SOUTH AUSTRALIAN STEEL AND ENERGY

Coober Pedy Iron Ore Investigation

Summary Report

MINES and ENERGY RESOURCES SOUTH AUSTRALIA

DEPARTMENT OF MINES AND ENERGY
GEOLOGICAL SURVEY
SOUTH AUSTRALIA

REPORT BOOK 97/1

SOUTH AUSTRALIAN STEEL AND ENERGY COOBER PEDY IRON ORE INVESTIGATION SUMMARY REPORT

by

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Mineral Resources Branch

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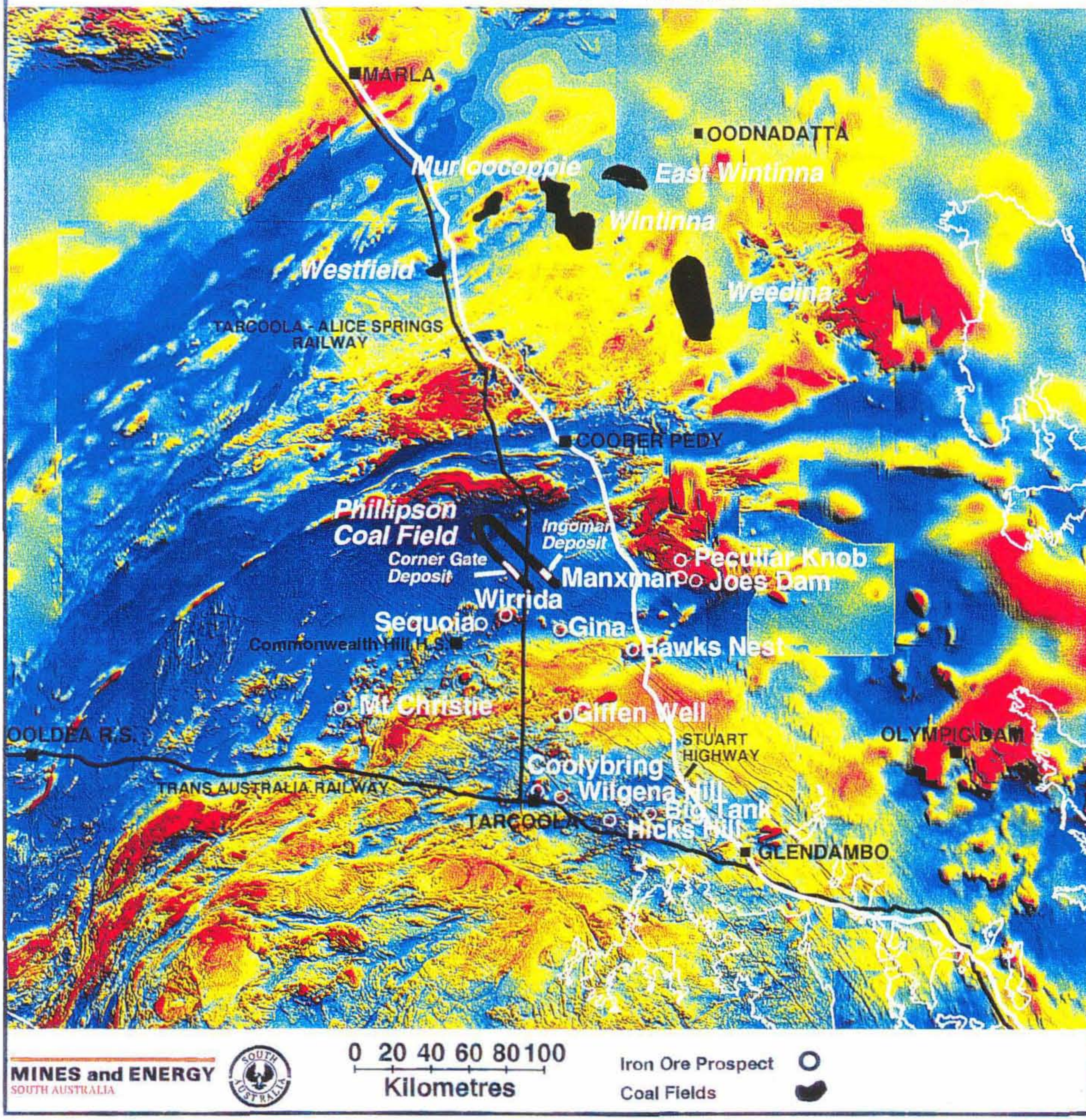

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South Australian Steel and Energy Project, Coober Pedy, Iron Ore Investigation, Summary Report

B J Morris, M B Davies and A W Newton

Mines and Energy South Australia as part of its contribution to the South Australian Steel and Energy Project has defined an iron ore resource in the Coober Pedy region. Extensive ground magnetic, gravity and drilling programs identified four prospect areas - Hawks Nest, Giffen Well, Peculiar Knob and Sequoia - all in close proximity to the Stuart Highway and the Tarcoola - Alice Springs Railway. Inferred or Indicated Resources have been calulated for a total of ten deposits (seven at Hawks Nest) of BIF, hosted by Archaean to Palaeoproterozoic basement and overlain by up to 20 m of Mesozoic and/or Cainozoic sediment.
Three types of iron deposits were encountered:

- **Low grade magnetite-BIF with total Inferred Resources of over 800 Mt, the largest of which is the Kestrel deposit at Hawks Nest with an Indicated Resource of 260 Mt at 36.4% Fe. Beneficiation tests indicate that a high grade iron concentrate (>64% Fe) with very low levels of alumina and phosphorus may be readily produced.**
- **High grade magnetite horizons (up to 69% Fe) of unknown lateral extent but up to 150 m wide within the low grade magnetite - BIF deposits of Kestrel and Kite at Hawks Nest.**
- **High grade hematite, the largest deposit is at Peculiar Knob with an Inferred Resource of 14 Mt at 63.2% Fe of massive coarse grained specular hematite.**

As a high priority further drilling is recommended at Hawks Nest to define a high grade magnetite resource.

INTRODUCTION

As part of the South Australian Steel and Energy Project (SASE) Mines and Energy, South Australia (MESA) commenced a search for iron deposits on the northern Gawler Craton in January 1995. The project, in conjunction with Meekathara Minerals Ltd (MML) and Ausmelt Ltd, aims to produce pig iron near Coober Pedy using local iron ore, coal from M ML's Phillipson Coalfield and the direct smelting Ausmelt technology.

MESA's exploration involved an assessment of the regional geology, aeromagnetic data and previous company exploration data followed by regional

ground magnetic surveys and reverse circulation (RC) drilling and resulted in the identification of four prospect areas (Fig 1) for detailed follow up investigation.

- Hawks Nest, 115 km SSE of Coober Pedy
- Giffen Well, 142 km south of Coober Pedy
- Peculiar Knob, 87 km SE of Coober Pedy
- Sequoia, 106 km SSW of Coober Pedy

Detailed exploration comprising ground magnetics, gravity, RC-hammer drilling, diamond drilling, geochemical, petrological and beneficiation testing subsequently outlined Inferred or Indicated Resources for a total of ten iron ore deposits (seven at Hawks Nest). All deposits are near to surface and in close proximity to the Stuart Highway, Tarcoola - Alice Springs Railway and the Phillipson Coalfield (Fig. 1).

MESA has tenure over the Hawks Nest and Giffen Well deposits while Peculiar Knob and Sequoia lie within Exploration Licences held by Normandy Exploration NL - Metals Exploration Ltd and Minotaur Gold NL respectively.

The Antakarinja people have native title over the region and all exploration work was approved by their delegates with field inspections arranged by Mr R Larkins (MESA, Aboriginal Liaison Officer).

The following separate detailed reports containing all the generated data will be issued:

- Review of Previous Company Exploration
- Regional Bedrock Drilling
- Hawks Nest Prospect
- Giffen Well Prospect
- Peculiar Knob Prospect
- Sequoia - Gina - Wirrida Prospect

REGIONAL GEOLOGY

The Gawler Craton (Fig 1) is a stable region of crystalline basement of Archaean (2700 Ma) to Mesoproterozoic (1450 Ma) age (Drexel, Preiss and Parker, 1993). Regional aeromagnetic and geological surveys (Ambrose and Flint, 1981; Benbow, 1982; Cowley and Martin, 1991; Daly, 1985) have shown that the Craton is host to two deformed metasedimentary sequences that contain BIF. These rocks are sparsely exposed, being generally overlain by thin soil and flat-lying Cretaceous sediment.

The older sequence occurs in the southern, central and western parts of the Craton. These Archaean rocks contain BIF generally less than 50 m thick with discontinuous strike lengths of up to 500 m. The Sequoia and Mount Christie occurrences are of this age.

Following the Late Archaean Sleafordian Orogeny (2640 Ma - 2300 Ma), which reached granulite facies metamorphism, Palaeoproterozoic sediment, including BIF, was deposited in extensional elongate shallow water basins. The sediments were deformed and metamorphosed to amphibolite facies, and extensively invaded by granites during the Kimban Orogeny (1850 Ma - 1700 Ma).
The Palaeoproterozoic BIF units (1900 Ma) are most extensive in the eastern and northern parts of the Craton. These are up to 700 m thick and persist along strike for up to 25 km, and are present at Peculiar Knob, Hawks Nest, Giffen Well and Wilgena Hill prospects and the Middleback Range.

PREVIOUS EXPLORATION

Large iron ore deposits were first recognised on the Gawler Craton in the Middleback Range near Whyalla in the late 1890s. The Broken Hill Proprietary Co Ltd (BHP) pegged the first claim in 1897 and commenced mining at Iron Knob in 1899. Further deposits were discovered in 1920 and the host ironstone has now been traced for 60 km (Drexel, 1982). Since 1900 about 200 Mt of high grade hematite ore have been mined, primarily for the BHP steelworks at Whyalla.

From aeromagnetic surveys in the late 1950s iron formations were recognised in the Tarcoola (Wilgena Hill) and Mulgathing (Mount Christie) areas in the northern and NW Gawler Craton. Whitten (1965) investigated several of the larger iron ore deposits, and although no systematic evaluation was undertaken a 20 Mt resource of 40% iron was inferred for Mount Christie, and 65 Mt at 40% iron, above plain, was inferred at Wilgena Hill.

Over the past ten years exploration in the northern Gawler Craton has not specifically targeted iron ore but has focussed on magnetic and gravity anomalies as indications of Olympic Dam style base metal-gold and banded iron formation (BIF) hosted gold mineralisation. However numerous magnetite and hematite occurrences have been found as steeply dipping layers or in breccias beneath 8 m to 100 m of mostly soft sediment cover. Iron ore resources were indicated by CRA Exploration Pty Limited (CRAE) at Hawks Nest (Sugden, 1990) and Peculiar Knob (Finch, 1986).

In 1993 detailed aeromagnetic surveys were flown over the northern Gawler Craton, at 400 m line spacing and 80 m mean terrain clearance, as part of the MESA South Australian Exploration Initiative, resulting in high quality aeromagnetic images.

MESA EXPLORATION JANUARY 1995 - DECEMBER 1996

Strategy and Statistics

Exploration was focussed on an area south of Coober Pedy and within 100 km of Phillipson Coalfield, the Tarcoola - Alice Springs Railway and the Stuart Highway (Fig 1 and Frontispiece). It is a region of sparse basement outcrop and MESA's exploration strategy was to initially target aeromagnetic anomalies, company drill intersections of iron ore and areas of BIF outcrop.

Regional ground magnetic, gravity and RC drilling surveys were undertaken and four prospect areas identified.

- Hawks Nest
- Giffen Well
- Peculiar Knob
- Sequoia

These were then tested with detailed ground magnetics, gravity, RC-hammer drilling and diamond drilling and a total of 10 potential economic deposits of iron ore outlined with Inferred or Indicated Resources calculated.

Exploration statistics are shown on Table 1, in addition 342 samples have been petrologically examined, 5716 samples submitted for whole rock and selected trace metal analyses and nine samples subjected to beneficiation and comminution tests. Total MESA expenditure is estimated at $2 million.

Hawks Nest Prospect

Lithology

Exposure of the Palaeoproterozoic BIF is sparse and limited to a few outcrops in a gently undulating area covered by a few metres of Quaternary red-brown sandy ferruginous clay and up to 20 m of flat-lying Cretaceous white, porcelaneous claystone and shale. The clay has a distinctive surface lag of 'buckshot' hematite gravel and eroded BIF fragments.

The subsurface extent of BIF is estimated from aeromagnetic, ground magnetic and gravity responses and from drilling results. Figure 2 shows the ground magnetic map for the shallowest part of the prospect. Several BIF units are evident but it is uncertain whether these are separate units or structural repetitions. The aeromagnetic anomaly extends along strike to the NE for 20 km but the depth of cover increases towards the NE to over 100 m.

Figure 3 is a typical cross section showing the BIF horizons interlayered with a steeply dipping sequence of metasediment that comprises metasiltstone, conglomerate, calc-silicate, basalt and carbonate layers. The sequence generally strikes northeasterly and is near vertical. It is folded and disrupted by northwesterly trending brittle faults and basic dykes of the Gairdner Dyke Swarm. The BIF is generally brecciated, has well developed microfaulting and microfolding, and has been partly to completely oxidised to hematite in the vicinity of faults (Appendix, Photos 1,2 and 3). The unoxidised magnetite-BIF zones stand out in Fig 2 as discrete magnetic anomalies. Surface oxidation extends to a depth of 30 to 35 m and changes magnetite to hematite, goethite and limonite (Appendix, photo 4).

Mineralisation

Three types of iron ore are indicated from the 110 RC-hammer holes totalling 11 912 m and four diamond drill holes totalling 350 m:

- Low grade magnetite-BIF bodies from 150m to 500m wide occur as unoxidised sections of the BIF horizons (Fig 2). They are finely laminated (0.2 mm - 5 mm) and composed of quartz and microgranular magnetite (0.05 mm) which dominate in alternate bands (Appendix Photos 1, 8 and 10). Some bands contain appreciable amphibole, predominantly cummingtonite and minor actinolite. The amphiboles are randomly oriented and also occur as narrow cross-cutting veinlets. Calcite is present as late stage veinlets. The BIF typically comprises 25-50% magnetite, 30-55% quartz, 10-25% amphibole and 2-5% carbonate.

  Modelling of ground magnetic and gravity data indicates the bodies have an estimate depth extent of 500 m to 1 000 m. Inferred Resources to 100 m below the level of oxidation are shown in Table 2. The magnetite-BIF bodies represent a low grade (35-40% iron) Inferred Resource of about 600 Mt that may be readily beneficiated to a high grade product. The average

Table 1 Exploration Statistics

DRILLING			GROUND MAGNETICS (line kms)	GRAVITY (stations)
Type	No of holes	metres		
REGIONAL RC	 279	 15673.75	 434.73	 2169
PROSPECTS Diamond RC-hammer RAB	 9 157 153	 973.2 15991.0 3738.6	 377.09	 4140
TOTAL	598	36376.55	811.86	6309

Table 2 Inferred and Indicated Resources, Northern Gawler Craton iron ore deposits

Body	Ore Type	Strike Length(m)	Width(m) *	Depth(m)	Resource(Mt)	Grade (Fe)
Hawks Nest						
Kestrel	magnetite-BIF	2 000	300-600	130	260*	36.4
Goshawk	"	1 500	250-350	130	148	34.8
Harrier	"	650	250	130	54	35.4
Eagle	"	1 400	200	130	92	31.3
Kite	"	600	150	130	30	50.5
Falcon	"	500	150	130	25	32.4
Buzzard	hematite	450	10-50	120	5*	60.2
Giffen Well	magnetite-BIF	3 000	250	150	240	36.5
Peculiar Knob	hematite	1 000	15-36	120	14	63.2
Sequoia	magnetite-BIF	1 000	2-45	145	22	28.4

(* Indicated Resource)

The estimates of mineral resources and ore reserves in this report were prepared in accordance with the standard set out in the Australasian Code for Reporting of Identified Mineral Resources and Ore Reserves (September 1992) as published by the joint committee of the Australasian Institute of Mining and Metallurgy, Australian Institute of Geoscientists and Australian Mining Industry Council.

