

Pilbara 2012: Drill Core Project Field Notebook

Roger Buick

Index

AIDP-1: pp. 3

AIDP-2: pp. 19

AIDP-3: pp. 37

Agouron | Mt. Magnet Drilling

Drillers: Gary Maguire Shane

 Darren Fox James

Drilling Manager: Jamie Hamilton

Safety Officer: J-P Van Loenhout

Mt. Magnet Drilling Supplies

Quik- Gel Gold (bentonite) Baroid – Halliburton

System Floc-360 (polymeric flocculant) Baroid - halliburton

Poly-bore (dry polymer) Baroid – halliburton

Quik-Mud Gold (clay stabilizer) Baroid – halliburton

Diamond Seal (absorbent polymer) Baroid – halliburton

IDP-214 (Vibration damping grease) Baroid – Halliburton

Fuse-it (polymer lost circulation) baroid – halliburton

AQF – 2 (Foaming agent, anionic surfactant) Baroid – halliburton

TR10 (biodegradable drilling lubricant) Baroid – Halliburton

Soda Ash dense

N-Seal (acid-soluble lost circulation) Baroid – halliburton

AIDP-1 (Coonterunah organic geochemical control)

Dip: 55°N

Azimuth: 005°

0718123, 7664005

Core orientation starts at 156.70m. Red grease-pen is initial orientation on TOP of core, black felt pen is up-core ext.

Hammer precollar – water @ ~ 50m

94m

Dark grey-green metabasalt, 0.5-1mm grain size, 30% pale green actinolite, 30% grey plagioclase laths, 40% dark green chlorite matrix. Abundant 0.5mm epidote veinlets; massive, competent, no evidence of amygdaloids or pillows

Hole flushed with 3000L water, change to NQ core after equipment cleaning. Hammer oil (rock drill oil), thread grease. AQF-2 foaming agent used and sampled during RC drilling.

(1) 95.80m-101.74m (5.95m thick)

Core start NQ. Massive green-grey tholeiitic metabasalt, not obviously, no evident amygdaloids or varioles, ~30% pale green actinolite prisms, ~30% pale grey plagioclase laths (felted), ~40% dark green chlorite matrix, 0.5mm grain size. Pervasive or patchy pale green calcite alteration zones up to 50cm across, crystal blocky 1-2mm across (fizz in HCl); patchy leucoxene **diferation** 5%, 1mm, abundant 1mm epidote- calcite veins; some 1cm chlorite-calcite veins; @100.96cm 2cm thick complex vein of 5mm calcite and chlorite crystals; no preferred orientation of veins, brittle fractures without shearing; no evident Cenozoic weathering; no evident porosity or permeability; little obvious drilling contamination; no tectonic fabric.

(2) 101.76m-101.98m (0.24m thick)

Possible pillow breccia. Rounded 10cm fragment of (1) in oblique chlorite-carbonate (5mm crystals) matrix cross-cutting (1). Apparent conel zonation in possible pillow fragment (more or less chlorite).

(3) 101.98m-103.31m (1.33m thick)

Massive green-grey metabasalt like (1), variably altered and veined, less leucoxene patches and less 1cm chlorite-carbonate veins.

(4) 103.31m-108.02m (4.71m thick)

Massive green-grey tholeiitic metabasalt like (1), but markedly less carbonate alteration (5% rather than 30%) in patches 3cm across rather than pervasive.

(5) 108.02m-109.10m (1.08m thick)

Massive green-grey tholeiitic metabasalt with little patchy carbonate alteration like (4), but with abundant carbonate-chlorite veins 1-3cm across with internal metabasalt breccia, angular fragments to 1cm. Veins have no preferred orientation, irregular rather than straight.

(6) 109.10m-109.80m (0.7m thick)

Massive green-grey tholeiitic metabasalt with limited carbonate alteration, like (4), but with scattered (0.5%) spherical amygdales 5-10mm, usually calcite then chlorite fill but sometimes the reverse; some planar 5mm calcite veins.

