CONTENTS ENVELOPE 1392

TENEMENT: S.M.L. 352 - Manunda.

TENEMENT HOLDER: Asarco (Australia) Pty. Ltd.

REPORT: Progress Report To 15th Aug. 1970. Pgs. 3-52

PLANS:

ENV. 1392.

0003

ASARCO (AUSTRALIA) PTY. LTD.

SPECIAL MINING LEASE NO. 352

MANUNDA

PROGRESS REPORT TO 15 AUGUST, 1970

Compiled by

R. A. ROYAL

Adelaide
South Australia.
7 September, 1970.

Technical Report No. 22
File No. 1-1-2-15
Copy No. 1

INDEX

APPENDICES

LIST OF FIGURES

0005A

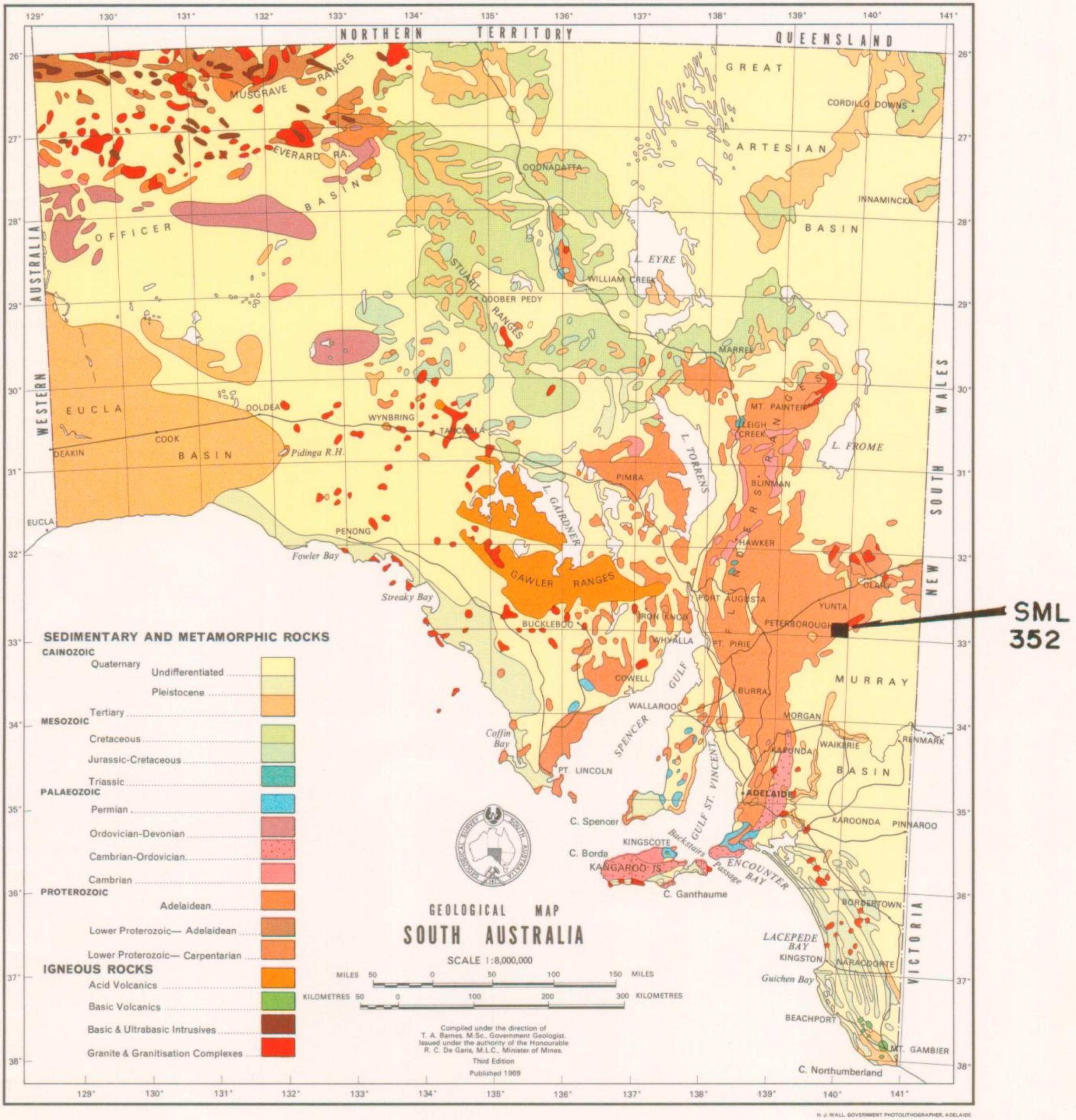


FIG. I
LOCATION SML 352 MANUNDA PROSPECT.

ASARCO (AUSTRALIA) PTY. LTD.

SPECIAL MINING LEASE NO. 352
MANUNDA

SUMMARY REPORT TO 15 AUGUST, 1970

Compiled: R. A. ROYAL

INTRODUCTION

This report summarises and tabulates the results of several phases of mineral exploration carried out in Special Mining Lease No. 352 surrounding Manunda Station, South Australia.

The programme followed the recognition by airphoto interpretation of several probable centres of hydrothermal activity and the investigations were focused mainly on these features.

Geologic field-checking, general prospecting, geochemical stream and rock sampling, detailed geologic mapping and bulldozer trenching have been completed during the nine months of tenancy.

Field work was carried out during this period by Messrs. A.T. McKee, B.J. Douglas, I.B. Freytag, S. Ross and L.R. Dodds.

LOCATION AND ACCESS

The Manunda Prospect is situated about 30 miles South-east of Yunta (see Fig. 1). Access is by sealed road to Yunta, 200 miles from Adelaide, and then by 32 miles of good unsealed road to Manunda Station. The Lease itself is covered by many good station tracks so that almost all of the area is accessible to a 4-wheel-drive vehicle.

LEASE HISTORY

The lease was granted to Asarco (Australia) Pty. Ltd. on application, for a term of 6 months, commencing 13 November, 1969. On 12 May the term of the Special Mining Lease was extended for a period of six months to 12 November, 1970.

The lease covers the eastern half of the Manunda One Mile Sheet (see Figure 2), an area of approximately 250 square miles.

PHYSIOGRAPHY

The area consists of broad undulating plains 500 feet above sea level, crossed by northeast trending ranges which rise to 1000 feet above the plains. The topography has a strong geological control.

Vegetation is largely dependent on rock type but most of the area has little more than a few inches of soil cover. In general saltbush covers the flatter ground and small hardy trees are scattered on the higher ground. Mulga trees are restricted to the areas of granite, and large gums mark the master streams of the area. The region is arid and averaging only 5 to 8 inches of rain per annum.

GEOLOGICAL SETTING

The lease area covers Upper Proterozoic sedimentary rocks of the Adelaide System, folded into a series of steeply plunging anticlines and synclines which usually form closed structures.

The Upper Proterozoic is represented in the Manunda district by rocks which have been subdivided in three Groups. The oldest is the Burra Group of Torrensian age which consists of the following succession (based on Mirams 1962):

1. a lower sequence of siltstones, sandstones and greywackes with occasional lenticular beds of marble.
2. an upper sequence of well-cleaved, partly pyritic and carbonaceous slates, with beds of dolomite.

These sediments become coarser where they grade into an essentially glacial and fluvio-glacial succession, with minor carbonate and iron constituting the Umberatana Group.

These are the youngest of the Adelaide sediments exposed in the lease area.

The Adelaide System rocks have undergone low grade metamorphism (lower green schist facies) during orogenic folding and igneous intrusion of the Palaeozoic Anabama Granite. As evidence of metasomatic activity tourmaline is a characteristic component of some of the sediments, particularly black slates which contain 5 to 7 percent of this mineral. Some quartz-tourmaline rock (TS 8218) containing 15% tourmaline was found in a highly altered area near the eastern border of the lease (see Fig. 3). Such deuteric alteration is probably related to the granite mass exposed several miles to the south east which impinges on the eastern border of the lease.

The Anabama Granite is a medium to coarse grained rock, which is thought to have been emplaced in the closing stages of the folding of the Adelaide System, probably in Lower Ordovician Lime. This granite has a metamorphic aureole zone elongated to the southwest, suggesting a subterranean extension of the granite mass in that direction. A zone of spotted slates in the north west of the lease area (see Fig. 2) and low grade metasomatism may relate to deep seated hydrothermal activity.

Intermediate to basic dyke rocks are found associated with the granite mass. These are iron-alkali rich rocks which intrude and probably post-date the granite intrusion (Mirams).

Most of the mineralization found at Manunda occurs in Burra Group sediments.

KNOWN MINERAL OCCURRENCE

Two old copper mines in the near vicinity of the Manunda Station homestead, together produced 60 tons of ore (malachite, cuprite and azurite) from 1887 - 1890.

The copper mineralization is associated with quartz-specular hematite-calcite veins carrying minor pyrite and presumably chalcopyrite below the zone of oxidation. These mineralized veins are in Upper Torrensian black slates.

The mine to the west of the homestead is at the moment under claim. Any possible extension to these mines appears improbable.

RESULTS OF EXPLORATION

Hydrothermally altered areas:

Of numerous colour air-photo anomalies, only five were confirmed in the field as hydrothermal centres. The remainder were found to be areas of superficial iron staining and leaching, pale coloured carbonate sediments, or calcrete.

Hydrothermal activity is evident in several features, the commonest being varying degrees of quartz veining with or without gossan, and bleaching, silicification, kaolinization and pyritization of sediments, generally, the dark, dolomitic, fine-grained clastics of the Burra Group.

The alteration is structurally controlled by fracturing and faulting most obvious in the Pidgeon Box prospect (see Fig. 2).

Stream sediment samples (Nos. A8101-8151) from creeks draining these zones and rock chip samples of outcropping rocks (Nos. A8001 - 8037, see Fig. 3) were taken for geochemical determination of Cu, Pb, Zn, Ag, Au and Mo.

Reference to Appendix I shows that analytical results are generally unencouraging, but low order anomalies were found to occur in several different localities. These areas were resampled (sample Nos. 8064-8092 and 1992, 1996, 1998, Appendix I), thus confirming a number of Cu anomalies range 100 p.p.m. to 310 p.p.m. Cu. These samples show values for Pb, Zn, Ag and Mo of background order only.

Field checking of anomalous localities disclosed that each could be related to gossanous rock, often associated with quartz veins, or merely very small patches protruding from alluvium. Almost all of the gossans seen have characteristics of a pyrite source which however can be responsible for total leaching of copper present during prolonged weathering.

Favourable geology and geochemical results led to the detailed examination of two specific areas.

1. Pidgeon Box Prospect

The geology of this prospect is shown in Figure 4. It is an area about 2000 feet square, encircled by hills of dark dolomitic shales and siltstones. The prospect area is masked by scree and alluvium but small outcrops, sub-crop and float indicate that quartz-gossan is common and widespread. In some creek outcrops, quartz-limonite-hematite veinlets are seen filling bedding plains in sediments as well as a set of near vertical joints.

Geochemical metal values are quite low, but it was decided to trench the prospect to examine the frequency of sulphide bearing veins and the nature of surface leaching. The results of this work are discussed in the section "Bulldozer Costeans" starting on page 9.

2. Area 2.

The detailed geology is represented in Figure 5. An area of alluvial flats approximately 2000 feet by 1000 feet and semi-surrounded by low hills of Proterozoic sediments, shows scattered outcrop of quartz, gossan, and highly-altered ferruginous rocks.

