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DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES GEOLOGY AND GEOPHYSICS

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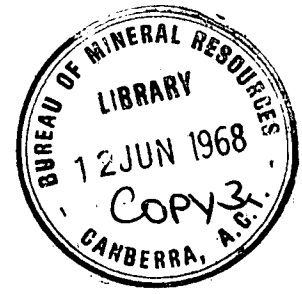

PETROLOGY OF SOME SEDIMENTS FROM THE LONGREACH - JERICHO - LAKE BUCHANAN AREA, QUEENSLAND

by

M.C. GALLOWAY

15928/65

THE PETROLOGY OF SOME SEDIMENTS FROM THE LONGREACH-JERICHO-LAKE BUCHANAN AREA QUEENSLAND

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SUMMARY

Fifty thin sections cut from outcrop samples collected by the 1964 Great Artesian Basin field party were examined petrologically. They ranged in age from Carboniferous to Cainozoic.

The Joe Joe Formation consists of lithic sandstone probably derived from an acid and intermediate provenance that also contained some probably small areas of older metamorphic sediments.

The Colinlea Sandstone consists of quartzose to lithic sandstone. The unit was probably derived from a provenance containing acid volcanics and quartzose sediments that lay west and north west of the area studied.

The Dunda Sandstone consists of lithic and lithic sublabile sandstone probably derived from the metasediments and acid volcanics of the Drummond Basin sequence.

The Clematis Sandstone consists of quartzose sandstone and was probably derived from an undetermined western source.

Arenites of the Moolayember Formation were derived from the Anakie Metamorphics and the volcanics of the Drummond Basin sequence.

The Hutton Sandstone consists of quartzose and lithic sublabile sandstone; the unit appears from the palaeocurrent data to have been derived from the west.

The Ronlo Beds vary from quartzose to lithic sandstone and were derived from a number of sources. They are a compound unit including the Hooray Sandstone, Westbourne Formation, Adori Sandstone, Birkhead Formation and Hutton Sandstone.

The Rolling Downs Group consists of muddy fine grained feldspathic, lithic, lithic sublabile sandstone, limestone and mudstone. The detritus was derived from a contemporaneous andesitic source. Most was probably wind borne from the Lower Cretaceous andesitic volcanic provenance that existed along and east of the present coastline between Townsville and Rockhampton.

INTRODUCTION

A petrological examination was carried out on fifty thin sections cut from outcrop samples collected during the 1964 field season by the Great Artesian Basin Party. The samples come from the Maneroo, Longreach, Jericho, Galilee and Buchanan 1:250,000 Sheet areas. Units examined range in age from Carboniferous to Cainozoic. The samples were selected to be as representative as possible of arenites in the units from which they were taken. They do not necessarily represent all rock types of each formation. The number of slides examined from each unit varies from one to nine; thus the conclusions as to provenance are only tentative.

The geology of the area from which the samples were collected is described by Vine, Jauncey, Casey and Galloway (1965). Subsequent mapping and drilling to the south has shown that the unit referred to by Vine et al. (op cit.) as the Lower Jurassic sandstone is the Hutton Sandstone. Figure 1 shows sample localities plotted on a geological map of the area studied; a stratigraphic table is included in the figure. Detailed descriptions of the samples, together with locality data, are given in Appendix 1. Specimen numbers are those of the Bureau of Mineral Resources Museum collections.

The classification for arenites used is that of Packham (1954) as modified by Crook (1960) and for carbonate rocks is that of Folk (1959), (1961). Grain sizes used are those of Wentworth (1922). Sphericity and roundness were determined by visual estimation according to Figure 2 which is modified from Figure 4-10 of Krumbein and Sloss (1963).

In describing certain rock fragments, use is made of the terms "textural andesite" and "textural basalt". The texture of these fragments indicates they were originally basaltic or andesitic. The textural andesite is recognized chiefly by the presence of a felted groundmass of extremely small feldspar laths. The textural basalt contains larger feldspar grains in a groundmass dominated by ferro-magnesian minerals. However, the presence of ferro-magnesian minerals may be suggested solely by the highly ferruginous nature of the groundmass and relict grain shapes.

Mineralogical percentages quoted are estimates for the Jurassic and younger units. Generally, percentages less than 5% are classed as a trace. Percentages for these units are probably accurate within 5%. Mineralogical and quartz-type point counts were made of sections from the Joe Joe, Colinlea, Dunda and Clematis formations. For these units percentages are probably accurate to 1%. Quartz was separated into one of three easily recognized categories:

1. Simple quartz with non undulose extinction (single quartz crystal fragments with uniform extinction).

2. Simple quartz with undulatory extinction (single quartz crystal fragments with undulose extinction).

3. Polycrystalline quartz (multiple quartz crystals).

For analysis of the petrography, three types of triangular diagrams are used. The first relates matrix, labile grains and quartz. These diagrams are referred to in the text as MLQ diagrams. The second uses quartz, feldspar and rock fragments as the three parameters and is referred to in the

text as a QFR diagram. The third uses the three quartz types referred to earlier as the parameters and is called a quartz-type diagram.

CARBONIFEROUS-PERMIAN SEDIMENTS

Joe Joe Formation

Three thin sections from the Joe Joe Formation were examined. All are lithic sandstone. Two are fine grained, the third is coarse.

Quartz (7, 8, 56%) is angular to highly angular with sphericity varying from moderate to very low. Corrosion embayments and bubble inclusion trails are common. Non undulose grains (80-90%) are dominant.

Feldspar (2-12%) is present in all sections, albite and oligoclase being the most common. Oligoclase is strongly altered in two of the thin sections.

Rock fragments (80, 52 and 26%) consist mainly of devitrified glass with some textural andesite and basalt.

Accessory hornblende and skeletal Fe-Mg minerals occur.

The quartz, with its non-undulose extinction and corrosion embayments was probably derived from an acid volcanic provenance.

Similarly the rock fragments consisting commonly of devitrified glass with minor textural andesite and textural basalt plus the presence of hornblende also indicate a volcanic provenance, with both acid and intermediate rather than purely acid rocks.

The persistent presence of traces of quartz mica schist suggests that small areas of older metamorphosed sediments occurred in the provenance.

The much larger quartz content and the subangular and rounded grains in sample 1744B as compared with samples 1453 and 1448 are not thought to be significant as the samples were collected from localities over 200 miles apart.

PERMIAN SEDIMENTS

Colinlea Sandstone

Five sections from this unit were examined. One is a siltstone; the remainder are coarse and medium grained arenites that vary from quartzose through lithic sublabile to lithic sandstone.

Quartz (55-80%) is generally angular to subangular with moderate to high sphericity. Non undulose grains predominate (50-70%), though polycrystalline grains (20-35%) are also common. Simple grains with undulose extinction constitute 2-17%; some grains have secondary overgrowths.

Fig 1

Reference

CAINOZOIC	QUATERNARY		Qa	Alluvium
			Q	Sand, soil, silt, clay, rubble
	TERTIARY		T	Sandstone, mudstone, conglomerate, limestone
MESOZOIC	LOWER TO UPPER(?) CRETACEOUS	Winton Formation (Mackunda Subgroup)	Kw	Mudstone, labile sandstone, sandy limestone, coal, intraformational conglomerate
	LOWER CRETACEOUS	Mackunda Formation (Mackunda Subgroup)	Klm	Labile sandstone, mudstone, sandy limestone, coquinite
		Allaru Mudstone Member (Wallumbilla Formation, Rolling Downs Group)	Kla	Mudstone, siltstone, cone-in-cone limestone
		Toolebuc Limestone Member (Wallumbilla Formation, Rolling Downs Group)	Klo	Limestone, calcareous shale, coquinite
		Coreena Member (Wallumbilla Formation, Rolling Downs Group)	Klc	Siltstone, labile sandstone, mudstone
		Doncaster Member (Wallumbilla Formation, Rolling Downs Group)	Kld	Mudstone, glauconitic mudstone and siltstone, minor concretionary limestone and quartzose sandstone
	JURASSIC TO LOWER CRETACEOUS	Ronlo Beds	J-Kr	Quartzose and labile sandstone, mudstone
	MIDDLE JURASSIC	Birkhead Formation	Jmb	Labile sandstone, mudstone, siltstone
	LOWER JURASSIC	Hutton Sandstone	Jl	Quartzose to sub-labile sandstone
	MIDDLE TO UPPER TRIASSIC	Moolayember Formation	Rm	Mudstone, siltstone, labile sandstone minor quartzose sandstone
	LOWER TO MIDDLE TRIASSIC	Clematis Sandstone	Re	Quartzose sandstone
	LOWER TRIASSIC	Dunda Sandstone	Rld	Labile to quartzose sandstone, mudstone, siltstone
		Warang Sandstone	Rlw	Quartzose sandstone, mudstone, siltstone
PALAEOZOIC	LOWER(?) TO UPPER PERMIAN	Colinlea Sandstone	Pc	Quartzose to sub-labile sandstone, minor mudstone, coal
	UPPER CARBONIFEROUS TO LOWER PERMIAN	Joe Joe Formation	C-P$_j$	Mudstone, siltstone, labile sandstone, some varves
	SILURIAN TO CARBONIFEROUS		S-C	Sediments of the Drummond Basin sequence and Broken River rift

Geological boundary

Fault grading to monocline (D,U indicate relative movement down up)

Anticline

Syncline

Where location of boundaries, folds and faults is approximate, line is broken; where inferred, queried; where concealed, boundaries and folds are dotted, faults are shown by short dashes

