U-PB DATING OF THE SHOCK MELT VEINS IN TWO L6 CHONDRITES.
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Introduction: Impact played an important role during the formation and evolution of the solar system [1]. However, dating an impact event is not an easy task [2]. Recently, a high pressure polymorph of phosphate, namely tuite, was found in the shock melt veins (SMV) of Suizhou [3]. During the phase transition, the U-Pb isotopic system in phosphates could have been reset, and consequently recorded the time of the impact event. We present in situ U-Pb dating of tuite and apatite in Suizhou and Sixiangkou (L6), with the recently developed technique using Cameca IMS-1280 HR ion microprobe [4].

Results and discussions:

Suizhou: Apatite in the host of Suizhou is structurally and isotopically undisturbed. Six analyses yield a concordia age of 4547 ± 20 Ma and weighted average 207Pb/206Pb age of 4546 ± 17 Ma (Fig. 1a). These ages are consistent with previous TIMS results of phosphate in unshocked L chondrite [5], and are interpreted to represent the time when their parent body cooling down to the closure temperature of apatite. Apatite adjacent to the wall of SMV was partly transformed to tuite. The tuite domain has a nanocrystalline texture, whereas the apatite domain is nearly unchanged. All analyses on these phosphates are “concordant” except one spot with a slight discordance. The U-Pb isotopic data plot on a discordia between 4524 ± 13 Ma and zero point (Fig. 1b). Apatite in the SMV shows a nanocrystalline texture. Raman and EPMA reveal that it was largely transformed to tuite with some residual apatite. Three analyses yield a discordia with an upper intercept of 4513 ± 260 Ma and a lower intercept almost through the coordinate origin. Among these three analyses, one spot gives a concordia age of 4480 ± 30 Ma and a 207Pb/206Pb age of 4482 ± 30 Ma. This is the youngest age and may indicate an early impact event on the Suizhou parent body. The U-Pb ages of phosphates in Suizhou decrease from the host, to the wall of SMV, and then to SMV, with increasing degree of shock metamorphism, which suggest the U-Pb system of most phosphate in or adjacent to the SMV were only partially reset.

Sixiangkou: Four analyses were made on an apatite grain adjacent to a wall of SMV, from the closest to the wall (the most altered region, spot 1) to the outermost in the host (the least altered region, spot 4), which are also showed in CL image and Raman mapping (Fig. 2). From spot 3 to spot 1, Pb loss increases, whereas spot 4 shows essentially no Pb loss. Two analyses of apatite in the host are also concordant (Fig. 2a). All six analyses yield a well-defined discordia with an upper intercept of 4548 ± 15 Ma and a lower intercept of 461 ± 110 Ma. Similar to Suizhou, the upper intercept is consistent with the cooling age of L chondrites [5]. The lower intercept is basically coincident with the major disruption event of the L chondrite parent body at ~ 467 Ma [6].

Summary: Suizhou and Sixiangkou L6 chondrites recorded two major impact events on their parent body. An early event (>4.4 Ga) was associated with the Moon-forming giant impact, and the later one reflected the disruption of the L chondrite parent body.


Acknowledgement: This work was supported by NSFC (41273079, 41573059), the Minor Planet Foundation of Purple Mountain Observatory, and Macau FDCT (039/2013/A2).