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PETROGRAPHY AND LITHOLOGICAL CORRELATION OF PERMIAN FORMATIONS IN A.F.O. INDERI NO.1 AND A.F.O. COOROORAH NO.1, QUEENSLAND.

by

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PETROGRAPHY AND LITHOLOGICAL CORRELATION OF PERMIAN FORMATIONS IN A.F.O. INDERI NO. I AND A.F.O. COOROORAH NO. I, QUEENSLAND.

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CONTENTS

Summary

Lithologies of Permian formations in A.F.O. Inderi No. I and A.F.O. Cooroorah No. I wells are described and compared. Comparison is also made with the lithologies of the relevant sections in Planet Warrinilla North No. I previously studied by the author. The following table shows a suggested subdivision and correlation of the units in the wells.

Name of Unit	Inderi No. I (feet)	Cooroorah No. I (feet)
Blackwater Group	92 - 930	
Black Ally Shale	930 - 1130	
German Creak Coal - Measures	-	0 - 390
Peawaddy Formation	1130 - 1669	390 - 1200
Catherine Sandstone	1669 - 1686	1200 - 1290
Ingelara Formation	1686 - 1869	1290 - 1638
Aldebaran Sandstone	1869 - 2750	1638 - 2640
Staircase Sandstone	2750 - 3830	2640 - 3010
Stanleigh Formation	3830 - 5433	-

The unit in Inderi No. I which is correlated with the Stanleigh Formation compares fairly well with the corresponding unit in Warrinilla North No. I. Both suites consist mainly of siltstone with some sandstone intercalations, but the unit in Inderi No. I appears to be more mature than that in the other well. The Staircase Sandstone in Inderi No. I and Cooroorah No. I is mainly fine - to medium-grained argillaceous sandstone, containing 55 to 65% quartz, 5 to 15% feldspar, 10 to 20% clay matrix and common to abundant pyrites.

Units correlated with the Aldebaran Sandstone show the most consistent lithology in both wells - mainly medium-grained ortho-quartzites and feldspathic sandstone, generally with abundant quartz

overgrowths. These are fairly clean sandstones, and probably were more porous, originally.

The Ingelara Formation and Catherine Sandstone are fairly consistent in both wells. The former consists of black carbonaceous shale, with some interbeds of dark grey milaceous siltstone and moderately sorted sandstone. The latter has a prominent electric log pattern and distinctive lithology; it is light grey, calcareous, feldspathic sandstone.

Units correlated with the Peawaddy Formation consist of dark shale and siltstone with a number of sandy intercalations towards the top. The sandstone in Inderi No. I seems to be more mature: it contains more quartz and no lithic fragments, which are fairly common in the other well and in the Peawaddy Formation in Warrinilla North No. I.

The Inderi section which is tentatively correlated with the Black Ally Shale contains dark grey to black mudstone and some clayey sandstone. The top 390 feet in Cooroorah No. I consists largely of micaceous sandstone and siltstone with some coal, and is correlated with the German Creek Coal measures.

The Blackwater Group is absent in Cooroorah No. I, but is probably present in Inderi No. I between 92 and 930 feet, where it consists of feldspathic and kaolinitic sandstone and coal.

I. INTRODUCTION

A.F.O. Inderi No. I is situated about 45 miles north of Warrinilla North No. I, and about 17 miles east-south-east of the township of Springsure, Queensland. A.F.O. Cooroorah No. I is about 75 miles north-north-east of Inderi No. I.

Forty-five thin sections were prepared from the Inderi well samples and the same number from the Cooroorah samples. Samples for thin sectioning were selected after study of the electric logs and the lithological descriptions of the sequences in the completion reports of the wells. (Derrington, 1960 and Mines Administration Pty Ltd., 1963). Arenites have been preferentially picked, because they afford the most useful data for correlation; thus proportions of lithologies in the tables do not necessarily agree with the descriptions in the completion reports.

The lithologies in each well are described first then lithological comparisons follow. Tables showing textures and mineral compositions of the samples and microphotographs of some of the thin sections are included at the end of the report.

II. PETROGRAPHY

(a) A.F.O. INDERI NO. I

Interval 92 - 930 feet:

Siltstone and sandstone are prominent in this unit, with some coal seams, especially in the lower part.

The sandstone is fine- to medium-grained, fairly well sorted, with angular to subangular grains of moderate sphericity. It contains about 45% quartz, 10% feldspar and about 30% kaolinite and illite matrix. Calcite and siderite cements, fragments of mudstone and acid volcanics, and some leached biotite are present in places. Accessory minerals are rare.

Interval 930 - 1130 feet:

This interval, in contrast to the one above, consists mainly of dark grey mudstone, with a few interbeds of siltstone and sandstone.

The sandstone is fine-grained, well-sorted, with angular to subangular grains of moderate sphericity. It is composed of 40% quartz, 15% feldspar (consisting of about the same amounts of potash feldspar and plagioclase), 30% kaolinite matrix, and 15% carbonate cement, mainly siderite.

Interval 1130 - 1669 feet:

The unit consists of dark grey, silty, fossiliferous marine shale and some interbeds of calcareous and argillaceous sandstone.

The sandstone is generally fine-grained, fairly well to well sorted, and grains are mainly subangular and of moderate sphericity. It contains 35 to 70% quartz, up to 10% feldspar, 10 to 15% clay matrix, 15% or more calcite cement, and about 10% "chert" or devitrified volcanic glass. In two samples, carbonaceous matter comprises 10 and 25% of the rocks.

Interval 1669 - 1686 feet:

The unit, although only 17 feet thick, is distinguished from the units immediately above and below by its sandy lithology and the strong deflections of both the S.P. and resistivity curves. It

consists of cream and light grey sandstone containing 50 to 65% quartz, 10 to 15% feldspar (mostly potash feldspar), and about 10% kaolinite. Some carbonaceous matter and pyrite are also present. It is fine to medium-grained, moderately sorted, and grains are subangular to subrounded and of generally moderate sphericity.

Interval 1686 - 1869 feet:

The interval consists dominantly of black micaceous and carbonaceous shale and siltstone with some interbeds of sandstone. The sandstone is generally medium to coarse-grained, rather poorly sorted; grains are angular to subangular and of low to moderate sphericity. It has about 55% quartz, up to 10% feldspar, 15% kaolinite, 10% micaceous matrix and 5% carbonaceous matter. Accessory minerals include abundant pyrite and some tourmaline and zircon. The quartz has minor overgrowth and moderate to strong wavy extinction.

Interval 1869 - 2750 feet:

The unit comprises mainly light coloured sandstone and some associated carbonaceous shale and siltstone. The sandstone is moderately sorted, generally medium to coarse-grained; grains are angular to subangular and of moderate sphericity. It contains 60 to 90% quartz, about 5% feldspar, 5% chert and about 10% clay matrix. Both calcite and carbonaceous matter are minor, while accessory minerals are also rarely present. The quartz contains moderate overgrowths and pressure solution effects.

