Chromite: key to understanding the metallogenic diversity of the East African Nickel Belt (EANB)

DAVID M EVANS[1]

[1]Scientific Associate, Natural History Museum, Cromwell Road, London SW7 2BY, United Kingdom, evans_dave_m@hotmail.com

The Kapalagulu, Musongati and Kabanga intrusions are part of the Mesoproterozoic Kibaran tectonomagmatic episode and together form the KMK alignment of the EANB. While the smaller Kabanga intrusions contain massive nickel-copper sulphides, the larger Musongati and Kapalagulu layered intrusions contain only weakly disseminated sulphides but are associated with much higher levels of platinum and palladium. Only the Kapalagulu intrusion contains reef-like concentrations of Pt and Pd, associated with chromitite seams within peridotitic cumulate rocks. I have used chromites to understand the processes resulting in these different styles of mineralization.

Chromites are early-formed high-temperature cumulate minerals, but are often modified by later lower-temperature equilibration with adjacent liquids and minerals in slowly-cooled intrusions. Compositions of chromites that have equilibrated with different amounts of fractionated interstitial liquid are usually aligned along an equilibration array on geochemical harker diagrams, for example Mg# ($Mg/(Mg+Fe^{2+})$) – Fe^{3+}# ($Fe^{3+}/Cr+Al+Fe^{3+}$)) and TiO_2 – Fe^{3+}#. The compositions of chromites in orthoculuate rocks of the three sulphide-mineralized EANB intrusions lie on distinct equilibration array trends, with decreasing enrichment of Fe^{3+}# relative to Mg# and TiO_2 from Kapalagulu to Musongati to Kabanga.

This is interpreted in terms of varying fO_2 of the magmas from which the chromites crystallized, due in part to varying amounts of assimilation of sulphide-bearing carbonaceous sediments before and during emplacement and crystallization of the cumulate grains. It is this varying degree of sedimentary contamination that has led to the differing styles and grades of sulphide mineralization in the deposits. Whereas at Kabanga, which is situated above the main formation containing carbonaceous sediments, a high degree of sediment contamination has led to the formation and concentration of large amounts of sulphide with low Pt and Pd enrichment, at Kapalagulu, which is situated in a crustal package that does not contain carbonaceous sediments, a more oxidized magma has crystallized chromitite seams with Pt and Pd-rich sulphides. Musongati is an intermediary example.