SPECIFICS OF THE COMPOSITION OF THE Fe,Ni-PHASE IN THE CHONDRULES OF CHONDRITES OF DIFFERENT CHEMICAL GROUPS. Lavrukhina A.K., Stakheeva S.A., Lavrentjeva Z.A., Ignatenko K.I; V.I.Vernadsky Institute of Geochem. and Analyt.Chem., USSR Academy of Sciences, Moscow.

In the present work we have studied M-chondrules and spherules of the Fe,Ni-phase in Kainsaz CO chondrite and compared their structures and compositions with those for other chondrites. The following main types of metallic chondrules have been identified.

Type I. M-chondrules consisting of polycrystalline kamacite, taenite and troilite. Chondrule a, oval in shape (Fig.1a) and ~140 μm in size, occurs in an isolated inclusion of the forsterite composition. High-Ni taenite in the form of separate inclusions: one in a troilite grain, another at the contact between metal and silicate. Sulfide associating with taenite is monocrystalline. Very fine chromite grains have been identified in the metal.

Type II. M-chondrules consisting of polycrystalline taenite and troilite with a small amount of kamacite. Chondrule b, ~200 μm in size (Fig.1b), consists of a metallic core and two shells: a sulfide one ~40 μm wide and an discontinuous metallic one. The chondrule occurs in a dark silicate matrix and has even edges. The chondrule core consists of high-Ni taenite of a slightly varying composition with a low Cr content. The sulfide shell consists of polycrystalline troilite and, possibly, mackinawite /deficit of S (33.1 mass %) and an increased Ni content (2.9mass %)/. Kamacite principally occurs on the periphery of the chondrule in the form of a small sharp inclusion in taenite.The chondrule is rich in chromite inclusions forming a thin discontinuous rim around the chondrule and separate larger grains occurring in taenite. Chromites consist of FeO and Cr_2O_3 practically without admixture of other elements. The larger part of the chondrule surface has a fine sulfide shell. Inside the chondrule there occur silicate inclusions with fairly high contents of CaO and P_2O_5 (3 mass %). Some inclusions correspond to whitlockite ($CaO/P_2O_5 \approx 1$), but have a high FeO content.

Type III. M-chondrules consisting of polycrystalline kamacite and troilite are most widespread. Chondrule c (Fig.1c) ~200 μm in size, occurs in a dark silicate matrix and has clear boundaries. Over the boundaries of kamacite and troilite grains there occurs a phosphorus-containing phase of a variable composition enriched in FeO. In all cases an increase in the SiO_2 and FeO contents is accompanied by a decrease of CaO and P_2O_5. The ratio $CaO/P_2O_5 \approx 1$ corresponds to whitlockite. Inclusions of fayalite and a phosphorus-containing phase were identified in kamacite. Discovered in this chondrule were kamacite grains with a very low content of Ni (~2.2 mass %) or Cr (~0.02 mass %). Other grains, on the contrary, are rich in Cr (up to 1.2 mass %).

Type IV. A unique concentrically-zonal chondrule-like metallic particle (Fig.1d). It consists of a metallic core

of a subhedral shape (cube faces are visible) of the taenite composition (Ni - 54.2 mass %), two sulfide shells and a metallic rim of the kamacite composition with a very low Co content (Ni - 4.7, Co - 0.04 mass %). High-Ni taenite is in association with troilite. The surface zone of the particle contains fine chromite crystals.

Comparison of the structures and compositions of the investigated M-chondrules and spherules of the Fe,Ni-phase in Kainsaz CO with similar literatury data /1-3, etc./ for other chondrites has enabled us to identify the relics of the following main processes: (1)an equilibrium condensation of metal under different P,T conditions; (2)fractionation of refractory and middle volatile elements; (3)evaporation and re-condensation of primary Fe,Ni particles; (4) partial oxidation and sulfurization of Fe,Ni,Co,Cr,P condensates under different fO_2 and O/S ratios; (5)partial decomposition of the products of these reactions down to metal; (6)reduction of dust-like Fe,Ni-particles in situ in olivine grains; (7)thermal metamorphism due to interaction with the gas phase and diffusion in a solid state under slow cooling at the rate of $1^{\circ}C/10^{3}$ years within $t \leq 500^{\circ}C$ range; (8)metasomatosis processes. The structure and morphology of M-chondrules point to eutectic metal-sulfide fusion and to their genesis in a single chondrule-forming process.

