



The role of impurity ions in the formation of phase composition of Norilsk ore types

Anatoly Mashukov (1) and Alla Mashukova (2)

(1) Siberian Federal University, Russian Federation (avmashukov@sfu-kras.ru), (2) Siberian Federal University, Russian Federation (amashukova@sfu-kras.ru)

Using the methods of X-ray and Mössbauer spectroscopy, scanning electron microscopy, there were studied the samples of Norilsk ore types in order to identify compounds containing Cu and Ni.

Depending on elemental composition there were singled out two sample series. Maximum concentration in percentage of selected elements for this series is presented below.

1: Ni (0), Cu (0,42), S (11,2), O (20,2), H (0,02), Fe(46,8), Ca (5,85), Mg (1,75), K (0,47), Na (0).

2: Ni (4,93), Cu (0), S (14,9), O (27,1), H (0,11), Fe (28,1), Ca (14,9), Mg (0), K (0), Na (1,61).

The research conducted by using the method of scanning electron microscopy and the X-ray microanalysis showed that iron and sulfur are spread uniformly over the scanned area.

Sulfur is absent in the inclusions containing Fe and Ni. There are areas, sizes 8 – 120 microns, strongly enriched by Fe. The inclusions of rectangular and rhomboid shapes sizes 8 – 15 microns contain Ni as the content of Fe increases.

There were identified the inclusions having a high content of Cu, with a maximum concentration of Ni. The presence of native elements testifies to the reducing mode of ore formation processes.

The phases, containing Cu Ni, have a complex composition: pentlandite (FeNiS_2), chalcopyrite (CuFeS_2), bornite (Cu_5FeS_4), nickelhexahydrate ($\text{NiSO}_4 \cdot 6\text{H}_2\text{O}$), wroewolfeite ($\text{Cu}_4(\text{OH})_6(\text{SO}_4) \cdot 2\text{H}_2\text{O}$), pyrrhotine (Fe_7S_8), pyrite (FeS_2).

The position of the absorption lines in the magnetically ordered areas indicates the presence of stoichiometric FeS and CuFeS_2 . Some of the samples of this group have broadened lines, indicating the existence of various positions of the Fe ions in the sublattices.

The ingrowths of CuFeS_2 are characterized by the degree of the structure defectiveness, by various impurities, which is reflected in the studied parameters.

As regards the other sample series, containing FeS and CuFeS_2 in pyrrhotine matrix of $\text{Fe}_{1-x}\text{S}_x$, the spectra are the superposition of the unsolved doublet, which shows the presence of paramagnetic areas.

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

The isomer shifts of the samples range from 0 to 1.394 mm/s, quadrupole splitting ranges from 0 to 2.688 mm/s. This indicates that the local electronic structure depends on the genesis of compounds.

Thus, most of the bulk of Cu, Ni is not dissipated in the crystal lattices of the ore, but it is part of the ore sulphides. The presence of the characteristic structures of the solid solutions decomposition shows a wide temperature range of sulphide crystallization.