PETROGRAPHY AND MINERALOGY OF NORTHWEST AFRICA 8687. Q. Zhou[1], G. L. Zhang[1], X. Y. Zhu[1], X. X. Zhang[1], Y. Y. Xiong[1], and C. L. Li[1]. [1]National Astronomical Observatories, Chinese Academy of Sciences, Beijing, 100012, China (zhanggl@bao.ac.cn).

Introduction: NWA 8687 is a troctolitic lunar meteorite collected from the Northwest African desert in 2014. It is composed primarily of plagioclase, olivine, and low-Ca pyroxene, with minor high-Ca pyroxene (augite) and spinel. Bsed on the petrology and geochemical data, NWA 8687 is likely paired with other lunar anorthositic troctolite granulitic breecias (NWA 5744, NWA 8599, NWA 10140, NWA 10178, NWA 10318, and NWA 10401) [1-3]. Here, we presented the petrological and mineralogical studies of NWA 8687.

Experiment: Three polished thin sections were examined using a Carl Zeiss SUPRA-55 field-emission scanning electron microscope equipped with energy dispersive spectrometer (EDS) at the National Astronomical Observatories (NAO), Chinese Academy of Sciences (CAS) in Beijing. The whole sections were mapped in element Kα X-rays using 15kV accelerating voltage, 300pA probe current, 70μs per pixel acquisition time with EDS detectors of NAO. Major element compositions of the silicate minerals were obtained with an electron probe microanalyzer (JEOL JXA-8230) at NAO, CAS. The minerals were analyzed at an accelerating voltage of 15kV and an electron beam current of 20 nA with a focused beam of 5μm. The ZAF correction method was used for all analyzed minrals. Data quality was verified by analyzing a combination of synthetic oxide and natural mineral standards.

Petrography: NWA 8687 exhibits a porphyroblastic texture. It is composed primarily of subhedral to anhedral large grained plagioclase (100-1500 μm) and olivine (50-3000 μm, Fig.1), with minor pyroxene (150-300 μm) and Cr-spinel (150-200 μm, Fig.2). They are surrounded by interstitial pyroxene (<10 μm) and olivine (<30 μm) grains in a matrix of plagioclase. Some large plagioclase grains are poikilitic and enclose small olivine and pyroxene grains.

Backscattered electron (BSE) and elemental maps of the section show that large plagioclase grains are distributed relatively evenly across the section (Fig.1). However, olivine is unevenly distributed with one large olivine grain up to 3mm.

The interstitial pyroxene and olivine grains show metamorphic texture in this section. They are embedded within matrix as rounded or elongated shapes (Fig.2). The matrix of plagioclase has been transformed into maskelynite.

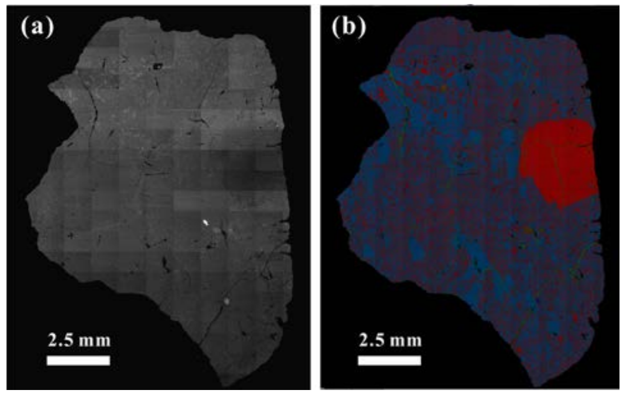

Fig. 1. (a) BSE image of the polished thin section of NWA8687. (b) Elemental map of the same thin section (RGB Mg, Ca, Al). Plagioclase is light blue, olivine is bright red, pyroxene is dark burgundy, Cr-spinel is purple and terrestrial calcite in the cracks is bright green.

