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Anionic solid solution uytenbogaardtite-petzite

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In the systems Ag-Au-chalcogenide, where X = S, Se, Te [*Osadchii, Rappo*, 2004], [*Osadchii, Echmaeva*, 2007], there are three isotypic compounds Ag_3AuX_2, known as minerals yutenbogaardtite (Ag_3AuS_2), fishesserit (Ag_3AuSe_2) and petzite (Ag_3AuTe_2). Minerals and their synthetic analogues have a cubic structure. Minerals exhibit limited miscibility, and their synthetic analogues may form a continuous series of solid solutions.

To investigate the solid solution for continuity and the definition of the lattice parameter dependence on the composition of six samples Ag_3Au $(Te_xS_{1-x})_2$ were synthesized with in increments of 0,2*x*. Synthesis of solid solutions was carried out by dry method in evacuated quartz glass ampoules of pre-synthesized end-members. In experiments on the synthesis using gold (99.9%) and silver (99.9%) foil, S (99.9%) and Te (99.9%) powder.

End-members, yutenbogaardtite and petzite, were synthesized from the alloy Ag_3Au and corresponding chalcogen. Alloy required composition was obtained by melting a mixture of small pieces of gold and silver foil (~ $1mm^2$) in an evacuated ampoule in the gas flame. Appropriate stoichiometric amounts of tellurium and sulphur were loaded into the ampoule. For the elimination of the gas phase in the ampoule was placed a well-fitting rod of quartz glass, after which the ampoule was evacuated to ~ 10^{-4} bar. and sealed in a gas flame.

Synthesis occurred in a horizontal resistance furnaces. End-members were annealed for 2 weeks at 600 ^{0}C with two intermediate grinding in a mortar to homogenize the mixture and increase the kinetic of the process. Same method was used to synthesise solid solutions from yutenbogaardtite and petzite. Samples of a given composition were annealed simultaneously at 500 ^{0}C for 2 weeks followed by gradual cooling.

During the synthesis petzite always remained unreacted gold in very small amounts (less than 0.5% by volume).This fact we can see in the photos given from the microprobe. Fig.1. Showing photos of two samples with different sulphur and tellurium density. Presence of similar particles of unreacted gold was noted in [*Smit et al*., 1970]. During the synthesis was obtained Ag_3AuS_2 phase, in which were found unreacted gold.

X-ray studies of the samples were carried out on a diffractometer Bruker-8 (Cukα1 radiation). To investigate the dependence of the lattice parameter were selected 3 peaks, present in the radiographs of each sample, sufficiently distant from each other. In the table are averaged over them((110), (431) and (222)).

x, $Ag_3Au(Te_xS_{1-x})_2$	0	0.2	0.4	0.6	0.8	1
a(Å)	9.72	9.88	10.02	10.15	10.28	10.38

For the other X-ray peaks of the lattice parameter deviation from the following data is not more than 0,01 Å.

Results of the determination of the lattice parameter of the composition of the reflections (110) (431) and (222) are shown on the Fig.2.

