

SECTION 3 - LITHOLOGICAL DESCRIPTION

ALEXANDER - 1

ROTARY CHIP DESCRIPTIONS

FROM TO

- 0 - 2 Dominantly micaceous siltstone, moderate red brown to dark red brown, with dark yellowish orange mottling, minor claystone interbeds colour as above.
- 2 - 10 Dominantly siltstone, slightly micaceous, moderate red to dark red brown dominant colour, dark yellow orange mottled, very minor very pale orange mottled chips, some ferruginous partings, sample significantly contaminated with surface material.
- 10 - 12 Interbedded siltstone and claystone, greyish red to moderate red, mottled interbedded minor dark yellowish orange. Sample contaminated by metal from casing shoe and cement.
- 12 - 14 As for 10-12 but increasing in dark yellow orange. Very minor thin interbeds of very light grey fine grained sandstone.
- 14 - 18 As for 12- 14, but common interbeds/mottling of dark green black fine grained sandstone and claystone, fine grained sandstone is micaceous, contamination by rubber from cement plug.
- 18 - 20 No sample recovered.
- 20 - 22 Interbedded claystone and siltstone, light olive grey and dark greenish black, platy nature of chip indicates probable thin laminations. Dark red brown siltstone fragments probably contamination from above. N.B. light olive grey is cement.
- 22 - 28 Dominantly siltstone, dark greenish grey to greenish black, partly micaceous, ? tending towards a very fine sand, possibly ? carbonaceous, sample contaminated by dark red brown cavings and cement. Severe cement contamination b/w 26 and 28.
- 28 - 34 Very fine grained sandstone, very finely laminated, minor medium grained sandstone and siltstone (micaceous). The sandstone is greenish grey. The siltstone is dark greenish grey with minor pyrite, hard and indurated, very little contamination. Dominantly siltstone as above b/w 32-34.

- 34 - 36 Interbedded fine grained sandstone and siltstone, colours same as for 28-34. Minor pyrite. Very fine grained sandstone, light grey very hard also present. No visible pyrite.
- 36 - 38 Interbedded dark greenish-grey to black mudstone and siltstone (greenish black to olive black) with greenish-grey fine grained sandstone and interbeds of yellowish-grey claystone. Mudstone appears carbonaceous. No pyrite visible.
- 38 - 40 Interbedded greenish-black siltstone dominant (as for 36-38). Greenish-grey fine grained sandstone and medium sandstone more prominent with light grey to mottled red colour, fine sandstone has minor carbonaceous material. No visible pyrite.
- 40 - 42 Even proportions of interbedded mudstone/siltstone and fine-medium grained sandstone. Colours as for 38-40. No visible pyrite or carbonaceous staining. Similar to above sample but sandier.
- 42 - 44 Dark greenish grey to olive black fine siltstone and siltstone (less mudstone) dominant (60%) with greenish-grey fine sandstone carbonaceous but no pyrite visible.
- 44 - 46 Light greenish-grey to greyish red fine-medium sandstone dominant with lesser (30-40%) dark fine siltstone carbonaceous (bituminous?) staining visible in sandstone. No visible pyrite. Samples becoming sandier.

ALEXANDER - 1

CORE DESCRIPTIONS

<u>FROM</u>	<u>TO</u>	
<u>46.6</u>	- <u>46.84</u>	<u>M-C Quartz Sandstone</u> Dark greenish grey with laminated and mottled dark greenish grey with dusky red lamination and mottling. Porous with abundant bitumen blebs infilling pores. Well sorted, x-bedded.
<u>46.84</u>	- <u>48.04</u>	<u>Interbedded F-M sandstone, siltstone and minor claystone.</u> Laminated yellowish-grey, greyish-green to dusky-green. Minor olive grey. Irregularly bedded with fine to medium sandstone x-bedded. Some soft sediment deformation; carbonaceous material in fractures. Dark red-brown oxidation alteration, oxidation fronts. 1cm of highly bituminous fine sandstone. Siltstones micaceous.
<u>48.04</u>	- <u>48.3</u>	<u>Interbedded mudstone with C-VC sandstone.</u> Mudstone is black and bituminous with some blackish-red alteration. C sandstone is a lithic arenite. Bedding highly irregular some x-bedding at base. Sandstone has a bituminous matrix.
<u>48.3</u>	- <u>49.12</u>	<u>F- M siltstone and mudstone.</u> Irregularly bedded light greenish grey and greenish grey to dark greenish grey. Bedding very irregular. Bituman blebs in poorly sorted sandstone. Thin bed of highly indurated black mudstone towards base. Sooty carbonaceous matter in fractures. Dark red-brown alteration patches. Rip up and slumping features? Soft sediment deformation.
<u>49.12</u>	- <u>49.3</u>	As for 48.04-48.3. Lithic arenite and bitumen blebs infilling pores and forming matrix.
<u>49.3</u>	- <u>50.27</u>	<u>Sandstone C-VC</u> Greyish-red mottled with minor yellowish-grey lamination and mottling. Some large vughs/pores. Greyish-green claystone intraclasts. Porous and fractured - vert. sub-vert with pyrite on fracture surfaces. Poorly sorted and x-bedded. Grading into unit below.
<u>50.27</u>	- <u>50.74</u>	<u>M-C Sandstone</u> Poorly sorted large dark grey-black mudstone clasts and dusky yellowish green clasts also. In parts porous with black sooty carbonaceous matter filling pores. Biodegraded oil? Sandstone dusky yellowish green to black.