Several of the gossans carry traces of copper, evidenced by geochemical values of 100 p.p.m. to 250 p.p.m. Cu (see Fig. 5).

Two large outcrops at the eastern side of the prospect consist of a silicified, ferruginous, coarse, cellular rock which initially was described in thin section as a weathered ultrabasic. This result prompted a ground magnetometer survey of the area, 3000 feet by 2000 feet, which however, was found to be magnetically "flat" (see Fig.5). Revision of the petrological interpretation of these rocks determined them as altered, very coarse carbonates with some serpentine.

Although gossans in this area appeared to be small and scattered, three trenches were bulldozed at chosen localities to examine these rock-types. Results are discussed in the section "Bulldozer Costeans".

Rhyolites(?) and black slates

Thin sections of a ?bleached, buff-coloured, siliceous aphanitic rock-type with disseminated pyrite, were described respectively as oligoclase dacite and sodic rhyolite (see samples 8209, 8215, Appendix III). These occur intimately with black slates at several localities in the north-eastern parts of the lease.

Geochemical analyses have shown that these rocks (8209, 8020, Appendix I) are not mineralized, other than by pyrite with traces of chalcopyrite (see 8215B, Appendix III). The black slates were similarly shown to contain only background amounts of Cu (45 p.p.m.), Pb (45 p.p.m.), and Zn (35 p.p.m.).

At the locality of sample 8209, the dacite(?) occurs apparently interbedded with the slates, in bands less than one foot thick. The rhyolite(?) (sample T.S.8215) occurs with recrystallized black shales.

However, in both cases relationship between the igneous(?) rock and slates is gradational and irregularly patchy. Field evidence suggests that their origin may be in recrystallization, silicification and pyritization related to hydrothermal activity.

<u>Metamorphic areas</u>

Two areas on the lease show evidence of somewhat higher degree of metamorphism.

One, at the eastern side of the lease is probably a contact aureole of the Anabama Granite. Rock sampling of this area (8047 to 8052) including granite, contact zone and metamorphosed shales, showed that only background metal values are present.

The other metamorphosed area is several miles west and south-west of Manunda Homestead. The rock types as such are barren, but gossan in quartz veins which cut the sediment at wide interval assayed in some cases, several hundred p.p.m. copper (8057, 8093 - 8100, Appendix I). Sample 8096 produced a value of 1900 p.p.m. Cu which may be explained by goethitic and manganiferous material in the rock (see Appendix III). However, mineralization in this area is too weak and minor to warrant further work.

A norite dyke 1½ miles long in the north eastern corner of the lease (see Fig. 2) was also chip sampled, (Sample Nos. 8038 - 8041). The analyses did not show any unusually high values for a basic rock so no further work is required.

BULLDOZER COSTEANS

Bulldozer costeans were made in order to intersect several zones of hydrothermal quartz veins and gossan material at a depth of a few feet below the surface.

Three costeans were sited on the Pidgeon Box Prospect and another three in Area 2 (see Fig. 3 for location of areas).

Samples were collected as a continuous channel along the trench, over 10 or 20 foot sample lengths depending on the degree of vein development.

The location of each costean is shown on the detailed maps of two areas of interest (Figs. 4 and 5). The detailed map or log of the individual costeans and the assay and position of all samples is shown in Figs. 6 and 7.

Assay results are very low (maximum 170 p.p.m. copper and only background Pb, Zn, Ag and Au). These results do not prompt any further work in these areas.

Pidgeon Box Prospect

The detailed map (log) and assays of these costeans are shown in Fig. 6.

Costean 1 was placed to intersect a zone showing several outcrops of gossan and veins lying in an area of soil covered by a dense quartz scree.

The trench is some 250 feet long and in places up to 5 feet deep. Some 240 feet of the costean has been sampled of which approximately 19 feet consists of hematite gossan, quartz gossan and gossanous quartz veins. These veins are parallel and generally only a few inches to a foot wide, the largest being 2¼ feet wide. The intermediate rock consists of highly weathered fine siltstones, sandstones and occasional horizons of hematite-cemented sandstone. The only sulphide mineral encountered was pyrite in a few of the less oxidized quartz veins.

Costean 2 was placed in a similar area of poorly exposed quartz and gossan material about 550 feet to the north of Costean 1. This costean was sampled over a length of 200 feet of which approximately 16 feet consists of hematite gossan and quartz in veins generally only a few inches (up to 18 inches) wide. Most of the veins are near the centre of the costean and become less numerous to each side. A 100 foot extension of the costean to the SE contains almost no quartz vein or gossan material and was not sampled. The interstitial rock between veins consists of highly weathered siltstones with occasional beds of sandstone and siltstone. Apart from very fine pyrite in some of the quartz veins, no sulphide mineralization was intersected.

Costean 3 was placed in an area of quartz scree about 1000 feet southeast of Costean 2. The trench is about 160 feet long of which the central 100 feet was sampled. This section contains a total of about 2 feet of vein(?quartz), individual veins ranging in width up to 5 inches. The country rocks are weathered fine siltstone, some sandstone and an horizon of hard quartzite. Very little hematite staining and no sulphides were encountered in this trench.

Area 2

The detailed map and assays of these costeans is shown in Fig. 7.

Costean 1 has been placed to intersect an area of quartz and gossan material accompanied by sub-outcrop of altered siliceous cellular rock. The costean is some 100 feet long, of which the central 60 feet have been sampled. The quartz veins and hematite gossan rock are restricted to the 20 feet central portion of the trench where several veins mushroom at the surface into a superficial cemented zone. The interstitial material between the veins is a yellow orange gypsiferous clay. The country rock is a highly weathered (and perhaps altered) sequence of fine siltstones and marls.

Costean 2 was placed to intersect a poorly outcropping area of quartz and gossan about 500 feet west of Costean 1. Several gossan (goethite-hematite-quartz) veins were intersected in a 100 foot section of weathered mudstones, siltstones and orange yellow gypsiferous clays. No sulphides including pyrite were encountered.

Costean 3. An area of scattered sub-outcrop of tourmalinized and silicified rock was cut in a trench some 100 feet long. Of the 60 feet sampled only a few inches of gossanous quartz veins were encountered within a general host rock of highly weathered yellow-stained mudstone and siltstone.

SUMMARY AND CONCLUSIONS

Probable centres of hydrothermal activity recognized by airphoto interpretation have been checked on the ground. Five areas of hydrothermal alteration were confirmed, but only two showed sufficient signs of base metal mineralization to warrant trenching. In both of these areas, bulldozer costeans reveal after-pyrite gossan associated with quartz veins cutting siltstones and sandstones. Channel sampling along the costeans has yielded very low assays, the highest being 170 p.p.m. Cu across 10 feet.

Following a review of remaining exploration possibilities, unless further targets are revealed, relinquishment of the S.M.L. will probably be recommended.

R. A. ROYAL

APPENDIX I

ANALYTICAL RESULTS BY ATOMIC ABSORPTION SPECTROSCOPY

ROCK SAMPLES

Sample No.	Cu ppm	Pb ppm	Zn ppm	Ag ppm	Mo ppm	Au ppm
8001	50	30	20	<2	2	<0.5
8002	45	25	15	<2	<2	<0.5
8003	45	40	15	<2	<2	<0.5
8004	110	40	20	<2	<2	<0.5
8005	45	20	20	<2	2	<0.5
8006	25	60	20	<2	<2	<0.5
8007	15	20	15	<2	<2	<0.5
8008	85	55	20	<2	2	<0.5
8009	55	70	30	2	<2	<0.5
8010	20	<20	20	<2	<2	<0.5
8011	30	20	15	<2	<2	<0.5
8012	20	20	20	<2	2	<0.5
8013	55	55	50	<2	2	<0.5
8014	35	20	40	<2	<2	<0.5
8015	210	100	40	2	<2	<0.5
8016	180	60	25	2	2	<0.5
8017	40	20	20	<2	<2	<0.5
8018	70	55	25	2	<2	<0.5
8019	190	70	120	2	2	<0.5
8020	110	<20	15	<2	2	<0.5
8021	85	30	15	<2	<2	<0.5
8022	50	25	35	<2	<2	<0.5
8023	20	<20	15	<2	<2	<0.5
8024	15	<20	10	<2	<2	<0.5
8025	25	<20	15	<2	<2	<0.5
8026	80	65	45	2	<2	<0.5
8027	150	70	55	2	<2	<0.5
8028	30	100	30	2	<2	<0.5
8029	20	65	25	2	2	<0.5
8030	20	100	30	2	<2	<0.5
8031	25	20	30	<2	2	<0.5
8032	45	35	35	<2	2	<0.5
8033	30	45	25	<2	<2	<0.5
8034	22000	20	30	<2	2	<0.5
8035	140	25	10	<2	2	<0.5
8036	680	30	5	<2	<2	<0.5
8037	160	70	20	2	2	
8038	70	70	100	2	<2	
8039	55	65	95	2	<2	
8040	40	30	20	<2	<2	
8041	40	20	20	<2	<2	
8042	40	20	10	<2	2	

Sample No.	Cu ppm	Pb ppm	Zn ppm	Ag ppm	Mo ppm	Au ppm
8043	190	80	45	5	2	
8044	160	60	30	2	<2	
8045	110	70	25	2	2	
8046	40	60	80	2	<2	
8047	75	35	10	2	20	
8048	50	55	15	<2	2	
8049	30	<20	10	2	<2	
8050	35	25	20	<2	<2	
8051	40	<20	10	<2	<2	
8052	45	20	10	<2	<2	
8053	20	30	30	<2	<2	
8054	25	35	20	<2	<2	
8055	20	<20	10	<2	<2	
8056	15	<20	5	<2	<2	
8057	400	30	15	<2	2	
8059	55	20	10	<2	<2	
8060	360	55	25	2	2	
8061	20	40	10	<2	<2	
8062	90	25	15	<2	<2	
8063	75	60	20	2	2	
8064	90	50	20	2	2	<0.5
8065	50	<20	5	<2	<2	<0.5
8066	35	<20	10	<2	<2	<0.5
8067	55	<20	10	<2	<2	<0.5
8068	100	50	20	2	2	<0.5
8069	45	<20	10	<2	<2	<0.5
8070	30	<20	5	<2	<2	<0.5
8071	310	40	30	2	5	<0.5
8072	110	50	25	2	5	<0.5
8073	180	70	55	2	2	<0.5
8074	60	30	10	<2	<2	<0.5
8075	missing					
8076	50	35	15	2	<2	<0.5
8077	45	20	10	<2	<2	<0.5
8078	110	50	30	2	2	<0.5
8079	35	20	15	<2	<2	<0.5
8080	30	<20	10	<2	<2	<0.5
8081	120	30	10	2	2	<0.5
8082	250	35	15	2	2	<0.5
8083	140	55	60	2	<2	<0.5
8084	missing					
8085	100	<20	15	<2	2	<0.5
8086	45	50	15	2	<2	<0.5
8087	missing					
8088	missing					
8089	40	30	30	<2	<2	<0.5
8090	340	35	40	2	2	<0.5

