The effect of fluorine on the stability of humite-type minerals in the upper mantle and transition zone

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Water is probably the most abundant and the most important volatile component in the deep Earth. Numerous studies focused on its role in Earth's mantle. However, there are other important volatile elements (e.g., C, S, N, or the halogens F, Cl, Br and I) which may have similar effects on mantle mineral properties and melting processes, but there is scant data on this. During the last years, interest in the role of halogens in the mantle has increased. Several recent studies focused on halogen partitioning and incorporation of halogens in nominally anhydrous minerals (NAMs) like olivine or pyroxene (e.g. [1-6].)

Here we investigate the stability of minerals of the humite group (e.g. clinohumite and chondrodite) in the Earth's mantle. Humite-group minerals are able to store much more water or F than NAMs but are only known as accessories in mantle rocks. OH^--rich humite endmembers are only stable at low temperatures, However, adding small amounts of F or Ti can stabilize these phases to higher temperatures [7] [8]. To determine the P-T stability of F-bearing humite-group minerals, experiments were performed in the water-free system MgO-SiO_2-F, at T up to 1900°C and pressure up to 17 GPa in both piston-cylinder and Walker type multi anvil apparatus at Münster University. The different F-rich phases were characterized using Raman spectroscopy, SEM and EPMA.

Our preliminary results show that the T-stability of F-humites is significantly higher than the stability of their OH^- counterparts. When modeling global halogen and water cycles, humite-type minerals, especially when they contain F, have to be taken into account as effective water and halogen carriers in subduction zones.

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