COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES GEOLOGY AND GEOPHYSICS

RECORDS:

1965/227

PETROGRAPHIC NOTES ON SOME TRIASSIC SEDIMENTS IN U.K.A. WANDOAN No.1 WELL IN ADJOINING AREAS.

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SUMMARY

Samples from the section in U.K.A. Wandoan No.1 between about 3500 feet and 6100 feet were studied, and compared with samples from outcrops of the Rewan Formation, Clematis Sandstone and Moolayember Formation in the Taroom, Mundubbera and Baralaba 1:250,000 Sheet areas. The samples from the well were also compared with those from the shallow holes B.M.R. Nos. 18, 19, 20, 21, 22, 23, 24 and 25, and from 906 feet to 3700 feet in U.K.A. Cockatoo Creek No.1 Well.

The results suggest that the unit examined below 4817 feet (the Cabawin Formation) in Wandoan No.1 correlates with a part of the Rewan Formation somewhat below the middle. In addition to red and green shale and claystone, both units are characterised by fine-grained subgreywackes, generally containing less than 10% quartz. Epidote and fragments of micrographic rocks are prominent in both the sediments examined from Wandoan No.1 and from the correlated part of the Rewan Formation. The data indicate that the upper part of the unit in the Wandoan area was removed by erosion before the Middle Triassic.

The unit between 4298 feet and 4817 feet (part of Wandoan Formation) is similar to the Clematis Sandstone. It consists mainly of fine to medium-grained protoquartzite which is fairly well sorted and has angular to subangular grains generally of moderate sphericity. The quartz content ranges from 50 to 80%, and the most common accessories are tourmaline and zircon. This unit is thinner and finer in grain-size than the nearest outcrop of Clematis Sandstone.

The upper unit, between 3530 feet and 4298 feet (an upper part of the Wandoan Formation) appears to be a correlate of the Moolayember Formation. A characteristic feature in both of them is the presence of swollen micas and of chamositic pellets; the latter being more common in the upper samples from Wandoan No.1.

I. INTRODUCTION

U.K.A. Wandoan No.1 was the first wildcat well drilled (in 1962) by the Union Oil Development Corporation in the north-eastern part of the Surat Basin. It is situated about 225 miles north-west of Brisbane and 70 miles north-east of Roma. The drilling operation was subsidized by the Commonwealth Government.

In the summary of data on the wells U.K.A. Wandoan No.1 and U.K.A. Burunga No.1 (U.O.D., 1965), the unit from 3530 feet to 4817 feet (1287 feet thick) in Wandoan No.1 was defined as Wandoan Formation, and was described as lying conformably below the Bundamba Formation and disconformably above the Cabawin Formation (the unit from 4817 feet to 9285 feet). However, palynological and petrographic data from outcrops and other wells (e.g. those described in Bastian, 1965) suggested that the Cabawin Formation should be correlated with the Rewan Formation, which outcrops about 60 miles to the north, and that the Wandoan Formation should be correlated in part with the Moolayember Formation and, in part, with the Clematis Sandstone. The study was undertaken to check this suggestion.

The position of U.K.A. Wandoan No.1 in relation to nearby B.M.R. shallow holes, U.K.A. Cockatoo Creek No.1, and outcrop samples used in comparisons, are shown on Figure 1. The selection of samples from U.K.A. Wandoan No.1 for thin sectioning was based mainly on electric logs and on binocular descriptions of the cuttings (Mack & Roy, 1962). Cuttings, believed to be reasonably representative of the stated intervals, were picked from the cuttings samples. Reference was also made to the petrography of units encountered in the B.M.R. shallow holes (Arman, 1965).

The textures and mineral compositions of the U.K.A. Wandoan No.1 samples are presented in tables at the end of this report.

II. LOWER REWAN FORMATION

A comparison was made between samples of the lower Rewan Formation, from outcrops about 5 miles south of Theodore, from U.K.A. Cockatoo Creek No.1, and from B.M.R. shallow holes Nos. 23, 24 and 25.

