

BOOK REVIEW

Earth's Materials: Minerals and Rocks. By Gautam Sen. Prentice Hall, Upper Saddle River, New Jersey 07458, U.S.A., 2001. 542 + xvii pages. US\$68 (hardcover). ISBN 0-13-081295-1.

This is a dismal book. I shall justify this harsh opinion following a brief outline of the book's contents.

Earth's Materials begins with a preface in which the author admits freely that his text is designed for an undergraduate program in Geology where substantive courses in Mineralogy, Optical, and the three Petrologies have been squeezed to make place for GIS, ESS, ES, RS, BS ... (Geographical Information Systems, Earth System Science, Environmental Science, Remote Sensing ...). The brief introductory chapter of *Earth's Materials* reviews the "big picture": The origin and structure of our globe and plate tectonics. The 500 pages of text that follow are presented in 16 chapters. Six (214 pages) cover basic mineralogy and include optical, quantitative analysis, and phase relations with some thermodynamics and phase diagrams. The final 11 chapters offer an introduction to petrology, with five chapters (136 pages) on igneous rocks, two (52 pages) on sedimentary rocks, two (65 pages) on the metamorphic rocks, and a final 19-page chapter on mantle rocks. Three appendices offer (1) Microprobe data on eight silicate minerals, (2) Simplified CIPW norm calculations, and (3) A brief introduction to isotope geochemistry (Rb-Sr, Sm-Nd, and U-Th-Pb systems). A 15-page general index concludes the volume. References are given at the close of each of the 17 chapters and Appendix III.

Why did I characterize *Earth's Materials* as dismal? First and foremost is the plethora of factual errors. These could fill pages of a review; here I shall limit myself to some of the more grievous ones. These begin on page 2, where we are told that "the silicate mineral perovskite is the principal component of the lower mantle". Then, the relative sizes of anions to cations in tetrahedral coordination is wrong in Figures 2.3a and 2.4. X-ray crystallography does not date from the 19th century (p. 40). If a mineral is named for a person, that person need not be a "famous scientist" (p. 53). Diamond is certainly not a good thermal insulator (p. 59), nor does it "show an especially brilliant luster due to its ability to reflect light extremely well from all its faces" (p. 62). The cyclosilicate structure chosen in Figure 3.4 is an unusual

one, and no illustration of the phyllosilicate structure is given. Chalk is not kaolin (p. 62, 142), and the Mohs' scale is not logarithmic (p. 64).

It is, however, in the optical chapter where things really get out of hand. Here we read that "during the propagation of white light, the red component must travel faster than the violet component" (p. 68), and that "in anisotropic crystals, light is slowed down along specific crystallographic directions" (p. 69). The angle of incidence is certainly not "the angle subtended by the incident ray with the interface" (p. 70). The concept of the optic normal is nowhere given, and the diagram to explain the critical phenomenon (Fig. 4.4) could not be more in error. The explanation of interference phenomena is wrong (Fig. 4.15); interference takes place above the analyzer where two out-of-phase rays that were vibrating in mutually perpendicular planes are resolved into a single plane of vibration by the analyzer. The discussion of the Michel-Lévy chart that follows is incomprehensible, as no colors are given. Then, "A mineral in a standard thin section (30 μm thick) with a second-order red/blue interference color should have a birefringence of 0.2 and a retardation of 600 nm" (p. 86). This is nonsense and misleading as the orientation of the mineral isn't specified. The explanation of the uniaxial optic axis interference figure is wrong (Fig. 4.20); the key lies with the progressively longer ray path as one moves away from the center in strongly convergent (conoscopic) illumination.

Lesser errors of fact abound in the following chapter, "Systematic Mineralogy", but most serious is the error of omission. Various important rock-forming minerals have been left out, including apatite, beryl, chloritoid, clinozoisite-zoisite, cordierite, pumpellyite, rutile, scapolite, and stilpnomelane. Several of the excluded minerals are mentioned elsewhere in the petrological chapters of the book, and some are shown on the numerous phase diagrams in Chapter 16. Finally, the box "Medical Mineralogy" (p. 157) serves only to further muddy the thorny asbestos issue.