- 50.56 Sample of black sandstone with sooty organic material in pores taken for organic geochem.
- 50.74 - 51.04 Irregularly laminated fine sandstone, siltstone and claystone (silicified). Yellowish grey and greyish green. Black over basal 1cm.
- 51.04 - 52.7 C Sandstone
Light olive grey mottled olive grey dark greenish grey minor reddish brown. Common dusky yellowish green claystone intraclasts, in parts porous and in part heavily silicified. Porous zones contain bituminous material, fractures contain bituminous material and are common. Minor pyrite.
- 52.7 - 54.58 Irregularly interbedded F-M sandstone siltstone and claystone. Bedded light olive grey greyish-green, minor greyish olive green. Silicified and fractured. Zone of lost circulation during drilling. Numerous compacted fluid escape structures and sand dykes. Alteration interval appears to be altered by invasion of hydrocarbon fluid. Intervals have black alteration which cuts across lithological boundaries and tends to be associated with fracturing. Blebs and stringers of pyrite also associated with fractures and black alteration. Minor thin stringers of gypsum in some fractures. Sample to be taken from 54.17-54.3
- 54.58 - 58.57 C-VC sandstone
Minor interbeds M sandstone. Light brownish grey-light olive grey. Very minor dark red-brown mottling. Porous with zones of silification. Silicification tends to be more common in finer intervals. Common interbeds of yellowish grey and greyish yellow fine sandstone siltstone and claystone towards top. Sandstone poorly sorted pyrite present along fractures. Minor bituminous material in pores, fractured sub-vert to vert, appear to be open fractures. Minor large siltstone intraclasts towards base.
- 58.57 - 58.64 F sandstone, claystone
Strongly silicified yellowish grey to pale olive and pale brown. Common compacted sand dykes of medium sandstone reddish brown. Fractured with bituminous material and tarnished pyrite.

- 58.64 - 61.79 Sandstone M-VC to granule Conglomerate (at base).
Light olive grey to pale red, with minor moderate red mottling. X-bedded. Porous with bands of silicification occluding porosity. Common large siltstone intraclasts towards base. Again more porous in coarse sandstone. Minor bitumen in pores. Common large fractures with pyrite. Many fractures appear open. Large vughs with bitumen and pyrite close to base. Thickly bedded.
- 61.79 - 65.86 Thinly interbedded F sandstone, siltstone and minor claystone.
Yellowish grey, pale olive, greyish yellow green with minor dusky yellow green. Olive black and light brown interbeds mottled, current x-bedded and minor planar lamination. Some intervals slumped. Minor pyrite laminae. Minor staining along laminae? Minor carbonaceous material. Grades into lower unit. Looks like bleached equivalent of unit below.
- 65.86 - 69.42 Laminated F-VF fine siltstone and mudstone - which are interbedded thinly. Light grey-olive grey very fine sandstone and dark greenish grey to olive black siltstone to mudstone. Bedding graded - fining upwards. Fine sandstone current bedded silty partings are micaceous and carbonaceous. Pyrite common; unit slumped strongly over basal 0.6m. Minor fractures containing pyrite. Basal contact gradational. Maximum bedding thickness/upward fining cycle is 5cm.
- 69.42 - 89.08 Dominantly siltstone grading to VF sandstone and carbonaceous mudstone. Planar to wispy laminated with structureless to slumped intervals containing disoriented plates of carbonaceous material. Siltstone dark greenish grey to olive black mudstone greyish black. Very fine sandstone light olive grey to light brownish grey. Soft sediment deformation features such as laminae crinkling and slumping are common. Very fine sandstone intervals exhibit current lamination. Interval less sandy, more carbonaceous and more thinly bedded than above.
- 89.08 - 126.85 Siltstone grading to silty mudstone with minor very thin interbeds of VF sandstone. Planar wispy and wavy laminated and irregular due to soft sediment deformation. Increase in pyrite in interval above. Dominantly dark grey to greyish black with olive grey interbeds. Abundant very fine pyrite throughout and carbonaceous material is in wisps and plates/flakes.

Carbonaceous material quite often disoriented as in above interval. Intervals of carbonaceous material quite often up to 0.45m thick. Pyrite dominantly very fine grained and parallel to the laminae with minor nodules up to 0.5cm. Bedding noted to be distorted around nodules. One particular variety occurs as abundant disseminated spots 0.5cm wide over an interval of 2.3cm. Gives "speckled appearance" to core. Siltstone partings are micaceous, very fine sandstone interbeds have irregular sole.

Beginnings of or incipient flame and ball and pillow structures. Very fine sandstone intervals (5cm) grade up to siltstone and are commonly x-bedded and have erosional contacts at base. Slumping is common, slumped intervals consisting of distorted/contorted mudstone/siltstone/very fine siltstone and some intraformational clasts. Organic content uniform throughout. Increase in varied intervals towards base as this unit grades into the one below.

- 126.85 - 141.3 Very finely laminated (varved) siltstone/mudstone - claystone. Dominantly mudstone. Finely laminated light olive grey, greyish olive, olive grey and brownish black with black carbonaceous interlaminae. Rhythmically laminated on a scale from < 1cm > 5cm. Rare interbeds of dark greenish-grey very fine sandstone increase in number and thickness towards base - mostly over basal 3.5m. Pyrite - very similar to that described for above unit, very common. Less slumping in this unit. Minor debris flow (?) interbeds up to 3cm consisting of silty mudstone, internally structureless containing disoriented wisps of platy/lenticular carbonaceous matter. Varved laminae may show upward fining grading but is difficult to tell.
- 141.3 - 141.54 Irregularly interbedded F sandstone grading to siltstone with claystone partings. Pale olive to pale olive grey moderate olive brown. Significant decrease in carbonaceous content compared to above and below. Wavy laminated.
- 141.54 - 165.81 Rhythmically bedded with rhythmites consisting of two types. (1) Fine silty sandstone grading from base up to structureless silty mudstone interval which is in turn overlain by varved interval. (2) Doesn't have basal sandstone interval, starts with structureless mudstone. Maximum thickness very fine sandstone 12cm normally 3cm.

