NOTES ON THE GEOLOGY OF THREE AREAS IN THE DUBBO 1:250 000 SHEET AREA, NSW.

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CONTENTS

GENERAL INTRODUCTION

Geological mapping of three areas in the Dubbo 1:250 000 Sheet area was carried out between January 1995 and May 1996 as part of the AGSO contribution to the remapping of this Sheet under a National Geoscience Mapping Accord agreement with the New South Wales Geological Survey. The locations of these areas are shown in Figure 1. The areas are the Ballimore-Tucklan area in the Dubbo and Cobbora 1:100 000 Sheets, an area west of Cumnock in the Wellington 1:100 000 Sheet, and the Tunnabidgee-Windeyer area in the southwest of the Mudgee 1:100 000 Sheet. Mapping was done during one and two week intervals over the period. Results were plotted on 1:50 000 scale bases for final compilation with other mapping by AGSO and NSWGS. Geological sketch maps of the three areas (Figs 2,3 & 4) accompany this Record. Cross sections of the three areas are shown in Figure 5.

BALLIMORE-TUCKLAN AREA

INTRODUCTION

Geological mapping of the Ballimore-Tucklan area (Figure 2) was carried out between November 1995 and May 1996. Previous mapping includes that shown on the first edition of the Dubbo 1:250 000 Sheet (Offenberg & others, 1971), a generalised interpretation of the Permian-Mesozoic sequence by Dulhunty (1966), and more detailed mapping of these rocks in the northern parts of the area by Loughnan & Evans (1978). Detailed mapping since 1971 of small parts of the area has been carried out by honours students from the University of New South Wales. A current mapping project in the Tallawang mine area is being carried out by a student from the University of Newcastle. Mapping by Newcrest Mining Limited in the Laheys Creek area (Pearson, 1996) has also recently become available. Extensive mapping of the Permian and Mesozoic formations in the region by E.K. Yoo (pers. comm.) forms the basis of the more detailed work on these formations in the area mapped.

STRATIGRAPHY

ORDOVICIAN

The Dubbo 1:250 000 Sheet (Offenberg & others, 1971) shows sedimentary and volcanic rocks in the Tucklan area divided into the Devonian Tucklan Beds and Silurian Chesleigh Formation. The two units are separated by an inferred fault. The reason for the inferred Devonian age of the Tucklan Beds is not clear as no fossils have been found (Pickett, 1982). The recent mapping indicates a somewhat different interpretation in which the rocks in most of this area are of Ordovician age, with only a relatively small area of Chesleigh Formation in the southwest.

The Ordovician age of rocks in this area is based on two observations. One is the resemblance of black slaty shale to Ordovician black shales elsewhere in the Lachlan Fold Belt, and the other is the similarity of mafic volcaniclastics in some of the area to the Ordovician Sofala Volcanics. However the lack of fossils in any of these rocks makes this interpretation still somewhat inconclusive. The inferred Ordovician rocks can be divided on

the basis of radiometric imagery and field mapping into a lower, sedimentary unit and an upper, volcanic and volcaniclastic unit. The lower unit is correlated with the Adaminaby Group as mapped on the new edition of the Bathurst 1 :250 000 Sheet (in prep.). The name Tucklan Formation, upgraded from Tucklan Beds, is retained for the upper unit.

Other rocks in the Gollan area east of Spicers Creek also previously mapped as Devonian are now regarded as probably of Ordovician age as well (see below).

Adaminaby Group (Oa?)

Possible Adaminaby Group rocks at the base of the inferred Ordovician sequence crop out along a meridional belt about 5km west of the Gulgong-Dunedoo road. The rocks consist of slaty white and purplish siltstone along the western boundary of the belt, and fine grained massive quartz sandstone and some siltstone to the east of Lambing Yard Creek in the southeast. Bedding is rarely evident; however, in one place east of Goodiman State Forest, a banded siltstone dips at a shallow angle towards the boundary with andesite of the Tucklan Formation. This is taken to indicate the stratigraphic position of the sediments below the Tucklan Formation, and supports correlation with the Adaminaby Group.

An alternative conclusion reached by G. Colquhoun (pers. comm.), mapping to the north, is that all boundaries with the Tucklan Formation are faulted, and that the sediments are a downthrown block representing a sedimentary facies of the Silurian Dungeree Volcanics. Evidence exists for a fault along the western boundary south of Tucklan (see Structure, below); however the sinuous eastern boundary would necessitate a complex intersecting fault system for which no evidence is forthcoming. The base of the supposed Adaminaby Group rocks is not exposed.

Tucklan Formation (Ot)

The Tucklan Formation is the part equivalent of the Tucklan Beds of Offenberg and others (1971). The formation extends west from the boundary of the Gulgong Granite, near the Gulgong-Dunedoo road, to a northwest-trending boundary with younger rocks east of Laheys Creek interpreted as Silurian. The latter boundary is partly covered by Permian and Mesozoic sediments of the Gunnedah Basin. The Tucklan Formation consists of basalt, volcaniclastic sandstone and siltstone, micaceous schist, black slaty shale and chert. Outcrop is poor in much of the area.

The main basalt unit occurs at the base of the formation overlying the Adaminaby Group east of the Tucklan Fault. Two types of basalt were observed in thin section. One is plagioclase-phyric in an uneven-grained microcrystalline to glassy groundmass and the other contains both plagioclase and clinopyroxene in equal amounts in a similar groundmass. A few small quartz crystals are also present in each type. The basalt passes up to the east into generally fine grained volcaniclastics. Basalt and hornfels crop out to the east of the Tallawang magnetite mine adjacent to the Gulgong Granite.

No direct correlation can be made between the rocks to the west of the Tucklan Fault with those east of the fault. The northwestern part of this area contains weathered micaceous schist and phyllite whilst to the south the full range of rock types in the formation is represented. The top of the formation has not been identified and it is not known whether the boundary with the Silurian Dungeree Volcanics to the west is conformable or unconformable.

No type section has previously been nominated for the Tucklan Formation. A suitable section is possibly along a creek southwest of 'Borderville' (GR232371) where volcaniclastics are well exposed along a distance of about 1km.

Undivided (Ov?)

Offenberg & others (1971) show an area of volcanic rocks east of Spicers Creek as Devonian Cuga Burga Volcanics containing 'keratophyre and quartz keratophyre, lavas and tuffs, sediments and limestone'. The rocks in the area mapped are poorly exposed and contacts with rocks of known age apart from the Mesozoic cover are not evident. Most of the area displays a high potassium red colour on the radiometric image typical of the Ordovician rather than the mafic Devonian volcanics in the Wellington region. In the Cumnock area, for example, the Cuga Burga Volcanics show up as dark areas on a radiometric image.

The rocks in the area mapped are mafic in composition but are not keratophyre. Two thin sections show basalt or andesite with varying proportions of plagioclase (An38) and clinopyroxene phenocrysts in an even grained to trachytic groundmass. One section also contains epidote and quartz-epidote veining. These inferred Ordovician rocks lie adjacent to, but not in exposed contact with, the Gollan Beds and are unconformably overlain by the Triassic Boulderwood Conglomerate. Mapping to the south of Gollan where Offenberg and others (1971) show both Ordovician volcanics and Cuga Burga Volcanics may clarify the stratigraphic position of these rocks.

SILURIAN

Gollan Beds (Sgoa, Sgob)

Brunker & Rose (1969) introduced the name Gollan Beds for rocks that extend from near the Wellington-Gulgong road north through Gollan into the area mapped. To the north of Gollan the rocks consist mainly of rhyolite, dacite and siltstone. The unit has been divided into two subunits mainly on the basis of colour on the radiometric image. The northern unit (Sgoa) is potassium dominant and coloured red on the radiometric image. The volcanics there appear to be mainly rhyolitic in composition and outcrops are fairly common. The southern unit (Sgob) is coloured yellow indicating a higher thorium content. Outcrops are sparse, and what outcrops there are appear to be dacitic rather than rhyolitic. In the northern area the rhyolite is commonly, though not invariably, leached white, and foliated or cleaved. The rock is aphanitic with only a few phenocrysts of quartz and feldspar. Biotite is evident where the rock is not leached.

Limestone is present locally in the northern area along Baragonumbel Creek. It strikes in a northwesterly direction. Its relationship to the other rock types is not clear. The limestone is massive and shows recrystallisation in thin section.

The stratigraphic relationship between Sgoa and Sgob is not clear. Bedding is not generally evident in the sediments of either unit, but possible flow banding dipping east in rhyolite was observed in one place in a road cutting at GR 985407. The relationship of subunit Sgob to the supposed Ordovician rocks (Ov?) is not clear on the ground because of poor outcrop. The boundary shown on the map is based mainly on the radiometric image, and is more sinuous than previously mapped. The Gollan Beds are unconformably overlain by the Permian Dunedoo Formation and the Triassic Boulderwood Conglomerate. A Silurian age in accord with previous interpretation is inferred. Volcanics of apparently similar composition

and of known Silurian age (Gleneski Formation) are shown in the 1st edition of the Dubbo 1:250 000 Sheet in the same structural block to the south, east of Wellington. The only fossils recorded are crinoid stems in the limestone (Frater, 1993).

Dungeree Volcanics (Std)

A northwest-trending belt of felsic volcanics crops out about 2-3km east of Laheys Creek immediately adjacent to, and probably overlying, the Tucklan Formation. The rocks consist of greenish-grey almost aphanitic rhyolite and white altered rhyolite. Brecciation is common. The volcanics lack any structure indicative of the dip of the formation but steep dips in the sedimentary rocks to both east and west suggest that the volcanics are steeply dipping as well. A thin section of the rhyolite at GR 181343 contains numerous small phenocrysts of quartz, some recrystallised, plus a few larger patches of chlorite representing an altered mafic mineral, all set in a quartzo-feldspathic groundmass. The rocks are most likely to correlate with the Dungeree Volcanics that occur at the base of the Silurian sequence east of Mudgee and extend north to near Gulgong (pers. comm., J. Watkins).

Chesleigh Formation (Ss)

Rocks probably belonging at least in part to the Silurian Chesleigh Formation crop out along Laheys Creek and immediately to the east. They consist of massive purple quartz sandstone and siltstone. The lower part contains one relatively thin rhyolite flow close to the contact with the underlying Dungeree Volcanics. The contact is considered conformable.

The rhyolite near the base contains sparse phenocrysts of quartz and altered plagioclase in a quartzo-feldspathic groundmass. Mafic minerals are represented by a few small patches of chlorite. The sandstone consists of angular to subrounded larger quartz grains in a matrix of smaller quartz, feldspar and opaque grains.

DEVONIAN?

Gabbro (Dgo)

Two small bodies of coarse gabbro intrude the Gollan Beds. The northern intrusion is elongate in a meridional direction and may extend farther to the north than shown judging by the very red soil beside the road west of 'Tallawonga'. Red soil in the next watershed to the west indicates another possible intrusion in that area. The southern intrusion is a wider body and finer grained than the northern one. The gabbro consists of large clinopyroxene phenocrysts to 5mm in a groundmass of clinopyroxene and altered plagioclase. The clinopyroxene is partly altered to actinolite. The age of the gabbro is not known. The rocks appear to be too coarse grained and altered to be of Tertiary age.

CARBONIFEROUS

Gulgong Granite (Cgga, Cggb)

Part of the Gulgong Granite, which has been dated radiometrically as Carboniferous (Packham, 1969), occurs at the eastern extremity of the area mapped. This part of the intrusion

appears to consist of two phases consisting of a core of granite and a rim of granodiorite. The granodiorite rim is narrow in the south and widens to the north. The boundary between the granite and granodiorite shows vaguely on the radiometric image and more clearly on the magnetic image. The granite is less magnetic and more potassium-rich than the granodiorite.

The granite is very coarse grained and crops out as very large boulders, commonly more than 10m in diameter, and as extensive pavements in which the rock is generally slightly weathered on the surface. It consists of quartz, K-feldspar, lesser plagioclase (~An36) and minor biotite in part altered to chlorite. The granodiorite is less coarse and forms smaller, fresh outcrops. Its composition is similar to that of the granite except that plagioclase is the dominant feldspar and the biotite more abundant.

A prominent meridional-trending aplite dyke occurs within the granodiorite 1km southeast of 'Black Hill' east of the Gulgong-Dunedoo road. It probably represents a late-stage intrusion into the granodiorite. Other late-stage phases associated with the main intrusion are represented by leucogranite dykes striking north-northwest within the metamorphic rocks between the Tallawang mine and the western boundary of the granodiorite.

PERMIAN

Illawarra Coal Measures (Pi)

Rocks previously mapped as Illawarra Coal Measures (Offenberg & others, 1971) crop out at the base of a Permo-Triassic sequence on Barneys Reef at the eastern margin of the area mapped. They represent the western limit of this extensive Permian formation. These sedimentary rocks unconformably overly the Gulgong Granite. Part of the section is exposed at the southern end of the Barneys Reef, where a basal breccia with angular rock fragments is overlain by carbonaceous siltstone with a bed of very coarse quartz sandstone at about the middle of the sequence. The entire section is about 30m thick. In contrast, 4km to the north, the Permian section consists of arkosic sandstone apparently derived directly from the underlying Gulgong Granite.

Dunedoo Formation (Pd)

The Dunedoo Formation (Higgins & Loughnan, 1973) is the westerly equivalent of the Illawarra Coal Measures and occurs generally in the area at the base of the Permo-Triassic sequence where it overlies older rocks unconformably. An exception is east of Spicers Creek where the Dunedoo Formation is missing and the Triassic Boulderwood Conglomerate directly overlies the basement. Another exception is southeast of Ballimore where at least 154m of breccia interpreted as early Permian (E.K. Yoo, pers. comm.) underlies the Dunedoo Formation in drillhole DDH3 (GR809337). It is not known how extensive the breccia is, as it does not crop out at the surface in the area mapped. Neither of the other two deep diamond drillholes near Ballimore, DDH1 (GR838473) and DDH2 (GR836384), reached the base of the Dunedoo Formation at 427.5m and 179m respectively. Graphic logs of the three drillholes are shown in Figure 6.

The Dunedoo Formation consists of a basal conglomerate overlain by generally white, coarse and fine grained feldspathic sandstone and siltstone, shale, minor black carbonaceous shale and thin coal seams. The basal conglomerate is matrix supported and contains angular rock fragments derived locally from the basement, plus angular and rounded quartz pebbles

and cobbles. In some places the fine grained cherty shale with conchoidal fracture near the top of the formation has been described as porcellanite (e.g. Loughnan & Evans, 1978). These sediments commonly contain plant fossils such as *Glossopteris* characteristic of Permian rocks. Silicified fossil wood is also present in places as reported by Wallin (1975). One such locality found during the present mapping is 2km east of 'Mt Dapper' homestead (GR 186313).

The thickness of the Dunedoo Formation exposed at the surface in the central part of the area ranges up to about 60m. In the western part of the area the formation does not crop out but a thickness of 48m was encountered in drillhole DDH3. The coal seam encountered in shafts beside Spicers Creek around GR894346 (Carne & Morrison, 1916) is now interpreted as being at the top of the Dunedoo Formation, as the depth recorded is immediately below the elevation of the Boulderwood Conglomerate that crops out at the surface in and beside the creek. Coal probably belonging to the Dunedoo Formation has also been noted in the drillers logs of several water bores west of this locality.

TRIASSIC

Narrabeen Group (TRn)

The Narrabeen Group as mapped by Offenberg and others (1971) overlies the Illawarra Coal Measures along Barneys Reef. It forms low cliffs of quartz pebble conglomerate and coarse quartz sandstone. The contact with the underlying coal measures is exposed in a cliff at the southern end of the Reef.

Boulderwood Conglomerate (TRb)

The Boulderwood Conglomerate (Higgins & Loughnan, 1973) is the basal Triassic formation west of the basement high known as the Rocky Glen Ridge (Yoo, 1988). It correlates with the Narrabeen Group in terms of stratigraphic position immediately overlying Permian formations. It is also the approximate equivalent of the Wollar Sandstone of Dulhunty (1973) and Loughnan & Evans (1978).

The Boulderwood Conglomerate consists of quartz pebble conglomerate and very coarse quartz granule sandstone. The formation commonly caps ridges or forms low, tree-lined escarpments with low cliffs. Semi-continuous outcrop makes it a good marker horizon. The formation is generally only about 3-4m thick if overlying coarse sandstone with minor interbedded siltstone is excluded. Where the formation caps hills and ridges it is commonly ferruginised. Because of the small thickness and narrow outcrop in most areas the formation is included in the overlying Napperby Formation in Figure 2.

