MINERALOGICAL AND RAMAN SPECTROSCOPIC STUDIES OF NORTHWESTERN AFRICA 2977 LUNAR METEORITE

Aicheng Zhang and Weibiao Hsu. Purple Mountain Observatory, Nanjing 210008, China. E-mail: aczhang@pmo.ac.cn

Introduction: Northwestern Africa (NWA) 2977 is a newly found lunar cumulate olivine gabbro. It is composed of olivine, low-Ca and high-Ca pyroxenes, and plagioclase with some minor phases [1]. Olivine and pyroxenes commonly exhibit radiation fractures, and plagioclase is partially converted to maskelynite, indicating a shock history. Here, we report mineralogical and Raman spectroscopic studies of this meteorite.

Results and Discussion: One polished thick section of NWA 2977 was studied using a scanning electron microscope (SEM), an electron microprobe (EMP), and a Raman microprobe (RMP). Modal abundances of the section are 40 vol% olivine (Fo_{68}), 50 vol% pyroxene (low-Ca: $Wo_{2.5-20.5}En_{58.3-70.8}Fs_{21.0-28.9}$, high-Ca: $Wo_{32.3-44.6}En_{38.7-51.9}Fs_{12.8-17.1}$), 7 vol% plagioclase ($An_{80.1-93.5}Ab_{5.4-12.9}Or_{0.9-7.5}$), 0.5 vol% oxide (Ti,Al-rich chromite, ilmenite, and baddeleyite) and sulfide, 0.2 vol% phosphate (apatite and whitlockite), and 0.1 vol% K-feldspar. NWA 2977 shows a cumulate texture of euhedral olivine and pyroxene grains. Plagioclase usually occurs interstitially between olivine and pyroxenes along with other minor phases (e.g., apatite, whitlockite, ilmenite, K,Ba-rich feldspar, and baddeleyite). Some olivine grains contain melt inclusions, but pyroxene grains do not. The melt inclusions are partially or completely crystallized and contain various mineral assemblages. Mineral assemblages in some melt inclusions are similar to those interstitial materials. Other inclusions contain Si,Al-glasses or pyroxene, K-rich glass (5.08 wt% K_2O), and Ca-rich glass (11.65 wt% CaO). The average Fe-Mn ratios of olivine and pyroxene are 99 and 52, respectively, consistent with previous results [1].

Two thin melt veins and some irregular melt pockets are observed in the section. In this study, a 25 μm-wide melt vein and some large grains of olivine, pyroxene, and Ti,Al-rich chromite are analyzed with a Raman microprobe. Raman spectra of minerals within and adjacent to the vein exhibit low-pressure characteristics. One large Ti,Al-rich chromite grain (170 μm) shows two sets of light lamellae (<2 μm wide) on its BSE image. EMPA results show no compositional difference between the chromite host and lamellae. The Raman spectrum of the chromite host has a broad band centered at 669 cm^{-1} and a relatively weak band centered at 507 cm^{-1}; whereas that of the lamellae shows a broad band at 669 cm^{-1} and two relatively sharp bands at 400 cm^{-1} and 287 cm^{-1}. The 400 cm^{-1} band can be attributed to spinel; but the nature of 287 cm^{-1} band is unclear. These Raman peaks are different from those of pure chromite and its high-pressure polymorphs in ordinary chondrite [2,3]. The Raman spectra suggest that the lamellae could be assemblage of chromite, spinel, and other oxides, which are decomposition products of Ti,Al-rich chromite under a high pressure. A detailed analysis is in progress.

Acknowledgement: The sample used in this study was generously provided by Mike Farmer.

References: [1] Bunch T.E. et al. 2006. 36th Lunar Planetary Science Conference. Abstract 1375. [2] Chen M. et al. 2003. *Geochimica et Cosmochimica Acta* 67: 3937−3942. [3] Zhang A.C. et al. 2006. *European Journal of Mineralogy* 18:719−726.