The vertical distribution of indicator minerals within Kalahari cover overlying a kimberlite pipe.

Baumgartner, M.C. [1] and Neuhoff, L.[2]

1. Mineral Services CC, P.O. Box 527, Howard Place, 7450, Cape Town , South Africa
2. GeoVentures Pty Ltd, P.O. Box 35004, Northcliff, 2115, Johannesburg, South Africa.

The objective of this study was to ascertain the vertical distribution of indicator minerals in Kalahari cover material overlying a kimberlite pipe. The indicator mineral distribution was evaluated in relation to proximity to kimberlite, and the lithology of the Kalahari cover material.

A borehole was drilled through 50 metres of Kalahari cover before intersecting crater facies kimberlite. The drill chips were sampled at 5 metre intervals from surface to 89 metres and the heavy mineral fraction was concentrated prior to manually picking kimberlitic minerals using a binocular microscope . The indicator minerals picked include garnet, ilmenite, chromite and chrome diopside. The concentrate was sieved into +300μm, + 425μm, +710μm and +1000μm fractions, and the indicator abundances were recorded for each fraction. For comparative purposes, all of the abundances were normalised to the screened weight of sample processed. Where the grains were picked from a concentrate split rather than the full concentrate, the data was first normalised to a per gram value prior to being normalised to the screened sample weight.

The results of the picking are present in Table 1 and Figure 1. The abundances reflect the total normalised count for all four size fractions. The lithology descriptions represent a summary classification based on the detailed borehole logs.

Depth (m)	# Gar	# Ilm	# Chr	# CD	# Total	Lithology Descriptor
0 - 5	0.48	2.88	0.00	0.24	81.49	Unconsolidated Sand
5 - 10	1.48	3.32	0.00	0.00	89.67	Unconsolidated Sand
10 - 15	0.00	0.80	0.00	0.00	38.96	Unconsolidated Sand
15 - 20	0.00	1.24	0.00	0.00	17.62	Unconsolidated Sand
20 - 25	0.00	2.95	0.00	0.00	27.27	Unconsolidated Sand
25 - 30	0.22	1.95	0.00	0.00	20.13	Unconsolidated Sand
30 - 35	0.00	1.38	0.00	0.00	25.99	Unconsolidated sand with minor calcrete and silcrete
35 - 40	2.60	9.64	0.00	0.00	390.36	White and pink calcrete and silcrete
40 - 45	3.85	7.69	0.00	0.00	296.15	White and pink calcrete and silcrete
45 - 50	20.27	95.61	1.35	0.00	1436.15	Pale grey calcrete and silcrete
50 - 55	35.08	94.76	0.00	0.52	997.91	Pale grey calcrete and silcrete with scattered opaques, garnets, and serpentinised kimberlite fragments.
55 - 60	48.18	134.09	0.00	3.64	1212.27	Alternating bands of kimberlite breccia and grey/brown mudstone
60 - 65	91.43	341.63	0.00	2.86	3836.33	Alternating bands of kimberlite breccia and grey/brown mudstone
65 - 70	45.78	152.32	0.00	2.45	2093.46	Alternating bands of kimberlite breccia and grey/brown mudstone
70 - 75	95.83	73.89	0.00	11.39	1838.33	Kimberlite breccia with occasional mustone and siltstone.
75 - 80	85.68	207.90	0.00	9.63	3417.28	Kimberlite breccia with occasional mustone and siltstone.
80 - 85	48.46	7.69	4.23	5.77	1324.23	Kimberlite breccia with occasional mustone and siltstone.
85 - 89	40.22	45.39	0.37	3.32	1443.54	Kimberlite breccia with occasional mustone and siltstone.

Table 1: Normalised indicator counts (grain counts per kg of screened material) for indicator minerals, and summary borehole log.

