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Solubilities of noble metals in Fe-containing silicate melts as derived from experiments in Fe-free systems

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ABSTRACT

The solubilities of noble metals (NM: Ir, Pd, Au, Pt, and Ru) in FeO-free silicate melts are known from recent experimental work. In this paper, calculations are presented that relate solubilities of NM in FeO-free melts to those in FeO-containing melts. The main difference between these two systems is the formation of Fe-NM alloys in FeO-containing melts. At f_{O_2} conditions of the QFM buffer and 1200 °C, binary alloys of Fe with Au, Ru, Ir, Pd, or Pt containing 1, 2, 10, 17, and 25 at% Fe, respectively, are in thermodynamic equilibrium with a silicate melt with 10 mol% FeO. Thus alloy formation leads to a significant reduction in the solubility of Pt and to a lesser reduction in the solubility of Pd. The effects for Ir and Ru are small, and for Au almost negligible. The reduction in solubilities depends on temperature, oxygen fugacity, and FeO content of the silicate melt. Formation of FePt-alloys would lead to a preferred depletion of Pt in partial melts from the Earth's mantle, which, however, is not observed. One explanation is that mantle melting occurs under very oxidizing conditions (QFM+2). The calculations presented here should be considered a first step toward gaining a better understanding of the behavior of NM during igneous processes.