MICROPROBE ANALYSIS OF CHONDRITE YEFREMOVKA (C3): NEW DATA AND THEIR GENETIC INTERPRETATION

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In meteorite Yefremovka (C3) we distinguish two primary matrix-chondrule systems M1-(IV,V) and M2-(I-II) complicated by a secondary splintering of liquid chondrule substance (VI-III and others), fig.1. A correlation was established between composition of chondrules and their relevant matrixes (M1 and M2), for example(atomic percentage of metals and sulphur): MI (V) : Si 29.46(35.30), Ti(1.44), Al 1.96 (25.28), Fe 27.73(0.89), Ni 0.61(traces), Mg 34.99(7.47), Ca 3.65(28.91), Na (0.51), S 1.10(0.17), Cr 0.31 (traces); M2 (I): Si 33.08(38.60), Ti (0.18), Al 2.45(3.98), Fe 24.63 (4.0), Ni 0.8 (traces), Mg 32.69(48.58), Ca 2.92(3.98), Na 0.22(0.66), S 0.30(0.21), Cr 0.42(0.26).

Crystallization of matrix substance on the surface of chondrules began with the appearance of iron or troilite followed by olivine (fig.2). Alternatively, it began directly with olivine. The composition of olivine changed ranging on the outside from forsterite similar to chondrules forsterite to iron rich olivine typical of matrix. Proceeding from these correlations it is obvious that in the process of formation of chondrules as liquid drops in fluid matrix liquids there were equilibrium between them (forsterite of equal composition was crystallized from both liquids). Then the equilibrium was distorted due to the migration of hydrogen from the fluid matrix melt. As a result the oxidized state of fluids (H_2O/H_2) increased accompanied as it was by oxidizing of iron (Fe-FeO) and its entry into olivine composition. The oxidized matrix fluid melt was characterised by aggressiveness in respect of the chondrules sometimes scattered and cemented by the matrix substance which penetrates chondrules in the form of finest veinlets of iron rich olivine. Group V (fig.1) is represented exclusively by clastic `light reflectory inclusions`. Their original chondrule nature can be finded out from the presence of olivine rim fractions. Crystallization of these inclusions begins with forming crystals of melilite. In interstitions between crystals melilite forms simplectic aggregates with spinel and perovskite. Chondrules are heterogeneous as they disintegrate into melilite-spinel and melilite-perovskite aggregates matching the composition of chondrules III and VI (fig. 1). Therefore they can be regarded as affiliated chondrules which take shape as a result of secondary chondrule substance splintering. This effect sheds light on the genesis of chondrule-in-chondrule texture in chondrites which can be originated not only as the result of confluence of chondrule drops.

The most important breakthrough of our research team has to do with data on earlier formation of the M1-(IV,V) system which appears in the form of titanum-calcium chondrite cut

