Effect of shock on H in Martian meteorite pyroxene via analogue impact experiments

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Constraining the amount of water in differentiated planetary interiors has seen renewed interest following recent detection of water in Mars, Moon and HED samples [e.g., 1-3]. The majority of these are meteorites, which are all affected by shock processes [4]. And yet the effect of shock on H mobility in meteorite phases has only been addressed in two experimental studies on serpentinites and amphiboles [5-7]. Although these are found in carbonaceous chondrites and rare amphibole has been observed in Martian meteorites [e.g., 8,9], meteorites are mainly composed of the nominally anhydrous minerals olivine, pyroxene (px) and plagioclase. These can incorporate trace amounts of water as H in their lattice defects. Here we present an exploratory study of the effect of shock on H in pyroxenes to decipher whether water could have been disturbed by shock in Martian meteorites.

Clinopyroxene (cpx) and orthopyroxene (opx) hand-picked grains from terrestrial peridotite xenoliths were used as meteorite mineral analogues. Two experimental setups were explored in the Experimental Impact Laboratory at NASA-JSC: the flat-plate accelerator at ~ 20 and 40 GPa, and the vertical gun, reaching maximum peak pressures of 10-20 GPa. Analyses of water were performed by FTIR. Two experiments were also conducted with the vertical gun on dehydrated px to verify the lack of water addition by the experimental setup. No change in water content was observed in the px prior and after shock in the vertical gun experiments. This is likely due to the biased choice, so far, of the least shocked grains from the retrieved shocked px pieces. The opx used in the flat-plate experiment, however, experienced loss of water. The material shocked in the flat-plate experiments is characterized by the formation of veins of glass of px and Al-rich silicate composition (where the water may have diffused to) and metal (melted from the sample holder) at the boundaries of the crushed px.

[1] Boctor *et al*. 2003 *GCA*, 67, 3971-3989; [2] Saal *et al*. 2008 *Nature*, 454, 192-196; [3] Sarafian *et al*. 2014 *Science*, 346, 623-626; [4] Stöffler *et al*. 1988 in *Meteorites and the early solar system* 165-202; [5] Tyburczy *et al*. 1990 *EPSL*, 98, 245-260; [6,7] Minitti *et al*. 2008 *EPSL*, 266, 288-302 & 46-60; [8] Bass 1971 *GCA*, 35, 139-147; [9] Floran *et al*. 1978 *GCA*, 42, 1213-1229.