0021

Sample No.	Cu ppm	Pb ppm	Zn ppm	Ag ppm	Mo ppm	Au ppm
8091	150	50	30	2	2	<0.5
8092	75	50	20	2	<2	<0.5
8093	40	<20	10	<2	<2	<0.5
8094	80	30	25	<2	10	<0.5
8095	330	30	10	<2	5	<0.5
8096	1900	20	5	<2	2	<0.5
8097	310	50	15	2	<2	<0.5
8098	320	35	15	<2	5	<0.5
8099	190	30	20	<2	5	<0.5
8100	45	20	10	<2	5	<0.5
8232	40	50	80	2	<2	
8233	35	<20	20	<2	<2	
8234	30	<20	10	<2	<2	
8235	50	40	10	<2	<2	
8236	25	20	10	<2	<2	
8237	230	20	40	<2	<2	
8241	55	40	5	<2	<2	
7330	60	40	25	<2	10	<0.5
7331	75	220	25	<2	10	<0.5
7332	120	200	85	<2	<2	<0.5
7333	80	20	45	<2	5	<0.5
7339	230	20	85	2	<2	<0.5
1992	120	50	15	<2	2	<0.5
1993	55	35	15	<2	<2	<0.5
1994	65	30	15	<2	<2	<0.5
1996	30	25	15	2	<2	<0.5

STREAM SEDIMENT SAMPLES

Sample No.	Cu p.p.m	Pb ppm	Zn ppm		Ag ppm	Mo ppm	Au ppm
8101	70	50	25			<2	
2	20	30	30			<2	
3	20	30	25			<2	
4	35	35	25			<2	
5	25	40	60			<2	
6	15	50	35			<2	
7	20	40	40			<2	
8	15	30	30			<2	
9	20	40	25			<2	
10	20	40	35			<2	
1	15	40	30			<2	
2	25	40	30			2	
3	10	35	25			<2	
4	20	50	40			<2	
5	35	40	20			2	
6	30	40	25			2	
7	30	40	35			<2	
8	30	35	25			<2	
9	40	45	30			2	
20	25	35	35			<2	
1	25	40	35			2	
2	25	30	25			2	
3	30	30	20			<2	
4	25	40	40			<2	
5	30	40	60			<2	
6	20	40	20			<2	
7	30	35	35			<2	
8	30	50	50			<2	
9	25	60	50			<2	
30	25	50	55			<2	
8131	25	40	50			<2	
8132	30	50	55			2	
3	25	50	60			<2	
4	20	50	55			<2	
5	25	50	50			<2	
6	25	50	50			<2	
7	30	50	60			2	
8	20	30	50			<2	
9	25	45	50			<2	
40	10	30	35			<2	
1	30	60	35			<2	
2	15	30	40			2	
3	20	30	25			<2	
4	15	30	30			<2	
5	10	30	40			<2	
6	15	30	35			<2	
7	10	30	30			<2	
8	15	35	40			<2	
9	20	40	35			<2	
50	5	30	25			<2	
51	65	40	25			<2	

Sample No.	Cu ppm	Pb ppm	Zn ppm	Ag ppm
8238+80	25	20	25	<2
-80	30	20	25	<2
8239+80	30	20	20	<2
-80	35	30	35	<2
8240+80	35	25	25	<2
-80	25	25	25	<2
8242+80	30	30	20	<2
-80	30	20	25	<2
8243+80	20	<20	15	<2
-80	20	<20	25	<2
8244+80	120	30	25	2
-80	85	30	30	<2
8245+80	25	<20	20	2
-80	20	20	20	<2
8246+80	20	25	15	<2
-80	15	30	20	<2
8247+80	20	30	20	<2
-80	20	35	25	<2
8248+80	20	25	20	<2
-80	30	20	30	<2
8496+80	30	40	45	2
-80	25	50	50	<2
8497+80	35	50	50	<2
-80	30	35	45	<2
8498+80	30	25	40	<2
-80	25	40	30	<2
8499+80	70	40	35	<2
-80	50	40	35	<2
8500+80	40	40	25	<2
-80	30	25	30	<2

All results above were obtained by McPhar Geophysics Pty. Ltd. in Adelaide.

Analytical Methods

Cu, Pb, Zn, Ag, by A.A.S. following HCl leach and HCl/HNO_3 leach in latter stages on 0.25 gm. sample.

Mo by modified Dithiol following potassium pyrosulphate fusion on 0.2 gm. sample.

Au by solvent extraction/A.A.S. following aqua regia leach on 2.5 gm. sample.

APPENDIX II

ANALYTICAL RESULTS BY SEMI-QUANTITATIVE SPECTROGRAPHIC SCAN

The following results were obtained by Spectrometer Services Pty. Ltd., Melbourne.

ASARCO (AUSTRALIA) PTY LTD.

232 WAKEFIELD STREET,

ADELAIDE, SOUTH AUSTRALIA. 5000

SPECTROMETER SERVICES PTY LTD.

29 CODDEN STREET.,

NORTH MELBOURNE. 3051.

Sample-	Mn.	Bi.	Cd.	Mo.	Ni.	Co.	Sn.	W.	Ge.	As.	Sb.	Be.	Th.	Te.	Ta.	Ti.
8001	50	1	.5	5	<1	6	1	<20	<5	<30	<30	1	<10	<50	<50	10
8002	160	5	1	5	10	12	1	<20	<5	<30	<30	5	<10	<50	<50	3000
8004	300	8	1.5	4	<1	6	1	<20	<5	<30	<30	1	<10	<50	<50	200
8005	740	1	.5	3	<1	13	3	<20	<5	<30	<30	.5	<10	<50	<50	200
8006	155	8	1.5	<.5	1	10	<1	<20	<5	<30	<30	2	<10	<50	<50	2000
8007	35	4	1	4	5	11	1	<20	<5	150	<30	1	<10	<50	<50	5000
8008	10	7	2	4	1	11	3	<20	<5	<30	<30	1	<10	<50	<50	3000
8009	225	8	1.5	8	2	26	<1	<20	<5	<30	<30	3	<10	<50	<50	3000
8010	35	3	.5	3	5	10	3	<20	<5	150	<30	3	<10	<50	<50	5000
8011	25	5	1	12	2	14	5	<20	<5	<30	<30	2	<10	<50	<50	5000
8012	50	5	1	13	<1	10	25	<20	<5	50	<30	2	50	<50	<50	5000
8013	173	5	1.5	11	5	12	<1	<20	<5	<30	<30	2	<10	<50	<50	4000
8015	70	8	2	2	2	85	5	<20	<5	<30	<30	4	<10	<50	<50	4000
8016	355	8	2	4	2	65	<1	<20	<5	<30	<30	2	50	<50	<50	4000
8017	45	10	1	2	8	12	5	<20	<5	<30	<30	2	<10	<50	<50	5000

Signed-

Spectrometer Services Pty Ltd.,

Sample -	Mn.	Bi.	Cd.	Mo	Li.	Co.	Sn.	W.	Ge.	As.	Sb.	Be.	Th.	Te.	Ta.	Ti.
8018	170	8	2	10	2	43	<1	<20	<5	<30	200	2	<10	<50	<50	2000
8019	175	8	2	16	4	26	<1	<20	<5	<30	<30	4	<10	<50	<50	2000
8020	30	7	1	5	2	12	20	<20	<5	<30	<30	2	<10	<50	<50	4000
8021	50	8	1.5	8	4	11	5	<20	<5	<30	<30	2	<10	<50	<50	3000
8024	50	7	1	6	1	14	5	<20	<5	<30	<30	2	<10	<50	<50	2000
8025	170	3	1	7	2	11	10	<20	<5	<30	50	2	<10	<50	<50	5000
8028	95	8	2	4	4	14	<1	<20	<5	<30	<30	1	<10	<50	<50	3000
8030	190	11	2	4	2	13	<1	<20	<5	<30	<30	1	<10	<50	<50	2000
8032	615	5	1	4	9	19	5	<20	<5	<30	<30	2	<10	<50	<50	3000
8033	3700	22	2	6	4	13	10	<20	<5	<30	<30	1	<10	<50	<50	2000
8034	190	5	1	6	6	145	5	<20	<5	<30	<30	3	<10	<50	<50	2000
8037	105	11	1.5	3	1	55	<1	<20	<5	<30	30	2	<10	<50	<50	2000
8038	890	8	1.5	2	3	16	<1	<20	<5	<30	<30	5	<10	<50	<50	3000
8041	195	3	1.5	2	19	19	10	<20	<5	<30	<30	2	<10	<50	<50	3000
8042	400	<1	.5	6	4	13	10	<20	<5	100	<30	1	<10	<50	<50	4000
8043	50	11	2	6	1	22	<1	<20	<5	<30	<30	4	50	<50	<50	500
8044	230	8	2	6	2	50	<1	<20	<5	<30	<30	4	<10	<50	<50	500
8047	105	51	.5	80	2	9	20	<20	<5	<30	<30	<.5	50	<50	<50	200
8048	290	19	1	14	4	14	5	<20	<5	<30	<30	3	<10	<50	<50	2000
8049	175	5	.5	7	3	10	10	<20	<5	<30	<30	3	<10	<50	<50	4000
8050	890	14	1.5	3	8	21	10	<20	<5	<30	<30	2	<10	<50	<50	4000
8051	295	5	.5	4	4	10	10	<20	<5	<30	<30	3	<10	<50	<50	2000
8052	120	11	1	3	2	6	10	<20	<5	<30	<30	2	<10	<50	<50	2000
8054	450	14	1.5	2	7	6	1	<20	<5	<30	<30	1	<10	<50	<50	3000

Signed Spectrometer Services Pty Ltd.

Contu. (2)

0027

Sample-	Mn.	Bi.	Cd.	Mo.	Li.	Co.	Sn.	W.	Ge.	As.	Sb.	Be.	Th.	Te.	Ta.	Ti.
8059	580	8	1.5	4	2	25	10	∠20	∠5	∠30	∠30	1	∠10	∠50	∠50	5000
8060	70	11	2	8	1	15	∠1	∠20	∠5	∠30	∠30	2	∠10	∠50	∠50	200
8061	40	19	2	2	1	8	5	∠20	∠5	∠30	∠30	1	∠10	∠50	∠50	2000
8064	130	8	2	2	1	24	∠1	∠20	∠5	∠30	∠30	13	∠10	∠50	∠50	2000
8065	170	1	.5	∠0.5	1	8	10	∠20	∠5	∠30	50	2	∠10	∠50	∠50	5000
8066	70	8	1	1	9	13	10	∠20	∠5	∠30	∠30	3	∠10	∠50	∠50	3000
8067	505	3	1	∠.05	3	17	5	∠20	∠5	∠30	∠30	2	∠10	∠50	∠50	500
8068	125	14	2	2	1	90	∠1	∠20	∠5	∠30	∠30	3	∠10	∠50	∠50	1000
8069	270	3	1	∠0.5	3	13	10	∠20	∠5	∠30	∠30	5	∠10	∠50	∠50	500
8070	290	3	.5	6	2	7	10	∠20	∠5	∠30	150	1	∠10	∠50	∠50	2000
8071	190	12	2	4	∠1	80	1	∠20	∠5	∠30	∠30	3	∠10	∠50	∠50	5000
8072	90	12	2	4	1	90	∠1	∠20	∠5	∠30	∠30	3	∠10	∠50	∠50	3000
8073	70	12	2	7	2	50	∠1	∠20	∠5	∠30	∠30	4	∠10	∠50	∠50	2000
8076	6500	17	1	3	4	16	10	∠20	∠5	∠30	∠30	1	∠10	∠50	∠50	2000
8077	135	∠1	.5	∠0.5	1	22	5	∠20	∠5	∠30	∠30	2	∠10	∠50	∠50	3000
8078	55	11	1	8	∠1	115	∠1	∠20	∠5	∠30	∠30	3	∠10	∠50	∠50	4000
8079	435	3	.5	∠0.5	2	11	5	∠20	∠5	∠30	∠30	2	∠10	∠50	∠50	2000
8080	330	3	.5	∠0.5	5	42	∠1	∠20	∠5	∠30	∠30	1	∠10	∠50	∠50	2000
8081	155	7	1	∠0.5	1	29	∠1	∠20	∠5	∠30	∠30	3	∠10	∠50	∠50	3000
8082	135	8	1	4	2	16	∠1	∠20	∠5	∠30	∠30	2	∠10	∠50	∠50	3000