The Boulderwood Conglomerate overlies the Dunedoo Formation, possibly with a slight unconformity. Exposures of the contact are visible in several places throughout the area. One particularly good and accessible exposure is in Four Mile Creek immediately north of the Dubbo-Dunedoo Road (GR983446).

Napperby Formation (TRp)

Rocks in the Ballimore-Sandy Creek area occupying the stratigraphic interval between the Permian Dunedoo Formation and the Jurassic Pilliga Sandstone are shown as 'Ballimore Formation' by Offenberg & others (1971). The formation, as shown, includes the

Boulderwood Conglomerate and is described as consisting of 'quartz sandstone, lithic sandstone, conglomerate, ferruginous sandstone and siltstone, carbonaceous shale and coal'.

Various attempts have been made, from mapping that incorporates larger areas to the north and northeast, to subdivide the 'Ballimore Formation'. They include Dulhunty (1973), Higgins & Loughnan (1973) and Loughnan & Evans (1978). Cored stratigraphic drillholes have also been put down by the New South Wales Department of Mineral Resources to define subdivisions within the Permian-Mesozoic succession. One of these drillholes (Mirrie DDH1) is between Dunedoo and Merrygoen to the north of the area mapped. The log of Mirrie DDH1 shows clear subdivisions in the Triassic-Jurassic succession. The logs of the other holes (Ballimore DDH1, DDH2 and DDH3) show these subdivisions less clearly. The Mirrie subdivision of the 'Ballimore Formation' into the lower, Napperby and upper, Purlawaugh Formations is defined by the presence of the intervening Garrawilla Volcanics. Generally pelitic, coal bearing strata are characteristic of the Purlawaugh Formation whereas the Napperby Formation is more sandy. The Napperby Formation is equivalent to the Wallingarah Formation of Loughnan and Evans (1978).

From radiometric age determinations of the Garrawilla Volcanics (Dulhunty & McDougall, 1972) it is known that the Garrawilla Volcanics are latest Triassic to earliest Jurassic in age. This confirms fossil evidence that the underlying Napperby Formation is Middle Triassic. Unfortunately the Garrawilla Volcanics only extend, if at all, to a point between Boomley and Elong Elong where some basalt possibly belonging to the Garrawilla Volcanics crops out in Boomley Creek (GR 953497). No Garrawilla Volcanics have been identified farther to the south. This, together with the general lack of outcrop of the 'Ballimore Formation' in the area mapped, and unknown variations in thickness of each formation, make it difficult to map the boundary of the Napperby and Purlawaugh Formations. A prominent sandstone unit forming a low escarpment in some places possibly represents the top of the Napperby Formation. In some areas the inferred Napperby Formation tends to be pale and yellowish coloured on the radiometric image and the Purlawaugh darker and greenish. In other places, however, no such subdivision is evident. More cored drillholes would be needed in the Elong Elong-Spicers Creek and Sandy Creek areas in order to check how meaningful in lithological terms the subdivision into the Napperby and Purlawaugh Formations is in the area mapped. Many water bores in the Ballimore-Sandy Creek area do have driller's logs of the cuttings. However, examination of these logs reveals inconsistencies that throw too much doubt on their reliability for use in identifying subdivisions of the Napperby and Purlawaugh Formations.

The lower part of the Napperby Formation is well exposed in a road cutting near Spicers Creek, GR908339, where it consists of interbedded sandstone and siltstone with minor carbonaceous siltstone near the base. The total thickness of the formation as mapped is estimated to range from about 50m in the east to 70m in the central part of the area. The thickness increases to 145m to the north of Ballimore as recorded in drillhole DDH1.

JURASSIC

Purlawaugh Formation (Ju)

The Purlawaugh Formation representing the upper part of the 'Ballimore Formation' consists of interbedded white siltstone and black carbonaceous siltstone and is well exposed beside the Talbragar River at Ballimore Hill (GR813396). Similar rocks are also exposed in a

road cutting at GR866397 and at several other places close to the boundary with the overlying Pilliga Sandstone. In many other places the only outcrop of the formation is ferruginised sandstone and siltstone float. The Purlawaugh Formation probably ranges in thickness from about 40m to 50m in most of the area. However the thickness increases to the north of Ballimore where 74m of the formation was recorded in drillhole DDH1. Loughnan & Evans (1978) divide the Purlawaugh Formation into the Ukebung Formation overlain by the Digilah Formation. The Digilah Formation is apparently distinguished from the Ukebung Formation by the absence of coal and carbonaceous beds. However at Ballimore Hill the uppermost part of the Purlawaugh Formation contains carbonaceous beds.

Pilliga Sandstone (Jpl, Jpu)

The Late Jurassic Pilliga Sandstone occurs mainly north of the Talbragar River with some isolated outliers on hills to the south of the river. The formation is divided into two subunits. The lower subunit unit (Jpl) consists of lithic sandstone and polymictic conglomerate. It occurs in the northwest of the area but lenses out rapidly to the south and east. Its base is well exposed at Ballimore Hill where it overlies the Purlawaugh Formation. The upper subunit (Jpu) is more quartz-rich, particularly the basal bed which is a very coarse quartz sandstone generally containing rounded quartz pebbles and subangular quartz granules. This sandstone forms low escarpments in places and is very similar to the Boulderwood Conglomerate. Higher beds in the upper unit consist of finer grained quartz sandstone and minor siltstone. The upper unit breaks down to give very sandy soil on which grows the characteristic Pilliga Scrub.

The Pilliga Sandstone overlies the Purlawaugh Formation. The top of the formation is not preserved. The maximum exposed thickness of the upper unit as mapped on the ground is about 100m. Drillhole DDH1 indicates a thickness of 195m for the lower subunit at that locality. This hole demonstrates the rapid thickening of the lower part of the formation north of Ballimore.

TERTIARY

Basalt(Tb)

Basalt and dolerite both of assumed Tertiary age crop out in a number of places throughout the area. The basalt occurs as flows and plugs mainly west of Ballimore. One plug to the east occurs beside Baragonumbel Creek east of the Wellington-Dunedoo road. A dark grey basalt containing olivine and titan augite phenocrysts caps a low ridge south of the Talbragar River. Paler grey basalt occurs to the west and northwest and forms hummocky ridges and isolated small plugs. The basalt in these outcrops contains a high proportion of glass and some contain olivine altered to red iddingsite.

The basalts appear to belong to the Dubbo Province of Wellman & McDougall (1974) for which a Miocene age has been determined for samples collected near Dubbo and Gulgong.

Dolerite intrudes the 'Ballimore Formation' and Pilliga Sandstone northeast of Boomley and forms two related sill-like bodies west of Sandy Creek. The dolerite near Boomley is regarded as intrusive because of its coarse grain size and lack of flow structure. The topographic relief suggests a sill at least 40m thick and a water bore in this area penetrated 77m of dolerite; the roof of the sill appears to have been removed. The dolerite

west of Sandy Creek is more obviously a sill with contact metamorphic effects evident in overlying sedimentary rocks.

The possibility exists that some of these basalt and dolerite bodies are not Tertiary but related to the Garrawilla volcanism of Triassic/Jurassic age where they occur on or within the 'Ballimore Formation'. The plug at Baragonumbel Creek and the dolerite west of Sandy Creek are particularly critically positioned. Age determinations would be the surest way of resolving the issue. In this context it should be noted that both Tertiary and Mesozoic mafic volcanics of similar composition occur to the north in the type area of the Garrawilla Volcanics in the Mullaley district (Bean, 1974) and also in the Binnaway district Dulhunty (1972b).

STRUCTURE

The area mapped straddles the northernmost part of the Hill End Trough and includes parts of the Molong High to the west and the Capertee High to the east as seen in cross section AB (Figure 5). Most of the Molong High and Hill End Trough are, however, covered by later horizontal and very gently dipping Permian and Mesozoic formations that are unconformable on the older rocks. The extent of the Hill End Trough under cover is indicated in the magnetic image by a zone of generally low magnetic response, apart from small areas of Tertiary basalt and dolerite, which narrows to the north and terminates east of Boomley. A northwest-trending magnetic ridge defines the eastern boundary of the zone. This ridge, where not under cover, coincides roughly with the boundary of the Dungeree Volcanics and the Chesleigh Formation.

The western boundary of the Hill End Trough coincides with a monocline in the cover rocks that may indicate a fault in the basement. The monocline appears to die out to the north.

Cleavage or foliation dominates the structure of the basement rocks in many outcrops, but what bedding is evident suggests complex folding. In the Tucklan Formation small scale, south-plunging folds in chert are evident in outcrop in one place immediately north of Brooklyn Road (GR 213342). In another place in a creek 2km south of 'Borderville' (GR 232371) bedding in volcaniclastics is steep to the south, and almost at right angles to the meridional cleavage.

The western boundary of the inferred Adaminaby Group rocks appears to be faulted (Tucklan Fault). This conclusion is reached from the straightness of the boundary, as observed on the ground and on the radiometric image, and from the east-west strike at right angles to the boundary of volcanic sediments at 'Borderville' to the west. An abrupt change over only a few metres from non-volcanic to volcanic sediments in a creek 3.5km south-southwest of Tucklan also suggests a fault, although the actual contact is not exposed.

Faulting close to the western boundary of the Gulgong Granite is indicated by several north-northwest striking mylonite zones in the adjacent metamorphic rocks of the Tucklan Formation (S. Ashford, pers. comm.). A fault along the northwest-striking part of the granodiorite-country rock contact is also suggested on the magnetic image. The image indicates truncation of northeast-striking magnetic trends against the contact. The diminished width of the granodiorite in the Tallawang area may be due to part of it having been removed by a fault.

AREA WEST OF CUMNOCK

INTRODUCTION

Geological mapping of an area west of Cumnock (Figure 3) was carried out during May and June 1995. Previous mapping in the area as shown in the Dubbo 1:250 000 Sheet (Offenberg & others, 1971) was based on the work of Maggs (1963), who covered a larger area extending to the east of Cumnock and south onto the Bathurst 1:250 000 Sheet area. Some revision of this mapping is shown in Pickett (1982). The area contains formations ranging in age from probable late Ordovician through early and late Silurian to early Devonian; these Palaeozoic formations are covered in a few places by ?Mesozoic terrestrial sediments and very minor Tertiary basalt. Some of these formations are more extensive in the Bathurst 1:250 000 Sheet area and are described more fully in the explanatory notes to that Sheet (Pogson & others, 1996).

STRATIGRAPHY

ORDOVICIAN-EARLY SILURIAN

CABONNE GROUP

Kabadah Formation (Ock)

Previous nomenclature and stratigraphic relationships

The Kabadah Formation as now mapped includes four previously described units conformably or disconformably underlying the Canowindra Volcanics - Kabadah Beds, Loombah Formation, Bournewood Formation and Yullundry Formation. It also includes two other units - Buckinbah Volcanics and Myrangle Formation - previously interpreted as overlying the Canowindra Volcanics and part of the Goonigal Group, but now regarded as underlying the volcanics as well. All these previously named formations were first mapped by Maggs (1963) and further described by Pickett (1982). Whilst some differences may exist in detail between the previously named formations, as described, they all contain mafic magnetite-rich volcaniclastic sandstones. Furthermore, the apparent superposition of the Loombah, Bournewood and Yullundry Formations in the north can be explained by repetition by faulting of a west-dipping sequence as indicated by repetition of narrow belts of Canowindra Volcanics.

Distribution

The formation extends in a north-northeast direction along several belts from beyond the southern margin of the Wellington 1:100 00 Sheet area, south and southwest of Cumnock, to northeast of Yeoval. The oldest exposed beds are in the northern part of the area mapped.

Type section and thickness

Maggs' type section of the 'Kabadah Beds' southwest of Cumnock around GR660510 is retained for the Kabadah Formation. A thickness of about 800m is represented there. The minimum thickness of the Kabadah Formation is estimated at about 1400m along Loombah Creek west from GR620690. The formation is well exposed along the western part of this section dipping consistently at about 70° to the northwest and is described by Maggs as his type section for the 'Yullundry Formation'. The base of the formation has everywhere been removed by faults.

Composition

The Kabadah Formation consists of mafic volcaniclastic sandstone, siltstone, banded cherty siltstone and minor allochthonous limestone. The sandstone beds are conglomeratic in places and thickest in the upper part of the unit. The sandstones and even the detrital limestone have a very high magnetic susceptibility (up to 15000 x 10^{-5} SI units) owing to the presence of abundant magnetite as seen in thin section.

The sandstones in the Kabadah Formation typically contain abundant fresh clinopyroxene, altered plagioclase, magnetite, and cherty siliceous rock fragments including jasper. The clinopyroxene is commonly greenish coloured in thin section indicating an aegerine-acmite composition. This composition has also been noted in the Ordovician-Silurian Millambri Formation to the south in the Bathurst 1:250 000 Sheet area (D. Wyborn - pers. comm.). The sandstones may also contain hornblende and minor quartz grains.

Age and correlation

The mafic character of the sandstones suggests correlation with other similar volcaniclastic formations in the region that are of Ordovician, or partly Ordovician, age such as the Millambri Formation mentioned above. However, graptolites indicating an early Silurian age have been found in the formation. They were collected about 2.5km south of the type section (Sherwin, 1973b). They include *Climacograptus* sp., *Glyptograptus* cf *sinuatus* (Nicholson) and fragments of possibly *Rastrites* or *Corynoides*. Other fossils found in the formation in this same area include the corals *Favosites* sp. and *Heliolites* sp., an undescribed blind form of aulocopleurid trilobite, ?*Otarion* sp., indeterminable sowerbeyellid and dalmanellid brachiopods, and indeterminable orthoconic nautiloid cephalopods (Sherwin, 1973a,b). Corals have also been recorded from localities along Loombah Creek in what was previously mapped as Loombah and Yullundry Formations. They include *Halysites* sp., *Heliolites* sp. and *Favosites* spp.(Maggs, 1963; Sherwin, 1973a). Thinly bedded detrital limestone rich in this coral fauna is exposed in Loombah Creek at GR635684.

The graptolites suggest a correlation with the lowermost part of the early Silurian Greengrove Formation (Savage, 1969) which crops out in the Manildra area. Corals, trilobites,

cephalopods and brachiopods have also been recorded in the Kabadah Formation (see Pickett 1982).

Environment of deposition

The Kabadah Formation was deposited in a marine environment in proximity to a volcanic rise. The increasing proportion of coarse sediments towards the top of the formation suggest shallowing upwards with time.

SILURIAN

CUDAL GROUP

Canowindra Volcanics (Scv)

The Canowindra Volcanics, formerly the Canowindra Porphyry (Stevens 1952; Pickett, 1982), overlie the Kabadah Formation and crop out extensively in the area mapped. The contact with underlying beds appears to be conformable, but may be disconformable owing to an appreciable time interval interpreted between deposition of the two formations. The youngest possible age for the Kabadah Formation is mid Llandoverian whereas the Canowindra Volcanics are known to be late Wenlockian. The Canowindra Volcanics are conformably overlain by the Cary Formation in the east and the Hanover Formation in the west. They are also unconformably overlain in the west by the Dulladerry Volcanics and intruded by the Yeoval Batholith.

The thickness immediately west of Cumnock is about 700m assuming a constant westerly dip of 45°. Folding and repetition by undetected faults probably at least partly account for greater apparent thicknesses elsewhere. Rocks mapped as Canowindra Volcanics in the Wellington 1:100 000 Sheet area are not continuous with the extensive outcrop in the type area around Canowindra to the south. It is possible that the volcanics mapped as Canowindra Volcanics west and northwest of Cumnock are derived from a different source.

The Canowindra Volcanics consist of coarse porphyritic dacite containing phenocrysts of quartz, plagioclase, altered biotite and minor garnet and altered cordierite. The texture varies in thin section from sparser phenocryst types indicating a lava to crystal rich types suggesting an ignimbritic origin, but the difference is not readily apparent in the field.

