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

by

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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 T1-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 T1-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 lithologixal 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).

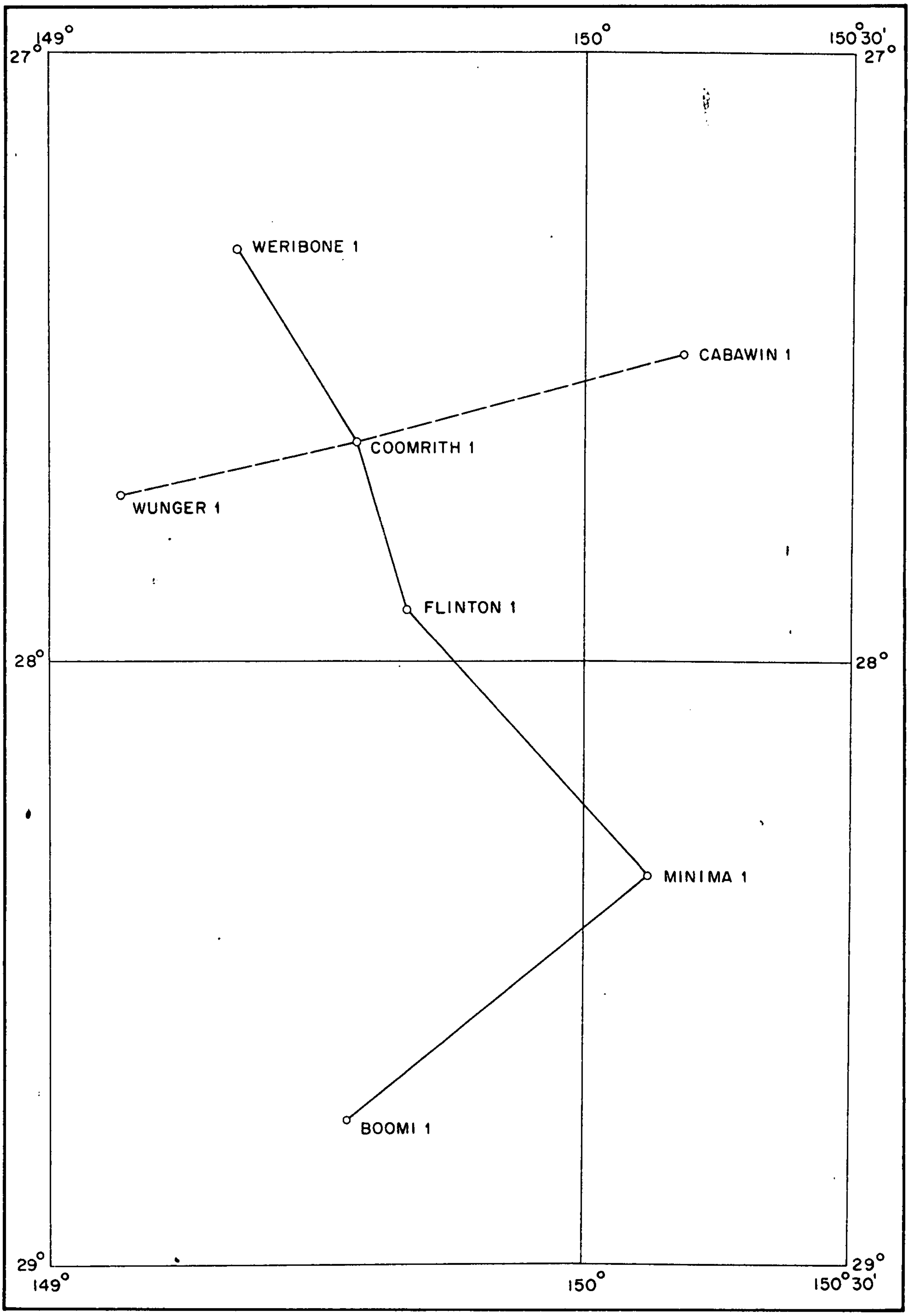
Shales and siltstones (for exceptions see below) do not appear to show systematic variations in their commonly grey to grey brown colours, due to erratic changes in the amounts and arrangement of fine carbonaceous debris. Furthermore they are subject to strong caving in places, obscuring sandstone beds 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.

