Lithogeochemistry of the Kabanga and Kapalagulu intrusions, Tanzania

Evans, D. M.[1], Wilhelmij, H.[2], Edwards, R.[2] and Hornsey, R.[3]

[1]Carrog Consulting, 83 Hartland Drive, Ruislip, Middlesex, HA4 0TJ, U.K.
evans_dave_m@hotmail.com
[2] Goldstream Mining NL, 22 Ventnor Place, West Perth, WA 6872, Australia
[3] Lonmin PLC, 17 Georgian Crescent, Bryanstown East, Johannesburg, South Africa

The Kabanga and Kapalagulu intrusions are Mesoproterozoic-aged mafic-ultramafic cumulate bodies that both contain considerable resources of nickel sulphides. Whereas the Kapalagulu sulphides are largely disseminated and low-grade, those of Kabanga include a considerable proportion of massive and near-massive sulphide. The Kabanga deposits are hosted by small-volume, very elongate tube-like bodies within sulphidic metasediments, whereas the Kapalagulu deposits occur in a larger, layered body that is intrusive at the contact between Ubendian basement and overlying Mesoproterozoic metasediments.

The sulphides at both intrusions show wide variations of their major components, Fe, S, Ni, Cu and Co, as well as trace components such as PGE. At Kabanga, previous work has shown that this compositional variation is largely due to inferred changes of the "R-factor" (ratio of equilibrated silicate to sulphide melts) of different batches of sulphide-enriched magma. Early batches have higher Ni and PGE tenors (Ni and PGE in 100% sulphides), inferred to be due to a higher R-factor, whereas later batches have lower Ni and PGE tenors, due to equilibration of much greater volumes of sulphide with silicate magma. The difference of R-factor, and hence sulphide compositions is thought to be due to differing flow rates and turbulence of magma flow, and subsequent differing degrees of interaction with sulphidic sedimentary rocks.

At Kapalagulu, a similar scenario exists in the 1.3km thick pile of olivine-chromite cumulates that forms the Lubalisi Zone. This zone is covered by a thick, undisturbed laterite profile, so is very poorly exposed and its geology has only recently been revealed by intensive drilling done by Goldstream Mining and Lonmin. Using their routine multielement assay database, a lithogeochemical stratigraphy incorporating well-defined marker horizons has been erected in the otherwise fairly uniform cumulate pile. All olivine cumulates are S-saturated from the base upwards, but the R factor is very high at the base, decreasing upwards in a regular fashion. The earliest cumulates contain a very low abundance of sulphide, which has high to very high PGE tenor, coupled with high estimated Ni-in-bulk silicate values (>=0.3% Ni). The upwards decrease of PGE tenor is matched by a decrease of the estimated Ni-in-bulk silicate value to <0.07% in the uppermost parts of the Lubalisi zone. Unlike at Kabanga, however, the Ni tenor of the sulphides does not change appreciably through the cumulate pile, suggesting that the overall volume of silicate magma available was much larger than in the later batches at Kabanga.

The similarity of magma type, cumulate sequence and sulphide behaviour at Kabanga and Kapalagulu suggests the two intrusions are comagmatic. Slight differences in tenors

and R factors are explained by their different host rock setting and different magma chamber properties. It can be argued that Kapalagulu represents a distinct intermediate class of mafic-ultramafic layered intrusion that has potential for both Ni sulphide and PGE deposits, in between those of the Kabanga-style chonoliths and Bushveld-style layered intrusions.

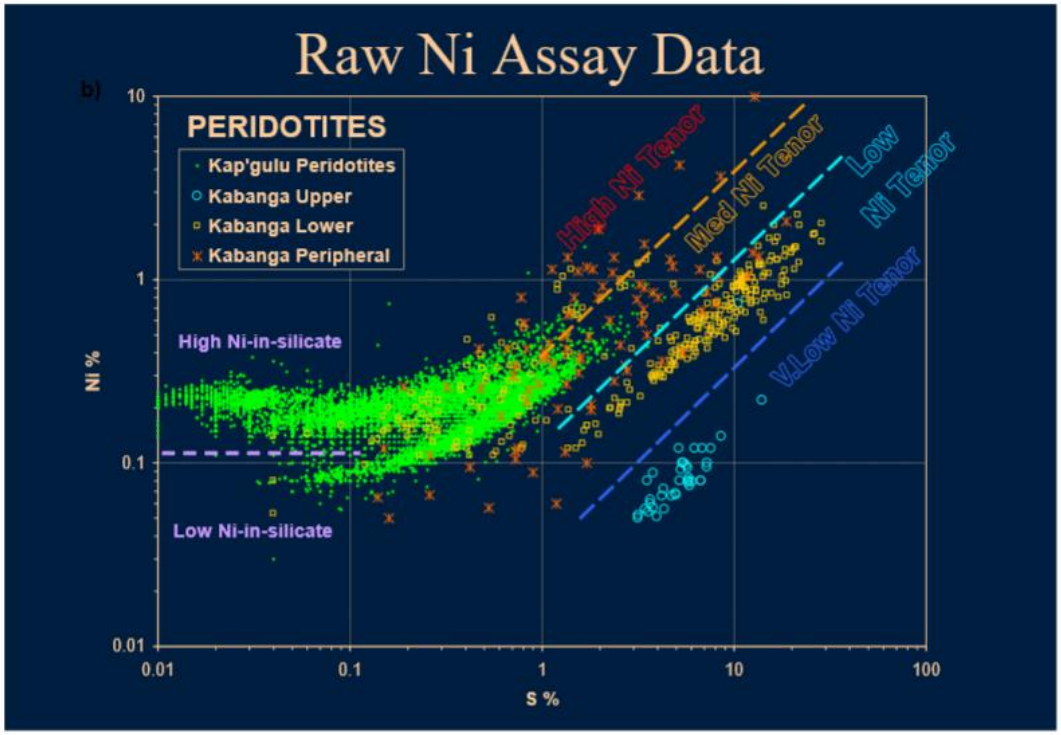

Figure 1. Plot of assay data (Ni% versus S%) of drill core samples from the Kapalagulu intrusion (green dots) and the Kabanga Main intrusion (orange, yellow and light blue symbols). The curved trends of the Kapalagulu samples on the log-log plot are due to the predominance of Ni in olivine and orthopyroxene at low S values (<0.2%), changing gradually to the predominance of Ni in sulphides at higher S values (S >1%), where there is a positive linear correlation between Ni and S. At least 2 populations are seen in the Kapalagulu data.