Cary Formation (Scc)

Previous nomenclature and stratigraphic relationships

The Cary Formation (Pickett, 1982) is equivalent to the Cary Beds of Maggs (1963) and Offenberg & others (1971). It conformably overlies the Canowindra Volcanics. The northern part around Loombah Creek and farther to the north is shown as Burragundy Formation by Pickett (1982), but this unit is almost certainly a continuation of the Cary Formation and is mapped as such herein. The Cary Formation is conformably overlain by the Burrawong Limestone.

Distribution

The formation extends along a narrow belt from about 4km south-southwest of Cumnock in a north-northeast direction to northeast of Yeoval.

Type section and thickness

The type section is on Buckinbah (Burgoon) Creek 0.5km north of the Cumnock-Peak Hill road around GR620558. The formation there is about 120m thick and was divided by Maggs (1963) into five subunits consisting from the base of massive brown shale (15m), ferruginous shale (6m), shale grading into chert (30m), feldspathic sandstone (6m) and chert (60m).

Composition

As indicated in the type section the Cary Formation consists mainly of shale and chert with minor quartzo-feldspathic sandstone. The base of the formation and its contact with the underlying Canowindra Volcanics to the east is also well exposed immediately south of the Cumnock-Peak Hill road. The rock there consists of well-bedded, fine grained cherty tuff or 'ashstone'. Near Loombah Creek in the north the formation consists of shale or mudstone, in part cherty or calcareous, and jasper. However the radiometric image indicates that the 'splintery brown shale' at the top of the type section of the 'Burragundy Formation' of Pickett (1982) is almost certainly part of the older Kabadah Formation faulted against the Cary Formation.

Age and correlation

The middle part of the Cary Formation at the type section contains a shale bed with a rich graptolite fauna indicating a late Wenlockian - early Ludlovian age (Maggs, 1963; Sherwin, 1973a; Pickett, 1982). Maggs (1963) identified the graptolite *Monograptus testis* (Barrande) and the trilobite ?*Trimerocephalus*. Additional graptolites identified by Sherwin (1973a) include *Monograptus dubius* (Suess) s.l., *M. irforensis* Elles, *M. flumendosae* Gortani and *M.* cf *uncinatus*. He also identified the brachiopods ?*Stropheodonta, Kirkidium* sp. and ?*Plectodonta* sp..

The graptolite fauna is similar to that in the Kurrajong Park Formation in the Manildra area (Savage, 1969) with which the Cary Formation is correlated.

Environment of deposition

The Cary Formation was deposited in a moderately shallow to shallow marine environment.

Burrawong Limestone (Scu)

Stratigraphic relationships

The Burrawong Limestone (Maggs, 1963; Pickett, 1982) conformably overlies the Cary Formation. The topmost part of the unit has been removed by faults.

Distribution

The main area of outcrop is a belt up to 1.5km wide along Buckinbah Creek extending north from the Cumnock-Peak Hill road. The belt of outcrop narrows to the north of the Cumnock-Yeoval road to discontinuous outcrops extending to about 1km north of Loombah Creek. The southern limit of outcrop is 1km south of 'Kabadah' where it is probably faulted out against the younger Burgoon Formation.

Type section and thickness

The type section is on Buckinbah Creek immediately west of that of the Cary Formation.. Maggs (1963) gives a thickness for the formation of 730m. However this may be excessive, as a strike fault identified in the Wansey Formation to the south probably continues to the north through the limestone to repeat some of the succession. As the top of the formation is also faulted out any estimate of thickness is necessarily a minimum thickness.

Composition

The Burrawong Limestone is pale to mid grey coloured and forms large massive boulders. The limestone consists of calcareous detritus made up of corals, bryozoa, crinoids, molluscs, brachiopods and algae (Pickett, 1982).

Age

The age is considered to be middle to late Ludlovian (Pickett, 1982). It is based on the late Wenlockian to early Ludlovian age of the underlying Cary Formation and the Pridolian age of the overlying Goonigal Group as well as on the fossils in the limestone itself. The age of the condonts as listed below from Pickett (1974, 1975) is apparently inconclusive.

Numerous fossils have been identified in the formation. Fauna identified in the formation as listed in Maggs (1963) include the brachiopod *Conchidium knighti*?; corals *Heliolites* sp., *Favosites* sp., *Syringopora* sp. and *Pseudamplexus*; stromatoporoid corals; and algae *Girvanella* sp. and *Spongiostromata*? sp.. Pickett (1974, 1975) recorded the conodonts *Ozarkodina* sp., *Neoprioniodus bicurvatus* (Branson & Mehl), *Spathognathodus inclinatus*? Rhodes, *Panderodus* sp., and ?*Spathognathodus* sp. . He also lists the brachiopod *Kirkidium and* the coral *Tryplasma*. Pickett (1982) and Lishmund & others (1986) mention also rugose corals, gastropods, bryozoa, stromatoporoids and crinoid ossicles.

Environment of deposition

The limestone was deposited in a shallow marine environment in proximity to coral reefs.

Hanover Formation (Scn)

Stratigraphic relationships

The Hanover Formation (Maggs, 1963; Pickett, 1982)) conformably overlies the Canowindra Volcanics in the western part of the area mapped, and is intruded farther to the west by the Yeoval Batholith.

Distribution

The main area of outcrop extends from 'Old Yullundry' to north of Yeoval. The formation also occurs in a syncline to the east of Hanover Creek. Maggs(1963) also mapped the formation along a discontinuous narrow strip extending south from the Cumnock-Peak Hill road but this has now been reinterpreted as Kabadah Formation.

Type section and thickness

The type section is in the basal part of the formation along a tributary of Hanover Creek at 'Old Yullundry' around GR560618. Maggs (1963) estimated a thickness there of 230m. The total thickness of the formation may be considerably more than this as the formation underlies an extensive area of probable upper section between Hanover Creek and Yeoval. However lack of structural data owing to poor outcrop precludes a precise estimate of total thickness.

Composition

The Hanover Formation typically consists of greenish buff almost massive siltstone with some purple siltstone and chert near the base. Occasional pale bands about 1cm thick define the bedding in some places, but at most exposures the bedding is not visible.

Age and correlation

Maggs (1963) recorded the graptolites *Monograptus bohemicus* and *Spinograptus spinosus* indicating a Ludlovian age from near the base of the formation along the Cumnock-Yeoval road at GR587676. The top of the formation is not preserved in the area mapped so the full age range of the formation is uncertain. The conformable relationship with the Canowindra Volcanics suggests that the Hanover Formation is a correlate of the Cary Formation and Burrawong Limestone. *Monograptus bohemicus* also occurs in the Mackeys Creek Shale in the Manildra area (Savage, 1969).

Environment of deposition

The Hanover Formation was probably deposited in deeper water offshore to the west of the Cary Formation and Burrawong Limestone.

GOONIGAL GROUP

Jews Creek Volcanics (Sgj)

The Jews Creek Volcanics (Maggs, 1963; Pickett, 1982; Raymond, O.L. in Pogson & others, 1996) is the lowermost formation of the Goonigal Group and overlies the Mackeys Creek Shale which occurs to the east and south of the area mapped. The volcanics occur on the southern margin of the area mapped about 2km east of 'Wansey' and extend to the south into the Bathurst 1:250 000 Sheet area which contains the type section. The formation consists of andesite forming a magnetic ridge on the magnetic image. The ridge dies out where the volcanics lens out to the north about 1.5km north of the southern boundary of the Sheet area.

The volcanics overlie the Mackeys Creek Shale conformably and are conformably overlain by the Burgoon Formation.

Burgoon Formation (Sgb)

The Burgoon Formation (Maggs, 1963; Pickett, 1982; Raymond, O.L. in Pogson & others, 1996) conformably overlies the Jews Creek Volcanics and the Mackeys Creek Shale to the east of 'Wansey', and is conformably overlain to the west by the Wansey Formation. The type section is in the Bathurst 1;250 000 Sheet area. The formation extends north as far as 'Kabadah' and 'Geneffe' where it is faulted out against older formations. In the area mapped it consists of shale grading up into chert and then into interbedded chert and volcaniclastic sandstone of andesitic composition. Maggs (1963) estimated the thickness of the formation at the type section as 630m, but this appears to be excessive as the total width of outcrop there is only about 500 to 600m as now mapped. A thickness of 350 to 400m is probably more likely. A similar thickness is estimated to the north, west of 'Kabadah'. Farther to the north at 'Geneffe' it appears to be only about 100m thick but the base there may have been removed by faulting. No fossils have been found in the formation but a Pridolian age is interpreted from the known ages of overlying and underlying formations.

Wansey Formation (Sgw)

The Wansey Formation as now named (Raymond, O.L. in Pogson & others, 1996) is the equivalent of the Wansey Tuff of Maggs (1963), Offenberg & others (1971) and Pickett (1982). It conformably overlies the Burgoon Formation and is conformably overlain by the early Devonian Maradana Shale. Like the Burgoon Formation the type section is in the Bathurst 1:250 000 Sheet area and the formation extends north to 'Kabadah' and 'Geneffe'. The formation consists of volcaniclastic sandstone and conglomerate of andesitic composition interbedded with an increasing proportion of shale to the north ('Geneffe Shale' of Maggs, 1963). The formation is distinguished from the underlying Burgoon Formation by the absence of chert, the base of the formation being defined by topmost chert in the Burgoon Formation. It is distinguished from the older Kabadah Formation, including the former 'Buckinbah Volcanics' with which it was previously correlated, by the textural variety of the andesitic rock fragments, as seen in thin section, and the relative lack of magnetite grains. The thickness of the formation decreases from 570m at the type section to about 300m in the north. The conglomerates are richly fossiliferous and contain brachiopods, trilobites, bryozoans and crinoid ossicles. A late Silurian age is indicated on the basis of the brachiopods (Sherwin, 1973a), and since the formation is conformable beneath the early Devonian Maradana Shale a late Pridolian age is interpreted.

DEVONIAN

GREGRA GROUP

Maradana Shale (Dgs)

The Maradana Shale as mapped southwest of Cumnock was originally mapped as 'Murrabah Shale' by Maggs (1963) but was renamed in Pickett (1982) to correlate with the

Maradana Shale of Savage (1969) in the Manildra area. The type section is near Manildra (for full description see Raymond, O.L. in Pogson & others, 1996). The shale conformably overlies the Wansey Formation at 'Murrabah'. It extends north to a point about 1km southwest of 'Geneffe' and is progressively faulted out to the north against the Kabadah Formation to the west. At 'Murrabah' the formation consists of buff brown cleaved shale. The thickness is not readily apparent there as much of the formation is concealed beneath alluvium. Maggs (1963) estimated a thickness of 450m in Wansey Creek to the south. The age of the Maradana Shale is interpreted as early Devonian from a rich fauna of brachiopods and trilobites (Maggs, 1963; Savage, 1974).

MESOZOIC

Sediments (Ms)

Sand and gravel of probable Mesozoic age occurs as terrace deposits in the south and southwest of the area. The gravels contain rounded cobbles of mainly quartz and sandstone to 10cm diameter. In places the deposits are ferruginised or silicified. The deposits were formerly regarded as Tertiary, but comparison with Mesozoic rocks to the north of Wellington suggests that they are outliers of these rocks which were never covered with sufficient overburden to consolidate them.

TERTIARY

Basalt (Tb)

Previously unmapped basalt crops out as a capping on top of a hill 10km north of Cumnock. The basalt is a dark grey, fine grained rock and forms numerous small boulders typical of basalts mapped as Tertiary elsewhere in the region.

STRUCTURE

Formations in most of the area have a prevailing dip to the west-northwest ranging from gentle to steep. One or two dips in the opposite direction indicate some minor folds. The Hanover Formation in the northwest appears to occupy a syncline or synclinorium with its axis striking north-northeast. A representative cross section of the area is shown in Figure 5 (Section CD).

A series of faults striking north-northeast parallel to bedding that are possibly reverse faults repeat parts of the succession. These faults are indicated by several repetitions of the Canowindra Volcanics. Another set of faults striking west-northwest is indicated by small offsets of the magnetic highs that pick out the main magnetic bed in the Kabadah Formation. A north-northwest striking fault southwest of Cumnock separates rocks of the Cudal and Goonigal Groups. This fault plus one of the north-northeast striking faults results in the Goonigal Group and Maradana Shale occupying a downfaulted wedge narrowing to the north.

TUNNABIDGEE-WINDEYER AREA

INTRODUCTION

Geological mapping of the Hill End Trough sequence in the Tunnabidgee and Windeyer 1:25 000 Sheet areas (Figure 4) was carried out between February and April, 1995. Little previous mapping is known to have been done in most of the area. The rock unit boundaries shown on the first edition of the Dubbo 1:250 000 Sheet (Offenberg & others, 1971) appear to have been extrapolated from adjacent areas to north and south by air photo interpretation. Rock formations in the area range in age from Late Silurian to Tertiary. They include the Late Silurian Bells Creek Volcanics and Chesleigh Formation, units of the Early Devonian Crudine Group, the Early to Middle Devonian Cunningham Formation, Permian sediments of the Shoalhaven Group and Tertiary basalt. The eastern bounding fault of the Hill End Trough, the Wiagdon Fault, forms part of the eastern boundary of the area mapped. Stratigraphic nomenclature, except where stated otherwise, is derived from Packham (1968). With two exceptions the Hill End Trough formations and their type sections are in the Bathurst 1:250 000 Sheet area and are formally described in the explanatory notes for that Sheet (Pogson & others, 1996).The exceptions are the Dunmoogin and Guroba Formations of the Crudine Group whose type sections are to the north of the area mapped.

STRATIGRAPHY

SILURIAN

MUMBIL GROUP

Bells Creek Volcanics (Sml)

Rhyolite of the Bells Creek Volcanics crops out within a small elongate wedge-shaped area in the southeast corner of the area mapped. Boundaries with other formations, the Cookman Formation to the west and the Sofala Volcanics to the east, are interpreted as faults in the Wiagdon Fault zone in accord with previous mapping. The rhyolite forms weathered, massive, blocky outcrops immediately west of the Sofala-Ilford road.

CHESLEIGH FORMATION (Ss, Ssv, Ssd)

The Chesleigh Formation in the area mapped consists of a lower sedimentary unit (Ss) and an upper volcaniclastic unit (Ssv). A volcanic member within the upper unit is mapped as Ssd. The lower unit is faulted at its base against various formations of the Capertee High to

the northeast. The upper unit is conformably overlain by the Cookman Formation (Dcc) or, where the Cookman Formation is missing, the Turondale formation (Dct).

The lower unit crops out in the north and northeast of the area along part of Meroo Creek and along Green Gully. It consists of interbedded greywacke sandstone and siltstone. Bedding dips to the southwest at moderate to steep angles in the Green Gully area; graded bedding, commonly observed in the sandstones, indicates consistent upward facing. Most of the unit occupies steep wooded country contrasting distinctly on the air photos with the less rugged cleared terrain of the upper unit.

The upper unit crops out in two areas, one east of Windeyer and the other in the southeast. In the northern area massive pale grey medium to fine grained feldspathic volcaniclastics are dominant. The top of the unit there is generally a hard fine grained cherty ashstone which forms a useful marker. In the southeastern area the upper unit contains a greater proportion of siltstone that is not so obviously of volcaniclastic origin. Nevertheless, it displays a marked red potassium signature on the radiometric image like the northern part, and the cherty uppermost beds are well developed on the western side immediately beneath the overlying Cookman Formation. Some conglomeratic beds are also developed in this area. The southeastern area of outcrop forms the core of a syncline overturned to the southeast.

The volcanic unit occurs at or near the base of the volcaniclastic unit in the north. It consists of coarse, dark dacite to andesite cropping out as large boulders. The unit can be traced by distinctive red-brown soil that shows up clearly on the ground and on colour air photos. The dacite lenses out to the southeast, although its exact extent in that direction is partly obscured by Permian cover.

DEVONIAN

CRUDINE GROUP

Cookman Formation (Dcc)

The Cookman Formation conformably overlies the Chesleigh Formation, and is the lowermost unit of the Crudine Group as now shown on the Bathurst 1:250 000 Sheet, 2nd edition. The formation crops out in two areas separated by an interval, in the Campbells Creek area, where the formation is missing. One of the areas of outcrop is north of Pyramul. There it crops out along a prominent, northwest-trending, wooded ridge and attains a maximum thickness of about 800m. In this area the formation consists mainly of hard resistant quartz sandstone with minor siltstone and a few thin lenses of coarse feldspathic sandstone similar to that in the overlying Turondale Formation. The quartz sandstone lenses to the north near Campbells Creek, 2.5km northeast of Windeyer, where a cutting on the Windeyer-Mudgee road exposes mainly siltstone. In the creek bed nearby a variety of interbedded rocks underlie the siltstone. These beds include a coarse feldspathic sandstone similar to that in the Turondale Formation rather than in the upper part of the Chesleigh Formation.