F sandstone - siltstone brownish grey to dark greenish grey. Mudstone intervals grade from brownish grey to base to greyish black at top. Carbonaceous content of each rhythmite increases upwards from poor at base to very highly carbonaceous at top. Abundant pyrite. Varved intervals the same as for that in unit above in colour and character. Varved intervals becoming thicker towards base of unit. Very fine sandstone at base of cycles very often x-bedded.

- 165.81 - 203.95 As for unit (2) of above but with varved siltstone-mudstone and claystone dominating with claystone most common. Mod thickly bedded structureless siltstone-mudstone alternating with equal or greater thickness of varved mudstone. Mudstone greenish black to olive black. Claystone (varves) dark greenish grey to greenish black to greyish black to black. Colour indicates organic rich but no organic matter visible in top section. Pyrite in form of nodules common. Pyrite nodules in mudstone disseminated horizons and spherical ovoid modules disturbing bedding. Dark greenish to olive grey very fine siltstone <1cm. Some minor x-beds. Structureless mudstone 6-10cm with varves in one 'couplet' of equal or greater thickness, i.e. 5 - 30cm. VF siltstone-mudstone olive grey-light olive grey at base of mudstone. Grades up into darker mudstone - often where disseminated pyrite is common and then into varves. Organic content appears to increase upwards perhaps with increasing reducing zone? First appearance of small scale x-beds in varved sequence noted 176m. Minor sandstone deformation in form of laminae distortion at boundary lighter siltstone-mudstone and dark mudstone. Rare siltstone 1cm-3m with flame and ball and pillow structures.
- 177.0 - 191 Less varves of mudstone more VF to F siltstone greenish grey to light olive grey. Almost unit (1) of above sequence but still has abundance of varves and not much siltstone. Appearance of debris flows some colour as mudstone with disoriented flakes of organic matter. Extensive vertical fractures.
- 191.0 - 203.95 Overall increased thickness of bed size - organic content of varves increased. Varves (mudstone) grey black to black with some olive grey-olive black interbedded siltstone units. Thicker with some internal lamination - olive grey. Basal debris flow of siltstone with disoriented organic fragments. Fines upward quickly to a mudstone. Varve sequence (colour as above).

Minor x-beds, no obvious soft sediment deformation. Low angle contact between varve and siltstone with increased organic content and varve thickness toward base of unit. Grey black to black almost uniform colour. Re-appearance of vertical fractures.

202

Green-grey to dark green-grey laminae in varve sequence. Maximum thickness 7cm some cross bedding or slumping in siltstone (lighter coloured).

203.95 - 224.90

(As for 126.85 - 141.3) Rythmite dominated sequence. Rhythmic bedding of silt and clay greenish grey-dark greenish grey. Some light olive grey to greyish black to black. Soft sediment deformation around brittle faults (minor displacement of laminae - synsedimentary growth faults and post depositional brittle fracture).

Pyrite common - hydrocarbon odour upon recovery and from fresh kerosene odour partings from 208m+.

Carbonate fracture infills. Pyrite nodules (small) present but not common.

Zones of hydrocarbon bleeds from 213m onwards.

Mudstone dom. below 214m olive gray - grayish black to black.

Zones of hydrocarbon bleeds from 1cm - 10cm thickness.

Claystone - very fissile, soft and crumbly - when fresh very strong H.C. odour, and liquid H.C. on surface.

H.C. rapidly evaporates, yellow to golden yellow fluorescence with some blue-white. Hydrocarbon bleeds to 222.90.

Thin brownish grey to olive grey laminae stand out - about 5mm thick.

Several 1-2cm thick bands of solid pyrite - with soft sediment deformation on upper and lower contacts and within bands.

224.90 - 260.40

Interbedded finely laminated organic rich.

Claystone-and less finely laminated organic poor siltstone-mudstone organic rich claystone - olive grey to olive black to brownish black (laminated on <1 mm scale with different character to varves organic poor siltstone-claystone. Greenish grey to dark greenish grey finely laminated in part but dominantly structureless with uniform colour. Occasional thin to thick (>8mm) laminae of F to very fine sandstone. Often glauconitic- associated with similarly coloured siltstone. Glauconite (visible) restricted to these laminae. Pyrite common and distributed throughout as nodules which distort bedding. Small scale brittle fracturing with associated sandstone deformation in places common. From 233m for 15m, the unit is dominated by the 'greenish' siltstone and organic content decreases to a minimum at the centre of the unit. Associated increase in number of fine to very fine sandstone and glauconite with decreasing organic content, fracturing increases. No porosity in fine to very fine sandstone pore spaces fully occupied by glauconite. Petroliferous odour throughout most strongly associated with organic laminae. Possible faint petroliferous odour in some fine to very fine sandstone in association with organic laminae. Some fluid escape structures in siltstone. Thin zones of extensive soft sediment deformation and brittle fracturing. Pyrite nodules occasionally glauconite rimmed. From middle of unit to base, increasing amount of organic matter (similar to top 10m of unit in organic content), colour change gives percentage of organic matter. By 260.40 unit is totally finely laminated. Greenish grey colour of siltstone changes to olive grey with organic content. Middle of unit 10-20% organic matter. Base and top 40-50% organic matter - why unit appears finely laminated over these intervals.