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(7) 109.80m-111.55m (1.75m thick)

Massive green-grey tholeiitic metabasalt with patchy carbonate alteration, like (4), but 10% carbonate altered in patches to 5cm across.

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(8) 111.55m-112.96m (1.41m thick)

Interlayered green-grey tholeiitic metabasalt, like (7), and massive very fine grained (<0.01mm) black kerogenous chert, layers 1-5cm, planar but with undulose to embayed margins, chert with some internal layering, diffuse 1-2mm planar; interlayered metabasalt has compositional banding parallel to orientation of chert layers, leucoxene-rich to chlorite-rich; chert layers fractured and cross-cut by 2-5mm chlorite veins. Either deformed interflow sediments of alternating chert/mafic tuff, or complex parallel chert/chlorite veins intruding and variably altering metabasalt. Minor pink-brown hematite? Staining in some chert.

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(9) 112.96m- 113.68m (0.72m thick)

Massive green-grey tholeiitic metabasalt like (4), but with little patchy carbonate alteration (<1%), occasional 1mm planar epidote veins, rare 3mm planar calcite veins, randomly oriented.

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(10) 113.68m-113.88m (0.20m thick)

Interlayered tholeiitic metabasalt and black(?) chert, like (8), but chert mostly lenticular 1cm thick 5cm long, some cream patches of siliceous? (very hard) diffuse alteration.

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(11) 113.88m-114.30m (0.42m thick)

Massive green-grey tholeiitic metabasalt like (4), but with abundant irregular mottled alteration patches to 10cm across; some cream, very hard diffuse margins, siliceous?; some chloritic, scattered 5-10mm subspherical chloritic amygdales? <1%.

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(12) 114.30m-114.82m (0.52m thick)

Massive green-grey tholeiitic metabasalt like (4), but with 3% 5-10mm subspherical chloritic amygdales, some with marginal cream, very hard siliceous? Alteration or pyrite crystals.

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(13) 114.82m-118.30m (3.48m thick)

Massive green-grey tholeiitic metabasalt like (4), but limited carbonate alteration, 5% patches of 5mm calcite scattered 1-3cm irregular chlorite-carbonate veins, random orientation, some with marginal epidote, patchy cream very hard siliceous alteration 1cm across, rare 5-10mm chloritic subspherical amygdales.

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(14) 118.30m-120.17m (1.87m thick)

Massive green-grey tholeiitic metabasalt like (4), but with little carbonate alteration and abundant very hard (siliceous?) alteration patches 1-5cm across, irregular; scattered subspherical 5-10mm chloritic amygdalites 2% often with marginal siliceous alteration.

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(15) 120.17m-124.62 (4.45m thick)

Massive green-grey tholeiitic metabasalt like (4), but no calcite alteration. Instead, widespread (70%) cream very hard (siliceous?) alteration, irregular mottled patches to 10cm across; scattered rare (1%) 5-10mm chloritic subspherical amygdalites often with marginal siliceous alteration, scarce 1-2mm planar chlorite veins with marginal siliceous alteration. Also rare 1-2cm planar chlorite/calcite veins without marginal alteration.

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(16) 124.62m-128.32m (3.7m thick)

Massive green-grey tholeiitic metabasalt like (4), but little calcite alteration, 3% disseminated; little cream hard siliceous alteration adjacent to veins 1mm planar epidote/chlorite, some 1cm planar chlorite /carbonate veins cross-cut by epidote/chlorite veins.

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(17) 128.32m-129.20m (0.88m thick)

Massive green-grey tholeiitic metabasalt like (4), but little calcite alteration (5% disseminated); abundant cream hard siliceous alteration in irregular mottled patches 5cm across; some 1-2cm chlorite/carbonate veins planar to irregular; scattered 1% 5mm chloritic subspherical amygdalites.

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(18) 129.20m-132.97m (3.77m thick)

Massive green-grey tholeiitic metabasalt like (4), with widespread 10-20% carbonate alteration, cream hard siliceous alteration restricted to margins of epidote/chlorite veins 1mm planar; rare 1cm planar to irregular chlorite/carbonate veins.