The outcrop samples (Field Numbers T154A,B,C and T168) are conglomerates, with pebbles of rhyolite, tuff and granophyre, in a matrix of volcanic sandstone which is probably tuffaceous. In most pebbles, the feldspars are mainly albite, but sanidine, orthoclase, oligoclase and andesine are present. Also present are 5 to 10% acicular amphiboles more or less altered to dark clots of iron oxide, up to 5% epidote occurring in clusters within porphyritic alkaline feldspar, and amygdules of chalcedony and zeolite.

The samples from cores within the interval 933 feet to 2652 feet in Cockatoo Creek No.1, are highly lithic subgreywackes (volcanic sandstones), consisting of up to 50% volcanics, 30% shale and silty shale clasts, and 5 to 10% micrographic grains. The feldspar content includes several different types and ranges up to 15%, while quartz does not exceed 5%. The volcanic detritus consists mainly of acid lava, subordinate intermediate lava tuff, chlorite, bentonite, and clusters of epidote and clinozoisite. The thin sections from the lower cores, notably those at 3204 feet and 3698 feet (about 530 feet and 40 feet respectively above the base), show a significant increase in volcanics relative to shales.

B.M.R. Taroom No.24 was drilled within the lower part of the Rewan Formation, B.M.R. Taroom No.25 spudded near the Rewan Formation/Baralaba Coal Measures contact and bottomed in the Baralaba Coal Measures (Jensen et al., 1964, App.C), and B.M.R. Baralaba No.23 also penetrated the lower part of the Rewan