Signed - [illegible]

Contu. (3)

Sample-	Mn.	Bi.	Cd.	Mo.	Li.	Co.	Sn.	W.	Ge.	As.	Sb.	Be.	Th.	Te.	Ta.	Ti.
8083	120	11	1	<0.5	<1	42	<1	<20	<5	<30	<30	5	<10	<50	<50	3000
8085	9000	<1	.5	<0.5	2	130	10	<20	<5	<30	<30	2	<10	<50	<50	2000
8086	240	12	1	<0.5	<1	90	5	<20	<5	<30	<30	1	<10	<50	<50	3000
8090	10000+	7	1	<0.5	1	75	1	<20	<5	<30	<30	13	<10	<50	<50	3000
8091	315	11	1	4	<1	235	1	<20	<5	<30	<30	4	<10	<50	<50	500
8092	135	8	1	6	1	14	<1	<20	<5	<30	<30	11	<10	<50	<50	4000
8093	10	8	.5	5	20	11	5	<20	<5	<30	<30	2	<10	<50	<50	5000
8094	35	14	.5	8	4	9	10	<20	<5	<30	<30	1	<10	<50	<50	3000
8095	40	5	.5	23	<1	11	<1	<20	<5	<30	<30	1	<10	<50	<50	500
8096	65	4	.5	8	<1	21	<1	<20	<5	<30	<30	2	<10	<50	<50	3000
8097	190	8	.5	5	<1	43	<1	<20	<5	<30	<30	<.5	<10	<50	<50	2000
8098	65	8	.5	12	2	14	<1	<20	<5	<30	<30	.5	<10	<50	<50	2000
8099	470	14	1	10	3	11	<1	<20	<5	<30	<30	2	<10	<50	<50	2000
8100	10	11	.5	12	8	5	5	<20	<5	<30	<30	2	<10	<50	<50	3000

Signed -

Spectrometer Services. Pty Ltd.,

APPENDIX III

PETROGRAPHIC DESCRIPTIONS

SAMPLE NOS.

8064
8065
8076
8079
8082
8093
8096
8203
8207
8209
8211
8212
8213
8215
8218
8219
8226
8227
8231

0030

CENTRAL MINERALOGICAL SERVICES

Date: 15th April, 1970.

SAMPLE REPORT (Mineralogy, Petrology, Ore Microscopy)

IDENTIFICATION

8064.

Gossan.

Job No. CMS 70/4/2 Date Received: 2/4/70

Reference O/N A23

Sample No. 8064

Nature of Sample: Hand-specimen

DESCRIPTION **SECTION No.** 1801

a. Hand Specimen:

Ferruginous gossan with boxworks.

b. Microscopic:

Examination of the gossan showed numerous well-defined boxwork-structures. Some of these fairly strongly suggested the former presence of massive chalcopyrite and probably of sphalerite. Gossans derived from pentlandite are not well documented, but the boxworks in this specimen could well have been derived from pentlandite, which has distinctive cubic cleavage.

This gossan will be investigated further. Meanwhile geochemical analyses for Ni, Cu, Pb, and Zn are recommended.

Remarks/Special Features

N.B.: Typewritten report will follow.

H.W.Fander, M.Sc.

CENTRAL MINERALOGICAL SERVICES

Date: 15th April, 1970.

SAMPLE REPORT (Mineralogy, Petrology, Ore Microscopy)

IDENTIFICATION
8065. Quartz-Breccia.

Job No. CMS 70/4/2 Date Received: 2/4/70

Reference 0/1" A23

Sample No. 8065

Nature of Sample: Hand-specimen

DESCRIPTION **SECTION No.** 1802

a. Hand Specimen:

Dark ferruginous, quartzose rock.

b. Microscopic:

A quartz-breccia, consisting of angular and subangular fragments of quartz of varying sizes from 0.05 to 3.0mm and showing strain extinction.

The interstitial areas between quartz fragments consist of myriads of exceedingly small tourmaline crystals, and clusters of small rutile crystals. These two minerals evidently represent a hydrothermal-metasomatic phase. The tourmaline crystals are generally below 0.005mm (5μ) in size, the rutile crystals range from a few microns to 0.04mm in size.

Remarks/Special Features

N.B.: Typewritten report will follow.

g35623

H.W. Fander, M.Sc.

CENTRAL MINERALOGICAL SERVICES

Date: 15th April, 1970.

SAMPLE REPORT (Mineralogy, Petrology, Ore Microscopy)

IDENTIFICATION
8076.
A. Marble
B. Schist.

Job No. CMS 70/4/2 Date Received: 2/4/70

Reference O/N A23

Sample No. 8076

Nature of Sample: Hand-specimen

DESCRIPTION **SECTION No.** 1803A and B

a. Hand Specimen:

Two specimens are quite different. A is a ?rhyolite, B is a micaceous metaquartzite.

Microscopic:

A. is actually a dolomitic marble, consisting of finely granular dolomite (about 55%) and fine mosaics of quartz (20%), oligoclase (20%) and poikiloblastic laths of margarite (a "brittle-mica", containing Ca). Small crystals of pale tourmaline occur sporadically and are probably the dravite variety. The rock is a calcareous (dolomitic) metasediment.

B. A fine-grained quartz-plagioclase-mica schist containing abundant ferruginous material associated with carbonate, probably due to weathering of ankerite or a similar iron-bearing carbonate. The rock consists of fine granular quartz and andesine, with parallel orientated muscovite and phlogopite, and interstitial ferruginous carbonate. Yellow tourmaline is conspicuous. The rock was probably a calcareous clayey sediment before metamorphism.

Remarks/Special Features

N.B.: Typewritten report will follow.

g35623

H.W.Fander, M.Sc.

0033

CENTRAL MINERALOGICAL SERVICES

Date: 15th April, 1970.

SAMPLE REPORT (Mineralogy, Petrology, Ore Microscopy)

IDENTIFICATION
8079.
Silicified Serpentinite.

Job No. CMS 70/4/2 Date Received: 2/4/70

Reference O/N A23

Sample No. 8079

Nature of Sample: Hand-specimen.

DESCRIPTION **SECTION No.** 1806

a. Hand Specimen:

Porous, ferruginous rockwith quartz-veining. ?Weathered ultrabasic.

Microscopic:

The original rock was undoubtedly coarse-grained ultrabasic rock. Relict serpentine fabric is still recognizable, though the rock has undergone several phases of alteration.

The original olivine was serpentinised, and this was followed by development of fibrous tremolite. Both these minerals are represented by limonite pseudomorphs; the rock has been thoroughly silicified. This has had the effect of preserving the delicate textures in a remarkable way.

Remarks/Special Features

N.B.: Typewritten report will follow.

g35623

H.W.Fander, M.Sc.

Sample No. 8082, 0034

Examination of the rock, before and after cutting, by binocular microscope revealed only one small patch of dark green mineralization approximately 2 x 5 mm.

This was seen to consist of greenish limonitic iridescence, a common product of the hydration of iron oxide and hydroxide minerals. The effect being produced by light interference due to formation of one or more thin films of hydrated mineral on the surface of the limonite.

It was however noted that the rock was an extremely well formed boxwork, obviously replacing a sulphide mineral. Furthermore the vesicles within the boxwork were seen to contain small tufts of white to cream coloured secondary carbonate coatings. For this reason zinc or lead mineralization was suspected, and the sample submitted for geochemical analysis, on your behalf, for these elements. In case there were green minerals we had failed to see it was submitted for copper as well, which metal may also adsorb within the limonite.

PETROGRAPHIC DESCRIPTION

Rock Name:	Quartz-limonite gossan	
Components:	Quartz	20 - 30%
	Limonite	40%
	Clay mineral	2 - 5%
	Voids	25 - 30%

This rock is a classical boxwork gossan containing a fine regular network of quartz replacing along the cleavages of an original sulphide mineral, or minerals. In most parts, the quartz has then been coated with an encrustation of limonite, but in others euhedral quartz terminations project into the regular shaped voids left by the solution of the original mineral.

/......3

The boxwork structure suggests cleavages in the original mineral at near cubical angles, and also at least two others at angles to these. This may indicate sphalerite, chalcopyrite, or a mixture of both. Chalcopyrite producing a rectilinear boxwork with a few angular partitions, and sphalerite predominantly triangular forms.

General width of the replacing quartz stringers is up to 0.05 mm. Some anhedral quartz mosaic is also present, apparently originating from minor hydrothermal quartz veining. Individual crystals are up to 0.2 mm. diameter.

Traces of clay minerals are also seen to be associated with the cryptocrystalline limonite present throughout. No carbonate minerals can be definitely identified in thin section.

This rock is dassified as a quartz-limonite gossan.

CONCLUSIONS

Geochemical analysis supports the suggestion that chalcopyrite was the original sulphide mineral, probably with minor sphalerite.

Date: 15th April, 1970.

CENTRAL MINERALOGICAL SERVICES

SAMPLE REPORT (Mineralogy, Petrology, Ore Microscopy)

IDENTIFICATION
8093.
Silty Shale.

Job No. CMS 70/4/2 Date Received: 2/4/70

Reference O/N A23

Sample No. 8093

Nature of Sample: Hand-specimen

DESCRIPTION **SECTION No.** 1804

a. Hand Specimen:

Friable pink silty shale.

Microscopic:

Subangular fragments of silt-size quartz grains are set in a matrix of well-orientated parallel flakes of sericite, with very fine ferruginous material interstitially. Occasional larger flakes of muscovite occur parallel to the bedding. Detrital grains of heavy-minerals are accessory, and consist of yellow tourmaline, zircon and opaques. The yellow tourmaline is conspicuous and suggests that this sediment was derived from 8076 or a similar provenance, particularly if the presence of the ferruginous material is taken into consideration.

Remarks/Special Features

N.B.: Typewritten report will follow.

H.W.Fander, M.Sc.

g35623

0037

CENTRAL MINERALOGICAL SERVICES

Date: 15th April, 1970.

SAMPLE REPORT (Mineralogy, Petrology, Ore Microscopy)

Job No. CMS 70/4/2 Date Received: 2/4/70

Reference O/N A23

Sample No. 8096

Nature of Sample: Hand-specimen

IDENTIFICATION

8096.

Feldspathic Metaquartzite.

DESCRIPTION **SECTION No.** 1805

a. Hand Specimen:

Strongly ferruginised fine ?quartzite.

b. Microscopic:

The original rock consists of a fine mosaic of quartz and fresh oligoclase-andesine, with occasional larger laths of muscovite (random orientation) and very small rutile crystals of hydrothermal origin. It is probably a recrystallized sediment and is similar to 8076B. The rock has been strongly ferruginised and iron-staining extends from goethite veins into the quartz and feldspar as limonite films. Veinlets of manganiferous matter also occur.