Interval 2750 - 3830 feet:

This unit consists of greyish sandstone and some intercalations of dark siltstone, coal and conglomerate. The sandstone contains 50 to 70% quartz, generally up to 15% feldspar, 20% clay matrix and abundant pyrite in most specimens. The grains are mainly fine, moderately to fairly well sorted, angular to subrounded and of moderate sphericity.

Thus, compared with the sandstone of the overlying unit, the

sandstone of this unit contains less quartz and chert and more feldspar and clay matrix. Further, in this unit plagioclase seems to be more plentiful than potash feldspar.

Interval 3830 - 5433 feet:

This thick unit comprises mainly dark shale and siltstone, with some sandstone intercalations especially in the upper part and pebbly beds near the bottom. The sandstone has from 35 to 70% quartz, 5% feldspar, generally 15 to 20% clay matrix and about 15% calcareous cement. It is fine- to medium-grained; grains are moderately sorted, subangular to subrounded and of moderate sphericity.

The specimens from 4484' and 4600' - 4610' differ from the others in that they have comparatively low quartz content (35%), plentiful chert (10 to 15%) and clay matrix, consisting of illite and micas (20 to 45%). The upper sample contains abundant pyrite and some calcite cement and calcareous fragments of strophalosia.

(b) A.F.O. COOROORAH NO. I

Interval 0 - 390 feet:

This unit consists of light coloured micaceous sandstone with some coal seams.

The sandstone is generally fine-grained, moderately sorted and has subangular grains of low to moderate sphericity. It contains from 35 to 70% quartz, 5 to 10% feldspar, 5 to 10% muscovite, and 5 to 25% clay matrix. Other constituents include 5 to 30% calcite and siderite cements, and some fragments of mudstone and acid volcanics. Zircon and tourmaline are rather common in the lower part of the section.

Interval 390 - 1200 feet:

This interval, unlike the overlying unit, consists predominantly of dark grey, micaceous siltstone and mudstone with numerous carbonaceous laminae throughout the section. Interbeds of sandstone occur in the upper part of the section.

The sandstone is fine- to medium-grained, fairly well sorted, and has angular to subangular grains of moderate sphericity. It

contains from 20 to 50% quartz, 10 to 15% feldspar (mainly potash feldspar), 5% muscovite, 5 to 25% clay matrix, 10 to 20% carbonate cement, up to 10% carbonaceous matter, and 10 to 25% fragments of mudstone, acid volcanics and "chert" (devitrified volcanic glass).

Zircon and tourmaline are common throughout most of the interval, whereas pyrite is abundant in the lower part.

Interval 1200 - 1290 feet:

The lithology of this section consists mainly of light grey sandstone, with minor intercalations of brown-grey siltstone and mudstone.

The sandstone ranges from ortho-quartzite at the top, to argillaceous sandstone and feldspathic sandstone in the lower parts. It is medium-grained, fairly well sorted, and has angular to sub-angular grains of moderate sphericity. The constituents include 60 to 75% quartz, up to 15% feldspar, 10 to 20% clay matrix and up to 10% calcite cement. Tourmaline, zircon and pyrite are present in places.

Interval 1290 - 1638 feet:

This unit is composed mainly of dark grey to black mudstone and siltstone with some sandy intercalations.

The sandstone is very fine-grained, fairly well sorted, and has subangular grains of low to moderate sphericity. It contains from 25 to 65% quartz, 5 to 10% feldspar, 10 to 25% clay matrix and 5 to 20% calcite cement. Muscovite, chert and pyrite are present in places.

A sample from 1620 to 1630 feet is a sandy limestone, with some marine fossils.

Interval 1638 - 2640 feet:

This interval is almost wholly sandy, having only a few intercalations of siltstone and mudstone.

The sandstone is generally medium-grained, fairly well sorted and grains range from subangular to rounded and are of moderate to high sphericity. It has generally from 65 to 80% quartz with common to abundant overgrowths, 5 to 15% feldspar (decreasing downwards) and about

10% kaolinite matrix with minor rock fragments in places. However, specimens at 2270' to 2280' and 2420' to 2430', have less quartz (40 and 50% respectively). The former has plentiful calcite, partly replacing both feldspar and quartz.

Pyrite, tourmaline and zircon are present in some specimens.

Interval 2640 - 3010 feet:

The unit consists of sandstone and siltstone with some interbeds of mudstone. The sandstone is fine to medium-grained, fairly well to well sorted, and has subangular to subrounded grains of moderate sphericity. It contains generally 30 to 40% quartz, varying proportions of feldspar from a few percent near the top to 20% near the bottom, 5 to 20% clay matrix (mostly kaolinite) and 20 to 50% calcite and some siderite cements. Also present in some samples are about 10% carbonaceous matter and up to 5% pyrites.

Interval 3010 to total depth (3523 feet):

Six thin sections were prepared from this interval - from depths of 3040 feet, 3090 to 3100 feet, 3146 feet, 3214 feet, 3351 feet and 3410 feet. In the following, brief descriptions of each thin section are given.

3040 feet:

The rock consists of phenocysts of quartz, feldspar (mostly oligoclase and andesine) and fragments of quartzite, sericitic siltstone, shale and andesite set in a very fine, pale brown matrix of volcanic glass and dust. Some of the quartz grains are embayed, whereas the plagioclase is often strongly zoned or slightly altered to sericite. The long axes of many feldspar grains are sub-parallel.

The groundmass shows some flow texture, and in parts, has been devitrified or altered to a brownish clay-like aggregate, probably montmorillonite. Also present in the matrix are widely disseminated black opaque grains, which may be ilmenite or magnetite.

Name: crystal-lithic tuff.

3090 - 3100 feet:

The sample shows a strongly interlocking and fine-grained texture, and consists of quartz, plagioclase (mostly albite) and micrographic crystals of quartz and feldspar. Sericite, chlorite and some glassy material are present, filling interstices or partly replacing some of the quartz and feldspar grains.

Name: sericitized dacite

3146 feet:

The rock is a breccia, consisting of pebbles, mainly of quartzite, set in a fine-grained matrix.

The matrix is composed principally of fine, angular to subangular grains of quartz set in microcrystalline silica, sericite and chlorite.

The rock also has veinlets consisting of quartz crystals and plagioclase microlites in a matrix of chlorite and kaolinite. The matrix is a sericitized siltstone.

3214 feet:

The rock consists mainly of coarse, lath-shaped plagioclase, actinolite, minor quantities of chlorite and iron oxide stain, with epidote and iron ores as accessories. The plagioclase (oligoclase - andesine) ranges up to 2.5 mm long and is partly altered to sericite and chlorite. Its relationship with the actinolite suggests a sub-ophitic texture. The latter occurs as tabular crystals and irregular masses.

Name: actinolite diorite.

3351 feet:

Fairly similar in composition and texture to the sample from 3214 feet. However, the plagioclase is slightly coarser (up to 3 mm), while the actinolite is slightly to moderately replaced by calcite. Ilmenite and pyrite are rather common, but epidote appears to be absent.

