

## SECTION 3 - LITHOLOGICAL DESCRIPTION

LADY PENRHYN - 1CORE DESCRIPTION

FROM      TO                  McMINN FORMATION - KYALLA MEMBER

10.23 - 17.98      Interbedded Silty Mudstone, Sandstone and Mudstone

Silty Mudstone - with common sandstone interbeds and minor mudstone. Moderate red, pale yellowish brown, pale brown, toward base of unit grades to medium dark grey mudstone and light grey sandstone with occasional thin dark reddish brown interbeds.

Sandstone - fine to medium grained. Dark reddish brown.

Thinly interbedded. Sandstone beds commonly several mm up to 1-2cm thick, occasionally up to 10cm.

Silty mudstone beds generally thicker up to 20 cm.

Sandstone crossbedded, ball and pillow structures, sandstone dykes - ? Beds generally exhibit sharp basal contact.

17.98 - 49.74      Interbedded sandstone, siltstone, silty mudstone and mudstone. Typically thinly interbedded.

Mudstone, silty mudstone: medium dark grey to dark grey with some dark greenish grey.

Sandstone: medium light grey to medium grey, occasionally greenish, due to fine to medium grained glauconite laminae. Fine and occasionally medium grained. Similar sedimentary features to above unit.

Thinly bedded sandstone - typically 1 to 3cm thick, massively crossbedded.

Thickly bedded sandstone - of order of 5-10cm. Horizontally thinly interlaminated with darker micaceous (?) laminae. Both basal and upper contacts sharp and also sharp basal and gradational upper contacts (upward fining). Basal contact occasionally shows scours and slumps. Compactional sandstone dykes most common with thinly interbedded sandstone/mudstone - irregular worm-like appearance, commonly intruding downwards from sandstone interbeds (don't appear to be fluid escape structures).

Ball and pillow and loading structures common. Occasional brittle fracture of beds. Occasional contorted bedding in thicker interlaminated sandstone.

Mudstone: generally thinly interbedded with sandstone. Massively bedded to thinly laminated within thick beds. Micro micaceous occasionally pyritic. Two thick, massive silty mudstone beds.

- 1) 36.70m to 37.83m
- 2) 43.62m to 44.62m

Fault zone: 44.62 to 45.09m Brecciated; slickensides, chloritic growth on fractures 45.09m to 45.37m. Near vertical and contorted bedding.

38.23: fracture zone infilled with calcite - associated thin lenticular anastomosing sub vertical veins.

49.74 - 99.74 Mudstone: with fine sandstone interbeds.

Colour and gross lithology change.

Sub units

- 1) 49.74 - 61.56m

Mudstone: with occasional sandstone interbeds up to 3cm thick dark grey to greyish black, brownish black and occasional black.

Mudstone: beds up to 20-30cm thick (occasionally 10cm)

Massive to very thinly laminated. Appear to become darker with increasing organic content.

Sandstone: light grey to medium light grey. Similar to thin, massive sandstone in previous unit - generally scoured bases and have mudstone interlaminae (sandstone: 5-10% of gross lithology).

Sedimentary features as for above units.

- 2) 61.56 to 66.37

As for above sub unit with sandstone increasing to 40-50% of gross lithology. Mudstones dark grey to greyish black in general. Sandstone interbeds up to 15m thick.

- 3) 66.37m to 81.17

Identical lithology to sub unit (1) with sandstone interbeds up to 3cm thick, generally several mm thick. Unit possibly more organic rich than sub unit (1).

- 79.58m - Pyrite bed ( $\frac{1}{2}$  cm)

- 4) 81.17m to 99.74 - identical lithology to sub unit (1)

From 91m onwards sandstone beds increase in thickness to 5 cm but mudstone still dominates unit (sandstone 5-10%)

#### McMINN FORMATION - MOROAK SANDSTONE MEMBER

99.74 - 139.50 Interbedded sandstone and mudstone with subordinate silty mudstone and siltstone.

Mudstone: to silty mudstone.

Dark grey to brownish grey, greyish black, massive to finely laminated. Beds commonly 1-5cm thick, occasionally 15cm.

Sandstone: Bed types

- 1) 10-15cm thick, finely laminated to thinly bedded, light grey to greenish grey. Glauconite common. Inter-laminae of light brownish grey to dark grey.
- 2) Commonly 1-2cm thick. Light olive grey to light grey. Massively bedded with thin organic mudstone interlaminae. Occasional glauconite and x-bedding. Sub vertical brittle fractures. Glauconite commonly defines bedding planes (particularly X-bedding).

