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# The mineral chemistry derived diamond potential of NW Botswana: on- or off-craton in West Gondwanaland?

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Major and trace element compositions were measured for a large number of mantle-derived clinopyroxene and garnet xenocrysts from ca. 85 Ma old kimberlites of the Xaudum province located in NW Botswana. We utilize these data to understand the thermal and compositional evolution of the continental mantle lithosphere in between two major Archean cratonic blocks of the West Gondwana assembly, namely the Congo and Kalahari cratons that amalgamated during the late Proterozoic. Pressure-temperature calculations using the single-grain clinopyroxene technique reveal a relatively cold cratonic geotherm between 37–38 mW/m$^2$ for the study region during the Late Mesozoic. Our data suggest that the mantle lithosphere beneath NW Botswana is strongly depleted to about 145 km depth, with an extensively metasomatized underlying layer between 145 and 210 km depth that represents the transition into the asthenosphere. The garnet population studied (496 individual grains) is dominated by lherzolitic G9 (38%) and megacrystic G1 (41%) compositions, with minor contributions from Ti-metasomatic G11 (7%) and eclogitic G3 (6%) type mantle sources. Harzburgitic G10 garnets are very rare (two grains only), which is consistent with a lherzolite-dominated mantle lithosphere section in a craton margin position. The rare eclogitic garnets identified have compositions similar to those of high-Mg eclogites of Type-A affinity, for which metasomatic origins are implied as well. For peridotitic garnets, projections of Ni-in-garnet temperatures onto the independently constrained geotherm suggest that lherzolite dominates at <145 km depth, whereas high-Ti lherzolitic G11 garnets and megacrystic G1 garnets appear to originate from greater depths all the way down to the cratonic lithosphere base at around 210 km depth. The dissimilarity of the deepest-derived garnets from kimberlites in NW Botswana to garnets that occur as inclusions in diamond from cratons worldwide suggests that extensive overprinting of the lowermost lithosphere between the Congo-Kalahari cratons by oxidative melt-related metasomatism has greatly diminished the regional diamond potential.