

AT LEAST TWO PARENT BODIES FOR SHOCKED L CHONDRITESM. Ciocco¹, M. Roskosz¹, B. Doisneau¹, S. Mostefaoui¹, E. Deloule² and M. Gounelle¹.¹IMPMC, CNRS, UMR 7590, Sorbonne Université, Muséum National d'Histoire Naturelle, UMR 7590 – 57 Rue Cuvier, 75005 Paris, France. (E-mail : marine.ciocco@mnhn.fr)²Centre de Recherches Pétrographiques et Géochimiques, CNRS, Université de Lorraine, Vandoeuvre lès Nancy 54501, France

Introduction: High pressure minerals from meteoritic shock melt veins are key to understand the collisional history of the Solar System. The L chondrites, the most shocked meteorites [1], present abundant shock melt veins from which we can retrace their history. To this day, their family of origin is still debated. The shock timescale of 7 chondrites was measured to deduce their parent body diameters. Moreover, we use tuite, a high pressure phosphate mineral to perform U-Pb datation by SIMS. We find a bimodal distribution of ages, which match closely the ages previously obtained for Creston and Novato, two other shocked L6 chondrites [2].

Samples and Methods: Seven samples were first studied by optical microscopy and Raman spectroscopy to identify high pressure (HP) polymorphs. Scanning Transmission Electron Microscopy (STEM) was then used to study microstructures and transformation/growth mechanisms. The EDX was used to locate eligible minerals for datation (phosphates). Combined STEM-EDX (UMET, Lille, France) and NanoSIMS (MNHN, Paris, France) chemical maps were finally collected on the same FIB sections in order to compare these two analytical approaches and produce chemical maps. The U and Pb isotope concentrations were then measured on the identified tuite grains with the help of a Cameca IMS 1280 LG SIMS (CRPG, Nancy France) for datation.

Results: Multiple high pressure textures were observed in all seven samples. Polycrystalline assemblages of ringwoodite are typically the dominant texture, but more exotic textures were also found. Some meteorites present ringwoodite as lamellae inside olivine crystals, whereas others seem to present an assemblage of MgSiO₃ glass with akimotoite crystallites. Both these textures allowed us to investigate elemental diffusion induced by structural changes. We therefore calculated shock timescales following the methods described in [3,4]. For all our samples, assuming a temperature of 2400K [5], shock timescales ranging between 0.5 and 20 seconds were derived. The meteorites that do not contain ringwoodite lamellae have significantly higher shock timescales, between 11 and 16 seconds. These larger shock timescales were caused by an impact between larger bolides, including a parent body of at least 150km wide. This is significantly higher than parent-bodies with diameters around 70km required by the other group. In almost all meteorites, we find tuites inside the shock melt veins. The meteorites that do not contain tuite have at least shocked apatites and whitlockites, with shifted Raman spectra indicating a change in structure. We date both the host rock apatites and the shock vein phosphates. This allows us to obtain conclusive collision ages from a normal concordia diagram for two of our samples, one of each group. The tuites record collisions ages of 461±57Ma for the group with the largest parent body, and 650±160Ma for the group with the smaller parent body. The host rock minerals record upper intercepts of 4481Ma in both meteorites.

Conclusion: Shocked L chondrites seem to define two groups, which are texturally different and appear to have a completely different history. A smaller, 70km-wide parent body exploded first (650 Ma ago) and yielded most of the shocked meteorites, and a larger one exploded in the cataclysmic collision known today as the “L chondrite parent body breakup” 470Ma ago. The upper intercept of 4481Ma could date the early separation of the original L chondrite parent body into different families.

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