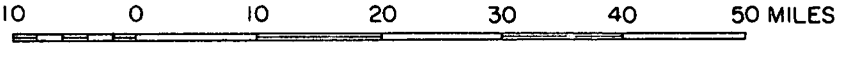
It is evident that the sandstones may vary considerably within a 10' interval and even more in bigger intervals. The sandstone lithology represented on the diagram is chosen to facilitate recognition of main lithological trends in time amd space. All the lithologies observed in a thin section of cuttings 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

FIG. 1

LOCALITY MAP



SCALE 1:1000,000



Bureau of Mineral Resources, Geology and Geophysics *September 1965* *To accompany Record 1965/175* duplication of points at a certain depth would again overload the diagram and reduce its legibility. Therefore, although in each thin 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

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*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 montmorillonitic (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. lb, 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 Tl-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 Tl:

This subunit is composed of a lower sandy part (Showground equivalent, top is line 1) and a very consistent shaly 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

Unit	U.K.A. Weribone No.1 K.B. 1115' a.s.l.		U.K.A. Wunger No.1 K.B. 1005' a.s.l.		U.K.A. Coomrith No.1 K.B. 875' a.s.l.		U.K.A. Cabawin No.1 K.B. 968' a.s.l.		U.K.A. Flinton No.1 K.B. 833' a.s.l.		U.K.A. Minima No.1 K.B. 691' a.s.l.		U.K.A. Boomi No.1 K.B. 611' a.s.l.	
	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
C	5936'		5646'		6633'		6092'		6302'		5112'		4870'	
B2	5936'-6084'	148'	5646'-5764'	118'	6633'-6820'	187'	6092'-6299'	207'	6302'-6507'	205'	5112'-5312'	200'		
B1	6084'-6280'	196'	5764'-5842'	78'	6820'-6978'	158'	6299'-6691'	392'	6507'-6647'	140'	5312'-5398'	86'		
A	6280'-6292'	12'	5842'-5919'	79'	6978'-7056'	78'	6691'-7025'	334'	6647'-6705'	58'	5398'-5695'	297'		
T5					7056'-7413'	357'			6705'-7020'	315'				
T4	6292'-6556'	264'	5919'-5994'	75'	7413'-7655'	242'			7020'-7328'	308'	5695'-5775'	80'	4870'-4912'	42'
T3	6556'-6824'	268'	5994'-6168'	174'	7655'-7910'	255'	7025'-7208'	183'	7328'-7536'	208'	5775'-5956'	181'	4912'-5164'	252'
T2	6824'-6975'	151'	6168'-6232'	64'	7910'-8100'	190'	7208'-7406'	198'	7536'-7686'	150'	5956'-6130'	174'	5164'-5353'	189'
T1	6975'-7115'	140'	6232'-6304'	72'	8100'-8412'	312'	7406'-7748'	42'	7686'-7939'	253'	6130'-6153'	23'	5353'-5499'	46'

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 Coomrith 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, quartz sandstone beds are minor; tuff becomes more important, but remains below 50%. Core 7 was cut in the more shaly-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 T3

At the base of this interval, the feldspar percentage 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 shaly-silty-sandy part. Near 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 ooliths 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.

Unit C (Hutton Sandstone = Lower-Middle Jurassic)

In all the wells, the base of this unit is clearly marked. It 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, schists, slate). Patchy, coarse kaolinite coats the pores, and there are 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 oer 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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No.13: UKA Weribone No.1 (1963)
No.15: UKA Boomi No.1 (1963)
No.18: UKA Flinton No.1 (1963)
No.19: UKA Coomrith No.1 (1963)
No.20: UKA Wunger No.1 (1963)

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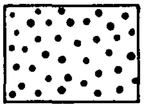
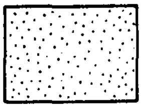
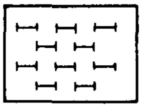
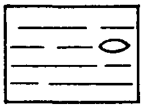
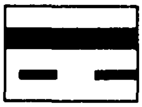
LITHOLOGICAL REFERENCE

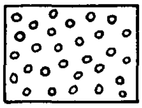

Sandstone, medium to coarse

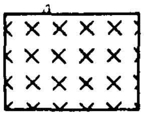

Sandstone, very fine to fine

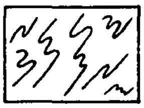

Siltstone


Shale, Claystone (pelletic)


Coal seams, lenses


Conglomerate


Granite


Slate


Fluorescence (hydrocarbons)

Bureau of Mineral Resources, Geology and Geophysics *September 1965* *To accompany Record 1965/175*

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	moderate
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	Qz	quartz, quartzose
detr	detrital		
dissem	disseminated	r	rather
Dol	dolomite	rd	round
		rp	replacing, replaced
ep	epidote		
esp	especially	S,s	sand, sandy
		Sh, sh	shale, shaly
f	fine	Sid	siderite
fe	ferruginous	Sil	silica
ff	very fine	sl	slightly
flm	films	sltst	siltstone, silty
Fos	fossils	sp	spot
frag	fragments	sst	sandstone
fsh	fresh	st	somtimes
Fsp	feldspar	str	streaks
		stylo	stylolites
Gar	garnet		
Gl	glass	T	tourmaline
Glauc	glauconite	Tit	titonite
glob	globules, globular	tr	trace
gran	granular	tuf	tuffaceous
gr igr	graphic intergrowth		
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