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(19) 132.97m-134.48m (1.51m thick)

Massive green-grey tholeiitic metabasalt like (4), but little carbonate alteration (5%); abundant 1-10cm veins of chlorite/carbonate filled with 1cm angular blocky fragments of chloritized metabasalt; minor planar 1mm epidote veins; minor 1-3mm planar calcite veins; no marginal cream siliceous alteration.

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(20) 134.48m-135.58m (1.10m thick)

Massive green-grey tholeiitic metabasalt like (4), but little carbonate alteration (3%); rare 1-2mm random planar carbonate veins.

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(21) 135.58m-137.50m (1.92m thick)

Massive green-grey tholeiitic metabasalt like (4), but variably altered with blocky to irregular patches 1-5cm across cream siliceous, green chloritic and grey carbonate alteration, often with sharp boundaries giving brecciated aspect, some 1cm planar carbonate veins.

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(22) 137.50m-138.16m (0.66m thick)

Brecciated massive green-grey tholeiitic metabasalt, like (4), fragmented by 5-30mm calcite veins, fragments angular to subrounded up to 10cm across adjacent to veins; rocks show compositional banding 0.5-2cm, planar, apparently defined by more or less chlorite and carbonate alteration; 1% pyrite adjacent to veins (pseudo-bedding?).

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(23) 138.16m-146.00m (7.84m thick)

Massive green-grey tholeiitic metabasalt like (4), but with variable and patchy grey carbonate (dominant) and cream siliceous(subordinate) alteration, patches irregular up to 10cm across, sometimes with diffuse boundaries by sometimes sharp giving pseudo-breccia aspect; some 1-2mm carbonate veins; one 5cm epidote-chlorite-calcite planar vein at 144.85m.

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(24) 146.00m-146.11m (0.11m thick)

Massive green-grey tholeiitic metabasalt like (4), but with cream hard siliceous alteration predominating over carbonate alteration, irregular patches up to 10cm; abundant irregular 2mm carbonate veins.

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Core orientation starts 156.70m on TOP of core, extended up-core by black felt pen

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(25) 146.11m-151.85m (5.74m thick)

Massive green-grey tholeiitic metabasalt with variable alteration like (23); some planar to irregular 1-3mm carbonate veins, some 1cm with metabasalt breccia fragments internally to 3cm.

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(26) 151.85m-154.58m (2.73m thick)

Massive green-grey tholeiitic metabasalt like (4), but no carbonate alteration. Instead chloritic alteration in 1mm irregular veinlets giving brecciated aspect. Rare 1-2mm chlorite/carbonate veins.

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(27) 154.58m-156.73m (2.15m thick)

Massive green-grey tholeiitic metabasalt like (4), but very fine grained (<0.2mm), pervasive chlorite alteration, occasional 0.5-1cm chlorite/carbonate, epidote/carbonate veins.

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(28) 156.73m-156.91m (0.18m thick)

Massive green-grey tholeiitic metabasalt like (4), but with moderate cream hard siliceous alteration surrounding parallel planar 3-5mm chlorite/epidote veins giving pseudo bedded aspect.

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(29) 156.91m-161.12m (4.21m thick)

Massive green-grey tholeiitic metabasalt like (4), but pervasive chloritic alteration like (27) with coarser grained (0.3m to 0.5m). Few 1mm planar epidote/chlorite veins, also 2mm chlorite/calcite veins.

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(30) 161.12m-162.18m (1.06m thick)

Massive green-grey tholeiitic metabasalt like (4), but with pervasive chloritic rather than carbonate alteration. Some 1-5cm chlorite/carbonate veins fragmenting adjacent metabasalt.

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(31) 162.18m-162.78m (0.60m thick)

Interlayered diffusely laminated grey chert, coarsely crystalline (5mm) clear vein? Calcite and chlorite-calcite-stipnomelane? (Black platy crystals acicular in cross-section but apparently one perfect tabular cleavage) rock with radiating crystal clusters of phyllosilicate; layering planar 1-10cm with undulose contacts; perhaps interflow sediments or parallel veins with marginal alteration zones.

