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Au-Fe-Pb-S (Gold-Iron-Lead-Sulfur)

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Recently, [2006Ryb] determined an isothermal section for the pseudo-ternary system Au-Pb-FeS at 1200 °C, which depicts the equilibrium between a metal-rich and a sulfide-rich liquid.

Binary Systems

There are no intermediate phases in the Au-Fe system. A continuous liquid solution is stable above the melting point of Fe. In the Au-Pb system [Massalski2], a continuous liquid solution is stable at 1200 °C. At lower temperatures, three intermediate phases form: Au_2Pb ($C15$, $MgCu_2$-type cubic), $AuPb_2$ ($C16$, $CuAl_2$-type tetragonal), and $AuPb_3$ (αV_3S-type tetragonal). In the Fe-S system, the monosulfide $Fe_{1-x}S$ (NiAs-type hexagonal; mineral name pyrrhotite) is stable at Fe-deficient (S-rich) compositions with a range of 50-55 at.% S. The composition with 52 at.% S forms congruently at 1188 °C. The disulfide FeS_2 (pyrite, cubic) forms peritectically at 743 °C.

Ternary Isothermal Section

Using starting materials of 99.95% Au, 99.95% Pb, and 99.55% FeS, [2006Ryb] melted in a resistance furnace about 10 alloy samples, which were equilibrated at 1200 °C for 60 min. On cooling, the solidified liquid layers of Au-Pb alloy and iron-monosulfide were separated. Chemical analysis, optical and scanning electron microscopy, electron probe microanalysis, and x-ray powder diffraction techniques were used to determine the tie-lines between the coexisting compositions. The pseudo-ternary Au-Pb-FeS section constructed by [2006Ryb] at 1200 °C is shown in Fig. 1. The tie-lines between the metallic liquid and the sulfide liquid are shown. The monosulfide dissolves 26.9 mass% Pb and 4.4 mass% Au. The gold distribution coefficient, defined as the ratio of the mass fractions in the coexisting metal and sulfide liquids, decreases from 32.8 to 12.7, as the Pb content of the metallic phase increases from 10.2 to 78.3 mass% [2006Ryb].

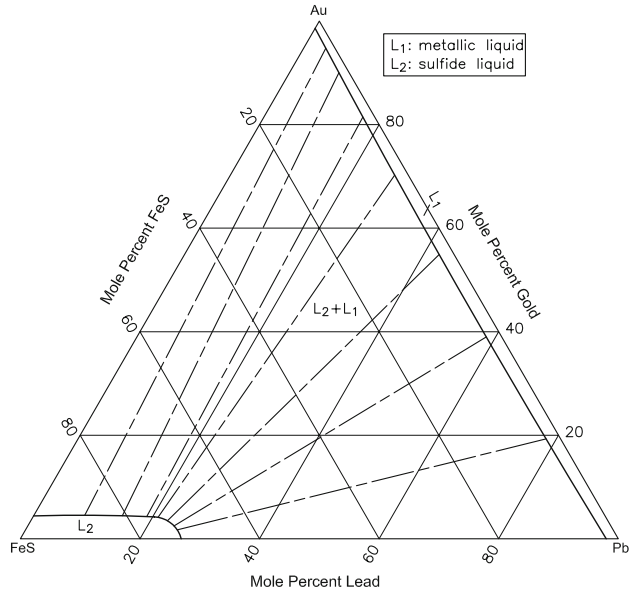

Fig. 1 Au-Pb-FeS pseudo-ternary section at 1200 °C [2006Ryb]

Reference

2006Ryb: S.G. Rybkin, Yu.L. Nikolaev, and V.G. Barankevich, Isothermal Sections at 1473 K through the Pb-Au-FeS and Pb-Ag-FeS Phase Diagrams, *Zhur. Neorg. Khim*., 2006, **51**(3), p 518-521, in Russian; TR: *Russ. J. Inorg. Chem*., 2006, **51**(3), p 470-473