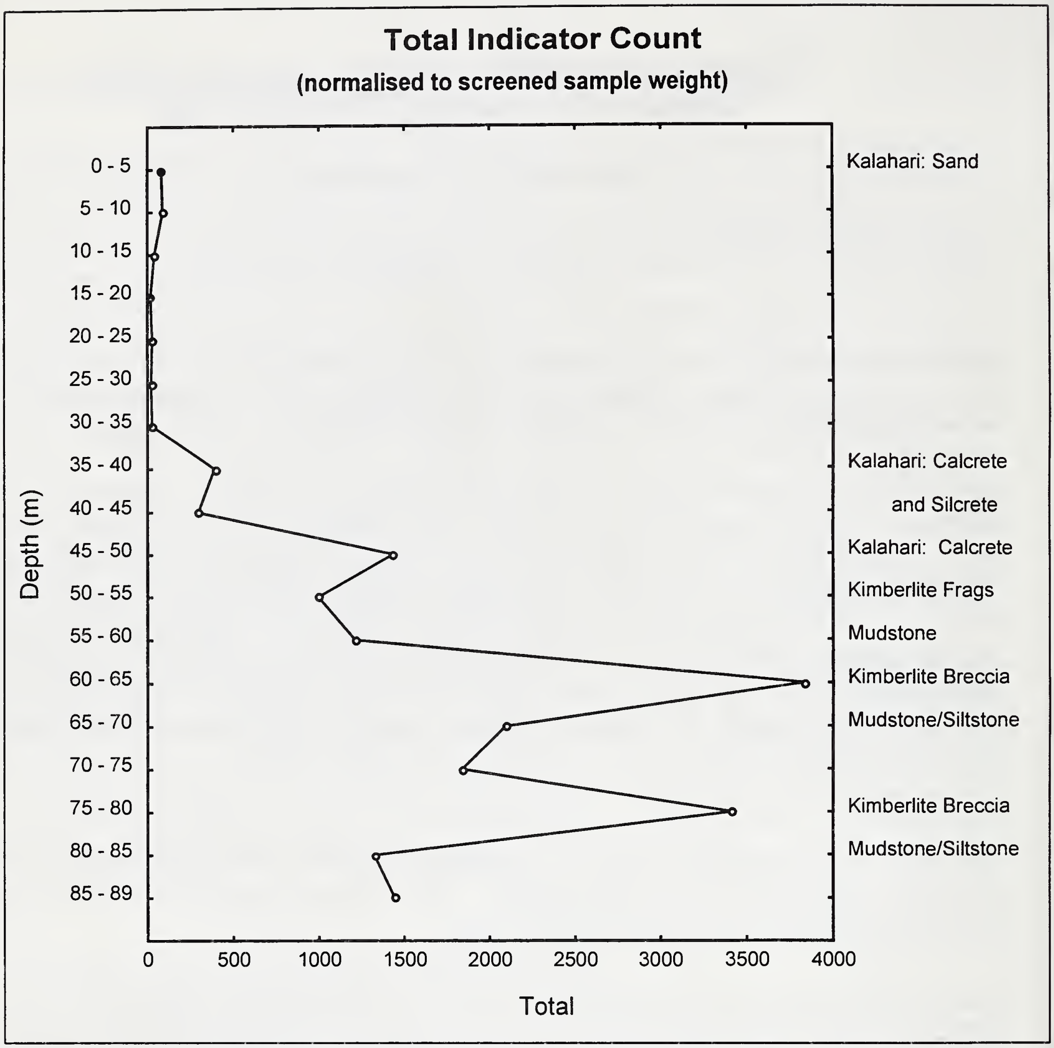

Figure 1: Down-hole profile depicting the total normalised indicator mineral count of samples collected at 5 metre intervals through the borehole.

Figure 1 and Table 1 show that a small indicator anomaly is developed at surface and in the first 5 to 10 metres of Kalahari sand cover directly over the kimberlite. Additional recoveries also occur at depth in the kalahari and appear to be associated with calcrete and silcrete horizons. The base of the kalahari lithology also shows a distinct increase in indicator mineral abundance. Within the kimberlite itself, the indicator mineral abundances fluctuate with the change in amount of kimberlite material present. Examination of the breakdown of indicator minerals recovered in each size fraction shows that the +425μm fraction contains the highest abundance of most minerals. In the kimberlite, ilmenite is by far the most abundant indicator mineral present, with the only exception being garnets in the +300μm fraction from the 75 – 80 metre depth interval. The predominance of ilmenite is reflected in the relative indicator mineral abundances within the Kalahari cover.

The presence of a surface anomaly in the Kalahari cover above the kimberlite may be attributed to either (a) bioturbation, which has been observed to occur to great depths in the Kalahari, or

(b) to standard landform development processes which have allowed for the migration of indicator minerals upwards through the Kalahari cover.

In both cases, the indicator minerals have subsequent to their transport, been concentrated by wind action on the current deflation surface. Additional recoveries in the Kalahari cover are believed to be lithologically controlled since they are associated with the presence of increased calcrete and silcrete within the profile. These horizons are interpreted to result from periods of quiescence during which heavy minerals accumulate on the deflation surface above the kimberlite. The mineral anomaly developed at the contact between the Kalahari cover and the kimberlite results from the release of indicators prior to deposition of the Kalahari sediment. Within the kimberlite crater itself, the indicator mineral trends are directly related to subtle lithological changes. The alternating kimberlite breccia – mudstone layers in the 60 – 90 metre depth interval are well depicted in the observed mineral trends.

The results of this study confirm that indicator minerals from kimberlites are transported to surface through thick Kalahari cover. In addition, the data indicate that within the Kalahari profile, concentration of indicator minerals occurs in association with the development of calcrete and silcrete. The presence of the surface mineral anomaly over the kimberlite confirms the validity of conducting mineralogical sampling in areas with considerable Kalahari cover.