The role of phlogopite in the deep Earth’s water and fluorine cycles

Jiaqi Sun\textsuperscript{1}, Yan Yang\textsuperscript{2}, and Qunke Xia\textsuperscript{3}

\textsuperscript{1}School of Earth Sciences, Zhejiang University, Hangzhou, China (jiaqisun@zju.edu.cn)
\textsuperscript{2}School of Earth Sciences, Zhejiang University, Hangzhou, China (0015119@zju.edu.cn)
\textsuperscript{3}School of Earth Sciences, Zhejiang University, Hangzhou, China (qkxia@zju.edu.cn)

Knowledge of the volatiles cycles is vital to understand the evolution of the planet Earth and the life it supports. Although it is gradually accepted that water and other volatiles are recycled into the mantle through subduction, it is still not unclear how these volatiles are transported down into the deep Earth. Phlogopite is an accessory mineral frequently observed in samples from the upper mantle, thereby acting as an important carrier of fluorine and water down to \textgreater 200 km depth. Previous experimental studies and textural relationships of natural samples have indicated that fluorine-rich phlogopite can be stable under ultra-high-temperature conditions. To further investigate effects of fluorine on the stability of phlogopite, here, we present an atomic level research of effects of fluorine on the structural stability using in situ high temperature infrared spectroscopy, Raman spectroscopy, and X-ray powder diffraction. Both X-ray powder diffraction and Raman spectroscopy suggests that fluorine-poor phlogopite decomposes earlier than the fluorine-rich phlogopite. Moreover, the O-H bonds and lattice modes are stiffer for the fluorine-rich phlogopite than the fluorine-poor phlogopite, which is well responsible for the mechanism of fluorine stabilizing phlogopite. Based on our studies, we propose that fluorine-rich phlogopite can effectively transport water and fluorine to the deep Earth.