3410 feet:

A fine-grained rock, consisting of silt-sized quartz grains embedded in a matrix of sericite, chlorite and microcrystalline material

of low birefringence, probably kaolinite.

Name: sericitized siltstone.

III. LITHOLOGICAL CORRELATION

The Cooroorah unit between 1638 and 2640 feet and the Inderi unit between 1870 and 2750 feet were found to correlate very well lithologically. The other units do not compare as well, but are tentatively correlated because of the general similarities in their lithologies and positions relative to the units referred to above.

Stanleigh Formation

The Inderi unit between 3830 and 5433 feet compares fairly well with at least part of the Cattle Creek Formation in Warrinilla North No. I, which is thought to be equivalent to the Stanleigh Formation. They consist mainly of siltstone with some intercalations of argillaceous and feldspathic sandstone.

However, the sands in the Inderi unit tend to have less feldspar (by 5%) and somewhat better rounded grains having higher sphericity. This may suggest that the unit in the Inderi well is more mature than that in Warrimilla North No. I.

Staircase Sandstone

The Inderi unit between 2750 and 3830 feet, which is rather distinct lithologically from the overlying unit, compares well with the Cooroorah unit between 2640 and 3020 feet, and may be regarded as part of the Staircase Sandstone.

Both units contain argillaceous and feldspathic sandstone, with 55 to 65% quartz, 5 to 15% feldspar, 10 to 20% clay matrix and claystone fragments and common to abundant pyrite. (Fig. 6). The grains are generally fine to medium, rather poorly sorted, subangular and of moderate sphericity. Thus compared with the overlying sandy unit, i.e. Aldebaran Sandstone, the Staircase Sandstone contains less quartz, more feldspar and more pyrite and argillaceous matter.

Aldebaran Sandstone

The unit 1638 to 2640 feet in Cooroorah and the unit 1870 to 2750 feet in Inderi will compare very well lithologically with the Aldebaran Sandstone encountered in Warrinilla North No. I. The units consist mainly of massive, siliceous sandstone, with intercalations of siltstone, shale and conglomerate. The sandstone contains 65 to 75% quartz, 5 to 10% feldspar, about 10% clay matrix, minor "chert" (or devitrified glass) and patches of carbonaceous matter and calcareous replacement. The grains are medium to coarse, moderately sorted, angular to subrounded and of moderate sphericity.

In all three wells the units are characterised by moderate to abundant quartz overgrowths and pressure solution effects. This may indicate that the sands were probably more porous originally than they are at present, but there is much more outgrowth in Cooroorah than in Warrinilla North No. 1.

Ingelara Formation

The Inderi unit between 1686 and 1869 feet compares fairly well with the Cooroorah unit between 1290 and 1638 feet and with the Ingelara Formation encountered in Warrinilla North No. I and B.M.R. Springsure No. 15.

All the units consist of black carbonaceous shale and some dark grey micaceous siltstone and sandstone. The sandy and silty units are moderately sorted, and contain 30 to 60% quartz, 5 to 10% feldspar, 10 to 30% clay matrix (mainly illite and some kaolinite), 10 to 25% carbonaceous matter and no rock fragments. Pyrite is generally common in the deep wells, but is absent in the shallow B.M.R. hole. On the whole, however, the units correlate well.

Catherine Sandstone

The Inderi unit between 1669 and 1686 feet, the Cooroorah unit between 1200 and 1290 feet, and the Catherine Sandstone in Warrinilla North No. I have similar lithologies. They are mainly cream to light grey calcareous feldspathic sandstone and some argillaceous sandstone.

The typical sandstones contain 50 to 75% quartz, about 10% feldspar (mostly potash feldspar), about 10% clay matrix and 10 to 15% calcareous cement. They are fine to medium grained, fairly well sorted and the grains are subangular to subrounded and have moderate sphericity.

However, the Inderi and Coororah samples appear to have more clay matrix, and some carbonaceous matter and pyrite, which are absent in the samples from Warrinilla North No. I. This difference suggests that the Inderi and Cooroorah sediments were probably deposited under a more reducing environment than those in Warrinilla North No. I.
(Warrinilla)

Peawaddy Formation

The Inderi unit between 1130 and 1669 feet was compared with the Cooroorah unit between 390 and 1200 feet. In both intervals dark shale and siltstone are the more abundant lithologies and a few sandy intercalations.

The sandy units are fine- to medium-grained, fairly well sorted, and have angular to subrounded grains with moderate sphericity. The constituents include about 40% quartz, 10 to 15% feldspar, 15% clay matrix, 15% calcareous cement and about 10% volcanic fragments. This composition is very similar to that of the Peawaddy Formation in Warrinilla North No. I.

German Creek Coal Measures and Black Ally Shale

The Cooroorah and Inderi units immediately above the Peawaddy Formation are correlated with the German Creek Coal Measures and Black Ally Shale respectively.

The Cooroorah unit (0 - 390 feet), besides containing some coal seams, is generally light coloured, sandy, fine grained and micaceous. This lithology if typical of the German Creek Coal Measures.

On the other hand, the Inderi unit (930 - 1130 feet) consists predominantly of dark grey to black mudstone and shale with some

clay-rich sandstone. It may, therefore, be correlated with the Black Ally Shale.

Blackwater Group

The Inderi interval between 92 and 930 feet is immediately above a section correlated with the Black Ally Shale and therefore is probably equivalent to the lower part of the Blackwater Group. The interval contains siltstone and argillaceous to feldspathic sandstone; coal seams are also present, especially in the lower part.

The Blackwater Group is not present in the Cooroorah well.

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APPENDIX I - TABLES OF COMPOSITION AND TEXTURE

	TEXTURE				PERCENTAGE ESTIMATES									ACCESSORIES					
DEPTH NAME	sorting	grain-size (mm)	round-ness	sphericity orientation	quartz	quartzite	chert	micas	K-felds	plag.	rock frags.	matrix	alter. cement	tourm.	zircon	garnet	pyrite	epidote
70'-80' silty volcanic claystone		max. fine silt size			10	40% devitrified glass 10% carbonaceous matter						40 clay						
500'-510' Feldspathic Kaolinitic sandstone	fairly good	max. 0.4 av. 0.2	ang.- subrd.	moderate	40			few	8	7	5 (Volc	30 kaol	>10 cal. & sider.					
650'-660' argillaceous sandstone	fairly good	max. 0.2 av. 0.08	Ang.- subang.	moderate	50				5	few	10 clay stone	35 (kaolinite 20%)			r			
884' Carbonaceous Kaolinitic sandstone	moderate	max. 0.5 av. 0.2	ang.- subang.	moderate	45	15% carbonaceous matter		5	6	4		20 (kaolinite 15%)	5 calcite					
940'-950' siderite kaolinitic sandstone	good	max. 0.25 av. 0.15	ang.- subang.	moderate	40				8	7		30 kaolinite	15 siderite		r			
1150'-1160' Argillaceous sandstone	fairly good	max. 0.2 av. 0.1	ang.- subang.	moderate	50			10	5	5		15 (Kaolinite)	15 calcite	r	r			