Moving on to the igneous rocks, the simple calculations of the "% anorthite crystals" (p. 194) and "% X exsolved" (p. 205) are wrong. Point "X" (p. 208; Figs. 7.23-7.25) is $\text{A}_{15}\text{B}_{30}\text{C}_{55}$, and not $\text{A}_7\text{B}_{30}\text{C}_{63}$ as given. The porphyritic texture is not limited to volcanic and hypabyssal rocks, phaneritic does not apply as a quali-

fier solely to rocks with a “coarsely crystallized texture” (p. 240), and not all pyroxenites are very coarse-grained (p. 245).

Sedimentary rocks fare no better. The concept of maturity (p. 378–379) is in error, and glaciers don’t deposit sediments when their velocity wanes (p. 382). Turbidity currents and marine evaporites are virtually ignored, and the subsidence of deltas is more complex than the mere compaction of mud (p. 394).

Metamorphism and metamorphic rocks are treated especially cavalierly. We are told that fluids present in rocks during their metamorphism are “groundwater heated by geothermal gradient or by an igneous intrusion, or it may be derived directly from the igneous intrusion” (p. 427, 443). Fluids released by dehydration and decarbonation of rocks undergoing metamorphism, far and away the major source, are nowhere mentioned. The definitions of blueschist (“...due to the abundance of the bluish, pleochroic, amphibole crossite”), and migmatite (“...lenslike rocks with felsic and mafic parts found near batholiths”) are erroneous, to say the least (p. 442). The author’s definition of metamorphism (p. 444) does not exclude weathering. Eclogites nowhere form “from blueschist facies assemblages in a low P–T facies series” (p. 467). The P-sensitive and T-sensitive univariant curves in Figure 16.14a are reversed. Finally, not all rocks “must undergo retrograde metamorphism” during exhumation (p. 470), and (Mg,Fe)SiO₃ is not Mg-perovskite (p. 495).

Apart from factual errors (those cited above are but a sample of those that I uncovered), *Earth’s Materials* is further weakened by poor writing, illogical punctuation, inconsistent capitalization, and downright incorrect grammar. Density and heavy (or light) are used interchangeably, even though they mean different things, and adverbs of time are used for place indiscriminantly. Fully half the citations in the text are not given in the references, and many figure captions include full references, duplicating those given at the conclusion of the corresponding chapter. The text is

broken by dozens (hundreds?) of parenthetical “to be discussed in a later chapter”, “defined later”, “discussed later”, or even “discussed in an earlier chapter and in a later section” (p. 448). It is patently evident that proof-reading was by students (p. xvi), and that no professional editor scrutinized the text. It is worth noting here that papers in this (and in every) issue of *The Canadian Mineralogist* are fundamentally clearly written and free of error at the current state of knowledge because they have undergone multiple peer review and been revised by professional editors. Perhaps publishers should invoke a similar policy for textbooks.

Illustrations in *Earth’s Materials* are slack as well. Some line drawings lack scales, others lack legends. A few are inadequately labeled. Curves on some phase diagrams are inexplicably wiggly (Fig. 16.17, for example). Photographs are poorly reproduced and add little to the text. Also, was it necessary to append “Courtesy of Gautam Sen” to each of the 50 or so photo captions? (One exception: Fig. 10.7).

In my view, *Earth’s Materials* has little to offer the student, and plenty to upset the teacher. The book is perhaps no more than a natural outgrowth of the “dumbing down” of the sciences of geology and mineralogy. If the current trend to eviscerate the core content of geoscience programs in our universities metastasizes, will we be able to state honestly that we are graduating geologists and mineralogists? It is a question that should concern every reader of this review.

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