Bedding trend lines

Joints

• 1657 Locality and sample number

Principal roads and vehicle tracks

Railway

	BUCHANAN	
	GALILEE	
MANDRAKE	LONG-REACH	JERICHO

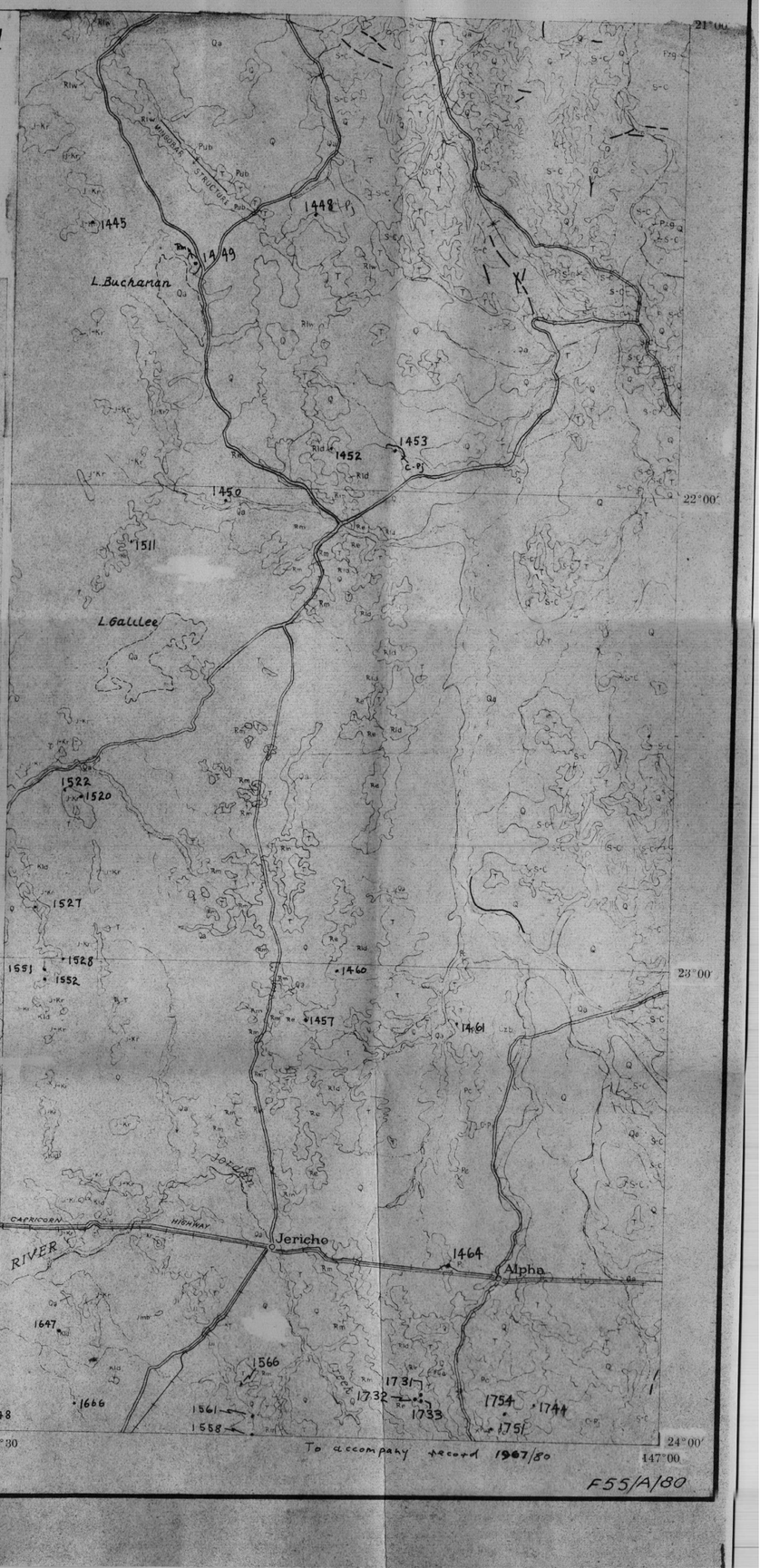

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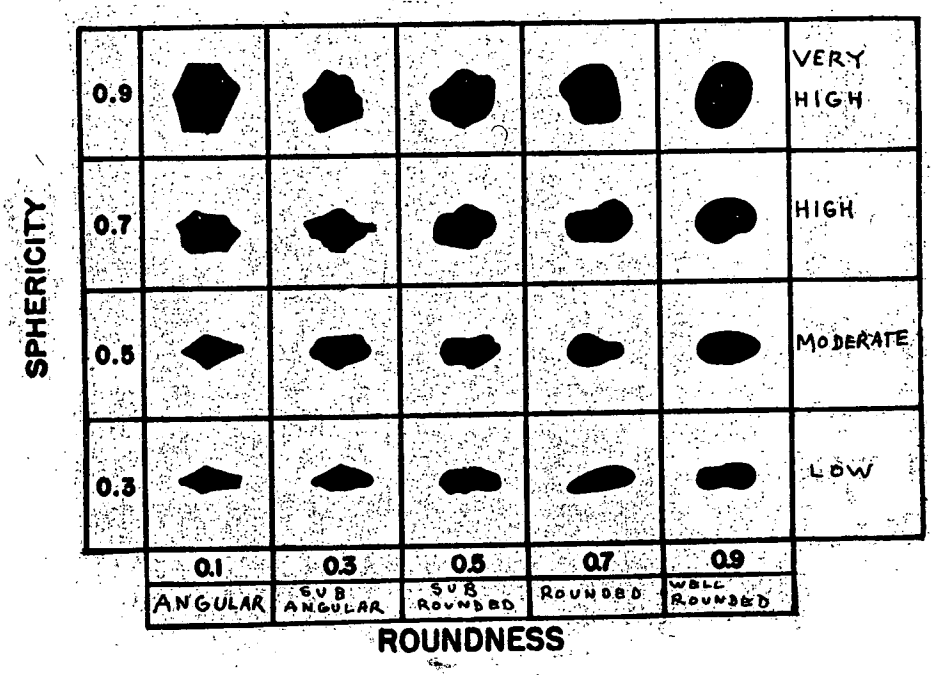
Fig 2

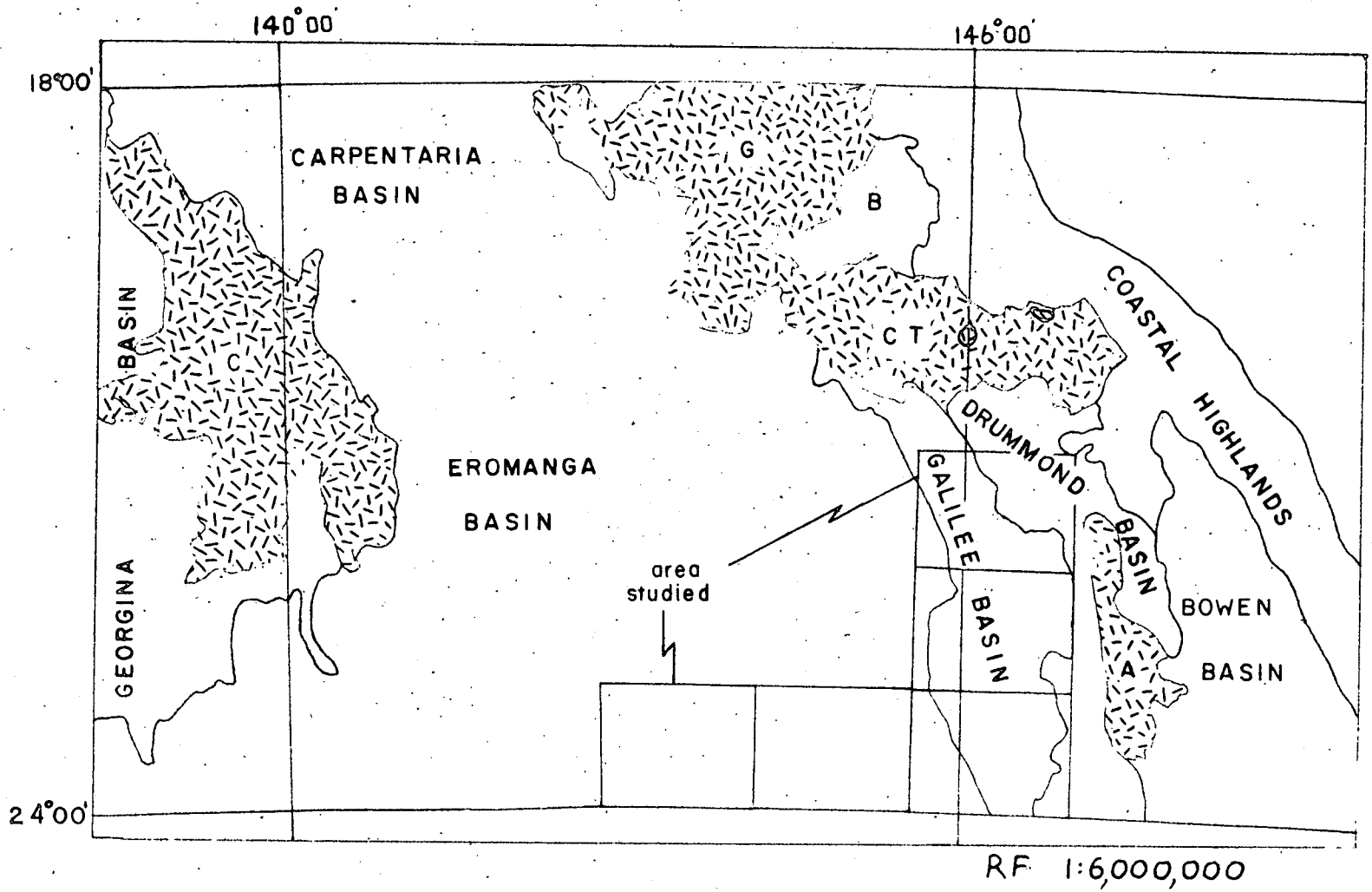
SPHERICITY AND ROUNDNESS TERMS USED



after Krumbein and Sloss (1963) Fig 4-10.

Fig 3

REGIONAL GEOLOGY



CRYSTALLINE BLOCKS

C Cloncurry Complex (Precambrian)

G C.T. Georgetown–Charters Towers (Precambrian – Lower Palaeozoic)

A Anakie Inlier (Lower Palaeozoic)

METAMORPHICS and INTRUSIVES

Coastal Highlands

SEDIMENTARY BASINS

Georgina – Carbonates – Lower Palaeozoic

B Broken River Embayment – – Carbonates & Clastics (Silurian – Carboniferous)

Drummond – Clastics & Volcanics (Devonian – Carboniferous)

Galilee – Clastics (Carboniferous – Triassic)

Bowen – Clastics & Volcanics (Permian & Triassic)

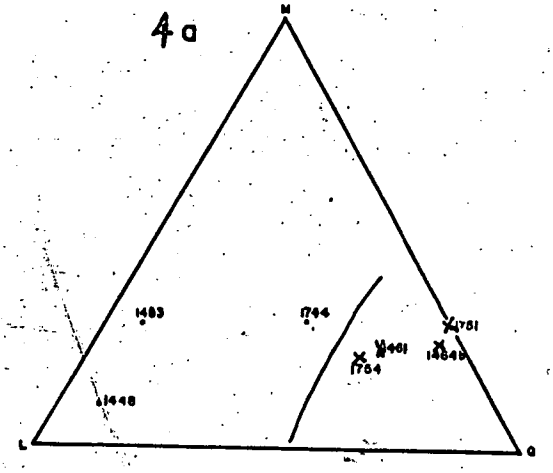
Eromanga – Carpentaria – Clastics (Jurassic & Cretaceous)

To accompany Records 1967/80

F/55/A/82

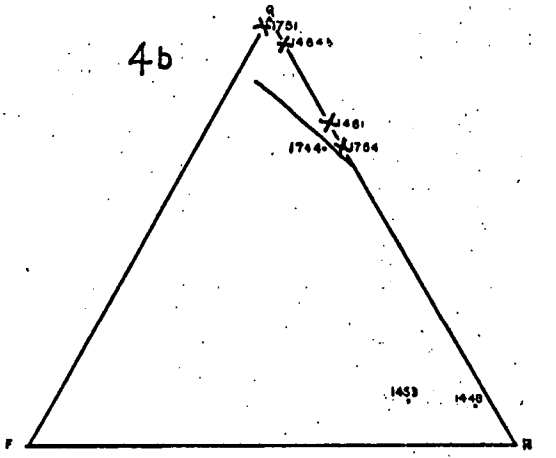
Fig 4

4a

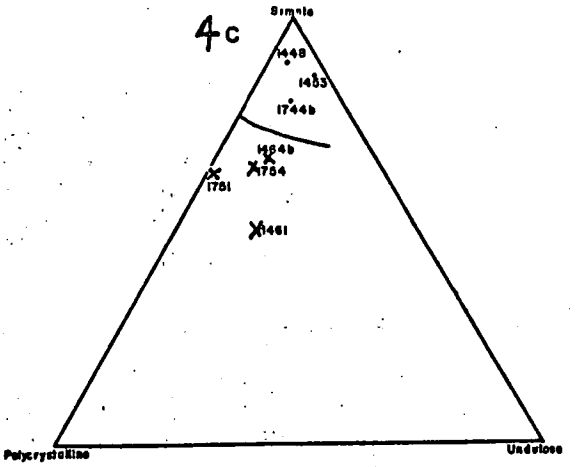


JOE JOE FORMATION •
COLINLEA SANDSTONE ×

4b



4c



Feldspar (Tr, 1%) is present in two thin sections. It is extensively altered, with indistinct extinction but is probably albite.

Rock fragments (Tr-23%) consist of cherty devitrified glass, schistose quartzite and quartz mica schist.

The sandstone generally had a high mineralogical maturity as quartz is dominant and the mostly quartzose rock fragments are stable. Sorting is generally moderate to high suggesting extensive transport or re-working.

The provenance was probably quartz bearing and contained acid volcanics and quartzose sediments or metasediments. This combined with extensive transport, re-working and weathering could yield the mineral assemblage found in the Colinlea Sandstone.

The dips of cross-stratification (Vine et al. 1965) in the unit are toward the south east and south suggesting a source toward the west or north west.

Discussion of MLQ, QFR and Quartz type diagrams for Joe Joe Formation and Colinlea Sandstone

The triangular diagrams shown in Figure 4 demonstrate the differences between the Joe Joe Formation and the Colinlea Sandstone.

The Colinlea Sandstone is more quartzose and mature than the Joe Joe Formation as demonstrated in the MLQ diagram (Fig. 4a) and the QFR diagram (Fig. 4b). The Joe Joe Formation also has a much higher proportion of simple non undulose quartz than the Colinlea Sandstone (Fig. 4c).