LOCATION OF WELLS, BMR SHALLOW HOLES AND OUTCROP SAMPLES

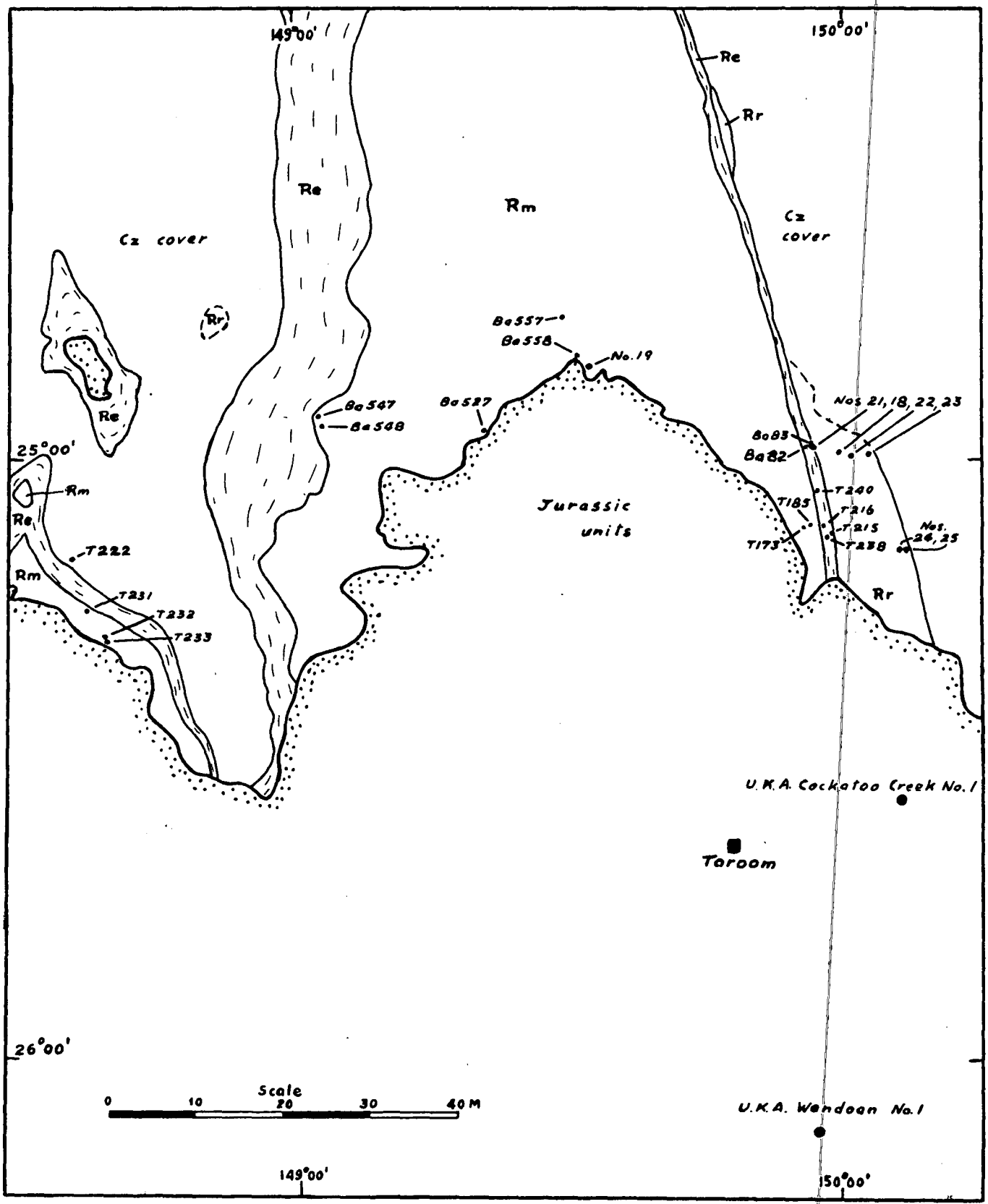

Fig. 1. To accompany B.M.R. Record 1965/227 G55/A/21

Formation, but substantially higher than the other holes. The samples from this drilling were mostly subgreywacke, but some lithological differences between them are worthy of mention. Clasts of both acid and intermediate volcanics, flow rocks, increase downwards, from about 25% in the samples from B.M.R. Baralaba No.23 to about 50% in those from B.M.R. Taroom Nos.24 and 25. On the other hand, the content of reworked shale decreases downwards, from 20 to 30% in No.23, to about 10% in Nos.24 and 25, and quartz decreases from about 10% to less than 5%. Further, epidote, micrographic grains and feldspars (about 15%) are common in No.23, but are generally minor in Nos.24 and 25.

It may be concluded, from the low quartz percentage and abundant volcanic detritus which increases downwards that the U.K.A. Cockatoo Creek No.1 samples are in part equivalent to the section between B.M.R. Baralaba No.23 and B.M.R. Nos.24 and 25; i.e. a low part of the Lower Rewan Formation.

III. MIDDLE AND UPPER REWAN FORMATION

Outcrop specimens T222B-E (the uppermost part of the Rewan Formation), exposed on the Carnarvon Highway in the north-western part of the Taroom 1:250,000 Sheet area, were examined. These were compared with samples from B.M.R. Baralaba No.18 and B.M.R. Baralaba No.22, which penetrated the middle part of the unit, from B.M.R. Baralaba No.21, which intersected the top of the unit, and with samples from U.K.A. Wandoan No.1 between 4817 feet and 6100 feet. The shallow B.M.R. holes are located on the eastern flank of the Mimosa Syncline about 90 miles east of the T222 locality, and 80 miles north of Wandoan. The U.K.A. Wandoan No.1 section (Cabawin Formation) will be designated for convenience as "interval 1"; the lower limit of the study was set at 6100 feet to ensure that a substantial amount of the Cabawin Formation was examined.

In the outcrop samples the quartz content ranges from 10 to 65%, feldspar is minor, and other labile fragments are present in variable amounts; these are comparatively the most mature of the Rewan specimens examined in this study. The unit in the Carnarvon Highway locality is 1300 feet to 2500 feet thick (Jensen et al., op.cit., p.39); to the east it is up to 12000 feet thick. This difference is probably caused by westerly wedging and erosional truncation of the Rewan Formation before deposition of the Clematis Sandstone; thus the T222 specimens may be stratigraphically equivalent to a low part of the Rewan in the east.