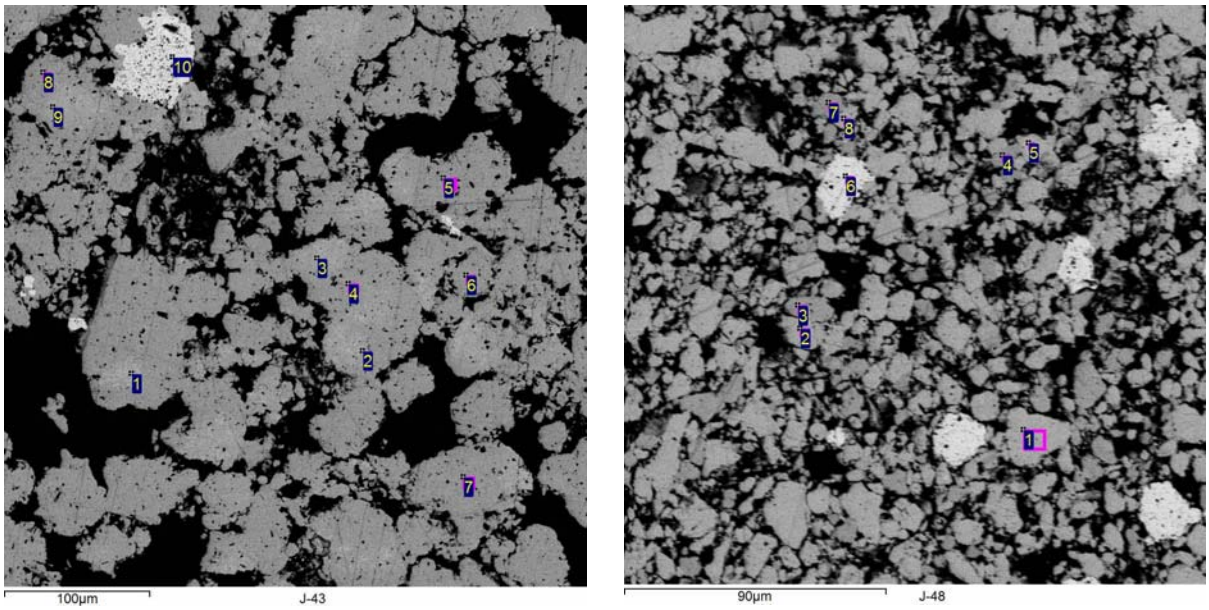

Fig.1. Photo of compositions $Ag_3Au\ (Te_{0.2}S_{0.8})_2$ on the left and $Ag_3Au\ (Te_{0.8}S_{0.2})_2$ on the right. A bright area in the photographs is a phase composition close to pure gold.

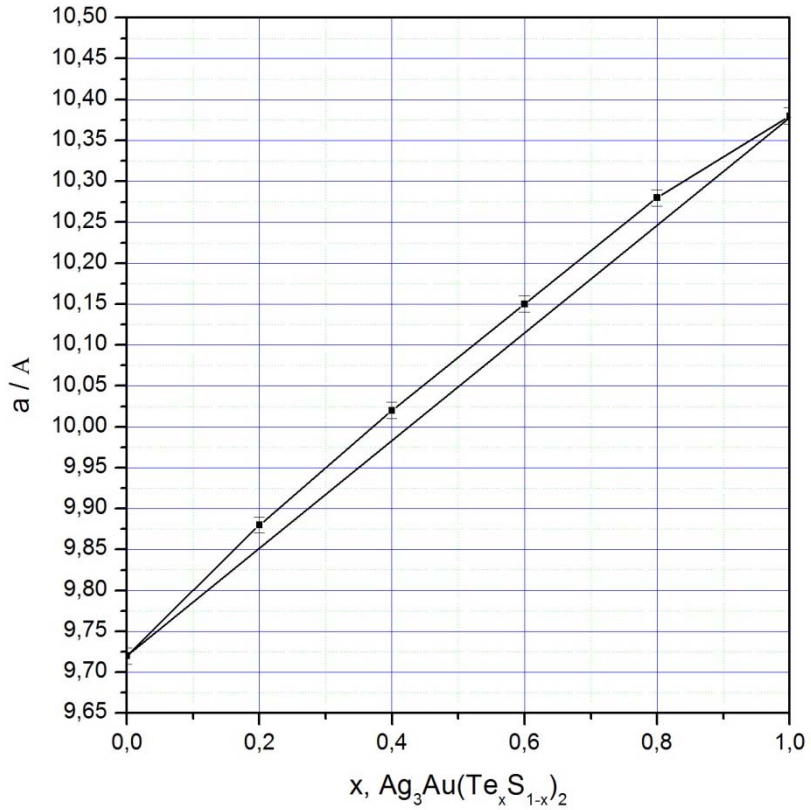

Fig.2. Graph of the lattice parameter of solid solution on composition

From the data shown in the graph we can see that the solid solution yutenbogaardtite -petzite has a slight positive deviation from Vegard's rule, which is the first step to proving the existence of a continuous series of solid solutions.

The quality of the samples was checked by XRD, using a microscope in reflected light and the microprobe. Lattice parameters of the end-members correspond to the data base MinCryst.

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