APPENDICES

APPENDIX I: DESCRIPTIVE GEOLOGY OF THE ROCKVALE - COFFS HARBOUR REGION

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APPENDIX 1: DESCRIPTIVE GEOLOGY OF THE ROCKVALE - COFFS HARBOUR REGION

CHAPTER 1: STRATIGRAPHY OF THE ROCKVALE - COFFS HARBOUR REGION

The stratigraphy for most of the Rockvale - Coffs Harbour region is defined here for the first time, although some of the nomenclature has been previously introduced by Binns and others (1967) and by Leitch *et al.* (1969). The absence of fossils from most of the region, together with a lack of continuous outcrop and the inaccessibility of some districts, cause difficulties in determining detailed stratigraphic subdivisions.

All major units are termed Beds rather than Formations, as recommended by the Australian Code of Stratigraphic Nomenclature (1973), because the relationships between units have not always been conclusively established. Most boundaries between units have not been observed in the field and hence their positions are only approximate or inferred. Further work involving detailed mapping of small areas may result in subdivision of the units described here and the raising of some of them to formational status. No type sections are defined but representative localities, displaying typical rocks, are listed for each unit.

A different lithostratigraphy for each tectonic block has been proposed owing to, in part, separate development during deposition, orogenesis and now to different levels of erosion. Hence the stratigraphy of each block will be described separately.

Discussion of the Stratigraphic Subdivision

It is difficult to correlate between the three tectonic blocks because of the lack of palaeontological data for the region. Binns and others (1967) divided the New England region into three sedimentary lithological associations.

The first association consists of greywackes, siltstones, slates, laminated cherts, massive jaspers and altered basic lavas, and is best developed just east of the Peel Fault (Woolomin Beds, Chappell 1961) and in the Nowendoc area (Myra Beds, Mayer 1972). Limestone lenses within the Woolomin Beds are Ordovician to Silurian in age (Hall 1970), but Mr. K. Fitzpatrick (pers. comm.) considers that the lenses are fault blocks intimately associated with serpentinite and hence are not conformable in the sequence. Similar rocks occur around Armidale (Sandon Beds, Crook 1958) and were thought to be Carboniferous by Crook (*op. cit.*) who found in them a plant identified as *Lepidodendron*. Smith (1973) found more plant remains at the same locality and they were identified as *Leptophloem* sp. by Dr. R. Gould and assessed as Late Devonian in age. Hence the age of the first association appears to range from Ordovician or Silurian to Late Devonian or Early Carboniferous. The Redbank River Beds (Korsch 1971) of the Coffs Harbour Block also belong to this association, and so might a Silurian or Devonian limestone (Whiting 1950) at Jackadgery (45 km northwest of Nymboida).

The second association is a similar geosynclinal sequence of interbedded greywackes, siltstones and argillaceous rocks but lacking in chert and jasper, and only containing rare basic lavas. Some conglomerates and diamictites occur. All fossils recorded from this assemblage are Middle or Late Carboniferous to Permian in age. It is possible to make a tentative twofold subdivision of this association on the basis of lithology. One subdivision consists of rocks from the Coffs Harbour and Rockvale Blocks (greywackes, siltstones, argillites) in which fossils are rare, being known only at Rockvale. The other subdivision would contain rocks such as those from the Dyamberin Block (greywackes, slate, diamictite and conglomerate), and similar lithologies occurring to the south of the thesis area. Most of the known Carboniferous or Permian fossil localities from New England occur in this subdivision.

The third association, mentioned by Binns and others (1967), is of a terrestrial nature and occurs north-west of Armidale. In it conglomerates, siltstones and mudstones are interbedded with lavas and pyroclastic rocks. It contains a *Glossopteris-Gangamopteris* flora and is only gently folded in contrast to the intensely folded Permian marine strata at Rockvale, 20 km to the east. Lewis (1973) mapped an outlier of the third association east of the Highlands Monzonite, and it overlies the Girrakool Beds with apparent angular unconformity.

