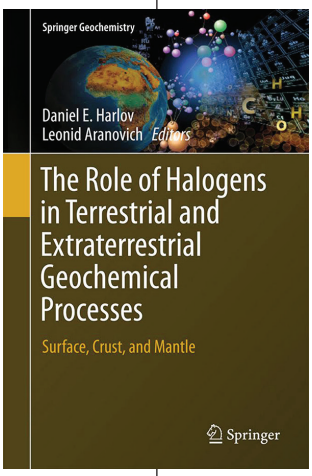
THE ROLE OF HALOGENS IN TERRESTRIAL AND EXTRATERRESTRIAL GEOCHEMICAL PROCESSES: SURFACE, CRUST, AND MANTLE[1]



The halogens—F, Cl, Br, I—are an incredibly reactive group of elements named for their ability to form a salt (*hal)* and to produce (*gen*) ionic compounds with metals (e.g. Na) by accepting outer-shell electrons from the metal to fill the outer shell of the halogen atom. Many of you may remember performing simple salt and water dissolution–evaporation–precipitation experiments, used to explore how the halogens bond with metal cations and how the resultant metal-chloride complexes are transported during geologic processes. Most readers here, I'm sure, have advanced far beyond a grade/primary-school understanding of ionic bonding. However, if your research program is as narrowly focused as mine, whereby I study the mobility of metals in aqueous fluids to understand the formation of mineral deposits, it is probably safe to assume that your breadth of knowledge regarding the importance of halogens during geologic processes is limited to your specific area of research.

To expand your knowledge base, I strongly recommend reading *The Role of Halogens in Terrestrial and Extraterrestrial Geochemical Processes* (Springer, 2018). This remarkably comprehensive compilation of papers has been edited by Daniel E. Harlov (GFZ Potsdam, Germany) and Leonid Aranovich (IGEM RAS, Russia) and has opened my eyes to the many roles that halogens play in geochemical processes across a wide range of geologic environments. What makes this collection of papers unique is the diversity of subject matter, all focused on halogens, but with contributions from authors whose paths never likely cross at scientific meetings. I particularly enjoyed the chapter on terrestrial and cosmic geochemical systems, which concisely presents an overview of the distribution of halogens among Earth's terrestrial geologic reservoirs, as well as halogens on/within the Moon, Mars, and asteroid Vesta. The book also includes tables that compile seminal references for the wide variety of analytical techniques used to quantify halogen abundances. Several chapters focus on the behavior of the halogens in magmatic systems across the compositional spectrum, from basalt to rhyolite, and two chapters connect magmatic processes to the formation of hydrothermal mineral deposits. The crystal chemistry of halogen-bearing minerals—including the common minerals apatite, amphiboles, and micas, as well as many of the nearly 700 minerals in which halogens are an essential structural constituent, including rare-earth fluorides, copper chlorides, mercury halides and halogenates—are comprehensively described in a chapter that includes a large number of eye-catching crystal structures in full color. Chapters on the behavior of the halogens in sedimentary systems, seawater and other marine systems, metamorphic systems, Earth's mantle, and extraterrestrial systems, including chondritic meteorites and oceans on the moons of Jupiter and Saturn, are wonderfully informative.

While each paper represents the state-of-the-art understanding of halogens in a particular environment, each provides an appropriate level of background that makes the material easily accessible for the nonexpert. The papers are incredibly rich in data, and the majority of the figures (many in color) are available online, which is great for teaching purposes. This volume would be a fantastic resource around which to scaffold an upper-level undergraduate or graduate seminar focused on the halogens. Importantly, in academia, where we often have minimum enrollment requirements for courses, such a course would be a wonderful way to draw students from multiple subdisciplines where the halogens can be used to build connections between seemingly disparate research programs. It is amazing how much one can learn from stepping outside the comfort zone of one's own research program to explore the magic that is happening in the research fields of our colleagues. This book does just that and is a must read for anyone interested in the halogens.

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1 Harlov DE, Aranovich L (eds) (2018) *The Role of Halogens in Terrestrial and Extraterrestrial Geochemical Processes: Surface, Crust, and Mantle.* Springer, 1,030 pp, ISBN 978-3-319-61665-0, doi: 10.1007/978-3-319-61667-4, ebook US$ 339.00, hardcover US$ 429.00