DEPTH NAME	TEXTURE: sorting	grain-size (mm.)	roundness	sphericity / orientation	PERCENTAGE ESTIMATES: quartz	quartzite	chert	micas	K-felds	plag.	rock frags.	matrix	alter. cement.	ACCESSORIES: tourm.	zircon	garnet	pyrite	epidote
1180'-1190' Argillaceous feldspathic sandstone	fairly good	max. 0.15 av. 0.08	ang.-subang.	moderate	45		10	<5	12	3		>10 clay	5 calcite		c			
1190'-1200' Kaolinitic feldspathic sandstone	good	max. 0.15 av. 0.12	ang.-sub rd.	mod. - high	50		>5	2	8	2		15 kaolinite	15 calcite					
1220'-1230' Argillaceous feldspathic sandstone	good	max. 0.15 av. 0.1	ang.-subang.	mod. - high	55		10		12	3		15 clay	5 calcite	c	c			
1250'-1260' calcareous feldspathic sandstone	very good	max. 0.3 av. 0.25	ang.-subang.	mod. - high	70				5	few		10 kaol.	15 calcite		r			
1300'-1310' calcareous feldspathic sandstone	rather poor	max. 0.4 av. 0.15	ang.-subang.	low - mod.	35	5			6	4			40 calcite					
					Carbonaceous matter:							>10%						
1410'-1420' carbonaceous micaceous siltstone	fairly good	max. 0.1 av. 0.06	subang.-sub rd.	moderate	30		20	<5				<10 mic.	>10 calcite					
					Carbonaceous matter:							25%						

	TEXTURE				PERCENTAGE ESTIMATES									ACCESSORIES						
DEPTH NAME	sorting	grain-size (mm.)	round-ness	sphericity orientation	quartz	quartzite	chert	micas	K-felds	plag.	rock frags.	matrix	alter. cement	tourm.	zircon	garnet	pyrites	epidote
1530'-1540' calcareous feldspathic sandstone	good	max. 0.2 av. 0.15	subang. - rd.	moderate	>55 mod. over-growth	5			10	few		10 mic.	20 cal-cite					
1670' (side wall core) cal-careous feldspathic sandstone	moderate	max. 0.35 av. 0.2	subang. - sub rd.	mod. - high	65				10	few		10 kao.	15 cal-cite					
1670'-1680' Feldspathic argillace-ous sand-stone	good (for finer, main mode)	av. 0.4 and 0.07	ang. - subrd.	moderate	50			5 musc.	10	few		30 (10% kao)		u			c	
					5% carbonaceous matter													
1680'-1690' argillace-ous feld-spathic sandstone	fairly good	max. 0.4 av. 0.25	subang. - subrd.	moderate	60				10	5	5 clay st.	15 (10% kao	5 cal-cite				c	
1720'-1730' Feldspathic argillace-ous sand-stone	good	max. 0.1 av. 0.07	ang. - subrd.	moderate	65			5 musc.	5	5		15 (kao lin)	5 cal-cite& side-rite	u	r		c	

Inderi No. I

DEPTH NAME	TEXTURE: sorting	TEXTURE: grain-size (mm.)	TEXTURE: roundness	TEXTURE: sphericity / orientation	PERCENTAGE ESTIMATES: quartz	quartzite	chert	micas	K-felds.	plag.	rock frags.	matrix	alter. cement	ACCESSORIES: tourm.	zircon	garnet	pyrites	epidote
1780'-1790' carbonaceous micaceous sandstone	moderate	max. 0.25 av. 0.1	ang.-subrd.	moderate	50			few muse	3	2		20 (kao 5%)	5 calcite & siderite	r	c		c	
					20% carbonaceous matter													
1821' argillaceous sandstone	rather poor	max. 0.8 av. 0.25	ang.-subang.	low-moderate	55		5	2	5	5		<25 (kao 15%)		u	r		a	
					5% carbonaceous matter													
1850'-1860' silty carbonaceous shale		max. 0.03			15				<5	few								
					40% illite 15% kaolinite 25% carbonaceous matter													
1894' argillaceous protoquartzite	moderate	max. 0.6 av. 0.3	subang.-rd.	mod.-light	70		10				10 misc. silt stone		10 misc.					
1907' Orthoquartzite	rather poor	max. 2.0 av. 0.7	subang.-rd.	moderate	80 mod. o'gr-owth	<10	9		2		5 kaol.			u				

DEPTH NAME	TEXTURE: sorting	grain-size (mm.)	roundness	sphericity / orientation	PERCENTAGE ESTIMATES: quartz	quartzite	chert	micas	K-felds	plag.	rock frags.	ACCESSORIES: matrix + alter. cement	tourm.	zircon	garnet	pyrite	epidote
2010'-2020' Ortho-quartzite	fairly good	max. 0.3 av. 0.15	ang.-subang.	high	90		5					5 mic.					
2100'-2110' argillaceous sandstone	fairly good	max. 0.25 av. 0.15	ang.-subrd.	moderate	>55	5	5		7	3		>20 (15% kao.)				c	
2161' pebbly ortho-quartzite	very poor	up to 4 mm.	ang.-subrd.	low-moder.	80 mod. o'growth		15		few	5							
2300'-2310' argillaceous sandstone	moderate	max. 0.45 av. 0.2	ang.-subang.	moderate	>65				>5	few		>25 (15% illite & mica)		r			
2458' Proto-quartzite	fairly good	max. 0.6 av. 0.35	ang.-subrd.	low-moder.	75 mod. o'growth				<5	few	10 mic silt-stone	10 (kao. 5%)	r				
2464'4" Feldspathic sandstone	poor	max. 2.5 av. 0.6	ang.-subang.	moderate	70	5	10		5	5	5 mic silt-stone						
2650'-2660' Ortho-quartzite	moderate	max. 0.4 av. 0.2	ang.-subang.	mod.-high	80				<10	few		10 (kao. 5%)					

DEPTH NAME	TEXTURE: sorting	grain-size (mm.)	roundness	sphericity orientation	PERCENTAGE ESTIMATES: quartz	quartzite	chert	micas	K-felds	plag.	rock frags.	matrix	alter. cement.	ACCESSORIES: tourm.	zircon	garnet	pyrite	epidote
2802' argillaceous sandstone	fairly good	max. 0.25 av. 0.15 (other mode 0.5mm)	ang.-subang.	low	60		<5	5 musc. & bio	5	5		20 (mic. 15%)		c	u			
2870'-2880' calcareous argillaceous sandstone	moderate	max. 0.2 av. 0.08	subang.-subrd.	moderate	50		5					20 (kao. 15%)	25 calcite					
3040'-3050' argillaceous siltstone	fairly good	max. 0.1 av. 0.05	ang.-subang.	moderate	70			10 musc		2		20 (kao. 10%)					a	
3250'-3260' Feldspathic greywacke	moderate	max. 0.3 av. 0.2	subang.-subrd.	low-moderate	35		5		10	5	10 mic. silt stone	15 kao.	20 (<10% siderite)					
3322'4" Pebbly proto quartzite	poor	max. 2.5 av. 0.8	ang.-subang.	moderate	50	20			<10	few	10 acid volc.	5 mic.	>5 silic.					
3324' Feldspathic argillaceous sandstone	moderate	max. 0.5 av. 0.2	ang.-subang.	mod.-high	70				4	6		<20 (ill. & mica 15%)					a	
3450'-3460' calcareous orthoquartzite	fairly good	max. 0.6 av. 0.3	ang.-subang.	mod.-high	60	5			>5	few		>5 kao.	25 calcite					

