

JWANENG DIAMOND INCLUSIONS

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Sixty-nine inclusions recovered from fifty-two diamonds from the Jwaneng kimberlite, Botswana, are two thirds (46) eclogitic and one third (23) peridotitic.

In the eclogitic suite twenty-one garnets, twenty clinopyroxenes, seven rutiles and two silica phases (expected to be coesite) have been identified. The proportion of rutiles is unusually high. The majority of the garnets are high in total FeO as measured by electron microprobe (15.3 - 22.4 wt %). Sodium is a trace constituent of all the eclogitic garnets within the range 0.08 wt % to 0.30 wt %. Only one garnet however has less than 0.17 wt % Na₂O. The eclogitic clinopyroxenes also have a high pressure signature with K₂O in the range 0.05 wt % to 0.37 wt %. The majority of the pyroxenes have unusually high aluminium (Al₂O₃ up to 12.2 wt %) and sodium (Na₂O up to 6.11 wt %).

Ten garnet/clinopyroxene pairs have been recovered from single diamonds as have a co-existing rutile and probable coesite, a coexisting garnet and rutile and a garnet / probable coesite pair.

In the peridotitic paragenesis only two garnets have been recovered, one of which is probably harzburgitic in origin. The second garnet is interpreted to be lherzolitic. The olivines (12) fall within the range Fo_{90.7} - Fo_{92.3} and the orthopyroxenes (2) are En_{92.2} and En_{92.1} respectively. These compositions are again suggestive of a lherzolitic rather than harzburgitic origin. Chromite inclusions (7) all have more than 63 wt % Cr₂O₃, less than 0.25 wt % TiO₂ and in all elements fall within the range of compositions that have been reported for inclusions of chromite from other kimberlitic diamonds worldwide. An olivine / orthopyroxene / chromite assemblage has been recovered from one diamond, as well as an olivine / chromite pair and olivine coexisting with presumed coesite.

The Jwaneng diamond inclusion suite is therefore dominated by eclogitic and lherzolitic parageneses with only a minor input from diamondiferous harzburgite. Mineral compositions are presented in Table 1.

The association of eclogitic diamonds and lherzolitic diamonds is consistent with an origin related to subduction of oceanic crust and associated lithospheric mantle less depleted than the Archaean cratonic harzburgitic keel recognised at localities such as Finsch mine.

Table 1: Jwaneng Diamond Inclusions

Sample #	27B	28B	29A	30A	31A	33A	34A	35A	35B	36A	37A	37B	38A	39A	40A	41A	41B	42A
Pts analysed	3	4	5	5	5	5	5	5	6	4	6	5	3	6	4	3	3	3
Mineral	rut	rut	opx	E-cpx	E-cpx	E-cpx	E-cpx	E-cpx	E-cpx	E-cpx	E-cpx	E-cpx	clir	clir	chr	chr	chr	rut
SiO ₂	N.D.	N.D.	57.50	55.10	54.70	54.60	54.30	54.50	55.10	54.60	54.60	54.80	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
TiO ₂	97.52	97.10	N.D.	0.48	0.67	0.67	0.64	0.54	0.49	0.61	0.60	0.59	N.D.	0.23	0.10	N.D.	N.D.	98.90
Al ₂ O ₃	0.91	0.93	0.43	11.70	12.20	8.90	7.53	10.80	10.50	11.00	10.80	10.50	6.05	6.07	5.65	6.20	7.91	0.45
Cr ₂ O ₃	N.D.	N.D.	0.16	N.D.	N.D.	0.08	0.17	N.D.	N.D.	N.D.	0.10	N.D.	64.70	65.90	64.50	65.30	63.30	0.07
FeO	0.52	0.88	4.74	6.67	6.12	6.16	6.83	5.18	5.08	5.54	5.68	5.63	14.90	12.50	16.40	14.30	14.50	0.31
MnO	N.D.	N.D.	0.07	0.06	N.D.	0.06	0.10	N.D.	N.D.	N.D.	N.D.	N.D.	0.23	0.21	0.26	0.24	0.24	N.D.
MgO	N.D.	N.D.	36.30	9.33	7.46	10.80	11.60	9.12	9.28	8.81	8.93	8.94	13.80	15.10	13.00	13.90	14.20	N.D.
CaO	0.52	10.00	12.20	13.30	13.90	13.70	13.80	13.40	12.90	12.80	12.80	5.69	0.05					
Na ₂ O	0.04	6.04	6.11	4.79	4.15	5.45	5.56	5.58	5.56	5.58	5.69	5.78						
K ₂ O	N.D.	0.13	0.22	0.37	0.15	0.05	0.06	0.07	0.06	0.07	0.07	0.08						
NiO													0.12	0.12	0.11	0.12	0.12	
Total	98.95	98.91	99.76	99.51	99.68	99.73	99.37	99.34	99.87	99.61	99.37	99.52	99.85	100.13	100.02	100.06	100.27	99.73

Sample #	42B	43A	43B	44A	45AO	45AC	45B	46A	61A	61A	62A	64A	68A	69A	69B	70A	71A	72A
Pts analysed	4	3	5	3	5	3	5	3	6	6	5	6	4	5	3	5	5	5
Mineral	rut	chr	oliv	chr	oliv	chr	opx	rut	oliv	oliv	P-gar	P-gar	oliv	oliv	oliv	oliv	oliv	oliv
SiO ₂	N.D.	N.D.	41.20	N.D.	40.70	N.D.	57.40	N.D.	40.70	40.70	40.20	41.00	41.20	40.70	41.10	41.30	41.20	44.10
TiO ₂	97.23	0.21	N.D.	N.D.	N.D.	N.D.	N.D.	97.50	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	
Al ₂ O ₃	0.93	2.98		5.76		5.63	0.65	0.95			12.80	16.50						
Cr ₂ O ₃	N.D.	67.14	0.06	64.60	0.08	62.40	0.57	N.D.	0.05	14.40	9.42	0.03	0.04	0.04	0.06	0.03	0.03	0.06
FeO	0.87	16.78	7.57	15.80	7.65	16.90	4.79	0.66	7.95	7.28	6.38	6.93	8.65	8.65	8.69	7.71	7.50	7.08
MnO	N.D.	0.30		0.26		0.25	N.D.	N.D.		0.45	0.30							
MgO	N.D.		50.90	13.00	50.60	12.60	36.54	N.D.	50.60	20.30	19.70	51.10	49.70	50.20	50.80	50.90	50.90	51.30
CaO							0.47			4.06	6.08			0.08				
Na ₂ O																		
K ₂ O																		
NiO	0.09	0.09	0.36	0.11	0.36				0.38			0.37	0.41	0.39	0.37	0.32	0.32	0.38
Total	99.12	100.18	100.09	99.53	99.39	97.78	100.42	99.11	99.68	99.49	99.38	99.63	99.50	100.52	100.22	99.95	102.92	102.92

All sample numbers have "JW" prefix
N.D. = Not Detected