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The Ag-Pd-Te system - experimental study and mineralogy

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The Ag-Pd-Te system comprises six binary minerals: merenskyite (PdTe2), kotulskite (PdTe), telluropalladinite (Pd9Te4), keithconnite (Pd3–xTe), empressite (AgTe), stützite (Ag5Te3), hessite (Ag2Te) and two ternary minerals: sopcheite (Pd3Ag4Te4), and telargpalite (Pd,Ag)3+xTe. In order to better understand the formation of minerals belonging to this system at natural conditions, predict possible new minerals and determine stable phase associations, the Ag-Pd-Te ternary system has been investigated at 350°C. Some preliminary experiments were also conducted at 450°C and 550°C. The evacuated silica glass tube technique was used for the purpose of this study. The experimental products were investigated in terms of reflected light, electron microprobe and X-ray diffraction techniques. Our first results are presented herein.

The following binary phases are stable at 350ºC: PdTe2, PdTe, Pd3Te2, Pd9Te4, Pd20Te7, Pd17Te4, Ag5Te3, Ag1.9Te, and Ag2Te. Merenskyite (PdTe2) coexists with all silver tellurides stable in the system (Ag5Te3, Ag1.9Te, and Ag2Te). Kotulskite (PdTe) coexists with Ag2Te. Mineral empressite (AgTe) has no synthetic analogue at 350ºC above this temperature. The beta polymorphs of phases Ag2Te and Ag5Te3 seem to be unquenchable at 350ºC and reverse to their alpha varieties Ag2Te (monoclinic P21/c) and Ag5Te3 (hexagonal P6/mmm) at 350ºC, respectively.

The experimental study revealed the existence of a new ternary phase of ideal composition Pd6AgTe4. The new phase forms stable associations with kotulskite (PdTe), sopcheite (Pd3Ag4Te4), telargpalite (Pd,Ag)3+xTe, telluropalladinite (Pd9Te4), Ag2Te, and Pd3Te2.

Sopcheite (Pd3Ag4Te4), coexists with kotulskite (PdTe), Ag2Te and phase Pd6AgTe4. It dissociates at about 450º. Telargpalite ((Pd,Ag)3+xTe), coexists with Ag2Te, Ag-Pd alloy (20 at.% Pd), and ternary phase Pd6AgTe4. The homogeneity range of telargpalite extends from Pd45Ag30Te25 to Pd47Ag28Te25 at 350ºC. The palladium-rich corner requires some further investigations.

Stable associations determined in this study can help to explain the formation, natural occurrences and conditions of formation of silver-palladium tellurides. Newly determined ternary phase Pd6AgTe4 can be expected to be found in nature, likely in association with palladium tellurides or other PGMs. This research was funded through the projects P210/11/P744; LA 11125 (Czech Republic), and MK-1557.2011.5 (Russia).