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LITHOLOGICAL CORRELATIONS OF MIDDLE-UPPER TRIASSIC AND LOWER JURASSIC UNITS IN SEVEN WELLS IN THE SOUTHERN BOWEN-SURAT BASIN, QUEENSLAND.

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ABBREVIATION LIST

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4.	II	11	Flinton No.1
5•	H		Minima No.1
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- 8. Lithological correlations of units T-C in wells Weribone No.1, Coomrith No.1, Flinton No.1, Minima No.1, and Boomi No.1.

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SUMMARY

This study deals with lithological correlations of Triassic and Jurassic units in several wells in the southern Bowen-Surat Basin.

Lithological observations are presented in detailed diagrams to facilitate comparisons and improve correlations between wells.

In all the wells studied, there is a fundamental lithological break between the Triassic and Jurassic sediments; predominantly tuffaceous sediments in the former, quartzose in the latter.

The Lower Triassic sediments were derived exclusively from volcanic sources. A persistent sequence can be recognised in the Middle to Upper Triassic sediments, particularly in the lower part, where dark claystone overlain by tight quartz sandstone cover great parts of the basin. In the west these are underlain by a porous quartz sandstone sheet. They are succeeded by a polygenetic, feldspathic sandstone, porous at the base, characteristically with chlorite coatings on the grains, deriving from abundant biotite. Thinly and regularly interbedded (paralic?) shale and sandstone characterize the next basinwide lithological unit, which is overlain in the centre of the basin by more sandstone and minor shale with coal intercalations.

After advanced peneplanation, quartzose sources in the west commenced shedding in the Lower Jurassic, with the axis of maximum deposition shifting to the east. Temporary incursions of the sea with extensive accumulation of fine lithologies and a pelletal horizon preceded the long lasting fluviatile sedimentation of Lower to Middle Jurassic quartz sands.

INTRODUCTION

The purpose of this study is to establish lithological subsurface correlations of the Triassic and Lower Jurassic units of the southern Bowen-Surat Basin and to tie in with wells studied in the north on the flank of the Roma High on one hand (Fehr and Bastian 1963) and with Cabawin-1 on the east side of the Basin on the other (Fehr and Bastian 1962). The results of studies on these wells are combined in a report by Bastian (1965).

In recent years, Union Oil Development Corp. has drilled many wells in the south-western part of the basin with the Precipice Sandstone and sandstones in the Wandoan Formation (named in U.O.D., 1964b) as primary targets.

Subsequent studies, especially palynological work have not supported the correlations proposed by this company in places and detailed petrological investigations were undertaken to study alternative correlations.

Similar log character of specific intervals in even distant wells suggests that during certain times the depositional environment was consistent over large areas and progressed in the same sense. It was hoped that large

scale similarities would also be reflected in their microscopic features, and that in time equivalent units, certain microscopic properties of primary or secondary nature or even minor, but distinct, lithologies or particular mineral associations may serve as lithological markers.

The investigation of the Triassic and Lower Jurassic of some wells on the Roma High has shown that a minor unconformity may affect the top of the Cabawin Formation (Unit S, Lower Triassic) and that a major unconformity truncates increasingly deeper parts of the Wandoan Formation equivalent (subunits Ti-T4, Middle-Upper Triassic) towards the north (Tissot 1963). The basinwide change from tuffaceous Triassic sediments to quartzose blanket deposits of Lower Jurassic age confirms the importance of this unconformity at the close of the Triassic. The extension of the study towards southern parts of the basin was undertaken to trace the development of the time equivalent of the Wandoan Formation (subunits Ti-T4) and to check the persistence of the unconformity and the overlying Lower Jurassic sediments in basinal and marginal positions.

The studied wells (most of them drilled in 1963) are grouped within 100 miles in a north-south direction and 65 miles in an east-west direction. They are U.K.A. Weribone No.1, U.K.A.Coomrith No.1, U.K.A. Flinton No.1, U.K.A. Minima No.1, U.K.A. Wunger No.1 and U.K.A. Boomi No.1, and are tied in with U.K.A.Cabawin No.1 in the east (see fig.1). The lithologizal correlations between these wells are shown on plates 7 and 8.

The available cores were studied in thin section. The cuttings were studied under the binocular microscope. Coarser lithologies (from sand size up) were picked from some intervals (see below) and thin sections and plastic mounts produced. Some clays have been determined by X-ray diffraction.

PRESENTATION OF RESULTS

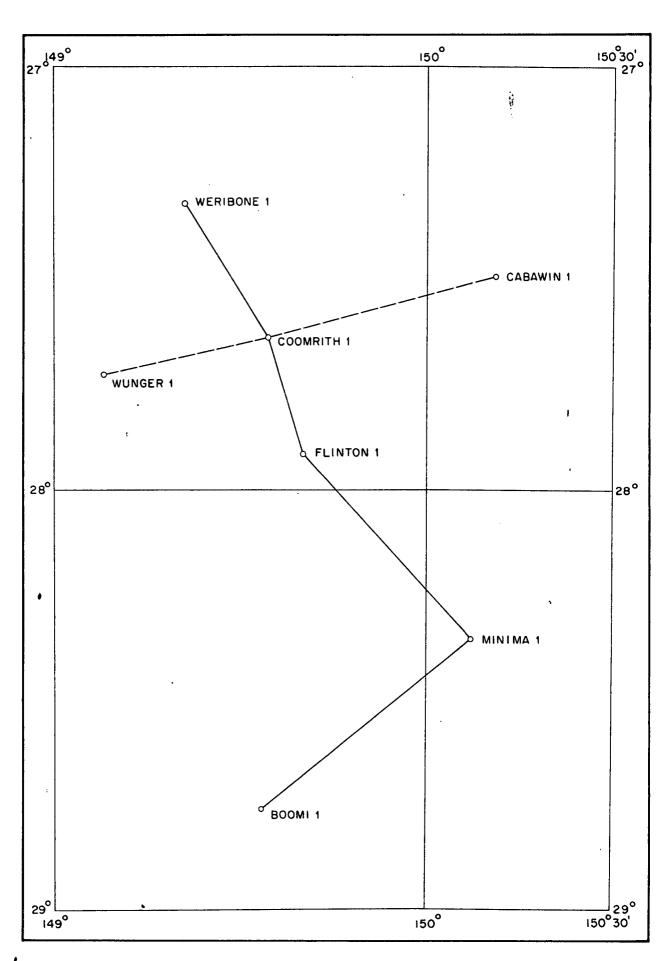
A detailed lithological diagram has been made for each well (plates 1-6).

Shales and siltstones (for exceptions see below) do not appear to show systematic variations in their commonly grey to grey brown colours, due to erratic changes in the amounts and arrangement of fine carbonaceous debris. Furthermore they are subject to strong caving in places, obscuring sandstone beds completely. These finer lithologies are only plotted on the diagram where present in cores. Their general appearance in cuttings is described in the column "interpreted lithologies".

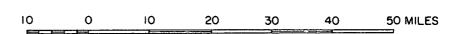
The sandstones show less caving and are more suitable for study; mainly sandstone variations are shown on the diagrams. For this purpose, the sandstones have been picked from all the cuttings samples. Depending on the importance of an interval, on the variability and properties of the sandstones, particular mineral associations and log characters, sandy cuttings from 10' intervals (each cutting sample) or from several continuous cuttings samples have been assembled in one thin section; no thin section represents more than a 100' interval.

It is evident that the sandstones may vary considerably within a 10° interval and even more in bigger intervals. The sandstone lithology represented on the diagram is chosen to facilitate recognition of main lithological trends in time amd space. All the lithologies observed in a thin section of cuttings cannot be presented as the diagram would, despite its objectivity, be overcrowded and major and minor varieties would be difficult to distinguish. Nor can the whole range of variation of the predominant lithology in a cuttings thin section be represented, as the

LOCALITY MAP



SCALE 1:1000,000



duplication of points at a certain depth would again overload the diagram and reduce its legibility. Therefore, although in eachthin section all groups of lithologies have been quantitatively described on filing cards (stored in the Core and Cuttings Laboratory of the B.M.R. in Fyshwick), only the predominant one has been represented on the diagram, after averaging its range of variation. Minor lithologies were depicted only if they contained noteworthy minerals, cements or structures which could prove useful markers. The horizontal lines on the diagrams are plotted at the most probable depth of that particular lithology based on cutting and Schlumberger logs.

The columns on the diagrams have the same significance as in previous reports, but some explanatory remarks may be added:

The column heading "elongation of grains" has been preferred to "sphericity", as anisometric grains are relatively rare but significant for special sources and show up better in a diagram.