260.40 - 280.64

(gradational boundary) Unit similar to organic rich base of above unit except for slightly higher organic content. Transitional between above unit and lower very organic rich unit. Thinly to finely laminated organic rich mudstone and siltstone-mudstone. Organic rich mudstone olive black to brownish black-olive black, siltstone olive grey. Pyrite common. Organic content 60-70%. Rare thin carbonate lenses unit thinly laminate but not varve-like. Rare fine sandstone 6cm with petroliferous odour and faint fluorescence. Gradational change to unit below.

- 280.64 - 364.59 Mudstone - black highly carbonaceous, very thinly laminated. Olive black to greyish black with brownish grey to brownish black interbeds from 308.79 (up to 10cm thick) common very thin inter-laminae of calcareous mudstone.
- whole section v pyritic
 - pyrite varies from very fine grained and finely disseminated to large nodules up to 4cm thick. Common to scattered sub-horizontal veins (5mm thick) of anhydrite/Ca CO₃ and pyrite.
 - pyrite does not occur in brown-grey to brown-black interbeds.
- Burnt-in bit - disrupted lithology
- 280.36 (depth to top of burnt-in zone)
280.46 (depth to base of burnt-in zone)
- 283.66 - Thin Ca CO₃ vein
- 290.60 - Thin Ca CO₃ interbed
- 290.98 - Thin Ca CO₃ interbed
- 291.50 - Pyr nodule - sub horizontal
Vein - Ca CO₃ around boundary.
- 292.81 - Anhydrite and Ca CO₃ vein.
- 293.8 - Sulphide band.
- 295.19 - Anhydrite and Ca CO₃ vein.
- 295.47 - Pyrite nodule.
- 296 - Large sub vertical fracture
- 296.36 - Anhydrite and Pyrite and Ca CO₃ vein (horizontal).
- 296.98 - Pyrite nodule.
- 297.43 - Anhydrite and calcite vein.
- 297.74 - Ca CO₃ vein.
- 297.84 - Ca CO₃ vein.
- 298.00 - Anhydrite
- 299.00 - Anhydrite
- 300.36 - Pyrite nodule
- 300.98 - Anhydrite and Pyrite - horizontal veins.

- 301.35 - Anhydrite and Pyrite - horizontal veins.
- 302.88 - Anhydrite and some Pyrite and Ca CO₃ vein.
- 304.00 - 2 x Anhydrite and some Pyrite and Ca CO₃ vein.
- 304.80 - Pyrite and Ca CO₃ nodule (irregular).
- 305.35 - Pyrite vertical veinlet - possibly fluid escape structure, distorted as a result of compaction.
- 305.4 - Anhydrite, Pyrite and Ca CO₃ vein.
- 305.94 - Same as (305.35).
- 306.23 - Same as (305.4).
- 306.40 - Same as (305.4).
- 306.78 - Same as (305.4).
- 307.84 - Same as (305.4) and a pyrite nodule.
- 308.89 - 309.15 - Very sulphide rich interval, pyrite and sphalerite - disseminated, nodular and vein sulphides in this interval.
- 310.27 - Anhydrite, pyrite, Ca CO₃ horizontal vein.
- 310.64 - Anhydrite, pyrite, Ca CO₃ horizontal vein - dominantly Ca CO₃.
- 310.75 - Pyrite nodule.
- 311.1 - Same as (310.27).
- 311.42 - Same as (310.27).
- 311.85 - Same as (310.27).
- 312.22 - Cross cutting and anastomosing fractures - sulphide infill.
- 312.38 - Horizontal pyrite vein with anhydrite and Ca CO₃ boundaries.
- 312.96 - Pyrite, anhydrite and Ca CO₃ vein.
- 313.34 - Pyrite, anhydrite and Ca CO₃ vein.
- 313.57 - Large pyrite nodule, underlain by a graded bed (silt - mudstone) scour surface at base 1cm thick.

- 313.59 - Calcite and anhydrite vein.
- 313.91 - Pyrite nodule.
- 314.11 - Calcite and anhydrite.
- 314.16 - Calcite and anhydrite.
- 314.8 - 315 - Veinlets of pyrite and carbonate in tensional fractures.
- 315.65 - Calcite and anhydrite veinlet.
- 315.87 - Ball and pillow soft sed. def. feature - at base of brown - black interbed.
- 316.06 - Calcite vein.
- 316.11 - Calcite vein.
- 316.28 - Calcite vein.
- 316.58 - Pyrite and calcite vein.
- 317.20 - Pyrite and calcite vein.
- 317.92 - Anastomosing calcite and sphalerite veins.
- 318.3 - Calcite vein.
- 318.85 - Band of disseminated Zn-rich sphalerite.
- 318.97 - Calcite vein.
- 319.28 - Calcite and anhydrite.
- 320.23 - Calcite and anhydrite.
- 321.2 - Slumping - steepening of bedding.
- 321.65 - Calcite and anhydrite.
- 321.89 - Fining upward cycle with a scour at base.
- 322.1 - Very fissile olive brown claystone interbed, (greasy feel). Upon exposure rapidly disintegrates.
- 322.87 - Calcareous interbed.
- 323.47 - Calcareous interbed.
- 324.61 - Calcareous interbed with calcite and anhydrite base.