A time correlation of the stratigraphic succession for each of the blocks within the Rockvale - Coffs Harbour region is shown in Table 1.

Table 1: Stratigraphic succession and possible correlatives in the Rockvale - Coffs Harbour region

Age	Rockvale Block	Dyamberin Block	Coffs Harbour Block
Permian	? Girrakool Beds (including Wongwibinda Complex)	? Sara Beds ? Dyamberin Beds	? Coramba Beds
Carboniferous	Girrakool Beds (including Wongwibinda Complex) ?	Dyamberin Beds ?	Coramba Beds ? Brooklana Beds ? Moombil Beds ?
Devonian and Older			Redbank River Beds

STRATIGRAPHY OF THE COFFS HARBOUR BLOCK

Palaeozoic sediments of the Coffs Harbour Block have been subdivided previously into the Redbank River Beds and the Coffs Harbour Beds (Korsch 1971) on the basis of lithological contrasts. Leitch *et al.* (1969) introduced a three-fold subdivision of the Coffs Harbour Beds into the Moombil Beds, Brooklana Formation and Coramba Beds but did not define their divisions. Because the type section of the Coffs Harbour Beds, as suggested by Korsch (1971, p.65), occurs in the Brooklana Formation of Leitch *et al.*, it is proposed to use the term Coffs Harbour Sequence in this thesis to refer to all Late Palaeozoic (?) rocks of the Coffs Harbour Block, apart from the Redbank River Beds. Subdivision of the Coffs Harbour Sequence follows the nomenclature of Leitch *et al.* (1969).

Redbank River Beds

Previous Reference: Korsch (1971).
Derivation: Redbank River, near Red Rock Village (GR 6341 2851).
Representative Locality: The headland at the south side of the mouth of the Redbank River.
Lithology: Well bedded jaspers and cherts, with an interbedded basic lava.
Thickness: Unknown, due to intense folding and limited exposure.
Age: Unknown. Other rocks of similar type in the New England area (e.g. Woolomin Beds, Chappell 1961; Myra Beds, Mayer 1972) appear to be Silurian, at least in part.
Relationships: Unknown, because this unit is surrounded by alluvium or water. Korsch (1971) suggested several alternatives for its relationship with the Coffs Harbour Sequence such as faulted, unconformable, diapiric or a megabreccia block.
Discussion: This small unit (approximately 0.2 sq.km) is tectonically important because it separates Coramba Beds with an approximate east-west strike occurring to the south, from rocks of similar lithology to the north, but having a north-south strike.

Coffs Harbour Sequence

Synonymy: Coffs Harbour schists (Denmead 1928); Coffs Harbour Series (Voisey 1934); Fitzroy Series (Kenny 1936); Fitzroy Beds (McElroy 1962); Coffs Harbour Beds (Voisey 1969; Korsch 1971).
Derivation: Coffs Harbour Township (GR 6224 2468).

Lithology: Interbedded volcanically-derived sandstones, siltstones, mudstones and siliceous units with rare calcareous siltstones.
Thickness: Unknown, but thought to be very thick. Korsch (1971) suggested 3000 (?) m but this is probably a conservative estimate. The true thickness is indeterminable because of lack of continuous outcrop, mesoscopic folding and small scale reverse faults.
Subdivision: This sequence is subdivided into the Moombil Beds, Brooklana Beds and Coramba Beds which, from structural evidence, are conformable.
Age: Unknown, but Korsch (1971) suggested an Upper Palaeozoic, possibly Carboniferous age.
Relationships: The relationship with the Redbank River Beds is unknown. The Coffs Harbour Sequence is separated by major faults from the Nambucca Fold Belt to the south and the Dyamberin Block to the west. The sequence is unconformably overlain by the Mesozoic Clarence - Moreton Basin to the north.