Sandstone beds generally display compactional sandstone dykes, penetrating mudstone below (particularly thicker sandstone beds). Occasional scouring, sometimes into lower sandstone beds. Occasional fluid escape sandstone dykes at the top of beds, along sub-vertical brittle fractures. Beds deformed by both brittle fracture, and contorted by soft sediment deformation and slumping.

Fractures occasionally infilled with quartz and carbonate (calcite and dolomite).

Occasional beds exhibit bright yellow and blue-white fluorescence along bedding planes and fractures.

Sandstone in general fine to very fine grained.

99.55-99.8 fracture zone. Core brecciated.

- above dips 45° to top of unit
- below dips <30°.

102.26 - 15cm sand: blue-white and yellow-brown fluorescence.

103.7m - dip 40°

105m - back to <30°

106.8 - 109.7 zone of 2.5m of core loss. Zone characterised by carbonate with blue-white and brown fluorescence.

110m - 35° dip.

109.7m - 121.7m - Sandstone content of unit increases to a maximum of 50-60% of gross lithology. This interval is regularly cut by fracture zones. Dips vary from 30-60° with evidence of brittle failure of sand units in more steeply dipping intervals. High dips and associated deformation continue to 122.35m. Toward base of unit dips vary from 10 to 25°.

Steeply dipping interval also characterised by deformation in the form of contorted and slumped bedding and associated brittle fracture. (Listric or glide-plane type).

109.8m, 126.30m, 127.30m, 130.50m, 132.50m, 133.55m, 134.23m, 135.3m, 135.57m; Sandstone beds characterised by abundant glauconite, and wispy lenticular intraclasts of shale and sandstone. Intraclasts contorted due to compaction.

139.50-171.46

Interbedded sandstone and mudstone

Mudstone: Grades to silty mudstone and siltstone. Occurs as interbeds from 1cm to 15cm thick, and as fine laminations within sandstone lenses. Dominantly dark grey to greyish black, subordinate brownish grey. Massive to finely laminated internal structure. Bed contacts often exhibit soft sediment deformation and fluidized flow (contorted bedding) - increasing toward base of unit. Upper contacts often intruded by sandstone dykes as for previous unit.

Sandstone: Fine to very fine, very occasionally medium grained. Light grey to light olive grey, some very light grey, light brownish grey to light olive grey.

Beds most commonly 1-3cm thick, finely laminated to massive internal structure - particularly towards top of unit finely interlaminated with mudstone.

Glauconite common. X-bedding common and compactional sandstone dykes commonly emanate downwards from base of beds, occasionally along fracture sets. Top of unit - sandstone and mudstone. Regularly interbedded, with sharp contacts, and only occasional graded bedding. Overall bed thickness increases to base of unit, (commonly beds 1-5cm thick).

Interbedding becomes less regular - and soft sediment deformation and brittle fracture increases. Thickest sandstone bed is basal bed in unit 54cm thick.

Number of fining upward, graded beds increase toward base of unit.

Soft sediment and brittle deformation -

Contorted bedding to the point of sedimentary brecciation (at 147.96).

Fracture infills: calcite and dolomite (e.g. 140.9, 140.53, 141.15, 153.35).

153.77 to 154.10m - single bed; light brown grey to olive grey. Unusual sandstone bed - soft, dominated by unknown crystal growth. Probably siderite.

Flourescence: zones of bright yellow - blue white fluorescence.

1	142.00 - 142.32m
2	143.40 - 143.9m
3	144.04 - 144.45m
4	159.45 - 159.62m
5	160.20 - 160.30m
6	160.58 - 160.85m
7	160.90 - 161.20m
8	165.30 - 165.40m
10	165.75 - 165.82m
11	166.03 - 166.13m
12	167.78 - 168.16m
13	168.51 - 168.58m
14	170.10 - 170.42m
15	170.56 - 170.65m
16	170.90 - 171.54m

## VELKERRI FORMATION - UPPER MEMBER

171.46 - 190.03 Interbedded sandstone and mudstone

Mudstone: dominates top of unit with rapid increase to sandstone dominated base of unit.

Top of unit dominated by mudstone beds up to 60cm thick. Greyish black, dark grey and thin light brownish grey. Internal structure massive (in general) to finely laminated. Soft sediment deformation to point of fluidized flow - sandstone/mudstone interbeds deformed to sandstone lenticules, augen, wisps, and blebs. Occasional wisps of organic matter within mudstone beds.

Toward base of unit mudstone content decreases from 80-90% at top of unit to 20-30% - beds at base commonly several mm to 5cm thick.

Sandstone: Medium light grey to medium grey. Medium dark grey where bituminous.

Also medium light grey to light brownish grey and some minor brownish grey. Beds at top of unit typically several mm to 2cm thick. Bedding highly disrupted by soft sediment deformation. Where bedding is coherent it is characterised by fine mudstone interlaminations, X-bedding and the presence of glauconite.

