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PETROLOGY OF CUTTINGS FROM KAKOONIE 1 NEAR BLACK HILL, SEDAN DISTRICT

GEOLOGICAL SURVEY

by

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ABSTRACT

Kakoonie 1 is an inclined, rotary drillhole sited by CSR Ltd on the southwestern margin of the Black Hill complex. Cuttings indicate alternating intersections of gabbroic lithologies with modified marginal facies and altered contact rocks. Local compositional changes in the gabbros are evident by petrographic examination of the cuttings and a general change from anorthositic at the top to ferromagnesian at depth is supported by geochemical data and possibly by geophysics. Examination of mineral concentrates analysed by fire assay indicates a low sulphide content and possible concentrations of 2ppm Au, and 0.2ppm of both Pt and Pd in the sulphide. Sulphur may have been drawn from both mantle and country rock sources.

INTRODUCTION

Kakoonie 1 is a rotary drillhole sited by Lindsay Curtis of CSR Ltd, Coal Division, 8km southwest of Black Hill township and 70m south of the Walmers Flat road (Fig. 1). The hole was drilled to 256m at an inclination of 60^{o} to the northeast. It was sited on a weak SP anomaly and an arcuate magnetic anomaly which were believed to indicate a contact on the southwestern margin of the high gravity anomaly produced by the Black Hill norite complex (Curtis, 1988).

Cuttings were collected at 2m intervals and samples for petrological examination were washed. Cuttings were examined under a binocular microscope and mineral identifications were confirmed by examination of fragments in refractive index liquids with a petrological microscope.

Fines washed out of the cuttings samples were bulked and sent to Amdel for separation of a sulphide concentrate. Various fractions were produced and one was analysed in duplicate by fire assay. It was examined microscopically and found to be low in sulphide.

MICROSCOPIC EXAMINATION OF CUTTINGS

Table 1; Petrographic log.

Sample	Depth (m)	
6728 RS 1640	40-42	Fossiliferous, coarse to fine grained quartz sand with sparse limonite cement. Grains rounded to irregular. Include silcrete fragments with manganese oxide dendrites. Abundant foraminifera including Amphistegina sp. (Oligo-Miocene) (J.M. Lindsay, pers. comm.).
6728 RS 1641	42-44	Same lithology.
6728 RS 1642	44-46	Grain size ranging up to 1cm. Less fossiliferous. Abundant reworked laterite grains and silcrete fragments. Most grains angular.
6728 RS 1643	46-48	Mainly fine sand but includes large mud flakes and silcrete fragments. Abundant limonitic laterite clasts. Finely divided carbonate fragments. Soft, opaque grains probably organic. Limonite cement and stains throughout.
No recovery	48-56	
6728 RS 1644	56-58	Mixed sedimentary and igneous lithologies. Tertiary sand, particles of clay up to 1.5cm across, cuttings of crystalline rock up to 1cm across. The latter contain a glassy plagioclase of brownish colour and a mineral with a pearly lustre and bronze colour which cleaves into flat sheets as well as prismatic splinters. This is probably diallage, a form of diopside.
6728 RS 1645	58-60	Almost all cuttings are of the gabbroic rock with coarse grain size and consisting of glassy plagioclase, bronze diallage and opaque, magnetic grains of magnetite. A green colouration is partly due to individual minerals and partly a general stain. A few grains are of decomposed rock and sediment.
6728 RS 1646	60-62	Hypersthene gabbro. Main pyroxene is still diallage but a few grains of hypersthene are present. Abundant chlorite and magnetite.

