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INJUNE CREEK GROUP - AMENDMENTS AND AN ADDITION TO STRATIGRAPHIC NOMENCLATURE IN THE SURAT BASIN

by

C.F.J. Swarbrick, A.R.G. Gray (Geological Survey of Queensland) and N.F. Exon (Bureau of Mineral Resources)*

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SUMMARY

New data have been obtained for the Injune Creek Group in the Surat Basin as a result of two Mines Department core-drilling projects. In the light of these, a) the Eurombah Beds of the Injune area are formally named the Eurombah Formation, b) the use of the names Walloon Coal Measures (instead of Birkhead Formation), Springbok Sandstone and Westbourne Formation in the subsurface of the northern Surat Basin is endorsed, and c) a new name, Norwood Mudstone Member, is proposed for the lower part of the Westbourne Formation.

INTRODUCTION

In the Surat Basin, the name Injune Creek Group (Exon, 1966) is applied to genetically related strata between the Hutton and Gubberamunda Sandstones. The group which consists mainly of non-marine clastic sediments and coal attains a maximum thickness of over 2,500 feet in the Mimosa Syncline. Paucity of outcrop and difficulties in wireline log interpretation have led to problems in subdivision and correlation, particularly in the middle and eastern parts of the basin. In outcrop west of Orallo, the group was subdivided (see Exon, 1971) into the Birkhead Formation, Springbok Sandstone and Westbourne Formation (top); further east the group was mapped largely as "undifferentiated", with the Eurombah Beds a basal unit north of Roma.

In two drilling projects by the Geological Survey of Queensland (Gray, 1972, Swarbrick, in press) the group was met in eighteen core-holes. This paper reviews and amends the stratigraphic nomenclature of the group in the northern Surat Basin in the light of this drilling. In order of deposition, the four formations now assigned to the group are the Eurombah Formation, Walloon Coal Measures, Springbok Sandstone and Westbourne Formation. Detailed lithology and wireline logs are available on open-file in the Geological Survey Office, Brisbane; cores are stored in the Core Library, Redbank. No further Departmental core-drilling is planned.

EUROMBAH FORMATION

Discussion: Exon *et al.* (1967) and Exon (1971) used the name "Eurombah Beds" for sediments between the Hutton Sandstone and the "Birkhead Formation" (mapped as "Undifferentiated" Injune Creek Group) which outcrop at and near the Eurombah Dome north of Roma. These beds were first mapped by Jensen (1921) as "Basal Walloon" whereas Reeves (1947) included them in his "Hutton Sandstone". Lithologically they are quite unlike the underlying Hutton Sandstone or the overlying Walloon Coal Measures ("Birkhead Formation"). The "Eurombah Beds" were not recognised when the Taroom Sheet area to the north was mapped (Forbes, 1968); in part they were included with the Hutton Sandstone and in part with the Injune Creek Group (Exon, 1971). The presence of permeable sandstones makes them difficult to separate from the Hutton Sandstone on the wireline logs of most petroleum wells and exploration companies have generally included them with the Hutton Sandstone. Departmental drilling of the "Eurombah Beds" near outcrop, and subsequent drilling of the Injune Creek Group in other parts of the Surat Basin has provided much additional information.

The "Eurombah Beds" are here named the Eurombah Formation because the unit is widespread and lithologically distinct. The formation is included in the Injune Creek Group because the outcrop character, core lithology and lensing nature of the unit are more typical of this group than of the underlying Hutton Sandstone.

Derivation of Name: The name Eurombah Formation replaces the informal name "Eurombah Beds" of Exon (1971), which was derived from Eurombah Creek, north of Roma.

*Type Section: From 89 to 393 feet in continuously cored stratigraphic bore DRD 22 (Figure 1), drilled at latitude 26°03'S., longitude 148°51'E., 1.3 miles south-east of Eurombah Homestead. The bore is on the south-western flank of the Eurombah Dome (Reeves, 1935; 1947) where the formation outcrops.

Distribution: Precise extent unknown. At outcrop, the formation can be traced eastward from the type area into the Mimosa Syncline at least as far east as Bullock Creek on the Wandoan - Nathan road (latitude 25° 53'S., longitude 150° 03'E.). West of Injune, the formation does not appear to outcrop in the Merivale Syncline but can be picked in the subsurface in AAO Killoran 1. The unit was encountered in DRD 22, 23, and 24 in the Injune area (Gray, 1972), in GSQ Taroom 3 (Swarbrick, in press), and in GSQ Roma 1 and Mundubbera 1 (Gray, ibid.) in the Taroom area. In the deep subsurface, the formation can be distinguished on wireline logs of petroleum exploration wells (Figure 2). It can be traced from AAO Lorne 1 eastward across the Roma Shelf and into the Mimosa Syncline, and so far as 27°S.

