HIGHLY EVOLVED BASALTIC SHERGOTTITE NORTHWEST AFRICA 2800: A CLONE OF LOS ANGELES.

T. E. Bunch[1], A. J. Irving[2], J. H. Wittke[1] and S. M. Kuehner[2] [1]Dept. of Geology, Northern Arizona University, Flagstaff, AZ 86011, [2]Dept. of Earth & Space Sciences, University of Washington, Seattle, WA 98195.

A coarse grained, 686 gram Martian meteorite found in Algeria in 2007 has many close similarities to the Los Angeles highly evolved basaltic shergottite (and may even be a launch-pairing of that specimen).

Figure 1: Whole NWA 2800 stone, showing the coarse grainsize and wind-ablated partial fusion crust.

Petrology: This specimen is very coarse grained with an ophitic to mostly subophitic texture and preferred orientation of elongate grains (some up to 7 mm long - see Figure 2). It is composed mainly of maskelynite ($An_{55.5-72.3}Or_{0.6-3.8}$; non-stoichiometric) and clinopyroxene (augite $Fs_{26.3-69.1}Wo_{35.3-23.3}$, pigeonite $Fs_{38.7-60.1}Wo_{10.2-19.1}$, FeO/MnO = 33 - 41). Fine symplectitic intergrowths (Figures 2-4) of fayalite + silica + ferroaugite (after pyroxferroite [1]) are associated with larger grains of chlorapatite, merrillite, ulvöspinel, ilmenite with included pyrrhotite, silica needles and silica-rich glasses.

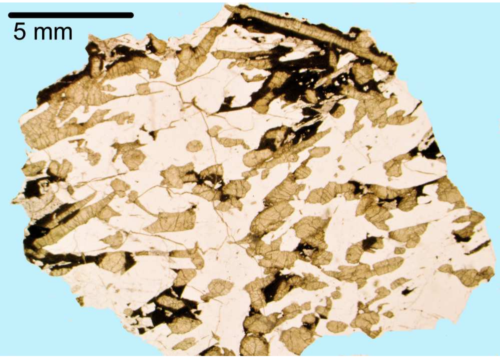


Figure 2: Plane-polarized light thin section image. Pigeonite (tan), maskelynite (clear), decomposed pyroxferroite and "chaotic" zones (black).

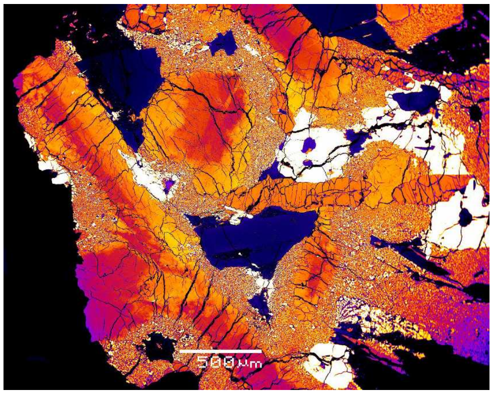


Figure 3: BSE image. Zoned pyroxene (magenta to yellow), maskelynite (blue), ulvöspinel (white), chlorapatite grain (dark orange, center). "Speckled" regions are mostly decomposed pyroxferroite (see Figure 4).

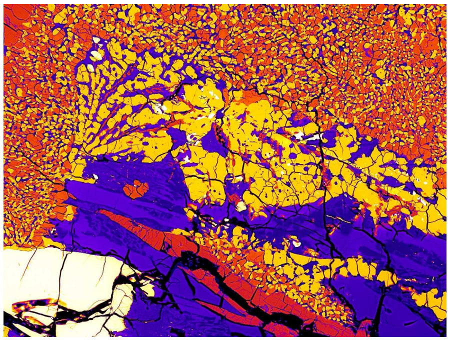
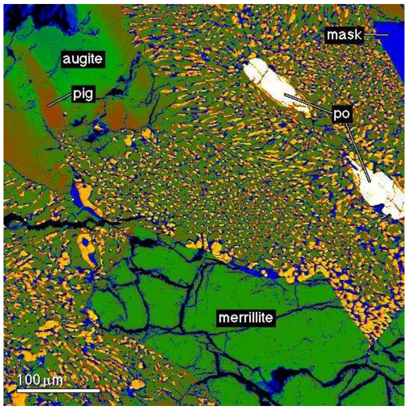


Figure 4: BSE images of symplectitic intergrowths. **A (above)**. Detail of part of Figure 3. Zoned pyroxene (magenta and orange), maskelynite and K-feldspars (indigo), silica and glass (dark blue), fayalite (yellow), ferroaugite (orange), ulvöspinel (white). **B (below).** Fayalite (yellow), ferroaugite (green), silica (blue).



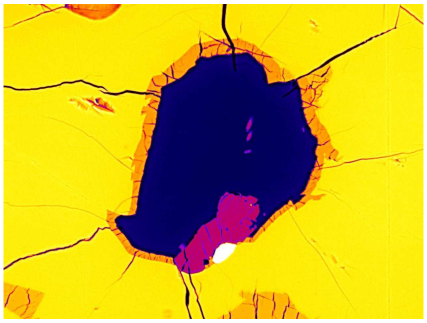


Figure 5: Melt inclusion (0.1 mm) within ulvöspinel (yellow) showing fayalite reaction rim (orange), glass (blue), chlorapatite (magenta) and pyrrhotite (white).