Remarks/Special Features

N.B.: Typewritten report will follow.

g35623

H.W.Fander, M.Sc.

0038

CENTRAL MINERALOGICAL SERVICES

Date: 25th February, 1970.

SAMPLE REPORT (Mineralogy, Petrology, Ore Microscopy)

IDENTIFICATION
8203.
Muscovite bearing limestone (?carbonaceous).

Job No. CMS 70/2/11 Date Received: 11/2/70

Reference O/N A10

Sample No. 8203

Nature of Sample: Hand-specimen

DESCRIPTION **SECTION No.** 1384

a. Hand Specimen:

Dark grey, massive limestone of very fine grain-size.

b. Microscopic:

Calcite is the dominant constituent in this rock and grains have an average size of less than 0.04mm. A certain amount of regional metamorphism has affected the rock so that most grains have a preferred dimensional elongation and orientation. Parallel to this direction minor muscovite and chlorite flakes have developed (<5%) accentuating the weak "SCHISTOSITY". Less than 5% quartz is also present as scattered grains throughout the rock.
Accessory very fine grained rutile is scattered throughout the rock and the dark grey colouration appears to be caused by extremely fine, dusty (?)carbonaceous matter. Opaques occurring as grains up to 0.3mm form less than 1% of the rock.

Remarks/Special Features

N.B.: Typewritten report will follow.

g35623

I.F.Scott, M.Sc.

CENTRAL MINERALOGICAL SERVICES

Date: 25th February, 1970.

SAMPLE REPORT (Mineralogy, Petrology, Ore Microscopy)

IDENTIFICATION
8207
Black shale.

Job No. CMS 70/2/11 Date Received: 11/2/70

Reference O/N A10

Sample No. 8207

Nature of Sample: Hand-specimen

DESCRIPTION **SECTION No.** 1387

a. Hand Specimen:

Dark grey, fine-grained shale. Numerous leached cavities are present.

b. Microscopic:

The rock is essentially the same as T.S. 1382 (8231). In this case the dark grey colouration is due to very fine dusty carbonaceous matter which is more abundant in some layers causing distinct bedding planes to be readily visible.

Numerous cavities in the rock up to 2mm across are euhedral in shape and probably represent rhombic carbonate which has been weathered away. Some have been infilled by secondary iron oxides and (?)salts. Characteristic tourmaline is present in this rock as in T.S. 1382 (8231).

Remarks/Special Features

N.B.: Typewritten report will follow.

g35623

I.F.Scott, M.Sc.

CENTRAL MINERALOGICAL SERVICES

Date: 25th February, 1970.

SAMPLE REPORT (Mineralogy, Petrology, Ore Microscopy)

IDENTIFICATION
8209
Oligoclase dacite.

Job No. CMS 70/2/11 Date Received: 11/2/70

Reference O/N A10

Sample No. 8209

Nature of Sample: Hand-specimen

DESCRIPTION **SECTION No.** 1385

a. Hand Specimen:

Sulphide bearing, pale creamy-buff, fine-grained rock (massive).

b. Microscopic:

In thin section the rock is composed of quartz and plagioclase feldspar, all grains being less than 0.1mm in diameter. The feldspar composition is approximately An_{25-30} and, although it is difficult to estimate, these grains form at least 25% of the rock.

In hand specimen a banding, which is accentuated by the presence of sulphides, is readily observable.

Accessory zircon and muscovite flakes are also present. Minor pockets of clay were also observed.

Secondary introduction of sulphides (mainly pyrite) has occured. Grains up to 0.4mm across form 7-10% of the rock. These grains of sulphide invariably contain inclusions of groundmass constituents.

Although volcanic textures have been removed during recrystallization this rock is essentially an oligoclase dacite.

Remarks/Special Features

N.B.: Typewritten report will follow.

535623

I.F.Scott, M.Sc.

CENTRAL MINERALOGICAL SERVICES

Date: 25th February, 1970

SAMPLE REPORT (Mineralogy, Petrology, Ore Microscopy)

IDENTIFICATION
8211. Gossan.

Job No. CMS 70/2/11 Date Received: 11/2/70

Reference O/N A10

Sample No. 8211

Nature of Sample: Hand-specimen

DESCRIPTION **SECTION No.** 1391

a. Hand Specimen:

Brown gossanous rock.

b. Microscopic:

This specimen consists of goethite in colloform aggregates which have replaced sulphides of a massive nature. Minor opaque areas also consist of iron oxides and relict textures suggest that the sulphides were mainly pyritic. However some boxwork textures may represent original chalcopyrite mineralization but it is difficult to be positive with these suggestions.

Minor redeposited limonite is present in some areas but virtually no quartz (or other silica species) was observed.

Remarks/Special Features

N.B.: Typewritten report will follow.

g35623

I.F.Scott, M.Sc.

0042

CENTRAL MINERALOGICAL SERVICES

Date: 25th February, 1970.

SAMPLE REPORT (Mineralogy, Petrology, Ore Microscopy)

IDENTIFICATION
8212.
Bedded carbonaceous siltstone.

Job No. CMS 70/2/11 Date Received: 11/2/70

Reference O/N A10

Sample No. 8212

Nature of Sample: Hand-specimen

DESCRIPTION **SECTION No.** 1392

a. Hand Specimen:

Black carbonaceous siltstone.

b. Microscopic:

Although essentially a strongly carbonaceous siltstone approximately 10% of the constituents fall into the fine-sand sizes, the maximum dimensions of some grains being 0.08mm.

Quartz and muscovite (10%) as well as significant amounts (5-7%) of pale green-brown tourmaline are the dominant, optically determinable, mineral species. However, severe discolouration of all components by coatings of carbonaceous matter could obscure the presence of other minerals. Accessory plagioclase feldspar was, in fact, observed. Weak bedding is present in both thin section and hand specimen. Minor clay pockets are present within bedding planes and occasional cryptocrystalline carbonate aggregates (1mm) have replaced irregular patches of groundmass.

Remarks/Special Features

N.B.: Typewritten report will follow.

g35623

I.F.Scott, M.Sc.

0043

CENTRAL MINERALOGICAL SERVICES

Date: 25th February, 1970.

SAMPLE REPORT (Mineralogy, Petrology, Ore Microscopy)

IDENTIFICATION
8213.
Silicified gossan.

Job No. CMS 70/2/11 Date Received: 11/2/70

Reference O/N A10

Sample No. 8213

Nature of Sample: Hand-specimen

DESCRIPTION **SECTION No.** 1390

a. Hand Specimen:

Brown, gossanous rock.

b. Microscopic:

In thin section the rock is a gossanous boxwork which has been silicified by secondary silica overgrowths. The gossanous boxwork consists of iron oxides and hydroxides, some of which are opaque. These oxides resemble alteration products of pyrite and chalcopyrite but no sulphides occur as remnants to confirm this suggestion. The silica overgrowths on these iron oxide frameworks is chalcedonic in nature.

Remarks/Special Features

N.B.: Typewritten report will follow.

g35623

I.F.Scott, M.Sc.

CENTRAL MINERALOGICAL SERVICES

Date: 25th February, 1970.

SAMPLE REPORT (Mineralogy, Petrology, Ore Microscopy)

IDENTIFICATION

8215A.

Carbonaceous muscovite schist.

Job No. CMS 70/2/11 Date Received: 11/2/70

Reference O/N A10

Sample No. 8215A

Nature of Sample: Hand-specimen

DESCRIPTION **SECTION No.** 1389A

a. Hand Specimen:

A black shaley rock similar to 8207 except for considerably more mica development.

b. Microscopic:

A quartz-muscovite rock in which the average grain-size due to recrystallization of the primary black shale is 0.15mm (fine-sand). The rock is therefore a muscovite schist still coloured by carbonaceous inclusions throughout all major components. Tourmaline as in 1382 etc. is still evident. Coarser-grained quartz-muscovite lensoid patches have acted as nuclei for the introduction of iron-rich jarositic minerals now associated with red iron oxides and in some cases dark clay aggregates.

Remarks/Special Features

N.B.: Typewritten report will follow.

g35623

I.F.Scott, M.Sc.

CENTRAL MINERALOGICAL SERVICES

Date: 25th February, 1970.

SAMPLE REPORT (Mineralogy, Petrology, Ore Microscopy)

IDENTIFICATION
8215B.
Sulphide-bearing porphyritic sodic rhyolite. Pyrite major Tr. chalcopyrite Tr. pyrrhotite.

Job No. CMS 70/2/11 Date Received: 11/2/70

Reference O/N A10

Sample No. 8215B

Nature of Sample: Hand-specimen

DESCRIPTION **SECTION No.** 1389B

a. Hand Specimen:

Sulphide bearing, flow-banded rhyolitic rock similar to 8209 (T.S. 1385).

b. Microscopic:

In thin section quartz (40%) and plagioclase (untwinned mainly) are the dominant components as in 8209 (T.S. 1385). However, in this rock the feldspar is considerably more sodic (lower relief) and therefore the rock is best called a sodic rhyolite. The rock has been considerably recrystallized but quartz aggregates indicate former phenocrysts of the same mineral.

Sulphides have been introduced into the rock and they commonly segregat in these coarser quartz aggregates. A common associate of the mineralization is a pale green muscovite and minor clay minerals. Accessory rutile is present in coarser quartz areas in rare cases and clay-minerals appear to have replaced minor rhomb-shaped carbonates. Red iron oxides have replaced some of the sulphide grains which, in P.S. 1389B, were identified as pyrite with very minor inclusions of chalcopyrite and pyrrhotite.

Remarks/Special Features

N.B.: Typewritten report will follow.

g35623

I.F.Scott, M.Sc.

CENTRAL MINERALOGICAL SERVICES

Date: 25th February, 1970.

SAMPLE REPORT (Mineralogy, Petrology, Ore Microscopy)

Job No. CMS 70/2/11 Date Received: 11/2/70

Reference O/N A10

Sample No. 8218

Nature of Sample: Hand-specimen

IDENTIFICATION

8218.

Quartz-tourmaline rock replacing ?porphyry.

DESCRIPTION **SECTION No.** 1386

a. Hand Specimen:

Dark grey, medium to coarse grained rock.

b. Microscopic:

Relict textures in this rock suggest that the original rock was fragmental or porphyritic (or both). The rock now consists of quartz aggregates, segregations of green-brown and blue-pink stumpy tourmaline crystals (10-15%) and minor (2%) anatase crystals.
Complete alteration of granitic rocks to quartz-tourmaline assemblages has been recorded and it appears that a similar pneumatolytic process has affected what was probably an acid porphyry in this case. Relict micas can still be destinguished in the quartz areas and patches of pink clouding probably represent areas which were primary cloudy potash feldspar.

Remarks/Special Features

Cassiterite and wolframite are common associates of these late stage deuteric alteration processes but assays would be necessary to check their presence (or absence) in this rock.

N.B.: Typewritten report will follow.

g35623

I.F.Scott, M.Sc.

0047

CENTRAL MINERALOGICAL SERVICES

Date: 25th February, 1970.

SAMPLE REPORT (Mineralogy, Petrology, Ore Microscopy)

IDENTIFICATION

8219A.
Gossanous ?porphyry containing possible ?anglesite.