Table 3 Whole Rock Analyses, Northern Gawler Craton Iron Ore Deposits

Deposit	Fe%	SiO_2%	Al_2O_3%	P_2O_5%	CaO%	K_2O%	Na_2O%	MgO%	MnO%	TiO_2%	SO_3%	1.05LOI%
HAWKS NEST												1.05
Kestrel	36.4	38.2	0.97	0.13	3.63	0.12	0.09	3.26	0.23	0.05	0.20	
Goshawk	34.8	40.2	0.89	0.12	3.67	0.10	0.05	3.32	0.30	0.04	0.31	1.69
Harrier	35.4	43.4	0.80	0.11	1.69	0.09	0.03	2.56	0.17	0.03	0.06	0.47
Eagle	31.3	48.3	0.38	0.11	2.95	0.03	<0.05	2.59	0.22	0.01	0.09	0.84
Kite	50.5	24.2	0.82	0.25	0.79	0.12	0.06	1.08	0.10	0.03	-	-
Falcon	31.7	48.2	0.38	0.11	1.98	0.01	0.01	3.47	0.21	0.02	0.02	0.32
Buzzard	60.2	11.0	1.41	0.08	0.15	0.21	<0.05	0.17	0.01	0.04	0.03	1.01
GIFFEN WELL	36.5	42.7	0.11	0.18	1.38	0.04	0.14	2.80	0.06	<0.01	0.09	0.23
PECULIAR KNOB												
DD1 (56.6-104.7m)	61.0	11.2	0.12	0.03	0.13	0.18	0.01	0.09	0.03	0.14	-	0.21
DD2 (41.9-54.6m)	67.2	2.4	0.18	0.04	0.13	0.23	0.01	0.19	0.04	0.10	-	0.94
DD3 (49.5-75.7m)	65.8	4.7	0.09	0.04	0.12	0.17	<0.01	0.13	0.02	0.11	-	0.07
SEQUOIA												
SE1 (112-164m)	39.0	37.76	1.56	0.09	2.78	0.57	0.20	2.31	0.19	0.08	0.15	0.01
SE2 (82-126m)	31.4	41.9	4.37	0.11	3.71	1.05	0.40	2.35	0.17	0.21	0.398	0.61
SE3 (52-68m)	33.1	43.32	3.47	0.13	2.45	0.09	0.62	2.07	0.10	0.20	0.21	0.50
SE4 (84-100m)	27.6	47.23	5.61	0.17	2.55	1.76	0.80	2.78	0.08	0.26	0.19	0.08
SE6 (38-88m)	25.0	47.43	6.10	0.13	4.54	1.56	0.85	2.87	0.21	0.29	0.26	0.53
SE8 (78-110m)	25.9	48.75	5.48	0.18	2.46	0.83	0.83	2.83	0.10	0.31	0.25	1.29

composition of the largest magnetite - BIF body, Kestrel (Plates 1 and 2), is shown in Table 3.

- The high grade magnetite Kite body (Fig 2) has drill intersections of 34% to 69.3% iron, and Table 3 shows the average composition. The body has a ground magnetic and gravity expression and contains a significant Inferred Resource (Table 2) that may require only limited beneficiation.

  A high grade, 24 m thick magnetite body of unknown lateral extent was intersected in the Kestrel body (Plates 1 and 2). This layer averages 67.2% iron, 3.22% silica, 0.40% alumina and 0.11% phosphorous pentoxide and represents direct feed magnetite ore.

- The high grade hematite Buzzard body (Fig 4) is a tectonically brecciated BIF adjacent to a northeasterly trending fault zone that has been oxidised to hematite and the silica leached out. The hematite comprises homogeneous, massive microplaty hematite as subangular to subrounded breccia clasts (1-10 mm in diameter) randomly disposed through a matrix of microcrystalline hematite (Appendix photos 5, 9 and 11). Remnant accessory magnetite is present as inclusions in hematite (Appendix photo 7). Drill intersections range from 48.6% to 67.2% iron (Plates 3 and 4) with an average composition as shown in Table 2. This body represents direct feed hematite ore, with an Inferred Resource of 5 Mt (Table 2).

Giffen Well Prospect

Lithology

Surface exposure of Palaeoproterozoic BIF is limited to a few outcrops along a gentle topographic rise. Quaternary red-brown sandy ferruginous clay with a distinctive surface lag of 'buckshot' hematite gravel and eroded BIF fragments covers the area to a few metres depth. The associated aeromagnetic anomaly strikes NNE and is 6 km long. However ground magnetic, gravity and drilling results (Fig 5) indicate that near surface BIF, with a depth extent of 500 m-1000 m and 150 m - 240 m wide is confined to a strike length of about 3 km.

A cross section (Fig 6) shows that the BIF is part of a conformable package of NNE striking and steeply east dipping metasediment intruded by Mesoproterozoic Hiltaba Suite granite. A lamprophyre dyke of minette to vogesite type has been identified in the diamond drill core.

The BIF is laminated (bands 1-8 mm thick), moderately to highly fractured, and microfolded. The stratigraphic facing is unknown. The BIF is equivalent to the Hawks Nest prospect BIF and is of mid to upper amphibolite grade metamorphism. Surface oxidation extends to 30 - 50 m depth altering primary magnetite-BIF to hematite, goethite and limonite BIF.

Mineralisation

The ore zone of low grade magnetite-BIF was investigated with 25 angled RC-hammer drill holes totalling 1 991 m and a 114 m deep angled diamond drill hole. It is a homogeneous regular micro to meso layered sequence of fine granular magnetite (0.01 mm-0.05 mm) and chert that often incorporates fine amphibole. The thicker and more magnetite-rich layers consist of aggregated magnetite grains about 0.08 mm in diameter. Some of the layering is repeated as rhythmic bands.

Two species of amphibole - actinolite and cummingtonite - are widespread through the chert layers and infill micro fractures. Apatite occurs as an accessory and there are late stage cross-cutting calcite veinlets. The BIF typically comprises 20-50% magnetite, 30-55% cherty quartz, 10-35% amphibole, 0-3% apatite and 0-3% carbonate, and the average composition is shown in Table 3.

An Inferred Resource of 240 Mt, to 100 m below the level of oxidation, has been defined (Table 2) that may be readily beneficiated to a high grade product.

Peculiar Knob Prospect

Lithology

This area is completely covered by Quaternary red-brown clay, sand and silt, over the Cretaceous Bulldog Shale, a pale brown shale with minor gypsum. The flat-lying shale overlies basement to a depth of 12 m at the western end of the deposit, and thickens to 32 m at the eastern end.

Basement comprises a northeasterly trending Palaeoproterozoic metasedimentary sequence of BIF, quartzite and quartz-microcline-sillimanite gneiss with a metamorphic grade of upper amphibolite facies. Mesoproterozoic porphyritic granodiorite (Balta Granite) intrudes the metasediment and has intense chloritic alteration.

Mineralisation

The ore zone of massive specular hematite (Figs 7, 8) was investigated by MESA with three angled diamond drill holes totalling 397 m and 14 RC-hammer holes totalling 920 m. Five diamond drill holes, including two drilled by CRAE (Finch, 1986), and seven RC-hammer holes have intersected the ore zone which formed by the hydrothermal alteration of a BIF. Leaching out of silica and concentration of iron produced a coarse mosaic of specular hematite (0.3 mm to 4 mm in size) with minor remnant banding and some residual magnetite (Appendix Photos 6a and 12). Metamorphic hematite has largely replaced the magnetite with the remainder subsequently replaced by martite. Minor interstitial subrounded quartz grains (0.1 mm to 0.4 mm diameter) are present.

Mineralisation is high grade (averaging 63.2% Fe) with low alumina and phosphorous contents. Typical analyses are shown on Table 3.

To a depth of 100 m below the cover there is an Inferred Resource of 14 Mt (Table 1) that may be beneficiated by simple two stage crushing and screening.

Sequoia Prospect

Lithology

The prospect lies beneath a gentle topographic high about 1000 m long, 200 m wide and rising 15 m above the surrounding plain. There is about 10 m of Quaternary cover comprising red-brown sandy clay with quartz and ironstone pebbles, with a friable calcrete cement at surface and also immediately above bedrock. A few small exposures of BIF are recorded on the Coober Pedy 1 : 250 000 scale map sheet (Benbow, 1982).

The bedrock comprises Archaean BIF, banded quartz-magnetite-diopside-hypersthene-amphibole gneiss, with interlayers of quartz-microcline-plagioclase gneiss and plagioclase pegmatoid. The sequence may be a high grade meta-igneous sequence from a differentiated basic intrusion. The bedrock is generally oxidised to a depth of about 45m.

Mineralisation

The magnetite-BIF zone has a well defined magnetic and gravity expression and was tested with eight angled RC-hammer holes totalling 1 167 m and one angled diamond drill hole totalling 111.8 m (Fig 9). The BIF layers from 2 m to 50 m wide are laterally discontinuous, strike north-south, dip steeply (70-80°) west, and are hosted by banded gneiss. BIF comprises 1 mm to 1 cm wide bands of quartz-actinolite-magnetite, actinolite-magnetite, and biotite-quartz-magnetite. Quartz is often lensoid and accessory minerals include apatite, garnet, and pyrite. Magnetite grains are 0.1 mm to 0.5 mm in diameter with some disseminated as rounded porphyroblasts to 1 mm diameter.

There are typically two magnetite rich zones, to 45 m wide, that vary laterally in width and grade. Grades vary from 21% to 39% iron (average 28% iron) and selected whole rock analyses are shown on Table 3.

The deposit contains an Inferred Resource of 22 Mt (Table 1) to 100 m below the level of oxidation and may be readily beneficiated to a high grade product.

BENEFICIATION

Preliminary beneficiation testing has been carried out by Amdel Ltd on diamond drill core of low grade magnetite-BIF (35-40% iron) from Hawks Nest, Giffen Well and Sequoia prospects, to produce a high grade product (+60% iron). Results indicate that two stage grinding and magnetic separation produces a high grade magnetite concentrate with good iron recovery rates (Table 4). The main impurity is silica, of which 40-50% occurs as liberated grains and a simple reverse flotation process may improve the product grade further.

Table 4 Summary of Magnetic Separation Tests
(Eriez wet magnetic separation)

FIRST CLASS

Sample	Sizing	Head	Concentrate				Iron Recovery
	P_{80}mm	Fe%	Fe%	SiO_2%	P_2O_5%	Al_2O_3%	%
Sequoia	106	37.2	61.9	12.9	0.03	0.52	89.8
Giffen Well	38	37.8	61.7	13.9	0.02	0.07	94.9
Hawks Nest (Kestrel)	38	43.1	55.3	21.3	0.05	0.13	92.2

SECOND PASS

Sample	Sizing	Head	Concentrate				Iron Recovery
Sequoia	63	61.9	70.3	3.7	<0.01	0.29	88.2
Giffen Well	30	61.7	69.5	4.4	<0.01	0.11	91.8
Hawks Nest (Kestrel)	28	55.3	64.2	10.0	<0.01	0.20	85.8

CONCLUSIONS AND RECOMMENDATIONS

The exploration program has been successful in locating iron ore deposits at:

- Hawks Nest where over 600 Mt of low grade magnetite - BIF has been located in six deposits. Kestrel is the largest with an Indicated Resource of 260 Mt at 36.4% Fe. In addition a small deposit (Buzzard) of massive hematite with an Indicated Resource of 5 Mt at 60.2% Fe has been outlined. High grade magnetite zones, up to 69% Fe, of unknown extent have been intersected at Kestrel and Kite deposits.

- Giffen Well where an Inferred Resource of low grade magnetite-BIF of 240 Mt at 36.5% Fe has been outlined.

- Sequoia where an Inferred Resource of low grade magnetite - BIF of 20 Mt at 28% Fe has been outlined.

All deposits are open at depth.

Beneficiation testing indicates that a high grade iron concentrate with very low levels of impurity may be readily produced from all deposits. The concentrate is suitable for the Ausmelt process and may be readily saleable on the World market as a premium iron ore feed.

Further RC-hammer and diamond drilling is required at Kestrel and Kite deposits to define a high grade magnetite resource.
Further RC-hammer and diamond drilling is required at Buzzard to test the southwest extension of the narrow massive hematite zone.

Further RC-hammer drilling is required to test low magnetic - high gravity areas at Hawks Nest for more massive hematite concentrations.

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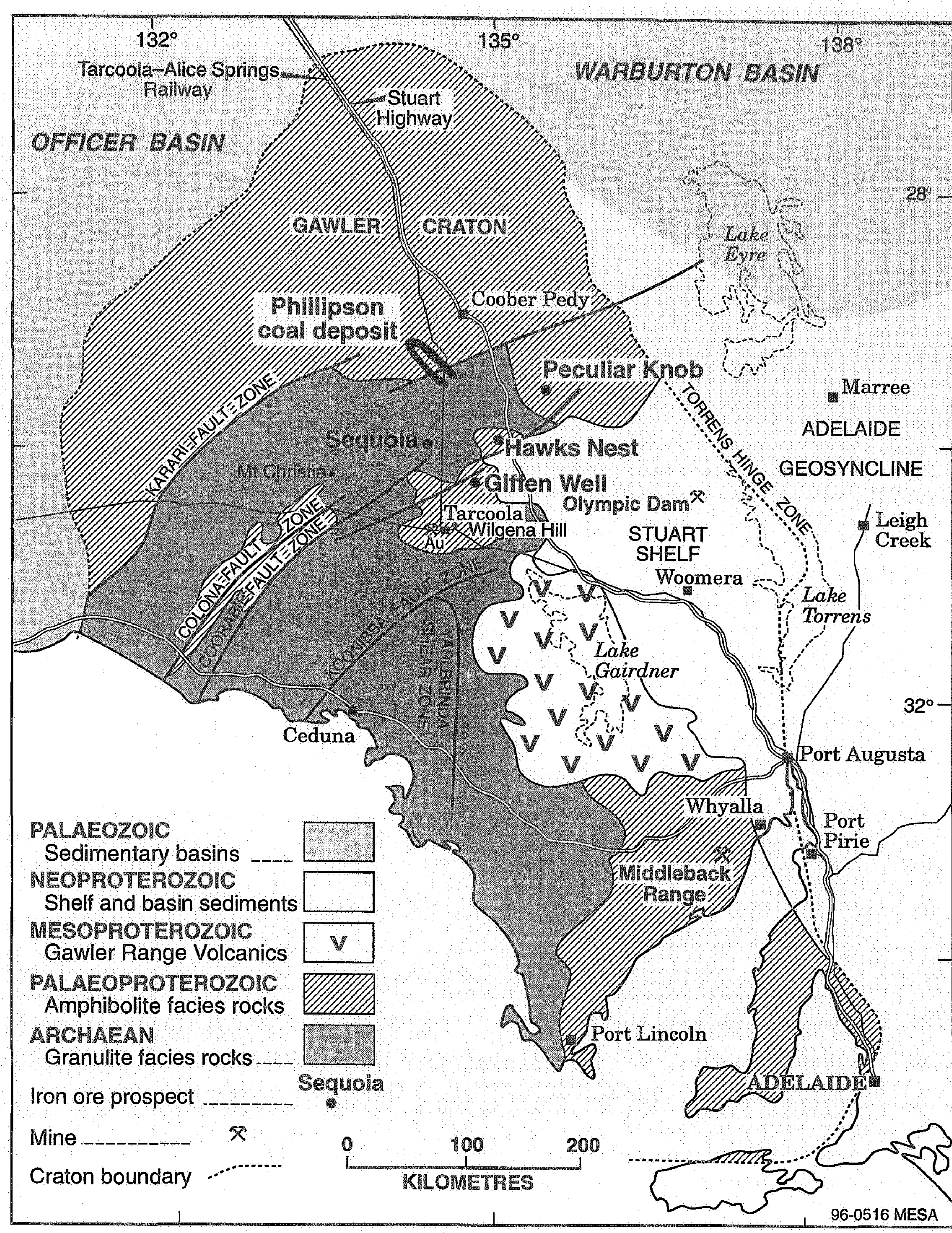

Fig. 1 Regional geological map and location of iron prospects, northern Gawler Craton

