ELEMENTAL AND PHASE COMPOSITION OF ORES OF NORILSK TYPE

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Elemental and phase composition of ore samples were studied using the methods of X-ray microscopy and Mössbauer microscopy. It was done for the purpose of revealing the distribution of ions Fe, Ni, Cu, Co, S. The elemental composition of the studied samples changes from one sample to another (Table 1).

There were revealed embedded crystals of $CuFeS_2$ and $(Fe,Ni)_9S_8$ in the pyrrhotite matrix. The Fe distribution of the whole scanned area was uniform. However, there are some 30–60 μm size sections which are highly enriched in Fe. Some inclusions, have rectangular and rhomboid forms (2–4 μm) containing Ni with increased content of Fe. The concentration of Ni has its maximum in inclusions, which contain Cu.

The spin magnetic moment changes the magnetic stability of the samples and Curie temperature, which changes with the replacement of magnetic ions of Fe with Co ions. The step-type thermomagnetic curves indicate the presence of a mechanical mixture, consisting of two or more ferromagnetic phases. It is proved by the discrepancy of Curie temperature in the cycle "heating–cooling". As it was shown by the studies, the presence of the impurity ions leads to changing magnetic properties. Its presence also leads to changing thermomagnetic properties of pyrites at $t > 350°C$ at the expense of high ion Co and S mobility.

The samples have a complex and varied diverse composition, which includes bornite, pentlandite, magnetite, hematite, pyrrhotite having the composition of Fe_7S_8. Wroewolfeite was detected in some samples.

In the synthesized samples of the system $FeS–Fe_7S_8$ after keeping them for 30 years at room temperature, there FeOOH was detected. In natural samples this phenomenon was not found.

Two sample groups have been established according to the Mössbauer spectra. The first group presents a superposition of two six-line spectra and single lines of paramagnetic states of the areas in the samples.

The position of absorption lines in the magnet-ordered areas show the presence of stoichiometric FeS and $CuFeS_2$. Some samples of this group have broadened lines, which testify the existence of different iron ion positions in sublattices.

For the other samples containing FeS and $CuFeS_2$ in the pyrrhotite matrix $Fe_{1-x}S_x$, the spectra are a superposition of insolved duplets, which testifies to the presence of paramagnetic areas.

The magnetic phase has a spectrum composed of two six-linear spectra. The peaks on the spectrum borders show the oxide presence.

The presence of native elements and the intermetallic compounds show a reducing mode of ore formation processes. The results of all the investigations are shown in the Table 2.

One can see that the given parameters vary in a wide range. It shows that the local electronic structure depends on the rock genesis. So, the presence of the character is the structures of the solid solutions decay, shows a wide temperature range of sulphide crystallization.

Table 1. Elemental composition of the samples.

Elements	Fe	Ni	Cu	S	Co
Maximum content (%)	50.0	5.0	25.0	36.0	0.4

Table 2. The parameters of hyperfine interactions.

Effective magnetic field, kA/m	Isomer shift, mm/sec	Quadrupole splitting, mm/sec
22.8–28.3	0.300–1.394	0.250–2.688