NWA 6601: INSIGHT INTO THE ORIGIN OF "PURE" IRON METAL IN EUCRITES

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Introduction: NWA 6601 is an equilibrated, brecciated, main series eucrite that is permeated with shock melt and possesses nearly pure Fe-metal grains. Here we explore the origin of "pure" Fe-metal in this new meteorite and implications for processes on eucrite parent body.

NWA 6601: This new eucrite consists of ~60% total pyroxene, low-Ca pyroxene (Fs61.2±0.9 Wo3.7±1.0 Fe/Mn=29±1), high-Ca pyroxene (Fs26.6±1.0 Wo44.5±0.8 Fe/Mn=30±2), and ~30% plagioclase ($Or_{0.5}Ab_{10.1}An_{89.4}$), with ubiquitous silica polymorph, Cr-spinel, ilmenite, troilite, and Fe-metal. Pyroxene shows exsolution lamellae and planar parting, fracturing, and microfaulting. Plagioclase often occurs as laths, some transitioning into impact melt pools or veins. Pyroxene and plagioclase grains are up to 500 microns in size and can appear texturally equilibrated, though some areas resemble fine grained cataclastite. Numerous impact melt veins and pools are present; some larger than 500 microns across, containing abundant silica grains, troilite crystallites and rafted basaltic clasts.

Fe-metal in NWA 6601: Fe-metal grains are conspicuous in NWA 6601 because of their relatively large size, uneven distribution, making up much less than 1% by volume. The Fe-metal occurs as distinct, equant or irregular clast-like grains, some up to 1 mm, found almost exclusively in cataclastic domains. The largest metal grain observed in our sample was bounded on all sides by plagioclase, though most are in multiphase contact. Troilite is commonly found nearby though rarely sharing a grain boundary with metal. None of the large metal grains occur in the impact melt veins or in the equilibrated domains of pyroxene and plagioclase. The metal is nearly pure iron, with Ni, Si, Mo below EMPA detection limits, low level of Co is detectable (~0.04 wt%).

Formation of "pure" Fe-metal in eucrites: Low-Ni metal (<1wt% Ni) is not uncommon in eucrites [e.g.:1,2], however its origin and formation may not be uniform in Vesta. In contrast to NWA 6601, Camel Donga possesses "pure" Fe-metal that is very fine grained (5-20µm), abundant (~2wt%), and finely dispersed in silicate crystals, and hypothesized to have formed by impact induced reduction of pyroxene facilitated through S_2 volatile loss by breakdown of troilite [3]. We also see evidence for impact related formation of "pure" iron metal in NWA 6601. However troilite consumption and S_2-loss does not seem to be consistent with the ubiquity of this phase in the impact melt veins and pools which are swamped with troilite crystallites, while troilite is nearly absent in texturally equilibrated domains. In NWA 6601, the large, "pure" metal grains and most of the associated troilite give the appearance of being intruded into the texturally equilibrated domain as part of the impact process, not as in situ melt or reduction products– simply because of the paucity of feedstock troilite in equilibrated domains. Future work to determine the trace concentration and distribution of Ni, Co, Mo, and other siderophile elements may help shed more light on the origin of "pure" Fe-metal in NWA 6601 and impact processes on Vesta.

References: [1] Seddiki, A. et al. 2007. Abstract #1049. 38th Lunar and Planetary Science Conference. [2] Wittmann et al. 2011. Abstract #1984. 42nd Lunar and Planetary Science Conference. [1] Palme, H. et al. 1988. *Meteoritics 23*, 49-57.