"Sedimentary structures" were in most of the cases observed on cores.

The composition of the sediment is expressed by % of:

- Clasts of quartz (incl. quartzite and pure chert).
- Lithics, comprising glass in all stages of devitrification and probably derived mainly from tuffs, as shards are often present (see discussion of nomenclature below). In some units, e.g. Hutton Sandstone, they include some schist and other polycrystalline fragments.
- Feldspars; they are anhedral, commonly rather fresh plagioclase (albite to andesine) and microcline. Positive indications of other feldspars were not encountered. *

The remainder which is matrix and cement is in most cases a mixture of different clays. Their fineness, intergrowth and alterations make their microscopic determination difficult. The authigenic cement is mainly calcite, replacing clay and corroding quartz, vitric fragments, and feldspar and minor siderite.

In "Others" are marked the minor admixtures in the matrix.

In "Remarks", alteration, diagenetic replacement, occasional accessories and particular rock fragments are marked.

On the right of the SP, lithological log, electrical and sonic log, all lithologies (fine included) are described and grouped.

Some comments on the nomenclature of the arenites are necessary here. As a general rule, the arenites of the Bowen Basin contain a significant

In order for the reader to follow both the compositional changes with depth, the end points of the horizontal lines have been joined.

admixture of volcanic clastics; these are abundant in the Permian and the Lower Triassic units, and are less abundant in the Middle and Upper Triassic units. The arenites of the overlying Jurassic units (Great Artesian Group of Union Oil), consist mainly of quartz. The name "greywacke" should not be applied to clastic rocks dominantly of volcanic origin; greywacke is characterized by abundance of non-volcanic rock fragments (primarily polycrystalline) and matrix, and is commonly deposited in orogenic belts under marine conditions. Furthermore the term greywacke has more connotations and is more confused than any other in the nomenclature of sediments (see Klein 1963).

Careful examination suggests that most of the non-quartzose clastics derive from volcanic sources: glass shards, typical of tuffs, have been observed in many instances despite the fact that their fineness and fragility makes them liable to destruction during devitrification and compaction. On the other hand, particles deriving from volcanic flow rocks, (e.g. clasts with flow structures, idiomorphic phenocrysts etc.) are rare. Considering the abundance of tuff in the eastern Bowen Basin during Permian time, it is assumed that most of the vitric material is tuffaceous and the sandstones are called tuffaceous sandstones, sandstone having a purely grain size connotation. Increasing tuff admixture has been designated as slightly tuffaceous, tuffaceous and very tuffaceous.

Sandstones in which more than 80% of grains are quartz are called quartz sandstones.

The "subsurface units" correspond to the ones described by Tissot (1963).

Age relationships are based mainly on the work of Evans (1965).

LITHOLOGICAL CORRELATIONS

The datum for the seven wells correlated is the easily recognizable base of the Hutton sandstone. The lithological description starts with the rocks immediately underlying unit T: in the wells on the western shelf, these are basement in Boomi No.1 and basement and a thin remnant of unit R in Wunger No.1; in Minima No.1, they belong to unit R, and in the others, to unit S.

The corresponding lithological units of the wells, are described in ascending order.

Basement

In Boomi No.1, the basement consists of a coarse hornblende-biotite-granite. The finely twinned plagioclase is often zoned, suggesting a relatively shallow intrusion. Apatite and titanite are significant accessories.

In Wunger No.1, very dark grey slates, similar to the Timbury Hills Formation on the Roma High, form economic basement. Folding produced steeply dipping schistosity and epimetamorphic minerals and textures.

A similar rock appears in the basement of Weribone No. 1.

Unit R (Upper Permian)

In Minima No.1, on the east side of the basin, this unit directly underlies unit T. The uppermost very tuffaceous conglomeratic sandstone is similar to the TL-sandstone (Showground equivalent) of Flinton No.1, though

it appears to be consistently more tuffaceous. Palynological evidence on cuttings 6180-6180 and coal seams farther down suggest that it is Upper Permian. A greenish white shale, core 5, 6195, according to X-ray diffractometer analysis, consists mainly of poorly crystallized illite. Fine imbricated streaks could indicate altered volcanic shards.

In Wunger No.1, 15° of brown grey, very dense, waxy montmorill-onitic (determined by X-ray analysis) shale overlies basement. Scattered in the very fine matrix are vermicules of coarse montmorillonite and bundles of carbonate fibres. This tuffaceous shale with dirty coal seams also suggests Upper Permian.

Unit S (mainly Lower Triassic)

This unit is present in wells closer to the centre of the basin: Weribone No.1, Coomrith No.1, Flinton No.1 and Cabawin No.1. Typical is the high content (more than 80%) of greenish, tuffaceous partly devitrified and rounded clastics. Illitic and chloritic matrix is common, and mica especially biotite, commonly leached or contorted is a regular accessory. Rapid deposition of this unit in a rapidly downwarping basin prevented development of small scale bedding.

In Weribone No.1, the unit has some glauconite, which may have formed from glass; the grains have impure cores and clean rims. Interbeds of brown-grey, rarely pale green, shales are minor.

In Coomrith No.1, the tuff clasts locally contain illite and chalcedony rosettes. Acid plagioclase, and quartz are rare and may be resorbed by authigenic calcite.

Unit S in Cabawin No.1 is very thick (more than 2300) and is described in Fehr and Bastian (1962). Palynological evidence from the Cabawin East No.1 well (at 7700' spore zone Tr. 1b, pers. comm. P.R. Evans) shows that in these wells only the lower part of unit S is present and that a time equivalent of the Showground Sandstone (see below) is absent on this side of the basin.

In Flinton No.1, unit S becomes very shaly towards the top; pale green, reddish and dark grey shales are predominant with a few interbeds of very tuffaceous sandstone.

Unit T (Middle-Upper Triassic)

Over the region studied, the sequence of different rock types in this unit remains remarkably constant and the definitions of the subunits T1-T4 are the same as in I.F.P. report AUS/84. These subunits are significantly thinner in marginal parts of the basin. However the thinning of the unit in Boomi No.1 is mainly due to deep truncation. In the centre of the basin, a further subunit T5 increases the total thickness of T considerably. Depths to subunits and their thicknesses are given in Table A.

Subunit T1:

This subunit is composed of a lower sandy part (Showground equivalent, top is line 1) and a very consistent shall upper part. In Minima No.1 and Cabawin No.1, only the latter is present.

In Weribone No. 1 (as in the Sunnybank wells to the north), the lower quartz sandstone shows loose packing; the few contacts between the grains are

TABLE A
DEPTHS TO AND THICKNESSES OF UNITS

	U.K.A. Wer K.B. 1115	ribone No.1		lunger No.1		oomrith No.1	EI .	abawin No.1	D)	linton No.1 a.s.l.	IL.	•	U.K.A. Bo K.B. 611	
Uni.t	Depth to Top and Bottom	Thickness	Depth to Top and Bottom	Thickness	Depth to Top and Bottom	Thickness	Depth to Top and Bottom	Thickness	Depth to Top and Bottom	Thickness	Depth to Top and Bottom	Thickness	Depth to Top and Bottom	Thickness
С	5936		5646 ¹		6633 '		6092		6302		5112 †		4870	
B 2	5936 '- 6084 '	148	5646° 5764°	118'	6633 '- 6820 '	187	6092 ' - 6299 '	207	6302 '- 6507 '	2051	5112 ' - 5312 '	200 '		, .
B1	6084 '- 6280 '	196'	5764°- 5842 °	78:	6820 ' - 6978 '	158	6299 !- 6691 !	392	6507 '- 6647 '	140	5312 '- 5398!	861		Jackson die 60 Juni 1-4 La 73 de Juni 20 Juni 1900 der 19 der Tale
A	6280 '- 6292 '	12'	5842 '- 5919 '	79	6978 '- 7056 '	78 '	6691 !- 7025 !	334	6647 '- 6705 '	58 ¹	5398 '- 5695 '	297		AND
T 5	ECHANDOSE, DO A. D. SUBJECT				7056°- 7413'	357'			6705 '- 7020!	315 '				
Т4	6292 '- 6556 '	264'	5919 '- 5994 '	75 '	7413¹- 7655 '	2421			7020 '- 7328 '	3081	5695 '- 5775 '	801	4870 '- 4912 '	42 1
Т3	6556 '- 6824 '	268	5994 '- 6168 '	174°	7655 ' - 7910 '	255'	7025 '- 7208 '	183*	7328 '- 7536 '	2081	5775 '- 5956 '	181	4912 '- 5164 !	252 °
Т2	6824 '- 6975 '	151'	6168 '- 6232 '	64'	7910 '- 8100'	1901	7208 '- 7406 '	198	7536 '- 7686 '	150 °	5956 ' 6130 '	174	5164 '- 5353 '	1891
T1	6975 '- 7115 '	140	6232 '- 6304 '	72	8100 '- 8412 !	312	7406 '- 7748 '	42*	7686 ' - 7939 !	253 t	6130 '- 6153 '	231	5353'- 5499'	461

generally large and smooth, but tend to be finely crenulated in presence of some illite. The quartz is poorly sorted or slightly bimodal; inclusions of vermcular chlorite, some chess-board albite fragments and occasional slight elongation of the quartz suggests shedding from an epimetamorphic source. Due to the patchy distribution of the kaolinite, the porosity of the sandstone is fairly high. Fine chips of brown grey and pale green shale may have been derived from the underlying unit S.