TRIASSIC SEDIMENTS

Dunda Sandstone

Seven sections from this unit were examined. One is a siltstone, the remainder vary from lithic to lithic sublabile and feldspatholithic sandstone.

Quartz (32-70%) is angular and subangular with moderate to high sphericity. Simple non undulose grains predominate (45-65%) but polycrystalline grains are also common (30-50%). Some sections contain quartz with corrosion embayments and subhedral grains.

Feldspar is generally present though commonly less than 3%; one thin section had 7%. Composition varies from albite to andesine; minor K-feldspar was also observed.

Rock fragments (13-57%) are commonly schistose quartzite and quartz-mica schist; some devitrified acid glass; chert also occurs.

The rock fragments indicate that the provenance included metasediments and acid volcanics. The presence of albite and K-feldspar suggests a dominantly acid provenance. The relative abundance of polycrystalline quartz may suggest tectonism in the source area.

Cross-stratification in the unit dips to the west, south-west and south (Vine et al., 1965). Possible sources for the schistose rock fragments can be found in the Anakie metamorphics and metamorphics of the Charters Towers area; for the feldspar in the granites of Charters Towers; and for the volcanic fragments in the Carboniferous and Devonian rhyolites and dacites of the Drummond Basin.

Clematis Sandstone

Two thin sections from this unit were examined; both are quartzose sandstone.

Quartz (89, 96%) is abundant, it is angular to subrounded with a moderate sphericity. One section showed no apparent relationship between quartz type and grainsize; in the other the granule size grains are polycrystalline while the medium size grains were predominantly non undulose.

Rock fragments (5, 0%) present only in one thin section, are contemporaneous siltstone and claystone; they are very micaceous.

From the thin sections examined, the formation appears to have high maturity and is made up of extensively reworked material. The climate was probably hot and humid ensuring the complete breakdown of unstable minerals.

Cross-stratification in the unit dips to the south east, east and north-east (Vine et al., 1965). The provenance of the sediments was probably toward the west.

Moolayember Formation

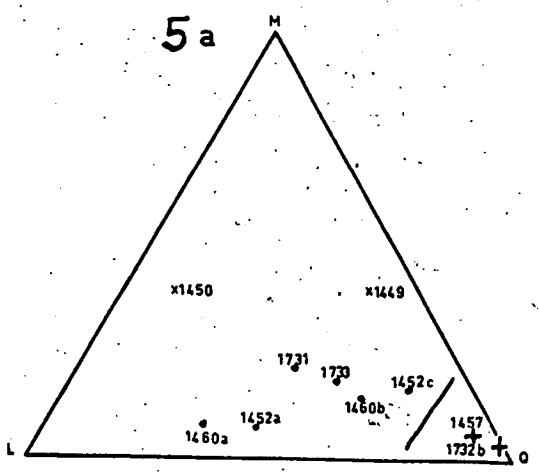
Two very fine grained sandstones from this formation were examined; one was lithic, the other lithic sublabile. They consist of quartz, albite and deeply weathered andesine and mica. The rock fragments include siltstone and mudstone fragments, schistose quartzite, metasediments and some textural basalt. Although not evident from the samples examined, the Moolayember Formation consists dominantly of siltstone and mudstone deposited fairly slowly (Vine et al., 1965). The rare grains of textural basalt suggest a volcanic source though extensive transport and weathering has taken place. The Anakie Metamorphics and Drummond Basin rocks may have been the source for the formation.

Discussion of MLQ, QFR and Quartz type diagrams for Dunda Sandstone, Clematis Sandstone and Moolayember Formation

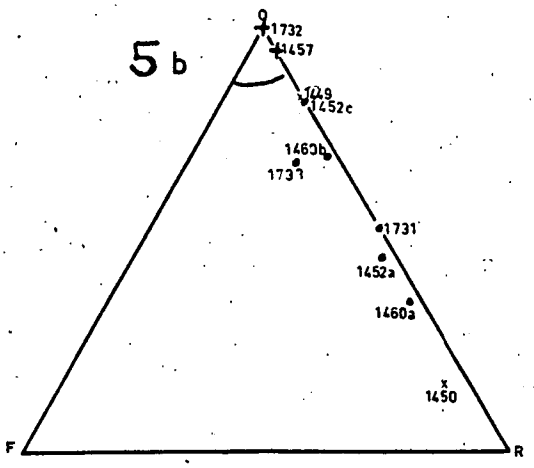
The field for the samples from the Clematis Sandstone is distinct and separate to the field for the Dunda Beds and Moolayember Formation in both the MLQ and QFR diagrams (Fig. 5a, b).

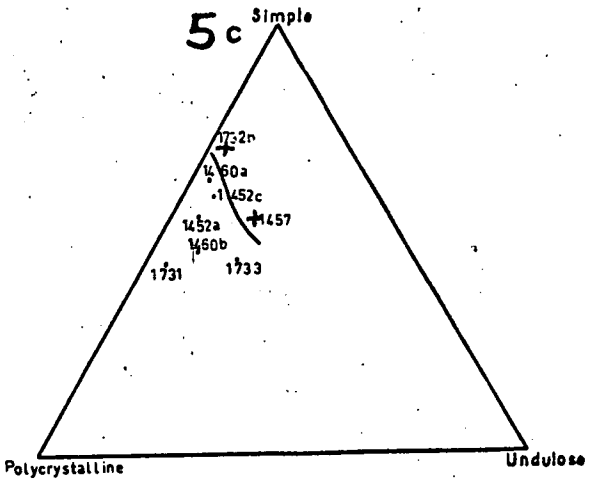
The Clematis Sandstone is more quartzose than the labile Dunda Sandstone and Moolayember Formation.

FIG 5



DUNDA BEDS •
CLEMATIS SANDSTONE +
MOOLAYEMBER FORMATION x





The Clematis Sandstone has somewhat more non undulose quartz grains than the Dunda Sandstone (Fig. 3c). Quartz types for the Moolayember Formation were not determined.

JURASSIC TO LOWER CRETACEOUS ARENITES

Hutton Sandstone

Three sections from this unit were examined. They are quartzose and lithic sublabile sandstones.

Quartz (65-83%) is the most common mineral. It is angular, subangular and rarely subrounded with a high to moderate degree of sphericity. Dustings of inclusion are common.

Feldspar, present only in one section (2%), is very weathered and includes albite and some probable K-feldspar.

Rock fragments (5-15%) include quartzose siltstone, carbonaceous siltstone, and quartzose metasediments.

The Hutton Sandstone appears to be highly mature. Grain stability is evident from the high proportion of quartz, and the fragments being quartzose.

The cross-stratification dips to the south, south-east and north-east (Vine et al. 1965), so the provenance was probably toward the west.

Ronlo Beds

The Ronlo Beds is a name given to the poorly outcropping non-marine sediments between the Rolling Downs Group and the Moolayember Formation north of Jericho. In bores a few tens of miles west of where the unit outcrops, the Hooray Sandstone, Westbourne Formation, Adori Sandstone, Birkhead Formation and Hutton Sandstone are recognizable. The Ronlo Beds may thus represent all of these units. Because of the very poor outcrop, these units are not mappable at the surface.

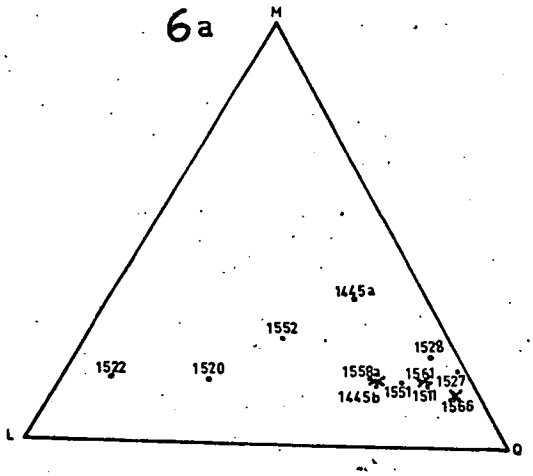
Nine sections from this unit were examined. They vary in composition from quartzose to lithic sandstone. Mineralogical percentages are highly variable, quartz being 10-70% and rock fragments 6-57%.

Rock fragments are generally quartzose devitrified glass, quartzose meta-sediments and contemporaneous siltstone and mudstone. This suggests that the unit was derived from a provenance composed of meta-sediments and acid volcanics.

The dips of cross-stratification in the unit are random. There is a great diversity in rock types and the unit is almost certainly made up of a number of different rock bodies each with its own provenance.

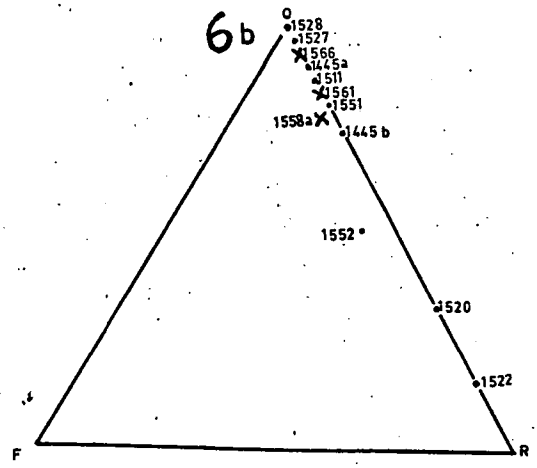
FIG 6

6a



RONLO BEDS •
LOWER JURASSIC ×

6b



Discussion of MLQ and QFR diagrams for Lower Jurassic sandstones and Ronlo Beds

The Ronlo Beds have a wide spread, extending from the labile to the quartzose sandstone fields (see Fig. 6a and b). The Hutton Sandstone falls into the more quartzose corner of each diagram. The spread of the Ronlo Beds reflects the variation in rock types within the unit.

ROLLING DOWNS GROUP

WILGUNYA SUB-GROUP

Sections were cut of the Wilgunya Sub-Group to see if any unsuspected minerals were present. Because of its extremely fine grain size the sections proved to be suitable only for petrography and not petrology. This had been suspected when choosing the samples for sectioning so very few were prepared.

With the exception of the Coreena Member, no discussion is made of the provenance of the detrital minerals as they are so fine grained and are present in such minor quantities. The Coreena Member is discussed with the Winton Formation.

Doncaster Member of Wallumbilla Formation

Only one section from the member was examined. It is very soft, friable, interlaminated mudstone and siltstone. The mudstone is pale grey and orange, while the siltstone is pale grey with scattered rich green glauconitic grains.

In thin section the average grain size is 0.05 mm. but ranges up to 0.08 mm.

Coreena Member of Wallumbilla Formation

Three sections from this member were examined; they are silty sparse biomicrites. Of the detrital minerals, quartz occurs as angular simple grains commonly with non-undulose extinction. Some silt-size needle-like grains occur. Feldspar occurs in elongate laths with irregular terminations. It is generally clear and fresh; andesine is predominant but some labradorite also occurs.

Glauconite occurs as irregular pellets, some of which are chloritised, though this is probably due to surface weathering.

Toolebuc Limestone

Two sections from this formation were examined. One is a sparse pelecypod biomicrite, the other a packed pelecypod biomicrite. Both are made up of grey and brown microcrystalline calcite mud, with calcareous mud pellets, pelecypod fragments, recrystallized Globigerina, hematite grains and a trace of polycrystalline quartz.

Allaru Mudstone

One section from this member was examined. It is a sparse biomicrite made up of micro and cryptocrystalline calcite, minor calcite prisms (probably pelecypod prisms), very angular quartz, (9%) glauconite (30%) and labradorite (tr).

The sections examined from the Wilgunya sub-group are all calcilutites or calcareous siltstone.

MANUKA SUB-GROUP

MACKUNDA FORMATION

Three sections from this formation were examined, they are calcareous glauconitic lithic siltstone and sandstone and silty feldspathic lithic micrite.

Quartz varies from 8-20%, it is angular with low sphericity, some needle-like grains occur of which some show corrosion embayments, some corrosion appears to be primary, much appears to be secondary calcite corrosion.

Feldspar (2-10%) is dominantly andesine with subordinate labradorite and minor amounts of K. feldspar. The mineral forms elongate laths with irregular terminations.

