THE KAIDUN METEORITE: COMPOSITION AND ORIGIN OF THE LARGE METAL CHONDRULE A.V.Ivanov*, V.I.Grokhovsky**, N.N.Kononkova* *Vernadsky Institute of Geochemistry and Analytical Chemistry, USSR Acad.Sci., Moscow; **Kirov Urals Polytechnical Institute, Sverdlovsk; USSR

The large metal chondrule were found among Kaidun's small fragments [1, 2] formed during fall and transport. The shape of the chondrule is ellipsoidal with d = 8.8 mm and h = 6.7 mm, the weight is 2.00 g.

The texture of the chondrule is globular. It consists of metal globules with interstitial material of complex composition. The size of globules is 100-140 μm. The numerous troilite spherules with d up to 25 um are observed within the globules. The spherules are mostly concentrated in the central part of the globules. They usually contain tiny (<1 μm) metal droplets and are surrounded by thin (1-2 μm) light rims. Troilite is present also as a nonspherical inclusions at the globule boundaries.

The table shows compositions of the metal globules and troilite spherules and inclusions. The metal of the light rims and droplets is Ni-rich (>11 % wt.). The interstitions are compositionally heterogeneous and appear to consist mainly of oxide compound of Fe and S with minor Ni (1-10 % wt.) and Si (1-4 % wt.).

The shape and texture of the chondrule indicate full melting and rapid solidification of the material.The cooling rate of the material as estimated from the size of the metal globules [3] is 0.8-0.3^{o}C/sec. The high P content and its homogeneous distribution indicate high cooling rate not only during crystallization but in temperature below 800^{o}C also [4].

The texture of the chondrule is explained by nonequilibrium crystallization of Fe-Ni-S melt [5] that leads to formation of the metal globules and interstitions of complex composition. The formation of nonspherical inclusions of troilite is to be explained by inherited chemical inhomogeneity of melt (local S rich) and immiscibility of metal and sulphide liquids in the presence of minor Mn, P, Si. Spherules of troilite can be formed from S-rich liquid wich is a result of decreasing of solubility of S in γ-Fe,Ni during cooling from peritectic (~1300^{o}C) to eutectic (~980^{o}C) temperatures. The Ni-rich metal droplets and rims can be formed under eutectic crystallization of this liquid.

The precursor material of the chondrules upon consideration must be searched first of all among components of the polymict Kaidun meteorite. Increased contents of Si in kamasite and Cr in troilite point out one of enstatite chondrite components of the meteorite as the precursor. One should expect of the intensive redistribution of the elements during formation of this intensive remelted chondrules. The partial refinement of metal and concentration of Si in the interstitions must take place in this process. On the other hand, it is difficult to suggest any process of removal of Ni from metal. Therefore we think that the precursor material of the chondrule was the Kaidun III EH5 as its metal contains less Ni as compared with metal of the chondrule [1]. Some Ni-enrichment of metal of the chondrule is connected with dissolution of Ni-rich schreibersite in metal under melting.

The chondrule formation occured in the last accretional event of the Kaidun parent body history, namely, a collision between carbonaceous

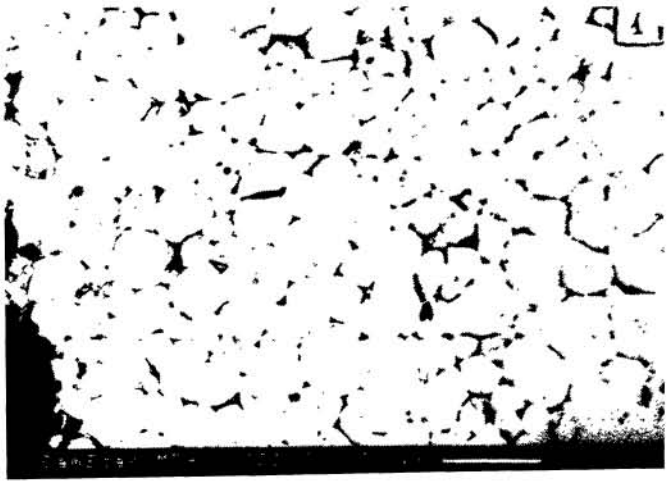
(Kaidun I+II) and enstatite (Kaidun III+IV) parent bodies [2]. Rather regular shape of the chondrule shows that its metal skeleton was formed in space. Cooling rate of the chondrule material indicate that final formation of texture of the chondrule took place in regolith of the Kaidun parent body.

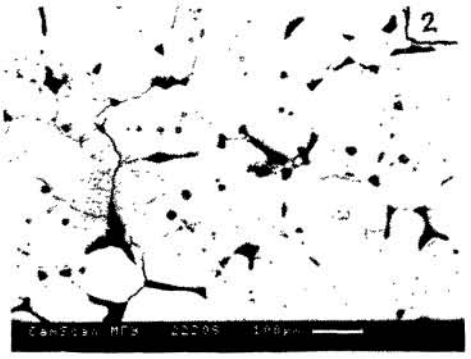
References:

[1] Ivanov A.V. et al. (1986) Meteoritika, N 45, p.3 (in Rus).
[2] Ivanov A.V. (1989) Geochem.Internat., v.26, N 9, p.84.
[3] Scott E.R.D. (1982) Geochim.Cosmochim.Acta, v.46, N 5,p.813.
[4] Narayan C., Goldstein J.I. (1985) Ibid., v.49, N 2, p.397.
[5] Fredriksson H., Stjerndahl J. (1977) Met.Trans., v.8A,p.1107

Chemical composition of kamasite and troilite, % wt.

	n		Fe	Ni	Co	Cr	Mn	S	P	Si
Kamacite	13	x	92.72	6.37	.42	.12	-	-	.47	.16
		SD	1.01	.16	.06				.05	
Troilite,	14	x	61.56	.96	-	1.84	.06	34.64	-	-
spherules		SD	1.92	.78		.16		2.27		
Troilite,	11	x	58.40	.57	-	2.78	.16	37.37	-	-
nonspheric.		SD	.99	.25		.65		.64		





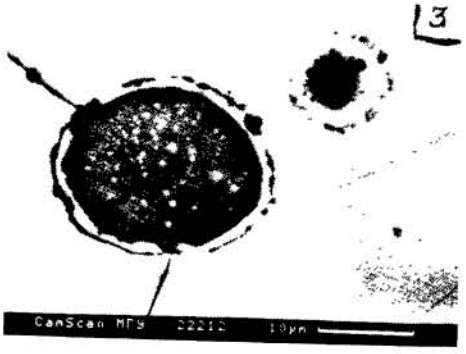


Fig.1. Overview of chondrule formation.
Fig.2. Section with troilite spherules and nonspherical inclusions.
Fig.3. Troilite spherules with Ni-rich droplets and rims.