- 324.2 - 7cm zone of fracturing with calcite infill and slickensides.
- 326.2 - Pyrite nodule.
- 326.75 - Calcite and anhydrite vein.
- 327.33 - Calcite and anhydrite vein.
- 327.34 - Brown interbed similar to 322.1.
- 328.8 - Sub horizontal calcite veins.
- 330.63 - Small pyrite nodule and thin calcite and anhydrite veins.
- 331.71 - Anhydrite and Ca CO₃ particles.
- 331.82 - Anhydrite and Ca CO₃ particles.
- 332.1 - Greyish brown 4mm thick fissile claystone parting.
- 332.96 - Ca CO₃ and anhydrite vein.
- 333.55 - Pyrite nodule.
- 333.62 - Ca CO₃ parting.
- 333.99 - Ca CO₃ parting.
- 334.67 - Ca CO₃ parting and anhydrite.
- 335.96 - Ca CO₃ parting and anhydrite.
- 336.44 - Ca CO₃ and anhydrite parting and grey brown claystone (fissile).
- 336.68 - Ca CO₃ and anhydrite vein.
- 337.8 - Calcareous vein - vuggy, bitumen in vugs.
- 337.87 - Sub horizontal pyrite nodule.
- 338 - 4cm parting of pyrite nodule.
- 338.3 - Calcareous/anhydrite vein.
- 338.9 - Pyrite nodule as above.
- 339.51 - Calcareous/anhydrite parting.
- 340.17 - 3cm thick interbed of graded calcareous, carbonaceous siltstone - calcite partings on upper and lower surfaces.

- 340.92 - Calcareous interbeds.
- 341.36 - Calcareous interbeds - inversely graded.
- 343.2 - Calcite and ? anhydrite vein.
- 343.59 - Calcite and ? anhydrite vein.
- 343.84 - Calcite and ? anhydrite vein.
- 344.29 - 5cm pyrite band - calcareous partings.
- 345.54 - Ca CO₃ vein.
- 345.66 - Ca CO₃ vein.
- 346.14 Large pyrite nodule with calcite veins at top.
- 346.77 3 small Ca CO₃ veins.
- 347.14 - Ca CO₃ vein.
- 347.33 - Pyrite nodule.
- 347.38 - 10cm fining up ward silty-mudstone interbed.
- 347.88 - 2cm interbed of brown-grey fissile mudstone (see 322.1m).
- 348.42 - Ca CO₃ vein.
- 347.8 - 349 - Common sub-vertical fractures with calcite infills.
- 349.16 - 3cm calcareous silty carbonaceous mudstone interbed - current bedding.
- 349.75 - 349.8 Numerous small interbeds of calcareous silty mudstone.
- 352 - 2cm of calcite with carbonaceous material.
- 352.26 - Ca CO₃ vein.
- 352.83 - 352.91 - Calcareous siltstone interbed - dark greenish grey - thinly bedded over basal 2cm - rest internally structureless - also carbonaceous and micaceous.
- 354.26 - Pyrite, calcareous parting.
- 354.39 - Pyrite, calcareous parting (not pyritic).
- 355.13 - Very thin calcareous interbed.

- 355.38 -Pyritic very thin calcareous interbed.
- 355.57 - Nodular and as above.
- 356.17 - Brownish grey to dark grey pyritic carbonaceous limestone.
- 356.56 - Ca CO₃ vein.
- 356.8
6.83 - Ca CO₃ interbed.116
- Pyrite nodule.
- 357.52 - Ca CO₃ interbed.
- 358.84 - Sub vertical fracture calcite infill.
- 359.2 - 359.25 Ca CO₃ veins.
- 359.73 - Ca CO₃ veins.
- 360.03 - Calcitic interval interbedded with dark brown-grey claystone.
- 360.15 - Fracturing, distorted bedding - dark brown to grey claystone with Ca CO₃ interbeds.
- 360.53 - Ca CO₃ interbed.
- 361.24 - Ca CO₃ interbed.
- 362.64 - 3cm interval - A series of small beds, grading from calcareous siltstone to silty mudstone.
- 362.8 - Ca CO₃ vein.
- From 362-64 to base of interval - an increase in thin (<1cm) brownish grey to olive grey calcareous siltstone to silty mudstone.
- 363.47 - Large pyrite nodule in silty carbonaceous mudstone.
- 364.59 - 371.88 Siltstone to silty mudstone - light olive grey to moderate olive brown and interbedded carbonaceous mudstone - olive grey to olive black. Interbed of light brownish grey to brownish grey calcareous siltstone to silty limestone with black carbonaceous partings 367.3 - 367.5. Dominantly planar laminated on mm scale. Minor current lamination. Individual beds tend to be graded.

367.7) large carbonate nodules with pyrite and
371.07) flecks of carbonaceous material and
inclusions of carbonaceous mudstone.

371.24 Cross cutting fractures sealed with
calcite
and pyrite. Bituminous material in
fractures?

Tends to grade into unit below with increase in
grayish black to olive black mudstone and silty
mudstone (very carbonaceous).

- 371.88 - 383.22 Silty mudstone to mudstone, highly carbonaceous -
olive black to brownish black with minor thin
interbeds of brownish grey - strong kerosene
odour.
- 2 thick interbeds with calcareous matrix (372.96
to 373.08 and 373.64 to 374.77 - same description
as above).
- 379.19 - 4 cm thick interbed of inversely graded calcareous
siltstone - medium dark grey.
- 381.03 - Calcareous parting; 2cm thick.
- abundance of disseminated pyrite (very finely)
throughout unit.
 - tends to grade into the unit below.
- 383.22 - 398 Dominant lithology as above, with increasing
abundance of interbeds of light olive grey to
brownish grey silty mudstone - possibly reflecting
decrease in quantity of carbonaceous detritus -
- partings still have a strong kerosene odor.
 - these light coloured intervals have a very dull
brown fluorescence.
 - minor, scattered calcareous partings
throughout unit.
 - unit contains disseminated pyrite, with
occasional nodules.
- 386.39 - Calcareous interval with oil bleed and associated
strong gold fluorescence surrounded by a ring of
white fluor. - 1cm thick.
- 398 - 416.57 Light olive grey to olive grey silty mudstone with
interbeds and partings of brownish black
carbonaceous mudstone.

