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Origin of the world-class PGE-Au mineralisation in the Skaergaard intrusion by bulk S-saturation, accumulation, partial dissolution, and secondary reef formation.

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The Skaergaard intrusion is the type locality for stratiform "Skaergaard-type" PGE-Au mineralisations with layers rich in PGE, followed by Au and Cu. Models for stratiform PGE mineralisations divide into uppers and downers models. Downers models assume bulk liquid S-saturation followed by a variety of accumulation processes and the second model the scavenging of metals by fluids deep in intrusions and deposition in chemical traps above.
This investigation is based on continuous profiling in roof, walls and floor. Cu anomalies in roof, walls and floor are contemporaneous and systematics in Pd/Pt and Pd/Au ratios document bulk liquid S-saturation, no loss of precious metal below the mineralisation and no obvious chemical traps. A classic downers process is documented. The timing of the mineralisation is controlled by composition of liquidus plagioclase and fraction of residual magma (F).
PGE concentrations are an order of magnitude higher in the floor mineralisation due to accumulation. Systematics across the mineralisation shows in the centre of the intrusion 5 main levels of Pd-concentration followed by an Au and a Cu-level. All levels PGE and Au levels have c. 100 ppm Cu and show no correlation to PGE and Au. 90% of all PGE is contained in one phase, skaergaardite (PdCu).The lower and main PGE concentration has moderate Pd/Pt ratios. Overlying secondary reefs have high, basal Pd/Pt and show local S-saturation reflecting d-values of PGE between sulphide and silicate liquid.
No basal high Pd/Pt anomaly occurs at Au and Cu levels and the floor shows four types of mineralisation. The main PGE reef (Pd5) has gradual increase and decrease in PGE and Pd/Pt, dissolution of sulphide, increasing PGE+Au/Cu due to reaction between interstial and documented reactive Fe-rich silicate melt and the bulk magma sulfides. Dissolution of Cu-sulfide increases PGE/Cu, reduces the size of droplets to 30μ (av.) and provides metals for secondary reefs above - formed by migration of interstitial melt – and show expected decrease in Pd/Pt and increase in Au/Pd due to fractionation and substitutions in Skaergaardite (PdCu) and tetra-auricupride (AuCu).
The main Au level is elevated relative to the top Pd-level (Pd1). High resolution X-ray tomography and petrography shows the precious metal phases on grain boundaries. The paragenesis is complex with many tellurides, arsenite and sulfides, and primary hydrous phases including amphiboles, ferrosaponite and chlorite. The Au mineralisation level is the residual of the Fe-rich interstitial silicate melt trapped by the layering of the gabbros. The Cu levels above are like the secondary Pd-levels secondary mineralisation levels caused by reaction between primary sulphide and Fe-rich melt. The Skaergaard-type mineralisation owes its characteristics to the concentration of Fe-rich interstitial melt and loss of immiscible granophyric melt from the mush zone at the floor of the residual bulk magma and a continuum of dissolution and S-saturation in an ever changing interstitial melt environment.