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THE RELATIONSHIP BETWEN INCLUSION COMPOSITION AND CARBON ISOTOPIC COMPOSITION OF HOST DIAMOND

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The ^{13}C content of the diamonds from the Premier and Fisch kimberlite is not related to diamond shape, color, state of deformation, type of mineral or the type of mineral paragenesis included. For the Premier mine it could be demonstrated that inclusion containing and inclusion free diamonds have the same mean $\delta^{13}C$ value. However, an isotopic composition difference between diamonds from Premier and Finsch kimberlites is observed, and in both occurrences there is a distinct association of diamonds of higher ^{13}C contents with inclusions low in SiO_2 (olivine, eclogite suite garnets and clinopyroxenes), Al_2O_3 (orthopyroxenes, peridotite suite garnets, eclogite suite garnets and clinopyroxenes), Cr_2O_3 (olivine, orthopyroxene, peridotite suite garnets, eclogite suite clinopyroxenes), MgO and Mg/(Mg+Fe), (clivines, orthopyroxenes, peridotite suite garnets, eclogite suite garnets), Na_2O, K_2O, TiO_2 (eclogite suite clinopyroxenes) and high in FeO (olivines, orthopyroxenes, and peridotite suite garnets), CaO (peridotite suite garnets, eclogite suite garnets and clinopyroxenes) and Ca/(Ca+Mg) (eclogite suite garnets and clinopyroxenes). Mg-Fe partitioning between ultramafic suite minerals occluded by the same diamond indicates higher pressure and temperature conditions of equilibration for diamonds with $\delta^{13}C$ larger than -4 o/oo and essentially peridotite subsolidus conditions for those with lower $\delta^{13}C$ values. For eclogite type inclusions, equilibration conditions in excess of 1100°C and 140 km depth are deduced and no further separation of carbon isotopic composition according to equilibration conditions was observed. The data are interpreted to indicate that in the mantle zones exist in which the average $\delta^{13}C$ value of carbon is above -4 o/oo and that these zones lie below about 140 km depth

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DIAMOND AND GRAPHITE ECLOGITE FROM ORAPA

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Orapa eclogite xenoliths are unique for the relative abundance of diamond eclogite (~0.7%) and graphite eclogite (~4.6%). The diamonds closely resemble mine production in colour, the common presence of interpenetrant twins and of aggregates. They differ in that octahedral growth forms are well preserved. The graphite is euhedral and tabular.

Mineral analyses confirm previous studies that diamond eclogites have a wide range of compositions. They tend to be calcium rich compared to inclusions in Orapa diamonds. There is only minor overlap of the two fields. The large garnet websterite field in the diamonds is rare in the diamondiferous rocks. Framesite minerals are contrastingly common in this region of the inclusion field. Minerals intergrown with coarser grained polycrystalline aggregates of diamond are more frequently similar to diamond eclogite minerals. This suggests slower growth is associated with calcium rich eclogite minerals.

Clinopyroxene in diamond from an eclogite is markedly less jadeitic than clinopyroxene in the host rock. This and other observations in mineral inclusions suggests the formation of the magnesian eclogites before the high iron and calcium types.

Graphite eclogites form two chemical groups, one with garnets of high Mg/Fe similar to garnet websterite xenoliths; the seond larger group form a narrow compositional band across the diamond eclogite field chiefly the result of a wide variation in Ca/Fe ratio.

Attempted application of the Ellis and Green (1979) geothermometer fails to account for the observed distribution of carbon phases as a temperature effect.

Ref : Ellis, D.J. and Green D.H. (1979) Contrib. Mineral Petrol. 71, 13-22.