- whole unit very finely laminated (Planar).

4 very fine grained siltstone intervals with calcareous matrix (402.66 to 402.81, 406.34 to 406.67, 408.53 to 408.6 and 410.11 to 410.29).

- also minor thin calcareous partings.

410.44 -

Fracture infilled with calcite, minor pyrite, and bituminous material.

413.55 to 422

Fault Zone -

Anastomosing fractures obliquely cutting bedding, some listric calcite infilling and minor bituminous material.

Bedding highly distorted.

413.95 - 414.17

A number of fractures filled with grains of dark yellowish green to dusky yellowish green material, superficially similar to glauconite but could possibly be associated with a doleritic intrusive

- thin section necessary to ascertain

- fractures tend to parallel bedding.

- slicken-siding on fractures throughout unit, occasional fault gouge.

416.57 - 445.99

Highly carbonaceous mudstone very finely laminated (sub mm scale) - greyish black to black with minor olive black and brownish black inter-laminae.

- minor light grey calcareous interbeds (several mm to 2 cm thick).

- abundant very finely disseminated pyrite and occasional large nodules e.g. 437.46, 440.41, 428.97.

- occasional calcite partings.

- scattered mudstone beds with calcareous cement.

- 6 large limestone interbeds up to 30cm thick - basal contacts exhibit soft sediment deformation e.g. 436.16 (14cm), 442.8 (30cm thick - exhibited blue and white fluorescence), 444.8, 445.3 and 445.55.

- strong kerosene odour throughout unit.

- 445.99 - 446.15 (Geophys. Log 443m)
Fracture zone - broad anastomosing fractures infilled with calcite and a green clay mineral possibly glauconite deposited during early diagenesis.
- 446.15 - 564.79 Claystone - Internally homogenous - medium bluish grey to dark greenish grey.
- bedding indistinct, in parts highly contorted.
 - poorly carbonaceous, carbonaceous material consisting of wisps and flecks, generally do not show preferred orientation, but crudely define bedding.
- Pyrite rare, and confined to more carbonaceous rich partings general increase in pyrite content down section in very finely disseminated form.
- Carbonaceous content gradually increasing down section.
- Increase in content of dark greenish grey beds over medium bluish grey down section, reflecting increase in units carbonaceous content.
- Much of unit is carbonate cemented.
 - Fractures toward top of unit are calcite infilled.
 - Toward base of unit, beds of medium dark grey, dark greenish grey and olive black appear and increase in frequency as carbonaceous content of unit increases.
 - Toward base of unit there is an increase in the number of planar laminations (i.e. decrease in contorted bedding planes and slumps) - bedding consistently dips at 12 to 15.
 - From 521.50 the unit is dominated by dark greenish grey, medium dark grey and olive black beds - unit is thinly bedded and finely laminated with minor slump intervals - lamination is predominantly defined by carbonaceous partings.
 - minor Ca CO₃, possibly in cement.

- 513.18 - 527.80 Subunit of Claystone
 Occurrence of thin (0.5 - 1cm thick) silty interbeds, generally confined to areas of lighter coloured mudstone - possibly turbidity flows - no visual porosity, no fluorescence.
- 516.15 - calcareous nodule ? 5cm thick.
 - 528.40 fracture zone - calcite infills - some slickensides, some associated bituminous material.
 - From approximately 527m carbonaceous intervals thicken from mm scale laminae to interbeds of up to several cm's thickness.
- 527.80 - 535.71 Subunit - Mudstone
 General lack of siltstone partings - mudstone dominated unit.
- 535.71 - 564.71 Subunit - Siltstone interbeds
 Reappearance of silty interbeds - with several thin (mm scale) glauconitic partings in top metre of unit.
- silty interbeds increase in frequency toward base of unit, ranging in size from 1mm - 10mm - some exhibit current lamination and are graded (fining upward).
 - Overall subunit is finely laminated, containing slumped intervals, up to 20cm thick.
 - Carbonaceous material tends to be concentrated in laminations and thin beds except in slump intervals.
 - 2 large limestone bands; 546.81 to 546.94 and 551.55 - 551.71.
 - Within subunit there are several intervals of rhythmically bedded siltstone and mudstone beds (each generally less than 1cm thickness) e.g. 544.9, 546.7, 548.7, 549.05, 551.6 (with calcareous cmt), 551.9.
- 2 coarser interbeds within unit; 559.25 and 559.12 - consist of medium and coarse quartz pebbles in a mud matrix - no visual porosity - orange/ brown fluorescence of qtz grains.

- 563.18: large pyrite nodule.

- 564.73: 2 pyrite nodules.

564.79 - 583.72 Silty mudstone.

From greyish black to brownish black to black from top to 570.17 to dark grey and greenish black at centre of unit to olive grey, brownish grey and dark greenish at base - throughout unit abundant black carbonaceous partings.

- Colour variation reflects decrease in carbonaceous content from highly carbonaceous top to moderately carbonaceous base.

- Overall increase in silt content down unit from graded silt-mudstone beds at top of unit to discrete silt beds unto 2cm thick interbedded silty mud and mudstone.

- Intervals up to 1m thick are slumped and internally structureless (e.g. 580.42 - 581.2).

- Smaller slumped intervals are defined by contorted silt interbeds (e.g. 569.7 - 8cm thick).

- Silt interbeds commonly exhibit soft sediment deformation and mass flow character.

- Very pyritic upper section to unit decreasing with carbonaceous content (finely disseminated).

