SEM STUDY OF METAL GRAIN SURFACE IN ORDINARY CHONDRITES. I. PRIMARY SCULPTURES. V.P.Semenenko, B.V.Tertichnaya. Institute of Geochemistry, Mineralogy and Ore Formation. Ukr.A.S., Palladin 34, Kiev, 252142, Ukraine.

Surfaces of chondrules and mineral grains of chondrites may contain sculptural features that are direct imprints of cosmic events [1-8]. Formation of these features is either connected with physical-chemical properties of the mineral or with conditions of their interaction with environments. The surface of iron nickel particles in contrast to other minerals offers the best perspective for sculptural investigations due to plastic properties of their grains. SEM-study of metal grains allows us to get important information on very small samples (< few mg) of meteorites.

The sculpture of metal particles was studied in 13 ordinary chondrites with different shock history [1]. Metal grains are kamacite, rarely taenite, and have generally irregular and sometimes globular shape. Regular metal crystals were observed by Christophe Michel-Levy in the Sena (H4) chondrite [2]. Four types of surface of the irregular metal particles can be distinguished: smooth, polygonal-concave (Fig.1), lamellar (Fig.2) and fine-granular. Particles with smooth and polygonal-concave surfaces are shining and the other are mat. The latter is typical of intensively shocked grains. Polygonal-concave surfaces contain imprints of near-by grains and are observed in some metal particles from equilibrated chondrites.

Primary and secondary sculptures of the metal grains are defined according to their history before and after agglomeration of parent body. Most of the sculptural features are located on free surfaces of grains that were not in tight contact with other minerals. The sculpture caused by internal factors is developed as the result of slow cooling of the metal particles and may be connected with primary or secondary origin. There are inclusions, crystallographic elements (vicinals, growth steps) and voids. Occurence of mineral inclusions (usually chromite) (Fig. 3) on the grain surface is connected with their preferable formation on the mineral phase boundaries during slow cooling of the metal particles containing dissolved minor elements such as Cr, P, Cu, etc... Relatively slow growth of metal grains promoted the formation on their surface of more or less developed vicinals (Fig.4) or growth steps (Fig.5). The presence of small spherical voids ($\leq 1\mu m$) on the surface and inside the metal particles could indicate possibly some gas inclusions.

The primary sculptures caused by the external factors are sticked globules (Fig.6), microcraters (Fig. 7) and melt sparks (Fig.8). The same sculptures were also observed on chondrules surface [3-6,8]. Their formation could result from collision with solid particles at different velocities other before or during agglomeration. However, some could result of interaction with associated grains during shock metamorphism on the parent body. Features of the melt sparks distribution testify to different moistening of the metal grain surface caused by the various temperature and composition of melt drops.

CONCLUSIONS: 1. The presence of the same sculptural features on metal grains and chondrules surface of chondrites indicates their common history under conditions of intermixing and interaction with each other before or during agglomeration of parent body. 2. The presence of metal grains with polygonal-concave surface found only in equilibrated chondrites confirms their origin as high temperature agglomerates. They are not found in unequilibrated chondrites. 3. Conservation of some primary sculptures on the metal surface of equilibrated chondrites suggests, that heating was not high enough to anneal them during agglomeration or metamorphism of the parent body.

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