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(32) 162.78m-164.67m (1.89m thick)

Massive green-grey tholeiitic metabasalt like (4), but with mild (<5%) carbonate alteration, scattered 3-5mm chloritic subspherical amygdales (up to 1%). Some 5cm brecciated zones with irregular 1-5mm chlorite veins surrounding strongly carbonated fragments (1cm).

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(33) 164.67m-166.12m (1.45m thick)

Massive grey tholeiitic metabasalt, slightly silicified (hard) varying in intensity over nebulous patches 10cm across, greyer where more silicified. Grains 0.3mm 40% chlorite, 40% plagioclase, 20% actinolite. Scattered 5mm subspherical amygdales filled by chlorite.

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(34) 166.12m-166.40m (0.28m thick)

Pale grey silicified metabasalt now chert with 3-5% 0.5mm chlorite, 1% 0.3mm pyrite; vaguely layered with diffuse undulose boundaries apparently defined by varying alteration intensity, some 1-3mm subplanar chlorite-calcite veins.

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(35) 166.40m-168.08m (1.68m thick)

Massive clear-white chert with 1-2% 0.5mm chlorite, 1% 0.5mm pyrite, rare black chert layers 1-2cm with 1-2mm internal wavy lamination defined by opaque contents. Very fine grained (<0.1mm) hard, opaques non-magnetic, kerogen? Rock is extremely silicified metabasalt with black sedimentary or vein chert. Some cross-cutting patches 5cm of pale yellow-green calcite and pyrophyllite? (Platy, one perfect cleavage, pale yellow-green, softish) alteration, maybe talc (powder has slightly greasy feel) or white mica or very pale chlorite, perhaps most likely talc!

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(36) 168.08m-169.08m (1.00m thick)

Banded black chert interbedded with massive clear-white chert with cross-cutting pale green/yellow talc-carbonate veins and patches. Black chert has 1cm bands with vague 1mm lamination, very fine grained (<0.1mm), opaques black, slightly magnetic (magnetite?), looks a bit waxy (kerogenous?). Massive white chert in bands 1-10cm, coarser grained (~0.1mm) with 1-5% chlorite crystals and 5mm patches, cross-cut by 1-5cm thick talc-carbonate veins subparallel to bedding (fizzes: calcite), crystals 0.3mm.

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(37) 169.08m-170.91m (1.83m thick)

Interlaminated black, grey, and white chert, layers defined by opaque abundance, 1-10mm planar, with some black laminae highly magnetic (magnetite-rich) but not waxy (kerogen

poor). No sedimentary structures other than layering. 20% subparallel to irregular veins and patches to 10cm across of talc-calcite (pale-green-yellow, soft, greasy, platy crystals with one perfect cleavage). Some 1mm white chert veins irregular, up to 2% pyrite in talc-calcite veins.

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(38) 170.91m-171.52m (0.61m thick)

Interlaminated black, grey, and white chert like (37), but with chlorite rather than talc-carbonate veining. Chlorite mid to dark green, after in radiating crystal aggregates, 1-10cm across, subparallel to bedding, subplanar, no carbonate.

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(39) 171.52m-171.96m (0.44m thick)

Massive dark green metamafic, fine grained (0.3mm) with chloritic alteration, 60% chlorite, 40% plagioclase, rare 1mm planar chlorite-calcite veins.

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(40) 171.96m-172.09m (0.13m thick)

Interbedded black, grey, and white chert with chlorite veins like (38), but veins with 0.5-2cm.

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(41) 172.09m-174.10m (2.01m thick)

Massive dark green metadolerite crystals ~1mm, 40% chlorite, 35% plagioclase, 25% pale green actinolite. Variably chloritized causing some color change, scattered subplanar 1mm calcite veins.

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(42) 174.10m-174.43m (0.33m thick)

Pale grey, variably silicified metadolerite, becoming increasingly cherty and brecciated where most silicified, banded by alteration intensity. Some 5mm irregular epidote veins.