In Wunger No.1, the interval starts with a conglomerate consisting of white and yellow pebbles of metaquartzite in a matrix of angular quartz sandstone. The pebbles have stylolitic contacts where illite separates them. Illite coats the walls, and kaolinite occupies the centre of pore spaces. In the typical quartz sandstone, the large contacts of the grains must originate by overgrowth, as crystal faces are commonly developed. The vermicular kaolinite, recrystallized from a primary matrix, was apparently present but did not prevent the overgrowths; alternatively it is possible that kaolinite formed in places after the authigenic quartz. Locally, light brown biotite becomes important; muscovite can appear in two generations as large, partly leached flakes and as wavy fine flakes deriving from illite. Rounded tourmaline and zircon are consistent accessories.

In Committh No.1, the sandstone is more than 200' thick and consists of an alternation of quartzose (up to 70% quartz) and tuffaceous (up to 70% vitric clasts) sandstones. The unit also contains more feldspar (especially K-feldspar, up to 20%) in contrast to Wunger No.1 and Weribone No.1, nearer to the basin margins. Chloritic or kaolinitic matrix may be replaced by brown, abundant calcite which also corrodes quartz grains. Biotite is often leached. Reworked material from unit S may be incorporated in the lowermost sandstone.

In Flinton No.1, the sandstone is thinner and appears to be more quartzose towards the top. Feldspar is only sporadic. The matrix includes illite, kaolinite and minor chlorite.

In Boomi No.1, the quartzose sandstones are very fine, with the grains slightly interlocking. Barite cement may have been introduced during a final hydrothermal phase of the granite underneath.

The uniform, dark grey claystone in the upper part of the subunit produces a very characteristic E-log pattern and appears to have basinwide significance. Even very minor rock types (e.g. the "reversed nose" on the E-log, line 2), can be traced in all the wells studied.

Subunit T2

Typical for the lower part of this subunit are very fine to fine quartz sandstones. The well sorted quartz grains strongly interlock, allowing only minor illite or rare chlorite matrix or films, reducing permeability and porosity to low values. Feldspars are rare, tourmaline and zircon are common and apatite is a rare accessory. Towards the upper part (above line 4), shale interbeds become more numerous and tuff admixture increases. This sequence gives to the unit a typical E-log pattern at the base a rather sudden increase in resistivity (and velocity), decreasing slowly towards the top.

In Weribone No. 1, many subparallel dark shale chips, sharp laminae and flat cross bedding suggest an environment of slightly increased energy with local reworking of the dark shale substratum. Traces of garnet are present.

In Coomrith No.1, the very fine sandstone includes dark shale laminae with horizontal and minor vertical worm tracks. As in Weribone, traces of garnet may be observed.

In Boomi No.1, quantil sandstone bels are minor; tuff becomes more important, but remains below 50%. Core 7 was cut in the more shally-silty upper part. The sharp lamellae of dark shale and very fine sandstone exhibit slumping and scour-and fill structures. Sand laminae in places show a sharp, smooth under-face and a reworked top.

Subunit 13

At the base of this interval, the feldspar percentige increases significantly, especially that of the K-feldspar. There is a lower porous, green grey sandstone generally with more vitric fragments than quartz grains (Top of sandstone is line 6), and an upper, tighter shalp-silty-sandy part. Wear the top is generally tuffaceous sandstone producing a "bell" shape on the E-log (base is line 6A).

In several wells, especially in the centre of the basin, tuffaceous sandstones with heavy chlorite coating on the grains are virtually restricted to this subunit. The coatings consist of very small needles oriented vertically to the grain surfaces. Biotite, a common mineral in this subunit, is commonly associated with the coating.

In Weribone No.1, the change from lower sandy to shalier upper part is present, but somewhat gradational. A typical slight sonic velocity reduction in the middle of the upper shalier part (as in Flinton No.1) is clearly visible.

In Coomrith No.1 and Flinton No.1, the sandier and shalier parts are well defined. The regular chlorite coatings are well developed and very common, the grains are commonly well rounded, and total feldspar content is high. Sporadic garnet may be present.

In Minima No.1, the quartz shows slight elongation, and the percentage of acid plagioclase in the tuffaceous sandstones rises considerably (up to 25%). The lower sandstone contains consistent traces of garnet; the upper sandstone has abundant siderite, occasionally replacing vitric clasts.

In Boomi No.1, the two tuffaceous sandstones have similar E-log character as in Minima No.1, and the upper sand contains abundant siderite as well. The E-log similarities, identical composition, and palynological evidence and the absence of pelletal claystone (see below) exclude any possibility of correlating these sands with those in the Evergreen Formation.

Subunit T4

Compared with T3, the number and purity of dark grey shale interbeds considerably increases in this interval, alternating with thin sandstone beds. This alternation produces characteristic, strong velocity differences in rapid succession on the sonic log. Coal seams appear to become more frequent in a south-east direction. Biotite appears to be less common than in other subunits of T.

The correlation lines 7A and 8 are mainly based on quite similar composition of the sandstones, despite somewhat different E-log character. In the comparable wells Coomrith No.1 and Flinton No.1, based on E-log pattern alone, one might place the sandstone base at 7413' and 7190' respectively, but the position of these sandstones relative to the T4 interval and differences in composition exclude this interpretation. In Minima No.1, close to the unconformity (core 4), a few silicified globular, organic fragments (d 0.08 mm) have been observed.

The characteristic, rapid alternation of thin beds of fine-grained, green grey tuffaceous sandstones and dark grey shales with abundant plant

leaves and coal seams, rare siderite, similar amounts of kaolinite, illite and chlorite, and the absence of primary calcite suggest a deltaic enviroment. Sharp, small scale bedding appears to be minor in these sediments due to repeated reworking by tidal action.

Subunit T5

This interval, present only in Coomrith No.1 and Flinton No.1, consists of three sandstone bodies at the base, a more shaly middle part and sandstones at the top. The average grain size increases considerably in Flinton No.1. The content of vitric fragments in both wells is generally between 50 and 70 percent. In contrast to subunit T4, sandstones are predominant, mainly as thick beds, coal is rarer, and calcite is more frequent. The relatively good rounding of the grains is restricted to the softer tuffaceous material. A slightly higher energy, more aerated (paralic?) environment is indicated.

Unit A (Precipice Sandstone = Lower Jurassic)

This unit shows a radical change in composition of the sandstones. Quartz content becomes consistantly high, more than 90%; sorting is poor, with an increase of the coarse sand and conglomeratic fractions; better rounding and scarcity of kaolinitic cement produce generally good porosities and permeability, permitting heavy overgrowth and the development of crystal faces on the quartz grains. Feldspar, especially K-feldspar, is consistently present, but rarely more than 10%. Besides rounded tourmaline and zircon, angular garnet is a characteristic accessory.

In Weribone No.1, the quartz sandstone is present with all its characteristic features, but is thin, as in all the wells on the Roma High (see Fehr and Bastian 1963).

In Wunger No.1, the quartz sandstone (5842-5919') is porous, well rounded, and garnet is common, in contrast to the sandstones underneath. Kaolinite or silica cements are frequently replaced by calcite. Despite its marginal position, the Precipice Sandstone here has a thickness comparable to that in Coomrith No.1.

In Coomrith No.1, the cuttings around 7000' contain typical quartz sandstone, but core No.1 contains up to 50% of tuffaceous clasts and finely scattered chlorite producing a greenish colour. Despite these lithological similarities to Triassic sandstones below, persistent angular garnet and palynological evidence both suggest that the unit is Precipice Sandstone.