The samples from B.M.R. Baralaba No.21, representing the top of the unit in the locality where it is 12000 feet thick, appear to be similar in composition to those of the western outcrops. The constituents include 25% to 30% quartz, 5% to 10% feldspar, up to 30% detrital clay matrix (where not replaced by calcite), 10% chert and 10% shale and mudstone. Thus there appears to be an increase in maturity of the Rewan Formation both upwards as well as westwards.

In contrast to these samples, the Wandoan No.1 section "interval 1" contains, in addition to red-green and dark grey shale and mudstone, a number of sandy intervals with only 10% or less quartz (including fairly common embayed quartz derived from volcanics), 10% to 15% feldspar, 10 to 25% clay matrix (mostly kaolinite), about 20% chert, 5 to 20% acid and intermediate volcanics, and up to 25% reworked shale and mudstone fragments. Biotite is uncommon, and where present does not show leaching effects. The mineralogy of the U.K.A. Wandoan No.1 samples, particularly the presence of some epidote rocks and micrographic-textured rocks is similar to that of the lower Rewan samples, except that the latter have more volcanics and little or no kaolinite.

Subgreywackes from B.M.R. Nos.18 and 22 are very similar to the greywackes in U.K.A. Wandoan No.1. They contain up to 30% shale and mudstone clasts, and about 15% feldspar; volcanic material is subordinate. The quartz content is rather inconsistent; in B.M.R. No.22 it is about 5% and in B.M.R. No.18, ranges between 10 and 20%. Epidote is common to abundant. The subgreywackes in U.K.A. Wandoan No.1 containing abundant volcanic detritus and micrographic grains, seem to be intermediate between those of B.M.R. No.23 and B.M.R. Nos.18 and 22. Thus the upper Cabawin Formation in U.K.A. Wandoan No.1 appears to represent a part of the Rewan Formation somewhat below the middle and further much of the Rewan Formation does not seem to be represented in U.K.A. Wandoan No.1. The marked change of lithology at 4817 feet in the well suggests an unconformity. Furthermore, none of the Wandoan samples from "interval 1" has a lithology closely similar to that of either the Clematis Sandstone (which is characterized by dominant quartz and relatively abundant tourmaline and zircon- see below) or the Moolayember Formation (which typically contains swollen micas and chamositic pellets). The hypothesis that the Cabawin Formation, i.e. the unit between 4817 feet and 9285 feet in Wandoan No.1, includes correlates of the Moolayember Formation and Clematis Sandstone on lithological grounds (U.O.D., 1965) cannot be substantiated.

IV. CLEMATIS SANDSTONE

The unit between 4298 feet and 4817 feet in U.K.A. Wandoan No.1 (which will be designated as "interval 2") was compared with the Clematis Sandstone of B.M.R. Baralaba No.20, which penetrated the base of the unit, and with Clematis Sandstone outcrop samples T215, T238, T240 and T216 from the north-eastern corner of the Taroom 1:250,000 Sheet area, and Ba82 and Ba83, from the same locality as B.M.R. No.20, in the south-eastern corner of the Baralaba 1:250,000 Sheet area.

In this area the Clematis sand body, although contiguous with the Clematis Sandstone of the type area, becomes less quartzose because of the incoming of substantial amounts of volcanic detritus (Bastian 1965b); quartz is, however, still the dominant mineral.

