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The metal grain size distribution in the NWA1878 mesosiderite

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Mesosiderites are brecciated meteorites consisting of ~50% silicate and ~50% metal. The silicate part is mostly basaltic and is considered to be derived from the crust of an igneously differentiated parent body. The metal part is generally considered to be derived from either a massive iron-meteorite-like projectile or from the core of the parent body. In the latter case, a large impact event disrupted the parent body and the silicate crust and the metallic core re-assembled to form the mesosiderite parent body. The metal composition is, however, chondritic which means, in the models described above, that the metal has to be molten (and homogeneous) when it was mixed with silicates. This is because many siderophile elements strongly fractionate during solidification as shown by the fractionated siderophile abundances in iron meteorites. NWA 1878 is a type B mesosiderite (which means it contains more pyroxene than plagioclase). To naked eyes, the metal grains appear small, granular and well size sorted, contrary to the expectation of derivation from massive liquid iron. If these observations are substantiated, then the provenance of metal may have to be completely reconsidered. Therefore, I obtained the size distribution of metal grains based on a scanning electron micro scope picture of a polished section. In spite of the granular appearance, the metal grains are somewhat sintered at the contact of two grains. This sintering is presumably due to slow cooling at low temperatures (~400C) which is well documented for mesosiderites in general and also for this mesosiderite in particular based on the metallographic features. Because of this sintering it is not possible to determine a unique size distribution. I have to use instinct and fit a spheroid to each (seemingly independent) grain. Then, a radius of a circle with the same area as a spheroid is calculated for each grain and the size distribution was obtained. The distribution is sharply peaked. The mean radius is ~120 micrometer and the standard deviation is ~36 micrometer. In spite of the ambiguity inherent to the way it was determined, the deviation is very small indicating that they are well size-sorted which may result from aerodynamic effects. The mean size is much smaller than that of chondrules and also that of metallic grains in chondrites.At present it is not known if such well size sorted, small grains could be produced from liquid metal by impact. It seems possible to consider that the metal is similar to the metals found in chondrites. This view is consistent with the chondritic siderophile abundances. Iron abundance systematics among chondrites (Urey-Craig diagram) suggests that some metal grains may have been lost from the L and LL chondrite forming regions. The missing metal grains could be the source of the metal in mesosiderites.

Keywords: size, metal, mesosiderite