In Flinton No. 1, the quartz sandstone at 6647 to 6704 has all properties of the Precipice sandstone. However a palynological examination of core 3 gave Triassic age (appendix in U.O.D. 1963). This determination could be compatible with the idea that reworked Triassic rocks are incorporated in Jurassic sediments or, less probably, that deposition of the Precipice Sandstone commenced in Triassic time.

On the east side of the basin, in Minima No. 1 and Cabawin No. 1, the quartz sandstones are typically developed with great thickness and increasing grain size.

Unit B (Evergreen Shale = Lower Jurassic)

This unit has relatively constant thickness (often about 300°) throughout the basin. The base of these dark and fine-grained sediments is transitional to the underlying unit A. The lower half is predominantly silty, the upper half shaly.

Subunit B1

Tuffaceous fine-grained sandstones and medium to dark brown grey siltstones and shales alternate, the latter commonly showing traces of pelletal claystone (see Appx. I.F.P. Rep. AUS/84), probably caved from above. A medium grained, slightly tuffaceous sandstone with a typical E-log pattern appears consistently in the lower half of this interval (base is line 11). Thin coal seams or lenses suggest an environment similar to that of T4.

Subunit B2

The base of this subunit is marked by a basinwide thin sandstone bed with particular, petrologic features. It is a very porous quartz sandstone; the quartz grains show all stages of rounding from angular to well rounded, and appear therefore in average to be somewhat less rounded than the Precipice Sandstone. The feldspar content is commonly lower than in the Precipice Sandstone. In the centre of the basin, the quartz sandstone shows a tendency to split into several thinner sheets. Pelletal claystone and coliths seem to come from this interval; this was substantiated by the shallow drill-hole B.M.R. Taroom No. 29 (Appendix in Jensen et al, 1964).

In Flinton No.1, pellets first appear in cuttings from 50° above the top of the sandstone.

Dark grey illitic, slightly chloritic shales and siltstones make up the bulk of this interval, but it is slightly more sandy towards the top.

In core 2 of Flinton No. 1, the high organic content of the sediments offered suitable conditions for burrowing and churning organisms.

In Minima No.1, this interval becomes increasingly sandy, but the basal sandstone still shows up well.

In general, B2 maintains greater constancy in thickness than B1 throughout the basin.

<u>Unit C</u> (Hutton Sandstone = Lower-Middle Jurassic)

In all the wells, the base of this unit is clearly marked. consists predominantly of thick beds of white quartz sandstone containing scattered quartz granules. Quartz grains are less rounded than in the Precipice Sandstone. Feldspar and tuffaceous fragments are almost absent in the finer fraction, but rare fragments of metamorphic rock appear (quartzite, Patchy, coarse kaolinite coats the pores, and there are schists, slate). some thin illite laminae which tended to initiate microstylotic contacts between the quartz grains. Coarse flakes of muscovite, partly leached or swollen, sporadic light brown biotite and traces of garnet all suggest a metamorphic source for the sandstone. A light brown to greenish mica of low birefringence appears to be diagenetic. Streaks of calcite cement are common throughout. Core 1 of Minima No.1, (4773'-4789', not on diagram) contains conglomeratic sandstones with pebbles of white or pale green sheared quartzite, white milky quartz, grey chert, soft white shale (possibly derived from vitric tuff) and big lumps of squeezed dark grey shale (d - 7cm), in a medium to coarse grained quartz sandstone matrix. At 4775°, there are intercalated thin and sharply defined shale beds showing low angle cross bedding and slumping.

CONCLUSIONS

Microscopic work on Triassic and Jurassic sediments in the southern Bowen-Surat Basin and the presentation of the observations on diagrams with the support by Schlumberger logs and palynological evidence allow recognition of several characteristic lithological units with similar or comparable development in time. However their lithofacies and thickness are affected by their position in the basin and relative to the generally slight vertical movements.

Delineation and downwarping of the basin were particularly accentuated in the Lower Triassic, with the deposition of thick tuffaceous sandstones and conglomerates in depressions in eastern parts of the basin, onlapped by finer sediments (pale green, reddish shales and tuffaceous sandstones) towards the west (Unit S). On the east flank of the Roma High, the top of this unit appears to be truncated, up to 230' between Combarngo No.1 and Sunnybank No.1 (Bastian, p.31). Weribone No.1 is similar in both lithology and thickness to the latter well. Coomrith No.1 is not suitable for comparison, as it bottomed in 15' of unit S. Flinton No.1 is more shaly than Weribone No.1. In the marginal wells Wunger No.1, Boomi No.1 and Minima No.1, unit S is truncated or was never deposited.

The sandstone at the base of subunit T1 (Showground equivalent) occurs only in western wells, thin and quartzose in marginal parts on the Roma High, thicker and with a tuff admixture nearer the centre of the Basin. The overlying very dark grey, pure claystone of regular thickness was deposited in a basinwide, poorly aerated, calm fresh water body. Even very thin sandstone interbeds extend over great distances.

Very fine pure quartz sands of T2 (in Boomi No.1 with some tuff admixture) were deposited on a base-levelled topography our the same area as T1 but in a more agitated environment. Towards the top, calmer conditions with increased deposition of dark shales favored the activity of burrowing organisms.

With renewed subsidence during deposition unit T3, new provenance areas shed polygenetic, feldspathic and tuffaceous sands. The regular chlorite coatings on the grains in this subunit, one of the few markers at a microscopic scale, appear to be of parasedimentary origin and were precipitated when the tuffaceous sediment was still unconsolidated in basinward areas. The unit was probably deposited in lacustrine conditions. In more marginal areas, siderite formed in a slightly reducing environment and was possibly remobilized during diagenesis.

Thinly interbedded fine grained tuffaceous sandstones and dark shales in T4, giving a characteristic sonic log pattern and increasing coal seams towards the centre of the basin and towards the south suggest a slightly transgressive phase with local marine incursions on a deltaic environment, and some reworking of the sediments by tidal action.

The sandier, more thickly bedded and less coaly subunit T5 was accumulated near the basin axis under slightly higher energy (paralic?) conditions with better aeration on the site of deposition.

With further regression at the close of the Triassic, a long time of base levelling set in, producing a mature, low relief topography. After slight movements on the west side of the basin, an extensive river system in Lower Jurassic time deposited repeatedly reworked blankets of quartz sand. These are thicker in the east, thinner in the west (unit A), and overlie various lithological units on a basinwide unconformity. The amount of accessory garnet increased sharply at this time.

In B time, especially in B2 time, the sea encroached on the basin, permitting deposition of fine-grained, uniform and widespread sediments. Shallow depth with wave action is indicated by a very extensive quartz sand sheet associated with pelletal claystone or oolites at the base of B2.

The sudden shedding of uniform, thick fluviatile quartz sandstone in unit C time might be related to a renewed strong upheaval on the west side of the basin. The degree of grain rounding at this time was less than the Precipice Sandstone suggesting more rapid and persistent deposition of sands, in part from metamorphic sources.

The area of Boomi No. 1, in high position since T4 time, was levelled down before receiving thick sediments of unit C.

In the wells studied, only the basal sandstone of T1 (Showground equivalent) on the western side of the basin produced some gas in Weribone No.1 and a subcommercial quantity of oil and gas in Wunger No.1. The relatively thin, but persistent dark claystone above it appears to provide a favourable cap rock for migrating hydrocarbons.

The main results of this study are that, apart from the marginal well Boomi No.1, the Precipice Sandstone with characteristic properties is present in all the other wells studied, thick in the east and thin in the west. This basinwide sandstone overlies with an important unconformity the tuffaceous Triassic sediments. Truncation of numerous readily identifiable beds in the Triassic sequence can be seen and there is no evidence of lateral intertonguing of the two facies.