Some similarities can be readily observed. The U.K.A. Wandoan No.1 samples are mostly fine to very fine-grained protoquartzites containing from 50 to 80% quartz, up to 10% feldspar (mainly K-feldspar), about 15% kaolinite, 5 to 10% chert, up to 15% micas and chlorites and, in some cuttings, plentiful tourmaline and zircon. A few coarser arenites in "interval 2" are subgreywackes; they are poorer in quartz (down to 25% in cuttings from 4700 feet to 4710 feet), and are correspondingly richer in volcanic detritus. Except for T215 and T238, which are volcanic sandstone and volcanic conglomerate respectively, the outcrop samples generally have a similar mineralogy to the bulk of the U.K.A. Wandoan No.1 samples: 40 to 65% quartz, 10 to 15% feldspar, 10 to 20% kaolinite, up to 15% chert, 5% reworked shale, and some tourmaline and zircon. The outcrop samples are generally coarser than the U.K.A. Wandoan No.1 samples which are fine-grained. Both the outcrop and subsurface samples are fairly well sorted, angular to subangular, and mostly of moderate sphericity. As with the Wandoan samples, the finer sandstones contain the most quartz, while coarser sandstones are rather poor in quartz (e.g. Ba83A with only 35% quartz).

The mineralogical differences (especially the difference in quartz content) between "interval 2" and "interval 1" in U.K.A. Wandoan No.1 are similar to those between the outcrop samples of the Clematis Sandstone and the samples of the Rewan Formation from the B.M.R. shallow holes - the former contain, in general, more quartz (by 20 to 35%), less detrital clay matrix (by 10%) and

less feldspar (by up to 5%). It is suggested therefore, that "interval 2" in U.K.A. Wandoan No.1 is probably part of the Clematis Sandstone. According to this interpretation the unit in U.K.A. Wandoan No.1 is thinner and finer-grained than in the Dawson Range where it is about 1000 feet thick (Jensen et al., 1964, p.42). Both these differences are consistent with the idea of a slight onlap of Middle to Upper Triassic units onto the Wandoan structural axis.

V. MOOLAYEMBER FORMATION

Nine samples from Wandoan No.1 between 3530 feet and 4298 feet (which will be called "interval 3") were compared with samples from B.M.R. Baralaba No.19, and with outcrop samples T173, T185, T231, T232, T233, Ba547, Ba548, Ba68, Ba527, Ba557 and Ba558. The unit above 3530 feet in U.K.A. Wandoan No.1 is the Precipice Sandstone. The samples prefixed with T were taken from the north-western (T231, T232, T233) and north-eastern (T173) parts of the Taroom 1:250,000 Sheet area, whereas the other samples were from the southern part of the Baralaba 1:250,000 Sheet area.

The material can be conveniently divided into two parts:-

(i) On comparing the Wandoan No.1 samples from 4100 feet and 4200 feet with the outcrop samples of the lower Moolayember Formation (T173, T185, T230, T231, Ba547 and Ba548) it was found that both groups have about 30 to 40% quartz, up to 15% feldspar, 5 to 15% micas and chlorites, including leached and swollen micas - of which biotite predominates - 15 to 30% clay matrix, up to 10% chert, and some carbonaceous matter. In contrast to the Rewan Formation, they contain little or no reworked shale, labile volcanic rock fragments or heavy minerals. They are generally fine-grained, fairly well sorted, and grains are angular to subangular and of moderate sphericity. Some are medium to coarse-grained.

The samples from 4000 feet to 4030 feet are mainly conglomerate, containing granules of quartz and chert up to 5 mm. in diameter. The rock types in these clasts are like those in pebbles of the conglomerate Ba68, from near the base of the Moolayember Formation in the south-east corner of the Baralaba 1:250,000 Sheet area. Fine-grained sandstones in the well section contain about 35% quartz, 5% feldspar, 10% chert, 10% micas and chlorites, 10% volcanic fragments, and about 25% kaolinite matrix.

(ii) Samples from higher levels in U.K.A. Wandoan No.1 (between 3530 feet and 3932 feet) were compared with samples from the upper part of the Moolayember Formation, including those from B.M.R. Baralaba No.19, and outcrop samples Ba527, Ba557, and Ba558. Both suites have 10 to 20% quartz, 10 to 15% feldspar (mostly K-feldspar), and plentiful swollen greenish-brown biotite. In B.M.R. Baralaba No.19 these swollen micas are particularly abundant. The Wandoan samples contain more kaolinite, chlorites, and chert, and little or no calcite cement, but, as up to 35% calcite cement is present in the other samples, it is probable that the calcite replaced some constituents. In both outcrop and well sections the trends between the upper and lower parts are the same; the upper part contains less quartz (by up to 20%), more feldspar (by 5 to 10%) and more leached micas and chamositic pellets.

