PETROGRAPHIC NOTES ON THE PEAWADDY FORMATION

BOWEN BASIN, QUEENSLAND.

by

L.V. Bastian

RECORD 1964/193

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SUMMARY

Twenty specimens from outcrops of the Peawaddy Formation were studied in thin sections. The main rock types are volcanic sandstones, subgreywackes, kaolinitic sandstones, siltstones and claystones, and non-kaolinitic siltstones, orthoquartzites are also present, but minor.

The upper half of the unit is sandier than the lower half, which contains most of the kaolinitic rocks. The kaolinite, which predominates in some specimens, is derived from breakdown of both micas and feldspars, and different features characteristic of each origin can be recognized. These kaolinite-rich intervals may be useful for correlation, and hint at possible periods of emergence during this part of the succession.

Volcanic detritus is abundant, and originated from acid and intermediate extrusives; other lithic material, derived from granitic, sedimentary or metamorphic rocks, is generally minor.* Calcite is plentiful, both as cement and replacement of detrital grains; one specimen has a microcrystalline calcite matrix.

INTRODUCTION

The Peawaddy Formation, named by Mollan, Kirkegaard, Exon and Dickins (1964), includes strata above the Catherine Sandstone in the eastern part of the Springsure 1:250,000 Sheet area, above the Colinlea Sandstone in the western part of the area, and below the Bandanna Formation. It includes the Mantuan Productus Bed and other poorly outcropping sediments, and has a total thickness of about 500 feet.

The thin sections described were cut from specimens from the following localities:

- specimens SP134/1, H to L, from measured section S15 (see Mollan et al., 1964), about 1 mile south-east of Mount Catherine;
- specimens SP137/1, A to E, from section S25, about 2 miles south of Mount Catherine;
- specimens SP470a and b, and SP471, from section S23, on the east flank of Reid's Dome about 2½ miles south of Rocky Creek;
- specimens SP476a and b from section S24, also on the east flank of Reid's Dome, about ½ mile south of Cattle Creek;
- specimens SP170 and 173 from section S26, about 3 miles east-north east of Tanderra Homestead;
- specimens SP130, 153, 156, and 157, not collected from measured sections (see Fig.1). These are described last.

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* The source area was probably to the east, where rocks such as the lower Bowen Volcanics and Camboon Andesite may have been exposed.

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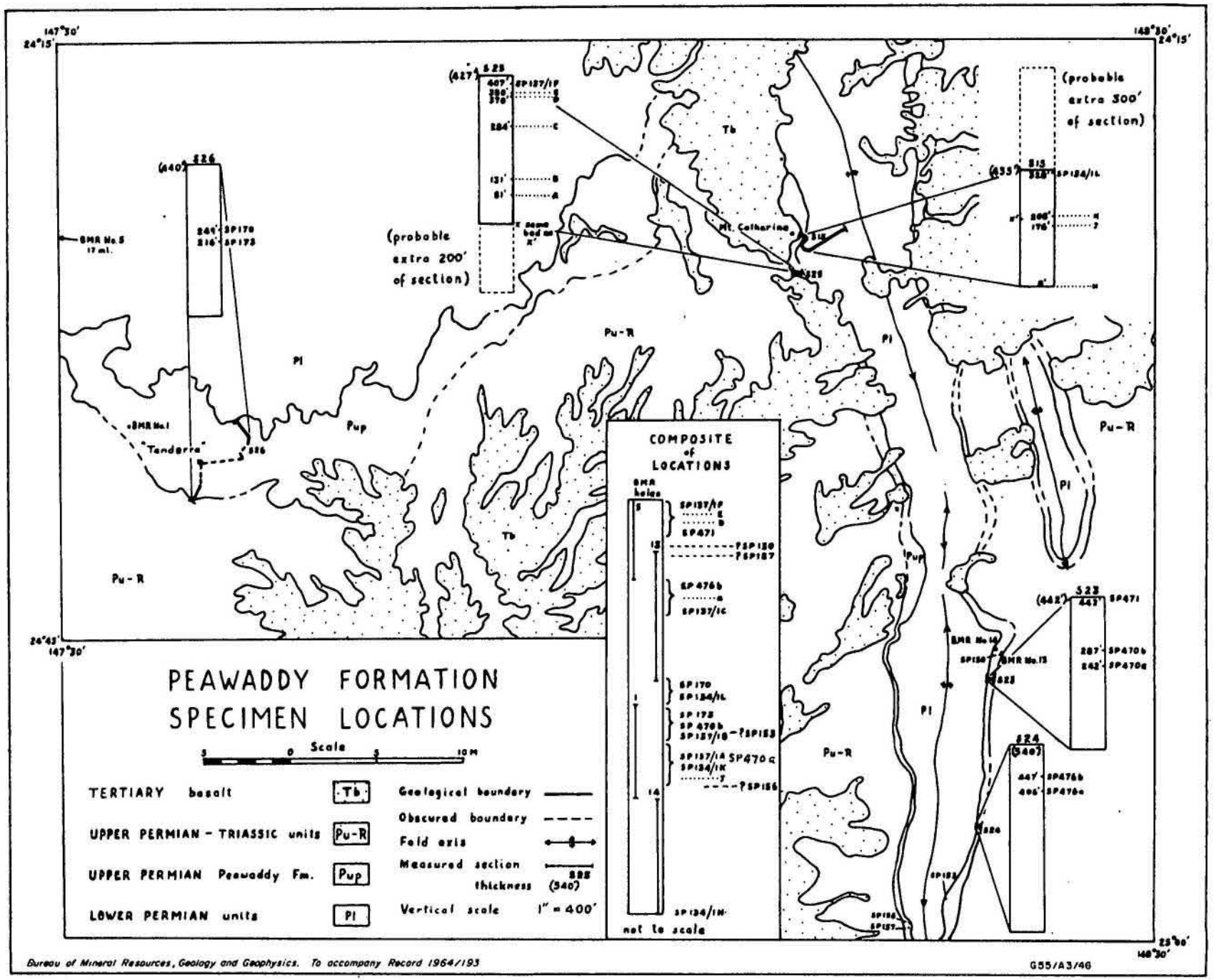