181.50 - 181.95 - highly contorted bed - sandstone, commonly glauconitic, fine to very fine grained deformed in part to augen (pod-like sandstone bodies). From this bed to base of unit significant reduction in soft sediment deformation. Rapid increase in sandstone content and bed thickness to basal sandstone bed 85cm thick (with several thin mudstone interbeds).

Soft sediment deformation (base of unit) flame structures, ball and pillow structures. Brittle fracture (small horst and graben).

Pyrite present in thin (up to 1cm thick) mudstone beds - speckled/disseminated form.

190.03 - 227.67 Interbedded sandstone siltstone and mudstone

Mudstone, Silty Mudstone: Dark grey to greyish black, greenish grey, dark grey to brownish grey, greyish black, greenish grey to dark greenish grey (5G7).

Very thinly and regularly interbedded with sandstone. Beds commonly several mm to 5cm (generally 1cm). Also occurs as fine laminations within sandstone beds. Mudstone beds internally structureless to finely laminated. Zones of incoherent bedding where sandstone/mudstone interbeds have suffered soft sediment deformation - contorted bedding and mixing of lithologies (e.g. 197.37 - 198.00m, 203.41 - 203.6m, 208.74 - 209.25m). Mudstone micromicaceous in general. Green nature of some mudstone beds probably due to finely divided glauconite.

Lenticular flakes of organic matter in silty mudstone beds - possibly debris flows (e.g. 205.70cm).

Pyrite common in finely disseminated form, associated with greener mudstones and as specks and flakes in thin dark mudstone interbeds.

Base of some mudstone beds, light brownish grey to pale yellowish brown due to oxidation.

Rare carbonate beds - moderate yellowish brown in colour. Calcite also present infilling occasional fractures.

Sandstone: Light grey to medium light grey to medium grey also medium light grey to light brownish grey and occasional medium light grey to brownish grey.

- 1 Beds 1 to 10cm thick, generally <5cm - light grey to medium light grey. Sharp basal and upper contacts. Homogenous to finely laminated, occasionally X-bedded.
- 2 Beds generally <1cm, sharp upper and lower contacts, occasionally lenticular in shape. Commonly X-bedded.
- 3 Sharp basal contacts, graded fining upward from fine sandstone to siltstone. Commonly X-bedded with mudstone interlaminae from 1cm to 10cm scale.

Sandstones 2 and 3 commonly exhibit soft sediment deformation, occasionally ball and pillow, flame structures and sandstone dyke emanate from base of units.

Occasional glauconite defines bedding in all sandstone types. Occasional brittle fracture of beds.

221.64 - 221.7 - Coarse crystalline calcite bed with dark mudstone matrix.

227.67 - 255.64 Interbedded sandstone, siltstone and mudstone.

Sandstone, mudstone and siltstone character identical to previous unit except:

- Overall bed thickness increased:
- Mudstones typically 5-10cm thick.
- Sandstones 3-10cm thick, occasionally <1cm.

Increase in number of fining upward cycles of fine grained sandstone to siltstone and mudstone.

- Less finely disseminated pyrite.
- Very little glauconite.
- Overall bed thickness increases from top to base of unit.

255.64 - 260.43 Interbedded sandstone, mudstone and silty mudstone

#### Units

- 1 Mudstone - Silty mudstone - medium dark to brownish grey at base to greyish black at top. Typically 10-15cm thick. Pyrite as aggregates, disseminated and as poorly defined nodules - concentrated in darker mudstone beds. Beds often graded from siltstone (- fine grained sandstone) at base to silty mudstone and mudstone at top - usually structureless.
- 2 Sandstone: Medium grey to greenish grey (5G). Typically 1-5m thick with sharp upper and lower contacts. X-bedded, occasionally slumped. Fine grained, glauconitic aspect in part.
- 3 Mudstone: Distinctly finely laminated - almost varved greenish grey to dark greenish grey in part - also brownish black and dark grey. Occasional flame structures at the top of the unit where overlain by sandstone. Greenish mudstone 80% of unit. Occasional pyrite nodules disrupt bedding.



257.13 - 257.17 - carbonate with mudstone interlaminae at base and glauconite rich sand directly overlying.

260.43 - 300.22

Interbedded finely laminated mudstone and massive siltstone, silty mudstone and massive mudstone

Unit is entirely composed of beds of units 1 and 3 above.

Unit 1 characterised by beds 2cm to 15-20cm. Augen 10cm.

Unit 3 characterised by beds 3cm to 45cm thick, augen 15-20cm (but up to 2m thick toward base of interval) colours identical to those for above unit 2, with brownish black, and darker colours dominating after first 10m.