It is evident from this data - notably the presence of leached micas and chamositic pellets - that "interval 3" in U.K.A. Wandoan No.1 compares well lithologically with the Moolayember Formation. The first few hundred feet of the unit in U.K.A. Wandoan No.1 is a transitional zone between the Clematis Sandstone and the main part of the Moolayember Formation. This transitional zone has been recognized in outcrop (Bastian, 1965b).

VI. CONCLUSION

The study has shown that the Cabawin Formation in U.K.A. Wandoan No.1 is petrographically like the Rewan Formation; in particular the upper 1000 feet of the unit in that well closely resembles a middle part of the Rewan Formation. The upper part of the Rewan Formation was probably removed by erosion in the Wandoan area before the Middle Triassic. Subgreywackes in this unit are characteristically rich in volcanic detritus, and poor in micas. It has also shown that the sequence comprising the Wandoan Formation in that well can be approximately divided into:

(i) a portion from 4298 feet to 4817 feet, mainly of quartzose sandstone, with subordinate volcanic detritus;

(ii) a transitional zone from about 4000 feet to 4298 feet, with fairly low quartz percentage and some coarse horizons; characterised by plentiful biotite and swollen leached micas;

(iii) an upper zone from 3530 feet to about 4000 feet, poor in quartz and with plentiful swollen micas.

These subdivisions can be recognized in outcrops of the Clematis Sandstone and Moolayember Formation; the lowest one is correlated with the Clematis Sandstone and the upper two with the Moolayember Formation.

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TABLE OF TEXTURES AND MINERAL COMPOSITIONS

DEPTH / NAME	TEXTURE				PERCENTAGE ESTIMATES										ACCESSORIES				
	sorting	grain-size (mm)	roundness	sphericity	quartz	quartzite	"chert"	micas	K-felds.	plag.	rock frags.	matrix	cement	alter.	tourm.	zircon	garnet	apatite	epidote
3550'-3560' Sandy, argillaceous siltstone	fairly good	max. 0.08 av. 0.03	subang.-subrd.	low - mod.	10		20	10	2	3	> 25 shale	15 kaol.				u			
					(10% carb. matter)														
2600'-3610' argillaceous sandstone	mod.	max. 0.15 av. 0.08	subang.-subrd.	mod.	20		10	20	10	< 5	10 shale	10 (5 kaol.							
					- 10% chlorites and chamosite - most of the micas are leached.														
3700'-3710' argillaceous siltstone		max. 0.02			10		20					60							
					matrix:- micaceous and clay aggregate 10% carbonaceous matter														
3800'-3810' lithic greywacke	fairly good	max. 0.15 av. 0.1	subang.-subrd.	mod.	5	5	20	10	5	5	20 (15 shale)	30 (20 kaol.)							
3900'-3910' lithic greywacke	mod.	max. 0.2 av. 0.1	ang.-subang.	low - mod	20		5	10	8	7	15 (10 volc,)	20 (10 kaol.)							
					(15% chamosite and glauconite)														
3932' sub-greywacke	mod.	max. 0.7 av. 0.4	ang. - subang.	mod.	30			5	15	few	25 (15 volc.)	20 (kaol.)							
					5% granophyre rocks														
4000'-4010' conglomeratic sandstone	mod.	max. 0.15 av. 0.08	ang. - subang.	mod.	35		10	5	5	few	10 volc.	30 (28 kaol.)							
		Pebbles of quartz and chert up to 5mm. diam.			(< 5% chlorites)														
4100'-4110' argillaceous sandstone	mod.	max. 0.25 av. 0.1	subang.	mod.	35		> 10	10	10	few		35 (20 kaol.)							
4200'-4210' argillaceous sandstone	mod.	max. 0.15 av. 0.08	ang.-subang.	mod.	20		25	15 (10 bio.)	< 10			30 mixed clay							
4300'-4310' Proto-quartzite	mod.	max. 0.35 av. 0.2	ang.-subang.	mod. - high	55		10	5	7	3	5 shale	15 kaol.							
4320'-4330' Proto-quartzite	mod.	max. 0.15 av. 0.07	subang.	mod.	55			10	5		10 shale	> 15 kaol.				u			

(Appendix A.)

