Surviving Metal in Meteoritic Iron Oxide from The Wolf Creek, Western Australia, Meteorite Crater

REED KNOX, Jr.

444 Woodbine Avenue, Narberth, Pennsylvania

Abstract. Some very small particles of metal, revealed by polishing a chunk of Wolf Creek meteoritic iron oxide, appear to consist entirely of moderately shocked kamacite. The apparent lack of surviving taenite tentatively suggests that the Wolf Creek crater was formed by a hexahedrite, although medium octahedrites have recently been found within 4000 meters of the crater. Macrosegregation of nickel within the Wolf Creek meteoroid could account for the discrepancy. Further research on surviving metal is indicated.

A large number of meteoritic iron oxide masses was recovered from the Wolf Creek crater by a National Geographic Society expedition to Australia in 1963. The expedition was a joint undertaking by Brian Mason, then of the American Museum of Natural History, and E. P. Henderson of the Smithsonian Institution.

A 10 ounce chunk, which had been cut from one of the masses thought to have come from inside the rim of the crater, was kindly presented to me by Dr. Mason when I visited him in December, 1964. This sample was polished metallographically on two mutually perpendicular planes, and several very small particles of surviving metal were thus revealed. The largest of these is about 200 microns wide and 700 microns long, and this entire particle is shown in Figure 1 after etching in Nital.

The oxide matrix itself is highly magnetic; and the polished faces have, under some conditions of illumination, an appearance suggestiv of a "fossil" Widmanstätten structure. Although this has been reported by others in Wolf Creek material, I do not find the evidence for a surviving pattern very convincing in this specimen.

Besides the few very small metal grains, the polished oxide was

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FIGURE 1—A nickel-iron granule in Wolf Creek oxide. 75×.

found to contain a bright non-metallic inclusion about 2mm across and having the shape of a trapezoid. This inclusion is interlaced with oxide filled cracks and appears to be schreibersite.

The microstructure of the etched metal (Figure 2) is apparently that of kamacite shocked near the lower limit of the "moderate" (130-800 kb) shock range of Heymann et al (1966). Such evidence for moderate shock in the Wolf Creek meteorite is consistent with the shock effects observed by these authors in irons found near the rim of Barringer Crater; although most of the latter meteorites are heavily shocked, judging by their recrystallized microstructures.

It is curious that I found no surviving taenite, despite the suggestion of a relict Widmanstätten structure in the Wolf Creek iron oxide. Because of its higher nickel content, taenite is normally more resistant to corrosion than is kamacite; and the absence of the former seems to imply that the impacting body was a hexahedrite. However, LaPaz (1954) reported the presence of both metallic veins and irregular nickel-iron granules in a 324 pound mass of meteoritic oxide recovered at Wolf Creek by Cassidy (1954) just outside the southwestern rim of the crater. Although LaPaz did not etch the metal, it is possible that the veins he found are taenite.

FIGURE 2—Part of the granule shown in Figure 1. Note the shock figures in the kamacite. 750×.

The medium octahedrites containing 8.6% nickel related by Taylor (1965) to have been found 3900 meters southwest of the Wolf Creek crater may represent a more recent fall unrelated to the crater. A meteorite containing that much nickel should have many taenite lamellae, some of which, presumably, would have survived the weathering that produced the meteoritic oxide masses found in and near the crater.

On the other hand, the newly discovered Wolf Creek octahedrites may well have come from the fall that produced the crater. In that case, the lack of taenite in the mass I examined may simply indicate that macrosegregation of nickel had occurred in the Wolf Creek meteoroid, as has been indicated by Heymann (1964) for Canyon Diablo.

In view of the preceding considerations, I think it important to examine the microstructure of metal particles found by other investigators in Wolf Creek oxide, and to press a search for additional nickel-iron granules in oxide masses recovered from various locations relative to the crater. Metallographic and electron microprobe investigations of such surviving metal, and of other enduring meteoritic minerals, could shed much light on any structural and compositional differences that may have been present within the crater-forming body, as well as on those produced by the impact itself.

Similar investigations on the iron shale found at the recently described Monturaqui crater in northern Chile (Sanchez and Cassidy 1966) might be able to show a relationship between the crater and the meteorites found in the nearby Atacama Desert.

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