Rock fragments (10-30%) consist of devitrified glass, textural andesite and basalt and metaquartzite. Dark brown, extensively altered grains are common; they are probably weathered andesite and basalt.

Glauconite (5-23%) occurs as rich olive green pellets. Some appear to be replacing rock fragments; others appear to be replacing micas. Some appear to be altering to chlorite; this is probably due to recent weathering of the glauconite.

The cement (45-58%) consists of finely crystalline calcite some of which is replacing and pseudomorphing rock fragments. Colourless very fine quartz also occurs.

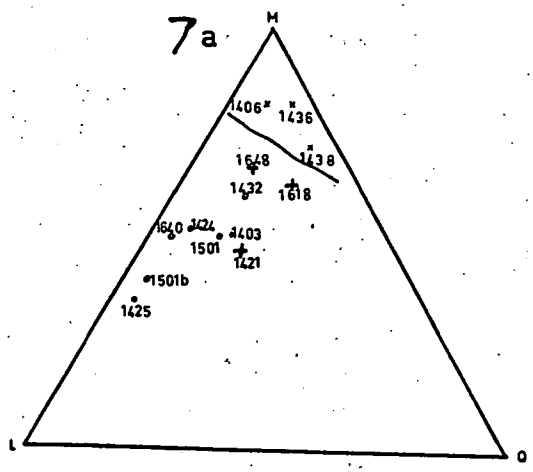
WINTON FORMATION

Six sections from this formation were examined. They vary from calcareous lithic sandstone to calcareous feldspatholithic sandstone, lithic sandy micrite and feldspathic sandy micrite.

The sandstones are mainly fine grained and thus coarser than the Mackunda Formation. The grains, being larger, were more easily identifiable than those of the Mackunda Formation and fewer of the rock fragments had been broken down to form groundmass.

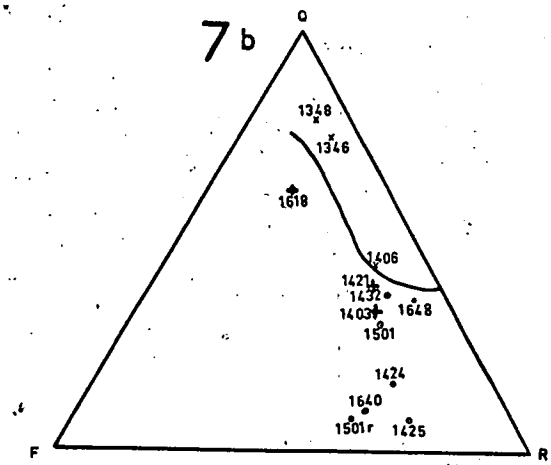
FIG 7

7a



WINTON ⊙
MACKUNDA +
COREENA x

7b



Quartz (5-15%) is angular with common very angular needle-like grains present. Calcite corrosion is evident in some cases. Grains with non-undulose extinction were common, but some grains with undulose extinction and corrosion embayments also occur.

Feldspar (5-15%) is dominantly andesine with rare labradorite, one section had some grains of oligoclase.

The rock fragments (19-38%) consist of devitrified, textural basalt textural andesite and extensively altered indeterminate volcanics(?). Siltstone and mudstone fragments, of probably contemporaneous origin, occur as well as minor amounts of quartz-mica-schist and metaquartzite.

Accessory minerals consist of minor amounts of mica with hornblende in one section.

The matrix consists of fine silt-size quartz, mica with 25-50% of cryptocrystalline calcite cement.

The source of the Winton Formation is probably much the same as for the Mackunda Formation. The apparently less stable nature of the grains is thought to be because the grain size is larger than for the Mackunda Formation.

Discussion of MLQ and QFR diagrams for Coreena Member, Mackunda Formation and Winton Formation

Figure 7 shows the difference in composition between the Coreena Member of the Wilgunya Sub-Group and the Mackunda and Winton Formation of the Manuka Sub-Group.

In both the MLQ and QFR diagram the sections for the two sub-groups fall into separate areas of the diagram.

The sections examined from all three units are highly calcareous, the calcite being included with the matrix in the MLQ diagram. Though this is strictly invalid, it was found that by including the calcite with the matrix that a better separation of units on the diagram could be obtained. The calcite is regarded as primary for the rock unit, but during diagenesis it was localised in the concretions. The Coreena Member and Mackunda Formation samples were mainly siltstones while the Winton Formation samples were mainly fine grained sandstones.

Source of detrital material in the Rolling Downs Group

One of the most striking features of these sediments is that the arenites are well sorted and almost exclusively fine grained or finer. Medium grained detritus is rare while coarse or conglomeratic beds are totally absent.

No palaeocurrent information is available for the group. However in thin section the predominance of andesine over labradorite and andesite over basalt indicates an andesitic volcanic provenance. Contemporaneous vulcanism is suggested by the needle-like quartz grains; the extreme

freshness, the lack of inclusions, and the zoning of the feldspar grains; and the presence in two sections of fresh hornblende. The extreme fineness of the grainsize could have assisted in allowing the grains to be transported a considerable distance without breaking of grains.

Some of the quartz was probably derived from the more acid phases of the andesitic volcanic provenance, while other quartz, along with the metamorphic and plutonic rock fragments was probably derived from the older basement rocks of the Anakie Metamorphics, Drummond Sequence and/or the Georgetown-Charters Towers Crystalline blocks. However, this basement source, contributed only a minor proportion of the detritus, the major proportion came from the andesitic volcanic provenance.

A volcanic provenance for the Lower Cretaceous sediments of the Murray Basin is postulated by Evans and Hawkins (1967), the Otway Basin (B.M.R., 1966) and the northern Eromanga Basin (Bastian, 1963).

Bastian (1963) working on samples collected from the northern Eromanga Basin (Hughenden and Richmond Sheet areas) claimed that detritus for the Cretaceous sediments was derived from the Lower Permian volcanics of the Bowen Basin. I question this view as it is difficult to understand how the Lower Permian volcanics, that generally are very hard and siliceous, could have been sufficiently weathered to be completely disaggregated and thus be able to supply the fresh, unweathered, angular feldspar and hornblende grains that appear in the thin sections.

An active Cretaceous andesitic volcanic provenance is difficult to find. There are three possible localities for such a provenance (see also Fig. 8).

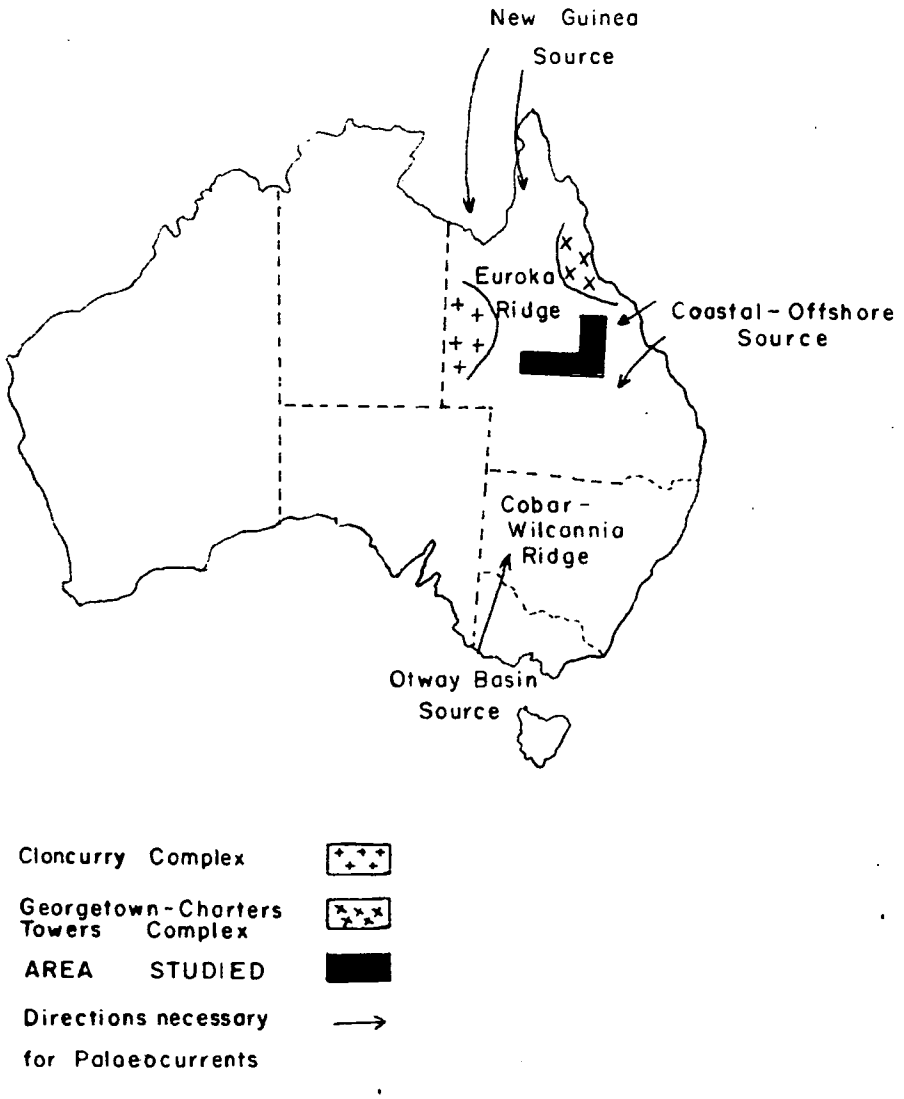
1. New Guinea, where Cretaceous volcanics occur.
2. A source south of the Otway Basin (B.M.R. 1966).
3. Volcanics of the Whitsunday and Cumberland Group of Islands and volcanics associated with the Great Barrier Reef.

Of these three possibilities a New Guinea source would necessitate transport for over 900 miles to the area studied. The Otway source would necessitate over 1100 miles of transport.

Along the present Queensland coast, Cretaceous basalt is associated with the Stanwell Coal Measures of the Rockhampton and Port Clinton 1:250,000 Sheet areas (Kirkegaard, Shaw and Murray, 1966); in addition, in the Whitsunday and Cumberland Group of Islands, andesite and dacite occurs (pers. comm. A.G.L. Paine) from which radioactive dating has indicated Lower Cretaceous age (pers. comm. A.G.L. Paine). These volcanics are strongly faulted, with most movements down to the east, thus the volcanics, when originally deposited were more elevated in the east, and were possibly at a much higher elevation than today. This locality is 200-300 miles from the area studied and is thus much closer than the possible New Guinea or Otway Basin sources. I suggest the Cretaceous volcanics along the current coastline were the most probable source for the arenites of the Rolling Downs Group.

Fig. 8

POSSIBLE SOURCES FOR MACKUNDA AND WINTON FORMATIONS



To accompany Records 1967/80

F/55/A/83

The glauconite appears to have formed both from volcanic rock fragments and mica.

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APPENDIX I

PETROGRAPHY

JOE JOE FORMATION

Sample 64581448 - LITHIC SANDSTONE - medium grained, poorly sorted, Map reference 41933244 Buchanan.

Hand Specimen

Pale brown, medium grained sandstone, poorly sorted with no apparent bedding, friable, porous with an uneven fracture. Consists of quartz with white, orange and brick-red grains in a fine silty groundmass.

Thin Section

Consists of sand grains of average size 0.4 mm. ranging up to 0.7 mm.

Quartz (8%) is angular with moderate sphericity, grains commonly occurring as simple grains with non undulose extinction, corrosion embayments, and irregular cracks. Dustings of inclusions are rare. Quartz types - non undulose 89%, undulose 4%, polycrystalline 7%. A volcanic origin for the mineral is evident. Chalcedony occurs as rare, finely radiating grains.

Feldspar (2%) is strongly altered and weathered, it is dark, hazy brown-grey in colour. Weathering is so extensive that no estimate of composition was made.

Rock fragments (80%) consist dominantly of devitrified glass (60% of total rock) with minor very fine silt size dark brown volcanic rock fragments (10%) traces of quartz mica-schist fragments (5%), and meta-quartzite fragments (5%).

Accessory minerals include yellow-brown phengite and brown biotite and occur as bent sheafs.

Matrix (10%) consists of pale brown to mid-brown very fine silt grains. It is very difficult to distinguish from the devitrified rock fragments.