Lithology: At outcrop the formation consists of several hundred feet of thickly bedded, fine to coarse, clayey, crossbedded, labile sandstone and polymictic conglomerate, and thinly bedded to laminated siltstone and mudstone. The type section (Figure 1) in DRD 22 (89 to 393 feet) was described by Gray (1972) as follows:

"From 89 to 260 feet, it comprised light green-grey to grey, very fine to very coarse, fairly and poorly sorted, subangular to subrounded, sublabile sandstone, with a white argillaceous matrix, and minor interbedded conglomerate and brown, carbonaceous mudstone. The sandstone contained many mudstone clasts; it was visibly porous in part (shown as peaks on the resistivity log). Measured porosity averaged 21 percent; horizontal permeability ranged from nil to 78 md and averaged 15 md. Conglomerate, in beds to 5 inches thick, was composed of pebbles of white quartz, brown mudstone, and dark igneous material in a sandstone matrix.

From 260 to 393 feet, it comprised interbedded and laminated light green-grey to light grey, very fine to fine, sublabile sandstone, light grey to brown and green-grey mudstone and siltstone, in part carbonaceous, and minor pebble bands. Measured porosity of two sandstone samples averaged 20 per cent; horizontal permeability was negligible. Contact with the underlying Hutton was transitional".

Relationships: The Eurombah Formation is the lowermost formation of the Injune Creek Group. It conformably overlies the Hutton Sandstone and is conformably overlain by the Walloon Coal Measures. Its lateral relationship to these units is not clear. It may become incorporated in the uppermost Marburg Formation in the east.

Distinguishing Characteristics: Sandstones of the Eurombah Formation are intermediate in colour between those of the Hutton Sandstone (white to light grey, weathering to yellow-brown) and those of the Walloon Coal Measures (dark grey to green, weathering to grey-brown). The Eurombah Formation contains

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* Copies of drafts of figures (large scale) are held by N. Exon. Otherwise refer to article in Q.G.M.J.

thickly bedded, crossbedded, coarse sandstone, pebbly sandstone and conglomerate, which are rare in the Hutton and Walloon sequences. The sandstones are more labile than those of the Hutton and less labile than those of the Walloon. In contrast to the overlying Walloon, the Eurombah Formation is non-calcareous. The clay matrix in sandstones of the Eurombah is white, but is yellow in those of the Walloon. Porosity of sandstones varies greatly and randomly in the Eurombah Formation and depends on the presence of matrix.

On wireline logs the top of the formation is frequently difficult to recognise. The true lithological top is often some tens of feet higher than the highest porous sandstone (which is easily identified on resistivity logs). The true top is 73 feet above the highest significantly porous sandstone in the type section (Figure 1). The base can be taken at the top of the highest resistivity peak of Hutton Sandstone type, below which the log does not return to the Walloon Coal Measures baseline for a considerable depth.

Environment of Deposition: Mainly fluviatile. The low degree of size sorting suggests rapid sedimentation. Increases in the proportions of lithics and feldspar grains upwards suggest that a) a provenance not eroded during the deposition of the Hutton began supplying immature sediment to the northern Surat Basin during deposition of the Eurombah, and/or b) the rigorous reworking conditions which applied during the deposition of the Hutton gave way to the sluggish conditions which applied during the deposition of the Walloon. The Eurombah may represent the transition stage. Alternative b) is preferred by the authors.

Thickness: 304 feet thick in the type section (DRD 22); 321 feet thick in DRD 24, near Injune. The formation appears to thin westward, southward and eastward away from the Injune area, being 180 feet thick in AAO Killoran 1, 216 feet thick in AAO Wyena 1 and 190 feet thick in UKA Dulacca 1. It appears to thin to zero on the eastern side of the Mimosa Syncline.

Fossils and Age: The formation contains plants of probable Jurassic age. Burger (1968) found a microflora belonging to Evans' (1966) division J4* of mid-Jurassic age in the formation at 2,911 feet in AAO No. 1 (Roma). Palynological investigations are currently being undertaken on cores at the Geological Survey of Queensland.

WALLOON COAL MEASURES

Two names - Walloon Coal Measures and Birkhead Formation - have been used in the Surat Basin for the same part of the lower Injune Creek Group. The Walloon Coal Measures (after Cameron, 1907) has its type area in the Moreton Basin and the Birkhead Formation (Exon, 1966) has its type area in the Eromanga Basin. Both are freshwater deposits consisting mainly of mudstone, siltstone and sandstone. The abundant coal of the Walloon Coal Measures distinguishes them from the Birkhead Formation, which contains only a little coal. The Walloon Coal Measures have a paludal and flood plain aspect; the Birkhead Formation is probably mainly lacustrine and is much thinner than the Walloon Coal Measures.

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* Division J4 starts with the first occurrence of *Leptolepidites verrucatus* and ends with the first occurrence of *Contigisporites* spp. and *Murospora florida*.