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(43) 174.43m-174.92m (0.49m thick)

Massive dark green chloritized metadolerite, patchy chloritic and siliceous alteration to 90% chlorite, 5% pyrite, 5% chert.

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(44) 174.92m-176.78m (1.86m thick)

Massive dark green metadolerite like (41), but with planar 2mm epidote-calcite veins with marginal pyrite alteration.

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(45) 176.78m-177.08m (0.30m thick)

Interlaminated black, grey, and white chert with talc-calcite veining like (37), black layers strongly magnetic, 0.5mm planar lamination, talc-calcite veins subparallel to bedding, 1-2cm thick.

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(46) 177.08m-178.49m (1.41m thick)

Brecciated massive white chert and laminated grey chert fragments in talc-calcite matrix. Fragments angular, blocky, 1-5cm, white chert has 3% chlorite (silicified metadolerite?). Matrix consists of anastomosing veins to 1cm shown by jigsaw fit of fragments in places.

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(47) 178.49m-179.60m (1.11m thick)

Massive green chloritized metadolerite with patches of white chert breccia. Chlorite alteration pervasive. Close to 100% breccia fragments of silicified metadolerite angular. Blocky to 2cm in chlorite matrix.

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(48) 179.60m-181.59m (1.99m thick)

Massive green chloritized metadolerite with patches of grey silicified breccia like (47), but breccia only partly silicified, not cherty. Chloritic matrix has minor calcite and pyrite, units to 40cm.

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(49) 181.59m-182.70m (1.11m thick)

Breccia of laminated to massive black chert, laminated and massive grey chert in dark grey chert matrix with chloritic veins and patches. Fragments tabular to blocky, angular to 5cm. Chlorite patches to 10cm. Some 2mm planar calcite veins.

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(50) 182.70m-186.78m (4.08m thick)

Massive green-grey metadolerite like (41), but more variable chlorite content from 60% to 25%. Some 1-3cm grey silicified patches, some 1mm chert veins subplanar, rare chlorite-carbonate veins 1-3mm subplanar.

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(51) 186.78m-188.01m (1.23m thick)

Variably chloritized, silicified and talc-altered massive metadolerite? Alteration patches irregular to 10cm giving pseudo-brecciated aspect, 1% pyrite, some 1-3mm calcite veins.

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(52) 188.01m-189.27m (1.26m thick)

Massive green-grey metadolerite like (50), but with chloritic alteration 40-65%. No silicified patches; rare carbonate veins, planar, 1mm.

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(53) 189.27m-189.40m (0.13m thick)

Variable chloritized, silicified and talc-altered metadolerite like (51), but alteration zones subplanar, 1-2cm thick, some 1-2mm calcite veins.

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(54) 189.40m-190.48m (1.08m thick)

Massive green-grey metadolerite like (50). Rare silicified patches irregular, 2cm. Some 1-2mm subplanar chert veins.

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(55) 190.48m-190.66m (0.18m thick)

Variably chloritized and silicified altered metadolerite like (51), but no talc alteration. Zones are subplanar, 1cm thick.

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(56) 190.66m-191.30m (0.64m thick)

Massive green-grey metadolerite like (50). Rare silicified patches angular irregular to 2cm. Very rare 1mm chert veins.

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(57) 191.30m-191.58m (0.28m thick)

Variably chloritized and silicified altered metadolerite like (51), but no talc alteration. Patches irregular 5cm. Some chlorite-chert veins 2mm irregular.

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(58) 191.58m-192.25m (0.67m thick)

Massive green-grey metadolerite like (50). Rare angular blocky silicified patches to 1cm. Some 1-2mm subplanar white chert veins.

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(59) 192.25m-193.30m (1.05m thick)

Interbedding black chert, grey chert, magnetite, and talc?-carbonate. Layers 1-10cm planar. Black chert is massive or plane-laminated 1mm, moderately magnetic, waxy aspect (kerogenous, magnetic). Grey chert is plane-laminated, 1mm, with rare 1mm planar magnetite interlaminae (highly magnetic, metallic, 100% 0.1mm magnetite). Talc-carbonate is soft, very pale green, greasy feel, platy crystals with one perfect cleavage. Has 1-2mm planar magnetite interlaminae. Some cross-cutting 1-2cm irregular talc-carbonate veins. Magnetite layers up to 1cm subplanar with undulose margins, highly magnetic, with 10-90% talc.