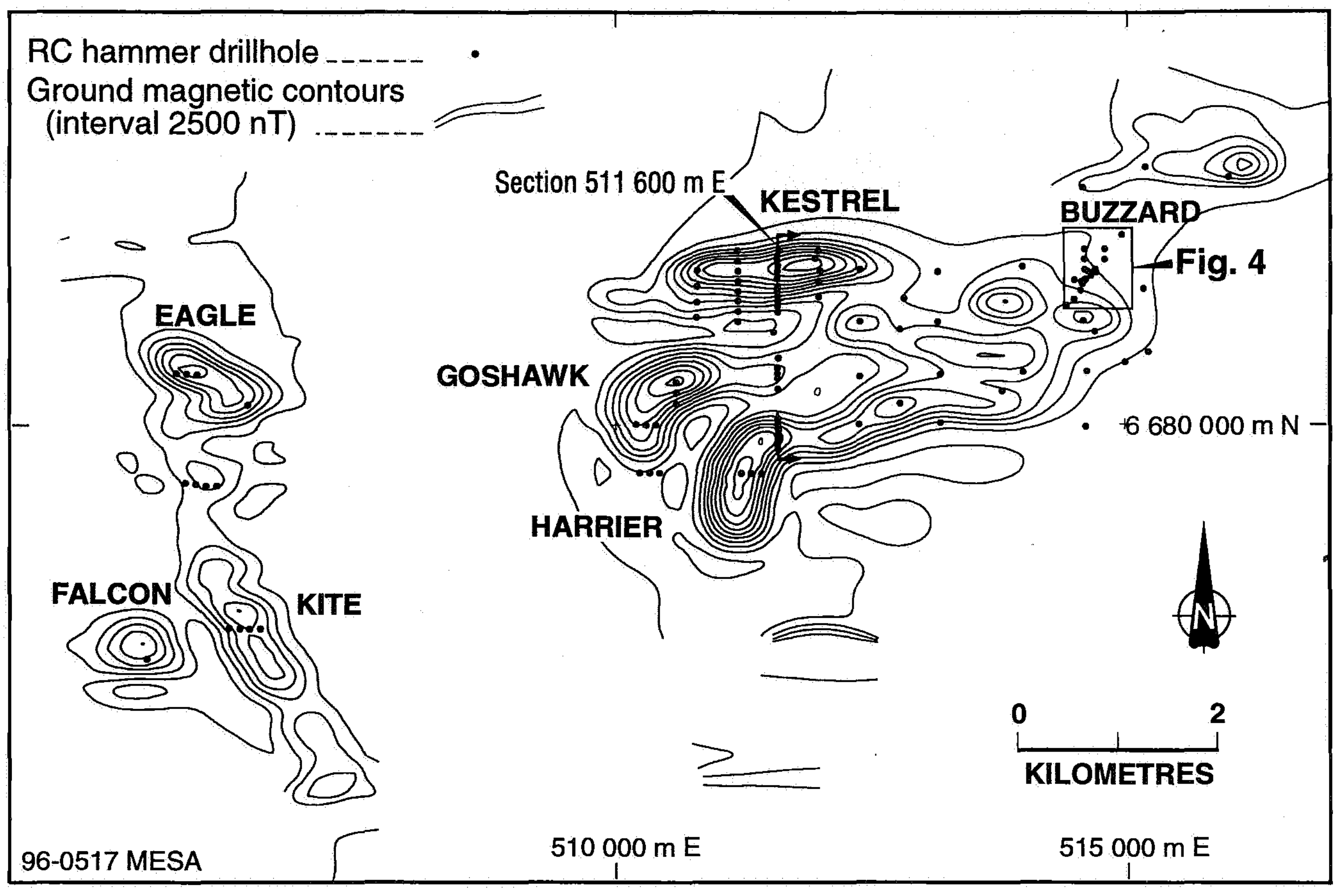

Fig. 2 Ground magnetic contours and drillhole locality plan, Hawks Nest prospect

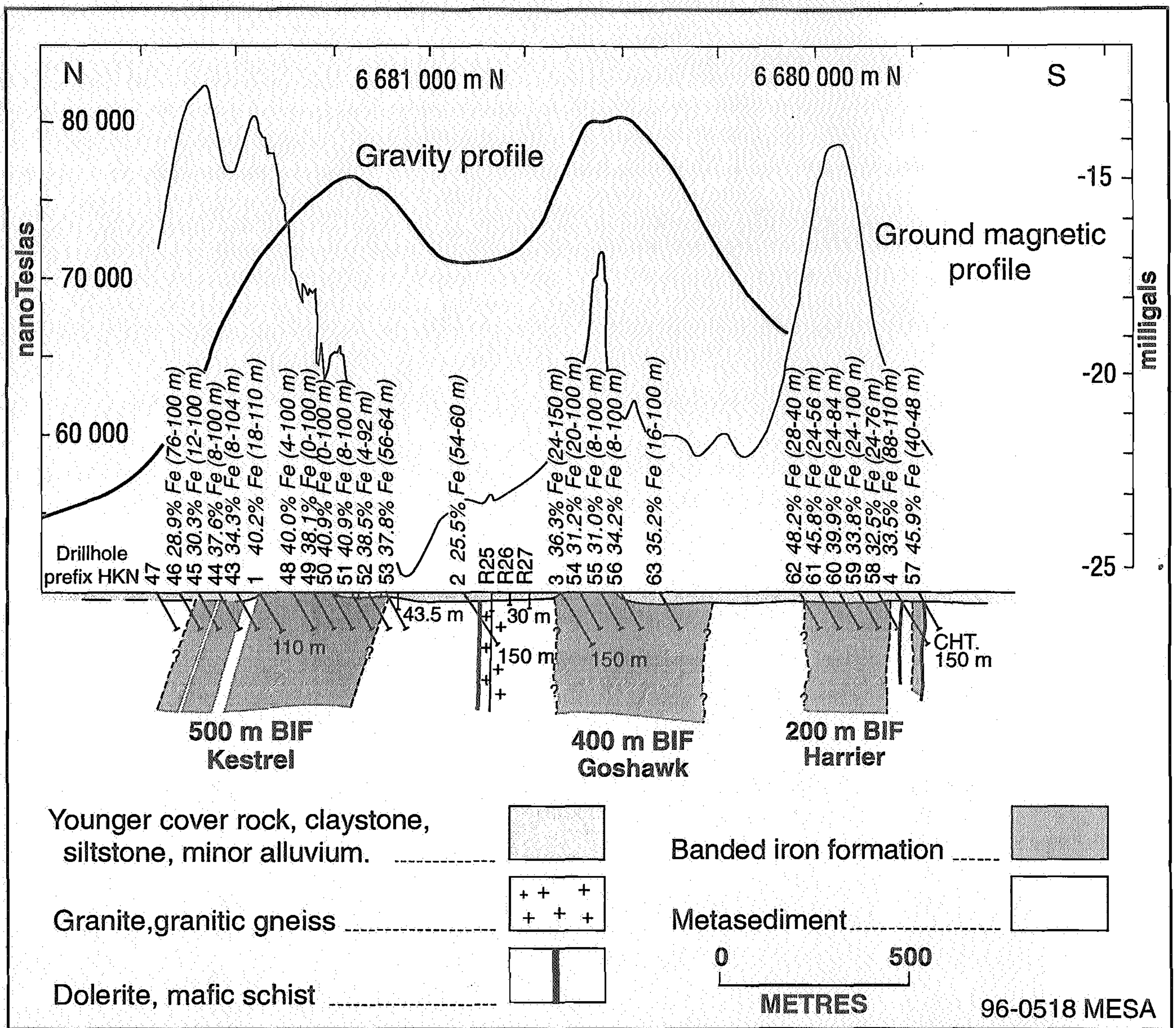

Fig. 3 Cross section on 511 600 E, Hawks Nest prospect

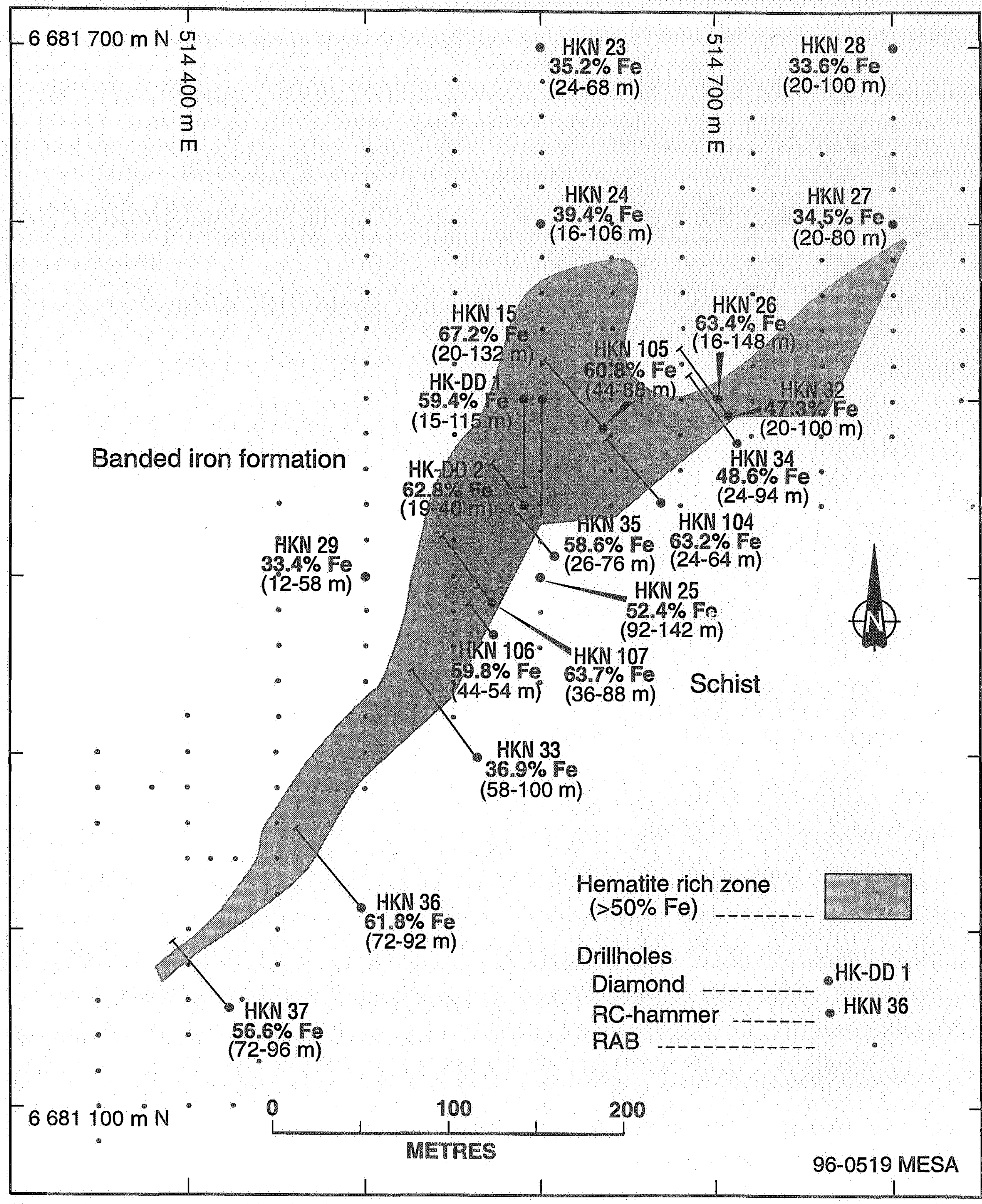

Fig. 4 Buzzard deposit, Hawks Nest prospect

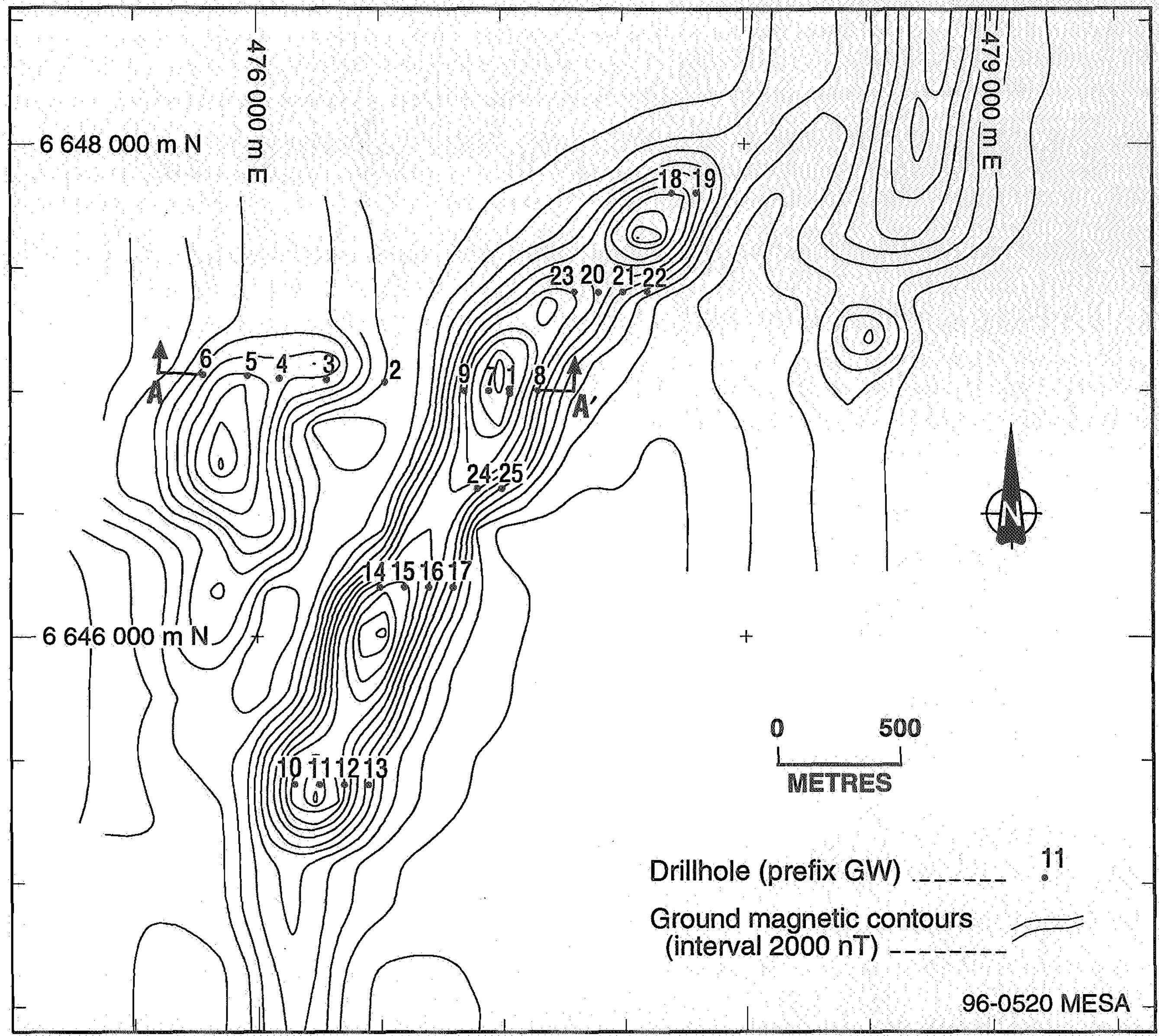

Fig. 5 Ground magnetic and drillhole locality plan, Giffen Well prospect

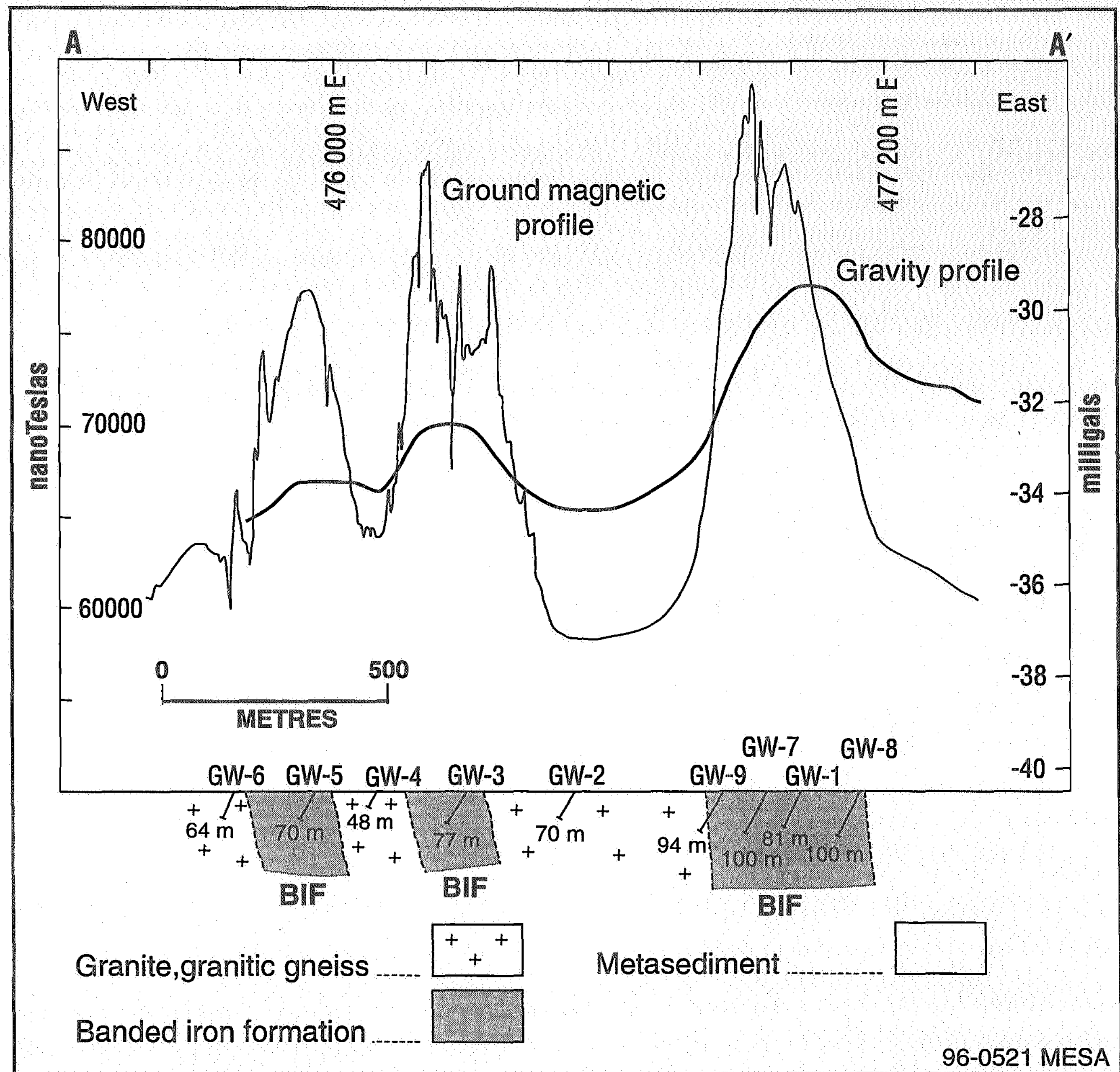

Fig. 6 Cross section on A–A', looking north, Giffen Well prospect

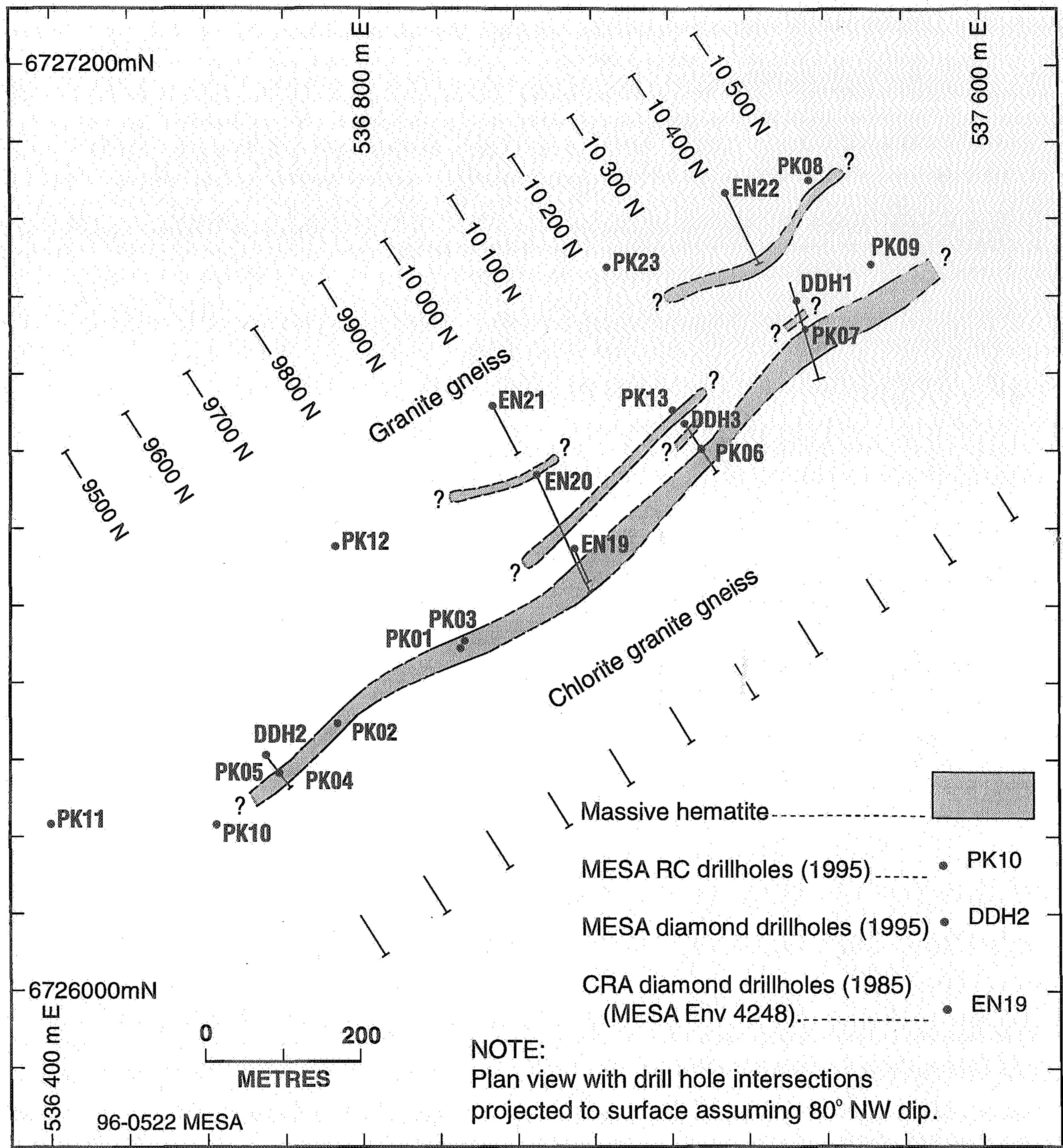

Fig. 7 Drillhole locations and projected geology, Peculiar Knob prospect.

