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The effect of TiO_2 on Pd, Ni, and Fe solubilities in silicate melts

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ABSTRACT

We have determined Pd, Ni, and Fe solubilities in silicate melts of anorthite-diopside eutectic composition with variable TiO_2 concentrations, from TiO_2-free melts to melts with up to 26 wt% TiO_2. The experiments were conducted with metal loops at 1300 °C, one atm total pressure, and at a wide range of oxygen fugacities. The glasses were analyzed with the electron microprobe and by laser ablation inductively coupled plasma mass spectrometry (LA ICP-MS).

The behavior of Ni was found to be nonlinear. At given T-f_{O_2} conditions, its solubility is relatively constant for melts with up to about 4 wt% (3 mol%) TiO_2. At higher TiO_2 concentrations, Ni solubility increases strongly with TiO_2 contents. The results obtained for Pd at oxidizing conditions are similar to those obtained for Ni. The solubility of Fe increases uniformly with TiO_2 contents within the whole TiO_2 concentration range.

In some experiments Pd-containing alloy micronuggets were encountered. In this case analyses were done in areas free of nuggets. Experiments in which the nugget density was too high were discarded. The regular behavior of Pd—even in nugget-containing silicates—indicates that Pd-oxide solubility and nugget formation are independent processes.

The occurrence of Ti-rich phases (karrooite and armalcolite) on the liquidus of TiO_2-saturated melts at reducing conditions, and the Pd partition coefficients between rutile and silicate melts, were determined and are briefly discussed.