

Age and Characteristics of the Lithospheric Mantle Beneath the Karowe Diamond Mine, Botswana

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The Karowe Diamond Mine is developed by Lucara Diamond from the AK/06 kimberlite pipe in the Orapa kimberlite cluster in north-central Botswana. The mine has famously recovered several large Type IIa diamonds, including the 1109 carat Lesedi La Rona. AK/06 is a Cretaceous pipe that erupted through the ~1.8 Ga Magondi belt on the western edge of the Zimbabwe craton. Nineteen peridotite and six pyroxenite xenoliths have been selected to characterise the level of depletion and any cryptic metasomatic alteration, as well as the age of the lithospheric mantle. The samples were analysed for mineral chemistry (EPMA and LA-ICP-MS), bulk rock major elements (XRF), and Re-Os plus platinum group elements. Peridotite mineral assemblages include clinopyroxene, present as bright green chromium diopside, orthopyroxene, olivine, and either spinel or garnet. Pyroxenite mineral assemblages are primarily clinopyroxene and garnet with variable olivine, orthopyroxene, amphibole and mica. Relative depletion (TRD) ages (relative to O-chondrite) show a peak at ~2.6-2.7 Ga that spread down to ~2.0-2.4 Ga. This older peak and the range in ages are similar to whole rock data reported from the Letlhakane mine. The spread to younger ages overlaps with the formation age of the Bushveld Intrusive Complex. The two samples with the most radiogenic Os and highest abundances of clinopyroxene yield Phanerozoic ages. This likely reflects the occurrence of metasomatic disturbance related to intense kimberlite activity in Cretaceous times.