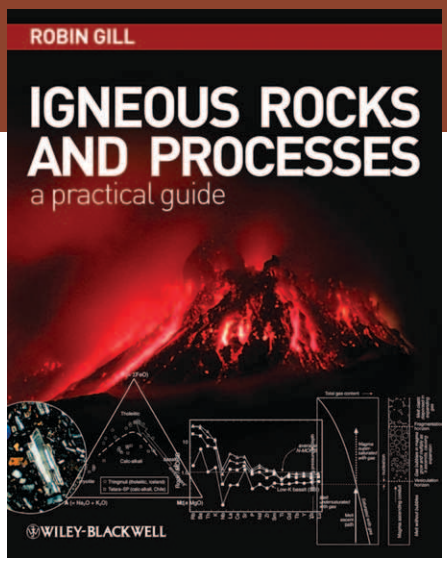
IGNEOUS ROCKS AND PROCESSES: A PRACTICAL GUIDE[1]



Igneous Rocks and Processes is a large (22 × 28 cm), weighty (1.5 kg), and thorough (428 pages) text/treatise on igneous petrology. The book is divided into nine chapters and ancillary material. The aim of the book "is to help students to develop appropriate descriptive and interpretative techniques … [with] a different order of priorities to those that one would embrace in writing a book on petrogenesis" (p. vii). In this reviewer's opinion, *Igneous Rocks and Processes* contains more than enough material to cover both aims at the intermediate level sought by the author, Robin Gill.

The nine chapters are arranged in a logical order and constitute a veritable promenade down petrogeny's lane, from the least to the most fractionated rocks. This structure is, however, interrupted by two chapters (3 and 7) on processes. The first chapter, at 19 pages, is the shortest. It lays the groundwork for much of what is to follow: magmas and their compositions, the classification and nomenclature of igneous rocks, and the role of volatiles. The second chapter deals with basalts and related rocks (but not gabbros). Treated are definitions, morphologies, alterations, and occurrences. These are interrupted by seven boxes that cover minerals common in basalts, grain size, and norms. In chapter 3, the author diverges from petrogeny's lane and digs into binary and ternary phase diagrams in considerable detail to elucidate magmatic differentiation. Again, boxes are used, with the fourth and final one explaining the basics of isotopes. The author returns to the rocks in chapter 4, now treating the gabbros. He discusses layering, the significance of textures, where gabbroic intrusions occur, and finally, the knotty anorthosite problem. A half-dozen boxes deal with optical data and procedures. Chapter 5 covers ultramafic and ultrabasic rocks, with a detailed treatment of komatiites, picrites and others particularly rich in magnesium. Spinels, garnets, ophiolites, and greenstone belts are dealt with in four of the six boxes in the chapter. Andesite, dacite, and rhyolite, the characteristic rocks of supra-subduction volcanism (but not exclusively so), are the subjects of chapter 6. These three rocks are contrasted in Table 6.1. Varieties also discussed include basaltic andesite, boninite, and adakite. The range of interpretations surrounding subduction, including flat-slab zones, are varied and complex. Six boxes break up the chapter. In chapter 7, the author turns to processes and products, chiefly pyroclastics. This chapter opens with a useful comparison of the five styles of eruption (Table 7.1) and carries on through extensive and interesting descriptions. Although the mechanics of volcanic eruptions were first discussed by Pliny the Younger nearly two millenia ago, much remains to be explained adequately. Chapter 8 (with five boxes) deals with the most abundant intrusive rocks in the Earth's crust: the granitoids. A long (pages 248–256) and detailed discussion of batholiths—their aspects, "granitization", their forms at depth—is nicely depicted in Figure 8.9. This is followed by summaries of structures, textures, and late-stage processes in granitoids. Extensive coverage of the chemical and isotopic characteristics of granitoids as well as the distinctions between I-, S-, and A-types (Table 8.3.l) conclude the chapter. Curiously, the least common igneous rocks take up the longest chapter of the book. The ninth chapter (pages 291–346, 16% of the text) is devoted to the alkali rocks, which make up <1% of exposed igneous rocks (page 291). Many of the early pages of the chapter are taken up by the complex and confusing nomenclature of the alkali rocks. Your reviewer, however, would be loathe to include quartz monzonite with the alkali rocks (Table 9.3). The bulk of the chapter, dealing with the varied occurrences of alkali rocks and backed up with appropriate phase diagrams, shows the enormous petrologic complexity of this group and substantiates the length of the chapter, which alone could easily make up a semester-length course. Nine boxes in the chapter deal with mineralogical, petrologic, and chemical topics.