No sign of any rocks which could be regarded as Cookman Formation occur in Meroo Creek 6km to the northwest of the Campbells Creek exposures. There the characteristic cherty ashstone at the top of the Chesleigh Formation passes directly into coarse feldspathic sandstone of the Turondale Formation. The exposures in Campbells Creek, and air photo interpretation, suggest that the Cookman Formation in this area interfingers with the lowermost part of the Turondale Formation.

The other area where the Cookman Formation crops out is extending north from the Crudine valley. Here it occurs under a cover of Permian rocks and reappears at the eastern end of the Campbells Creek road. This part of the Cookman Formation consists mainly to almost entirely of siltstone with only minor thin interbeds of quartz sandstone. An exception is at the southernmost edge of the area mapped where sandstone again becomes dominant. The formation is about 700m thick in the Crudine valley.

Turondale Formation (Dct)

The Turondale Formation conformably overlies, and to some extent interfingers with, the Cookman Formation. The mapping in the Tunnabidgee-Windeyer area appears to indicate from the sequence of overlying formations that the Turondale Formation is equivalent to the Lana Formation as first mapped north of Burrendong Dam by Dickson (1962), and shown on the Dubbo 1:250 000 Sheet (Offenberg & others, 1971). However, as the name Turondale Formation was published first it is deemed to take precedence, and the name Lana Formation is not used further in these notes.

The Turondale Formation consists of several thick units of coarse lithic, feldspathic sandstone separated by siltstone units of generally lesser thickness. The formation is well exposed along part of Meroo Creek northeast of Windeyer where it is about 1000m thick. This section includes beds at the base that probably interfinger with the Cookman Formation which lenses out a short distance to the south. Where the formation overlies the Cookman Formation 4km north of Pyramul it is only about 400m thick. However, farther to the southeast in the Crudine valley, it thickens again to about 800m.

The sandstone is particularly coarse at the base of the formation where it is locally conglomeratic. A greater development of siltstone than elsewhere occurs in the Campbells Creek area, and the folding pattern there makes it difficult to be sure which siltstone is part of the Turondale Formation and which may be part of the overlying Waterbeach Formation.

Waterbeach Formation (Dcw)

The Waterbeach Formation conformably overlies the Turondale Formation. It consists typically of slaty shale and siltstone which is commonly laminated, plus very minor thin beds of lithic, feldspathic sandstone. The formation is conformably overlain by the Merrions Formation. The Waterbeach Formation is about 1200m thick on the western side of the Crudine valley.

This description of the Waterbeach Formation is valid for the eastern and southern parts of the area mapped. However, to the north of Pyramul the proportion of sandstone in the upper part of the formation rapidly increases to the point where a twofold subdivision can be made. This subdivision probably corresponds with that shown on the Dubbo 1:250 000 Sheet (Offenberg & others, 1971) north of Burrendong Dam derived from Dickson (1962). The lower and upper subdivisions there are respectively the Dunmoogin and Guroba Formations and have been used for the time being in the present mapping. An alternative would be to regard the two subdivisions as local, unnamed members of the Waterbeach Formation. A decision on what solution to adopt as to stratigraphic nomenclature awaits completion of further mapping on the Dubbo 1:250 000 Sheet.

Dunmoogin Formation (Dcd)

The Dunmoogin Formation (Dickson, 1962) as mapped in the Windeyer area consists of laminated siltstone similar to that in the Waterbeach Formation. The siltstone is well exposed in road cuttings between 4 and 6km north of Windeyer. Minor sandstone beds in the formation in some places make the precise location of both upper and lower boundaries difficult to map accurately where outcrop is poor. The formation is about 500m thick.

Guroba Formation (Dcg)

The Guroba Formation (Dickson, 1962), consisting of interbedded sandstone and siltstone, conformably overlies the Dunmoogin Formation and interfingers with the Waterbeach Formation east of Pyramul. For convenience the map shows the Guroba Formation terminating against a fault in this area. Like the Turondale Formation the Guroba Formation consists of thick lithic, feldspathic sandstone units with minor siltstone interbedded with thicker siltstone units. The top of the formation is defined as the first very coarse feldspathic sandstone of the Merrions Formation. The sandstones in the Guroba Formation tend to be darker coloured than those in the Merrions Formation, owing to their content of lithic fragments, and not as coarse grained. The Guroba Formation is well exposed along Meroo Creek northwest of Windeyer where, allowing for folding, the total thickness of the formation is about 1000m.

Merrions Formation (Dcm)

The Merrions Formation, formerly known as the Merrions Tuff, is the uppermost formation of the Crudine Group. It conformably overlies the Waterbeach Formation in the southeast of the area and the Guroba Formation in the northwest. In the area mapped it consists of very coarse pale coloured feldspathic sandstone, with very minor siltstone interbeds where the formation is thickest along Green Valley Creek. The total thickness ranges from about 300 to 400m in most places. The thickest part in the southwest is about 700m thick.

The Merrions Formation generally forms prominent ridges except where the thickness decreases markedly in the vicinity of Pyramul. The sandstone typically forms very large boulders owing to wide joint spacing. It is possible that the formation lenses out completely in places for one section between 3 and 6km southeast of Pyramul where there is little outcrop; otherwise it is usually an easily identifiable marker unit in the field. It also shows up prominently in most places as black or red on radiometric images. Cas (1978) has subdivided the Merrions Formation from representative sections throughout the Hill End Trough including the Tunnabidgee-Windeyer area. Subdivision was not attempted as part of the present mapping, but comparison of Cas' sections with the present mapping indicates that lower parts of the Merrions Formation elsewhere to the west and southwest are missing in the Tunnabidgee-Windeyer area. This raises the possibility of interfingering of the Merrions and Guroba Formations although no such interfingering was observed during the present mapping.

Very coarse feldspathic sandstone resembling that in the Merrions Formation crops out in an area around 5km southwest of Pyramul. It was at first thought that the sandstone might be inliers or faulted into the surrounding Cunningham Formation which overlies the Merrions Formation; however a creek section near GR420530 indicates that the sandstone in question is

within the Cunningham Formation. This appears to indicate separate sources for the Merrions and Cunningham Formations.

CUNNINGHAM FORMATION (Dn)

The Cunningham Formation conformably overlies the Merrions Tuff and is the youngest unit in the Siluro-Devonian Hill End Trough sequence. In the area mapped it consists mainly of slaty grey siltstone with subordinate coarse lithic and feldspathic sandstone. It also contains, near the base, the sandstone resembling that in the Merrions Formation mentioned above. Some quartz sandstone was observed southwest of Windeyer. The basal unit is everywhere a thick bed of siltstone immediately overlying the Merrions Formation. The siltstone in the Cunningham Formation is commonly cleaved and slaty with faint banding defining bedding. Areas mapped in any detail show numerous folds, commonly with steeply dipping limbs. This makes it difficult to estimate the total preserved thickness of the formation. Packham (1968) estimated a minimum thickness west of Hill End of 3700m.

PERMIAN

SHOALHAVEN GROUP (Ps)

Subhorizontally bedded sedimentary rocks of the Permian Shoalhaven Group, with a regional dip of about 1° to the northeast, unconformably overlie the older Palaeozoic formations in elevated terrain in the northeast of the area. The basal sandstone which is commonly conglomeratic forms low cliffs in many places; the cobbles and boulders in it are derived from the underlying formations. The basal unit which is about 20m thick is succeeded by fine white sandstone. This is overlain by white siltstone which is preserved only in the topographically highest areas. The basal unit has been mapped as Snapper Point Formation in Cudgegong-Ilford area to the east (Pemberton and others, 1994). In some areas near the southwestern limit of outcrop of the Shoalhaven Group the basal unit is preserved on rises only as residual rounded cobbles and gravel.

TERTIARY

Basalt(Tb)

Tertiary olivine basalt caps three hills in the area, one east and two west of Pyramul. The age of the basalt at Mount Carcalgong 6km east of Pyramul is known to be Late Eocene from K/Ar dating giving an age of 41.6±2.6ma (Dulhunty, 1972a). This compares with an age of 35.6±2.1ma for a dolerite sample from Mount Bocoble 9km to the northeast of Mount Carcalgong and just outside the area mapped. The age of the basalts on Mount Boiga 5km west of Pyramul and of another small capping 4km farther to the west is not known but their proximity, similar topographic position and similar elevation to Mount Carcalgong suggest that they are related in age.

STRUCTURE

The Silurian and Devonian rocks in the area are folded into a series of anticlines and synclines as shown in cross section EF (Figure 5). Apart from the major bounding faults on the eastern side of the area faulting is only minor. Dips are moderate to steep and most of the folds plunge in a southerly direction. An anticline in the Merrions Formation in the southwest, however, plunges to the north.

A strike swing in the fold axes from north-northwest in the north to south-southwest in the south is evident, and is part of a wider regional structural feature that is pronounced in the east but less prominent to the west. Folds also tend to die out to the north. For example several anticlines and synclines in the Cunningham Formation west of Pyramul become one syncline in the Merrions Formation to the north. This syncline itself dies out farther to the north, east of Windeyer.

The subhorizontal Permian sediments that overlie the older Palaeozoic rocks are unconformable on the older rocks. The regional dip of these rocks is about 1° to the northeast.

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Geological interpretation in all three areas mapped benefited from discussions with geologists of the New South Wales Geological Survey and with colleagues at AGSO. The graphic logs of diamond drillholes in the Ballimore area (Figure 6) were derived from detailed descriptive logs supplied by NSWGS.

REFERENCES

BEAN, J.M., 1974 - The geology and petrology of the Mullaley area of New South Wales. *Journal of the Geological Society of Australia* 21(1), 63-72.

BRUNKER, R.L. & ROSE, G, 1969 - Sydney Basin 1:500 000 Geological Sheet. *New South Wales Geological Survey, Sydney.*

CARNE, J.E. & MORRISON, M., 1916 - Report on the Ballimore or Talbragar River Coalfield. *Annual report of the Dept of Mines, New South Wales* (1915), 179-181.

CAS, R.A.F., 1978 - Basin characteristics of the early Devonian part of the Hill End Trough, New South Wales, based on a stratigraphic analysis of the Merrions Tuff. *Journal of the Geological Society of Australia* 24(7), 381-401.

COSIS, S., 1975 - Geology of the Laheys Creek area, central western New South Wales. *B.Sc. (Hons) Thesis, University of New South Wales* (unpublished).

DALE, M.J., 1975 - Geology of the Dapper State Forest area, central western New South Wales. *B.Sc. (Hons) Thesis, University of New South Wales* (unpublished).

DICKSON, T.W., 1962 - The geology of the parishes of Guroba and Merinda. *B.Sc.(Hons) Thesis, Sydney University* (unpublished).

DULHUNTY, J.A., 1972a - Potassium-argon basalt dates and their significance in the Ilford - Mudgee -Gulgong region. *Journal of the Royal Society of New South Wales* 104, 39-44.

DULHUNTY, J.A., 1972b - Potassium-argon dating and occurrence of Tertiary and Mesozoic basalts in the Binnaway district. *Journal & Proceedings of the Royal Society of New South Wales* 105, 71-76.

DULHUNTY, J.A., 1973 - Mesozoic stratigraphy in central western New South Wales. *Journal of the Geological Society of Australia* 20(3), 319-328.

DULHUNTY, J.A., & McDOUGALL, I, 1966 - Potassium-argon dating of basalts in the Coonabarabran Gunnedah district. *Australian Journal of Science* 28, 393-394.

FRATER, D.R., 1993 - Geology of the Elong Elong area, New South Wales. *B.Sc. (Hons) Thesis* (unpublished)

HIGGINS, M.L. & LOUGHNAN, F.C., 1973 - Flint clays of the Merrygoen-Digilah area. *Proceedings of the Australian Institute of Mining & Metallurgy* 246, 33-40.

KENNY, E.J., 1929 - Geological survey of the Coonabarabran-Gunnedah district, with special referenceto the occurrence of sub-surface water. *Annual report of the Dept of Mines, New South Wales* (1928), 117-118.

LISHMUND, S.R., DAWOOD, A.D., & LANGLEY, W.V., 1986 - The limestone deposits of New South Wales (2nd edition). *Geological Survey of New South Wales, Sydney, Mineral Resources* 25.

LOUGHNAN, F.C. & EVANS, P.R., 1978 - The Permian and Mesozoic of the Merriwa-Binnaway-Ballimore area, New South Wales. *Journal & Proceedings of the Royal Society of New South Wales* 111, 107-119.

MAGGS, D.F., 1963 - The stratigraphy of the Yeoval - Cumnock - Manildra region. *M.Sc. Thesis, University of Sydney* (unpublished).

OFFENBERG, A.C., 1968 - Gilgandra 1:250 000 geological Sheet SH 55-16. *Geological Survey of New South Wales, Sydney.*

OFFENBERG, A.C., ROSE, D.M. & PACKHAM, G.H., 1971 - Dubbo 1:250 000 geological Sheet SI 55-4. *Geological Survey of New South Wales, Sydney*

PACKHAM, G.H., 1968 - The Lower and Middle Palaeozoic stratigraphy and sedimentary tectonics of the Sofala - Hill End - Euchareena region, N.S.W. *Proceedings of the Linnean Society of New South Wales* 93, 111-163.

PACKHAM, G.H., (ed.), 1969 - The geology of New South Wales. *Journal of the Geological Society of New South Wales* 16(1).

PEARSON, D.F., 1996 - Newcrest Mining Limited EL 4812 Laheys Creek first annual and final report.*Newcrest Mining Limited.*

PEMBERTON, J.W., COLQUHOUN, G.P., WRIGHT, A.J., BOOTH, A.N., CAMPBELL, J.C., COOK, A.G., & MILLSTEED, B.D., 1994 - Stratigraphy and depositional environments of the northern Capertee High. *Proceedings of the Linnean Society of New South Wales* 114(4), 195-224.

PICKETT, J.W., 1974 - Ordovician and Silurian conodonts from central-western New South Wales.*Geological Survey of New South Wales, Sydney, Palaeontological Report 1974/11* (unpublished).

PICKETT, J.W., 1975 - Conodont samples from the Central West. *Geological Survey of New South Wales, Sydney, Palaeontological Report* 1975/7 (unpublished).

PICKETT, J., (ed.) 1982 - The Silurian system in New South Wales. *Geological Survey of New South Wales, Sydney, Bulletin* 29.

POGSON, D.J., WYBORN, D., RAYMOND, O.L., GLEN, R.A., HENDERSON, G.A.M., KRYNEN, J., MEAKIN, S., MORGAN, E.J., SCOTT, M.M., STUART-SMITH, P., WALLACE, D., WARREN, A.Y.E., & WATKINS, J.J., 1996 - Bathurst 1:250 000 Geological Sheet SI/55-8. Geological Survey of New South Wales, Sydney / Australian Geological Survey Organisation, Canberra.

SAVAGE, N.M., 1969 - The geology of the Manildra district, New South Wales. *Journal and Proceedings of the Royal Society of New South Wales* 101, 159-169.

SAVAGE, N.M., 1974 - The brachiopods of the Lower Devonian Maradana Shale, New South Wales. *Palaeontographica* A146, 1-51.

SHERWIN, L., 1973a - Silurian and Devonian fossils from the Manildra - Cumnock district. *Geological Survey of New South Wales, Sydney, Palaeontological Report* 1973/8 (unpublished).

SHERWIN, L., 1973b - Early Silurian fossils from the Cumnock district. *Geological Survey of New South Wales, Sydney, Palaeontological Report* 1973/14 (unpublished).

STEVENS, N.C., 1952 - The petrology of the Cowra Intrusion and associated xenoliths. *Proceedings of the Linnean Society of New South Wales* 77, 132-141.

WALLIN, P., 1975 - Geology of the Spring Ridge area, central western New South Wales. *B.Sc. (Hons) Thesis, University of New South Wales* (unpublished).

WELLMAN, P. & McDOUGALL, I., 1974 - Potassium-argon ages on the Cainozoic volcanic rocks of New South Wales. *Journal of the Geological Society of Australia* 21(3), 247-272.