- 566.46 - Example of graded rhythmites (silt - mud) in upper highly carbonaceous interval (carbonaceous content increases up the rhythmite) - 0.5mm to 30mm thick.

- Some vertical fracturing.

- 567.2 - classic progradational flow structure.

- Minor calcareous cement increasing toward base of unit.

583.72 - 597.4 Silty mudstone grading to mudstone with silt to very fine sand interbeds - in upward fining cycles.

Silty mudstone - brownish grey - greenish grey - olive grey - brownish black - very micaceous.

Silt - olive black to brownish black.

Very fine sand - silt interbeds - light brownish grey to brownish grey to medium dark grey.

Fine sand - Silt beds are current laminated - up to 4cm thick - often slumped.

- Large part of interval exhibits contorted bedding and slumping.
- Finely disseminated pyrite more common towards the base of the unit.
- Carbonaceous content also increases down unit and correspondingly, overall colour of unit darkens.
- 592.34 to 592.9 - slumped interval containing 2 highly contorted very fine sand lenses.

597.4 - 605.39 Black organic rich mudstone - silty mudstone (olive black to brownish black) with abundant finely disseminated pyrite - very thinly laminated. (Rapid increase in organic content to).

Minor light brownish grey silt intervals e.g. 601.75 scour and fill structure.

- bedding dips 15°.
- minor carbonate cement.

605.39 - 617.34 Mudstone to silty mudstone with silt to very fine sandstone interbeds.

Mudstone - olive grey to dark greenish grey - grades to olive black to brownish black at 612.07 - corresponds to an increase in the carbonaceous content of the unit.

- From 612.04 - increase in number of 1-2cm thick current laminated (and scour and fill) fine sand and silt interbeds. To base of unit where lithology is dominantly sand and silt (basal 80cm).

- 608.80 - large pyrite nodule.
- minor subvertical fracturing.
- bedding appears to dip at about 8° (616.57m).

617.34 - 617.85 Interbedded fine to medium grained sandstone, siltstone and mudstone. Irregular bedded, silicified. Mudstone is dominantly light olive grey grading to brownish grey. Sand interbeds are light greenish grey to light olive grey.

617.85
(Geophys Log
614m)

Base of Velkerri.

617.85 - BESSIE CREEK SANDSTONE.

617.85 - 621.23 Sandstone. Fine to medium grained, dominantly medium grained medium dark grey to dark grey with minor black partings at base grading upwards to light olive grey (and light bluish grey) Bitumen? in matrix common over basal 1.5m. Poor? porosity appears to be occluded by silicification. Thickly cross bedded. Minor yellow fluorescence 618.57.

621.23 - 621.6 Fine to medium grained sandstone with irregular mudstone partings and then interbeds up to 0.5cm thick. Light greenish grey to greyish green - along several partings, mottled alteration to moderate brown.

Mudstone - very pale orange to moderate yellowish brown to olive black (carbonaceous).

621.6 - 627.78 Sandstone - (colour as for 617.85 - 621.23) - fine to medium grained (med. dominates).

- Poor porosity due to silicification.
- Common vertical fractures, some of which appear to be open.
- Dull - bright orange fluorescence associated with fractures.
- Toward base of unit, common aggregates or "clouds" of sooty black carbonaceous material in the matrix.

- Common pyrite associated with carbonaceous material.
- 626.20 - 626.33 Interval with common mudstone partings and thin interbeds.
- Mudstone interbeds also occur at 626.90m and 627.27.
- 627.78 - 631.08 Mainly interbedded fine-medium sst, sltst and mudstone - beds up to 20mm thick.
- Irregular and wavy laminated sst intervals: light olive grey to medium grey.
- Mudstone: light brownish grey to brownish grey to greenish grey to dark greenish grey to light bluish grey.
- Compacted sand dykes from 628.63 to 629.61 - moderate red to light red mottling.
- From 629.91 to 630.91 thick interbed of very strongly silicified medium grained sst.

Fluorescence details of intersection from 630.91-661.28 metres i.e. Bessie Ck. sst.

- 630.91 - 630.985 Yellow fluorescence in bedding dispersed bitumen? matter.
- 630.94 - 630.95 Orange fluorescence in soft elongate (11 to bedding clay pellet.
- 632.975- 633.01 White and orange fluorescence.
- 633.205- 633.240 White fluorescence.
- 633.165- 633.635 Yellow Fluorescence.
- 633.820- 633.83 Yellow Fluorescence.
- 635.22 - 635.24 Orange Fluorescence.
- 636.65 - 636.71 ? Fluorescence.
- 637.06 - 637.095 White Fluorescence.
- 641.23 - 641.340 Orange Fluorescence.
- 640.89 - 640.95 White Fluorescence.

640.51 - 640.58 Speckled orange fluorescence.
641.91 - 641.99 White Fluorescence.
642.96 - 643.01 Orange Fluorescence.
643.29 - 643.40 Orange Fluorescence.
643.79 - 643.85 Yellow Fluorescence.
643.89 - 643.985 Yellow Fluorescence.
644.64 - 644.78 Yellow Fluorescence.
646.635- 646.70 Yellow Fluorescence.
646.99 - 647.09 Yellow Fluorescence.
647.69 - 674.78 Yellow Fluorescence.
648.68 - 648.84 Yellow Fluorescence.
649.31 - 649.395 Orange Fluorescence in vein.
649.74 - 649.77 Orange Fluorescence in bedding.
649.81 - 649.89 Very yellow fluorescence in bedding.
649.94 - 650.10 Medium yellow and orange fluorescence in bedding.
650.31 -650.415 Very yellow in bedding.
652.36 -652.39 Yellow fluorescence in bedding.
656.32 - 656.35 ? Fluorescence.
656.44 - 656.51 ? Fluorescence.
656.53 - 656.73 ? Fluorescence.
656.80 - 657.34 ? Fluorescence.
657.47 - 657.51 ? Fluorescence
657.56 - 658.14 ? Fluorescence
660.70 - 660.725 Yellow Fluorescence.
660.985- 661.00 Yellow Fluorescence.