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Of the 16 from measured sections, these have been roughly grouped into six lots according to the positions in the sections, as shown in the composite column in Fig.1, and those not from measured sections are also shown in their estimated positions.

PETROGRAPHY

The petrological features of each specimen are presented in Tables at the back, and special features are discussed below. Mineral percentages have been estimated, as also the grain-size figures and other textural features. More detailed comments on the identification of minerals are given in Bastian (1965).

Specimen SP134/1H

This rock is composed mainly of kaolinite, occurring both as finely disseminated material, much of it almost isotropic, and as discrete patches made up of aggregates of fine "books", clearly derived from the complete breakdown of feldspar and mica grains. Its original composition was probably a volcanic sandstone * or subgreywacke. The rock has been weathered and has a fine ribbon-like colour banding in the hand-specimen.

Specimens SP134/1J, K, SP137/1A and Sp470a.

Three of these are very kaolinitic rocks. In J the abundant kaolinite occurs as "books" of various sizes, and looks like the common type of diagenetic matrix material derived from the breakdown of micas; many swollen, partly leached micas, can be seen. Because this matrix is not of detrital origin, the rock is not a greywacke. In K the kaolinite comprises virtually the whole of the fine fraction, and quartz grains appear to "float" in it. It has a very fine, even texture, and "books" cannot be distinguished. This texture suggests that the kaolinite in K was derived from breakdown of feldspars, a feature common in specimens of the Peawaddy Formation from the holes BMR Springsure Nos.13 and 14. There is a distinct streaky appearance normal to the bedding, and the whole rock appears to have expanded considerably in this direction. In A the kaolinite occurs as smallish nodules or equant grains, some lobate. The texture is notmas fine as in K, and small "books" can be seen. Many of the grains have shapes like feldspar prisms, pointing to derivation from feldspars rather than micas.

SP470a is a volcanic sandstone, containing nearly 25% of volcanic fragments, mainly andesitic (Fig.2) with subordinate rhyolite, tuff and rare granophyre. There are also fragments of shales and other sediments. Plagioclase in the sandstone is labradorite. Abundant calcite (50%) of fine, granular texture, has replaced much of the detritus; the amount of volcanic material was probably much greater before replacement, and the rock name has been assigned on this assumption.