YOO, E.K., 1988 - The Rocky Glen Ridge and Gilgandra Trough, beneath the Surat Basin. *Geological Survey of New South Wales, Quarterly Notes* 72.

APPENDIX 1

FIELD OBSERVATION DATA

SITEID	MAPNO	EAST	NORTH	STRATNAME	LITHNAME	DESCRIPTION	AGE
95840413	8832	745100	6360300	Dunmoogin Formation	slate	grey; minor 10cm thick coarse feldspathic sandst. interbeds	Early Devonian
95840414	8832	745150	6361150	Dunmoogin Formation	slate	laminated; 2-3m thick feldspathic sandstone interbed	Early Devonian
95840415	8832	745550	6361200	Turondale Formation	sandstone	feldspathic, lithic, coarse grained	Early Devonian
95840416	8832	745650	6361400	Cookman Formation	sandstone	fine grained quartz bearing; interbed of buff to red brown slate	Early Devonian
95840417	8832	746450	6361550	Chesleigh Formation	sandstone	feldspathic; banding on one loose boulder	Late Silurian
95840418	8832	746200	6361450	Cookman Formation	sandstone	quartz-bearing, fine grained, banded	Early Devonian
95840419	8832	744450	6362450	Dunmoogin Formation	slate		Early Devonian
95840420	8832	744350	6362550	Guroba Formation	sandstone	quartzo-feldspathic	Early Devonian
95840421	8832	743000	6364500	Guroba Formation	sandstone	laminated feldspathic sandstone	Early Devonian
95840422	8832	741550	6367100	Dunmoogin Formation	sandstone	feldspathic fine grained sandstone and massive siltstone	Early Devonian
95840423	8832	741050	6367550	Dunmoogin Formation	siltstone	interbed 3cm thick of fine grained feldspathic sandstone	Early Devonian
95840424	8832	737800	6370600	Guroba Formation	sandstone	coarse, feldspathic, lithic; rounded lithic pebbles to 1 cm diam	Early Devonian
95840425	8832	736000	6370600	Merrions Formation	sandstone	feldspathic, lithic, very coarse pale rock with dark inclusions	Early Devonian
95840426	8832	736100	6370700	Guroba Formation	siltstone		Early Devonian
95840427	8832	748750	6373000	Chesleigh Formation	siltstone	interbeds of fine grained greywacke sandstone	Late Silurian
95840428	8832	748000	6373100	Chesleigh Formation	slate		Late Silurian
95840429	8832	748250	6370350	Chesleigh Formation	sandstone	quartz-bearing, medium grained	Late Silurian
95840430	8832	748000	6370250	Chesleigh Formation	sandstone	quartz-bearing	Late Silurian
95840431	8832	747500	6370700	Chesleigh Formation	tuff	very fresh, fine grained, blue grey rock	Late Silurian
95840432	8832	746900	6371450	Chesleigh Formation	dacite	slightly to moderately weathered, coarse grained rock	Late Silurian
95840433	8832	745700	6373150	Chesleigh Formation	sandstone	interbedded sandstone & siltstone, both with intense cleavage	Late Silurian
95840434	8832	746700	6372100	Chesleigh Formation	sandstone	feldspathic, medium grained	Late Silurian
95840435	8832	744500	6371600	Chesleigh Formation	sandstone	feldspathic, medium to fine grained; interbedded siltstone	Late Silurian
95840436	8832	743450	6371150	Chesleigh Formation	tuff	medium grained	Late Silurian
95840437	8832	742700	6370900	Chesleigh Formation	sandstone	quartz-bearing, medium grained	Late Silurian
95840438	8832	738700	6365850	Guroba Formation	sandstone	feldspathic, medium grained	Early Devonian
95840439	8832	738100	6365550	Merrions Formation	tuff	fine grained, cherty, 1-15cm beds, massive in upper part	Early Devonian
95840440	8832	737600	6365550	Cunningham Formation	slate		Early - Middle Devonian
95840441	8832	737450	6365400	Cunningham Formation	sandstone	quartz-bearing, medium to fine grained; interbedded siltstone	Early - Middle Devonian
95840442	8832	738700	6365600	Guroba Formation	sandstone	feldspathic, medium grained, dark blue grey	Early Devonian
95840443	8832	742300	6370600	Chesleigh Formation	slate		Late Silurian
95840444	8832	741850	6369000	Chesleigh Formation	sandstone	feldspathic, coarse grained	Late Silurian
95840445	8832	741650	6369050	Cookman Formation	sandstone	quartz-bearing	Early Devonian
95840446	8832	744100	6360500	Guroba Formation	siltstone	thinly bedded, laminated in places; interbedded fine sandstone	Early Devonian
95840447	8832	743700	6360100	Cunningham Formation	slate		Early - Middle Devonian
95840448	8832	742900	6360050	Cunningham Formation	slate		Early - Middle Devonian
95840449	8832	742800	6359350	Cunningham Formation	slate	minor very coarse lithic sandstone	Early - Middle Devonian
95840450	8832	741850	6359350	Merrions Formation	sandstone	feldspathic, coarse, pale grey; minor quartz	Early Devonian

95840451	8832	741750	6359300	Guroba Formation	slate		Early Devonian
95840452	8832	741550	6359400	Guroba Formation	sandstone	thickly bedded, medium grained	Early Devonian
95840453	8832	740900	6359750	Guroba Formation	sandstone	feldspathic	Early Devonian
95840454	8832	740800	6359750	Guroba Formation	slate		Early Devonian
95840455	8832	739450	6359950	Guroba Formation	sandstone	fine grained	Early Devonian
95840456	8832	740350	6359750	Guroba Formation	sandstone	feldspathic, medium grained	Early Devonian
95840457	8832	741750	6363700	Guroba Formation	siltstone	thinly bedded	Early Devonian
95840458	8832	742250	6363350	Guroba Formation	sandstone	feldspathic, medium grained	Early Devonian
95840459	8832	741950	6364200	Guroba Formation	sandstone	feldspathic, medium grained	Early Devonian
95840460	8832	742250	6364400	Guroba Formation	siltstone	interbedded with thin sandstone layers	Early Devonian
95840461	8832	739550	6371000	Turondale Formation	sandstone	feldspathic, medium grained	Early Devonian
95840462	8832	739750	6371200	Turondale Formation	sandstone	feldspathic, medium to fine grained, massive and banded	Early Devonian
95840463	8832	739950	6371350	Turondale Formation	chert		Early Devonian
95840464	8832	740050	6371350	Turondale Formation	sandstone	feldspathic, very coarse; prominent pink feldspar	Early Devonian
95840465	8832	739050	6371400	Turondale Formation	sandstone	feldspathic, fine grained	Early Devonian
95840466	8832	738750	6371400	Dunmoogin Formation	siltstone		Early Devonian
95840467	8832	738350	6371000	Dunmoogin Formation	siltstone	laminated; interbedded with fine sandstone	Early Devonian
95840468	8832	737800	6371450	Dunmoogin Formation	siltstone	laminated, grey, fine grained; pale sandy bands define bedding	Early Devonian
95840469	8832	737650	6372500	Dunmoogin Formation	siltstone	slaty; contains 30cm thick sandstone bed	Early Devonian
95840470	8832	737600	6372250	Dunmoogin Formation	siltstone	faintly laminated siltstone and fine sandstone	Early Devonian
95840471	8832	739000	6369650	Dunmoogin Formation	siltstone	laminated	Early Devonian
95840472	8832	739400	6369400	Turondale Formation	sandstone	feldspathic, medium grained	Early Devonian
95840473	8832	741200	6369000	Turondale Formation	siltstone		Early Devonian
95840474	8832	741250	6371950	Chesleigh Formation	tuff	fine grained; contains volcanic bombs with reaction rims	Late Silurian
95840475	8832	740850	6371700	Chesleigh Formation	gabbro	very coarse grained, dark rock with large white feldspars	Late Silurian
95840476	8832	756850	6354050	Chesleigh Formation	tuff	fine grained, blue grey cherty rock	Late Silurian
95840477	8832	756100	6353550	Cookman Formation	sandstone	silicified, quartzo-feldspathic	Late Silurian
95840478	8832	750350	6349250	Turondale Formation	siltstone	interbedded feldspathic sandstone	Early Devonian
95840479	8832	749100	6348750	Turondale Formation	siltstone	interbedded fine grained feldspathic sandstone	Early Devonian
95840480	8832	747000	6346500	Turondale Formation	siltstone	laminated; interbedded fine grained feldspathic sandstone	Early Devonian
95840481	8832	741200	6362700	Guroba Formation	siltstone	interbedded in med gr blue grey ss with dark mudst inclusions	Early Devonian
95840482	8832	740550	6362300	Guroba Formation	sandstone	feldspathic; thin siltstone interbeds	Early Devonian
95840483	8832	740150	6364200	Guroba Formation	sandstone	feldspathic, medium grained; small siltstone clasts locally	Early Devonian
95840484	8832	739750	6367850	Dunmoogin Formation	slate		Early Devonian
95840485	8832	740150	6367850	Turondale Formation	siltstone		Early Devonian
95840486	8832	740500	6367600	Turondale Formation	sandstone	feldspathic, medium, even grained; prominent white feldspar	Early Devonian
95840487	8832	744350	6367850	Chesleigh Formation	siltstone	interbedded with fine grained greywacke sandstone	Late Silurian
95840488	8832	744550	6368100	Chesleigh Formation	siltstone	in part cherty	Late Silurian
95840489	8832	748900	6366250	Turondale Formation	siltstone	laminated	Early Devonian

95840490	8832	749150	6365650	Turondale Formation	sandstone	medium to fine grained; prominent white feldspar	Early Devonian
95840491	8832	749100	6365350	Waterbeach Formation	siltstone		Early Devonian
95840492	8832	748750	6365050	Waterbeach Formation	siltstone	thin coarse feldspathic sandstone interbeds and stringers	Early Devonian
95840493	8832	748400	6364500	Turondale Formation	sandstone	feldspathic, coarse grained	Early Devonian
95840494	8832	747500	6364350	Turondale Formation	sandstone	feldspathic, coarse grained	Early Devonian
95840495	8832	746600	6364900	Chesleigh Formation	sandstone	feldspathic, medium grained	Late Silurian
95840496	8832	746250	6364900	Chesleigh Formation	siltstone	laminated, siliceous	Late Silurian
95840497	8832	746250	6367600	Chesleigh Formation	sandstone	feldspathic, medium grained	Late Silurian
95840498	8832	745800	6363400	Chesleigh Formation	tuff	fine grained, massive rock with local banding	Late Silurian
95840499	8832	745600	6364250	Chesleigh Formation	sandstone	fine grained; contains siltstone interbed	Late Silurian
95840500	8832	745550	6366000	Chesleigh Formation	sandstone	thin siltstone interbeds	Late Silurian
95840501	8832	744950	6365850	Chesleigh Formation	siltstone		Late Silurian
95840502	8832	749000	6363750	Waterbeach Formation	siltstone		Early Devonian
95840503	8832	750000	6363000	Waterbeach Formation	slate		Early Devonian
95840504	8832	749650	6361650	Waterbeach Formation	slate	thin silty interbeds	Early Devonian
95840505	8832	749200	6361300	Turondale Formation	sandstone	feldspathic, banded	Early Devonian
95840506	8832	751050	6362000	Turondale Formation	siltstone	laminated	Early Devonian
95840507	8832	751700	6361950	Turondale Formation	siltstone	interbedded feldspathic sandstone	Early Devonian
95840508	8832	751950	6361750	Turondale Formation	slate		Early Devonian
95840509	8832	752450	6361550	Turondale Formation	siltstone		Early Devonian
95840510	8832	752900	6361550	Turondale Formation	sandstone	feldspathic; succession of coarse - fine sandstone - siltstone	Early Devonian
95840511	8832	753000	6361850	Cookman Formation	sandstone	quartz-bearing	Late Silurian
95840512	8832	754250	6362650	Chesleigh Formation	siltstone		Late Silurian
95840513	8832	752550	6362800	Chesleigh Formation	sandstone	silty	Late Silurian
95840514	8832	754500	6368850	Chesleigh Formation	siltstone	interbedded with fine greywacke sandstone	Late Silurian
95840515	8832	754400	6368450	Chesleigh Formation	sandstone	greywacke sandstone with interbedded siltstone	Late Silurian
95840516	8832	753650	6368450	Chesleigh Formation	sandstone	20cm thick sandstone beds with 10cm thick siltstone beds	Late Silurian
95840517	8832	753100	6368650	Chesleigh Formation	sandstone	greywacke sandstone	Late Silurian
95840518	8832	753050	6365950	Chesleigh Formation	siltstone	laminated	Late Silurian
95840519	8832	752250	6366500	Chesleigh Formation	sandstone	feldspathic, coarse grained; siltstone interbeds	Late Silurian
95840520	8832	751700	6367800	Chesleigh Formation	sandstone	feldspathic, medium grained	Late Silurian
95840521	8832	751900	6368200	Chesleigh Formation	siltstone	greenish buff	Late Silurian
95840522	8832	751600	6368800	Chesleigh Formation	breccia	sedimentary breccia with phyllite clasts; bed in g'wacke sst	Late Silurian
95840523	8832	751350	6369450	Chesleigh Formation	siltstone	siltstone and fine sandstone	Late Silurian
95840524	8832	750900	6370100	Chesleigh Formation	siltstone		Late Silurian
95840525	8832	749750	6371900	Chesleigh Formation	sandstone	medium and even grained greywacke sandstone	Late Silurian
95840526	8832	752300	6367000	Chesleigh Formation	dacite		Late Silurian
95840527	8832	743450	6351400	Cunningham Formation	sandstone	medium grained greywacke sandstone	Early - Middle Devonian
95840528	8832	743100	6351300	Cunningham Formation	sandstone	medium grained greywacke sandstone	Early - Middle Devonian

95840529	8832	743650	6351250	Cunningham Formation	sandstone	medium grained greywacke sandstone interbedded with siltst	Early - Middle Devonian
95840530	8832	744150	6351050	Cunningham Formation	sandstone	quartz-bearing, fine to coarse, blue-grey well-bedded	Early - Middle Devonian
95840531	8832	744800	6350800	Cunningham Formation	siltstone	lithic, quartz-bearing, well bedded, cleaved	Early - Middle Devonian
95840532	8832	744900	6350550	Cunningham Formation	sandstone	fine to coarse with siltstone interbeds	Early - Middle Devonian
95840533	8832	745550	6350750	Cunningham Formation	siltstone		Early - Middle Devonian
95840534	8832	746800	6350750	Cunningham Formation	sandstone	feldspathic, medium grained, blue-grey, thickly bedded	Early - Middle Devonian
95840535	8832	747450	6350400	Waterbeach Formation	siltstone		Early Devonian
95840536	8832	748900	6350700	Waterbeach Formation	siltstone	interbedded sandstone	Early Devonian
95840537	8832	746150	6351150	Cunningham Formation	siltstone	contains a fine sandstone bed	Early - Middle Devonian
95840538	8832	746700	6352050	Waterbeach Formation	siltstone		Early Devonian
95840539	8832	746700	6353300	Cunningham Formation	siltstone		Early - Middle Devonian
95840540	8832	746650	6353700	Cunningham Formation	siltstone		Early - Middle Devonian
95840541	8832	742750	6355300	Cunningham Formation	siltstone		Early - Middle Devonian
95840542	8832	742450	6355100	Cunningham Formation	siltstone	faintly banded	Early - Middle Devonian
95840543	8832	741100	6354350	Cunningham Formation	siltstone	interbedded with fine sandstone	Early - Middle Devonian
95840544	8832	739950	6353500	Cunningham Formation	siltstone		Early - Middle Devonian
95840545	8832	742500	6352200	Cunningham Formation	slate	contains a few clasts of sandstone	Early - Middle Devonian
95840546	8832	743200	6353300	Cunningham Formation	sandstone	feldspathic, fine to medium grained; a few siltstone interbeds	Early - Middle Devonian
95840547	8832	742800	6353250	Cunningham Formation	sandstone	feldspathic, medium grained; interbedded with slate	Early - Middle Devonian
95840548	8832	742400	6352950	Cunningham Formation	slate		Early - Middle Devonian
95840549	8832	742200	6353000	Cunningham Formation	sandstone	graded coarse to fine; interbedded siltstone	Early - Middle Devonian
95840550	8832	741800	6353200	Cunningham Formation	sandstone	fine grained; interbedded siltstone	Early - Middle Devonian
95840551	8832	742350	6353000	Cunningham Formation	siltstone		Early - Middle Devonian
95840552	8832	742600	6351700	Cunningham Formation	sandstone	feldspathic, fine to coarse grained	Early - Middle Devonian
95840553	8832	742050	6355900	Cunningham Formation	sandstone	graded coarse to medium to fine grained in dip direction	Early - Middle Devonian
95840554	8832	742200	6355750	Cunningham Formation	sandstone	interbedded siltstone	Early - Middle Devonian
95840555	8832	742400	6355650	Cunningham Formation	siltstone		Early - Middle Devonian
95840556	8832	742850	6355750	Cunningham Formation	sandstone	interbedded laminated siltstone	Early - Middle Devonian
95840557	8832	742600	6355550	Cunningham Formation	siltstone		Early - Middle Devonian
95840558	8832	744500	6355200	Cunningham Formation	siltstone	5cm thick sandstone interbed	Early - Middle Devonian
95840559	8832	743800	6353800	Cunningham Formation	siltstone		Early - Middle Devonian
95840560	8832	743500	6353800	Cunningham Formation	sandstone	medium grained	Early - Middle Devonian
95840561	8832	743900	6355200	Cunningham Formation	sandstone	lithic, quartzo-feldspathic, medium to coarse grained	Early - Middle Devonian
95840562	8832	744150	6355550	Cunningham Formation	slate	numerous thin fine sandstone beds up to 1cm thick in slate	Early - Middle Devonian
95840563	8832	736350	6348050	Waterbeach Formation	sandstone	fine grained with minor siltstone interbeds	Early Devonian
95840564	8832	735600	6348050	Merrions Formation	sandstone	coarse to very fine in thick graded bed	Early Devonian
95840565	8832	735000	6347900	Cunningham Formation	sandstone	interbedded siltstone	Early - Middle Devonian
95840566	8832	738200	6346500	Cunningham Formation	sandstone	medium grained with faint banding	Early - Middle Devonian
95840567	8832	738600	6345950	Cunningham Formation	sandstone	coarse grained; overlain by siltstone	Early - Middle Devonian

