

TRANSMISSION ELECTRON MICROSCOPY OF OLIVINE IN THE LAR06319 OLIVINE-PHYRIC SHERGOTTITE.

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Introduction: Some Martian meteorites (especially, NWA2737 chassignite) are known to contain brown colored olivine. Recent TEM studies revealed that nano-particles of Fe-Ni metal in olivine are responsible for the brown color of olivine in NWA2737, which was probably formed by reduction of olivine due to heavy shock events [1,2]. Our TEM study demonstrated broad existence of Fe-rich nano-particles (Fe-Ni metal and magnetite) in olivine among lherzolitic shergottites (ALH77005, LEW88516 and Y000097) [3]. It is quite natural to expect the same story in other shergottites with brown colored olivine. In this abstract, we report TEM observation of olivine in LAR06319, a new olivine-phyric shergottite from Antarctica, to look for Fe-rich nano-particles.

Olivine Mineralogy: Olivine in LAR06319 reaches 1-2 mm in size and shows extensive chemical zoning (Fe_{75-45}). The olivine grains in the thin section display brown to dark color similar to NWA2737 olivine. Another remarkable feature of olivine in LAR06319 is the presence of abundant tiny dark inclusions usually a few micrometers in size. These inclusions are widely distributed in olivine grains and not related to the color of olivine. The FE-SEM (Hitachi S-4500) observation revealed that these inclusions were symplectite exsolution composed of submicron intergrowth of augite and chromite.

TEM Observation: We prepared TEM samples by crashing a small rock chip of LAR06319 into powder by hand (~100 μ m in size) to look for nano-particles in olivine. The TEM observation was performed by JEOL JEM 2010 TEM equipped with EDS. Careful observation by TEM showed that nano-particles were present in LAR06319 olivine. The diameter of nano-particles is 5-20 nm. The electron diffraction patterns show that they are Fe metal. The EDS analysis shows that these particles are enriched in Fe supporting the result by electron diffraction analysis. No obvious secondary phases were found around the nano-particles. These nano-particles are very similar to those in olivines from other Martian meteorites with brown colored olivine, in their size, texture and compositions.

Conclusion: Fe metal nano-particles in LAR06319 olivine can account for the dark color of their host olivine. The formation of nano-particles yields minimum shock pressure of 40 GPa according to the result from shock experiments [4]. This shock pressure is consistent with the presence of maskelynite and shock melt vein in LAR06319. We plan to analyze other olivine-phyric shergottites such as Dar al Gani 476 and Dhofar 019 for comparison.

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] Kurihara T. et al. 2008. Abstract #2478. 39th Lunar & Planetary Science Conference. [4] Kurihara T. et al. et al. 2008. Abstract #2505. 39th Lunar & Planetary Science Conference.