Job No. CMS 70/2/11 Date Received: 11/2/70

Reference O/N A10

Sample No. 8219A

Nature of Sample: Hand-specimen

DESCRIPTION **SECTION No.** 1393A

a. Hand Specimen:

Brown, iron oxide-rich, quartz-bearing rock.

b. Microscopic:

In thin section both gossanous material and host rock are present. The host rock is completely silicified but appeared to have a porphyritic texture. However, secondary quartz overgrowths and development of euhedral crystals tends to confuse these textures. The iron oxide rich portion of the rock is a silicified gossanous boxwork, in which the primary framework is suggestive of galena. Secondary limonitic aggregates form "spaghetti-like" intergrowths in secondary quartz veins and across boxwork textures.
Accessory amounts of a high relief secondary mineral (possibly ?anglesite) were observed. An assay of the rock may help confirm the apparently lead-type origin of this gossan and the secondary mineral enclosed.

Remarks/Special Features

N.B.: Typewritten report will follow.

g35623

I.F.Scott, M.Sc.

CENTRAL MINERALOGICAL SERVICES

Date: 25th February, 1970.

SAMPLE REPORT (Mineralogy, Petrology, Ore Microscopy)

Job No. CMS 70/2/11 Date Received: 11/2/70

Reference O/N A10

Sample No. 8219B

Nature of Sample: Hand-specimen

IDENTIFICATION
8219B False gossan.

DESCRIPTION **SECTION No.** 1393B

a. Hand Specimen:

Porous, brown and yellow, ?gossan.

b. Microscopic:

The rock is extremely porous with cavities up to 1mm across being very common. More than 65% of the area of any one section is cavities. The cavity walls are quartz and minor iron oxides now line these open spaces. Some iron oxide has also penetrated quartz grain boundaries and caused staining.

Cavity shapes suggest rhomic carbonates were the original occupants and therefore the original rock was a quartz-carbonate assemblage. The secondary iron oxides are not related to their present host and therefore represent a form of false gossan.

Remarks/Special Features

N.B.: Typewritten report will follow.

g35623

I.F.Scott, M.Sc.

0049

CENTRAL MINERALOGICAL SERVICES

Date: 25th February, 1970

SAMPLE REPORT (Mineralogy, Petrology, Ore Microscopy)

IDENTIFICATION
8219C. Quartz-iron oxide rock with replaced disseminated sulphides

Job No. CMS 70/2/11 Date Received: 11/2/70

Reference O/N A10

Sample No. 8219C

Nature of Sample: Hand-specimen

DESCRIPTION **SECTION No.** 1393C

a. Hand Specimen:

Gossanous rock in which specular hematite is present in addition to goethite.

b. Microscopic:

"extures in hand specimen indicate areas in which euhedral (rectangular clay aggregates have replaced ?feldspars in what was probably a porphyritic volcanic. In thin section quartz is also seen to be present in these clay aggregates and the remainder of the rock is a quartz-iron oxide intergrowth. Most of the quartz which is enclosed in iron oxides (some of which is hematite) is subhedral to euhedral in shape and the iron oxides occur as coatings or interstitial material. What appears to be disseminated, although relatively coarse grained, opaques probably replaces primary sulphides (pyritic).

Remarks/Special Features

N.B.: Typewritten report will follow.

g35623

I.F.Scott, M.Sc.

CENTRAL MINERALOGICAL SERVICES

Date: 25th February, 1970.

SAMPLE REPORT (Mineralogy, Petrology, Ore Microscopy)

IDENTIFICATION
8226.
Metaquartzite.

Job No. CMS 70/2/11 Date Received: 11/2/70

Reference O/N A10

Sample No. 8226

Nature of Sample: Hand-specimen

DESCRIPTION **SECTION No.** 1388

a. Hand Specimen:

Grey, sandy quartzite.

b. Microscopic:

Quartz with granulated and sutured margins is the dominant mineral in this specimen. The average grain size is 0.3mm. Less than five percent of the rock is composed of recrystallized (to muscovite) feldspar grains or clay grains as well as minor black shale fragments. Incipient muscovite is developing along some grain boundaries and minor, filamentous, black (?)carbonaceous matter is also confined to these boundary areas. Minor iron staining is also common. Accessory zircons are found in the rock.

Remarks/Special Features

Quartz grains are strained, as well as being deformed along grain boundaries. The metamorphism has mostly been dynamic in nature.

N.B.: Typewritten report will follow.

g35623

I.F.Scott, M.Sc.

0051

CENTRAL MINERALOGICAL SERVICES

Date: 25th February, 1970.

SAMPLE REPORT (Mineralogy, Petrology, Ore Microscopy)

IDENTIFICATION
8227.
Metaquartzite.

Job No. CMS 70/2/11 Date Received: 11/2/70

Reference O/N A10

Sample No. 8227

Nature of Sample: Hand-specimen

DESCRIPTION **SECTION No.** 1383

a. Hand Specimen:

A light buff coloured, sandy, quartzite.

b. Microscopic:

Quartz is the dominant constituent in this rock. Quartz grains averaging less than 0.25mm (fine sand) have sutured margins, the whole rock being welded together as a tight compact unit under low grade metamorphic conditions. Minor fine-grained muscovite (5%) occurs along grain boundaries in "trains" which overall follow a preferred direction.

Accessory zircon, rutile and brown-yellow tourmaline occur in the rock. Very minor dusty opaque inclusions appear associated with clay patches which probably replace accessory feldspars.

Remarks/Special Features

N.B.: Typewritten report will follow.

g35623

I.F.Scott, M.Sc.

CENTRAL MINERALOGICAL SERVICES

Date: 25th February, 1970.

SAMPLE REPORT (Mineralogy, Petrology, Ore Microscopy)

Job No. CMS 70/2/11 Date Received: 11/2/70

Reference O/N A10

Sample No. 8231

Nature of Sample: Hand-specimen

IDENTIFICATION

8231.

Malachite veined quartz-sericite schist.

DESCRIPTION **SECTION No.** 1382

a. Hand Specimen:

Malachite veined, brown silty sediment.

b. Microscopic:

The rock is essentially a sericite schist in which quartz and sericite are the two major components and sericite commonly exhibits a preferred orientation resulting in a weak schistosity being developed. Accessory tourmaline with pale brown-green cores and colourless rims is a characteristic feature of the rock. The maximum grain sizes in the rock are equivalent to the upper limit of silt (0.0625mm). Secondary opaques (<0.1mm) have almost invariably altered to red iron oxides. Some have partly weathered away so that cores of these opaques contain clay or recrystallized quartz. Iron staining has discoloured many of the constituents and secondary introduction of malachite along fractures parallel to schistosity is common. Malachite also fills joints at right angles to this planar feature and minor malachite has replaced clay cores in weathered iron oxide grains. The malachite is from an external source and not related to the opaques (altered) in the rock which, from their habit, may have been magnetite.

Remarks/Special Features

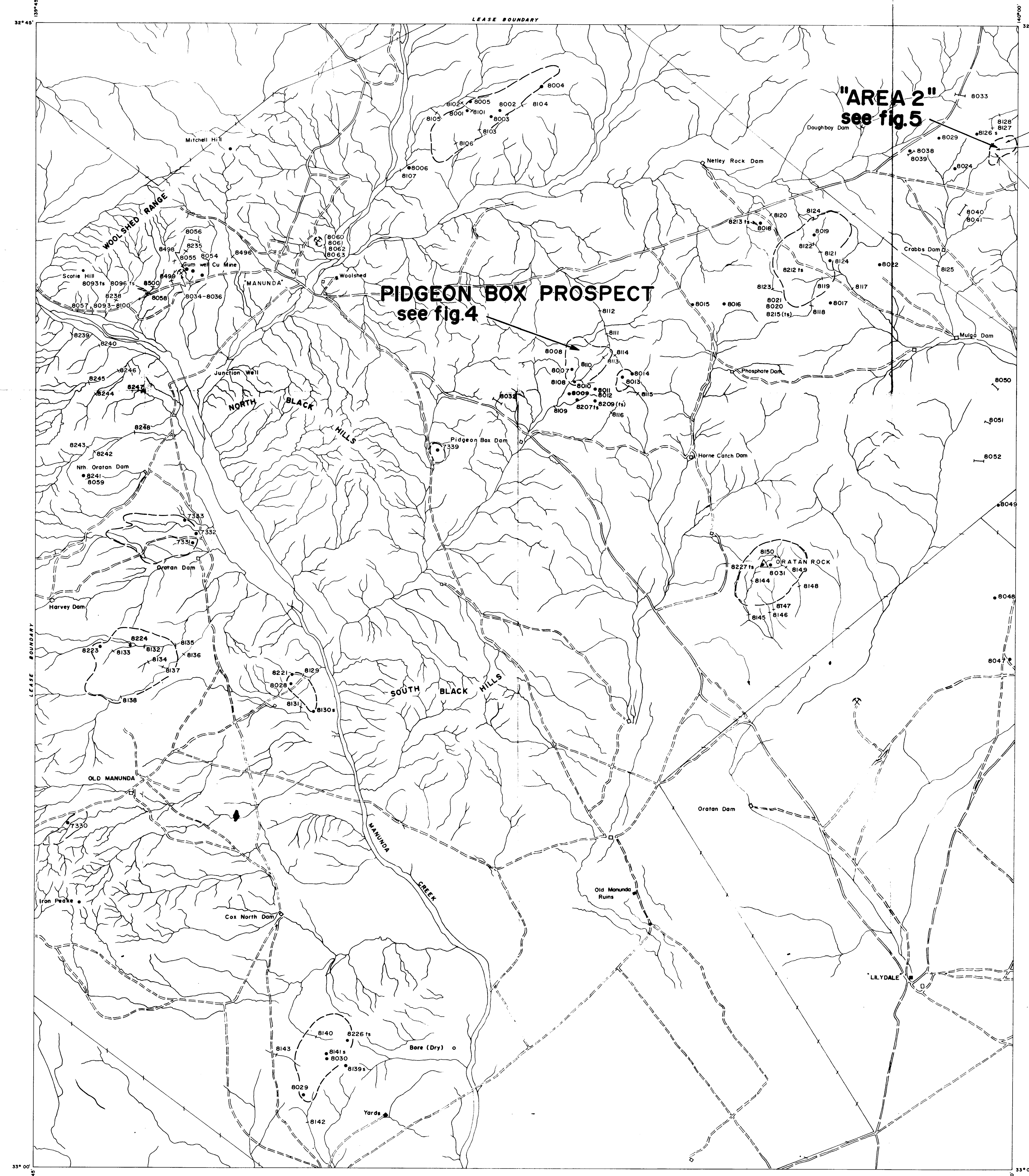
N.B.: Typewritten report will follow.

g35623

I.F.Scott, M.Sc.