95840568	8832	741650	6349700	Cunningham Formation	sandstone	sandstone grading up to siltstone	Early - Middle Devonian
95840569	8832	745050	6356400	Guroba Formation	siltstone	interbedded fine sandstone	Early Devonian
95840570	8832	744450	6356400	Cunningham Formation	sandstone	interbedded siltstone	Early - Middle Devonian
95840571	8832	745050	6357300	Guroba Formation	slate		Early Devonian
95840572	8832	745350	6356150	Guroba Formation	siltstone	1m thick coarse sandstone interbed	Early Devonian
95840573	8832	746100	6356500	Guroba Formation	sandstone	feldspathic, thinly bedded, medium grained	Early Devonian
95840574	8832	746450	6358700	Cookman Formation	sandstone	quartz-bearing, medium grained	Early Devonian
95840575	8832	746750	6358400	Cookman Formation	sandstone	quartz-bearing, medium grained	Early Devonian
95840576	8832	747650	6359500	Turondale Formation	sandstone	feldspathic, very coarse grained	Early Devonian
95840577	8832	748050	6359200	Turondale Formation	sandstone	quartz-bearing, coarse to medium grained	Early Devonian
95840578	8832	746350	6358000	Turondale Formation	sandstone	feldspathic, coarse grained	Early Devonian
95840579	8832	746700	6357500	Turondale Formation	sandstone	feldspathic; contains siltstone interbed	Early Devonian
95840580	8832	747400	6357300	Dunmoogin Formation	sandstone	feldspathic; contains siltstone interbeds	Early Devonian
95840581	8832	747650	6357000	Turondale Formation	sandstone	feldspathic, medium to coarse, blue grey	Early Devonian
95840582	8832	747500	6356600	Waterbeach Formation	siltstone	some folding of cleavage; small thrust faults	Early Devonian
95840583	8832	748300	6357100	Turondale Formation	sandstone	feldspathic, banded, coarse grained	Early Devonian
95840584	8832	749850	6357550	Waterbeach Formation	siltstone	mostly massive but i/b siltstone & fine sandstone in one place	Early Devonian
95840585	8832	751000	6357950	Turondale Formation	siltstone	interbedded sandstone	Early Devonian
95840586	8832	746750	6368600	Turondale Formation	slate		Early Devonian
95840587	8832	747200	6368850	Turondale Formation	siltstone	locally faintly laminated but mostly massive	Early Devonian
95840588	8832	746750	6369100	Turondale Formation	sandstone	feldspathic, fine grained	Early Devonian
95840589	8832	746450	6369550	Chesleigh Formation	tuff	overlain by medium grained, feldspathic sandstone	Late Silurian
95840590	8832	746100	6370100	Chesleigh Formation	sandstone	feldspathic, fine grained, pale grey	Late Silurian
95840591	8832	745700	6369900	Chesleigh Formation	siltstone	cherty	Late Silurian
95840592	8832	745600	6369450	Chesleigh Formation	siltstone	cherty	Late Silurian
95840593	8832	749950	6346150	Turondale Formation	sandstone	feldspathic, medium to coarse grained	Early Devonian
95840594	8832	750500	6346200	Turondale Formation	sandstone	feldspathic; interbedded siltstone	Early Devonian
95840595	8832	750950	6346050	Cookman Formation	siltstone	interbedded fine grained quartz sandstone	Early Devonian
95840596	8832	751550	6345950	Cookman Formation	sandstone	quartz-bearing	Early Devonian
95840597	8832	749700	6346700	Waterbeach Formation	siltstone	laminated	Early Devonian
95840598	8832	749350	6346750	Turondale Formation	siltstone	thickly interbedded with medium grained feldsp. sandstone	Early Devonian
95840599	8832	748950	6346800	Turondale Formation	sandstone	feldspathic, coarse grained, mostly massive but locally banded	Early Devonian
95840600	8832	748700	6346850	Turondale Formation	sandstone	feldspathic, coarse grained	Early Devonian
95840601	8832	748400	6346900	Turondale Formation	slate	thin silty bands	Early Devonian
95840602	8832	751600	6353500	Turondale Formation	siltstone	laminated	Early Devonian
95840603	8832	751350	6353700	Turondale Formation	sandstone	feldspathic, medium grained with faint banding	Early Devonian
95840604	8832	751300	6353800	Turondale Formation	siltstone		Early Devonian
95840605	8832	750900	6353850	Turondale Formation	siltstone		Early Devonian
95840606	8832	752100	6353200	Cookman Formation	siltstone		Early Devonian

95840607	8832	753150	6353400	Turondale Formation	sandstone	feldspathic, coarse grained, banded	Early Devonian
95840608	8832	752600	6354050	Cookman Formation	siltstone	banded	Early Devonian
95840609	8832	752350	6353950	Cookman Formation	siltstone	thinly interbedded with quartz sandstone	Early Devonian
95840610	8832	753200	6354100	Turondale Formation	siltstone	interbedded with feldspathic sandstone	Early Devonian
95840611	8832	752700	6353900	Turondale Formation	siltstone	interbedded with medium grained feldspathic sandstone	Early Devonian
95840612	8832	753000	6353200	Turondale Formation	siltstone	interbedded with feldspathic sandstone	Early Devonian
95840613	8832	753300	6353100	Turondale Formation	siltstone	thinly interbedded with banded feldspathic sandstone	Early Devonian
95840614	8832	754550	6353100	Turondale Formation	sandstone	feldspathic, coarse grained	Early Devonian
95840615	8832	754050	6353300	Turondale Formation	sandstone	feldspathic, coarse grained with a few siltstone clasts	Early Devonian
95840616	8832	755050	6353100	Turondale Formation	sandstone	feldspathic, coarse to fine, banded & interbedded with siltst.	Early Devonian
95840617	8832	755500	6353350	Cookman Formation	siltstone	mostly massive; faint banding in one place	Early Devonian
95840618	8832	754100	6346450	Cookman Formation	slate		Early Devonian
95840619	8832	753950	6346550	Cookman Formation	sandstone	quartz-bearing, banded, fine grained	Early Devonian
95840620	8832	753800	6346650	Cookman Formation	sandstone	fine grained greywacke sandstone and siltstone	Early Devonian
95840621	8832	753150	6346850	Chesleigh Formation	siltstone		Late Silurian
95840622	8832	752950	6346700	Chesleigh Formation	siltstone	thin fine grained sandstone interbeds	Late Silurian
95840623	8832	752550	6346600	Chesleigh Formation	sandstone	quartzo-feldspathic, banded	Late Silurian
95840624	8832	752800	6346200	Chesleigh Formation	siltstone	banded	Late Silurian
95840625	8832	753150	6345750	Cookman Formation	siltstone	thinly interbedded with fine sandstone	Early Devonian
95840626	8832	737800	6350150	Cunningham Formation	slate		Early - Middle Devonian
95840627	8832	737350	6350450	Waterbeach Formation	slate		Early Devonian
95840628	8832	738250	6348850	Cunningham Formation	sandstone	feldspathic; thinly interbedded with slate	Early - Middle Devonian
95840629	8832	739150	6348650	Cunningham Formation	sandstone	feldspathic; thinly interbedded with slate	Early - Middle Devonian
95840630	8832	739500	6348100	Cunningham Formation	siltstone		Early - Middle Devonian
95840631	8832	739650	6347650	Cunningham Formation	sandstone	feldspathic, medium to coarse grained; minor siltstone	Early - Middle Devonian
95840632	8832	752200	6351200	Turondale Formation	sandstone	feldspathic, coarse grained	Early Devonian
95840633	8832	751100	6349600	Turondale Formation	siltstone		Early Devonian
95840634	8832	749400	6348700	Turondale Formation	sandstone	feldspathic, coarse to fine grained	Early Devonian
95840635	8832	748550	6348550	Turondale Formation	sandstone	feldspathic, coarse, massive to medium grained, laminated	Early Devonian
95840636	8832	748350	6348800	Turondale Formation	sandstone	feldspathic, banded, fine grained	Early Devonian
95840637	8832	748050	6349150	Waterbeach Formation	siltstone		Early Devonian
95840638	8832	748800	6347650	Turondale Formation	sandstone	feldspathic	Early Devonian
95840639	8832	746550	6345800	Waterbeach Formation	siltstone	laminated sandy siltstone and siltstone	Early Devonian
95840640	8832	741350	6353700	Cunningham Formation	sandstone	feldspathic	Early - Middle Devonian
95840641	8832	736150	6358450	Cunningham Formation	slate	interbedded with fine sandstone	Early - Middle Devonian
95840642	8832	735500	6359000	Cunningham Formation	slate	a few 10cm thick medium grained feldsp sandstone interbeds	Early - Middle Devonian
95840643	8832	749050	6357100	Waterbeach Formation	siltstone		Early Devonian
95840650	8632	661800	6369450	Kabadah Formation	siltstone	banded	Late Ordovician - Early Silurian
95840651	8632	661550	6369800	Kabadah Formation	sandstone	dark grey, laminated, silty fine grained	Late Ordovician - Early Silurian

95840652	8632	661450	6370000	Kabadah Formation	sandstone	greenish grey, volcaniclastic; small, red, cherty inclusions	Late Ordovician - Early Silurian
95840653	8632	662250	6368000	Kabadah Formation	siltstone	laminated, purple	Late Ordovician - Early Silurian
95840654	8632	663200	6368600	Kabadah Formation	siltstone	laminated, silicified	Late Ordovician - Early Silurian
95840655	8632	663400	6368400	Kabadah Formation	limestone	thinly bedded calcareous siltstone and impure limestone	Late Ordovician - Early Silurian
95840656	8632	663500	6368250	Kabadah Formation	sandstone	fine grained, volcaniclastic; small rounded clasts	Late Ordovician - Early Silurian
95840657	8632	662250	6355100	Canowindra Volcanics	dacite	coarse grained, porphyritic	Late Wenlockian
95840658	8632	662100	6355150	Cary Formation	tuff	fine grained	Late Ordovician - Early Silurian
95840659	8632	659400	6357100	Kabadah Formation	siltstone	purplish grey	Late Ordovician - Early Silurian
95840660	8632	661350	6361250	Kabadah Formation	sandstone	mafic volcaniclastic, with faint banding	Late Ordovician - Early Silurian
95840661	8632	661650	6361050	Kabadah Formation	sandstone	fine grained with interbedded siltstone; well banded in places	Late Ordovician - Early Silurian
95840662	8632	660900	6362100	Kabadah Formation	siltstone	purple, laminated	Late Ordovician - Early Silurian
95840663	8632	658250	6359400	Hanover Formation	chert	blue grey, siliceous	Ludlovian
95840664	8632	657000	6358800	Canowindra Volcanics	dacite	coarse grained, porphyritic	Late Wenlockian
95840665	8632	655000	6354600	Hanover Formation	mudstone	calcareous	Ludlovian
95840666	8632	662000	6352000	Burrawong Limestone	limestone	coralline, pale grey; underlain by greenish-buff siltstone	Ludlovian
95840667	8632	661750	6351600	Burgoon Formation	siltstone	buff	Pridolian
95840668	8632	662000	6351100	Burgoon Formation	siltstone	blocky, siliceous	Pridolian
95840669	8632	661450	6350300	Wansey Formation	sandstone	andesitic volcaniclastic with small purple mudst inclusions	Pridolian
95840670A	8632	660850	6350150	Wansey Formation	mudstone	banded, calcareous	Pridolian
95840670B	8632	660850	6350150	Wansey Formation	sandstone	volcaniclastic	Pridolian
95840671	8632	661000	6350200	Wansey Formation	conglomerate	andesitic detritus	Pridolian
95840672	8632	661100	6350200	Wansey Formation	siltstone		Pridolian
95840673	8632	660950	6352350	Wansey Formation	siltstone		Pridolian
95840674	8632	660750	6351700	Wansey Formation	siltstone		Pridolian
95840675	8632	660550	6351200	Wansey Formation	sandstone	volcaniclastic	Pridolian
95840676	8632	662000	6361850	Kabadah Formation	siltstone	overlain by mafic volcaniclastic sandstone	Late Ordovician - Early Silurian
95840677	8632	661000	6363650	Kabadah Formation	sandstone	medium grained, mafic volcaniclastic	Late Ordovician - Early Silurian
95840678	8632	658150	6369200	Hanover Formation	siltstone	buff	Ludlovian
95840679	8632	657600	6371650	Hanover Formation	siltstone	buff	Ludlovian
95840680	8632	657000	6372150	Hanover Formation	siltstone	buff	Ludlovian
95840681	8632	658050	6367650	Hanover Formation	siltstone	purple and buff	Ludlovian
95840682	8632	659100	6365750	Hanover Formation	siltstone	purple; with black Mn staining of joint surfaces	Ludlovian
95840683	8632	658500	6362950		dolerite	medium grained	
95840684	8632	656750	6363300	Hanover Formation	siltstone		Ludlovian
95840685	8632	655950	6363400	Hanover Formation	siltstone	buff with a few 1cm thick pale bands	Ludlovian
95840686	8632	654650	6363150	Hanover Formation	mudstone	calcareous	Ludlovian
95840687	8632	664450	6367500	Kabadah Formation	siltstone	tuffaceous	Late Ordovician - Early Silurian
95840688	8632	663900	6372600	Kabadah Formation	sandstone	greenish grey, massive, volcaniclastic	Late Ordovician - Early Silurian
95840689	8632	663100	6370450	Kabadah Formation	siltstone		Late Ordovician - Early Silurian

