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# Thermodynamic properties of alloys of gold-74/palladium-26 with variable amounts of iron and the use of Au-Pd-Fe alloys as containers for experimental petrology

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## Abstract

Iron oxide-alloy equilibration experiments were conducted in $H_2$-$CO_2$ gas mixtures at 1 atm and 1125–1240 °C using strips of $Au_{74}Pd_{26}$ (wt%) and produced Au-Pd-Fe alloys with 0.03–13 wt% iron. A thermodynamic calibration for the mixing of $Au_{74}Pd_{26}$ with iron using an asymmetric regular solution leads to $W_{G\text{-}Fe} = -45.0 \pm 1.8$ kJ/mol and $W_{G\text{-}AuPd} = +19.5 \pm 7.7$ kJ/mol ($1\sigma$). Internal oxidation of iron was observed in a reversal experiment, suggesting that oxygen can be transferred across capsule boundaries during high-temperature experiments. This thermodynamic calibration is applicable to a wide range of oxygen fugacities and iron activities relevant to petrological and metallurgical applications at 1 atm and, as previous studies suggest excess volumes in this system are small, it can also be used to predict Fe activities in experiments at elevated pressure (up to 3 GPa). By pre-doping Au-Pd capsules to match Fe activities expected for the sample during an experiment, it is possible to maintain samples with little to no loss of iron. Pre-saturation of the capsule also provides a method for controlling the oxygen fugacity of samples if no formal oxygen buffer is available.

**Keywords:** Gold-palladium, capsules, iron, internal oxidation