

UNUSUAL IKUNOLITE FROM NAGYBÖRZSÖNY ORE DEPOSIT, BÖRZSÖNY MTS., HUNGARY

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The famous Nagybörzsöny ore deposit, Börzsöny Mts., Hungary, is hosted by Miocene calc-alkaline volcanic rocks and occurs as a stockwork in a dacite breccia pipe (NAGY, 2002). It is the type locality of pilsenite and jonassonite. The mineralization is multi-stage, from mesothermal to epithermal: Cu-Fe-(Au-Mo); Zn-Pb-Cu; Bi-Pb-As-W-(Au-Ag-Te); Zn-Pb-Ag-(Cu-Sb); Au-Ag. Ikunolite-containing ores were found in the Alsó- and Felső-Rózsa adits, Rózsa Hill. The ikunolite assemblage belongs to the third stage of mineralization. In this stage the main sulphides are bismuthinite and arsenopyrite, accompanying minerals are native bismuth, pyrite, marcasite, ferberite, hübnerite, gold, jonassonite, Bi-Pb-(Ag) sulphosalts (cosalite, lillianite, cannizzarite, pavonite, gustavite) and rare Bi-Te-sulphides (joséite-A, ingodite). Ikunolite, $\text{Bi}_4(\text{S},\text{Se})_3$, occurs together with arsenopyrite and bismuthinite in quartz veinlets. It forms well-developed plates and foliated masses up to 3–4 cm in size. Accompanying bismuth sulphides may alter to cannonite and other secondary minerals. The lamellae of ikunolite are lead grey in color, black in streak color. It has perfect cleavage parallel to $\{0001\}$.

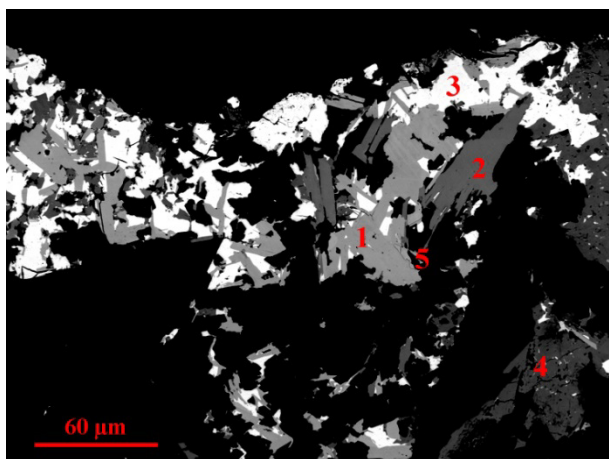


Fig. 1. Typical assemblage of ikunolite from Nagybörzsöny (Se-zoning of ikunolite). 1 = ikunolite, 2 = lillianite, 3 = bismuth, 4 = bismuthinite, 5 = electrum (BSE image, 15kV, 20nA).

Ikunolite was identified by X-ray powder diffraction and electron-microprobe analyses. X-ray powder diffraction was performed on a Bruker D8 Advance diffractometer ($\text{CuK}\alpha_{1-2}$, 40 kV and 40 mA) in parallel-beam geometry (Goebel mirror 2) with 0.12° long-Soller on detector side. The careful sample preparation resulted in pure ikunolite specimens, with reduced preferred orientation. Variations in peak positions were observed, the main peaks for 3 specimens [hkl : $d_1/d_2/d_3$ (d_{calc}) \AA]: 107: 3.024/3.027/3.029 (3.024); 0.1.14: 2.214/2.216/2.215 (2.208); 015: 3.272/3.269/3.280 (3.267); 110: 2.071/2.073/2.074 (2.075). Ikunolite is trigonal, space group $R\bar{3}m$. The cell parameters measured for the three specimens: (1) $a = 4.149 \text{ \AA}$, $c = 39.261 \text{ \AA}$, $V = 585.34 \text{ \AA}^3$; (2) $a = 4.143 \text{ \AA}$, $c = 39.449 \text{ \AA}$, $V = 586.44 \text{ \AA}^3$; (3) $a = 4.149 \text{ \AA}$, $c = 39.397 \text{ \AA}$, $V = 587.39 \text{ \AA}^3$.

Wavelength dispersive microprobe analyses show a wide variability of the chemical composition of ikunolite. Results of our analyses document a continuous range of Se-for-S substitution. According to selenium content, the two observed end types of ikunolites are: first type contains up to ca. 1–2 wt% Se, while the second type contains up to ca. 9 wt% Se. The latter data may indicate a continuous solid-solution series with litaikarite, $\text{Bi}_4(\text{Se},\text{S})_3$. Similar ikunolite was mentioned from Rędziny, Poland (PARAFINIUK *et al.*, 2011). Most ikunolite compositions reveal substantial amounts of Pb substituting for Bi, in the range 0.15–0.44 *apfu*. The lead can substitute bismuth in the structure (MARKHAM, 1962). The tellurium content is up to ca. 0.3 wt%. The chemical formulae of the two Se-end types are the following (average of 5 and 3 analyses): $(\text{Bi}_{3.71}\text{Pb}_{0.26})_{\Sigma 3.97}(\text{S}_{2.86}\text{Se}_{0.14})_{\Sigma 3}$ and $(\text{Bi}_{3.40}\text{Pb}_{0.44})_{\Sigma 3.84}(\text{S}_{2.34}\text{Se}_{0.66})_{\Sigma 3}$.

References

- MARKHAM, N.L. (1962): American Mineralogist, 47: 1431–1434.
 NAGY, B. (2002): Földtani Közlöny, 132: 401–422.
 PARAFINIUK, J., PIECZKA, A. & GOŁĘBIEWSKA, B. (2008): Canadian Mineralogist, 49: 1305–1315.