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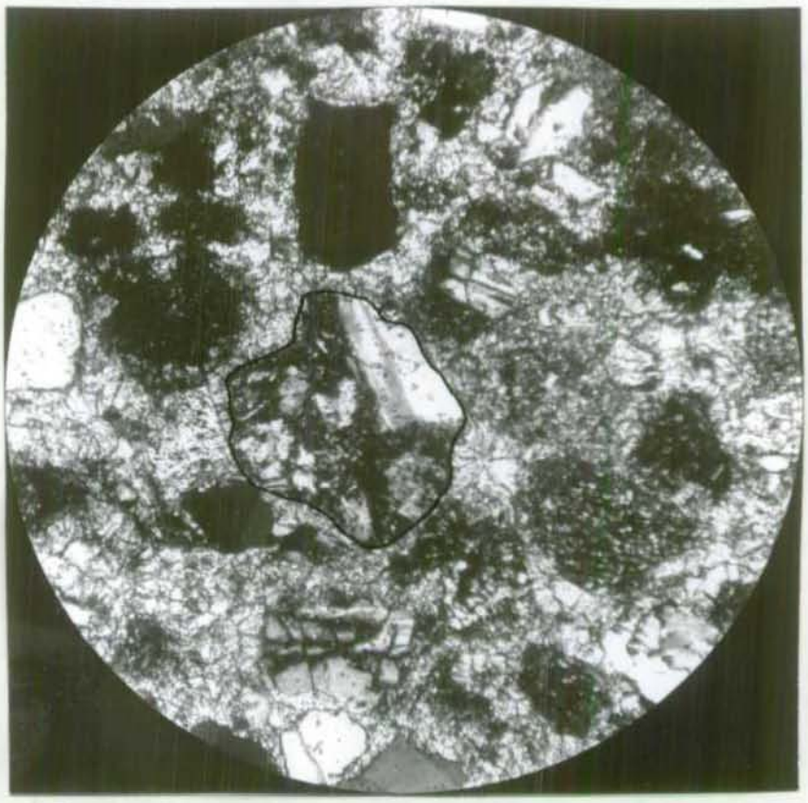
* "Volcanic sandstone" is used according to Williams, Turner and Gilbert (1955) for an arenite composed dominantly of volcanic detritus.



Field 1.0mm mag. X110. crossed nicols.
Fig. 2 SP470a. Calcite cement, partly replacing volcanic detritus and feldspar; in the centre a fragment of ?andesite, showing portion of a plagioclase crystal and the groundmass.

B.M.R. Neg. G/7951

Specimens SP137/1B, SP470b and SP173

SP137/1B is very similar to SP137/1A, the kaolinite occurring as small nodules or grains, but in much smaller quantity. Carbonaceous matter is plentiful. Like SP470a, SP470b is a volcanic sandstone, with plentiful calcite. SP173 is similar to SP470a and b, but contains more shale and schist fragments (hence named a subgreywacke), although volcanic detritus is still plentiful. "Chert" in this specimen is probably mainly devitrified siliceous volcanic glass.

Specimens SP134/1L and SP170

SP134/1L is a ferruginized sandy claystone, and fine-grained sand makes up only 30% of the rock. The remainder is too heavily ferruginized for its original components to be determined, but some patterns in it are suggestive of kaolinite vermicules. The replacing mineral is a hydrated iron oxide, mostly isotropic, but showing very weak birefringence in spots. SP170 belongs to an orthoquartzitic facies; it shows much better rounding of grains than in other sandstones, and there are numerous overgrowths on K-feldspars. The calcite cement is clean (sparry), and has partly replaced some grains.

Specimens SP137/1C, SP476a and b.

SP137/1C is a siltstone, with a composition intermediate between those of the quartz-rich and volcanic-rich sandstones. SP476a is similar to the volcanic sandstones lower in the section, with similar feldspars, volcanic detritus - which appears to be mainly trachy-andesites - and calcite cement; it is coarser in grain than most. SP476b, from the Mantuan Productus Bed, is very similar. Plagioclase in this specimen is andesine/labradorite, and is commonly strongly zoned.

Specimens SP137/1D, E,F, SP471, and probably SP130.

SP137/1D is more quartz-rich than its associated sandstones, and is virtually an orthoquartzite apart from its having much diagenetic clay matrix. It came from a relatively minor bed, as shown by measured section S25. E is another kaolinite-rich rock, containing abundant nodules up to 0.8 mm in size, most of them composed of aggregates of twisted vermicular crystals, although a few of the nodules are aggregates of tiny "books". All micas in this specimen are strongly leached and swollen, and afford an obvious source for the kaolinite. The clay groundmass has a corrugated appearance, indicating that the nodules grew in place, disturbing the surrounding material. SP471 is a volcanic sandstone, but much of the volcanic detritus is distinctly different from that in other specimens, having on the whole very fine-grained or glassy groundmasses, suggesting that these were more acid volcanics. SP130 is the coarsest of the volcanic sandstones. Besides the usual volcanic detritus, minor amounts of a granitic rock, a crushed acid igneous rock, and fine-grained sericite-rich metamorphics (? slate) have been noted.