MANUNDA
GEOLOGICAL SURVEY OF SOUTH AUSTRALIA
DEPARTMENT OF MINES ADELAIDE
FIRST EDITION 1960
Map corners from data available at publication
GEOLOGICAL ATLAS 1 MILE SERIES
MAP REFERENCE No. 732 ZONE 6
REFERENCE
Alluvial deposits of creek channels and flood plains.
Low angle slope deposits, talus, rock waste, clays and gravels; residual soil deposits.
Sand, sand dunes.
Sandstones and gravels.
Mottled estuarine clays with micro-fauna.
Laterite and duricrust remnants.
Grey-green shales and slates.
Shales and siltstones.
Sandstone and quartzite.
Boulder tillite.
Arkosic sandstone.
Tillite.
Dolomite.
Marble.
Sandstones and quartzite, slumped, silicified and dolomitized.
Shales and slates.
Tillite.
Laminated slates and siltstones, calcareous and coarser grained near top.
Dolomite.
Haematite siltstone. } Braemar Iron
Ferruginous tillite. } Formation.
Boulder tillite with interbedded quartzites.
Shales and felspathic siltstones with thin interbedded dolomites.
Arkosic sandstone.
Dolomite lenses.
Felspathic siltstones, black slates with thin dolomite bands.
Sandstones, greywackes, quartzites, and siltstones.
Lenses of marble.
IGNEOUS ROCKS
Granite, medium grained intrusive.
Quartz veins.
Dolerite.
(?)Norite.
Sandstone dyke.
Zone of Metamorphism.
Areas of incipient metamorphic spotting.
LEASE BOUNDARY
LOCALITY
SOUTH AUSTRALIA
INDEX TO ADJOINING SHEETS
PARATOO
YUNTA
WADNANINGA
NACKARA
MANUNDA
ANABAMA
FRANKLYN
BRAEMAR
LILYDALE
SCALE: 1:63,360 — 1 INCH TO 1 MILE
TECTONIC SKETCH
Geology by R. C. MIRAMS, B.Sc.
Published 1960
1392-1

FIG. 2



REFERENCE

- ROAD OR TRACK
- FENCE
- CREEK
- DAM
- MINE
- BUILDING(S)
- 8013 STREAM SEDIMENT SAMPLE
- 8017s SOIL SAMPLE
- 8026 ROCK CHIP SAMPLE
- 8079ts THIN SECTION SAMPLE
- BOUNDARY OF PHOTO ANOMALY

SCALE

CHAINS 80 60 40 20 0 1 2 3 MILES

METRES 1000 0 1 2 3 4 5 KILOMETRES

MAP COMPILED FROM S.A. DEPARTMENT OF MINES 60 CHAINS TO 1 INCH TOPOGRAPHIC MAP Nº 732. ZONE 6 "MANUNDA".

FIG. 3 Env 1392

ASARCO (AUSTRALIA) PTY. LTD.

S.M.L. 352 MANUNDA PROSPECT
ROCK CHIP, STREAM SEDIMENT AND PHOTO ANOMALY LOCATIONS

COMPILED: R. R.	CHECKED: RR.	PLAN Nº
DRAFTED: M.J.U.	DATE: August '70	188

1392-2

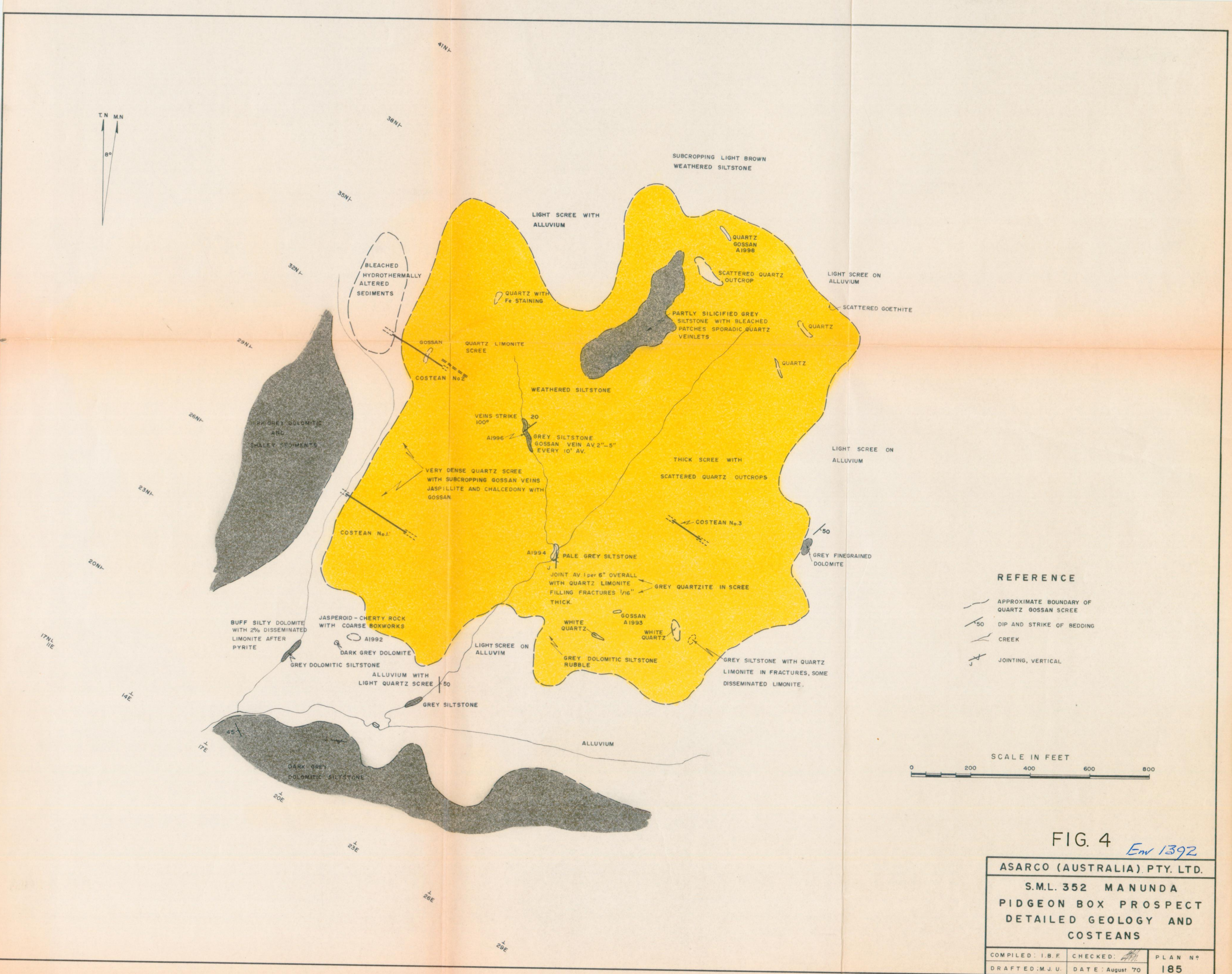
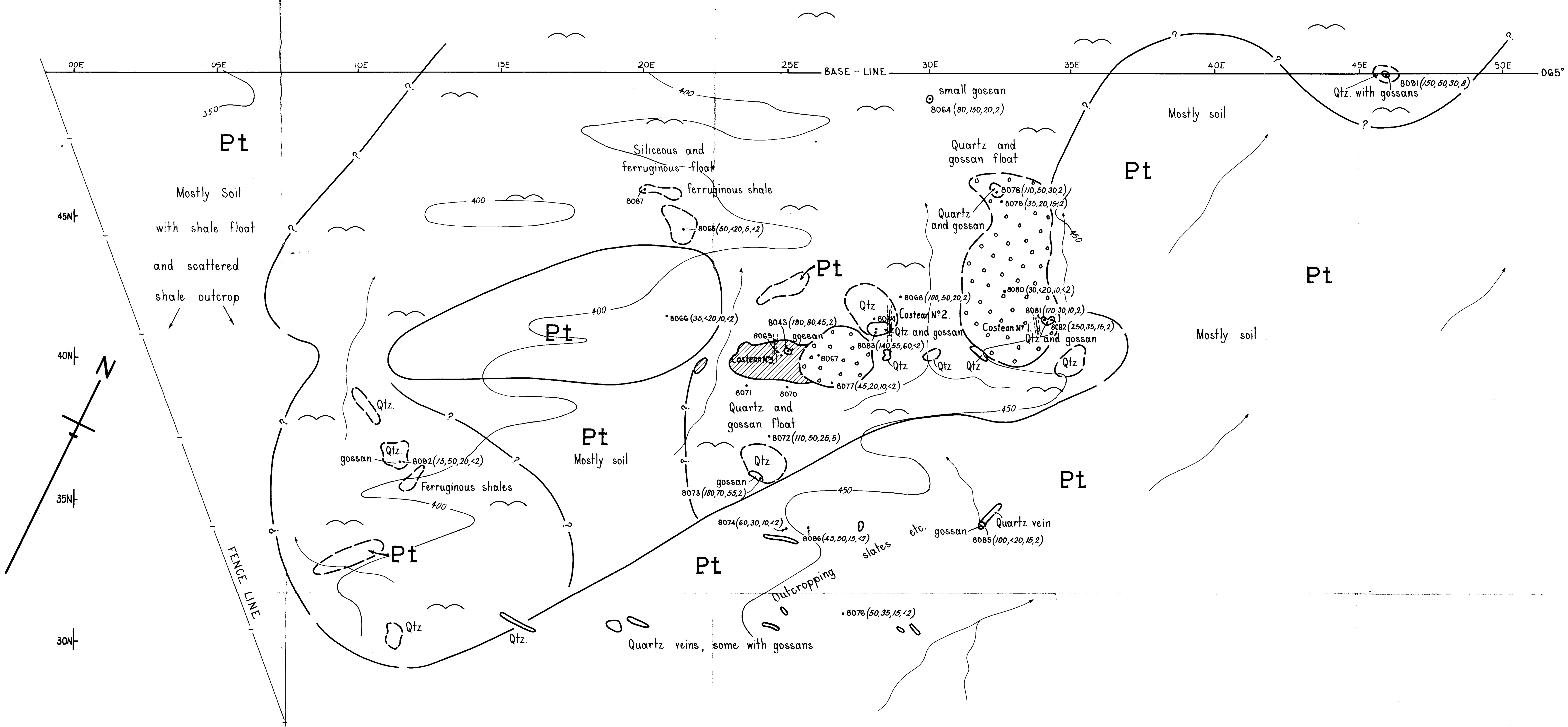


FIG. 4

Env 1392

ASARCO (AUSTRALIA) PTY. LTD.		
S.M.L. 352 MANUNDA PIDGEON BOX PROSPECT DETAILED GEOLOGY AND COSTEANS		
COMPILED: I.B.F.	CHECKED: [signature]	PLAN No
DRAFTED: M.J.U.	DATE: August '70	185

1392-3



LEGEND

Alluvium

Pt — Black Slates, quartzites, siltstones, dolomite lenses

Altered, siliceous, cellular rock

Tourmalinized and/or silicified rock

Qtz. — Hydrothermal vein; quartz

gossan — Heavy black rocks; mainly goethite & limonite, with minor haematite and quartz

Outcrop Boundary

Established boundary of outcrop suboutcrop scree areas.

Approximate, boundary of outcrop suboutcrop scree areas.

Possible, sub-outcrop

8027 (110,70,45,5) Sample locality with analyses in p.p.m. (Cu, Pb, Zn, Mo)

Magnetic contours (Values in gammas.)

SCALE

FEET 200 100 0 200 400 600 800 1000 FEET

(See figure 3. for locality)

FIG. 5

Env 1392

ASARCO (AUSTRALIA) PTY. LTD.

S.M.L. 352 MANUNDA PROSPECT
AREA 2 DETAILED GEOLOGY
MAGNETIC CONTOURS AND
COSTEANS.

COMPILED: RWR	CHECKED: RAP	PLAN N°
DRAFTED: RH, MJU	DATE: August '70	186.

