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Geochemical Characteristics of Garnets from Tanzanian Kimberlites (Mwadui, Singida, Nyangwale, and Galamba kimberlites)

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More than 350 kimberlite pipes and clusters have been found in Tanzania up to date. Many of the occurrences are found in and around Shinyanga, northern Tanzania. They are characterised by the presence of crater deposits, suggesting that minimal erosion has taken place in this region since Neogene times (∼50 Ma) when the kimberlites were emplaced. The kimberlites are typically found in Archean granitic basement and meta-sediments. The most prominent kimberlite pipe, the Mwadui kimberlite, which is mined for diamonds, is one of the worlds largest and measures ∼146 ha at surface. Since only weathered crater deposits are exposed, no mantle xenoliths were found in the four visited / sampled kimberlite pipes: 1) Mwadui kimberlite, 2) Singida kimberlite, 3) Nyangwale kimberlite, 4) Galamba kimberlite. However, garnets could be sampled either in heavy mineral separates or as garnet megacrysts. These garnets have been studied using major, trace and rare earth element compositions in order to obtain information on the underlying upper mantle.

Garnets from the Williamson diamond mine are cm sized megacrysts. All of these mantle garnet megacrysts are low Cr megacrysts in composition (group G1). The $Cr2O_3$ values are low with 0.6-1.9 wt.%, TiO_2 values are high with 0.5-1.2 wt.% and CaO ∼4.7 wt.%. Only one megacryst from the Williamson Mine is harzburgitic (G10D diamond facies). The $Cr2O_3$ values are also very low with 1.5 wt. % , TiO_2 <0.04 wt.% and CaO ∼2.4 wt.%. Garnets are depleted in LREE and enriched in HREE relative to a primitive mantle. Ni in garnet geothermometry for the harzburgitic megacryst shows a temperature of 1015°C.

From the Singida kimberlite garnet grains of only a few mm could be recovered. Most of these garnet grains are eclogitic (G3) and low Cr megacrysts (G1), but there are also pyroxenitic (G4) and lherzolitic (G9) grains. The $Cr2O_3$ content: G3= <0.1 wt.%, G1= 0.07-3 wt.%, G4= ∼0.5 wt.% and G9= ∼3.5 wt.%. TiO_2: G3=<0.1 wt.%; G1= ∼0.7 wt.%, G4= 0.02-0.60 wt.% and G9= ∼0.05 wt%. CaO: G3= 7-13.5 wt.%, G1= ∼4.5 wt.%, G4= 3.8-5.0 wt.% and G9= 5.1-6.3 wt.%. Ni- Thermometer of G9 garnets give ∼830°C.

From the Nyangwale kimberlite only few garnet samples from heavy mineral concentrates were obtained. They are classified as group 9 (lherzolitic). The chemical composition is different from the Mwadui kimberlite garnets. The $Cr2O_3$ values are significantly higher with 3.7-4.9 wt.%, the TiO content is <0.5 wt.% and CaO ranges from 4.9-5.4 wt.%. Ni-Thermometer: 1160-1200°C.

The Galamba kimberlite is situated to the south of the Mwadui kimberlite. The chemical composition of the garnet is slightly different from the garnet megacrysts from the Mwadui kimberlite. They are lherzolitic (G9) and low Cr megacrysts (G1). The garnets from the Galamba kimberlite are also low in $Cr2O_3$ (0.2-2.5 wt.%). Garnets from the G9-group have a higher Cr content (∼2.5 wt.%) than these from group 1. The TiO_2 values ranges from 0.3-0.9 wt.% and CaO 4.5-4.9 wt.%. Ni- Thermometer of lherzolitic garnets show a temperature interval of 880-1015°C.

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