MINERALOGY OF ITOKAWA DUST PARTICLES WITH POSSIBLE SHOCK-INDUCED MELTING

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Introduction: Itokawa parent asteroid experienced a catastrophic impact so as to become a small rubble pile asteroid. MUSES-C particles show a variety of impact features [e. g., 1], suggesting that each particle records different shock and heating history. In the present investigation, we performed a detailed mineralogical study for five MUSES-C particles that appear to have experienced severe shock heating and melting. Parts of the results were already reported [2].

Results and Discussion: The five particles were classified to three types based on the mineralogy and mineral chemistry.

RA-QD02-0060: This 50 μm size particle consists of two different parts: one is a coarse low-Ca clinopyroxene crystal with Mg-Fe zoning from Fs12 to 20 and the other is an aggregate of small olivine grains (Fa24 to 26). The olivines faced each other without any interstices material (thus sintered) or connected by feldspathic, vesiculate glass. Some olivines shows high-density cracks and dislocations but others are not. The coarse pyroxene is also accompanied with heavily vesiculate glass on its surface. These features suggest that this particle formed by an impact on the powdered regolith material where only plagioclase was melted and vesiculated. As a result, the powders were sintered by impact.

RA-QD02-0048, RA-QD02-0039, and RA-QD02-0070: These three particles contain coarse pyroxene with an extensive Ca zoning, for instance, from Wo6 to 47 in the case of RA-QD02-0048. Ca-poor pyroxene is located at the center and Ca-rich pyroxene is at the rim. In addition, all particles contain a vesiculate melt with small troilite inclusions. Three dimensionally, the melt in RA-QD02-0048 spreads as a plain with ~10 μm thick and ~30 x 50 μm width between coarse silicates. The Ca zoning in pyroxene is supposed to have formed by crystallization of Ca-rich pyroxene from Al-poor, Ca-rich silicate melt, on an earlier-formed Ca-poor pyroxene during cooling from impact heating. As pointed out by [3], the Ca zoning profile is very similar to that found in shock melted Y-790964 LL chondrite [e. g., 4].

RA-QD02-0011-1: The particle consists of coarse (~10 μm) olivine and Ca-rich pyroxene with a melt between them. The melt is made of fine-grained Ca-rich pyroxene, troilite, feldspatic glass and some blebs, basically similar to the melt in the other particles. But the coarse Ca-rich pyroxene is not zoned. The mineralogy and chemical composition of the melt is similar to mesostasis glass in UOC chondrules. For this particle, it is difficult to infer formation process of the melt.

References: [1] Nakamura et al. (2012) *Proc. Nat. Acad. Sci*. 109:E624-E629 [2] Nakamura et al. (2011) *Science* 333:1113-1116. [3] Takeda et al. (2013) *HAYABUSA2013*: Symposium of Solar System Materials. [4] Yamaguchi et al. (1998) Antarct, Meteorite Res. *11*:18-31.