6728 RS 1647	62-64	Anorthosite gabbro. Plagioclase much more abundant than pyroxene. Green colouration is often a stain, not a mineral. Possibly associated with magnetite. Still a few grains of sediment.
6728 RS 1648	64-66	Gabbro richer in pyroxene. Main pyroxene is closer to normal augite. Diallage is possibly an alteration product. Minor hypersthene, magnetite and a trace of pyrite.
6728 RS 1649	66-68	Sample more finely divided. Plagioclase-rich. Rare sulphide, abundant magnetite. Blue-green staining. Green mica as well as chlorite.
6728 RS 1650	68-70	Sample fine in grain size. Diallage more common. Much green staining. Blue-green amphibole. Abundant magnetite. Trace of sulphide. Some limonitic material.
6728 RS 1651	70-72	Sample is a mixture of chips and slimes and includes several rock types. A little coarse gabbro with diallage is mixed with fine grained dioritic facies composed of plagioclase and biotite. Limonitic, oxidised material is common and appears to include sediment. Green mica and pink quartz and feldspar form another rock type. Magnetite is still present but sulphide is absent. The green mica may be chromium-bearing. The lithologies appear to indicate that the hole has emerged from the intrusive contact into contact-altered hybrid rocks.
6728 RS 1653	72-74	Coarse grain size again. Varied granitoids, probably remelted country rock. Quartz, biotite, muscovite, white feldspar, pink feldspar. Also green mica in chlorite.
6728 RS 1654	74-76	Contact rocks of siliceous and granitoid composition. Possibly hybridised as well as remelted.
6728 RS 1652 Rock Chips	70-80	Large rock chips without exact depths consist of similar lithologies as the smaller cuttings. The proportions of dark and light minerals and the grain sizes vary.

6728 RS 1655	76-78	Contact rocks with diverse lithologies. Green amphibole, mica and chlorite.
6728 RS 1656	78-80	Marginal facies of plutonic gabbroid as well as contact rocks. Coarse grained green amphibole and brownish plagioclase. Some oxidised facies. Hole passing back into intrusion.
6728 RS 1657	80-82	Plutonic lithology predominant. Only a few chips of country rock. Ferromagnesian mineral still largely green amphibole but some brown to bronze pyroxene present.
6728 RS 1658	82-84	Similar mixture of lithologies. Much green staining. Several grains of sulphide.
6728 RS 1659	84-86	Few contact rocks but main ferromagnesian mineral still amphibole. Several grains of sulphide. A little magnetite.
6728 RS 1660	86-88	Both black pyroxene and green amphibole present. Sulphide clearly associated with green amphibole-probably derived from country rock. Little magnetite.
6728 RS 1661	88-90	Bronze and black pyroxene and green amphibole. Sulphide again with green amphibole. Probable olivine with black pyroxene. Abundant magnetite.
6728 RS 1662	90-92	Mainly gabbroic lithologies but wide range of components particularly ferromagnesian minerals. Green amphibole, white plagioclase and sulphide. Black or bronze clinopyroxene sometimes intergrown with green amphibole (the latter is probably an alteration product of the former). Both hypersthene and ?olivine present. Pinkish brown plagioclase. Some magnetite present.
6728 RS 1663	92-94	Plagioclase-rich facies with minor pyroxene and amphibole. A range of sulphide minerals occurs as inclusions in plagioclase. The minerals include pyrrhotite and chalcopyrite as well as pyrite and may be derived from the magma, not country rock. Some magnetite present.
6728 RS 1664	94-96	Mixed lithologies - green amphibole with white plagioclase and bronze pyroxene with abundant brown plagioclase. A little sulphide. Some magnetite.

6728 RS 1665	96-98	Abundant brown plagioclase, less abundant bronze to black pyroxene. Rare green amphibole and white feldspar. Occasional olivine, often with pyroxene rim. Scattered sulphide of both country rock and magmatic origin. Frequent magnetite.
6728 RS 1666	98-100	Green amphibole facies more abundant than at 98-100m but brown plagioclase facies still major paragenesis. Traces of pyrite and pyrrhotite. Little magnetite.
6728 RS 1667	100-102	Finely divided grains. Brown plagioclase facies more abundant than green amphibole. Very little sulphide. Moderate magnetite.
6728 RS 1668	102-104	Facies about equal. Sulphide more abundant than at 100-102m but probably pyrite. Less magnetite. Green mica present.
6728 RS 1669	104-106	Plagioclase-rich but abundant green amphibole. More abundant sulphide of both types. Particularly abundant pyrrhotite. Green mica, brown mica, colourless mica. Magnetite less abundant.
6728 RS 1670	106-108	Brown plagioclase abundant but green amphibole frequent. Magnetite frequent and in large aggregates. Radial clusters of zeolite. Less sulphide but of magmatic type.
6728 RS 1671	108-110	Both facies still present. More pyroxene-rich than preceding samples. Sulphides rare. ?Sphene surrounded by rim of magnetite.
6728 RS 1672	110-112	Two facies amalgamated - green amphibole and brown plagioclase with dark pyroxene in same chip. Frequent fine grains of sulphide. White mineral possibly zeolite. Magnetite moderately abundant.
6727 RS 1673	112-114	Brown plagioclase, white plagioclase, green amphibole, dark pyroxene, hypersthene all in some grains. Sulphide of all types relatively abundant. Magnetite often in large masses.
6728 RS 1674	114-116	The same assemblage, including magnetite and sulphide is present in more finely ground sample.
6728 RS 1675	116-118	The same mixed assemblage in coarser particles. The hole may be passing through marginal intrusion with the contact parallel to the hole.