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LITHOLOGICAL REFERENCE



Sandstone, medium to coarse



Sandstone, very fine to fine



Siltstone



Shale, Claystone (pelletic)



Coal seams, lenses



Conglomerate



Granite



Slate



Fluorescence (hydrocarbons)

ABBREVIATION LIST

abd	Abundant	kaol	kaolinite
Ab	above		
acc	accessory	lam	laminae, lamellae
aggl	agglomerate	lim	limonite
And	andesite	loc	locally
ang	angular	lt	light
Ap	Apatite	•	
		m	medium
Bi	biotite	met	metamorphic
blk	black	Mic	microcline
brn	brown	mod	mçderate
C, c	coal, coaly	Mu	muscovite
Calc	calcite, calcarepus	mx	matrix
carb	carbonates	Myr	myrmekite
cem	cement		
Chalc	chalcedony	occ	occasionally
Chl	chlorite	ogr	overgrowth
cgl	conglomerate	•	_
coatg	coating	Plag	plagioclase
crs	coarse	por	porous
		.	•
deb	debris	$\mathbf{Q}_{\mathbf{Z}}$	quartz, quartzose
detr	detrital	42	4 2, 4
dissem	disseminated	r	rather
Dol	dolomite	rd	round
201		rp	replacing, replaced
ep	epidote	- 4	101100118, 1011110
esp	especially	S, s	sand, sandy
Cap	Opporturi	Sh, sh	shale, shaly
f	fine	Sid	siderite
fe	ferruginous	Sil	silica
ff	very fine	sl	slightly
flm	films	sltst	siltstone, silty
Fos	fossils		spot
		sp +	sandstone
frag	fragments	sst -+	sandstone
fsh	fresh	st 	
Fsp	feldspar	str	streaks
Ø		stylo	stylolites
Gar	garnet	Т	tourmaline
G1	glass		titonite
Glauc	glauconite	Tit	
glob	globules, glimbular	tr	trace tuffaceous
gran	granular	tuf	turraceous
gr igr	graphic intergrowth	33	
grn	green	unbd	unbedded
grs	grains		
gy	grey	v	very
Hbl	hornblende	wh	white
hd	hard		
		X	crystal
Il	illite	xbd	crossbedded
intercal	intercalation		
interl	interlocked	yl	yellow
isotr	isotropic	Zir	zircon
	-		

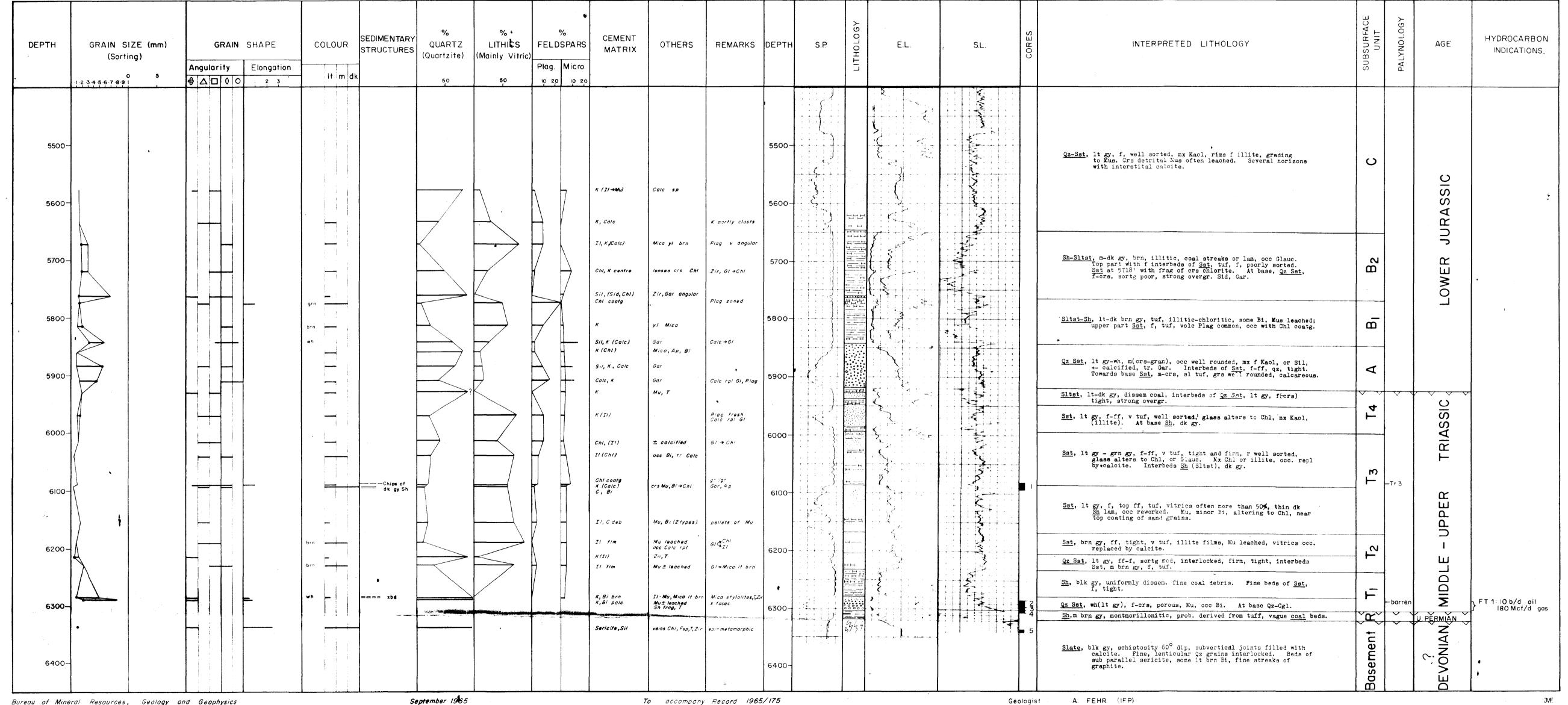
WERIBONE 1

Lat. 27° 19' 38"S Long.149° 21' 02"E K.B. 1115'

DEPTH 1	GRAIN SIZE (mm) (Sorting) 5	GRAIN SHAPE Angularity Elongation Angularity 2 3	COLOUR SEDIMEN STRUCT	RES	% % LITHICS FELDSPARS Mainly vitric) Plag. Micro. 50 10 20 10 20	CE M ENT MATRIX	OTHERS	REMARKS	DEPTH	S.P.	LITHOLOGY	E.L.	S.L.	CORES	INTERPRETED LITHOLOGY	SUBSURFACE UNIT	PALYNOLOGY	AGE	HYDROCARBON INDICATIONS	
-5900			wh			K, ChI	Mu, Bi, Gar	some Quartzite Mu swelling Bi str leached	5900-					2	Qz Sst, wh, m-crs, many overgrowths, but brittle, sortg poor, Mus, minor lt brn Bi, cement patches of Kaol (col), tr. Gar. Interbeds of Sltst, brn gy, coal lam.	U		ပ	◇	
6000			wh			K (GhI)		some Qz granules	6000-						Sh-Sltst, m-dk brn, dk gy, illitic, with c streaks or lam, minor lt grn gy, occ Clauc, with brn grn core and lt grn rim, some beds of QzSst, lt gy, f-m(crs), tight, kaol. At the base Qz Sst, f, well sortd, subrd, strong overgr, Kaol, granule streaks.	B2		JURASSI		
- 6200 - 6100			wn					•	6200-						Sltst(Sh), m-dk brn gy, coaly deUris, with occ Sh, pelletic, upper part with thin beds of Sst, ff, lower part more shaly, coal seams.	j i		LOWER	₩	
- 6300			wh				T, Gar Bi, Mu stylolites		İ		0. 00				Qz Sst, lt gy, m-crs, subrd, sortg poor, grains loose, prob with abd clay mx, tr. Gar. At the base, Sh, dk gy, illitic, (Glauc). Qz Sst, wh, m-gran, sortg poor, subrd, porous.	√ 4,	V V	· · · · · ·	.	
64 00			できる。	•		Il fim		GI+ChI, Perthite GI+Glauc							Sltst-Sh, m-dk gy, brn, f c streaks, v tuf, vitric clasts altering to Chl, occ. Glauc. Mx illitic, less Chl. Numerous thin interbeds of Sst, lt-m gy, v tuf, f, and, Bi lt brn, Mus. At base Sltst, m gy, occ Glauc, with intercal of Sst, grn gy, v tuf, with Chl coatings, fine Sh chips.	Т4				
6500 6600			grn			II, (Glauc) Chi, (coatg) Chi, Sh chips K, Chi fim	Mica grn Calc, leaves	poly ge nic	6500					■ 3			, M-L.U Tr	TRIASSIC	•	
 6700			grn xbd fl			II.	C deb.Mu Glauc, C	GI + ChI Sh, chips GI + ChI + Glauc GI + ChI	6700					4	Sst, lt gy-grn gy, f-ff, tuf-v tuf; in upper part sortg good, vitric frag in different stages of devitrification and chloritisation, giving to rock greenish colours. Some Feldsp, Mus, occ Bi, grn brn, leached, and green mica. Mx illite or Kaol, partly calcified. F c debris in thin lam, xbeddg and dk Sh chips. Towards base, some intercal of Qz Sst, ff, with overgr; f interbeds of Sltst, m gy, tuf, illite mx, some Glauc.	T3		UPPER T		
 68 00			grnxbd fla			K II→Mu, C K, Colc, C	Mica, C deb Mu, Calc Mu, Bi It brn Bi, Mica grn Mu, (Chl) Mu, Bi Mu, (Gar)	bimodal GI →ChI Sand lam occ ogr, tr Gar sharp Sh lam	6800-				A A A A A A A A A A A A A A A A A A A	5	Sst, wh, f-m, sl tuf, grs interlocking, v tight, some Feldsp, mx Kaol, patchy Calc, tr. Gar; interbeds of Sst, ff, v tuf, mx Chl, illite to Mus, Glauc.		_M. Tr	MIDDLE -		
 6900			-				Mu, Zir,T	1	6900-						Qz Sst, v lt gy, ff, well sortd, grs interlocked, thin Chl films: At top more vitric frag, large chips of Sh, dk gy, minor chert peb.	T				
- 7000							(Mu) Mu leached		7000				\$ 1 \$ 1		Sltst, lt-m gy, tuf, mx illite-chlorite. Towards base Sh, blk gy, Kaol with f c debris. Interbeds of QzSst as above.	<u> </u>				
-7100			grnsh chips				Mu, gr igr Mu leached	bimodal Rhyolite, Zir, T Glauc	7100-					7	Qz Sst, wh gy, f-m(crs), sortg poor, occ bimodal. Grs often elong, large contact, but loose packing, occ chips of Sh, dk gy.				FT 1:150 Mc.f./d. Gas	
-7200 -7300			grn grn				Mu, fine Bi, Calc	frag Sh,Chaic	7200- 7300-					8	Sst, ff(-m), m gy - lt grn gy, v tuf, vitric frag often altered to f grn mica or Chl, occ Glauc with impure core, clean rim. Mx f illite and Chl, scattered leached Mus; frequent transitions to crs Sltst, brn gy, minor grn gy. Interbeds of Sst,m (cgl), lt grn gy, v tuf, f Mus, minor Bi, Chl coatings. Intercal of brn gy, minor lt gy-pale grn Sh. Micro-crystalline cuttings may also derive from pebbles of Cgl.	S		OWER TRIASSIC	∴	
—7400 Bureau of M	Mineral Resources, Geolo	gy and Geophysics		Sep	ptember 1965				7400-	o accompany	Recor	rd 1965/175			Geologist : A. FEHR (IFP)			CO	JMF:	

