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Trace element geochemistry of co-crystallizing minerals in the Panzhihua layered intrusion, SW China

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Trace element contents in magnetite, ilmenite, and clinopyroxene from the Panzhihua intrusion, SW China, have been determined using Laser Ablation ICP-MS to estimate the factors and processes that control trace element partitioning among co-crystallizing cumulus minerals in layered mafic intrusions. Our results show that the cumulus minerals display strong depletions of Ni, Co, and Cr, indicating that their parental magmas are low in abundance of these trace elements probably due to prior sulfide removal and the fractionation of chromite or Cr-magnetite in a staging magma chamber. Both magnetite and clinopyroxene present cyclical variations in some transition elements along the stratigraphic section, such as Cr, V, and Ni. The average contents of these transition elements in magnetite are positively correlated with those in clinopyroxene, likely resulting from co-crystallization of magnetite and clinopyroxene from the parental magmas. The incompatible element concentrations, for example, Zr, Hf, and Nb, of all cumulus minerals in the Lower Zone are highly variable compared with those in the Middle and Upper Zones. The large variations of trace element compositions in cumulus minerals resulted from a “trapped liquid shift” in the Lower Zone. Furthermore, ilmenite crystals from the Panzhihua layered intrusion may have undergone extensive modification of transition elements during subsolidus re-equilibration with magnetite, giving rising to the decoupled variations of these transition elements in ilmenite across the Lower Zone stratigraphy. Consequently, our study indicates that systematic trace element variations of the main cumulus mineral assemblage, rather than a single mineral, should be considered to better constrain the magmatic differentiation and elemental fractionation of layered intrusions.