

Ordered distribution of Au and Ag in the crystal structure of muthmannite, AuAgTe₂, a rare telluride from Sacarîmb, western Romania

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ABSTRACT

Muthmannite, AuAgTe₂, a rare gold-silver telluride was discovered in a sample from the historical mineralogical collection of the Naturhistorisches Museum of Vienna. The sample is from the gold-telluride deposit of Sacarîmb, Metaliferi Mountains, western Romania. Muthmannite occurs as anhedral grains up to 200 µm associated with large sylvanite crystals and does not show any inclusions or intergrowths of other minerals. The associated minerals are sylvanite, calaverite, and petzite, whereas the gangue mineral is quartz. Muthmannite is pale bronze in color and shows a gray-black streak. No cleavage was observed, the fracture is uneven, and the Vickers hardness (VHN₁₅) is 186 kg/mm². Muthmannite is grayish white in reflected light, with very low bireflectance and pleochroism. When observed near sylvanite it is darker and shows a gray color with a slightly bluish tint. Reflectance percentages for R_{\min} and R_{\max} were found to be 40.1, 40.8 (471.1 nm), 38.3, 38.6 (548.3 nm), 37.9, 38.3 (586.6 nm), and 37.7, 38.1 (652.3 nm), respectively. Muthmannite is monoclinic, space group $P2_1/m$, with the following unit-cell parameters: $a = 5.124(2)$, $b = 4.419(1)$, and $c = 7.437(2)$ Å, $\beta = 89.96(1)^\circ$, $V = 168.4(4)$ Å³, and $Z = 2$. Electron microprobe analyses gave the chemical formula Au_{0.97}Ag_{0.99}Te_{2.03}. The calculated density (from the ideal formula) is 11.04 g/cm³. The crystal structure was solved and refined to $R = 5.52\%$. It is based on the NiAs-type structure, with a distorted hexagonal closest-packed array of Te²⁻ atoms with Au³⁺ and Ag⁺ occupying all the octahedral sites. The crystal-chemical relationships with other gold-silver tellurides are outlined.