

MINERALS OF TURQUOISE GROUP FROM SÂNDOMINIC, GURGHU MTS., ROMANIA AND FROM PARÁDFÜRDŐ, MÁTRA MTS., HUNGARY

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1) The Sândominic occurrence (Dorma Hill) is located in the southern termination of Gurghiu Mts, Eastern Carpathians, Romania, in the vicinity (~5 km from Fagul Cetății deposit) of the Bălan copper ore mineralization. The site is located on the contact of the Rebra metamorphic limestones and Tulgheș Lithogroup. Turquoise (Fig. 1) was found as incrustations in a highly fractured and oxidized, quartz dominated part of a miolitic rock. In the cracks and voids of quartz it is associated with goethite, occasionally with mm-size euhedral quartz. Here the meteoric fluids permeated the metamorphic rocks creating oxidizing environment, where turquoise formed of supergene origin. The pale blue or pale greenish blue mamillary form crusts (up to 0.2 mm thickness), according to the BSE images, consist of globular aggregates up to 5–10 μm in diameter. The samples are of poor crystallinity, according to X-ray powder diffraction (XRD; $\text{CuK}\alpha_1$). The main observed peaks were 6.193 Å, 4.791 Å, 3.682 Å, 3.427 Å, 3.279 Å and 2.905 Å, which correspond to the (011), ($\bar{1}$ 01), ($\bar{1}$ $\bar{1}$ 1), (210), (200) and (123) peaks of ferroan turquoise (ICDD 00-025-0260). According to wavelength dispersive microprobe measurements (WDX) the crusts are chemically homogenous. The empirical formula (water calculated from the difference) is $(\text{Cu}_{0.58}\text{Fe}_{0.37}\text{Ba}_{0.06}\text{Zn}_{0.04})\text{Al}_{5.94}(\text{PO}_4)_4(\text{OH})_{7.92} \cdot 4.45\text{H}_2\text{O}$. The B-site of the structure contains Al, the A-site is fully occupied by Cu and Fe^{2+} . (The measured data in wt%: Al_2O_3 33.05, P_2O_5 32.86, Fe_2O_3 3.60, CuO 5.63, ZnO 0.37, BaO 1.13, H_2O 23.35.)

2) At the Parádfürdő polymetallic ore deposit, Mátra Mts., Hungary the main sulphides are chalcopyrite, sphalerite and tetrahedrite/tennantite. Here the turquoise group mineral is of late-stage hydrothermal origin, it occurs in the cavities of quartz veinlets and is associated with quartz, barite, variscite, wavellite, jarosite and illite. The source of the hydrothermal fluids was likely meteoric water that was heated up during interaction

with the sulphide-rich plutons at depth. This interaction with Cu-Zn-Fe-rich sulphides produced acidic fluids with leached out ions (Cu-Zn-Fe), which were necessary to form turquoise group minerals. The source of phosphorus could be the hydrothermally altered rock-forming apatite. Here the turquoise mineral (Fig. 1) is a solid solution of aheylite $(\text{Fe}^{2+}, \text{Zn})\text{Al}_6(\text{PO}_4)_4(\text{OH})_8 \cdot 4\text{H}_2\text{O}$, faustite $(\text{Zn}, \text{Cu})\text{Al}_6(\text{PO}_4)_4(\text{OH})_8 \cdot 4\text{H}_2\text{O}$ and planerite $\square\text{Al}_6(\text{PO}_4)_2(\text{PO}_3\text{OH})_2(\text{OH})_8 \cdot 4\text{H}_2\text{O}$. Similar situation was already observed elsewhere (FOORD & TAGGERT, 1998). The mineral appears as pale yellowish brown hemispheres, up to 0.5 mm in diameter. The inner part of the spheres is massive, while the rim is formed of porous aggregates of crystals (up to 1–2 μm in size). These hemispheres build up loose aggregates (up to 1–2 cm in size). Good quality XRD patterns ($\text{CuK}\alpha_1$) gave peaks at 6.773 Å, 3.088 Å and 2.931 Å which correspond to the (001), (0 $\bar{2}$ 2) and ($\bar{1}$ 12) peaks of planerite (ICDD 00-050-1654). Aheylite was also identified by the reflections 4.802 Å, 2.057 Å and 2.014 Å representing the ($\bar{1}$ 10), (231) and (202) *hkl* planes (ICDD 00-050-1653). The strongest peaks are overlapping at 6.185 Å, 3.690 Å and 3.436 Å. The hemispheres, both their inner part and their rim, are chemically homogenous. The empirical formula is $(\text{Zn}_{0.21}\text{Fe}_{0.18}\text{Cu}_{0.11})\text{Al}_{5.91}(\text{PO}_4)_4(\text{OH})_{6.73} \cdot 5.07\text{H}_2\text{O}$. The B-site is occupied by Al, however, the A-site is only half-occupied by $\text{Zn} \approx \text{Fe}^{2+} > \text{Cu}$ cations, thus the mineral is between aheylite, faustite and planerite. [The measured WDX data in wt%: Al_2O_3 38.51, P_2O_5 36.27, FeO 1.65, CuO 1.14, ZnO 2.20, H_2O 22.23 (calculated from difference)]. Seemingly this is a complicated, but characteristic solid solution in the turquoise group.

Reference

FOORD, E.E. & TAGGERT, J.E., Jr. (1998): Mineralogical Magazine, 62: 93–110.

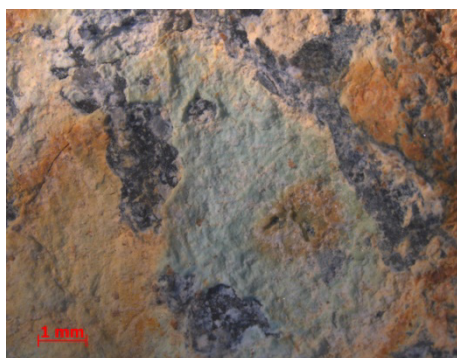


Fig. 1. Light green crust of turquoise from Sândominic, Romania (left) and yellowish brown hemispheres of aheylite-planerite from Parádfürdő, Hungary.