

Efficient fluorine transport to the deep mantle during serpentinite subduction

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Subduction zones serve as critical pathways for the cycling of volatiles between Earth's surface and its interior. Mantle is an important fluorine reservoir. However, current studies on the fate of fluorine in subduction zones are limited to observations of natural samples from shallow forearc regions (<80 km depth) [1], lacking systematic constraints on fluorine behavior at greater depths. What are the transport flux and efficiency of fluorine from subduction zones to the deep mantle? This study investigates the partitioning behavior of fluorine at 2.5–8 GPa and 850–1105 °C using a natural fluorine-bearing antigorite as starting materials. High temperature and high pressure experiments were conducted using the piston cylinder press and multi-anvil apparatus. The results show that the humite-group minerals (HGMs) are the main fluorine carriers after serpentine breakdown. Fluorine contents in HGMs increases with increasing temperature and decreases as pressure increases. The partition coefficient of fluorine between HGMs and fluid range from 3 to 25 displaying a negative correlation with pressure. More than 93% of fluorine is retained within HGMs at 8 GPa and is not released into the fluid. Because fluorine can stabilize HGMs to the depth of the mantle transition zone [2], fluorine in serpentine can be efficiently transported to the deep mantle.

[1] John, T. et al. (2011), *Earth and Planetary Science Letters*. **308**, 65-76.

[2] Grützner, T. et al. (2017), *Geology*. **45**, 443-446.