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The phase composition of ores of the Norilsk type with the content of copper, nickel and cobalt

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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 u, Ni, Co. Depending on elemental composition there were singled out the sample series, containing only copper (first series), nickel and cobalt (second series), only nickel (third series):
1: chalcopyrite (CuFeS2), cubanite I (CuFe2S3), cubanite II (CuFe2S3), bornite (CuFeS4), wroewolfeite (Cu4(OH)6(SO4) $\bullet H_2O$);
2: pentlandite (Fe1.68Ni1.82Co5.6S8) and (Fe4.40Ni4.57Co0.3S8);
3: nickel sulfide (Ni2.824S2), nickel-hexahydrite (NiS0.04($6H_2O$)).
The research conducted by using the method of scanning electron microscopy and the X-ray microanalysis showed that iron and sulfur are distributed unevenly over the scanned area. However, there are some areas highly enriched with Fe. Some inclusions, having rectangular and rhomboid forms, contain Ni with increased content of Fe. The concentration of Ni has maximum in inclusions, which contain Cu. The replacement of magnetic ions of Fe with Co ions with nearest values of spin magnetic moment changes the magnetic stability of the samples and Curie temperature. 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.
Sulfur is absent in the inclusions containing Fe and Ni. There are areas, strongly enriched by Fe.
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 0,3 to 1,394 mm / s, quadrupole splitting ranges from 0,25 to 2,468 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.