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

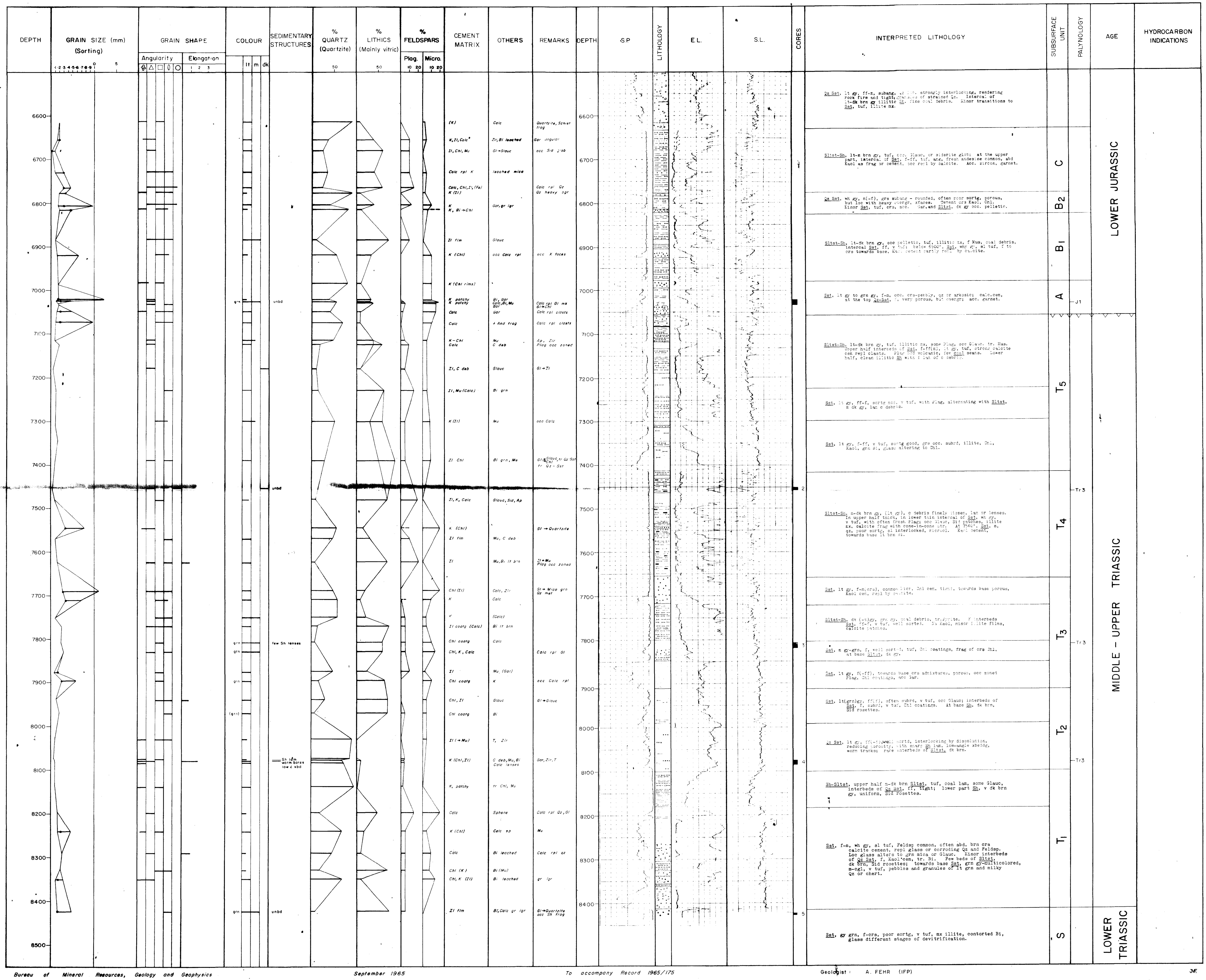
WERIBONE 1

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

WUNGER 1

Lat. 27° 38' 14"S
Long. 149° 34' 08"E
K.B. 875'