Lat. 27°40'45" S Long.149° 07' 34" E K.B. 1005

WUNGER



K.B. 875'																	———		
DEPTH	GRAIN SIZE (mm) (Sorting) 1:2:3:4:5:6:78:9:1	GRAIN SHAPE Angularity Elongation ♣ △ □ ○ ○ ! 2 3	COLOUR SEDIME STRUC	TURES	(Mainly vitric)	% FELDSPARS Plag. Micro.	CEMENT MATRIX	OT HERS	REMARKS DEF	PTH S.F	LITHOLOGY	E.L.	S.L.	CORES	INTERPRETED LITHOLOGY .	SUBSURFACE UNIT	PALYNOLOGY	AGE	HYDROCARBON INDICATIONS
. 6600-	1234343						(K)	Caic	Quartzite, Schist			1	CAN A MAN A		Qz Sst, lt gy, ff-m, subang, we like strongly interlocking, rendering rock firm and tight, grandles of strained Qz. Intercal of lt-dk brn gy illitic Sh. Time coal debrie. Kinor transitions to Sst, tuf, illite mx.				
6700—							K, II, Calc ^a II, Chi, Mu Calc rpi K Calc, Chi, Ii, (Fe)	Zir, Bi leached GI→Glauc leached mice	Gar angular acc Sid glab 670 Calc rpl Qz	00-				, righter :	Slist-Sh, lt-m brn gy, tuf, coo. Glauc, or siderite glob: at the upper part, intercal of Set, f-ff, tuf, ang, fresh andesine common, abd Kaol as frag or cement, occ repl by calcite. Acc. zircon, garnet.	U		JURASSIC	
6800							K (II) K K, Bi →Chi	Gar, g r i g r	Oz heavy ogr 680						Qz Sst, wh gy, m(-f), grs subang - rounded, often poor sortg, porous, but loc with heavy overgr, xfaces. Cement ors Kaol, Chl. Winor Sst, tuf, crs, acc. Gar, and Sltst, dk gy occ. pelletic.	B ₂		OWER .	
6900—						/ \	II (Im	Glauc occ Colc (pl	1 1	00-					Sltst-Sh, lt-dk brn gy, occ pelletic, tuf, illitic mx, f Mus, coal debris, intercal Sst, ff, v tuf; below 6900', Sst, why gr, sl tuf, f to ers towards base. Karl cement partly repl by calcite.	, B		J	
7000-			grn				K (Chi rims) K patchy K patchy Calc	Bi, Gar Calc,Bi,Mu Gar Gar	Calc rpi Gi m# Gi→Chi Calc rpi clasts	00-		2			Sst, lt gy to grn gy, f-m, occ. crs-perbly, qz or arkosic; calc.cem, at the top <u>Qz-Sst</u> , f, very porous, but overgr; acc. garnet.		− J1		
7100— 7200—							K-Chi Caic	+ And frag Mu C deb Glouc	Ap, Zir Plag occ zoned GI→II						Sltst-Sh, lt-dk brn gy, tuf. illitic mx, some Plag, occ Glanc. tr. Mus. Upper half interbeds of Sst, f-ff(m), it gy, tuf, strong calcite cem repl clasts. Plag occ volcanic, few coal seams. Lower half, clean illitic Sh with f lam of c debric.	5			
7300—							II, Mu (Caic) · K (II)	Bi grn Mu	000 Calc 73(00					Sst, it gy, ff-f, scrtg mod, v tuf, with Plag, alternating with Sltst, m dk gy, lam c debris.			<u> </u>	
7400—							II Chi	Bigrn, Mu	G1=Glauc, tr Qz-5st						<u>Sst</u> , lt gy, f-ff, v tuf, sortg good, grs occ. subrd, illite, Chl, Kaol, grn Bi, glase altering to Chl.			•	
7500 —	Annua originatus troppula sistematika, siatuka antaka siatuka siatuka siatuka siatuka siatuka siatuka siatuka si		unbd				II, K, Coic K (Chi) II fim	Glouc, Sid, Ap	750 61 → Quartzite					<i>a</i>	Sltst-Sn, m-dk brn gy, (lt gy), c debris finely dissem, lam or lenses. In upper half thick, in lower thin intercal of Sst, wh gy, v tuf, with often fresh Plag; occ Flauc, Sid patches, illite mx. calcite frag with cone-in-cone str. At 7540', Sst, m, qz, poor sortg, sl interlocked, microcl. Kapl bement, towards base it brn di.	1	-Tr3	SIC	
7700-								Mu, Bi It ben Colc, Zir Colc	31 → Mu Plag occ zoned G1 → Mica grn Or met	200					Sst, lt gy, f-m(crs), common licr, Onl cem, tight, towards base porous, Kaol cem, repl by condite.			7 TRIAS	
7800—			grn few Sh 10	nses			K Il coatg (Calc) Chi coatg	(Calc) Bi II brn Calc	78	00-					Sltst-Sh, dk (-x)gy, grn gy, scal debris, tr.2prite. F interbeds Set, ff-f, v tuf, well sorted. Mx Kaol, minor illite films, calcite patches.	<u>F</u>	— Tr 3	- UPPE	
7900—	·		grn				Chi, K , Caic Ii Chi coaig	Mu. (Gar) K	Calc rp/ GI						Sst, m gy-grn, f, well sorted, tuf, Col coatings, frag of crs Shl, at base Sltst, dx gy. Sst, lt gy, f(-ff), towards base ors admixtures, porous, occ zoned Plag, Shi coatings, acc Sar.			AIDDLE .	
			(grn)				Chi, Ii Chi coatg	Glauc Bi	G! →G!auc						<pre>Sst, lt(grn)gy, ff(f), often subrd, v tuf, occ Glauc; interbeds of</pre>			2	
8000-			Sh I wern	m bores	7		II (→Mu) K (GhI,II)	T, Zir C deb,Mu,Bi Calc lanses	6ar, Zir, T	00-				4	<pre>2z Sst, lt gy, ff(-f),well sortd, interlocking by dissolution,</pre>	7	Tr3		
8100-							K, palchy	tr Chi, Mu	810	00-	From Bright State of the Control of				Sh-Sltst, upper half m-dk brn Sltst, tuf, coal lam, some Glauc, interbeds of Qz Sst, ff, tight; lower part Sh, v dk brn gy, uniform, Sid rosettes.				
8200- 8300-			-				Calc K (Chi) Calc Chi (K) Chi, K (II)	Sphene Colc sp Bi leached Bi (Mu) Bi lecched	Mu Colc (p) qz	00-					Sst, f-m, wh gy, sl tuf, Feldsp common, often abd, brn crs calcite cement, repl glass or corroding Qz and Feldsp. Loc glass alters to grn mica or Glauc. Minor interbeds of Qz Sst, f, Kaol'cem, tr. Bi. Few beds of Sltst, dk brn, Sid rosettes; towards base Sst, grn gy-multicolored, m-cgl, v tuf, pebbles and granules of It grn and milky Qz or chert.	F			
8400- 8500-			grn unbd	•	·		II 11m	Bi,Ca le gr igr	GI→Quarizite acc Sh frag	00-				5	Sat, gy grn, f-crs, poor sortg, v tuf, mx illite, contorted Bi, glass different stages of devitrification.	, w		LOWER	
Bureau of	Mineral Resources,	Geology and Geophysics			September 196	5			To ac	company Re	cord 1965 /	175			Geologist: A. FEHR (IFP)				JMF.