DEPTH NAME	TEXTURE: sorting	grain-size (mm.)	roundness	sphericity / orientation	PERCENTAGE ESTIMATES: quartz	quartzite	chert	micas	K-felds	plag.	rock frags.	matrix	alter. cement	ACCESSORIES: tourm.	zircon	garnet	pyrite	epidote
3590'-3600' argillaceous feldspathic sandstone	moderate	max. 0.35 av. 0.15	ang.-subang.	moderate	<50		5		5	10		20 clay	5 calcite & siderite		r		a	
3830' argillaceous feldspathic sandstone	rather poor	max. 0.45 av. 0.15	ang.-subrd.	low-moder.	55	5		5 musc	8	12		15 kao. 10%)		r	r			
3930'-3940' calcareous argillaceous sandstone	fairly good	max. 0.15 av. 0.1	subang.-subrd.	moderate	45		10		5	few		15 mic.	25 calcite	r	r			
4334' carbonaceous silty claystone		max. fine silt			10	15%	15% microcrystalline silica carbonaceous matter					60 illite						
4400'-4410' kaolinitic quartz sandstone	fairly good	max. 0.4 av. 0.2	subang.-rd.	mod.-high	75 mod. o'gr owth				5	few		>15 kao.	5 calcite					
4484' calcareous argillaceous sandstone	moderate	max. 0.45 av. 0.2	subang.-rd.	mod.-high	35	5	15					20 illite	25 calcite fossils	r			a	

Inderi No. I

DEPTH NAME	TEXTURE: sorting	grain-size (mm.)	roundness	sphericity / orientation	PERCENTAGE ESTIMATES: Quartz	quartzite	chert	micas	K-felds	plag.	rock frags.	matrix	ACCESSORIES: alter. cement	tourm.	zircon	garnet	pyrite	epidote
4600'-4610' argillaceous siltstone	moderate	max. 0.08 av. 0.03	ang.-subrd.	moderate	35		10		<5			45 (mic, 30%)	5 calcite	r				
5370'-5380' calcareous granitic conglomerate					10				5	15			50 calcite					
								20% granophyre										
5429' Granophyre pebble conglomerate		pebbles up to 3 cm.			matrix: 55	5	10					10 illite	20 calcite				3%	
								Pebbles: granophyre										

DEPTH NAME	TEXTURE: sorting	grain-size (mm.)	roundness	sphericity orientation	PERCENTAGE ESTIMATES: quartz	quartzite	chert	micas	K-felds	plag.	rock frags.	matrix	alter. cement.	ACCESSORIES: tourm.	zircon	garnet	apatite	epidote
40'-50' Argillaceous sandstone	good	max. 0.2 av. 0.12	subang.-subrd.	low-mod.	35		10		5	few		45 clay & mica	5					
80-90' Calcareous subgreywacke	moderate	max. 0.25 av. 0.1	subang.-subrd.	moderate	15		15		5	15		25 andesite 10%	25 calcite					
					some carbonaceous matter & pyrite													
170'-180' Protoquartzite	good	max. 0.2 av. 0.15	subang.-subrd.	mod.-high	70		5	2	<5	few		10 kao.	10 calcite	u	c			
240' argillaceous sandstone	moderate	max. 0.2 av. 0.07	subang.-subrd.	low-mod.	50		<10 musc		5	5		20 kao. 10%	calcite	u	u			
270'-280' argillaceous sandstone	moderate	max. 0.25 av. 0.1	subang.-subrd.	mod.-high	70		5 musc					20 kao. 10%	5	r	u			
326' argillaceous sandstone	poor	max. 0.7 av. 0.2	ang.-subang.	low-mod.	60	5	5 musc		8	2		15 illite 10%	5 siderite	u	c			
450'-460' calcareous subgreywacke	moderate	max. 0.3 av. 0.12	subang.-subrd.	moderate	15		10		10	5	15 clay stone & volc (5)	20 kao.	25 calcite		r			

DEPTH NAME	TEXTURE: sorting	grain-size (mm.)	roundness	sphericity-orientation	PERCENTAGE ESTIMATES: quartz	quartzite	chert	micas	K-felds	plag.	rock frags.	matrix	alter. cement	ACCESSORIES: tourm.	zircon	garnet	pyrite	epidote
520'-530' calcareous subgrey-wacke	moder-ate	max. 0.3 av. 0.12	subang.-subrd.	moderate	20		10		>10	5	10 clay st. & volc	20 kao.	25 cal-cite		r			
598' calcareous kaolinitic sandstone	rather poor	max. 0.25 av. 0.07	ang.-subrd.	low	20			5 musc	<10	few	5 clay st.	15 kao.	40 cal-cite		u			
					5% carbonaceous matter													
680'-690' calcareous kaolinitic siltstone	good	max. 0.1 av. 0.06	ang.-subrd.	low	25			5 musc	10	few	5 clay st.	15 kao.	45 cal-cite					
					5% carbonaceous matter													
769' carbonaceous argillaceous sandstone	fairly good	max. 0.15 av. 0.07	ang.-subang.	low-mod.	40			<10 musc	>5	few		25 ill. & mica 15%	10 cal-cite & sider.	r	u		c	
					10% carbonaceous matter													
820'-830' calcareous arkose	fairly good	max. 0.35 av. 0.2	ang.-subang.	mod.-high	30		20		10	5	5 clay st.	10 kao.	20 cal-cite		u			
910'-920' Feldspathic sandstone	fairly good	max. 0.7 av. 0.4	ang.-subrd.	moderate	50		20		<15	few		5 kao.	>5 sider-ite	r			a	
					5% carbonaceous matter													
932' calcareous sandstone	good	max. 0.15 av. 0.08	ang.-subang.	mod.-high	30		10	5 musc	10	5	5 clay st.	5 kao.	20 cal-cite & sider.	c	c		a	
					10% carbonaceous matter													
1050'-1060' calcareous feldspathic greywacke	fairly good	max. 0.2 av. 0.1	subang.-subrd.	moderate	20		5		10	5	10 clay st.	20 kao. 15%	30 cal-cite	c	a			

