POLYTHERMAL SECTION OF SYSTEM Fe-FeS-NiS-Ni at Fe:Ni = 1:1

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Section Fe:Ni=1:1 is a key for understanding of phase diagram topology of the system Fe-FeS-NiS-Ni and the description of formation mechanisms of such minerals as monosulfide (mss) and pentlandite (pn) solid solutions, taenite γ-Fe,Ni (tn), and also heazlewoodite solid solution (hzss), undergoing subsolidus decay at cooling. According to work [1] this section is quasi-binary, and pentlandite exists in two forms: high-temperature (hpn) and low-temperature (pn). Updating hpn crystallizes from liquid, and then pn is formed from hpn as a result of the phase transition between 615 and 584°C. Such section contradicts isothermal section at 850°C, brought in the same work, and to sections at other temperatures constructed in [2-4]. Really, tie lines mss+hpn and hpn+L (in designations of work [1]) do not situate in the plane of section Fe:Ni = 1:1, therefore on a corresponding polythermal section should present two three-phase areas mss+hpn+L. Further, if a section is quasi-binary, liquidus surface should include quasi-binary eutectic point (L+hpn+tn) which is absent in all works with the description of the liquid-solid diagram of system Fe-FeS-NiS-Ni [5-8].

This section constructed earlier in work [2] isn't quasi-binary. Single-phase fields of hzss (between 876 and 675°C) and pentlandite (below 613°C) present in the section. Fields of stability heazlewoodite solid solution and pentlandite do not adjoin, so they are divided by a mss+hzss+tn three-phase region.

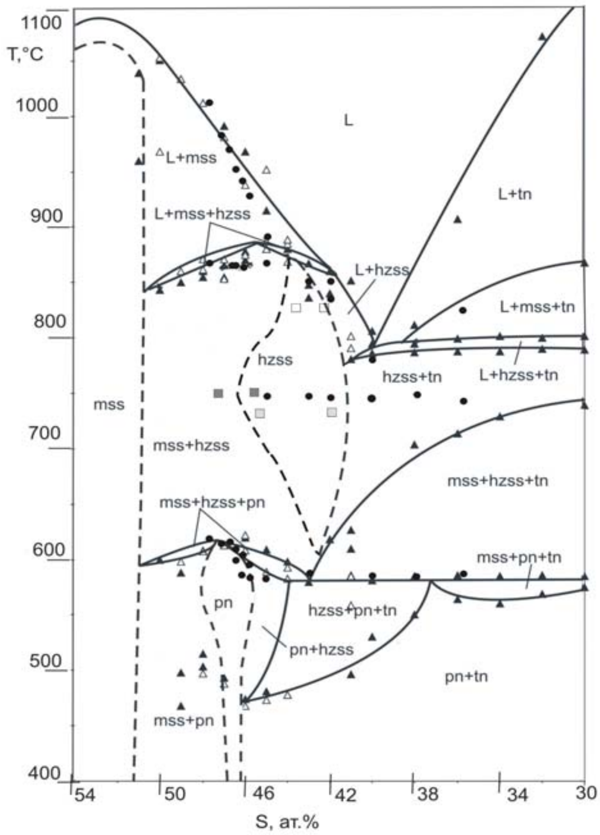

Fig.1. A polythermal section of the system Fe-FeS-NiS-Ni at Fe:Ni = 1. The close and open triangles designate own DTA data of the samples after annealing at 900 and 750°C accordingly; close circles show data from [1]. Open, shaded and close squares designate hzss composition from [2], [3] and [1] accordingly

The specified version of section Fe:Ni = 1:1 is built in the present work (figure). It constructed on the basis of the critical analysis and concordance of all published data concerning examined area of the phase diagram. We have shown that heazlewoodite solid solution is crystallized at cooling of the liquid, but pentlandite is formed by solid-state reaction. Fields of hzss and pn are divided by a narrow (10°C) interval. It is formed as a result of the phase reaction mss+hzss → pn+tn (T=584°C). For confirmation of that we studied the phase composition of three samples annealing at 635 and 575°C within 70 day. The samples contained 40, 34 and 32 at.% S and they were examined by X-ray, optical and electronic microscopy. Samples annealing at 635°C consisted from taenite, Fe-rich mss and fine-dispersed mixes of decay products of hzss. According to representations of work [1] microstructure of such samples should consist only of two phases tn and hpn. Samples, annealing at temperature 575°C, consist of a pn and tn mixture. Taenite is presented in the form of two generations - the faceted crystals up to 70 microns and grains near 10 microns distributed in a pn matrix in a view of apparently regular net. This fraction of tn is formed as a result of hzss decay. It allows assuming, that described samples belong to a field pn+tn+hzss, shown on fig.1. Under version [1] at this temperature the two-phase association (pn+tn) is stable, because of the sample with 40 aт. % S should be contain crystallite tn only one generation.

It is necessary to note, that we have not found out the thermal events at 746°C on DTA curves. They correspond to cotectic reaction of formation high-temperature pentlandite (hpn) and taenite from liquid in accordance with the data of [1].

The version of the section under discussion from [1] was used sometimes to description of mineral formation in the Fe-FeS-NiS-Ni system. More reliable data testify to formation from liquid heazlewoodite solid solution and pentlandite - as a result solid-phase process.

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