The compositional structure and thermal state of the lithospheric mantle beneath the western edge of Zimbabwe Craton

T Motsamai[a], JW Harris[a], T Stachel[a], DG Pearson[a], and J Armstrong[a]

[a] *Earth and Atmospheric Sciences, University of Alberta, AB, Canada*

[b] *School of Geographical and Earth Sciences, University of Glasgow, Glasgow, U.K.*

[c] *Lucara Diamond Corporation, Vancouver Corporate Office, BC, Canada*

The petrography and major element geochemistry of mantle xenoliths recovered during mining at Karowe provide a window into the lithospheric mantle beneath the western edge of Zimbabwe Craton. Twenty-four mantle xenoliths and more than one hundred clinopyroxene grains recovered from mineral concentrates were analysed.

Mantle xenoliths from Karowe mine have ellipsoidal shapes and measure 1.5 to 4.0 cm along the longest dimension. They are dominated by spinel lherzolites suite (67 %) and variably metasomatised and altered garnet-clinopyroxenites (17 %) being the next abundant type. Garnet lherzolite, garnet spinel lherzolite, dunite and eclogite are represented by single samples each (i.e 4 % relative abundance each).

Spinel bearing lherzolites have a coarse-granolublastic texture. Olivine Mg-number ranges between 91.2 and 92.5 (median: 92.1). Spinel Cr number varies from 12.9 to 47.2(median: 35.6) and is accompanied by low TiO_2 (<0.2wt %), consistent with a mantle peridotite origin. Although, the textural features match those observed for spinel lherzolite samples from Letlhakane, there is noticeable distinction in chemical composition of spinels; Letlhakane lherzolites xenoliths contain spinel with high Cr number (median: 74) and TiO_2 content (>0.5 wt %). This suggest that Karowe xenoliths might have derived from less depleted mantle peridotite and encountered less metasomatic effects.

Clinopyroxene-based geothermobarometry on mineral concentrates and peridotitic mantle xenoliths gives a 39-40 mW/m^2 paleogeotherm, intersecting the mantle adiabat at about 210 km depth. This implies that the diamond window in the lithospheric mantle beneath Karowe is 60 km thick.

Corresponding author: motsamai@ualberta.ca