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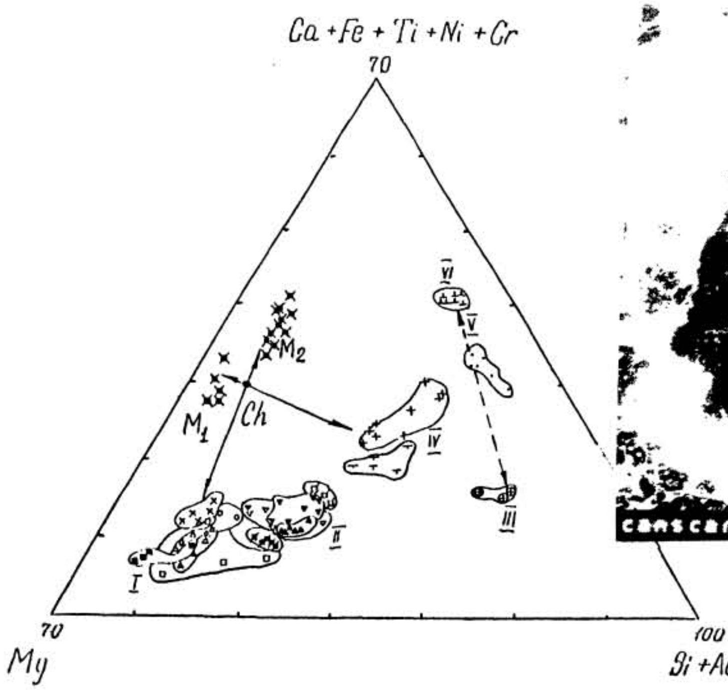
through by high-magnesium veinlets of chondrite M2 -(I,II). The late is similar to ordinary chondrites LL-L-H-F. In this chain it occupies the extreme position alongside of forsterite chondrites (F), e.g., in terms of Fe/(Fe+Mg) ratio in silicates of chondrules (indicated in brackets): LL(0.27) - L(0.24) - -H (0.18) - F,C3 (close to zero).This chain represents a consequtive increase in the chondrule formation reducing conditions which are connected with enrichment of chondrites by light oxygene isotope ^{16}O (relative to ^{17}O and ^{18}O) widely known from works of R.N.Clayton et.al. Oxygene compounds with unusually low degree of element oxidization (Al_2O , Ca_2O , etc.) originate in the extreme reducing environment of chondrite C3 formation. These compounds act as concentrators ^{16}O according to the exchange reactions shifted to the right: $Al_2{}^{16}O_3 + 3Al_2{}^{18}O = Al_2{}^{18}O_3 + 3Al_2{}^{16}O$; $Al_2{}^{16}O_3 + 3Al_2{}^{17}O = Al_2{}^{17}O_3 + 3Al_2{}^{16}O$; $Ca{}^{16}O + Ca_2{}^{18}O = Ca{}^{18}O + Ca_2{}^{16}O$; $Ca{}^{16}O + Ca_2{}^{17}O = Ca{}^{17}O + Ca_2{}^{16}O$, etc. Supposed existence of the unusual oxides (Al_2O , Ca_2O etc.) explains shortage of oxygen in structure of some minerals (spinel, fassaite, etc.) of C3 chondrites.

Fig. I. Petrochemical diagram of chondrite Yefremovka. M1 and M2 - composition of the matrixes which contain chondrules designated by arrows: high-magnesium (I,II) and calcium (IV,V). Affiliated chondrules indicated by auxiliary arrows: aluminium (III) and titanic (VI).

Fig.2. Chondrule II consisting of forsterite and pyroxene-anorthite simplectite crystals in interstitions surrounded by troilite (light-gray grains) and forsterite- -olivine rim.



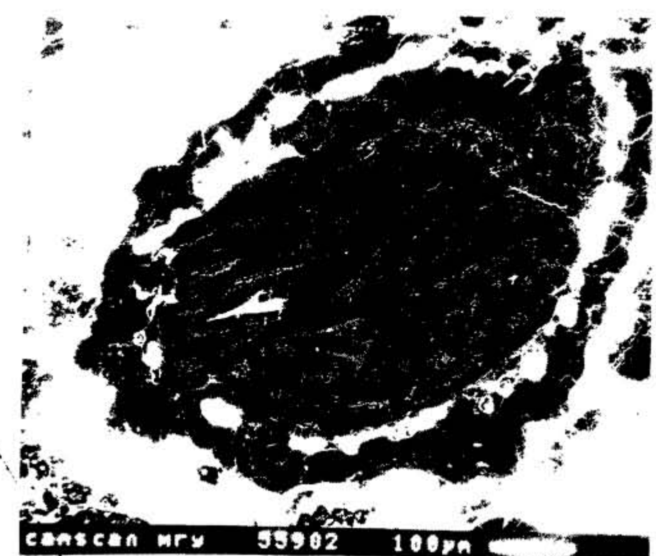


Fig. 2.

Fig. 1