95840690	8632	661050	6370050	Kabadah Formation	sandstone	coarse, clast-rich plus conglomerate; clasts include red jasper	Late Ordovician - Early Silurian
95840691	8632	662450	6370850	Kabadah Formation	siltstone		Late Ordovician - Early Silurian
95840692	8632	660800	6366500	Canowindra Volcanics	dacite	coarse, porphyritic; columnar jointing	Late Wenlockian
95840693	8632	662450	6364800		basalt	fine grained, dark grey	Tertiary
95840694	8632	660750	6352800	Wansey Formation	siltstone	tuffaceous	Pridolian
95840695	8632	660350	6352750	Wansey Formation	sandstone	coarse, dark, white feldspar rich, volcaniclastic	Pridolian
95840696	8632	660000	6353700	Kabadah Formation	sandstone	medium grained, dark grey, volcaniclastic	Late Ordovician - Early Silurian
95840697	8632	659400	6353550		basalt	dark grey, fine grained; probably a dyke	
95840698	8632	658800	6354000	Kabadah Formation	sandstone	mid grey, volcaniclastic	Late Ordovician - Early Silurian
95840699	8632	659450	6347950	Kabadah Formation	sandstone	dark grey, faintly banded, silty, volcaniclastic	Late Ordovician - Early Silurian
95840700	8632	660650	6348850	Wansey Formation	sandstone	coarse, quartz-bearing, volcaniclastic	Pridolian
95840701	8632	662000	6348650	Burgoon Formation	sandstone	banded, coarse, quartzo-feldspathic	Pridolian
95840702	8632	660100	6349700	Kabadah Formation	sandstone	medium grained, volcaniclastic, with some thin cherty bands	Late Ordovician - Early Silurian
95840703	8632	660700	6374700		dolerite	coarse to fine grained	Late Wenlockian
95840704	8632	659300	6374550	Hanover Formation	siltstone	buff	Ludlovian
95840705	8632	656350	6361300	Canowindra Volcanics	dacite	coarse grained, grey	Late Wenlockian
95840706	8632	656200	6361750	Hanover Formation	chert	massive	Ludlovian
95840707	8632	655650	6361850	Hanover Formation	siltstone	grey to buff, faintly banded, blocky jointed	Ludlovian
95840708	8632	654950	6361900	Hanover Formation	siltstone	cherty, fine grained, volcaniclastic	Ludlovian
95840709	8632	654750	6361250		granite	pinkish-grey, medium grained; probably a dyke	
95840710	8632	654400	6360100	Canowindra Volcanics	dacite	dark grey, porphyritic	Late Wenlockian
95840711	8632	664200	6367600	Kabadah Formation	sandstone	greenish grey, medium grained; interbedded laminated siltst.	Late Ordovician - Early Silurian
95840712	8632	657000	6354750	Canowindra Volcanics	dacite	coarse grained, porphyritic	Late Wenlockian
95840713	8632	652750	6352050		gabbro	altered, greenish	
95840720	8733	726650	6439100	Tucklan Formation	chert	banded, blue-grey	Ordovician
95840721	8733	727800	6440600	Tucklan Formation	siltstone	banded, cream and purplish-brown	Ordovician
95840722	8733	727350	6434950	Tucklan Formation	basalt	pale, green-grey	Ordovician
95840723	8733	725000	6432200	Adaminaby Group	siltstone	red-brown, yellow and white	Early Ordovician
95840724	8733	724450	6432350	Adaminaby Group	siltstone	purplish and white	Early Ordovician
95840725	8733	724300	6431150	Adaminaby Group	siltstone	purple	Early Ordovician
95840726	8733	723000	6431550	Dunedoo Formation	sandstone	feldspathic, coarse, conglomeratic, in part ferruginised	Late Permian
95840727	8733	723100	6432850	Tucklan Formation	siltstone		Ordovician
95840728	8733	721700	6434000	Tucklan Formation	siltstone	white	Ordovician
95840729	8733	719950	6434500	Tucklan Formation	chert	thinly bedded chert within phyllite	Ordovician
95840730	8733	710300	6430800	Dunedoo Formation	siltstone	white; interbedded with coarse quartzo-feldspathic sandstone	Late Permian
95840731	8733	709500	6432250	Napperby Formation	siltstone	a few interbeds of medium to coarse sandstone 10-20cm thick	Middle Triassic
95840732	8733	708950	6439600	Dunedoo Formation	coal	overlain by coarse sandstone with thin carbonaceous interbeds	Late Permian
95840733	8733	709800	6441100	Dunedoo Formation	siltstone	white; interbedded with coarse sandstone	Late Permian
95840735	8733	690950	6430500		basalt	dark grey, fine grained	Ordovician

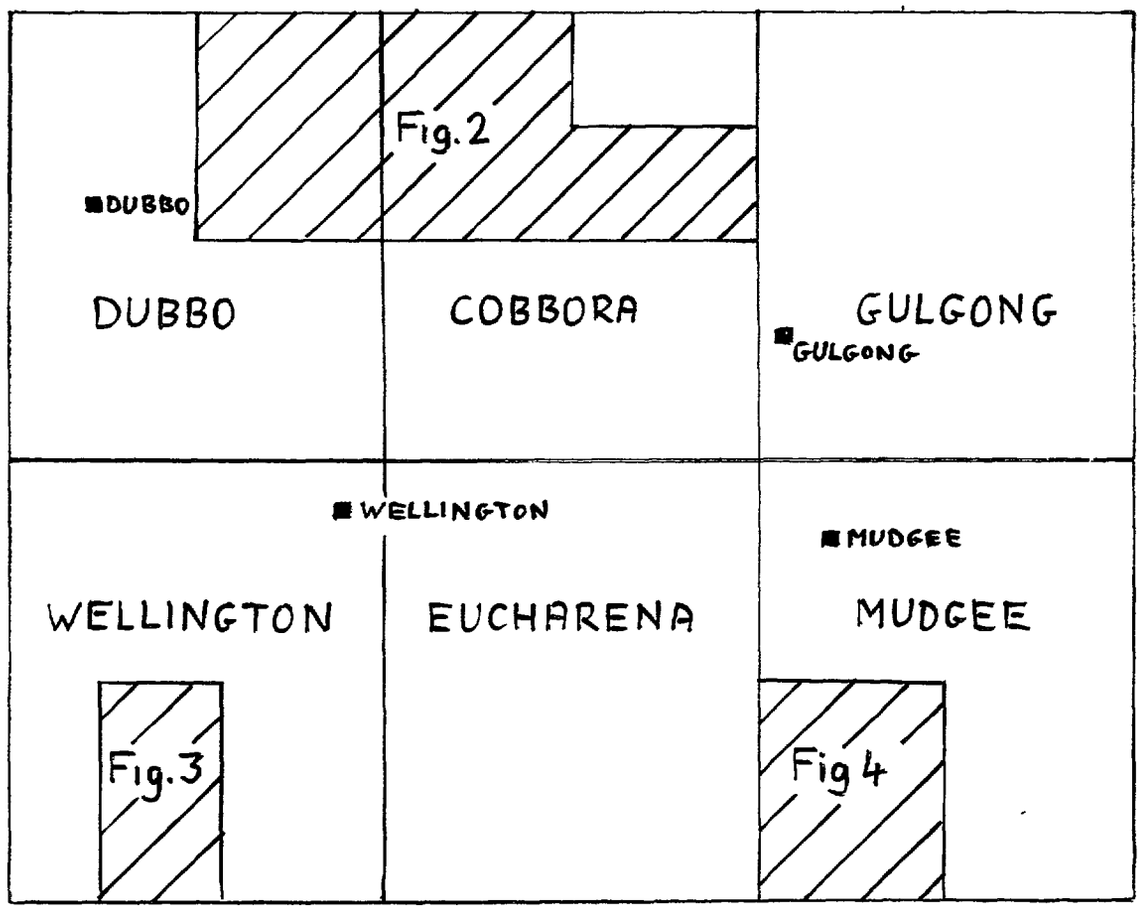
95840736	8733	695850	6437700	Gollan Beds	limestone	pale grey	Silurian
95840737	8733	696250	6437250	Gollan Beds	dacite	massive to foliated, leached, feldspar rich	Silurian
95840738	8733	696550	6437100	Gollan Beds	slate	white and pale grey	Silurian
95840739	8733	696950	6435950		gabbro	large clinopyroxene phenocrysts	? Devonian
95840740	8733	712600	6437900	Chesleigh Formation	sandstone	medium grained, foliated	Late Silurian
95840741	8733	705500	6456450		dolerite	medium grained, blue-grey	Tertiary
95840742	8733	699900	6438000		gabbro	coarse grained, rich in clinopyroxene	? Devonian
95840743	8733	699750	6438750	Gollan Beds	rhyolite	white, feldspar-rich	Silurian
95840744	8733	699350	6440100	Gollan Beds	rhyolite	white, intensely foliated	Silurian
95840745	8733	698800	6440500	Gollan Beds	rhyolite	white, intensely foliated	Silurian
95840746	8733	698450	6440700	Gollan Beds	dacite	foliated, leached, with local flow banding	Silurian
95840747	8733	697700	6438800	Gollan Beds	dacite	foliated, leached and ferruginised	Silurian
95840748	8733	697350	6438200	Gollan Beds	dacite	leached dacite or dacitic volcaniclastic	Silurian
95840749	8733	696550	6438300	Gollan Beds	dacite	foliated, leached	Silurian
95840750	8733	696850	6432700	Gollan Beds	andesite	foliated, weathered	Ordovician
95840751	8733	692200	6430150		basalt	fine grained, purplish grey with epidote veining	Ordovician
95840752	8733	714500	6435800	Chesleigh Formation	sandstone	pale mauve, quartzo-feldspathic	Late Silurian
95840753	8733	715550	6436800	Chesleigh Formation	rhyolite	pale grey, very siliceous with quartz phenocrysts to 1mm	Late Silurian
95840754	8733	715250	6436200	Chesleigh Formation	slate	buff brown	Late Silurian
95840755	8733	715300	6435300	Chesleigh Formation	sandstone	pale mauve, quartzo-feldspathic	Late Silurian
95840756	8733	716000	6435100	Chesleigh Formation	siltstone	slaty, purple	Late Silurian
95840757	8733	716400	6435250	Chesleigh Formation	rhyolite	greenish	Late Silurian
95840758	8733	717750	6434150	Chesleigh Formation	siltstone	purple, slaty	Late Silurian
95840759	8733	718100	6434300	Dungeree Volcanics	rhyolite	aphanitic, mid grey	Late Silurian
95840760	8733	721150	6432550	Tucklan Formation	slate	carbonaceous	Ordovician
95840761	8733	700750	6434200	Gollan Beds	sandstone	fine grained, foliated, matrix-rich	Silurian
95840762	8733	702500	6432900	Napperby Formation	siltstone	laminated; interbedded with fine sandstone	Middle Triassic
95840763	8733	700900	6439000	Gollan Beds	phyllite	pale, leached	Silurian
95840764	8733	718650	6441650	Tucklan Formation	schist	fine grained, micaceous	Ordovician
95840765	8733	715800	6440300	Tucklan Formation	siltstone	grey; interbedded with coarse purple sandstone	Ordovician
95840766	8733	721800	6443250	Tucklan Formation	siltstone	grey; interbedded with purple sandstone	Ordovician
95840767	8733	720050	6438800	Tucklan Formation	schist	fine grained, buff, weathered	Ordovician
95840768	8733	721050	6436500	Dunedoo Formation	conglomerate	30cm siltstone interbed with carbonaceous laminae	Late Permian
95840769	8733	725100	6439900	Adaminaby Group	slate	purple and white	Early Ordovician
95840770	8733	694400	6438750		basalt	dark grey, fine grained	Tertiary
95840771	8733	693900	6440300	Napperby Formation	sandstone	banded, fine grained, brown and white	Middle Triassic
95840772	8733	699900	6432450	Gollan Beds	phyllite	red brown to white	Silurian
95840773	8733	699950	6433600	Gollan Beds	dacite	foliated, weathered	Silurian
95840774	8733	699900	6433500	Gollan Beds	dacite	massive, grey	Silurian

95840775	8733	694900	6431300	Gollan Beds	dacite	grey with sparse pinkish brown feldspar phenocrysts to 1mm	Silurian
95840776	8733	697700	6441800	Dunedoo Formation	siltstone	white; interbedded with carbonaceous siltst. and coaly shale	Late Permian
95840777	8733	701500	6439950	Dunedoo Formation	sandstone	white, conglomeratic, coarse; overlain by med. grained sandst.	Late Permian
95840778	8733	700050	6441150	Gollan Beds	rhyolite	white, fine grained, weakly foliated	Silurian
95840779	8733	695300	6449650		basalt	dark grey, fine grained	Tertiary
95840780	8733	698300	6444600	Dunedoo Formation	siltstone	grey, carbonaceous	Early Permian
95840781	8733	707600	6433950		dolerite	coarse, dark, slightly greenish	Tertiary
96840782	8733	726724	6442741	Tucklan Formation	slate	pale buff	Ordovician
96840783	8733	727115	6443340	Tucklan Formation	siltstone	pale grey to purplish	Ordovician
96840784	8733	732000	6439650	Gulgong Granite	granodiorite	coarse, pale grey	Carboniferous
96840785	8733	725445	6441050	Adaminaby Group	siltstone	pale greenish white	Early Ordovician
96840786	8733	734700	6432550	Gulgong Granite	granite	very coarse; consists mainly of quartz & pale pink feldspar	Carboniferous
96840787	8733	726183	6433828	Tucklan Formation	basalt	grey, sparsely porphyritic, weakly foliated	Ordovician
96840788	8733	725062	6436351	Adaminaby Group	siltstone	yellow brown, cleaved	Early Ordovician
96840789	8733	724314	6436286	Adaminaby Group	siltstone	yellow brown, cleaved	Early Ordovician
96840790	8733	723850	6436200	Tucklan Formation	siltstone	leached; local banding	Ordovician
96840791	8733	731885	6430393	Gulgong Granite	granodiorite	coarse, pinkish-grey, with sparse, small fine grained xenoliths	Carboniferous
96840792	8733	730942	6431110	Tucklan Formation	hornfels	grey, weathered, medium grained, micaceous	Ordovician
96840793	8733	730919	6430807	Tucklan Formation	hornfels	grey, foliated, micaceous	Ordovician
96840794A	8733	730150	6430100	Tucklan Formation	magnetite ore	from Tallawang mine pit	Ordovician
96840794B	8733	730150	6430100	Tucklan Formation	skarn	from Tallawang mine pit	Ordovician
96840794C	8733	730150	6430100	Tucklan Formation	hornfels	from Tallawang mine pit	Ordovician
96840795	8733	728105	6430977		andesite		Ordovician
96840796	8733	727630	6431129	Adaminaby Group	slate	purplish grey	Early Ordovician
96840797	8733	727290	6431446	Adaminaby Group	slate		Early Ordovician
96840798	8733	726542	6432481	Adaminaby Group	siltstone		Early Ordovician
96840799	8733	722450	6434200	Tucklan Formation	siltstone	?volcaniclastic, pale grey	Ordovician
96840800	8733	721300	6434200	Tucklan Formation	siltstone	indurated, small scale folding	Ordovician
96840801	8733	724074	6437498	Tucklan Formation	sandstone	brown, weathered; white feldspar and ferrug. mafic grains	Ordovician
96840802	8733	722750	6437000	Tucklan Formation	siltstone	purplish grey	Ordovician
96840803	8733	723213	6437081	Tucklan Formation	siltstone	banded, weathered	Ordovician
96840804	8733	723315	6437277	Tucklan Formation	siltstone	banded; within medium grained volcaniclastic sandstone	Ordovician
96840805	8733	724750	6438850	Adaminaby Group	siltstone	pale purplish-grey	Early Ordovician
96840806	8733	728848	6434488	Tucklan Formation	chert	silicified, thin bedded, with claystone interbeds	Ordovician
96840807	8733	717753	6431536	Chesleigh Formation	sandstone	purple, lithic feldspathic, medium bedded; siltst. interbeds	Late Silurian
96840808	8733	718900	6432100	Chesleigh Formation	siltstone		Late Silurian
96840809	8633	682400	6437050	Purlawaugh Formation	sandstone	coarse & medium grained, lithic, feldspathic	Early - Middle Jurassic
96840810	8633	672150	6433650		basalt	fine grained, mid grey	Tertiary
96840811	8633	671500	6433600		basalt	medium to coarse grained, mid grey	Tertiary

