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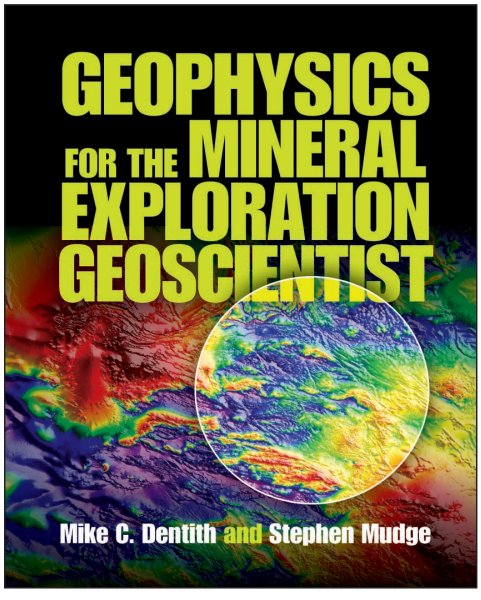
Book Review

Book Review: Geophysics for the Mineral Exploration Geoscientist. (2014) By Michael Dentith and Stephen T. Mudge. Cambridge University Press. ISBN: 9780521809511 Available in hardback or e-book, 438 pp. $68.



At the outset, Dentith and Mudge state that the goal of this book is to explain "...the principles and modern practice of geophysics in the search for mineral deposits. ... from a perspective relevant to a mining industry geologist." I would add that this book is relevant to all geoscientists.

A good description of *Geophysics for the Mineral Exploration Geoscientist* is provided in the preface: "Our aim is to provide an understanding of the physical phenomena, the acquisition and manipulation of geophysical data, and their integration and interpretation with other types of data to produce an acceptable geological model of the subsurface." The authors present the essential mathematical formulae necessary to explain the techniques described. The text offers detailed descriptions of petrophysical properties and their importance, and techniques used to interpret the geological significance of the data. This volume is for the all those involved in mineral exploration from geologist and geophysicists to mining engineers and managers. Note: A basic physics and calculus course are required.

Throughout this book the link between geological and geophysical measurements, that is petrophysics, is a recurring theme. Again the authors state: "Interpretation of geophysical data is critically dependent on their calibration against geological and geochemical data." Commonly books on exploration geophysics put great emphasis on the measurements and somewhat less on the geological and geochemical data required for interpretation.

To show the emphasis on practical application: A plot of the area in km^2 covered (footprint) by a geophysical method vs. its approximate relative cost is presented, this graph may be unique to this volume, while another table lists the names of 74 important mining location with relevant data (e.g., Olympic Dam, Cu-U-Au-Ag-REE, iron oxide copper gold, Australia).

An introductory chapter is followed by a generalized chapter discussing survey design, data processing and presentation, and other features common to all current geophysical methods. Gravity and magnetic procedures are presented and discussed in chapter 3. Earth's ambient magnetic and gravity fields are discussed followed by the basic physics formulas, types of magnetization, instrumentation, data reduction for gravity and magnetic surveys, analysis display and interpretation. Rock density and magnetism are the two physical parameters for these potential field methods. The range of density values for familiar rock and ore minerals is displayed; while, a similar presentation of the range of magnetic susceptibility of mineral and rocks with induced and remanent magnetization is also illustrated.

The radiometric method is described in the next chapter. Once again the basic physics of radioactive decay is presented. In contrast to gravity (density) and magnetic (susceptibility) physical properties there are only three common sources for radioactive anomalies (potassium, K; uranium, U; and thorium, Th) with radon being considered a non-geologic parameter and cesium, ^{137}Cs and cosmic rays, background radiation. The radioactive targets are confined to the near surface layer. Instrumentation is also relatively simpler, gamma ray detector (scintillometer and spectrometer). There are examples of actual surveys (Flinders Ranges, South Australia).