6728 RS 1676	118-120	The same assemblage.
6728 RS 1677	120-122	Olivine gabbro predominant. Disseminated sulphide present. Magnetite rare.
6728 RS 1678	122-124	Almost exclusively olivine gabbro with trace sulphide and magnetite.
6728 RS 1679	124-126	Plagioclase-rich gabbro. Trace sulphide. Moderately abundant magnetite.
6728 RS 1680	126-128	Gabbro with green amphibole. Sparse sulphide, moderate magnetite.
6728 RS 1681	128-130	Return of substantial green amphibole. Finely ground sample. Abundant plagioclase.
6728 RS 1682	130-132	Coarse grain size. Both 'brown' and 'green' paragenesis present. Traces of sulphide and magnetite.
6728 RS 1683	132-134	Coarse particles. Feldspathic. Rare sulphide and magnetite.
6728 RS 1684	134-136	Green amphibole predominates. Sulphide more abundant. Magnetite sparse.
6728 RS 1685	136-138	Pink and white feldspar, fine grained hybrid rocks. Plutonic grains with green amphibole. Magnetite rare. Sulphide absent.
6728 RS 1686	138-140	Finely ground. Plagioclase and green hornblende. Rare sulphide and magnetite. ?Back into pluton.
6728 RS 1687	140-142	Coarse particle size and coarse crystals. Plutonic lithology again. Green amphibole. Sulphide more abundant. Magnetite rare.
6728 RS 1688	142-144	Brown pyroxene as well as green hornblende. Disseminated magmatic sulphide and rare magnetite present.
6728 RS 1689	144-146	Anorthositic differentiate. Brown and green ferromagnesians. Frequent fine sulphide grains.
6728 RS 1690	146-148	Mainly brown plagioclase and dark pyroxene. Sulphide and magnetite rare.
6728 RS 1691	148-150	Some green lithologies with oxidised iron present but otherwise similar to 146-148m.

6728 RS 1692	150-152	Same lithologies but more sulphide and magnetite.
6728 RS 1693	152-154	A little green amphibole but mainly feldspathic plutonic lithology. Sparse sulphide and magnetite.
6728 RS 1694	154-156	Feldspathic plutonic lithology. Rare sulphide, magnetite more common.
6728 RS 1695	156-158	Same lithology. Magnetite common, sulphide very rare. Highly feldspathic.
6728 RS 1696	158-160	Abundant green amphibole. No brown pyroxene. Sulphide very rare but magnetite common.
6728 RS 1697	160-162	Both 'green' and 'brown' paragenesis. Sulphide extremely rare, magnetite relatively common.
6728 RS 1698	162-164	Anorthositic facies with rare sulphide and more common magnetite.
6728 RS 1699	164-166	Same assemblage. Sulphide slightly more common.
6728 RS 1700	166-168	Assemblage richer in ferromagnesian minerals, both green amphibole and brown pyroxene. Poor in sulphide, richer in magnetite. White feldspar present.
6728 RS 1701	168-170	Almost exclusively green amphibole with brown and white plagioclase. Sulphide rare, magnetite absent.
6728 RS 1702	170-172	Green amphibole almost as abundant as pinkish brown plagioclase. Very little pyroxene. Sulphide rare, magnetite absent.
6728 RS 1703	172-174	Green amphibole more abundant than brown pyroxene but brown plagioclase more abundant than white plagioclase. A few large patches of sulphide. Magnetite fairly abundant.
6728 RS 1704	174-176	Very little brown pyroxene but abundant green amphibole. Brown plagioclase more common than white. Sulphide and magnetite moderate.
6728 RS 1705	176-178	Same assemblage. Sulphide and magnetite relatively abundant.
6728 RS 1706	178-180	Identical.
6728 RS 1707	180-182	Same assemblage but with some oxidation. Magnetite more abundant than trace sulphide.

