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The low-temperature shift of antigorite dehydration in the presence of sodium chloride: In situ diffraction study up to 3 GPa and 700 °C

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Abstract

The dehydration of serpentine mineral antigorite, $Mg_{2.8}Si_2O_5(OH)_{3.6}$, is regarded as the key step in metamorphic transformation of ultramafic hydrated rocks in subduction zones, which affects seismicity and feeds volcanic activity. The abundance of alkali-chloride brines derived from deep subduction/upper mantle sources implies the possibility of a large control of the H_2O activity by the dissolved salts. The present study examines the effect of alkali chlorides, lowering the H_2O activity in fluid, on antigorite stability at high pressure. The decomposition of natural antigorite (Ural) in the presence of a halite-saturated NaCl-H_2O fluid was studied up to 3 GPa and 700 °C by in situ X-ray diffraction combined with resistively heated diamond-anvil cell. Reference experiments were also performed on salt-free sample. At 1.5–3 GPa in the presence of halite-saturated fluid ($X_{NaCl} \approx 0.15$), antigorite decomposes to an intermediate product assemblage of talc+forsterite at about 550 °C, which is ≈150 °C lower compared to salt-free H_2O-unsaturated system. Such a low-temperature shift supports the previous models of a broadened *P-T* area of serpentinite dehydration in the subducting slab. In addition, the present experiments reveal active dissolution of the product Mg silicates, first of all forsterite, in the NaCl-H_2O fluid at 600–700 °C/1.5–3 GPa. This implies that dehydrated serpentinites are a potential source of fluids enriched in MgO and SiO_2, which play an important role in deep metasomatic processes.

Keywords: Antigorite, decomposition, subduction zone, NaCl aqueous fluid, H_2O activity, high pressure, high temperature, in situ X-ray diffraction