Moombil Beds

Previous References: Leitch *et al.* (1969) named this unit and indicated its areal extent, but did not define it. Leitch (1972) briefly described the rocks from immediately north of the Bellinger Fault.
Derivation: Mount Moombil (1040 m) GR 5927 2448.
Reference Locality: Typical rocks are well exposed along the road leading to the summit of Mount Moombil.
Lithology: Black massive argillite with minor volcanically-derived sandstones and siltstones. Bedding is rarely present and other sedimentary structures were not observed.
Thickness: Indeterminate, because of the massive nature of lithologies and discontinuous outcrop. Where present, bedding mainly dips steeply to the north and this suggests that several thousand metres of sediment may occur.
Distribution: The Moombil Beds crop out over an area of approximately 750 sq.km stretching in a broad arc from east of Crossmaglen (GR 6098 2386) to the Demon Fault south of the Chaelundi Complex.
Age: No fossils were found but a late Palaeozoic age is postulated.
Relationships: The lowermost exposed part of this unit is faulted against the Nambucca Fold Belt. Structural evidence indicates a conformable relationship with the overlying Brooklana Beds, and the boundary between these units has been displaced in numerous localites by faulting.

Brooklana Beds

Previous References: Brooklana Formation (Leitch *et al.* 1969). Leitch (1972) revised the name to Brooklana Beds in accordance with the Australian Code of Stratigraphic Nomenclature (1973) because he had designated no type section.

Derivation: Village of Brooklana (GR 5952 2506).

Representative Section: Leitch (1972) considered the Brooklana Beds were characteristically exposed around the village of Brooklana. The type section for the rocks previously called Coffs Harbour Beds was the quarry and cliffs on the south side of the town of Coffs Harbour. These rocks occur within the Brooklana Beds and may be regarded as the representative section.

Lithology: Thinly-bedded siliceous mudstones and siltstones with rarer volcanically-derived sandstones. Dark, highly-cleaved mudstones in beds from 1 cm to several metres thick occur interbedded with lighter coloured more siliceous rocks which may be finely laminated. Sandstones are more common than in the Moombil Beds.

Thickness: Unknown, but because bedding is dominantly steeply-dipping to the north, a thick sequence of several thousand metres is suggested.

Distribution: The Brooklana Beds occupy a belt of approximately 1100 sq.km trending north-west from the coast at Sawtell and Coffs Harbour, to west of the tunnel (GR 5473 3038) on the Grafton to Newton Boyd Road. A thin sliver of rocks with Brooklana Beds affinities occurs as a fault slice along the Demon Fault, about 10 km south of Newton Boyd school.

Age: No fossils were discovered but a late Palaeozoic age is postulated on the tenuous basis of lithological correlation with sediments of known Carboniferous age (e.g. Halliday's Point, Leitch and Mayer 1969).

Relationships: No contacts were observed in the field but the conformable nature of the Brooklana Beds with the underlying Moombil Beds and overlying Coramba Beds was deduced from structural evidence.

Coramba Beds

Previous References: Leitch *et al.* (1969) named this unit and indicated its areal extent, but did not define it. The rocks from the Coffs Harbour Beds described by Körsch (1968, 1971) occur wholly within the Coramba Beds, as used in this thesis.

Derivation: Village of Coramba (GR 6122 2759).

Lithology: Volcanically-derived lithic and feldspathic greywackes, with minor siltstones, siliceous siltstones and mudstones. Calcareous siltstones and acid and basic volcanics are rare. Two distinctive sedimentation types are present and have been described by Korsch (1971, p.65).

Members: It is possible to divide the Coramba Beds into two units on the basis of greywacke types in the field. On petrographic inspection, further subdivision of both units was possible and a four-fold division of greywacke types has been constructed. The stratigraphic units are as follows:

Mesozoic Clarence - Moreton Basin		
	Unit D	Hornblende-bearing lithic greywackes
Coramba Beds	Unit C	Hornblende-bearing feldspathic greywackes
	Unit B	Feldspathic greywackes
	Unit A	Lithic greywackes
Brooklana Beds		

From Map 1, showing the distribution of the greywacke types, it can be seen that Units B and C are much more limited in extent than Units A and D.