6728 RS 1708	182-184	Same assemblage. Brilliant red oxidation on the surface of magnetite grains. A few patches of sulphide.
6728 RS 1709	184-186	Same assemblage with a little biotite and mainly without oxidation. Rare sulphide, moderate magnetite.
6728 RS 1710	186-188	More biotite. Ferromagnesian mineral still mainly green hornblende. Plagioclase pinkish brown. Scattered trace of sulphide. Magnetite rare.
6728 RS 1711	188-190	As above. Fine, scattered sulphide. Rare magnetite.
6728 RS 1712	190-192	More brown pyroxene but also white plagioclases or ?zeolites. Pale brown mica. Some oxidation. Sulphide and magnetite more abundant.
6728 RS 1713	192-194	Very mixed lithology. Much white ?plagioclase. Green staining. ?Hybrid fragments. Moderate sulphide and magnetite.
6728 RS 1714	194-196	Blue green, yellow green, pink lithologies with brilliant red oxidation on some grains. Definite hybrids. Trace sulphide and magnetite.
6728 RS 1715	196-198	Still mixed but with 'brown lithology' predominant. Magnetite moderately abundant but sulphide rare.
6728 RS 1716	198-200	Mixed but highly feldspathic (pink brown). Magnetite moderate but sulphide rare.
6728 RS 1717	200-202	Dark ferromagnesian minerals more abundant. A little of 'green lithology' remains. Sulphide more abundant. Magnetite moderate.
6728 RS 1718	202-204	Same lithology. Sulphide moderate, magnetite plentiful.
6728 RS 1719	204-206	Almost none of the green lithology present. Sulphide and magnetite sparse. Ferromagnesian minerals abundant.
6728 RS 1720	206-208	More green lithology. More sulphide. Magnetite rare.
6728 RS 1721	208-210	Less green lithology. Less sulphide. Magnetite still rare.
6728 RS 1722	210-212	Green hornblende and white feldspar common but bronze pyroxene and black biotite in plagioclase in main lithology. Fine grained, doleritic cuttings with

		abundant sulphide also present. Sulphide relatively abundant in plutonic rock, both 'brown' and 'green'. Magnetite moderate. Probably post-intrusion dyke.
6728 RS 1723	212-214	Both brown and green plutonic lithologies, moderate sulphide and magnetite.
6728 RS 1724	214-216	Same lithologies. Less abundant sulphide and magnetite.
6728 RS 1725	216-218	Roughly equal amounts of brown and green lithologies. Frequent biotite. Sulphide more abundant. Moderate magnetite.
6728 RS 1726	218-220	Almost identical. Possibly more white feldspar and magnetite.
6728 RS 1727	220-222	More brown than green lithologies. Moderate sulphide and magnetite.
6728 RS 1728	222-224	Green and white lithology more abundant but brown still dominant. Less sulphide and magnetite.
6728 RS 1729	224-226	Same lithologies. Sulphide and magnetite moderate.
6728 RS 1730	226-228	Same again.
6728 RS 1731	228-230	Mainly medium grained hybrids of biotite and pink feldspar. May be more chilled gabbro than mobilised country rock. Pink, orange, white and green ?zeolites. Some plutonic chips of both green and brown lithologies. Sulphide and magnetite rare.
6728 RS 1732	230-232	Mainly medium and fine grained hybrids. Sulphide content appears higher. Magnetite moderate.
6728 RS 1733	232-234	Finer grains are coloured ?zeolites, coarser grains are of plutonic lithologies, mainly green type. Sulphide and magnetite contents moderate. Pale brown mica.
6728 RS 1734	234-236	White and green plutonic lithologies with dominant brown plagioclase. Moderate magnetite but low sulphide.
6728 RS 1735	236-238	Mainly brown plagioclase with bronze and green ferromagnesian minerals. Some biotite. Magnetite fairly abundant. Sulphide in rare patches.
6728 RS 1736	238-240	Same lithology. Sulphide quite abundant. Magnetite rare.

