Goldschmidt 2021 Abstract
https://doi.org/10.7185/gold2021.7823

Precious Metal Systematics During Mantle Metasomatism and its Implications for Crustal Ore Forming Processes

JASON C HINDE, D. GRAHAM PEARSON AND HÉLÈNE LEGROS

University of Alberta

Presenting Author: jhinde@ualberta.ca

Platinum group elements (PGEs) and other highly siderophile elements (such as Au) have critical economic importance in our technology focused society which drives a need to discover new deposits. The scale, timing, and nature of the transfer of these elements from Earth's mantle to the crust is poorly understood and the role of the sub-continental lithospheric mantle (SCLM) in this process remains uncertain. Metasomatism is a major source of elemental heterogeneity within the SCLM that creates enrichment of PGEs and HSEs and acts as a transfer mechanism from asthenosphere, through SCLM, into the crust. The true level of precious metal enrichment in the SCLM created by mantle metasomatism and the nature of the fluids affecting this change are poorly constrained. The Kaapvaal craton of Southern Africa provides an ideal location to investigate precious metal enrichment within the SCLM as it hosts numerous kimberlite pipes that deeply sample portions of the lithospheric mantle and is home to some of the world's major ore deposits including the chromite-PGE rich Bushveld Complex.

Here we report the results of geochemical investigations of nine variably metasomatized mantle xenoliths, primarily from the Kaapvaal craton, to identify the key host phases of precious metals in the SCLM and to constrain the nature of the metasomatic agents. New analyses of primary silicate, oxide, and sulphide phases conducted via LA-ICPMS indicate that the PGE-HSE budget is largely controlled by secondary metasomatic sulphides. Whole rock data (ID-ICPMS) show a strong re-fertilization trend in palladium-group PGEs (Pd values from 0.57-6.3 ppb; Pt values from 0.54-52 ppb) relative to typical melt-depleted Kaapvaal peridotites. Chondrite-normalized PGE patterns of MARID (Mica-Amphibole-Rutile-Ilmenite-Diopside) xenoliths display contrasting signatures that may represent the geochemical fingerprints of both peridotitic and metasomatic sources. The chemistry of primary phlogopite and clinopyroxene show a metasomatic agent rich in Fe, Ti, and LILEs has significantly modified portions of the Kaapvaal SCLM adjacent to kimberlite activity. The radiogenic Os isotope compositions of some of these metasomatites indicate they may play a role in the formation of magmatic PGE deposits.