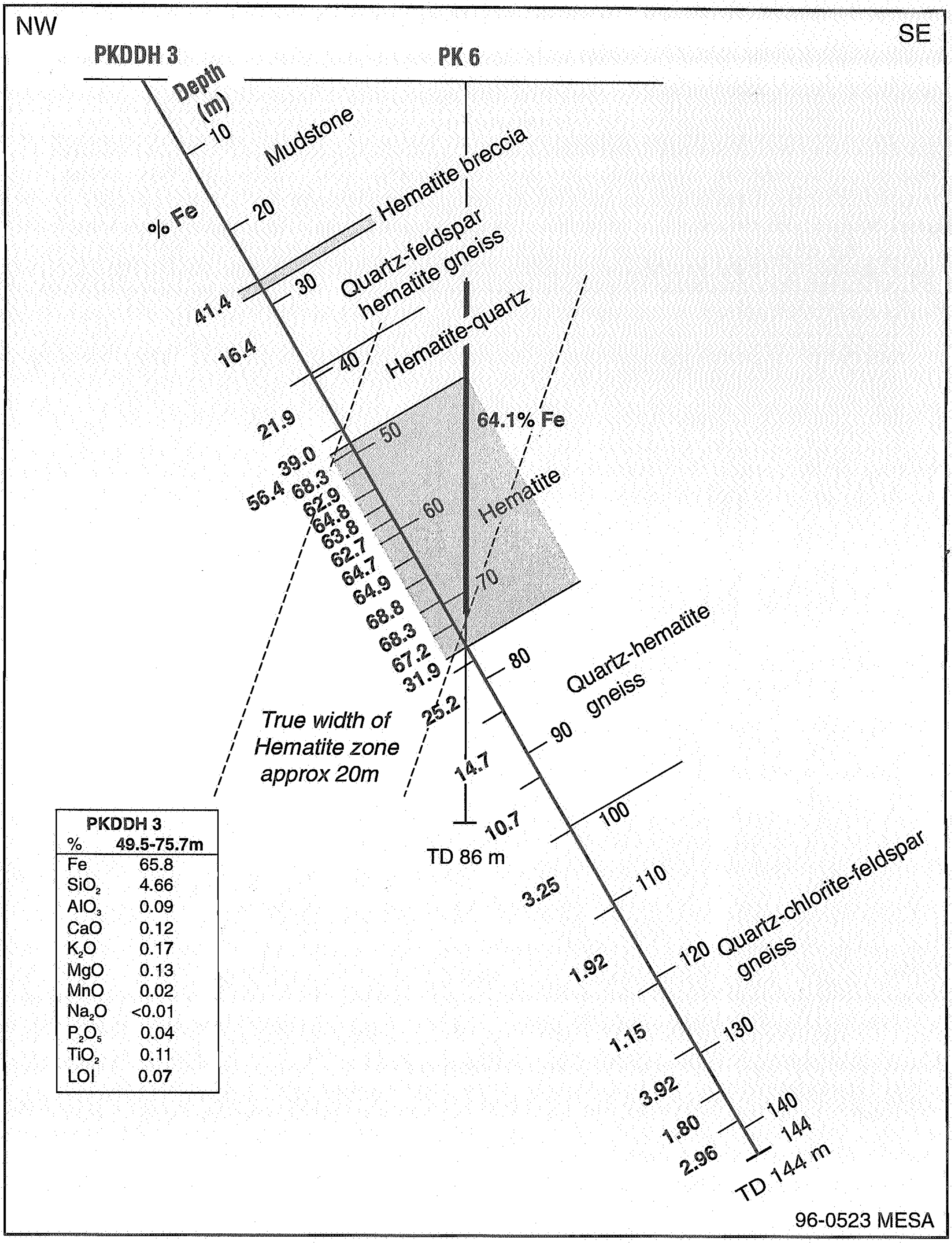

Fig. 8 Log of drillhole PKDDH3 on line 10 2000 N, Peculiar Knob prospect.

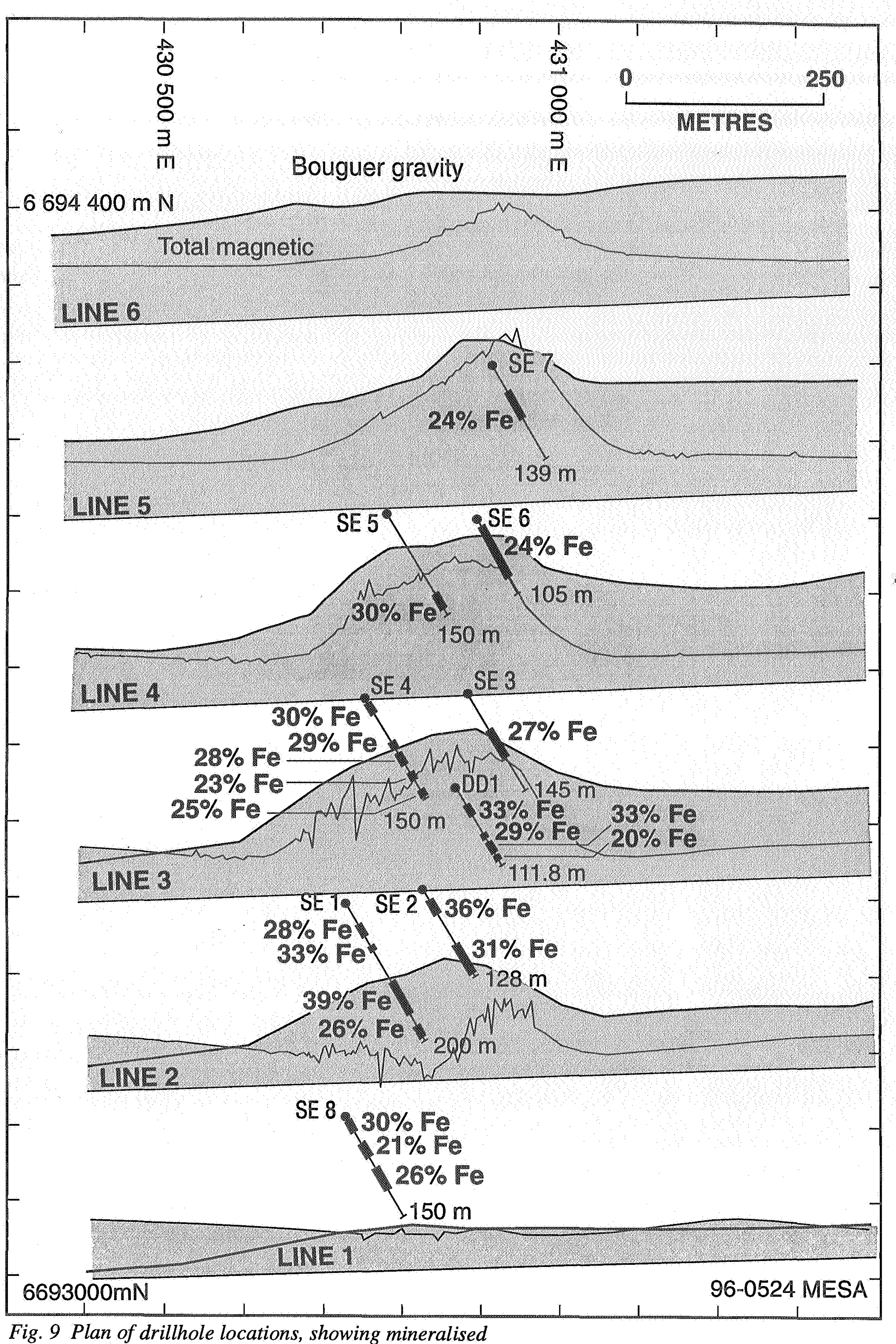

Fig. 9 Plan of drillhole locations, showing mineralised intervals, plus ground magnetic and Bouguer gravity profiles, Sequoia prospect

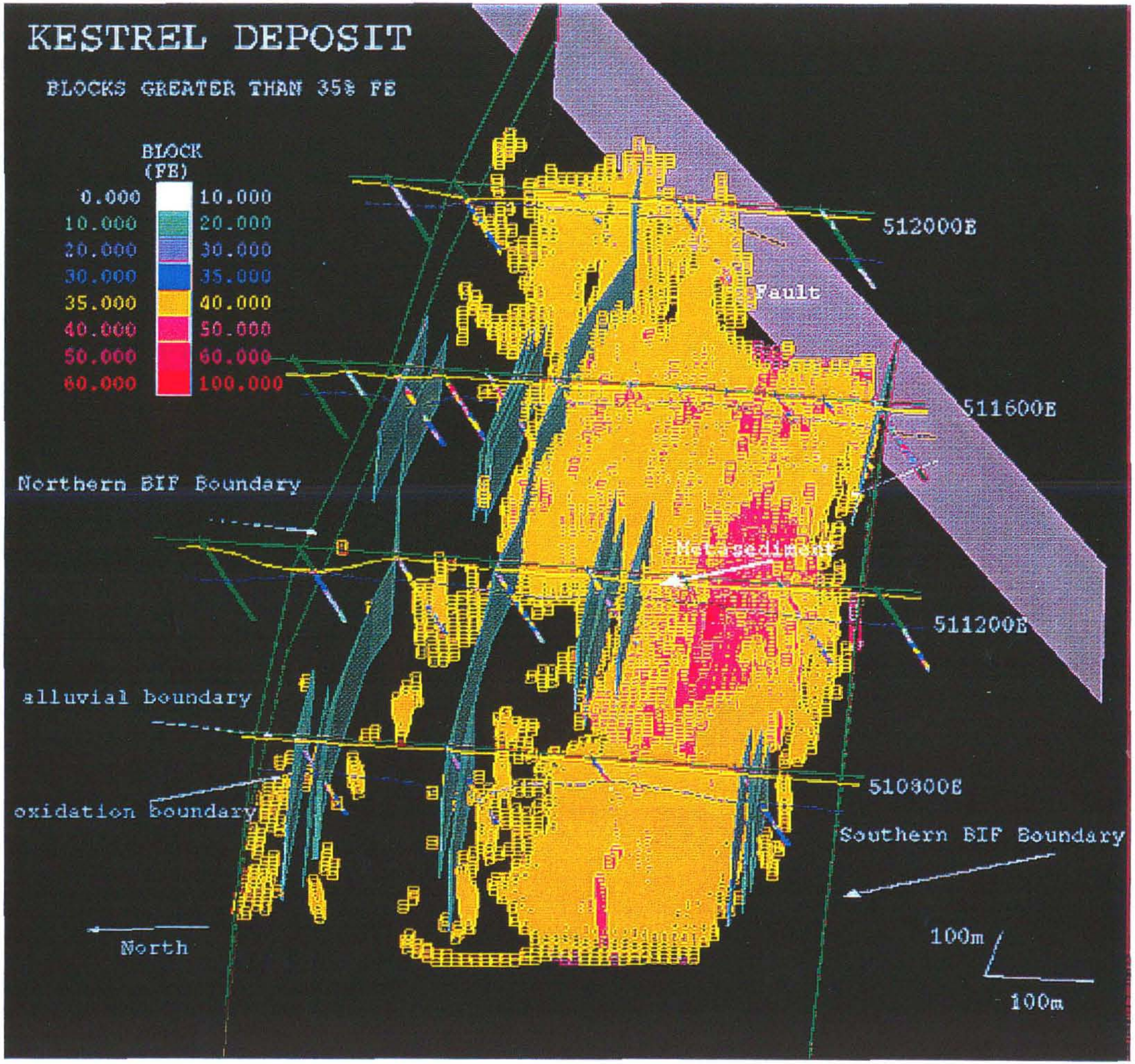
KESTREL DEPOSIT
BLOCKS GREATER THAN 35% FE
BLOCK (FE)
0.000 10.000
10.000 20.000
20.000 30.000
30.000 35.000
35.000 40.000
40.000 50.000
50.000 60.000
60.000 100.000
512000E
Fault
511600E
Northern BIF Boundary
Metasediment
511200E
alluvial boundary
510800E
oxidation boundary
Southern BIF Boundary
North
100m
100m

Plate 1.

