

APPLICATION OF THE RE-OS ISOTOPE SYSTEM TO THE STUDY OF MAGMATIC SULFIDE DEPOSITS

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The formation of magmatic Cu-Ni-Co-platinum group element (PGE) sulfide deposits is dependent on mantle-derived silicate magmas (komatiites and basalts) attaining sulfide saturation. Many current models for the petrogenesis of magmatic sulfide deposits associated with mafic-ultramafic rocks propose that sulfide saturation and immiscible sulfide ore-formation were a consequence of assimilation of crust or crustally-derived sulfur into sulfide-undersaturated mafic-ultramafic magmas that transported base and precious metals from the mantle to the upper crust. Constraining the sources of sulfur and metals in magmatic ore deposits is important for understanding the dynamic and potentially open-system behavior of their parental magmatic systems. The Re-Os isotopic system is a direct sulfide geochronometer and tracer of magmatic ore-forming processes because both elements are highly concentrated in immiscible sulfide ore magmas and their crystallization products. This chalcophilic behavior of the Re-Os isotopic system is one of the most powerful aspects of this system compared to the more lithophilic Rb-Sr, Sm-Nd and U-Th-Pb systems. Moreover, there is a large Os isotopic contrast between mantle and old crustal metal sources, making the Re-Os isotopic system one of the most sensitive means of assessing interactions of silicate magmas with the continental lithosphere. The aim of this presentation is to present fundamental aspects of Re-Os geochemistry, in particular geochronology and isotopic tracer studies, as applied to magmatic ore systems. These concepts will be illustrated using Re-Os isotopic data from komatiite-associated Ni deposits (Kambalda, Abitibi) and basalt-associated Cu-Ni-Co-PGE deposits (Noril'sk-Talnakh, Sudbury, Duluth, Voisey's Bay, J-M Reef).