Sample 64581453 - LITHIC SANDSTONE - fine grained well sorted, Map reference 44182615 Buchanan.

Hand Specimen

Pale orange, fine grained, moderately sorted, with no apparent bedding; uneven fracture, non friable, non porous, tough, almost conchoidal fracture, composed of rare quartz(?), pink, grey or rarely pastel green grains, a trace mica.

Thin Section

Consists of sand grains of average size 0.2 mm.

Quartz (7%) is angular and highly angular with a low to very low sphericity; grains commonly show uniform extinction. They have corrosion embayments, but bubble trains and inclusions are uncommon. Quartz types: non undulose 86%, undulatory 11% and polycrystalline 3%. A volcanic source for the mineral is evident.

Feldspar (12%) consists mainly of albite with oligoclase and some microcline.

Skeletal Fe-Mg minerals (tr) occur with red-brown haematitic cores.

Rock fragments (52%) consist dominantly of devitrified glass (35% of total rock) with some textural andesite (9% of total rock) textural basalt (3%) quartz-mica schist (3%) and chalcedonic fragments with scattered biotite (2%).

Accessory minerals include traces of muscovite and phengite.

The matrix (29%) consists of cryptocrystalline calcite.

Sample 64581744B - LITHIC SANDSTONE - fine grained, well sorted, Map reference 48000213 Jericho.

Hand Specimen

Pale grey, fine grained, no apparent bedding, irregular fracture, poorly friable, non porous, even texture. Composed of quartz with white, black and pale grey grains, some contemporaneous shale fragments.

Thin Section

Consists of sand size grains of average size 0.15 mm.

Quartz (56%) is subangular to rounded with a high sphericity, commonly with irregular cracks; dustings of inclusions and trails of inclusions are uncommon. Quartz types: non undulose 80%, undulatory 9% and polycrystalline 11%. A volcanic provenance is indicated for the mineral.

Feldspar (3%) occurs commonly as albite in almost square and stubby lath-like grains; some oligoclase also occurs but is extensively altered and sericitized.

Rock fragments (26% of total rock) occur dominantly as indistinct green, very fine grained subrounded grains (15%), acid volcanics (5%) and some fragments with intimately interlocking sutured boundaries occur. Quartz-mica schist fragments also occur.

Accessory minerals includes hornblende (tr) as scattered altered grains, mica (tr), and pale green tourmaline (tr) also occur.

Matrix (21%) consists of cryptocrystalline calcite.

COLINLEA SANDSTONE

Sample 64581464A - SILTSTONE - fine grained, poorly sorted, Map reference 45800570 Jericho

Hand Specimen

White, fine silt size grains with scattered coarse grains, moderately sorted, no apparent bedding, uneven fracture normal to bedding parting sub-parallel to bedding, slightly friable, porous.

Thin Section

Consists of silt grains of average size 0.02 mm. ranging up to 0.04 mm.

Quartz (25% estimate) is angular with a moderate sphericity and consists generally of simple non undulose grains.

The matrix consists of pale green cryptocrystalline unrecognisable minerals with scattered phengite and muscovite.

Sample 64581464B - QUARTZOSE SANDSTONE - medium grained poorly sorted, Map reference 45800570 Jericho.

Hand Specimen

Pale pink-white, medium grained, no bedding recognisable, uneven fracture, friable, porous. Composed of quartz in a fine white silty groundmass.

Thin Section

Consists of sand grains commonly 0.3 - 0.4 mm. but range from 0.1 - 0.6 mm.

Quartz (80%) is commonly subangular or angular, some less common subrounded grains also occur. Dustings and trails of inclusions also occur. Some grains have secondary overgrowths. Quartz types: non undulose 11%, undulose 67% and polycrystalline 22%.

Rock fragments (5%) consist of devitrified glass and quartz-mica schist.

Accessory minerals consist of "books" of illite and traces of zircon.

The matrix (15%) consists of fine silt size quartz with some illite and some greenish yellow chloritic patches.

Sample 64581461 - LITHIC SUBLABILE SANDSTONE - medium grained poorly sorted, Map reference 45731185 Jericho.

Hand Specimen

Orange-white medium-grained, with scattered coarse grains; no bedding evident, uneven fracture, friable and porous. Composed of quartz and rare scattered white and pink grains, in a white silty groundmass.

Thin Section

Consists of sand grains commonly 0.4 - 0.5 mm. diameter and rarely as much as 0.6 mm.

Quartz (56%) grains are commonly simple with rare overgrowths. Dustings and trails of inclusions, and corrosion embayments are common. Quartz types: non undulose 63%, undulose 2% and polycrystalline 35%.

Rock fragments (18%) consists mainly of devitrified glass, schistose quartzite and quartz-mica schist.

Illite (1%) occurs in small sheafs.

The matrix (25%) consists of very fine grained quartz and pale brown chlorite.

Sample 64581751 - QUARTZOSE SILTSTONE - coarse grained, well sorted, Map reference 47050144 Jericho.

Hand Specimen

Pale pinkish white, coarse silt size, no apparent bedding, uneven fracture, even texture, friable porous, composed of quartz and some white fine silty minerals. The groundmass consists of fine purple and cream silt.

Thin Section

Consists of silt grains of average size 0.05 mm.

Quartz (69%) is angular and subangular with common bubble trails and rare dustings of inclusions; grain boundaries are commonly very irregular; secondary overgrowths are rare. Quartz types: non undulatory 63%, undulatory 2% and polycrystalline 35%. Chalcedony occurs in sheafs up to 0.5 mm. long and are the largest grains in the rock.

Feldspar (1%) consists of extensively altered plagioclase possibly albite; extinction is hazy and indistinct.

Rock fragments (tr) consists of fine siltstone with scattered randomly oriented quartz; this may be devitrified glass.

Accessory minerals consist of muscovite and phengite (1%). Tourmaline is pleochroic from olive-green to colourless.

The matrix (29.0%) consists of very fine silt size laths and irregular quartz grains with a low sphericity.

Sample 64581754 - LITHIC SANDSTONE - fine to medium grained, poorly sorted, Map reference 47320199 Jericho.

Hand Specimen

Purplish-grey, fine to medium grained. Bedding is poorly defined and the rock is poorly friable and slightly porous; the fracture is uneven and the texture even. It is composed of quartz and dark purple and grey grains.

Thin Section

Grains vary in size from 0.5 to 0.1 mm. but are commonly from 0.2 to 0.3 mm. in size.

Quartz (55%) is commonly subangular or subrounded. Secondary overgrowths are common and cause grains to have an angular outline surrounding a subrounded core. Polycrystalline grains with crenulated intergrain boundaries and "alternate" extinction also occur. Quartz types: non undulose 65%, undulose 9%, and polycrystalline 26%. Radiating sheafs of chalcedony about 0.1 mm. in diameter occur. The individual crystals are about 0.05 mm. by 0.005 mm.

Feldspar (tr) consists mainly of microcline with prominent cross-hatched twinning.

Rock fragments (23%) consist of devitrified acid glass with textural basalt and less common quartz-mica schist and schistose quartzite grains.

Illite (tr) occurs in sheafs.

The matrix (22%) consists of abundant haematite which appears to be forming by alteration of groundmass minerals; fine silt size quartz also occurs.

DUNDA SANDSTONE

Sample 64581452A - LITHIC SANDSTONE - fine and medium grained poorly sorted, Map reference 42392656 Buchanan.

Hand Specimen

Creamy orange, fine grained with scattered medium grains, no apparent bedding, very friable, even texture slightly porous. Composed of white cream and pink grains with scattered quartz grains.

Thin Section

Consists of sand size grains of average size 0.2 mm. but ranging up to 0.4 mm.

Quartz (43%) is angular with a moderate sphericity. Dustings of inclusions in some grains give an apparent high relief. Quartz types: non undulose 56%, undulose 5% and polycrystalline 39%.

Feldspar (2%) consists of untwinned very hazy extensively altered grains with refractive index greater than balsam.

Rock fragments (47%) consist dominantly of schistose quartzite grains commonly with dustings of mica; devitrified glass and chert also occur. Tourmaline (tr) is pleochroic from olive-green to colourless.

The matrix (8%) consists of yellow brown to colourless material with very fine quartz.

Sample 64581452B - SILTSTONE - fine grained, well sorted, Map reference 42412657 Buchanan.

Hand Specimen

Deep brick red, fine silt size grains without apparent bedding; even texture, friable non porous. Extensively ferruginized.

Thin Section

Consists of silt grains of maximum grain size 0.015 mm.

Quartz is angular with a very low sphericity. Dustings of inclusions and corrosion embayments are common. Chalcedony occurs in radiating bundles.

Some grains of feldspar appear to be present but they are very weathered.

The matrix consists of very fine mica, red brown microcrystalline material and some very fine isotropic crystallites.

Sample 64581452C - LITHIC SUBLABILE SANDSTONE - medium grained, moderately sorted, Map reference 42432658 Buchanan.

Hand Specimen

Pale cream, medium grained with some coarse grains, friable, no

apparent bedding, even texture and poorly porous, composed of colourless and pale coloured quartz in a pale cream, fine silt groundmass.

Thin Section

Consists of sand grains of average size 0.25 mm. but ranging up to 0.5 mm.

Quartz (70%) occurs in subangular grains with moderate and high sphericity rare euhedral grains occur. Some polycrystalline grains have sutured intercrystalline boundaries. Quartz types: non undulose 61%, undulose 6% and polycrystalline 33%.

Rock fragments (13%) consist of schistose quartzite and quartz-mica schist grains.

Mica (tr) occurs and includes phengite and muscovite.

The matrix (17%) consists of fine lath-like grains of ?feldspar and angular irregular grains of quartz.

Sample 64581460A - LITHIC SANDSTONE - fine grained, well sorted, Map reference 43551315 Jericho.

Hand specimen

Brown, fine grained, with no apparent bedding, friable, porous, even grained. Composed of brown and grey grains with common scattered quartz.

Thin Section

Consists of sand grains 0.2 mm. in size.

Quartz (32%) is angular with a moderate degree of sphericity. Grains commonly show non undulose extinction, have irregular cracks and the uncommon euhedral grains have large corrosion embayments. These features suggest a volcanic origin. Chalcedony (tr) occurs as irregular radiating sheafs and bundles. Quartz types: non undulose 65%, undulose 3% and polycrystalline 32%.

Feldspar (3%) is commonly strongly weathered and shows very poor twinning and thick dustings of alteration products. Most common are andesine and some fresher albite.

Rock fragments (57%) most commonly include grains of metaquartzite consisting of interlocking grains commonly with abundant scattered mica grains. Devitrified acid glass and chert grains are also common. Minor amounts of quartz-mica schist and schistose quartzite also occur. Rare grains of textural basalt were also recognised.

The matrix (8%) consists of pale to mid brown chloritic material and some very fine quartz and mica. The matrix is difficult to distinguish from some of the rock fragments.

Sample 64581460B - LITHIC SANDSTONE - medium grained, moderately sorted, Map reference 43551315 Jericho.

Hand Specimen

Pale orange, medium grained, bedding marked by horizontal clay bands, very friable, and poorly porous. Composed of quartz and abundant scattered pale brown grains in a pale creamy-orange matrix.

Thin Section

Consists of sand size grains generally 0.3 mm. in diameter but ranging up to 0.5 mm.

Quartz (61%) is generally angular with a moderate degree of sphericity, uniform non undulose extinction with common bubble trails. Dustings of inclusions are uncommon and the polycrystalline grains rarely show dustings of inclusions. Some grains have scattered tourmaline laths, they predominantly occur parallel to the C axis of the quartz grain. Percentages of the total quartz for each quartz type are: non undulose 48%, undulose 9% and polycrystalline 43%.

Feldspar (1%) consists of altered albite.

Rock fragments (23%) are predominantly schistose quartzite and some ?devitrified glass or chert.

Sub-equant grains of Zircon (tr) occur.

Mica including muscovite, phengite and biotite occur. These are commonly hydrated and swollen where not confined by adjacent grains.

The matrix (15%) consists of very fine quartz and very pale brown to green chloritic minerals.

Sample 64581731 - LITHIC SANDSTONE - very fine grained moderately sorted, Map reference 44960224 Jericho.

