TRANSMISSION ELECTRON MICROSCOPY OF DARK OLIVINE IN NWA 1950 LHERZOLITIC SHERGOTTITE

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Introduction: Lherzolitic shergottites show nearly identical mineralogy and ages, and are thus believed to have been from the same igneous body on Mars [e.g., 1]. NWA1950 is a typical lherzolitic shergottite similar to other samples of this Martian meteorite group [e.g., 2], but the optical property of olivine is somewhat different from those of other lherzolitic shergottites. Olivine in NWA1950 shows strong dark color in thin sections and dark parts consist of crystallographically-controlled dark stripes present in colorless olivine crystal. Such optical features are similar to LAR06319 olivine-phyric shergottite rather than NWA2737 chassignite where colorless stripes are visible in dark crystals. In this abstract we report TEM observation of dark olivine in NWA1950.

Sample and Methods: We prepared an FIB sample for TEM by a cross-section of the selected area in NWA1950 by multi-beam SEM-FIB JIB-4600F. Imaging and selected area electron diffraction (SAED) analyses were performed using a JEOL JEM-2100 TEM, a scanning transmission electron microscope (STEM) system, and an EDS system (JEOL JED-2300T) at the JEOL R&D Laboratory.

Results: Parallel stripes of 200-500 nm width were observed under TEM that are corresponding to dark stripes under optical microscope. Crystallographic properties of these stripes are somewhat different from the surrounding host crystal. Stripes consist of tens-nanometer-sized minute crystals although they are inside of a single crystal. The SAED patterns of the interior and exterior of stripes are mostly identical, however diffraction spots of the interior are broadened concentrically due to slight difference of crystal orientation. Dislocations are present in the surrounding host crystal, but not in stripes. Fe-rich nano-particles are concentrated only in stripes and are not observed in the other areas. Nano-particles are usually 10-20 nm in diameter and do not contain Ni. The Fast Fourier Transform patterns of these nano-particles are consistent with hematite.

Discussion and Conclusion: Fe-Ni metal nano-particles in NWA2737 olivine have been reported as a significant factor of darkening [e.g., 3]. NWA1950 also contains nano-particles in olivine, but they do not contain Ni. The difference in the olivine bulk composition has been suggested for the difference in chemical composition of nano-particles between two meteorites [3]. However, our results suggest that NWA1950 nano-particles lack Ni because they are hematite. The absence of dislocation and polycrystalline texture indicate that stripes (lens in 3-dimensions) formed by recrystallization, probably during the ejection event. Similar stripes are also present in NWA2737. However, in contrast to NWA1950, stripes in NWA2737 are colorless and nano-particles are concentrated in the surrounding host crystal.

References: [1] Mikouchi T. 2005. *Meteoritics & Planetary Science* 40:1621–1634. [2] Mikouchi T. and Kurihara T. 2008. *Polar Science* 2: 175–194. [3] Van de Moortele B. et al. 2007. *Earth & Planetary Science Letters* 262:37–49.