OLIVINE DARKENING AND SHOCK TEXTURES IN ALH 77005 LHERZOLITIC SHERGOTTITE.

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Introduction: Some Martian meteorites are known to contain darkened olivine (so-called "brown olivine") [1,2] and it is suggested that such darkening is induced by unique shock histories they have undergone during ejection from Mars [1-3]. ALH 77005 (hereafter ALH), LEW 88516 (LEW), Y 984028 (Y98) and NWA 1950 (NWA) are classified into lherzolitic shergottite, showing similar REE patterns ("intermediate") and crystallization and cosmic-ray exposure ages. These similarities indicate that they are derived from the same region on Mars and may have been ejected by the same shock event. However, they are reported to have undergone different shock pressures and temperatures [e.g., 4-6] and the degree of olivine darkening is variable. Then, micro-textures related to the olivine darkening should be also different in each meteorite. In this study, we studied olivine coloration and related shock textures in ALH and compared with those in other lherzolitic shergottites reported in [3] in order to see variation induced by the same shock event.

Results: Olivine in ALH is heterogeneously darkened and the degree of the coloration is similar to that of Y98, which is less darkened than those of LEW and NWA. ALH has large shock melt pockets and olivine around them are recrystallized. These recrystallized olivines are not darkened as is the same case with those in the other Martian meteorites. The darkened areas in ALH show the same mineralogical features to those of darkened olivine in LEW and Y98 (less abandance of cracks, low crystallinity and brighter BSE contrast) although the lamellar textures observed in NWA [3] are not found. FEG-SEM observation with high magnification reveraled that there are submicron-sized Fe-rich particles (about ~100 nm in size) within the darkened area. Such particles may cause the darkening as reported in [1,2], but their sizes are larger than those reported in NWA 2737 (average size: ~20 nm). In addition, in the colorless areas, healed cracks are observed. The large submicron-sized particles and healed cracks may indicate that this meteorite has undergone higher temperature throughout the meteorite. This also results in absence of high pressure minerals similar to the other Martian meteorites with brown olivine.

Conclusion: Darkened olivine in ALH shows similar features to those in Y98. Both of these meteorites contain abundant shock melts (pockets/veins) and this may have induced long thermal effects after decompression, which is different from LEW and NWA with smaller amount of shock melts. Long thermal effects may result in decoloration of darkened olivine (or less darkening). Thus, the strong olivine darkening (NWA and LEW) may be induced by specific temperature, pressure and time, and this could constrain shock histories of meteorites with darkened olivine.

References: [1] Van de Moortele B. et al. (2007) *Earth and Planetary Science Letters* 262:37-49. [2] Treiman A. H. et al. *Journal of Geophysical Research* 112, E4:E04002. [3] Takenouchi A. et al. 2015. Abstract #1650. 46th Lunar & Planetary Science Conference. [4] Fritz J. et al., 2005. *Meteoritics & Planetary Science* 40:1393-1411. [5] Walton E. L. et al., 2007. *Meteoritics & Planetary Science* 42:63-80. [6] Hu S. et al., 2011. Chinese Science Bulletin 56:1579-1587.