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Aillikite as the protokimberlite melt: evidence by the olivine composition from kimberlite and ultramafic lamprophyre

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This study describes the composition of olivine from ultramafic lamprophyres (aillikites and damtjernites) and discusses carbonate-rich aillikitic melts as primary melts for kimberlites. We have studied the composition (EPMA, LA-ICP-MS) of olivine from Devonian and Triassic aillikites and damtjernites from the Irkineeva-Chadobets Trough, the SW Siberia craton, Russia. The obtained data have been compared with olivine from archetypal kimberlites (similar with the Group 1 kimberlite of South Africa): (i) the Grib kimberlite, Arkhangelsk diamond province, Russia(1–3); (ii) the Catoca kimberlite, Angola(4) and with the published data for olivine from archetypal aillikites from Aillik Bay, Labrador, Canada.

The composition of olivine from the Devonian and Triassic aillikites and damtjernites from the Irkineeva-Chadobets Trough suggests various degrees of interaction of primary aillikitic melts with the lithospheric mantle:

1) Devonian aillikitic melts have experienced an intensive interaction with cool depleted lithospheric peridotites including assimilation of orthopyroxene.

2) Triassic aillikitic melts intruded after the Triassic Siberian traps ascended through relatively heated lithospheric mantle without intensive interaction with one; the olivine composition suggests the presence of pyroxenites (or carbonate-metasomatized lithospheric mantle) in their source.

The comparison of olivine from studied ultramafic lamprophyres with the mineral from a kimberlite matrix and peridotite xenoliths from archetypal kimberlites suggests that early portions of protokimberlite melts could be carbonate-rich ultramafic aillikite-like melts. However, further evolution of the protokimberlite melts differ from aillikites by the higher degree of interaction with depleted lithospheric mantle.

The neoblastic olivine from sheared peridotite xenolith(3) and the mineral of some inner zones of macrocrysts(1,2) equilibrated with protokimberlite melts show similar composition with olivine phenocrysts from aillikites. Porphyroblastic olivine from sheared peridotite xenolith3 together with part of inner zones of olivine macrocrysts show a trend indicating re-equilibration of peridotitic olivines with aillikite-like protokimberlite melts.

The modes of compositional evolution of outer zones (rims) of olivine from kimberlite and aillikite that crystallized from kimberlitic or aillikitic melts are similar.

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