Advances in understanding ore deposits in mafic/ultramafic rocks

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Mafic and ultramafic rocks host major Cr, PGE, V, Ti, Ni and Cu deposits. Giant magmatic systems contain the largest of these deposits such as the Ni-Cu-PGE ores in the Siberian Noril'sk sills feeding flood basalts and the Bushveld layered complex. These large magmatic systems have great potential for new discoveries as occurred recently in the Bushveld with the Flat Reef. Many of these deposits are polymetallic with PGE collecting with Ni and Cu sulphides sometimes all associated with chromite and V occurs with Ti in magnetites at higher stratigraphic levels. If the grade is sufficient then small deposits have potential to be economic too.

PGE have just been discovered in high level magnetites in the Nuasahi complex in Orissa state, India. This complex also contains PGE with base metal sulphides in breccias and thick layers of chromite. Thus PGE at one level may be indicative of more mineralisation elsewhere in a complex. This knowledge can be applied to other similar complexes around the world, where known occurrences of PGE should inspire exploration at different stratigraphic levels.

Small scale studies of mineralogy using 3D computed tomography, EBSD, LA-ICPMS and isotopes are now possible and help us to understand the processes of formation of these deposits as well as having the potential to help in the design of mineral processing of these ores.

Recently there has been much interest in the role of semi-metals in these ores. Arsenic for example can act as an early collector of PGE during crystallisation of Ni and Cu ores as in the Sudbury igneous complex [1] and elements such as Se and Te that are collected in these ores have a critical element status and in the low carbon economy may be valuable by products from these ores.

Ultramafic rocks are the major source of Cr, PGE, V, Ti, Ni and Cu all of which may be redistributed by natural processes, for example forming PGE placer deposits or Ti-rich ilmenite beach sands but they are also being redistributed by mining resulting in concentrations in cities leading to the potential for urban mining and sustainable supplies.

[1] Dare et al. (2010) Min Dep. 45, 765-793.