Representative Localities: Leitch (1972) considered the Coramba Beds were typically exposed along the Coramba to Dorrigo Road immediately west of Coramba Village. This section occurs low in Unit A and hence is representative of only the lowermost part of the Coramba Beds. It is proposed to list representative areas for each of the four greywacke units, as there is no area where a complete section from Unit A to Unit D was observed. Korsch (1968) has provided a detailed map of many of the coastal headlands where the Coramba Beds crop out.

Unit A: Representative lithologies occur in the section listed by Leitch (1972) and at the headlands of Signal Hill (GR 6311 2619) and Look-at-me-now (GR 6308 2611).

Unit B: This unit is limited in extent to the eastern half of the Coramba Beds and occurs typically at McCauleys Headland (GR 6257 2492).

Unit C: This unit is the most localised in areal extent and is best observed at Ocean View headland (GR 6327 2743).

Unit D: This is the most extensive unit of the Coramba Beds and a representative area is Woolgoolga Headland (GR 6330 2692). See also Plate 2A.

Thickness: Unknown, because of lack of continuous outcrop, mesoscopic folding and small scale reverse faults. A regionally consistent steep dip to the north suggests a thickness of several thousand metres.

Distribution: The Coramba Beds crop out as a broad arc surrounding the southern portion of the Clarence - Moreton Basin. The Beds occupy an area of approximately 2000 sq.km reaching from Broomes Head (GR 6481 3303) in the north to McCauleys Head in the south and westwards past Dalmorton to the tunnel on the Grafton - Newton Boyd road.

Age: The only fossil found was a fragment of a bryozoan (polyzoan) of unknown affinities from a thin section in Unit D (S32436, Plates 2B, 2C). Attempts at conodont extractions from calcareous siltstones were unsuccessful. Fission-track dating of hornblendes from the Coramba Beds is being undertaken, but as yet no results have been received. It is postulated that the age of the Coramba Beds is late Palaeozoic, possibly Carboniferous.

Relationships: Structural evidence indicates the Coramba Beds conformably overlie the Brooklana Beds and are unconformably overlain by the Clarence - Moreton Basin.

STRATIGRAPHY OF THE DYAMBERIN BLOCK

The Dyamberin Block has not been examined in detail previously, because it is rugged, heavily forested, and more difficult of access than any other region in New South Wales. Even in this study the field work was limited to examining areas of easy accessibility and traversing along the Guy Fawkes River from Marengo to Newton Boyd. Binns (1966) named the rocks immediately to the west of the Wongwibinda Fault the Dyamberin Beds but did not define the unit. Leitch *et al.* (1969) described the sediments as greywacke, slate, siliceous argillite and pebbly mudstones. Brunker *et al.* (1969) divided the sediments of the block into two unnamed units, one described as massive silicified mudstones and siltstones with a conglomerate horizon.

In the present study it has been possible to subdivide the Dyamberin Block into two conformable stratigraphic units. The older unit occurs to the south and the name Dyamberin Beds, proposed by Binns (1966) is retained for it. The northern, younger, unit is here termed the Sara Beds. The two units differ in occurrence from the units proposed by Brunker *et al.* (1969) and field work by the present author suggests that the conglomerate horizon mapped by Brunker *et al.* (with an approximate strike of 050°) does not exist. It is possible that Brunker and his associates observed conglomerates at localities along the London Bridge Fire Trail and concluded that they belonged to a single layer. Structural and stratigraphic work by the present author does not support that conclusion, but suggests that several conglomerates are interbedded with finer-grained units, and strike at approximately 150°.

PLATE 2

A. Steeply-dipping well-bedded sediments at Tree Point (GR 6432 3086). Unit C, Coramba Beds.

B. Unidentifiable fragment of a bryozoan in a lithic greywacke. Unit D, Coramba Beds. S32436, magnification x 50, plane light.

C. Enlargement of portion of the bryozoan illustrated in Plate 2B. Magnification x 200, plane light.

D. Porphyritic euhedral crystal of plagioclase in a Tertiary tholeiitic basalt. S32823, magnification x 20, crossed nicols.

