Cohenite in Chondrites: Further Support for a Shock-Heating Origin

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Introduction: The iron-nickel carbide cohenite [$(Fe,Ni)_3C$] is mainly known from iron meteorites but has been found also in some chondrites. It was suggested that cohenite formed in some chondrites by a process of shock-induced contact metamorphism involving heating by adjacent shock melts [1].

Methods: Two meteorite thin sections were chosen for investigation including NWA5964 (CML0175-4-3), an L3-6 chondrite known to have cohenite and containing a large shock melt region [1]. Another sample in which we identified cohenite was selected, Buck Mountain Wash (CML0236-3A), an H3-6 chondrite with a smaller shock melt region [2, 3].

We used reflected light optical microscopy to locate each cohenite grain in the thin sections to determine whether cohenite is spatially related to shock melt areas. SEM was used to confirm that the mineral identified as cohenite was not schreibersite, which appears nearly identical to cohenite in reflected light.

Results: Shock melt covers most of CML0175-4-3, and some of the adjacent unmelted chondrite host appears to be darkened. Over 50 occurrences of cohenite were found in the sample, located preferentially at the edge of the melt and excluded from the small areas where the host remained undarkened. One of the grains has been confirmed as cohenite using the SEM. The few cohenite-bearing metal grains within the melt region are in small transition zones, containing unmelted silicate and metal grains, some of which are directly in contact with shock melt containing igneously-zoned silicates. Some very coarse grains with dendritic intergrowths of metal and troilite are found in the melt. None of these appear to contain cohenite.

CML0236-3A displays a shock melt area that merges into a darkened area of the host. Cohenite was identified in 25 places, and four of these areas have been confirmed as cohenite using element analysis with the SEM. Notably, the only detections of cohenite were at the edges of the shock melt region and in the adjacent darkened material of the host. There is no cohenite in the undarkened host or shock melt. In both samples, the cohenite is typically found at the edges of metal grains.

Discussion: The locations of cohenite in both samples are clearly associated with the shock melt and associated shock-heated (darkened) host material. This is as expected if the cohenite formed due to contact metamorphism as a result of heating from nearby shock melt.

References:

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