Fe-Ni METAL IN NWA 1814, THE 6TH BENCUBBIN-LIKE METEORITE: PROPERTIES AND ORIGIN.

C. Perron[1] and H. Leroux[2]. [1]Muséum National d'Histoire Naturelle, 75005 Paris, France. perron@mnhn.fr. [2]Université des Sciences et Techniques de Lille, 59655 Villeneuve d'Ascq, France.

Introduction: Bencubbin and its siblings are rare, metal-rich meteorites with intriguing properties. They have been ascribed a number of origins, especially for their metal constituents, from very primitive – condensation in the solar nebula – to highly processed – result of impact melting or vaporization. Here we describe the most recently found of these meteorites, NWA 1814 (total mass 156 g), with emphasis on the distinctive properties of its metal, and their implications for its possible origin.

Results: Overall, NWA 1814 is similar to Bencubbin, Weatherford and Gujba (BWG). It is made of large (several mm) clasts of Fe-Ni metal (about 60 vol %) and of barred to cryptocrystalline silicates. In between the clasts is a shock melted mixture of silicate and metal, with embedded silicate fragments. The metal clasts are roughly hemispheroidal, all with the same orientation, different from the ellipsoidal clasts of Gujba, and the more irregular clasts of Bencubbin and Weatherford. They are essentially made of kamacite (most with ~6 wt% Ni) containing varying amounts of P (0.2-0.3 wt%) and Cr (0.1-0.3 wt%). The metal clasts are polycrystalline, composed of large grains (100 to a few hundred µm in size), often looking warped, whose boundaries are highlighted by clusters of spongy, filamentous troilite. Compact, angular inclusions or rounded blebs of troilite, as are found in BWG, are extremely rare in NWA 1814. Subhedral crystals of daubréelite (1-10 µm across) are set in the troilite clusters, in which areas of tetrataenite (53 wt% Ni, up to ~50 µm in length) are also often observed. The Fe-Ni coarse grains themselves are in turn made of finer grains (typically 10 µm across), clearly products of recrystallization. The boundaries of these grains are often outlined by thin (0.5 µm in width), discontinuous ribbons of troilite, and by small grains of daubréelite or tetrataenite. Tiny inclusions of schreibersite and cohenite are also frequent.

Discussion: We interpret the microstructures of the NWA 1814 metal clasts as due to the rapid cooling of an S-poor metal-sulfide liquid, and their hemispheroidal shape as resulting from their fall, when they were hot and plastic spheres, onto a cooler planetary surface. Upon landing, the bottom part of the spheres became flat or even concave, depending on the shape of the surface beneath. The metal was quenched and the coarse grains became warped. The fine kamacite grains and their troilite ribbons probably formed at that time. Each hemispheroid had the time to harden before the next sphere fell upon it. If this hypothesis is correct, the Gujba metal globules were obviously much less plastic, i.e. less hot, when they landed. The NWA 1814 metal microstructures (coarse and fine grains) also exist in BWG, but the smaller grain sizes and the troilite morphology in NWA 1814 indicate faster quenching from high temperatures. Paradoxically, some observations (tetrataenite, daubréelite) also indicate that NWA 1814 remained at moderate temperatures (around 600°C) for a longer time than BWG. This may be due to a deeper burying after landing. Overall, we thus consider our observations consistent with an origin in an impact plume [1].

References: [1] Rubin A. E. et al;. 2003. *Geochimica et Cosmochimica Acta* 67:3283–3298.