Swarbrick (in press) has shown that in the Surat Basin as far west as Injune this part of the lower Injune Creek Group has a greater lithological affinity to the Walloon Coal Measures than to the Birkhead Formation. Accordingly Walloon Coal Measures is the more appropriate name. The lateral transition from the Walloon to the Birkhead must occur between Injune and the western margin of the Surat Basin. Power and Devine (1970, Figure 10) drew an isopach map on an interval which approximates the Birkhead-Walloon interval. This shows clearly that the sequence is much sandier and thinner over the Nebine Ridge than in the Surat Basin. On their evidence, a meridional facies boundary could be drawn somewhere between Roma and Mitchell, separating the Birkhead Formation to the west from the Walloon Coal Measures to the east.

SPRINGBOK SANDSTONE

The name "Springbok Sandstone Lens" was used by Exon (1966) in the western Surat Basin. The unit was redefined as a formation by Power and Devine (1968) on the basis of subsurface correlations. The Springbok Sandstone was intersected in three Departmental bores - DRD 25, GSQ Roma 4 and 7, where it is 156, 327 and 266 feet thick respectively. The base of the unit provides an easily recognisable and reliable marker for subsurface correlation, and is used to define the top of the Walloon Coal Measures in the Surat Basin. The Springbok Sandstone thickens south-eastward from the Mimosa Syncline, and is incorporated in the outcropping Kumbarilla Beds (Exon and Vine, 1970). The undefined "Proud Sandstone" of Traves (1962) appears to be restricted to the permeable developments of the Springbok Sandstone in the Roma area.

WESTBOURNE FORMATION

The Westbourne Formation was recognised in the Eromanga Basin by American Overseas Petroleum (1964) and formally defined by Exon (1966). It was mapped eastward from the type area into the Surat Basin as far as Tallawalla Homestead on the Roma 1:250,000 Sheet area (Exon, 1971). Power and Devine (1968, 1970) have traced the unit widely in the subsurface, and have shown that it cannot be recognised in the southern parts of the basin.

The Westbourne Formation was met in three Departmental bores in the northern Surat Basin - DRD 25, GSQ Roma 4 and 7 where it was 265, 417 + and 472 feet thick respectively. It is readily divisible into two parts - a lower consisting of alternating mudstone and lithic sandstone with minor siltstone and coal which we propose to name the Norwood Mudstone Member, and an upper part consisting of thinly bedded to laminated siltstone and generally impermeable quartzose to sub-labile sandstone. Mudstone and coal are virtually absent from the upper part except in DRD 25 where some mudstone was encountered. The "Westbourne Formation" as mapped north of Roma (Exon, 1971) is equivalent to the upper sandy part of the Westbourne Formation in DRD 25, the Norwood Mudstone Member not being distinguishable in outcrop from the rest of the Injune Creek Group. In the Roma area, a permeable sandstone, the undefined "Weald Sandstone" of Traves (1962), occurs at or near the base of the upper part. Thin sandstones, probably correlatives of the Weald, were encountered in all three GSQ bores.

Norwood Mudstone Member of the Westbourne Formation

Derivation of Name: Norwood Block, Parish of Dinoun, County of Aberdeen; latitude 26°10'S., longitude 149°28'E.

Type Section: The section from 397 to 570 feet below drilling floor in continuously cored bore GSQ Roma 7, latitude 26°15'S., longitude 149°23'E. The unit outcrops poorly.

Distribution: The member cannot be traced in outcrop. In subsurface, the member can be traced in Departmental core-holes from DRD 25 to GSQ Roma 4 - a distance of almost 70 miles. It can be distinguished in nearby petroleum wells (Figure 2).

Lithology: The type section in GSQ Roma 7 (Figure 3) consists of alternating mudstone and sandstone with minor siltstone and coal. The mudstone is dark grey to grey, mainly carbonaceous, bentonitic in the lower part, and is associated with thin bitumenous coal seams. The sandstone is typically thinly bedded or laminated, medium to coarse near the base and fine (in part very fine) near the top. Sorting improves towards the top. Near the base the sandstone is lithic labile but the quartz content increases upwards. It contains abundant coal fragments, generally concentrated in discrete bands. The siltstone is typically light grey and argillaceous.

The wireline logs show a low resistivity profile with marked positive deflections corresponding to the coal seams; the limits of the member are apparent on this log. The gamma-ray profile is relatively high with lower readings over the sandstone components. Particularly high gamma-radiation was detected in the lower part of the interval both in the type section and in GSQ Roma 4.

Relationships: A member constituting the lower part of the Westbourne Formation. Conformably overlies the Springbok Sandstone; conformably overlain by the upper Westbourne Formation.

Environment of Deposition: Low energy, back-swamp environment with meandering stream channels. Contemporaneous vulcanism is suggested by the presence of bentonitic mudstone in the lower part.

Thickness: 173 feet thick in the type section; 175 and 124 feet thick in GSQ Roma 4 and DRD 25 respectively.

Fossils and Age: Contains plants of probable Jurassic age. Palynological investigations are to be undertaken at the Geological Survey.

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