Electrical and electromagnetic methods presented in chapter 5 are divided into two primary methods: passive, measuring the Earth's natural ambient electrical fields; and active where electromagnetic fields are generated at or above the Earth's surface and the resulting modification produced by the electrical properties of these lower layers recorded. In the "Properties of rocks and minerals" section; these range from conductive metals to silicate and carbonate insulators. A table illustrates both the conductivity and resistivity of rock-forming minerals, regolith,

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crystalline, and sedimentary rocks. Variations in dielectric properties for rocks and minerals are also shown. The follow section (measurements of electrical and electromagnetic phenomena) describes self-potential surveys where massive sulfide and other conductive bodies are primary targets. Resistivity and induced polarization methods and other methods are presented with examples given describing their success in key mineral deposits (e.g., Olympic Dam).

Chapter 6, seismic method, is the final and shortest chapter since its use is limited in mineral exploration. There are two basic methods: reflection where energy generated at the surface bounces off horizontal layers of varying velocity, and density (acoustic impedance) and the time when the "reflections" are recorded by a line or an array of sensors (geophones) is recorded and plotted. Coal and potash exploitation makes most use of the seismic reflection methods. Refraction seismic is the second method, but is not described in detail since they have limited use in mineral exploration. Refraction surveys are, however, used to determine the nature of the regolith and in the exploration for near surface placer deposits. There is a full page figure of four plots of seismic velocity vs. rock densities for all rock types and a companion figure with the same four plots but showing the variation of velocity vs. pore water and fractional porosity.

The physical properties of target rocks and minerals that are relevant to mining are presented in detail. In each chapter there is a comprehensive and detailed description of the various geophysical methods. They are clearly presented and illustrated with over 300 figures rendered in color, therefore this volume could be used in an introductory exploration geophysics course. Each chapter has a list of review questions and a further reading list, in addition to the list of references.

Anyone involved in any way with mineral exploration should have this volume on their shelf.

A word of advice; the Appendices are accessed via url. Once there, you must then go to Resources to find them. Not the most intuitive interface.

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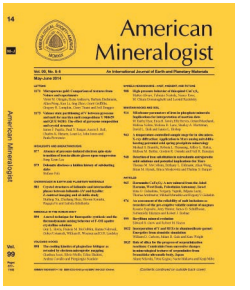

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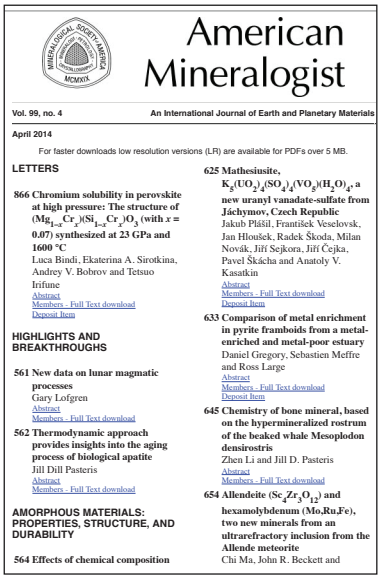
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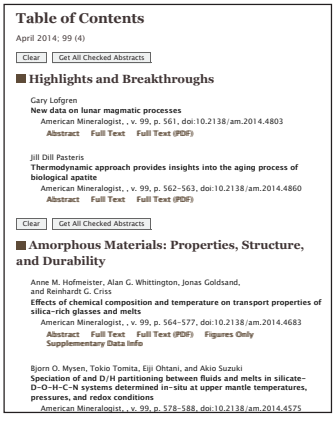
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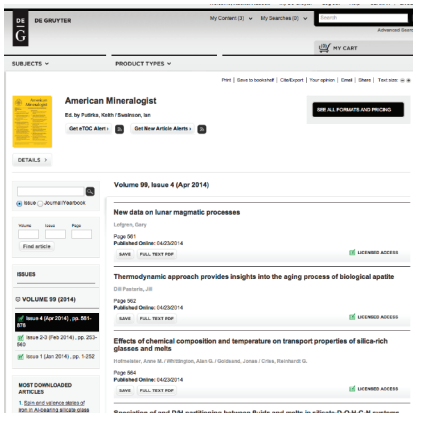
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