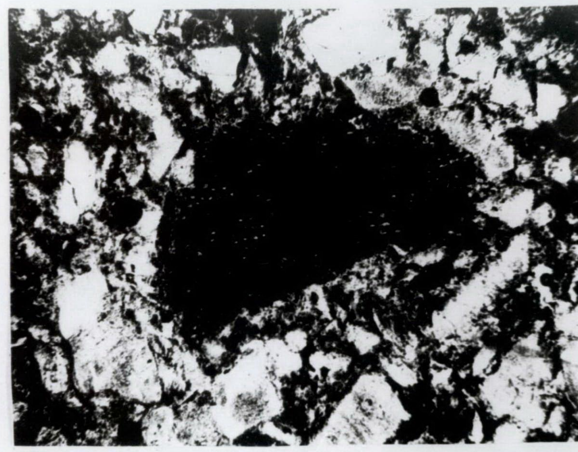
E. Tertiary alkali-olivine basalt showing laths of plagioclase and residual glass with minor augite and opaque oxides. S32821, magnification x 50, plane light.

F. Plagioclase, olivine, augite, opaque oxides and residual glass in an hawaiite. S32825, magnification x 50, plane light.

G. Tertiary alkaline basaltic rock with mugearite affinities, consisting predominantly of plagioclase and minor opaque oxides. S32822, magnification x 50, plane light.

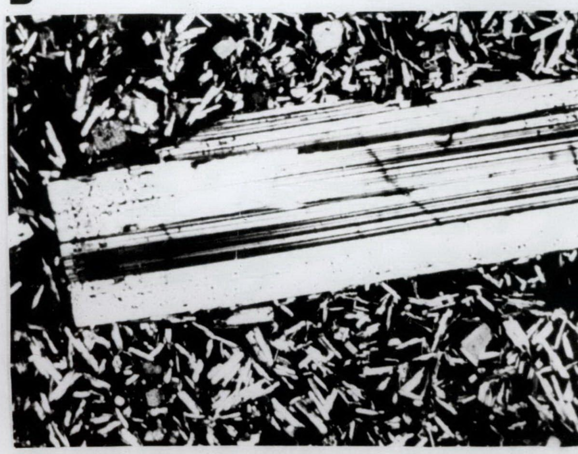
H. Phenocryst of olivine in a very fine grained groundmass from an hawaiitic basalt forming a dyke in Boundary Creek, Rockvale (GR 5032 2460). S32824, magnification x 50, plane light.