Units 1 and 2 are in roughly equal proportion.

265.5 and 271.97 - carbonate lenses less than 1cm thick.

275.7 hairline fracture zones, carbonate infill (horse-tail) (also 276.9, 278.7m).

280.80 - 300.22 Unit 11 absent of siltstone - colour dominately greyish black to brownish grey.

Pyrite abundant as nodules and disseminated.

Occasional 1-2cm greenish grey mudstone (5G) beds toward base.

300.23 - 336.96

Mudstone and silty mudstone

1. Mudstone: Greyish black to brownish black. Typically sub-mm scale laminae and beds 2-10cm thick.
2. Mudstone to silty mudstone: Light olive grey to greenish grey (5GY) and also (in centre of unit) light greenish grey to light olive grey. Also light brownish grey. Typically occurs as laminae on sub millimetre scale to beds 1cm to 25cm thick. Thin light brownish grey to dark grey mudstone interbeds associated with this lithology.

Pyrite aggregates and nodules and occasional beds throughout unit often disturbing bedding.

Flourescence not common.

Strong petroliferous odour from some intervals.

322.38 - 322.43m, 330.03 - 330.10 - carbonate beds.

Occasional fractures throughout unit, filled with calcite.

Top of unit is characterised by roughly equal proportions of lithologies 1 and 2. The amount of lithology 2 then increases to 80-90% in the centre of the unit. The base of the unit is again characterised by equal proportions of lithologies 1 and 2.

#### VELKERRI FORMATION - MIDDLE MEMBER

336.96 - 377.70

Mudstone: Brownish black to black with occasional interbeds of medium dark grey to dark grey carbonate and very occasional brownish grey to brownish black thin mudstone interlaminae. Finely laminated where brown laminae visible - otherwise massive.

Limestone and carbonate beds: several mm to 10cm thick (e.g. 353.73 to 353.81m and 360.36 to 360.45m).

Anastomosing fracture zone 345.30m - 346.97m entirely infilled by calcite.

350.50m - 5cm pyrite and carbonate bed.

Pyrite nodules - 355.06m, 341.52m 352.72m, 354.92m and at numerous other localities throughout section (e.g. 369.54m, 371.35m, 371.57m and at 2m bed at 373.95m).

375.2 - 5mm bed of highly fissile brown shale - brown fluorescence associated with this bed.

376.48 - calcite veinlet.

377.20 - fracture infilled with calcite - associated green and yellow fluorescence.

377.70 - 382.78 Mudstone to silty mudstone. Very occasional fine grained sandstone.

1. Mudstone: Brownish black, finely laminated to massive beds 1 to 7cm thick.
2. Mudstone to silty mudstone: Pinkish grey to light brownish grey, light brownish grey to light olive grey. Finely laminated and beds from 1cm to 5cm.

Low angle brittle faulting in beds.

Anastomosing fractures infilled with calcite.

381.58 - 2cm fracture zone, calcite infilled.

Equal proportions of 1 and 2 in interval.

382.78 - 422.30 Interbedded mudstone, silty mudstone and minor sandstone calcareous mudstone.

Mudstone: Greyish black to brownish black. Some brownish grey to greyish black at top of unit - dominates lithology; beds 1cm to 1m. Typically >50cm.

Mudstone-silty mudstone: Light brownish grey to pinkish grey to medium grey and light olive grey. Finely laminated with darker mudstone interlaminae. More common than calcareous mudstone. Beds on mm scale to 1cm scale at top of unit, increasing to 5cm-10cm toward base of unit.

Calcareous mudstone: Pinkish grey to light grey with occasional medium grey. Finely laminated, with dark mudstone interlaminae, beds up to 10cm thick - more common toward base of unit.

To 400m dark mudstones dominate unit. Below this increasing proportions of lighter mudstone and calcareous mudstone to approximately 50% of gross lithology from 412m to 422.3 (where general appearance of unit is similar to unit from 377.70m to 382.78m).

Sandstone: (Minor thin (0.5cm) coarse to medium grained sandstone with calcareous cement (385.80m). Pyrite nodules 391.4m (1cm pyrite bed), 400.32m, 408.54m, 409.09 - 1cm pyrite bed, surrounded by carbonate halo (fracture infill).

422.30 - 456.57

Mudstones and Minor silty mudstone and carbonate beds.

Mudstone: Brownish black to black. Finely laminated to massive beds. Over top 10m of unit there are interbeds of light brownish grey to brownish grey mudstone. Typically as laminae and as beds 1 to 2cm thick.

Micromicaceous and disseminated pyrite throughout.