Hand Specimen

Pale purple-brown, fine-grained, somewhat friable, poorly porous, no bedding apparent, uneven fracture, even texture, composed of white and purple grains with rare scattered mica and quartz.

Thin Section

Grains are generally 0.1 mm. in size but range to 0.2 mm.

Quartz (43%) consists of angular grains with common irregular cracks and rare dustings of inclusions. Quartz types: non undulose 45%, undulose 4%, and polycrystalline 51%. Rare bundles of radiating chalcedony occur.

Feldspar (tr) occurs in extensively altered untwinned grains.

Rock fragments (38%) include schistose quartzite, quartz-mica schist, cherty fragments with hazy dark intergranular material. The latter is possibly devitrified glass.

Accessory minerals (1%) include scattered zircon, and tourmaline, with poorly developed olive green - to colourless pleochroism. Muscovite, phengite and biotite also occur.

The matrix (18%) consists of red-brown ferruginous mica, crystalline material and very fine quartz with a mineral that resembles a soil type recognised by geographers and called brown "cutin".

Sample 64581733 - FELDSPATHOLITHIC SANDSTONE - fine grained, moderately sorted, Map reference 45160200. Jericho.

Hand Specimen

Brown fine grained, very thinly bedded and laminated, uneven fractures, fairly even texture, friable, poorly porous. Composed of white brown and grey grains, most of these brown grains appear to be coated quartz grains.

Thin Section

Grains are generally about 0.15 mm. in diameter.

Quartz (54%) is angular. Quartz types: non undulose 46%, undulose 18%, and polycrystalline 36%.

Feldspar (7%)includes untwinned ?K feldspar grains with dusty inclusions and fresh green biotite inclusions, andesine with very hazy poorly defined twin lamellae; fresh microcline with sharp distinct lamellae and less common fresh albite with fresh sharp twin lamellae.

Rock fragments (17%) are commonly schistose quartzite and some quartz-mica schist.

Accessory (6%) minerals include bent sheafs of biotite showing yellow green pleochroism and phengite.

The matrix (16%) includes pale red brown and black angular aggregates and less common platy minerals which show a preferred orientation parallel to the bedding planes.

CLEMATIS SANDSTONE

Sample 64581457 - QUARTZOSE SANDSTONE - medium grained, very poorly sorted, Map reference 42101178 Jericho.

Hand Specimen

Pale brown-grey, medium grained with scattered coarse and granule grains. Uneven fracture, friable, porous, bedding evident from orientation of pebbles and granules. Composed of quartz with rare white and orange

angular grains and rare mica in a fine white silty groundmass.

Thin Section

Consists of sand grains generally 0.3 mm. but with scattered granules 1.5 to 3.0 mm. in diameter.

Quartz (89%) is angular with moderate sphericity, medium grains are commonly simple grains with non undulose extinction, abundant dustings of inclusions and bubble trails; rare grains contain needles of rutile. The coarse and granule size grains are commonly polycrystalline. Quartz types: non undulose 55%, undulose 17% and polycrystalline 28%. Chalcedony occurs in "clusters" of laths between the medium size quartz grains.

Rock fragments (5%) consist of contemporaneous siltstone and claystone fragments; they are very micaceous. Rare schistose quartzite fragments also occur.

Accessory minerals (1%) consist mainly of mica as muscovite and rare phengite.

Matrix (6%) consists of very fine quartz, illite and "cutin" lined voids.

Sample 64581732B - QUARTZOSE SANDSTONE - medium grained, very poorly sorted, Map reference 4497019 6 Jericho.

Hand Specimen

Pale orange, medium grained with scattered granules. No apparent bedding, very friable, porous. Composed of quartz in a pale orange fine silt groundmass.

Thin Section

Consists of sand size grains commonly 0.3 mm. but ranging up to 2.5 mm. in diameter.

Quartz (96%) is angular and sub-angular or sub-rounded; rarely is it corroded. Extremely fine dustings of inclusions and bubble trails occur and rare scattered grains have fine acicular trails of tourmaline. There is no apparent relation between grain size and quartz types. Quartz type: non undulose 72%, undulose 3%, and polycrystalline 25%.

One grain of zircon was recognised.

The matrix (4%) consists mainly of very fine quartz of 0.02 mm. diameter.

MOOLAYEMBER FORMATION

Systematic grain counts were not carried out on the thin sections from samples of this formation because of the fineness of the grain size.

Sample 64581449 - LITHIC SUBLABILE SANDSTONE - very fine grained, poorly sorted, Map reference 38873122 Buchanan.

Hand Specimen

White very fine sand grains, no apparent bedding, friable, poorly porous, even texture. Composed of quartz with rare scattered black grains.

Thin Section

Consists of very fine sand grains generally 0.1 mm. diameter but ranging to 0.5 mm (rarely) and 0.05 mm. (groundmass).

Quartz (50%) is angular, showing uniform extinction with common dustings of inclusions. The grains are angular and elongate.

Rock fragments (10%) consist mainly of mudstone.

Mica (5%) consists of fine silt size phengite and biotite.

The matrix (35%) consists of chalcedony in extremely fine radiating sheafs and very fine silt grains.

Sample 64581450 - LITHIC SANDSTONE - fine grained, poorly sorted, Map reference 39632522 Galilee.

Hand Specimen

Mid grey, fine grained with scattered medium grains, non friable, non porous tough, calcareous, rough uneven fracture, with no apparent bedding. Composed of pale brown and grey grains and rare colourless quartz grains.

Thin Section

Consists of very fine sand grains generally 0.1 mm. diameter but ranging up to 0.5 mm.

Quartz (10%) consists commonly of grains 0.1 mm. in diameter with rare scattered grains up to 0.5 mm. The angular grains commonly show undulose extinction but some scattered polycrystalline grains also occur.

Feldspar (3%) occurs as angular fresh albite and deeply weathered and altered ?andesine.

Rock fragments (47%) are generally rounded and consist of schistose quartzite grains with interlocking hazy crystal boundaries (20% of total rock), textural basalt (7%) and metasediments with scattered feldspar laths, rarely schistose (20%).

Mica (5%) occurs as muscovite.

The cement (35%) consists mainly of microcrystalline calcite which ranges in size up to 0.15 mm.

HUTTON SANDSTONE

Mineral percentages quoted are estimates only.

Sample 64581558A - LITHIC SUBLABILE SANDSTONE - fine grained, moderate sorting, Map reference 40930118 Tambo.

Hand Specimen

Greyish-white, medium grained, friable, porous with no bedding visible. Composed of quartz with scattered white and pale grey grains.

Thin Section

Consists of sand grains generally 0.2 mm. in diameter but ranging up to 0.5 mm.

Quartz (65%) is commonly angular with rare subrounded grains. Polycrystalline grains with sutured crystal boundaries are common. Simple grains with dustings of inclusions are also common, some with irregular cracks.

Feldspar (2%) includes albite which is very weathered and shows hazy cloudy twin lamellae and probable K feldspar that occurs as untwinned very hazy grains.

Rock fragments (15%) include very fine grained siltstone and carbonaceous siltstone, each containing scattered microcrystalline quartz and mica flakes.

Accessory minerals (3%) include muscovite, phengite and rare equant grains of rutile.

The matrix (15%) consists of very fine, pale green chloritic minerals.

Sample 64581561 - LITHIC SUBLABILE SANDSTONE - medium grained, poorly sorted, Map reference 40910160 Jericho.

Hand Specimen

White, fine and medium grained, with scattered coarse grains, no bedding visible, friable, porous, composed of quartz and scattered white grains.

Thin Section

Consists of sand grains commonly from 0.4 to 0.05 mm. in a diameter, but ranging up to 1 mm, poorly sorted.

Quartz (75%) is subangular and subrounded with less common scattered angular grains. Simple grains with uniform extinction are most common, grains showing undulose extinction are rare, some polycrystalline grains and grains with dustings of inclusions, bubble trails and trails of inclusions also occur.

Rock fragments (13%) include quartzose siltstone, and mudstone, and metamorphic and schistose quartzite.

Mica occurs as phengite (2%).

The matrix (10%) is made up mainly of very fine quartz, muscovite and phengite and microcrystalline pale orange-yellow grains.

Sample 64581566 - QUARTZOSE SANDSTONE - coarse grained, very poorly sorted, Map reference 40890254 Jericho.

Hand Specimen

Pale brown, medium to very coarse grains, very poorly sorted, porous, no bedding visible composed of quartz in a red-brown matrix.

Thin Section

Consists of sand grains, generally 0.5 mm. in diameter but ranging up to 3 mm.

Quartz (83%) is subangular and less commonly subrounded; simple grains with uniform extinction predominant. Some polycrystalline grains occur. Dustings and trails of bubbles and inclusions occur but are not common.

Rock fragments (5%) include schistose quartzite grains with sutured interlocking boundaries.

The matrix consists of "Cutin" (2%) while voids account for the remaining 10%. The lack of groundmass is possibly due either to a high primary porosity or to surface leaching. The presence of "Cutin" in the groundmass indicates that the rock was well weathered.

RONLO BEDS

With the exception of section 64581528, percentages of minerals present are estimates only.

Sample 64581528 - QUARTZOSE SANDSTONE - medium grained poorly sorted. Map reference 35831330 Jericho.

Hand Specimen

Pale creamy white, medium grained with common scattered coarse grains, no bedding is visible, friable and porous. Composed of quartz with rare pale cream grains.

Thin Section

Consists of sand grains generally 0.25 mm. but ranging up to 0.8 mm.

Quartz (76%) is angular to subangular. Some grains have dustings of inclusions. Quartz types: non undulose 84%, undulose 3% and polycrystalline 13%.

Accessory minerals are limited to angular, black ?iron-oxide grains.

The matrix (24%) consists of pale green grey and grey? chloritic material.

Sample 64581522 - LITHIC SANDSTONE - medium grained, very poorly sorted, Map reference 35871763. Galilee.

Hand Specimen

Pale purple medium grained, somewhat friable and porous. Composed of quartz with angular white, cream and purple grains.

Thin Section

Grainsize of rock fragments ranges from 0.1 to 3 mm., but is commonly about 1 mm., quartz averages 0.3 mm. but ranges up to 0.8 mm.

Quartz (10%) is angular with low to moderate sphericity; small corrosion embayments occur, grains are commonly simple with non undulose extinction, polycrystalline grains are uncommon; they have interlocking sutured crystal boundaries and are dusty with inclusions.

Rock fragments (75%) consist dominantly of dark brown siltstone and mudstone (45% of total rock) in addition devitrified glass with abundant scattered micro laths (10%); devitrified glass consisting of very fine interlocking quartz with intersecting quartz veinlets (10%); metaquartzite consisting of interlocking quartz grains with sutured intergrain boundaries (5%) and shard fragments (5%).

Matrix (15%) consists of yellow-green chloritic material and pale grey brown unidentified matter.

Sample 64581445A - QUARTZOSE SILTSTONE - coarse silt moderately sorted. Map reference 36303196 Buchanan.

Hand Specimen

Pale purple siltstone, finely laminated, soft, friable and poorly porous.

Thin Section

The average grain size is 0.05 mm.

Quartz (50%) occurs as angular simple colourless grains with uniform extinction. In addition phengite (10%), chalcedony (3%), some very fine laths of feldspar (2%), and tourmaline (trace) occur.

The matrix (35%) consists of microcrystalline grains of quartz, indeterminate material and ?limonite.

Sample 64581445B - LITHIC SUBLABILE SANDSTONE - medium grains poorly sorted, Map reference 36303196 Buchanan.

Hand Specimen

Pale brown, coarse grained with scattered granules and rare pebbles. Very thinly bedded, friable, very porous, composed of quartz with scattered cream grains and a pale brown groundmass.

Thin Section

Average grainsize is 0.25 mm. but scattered grains up to 1.5 mm. occur.

Quartz (65%) consists of angular grains with non undulose extinction and angular and subrounded polycrystalline grains; intercrystalline boundaries of polycrystalline grains are commonly sutured. Bubble trails are also common. Interstitial chalcedony occurs in fine radiating bundles.

Rock fragments (20%) include metaquartzite grains (4%), quartz-mica schist (8%) and green chloritic rock fragments (3%).