DEPTH GRAIN SIZE (mm) (Sorting) 0 5	GRAIN SHAPE Angularity Elongation ♣ △ □ ○ ○ 2 3	COLOUR SEDIMENTARY STRUCTURES It m dk SEDIMENTARY QUARTZ (Quartzite) (Mainly Volcanic Glass) 50 50 50	% CEMENT MATRIX Plag. Micro.	OTHERS	EPTH S.P	LITHOLOGY TITHOLOGY	S.L.	INTERPRETED LITHOLOGY	SUBSURFACE	AGE AGE	HYDROCARBOI INDICATIONS
6300-		wh Sh chips	К (СПІ) ІІ (СПІ)	Mu i leach e d	6200			Qz Sst, lt gy, f- crs, grs subrd-subang, in places interlocking (by dissolution?).	O	<u>5</u>	
6400		Durrows ?	K, Chi Calc, K II (Fe) K, Mu	T, Zir Gl→grn Mica Gl→Chl rims Zir, X faces	,			Sh-Sltst, m-dk gy, tuf, fine coal debris, occ reworked, worm burrows. Intercal Sst, ff, tuf, lt gy, tight towards top. At 6390' Qz Sst, lt gy-cream, f-m, poor sortg, calc cem, porous. Qz Sst, v lt gy, m-crs, (f-gran), subrd grs occ overgr. Intercal of pelletic Clst-Sltst, gy to gy brn, occ Glauc.	B2	WER JURASS	
6600		xbd	K, Calc K (Chi) K, Calc (+Gi) Calc (K) Chi, (K) K(Calc) K(II)	Bi, Zir, (Glauc) Gar, Myr (Mu) Plag zoned (Mu) Mu, Bi, Ep	6600			Qz-Sst, lt gy, ff, subrd, tight, tr. Gar, frag Myrmekite. Sh-Sltst, m-dk brn gy. Sst, lt gy, f-m, sl tuf, calc cem, occ overgr. Sh-Sltst, m-dk brn, thin intercal of Qz Sst, ff, or Sst, f, sl tuf, with abd zoned Plag. 2 Sst, wh.gy, m-crs, very porous, subrd to subang, overgr or xfaces.	B B	N	
6800		gy/grn .	K, Bi (leached) K, Ti, Calc	Mu, Sphene GI → Chi → Glauc Mu, Bi, Glauc frag Qz-Mic igr GI → Ch!	5800			Sst, why gy, f(m), tuf, few gy - dk gy grs in wh mx, occ thin coal lam. Sltst-Sh, coal debris, dk gy, illitic, micaceous, occ Glauc. Sst, wh gy, lt grn, occ dk gy, f(-m) tuf, subrd, sortg poor, well cemented by Kaol; thin interbeds of Sltst, m gy, tuf, occ calc, Glauc. Basal coal seam.	T ₅		
7100-		gy/grn ===	Calc rpl Gl Calc rpl Gl, K K, Sid lenses II, Chl	Bi, Mic - Qz igr	7000			Sst, lt gy, few grn gy grs, tuf, m-crs, subrd, calcite repl often vitric clasts. Few strongly indurated beds, some Sltst and Sh beds. Sltst-Sh, m-dk brn gy, f c debris, thin Sst lam. Sst, lt gy, f(-m), tuf, vague beddg, Kaol cem, Sid lenses. Sh-Sltst, m-dk gy, brn, mx illite-chlorite; manuseams or lenses of blk coal. Thin intercal of Sst, tight			
7300			Sil Chi ccatg, II, Cala		200			Sst, lt gy, wh, minor lt grn grs, tuf, f-ff at top, f-m in main part. Towards base Qz Sst, f, subrd, overgr. Minor thin interbeds Sltst-Sh, m-dk gy. Sh-Sltst, lt-m brn gy, dk gy, fawn, occ grn, illitic, f c debris, intercal of Sst, v tuf, f (ff-m), wh or lt gy, few lt grn grs, tight, occ Chl coatings, calcite, Glass may alter to Glauc. Several seams of blk coal.	T 4	R TRIASSIC	
7500		grn gy unbd	Ghi, Ii R, Chi cootg K, Chi cootg, Coic	Bi, C deb				Sst, lt grn gy, some wh, green, dk gy, rare orange grs, tuf, m(-f), sortg mod, ang, Feldsp common, frag of kyr, graph intergr from granitic source, coating of Chl. At the top more Qz, towards base finer, butter sortd. Sst, why gy, f-m, grs subrd, sortg mod, Chl coatings, Kaol repl by calcite.	T3	MIDDLE - UPPE	
7700-			Chi, Mica grn K patchy	T, Zir, Mu, Bill bin	600			Qz Sst, lt gy, ff(-f), tight, hard, well sortd, Qz interlocked by dissolution, occ thin coal lam, patcay Kaol, thin Chl films, acc. tourmaline or zircon. Thin intercal of Sltst-Sh, dk-m brn gy, number increasing toward top.	T ₂		
7900-			K, Caic II - K, II brn Bi Chi, II Calc K-II	Mutleoched, Si+Chi	700-			Sh-Clst, dk gy-blk gy, illitic with very fine coal debris, occ Glauc. Intercal of tight Qz Sst, ff. Qz Sst, ff-f, tight as ab. and Sst, lt gy, f, v tuf, illitic, minor Kaol mx, tight. Sst, wh gy, f(-m), sortg good and more Qz in upper part; coarser, more congl and poorer sortg, v tuf in lower part. Mx occ. repl by abd calcite, corroding Qz, Feldsp, glass.			,
8100-		gy grn unbd	II, Chi	Bi,Mic →Glauc	A Property of the second secon			Sh, slty, gy grn, lt-dk brn gy, occ reddish brn, with few distinct beds of Sst, lt gy, tuf, cgl.	S	LOWER	