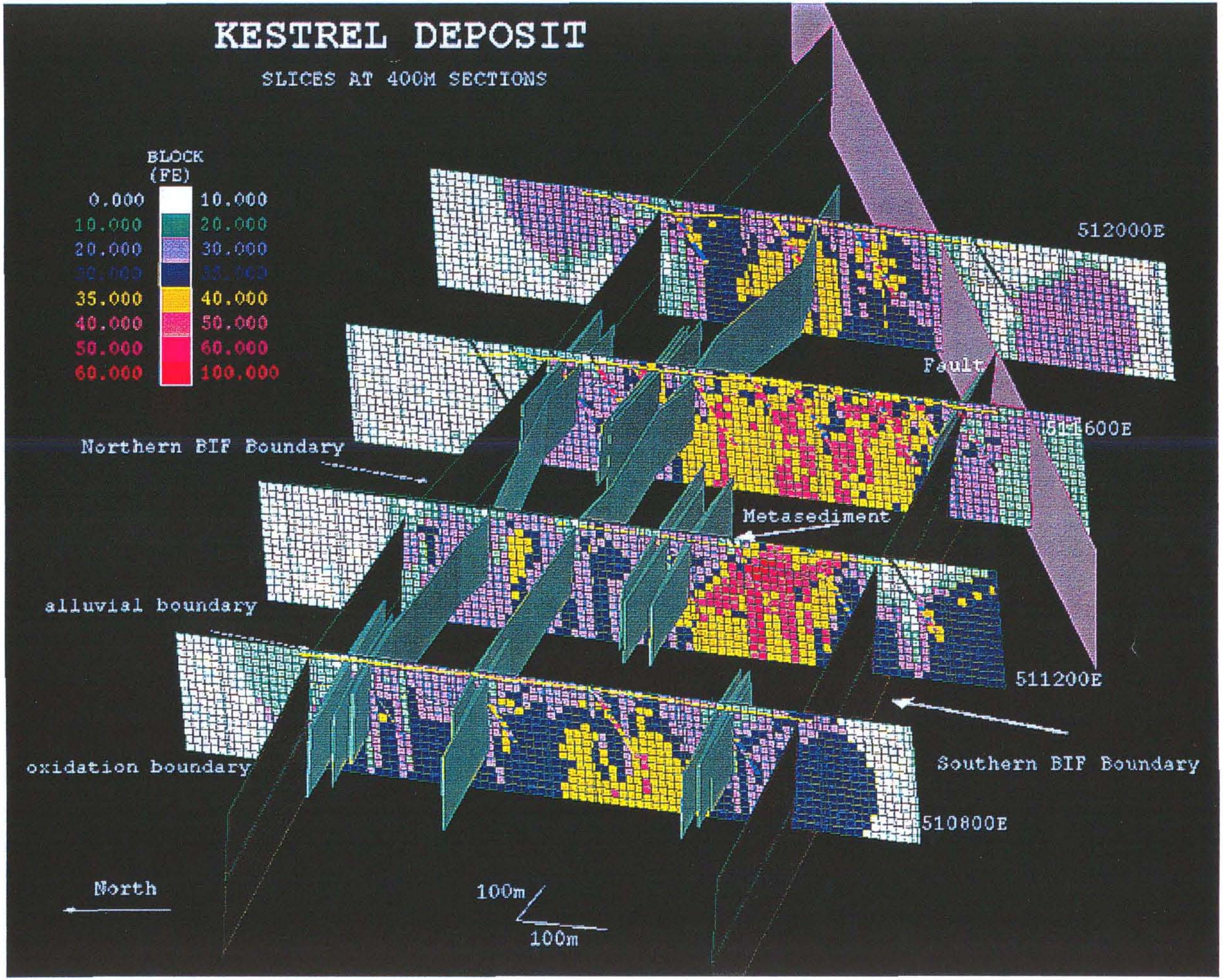
KESTREL DEPOSIT
SLICES AT 400M SECTIONS
BLOCK (FE)
0.000 10.000
10.000 20.000
20.000 30.000
35.000 40.000
40.000 50.000
50.000 60.000
60.000 100.000
512000E
Fault
511600E
Northern BIF Boundary
Metasediment
alluvial boundary
511200E
Southern BIF Boundary
oxidation boundary
510800E
North
100m
100m

Plate 2.

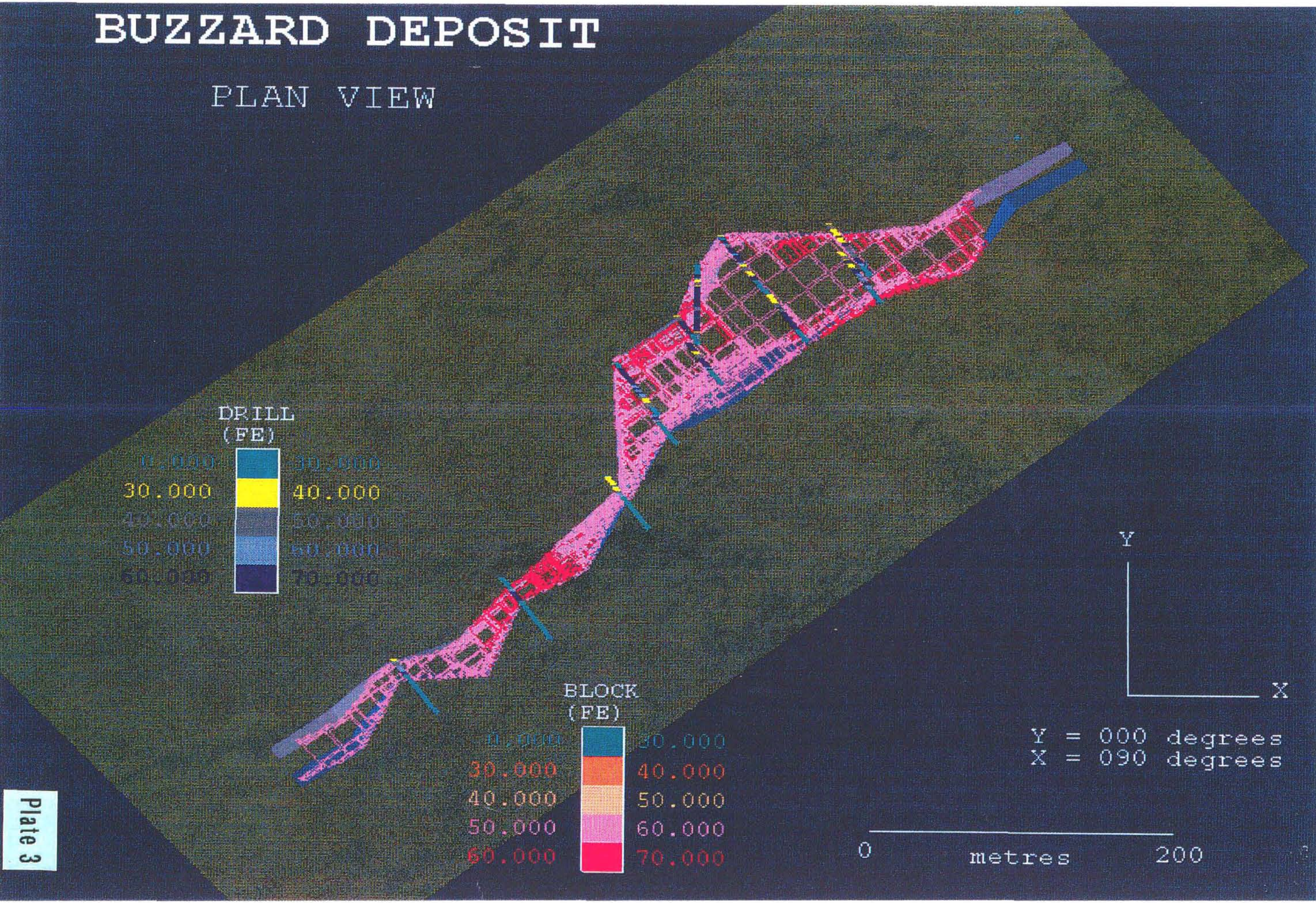
BUZZARD DEPOSIT
PLAN VIEW
DRILL
(FE)
0.000 30.000
30.000 40.000
40.000 50.000
50.000 60.000
60.000 70.000
BLOCK
(FE)
0.000 30.000
30.000 40.000
40.000 50.000
50.000 60.000
60.000 70.000
Y
X
Y = 000 degrees
X = 090 degrees
0 metres 200

Plate 3

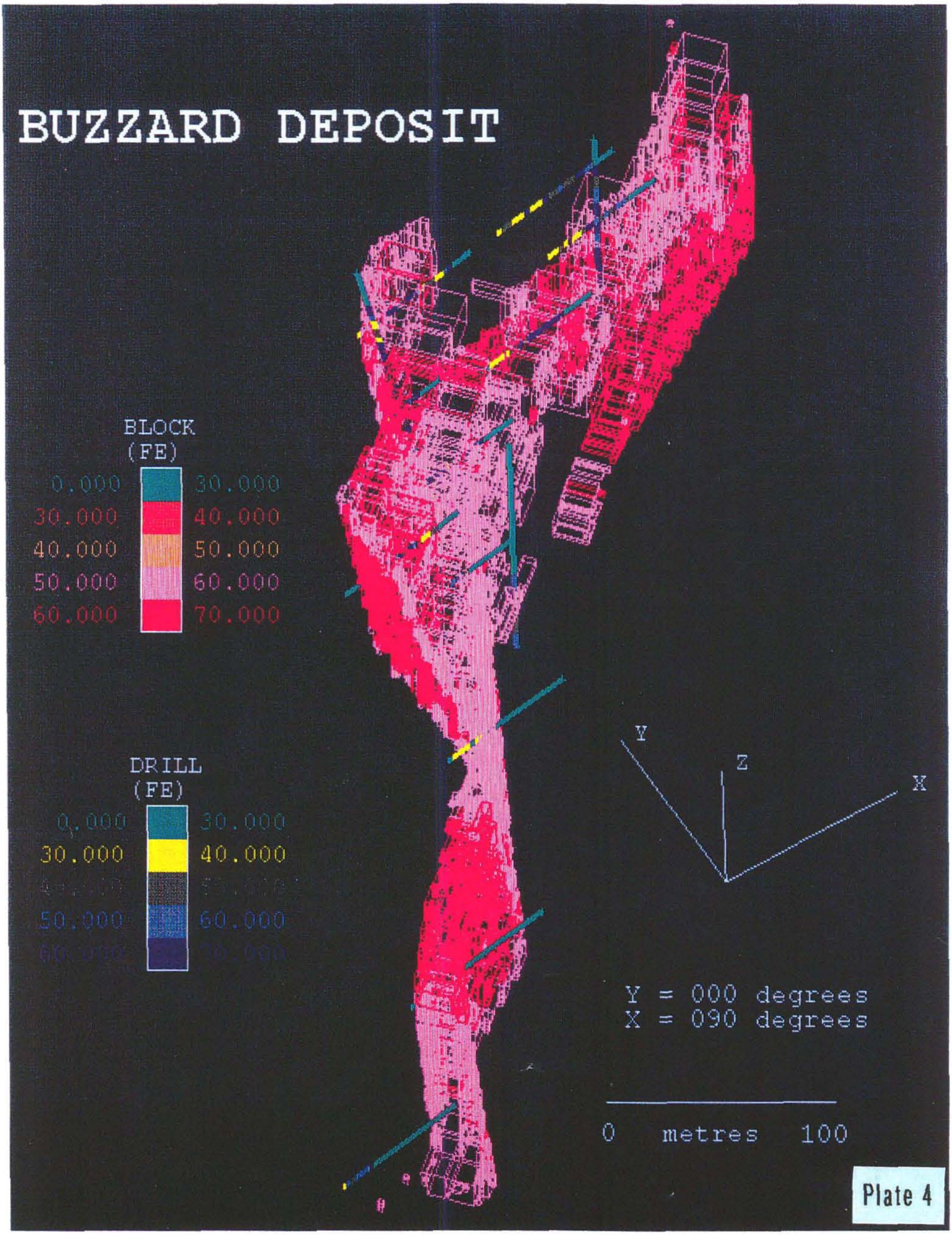
BUZZARD DEPOSIT
BLOCK
(FE)
0.000 30.000
30.000 40.000
40.000 50.000
50.000 60.000
60.000 70.000
DRILL
(FE)
0.000 30.000
30.000 40.000
50.000 60.000
Y
Z
X
Y = 000 degrees
X = 090 degrees
0 metres 100

Plate 4

APPENDIX

Petrological Photographs

Photo 1 Kestrel Deposit, thinly laminated BIF with micro faulting and amphibole veinlets (Photo No. 44364).

Photo 2 Kestrel Deposit, thinly laminated BIF with micro faulting and brecciation (Photo No 44365)

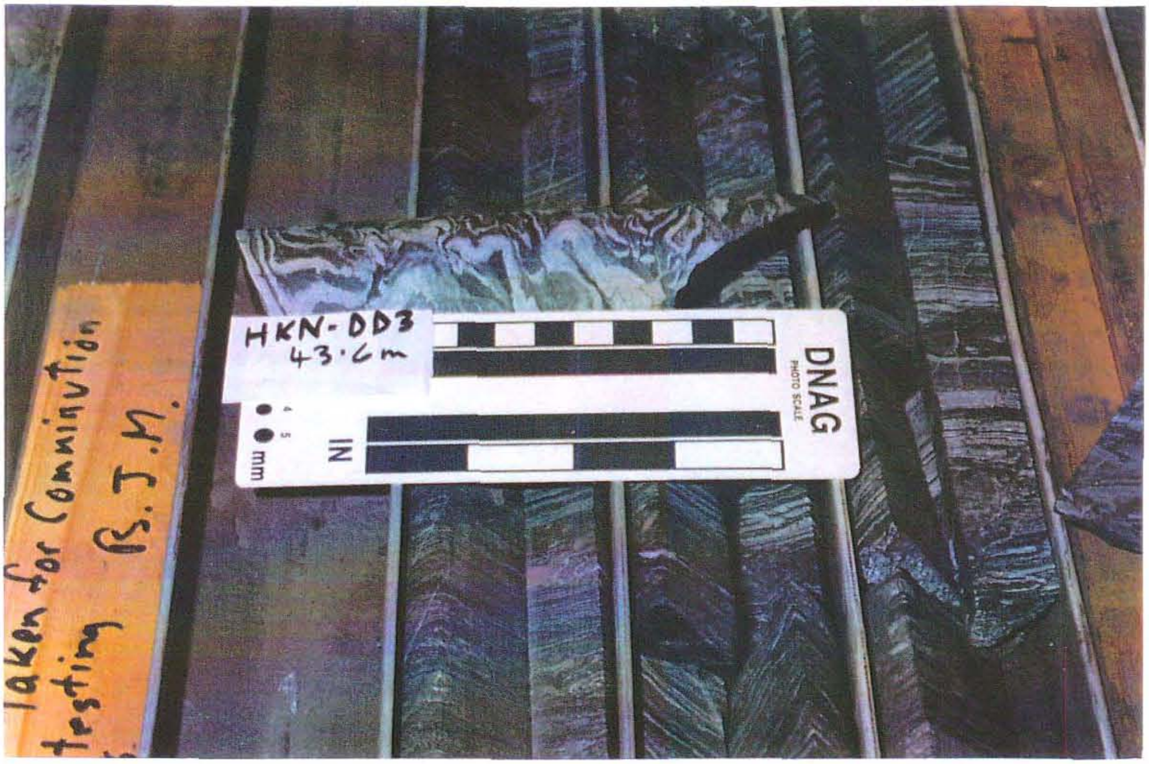

Photo 3 Kestrel Deposit, thinly laminated BIF with microfolding (Photo No 44366).