Accessory (5%) minerals include sheafs of muscovite and phengite, and very fine euhedral zircon.

The matrix (10%) consists of fine quartz, chalcedony and pale orange-green lenticular and lath-shaped grains.

Sample 64581511 - LITHIC SUBLABILE SANDSTONE - medium grained poorly sorted, Map reference 37472382 Galilee.

Hand Specimen

Banded white, cream, orange and purple; medium grained with scattered coarse grains; very thinly and poorly bedded, friable, porous. Composed of quartz with a variably coloured groundmass.

Thin Section

Generally 0.3 - 0.4 mm. but ranging up to 0.8 mm.; poorly sorted.

Quartz (75%) is angular with rare hazy secondary overgrowths. Uniform extinction is common but scattered grains show undulose extinction. Some polycrystalline grains occur with sutured crystal boundaries. Some grains have dustings and trains of inclusions, some forming crossing sets.

Rock fragments are limited to devitrified glass (6%) and metaquartzite grains (4%).

The matrix (15%) consists of pale yellow-green ?chloritic minerals and scattered clusters of muscovite.

Sample 64581520 - LITHIC SANDSTONE - medium grained poorly sorted, Map reference 36231749 Galilee.

Hand Specimen

Purple-brown, medium grained with scattered coarse grains and scattered pebbles of siltstone, poorly friable, porous, composed of quartz with white and purple grains. Bedding indicated by orientation of pebbles.

Thin Section

Grainsize generally 0.25 to 0.5 mm. but ranging up to 1.25 mm. sorting poor.

Quartz (30%) occurs as angular simple grains with irregular cracks; bubble trails, as well as inclusion trails and dustings occur. Corrosion embayments are moderately common. Rare polycrystalline grains with sutured crystal boundaries occur; also chalcedony.

Rock fragments (55%) include quartzose siltstone and mudstone and some devitrified glass (30% of total rock); fragments contain dark, weathered ferromagnesian grains, and appear to be metasediments (20%) and metaquartzite with dustings and transverse quartz veinlets (5%).

The matrix (15%) consists of green-yellow pale ?chloritic material and some phengite and muscovite.

Sample 64581527 - QUARTZOSE SANDSTONE - medium grained poorly sorted, Map reference 35201448 Galilee.

Hand Specimen

Yellow-ochre, medium grained, poorly friable, slightly porous, no bedding visible. Composed of quartz with an ochre groundmass.

Thin Section

Grainsize is generally 0.25 mm. but ranges up to 1.25 mm.; sorting is moderate.

Quartz (80%) is subrounded and subangular. Simple grains with non-undulose extinction predominate; some grains show undulose extinction. Scattered polycrystalline grains with sutured crystal boundaries and undulose extinction also occur.

Rock fragments (2%) are restricted to schistose metasediments.

A trace of rutile is also present.

The matrix (18%) consists of pale yellow-green ?chloritic minerals with some scattered illite flakes: the majority of groundmass is isotropic.

64581551 - LITHIC SUBLABILE SANDSTONE - very fine grained, poorly sorted, Map reference 35371298 Jericho.

Hand Specimen

White, very fine grained with scattered grains ranging up to very coarse, poorly developed bedding, friable and porous. Composed of quartz and scattered intergranular white material.

Thin Section

Grains are generally 0.1 mm. but range up to 0.3 mm.

Quartz (70%) consists of subangular grains with non undulose extinction polycrystalline grains are rare. Rare grains have dustings of rutile needles.

Rock fragments (15%) consist of devitrified glass (10% of total rock) and subrounded grains of metaquartzite; mudstone and siltstone (5%) also occur.

Mica (tr) occurs in bent sheafs between quartz grains.

The matrix (15%) consists of first order grey and white and very pale green grains.

Sample 64581552 - LITHIC SANDSTONE - medium grained poorly sorted, Map reference 35381267 Jericho.

Hand Specimen

Red-brown, medium grained with scattered very coarse grains, friable porous, with no bedding visible. Composed of quartz, mainly colourless with common scattered white, pink and deep brick red grains.

Thin Section

Grains are generally 0.4 mm. and ranging up to 1.25 mm.

Quartz (40%) occurs as subangular and less common subrounded and angular grains. Simple extinction is common, some polycrystalline grains also occur. Dustings of inclusions and bubble trails occur but are not common.

Feldspar (5%) occurs as very hazy, extensively altered blue-grey grains.

Rock fragments (30%) include mainly green chloritic, clayey siltstone and mudstone (23% of total rock) some devitrified glass (5%), and rare textural basalt (2%).

One grain of zircon was recognized.

The matrix (25%) consists of very fine illite flakes, green chloritic material, kaolin and red brown limonite.

ROLLING DOWNS GROUP

Percentages of minerals observed in thin sections from the Rolling Downs Group are estimates only and were not determined by systematic point counts.

WALLUMBILLA ~~WILGUNYA~~ FORMATION

DONCASTER MEMBER

Sample 64581647 - CALCAREOUS - coarse and fine SILTSTONE interlaminated well sorted, Map reference 35930379 Jericho.

Hand Specimen

Pale grey, very soft, non porous, friable, interlaminated mudstone and siltstone; mudstone pale grey and orange, siltstone pale grey with scattered rich green glauconite grains.

Thin Section

Section consists of interlaminated fine and coarse siltstone. The coarse siltstone grains are generally 0.05 mm. but range up to 0.08 mm.; the fine siltstone grainsize is generally 0.02 mm.

Coarse siltstone

Quartz (10%) is angular and consists of simple grains with non undulose extinction.

Glauconite (15%) is olive green, pleochroic from yellow green to dark olive green. Occurs in pellets of 0.1 mm. diameter.

The matrix (75%) is mainly mica (30%) in flakes approximately 0.05 x 0.005 mm.; the remainder consists of microcrystalline quartz and cryptocrystalline calcite.

Fine siltstone

Quartz (5%) occurs as simple grains with uniform extinction and fine radiating sheafs of chalcedony (15%).

Glauconite (10%) was olive green, pleochroic from yellow to green to dark olive green and occurs in pellets 0.1 mm. in diameter.

Mica (30%) is similar to that in the coarse siltstone laminae.

The matrix (40%) is too fine-grained to recognize constituent minerals.

COREENA MEMBER

Sample 64581406 - PALE GREY-BROWN HARD, POORLY BEDDED SILTY SPARSE BIOMICRITE, Map reference 32581135 Longreach.

Hand Specimen

Pale grey brown calcareous, tough, irregular fracture, poor bedding traces, non friable, non porous.

Thin Section

Average grain size is 0.025 mm. with a maximum of 0.05 mm.

Calcite (80%) occurs as prisms, probably derived by mechanical breaking up of pelecypod shells, in particular "Inoceramus".

Quartz (8%) occurs in angular simple grains with non undulose extinction. Rare grains have abundant dustings of inclusions. A trace of chalcedony is present.

Feldspar (2%) occurs in laths 0.05 x 0.01 mm.; multiple twins and rare simple twins occur; grains are clear and fresh.

Rock fragments (5%)consist of devitrified glass and quartzose metasediments.

Glauconite (2%) occurs in irregular pellets about 0.05 mm. diameter.

Mica (3%) consists of very small sheafs of muscovite.

Sample 64581436 - BLUE GREY HARD SILTY SPARSE BIOMICRITE - Map reference 32381087 Longreach.

Hand Specimen

Blue-grey silty limestone, tough calcareous, non porous with an irregular fracture, even texture and no bedding recognizable.

Thin Section

Calcite (75%) consists of microcrystalline and cryptocrystalline calcite and scattered calcite prisms; the former appears to be either primary calcite ooze or secondary microcrystalline calcite that has formed within the grain framework of the original detrital matrix. The calcite prisms were probably derived by breakdown of pelecypod shells.

Size of detrital grains ranges from 0.07 to 0.1 mm.

Quartz (8%) consists of highly angular grains without inclusions or embayments; some needle shaped grains occur.

Feldspar (1%) consists of andesine and labradorite.

Rock fragments? (3%) consist of very altered dark limonitic material.

Glauconite (3%) is partly green and partly brown; most appears to be at least partially chloritized.

Accessory minerals (10%) occur mainly as illite with isotropic black minerals probably iron oxides, and zircon occurring as medium silt size grains.

Sample 64581438 - PALE BROWN HARD, SILTY, SPARSE PELECYPOD BIOMICRITE, Map reference 32440829 Longreach.

Hand Specimen

Pale brown limestone, blue grey, no bedding recognizable but abundant shell fragments occur near parallel to each other.

Thin Section

Calcite (55%) is microcrystalline and cryptocrystalline.

Detrital sand grains are generally 0.025 mm. but range up to 0.1 mm.

Quartz (22%) is very angular and consists of simple grains with uniform extinction (20%) and polycrystalline grains (2%).

Feldspar (2%) consists of irregular angular grains of fresh andesine.

Glauconite (1%) occurs as pellets; they are pleochroic, pale green to yellow green and appear to be partly chloritic.

Accessory minerals include traces of brown limonite, biotite and zircon.

Calcite prisms (5%) were probably derived by breakdown in situ of pelecypod shells.

Pelecypod valves (15%) are very common and invariably occur as disarticulated single valves.

TOOLEBUC LIMESTONE

Sample 64581771 - PALE GREY HARD SPARSE PELECYPOD BIOMICRITE, Map reference 38349485 Tambo.

Hand Specimen

Pale grey silt size crystalline limestone.

Thin Section

Consists of calcareous mud pellets (20%), mid grey and globular or elongate in shape, pelecypod shell prisms (7%), other shell fragments (5%) and haematite cubes and irregular grains (2%). Globigerina tests occur (1%) but are commonly recrystallized.

Calcite (65%) is made up of brown-grey microcrystalline carbonate mud.

Sample 64581401 - PALE GREY HARD PELECYPOD BIOMICRITE - Map reference 31551189, Longreach.

Hand Specimen

Pale grey, finely crystalline limestone.

Thin Section

Consists mainly of calcite prisms (40%) probably derived from breakdown of pelecypod shells, mid grey calcareous mud pellets (10%), black angular grains of haematite (3%) and polycrystalline quartz (1%).

Globigerina tests (6%) are commonly partially recrystallized.

The matrix (40%) consists of mid grey calcareous mud.

ALLARU MUDSTONE ~~MEMBER~~

Sample 64581413 - GREYISH WHITE HARD SPARSE BIOMICRITE - Map reference 27340877 Longreach.

Hand Specimen

Grey-white fine silty limestone, irregular fracture, non friable, non porous and with irregular molluscan shell fragments.

Thin Section

Calcite (85%) constitutes the majority of the section. It is microcrystalline and cryptocrystalline with scattered rare molluscan prisms.

Grainsize of clastic grains varies from 0.025 to 0.1 mm.

Quartz (9%) is highly angular or irregular. It occurs as simple non undulose grains lacking inclusions or bubble trails. Rare equant grains occur; they consist of secondary overgrowths and primary detrital quartz grains. Rare subrounded polycrystalline grains also occur.

Feldspar (tr) occurs as angular irregular grains with hazy outlines. It is fresh and unaltered and consists mainly of labradorite.

Glauconite (3%) is olive green and pale brown and party chloritic. It is generally pelletal in shape and constitutes the largest grains in the rock, being 0.15 mm. in diameter.

Accessory minerals (2%) include biotite (1%) and limonite (2%); the limonite appears to be a secondary mineral formed by weathering of the labile grains.

MACKUNDA FORMATION

Sample 64581403 - GLAUCONITIC CALCAREOUS LITHIC SANDSTONE - very fine grained, calcareous, Map reference 28921148 Longreach.

Hand Specimen

Pale brown, very fine grained, non friable, non porous, tough, irregular fracture, pale yellow and brown grains, scattered black ores; trace quartz, no bedding recognizable.

Thin Section

Grain size generally 0.1 mm. ranging to 0.05 and 0.2 mm.

Quartz (15%) is angular composed of simple grains with non undulose extinction. Highly angular grains are elongate and needle-like. Larger grains show corrosion embayments and rarely have parallel bubble trails while others have dustings of inclusions.

Feldspar (7%) consists of fresh labradorite and andesine; it occurs as elongate laths with irregular fractured terminations.

