Insights into the Crystal Chemistry of Platinum-Group Minerals: Issues facing development of a PGM Classification Hierarchy

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Summary

Platinum-Group Minerals (PGM), *i.e.*, those minerals containing at least one of the Platinum-Group Elements (Ir,Os,Ru,Rh,Pt or Pd) as essential constituents, represent one of the most economically important mineral groups in nature. With almost 130 distinct species having been recognized, it is logical to conclude that a hierarchical scheme facilitating classification of PGM would exist but this is not the case. There are several reasons for this: a. poor knowledge regarding the extent of solid-solution in certain series (*e.g.*, braggite-vysotskite); b. general acceptance of questionable species (*e.g.*, mertieite-I vs. mertieite-II); c. poorly defined chemical formulae (incorrect elemental ratios or presence of PGE as non-essential constituents); d. the fact many develop in aggregates containing more than one species; e. minute size of PGM in general and f. lack of reliable crystal-structure determinations. Of these, arguably the most important is the near absence of single-crystal structure determinations (of the 127 accepted PGM species, no more than 15 have had independent, reliable single-crystal structure determinations conducted on them). These provide data critical to defining reliable chemical formulae, testing for the existence of polymorphs and establishing crystal-structure features useful in guiding development of a classification hierarchy.

The main hurdles facing single-crystal studies is the size and rarity of PGM: the former may be a function of PGM developing through self-organization of nanoparticles and the latter from the low concentrations of PGE present in most lithologies. Despite these, advances are being made in the study of PGM. These include new methodologies that serve to: a. liberate and concentrate PGM (EPD, HS), b. elucidate crystal-structure features (Raman spectroscopy, EBSD, advanced powder diffraction) and c. determine their absolute crystal structures (single-crystal diffraction techniques).

This talk will present concrete examples of the major issues facing complete characterization of PGM and the new methodologies being employed to overcome these issues. Based on solutions provided, an outline for a comprehensive PGM classification scheme will be discussed, making particular reference to the significance that can be attributed to a more complete understanding of this economically and scientifically important group of minerals.