Dehydration process of serpentine by impact

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Serpentine has been proposed to play an important role as one of water carriers in the Earth mantle and beyond the snowline in the solar system because they are required to have enough water contents and high thermal stability against heat as well as high resistance to impact heating. The stability and formation of serpentine has been determined experimentally under various conditions to show a wide range of temperature and pressure. Serpentine can be formed by hydration reactions of enstatite and forsterite, and indicates in fact high thermal stability and impact resistance, and can produce another high pressure hydrous mineral (H-phase).

Natural serpentine samples (antigorite, crystallite) have been investigated by shock recovery experiments and Hugoniot measurements. In the recovery shots, the serpentine dehydration is considred to depend upon its initial sample conditions (porosity, species, etc) and whether the system is open or closed. We have performed time-resolved Hugoniot measurements and recovery experiments on a high quality antigorite to compare with the previous studies on similar serpentine. We focused on the effects of porocity, the difference between open and closed systems, and characterization of products. According to the time-resolved wave profile measurements, we also estimated the sound velocity at high pressures to check phases present.

The results of recovery and Huginiot experiments will give us detailed understanding of impact induced dehydration process of serpentine as well as thermodynamic constrains of stabilty in the deep mantle. Below a critical impact condition, the dehydration will be initiated by hot spot mechanism. Explosive dehydration may occur at extensive impacts. At the intermediate impact conditions, partial dehydration will occur mainly as a function of impact pressure. According to the Hugoniot, H-phase can be a product at 40-70 GPa and it dehydrates above 80 GPa.

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