	TEXTURE				PERCENTAGE ESTIMATES								ACCESSORIES					
DEPTH NAME	sorting	grain-size (mm.)	roundness	sphericity orientation	quartz	quartzite	chert	micas	K-felds	plag.	rock frags.	matrix	alter. cement	tourm.	zircon	garnet	pyrite	epidote
1110'-1120' Pyrite-cemented calcarenite	moderate	max. 0.15 av. 0.06	subang.-subrd.	mod.-high	20	40% calcite fragments	10	few					<30 pyrite					
1181' carbonaceous argillaceous sandstone	poor	max. 0.8 av. 0.25 (other mode: fine silt)	ang.-subrd.	low-mod.	15	15% carbonaceous matter			few			50 mainly ill.	20 calcite with fossils	r			c	
1200'-1210' orthoquartzite	moderate	max. 0.8 av. 0.4	ang.-subang.	mod.-high	75	5% carbonaceous matter						<10 kao.	10 calcite repl.				a	
1242' argillaceous sandstone	very good	max. 0.1 av. 0.08	subang.-subrd.	low-mod.	60			<5 muse	<5			20 ill. & micas 10%	10 calcite	r	u			
1270'-1280' Feldspathic sandstone	fairly good	max. 0.5 av. 0.25	ang.-subang.	mod.-high	60		10		10	5		10 kao. 5%	5 calcite	u	r			
1345' micaceous siltstone	fairly good	max. 0.08 av. 0.05	subang.-subrd.	low-mod.	25			<15 muse	<5	few		25 ill. & mica 20%	5 calcite				a	
1380'-1390' calcareous feldspathic sandstone	fairly good	max. 0.15 av. 0.08	ang.-subang.	moderate	60				5	5		10 kao.	20 calcite	u				
1620'-1630' sandy limestone	fairly good	max. 0.15 av. 0.1	subang.-subrd.	low-mod.	<20	10% carbonaceous matter	10	2	5	few		5 kao.	50 calcite with fossils					

DEPTH NAME	TEXTURE: sorting	TEXTURE: grain-size (mm.)	TEXTURE: roundness	TEXTURE: sphericity / orientation	PERCENTAGE ESTIMATES: quartz	quartzite	chert	micas	K-felds	plag.	rock frags.	matrix	cement	alter.	ACCESSORIES: tourm.	zircon	garnet	pyrite	epidote
1677' Argillaceous feldspathic sandstone	good	max. 0.3- av. 0.2	subang.- rd.	mod.-high	75 abund. o'gr owth				3	7	some	<15 ill. & mica 10%			u				
1770'-1780' kaolinitic feldspathic sandstone	fairly good	max. 0.45 av. 0.3	subang.- subrd.	mod.-high	65 mod. o'gr owth				5	7	5 mic.	15 kao.		3 calcite					
1800'-1810' kaolinitic feldspathic sandstone	fairly good	max. 0.45 av. 0.3	subang.- subrd.	mod.-high	65 mod. o'gr owth		5		7	8		15 kao.							
1884' kaolinitic feldspathic sandstone	moder- ate	max. 0.6 av. 0.25	subang.- rd.	mod.-high	65 abund. o'gr owth		5		10	5		10 kao.		5 calcite					
2000'-2010' kaolinitic feldspathic sandstone	fairly good	max. 0.3 av. 0.2	subang.- rd.	mod.-high	75 abund. o'gr owth		5		6	4		10 kao. & ill.			r			c	
2089' orthoquart- zite	fairly good	max. 0.6 av. 0.3	subang.- rd.	mod.-high	80 abund. o'gr owth				4	4		12 kao. 12%			r	r			
2160'-2170' kaolinitic feldspathic sandstone	fairly good	max. 0.7 av. 0.4	subang.- rd.	mod.-high	75 abund. o'gr owth		5		10	few		10 kao.				r			
2270'-2280' calcareous sandstone	fairly good	max. 0.4 av. 0.2	subang.- subrd.	mod.-high	40 mod. o'gr owth				5	5	5 clay st.	5 kao.	40 calcite						

DEPTH NAME	TEXTURE: sorting	TEXTURE: grain-size (mm.)	TEXTURE: roundness	TEXTURE: sphericity / orientation	PERCENTAGE ESTIMATES: quartz	quartzite	chert	micas	K-felds	plag.	rock frags.	matrix	ACCESSORIES: alter. cement	tourm.	zircon	garnet	pyrite	epidote
2420'-2430' calcareous argillaceous sandstone	fairly good	max. 0.4 av. 0.2	subang.-subrd.	moderate	50 minor o'growth		10		10	few	5 clay stone	15 kao. 10%	10 calcite					
2506' argillaceous quartz sandstone	moderate	max. 0.6 av. 0.3	ang.-subrd.	moderate	70				2	3		20 ill. & mica 15%			r	\		
					5% carbonaceous matter													
2620'-2630' argillaceous sandstone	fairly good	max. 0.25 av. 0.15	subang.-rd.	moderate	60 mod. o'growth				5	few	5 clay stone	30 kao. 15%						
2704' argillaceous sandstone	poor	max. 1.6 av. 0.6	ang.-subrd.	mod.-good	>50	5			12	3		>15 mic.	2				3%	
					5% devitrified glass 5% carbonaceous matter													
2706' pyritic calcareous sandstone	good	max. 0.08 av. 0.06	ang.-subang.	moderate	30					few		15 micaceous 10%	50 calcite		u	-	5%	
2820'-2830' orthoquartzite	good	max. 0.4 av. 0.3	subang.-rd.	mod.-high	80 mod. o'growth				5	few		<15 kao.						
2916' carbonaceous calcareous sandstone	moderate	max. 0.5 av. 0.2	subang.-rd.	low-mod.	40	5	5		5	few		5 kao.	30 sid. 5%				3%	
					10% carbonaceous matter													
2960'-2980' calcareous feldspathic greywacke	fairly good	max. 0.3 av. 0.2	subang.-subrd.	moderate	30		10		15	5		20 kao.	20 calcite					

DEPTH NAME	TEXTURE: sorting	TEXTURE: grain-size (mm.)	TEXTURE: roundness	TEXTURE: sphericity / orientation	PERCENTAGE ESTIMATES: quartz	quartzite	chert	micas	K-felds	plag.	rock frags.	matrix	alter. cement	ACCESSORIES: tourm.	zircon	garnet	pyrite	epidote
3040' crystal-lithic tuff		max. 2mm. long			10				few	20	10 and-esite	10 clay						
					50% glassy groundmass													
3090'-3100' sericitized dacite		max. 0.15 mm.			60			10		30 albite								
3146' micaceous siltstone (matrix of breccia)	fairly good	max. 0.1 av. 0.05	ang.-subrd.	mod.-high	40				5	few					c			
					Matrix: 20% sericite 15% chlorite 20% kaolinite													
3214' actinolite diorite		max. 2.5 mm. long						10 chlorites		60							c	a
					20% actinolite 10% iron oxide stain													
3351' actinolite diorite		max. 3 mm. long						10 chlorites		65							c	
					25% actinolite													
3410' sericitic siltstone	good	max. 0.03 av. 0.02	ang.-subang.	moderate	30													
					matrix: 40% sericite 10% chlorite 20% kaolinite													

APPENDIX 2

List of the Abbreviations used in the Tables

a	abundant
alter	alteration
ang	angular
av	average
bio	biotite
c	common
kaol	kaolinite
mic	micaceous
mod	moderate
musc	muscovite
plag	plagioclase
r	rare
rd	rounded
tourm	tourmaline
u	uncommon
volc	volcanic

APPENDIX 3. MICROPHOTOGRAPHS

Fig. 1

Field 1.9 mm., mag. x 59, crossed nicols Inderi No. I, 884'; Carbonaceous, kaolinitic sandstone, showing kaolinite "books", an embayed quartz grain and coal fragments. Also present are muscovite flakes and partly oxidised siderite patches.