A



B

C

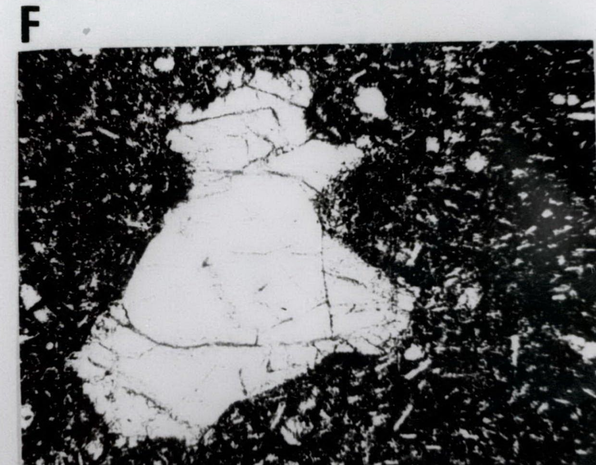


D

E

F

G



H

Dyamberin Beds

Previous References: Binns (1966), Packham (1969, p.269), Runnegar (1970).
Derivation: Dyamberin Homestead (GR 5259 2568).
Representative Section: Binns (1966) listed no type section but Voisey (1950) described Permian fossils from Kangaroo Creek, and it is proposed that this creek, from GR 5232 2568 to its junction with the Aberfoyle River, be designated the representative section of the Dyamberin Beds. Another area of good exposure is Marengo Creek west of the Demon Fault until it flows into the Guy Fawkes River.
Lithology: Interbedded greywackes, siltstones and mudstones with horizons of diamictite. In places a well developed cleavage occurs in slates and is intense enough to cut across sandy and conglomeratic horizons. Diamictite with either a sandy or muddy matrix is more abundant than orthoconglomerates. Voisey (1950) also recorded tuff and acid lava flows.
Members: No distinctive mappable units were observed, except possibly for the diamictites.
Thickness: The presence of folding and slaty cleavage, and the absence of continuous outcrop hinders determination of thickness, but the steep dip of bedding planes to the north suggests a thickness of several thousand metres.
Distribution: The Dyamberin Beds occupy an area of approximately 800 sq.km in the southern part of the Dyamberin Block.
Age: The fossil locality at Kangaroo Creek (GR 5249 2622) has been ascribed a Permian age by Voisey (1950). Runnegar (1970) collected material from a ridge striking north-north-east approximately 3 km south-east of the junction of the Aberfoyle River with Kangaroo Creek (GR 5249 2622) and listed the following fossils indicative of an early Permian age (equivalent to the Allandale fauna of Runnegar, 1969).

Deltopecten illawarensis (Morris)
Trigonotreta Sp. A
Fletcherithyris sp. ind.
fenestrate polyzoans

Mr. G.R. McClung (pers. comm.) regards the Allandale fauna as possibly being latest Carboniferous in age.
Relationships: The Dyamberin Beds are bounded on the west by the Wongwibinda Fault, and on the east by the Demon Fault. To the south they are intruded by the Round Mountain Leucoadamellite and overlain by the Cainozoic Ebor basalts. To the north they are conformably overlain by the Sara Beds.

Sara Beds

Name and derivation: New name, derived from Sara River which flows eastwards from the New England Plateau until it joins the Guy Fawkes River at GR 5343 2911.

Representative Localities: Good, although not continuous, exposures occur along the Guy Fawkes River between GR 5351 2730 and GR 5376 2797 and also in the Guy Fawkes River in the vicinity of the Sara River (GR 5358 2884 to GR 5354 2949).

Lithology: Orthoconglomerate horizons and associated siliceous mudstones, siltstones and volcanically-derived greywackes. Diamictites are less common than in the Dyamberin Beds. Rare basic and acid igneous rocks occur also.

Thickness: Not determined but steep bedding planes indicate that a thick sequence is probably present.

Distribution: The Sara Beds occupy an area of approximately 350 sq.km in the northern part of the Dyamberin Block bounded on the east by the Demon Fault and to the north and west by granitic rocks of the New England Batholith.

Age and Relationships: The only fossils found were crinoid stems. Structural relations indicate that where they are preserved these rocks conformably overlie the Dyamberin Beds and hence it is assumed that they are also of Permian age. However these rocks have been, in part, derived from the Dyamberin Beds, often including clasts of material derived from the older unit. A large clast (0.7 m) of diamictite incorporated as a boulder within a conglomerate from the Sara Beds is shown in Plate 1D.

STRATIGRAPHY OF THE ROCKVALE BLOCK

Rocks from this block have been divided into low-grade metamorphosed sediments in the western part of the field area, and the high-grade metamorphic Wongwibinda Complex to the east. Binns (1966) named the metamorphic rocks the Wongwibinda Complex and divided them into the Zone of Transitional Schists, Rampsbeck Schists, Zone of Migmatites and the Abroi Granodiorite. No new petrological work was attempted on the Wongwibinda Complex for this thesis and hence the informal nomenclature of Binns is retained. The petrography has already been treated by Binns (1966) and Fisher (1968).

Girrakool Beds

Synonymy: Lyndhurst Beds, Binns (1966), Packham (1969, p.270), Runnegar (1970). Girrakool Beds, this thesis. According to the Australian Code of Stratigraphic Nomenclature (1973), the name Lyndhurst is invalid having been used for the Lyndhurst Formation (Coats 1964) in South Australia.