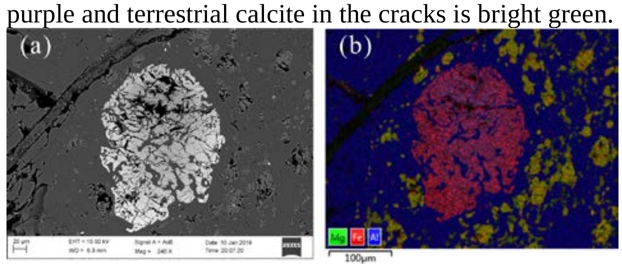

Fig. 2. (a) BSE image of the Cr-spinel grain in NWA 8687. (b) Elemental map of the same Cr-spinel grain (RGB Fe, Mg, Al). Cr-spinel is dull red, Plagioclase is dark blue, olivine is pale yellow, and pyroxene is green.

Mineralogy: The plagioclase is relatively homogeneous with the An values (molar Ca/[Ca+Na+K] *100) ranging from 96.0-98.3 (n=37).

Most olivine grains have fractures or cracks, with the larger grains generally being more heavily fractured. There are obvious differences in Fo (molar Mg/[Mg+Fe]*100) between the large and small olivine grains: one largest grain of 3mm in size has Fo from 85.5 to 88 (n=17), and the other olivine grains are less magnesian with Fo from 74.9 to 81.2 (n=18). The largest olivine grain exhibits compositional zoning from core to rim. The rim of this large olivine grain tends to have enhanced MgO (46-47 wt%) and decreased FeO (11-12 wt%). However, individual points on the small olivine grains do not exhibit any heterogeneity of major element within a single grain.

The vast majority of pyroxene are low calcium (low-Ca) pyroxene with composition of $En_{72-80}Fs_{18-25}Wo_{2-8}$ (n=15). According to their mineral composition, most of the low-Ca pyroxene is enstatite and pigeonite is rare (Fig.3). High calcium (high-Ca) pyroxene ($En_{45-55}Fs_{7-}$

$_{13}Wo_{37-42}$, n=8) is also present in NWA 8687 and classified as augite.

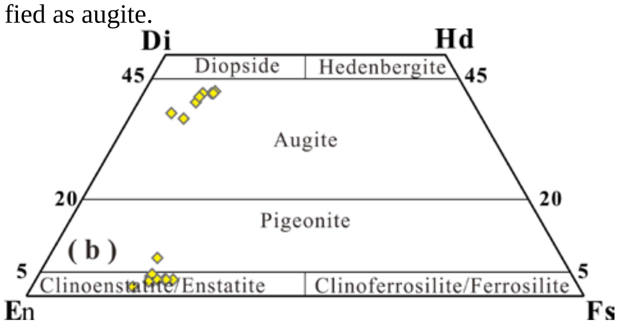

Fig. 3. Mineral compsitions of pyroxene in NWA 8687. Endmembers on the plot are diopside (Di), hedenbergite (Hd), enstatite (En), and ferrosillite (Fs).

Discussion: Based on the petrological and mineralogical studies, NWA 8687 is an troctolitic breccia with a porphyroblastic texture that has chemical charcateristics similar to the NWA 5744 clan meteorites ($An_{93.6-97.4}$ and $Fo_{78.0-82.1}$ for NWA 5744; $An_{92.1-97.6}$ and $Fo_{78.7-84.4}$ for NWA 10401) [1,2]. Interestingly, there is one large olivine grain in NWA 8687 (Fig.1), which is unique because of its large grain size and more magnesian than the other olivine in lunar troctolitic breccia [1-2]. This grain seems to have retained at least some protolith texture, morphology, and composition. The chemical zoning observed in this large olivine grain may indicate partial chemical equilibration during metamorphism.

In addition to large olivine grain, Cr-spinel is also reported to present in NWA 8687. The poikioblastic Cr-spinel enclose fine grained plagioclase (Fig.2). NWA 10401 also contains spinel with symplectitic texture [3]. In Apollo samples, spinel-bearing rock fragments (e.g., 67435) usually retain plutonic igeous crystallization texture [4]. The different textures of spinel indicate the complex formation progress for troctolitic breccia. Further study of this sample will help us place constraints on its formation history.

References: [1] Kent J.J. et al. (2017) MAPS, 52, 1916-1940. [2] Hilton A. et al. (2016) 47th LPSC, 1168. [3] Gross J. et al. (2017) 48th LPSC, 2589. [4] Prinz M. et al. (1973) Science, 179, 74-76.