In basal 5m of unit interbeds dark greenish grey (5GY) to dark grey mudstone and silty mudstone and occasional medium to coarse glauconitic lithic sandstone.

427.53 to 528.15 - zone of  $\frac{1}{2}$ cm to 5cm fine to medium grained glauconite beds containing pyrite - generally in the form of thin, regular laminae.

Occasional thin laminae of glauconite occur throughout rest of unit.

430.90 - 430.95 - fissile brown mudstone with yellow to orange fluorescence (also 1cm at 431.88m, 433.30m, 433.43 436.70m).

434.54m - pyrite nodule.

435.70m - pyrite nodule.

438.70m - pyrite nodule.

441.59 - 441.76 - limestone bed with mudstone matrix.

442.60m - 2cm pyrite bed.

446.16m - 1cm carbonate bed.

451.15m - 451.30m - limestone bed with mudstone matrix.

451.67 - 451.72m - calcareous mudstone bed - gradational upper and lower contacts.

452.10 - 452.37m - limestone bed (layered).

Occasional fractures throughout section calcite infilled.

456.57 - 462.14

Mudstone, silty mudstone and carbonate beds

Mudstone: Greyish black, fine laminae to 10cm beds.

Mudstone to silty mudstone: Greenish grey to olive grey laminae to 5cm beds - commonly contains glauconite and pyrite aggregates and is interlaminated with the darker mudstone. Common brittle fracture within lighter units - commonly low angle - increasingly more common toward base.

Carbonate beds: 456.75 - 456.80m, nodule @ 457.1m, 458.03 to 458.23m, 459.16 to 459.35m, 459.91 to 460.21m, 461.25 to 461.49m, 461.67 to 461.74 (carbonate cemented silty mudstone), 462.05 to 462.15m

Carbonate bed: 458.03m to 458.23m - Carbonate bed contains minor oil bleeds with blue-white fluorescence, 459.30 - 460.20m same again.

Last metre of unit - large open vertical fractures filled with carbonate.

#### VELKERRI FORMATION - LOWER MEMBER

462.14 - 467.82

#### Interbedded mudstone and Claystone

##### Subunit - 1

Mudstone: 462.14m to 462.66m almost claystone.

Light greenish grey to light olive grey to medium dark grey. Thinly bedded, brittle fractured. Lighter coloured claystone is homogenous, appears to be silicified and is very hard. Darker claystone contains organic flakes and specks 1.2mm to mm diameter.

##### Subunit - 2

Mudstone to claystone: 462.66m to 467.82m. Highly variable colour from medium dark grey to medium grey to greenish grey (5GY) and greenish grey (5G). 1m of light bluish grey claystone, majority is medium grey with other colours subordinate. Minor greyish black organic layers.

Thinly to thickly bedded - brittle fracturing locally intense, but present throughout unit. Homogenous claystone characterised by crumbling into small fragments. Occasional evidence of soft sediment deformation within massive beds.

467.82 - 545.3

#### Claystone - thick massively bedded to laminated and thickly bedded

Claystone: Medium bluish grey to greenish black, (5G).

Medium dark grey to dark greenish grey (5G).

Occasional thin dark grey beds to medium dark grey.

General colour - medium bluish grey - medium dark grey.

Greenish grey - medium bluish grey.

Greenish grey towards base, with other colours subordinate.

Uniform unit apart from colour differences as noted above.

Grey colour dominant at top, greenish towards 535m.

Massive, bedding generally distinct occasionally highlighted by organic rich, dark-grey layers.

Occasional thin, laminated beds visible.

Soft sediment deformation - slumping, contorted bedding - visible but often subtle. Shown by organic-rich layers.

Small 1mm organic flecks are ubiquitous.

Unit characterised by difficulty in drilling and crackling when wet.

Presence of limey? substance on surface after wetting - appears to come from out of the rock.

Homogenous nature of unit - doesn't break into bedding planes but crumbles.

Fractures filled with carbonate, mostly calcite, are common, mostly a few mm in diameter 1cm.

Fractures filled with carbonate:

Depths: 469 - 473.3m  
 473.9 (thin)  
 480.62  
 486.2  
 490.27 (5cm zone)  
 495.96 (5cm zone)  
 505 (10cm zone)  
 507 - 507.4  
 512.13 (5cm zone)  
 526.4 (1cm thick - follows bedding)

Dips increase downwards through unit from subhorizontal at top to 5-10° at base.

Becomes more regularly bedded towards base.

White substance on surface of core has salty taste (appearing on surface with mottled effect).

Last metre fairly heavily fractured with carbonate veins and fractures.

545.3 - 562.78

Mudstone - silty mudstone

Mudstone: Olive grey - medium dark grey.

