Platinum Group Element Geochemistry and Platinum Group Mineralogy of the Jinbaoshan PGE-(Cu)-(Ni) Deposit, Western Yunnan, China

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The ~260 Ma Jinbaoshan PGE-(Cu)-(Ni) deposit is located in the western part of the Yangtze Plate, along the eastern margin of the Red River fault system in southwest China, and is the largest PGE-(Cu)-(Ni) deposit in China. The Jinbaoshan intrusion is exposed as a large sill-like ultramafic intrusion approximately 5 km long, up to 1.2 km wide, and up to 170 m thick. It is composed mainly of wehrlite (92 vol.%) with minor gabbro and clinopyroxenite. The mineralization occurs as stratiform or lensoid bodies in the central part of the wehrlite at multiple levels of the intrusion. The sulfide assemblage includes pyrite, chalcopyrite, millerite, violarite, and magnetite, most likely representing oxidation of an original pyrrhotite-pentlandite- chalcopyrite assemblage. A Fe-Ni-S diagram indicates the sulfide assemblage is richer in S and poorer in Fe than most primary magmatic sulfide assemblages. Platinum-group minerals (PGMs) are 0.5-10 μm in diameter and include moncheite $Pt(Te,Bi)_2$, merteite I $Pd_{11}(Sb,As)_4$, atokite or rustenburgite $(Pd,Pt)_3Sn$, irarsite IrAsS, and sperrylite $PtAs_2$, hosted mainly by violarite, silicates (primarily serpentine), and millerite. Nearly all merteite I grains occur at the edges of their host minerals, appearing anhedral in metagabbroic rock. Mineralized rocks have a significantly lower Nb/Th and higher Th/Yb ratios than typical mantle melts. It has been used by other workers to suggest that the magma experienced crustal contamination, which induced segregation of a Ni-Cu-PGE enriched sulfide melt. Whole rock Sr-Nd isotopes suggest that the Jinbaoshan magma experienced up to ~20% contamination with Yangtze upper crust. Primitive mantle-normalized PGE patterns have strong negative Ru and slightly negative Rh anomalies, both of which are known to also partition into chromite, indicating crystallization of chromite at an early stage. The mineralization is enriched in PGE > Cu > Ni, consistent with formation at a high magma:sulfide ratio (high “R” factor), suggesting a dynamic open magmatic system whereby the segregated sulfide liquid interacted with a very large mass of magma. At a later stage, the ores were hydrothermally altered by S-rich fluids, which modified the distributions of PGEs and the textures of PGMs.