Specimens SP153, 156 and 157

SP153 is believed to have come from the lower half of the unit. It is a calcareous subgreywacke, and was probably fairly rich in volcanic detritus before replacement by calcite occurred. SP156, from the lower half of the unit at the south end of Reid's Dome, is the only specimen in which primary microcrystalline calcite matrix can be recognised. As well as this, the rock has patches of fibrous calcite adjacent to every detrital grain, each patch reflecting the shape of the grain beside it. Fibres are all elongated in the same direction, parallel to the direction of grain orientation in the rock, and indicate a general expansion of the rock took place in that direction. Since the orientation of grain long axes usually indicates the bedding plane (this cannot be verified from the hand-specimen, which lacks bedding features), the expansion indicates the rock underwent a period of strong tension, perhaps due to folding, the calcite occupying available space as grains were pulled apart. SP157, probably from near the top of the unit, has, besides the usual volcanic material, much detritus from other rocks, notably metamorphics. Small amounts of glauconite have been noted in SP153 and 157.

Accessory minerals are on the whole uncommon in these specimens, possibly reflecting a deficiency in the source rocks rather than any depositional conditions, as fine-grained sands such as these commonly contain plenty of accessories.

COMPARISON WITH SPECIMENS FROM BMR SHALLOW HOLES

Four of the BMR shallow stratigraphic holes drilled in 1963 entered the Peawaddy Formation. The petrography of these is described by Arman (1965). BMR Springsure No.1, drilled through the lower part of the Peawaddy Formation 5 miles north-west of Tanderra Homestead, has sandstones with lithologies very similar to those at the surface, the most obvious similarity being a low percentage of quartz. Like SP173, they contain less volcanic detritus than sandstones further east and have plenty of detrital matrix; hence they are described as feldspathic and lithic greywackes. BMR Springsure No.5 went through lower Bandanna Formation and the top 115' of the Peawaddy Formation, 2 miles north of Mantuan Downs Homestead, i.e. about 60 miles west of the SP134 and 137 specimens. The unit in this hole consists mostly of calcareous and volcanic sandstones, again with a low percentage of quartz. There is somewhat more volcanic detritus than in the lower half of the unit, and more calcareous cement. These two holes show that there is little change in the lithologies over an appreciable distance.

BMR Springsure No.13, 10 miles south-west of Consuelo Homestead, went through 250' of the Peawaddy Formation, starting from immediately below the Mantuan Productus Bed:; it probably terminated below the middle of the unit. The lithologies are mainly greywackes, subgreywackes and volcanic sandstones, more or less the same as those of the surface specimens SP470b, SP476a and SP471. Feldspars, especially around 200', have been largely converted to

kaolinite, leaving only skeletal relics of the original grains; the texture of this kaolinite is virtually the same as that seen in SP134/1K and SP137/1A. Siltstone and shale are subordinate. BMR Springsure No.14 one mile west of No.13, went through the bottom 170' of the unit, which was not sampled in outcrops, because of very poor outcrop. Lithologies are mainly carbonaceous siltstone and shale, with interbedded sandstones, commonly carbonaceous. Shales and siltstones in the top 40' contain fairly plentiful fine kaolinite, derived from feldspars. The arenites are volcanic sandstones, calcareous subgreywackes and argillaceous sandstones, again similar to outcrop material.

CONCLUSIONS

Four general lithology types were recognized.

(i) Kaolinitic claystones, siltstones and sandstones, with kaolinite of diagenetic origin developed from both feldspars and micas. Some of these were probably originally sandstones rich in feldspar.

(ii) Volcanic sandstones, subgreywackes and greywackes. The specimens from the Tanderra area and BMR Springsure No.1 suggest a possible trend towards more primary matrix (greywackes) westwards.

(iii) Siltstones, virtually just finer variants of (ii), with more clays. These make up much of the unit.

(iv) Quartzose sandstones. These sands, markedly different from the rest, are minor.

To these types may be added the carbonaceous shales and claystones which virtually do not outcrop.