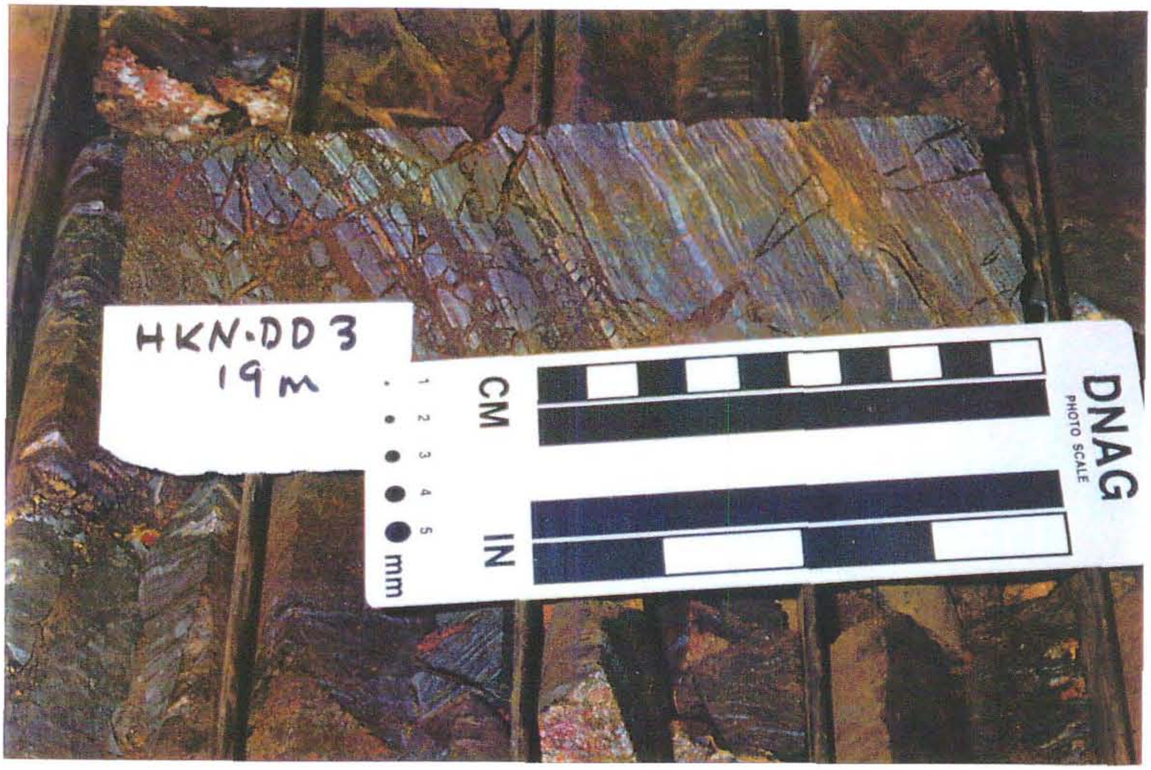

Photo 4 Kestrel Deposit, supergene oxidised BHIF (Photo No. 443670).

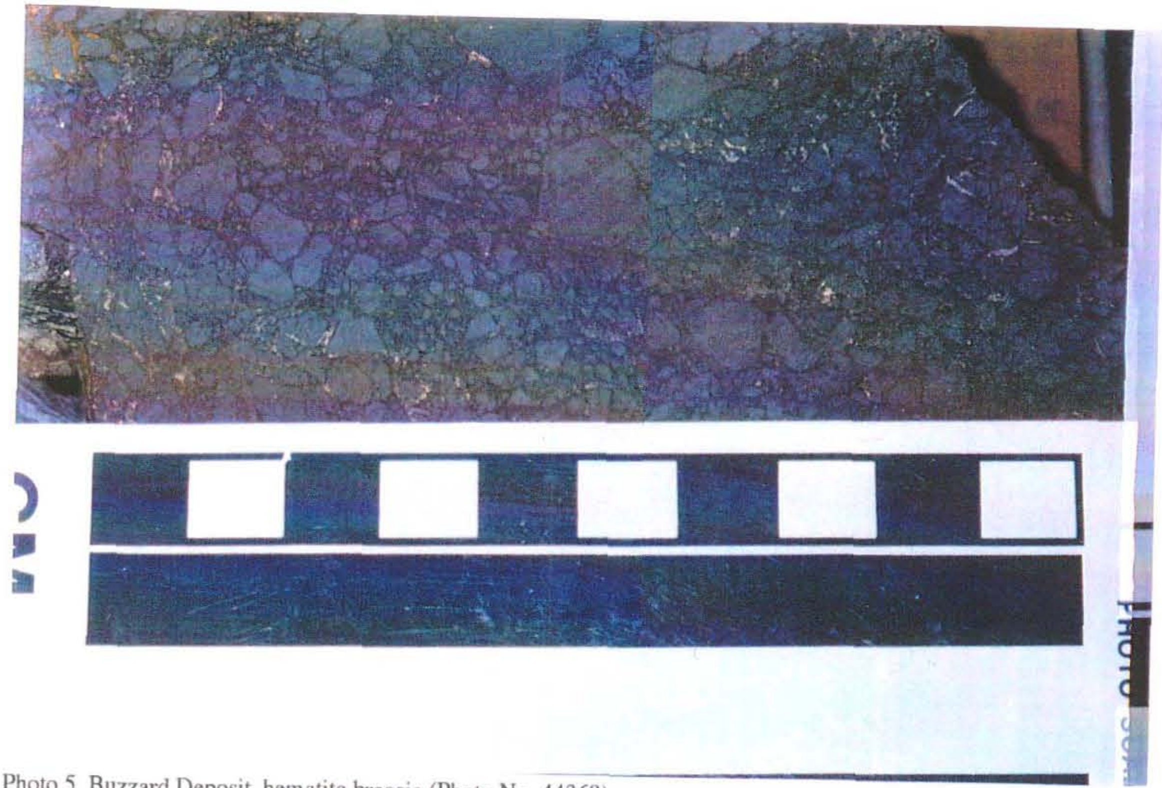

Photo 5 Buzzard Deposit, hematite breccia (Photo No. 44368).

Photo 6 Peculiar Knob Deposit, coarse grained massive specular hematite (Photo No. 44369).

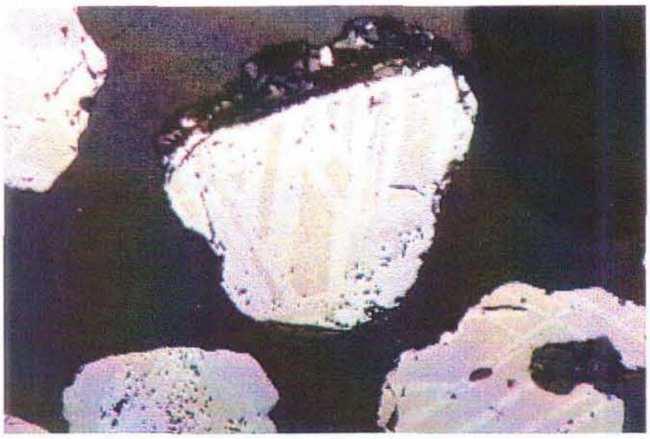

Photo 7 *Magnetite showing oxidation to hematite along structural plains (x 275)*

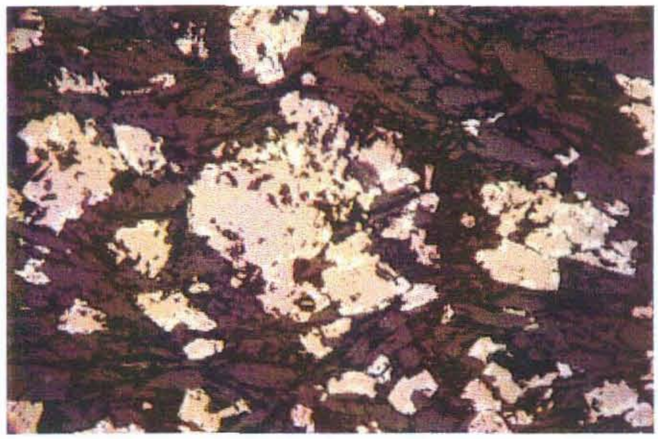

Photo 8 *Magnetite rimmed with hematite oxidation in groundmass of amphibole and cherty quartz (x200)*

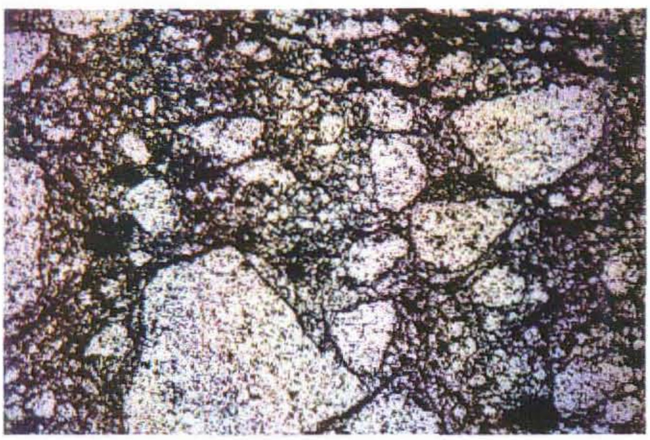

Photo 9 *Hematite breccia fragments of microplaty hematite in similar matrix (x 40)*

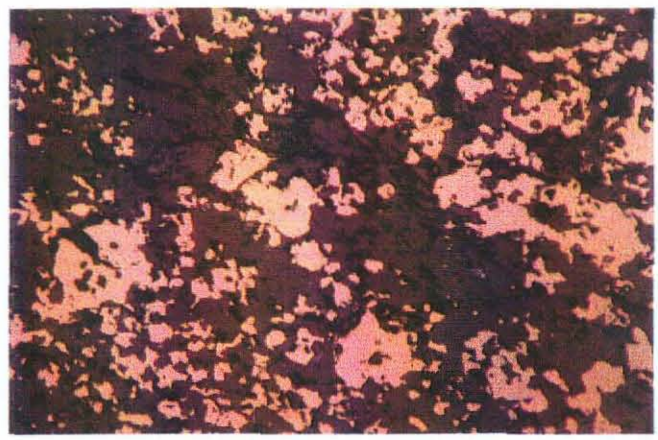

Photo 10 *Magnetite in cherty quartz and amphibole matrix (x 200)*

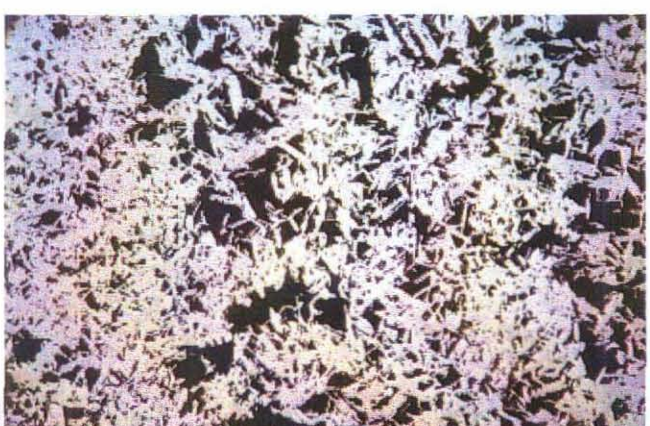

Photo 11 *Massive microplaty hematite (x 200)*

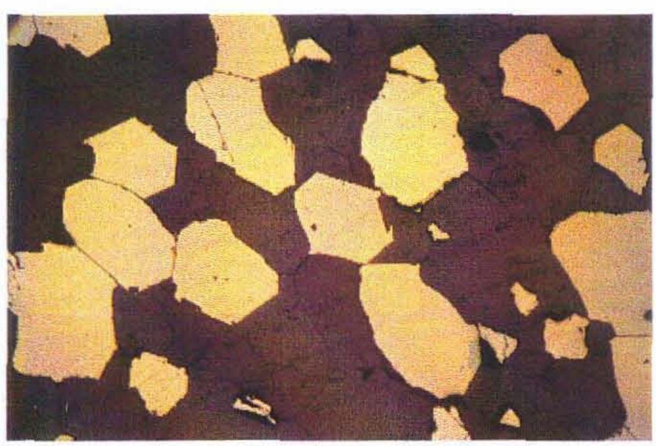

Photo 12 *Polygonal crystals of hematite with quartz mozaic (x 40)*

IRON ORES FROM THE COOBER PEDY AREA
MINERAGRAPHIC OBSERVATIONS

E.R. SEGNIT

15th July 1996

IRON ORES FROM THE COOBER PEDY AREA

Three samples were submitted for a preliminary examination. These were:

1. A sample of fine drill cuttings, locality unspecified.

2. A drill core of what appeared to be primary material. Locality: Hawk's Nest

3. A drill core of oxidised material. Locality: Hawk's nest

Methods used

Polished sections were prepared of all samples, and examined by reflected light in an optical microscope. A thin section was also prepared of sample no. 2 for examination by transmitted light.

Samples 1 and 2 were also examined in the scanning electron microscope (SEM), with particular reference to the qualitative elemental composition of various phases.

Sample 1

Microscope examination by reflected light showed that the major mineral was magnetite. It occurs largely as independent grains free from gangue or other minerals (Fig.1). A proportion of the magnetite grains, however, are still attached to, or even enclosed by, gangue minerals at this crushing level (Fig.2). In some grains, much finer magnetite is intimately admixed with gangue minerals (Fig.3).

A small proportion of the magnetite grains show partial alteration to hematite (Fig.4). The lamellar alteration structure, with the hematite showing as brighter bands, is characteristic of this oxidation. Such particles will, however, still be strongly magnetic. Few grains were entirely hematite.

A feature of this sample was the occurrence of small sulphide particles in unaltered magnetite grains. Fig. 5 shows what are clearly two small pyrite crystals, while Fig. 6 shows several minutes, rounded particles of sulphides.

The SEM yielded the following additional information:

1. The magnetite in this sample is distinctly titaniferous; the energy dispersive pattern (EDS) suggests a titanium content in the region of 5% or more. One

magnetite grain contained wide bands of highly titaniferous minerals, probably ilmenite. The Fe:Ti ratio appears to be rather uniform across the grains examined.

2. Most of the sulphide particles are pyrite; a few are chalcopyrite.

3. Phosphorus was detected in some of the gangue. It occurred as rounded grains of a calcium phosphate, probably apatite.

4. Feldspar occurred as a gangue mineral; it was a calcic plagioclase with a high Ca/Na ratio.

5. Another silicate had a high Ca content, moderate Mg, low Al and some Fe; it was probably an amphibole such as hornblende.

6. One small interstitial grain of high contrast against magnetite and hematite was encountered. It appears to be metallic iron, with little or no Ti content (Fig.7). It is uncertain at this stage as to whether it is natural, or whether it is tramp iron picked up during drilling or grinding operations.

Sample 2 (Drill core HK-DD3, 102.3- 102.38 m)

This sample comprised a length of drill core cut longitudinally. It was strongly magnetic and showed a well defined banded structure of gangue and magnetite. It appears to be a BIF type material.

The polished section shows that it is largely composed of magnetite as poorly formed crystals evenly distributed though gangue, although the magnetite/gangue ratio varies markedly from band to band. The magnetite crystallites are generally < 50 microns (0.05 mm) in size, commonly forming aggregates of such particles.(Fig.8). The magnetite appears to be quite unaltered; no hematite lamellae were seen in the section (Fig.9).

In thin section, the amphibole gangue was clearly seen as aggregates of fine, fibrous crystals (Fig.10).

Examination in the SEM showed that the magnetite in this case was almost free from titanium, in contrast to the crushed material of sample 1. Three gangue minerals were identified by their elemental composition (Fig.11). They were quartz, calcite and amphibole, probably hornblende.

Sample 3

This was a highly oxidised sample containing numerous cavities. It was mainly brown in colour, the major component clearly being goethite. Some bands were darker in colour and more dense, and examination in a polished section showed that they were composed of goethite with a variable content of rather fine grained residual hematite.

There also appeared to be less gangue in this sample.

