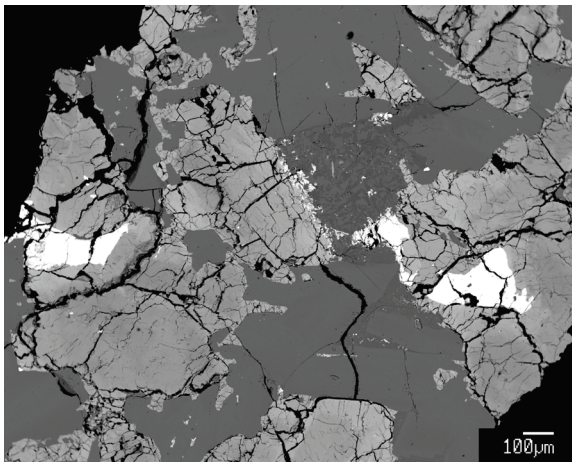


### NEW MARTIAN SHERGOTTITE NWA 6963

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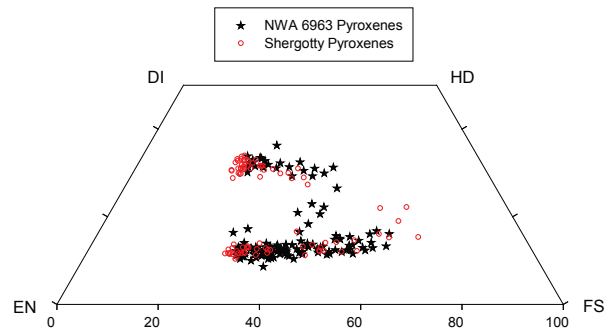
**Introduction:** NWA 6963 was purchased by A. Habibi in Morocco in 2011. It was found as three pieces that fit together as parts of a 83 gram single stone with shiny dark fusion crust covering most of the exterior, and minimal surface weathering. Broken surfaces show abundant reflective maskelynite. Microprobe examination of a polished epoxy mount shows 60% pyroxene, 35% maskelynite, 2% ulvöspinel, 2% melt pockets with a silica phase, minor merrillite, trace chlorapatite and pyrrhotite. Pyroxenes have core-to-rim zonation in BSE images (see figure 1). Pyroxene grain size ranges from 200 microns to >1mm, maskelynite domains range from 50 microns to >1mm.



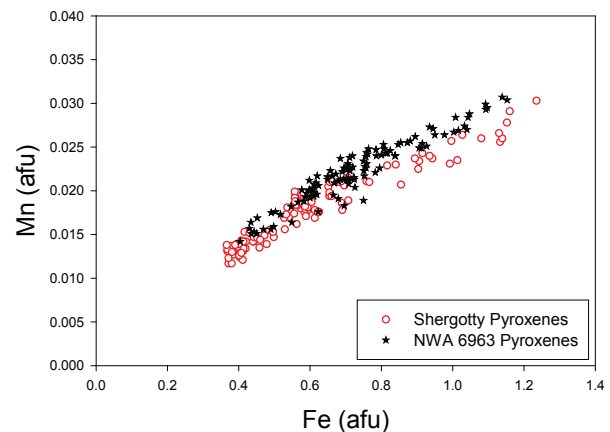
**Figure 1.** BSE image showing zoned pyroxene (light gray), maskelynite (dark gray), ulvöspinel (white), melt pocket with a silica polymorph and mesostasis (patchy dark gray in middle).

**Mineral Compositions and Geochemistry:** Electron microprobe analyses reveal two distinct pyroxene compositional trends present in NWA 6963: a pigeonite trend ranging from  $Fs_{29}Wo_{11}En_{59}$  to  $Fs_{58}Wo_{16}En_{26}$  with an average value of  $Fs_{39.7\pm 7.7}Wo_{13.0\pm 2.3}$  ( $n=108$ ), and an augite trend ranging from  $Fs_{21}Wo_{34}En_{45}$  to  $Fs_{39}Wo_{31}En_{30}$ , with an average value of  $Fs_{28.1\pm 6.2}Wo_{31.6\pm 1.9}$ . Figure 2 shows that NWA 6963 pyroxene compositions are similar to the pyroxene compositional trends in the Shergotty martian meteorite. Fe/Mn (molar) of pyroxenes has been used successfully to categorize planetary basalts [2]. NWA 6963 pigeonites have  $Fe/Mn=33\pm 3$  and augites with  $Fe/Mn=31\pm 3$  which are consistent with average SNC values. Figure 3 illustrates this consistency by compar-

