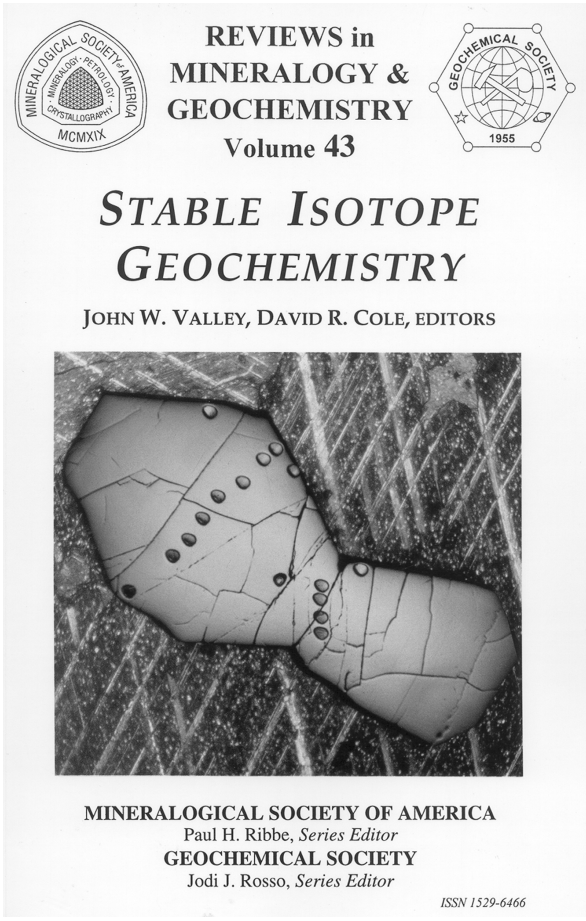
Meteoritics & Planetary Science 38, Nr 10, 1547–1548 (2003)
Abstracts available online at http://meteoritics.org

Book Review

Stable isotope geochemistry, edited by John Valley and David R. Cole, Reviews in mineralogy and geochemistry, Vol. 43 (series editors Paul H. Ribbe and Jodi J. Rosso), Mineralogical Society of America and the Geochemical Society, Washington, DC, USA, 2001, 662 p., $32 (ISBN 0–939950–55–3).

The year 1947 marks the birth of stable isotope geochemistry. In this year, Urey and Bigeliesen and Mayer published papers which, for the first time, allowed a high precision calculation of the temperature dependency of the position of isotopic equilibrium for exchange reactions. In the same year, Al Nier published a paper with Ney and Ingraham that reported the development of the stable isotope ratio mass spectrometer which, for the first time, allowed high precision isotope ratio measurements to be made. Subsequent to these papers, the applications of stable isotope ratio measurements have flourished and encompass an incredible array of disciplines in earth and planetary sciences. With the ever expanding range of applications, up-to-date review texts become increasingly important. The text, *Stable isotope geochemistry*, Volume 43 of *Reviews in Mineralogy and Geochemistry,* is such a text. The specific goal of this text is to provide reviews on state-of-the-art reviews in selected subjects since the publication of its predecessor text in 1986. With the enormous range of applications of stable isotopes, the authors of this text have wisely chosen to restrict the review chapters to lower temperature environments, including both inorganic and biological processes.

The first few chapters of the text focus on the processes of isotope exchange equilibrium and their applications. The first chapter by Chacko, Cole, and Chakraborty is a nicely written chapter that introduces the theoretical basis for the calculation of equilibrium in isotope exchange reactions. The chapter is well-referenced and includes a useful table for obtaining the experimentally determined exchange values for differing mineral exchange reactions. The subsequent chapter by Cole and Chakraborty follows up with a development of the theory and measurements of the rates of exchange and how such observations are used to determine mechanisms. In the third chapter, Hayes has provided a well-rounded and detailed description of how stable isotope ratio measurements and their principles are used to understand biosynthetic processes. I found this to be a well-written chapter that does a nice job in recounting the applications of stable isotopes in understanding biosynthetic processes. This is a rapidly developing field, and this is a useful chapter that could also be used as a text for an undergraduate or graduate level course.



Chapter 4, Stable isotope variations in extraterrestrial materials, by McKeegan and Leshin is an excellent presentation of the observations of hydrogen, carbon, nitrogen, and oxygen isotopes in extraterrestrial materials. This is an excellent chapter and also includes a discussion of the analytical measurement techniques, which is most useful given the emergence of ion microprobe technology in making isotopic measurements on micron scales (and below). As discussed in this chapter, the issue of the source of meteoritic oxygen isotopic anomalies is one of the most important unresolved issues in cosmochemistry. The authors of this chapter do an excellent job of presenting a clear overview of the multitude of measurements of meteoritic oxygen isotopes and their consequences for early solar system processes. They also give a nice presentation of astronomical spectroscopic observations and their relation to isotopic measurements.

Presently, a wide array of isotopic measurements of oxygen isotopes in basaltic and upper mantle rocks exist. The

chapter by Eiler reviews the measurements and has a clear discussion of how these measurements are used to resolve geologic processes such as subduction, arc-lava production, and mantle processes. The subsequent chapter by Valley is a very detailed discussion of stable isotope thermometry that is quite complete and presents a review of applications not generally encountered in other review chapters and books, such as carbon and sulfur isotope thermometry and the tests of isotope thermometry, such as δ-δ and δ-Δ plots.

Other chapters in the book provide reviews of specific environments, all of which are of wide ranging interest to the isotope community. This includes transport and contact metamorphic flow (Baumgartner and Valley, Seafloor hydrothermal systems (Shanks, III), Precipitation and paleothermometry (Alley and Cuffey), The carbon cycle and its evolution (Desmarais), Marine organic carbon (Freeman), Sulfur biogeochemistry (Canfield), and The marine carbon cycle (Ripperdan). In each case, the review chapters are well-written and complete as well as useful.

In sum, this is an excellent volume, and I recommend it to any researcher (including students) in stable isotope geo- and cosmochemistry. The layout of the book allows it to be used as a text for courses in geochemistry or stable isotopes.

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