Lat. 28° 21′ 33″ S Long.150° 06′ 54″ E K.B. 691′

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MINIMA 1

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DEPTH	GRAIN SIZE (mm)	GRAIN SHAPE Angularity Elongation A D O 1 2 3	COLOUR SEDIMENTA STRUC TU R	ES QUARIZ	Mainly Vitric)	% FELDSPARS Plag. Micro.	CEMENT MATRIX	OTHERS	REMARKS	DEPTH	S.P.	LITHOLOGY	E.L.	SL.	CORES	INTERPRETED LITHOLOGY	SUBSURFACE	PALYNOLOGY	AGE	HYDROCARBON , INDICATIONS
-5100			-		7		K,(II)	Mu ± leached occ Calc	Micro- styloutes	5100-)				Qz Sst, lt gy to wh gy, f-crs, occ.cgl, poor sortg, mainly unbd, occ. vague x-beddg, Qz few but large contacts, occ. mi-stylo. Mx Kaol, minor illite films, calcite. Tr. Gar, Zir; minor beds of Sh, dk gy with pockets of Sst.	U			
-5200							K (II) (Calc) II→Mu	Zir, rounded T tr Gar	Mu leached, K fraç Oz occ interi GI →II	5 200–						Sltst-Sh, lt-dk brn gy, occ eream, gy, soft, scattered coal debris or lam, fine mica. Interbeds Sst, wh gy, f-m, sl tuf, Qz occ interlocked, overgr, sortg poor, creer fraction st. well rounded. Lower part Sst, lt-m gy, - v tuf, dense, illitic mx, Mus leached, glass often opaque, altering to f mica. Tr. Gar.	B ₂		O	
-5300							K, Caic		Gala rpi K	5300-			i i i i i i i i i i i i i i i i i i i			Sst, lt-wh gy, m-crs(f), sertg poor, bigger grains subrounded, porous parts rich in Kaol, often repl by calcite. Pew Sh beds, coal seam.			RASSIC	
			cream xbd scour - fill		\geq		II,fim K(Calc) II,Calc, C deb	Bi, Calc Gar Mu	K in fraz(Fso?) Plant deb						2	Sltst-Sh, dk gy, tuf, large plant debris, with beds of m gy Sst, ff, v tuf, low-angle xbeds, scour-fill; at 5360' Sst, qz, abd Kaol xx, partly calcified, grs subrd, some microcline altered to Kaol. Tr. Gar.	8	J1	R JUF	
-5400			unbd		·	.	K, Mu	(C str)	lenses Strst microstylalites	5400-					3				LOWER	FT 1: 2700' H ₂ O fsh, strong-medium blow
-5500							K, II fim	I/→Mu	And frag	5500-						Qz Sst, wh gy-cream, lt gy, m-crs(f), often pebbly, v porous, sortg poor, occ. birodal, Qz subrounded with strong overgr and xfaces. When illite lam present, microstyl, some Mus with finer grain. Rare particles of vitric tuff, quartzite or stressed Qz. Common cement crs Kaol, occ repl by calcite which may corrode Qz. In upper half few interbeds of Sltst-Sh, lt-dk gy, and minor Sst lt gy, f, tuf, minor andesite frag and zoned Plag.	4			
– 5600							K (II)	Zir, T, Tit ?		5600-						andesite irag and zoned riag.		ý		
-5700			≈ 1bd		$ \rightarrow $		III→Mu), Sid ↓ Sid agg!	Mu leached	Chert-GI brn	5700-					- ■ 4	Sltst-Sh, lt-dk brn to gy, tuf, f coal debris, minor lam, lenses and some seams. Interbeds of Sst, lt gy, tuf, or chert frag, siderite. At top rare sillcified glob. Fos.	1	Tr3	<u>S</u>	
-5800							K,CAI,II	Sid up to 75%	Mu, Ap, Zir	5800-						Sst, lt gy, ff, tuf, angular, mx f Kaol, Chl, illite, rare leached Mus, glass often repl by Sid.		.113	RIASS	
-5900						\rightarrow	II (Im II,(ChI) II± f	Mu deb ± Glauc, Bi Mu ± leached	tr Gor	5900-	1					Sh-Sltst, lt-dk brn gy, lt gy-fawn, coaly plant debris, tr.pyrite. Sst, lt(-m)gy, ff-f, well sorted, sl tuf, elong grs, occ Glauc. Interbeds of Sst, f, lt gy, qz, with zoned andesine, and regular coatgs of Chl. Acc. subang Gar. In places, ferruginous illite.			PPER TI	
-6000								Mu Z Loce No.	tr Bar	6000-					:	Sst, wh gy, -+ tuf, well sorted, tight. Mx illite, minor Chl, partly repl by calcite or dol rhombs. In upper half, many intercal of Sltst, lt-dk gy, brn, occ grn gy. In lower half, minor interbeds of Qz Sst, (Sltst), well sorted, grs interlocked, f Mus. Acc. Zir, T, Ap.	72	Tr3	DLE - UP	
- 6100					$\Rightarrow $) K	II (K) II (Chi) ± corb K (II)	Zir,T,Mu Zir,Ap,Mu,Bi Calc,Dol,C lam	30% Calc, Dol Mu, gr igr	6100-						•			MID.	
– 6200			II lensas				K frag II, C døb	Calc rpl Gl	GI+ Chert	6200-) (- 5	Sh-Sltst, blk gy uniform, dense, with rare lam of Qz Sst, tight.	1 -	- P3 or P4	R Z N	
-6300								Glouc, Colc		6300-						Sst, wh-lt gy, m-granule size, frag of wh chert, minor cream clay, v tuf. Particles resembling Timbury Hills Fm. Interbeds of green, wh illitic Sh, (prob from vitric tuff) and Sltst-Sh, dk gy and coal seams.	<u>a</u>	l	UPPE	

Lat.28° 45' 27" S Long.149° 33' 40" E K.B. 611'

BOOMI 1

							<u> </u>								<u> </u>	
DEPTH	GRAIN SIZE (mm) (sorting) 0 5	GRAIN SHAPE Angularity Elongation A D O 2 3	COLOUR SEDIMENTARY STRUCTURES	% % QUARTZ LITHICS (Quartzite) (Mainly Vitric	% FELDSPARS Plag. Micro.	CEMENT OTHERS	♥ REMARKS	DEPTH	S. G. G. T. LITHOLOGY	E.L.	SL.	CORES	INTERPRETED LITHOLOGY	SUBSURFACE UNIT PALYNOLOGY	AGE	HYDROCARBON INDICATIONS
4800						K,(II) Mu‡leached Sid sp Ap, Zir	Mic-stylolites	1					Qz Sst, wh gy - lt gy, m-crs(gran), porous, r friable, apart thin // coal streaks, unbedded. Subang, occ. elong, poorly sorted Qz have often large contacts, but overgr rare. Microstylo. Some chert, quartzite. Frag graphic intergr, Mus, Tourm, Zircon. Few interbeds of Sltst, lt-m brn gy.	S	LOWER	
4900-			≡ Sh chips			Sid sp, K Bi, Mu, gr igr Sid sp, K Calc	Αρ , Zir, g r igr	4900			3	6	Sltst-Sh, fawn, lt-m brn gy, with coal lam-streaks, minor interbeds of Sst, v tuf, f, lt gy, often with spots of Sid. Sst, lt gy, f(ff), tuf, well sorted, ang, feldsp, common Sid spots, minor calc cement, often abd Kaol.	-Tr 3		
5000-						II → Mu, c deb Ap (Glauc) Caic (K)	Gl often isatr Gl occ fluidal	5000					Sltst-Sh, fawn, lt-dk brn gy, tuf, f coal debris or lam; f interbeds of Sst, lt gy, f, tuf, occ. subrd Qz or X faces, Kaol cement often repl by crs calcite, occ chlorite mx.	——————————————————————————————————————	ASSIC	
5100-		,				Calc (K) (Chl) K (± Calc) Chl, Bi Calc / K Bi	occ Gar X faces Wica & leached						Sst, wh gy-cream, f(-ff), streak m, porous, subang, Micr common occ Bi, Mu + leached, chlorite; Kaol cement often replaced by calcite.		R TRIA	
5200-			grn ————————————————————————————————————			Calc / K T, Zir, Ap K (Calc) Bi, Mu, leached Chl, K, C deb Mu, Bi, Zir, T K, Calc Chl K (Il flm) Calc sp	occ Fe scour - fill c deb, plag zoned	5300				7	Sst, lt(m) gy, occ. cream, greenish, ff, (streaks f-m esp. in upper part), quartzose in places with Qz interlocked, feldpatic, more andesine towards base. Mx Kaol or illite films, minor chlorite. Upper part abd calcite, some leached Bi and Mus. Lower part occ. abd Glauc. Esp. upper part Sh (Sltst), v dk gy lam, illitic (chloritic), with slumping.	-Tr 3	LE - UPPE	
5400-						II fim, (K) Mic It brn, Bi II Mu, Bi, T Barite, K sp Calc, Chi	oec Glauc Mu, Bi, Zir	5400					Sh, (Sltst), blk gy, uniform v fine coal debris, loc. f mica. Occ. f interbeds of 32 Sst, ff, firm, Qz interlocked. Sst, lt gy - cream, ff, quartzose-sl tuf, Qz subrd-subang, well sorted, often interlocked. Cement, kaol, but often repl	— -Tr3?	MIDD	
5500-	•					Barite, K (II, Chi)	Mu, Bi	5500				8	by barite or calcite. Occ. <u>Sst</u> , f, tuf, + Glauc, sharp interbeds of <u>Sh</u> , dk gy.		ROUS	
5600-				e fe gweg glewerzen (1992) gewerzen.				5600-	X X	v v v v v v v v v v v v v v v v v v v	оменьенто админічні докупійне често інсейнай тивн	Mark o instruction in the second	Hbl-Biotite-Granite, gy-pink, crs. Finely twinned Plag often zoned Acc. Zircon, Apatite, Titanite; weathered at top. Minor variety Hbl-Diorite.	BASEMENT	L. CARBONIFERO	

To accompany Record 1965/175

Geologist: A. FEHR (IFP)

Bureau of Mineral Resources, Geology and Geophysics

September 1965

