NMR studies of fluorine defects in forsterite and wadsleyite

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Halogens, especially Fluorine, are important volatile components of the upper mantle. Whilst a lot is known about the role of water in the Earth's mantle, there is only scant data on the influence of F or Cl on mantle processes. However, recent experimental studies show that F is less incompatible than water in forsterite and enstatite [1], but it tends to be more incompatible than water in wadsleyite [2]. This implies that F may be fractionated from water in the upper mantle and its transition zone.

To further our understanding of how F is incorporated into olivine, we synthesized F-saturated Forsterite at pressures between 1 to 8 GPa and 1500-1700 °C in piston cylinder and multi anvil presses at Münster. We also synthesized F-saturated wadsleyite at 21 GPa and 1700-1900 °C using the 5000 ton multi anvil press in Bayreuth. Further experiments were conducted in a F- and water-saturated system to study the influence of water on F incorporation. The experiments were characterized with EPMA and Raman Spectroscopy in Münster and ^{19}F NMR spectroscopy was performed in Bochum.

Preliminary results show that F defects coupled with Mg vacancies are the most important mechanism by which F is incorporated into forsterite. This is independent of P, T and water content. Therefore, F incorporation is quite different from the favoured mechanism for OH incorporation in high-pressure forsterite, i.e. Si vacancies [3]. In wadsleyite F incorporation seems to be dominated by humite-type defects.

The different incorporation mechanisms for F and OH in forsterite and wadsleyite may help to better constrain storage of both volatiles in the mantle. Further results and implications will be presented at the conference.

[1] Grützner et al., 2017, *GCA* **208**, 160-170. [2] Grützner et al., 2018, *EPSL* **482**, 236-244. [3] Xue et al., 2017, *Am. Min.* **102**, 529-536.