Book Review

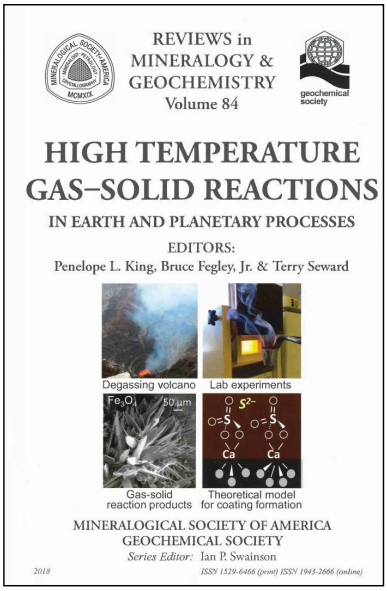
Book Review: High Temperature Gas–Solid Reactions in Earth and Planetary Processes. (2018) By Penelope L. King, Bruce Fegley, Jr. and Terry Seward, editors. Reviews in Mineralogy and Geochemistry, Volume 84. ISBN: 978-0-946850-00-3, 514 p. (25% discount for MSA, CMS and GS members, except shipping).

Gas–solid reactions are ubiquitous in Earth and planetary processes, but this topic does not often receive as much attention as it deserves. At long last, there now exists a comprehensive review about high temperature gas-solid reactions. For those who are in the Earth and planetary sciences, this volume will prove to be invaluable.

As a phase, gas is everywhere and is essential in many planetary process as well as in planet formation. High-temperature gas–solid reactions can be witnessed firsthand at volcanic vents as hot gases react with surrounding rock. Gas is fleeting—it is volatile and once it reacts, it departs only to leave evidence of its previous presence by the solids left behind. Gases play a significant role in subduction zones as well as in volcanic ash plumes. In truly high temperatures, solids can volatize and then condense into a different form with only a slight change in temperature. There is a sizeable scientific community that has a vested interest in these types of high-temperature reactions and since the advent of solar system exploration this interest has expanded by orders of magnitude. There is a vast array of environments to explore in the solar system where high-temperature gas–solid reactions could occur whether in the past or under current conditions. Many planets show evidence of previous volcanic activity. A different type of example is provided by the surface of Venus. The Venus surface is likely undergoing current gas–solid chemical weathering because of its high surface temperature of ~470 °C (740 K) and dense atmosphere. This volume offers a much-needed resource in the community and brings together a variety of related topics that have remained largely on the sidelines.

High Temperature Gas-Solid Reactions in Earth and Planetary Processes made its debut in August 2018 at the short course of the same name held prior to the Goldschmidt Conference in Boston, Massachusetts. This review was compiled and edited by King, Fegley, and Seward, a trio of reputable and experienced researchers who have the benefit of practical experience with these types of reactions. The experts they recruited as authors are well-respected in their fields; each of their chapters is fully able to stand alone because, as written, they are thorough and informative. Together these chapters form a comprehensive and logical discussion that covers the triumvirate of modeling, experimental, and theoretical approaches to terrestrial, planetary, and industrial applications.

This volume consists of 13 chapters, each with extensive reference lists. Many of the chapters are preceded by a list of defined acronyms and abbreviations, which is useful for those not fully versed in the jargon. The table of contents is constructed such that it is easy to locate specific information.



Overall, the volume is divided into five main topics: (1) Experimental and analytical approaches to characterizing gas–solid reactions; (2) Modelling approaches to examining gas–solid reactions; (3) Terrestrial volcanic systems; (4) Planetary systems; and (5) Industrial processes. Two chapters are dedicated to describing analytical techniques typically used to study reaction products or reactions in real-time. There are multiple chapters that address reactions with sulfur dioxide, SO_2, a prevalent reactive gas in high-temperature environments. It is very much appreciated that there are chapters that specifically address the individual, but related, disciplines of reaction mechanisms, thermodynamics, and kinetics. Often, thermodynamics are discussed but without mention of reaction rates, or reaction progress is highlighted without consideration of the reaction mechanism. Having the three interdisciplinary topics co-located is a definite advantage.

There are many illustrative graphs and images that employ a judicious use of color when needed. The tables are extensive and useful resources precisely because they are so comprehensive, with related references. The text is well-written and understandable. Most chapters could serve as concise primers.

It would not be surprising if *High Temperature Gas–Solid Reactions in Earth and Planetary Processes* becomes a required text for graduate students in the planetary sciences, or is found on the desk of any high-temperature reaction researcher. It is an invaluable resource not only for the information it provides, but because the comprehensive and inclusive coverage of such a diverse and important topic is necessary for understanding our environment and solar system. Overall, this volume is highly recommended to both experienced researchers and to those just entering the field; it has much to offer to both communities.

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