Layered Mafic-Ultramafic Intrusive (stratabound) PGEs, Cr

Province Blank
Potential: **Certainty:**

Critical Elements (Assessment Criteria)	**Identified**	**Not Identified, but likely**	**Unlikely**	**Weighting**
Setting				
• Large mafic–ultramafic intrusions in stable Archaean cratons and Palaeoproterozoic mobile zones • Intrusions along major lithological crustal discontinuities at depths of ~8–24 km • Intrusions along or near major crustal lineaments • Magmas derived from mantle plume intersecting an intraplate rift • Intrusions (generally >5 km thick) form concordant lopoliths, dipping sheets, funnel shaped bodies, folded sills, fault–bounded blocks •				
Source (fluid, metal, energy)				
Fluids • Nil • *Metals (including sulphur)* • S–unsaturated fractionating magmas with late magmatic PGE–enriched highly fractionated intercumulus fluids • Magmas may be derived from an intraplate mantle plume; mantle plume provides metal–rich magmas	 • •			

• Sulphur from later S–saturated mafic magmas or from country rocks. *Energy* • Multiphase igneous intrusive activity • Magma may be derived from an intraplate mantle plume •	• • • •			
Fluid/magma pathway				
• Feeder conduits along deep crustal structures, discontinuities • Intraplate rift intersecting a mantle plume; mantle plume provides metal–rich magmas, rift structure facilitates rapid transport of magma into crust				
Trap (any of the following)				
• S saturation at a late and crucial stage of crystallisation of the intrusion • Magma mixing to give high R factor for interaction between siliceous magma and sulphide melt and facilitate scavenging of PGEs indicated by: – Presence of major compositional interface where plagioclase first becomes a cumulus mineral (i.e. the stratigraphic level first dominated by gabbroic rather than ultramafic cumulates). – Magmatic erosion/disruption unconformities – Mixing of magmas of contrasting composition				
Signs of mineralising process (any of the following, but if occurrences have been identified the level of certainty increases) • Parent magmas variable but high–Mg, high–Cl basaltic magmas with Pt and Pd concentrations >10–30 ppb have the greatest potential for PGEs. MORB apparently unfavourable. • Intrusion is only partly S saturated; repeated large pulses of S–undersaturated primitive magma into the chamber.				

• Prominent layering, cyclic units • Presence of disseminated Fe–Ni–Cu sulphides 20 m below to 500 m above the level where plagioclase first becomes a cumulus mineral may indicate presence of PGEs; i.e. near gabbroic/ultramafic interface. • Presence of chromite between 150 m below and several hundred metres above gabbroic/ultramafic interface may indicate presence of persistent economic chromite layers. • Presence of thick ultramafic layers favourable for formation of chromite layers. • Marked discontinuities in stratigraphic profiles of S, Cs, Zr, Rb, Sr, Se, Cu, (Pt+Pd)/Cu, (Pt+Pd)/Zr, (Pt+Pd)/Ir, Pt/Pd, Cu/Zr, Cu/Pt, Cu/Pd and Mg/(Mg+Fe) may indicate pulses of magma, timing of S saturation, mineralised stratabound layers from magma mixing • S/Se ratio of major PGE–rich stratabound sulphide layers less than inferred mantle value of ~3000. • PGE-Cr deposits associated with olivine and/or orthopyroxene (not clinopyroxene) cumulates • geochemical anomalies – pathfinder elements Cu, Ni, Cr, Co, Au, Pt, Pd, Mg, As, Hg • geophysical anomalies • Known occurrences of PGEs, Cr, Ni, Cu •				
Age				
• Archaean to Proterozoic: major mineralised intrusions are 2940–1080 Ma. •				
Preservation				
• Need preservation of intrusives.				

List of possible provinces in Australia for mafic-ultramafic PGEs, Cr, Fe–Ti–V.

Yilgarn Craton
West Pilbara

Musgrave Block
Halls Creek
Gawler Craton
Arunta
Albany Fraser province

References

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