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SPECIAL COLLECTION: FROM MAGMAS TO ORE DEPOSITS

Sulfide-silicate textures in magmatic Ni-Cu-PGE sulfide ore deposits: Disseminated and net-textured ores

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Abstract

A large proportion of ores in magmatic sulfide deposits consist of mixtures of cumulus silicate minerals, sulfide liquid, and silicate melt, with characteristic textural relationships that provide essential clues to their origin. Within silicate-sulfide cumulates, there is a range of sulfide abundance in magmatic-textured silicate-sulfide ores between ores with up to about five modal percent sulfides, called "disseminated ores," and "net-textured" (or "matrix") ores containing about 30 to 70 modal percent sulfide forming continuous networks enclosing cumulus silicates. Disseminated ores in cumulates have various textural types relating to the presence or absence of trapped interstitial silicate melt and (rarely) vapor bubbles. Spherical or oblate spherical globules with smooth menisci, as in the Black Swan disseminated ores, are associated with silicate-filled cavities interpreted as amygdales or segregation vesicles. More irregular globules lacking internal differentiation and having partially facetted margins are interpreted as entrainment of previously segregated, partially solidified sulfide. There is a textural continuum between various types of disseminated and net-textured ores, intermediate types commonly taking the form of "patchy net-textured ores" containing sulfide-rich and sulfide-poor domains at centimeter to decimeter scale. These textures are ascribed primarily to the process of sulfide percolation, itself triggered by the process of competitive wetting whereby the silicate melt preferentially wets silicate crystal surfaces. The process is self-reinforcing as sulfide migration causes sulfide networks to grow by coalescence, with a larger rise height and hence a greater gravitational driving force for percolation and silicate melt displacement. Many of the textural variants catalogued here, including poikilitic or leopard-textured ores, can be explained in these terms. Additional complexity is added by factors such as the presence of oikocrysts and segregation of sulfide liquid during strain-rate dependent thixotropic behavior of partially consolidated cumulates. Integrated textural and geochemical studies are critical to full understanding of ore-forming systems.

Keywords: Nickel deposits, magmatic sulfides, komatiites, layered intrusions, Invited Centennial article