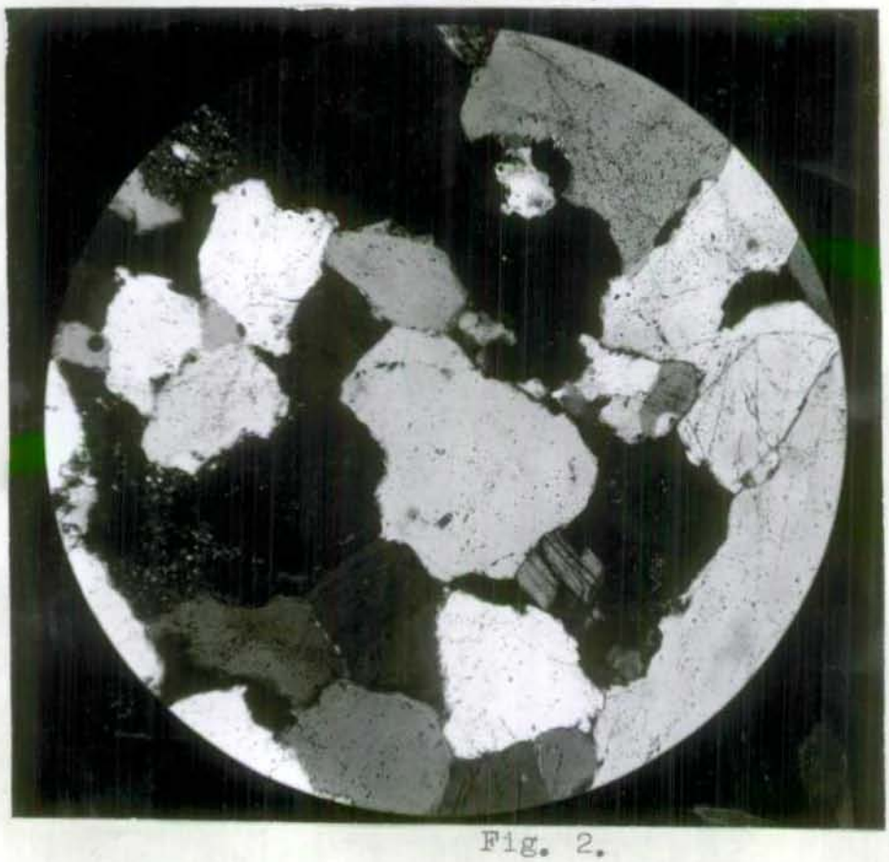

Fig. 2.

(B.M.R. neg. F/4752)

Field 1.9 mm, mag. x 59, crossed nicols, Inderi No. I, 1907'; rather poorly sorted orthoquartzite, with quartz overgrowth; feldspar grains and patches of kaolinite matrix.

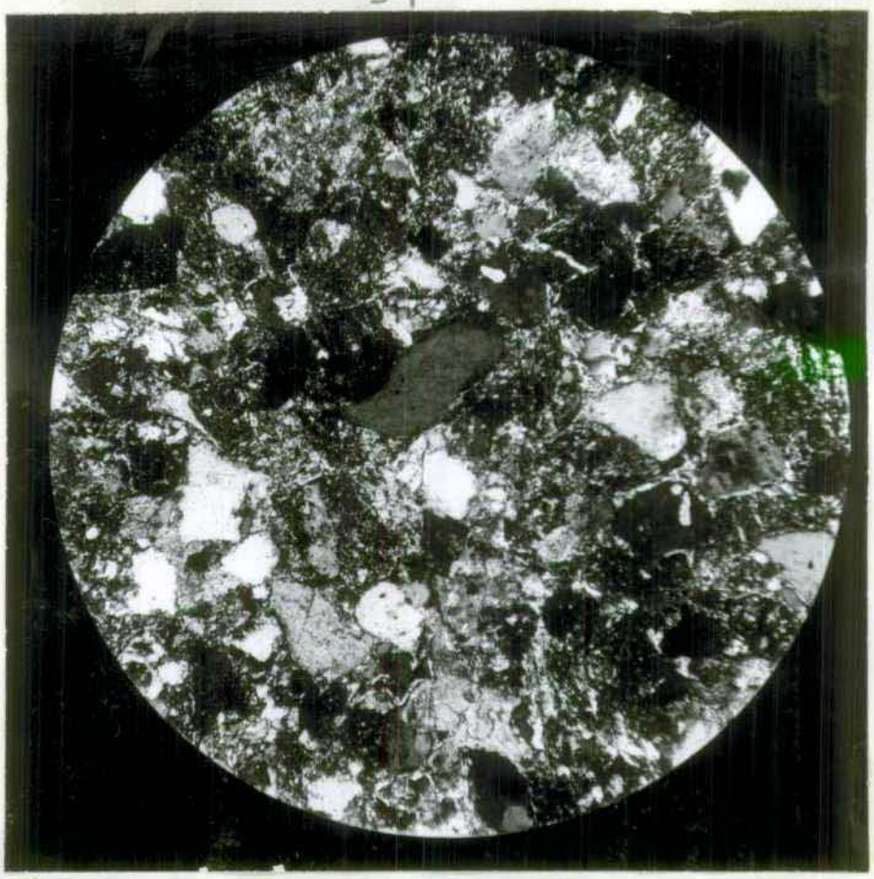

Fig. 3

Field 1.9 mm, mag x 59, crossed nicols, Cooroorah No. I, 450'-460'; Calcareous subgreywacke, showing quartz and feldspar grains with fragments of shale, claystone and "chert" and patches of calcite cement and kaolinite.

