Origin of chromitite dykes by *in situ* crystallization in feeder conduits: a case study of the Monchegorsk Layered Intrusion, Russia

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We have discovered for the first time several chromitite dykes that cut a sequence with alternating layers of dunite and chromitite in the lower part of the Monchegorsk Layered Intrusion, Russia. The chromitite dykes are up to 18 cm thick and several meters long, have sharp boundaries with host dunite, and are fine-grained cumulate with up to 80-85% of chromite. The dykes are internally zoned, with chromite showing an inward decrease in FeO and an increase in MgO and Mg-number ($Mg/(Mg+Fe^{2+})$). Most olivine grains in dunite adjacent to chromitite dykes are reversely zoned in terms of Mg-number (up to 3-5) and their rims become higher in an Mg-number as contacts of chromitite dykes are approached. The dykes and layers are also disparate in platinum-group element (PGE) patterns, with the former being significantly enriched in an Ir-subgroup PGE (Os, Ir and Ru) and depleted in a Pt-subgroup PGE (Pt, Pd and Rh). These differences preclude the formation of chromitite dykes from tectonically remobilized chromitite layers. Similarly, the dykes cannot be formed from chromite-rich slurries replenishing the evolving magma chamber. Gravity-induced separation of chromite from such slurries in feeder conduits cannot result in chromitite dykes with such a high concentration of chromite. Also, the lack of stratiform chromitite layers to be produced from such slurries higher up in the section of the intrusion is not compatible with this idea. We propose that chromitite dykes are produced from the prolonged flow of initially chromite-saturated magma that crystallized chromite cumulate *in situ* along sidewalls of feeder conduits. A high abundance of chromite in dykes can be explained by a high ability of magma flowing along the channel to remove interstitial liquid from *in situ* growing chromite. Internal zonation of dykes and reversely-zoned olivine can be attributed to a postcumulus interaction between chromite in dykes and olivine in adjacent dunite, a process not fully understood but thought to mediate through a film of trapped liquid.