Derivation: Girrakool Homestead (GR 5008 2408).

Representative Sections: A reference section where the rocks are well exposed occurs along Rockvale Creek from GR 4954 2449 to where the sediments are intruded by the Rockvale Adamellite - Granodiorite at GR 5000 2386. Included within this section are the "Double Fold Locality" at GR 4981 2405 and the "Fossil Locality" at GR 4992 2395, both visited frequently by excursions from the University of New England.

Lithology: The Girrakool Beds consists of indurated mudstones, siltstones and lithic to feldspathic greywackes of volcanic derivation. Hornblende occurs in some rocks but, because of the more intense nature of the folding and relative scarcity of the hornblende-bearing lithologies, it has not been possible to subdivide the Girrakool Beds into petrographic units as has been done with the Coramba Beds.

Thickness: A large area of the Girrakool Beds has been overturned and has suffered two to three deformations. The intense folding has made the measuring of a section impracticable and hence no estimate of the thickness can be given. It is possible that a very thick sequence of sediments is present.

Distribution: The Girrakool Beds occupy an area of approximately 600 sq.km stretching from the Hillgrove Adamellite in the south to the Tobermory Adamellite and associated granitic plutons in the north. The Beds have been intruded by the Rockvale Adamellite - Granodiorite.

Age and Relationships: Gunthorpe (1963) found fossil fragments near Rockvale Homestead which were determined by Runnegar (1970) as *Atomodesma* sp. indicating a Permian age. The beds become increasingly metamorphosed to the east until the Glen Bluff Fault is reached. Further to the east the Wongwibinda Complex occurs. To the west unsuccessful efforts have been made by the author and others to define the contact between the Girrakool Beds and the Devonian to Carboniferous Sandon Beds in the vicinity of Armidale. The approximate position of the contact can be determined and Leitch *et al.* (1969) mapped it as a fault. Lewis (1973) studied the supposed line of fault and could find neither a fault nor an unconformity. The line of contact seems to be defined only by gross changes in lithology, notably a rapid decrease in the amount of chert and siliceous mudstones in passing from the Sandon Beds to the Girrakool Beds.

MESOZOIC STRATIGRAPHY

The soft sediments of the southern portion of the Mesozoic Clarence - Moreton Basin lie unconformably on the metasediments of the Coramba Beds in the northern part of the Coffs Harbour Block. The stratigraphy of the basin is discussed here only in sufficient detail to allow it to be used in the tectonic discussion in Section II.

McElroy (1956, 1962) mapped that part of the basin that is in New South Wales, concentrating on an area around Nymboida where coal occurs. He proposed a basic stratigraphic subdivision for the sequence. Flint (1973) has amended the stratigraphy in the eastern portion of the basin from Red Cliff (GR 6449 3338) to west of Wooli (GR 6281 3000). He showed (Table 2) that the Nymboide Coal Measures contain a Middle Triassic (Anisian to Ladinian) flora whereas the flora of the Red Cliff Coal Measures is Late Triassic (Karnian). Other changes by Flint were the separation of the Peak Formation and Maclean Sandstone Member; and the inclusion of the Marburg Formation in the Bundamba Group.

CAINOZOIC ROCKS

1. Tertiary Sediments

Very thin deposits of horizontal poorly-consolidated quartzose sandstone and conglomerate occur locally in the Rockvale area beneath basalt flows and are probably fluvial deposits. Possible correlatives beneath the basalts around Armidale (Voisey 1942) are of Late Eocene age (Slade 1964).

2. Tertiary Basaltic Rocks

Basaltic rocks occur as a series of flows in the Ebor area and west of Rockvale. Throughout the southern portion of the field area small residual outliers occur along higher ridges, for example at Tyringham and in the Wild Cattle Creek State Forest.