The lower half of the unit is in general finer-grained than the upper; this is reflected in very poor outcrops. The interval rich in kaolinite, which may be taken as somewhat below the middle, may be useful for correlation. The reason for the abundance of kaolinite is not clear. It could be at least partly due to weathering, as no kaolinite percentages approaching those of the outcrop samples were noted in theholes. On the other hand there is no certainty that the shallow holes intersected the abundantly kaolinitic horizons sampled in outcrop. If the kaolinite is not due to present-day weathering, then its presence may be related to the environment at time of deposition. The kaolinite could indicate a period during which very slow accumulation occurred under terrestrial conditions, resulting in concomittant alteration of some minerals in the sediment.

The volcanic sandstones and subgreywackes are most common in the upper half, and especially near the top, making up one or more generally sandy intervals. The upper beds constitute, with shelly material, the Mantuan Productus Bed. The common replacement of sand or silt by calcite suggests that appreciable amounts of carbonate were precipitated during marine deposition, then became concentrated into these sandy beds.

The predominant source rocks for the unit are acid and intermediate tuffs and flow rocks. The plagioclase, of intermediate to basic composition and commonly zoned, is clearly derived from the volcanics. Of the K-feldspars, microcline is minor, contrasting with its dominance in arkoses -

derived from nearby granitic rocks - of adjacent units. Much of the K-feldspar was probably derived from the volcanics rather than granites. Material designated as "chert" appears to be just devitrification products of the volcanic glasses. Other rocks, such as granites, sediments and low-grade metamorphics, in general supplied much less detritus. The major source for the Peawaddy Formation was most likely in the volcanic region east of the Springsure area, where rocks such as the Lower Bowen Volcanics and Camboon Andesite were probably exposed, and vulcanism was active. This easterly source direction is supported by the slight tendency for volcanic content to decrease westwards. Mollan, Exon and Kirkegaard (1964) reported cobbles of probable hornfels, granite and schist in the unit in western parts of the Springsure area. Further support for a dominant eastward source area is the gradual thinning of Peawaddy Formation westwards.

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APPENDIX A.

List of specimen field numbers and registered rock numbers.

Field No.	Registered No.
SP 134/1H	R 17096
SP 134/1J	R 17097
SP 134/1K	R 17098
SP 134/1L	R 17099
SP 137/1A	R 17100
SP 137/1B	R 17101
SP 137/1C	R 17102
SP 137/1D	R 17103
SP 137/1E	R 17104
SP 470a	R 17155
SP 470b	R 17156
SP 471	R 17157
SP 476a	R 17158
SP 476b	R 17159
SP 170	R 17153
SP 173	R 17154
SP 130	R 16302
SP 153	R 17150
SP 156	R 17151
SP 157	R 17152

APPENDIX B

List of abbreviations used in Tables.

Andesite	andes
biotite	biot
calcite	calc
coarse	crs
common	c
devitrified	devit
diagenetic	diagen
glauconite	glauc
granitic	gran
hydrated	hyd
illite	ill
iron-oxides	Fe-ox
kaolinite	kaol
metamorphics	mm
microcrystalline	microX
muscovite	musc
overgrowth	o'growth
phyllosilicate	phyllo
rare	r.
rather	r.
replacement	repl
shale	sh
siltstone	sltst
uncommon	u

