NEW UNIQUE PYROXENE PALLASITE: NORTHWEST AFRICA 10019

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Introduction: Pyroxene pallasites were originally defined by the grouplet of Vermillion and Yamato 8451 [1], which have minor amounts (~1-3 vol%) of pyroxene, with oxygen isotope values that are distinct from the pallasite main group (PMG) and the Eagle Station grouplet (PES). In the meantime, additional pyroxene-bearing pallasites, Zinder, NWA 1911, and Choteau, have been discovered [2,3], however each of these meteorites appears to be unique based on oxygen isotopes and mineralogy -- thus not belonging to the original pyroxene pallasite grouplet. Here we report on yet another unique ungrouped pyroxene pallasite, Northwest Africa 10019, which now brings the total of distinct pyroxene pallasite types – possibly all from different parent bodies – to a total of five.

History and Physical Chracteristics: NWA 10019 was purchased by Steve Arnold from Morocco in January 2015 and consisted of one 580 gram fusion crusted individual and 26 grams of several small fusion crusted pieces. Saw cuts and thin slices show angular orange-brown-green, translucent olivines (~50 vol%), the largest 28 mm long, with many smaller (0.5-5 mm) angular grains, some of which are darker colored orthopyroxenes (Fs15.4±0.2Wo1.0±0.2, Fe/Mn=23±1, n=6, ~10 vol %), all set in a matrix of taenite (Fe=72.0±4.0, Ni=27.4±2.4, Co=0.19±0.05 wt%, n=5, ~20 vol%) and kamacite (Fe=93.1±2.0, Ni=6.6±0.2, Co=0.61±0.03 wt%, n=4, ~15 vol %). Minor phases detected are troilite, chromite, and calcium-magnesium phosphates.

New, Unique Pyroxene Pallasite: NWA 10019 clearly possesses all the textural characteristics of a pallasite, however it has a unique set of charcteristics that are unlike any other pyroxene pallasite. For example, its oxygen isotope values of $\delta^{17}O$=1.669±0.120, $\delta^{18}O$=3.639±0.229, $\Delta^{17}O$=-0.252±0.017 (all permil, linearized, acid-washed material analyzed in 11 replicates by laser fluorination) are different from other pyroxene pallasites in that they overlap with the HEDs, mesosiderites, and PMG [4]. NWA 10019 also has olivine compositions (Fa16.8±0.2, Fe/Mn=35±2, n=7, EMPA) that are significantly elevated in fayalite content relative to PMG and are similar to olivines in Springwater (PMG-an). Furthermore, NWA 10019 is unique among all pallasites in that it is plagioclase-bearing (<1 vol%) (An75.9Ab23.1Or1.0).

Eight Distinct Pallasite Parent Bodies: Discovery of NWA 10019 brings the number of different pyroxene pallasite types to five. These combined with the PMG, PES, and Milton [5] would require a minimum of eight distinct parent bodies for the pallasite meteorites. This number could be larger still, considering there are 12 known PMG-an. It is interesting to note that discoveries of additional new pyroxene pallasites have not increased or consolidated the original pyroxene pallasite grouplet, rather we continue to see an emerging picture of pallasite diversity.

References: [1] Boesenberg J. S. et al., 1995. *Meteoritics*, 30: 488–489. [2] Bunch T. E. et al., 2005. Abstract #5219. 68th Annual Meteoritical Society Meeting. [3] Irving A. J. and Kuehner S. M., 2013. Choteau. Meteoritcal Bulletin 102. [4] Ziegler K. and Young E. D., 2011. Abstract #2414. 42nd Lunar & Planetary Science Conference. [5] Jones R. H. et al., 2003. Abstract #1683. 34th Lunar & Planetary Science Conference.