The chonolith Ni-Cu model: expanding the footprint of Ni-Cu deposits and chasing weaknesses in the Nickel mineral system model

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We outline a new model for the physical controls on emplacement of Ni-Cu deposits. The focus of this model is on defining the camp and deposit footprint of Ni-Cu deposits and is the basis for new innovative approaches to image this footprint at various stages in the exploration process.

In recent years it has become clear that the deposit scale footprint for mafic intrusion-hosted Ni-Cu deposits of massive sulfide deposits hosted at the base of intrusions or funnel shaped intrusions does not apply to the entire class of the deposit and in particular not to the world class deposits. We propose a new classification for Ni-Cu deposits based on intrusion geometry i.e. the definable distal footprint of Ni-Cu deposits. We find this a useful practical guide in exploration as opposed to mineralization style or geotectonic setting, both of which are poorly or unknown during area selection in exploration.

The largest Ni-Cu deposits are associated with an unusual and somewhat unique intrusion termed a chonolith. A chonolith is an irregular to pipe like intrusion. The intrusion geometry defines the outer footprint of the Ni-Cu sulfide deposit. The deposit itself is hosted within and often fills or is centrally located within the intrusion i.e. not restricted to the basal contact. A key feature is that the massive sulfides are often discordant with respect to disseminated sulfides and are hosted in a distinctive variably textured facies. We propose a new emplacement model for the host intrusions.

At present, like most mineral systems, the Ni-Cu mineral system is challenged at the transition from larger scale geodynamic scale targeting to the use of detection methodologies. Area selection, especially under cover is comprised at this so called camp scale. This transition occurs at the scale where datasets are usually pre-competitive. The area selection decision is thus a huge opportunity cost, especially so in Ni-Cu systems because of the small footprint cf other large base metals systems like IOCG and Sedimentary Copper deposits. The footprint is small and rare but there are significant advantages over other deposit styles, if the footprint can be imaged in pre-competitive datasets, because unlike other deposit styles the geometry is intimately linked to deposit size and also the probability of an economic threshold. This later point has driven us to embark on innovative approaches to expand the intrusion-based distal footprint and image chonoliths at various stages in the exploration process. This has required new approaches to dealing with magnetic remanence, and the development of new automated mapping techniques.

The theory of constraints suggests focusing innovation at the weakest point in our understanding of the mineral system, i.e. camp scale, will lead to the best chance of improving the overall probability of new discoveries.