

MINERAL INCLUSIONS IN DIAMOND: PREMIER, JAGERSFONTEIN AND  
FINSCH KIMBERLITES, SOUTH AFRICA, AND WILLIAMSON MINE, TANZANIA

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A major consideration with regard to inclusion research is the possibility of overall variation in inclusion type and mineralogy between different diamond-bearing localities. The answer to this and other questions related to inclusions should reveal the petro-chemical link between host kimberlite, associated xenoliths, and transported diamond.

We have undertaken a reconnaissance study of diamonds from four known localities: Premier, Jagersfontein, Finsch kimberlites, South Africa; and Williamson Mine, Tanzania. These localities were chosen because of availability of diamonds, difference in geographic locality and divergent differences in geologic age. Premier kimberlite is known to have been intruded in pre-cambrian times whereas the other kimberlites are phanerozoic. Also this was the first opportunity to sample inclusions from East African diamonds.

Overall the chemistry of inclusions from all four localities are similar to previously reported inclusions (1,2,3). For example, olivine, enstatite, garnet, clinopyroxene and spinel are all present (Table 1). However, as noted earlier (4) the inclusions may be subdivided into two distinct suites. One suite contains minerals that resemble the mineral assemblages in ultramafic xenoliths, whereas the other contains minerals comparable to those occurring in eclogite (Fig. 1).

Based on our limited sampling the Williamson Mine in particular is characterized by inclusions of the ultramafic suite. In contrast the diamonds from the Premier Mine contain fairly abundant pyrope-almandine and omphacitic diopside that are characteristic of eclogite. It appears that such minerals are more common in Premier diamonds than from any other locality. Whether this is due to the Pre-cambrian age of the pipe or otherwise is unknown. However, other diamonds which reached the earth's crust in Pre-cambrian times do not show this trait.

Of interest is the occurrence of two unusual pyrope garnets from Jagersfontein diamonds. These garnets appear transitional between the Cr-pyrope and eclogitic types and thus support the contention (5) of a sub-group of garnet inclusions. These garnets are much more akin to those from garnet lherzolite xenoliths. This could possibly indicate not two, but three chemical environments for diamond genesis.

With regard to this last point it should be noted that in general most unequivocal pre- or syngenetic inclusions do not resemble the present constituent minerals of kimberlite. The evidence at present, based on undeniable primary inclusions in that diamond does not form in kimberlite as presently defined but in some other preexisting chemical environments.

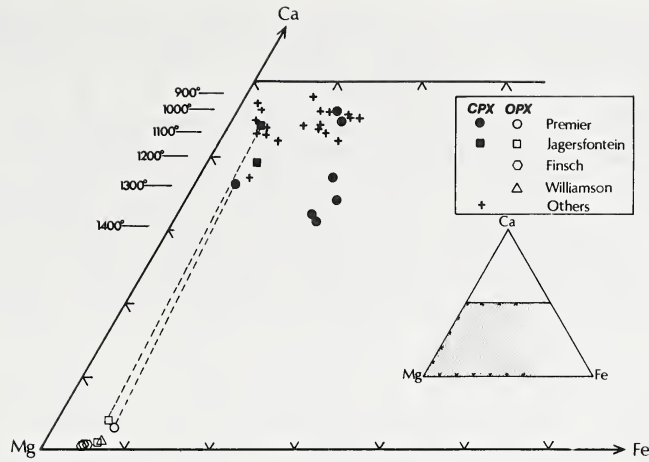
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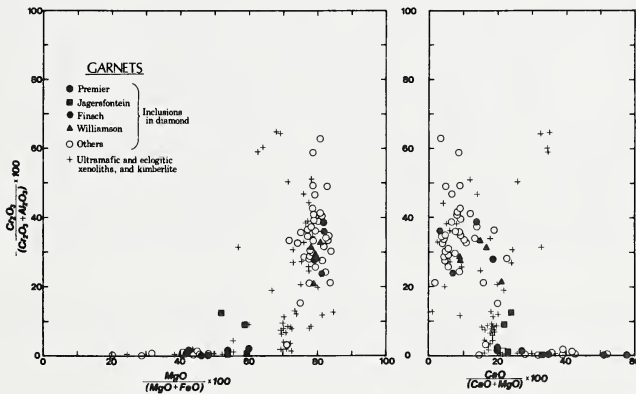
Table I. Representative analyses of inclusions in diamonds from Premier (P), Finsch (F), Jagersfontein (J) and Williamson (W) kimberlites.

Oxide	Garnet			Clinopyroxene			Orthopy- roxene	Chro- Olivine	mite
	F	J	P	J	P	P	F	W	F
SiO <sub>2</sub>	42.3	41.3	41.3	55.3	54.3	54.8	58.2	40.6	0.16
TiO <sub>2</sub>	0.04	0.71	0.31	0.04	0.94	1.23	<0.01	0.01	0.48
Al <sub>2</sub> O <sub>3</sub>	16.7	19.4	22.4	2.39	7.43	0.89	0.46	<0.01	7.16
Cr <sub>2</sub> O <sub>3</sub>	9.61	1.27	0.11	2.01	0.09	0.12	0.37	0.02	63.9
FeO*	5.46	12.8	14.7	1.95	8.18	9.21	3.64	7.24	10.7
MgO	25.2	18.2	13.5	16.2	12.5	16.6	37.0	51.6	14.7
CaO	0.69	5.28	7.35	19.2	12.1	14.0	0.24	0.04	0.05
NiO	<0.01	<0.01	<0.01	0.05	0.05	0.05	0.10	0.40	0.11
Na <sub>2</sub> O	0.10	0.07	0.35	2.17	4.34	2.64	0.06	0.04	<0.01
K <sub>2</sub> O	0.01	<0.01	<0.01	0.24	0.09	0.05	0.02	<0.01	<0.01
Total	100.2	99.0	100.0	99.5	100.0	99.6	100.1	100.0	97.3

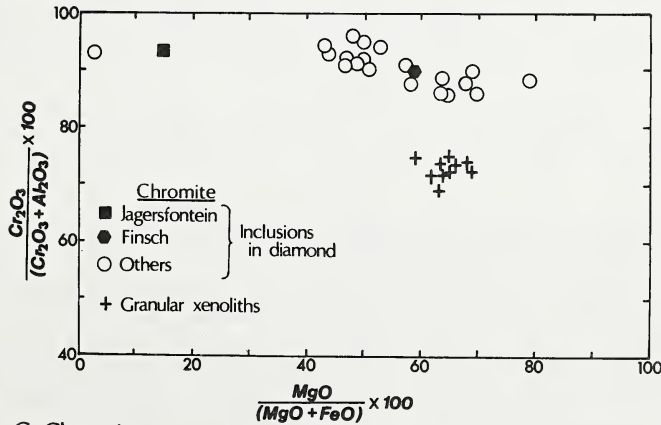
\* All Fe reported as FeO



A. Pyroxenes



B. Garnets



C. Chromites

Fig.1. Mineral inclusions in diamonds from Premier, Jagersfontein, Finsch and Williamson mines.