E. R. SEGNIT

15th July, 1996

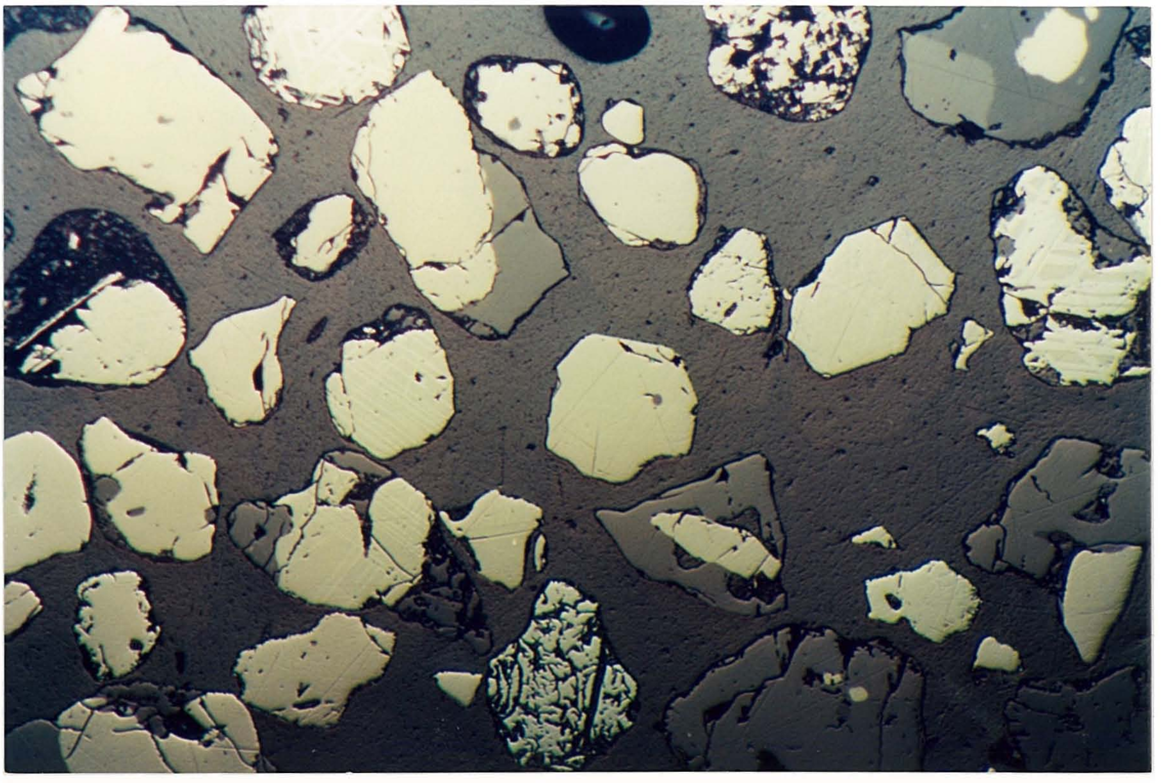

Fig.1 Sample No.1: Mainly free magnetite grains, with a few composite gangue/ magnetite particles. x100

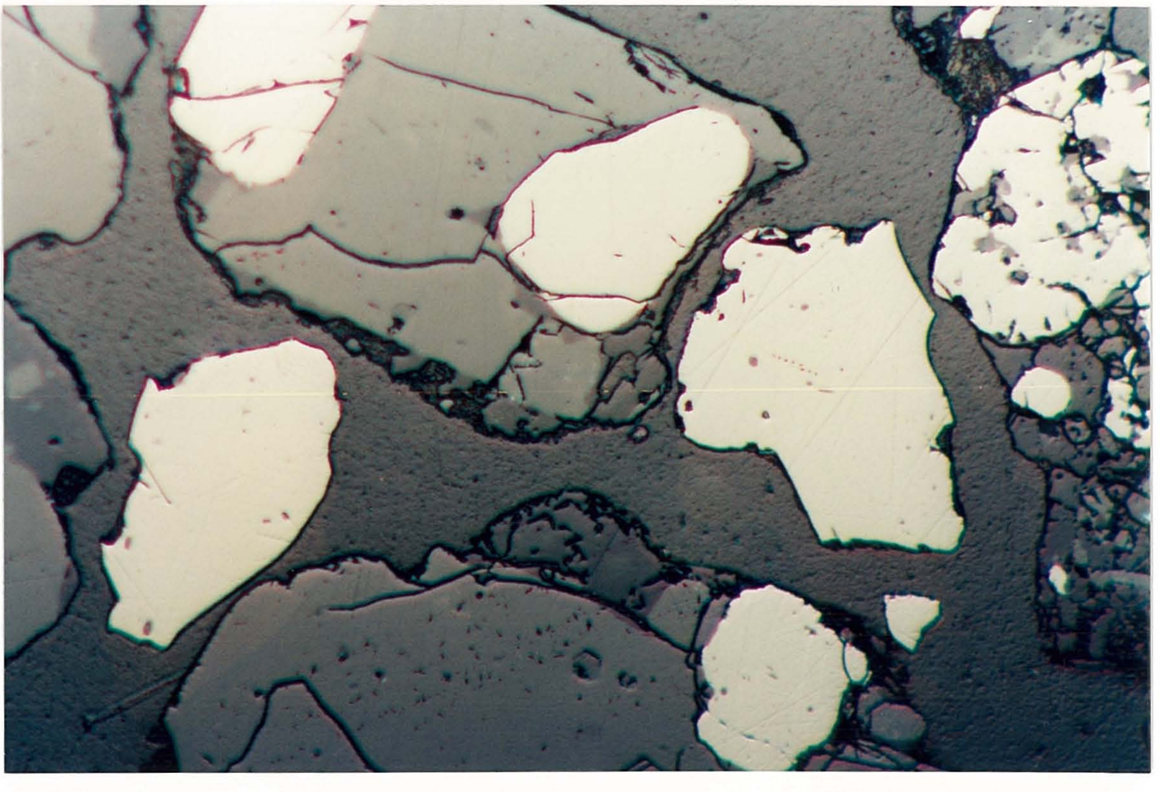

Fig.2 Sample No.1: Shows some magnetite particles enclosed in gangue. x275

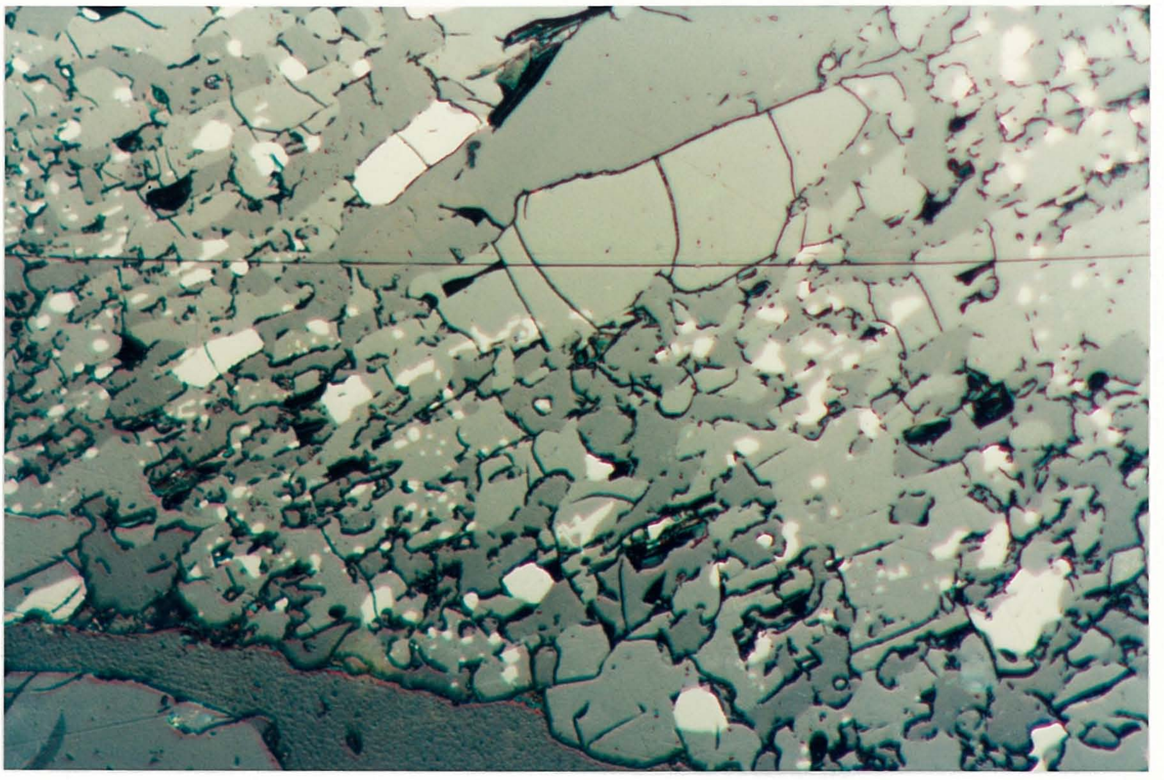

Fig.3 Sample No.1: Larger complex gangue grain enclosing fine grained magnetite. x275

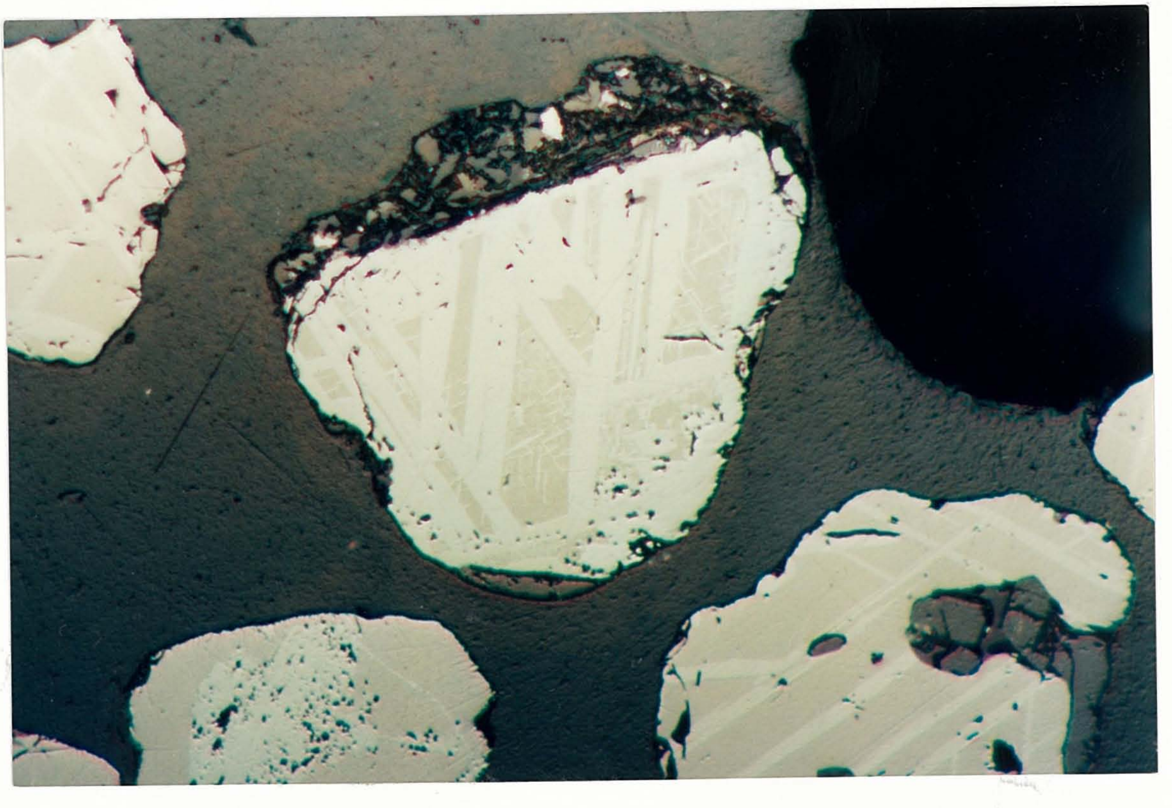

Fig.4. Sample No.1: Magnetite showing the characteristic oxidation to hematite along structural planes. x275

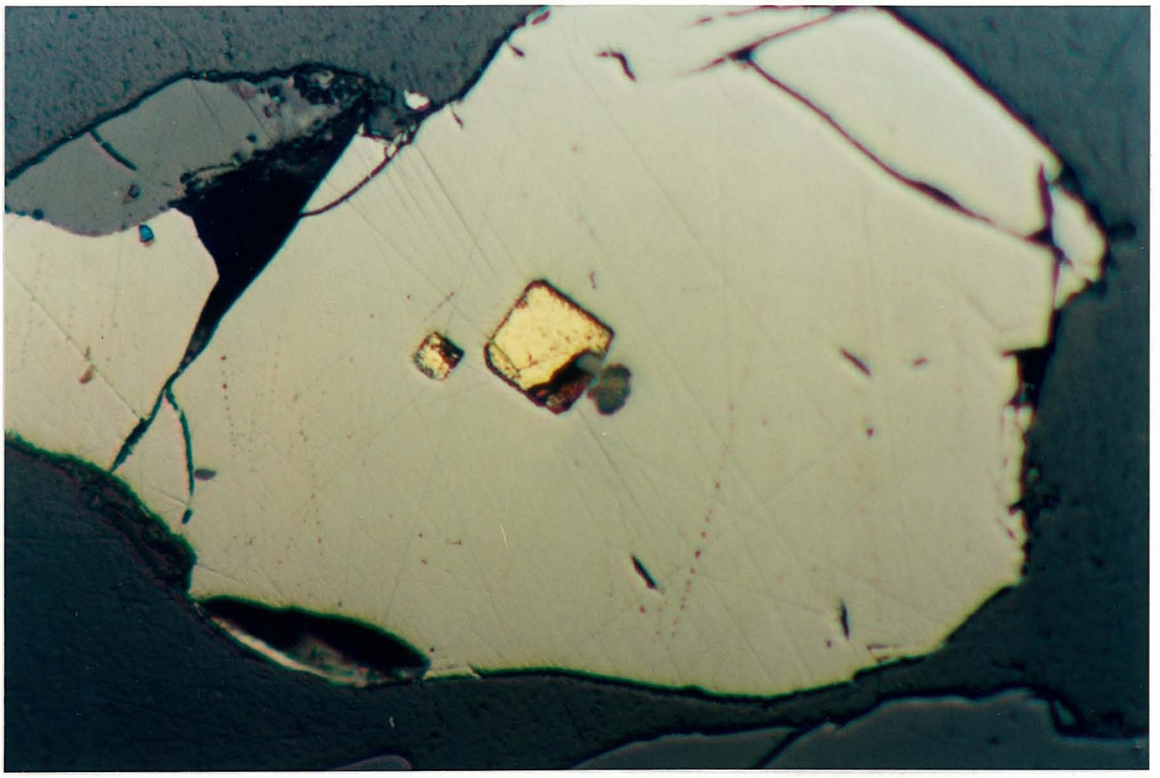

Fig.5. Sample No.1: Pyrite crystals enclosed in magnetite. x430

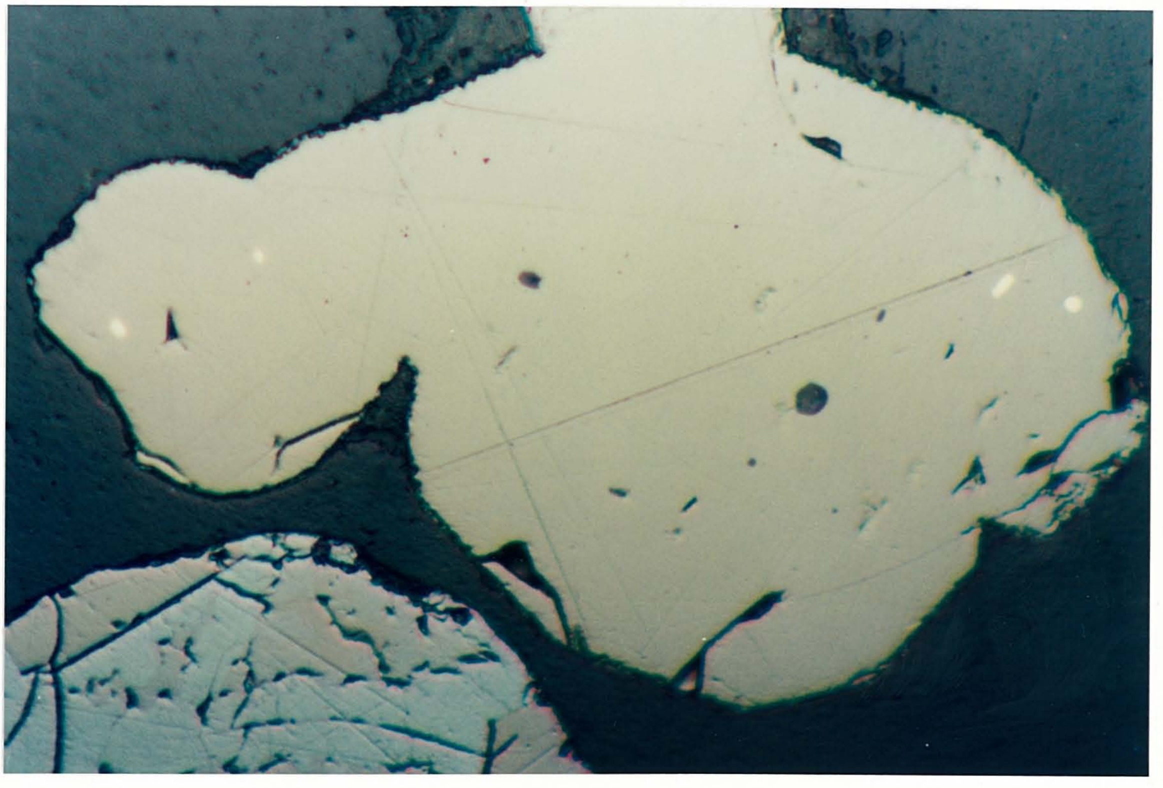

Fig.6 Sample No.1: Minute sulphide particles, possibly chalcopyrite, included in a magnetite grain. x430.