	TEXTURE				PERCENTAGE ESTIMATES									ACCESSORIES				
DEPTH / NAME	sorting	grain-size (mm)	roundness	sphericity / orientation	quartz	quartzite	"chert"	micas	K-felds.	plag.	rock frags.	matrix	cement	alter.	tourm.	zircon	garnet	apatite	epidote
4400'-4410' kaolinitic ortho-quartzite	very good	max. 0.25 av. 0.15	ang.-subang.	mod. - high	80				5			15 kaol.			c	u			
4500'-4510' Proto-quartzite	good	max. 0.25 av. 0.15	ang. - subrd.	mod.	50		10	5	12	3	5 shale	15 (5 kaol.)			c	a			
					Quartz: abundant overgrowth														
4600'-4610' Proto-quartzite	fairly good	max. 0.15 av. 0.08	subang.	mod. - high	< 50		10	> 5	10	few		20 (15 kaol.)							
4700'-4710' argill-aceous sandstone	mod.	max. 0.3 av. 0.15	ang. - subang.	mod.	50		5	5	< 10	few	5	25 (10 kaol.)			a	a			
4800'-4810' Proto-quartzite	good	max. 0.15 av. 0.1	ang. - subang.	mod.	55		5		5		15 shale	20 (15 kaol.)			c	a			
4900'-4910' silty clay-stone		max. 0.04	ang. - subang.	low - mod.	10				?10										
					80% clay aggregate														
4970'-4980' sub-greywacke	mod.	max. 0.5 av. 0.2	ang. - subang.	mod.	15	10	15	5	7	3	30 (25 shale)	15 kaol.							c
5000'-5010' silty claystone	mod.	max. 0.08 av. 0.04	subang. - subrd.	low - mod.	10		20	5	5		10	50 clay							
5040'-5050' sub-greywacke	mod.	max. 0.4 av. 0.15	subang.	mod.	10	5	20	< 5	10	few	25 shale	25 (20 kaol.)				u			c
5150'-5160' sub-greywacke	fairly good	max. 0.6 av. 0.3	ang. - subang.	mod. - high	15	5	20		4	6	40	10 kaol.							
5180'-5190' silty shale					5		10	5				75 clay							
					5% carbonaceous matter (laminae)														
5200'-5210' sub-greywacke	mod.	max. 0.5 av. 0.25	ang. - subrd.	low - mod.	15	10	15		10	few	35 (20 shale 15 volc.)	15 kaol.				c			c
5300'-5310' sub-greywacke	mod.	max. 0.4 av. 0.2	ang. - subang.	mod.	10	10	20	3 (biot.)	12	3	> 30 (20 shale)	10 kaol.							c
5400'-5410' claystone		dark grey to green			5 silt.							95 clay							
5700'-5710' shale		greenish						5				95 clay							
5800'-5810' shale		red and green			5		5					90 clay							
6100'-6110'		"			5			15				80							

APPENDIX B

LIST OF ABBREVIATIONS USED IN TABLES

a	-	abundant
ang.	-	angular
av.	-	average
c.	-	common
calc.	-	calcite
carb.	-	carbonaceous
clst.	-	claystone
Fe Ox	-	iron oxide
fos.	-	fossil
frags.	-	fragments
kaol.	-	kaolinite
max.	-	maximum
mic.	-	micaceous
mod.	-	moderate
r.	-	rare
rd.	-	rounded
repl.	-	replacement
sid.	-	siderite
slst.	-	siltstone
subang.	-	subangular
subrd.	-	subrounded
u.	-	uncommon
volc.	-	volcanic