Occasional greyish black. Mostly greenish grey (5G) with greenish grey (5G) to medium dark grey interbeds.

Regularly bedded with thin - medium beds of greenish grey mudstone.

Carbonaceous laminae thin mudstone beds, 1mm - 1cm of greyish black and medium dark grey.

Dip 5-10°.

Organic content no longer as flakes - contained in discrete laminae.

Minor soft sediment deformation disrupts regular bedding. Occasional contorted bedding.

Majority of unit claystone - mudstone.

Silty mudstone: Basal 5m identical in colour and bedform. Minor silt - no discrete beds.

Uniform greenish grey, with other colours subordinate.

Fracture zones filled with carbonate, carbonate bed at 554.14m - 554.25m. Partially layered. Irregular contents. Lst lenses into mudstone. Also some mudstone at centre. ?Possibly replacement. Very gradational contact.

562.78 - 567.93

Mudstone, silty mudstone and minor siltstone

Mudstone:

1. greenish grey, massive thickly bedded mudstone, in contrast to previous unit, over top 10m of this unit.

2. Finely laminated brownish grey - medium dark grey and light grey - medium dark grey and brownish black.

Silty mudstone: Medium dark grey-olive grey. Massive to chaotically bedded with flakes and fragmented layers of organic material.

Type 1 mudstone dominated lithology with grey silty mudstone becoming more common towards base. Dark laminated mudstone minor.

Gradational boundary top and bottom. Occasional greenish grey angular fragments of mudstone in mudstone - silty mudstone at 563.7m.

567.93 - 603.37

Interbedded mudstone and silty mudstone of lithologies.

Mudstone: Olive grey - olive black and brownish black - greyish black and rarely black.

Finely laminated - massive and forms thin beds.

Massive, thinly bedded olive grey-olive black generally forms beds few mms to 2cm thick.

Organic content increases towards base of unit.

Minor siltstone: within well laminated to massive mudstone. Light grey - medium light grey. Maximum thickness 2-3mm.

Massive chaotically bedded silty mudstone. Olive grey - olive black and olive black. Becomes darker towards base.

Unit characterised by soft sediment deformation in the form of slumping with contorted bedding, low angle faulting.

Massive structure with chaotic bedding - debris flow?

Typically 10-30cm thickness characterised by grey-black organic flakes and laminated beds. Fragmented and distributed at random angles throughout the greyish black mudstone matrix.

Towards the top of the unit massive dominates with laminated becoming dominant towards base - 50-50.

Pyrite aggregates.



603.37 - 607.59

Mudstone: Brownish black-black.

Finely disseminated pyrite and occasional beds. Massive with occasional thin bedding. Carbonate - filled cracks.

Graphite occurs on some plane surfaces.

607.59 - 638.6

Mudstone, siltstone and ferruginous sandstone

Silty mudstone: Olive black-grey black at top massive. Thinly - thickly bedded.

Ranging in thickness 10cm - 2m.

Dark greenish grey - olive grey near base. Appears to be micaceous.

Graded bedding fining up to mudstone.

Soft sediment deformation with contorted bedding.

Siltstone -very fine - fragments sandstone

Siltstone - Greenish grey - dark greenish grey (GY).

Sandstone - light grey - greenish grey.

Thinly interbedded with the other lithologies.

Siltstone varies in thickness 1cm - 10cm.

Often forms the base of upward - fining units into silty mudstone. Similar soft sediment deformation features to silty mudstone. Sandstone - very fine to fine-grained 1cm thick increasing in abundance towards base of unit.

Commonly grade up into previous units carried forward soft sediment deformation including flame str. and ball and pillow str.

Low angle faults - fractures.

Occasional thin greyish black - dusky blue sandstone. Generally few mm's thick fine to very fine-grained bitumen stain.

Minor mudstone: Olive grey - olive black 1cm - 10cm thick. Occasionally at top of fining sequence.

General - increase in siltstone and sandstone towards base. Colour - dark grey medium grey towards base. 619.56 ->

Reticulate - lenticulate carbonate lenses (mottled).

Red/brown fluorescence.

Soft sediment deformation most noticeable 631.9 - 632.1m, 633.4 - 633.61 Calcareous sandstone, 636.42 - 636.51 Brownish grey. Some pyrite. Turbulent, compaction feature 'crinkly'.

638.6 - 660.62

Cf: mudstone (603.37 - 607.59m)

Basal 7m; some paler mudstone interbeds - dark grey - greyish black. Decrease in organic content assumed 659.54 - 659.74m. Fracture zone with brecciated mudstone with carbonate cemented fractures.

660.62 - 664.96

Silty mudstone with minor sandstone laminae

Gradational with above unit over 63cm.