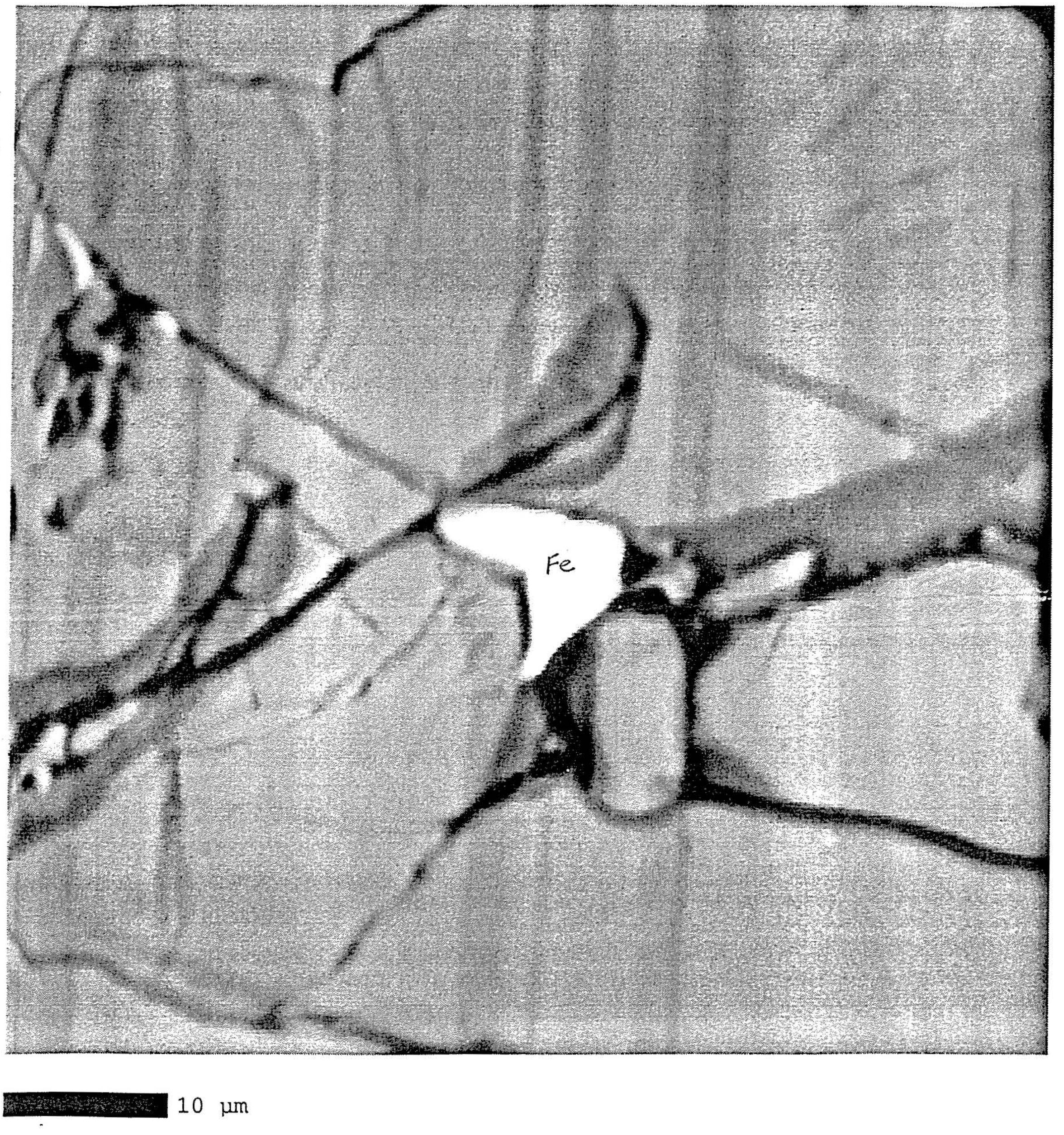

Fig.7 Sample No.1: SEM printout of a small particle of metallic iron enclosed in a grain of magnetite.

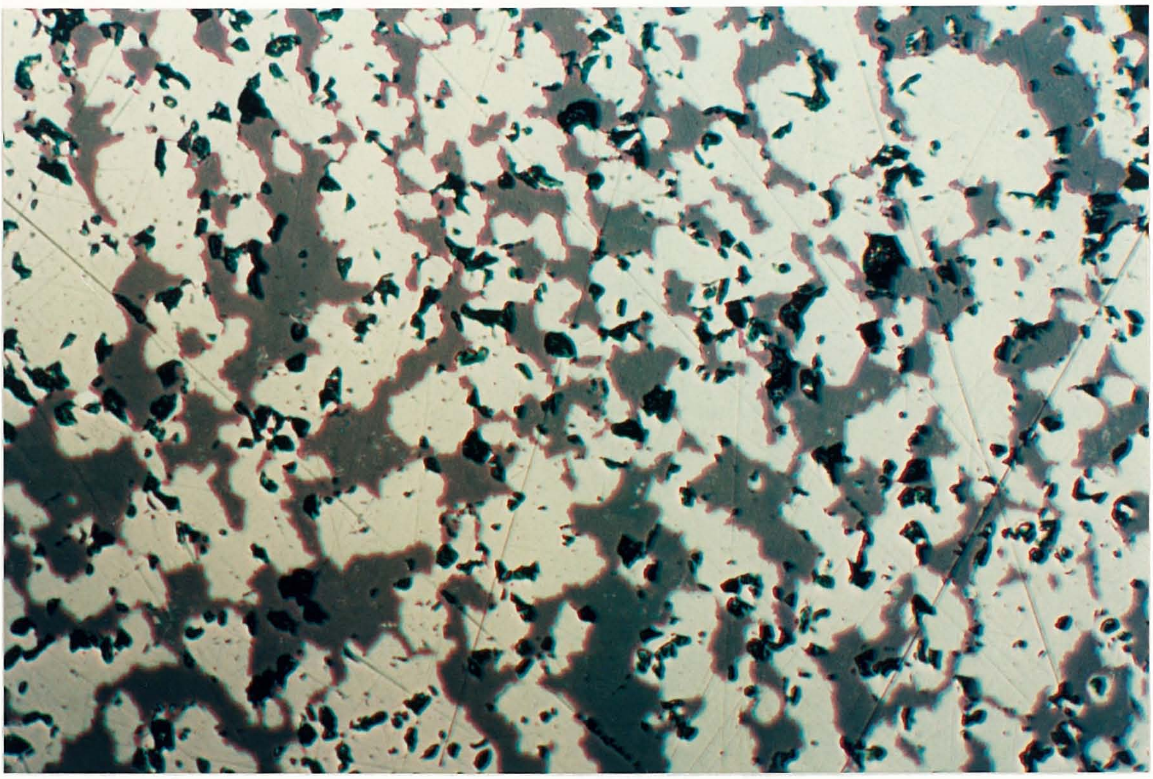

Fig.8 Sample No.2: Shows magnetite evenly distributed through the gangue. x275

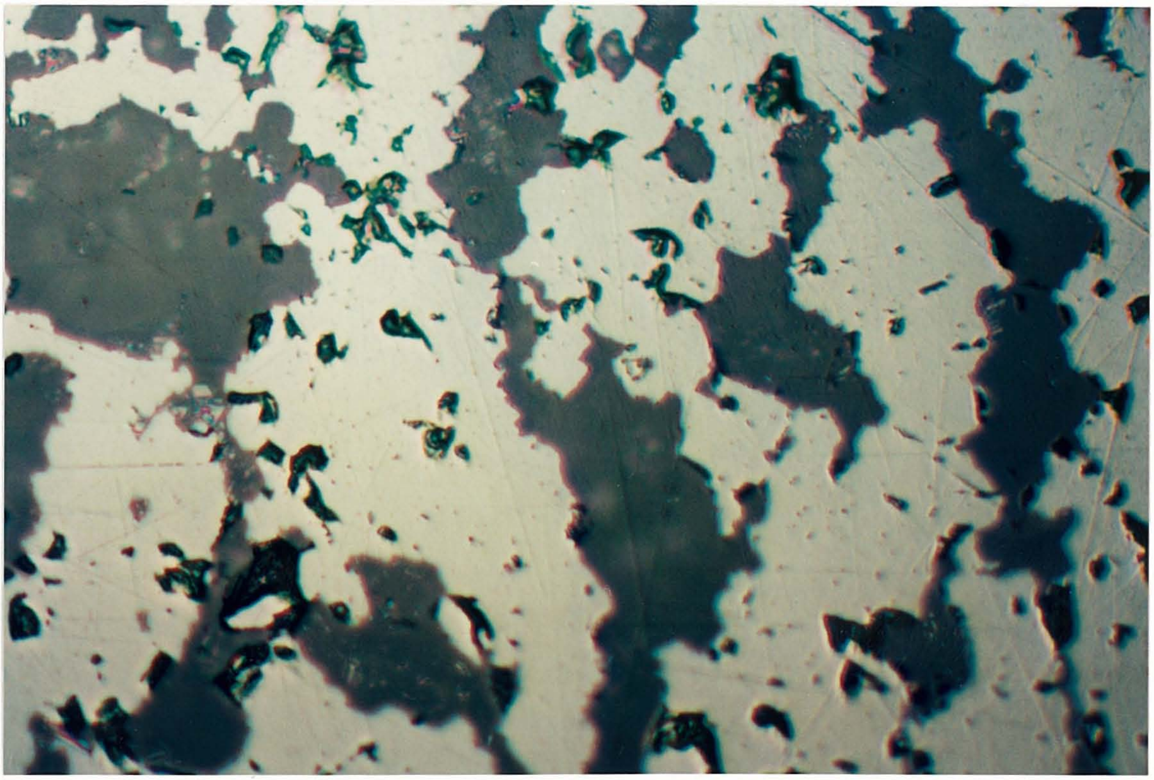

Fig.9 Sample No.2: Magnetite grains showing no evidence of oxidation to hematite. x430

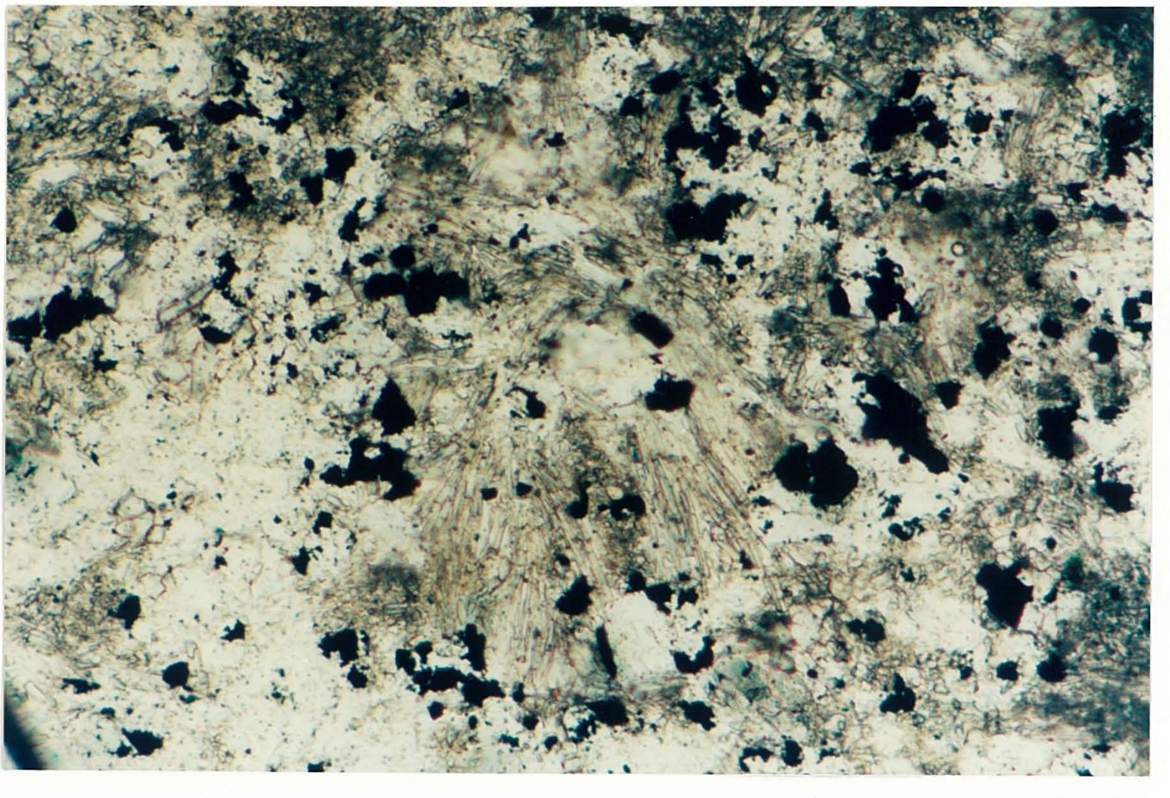

Fig.10 Sample No.2: Thin section (transmitted light) showing fibrous crystallites of amphibole. x430

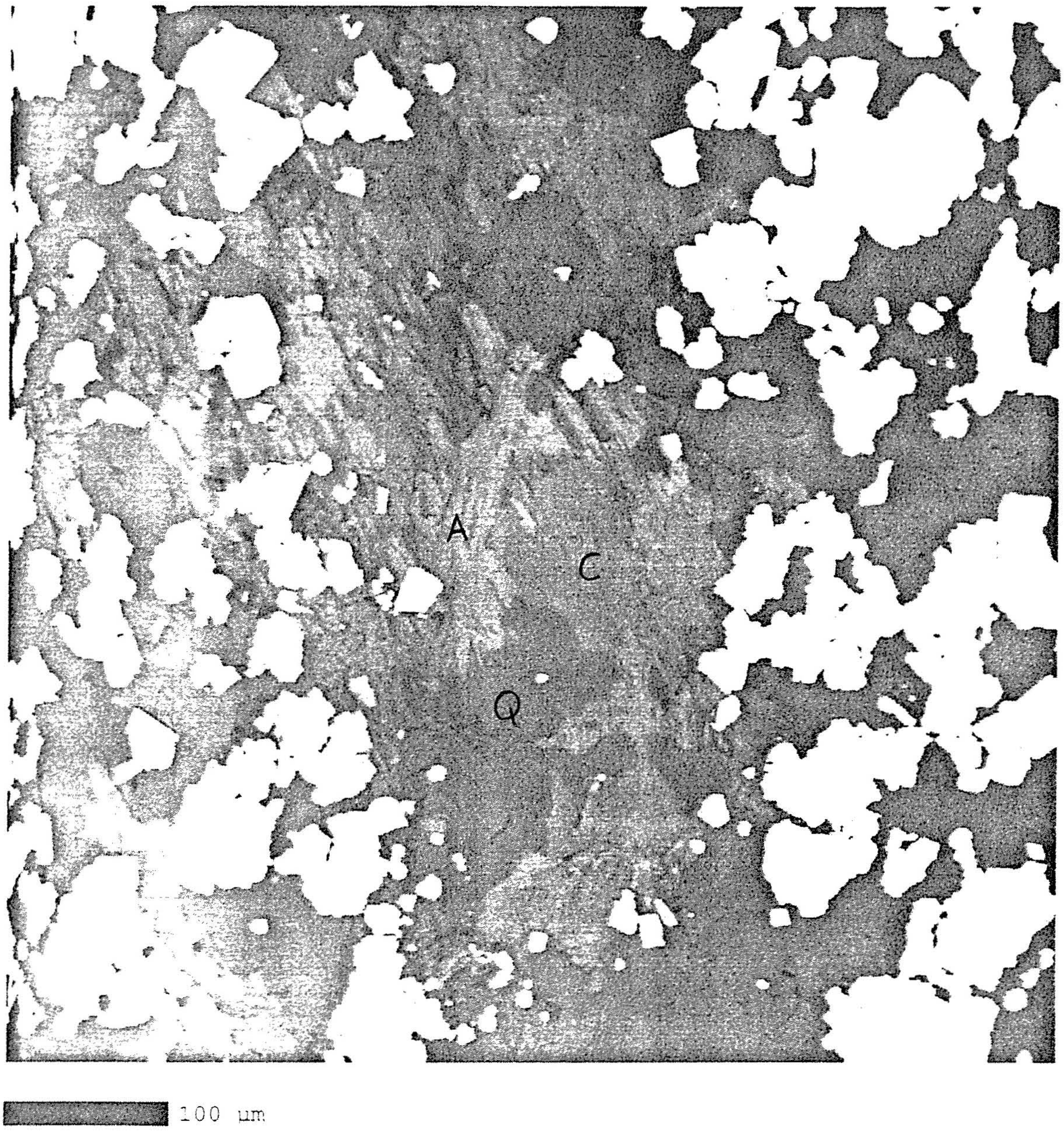

Fig.11 Sample No.2: SEM printout of a section showing a higher proportion of gangue. Q - quartz; C - calcite; A - amphibole, probably hornblende (high Ca-Mg-Fe, some Al).