Interstitial pockets (“chaotic” zones) representing late stage residuum (which are contiguous with patches of decomposed pyroxferroite) consist of hopper and acicular crystals of K-feldspar ($Or_{59}Ab_{31}$), clusters of anhedral fayalite grains, solitary fayalite euhedra ($Fa_{89.3}$, CaO = 0.35 wt.%), silica crystals and graphic intergowths of silica and plagioclase ($An_{73.9}Or_{5.6}$) all set in an inhomogeneous glassy matrix.

A Clone of Los Angeles? In almost every textural and mineralogical aspect, NWA 2800 is identical to the two stones collectively named Los Angeles [2]. We thus infer that NWA 2800 is a highly evolved, “enriched” basaltic shergottite derived by prolonged fractional crystallization of more primitive magmas like NWA 1068 and NWA 4468 [3], and that Shergotty, Zagami and NWA 3171 [4] are intermediate samples in the liquid line of descent.

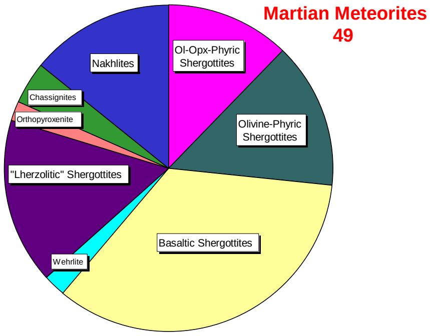


Figure 6: Pie chart of 49 known unpaired Martian meteorites. Basaltic shergottites are the most abundant petrologic type. Most such specimens are chemically “enriched”, but three (EETA 79001B, NWA 480/1460 and NWA 4480) are related to “lherzolitic” shergottites and one (QUE 94201) is related to depleted shergottites (namely, most of the olivine-opx-phyric and olivine-phyric examples).

NWA 2975 Strewnfield: Within the past year hundreds of mostly very small, complete stones paired with basaltic shergottite NWA 2975 [5] have been recovered and classified under many names. The total weight of material from this strewnfield (probably in Algeria) is at least 1.6 Kg. This occurrence is notable among recent shergottite falls, since it appears to record the uncommon atmospheric breakup of a Martian meteoroid. Among other Northwest African and Omani Martian meteorites, the only pairings that represent separate crusted stones are NWA 480/NWA 1460 [6] and the ten specimens paired with SaU 005. Other shergottites with multiple assigned names (e.g., NWA 1068, DaG 476) are individual fragments recovered from single sites, which most likely result from postfall dispersion by terrestrial processes.

Shergottite Launch Pairings: Although there now are a total of 49 Martian meteorites that do not seem to be terrestrially paired (see Figure 6), there may be no more than 8 launching impacts [7]. Other than NWA 2800 and Los Angeles, the possibility of launch pairings among certain other Martian meteorites is difficult to establish with certainty, even when cosmic ray exposure ages permit such an inference. For example, the olivine-orthopyroxene-phyric shergottites NWA 1195, NWA 2046, NWA 2626 and NWA 4527 [8] all could represent subsamples from the same depleted target site on Mars, and may be related also to DaG 476 and SaU 005 (and possibly even Yamato 980459). Although these specimens have a range of core compositions in their mafic silicates, they plausibly could have been related by differing magmatic cooling rates within a single igneous complex on Mars.

References: [1] Aramovich C. J. et al. (2002) *Amer. Mineral.* **87**, 1351-1359 [2] Rubin A. E. et al. (2000) *Geology* **28**, 1011-1014; Xirouchakis D. et al. (2002) *Geochim. Cosmochim. Acta* **66**, 1867-1880 [3] Barrat J.-A. et al. (2002) *Geochim. Cosmochim. Acta* **66**, 3505-3518; Irving A. J. et al. (2007) *Lunar Planet. Sci.* **XXXVIII**, #1526 [4] Irving A. J. et al. (2007) *Meteorit. Planet. Sci.*, in revision [5] Wittke J. H. et al. (2006) *Lunar Planet. Sci.* **XXXVII**, #1368 [6] Barrat J.-A. et al. (2002) *Meteorit. Planet. Sci.* **37**, 487-499; Irving A. J. and Kuehner S. M. (2003) *Lunar Planet. Sci.* **XXXIV**, #1503 [7] Nishiizumi K. and Caffee M. W. (2006) *Meteorit. Planet. Sci.* **41**, #5368 [8] Irving A. J. et al. (2002) *Meteorit. Planet. Sci.* **37**, A69; Irving et al. (2004) *Lunar Planet. Sci.* **XXXV**, #1444; Irving A. J. et al. (2005) *Lunar Planet. Sci.* **XXXVI**, #1229; *Meteorit. Bull.* **92**.

Acknowledgement: We thank Adam Aaronson for making this specimen available and for the image in Figure 1.