

Sulfide Migration in a Temperature Gradient as a Means for PGE Concentration in Layered Mafic Intrusions

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The Platinum Group Elements (PGE) are vital in today's economy for their catalytic properties and high melting points. While concentrations of platinum are ~10 ppb in basalt, economic deposits of platinum in layered mafic intrusion reefs can reach 10 ppm. How these PGE-rich layers form remains debated. Commonly proposed ideas to explain reef formation involve sulfide settling, magma mixing, or concentration by secondary fluids. Regardless, PGE deposits are found in association with sulfides.

Previous work showed that base metal sulfides placed within a fixed temperature gradient between 1100°C and 870°C will migrate to the location of sulfide phase saturation forming a discrete layer ~1050°C [1]. Partition coefficients of Pt between sulfides and silicate melt are very high. Thus, if sulfides move through a mush, they will incorporate and transport any PGE present potentially producing reefs in an intrusion.

We have run similar experiments to [1] using PGE sulfides (PtS, PdS) to assess their migration in a thermal gradient. A mixed powder of 5% PGE sulfide, 90% 1:1 mix of size sorted OPX-Olivine and 5% 9:1 mixture of $\text{Na}_2\text{Si}_2\text{O}_5 \cdot \text{H}_2\text{O}$: NaCO_3 was homogenized into a single powder. This was loaded into 2mm bore fused quartz tubes and sealed. These tubes can withstand up to 1 kbar of water vapor saturation pressure. A tube was placed within a known fixed temperature gradient (1050°C to 1080°C over 4 cm) in a 1 atm furnace for 1-2 days and rapidly quenched to glass in a water reservoir. Run durations were varied to assess rates of migration and assess equilibrium. We analyzed major elements using SEM-EDS and PGE by LA-ICP-MS and have observed an increase of Mg and decrease of alkalis with temperature and position. Measurements of PGE abundance and distribution are currently underway.

[1] C. C. Lundstrom & N. Gajos (2014), *Economic Geology* 109,1257-1269.