Silty mudstone - greenish grey - dark greenish grey (5G). Massive, bedding angle 2-5. Uniform colour. Becomes more dark greenish grey towards base.

Disseminated pyrite layer at 662.24m.

Sandstone - fragment thin 1-5mm; maximum 1cm bands (lenticular sandstone laminae) occur fairly regularly throughout mudstone.

Contains glauconite, increasing towards base.

664.96 - 666.97

Interbedded silty mudstone and dominantly fine sandstone

Silty mudstone - Greenish black (5G) to olive black with occasional black laminae. Thinly bedded - laminated.

Soft sediment deformation, brittle fracturing and slumping towards base of unit.

Sandstone - Greenish grey (5G) to light grey. Appears regularly throughout, typically 3mm to 1cm thick. Lenticular but less wispy in appearance.

666.97 - 670.06

Upward fining.

Silty mudstone - greenish black - olive black and olive black - brownish black at base.

Massive and featureless.

Basal 2 metres is characterised by presence of quartz grains (coarse) distributed throughout matrix. Basal in 'dirty' sandstone (greywacke).

670.06 - 671.00

Thinly interbedded carbonaceous silty mudstone and fine - medium sandstone

Carbonaceous silty mudstone - dark grey - grey black with occasional brownish black.

Beds typically 1.2cm - 5cm thick. Irregular and often penetrated by sandstone dykes - dewatering or compaction feature?

Sandstone - light brownish grey - light grey - medium grey. X-beds vertical tensional fractures. Abundance of load casting structures and worm-like sandstone intrusions.

671.00 - 672.43

Interbedded coarse sandstone and mudstone

Mudstone - Greenish grey (GY) to light olive grey. Occasional greenish grey (5G) intraclasts. Occasional medium bluish grey intraclasts.

Mudstone beds 1cm-10cm thick. Laminated in part but generally thinly bedded irregularly bedded texture.

Intimately associated with the coarse sandstone.

Medium-coarse sandstone - light brownish grey - brownish grey. Often irregular boundaries between mudstone/sandstone layers. Mudstone intraclasts common in sandstone. Layers of intraclasts with sandstone matrix.

Possible tuff.

Large pyrite body 3cm diameter, 1cm thick on lower boundary.

## BESSIE CREEK SANDSTONE

672.43 - 685.8

Thickly - massively bedded sandstone.

Medium dark grey - dark grey. Occasional greenish - grey - dark brown grey. Occasional pinkish grey - light brownish grey in basal 1-2m x bedded. Alternating fine medium and medium coarse sandstone layers. Silicification.

Stylolites and vertical fractures.

Fairly light but does absorb water over 1-2m interval speckled appearance with dark spots in sandstone.

Gradational boundary to lower unit over 1m.

Fluorescence:

682.11 - 682.18

683.85 - blue white - green

685.61 - 685.69 - blue white - green.

685.8 - 694.37

Thinly bedded sandstone with mudstone interbeds/intraclasts.

Mudstone - Mod. yellow green - greenish grey irregularly bedded, decreasing abundance towards base, most abundant in top 2 metres. Intimately associated with sandstone, often occurring as irregular lenses, pellets of mudstone have minor grains interspersed throughout, some lenses 1cm thick and broken apart.

Sandstone - yellowish grey to pinkish grey - with some light olive grey, medium grey to dark grey, ranges from fine to medium grained, cross bedding, massive to thinly and thickly bedded, darker bands possibly concentrated bitumen?

Brown Fluorescence 686.56 - 686.63

Brown Fluorescence 686.26 - 686.31

Small closed vertical fractures - some infilled with dark (bituminous?) material, similar horizontal fractures - some almost approximating stylolites, some of fine grained sandstone exhibits mottling of a darker colour than surrounding rock? possible H/c staining.

694.01 - 694.37 Transitional boundary from above unit to unit below.

694.37 - 701.18 Sandstone

- medium dark grey to brownish grey, becoming pinky grey to base.

- massively bedded with some intervals of finely bedded sandstone (very minor mudstone between green grey 5G), fine to coarse grained.

- some cross bedding towards base of unit.

- 1-2m at top of interval exhibits distinct mottling when wet, dark grey spots (possibly H/C stains? and silica cementing effect) (similar to Scarborough-1).

- subvertical fractures infilled with quartz.

- occasional vugs infilled with degraded bitumen/altered mudstone/claystone.

Fluorescence: 697.85 Orange brown fluorescence in subhorizontal fracture.

697.11 Orange brown infilling vertical fracture.

701.18 - 703.27 Sandstone

Sandstone: yellowish grey, green grey (5GY), brownish grey and very light grey to light brownish grey.