6728 RS 1737	240-242	Same again. Magnetite and sulphide (including bornite) quite abundant.
6728 RS 1738	242-244	Plutonic lithologies. Mainly brown plagioclase but with green hornblende, bronze pyroxene, hypersthene and olivine. Sulphide less abundant than in 240-242m but still substantial as a trace. Magnetite low.
6728 RS 1739	244-246	Same lithologies. Sulphides (including chalcopyrite) in large but rare patches. Magnetite sparse.
6728 RS 1740	246-248	Mixed brown and green plutonic lithologies with hypersthene and olivine. Sulphides and magnetite somewhat less abundant.
6728 RS 1741	248-250	Mixed plutonic lithologies with increased abundance of both sulphides and magnetite.
6728 RS 1742	250-252	Similar lithologies but with higher proportion of white ?feldspar. Sulphides moderate. Magnetite trace.
6728 RS 1743	252-254	Similar in all respects except higher magnetite.
6728 RS 1744	254-256	The hole ended in a plutonic lithology consisting of abundant pinkish brown plagioclase with both blue green amphibole and bronze pyroxene. In some chips hypersthene and in others white feldspar. Sulphides make an abundant trace component and magnetite is a moderately abundant trace.

HYPOTHETICAL CROSS-SECTION

Data from the petrological log have been summarised and interpreted in Figure 2, a schematic cross section of the northwestern margin of the Black Hill complex. The drill has passed through alternations of metamorphosed, probably remelted and hybridised, country rock, modified intrusive rock and unaltered gabbroic rock. This has been interpreted as a succession of apophyses emplaced by differential melting and wedging of contact rock by very hot magma but it is possible that offshoots from the main pluton are more extensive and form a series of sheeted dykes (W. McCallum, pers. comm.).

Contact modification of the gabbroic rocks is essentially a hydration, probably from formation water in the contact rocks, but also possibly in part from hydrothermal fluids within the pluton. Feldspars are first albitised, then replaced to varying extents by zeolites. Pyroxenes are first modified to diallage, then hydrated to form a green hornblende. Sulphides in the contact zone appear to be of two origins. Pyrite is often closely associated with green hornblende in the modified mafic rocks and the sulphur is possibly derived from contact rocks. Pyrite is also associated with unaltered ferromagnesian minerals and with other sulphides such as pyrrhotite, chalcopyrite and bornite. The sulphur for this association is possibly magmatic, that is of mantle origin, but may also include country rock sulphur. Isotope determinations would clarify this point, which is of critical importance in terms of platinoid ore genesis. Layers of varied composition have been logged in the magmatic rocks and in general the upper parts of the intrusion are dominantly anorthositic with an increase in pyroxene and olivine with depth.

GEOPHYSICAL CORRELATION

There is no clear correlation between the SP anomaly and the distribution of accessory sulphide in the logged samples.

The anomalous magnetic unit, as delineated by ground magnetometry, is possibly correlated with a general change in composition of the gabbroic rocks from dominantly anorthositic in the upper levels to more ferromagnesian lithologies, such as hypersthene - olivine gabbros, below about 200m. This is not proven as the hole was not drilled below 256m and only a few intersections of intrusive rock were logged below 200m.

A down-hole magnetic log (Curtis, 1988) correlates moderately well with intersections of intrusive and contact rocks as interpreted from the cuttings but correlation is not exact between concentrations of magnetite as logged and high magnetic intensity.

EXAMINATION OF MINERAL CONCENTRATES

Fine grained material washed out of cuttings samples to permit petrographic examination was bulked. Amdel was requested to separate a sulphide concentrate for fire assay. The sample was tabled as +250μm and -250μm fractions (Amdel Report No. 06722/88). No band of heavy mineral concentrate was observed in the +250μm fraction but an arbitrary cut was taken as 'concentrate'. A heavy mineral concentrate was separated from the -250μm fraction and a sample was treated by froth flotation. The final product weighed too little for fire assay but was examined petrographically (see below).

A composite sample prepared from +250μm and -250μm table concentrates was reground and treated by froth flotation. A small sample of the float product was retained for mineralogical examination and the remainder was analysed in duplicate by fire assay (Amdel report Ac 39459/88). Results are given in Table 3.

Table 3. Results of fire assay; ppb.

	Au	Pt	Pd	Ru	Rh	Ir	Os
Sample 1	200	18	23	5	2	1.0	<2
Sample 2	170	19	25	4	1	<0.5	<2

Selected mineral fractions were examined microscopically. Results are given in Table 4.