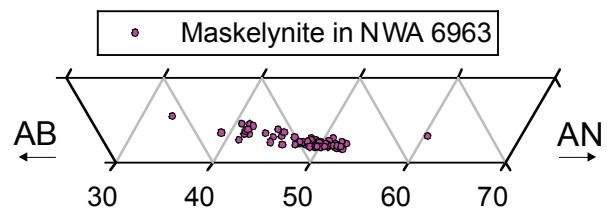
ing Fe-Mn compositions of NWA 6963 pyroxenes to Shergotty.



**Figure 2.** Pyroxene quadrilateral showing the compositional trend of augites and pigeonites in NWA 6963 (black stars, 132 microprobe analyses) and in Shergotty [1] (red circles).



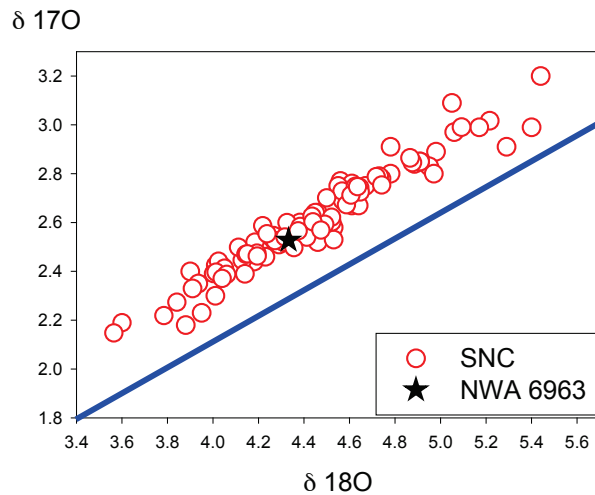
**Figure 3.** Fe versus Mn (atomic formula units) showing the trend for NWA 6963 pyroxenes (black stars, 132 microprobe analyses) and for comparison Shergotty pyroxenes [1].



**Figure 4.** Or-Ab-An feldspar ternary, truncated at Or10, illustrating the compositional range of maskelynite in NWA 6963 (92 microprobe analyses).

All plagioclase in NWA 6963 has been transformed to maskelynite. Nonetheless, the maskelynite forms a tight compositional trend shown in figure 4, with average value of  $Or_{2.4\pm 0.8}Ab_{48.9\pm 3.4}An_{48.7\pm 3.9}$   $n=92$ , which is in agreement with maskelynite compositional trends seen in other shergottites [2].

**Oxygen Isotopes:** We performed oxygen isotopic analysis on NWA 6963 by laser fluorination at the UNM stable isotope laboratory. The sample was taken from the whole rock, ground to a fine grain-size, and acid-washed. Values obtained are respectively:  $\delta^{18}O=4.332$ ;  $\delta^{17}O=2.528$ ;  $\Delta^{17}O=+0.241$  (all per mil, assuming TFL slope=0.528). The precision on San Carlos olivine standard for  $\Delta^{17}O=\pm 0.03$  per mil. Figure 5 shows that NWA 6963 has oxygen isotope values that plot on the SNC fractionation array.



**Figure 5.** Oxygen isotope plot showing the values of NWA 6963 from this study (black star) compared to SNC meteorites (red circles) [3-6]. TFL=terrestrial fractionation line. (all values per mil)

**References:** [1] BVSP (Basaltic Volcanism Study Project) (1981) Basaltic Volcanism on the Terrestrial Planets. Pergamon, New York, 1286 p. [2] Papike J. J. et al. (2009) *GCA*, 73, 7443-7485. [3] Meteoritical Bulletin Database (2012). [4] Franchi I. A. et al. (1999) *MAPS* 34, 657-661. [5] Mars Meteorite Compendium (2011) Meyer C., NASA JSC. [6] Rumble D. III et al. (2009) 40<sup>th</sup> LPSC, Abstract #2293.