Three appendices follow chapter nine: A. Mineral identification using a polarizing microscope (pages 347–357, an entry "intended merely as a reminder, not as an introductory course."), B. Petrographic calculations (7 pages), and C. Symbols, units, and constants used (2 pages). The book closes with a 15-page glossary (~450 terms on 15 pages), answers to the questions posed at the close of each chapter, an extensive bibliography (~500 entries on 19 pages), and a 14-page general index.

Although relatively free of errors, some must not pass unnoticed. Particularly annoying is the cavalier use of the slash, such as "SiO_2/mass %" (Fig. 1.2), "Temperature/°C", "Pressure/Gpa" and even "height/km", "depth/km", and "gravity anomaly/mgal" (Fig. 8.7). The use of "coarse-grained" is incorrect. Gabbro is "a coarse-grained igneous rock" (p. 93), granite is "a coarse-grained … rock" (p. 242) and so on throughout the text. Certainly your reviewer has mapped multitudinous medium- and fine-grained gabbros, granites, and many other intrusive rocks. The sizes of granitoid intrusions (Table 8.3) are confusing. What do 12 × 12 km^2, 800 × 25 km^2, and 1600 × 65 km^2 mean? Many of the large-scale maps lack north arrows; a reader in Uruguay might have a different view than a Canadian. The low totals of the two analyses in Table 9.4 are perplexing. Why the author chose RRM ("relative molecular mass", p. 38) and a.m.u. ("atomic mass unit", p. 92) rather than the familiar atomic weight is evident to him alone. Finally, differences in numeration of figures, figures in boxes, and plates (i.e. Fig. 5.1, Fig. 5.1.1, and 5.1) lead to confusion.

A personal peeve is the absence of a discussion of the consequences of subglacial eruptions of "gentle," effusive basaltic magma. The eruption in Iceland of Eyjafjallajökull under its icy cover in April, 2010, shut down air travel over Europe for more than a week. Eyjafjallajökull's larger neighbors to the northeast, Mýrdalsjökull and Vatnajökull, offer catastrophic potential. Then we have (p. 94): 'In older literature magnesian orthopyroxenes were divided into enstatite (En_{90-100}), bronzite (En_{70-90}), and hypersthene (En_{50-70}). Current usage includes all of these in the term "enstatite" (En_{50-100}).' This change may please chemists, but certainly not geologists. At least time-honoured "sphene" has survived (page 351).

On the plus side, *Igneous Rocks and Processes* is clearly written, the Michel-Lévy chart of interference colours is superb, and the splitting of photomicrographs into halves, one in plane-polarized light, the other under crossed nicols, is highly effective. Some specific data are supported by cited websites.

Would I use this text were I again to teach undergraduate igneous petrology? Yes, but with caveats. *Igneous Rocks and Processes* is thorough and complete. Nevertheless, a careful choice of topics ("weeding") would be necessary to keep an undergraduate course within realistic limits. Such would add an extra burden on the teacher. Finally, to use a text as rigorous as this one, the student must have a solid semester of optical mineralogy, theory and labs under his belt.

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1 Gill R (2010) Igneous Rocks and Processes: A Practical Guide. Wiley-Blackwell, Chichester, UK, 440 pp, ISBN 978-06320-6377-2, $144 (hardcover), $90 (softcover)