PETROGRAPHIC TABLES

SPEC. NO. NAME	TEXTURE: sorting	grain-size mm.	round-ness	sphericity / orientation	PERCENTAGE ESTIMATES: quartz	quartzite	chert	micas	K-felds	plag.	rock frags.	matrix	cement	alter.	ACCESSORIES: tourm.	zircon	garnet	apatite	epidote
SP 134/1H kaolinitic sandy claystone	rather poor	max. .75 min. <.1 & clay mode	subang. (-subrd)	high poor	20	<5 (plus- ~~ters~~ kaol.,30% patches of)	r					20 (kaol.) (&ill.)		25 (calc.) (& Fe ox)					
SP 134/1J kaolinitic silty sandstone	fairly good	max. .2 mode .06	ang.	mod. rather weak	30	5	<10	>5 (musc.) (biot.)	2		5	>40 (mostly) (kaol.)			c	c[II]			
SP134/1K sandy kaolin	bimodal	max. .2 sand mode .08 clay <.01	ang. -subang.	mod. fairly strong	< 25			2 (musc.)				75 (kaol.) (diagenetic)							
SP137/1A kaolinitic, sandy siltstone	bimodal	max. .45 sand mode >.1 silt <.02	ang. -subrd.	mod. rather poor	< 20	(plus- ~~ters~~ kaol.,15% patches of)	few		few			65 (detrital,) (~~mostly~~ silt & illite)							
SP470a calcareous, volcanic sandstone	bimodal well sorted	max. .5 crs.mode .3 main " <.15	ang.- subang. (-subrd)	mod.-low strong	<10			2	5	<10 (25% volcanics) (<5% shale,mm.)	<30			50 (calc.)					
SP173 subgreywacke	well sorted	max. <.3 mode .15	(ang.)- subang.- subrd.	mod.-high rather poor	15	< 5	>20 (devit.) (glass)	10	>5	<10	<25 (andesite,&) (shale,sltst) mm.)	10			u				
SP137/1B sandy siltstone	bimodal	max. .6 sand >.1 silt <.02	ang.- subrd	mod. weak	>15	<5 (plus- 3% diagen.kaol.)			2			75 (ill. &) (kaol.)							
SP470b calcareous volc.sandstone	well sorted	max. .3 mode <.15	ang.- subang. (-subrd.)	mod.-low strong	<10	r		<1	5	>5 (tuff, andes.,) (shale,sltst.)	<35			45 (calc. cem.) (& repl.)	(glauc.-u)				
SP134/1L ferruginized sandy clayst.	poorly sorted	max. 1.0 mode .1 to .15	(ang.)- subang. (-subrd)		30									70 (red-brn.) (hyd.Fe-ox)					
SP170 calcareous sandstone	fairly good	max. 1.2 mode .45	subang. -subrd (-rd)	r. high r. poor	<45	5	5		5 (o'growths)	r				>40	u		u	c	
SP476a calcareous volc.sandstone	v.well sorted	max. .4 mode .25	ang.- subrd.	r. high nil	>10			2	>5	10 (volc.flow rocks,) (devit.glass,) (sltst. sh.)	35			35					u
SP137/1C sandy siltstone	well sorted	max. .25 crs. mode .2 main mode .05	ang. (-subang.)	mod. fairly good	40		5 (musc.,biot.) (grn.bru) (phyllo.)	10	5		>10	10		<10 <10 (Hyd.Fe-ox.)	u	u		u	

II see end of Table

SPEC. NO. 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	apatite	epidote
SP476b calcareous volc. sandstone	good	max. .5 mode .2-.25	ang-subang. (-subrd)	mod. nil	10 (plus 2% sed & mm. rocks 1% fossils)			<5	>5	10	>25 (volc., granophyre, trachy andesite)		40 (calc.)		r				
SP137/1D ortho-quartzite	mod.	max. 1.2 min. .15	(subang.) -subrd.	high	<70 (sl. o'growth)	10	>5	2 (musc.)			<15 (kaol., colloform aggregates) →				u				
SP137/1E sandy kaolin	poly-modal	kaol. <.8 sand max. .2 mode .1 & clay mode	ang.-subang.	mod. mod.	sand fraction <10% - quartz; clay fraction >30% - lt. brown, abundant opaque matter; kaolin. nodules 60% - vermicular														
SP471 kaolinitic volc. sandstone	good	max. .5 mode .25	(ang.) - subang. -subrd.	fairly high mod.	<20	u	28 (devit.) (volc. glass)	u	10	1	25 (20% volc.-flow rocks 5% sed. & mm.)	25	(mostly kaol.)						
SP130 calcareous volc. sandstone	r. poor	max. 1.0 min. .1	subang-subrd.	mod. slight	>10 (2% fossils)	>5	5		<10	>5	25 (volcs.-acid, & interm. flow rocks; minor gran., mm. & sed.)		35 (calc.)						
SP153 calcareous ~~volc. sandstone~~ subgreywacke	fairly good	max. .3 mode .12	ang.-subang. (-subrd.)	mod. mod.	10	1	10	u	<10	>5	15 (volc.-acid & interm., few sed.)		50 (calc.)		glauc. u				
SP156 sandy lime-stone	fairly good	max. .45 mode .2	ang.-subang.	fairly low strong	5	2	<5 (musc., biot. & grn. phyllo.)	<5	5	15 (volc.)	30 (calc., microx) →		35 (calc.)		r				
SP157 subgreywacke	v. well sorted	max. .3 crs. mode .25 main mode .15	ang.-subang.	fairly low random	10	<5	5	>5	<10	>10	45 (30% volc.-tuffs & flow rocks 15% sed., mm.)	10			glauc. u			r	r

Abbreviations
r rare
u uncommon
c common
a abundant
mm. metamorphic
crs. coarse