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Nano-sized particles and semimetal-rich melts in PGE-rich magmatic mineral systems

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The results of several high temperature experiments predict that nanoparticles and nanomelts enriched in noble metals indeed exist in magmatic systems. Nanoparticles of Ru-Os-Ir or P-bearing sulfides alloys have been synthetized from S-free or S-undersaturated basaltic silicate melts at > 1000 °C at > 1000 °C. Pt-rich arsenide nanoparticles have also been synthesized in high-temperature sulfide melts well before the melt had reached a Pt–As concentration at which discrete Pt arsenide minerals become stable phases. More recently, the immiscibility of PGE-rich bismuthide melts within Ni-Fe-Cu sulfide liquids have also observed in high-temperature experiments, evidencing the key role played by nanomelts in controlling the PGE partitioning in magmatic mineral systems and their necessary existence for the formation of PGE-rich nanoparticles. However, many researches still remain convinced that these nanoparticles represent artifacts produced during quenching of experimental runs. The combination of focused ion beam micro-sampling techniques with high-resolution transmission electron microscopy (HRTEM) observations allowed the identification of PGE nanoparticles and nanominerals in magmatic base-metal sulfides from the PGE-Cr deposits from the Bushveld Complex in South Africa and the eastern Cuban ophiolites. Moreover, nanometer sized of all six PGEs (Os, Ir, Rh, Ru, Pt, Pd) are relatively frequent natural quenched silicate melts preserved in mantle xenoliths. Collectively, all these observations made on natural rocks confirm the predictions of previous experiments on the possible formation of PGE mineral nanoparticles in magmatic systems rather to be result of low-temperature subsolidus re-equilibrium of magmatic minerals.