overwhelming impact of plate tectonics. More than any other event, since 1963 the seafloor-spreading concept has continued to stimulate interest in basin interpretation, including aspects of paleogeography and paleocir-

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culation. It is now generally recognized that paleocurrent and petrologic techniques that involve the regional distribution of structures and textural and mineralogical associations are a necessary adjunct to any complete regional survey.

The text, clear and often entertaining, should find ready use in the classroom as well as in the field. The updated annotated reference lists include a well-balanced selection of North American, French, German, and other key papers. Thirty photoplates of excellent quality at the end of the book illustrate many common structures and stratification features. These and the 176 line drawings, many redrafted from other sources, clarify the basic subject material. I regret that results gained from modern sediment basin studies have not been adequately integrated here, and that there is too little emphasis on the recent experiments on sedimentary transport and current structure origin that bear directly on paleocurrent analysis. Nevertheless, Potter and Pettijohn demonstrate that the field has continued to move toward solving basic problems that range in scope from the hand specimen to the outcrop to the regional basin level and beyond. This reference will continue to stimulate sedimentologists—and thus help keep the field alive and well—by calling attention to gaps that remain in areas of paleogeographic analysis, sediment dispersal, and basin development.

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THERMODYNAMIC PROPERTIES OF MINERALS AND RELATED SUBSTANCES AT 298.15 K AND 1 BAR (10^5 PASCALS) PRESSURE AND AT HIGHER TEMPERATURES. By Richard A. Robie, Bruce S. Hemingway and James R. Fisher. U.S. Geological Survey Bulletin 1453, 1978. 456 pages. For sale by U.S. Government Printing Office, Washington, D.C. 20402, Stock Number 024-001-030659. $4.75.

The scope of this publication is concisely summarized in the authors' abstract: "Selected values for the entropy (S^o) molar volume (V^o), and for the enthalpy and Gibbs free energy of formation (ΔH_f^o and ΔG_f^o) are given for the elements, 133 oxides, and 212 other minerals and related substances at 298.15 K. For those materials for which high-temperature heat-capacity or heat-content data are also available ($H_T^o - H_{298}^o)/T$,S_T^o, ($G_T^o - H_{298}^o)/T$,C_P^o,$\Delta H_{f,T}^o$, $\Delta G_{f,T}^o$ and log $K_{f,T}$ are tabulated at 100 K intervals for temperatures up to 1,800 K. For substances that have solid-state phase changes or whose melting or boiling point is less than 1,800 K, we have also tabulated the properties listed above at the temperature of the phase change so that the enthalpy or entropy changes associated with the transformation form an integral part of the high-temperature tables." In the review copy the following corrections are made to the molar volume data (in cm^3) on p. 26: szomolnokite, 55.9±0.4; melanterite, 146.5±0.3; epsomite, 146.8±0.2; retgersite, 126.6±0.2; morenosite, 143.8±0.5; bianchite, 130.2±0.5; goslarite, 145.8±0.1; borax, 222.7±0.2.

This compilation is a worthy addition to similar USGS publications, and should be of value to all mineralogists and chemists concerned with thermodynamic data. A useful feature is the inclusion of the compilation date for each table (most compilation dates are in 1976, some in 1977).

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REMOTE-SENSING APPLICATIONS FOR MINERAL EXPLORATION. Edited by William L. Smith. Dowden, Hutchinson, and Ross, Inc., Stroudsburg, Pennsylvania, 1977. xiv + 391 pages. $50.00.

Mineral exploration was one of the main uses predicted for Landsat-1 before the satellite was launched (as ERTS-1) in 1972, a prediction since amply verified despite the wide use of Landsat imagery in other fields. This book presents a useful and well-illustrated compilation of several of the first publications on mineral exploration using Landsat data. The title is somewhat misleading as to the actual subjects covered, since the book concentrates on the use of orbital remote sensing, chiefly by Landsat, with little space devoted to aerial methods. It is intended, according to the preface, as essentially a progress report, rather than a text or reference handbook.

Of the fifteen chapters, four are concerned primarily with the strategy and economics of orbital remote sensing in mineral exploration, "mineral" as used here including fossil fuels. These chapters are perhaps the most useful in that they are not likely to be out-dated by technical progress. The chapter on "Foreseeable energy and mineral resource problems," by the editor (Smith), is especially useful, being thorough and well-documented. "Landsat applications in the less-developed areas," also by Smith, has an unusual side-by-side comparison of mineral exploration strategies by conventional and Landsat-based methods. Several other chapters cover early applications of Landsat and Skylab data to geologic investigations in various areas, including the western United States, Bolivia, Brazil, and India. The papers by foreign authors are of particular interest, since it has been expected that the developing nations would be among the first beneficiaries of Landsat.

Although the book is not intended as an instructional manual, there are useful chapters on data analysis techniques, including digital image enhancement and spectral band-ratioing techniques, both oriented toward Landsat multispectral scanner imagery. The sensors themselves (photography, television, scanners, radar, *etc.*) are briefly described and explained in a chapter by Johnston and Janza. Some of their descriptions are unclear, such as one in which the sun is described as a "passive" source of radiation.

There are several weaknesses in the book as a whole. The treatment of imaging radar as a geologic tool is particularly deficient. One author, for example, perpetuates the misconception that radar somehow penetrates jungle vegetation, which simply is not true for the frequencies generally used in aerial surveys (X- and K-bands). Johnston and Janza discuss radar at some length, but unfortunately do not explain clearly the differences between real-aperture and synthetic aperture radar. They also state that a "main" disadvantage of radar is poor spatial resolution resulting from the long wavelengths used. But the wavelengths generally used are in the 10 centimeter range, far below the resolution achievable by other high-altitude remote methods; Landsat images, for example, have about 79 meter resolution.

Editorially and typographically, the book is well done. Most of the orbital images are printed in full-page size, and generally (though unfortunately not always) facing the maps explaining them. A number of color plates are included, all of excellent quality.

Generally speaking, *Remote-sensing Applications for Mineral Exploration* should achieve its intended purpose very well, although much of the material will soon be out-dated. The high price will unfortunately keep the book out of the hands of students and many professionals. However, it will be valuable as documentation of the early uses of Landsat imagery, and as an aid in planning future uses of similar orbital data; every well-stocked technical library should have a few copies.

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