Rock fragments (22%) consists of dark brown indeterminate material, devitrified glass, and textural basalt; a trace of metaquartzite also occurs.

Glauconite (5%) is yellow to olive green and occurs in pellets.

Accessory minerals (3%) include biotite in bundles of bent fibres, zircon in elongate, commonly subhedral grains and opaque black minerals, probably iron oxide.

The cement (48%) consists of cryptocrystalline calcite and colourless very fine quartz.

Sample 64581618 - DARK BLUE GREY, TOUGH, SILTY FELDSPATHIC LITHIC MICRITE, Map reference 28620931 Longreach.

Hand Specimen

Dark blue grey, silt size grains, no bedding recognizable irregular fractures, even texture, non porous and non friable. Composed of dark brown-grey grains with a trace of quartz.

Thin Section

The calcite (58%) is brown and microcrystalline.

Grainsize ranges from 0.1 to 0.005 mm.

Quartz (15%) occurs commonly as simple grains; they are angular and highly angular with scattered slender needle-like grains.

Feldspar (7%) occurs as andesine with some labradorite; it is commonly fresh but rare strongly altered grains occur. Grains are commonly elongate laths with irregular terminations.

Rock fragments (10%) occur as very fine grained dark coloured and extensively altered grains, as metaquartzite grains, and as devitrified glass.

Glauconite (7%) occurs as rich olive green pellets.

Accessory minerals (3%) include muscovite mica in bent short sheafs; zircon; tourmaline, olive green to yellow green; and opaque minerals (1%), probably magnetite or ilmenite that is slightly leucoxinised.

Sample 64581648 - GLAUCONITIC CALCAREOUS LITHIC SILTSTONE - composed of coarse silt grains moderately sorted. Map reference 33980147 Longreach.

Hand Specimen

Pale creamy grey, hard, tough, non friable, non porous, irregular fracture, silt size grains, thinly laminated, calcareous.

Thin Section

The maximum grain size is 0.05 mm. with finer material predominating.

Quartz (10%) is angular and subangular occurring as simple grains with uniform extinction. Some chalcedony also occurs as rounded and sub-rounded radiating sheafs.

Feldspar (2%) is angular and fresh, forming simple twins (probably K feldspar) and rare multiple twins (probably albite) some of which are extensively altered.

Rock fragments (15%) are very fine grained, extensively altered, and very dark in colour.

Glauconite (23%) occurs as scattered olive green and pale green pellets with some (?chloritised) pale brown grains; some grains appear to be replacing rock fragments, others appear to be raplacing micas.

Mica (Tr) occurs as muscovite, phengite and biotite; it forms laths, some being very swollen and apparently altering to glauconite.

The calcite (50%) is cryptocrystalline, some is replacing and pseudomorphing rock fragments.

WINTON FORMATION

Sample 64581425 - CALCAREOUS LITHIC SANDSTONE - fine grained, moderately sorted, Map reference 25680255 Longreach.

Hand Specimen

Brown and ochre, indistinctly banded, non porous fine grained with medium grained interlaminae, firm calcareous; minor amounts of quartz recognizable.

Thin Section

Grains are generally 0.1 mm. in size but range to 0.2 mm.

Quartz (5%) is angular and occurs as clear simple grains with non undulose extinction; sphericity is very low. Grains are commonly needle-like, suggestive of shards. Rare grains are equant with abundant dustings of inclusions.

Feldspar (14%) occurs as elongate laths with irregular terminations; grains are unweathered and commonly clear, generally without inclusions but rarely with scattered black (?ferruginous) inclusions; some grains are strongly zoned; rare grains show alteration to mica. Most common form is andesine but labradorite and oligoclase also occur.

Rock fragments (43%) consist dominantly of devitrified glass (25% of total rock) sometimes with deep red and green chloritic material between the grains; textural basalt (3%) quartz mica schist (2%) and ?contemporaneous subrounded grains of siltstone (8%) composed of dark green, very fine grains. Voids (5%) appear to be formed by plucking out of rock fragments during slide preparation.

Accessory minerals (3%) include, hornblende (2%) occurring as rounded elongate deep green and rarely brown grains; mica (muscovite and phengite), form bent sheafs.

The cement (35%) consists of cryptocrystalline calcite (25% of total rock) and dark brown limonitic material (10%).

Sample 64581432 - LIGHT GREY, TOUGH LITHIC MICRITE - Map reference 26030490 Longreach.

Hand Specimen

Light grey, even textured, very fine grained, non fissile, no bedding apparent, non porous, firm with an irregular fracture; composed of dark grey and white grains, some pale orange grains and a trace of quartz.

Thin Section

Calcite (60%) is cryptocrystalline.

Size of detrital grains is generally 0.05 - 0.1 mm. but ranges up to 0.2 mm.

Quartz (15%) occurs as angular simple grains with non undulose extinction and rare bubble trails; undulose extinction and corrosion embayments are rare.

Feldspar (5%) consists mainly of andesine, commonly as multiple grains, some showing well developed zonation; simple twins are very rare.

Rock fragments (19%) are commonly quartzose (13% of total rock) and include siltstone and fine sandstone fragments, devitrified glass and metaquartzite. Textural basalt (3%), quartz mica schist (2%) and green chloritized rock fragments (1%) also occur.

Accessory minerals include zircon and hornblende as deep olive green, moderately fresh grains. Epidote occurs associated with the metaquartzite and volcanic rock fragments.

Sample 64581501 - CALCAREOUS FELDSPATHOLITHIC SANDSTONE - fine to very fine grained, moderately sorted, Map reference 16040163 Maneroo.

Hand Specimen

Pale grey, fine to very fine grained, non friable, non porous apparently unbedded, irregular fracture. Composed of pale grey, yellow and black grains with a trace of quartz.

Thin Section

Grainsize varies from 0.2 to 0.05 mm.

Quartz (15%) consists of angular, commonly irregular, elongate, simple, non undulose grains, with rare inclusions and bubble trails ; rare grains are subrounded; other rare grains are strongly corroded by calcite; the replacement being irregular.

Feldspar (8%) consists of andesine and labradorite as stubby laths, rare grains are markedly zoned, some grains show partial replacement by calcite.

Rock fragments (25%) consist of devitrified glass (10% of total rock) metaquartzite (10%) textural basalt (3%) and textural andesite (2%).

Accessory minerals (2%) include biotite, deep olive green to colourless and occurring in bent sheafs, and epidote occurs as rare very small grains.

The cement (50%) is cryptocrystalline calcite.

Sample 64581424 - OCHRE BROWN, TOUGH, FELDSPATHIC SANDY MICRITE, Map reference 25670456 Longreach.

Hand Specimen

Ochre brown, tough probably calcareous, medium grained, non fissile, non porous, and even texture, no trace of bedding, with rough uneven fracture. Composed of brown grains and rare quartz; the groundmass is also brown.

Thin Section

Grain size ranges from 0.1 to 0.4 mm.

Calcite (52%) consists mainly of primary calcite ooze.

Quartz (8%) occurs in long angular, clear simple grains with rare dustings of inclusions, bubble trails and corrosion embayments. Subrounded polycrystalline grains are rare; they have sutured crystal boundaries and individual extinction.

Feldspar (10%) consists of clear, fresh andesine and rare labradorite; it occurs in elongate laths with irregular angular terminations; rare grains show zoning; some grains show simple twinning and may be K feldspar.

Rock fragments (30%) are dominantly devitrified glass (15%) with microcrystalline grains consisting of mica, opaque grains and chlorite (5%) textural basalt (5%) schistose quartzite (3%) and textural andesite (2%).

Sample 64581640 - CALCAREOUS FELDSPATHIC LITHIC SANDSTONE - very fine grained, moderately sorted, Map reference 17570986 Maneroo.

Hand Specimen

Brown-grey, fine and very fine grained, portion of a single bed one inch thick, non porous, non friable, irregular fracture oblique to bedding. Composed of angular yellow and pale grey grains with a trace of quartz in a calcareous groundmass.

Thin section

Grainsize is from 0.05 to 0.2 mm. but generally 0.1 mm.

Quartz (5%) occurs as angular grains with low sphericity, simple grains with non undulose extinction predominate; some show corrosion embayments.

Feldspar (15%) consists of andesine and rare labradorite; zoning is rare; grains are commonly elongate laths with irregular terminations; some dustings of inclusions occur.

Rock fragments (30%) consists dominantly of - devitrified glass (15%) with 5% textural basalt and textural andesite, 5% metaquartzite and 5% green brown siltstone.

Accessory minerals include biotite green brown to yellow brown in colour, epidote as masses of very fine irregular grains and ?glauconite possibly chamosite.

The cement (50%) consists of cryptocrystalline calcite.

Sample 64581421 - GLAUCONITIC CALCAREOUS LITHIC SANDSTONE - very fine to fine grained, well sorted, Map reference 25680670 Longreach.

Hand Specimen

Brown exterior surrounding a blue-grey core, non friable, non porous very fine to fine grained, poorly developed bedding traces, tough irregular fracture, non friable, dark grains and trace of quartz recognized.

Thin Section

Grainsize is generally 0.1 mm., but ranges from 0.05 to 0.25 mm.

Quartz (20%) is angular with elongate needle-like fragments common, rarely euhedral, some show irregular (?corroded) outlines. A trace of chalcedony also occurs.

Feldspar (7%) consists of andesine and labradorite. It forms elongate laths with irregular terminations.

Rock fragments (23%) consist of devitrified glass (15%). Textural basalt (3%) and grains of metaquartzite (5%).

Glauconite (8%) occurs in ovoid irregular pellets.

Accessory minerals include mica (1%) and rare tourmaline.

The cement (45%) consists of finely crystalline calcite.

TERTIARY

Sample 64581712 - QUARTZOSE SANDSTONE - coarse grained poorly sorted, Map reference 61300592 Maneroo.

Hand Specimen

Pale orange to white, fine grained, no apparent bedding, uneven fracture, friable, porous. Composed of quartz in a fine white silty groundmass.

Thin Section

Grainsize is highly variable and ranges from 0.2mm. to 1.0 mm., but is generally 0.4 to 0.2 mm.

Quartz (75%) is subangular to subrounded with moderate to low sphericity, dusty grains with common inclusion trails and bubble trails are common; some rare grains show overgrowths. Chalcedony is present but rare.

Rock fragments (5%) are quartzose devitrified glass. A trace of tourmaline is present.

The matrix (20%) consists of pale brown kaolin.

Sample 64581716 - QUARTZOSE SANDSTONE - very fine grained with scattered fine and medium grains poorly sorted, Map reference 57170592 Maneroo.

Hand Specimen

Pale grey with red mottling, fine grained, orientation of mottles suggest they are parallel to bedding, uneven fracture, friable, porous. Composed of quartz in a white silty groundmass.

Thin Section

Grainsize is generally about 0.1 mm., but ranges from 0.05 to 0.3 mm.

Quartz (65%) is angular to subangular generally with a moderate to high sphericity but with scattered elongate grains with very low sphericity. Grains are commonly simple with non undulose extinction; bubble and inclusion trails and dustings are common; scattered grains have corrosion embayments.

Rock fragments (7%) consist of metaquartzite (5%) and quartzose devitrified glass (2%).

Accessory minerals (3%) include mainly phengite, mica, with rutile and traces of tourmaline, haematite and zircon.

The groundmass (25%) consists of kaolin and fine silt to very fine sand size quartz.

CAINOZOIC

Sample 64581666 - CREAMY WHITE SILTY AND SANDY MICRITE, Map reference 36650184 Jericho.

Hand Specimen

Creamy white, silty limestone, irregular apparent bedding that is probably due to evaporite surface concretions; fracture is sub-conchoidal and irregular, non friable, non porous.

Thin Section

The calcite (95%) is pale varicoloured and cryptocrystalline.

Quartz (5%) is the only other mineral recognized; size ranges from 0.015 - 0.15 mm., grains are angular to subangular and consist of colourless simple grains with non undulose extinction, bubble and inclusion trails and rare dustings of inclusions occur; polycrystalline grains are rare and composed of aggregates of extremely fine quartz crystals closely interlocking with planar crystal boundaries. The simple grains appear to be of volcanic origin.