BASE OF BESSIE CREEK 661.28 (Geophys. Log. 656m.)

- 630.91 - 642.69 Fine and medium grained very mottled sandstone, light grey to very light grey gradually changing to light grey to medium grey down sequence, due to increasing carbonaceous matter some pink mottling in sandy areas, silicified but with some slightly more porous beds interspersed (larger grain size), numerous stylolites and fractures. Lenticular mud clasts interspersed.
- 631.31 - Stylolite of carbonaceous/bituminous matter.
- 631.34 - 631.41 Vertical open fracture partly infilled with quartz close to stylolite at 631.31.
- 632.09 - 632.19 Vertical fracture (open).
- 632.67 Stylolite
- 632.8 - 632.86 Fine grained sandstone, of medium grey colour (due to carbonaceous matter).
- 633.03 - 633.04 Coarse grained sandstone band completely infilled with silica cement.
- 633.5 - Fracture at 45° to core with associated vertical fracturing.
- 633.73 - 633.84 Open vertical fracturing - no fluorescence.
- 634.82 - Stylolite filled with bitumen/carbonaceous matter.
- 635.38 - 635.46 Open fracture, vertical.
- 635.55 - 635.71 Fracture, vertical.
- 636.02 - Stylolite.
- 637.1 - Large stylolite.
- 638.09 - Stylolite
- 638.405- Poorly dev. stylolite.
- 638.65 - Stylolite.
- 639.1 - Stylolite.
- 639.23 - 639.41 Large vertical fracture - open.
- 639.76 - 639.85 Vertical fracture (open).
- 640.17 - Stylolite.

- 640.32 - Stylolite.
- 640.39 - Stylolite.
- 640.60 - Stylolite.
- 640.70 - Stylolite.
- 641.08 - 641.09 Very poorly developed stylolites.
- 641.96 - Stylolite.
- 642.69 - 652.33 Finely laminated fine grained light grey sst and very fine medium grained sandstone, laminations are not parallel but convoluted and most darker areas have very fine laminations of black carbonaceous (?) matter and lenticular pods of this also occur throughout section (bitumen probably).
- 642.78 - 642.79 Black thick layer of carbonaceous material but more likely mud clast.
- 652.33 - 656.25 As for 630.91 - 642.69
- 652.54 - Stylolite
- 652.47 - 652.54 Vertical fracture.
- NOTE Vertical fracturing appears to be associated closely with stylolites (as feeders? or consequence?)
- 652.82 - Stylolite.
- 653.42 Stylolite with ass. soft white material which dissolves but does not effloresce in HCL. White material infilling vertical fracturing close to stylolite.
- 653.91 - Stylolite.
- 654.29 - Stylolite.
- 654.40 - Stylolite.
- 654.58 - Vertical fractures.
- 655.18 - Stylolite.
- 655.28 - Stylolite.
- 655.84 - Stylolite.

- 656.24 - Stylolite.
- 656.25 - 658.16 As for 642.69-652.33 but less black carbonaceous matter and larger content of fine sand (bands 1-3cm thick).
- 658.16 - 661.28 As for 630.91-642.69 but consistent in colour and slightly finer grained over all. Only hints of laminations, fewer stylolites.
- 660.01 - Stylolite.
- 660.22 - Stylolite.
- 660.5 - Stylolite with ass vertical fractures.
- 660.68 - 661.28 Transitional zone from Bessie Creek to Corcoran. Base of Bessie Creek taken at 661.28.
- Finely laminated light grey to dark grey siltstone and very fine grained. light grey sandstone increasing in darkness toward 661.28.
- 661.28 - EOH (683.3, Logger)

CORCORAN FORMATION

- 661.28 - 683.3 Finely laminated siltstone and very fine grained sandstones. Varying in colour from medium grey to black and gradually becoming darker overall with depth. Dewatering and loading features common.
- 661.28 - 662.8 Light to dark grey.
- 665.24 - 665.45 Sandy interval of fine grained light grey sandstone.
- 665.35 - 665.38,
665.45 - 665.46 Good examples of dewatering structures, now convoluted with loading from above. Features like this are common - compaction.
- 667.41 - Cross laminations.
- 667.5 - 667.8 Very fine laminations.
- 673.54 - 674.38 Very sandy (fine grained.) section with cross bedding exhibited.
- 675.58 - Scour.
- 675.58 681 Very fine laminations with numerous vertical and cross fracturing and some herringbone cross bedding.

- 678.91 - 678.93 Sulphides dispersed throughout but concentrated in this area.
- 676.3 - 680 Vertical fracturing much more common in this section than elsewhere in very finely laminated section. Almost looks fault brecciated in places.
- 681.5 - 681.75 Pyrite diagenetic? or rafts in situ?
- 681.34 - Rotated fault block of finely laminated material.
- 683.3 -EOH As for general description.
- 684.67 - 684.73 Bitumen layers - dispersed amongst quartz grains and shale laminae.
- 685.55 -685.75 Greyish green in colour very fine grained siltstone/shale. (EOH - Driller).

KEYWORDS

Hodgson Downs SD5314; 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

Hodgson Downs SH5314; EP4; Alexander-1; McArthur Basin; Northern Territory