*American Mineralogist, Volume 107, pages 815–825, 2022*

# Impact of fluorine on the thermal stability of phlogopite

**Jiaqi Sun[1], Yan Yang[1,*,‡], Jannick Ingrin[2], Zhongping Wang[3], and Qunke Xia[1,†]**

[1]Key Laboratory of Geoscience Big Data and Deep Resource of Zhejiang Province, School of Earth Sciences, Zhejiang University, Hangzhou, China
[2]Université de Lille, CNRS, INRA, ENSCL, UMR 8207, UMET, Unité Matériaux et Transformations, F 59000 Lille, France
[3]Department of Physics, University of Science and Technology of China, Hefei, China

## Abstract

Knowledge of volatile cycling is vital to understanding the evolution of the planet and the life it supports. Although it has been gradually accepted that the mantle is a vast storehouse of $H_2O$ and other volatiles, the impact of coexisting volatiles on the thermal stabilities of OH and the lattice of the host mineral is still poorly understood. Phlogopite is one of the few hydrous minerals capable of carrying both water and halogens into the mantle. Previous observations from both experiments and textural relationships in natural samples have indicated that F-rich phlogopite can be stable under ultrahigh-temperature conditions. Here, the impact of F on the thermal stability of phlogopite was investigated via XRD, Raman, and IR spectroscopy from room temperature to 1000 to 1200 °C. Based on the experimental results from F-poor and F-rich natural phlogopites, we show that about 4 wt% F can increase the breakdown temperature of phlogopite by 100 °C under ambient pressure. The impact mechanism mainly involves preventing OH and lattice softening at high temperatures. This study reveals the links between F and the behavior of OH and phlogopite lattice, which is important for constraining volatile cycling, as well as the role of F in the physical and chemical properties of the upper mantle.

**Keywords:** Fluorine, water, thermal stability, phlogopite, mantle; Experimental Halogens in Honor of Jim Webster