References. 1.Yabuki M., El Goresy A. Mem.Nat.Inst. Polar Res. Spec.Issue, N41, 1986, p.235. 2.Grossman L. In: Cosmochemistry of the Moon and Planets. M., Nauka, 1975, p.89, 3.Wlotzka F. Meteoritics, 1976, N11, p.393.

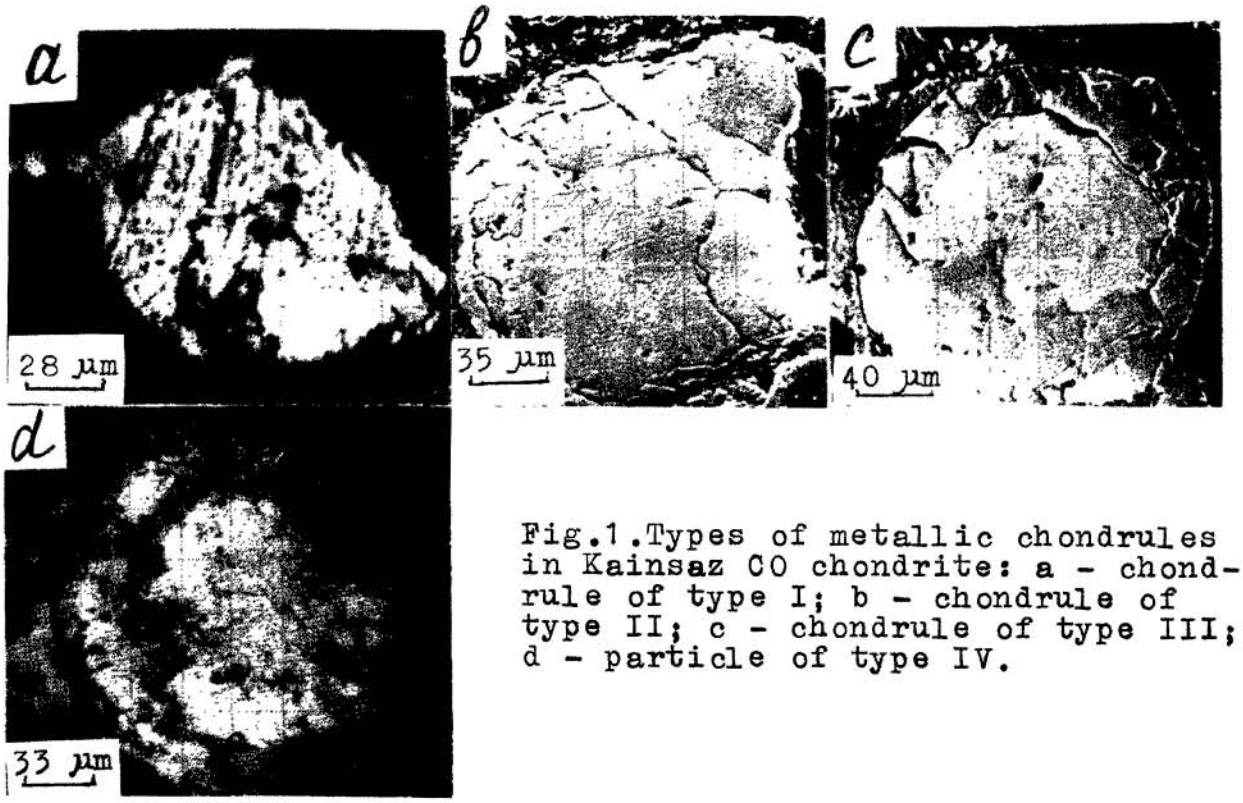

Fig.1.Types of metallic chondrules in Kainsaz CO chondrite: a - chondrule of type I; b - chondrule of type II; c - chondrule of type III; d - particle of type IV.