REVIEWS

Geochemistry: An Introduction

by Francis Albarede
Cambridge University Press,
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As an instructor in undergraduate geochemistry, and occasionally looking for other text options, I admit I looked forward to reading and reviewing this book. Having seen quite a few different general geochemistry texts, it is safe to say this book has a very different 'flavour' in three commendable aspects – the extremely quantitative treatment of Earth processes, the unification or comparison of similar geochemical principles operating in different parts of the earth (e.g. waters, mantle, atmosphere), and the humour. On the latter point, we are off to a great start when the author admits his previous geochemical modeling book is below number 300,000 on the Amazon.com best-seller list! Such an honest introduction made me look forward to what was coming – isotopic fractionation amongst black and white cats, elemental fractionation between cats and dogs, advection and diffusion of fish in rivers, and chromatography amongst a parade of people on a hot day. These, and other humourous pedagogical analogies used throughout the book, will not be forgotten by its readers.

This is a refreshingly different Geochemistry textbook in several other ways. The text is intentionally brief, though all the essential aspects of this enormous subject are covered. The book begins with an excellent chapter on the elements. A student could learn more in the first few paragraphs than what is described in several pages of more austere chemistry texts. There is also a great overview of crystal field effects, a concept that is important but never before so easily explained, and which can be a struggle to describe to students in other subjects such as mineralogy. There are, however, other parts of the book that contain unnecessarily lengthy explanations. The parts on radioactivity, or the age of the earth using Xe isotopes, seem far too long, too complicated or in unnecessary detail for most undergraduates or in a textbook this brief.

The approach of the remainder of the book is to first explain fractionation, distillation, element transport, mixing and reservoir theory, essential principles that underlie many geochemical processes. These principles are grounded in mathematical reasoning, and the underlying equations then applied repeatedly in subsequent chapters on waters, weathering, and the solid earth, using various examples that concern lakes, rivers, sediments, volcanoes, mantle convection, and planetary accretion. An advantage of this approach is that some geochemical processes proceed opposite to what is intuitive, but when expressed through equations, behave predictably in a mathematical sense. Indeed, there is a constant connection made throughout the book between theory and some simple yet profound observations. A great example is the use of oxygen isotope fractionation to demonstrate the unequivocal link between the Earth and Moon.

Unfortunately, for the sake of brevity, some large steps in the development of equations and/or their application were taken, making some parts of the text difficult to follow for the uninitiated. Parts on residence time, forcing, the carbonate system, water speciation and water-rock reactions are particularly heavy going. Even in the lengthy chapter on waters, too much material is delivered in too limited a space (but be wary because this reviewer works in igneous systems). Conversely, in some of the solid Earth topics, much of the element behaviour is described in words, instead of equations or quantitative treatment.

The ordering of the material is also nonconventional. It is curious that the reader is introduced to the elements and all their behaviour in the Earth system before knowing where or how elements originate in the solar system, a topic that is left as one of the last chapters in the book. This was likely done to ensure that the necessary theory and equations were in place to explain nucleosynthesis, early isotope fractionation and the timing of events. Also notable is the mixing of different levels of presentation of a subject. For example, on the same page, the reader is introduced to something as basic as metamorphism and a few sentences later is expected to know about granulite facies. One statement assumes almost no prior knowledge or geology and the other presumes a background in metamorphic petrology.

Despite these very minor peculiarities, the book could serve as a very successful, useful and state-of-the-art text in an upper-level undergraduate or graduate course on geochemistry. The book covers waters, mineral reactions,

the solid Earth and the solar system in incredibly short order, and provides neat and efficient appendices on equation derivations, geochemical data, analytical methods, and further reading. Also unique to this book are the brief individual exposés on the behaviour of some common elements. The breadth and depth in a book only 248 pages long is amazing. The true beauty of this book, however, is in its incessant use of examples that link the same geochemical principles in different parts of the Earth system. One shows that rivers or lakes are not really so unlike the Earth's mantle or a volcano, when viewed in terms of residence times and reservoirs. The reader learns much from this unifying approach, which should bode well with a research and education community that is evolving toward erasure of the artificial boundaries between traditional disciplines in Earth science. At $50 USD, this book is an excellent and long-lasting value for both students and practitioners of geochemistry.

World Water Resources at the Beginning of the 21st Century

Edited by I.A. Shiklomanov and John C. Rodda

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This monograph is the result of an UNESCO project aimed at providing an up to date assessment of global water resources, undertaken by the State Hydrological Institute of the Russian Federation. While considering the role of groundwater the monograph examines mainly surface water resources, with a separate groundwater monograph planned for publication by UNESCO. Since it is focused on water resources, the manuscript does not deal with contamination issues in a significant way.

As might be expected, a review of this magnitude cannot be done in a short space. The 435 pages of this book are structured in 12 chapters grouped as 1) three chapters providing a general overview and methods; 2) six chapters that provide an overview for each continent, including descriptions of natural conditions, use of water, economic development, hydrology, and an analyses of water resources; and 3) three chapters that provide a global analysis of world water resources and use, including an analysis of potential climate change impacts. Amalgamating information on global water resources and water use is a monumental task. Trying to compile data from multiple sources, with various standards of water monitoring networks, and dealing with the global trend of decreasing monitoring stations, makes this particularly difficult. The well-defined methodology used in this monograph provides an internally consistent global review making it a powerful resource. Numerous tables throughout the text also provide excellent data summaries that can be extracted, although it would have been helpful to have electronic access to this information. The reviews provided for each continent are by necessity of broad scope. I found them useful though, as they tend not to be bound by national issues or viewpoints, but rather present common issues and problems faced by a broad range of nations that share water resources and river basins. Projections for growing demand of water resources also helps focus attention on what regions of the world will be facing water shortages within the next 25 years. In summary, I found the text well written and the data tables extremely useful, but now on to the illustrations.

As the famous saying goes, a picture is worth a thousand words. In this case, the pictures are worth only a handful of words that cannot be used in polite company. The illustrations can be divided into three classes: 1) Plots cut and pasted from spreadsheet programs, which are typically acceptable, except for cases where grey scales are too close to distinguish or to compare with the legend; 2) computer-drafted diagrams and maps that use grey scales that tend to blend into one another – in this case it is often impossible to distinguish the grey scales shown in the legend yet alone on the maps (i.e. you cannot tell what part of the map relates to what part of the legend as the three or four shades of grey used all look the same; 3) badly scanned images of badly hand drawn and shaded figures. For many of these the text in the figures is illegible and much of the diagram is difficult to decipher. This is by far the worst collection of illustrations I have ever seen published, with many diagrams being completely useless.

At the end of the day the reader has to balance the value of information found in the text and numerous tables, against the shockingly poor quality of illustrations and the price tag of $150US. I would suggest that if you have a strong interest in water resource issues then this would be a worthwhile reference. Otherwise it would still be useful to have on the shelf of you local library as it does have the most up-to-date and consistent review of global water resource data. For the more casual reader your money would be better spent elsewhere.