1392-4

COSTEAN 1

SAMPLE Nº	Cu	Pb	Zn	Ag
4602	10	–	5	–
03	110	20	10	–
04	170	20	10	–
05	20	–	10	–
06	15	–	10	–
07	20	–	10	–

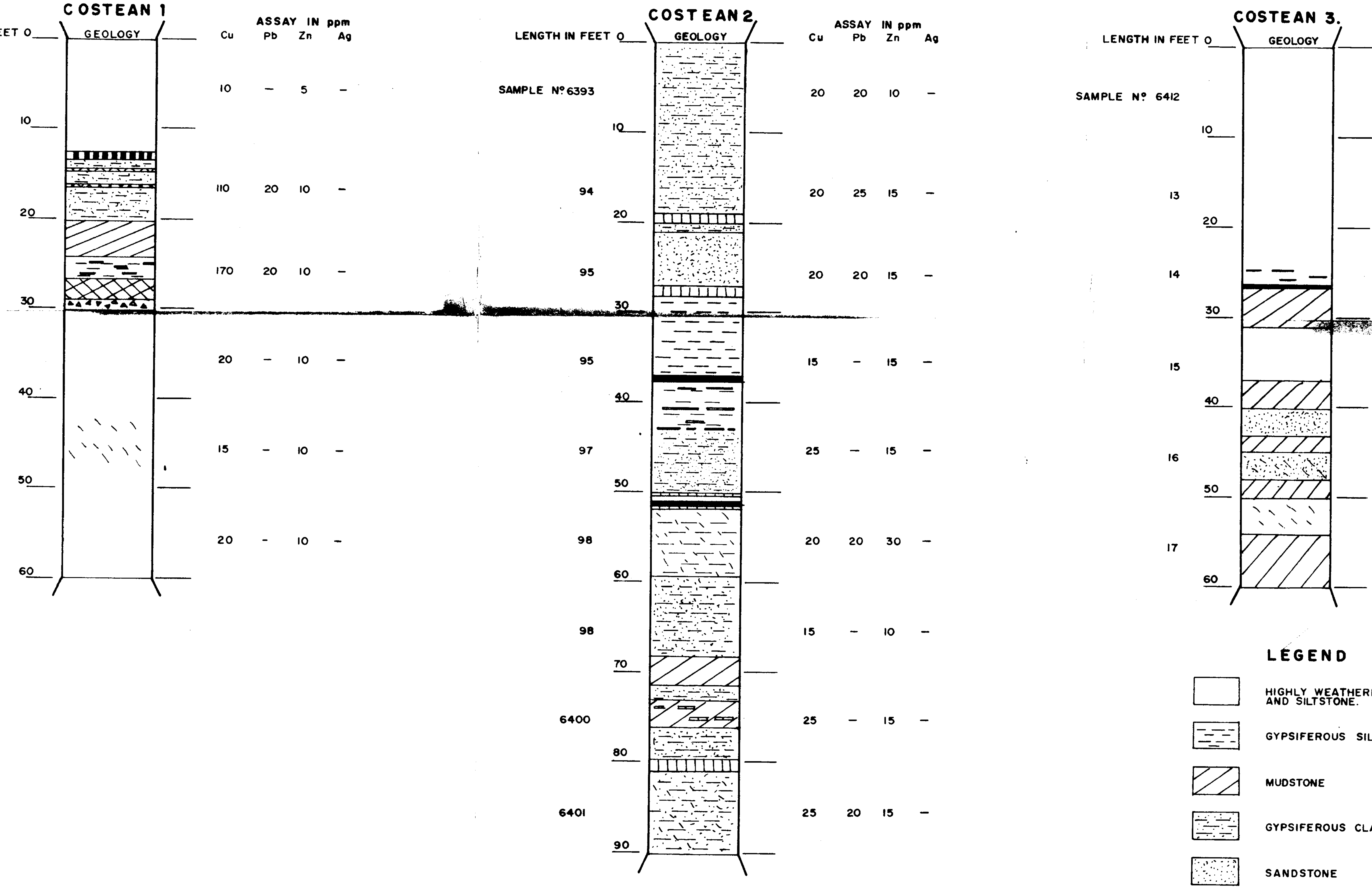
COSTEAN 2

SAMPLE Nº	Cu	Pb	Zn	Ag
6393	20	20	10	–
94	20	25	15	–
95	20	20	15	–
95	15	–	15	–
97	25	–	15	–
98	20	20	30	–
98	15	–	10	–
6400	25	–	15	–
6401	25	20	15	–

COSTEAN 3.

SAMPLE Nº	Cu	Pb	Zn	Ag
6412	20	–	10	–
13	20	–	15	–
14	25	–	10	–
15	15	–	10	–
16	25	–	15	–
17	30	–	15	–

ASSAY IN ppm



LEGEND

- HIGHLY WEATHERED CALCAREOUS MUDSTONE AND SILTSTONE.
- GYPSIFEROUS SILTSTONE
- MUDSTONE
- GYPSIFEROUS CLAYS
- SANDSTONE
- CRUSH BRECCIA
- LIGHT HAEMATITE CEMENTATION
- QUARTZ VEIN
- POROUS QUARTZ VEIN
- HAEMATITE GOETHITE VEIN
- POROUS GOSSAN (HAEMATITE, GOETHITE, CLAY.)
- – DENOTES LESS THAN DETECTION LIMIT (20ppm for Pb, 2ppm for Ag)

FOR COSTEAN LOCATIONS REFER TO FIG. 5

FIG. 7 Env 13921

ASARCO (AUSTRALIA) PTY. LTD.

S.M.L. 352 MANUNDA

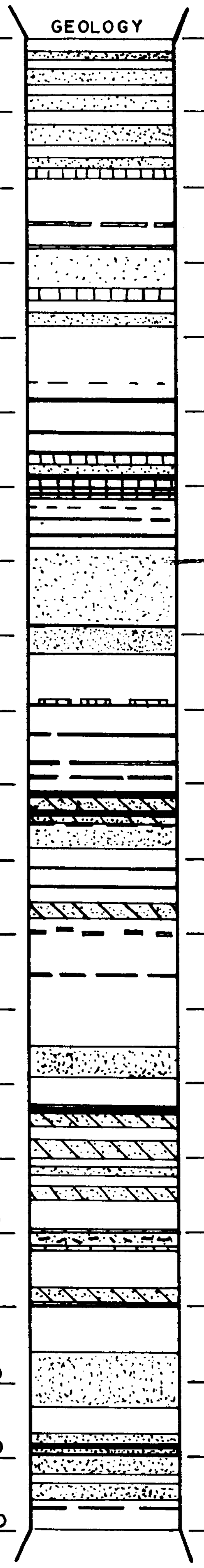
"AREA 2"

DIAGRAMMATIC LOG OF COSTEANS 1, 2 and 3.

COMPILED: L.R.D.	CHECKED:	PLAN Nº 190.
DRAFTED: R.R.; M.U.	DATE: August '70	

1392-45

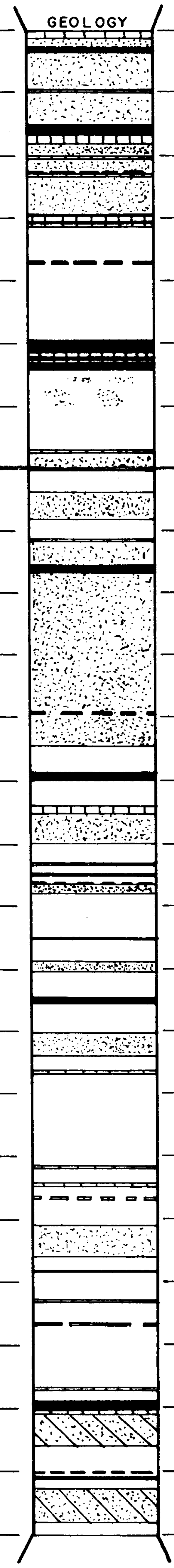
COSTEAN 1.



ASSAY IN ppm

SAMPLE Nº	Cu	Pb	Zn	Ag	Au
6362	10	–	5	–	–
63	5	–	5	–	–
64	5	–	5	–	–
65	5	–	5	–	–
66	5	–	5	–	–
67	5	–	10	–	–
68	15	–	5	–	–
69	75	–	10	–	–
70	5	–	5	–	–
71	10	–	5	–	–
72	10	–	5	–	–
73	10	20	10	–	–
74	10	20	10	–	–
75	10	20	10	–	–
76	10	–	10	–	–
77	10	–	10	–	–
78	10	–	10	–	–
79	10	–	10	–	–
80	10	–	10	–	–
6381	10	–	10	–	–

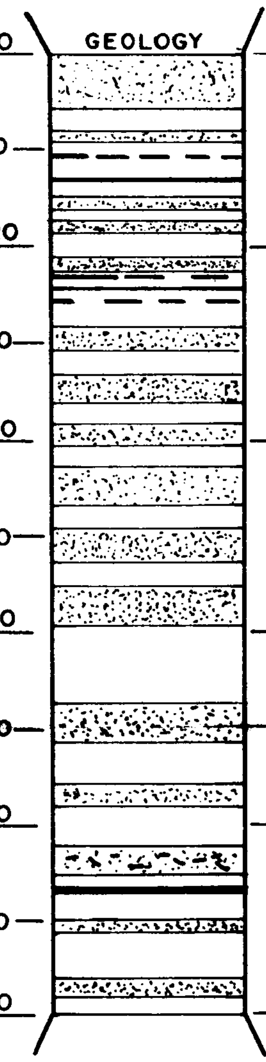
COSTEAN 2.



ASSAY IN ppm

SAMPLE Nº	Cu	Pb	Zn	Ag	Au
6338	100	–	10	–	–
39	40	–	5	–	–
40	100	–	10	–	–
41	50	–	10	–	–
42	25	–	15	–	–
43	100	–	10	–	–
44	40	–	10	–	–
45	25	20	15	–	–
46	45	20	15	–	–
47	20	–	15	–	–
48	20	–	20	–	–
49	20	20	10	–	–
50	20	20	10	–	–
51	20	20	10	–	–
52	20	20	10	–	–
53	15	–	10	–	–
50	10	–	15	–	–
55	15	–	10	–	–
56	50	–	15	–	–
57	30	–	15	–	–
58	25	–	15	–	–
59	25	–	10	–	–
60	20	–	5	–	–
6361	10	–	10	–	–

COSTEAN 3.



ASSAY IN ppm

SAMPLE Nº	Cu	Pb	Zn	Ag
6382	20	–	10	–
6383	25	–	10	–
6384	35	–	20	–
6385	20	–	20	–
6386	15	–	20	–

LEGEND

- HIGHLY WEATHERED CALCAREOUS MUDSTONE AND SILTSTONE
- SANDSTONE
- HAEMATITE SANDSTONE
- HAEMATITE GOETHITE VEIN
- QUARTZ VEIN
- – DENOTES LESS THAN DETECTION LIMIT (20ppm for Pb, 2ppm for Ag)

FOR COSTEAN LOCATIONS REFER TO FIG. 4.

FIG. 6 Env 1392

ASARCO (AUSTRALIA) PTY. LTD.		
S.M.L. 352 MANUNDA PIDGEON BOX PROSPECT DIAGRAMMATIC LOG OF COSTEANS 1, 2 and 3.		
COMPILED: L.R.D.	CHECKED:	PLAN Nº 189.
DRAFTED: R.R.; M.U.	DATE: August '70	

1392-6