Table 4. Mineralogy of fractions

<u>+250μm table concentrate</u>

Diallage
Plagioclase
Hornblende
?Zeolite
Hypersthene
Olivine
Epidote
Magnetite
Ilmenite
Pyrite-rare

<u>+250μm table middlings</u>

Plagioclase
Diallage
Hornblende
Hypersthene
Epidote
Magnetite
Ilmenite
Pyrite-rare

<u>-250μm table concentrate</u>

Plagioclase
Diallage
Hypersthene
Hornblende
Epidote

Olivine
Magnetite
Ilmenite
Pyrite - very rare

<u>First Sulphide concentrate from flotation</u>

Plagioclase
Diallage
Magnetite
Ilmenite
Sulphide - not more than c15% mainly pyrite, some chalcopyrite.

<u>Sulphide flotation tail</u>

Plagioclase
Diallage
Hornblende
Hypersthene
Olivine
Magnetite
Ilmenite

<u>Analysed sulphide concentrate</u>

Plagioclase
Diallage
Hornblende
Hypersthene
Magnetite
Ilmenite
Sulphide 10%

The mineral content of the analysed sample indicates that precious metal concentrations should be multiplied by about ten if all such metals are contained in the sulphides. Poor mineralogical control of flotation has resulted in a 'concentrate' in which non-sulphides are overwhelmingly dominant. The initial flotation of the -250μm table concentrate was slightly better. However, precious metal contents do not indicate significant concentrations even when multiplied by ten (Au 2ppm and 0.2ppm of Pt and Pd).

NOTES ON GEOCHEMICAL ANALYSES

Drill cuttings were analysed for sixteen elements by ICP (Amdel report AC 3369/88). Full results are listed in Curtis (1988) and are summarised here.

Determinations of Ag, As, Bi, Cd, Co, Cu, Mo, Pb, Sb and Zn were either below detection or too close to background to be significant as anomalies. Determinations of Sb and Bi lack credibility in the light of As values.

Chromium exhibits a relatively consistent variation with depth but no correlation could be established with rock type except that chromium tends to be less abundant at levels where the pluton is anorthositic than where ferromagnesian minerals are more frequent in the pluton. However, this variation appears to affect gabbroids, marginal rocks and country rocks alike and the significance is uncertain. It is listed in Table 5.

Table 5, variation of chromium with depth

m	Crppm
58-178	<25
180-218	40-65
220-242	85-150
244-256	55-75

Iron is notably more abundant above 78m than below and may reflect a late enrichment during differentiation. The origin of a second enrichment below 232m is less evident.

Variation in manganese generally echoes that in iron.

Nickel is enriched above 80m and below 240m and may also reflect iron concentrations.

Both phosphorous and vanadium are enriched in hybrid contact rocks and in marginally modified gabbroic rocks. It is possible that phosphorous is mobile as the phosphate radical and vanadium as a vanadate radical until fixed by calcium as apatite. Calcium is probably exsolved when plagioclase is albitised and replaced by zeolites in reactions with hot aqueous fluids in both marginal gabbros and altering contact rocks.

Firm conclusions on the significance of geochemical data are not possible until many more data are available.

CONCLUSION

Kakoonie 1 was sited on a steep magnetic gradient believed to mark the southwestern edge of the Black Hill plutonic complex (Curtis, 1988). Like similar holes sited between 1975 and 1977 by North Broken Hill Pty Ltd, it intersected an irregular contact zone of considerable lateral extent. It is unlikely, however, that the zone extends from the Black Hill intrusion itself. It is more likely that a separate cupola subcrops to the northeast of Kakoonie 1, probably joined at a depth in the order of 100m to the Black Hill body (Fig. 1). The Kakoonie body was probably exposed for a long enough time to acquire a weathered zone which was later leached and developed a duricrust early in the Tertiary.

Like the Black Hill intrusion, the Kakoonie dome appears from cuttings to be strongly feldspathic at the top becoming richer in ferromagnesian minerals at depth, particularly below about 200m. There is support in some of the geochemical data for this suggestion but the data are somewhat ambiguous since remelted and hybridised country rock and modified marginal varieties of gabbroids alternate in drillhole intersections. Some primary compositional layering or zoning appears possible but cuttings from rotary drilling are not ideal material for determination of fine layering.

Fire assay of a sulphide-bearing sample did not indicate anomalous concentration of gold or platinum group elements. Probably neither mantle derived sulphur nor sulphur acquired from contact rocks was sufficient to bring the magma anywhere near sulphur saturation at the time of intrusion of the rocks intersected.

REFERENCES

Curtis, J.L., 1988. Investigations into the platinoid potential of the Black Hill Norite, EL 1419, Sedan, South Australia. CSR Coal Division report. SADME open file envelope.