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Mantle sequences beneath Colorado from xenocrysts from Sloan and Kelsey lake kimberlites.

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The mantle sequences beneath the Sloan and Kelsey Lake kimberlites, Colorado, were reconstructed using analyses (∼2000) of mineral grains from a concentrate composed of xenocrysts and mineral intergrowths. The SCLM beneath Sloan reconstructed by thermobarometry (Ashchepkov et al., 2010) shows a sharp division into two major parts which are divided by the PT estimates for Opx, together with some eclogitic pyroxenes (omphacites with up to 6 wt% Na2O) and some Al-augites from Ga- Cpx cumulates, in the 40-30 kbar interval. Similar PT conditions were found for Cr -rich ilmenites and diopsides from metasomatitic veins. Estimates for garnets that form a lherzolitic trend (G11) enriched in TiO2 show heating of the base of the SCLM and common peridotites and metasomatites that reflect conditions of ∼37mw/m-2. In the lower part of the section, two branches for the Cr-diopsides related to sheared and Ti-rich garnets mark the heating of the base of the SCLM at 75 kbars. The deeper Cr-spinels show variations from 60% Cr2O3 to Cr-picotites with a linear enrichment of Ti with depth. Enrichment in NiO increases with decreasing pressure for the peridotitic picotites. The PT conditions for low-Cr diopsides and ilmenites at the base of the SCLM reflect the conditions of protokimberlite magma fractionation in the conduit. Those forming the stepped rise of Cr2O3 reflect development of the branches of the metasomatites derived from a larger magma chamber (feeder).

Three major branches for Cr-diopsides and ilmenites at the base of the SCLM are evident in the P- Fe#Ol diagram. The branch with Fe# = 17 reflects evolution of the protokimberlite melts which formed Cr- diopsides with features similar to sheared peridotites. The branch of the metasomatites shows a relatively constant Fe# at about 12, while typical mantle peridotites and some ilmenites reflect a branch with Fe# near 8-10. The upper level of the mantle column above 30 kbar shows three branches of PT paths. The hottest is for Opx and Cpx, the middle one for the garnets and Cpx and the lowest temperature for Sp, Cpx and Gar. Fe# variations from 9 to 11 possibly reflect mineral disequilibrium.

The mantle sequence beneath Kelsey Lake pipe shows lower temperature conditions with some deviations to conditions < 35 mw/m-2. Relatively HT branches occur for Cr-rich garnets in the base of SCLM with pyroxenitic tendencies. Several joined trends (Fe#∼15-17; 11-14) in the 65 to 30 kbar interval indicate refertlization of ilmenites and Cr diopsides. Chromites reflect splitting trends (Fe# ∼10-12) at 55-40kbar. High T conditions with sub-adiabatic path are detected for some ilmenites.

Trace elements for Kelsey Lake megacrysts were determined using LAM ICP-MS. Garnet with increasing Cr reveals lower REE and progressive S-shaping, with pressure increase. The peak in U is higher for garnets with common rounded REE patterns. Clinopyroxene REE patterns show rotation around Gd (La/Yb variations) suggesting different percentages of garnet in melting/precipitation assemblages. Zr-HF depletion was found for two grains while Ta-Nb troughs are common. Depletion in HFSE coincides with growth of the U peaks. Cpx with one order REE enrichment display enrichment in LREE and Th, probably derived from a carbonatite melt. The pattern for Cpx from Sp lherzolites displays LREE enrichment and U, Ba peaks possibly relating to subduction. Spinels have very low concentrations of REE but with higher LREE and HFSE peaks. Ilmenites from this pipe are very enriched in trace elements, especially in LREE. The inclination of REE patterns (La/Yb)n is higher for the less enriched grains. Divergence in HREE may indicate garnet dissolution because other components especially Ta-Nb-Zr-Hf reveal very strong enrichment. Grant RBRF 05-05-64718