MINERALOGY OF PHOSPHATE-SILICATE INCLUSIONS IN THE CHAUNSKIJ IRON

Zaslavskaya N.I., Petaev M.I., Kononkova N.N., Barsukova L.D. - Vernadsky Inst. Geochem. Analyt. Chem., USSR Acad. Sci., Moscow, USSR

Chaunskij iron (Ni 14.37, Co 0.53 and P 0.43 wt.%) displays band structure without clear Widmanstatten pattern on the polished surfaces. There are evidence of shock (deformation twins in troilite and ε-phase of kamacite) followed by relatively fast cooling resulted in disappearence of cloudy taenite zone. The meteorite contains about 10 vol.% of mono- and polymineral troilite-phosphate-silicate inclusions sizing from some microns to some cantimeters across.

Structure. Troilite and phosphate inclusions are usually rounded with smooth outlines. Silicate areas of the polymineral inclusions are as a rule angular but their boundaries are slightly smoothed. Silicate areas of large polymineral inclusions are usually surrounded by phosphate rims. Of these inclusions are of most interest the silicate and phosphate-silicate inclusions which mineralogy is quite different from other meteorites.

Mineralogy. The groundmass of a polymineral inclusion is a fine-grained intergrowth of pyroxene, cordierite, whitlockite and minor minerals with rare large (50-100 um) grains of pyroxene and whitlockite. Large grains of pyroxene have usually irregular or indented outlines. Minor minerals are SiO2, kamacite, taenite, troilite, chromite, ilmenite, rutile and rare grains of plagioclase. Chromite and ilmenite in the silicate assemblage are unhedral, but the chromite enclosed in troilite is usually euhedral. Many ilmenite grains contain exsolution lamellae of rutile and sometimes the rutile predominates in such grains. Rare grains of alabandite, native copper, stanfieldite and a mineral of graftonite-farringtonite series are also observed in the meteorite.

Mineral chemistry. Chemical compositions of major minerals are relatively uniform (Table 1) with minor variations in Mg/(Mg+Fe) ratio. In contrast, chromite and ilmenite display substantial variations in MgO, MnO and Al2O3 contents (Table 1).

Bulk chemistry and mineralogy. Fourteen 50x50 um areas containing no large grains were studied by DBA. Of these 14 analyses 5 ones were rejected based on high contents of S and Ni. The average of 9 analyses is listed in the Table 2. This composition cannot be considered as representative analysis because we have analyzed silicate-rich areas and the Ca and P contents are certainly lower than in the inclusion as a whole. Since the inclusion is composed of minerals varing considerably in densities Table 2 lists also the composition corrected for density differences. We didn't prefer anyone of these analyses because the validity of such correction is not clear. For example, uncorrected DBA compositions of the fine-grained CAI's are in good agreement with compositions calculated based on modal data [1]. Table 2 lists also normative mineralogy of the inclusion studied.

Proposed origin. Structural relations of silicates and metal evidence against simultaneous melting of these phases. Therefore, chemical and mineralogical data propose that the Chaunskij is a mixture of metal and metamorphozed silicate material which precursor might be basalt fragments enriched in Al2O3 and metal in comparision to other meteoritic basalts known. Considerable variations in the chromite and ilmenite chemistry suggest that basaltic fragments may represent a series of basaltic rocks. In such scenario, the phosphate-silicate assemblage may be considered as a resust of metamorphic reaction between a basalt and phosphorus dissolved in metal:

Px + An + P [ss in metal] + O --> Cord + Q + Whit,

taken place under moderate temperatures ($750^{o}C$ - $820^{o}C$) and relatively high

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(for meteorites!) pressures (3.5-5.0 kbars) [2] in the interior of the Chaunskij parent body. However, such simple scenario has some problems with explanation of details of inclusions mineralogy, but the mineral assemblage mentioned is certainly the result of high-pressure metamorphism taken place in the interior of relatively large parent body.

References: [1] Ulyanov A.A.et al. (1991) J.Analyt.Chem.(in Russ.), in press [2] Hess P.C. (1969) Contrib. Miner. Petrol., v.24, #3, 191

Table 1. Representative compositions of minerals(wt.%)

	Cord	Px	Pl	Whit	Stan	Graf
SiO2	50.89	54.39	48.56	-	-	-
TiO2	-	0.15	-	-	-	-
Al2O3	34.79	0.78	34.20	-	-	-
Cr2O3	-	0.08	0.31	-	-	-
FeO	3.15	18.76	0.36	1.18	8.24	17.17
MnO	0.08	0.56	-	0.48	3.36	1.05
NiO	-	-	-	-	-	0.25
MgO	3.74	25.77	-	3.35	18.19	31.67
CaO	0	0.16	17.12	46.99	23.21	0.04
Na2O	-	-	1.03	1.45	0.03	-
K2O	-	-	0.04	0.07	-	-
P2O5	-	-	-	46.35	46.55	50.04
Total	92.65	100.65	101.62	99.58	99.58	100.22

	Chromites			Ilmenites			Rutile
SiO2	0.03	-	0.21	-	-	-	-
TiO2	1.14	0.74	1.01	52.0	52.16	52.74	98.76
Al2O3	0.07	4.78	14.80	0.0	0.21	0.05	-
Cr2O3	64.23	56.95	48.50	0.08	0.10	0.01	0.02
V2O3	1.04	1.75	0.59	-	-	-	-
FeO	29.73	32.1	30.73	43.71	40.92	36.15	0.58
MnO	1.96	2.29	0.70	3.19	5.53	9.63	0.02
MgO	1.28	0.74	2.41	1.02	0.63	1.19	-
CaO	-	-	-	0.01	0.06	0.05	-
Total	99.48	99.42	98.95	100.01	99.61	99.82	99.38

Table 2. Bulk chemistry and mineralogy of inclusion

	$\overline{X}(\sigma)$,uncorr	corr	mineral	uncorr	corr
SiO2	52.76(2.57)	46.55	Cord	50.9	42.1
TiO2	0.30(0.21)	0.40	Opx	29.6	31.9
Al2O3	18.10(0.61)	14.36	SiO2	10.7	9.3
Cr2O3	0.23(0.12)	0.31	Pl	0.8	1.4
FeO	11.80(2.02)	19.76	Whit	4.6	4.5
MnO	0.29(0.04)	0.28	Metal	2.4	6.9
MgO	13.02(0.51)	12.34	Troil	1.9	2.8
CaO	2.58(1.10)	2.53	Ilm	0.6	0.8
Na2O	0.11(0.07)	0.11	Chr	0.4	0.5
K2O	0.03(0.01)	0.02			
P2O5	2.06(0.60)	2.04	Ratios	uncorr	corr
Ni	0.20(0.13)	0.47	Fe*/Si	0.226	0.344
S	0.69(0.26)	0.96	Mg/Si	0.226	0.344
Total	102.17	100.13	Al/Si	0.316	0.340
FeO*	7.80	9.65	Ca/Si	0.075	0.083
Fe(sul)	1.23	1.68	Mn/Fe	0.024	0.029
Fe(met)	2.24	6.16	Fe,tot/Si	0.371	0.704

* Calculated based on norms of metal, troilite and silicates