Fluid conditions of the formation of the veinlet-impregnated mineralization in the Zabolottia suite of the trap formation of the West Volyn (Ukraine)

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An analysis of fluid inclusions research in deposits of trap formation of the Lower Wendian of the West Volyn (Ukraine) (Naumko *et al.,* 2012) testifies that investigations of veinlet-impregnated mineralization as a direct indicator of migratory processes and products of healing of migration fractures (Svoren & Naumko, 2005), makes it possible to determine physical-chemical nature, spatial-temporal sequence of the manifestation and the changeability of indicators of parametric characteristics of fluids at post-magmatic phase and to reconstruct fluid conditions of mineral genesis in raw material deposits (Naumko, 2006).

We have used this approach for determination of temperature conditions and the composition of mineralizing fluids based on data of the studies of the mineral composition and investigations of fluid inclusions in analcimes and calcites from the veinlet-impregnated formations of the Zabolottia suite of the trap formation of the West Volyn.

The Zabolottia suite makes the beginning of the formation of the common section of the trap formations. The difference of the given basaltic formations is not important, from the point of view of the native copper mineralizations.

Nevertheless, investigation of this suite allows us not only to understand the reason of the absence of the mineralization in these rocks, but to explain the presence of native copper mineralization in other suites of the trap formation, to construct a genetic model of native copper mineralization, to proceed uniquely to the contouring of potentially ore-bearing fields and concrete prospecting areas.

According to X-ray analysis (analyst Ya. V. Yaremchuk), the veinlet-impregnated mineralization of the Zabolottia suite is represented by zeolites (analcime, chabasite, stilbite), that are concentrated mainly in amygdales, by quartz and calcite. In particular, in the section of the borehole 8265 from the basement to the cover one can observe the following picture: at a depth of 293.0 m (sam. 8265/20б) it was found quartz, chabasite, calcite, stilbite; at a depth of 284.0 m (sam. 8265/16б) – analcime, quartz, calcite; at a depth of 269.0 m (sam. 8265/8) and 255.0 m (sam. 8265/1) – analcime.

According to data of thermometric analysis it was possible to reveal conditionally-primary and secondary inclusions. By phase composition these are two-phase gase-liquid and liquid-gaseous, with significant predominance of gas-liquid inclusions. The highest temperature of homogenization of fluid inclusions fixed in analcime is 280ºC (by conditionally-primary inclusions). The majority of inclusions are homogenized at the temperature intervals of 190–200±5°C and several inclusions were homogenized at temperature of 215–230°C. Very often one can observe phenomena of unlacing and refilling of inclusions, however, because of the fear of cracking during the lab test, repeated thermometric analyses were performed. Analcime is more earlier formation of veinlet-impregnated mineralization in comparison to calcite.

In calcite, gas-liquid inclusions are predominant and their size ranges from 0.1–0.01 mm. In most cases one can observe inclusions of a regular shape, which are concentrated in minerals as individual groups. These are mainly long quadrangles and negative crystals with well-developed faceted surfaces-primary fluid inclusions homogenization of which occurs at temperature of 70±5°C into liquid phase. Secondary gas-liquid inclusions are found as families in the healed fractures, the temperature of homogenization of which is 70±5°C into liquid phase. The presence of sufficient quantity of primary fluid inclusions testifies to calm conditions of the calcite forming.

The composition of volatile of fluid inclusions in minerals and close pores according to data of mass-spectrometry analysis, the relationship between nitrogen and carbon dioxide is defined (analyst B.Ye. Sakhno). Similarly to results obtained earlier for basalts of the Luchychi stratum (Naumko *et al.,* 2013), in most samples of the Zabolottia suite, nitrogen is considerably prevailing, too. Nitrogen content ranges from 36.6 to 90.7 vol. %, and for zeolites from veinlet-impregnated mineralization for the given suite – within the limits of 92.4–96.7 vol. %. Sometimes gas saturation is within the bounds of threshold sensitivity of the instrument.

In paper (Govtulja *et al.,* 1980) it is indicated on the increased content of N_2 composition of volatile in rhombic and monoclinic pyroxene as well as in plagioclase from andesite of the volcanic area of Sheveluch. Because plagioclase and pyroxene are minerals of early-magmatic origin, it can be supposed that during mineral formation a high-temperature early-magmatic fluid was acting. Nitrogen content (up to 100 vol.%) in zeolites may be explained by the special features of the structure which can be imagined as a kind of caverns of molecular size where nitrogen penetrates.

Therefore, fluidal environment of the mineral crystallization was in the state of two-phase equilibrium caused by heterogeneity of the mineral-forming fluid. Inclusions of heterogeneous origin testify to that. The availability of the families of uneven filling and manifestation of phenomena of unlacing and refilling of inclusions also indicate instability of the minerogenetic environment. Small depths of occurrence of the rock complexes contributed to this.

It is evident that forming and developement of ore-generating system as the part of melt physicochemical system needs near-intrusive conditions. This suite do not reaches such conditions because of small thickness of flood and substantive gas saturation. This is the reason of low copper content in Zabolottia suite.

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