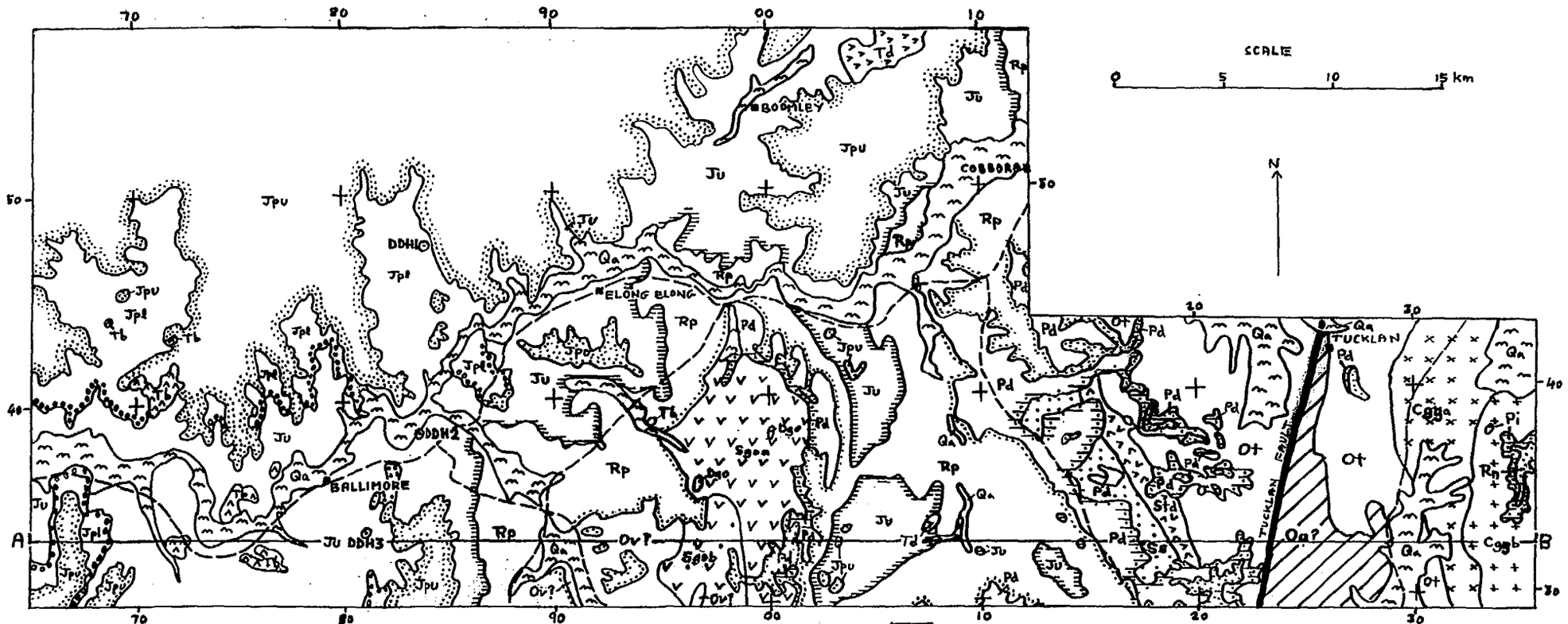
96840812	8633	672850	6433650	Purlawaugh Formation	sandstone	feldspathic, medium grained, white	Early - Middle Jurassic
96840813	8633	674850	6432650		basalt	medium grained, dark grey	Tertiary
96840814	8633	682050	6431200	Pilliga Sandstone	sandstone	lithic, coarse grained, yellow brown, partly leached white	Late Jurassic
96840815	8633	668700	6444000		basalt	grey, fine grained; small feldspar phenocrysts	Tertiary
96840816	8633	676650	6436750		basalt	dark grey, fine grained	Tertiary
96840817	8633	672300	6441050		basalt	dark grey, fine grained	Tertiary
96840818	8633	671550	6442950		basalt	medium grained, all slightly weathered or altered	Tertiary
96840819	8633	673450	6441400		basalt	medium grained, dark grey	Tertiary
96840820	8733	692350	6429950		basalt	medium grained, dark grey with green epidote grains	Ordovician

Fig. 1

LOCALITY MAP
DUBBO 1:2500000 SHEET AREA



GEOLOGY OF THE BALLIMORE-TUCKLAN AREA

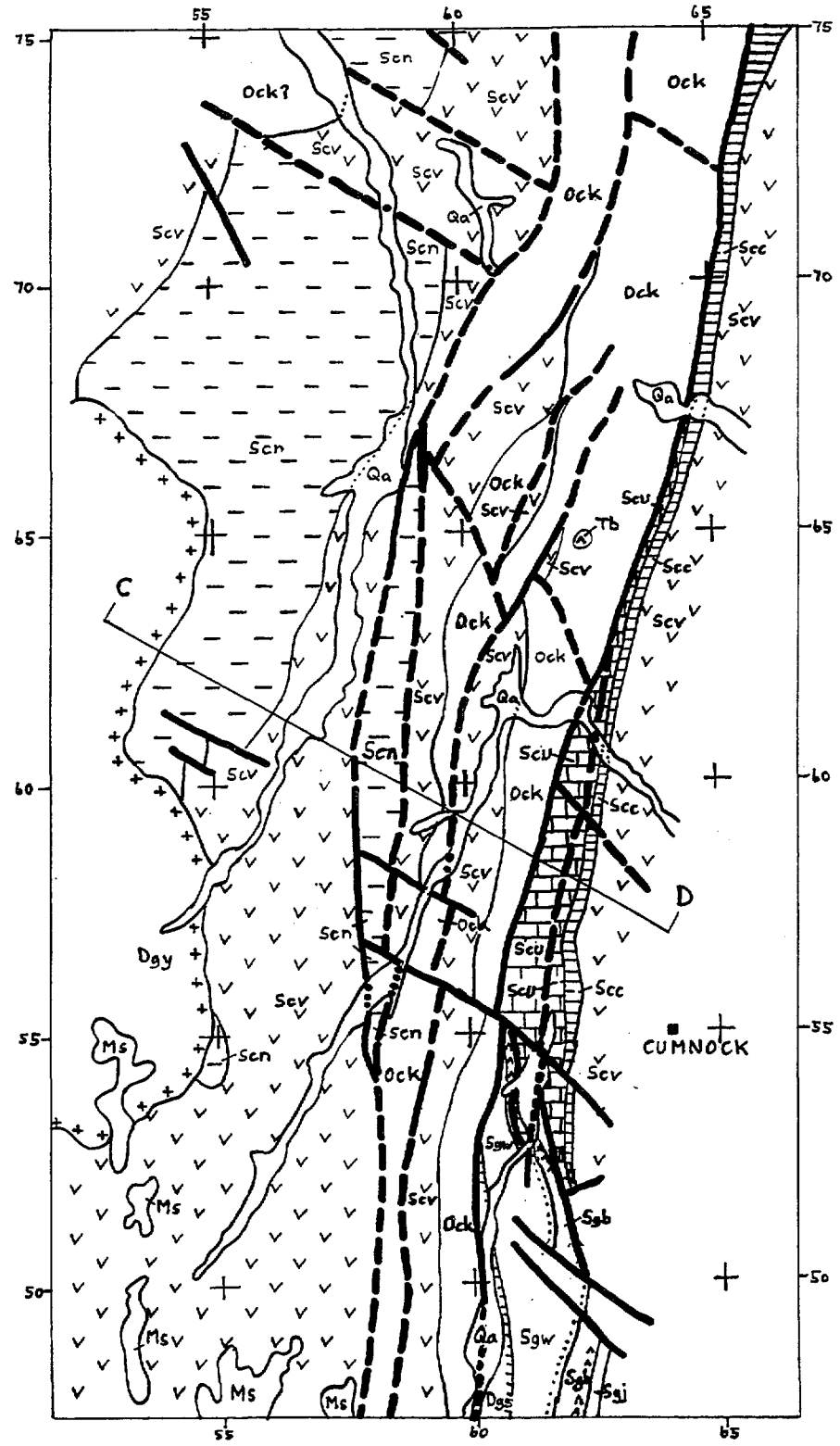


CARBONIFEROUS	Cggg	Gulgong Granite - granodiorite
	Cgga	Gulgong Granite - granite
DEVONIAN?	Dgb	Gabbro
SILURIAN	Sgvg	Gollan Beds - rhyolite, slate
	Sgvb	Gollan Beds - dacite
	Ss	Cheshleigh Formation
	Std	Dungeree Volcanics
ORDOVICIAN	Ovf	Undivided ?Ordovician volcanics
	Ot	Tucklan Formation
	?Oa	? Adaminaby Group
QUATERNARY	Qa	Alluvium
TERTIARY	Tb	Basalt
	Td	Dolerite
JURASSIC	Jpu	Upper Pilliga Sandstone
	Jpl	Lower Pilliga Sandstone
	Ju	Purlawaugh Formation
TRIASSIC	Rp	Napperby Formation & Bulderwood Formation
	Rn	Narrabeen Group
PERMIAN	Pd	Dunedoo Formation
	Pi	Illawarra Coal Measures

Fig. 2

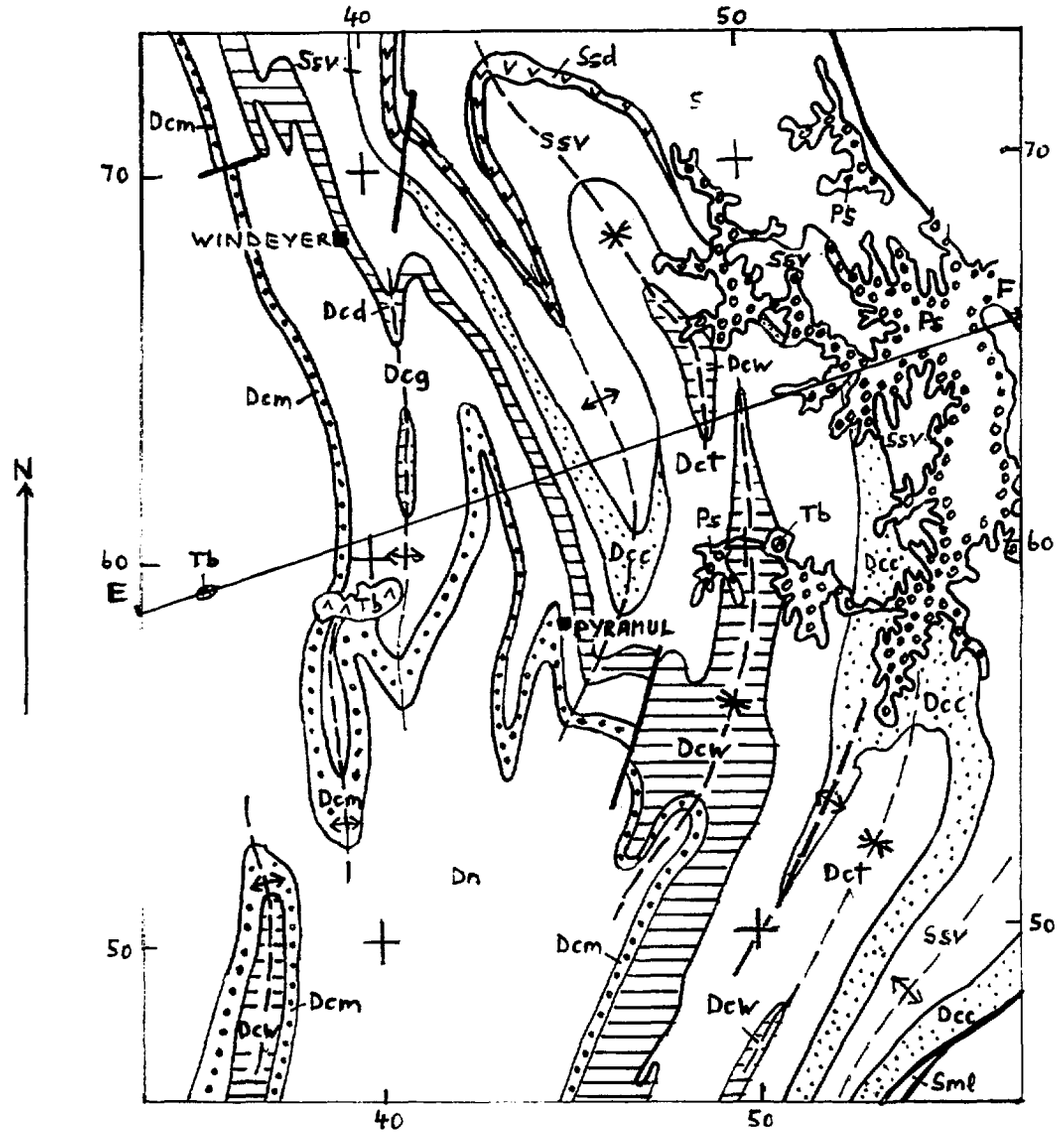
Fig. 3

GEOLOGY WEST OF CUMNOCK



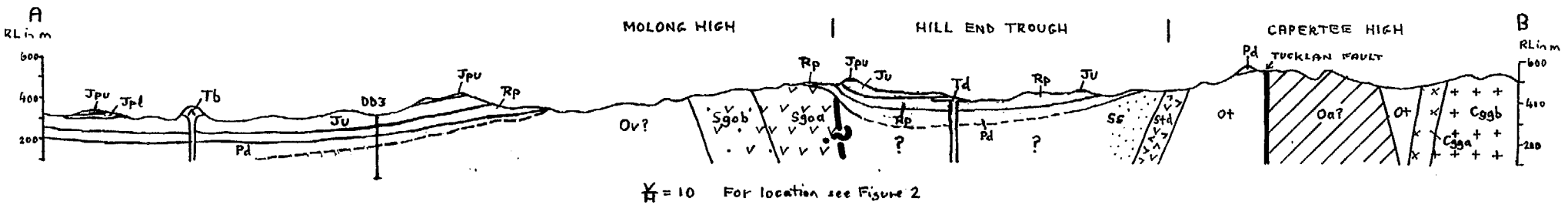
QUATERNARY	Qa	Alluvium
TERTIARY	Tb	Basalt
MESOZOIC	Ms	Sand, gravel
DEVONIAN	Dgy	Yeoval Batholith
	Dgs	Maradana Shale
SILURIAN	Sgw	Wansey Formation
	Sgb	Burgoon Formation
	Sgj	Jews Creek Volcanics
	Scn	Hanover Formation
	Scu	Burrawong Limestone
	Scc	Cary Formation
	Scv	Canowindra Volcanics
ORDOVICIAN TO SILURIAN	Ock	Kabadah Formation

GEOLOGY OF THE TUNNABIDGEE WINDEYER AREA

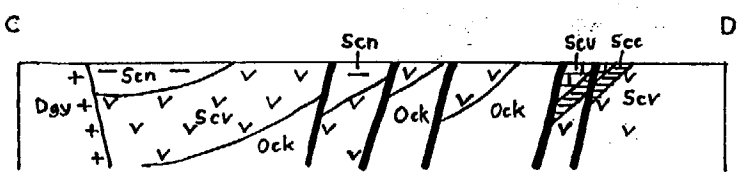


TERTIARY		Tb	Basalt
PERMIAN		Ps	Shoalhaven Group
DEVONIAN	Crudine Group	Dn	Cunningham Formation
		Dcm	Merrions Formation
		Dcg	Guroba Formation
		Dcd	Dunmoogin Formation
		Dcw	Waterbeach Formation
		Dct	Turondale Formation
		Dcc	Cookman Formation
SILURIAN	Chesleigh Formation	Ssv	Volcaniclastics
		Ssd	Dacite
		Ss	Sediments
		Sml	Bells Creek Volcanics

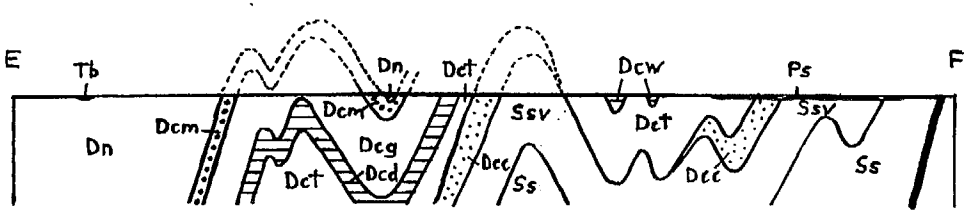
CROSS SECTIONS



$\frac{V}{H} = 10$ For location see Figure 2



$\frac{V}{H} = 1$ For location see Figure 3



$\frac{V}{H} = 1$ For location see Figure 4

Fig. 5

Fig. 6

GRAPHIC LOGS OF CORED DIAMOND DRILLHOLES IN THE BALLIMORE AREA

For locations see Figure 2