Most of these rocks are clearly basalts but Browne (1933) mentions a tholeiitic andesitic basalt at the Ebor Falls. McDougall and Wilkinson (1967) and Wilkinson (*in* Packham 1969) note that both tholeiitic and

Table 2: Mesozoic Stratigraphy of the southern portion of the Clarence - Moreton Basin after McElroy (1962) and Flint (1973)

AGE	FORMATION	
Late Jurassic	Grafton Formation Kangaroo Creek Sandstone	
Middle Jurassic	Maclean Sandstone Member Walloon Coal Measures	
Early Jurassic	Marburg Formation Peak Formation	Bundamba Group
Late Triassic	Mill Creek Siltstone Corindi Conglomerate (≡Shelley Beach Sandstone)	
Karnian	Red Cliff Coal Measures	
Middle Triassic (Ladinian-Anisian)	Nymboida Coal Measures	
Palaeozoic	Basement (mainly Coramba Beds)	

alkaline types occur and have provided chemical analyses of a tholeiitic andesite and a trachyte from the Ebor area.

McDougall and Wilkinson (*op. cit.*) reported a K/Ar age of 18.7 million years for the Ebor tholeiitic andesite. This Middle Miocene age is inferred for all the Tertiary volcanics situated in the field area. The Doughboy Range basalts west of Ebor have been shown to be alkaline in their affinities by Binns (1966) and Collerson (1967).

Several small outliers between Ebor and the Clarence - Moreton Basin were mapped during this study and samples have been examined in thin sections. Two of them show distinct tholeiitic affinities with an abundance of black residual glass. The development of a reaction rim around a plagioclase phenocryst, and granular aggregates of olivine possibly forming from the breakdown of orthopyroxene, might indicate that at least one of these tholeiites (S32823, Plate 2D) has crystallised at a high pressure.

Some lavas with alkaline affinities were also noted. These varied from alkali-olivine basalt (S32821, Plate 2E) to hawaiite (S32825, Plate 2F) and mugearite (S32822, Plate 2G) and all exhibit common characteristics of this lineage such as an intergranular texture consisting of olivine, titanaugite, plagioclase and K-feldspar with residual glass. A basaltic dyke (S32824, Plate 2H) at Boundary Creek, Rockvale, has hawaiitic affinities and is thought to be related to the lavas further to the west around Chandlers Peak. Within this rock there is a lherzolite relic of clinopyroxene with a reaction rim, indicative of a high pressure origin.

The base of the volcanic sequence in the field area is irregular with the flows being guided by pre-existing topography. In the Doughboy Range area the pre-basalt topography has a local relief of about 100 m (Collerson 1967). In the Ebor district the flows are gently inclined to the west and may be remnants of a large shield structure once centred several kilometres to the east of Point Lookout (Leitch 1972).

The altitude of the base of the volcanic sequence also decreases to the north and east. Measured values are at Point Lookout about 1160 m; Chapmans Plain (GR 5769 2654), 610 m; Kellys Creek (GR 5786 2704), 590 m; Wild Cattle Creek State Forest (GR 5836 2698), 550 m; Clouds Creek State Forest (GR 5833 2777), 450 m; and in the Kangaroo Creek State Forest (GR 5974 2750), 380 m. There is a similar decrease to the east in the Bellingen area (Leitch 1972). It is uncertain whether the above differences in heights are due to pre-basalt-surface relief or to the later repeated differential uplifts of the Late Pliocene or Pleistocene Kosciusko "epoch" (Browne 1969, p.566).

Glenugie Peak, south of Grafton, is a basaltic-type mass intruding Mesozoic Clarence Basin sediments. Browne (1933) referred to three phases of intrusion in it. Mason (1969) described two separate and distinct intrusive phases. The first was an outer marginal phase of fine-grained, xenolithic olivine-nepheline analcimite and the second was a flow-differentiated picroteschenite. He divided the picroteschenite into an inner medium-grained phase and an outer finer-grained phase marginal to the olivine-nepheline analcimite.

3. Quaternary sediments

These deposits have been mapped in part and include beach sands and dunes near the coastline, estuarine-type sediments in the lower reaches of the Redbank, Wooli and Sandon Rivers and creeks that enter the sea, and extensive areas of river alluvium further inland.