FIRST EVIDENCE FOR MULTI SHOCK EVENTS ON THE L CHONDRITIC PARENT BODY

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Introduction: Shocked meteorites preserve information about collision histories of planets and asteroids. ^{39}Ar-^{40}Ar dating of shocked L-6 chondrites yields a single major collision in the asteroid belt leading to the destruction of the parent body [1]. We conducted a comprehensive study on a shocked H5 (GRV 052529) and a L5 (GRV 052049) chondrite to clarify the collision histories on their parental asteroids.

Observations: A shock-induced melt vein (SMV) up to 1 mm in width was found in the H5 GRV 052529. Matrix of the SMV mainly consists of zoned fine-grained olivines (1-3 μm) with Fe-poor cores and Fe-rich rims. Many large olivine fragments (10-20 μm) entrained in the SMV also have concentric zoning, with the Fa-content rhythmically varying from $Fa_{17.6}$, $Fa_{12.7}$ to $Fa_{14.0}$ from core to rims.

In L5 GRV 052049, we encounter several concentrically FeO-zoned olivine-ringwoodite (Ol-Rgt) assemblages in the SMV. The zoned Ol-Rgt assemblages (up to 300 μm in size) are idiomorphic and composed of rhythmically alternating dark-bright zones with bulk Fe-contents changing from 14.3 and 26.6 mol%. The dark-bright zoning is due to various proportions of three submicron-sized phases, *i.e.* Fe-rich irregular ringwoodite (Fa_{55-81}) scattered in matrix of intergrown amorphous olivine (Fa_{24-35}) and Fe-poor lath-like grains (Fa_{7-18}). In addition, several nodule-shaped objects of micron-sized ringwoodite (Fa_{38-80}) overlay the assemblages. Faulting was observed in a zoned Ol-Rgt assemblage, as some parts of the zones depict sliding up to 5μm.However, the polycrystalline ringwoodites across the fault plane show a continuous outline, suggesting that crystallization of ringwoodite postdated the fault and the zoning.

Discussion: The concentric zoning of fine-grained olivines observed in the SMV in GRV 052529 (H5) was probably produced by fractional crystallization from a small shock-induced melt. However, the same scenario is difficult to be applied to the large rhythmically zoned Ol-Rgt assemblages in GRV 052049 (L5). The large grain sizes up to 300 μm and the straight cutoff boundaries of the zoning inside these assemblages are inconsistent with crystallization of melt. On the other hand, a nebular origin of the rhythmic zoning of the coarse-grained olivine can be excluded, because GRV 052049 was highly equilibrated and no similar zoning was reported in unequilibrated chondrites. The rhythmic zoning of olivine must have been formed from a shock event. After formation of the rhythmic zoning, another impact event converted the zoned olivines into its high-pressure polymorphs. The unique, complicated textures and compositions of these Ol-Rgt assemblages in GRV052049 (L5) depict the first petrographic evidence for multi shock events on L chondritic parent body.

References: [1] Korochantseva E.V. et al. (2007) *MAPS*, 42, 113-130.