Primary and Secondary Textures of Fe-Ni-Cu Sulfide Mineralization in the Katinniq Member of the Raglan Formation, Cape Smith Belt, New Québec

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Thesis Abstract

Low grade disseminated Ni-Cu-(PGE) mineralization in komatiitic peridotites and dunites represents an enormous untapped resource that can be mined by low-cost open pit methods. However, the textures and genesis of disseminated sulfide mineralization are much less well understood than more massive counterparts. Although disseminated mineralization in some deposits is relatively uniformly distributed, disseminated mineralization in other deposits is texturally highly variable and unevenly distributed, forming a wide range of patchy textures. Understanding the textures and genesis of disseminated mineralization is critical in designing effective exploration models and in developing efficient beneficiation processes. The sulfide ores in the Raglan area of the Cape Smith Belt in northern Québec exhibit a wide range of heterogeneous primary and secondary textures. Primary magmatic textures include fine patchy disseminated, oikocrystic disseminated, blebby disseminated, and patchy net-textured sulfides in orthocumulate rocks, net-textured sulfides in mesocumulate rocks, and semi-massive and massive sulfides. Secondary textures include very fine (cloud) disseminated sulfides, modified patchy disseminated sulfides, modified patchy and oikocrystic net-textured sulfides, and reverse net-textured sulfides. Models involving cotectic precipitation of olivine and sulfide account for the low and relatively uniform abundances of disseminated sulfides in some komatiitic dunite-hosted deposits, but such models do not explain the high abundances and heterogeneous distributions of sulfides in deposits like Raglan. The basal ore segregation profiles in some deposits are relatively simple, comprising massive sulfides overlain by net-textured sulfides and disseminated sulfides, in which the layering has been attributed to density segregation, but the profiles in other deposits, including

Raglan, are much more complex and suggest that dynamic flow segregation and capillary infiltration processes also influenced the formation of the ore segregation profiles. Mesoscopic variations in sulfide textures at Raglan, manifested by cm-dm scale variations in the abundances and textures of sulfides, appear to have been controlled by variations in the proportions of sulfide and silicate liquids resulting from heterogeneities in the S contents of footwall rocks and/or variations in fluid dynamics, which influenced the sulfide saturation state and which produced the variability of primary textures and the stratigraphic complexity of the ore zones. Microscopic variations in sulfide textures, manifested by mm-cm scale variations in the abundances and textures of sulfides, appear to have been controlled by variations in permeability (orthocumulate vs. mesocumulate) and differences in wetting properties between olivine, pyroxene, sulfide melt, and silicate melt. The formation of uniformly disseminated sulfides (interstitial droplets), isolated patches of net-textured sulfides, and continuous networks of sulfide mineralization appears to have depended principally on the amount of interstitial silicate melt and the ability of sulfides to wet olivine or be wetted by silicate melt. Secondary processes modified primary sulfide textures by destroying original textures and dispersing sulfides during metamorphic crystallization of serpentine and by upgrading ore tenors within secondary (post-serpentine) sulfides.