

Solubility of PGE in a Hydrous Sodium Silicate Fluid

JACOB HUFFAKER, QI CHEN AND CRAIG LUNDSTROM

University of Illinois - Urbana Champaign

Presenting Author: Jacobwh3@illinois.edu

Platinum group elements (PGE), Platinum, Palladium, Ruthenium, Rhodium, Iridium, and Osmium are vital in today's economy for their catalytic properties, high melting points, and corrosion resistance. While crustal concentrations of Pt are ~0.5 ppb and magmatic concentrations can reach 10 ppb, economic deposits of PGE in sulfide seams <1m thick (called PGE reefs) can have Pt concentrations up to 10 ppm. How these PGE-rich layers form in layered mafic intrusions remains debated. Commonly proposed ideas to explain reef formation processes involve sulfide settling, mixing of two magmas, or concentration by secondary fluids.

We have performed experiments in a rapid quench cold seal system measuring solubilities of PGE source phases in H₂O-Na₂Si₂O₅ liquids at 1 kbar with variable fO₂ and temperature (550 °C - 760 °C). This system allows us to probe liquids ranging from hydrothermal fluids to anhydrous silicate melts. Gold capsules were loaded in layers having 10 mg of hydrous sodium disilicate ~10 mg of 50:50 quartz:albite and ~0.5 mg of Pt or Pd (PtO₂, PtCl₂, PdO, PdCl₂). We analyzed major elements using SEM-EDS and PGEs by LA-ICP-MS. All experiments were weighed before and after a run to ensure capsule integrity. Experiments were mounted in epoxy and polished to reveal the glass layer juxtaposed with crystals including residual PGE sources.

We collected XANES and EXAFS on glasses at the Advanced Photon Source (APS) at Argonne National Laboratory to determine valence and nearest neighbor bonding. While Ni-NiO experiments yielded heterogeneous Pt and Pd distributions with concentrations in the 10s of ppm in glass, XANES indicated dominantly zero valent Pt and Pd. Under more oxidized fO₂ (using double capsules buffered with hematite-magnetite, Ru-RuO₂, or MnO-MnO₂), Pt and Pd concentrations increased to 100s-1000s of ppm with the most oxidizing experiments showing signs of Pt and Pd complexes forming within the hydrous silicate melt. From our experiments, we conclude the most oxidizing silicate melts in nature require temperatures greater than 1000 °C for Pt and Pd to exist above a 0-valence state.