

THE OCCURRENCE AND DISTRIBUTION FEATURES OF BISMUTH IN NEOGENE VOLCANITES OF SLOVAKIAN AND UKRAINIAN CARPATHIANS

JELEŇ, S.^{1*}, PONOMARENKO, O.², MIKUŠ, T.¹, SKAKUN, L.³, BONDARENKO, S.², GRINCHENKO, O.⁴ & PRŠEK, J.⁵

¹ Geological Institute of Slovak Academy of Sciences, Ďumbierska 1, 974 11 Banská Bystrica, Slovakia

² Institute of Geochemistry, Mineralogy and Ore Formation, NAS of Ukraine, Palladina av. 34, 03680 Kiev-142, Ukraine

³ Geological Faculty of Ivan Franko National University of L'viv, Hrushevskogo str. 4, 79005 L'viv, Ukraine

⁴ Geological Faculty of Kiev National Taras Shevchenko University, Str. Vasyl'kivska 90, 03022 Kiev, Ukraine

⁵ Department of Economic Geology, Faculty of Geology, Geophysics and Environmental Protection, AGH – University of Science and Technology, al. Mickiewicza 30, 30-059 Kraków, Poland

* E-mail: jelen@savbb.sk

General review of regional mineralogical-geochemical data on bismuth of neovolcanites of the Ukrainian and Slovakian Carpathians show some features of its distribution and typical mineralogical forms of its occurrence. As a whole regional geochemistry bismuth is characterized by its ununiform distribution, from wide dispersion in sedimentary and volcanic rocks to high concentration found in products of metasomatic alteration of these volcanites.

Two stages of bismuth mineralization, which are closely coeval with hydrothermal activity associated with Miocene (Sarmatian) and Pliocene volcanic stages, are established. Mineralization of the first stage is mostly occurred in internal zone of Inner Carpathian volcanic belt (Beregove, Prešov, Middle Slovakian focus structures), and the second one is found confined to the external zone, namely Vyghorlat-Ghutin ridge. Each stage is characterised by the set of bismuth minerals and different intensity of mineralization processes.

Hydrothermal deposits of Sarmatian age (Beregove and Banská Štiavnica-Hodruša ore fields) might be related to epithermal-copper-porphyric and epithermal precious- and base-metal vein type. Sulphosalts association of Ag-Cu-Bi system is localized in copper ores, at sites of superposition of quartz-chalcopyrite mineralization on much earlier galena-bearing aggregates. It is formed from neutral solutions that is manifested by the stability of adularia-carbonate-sericite association. Reactional nature of Ag-Cu-Bi-S sulphosalts is proved by wide development of symplectites (KOVALENKER *et al.*, 1993). The composition of sulphosalts naturally changes with increasement of chalcopyrite contents in aggregates, forming sequence: (1) matildite-galena solid solution that replaces galena; (2) minerals ranging in composition from ourayite-mummeite to gustavite-lillianite series; (3) sulphosalt series from Ag-Cu-Bi-Pb (pavonite homologues) to Cu-Bi and Cu-Bi-Pb (cuprobismutite homologues) and emplectite as well as bismuthinite derivatives in Banská Štiavnica (JELEŇ *et al.*, 2009) and gladite-krupkaite in Beregove. Bismuthinite was found only in massive chalcopyrite aggregates (Beregove, Hodruša-Hámre). Gold occurs in association with chalcopyrite that is caused (in ore bodies of

Beregove) by formation of Ag-Cu sulphosalts in front of distribution of solutions of Cu-Au stage, with gold being found in rear part.

Volcanic formations of Pliocene age of the Vyghorlat-Ghutin ridge are represented by the chains of late Pannonian-Levantian volcanic centres, which form complex polygene domal-focus structures (Vyghorlat, Latovka, Borzhava, Ghutin). Hydrothermal systems of this age form fields of metasomatic rocks related to argillaceous and greisen types. The most wide area of these rock distribution are known in Perechin, Dubrini-chi, Kibliary, Ilkovtsy, tract Podulki, river Syniak, tract Smerekov Kamin', mountains Dehmaniv and Tolsty Verh (in Ukraine) and in Poruba pod Vihorlatom and Remetské Hámre (in Slovakia). Metasomatic rocks show the development of Bi-Te-S-Se mineral associations. The tellurium content may reach 4 wt%, that is found in some pseudo-breccias.

Tellurides and sulphotellurides show the presence of groups with different values of Bi/(Te + Se + S) ratios, 2:2, 2:3, 3:2, 4:3 and 8:5. Bismuth-bearing associations include following minerals: native bismuth, hedleyite (Bi₇Te₃), tsumoite (BiTe), pilsenite (Bi₄Te₃), joséite-A (Bi₄TeS₂), joséite-B (Bi₄Te₂S), tetradymite (Bi₂Te₂S), phase on structure to Bi₂Te and Bi₃Te₂ (MELNIKOV *et al.*, 2009), telluronevskite (Bi₃TeSe₂), vihorlatite [Bi_{8+x}(Se, Te, S)_{11-x}], ikonolite (Bi₄S₃). Secondary bismuth minerals are represented by montanite and some other oxides. Some phases of tellurides need more detailed investigation to be properly established. It is also found, that selenium essentially increases in mineralization processes in Slovakian area of the Vyghorlat-Ghutin zone (MELNIKOV *et al.*, 2009).

References

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