B.M.R. neg. F/4740

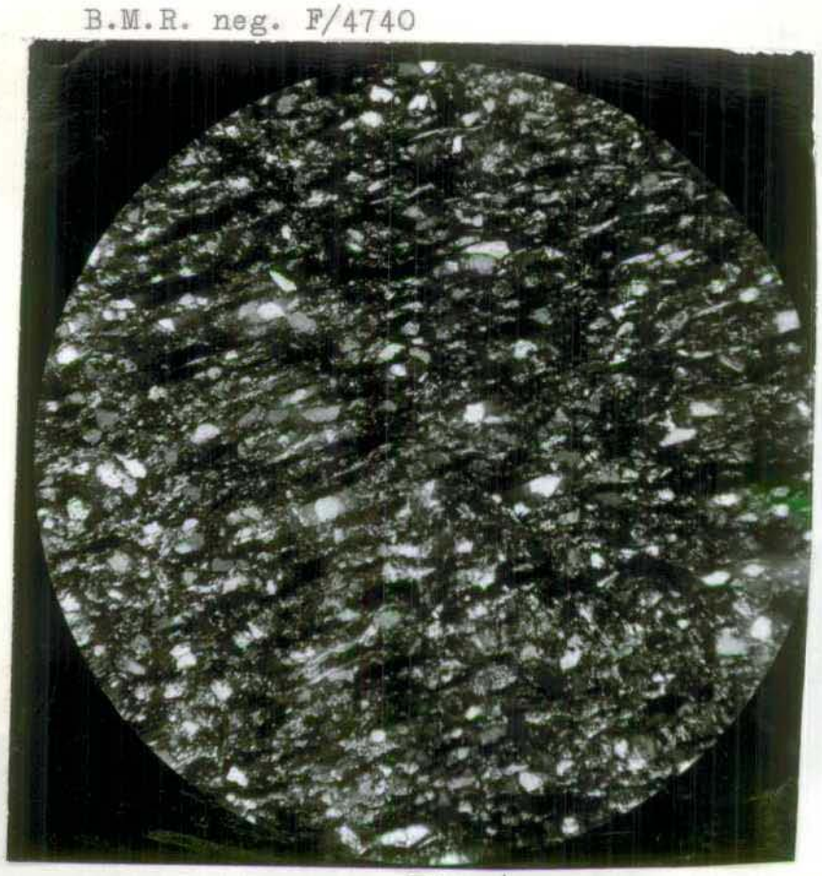

Fig. 4

.M.R. neg. F/4746)

Field 1.7 mm, mag. x 64, crossed nicols; Cooroorah No. I, 1345'; micaceous, carbonaceous siltstone, showing sub-parallel arrangement of carbonaceous matter, clay (mainly illite) and quartz grains.

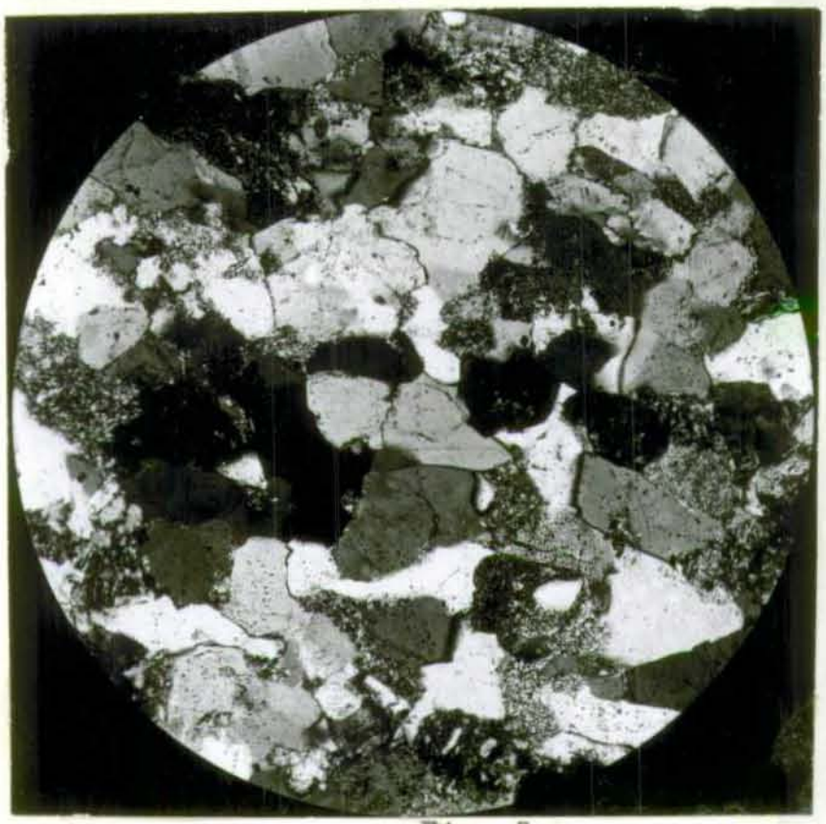

Fig. 5

Field 1.7 mm, mag. x 64, crossed nicols. Cooroorah No. I, 1677'; feldspathic sandstone, showing quartz overgrowth, feldspar grains, sutured boundaries and illite and kaolinite matrix.

B.M.R. neg. F/4751

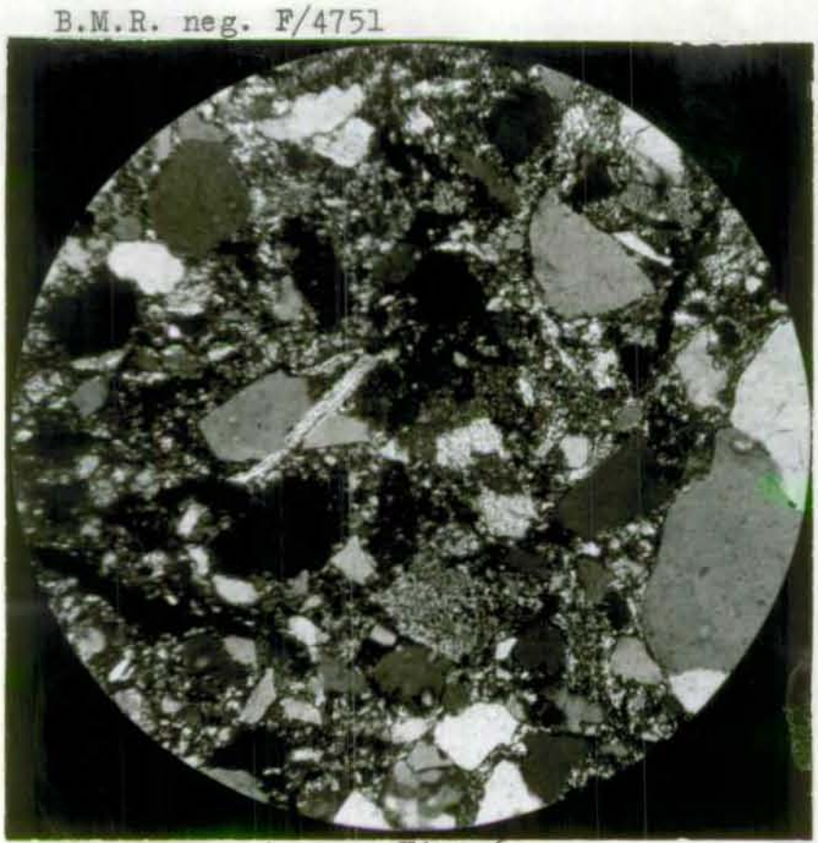

Fig. 6

Field 1.7 mm, mag. x 64, crossed nicols, Cooroorah No. I, 2704'; poorly sorted argillaceous sandstone, showing grains of quartz and "chert" set in micaceous matrix.

B.M.R. neg. F/4744