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IMAGE ANALYSIS AND COMPOSITION OF PLATINUM-GROUP MINERALS IN THE J-M REEF, STILLWATER COMPLEX

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Abstract

Detailed imaging, bulk geochemical analyses, and laser ablation ICP-MS analyses were conducted on mineralized samples from the platinum-group element (PGE)–bearing J-M reef, Stillwater Complex (Montana). The aims of the study were to determine which phases are the main hosts of the PGE, to examine the textural relationships of the PGE-bearing minerals, and the associated base metal sulfides, silicates, and secondary magnetites. The platinum-group minerals (PGM) observed in the studied samples consist of Pd ± Pt sulfides, Pt-Fe alloy (isoferroplatinum), Pd ± Pt tellurides, and Pd-Cu alloy (skaergaardite) with minor native Pd, [Ru(Ir, Os)S_2] (laurite), and Au-Pd-Ag alloy (palladian electrum). These minerals account for all the Pt, half the Pd, Ru, and Ir, and a smaller proportion of the Os in whole rocks (the balance being found in the base metal sulfide). Most of these PGM are closely associated with base metal sulfides, either included in the base metal sulfide or located at the contact between the base metal sulfide and the silicate or oxide minerals. The textures of the PGM within and at the margins of the base metal sulfide suggest that they exsolved from the sulfides. We suggest that the PGE, Ni, Cu, and Te partitioned into a magmatic sulfide liquid that crystallized into base metal sulfide. The Pt-Fe alloys and some of the Pd sulfides exsolved from the base metal sulfide during desulfurization at fairly high temperatures. In contrast, the skaergaardite and some Pd sulfides are found in association with secondary magnetite and probably formed at relatively low temperatures (~250°–465°C) during a second fluid migration event. The Pd/Pt ratio of the reef (~3.3) is higher than most mafic magmas and the Pd/Pt ratio of the footwall is lower (0.3–0.7). It is possible that some of the Pd in the reef was leached from the underlying rocks and deposited in the reef as PGM associated with secondary magnetite.

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