- extremely silicified, no vis. porosity. Thinly bedded (0.5cm), some lenticular bedding.

- mainly fine to fine medium sandstone with very occasional coarse intervals <0.5cm.

- 45° fractures slightly offsetting bedding.

- very little grey sandstone, extremely silicified and almost quartzitic and massive.

- rare dark grey vugs filled entirely with bitumen?

702.82 - Blue white fluorescence.

702.94 - Blue fluorescence.

703.27 - 708.82

Sandstone with very minor mudstone.

Mudstone: light olive grey, forming very thin bands, up to 0.75cm thick, only occurs occasionally, sometimes lenticular.

Sandstone: light grey to medium dark grey, also light grey bands becoming dark grey towards base as organic/bitumen content increases.

- massive to thinly bedded with occasional crossbeds.
- bitumen? filled vugs and lenses occur occasionally but degraded - brown.
- common quartz filled fractures.
- poor porosity visible but retains water well.

705.17 Brown orange fluorescence.

## CORCORAN FORMATION

708.82 - 709.06

Mudstone, silty mudstone and fine to medium sandstoneMudstone:

- light olive grey.
- range from 1mm to 2mm thick.
- irregular wavy bedding.
- possibly distorted due to rip up and compaction but not severe.

Silty mudstone

- olive grey.
- irregular bedding - flame structures and compactional features into sands - contorted load casts.

Sandstone:

- very light grey, light olive grey to yellowish grey.
- contorted and often boudined by mudstone above.
- mainly massive to thinly (1cm) bedded.
- dark greyish black bands (1mm) of organic matter contained in sandstone.
- gradational boundary to unit below.

709.06 - 710.43

Minor mudstone, dominant fine to medium sandstone and siltstone

Mudstone - olive grey to brownish grey and brownish black mudstone in lenticular lenses, ripped up and contorted.

Siltstone

- brownish grey to dark grey.
- exhibits soft sediment deformation.
- lensoidal bedding.
- intimately associated with sandstone.

Sandstone

- very light grey to medium grey, some dark grey.
- massive to thinly bedded.
- subhorizontal fractures and subvertical fractures, vertical are infilled with darker material.
- highly silicified.
- scours.
- high dips occasionally occur and are attributed to sedimentary effects.
- fractures have been infilled which has altered surrounding sandstone (0.5cm out from closed fracture). 2 generations of fracturing (one cross cuts other).

Fluorescence - in next intervals to EOH.

711.65 Orange brown 1cm

712.24 Green and brown in vertical fracture.

710.43 - 712.01

Mudstone and siltstone - thinly interbedded.Mudstone

- brownish black, medium grey
- massive to thinly bedded
- penetrated by siltstone "intrusions".
- "Wormlike" dewatering/compactional features.
- some 10cm bands are extremely incompetent.
- crossbedding, low angle.
- minor dispersed pyrite.

Siltstone

- light olive grey to medium grey
- thinly interbedded with mudstone up to 1cm thick.

712.01 - 712.70 Fine to medium sandstone with minor mudstone

Mudstone

- as for above interval and also occurring as clasts within sandstone.
- wormlike features.

Sandstone

- medium light grey to dark grey.
- mainly massive with some thin bedding, low angle x bedding

712.70 - 745.00 Similar to 710.43 - 712.01 in colour and lithology

- no incompetent intervals.
- soft sediment deformation (wormlike), faulting on 2mm-1cm displacement scale.
- striped appearance in 1cm beds.
- areas of massive mudstone - 713.8 - 714.10
- areas of massive fine sandstone 715.70 - 715.9
- areas of massive fine sandstone 719.70 - 720
- areas of massive fine sandstone 721.10 - 721.2
- interval of massive mudstone 727.8 - 728.40
- interval of massive mudstone 738.0 - 738.30
- interval of massive mudstone 738.70 - 739.20
- interval of massive mudstone 739.60 - 740.50
- interval of massive mudstone 736.40 - 736.8
- rip up mudstone clasts into sandstone.
- pyrite aggregates (1cm diameter)
- areas of finely laminate bedding in scour like structure.
- finely laminated overall

Interval of massive mudstone 743.0 - 743.5

Interval of massive mudstone 741.6 - 742.4



KEYWORDS

Urapunga SD5310; Drill Rotary; Drill Stratigraphic; Petroleum; Geochemistry; Drilling Mud; Well Logs; Geophys Borehole; Hydrocarbon Potential; Analysis Source Rock; Maturation; Reservoir; Source; Proterozoic; Geothermal; Petrography; Porosity

LOCATION

Urapunga SD5310; EP5; Lady Penrhyn-1; McArthur Basin; Northern Territory