COOMRITH 1

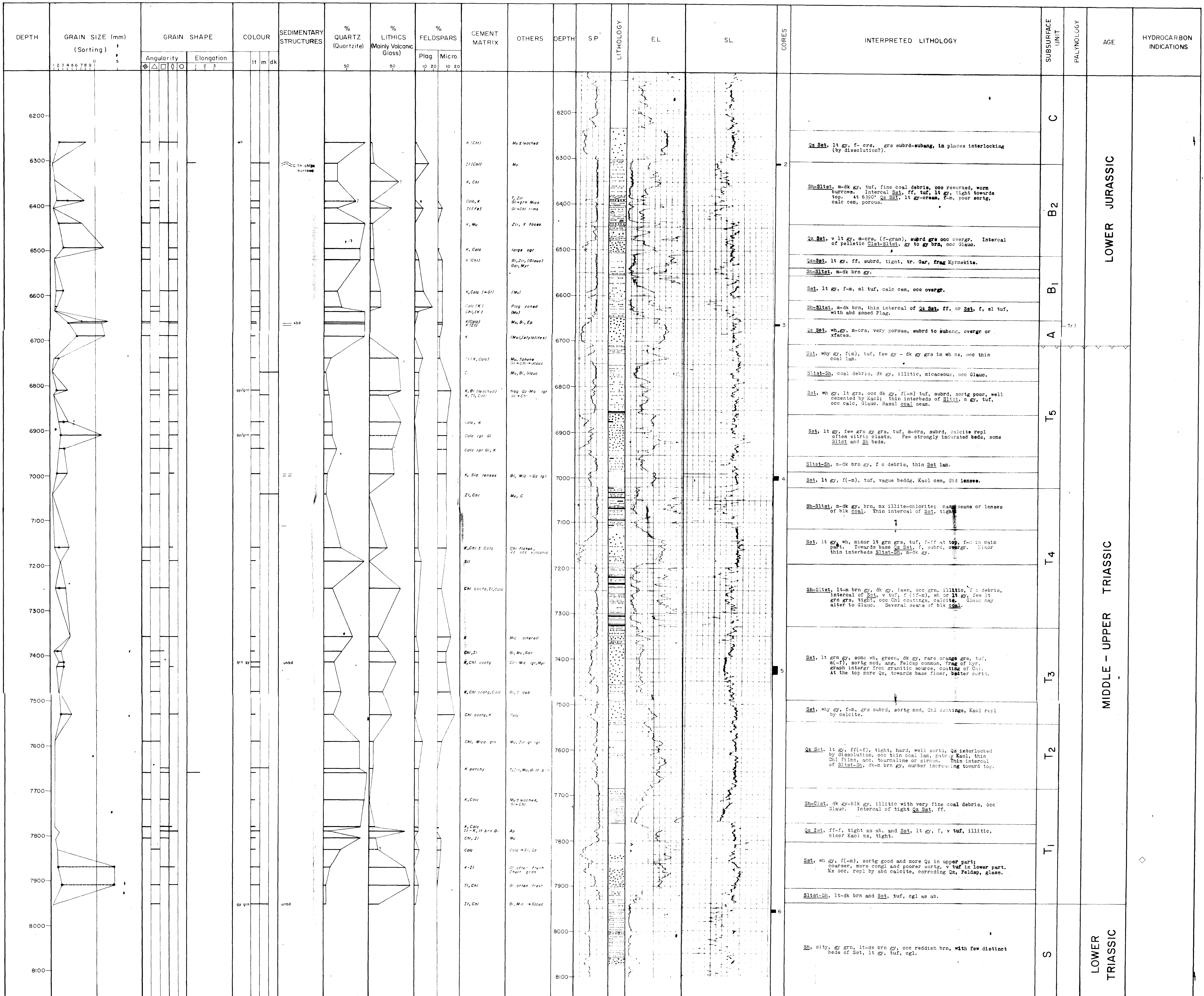


Geologist : A. FEHR (IFP)

Lat. 27° 54' 52" S
Long. 149° 40' 10" E
K.B. 833'

FLINTON 1

PLATE 4



Lat. 28° 21' 33" S
Long. 150° 06' 54" E
K.B. 691'

MINIMA 1

Geologist : A. FEHR (IFP)

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

BOOMI 1

LITHOLOGICAL CORRELATION IN THE TRIASSIC AND JURASSIC OF THE SOUTHERN BOWEN-SURAT BASIN

VERTICAL SCALE 1":100'

N.N.W.
WERIBONE 1
COOMRITH 1
FLINTON 1
MINIMA 1
S.S.E.
BOOMI 1
S.W.
24 MILES
23 MILES
42 MILES
45 MILES
DEPTH
S.P.
LITH.
E.L.
S.L.
LOWER JURASSIC
MIDDLE - UPPER TRIASSIC
LOWER TRIASSIC
L. JURASSIC
Basement
? L. CARBF
C
B2
B1
A
T4
T3
T2
T1
T5
S
R
LITHOLOGICAL CORRELATION
IN THE TRIASSIC AND JURASSIC
OF THE SOUTHERN BOWEN-SURAT BASIN
VERTICAL SCALE 1":100'
Correlation certain
Correlation probable
Correlation possible