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(60) 193.30m-194.10m (0.80m thick)

Irregular and diffusely interlayered black chert, grey chert, magnetite, and talc-carbonate like (59), but no distinct beds, layers 1-20mm thick but laterally variable, lithologies like (50) but patches to 1cm of 100% pyrite crystals 1mm 2% of rock in places, Layers seem brecciated, elsewhere look like soft-sediment folding and loading. Magnetite bands pure, highly magnetic, disrupted by talc veins? 50% chert? 0-1mm xtat.

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(61) 194.10m-196.07m (1.97m thick)

Interbedded black chert, grey chert, magnetite, and cream chert like (59), but talc is clearly secondary (some magnetite layers become talc across 1mm chert vein). Magnetite layers are subplanar with sharply defined but wrinkled margins (loaded or deformed?). 1% 1cm pyrite patches of 1mm crystals.

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(62) 196.07m-198.02m (1.95m thick)

Deformed and brecciated black chert, grey chert, magnetite, and talc like (60), but more irregular, cut by 1-5cm chert-talc veins. 3% pyrite patches and veins up to 2cm. Some chlorite veining and alteration downwards partially replacing talc.

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(63) 198.02m-210.69m (12.67m thick)

massive grey-green metadolerite crystals 1-1.5mm, elongated pale green actinolite in 60% plagioclase matrix. Little chlorite restricted to abundant 1-2mm subplanar chlorite-calcite veins. 1-2% blocky skeletal white leucoxene. Very even crystal size with chilled margin against overlying chert 5cm at maximum. No indication of any flow-top breccia, amygdaloidal zones, or other structures, so probably intrusive. Maybe some marginal shearing in top 5cm (broken core). Occasional 1cm planar chlorite-calcite veins subperpendicular to 1mm chlorite-calcite veins with 1cm blocky angular metadolerite fragments within.

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(64) 210.69m-211.27m (0.58m thick)

fine-grained banded metamafic with coarse interlayers like (63), but chilled margin? Layers 1-10cm, either chlorite-rich fine, silica-rich fine, fine, or coarse grained (fine-

grained: 0.2mm. coarse-grained: 1mm). If chilled margins to separate intrusive event, then chilling from up-hole down, but maybe just alteration horizon.

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(65) 211.27m-211.40m (0.13m thick)

Massive green-grey metadolerite like (63), but more chloritized (40%), with cream silicified patches to 10cm.

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(66) 211.40m-222.83m (11.43m thick)

Massive green-grey metadolerite like (63). Abundant subplanar, subparallel calcite and epidote-calcite veins 1-5mm, medium-grained 1mm. Not chloritized.

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(67) 222.83m-231.40m (8.57m thick)

Massive green-grey metabasalt, grains 0.5-0.8mm. 40% chlorite, 40% actinolite, 20% plagioclase, with <1% scattered subspheroidal amygdales 3-8mm coarsening and increasing in abundance up-hole up-stratigraphy filled with calcite then chlorite. Sparse 1mm short chlorite-calcite veins. Rare 2mm epidote-calcite veins. Chloritic alteration varies in intensity from 60%-30% getting less down-hole.

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(68) 231.40m-240.70m (9.30m thick)

Interlayered black chert, grey chert, white chert, magnetite, chlorite, and mafic rock. Layers 1-10cm, subplanar subparallel with sharp contacts, brecciated in places by cross-cutting mafic rock, white chert and chlorite into blocky to tabular angular fragments up to 5cm across. Black chert is opaque, waxy (kerogenous?), nonmagnetic with 1mm diffuse laminae defined by opaque content. Grey chert is diffusely plane laminated 1mm. White chert is massive to weakly layered defined by chlorite inclusions. Magnetite is massive to weakly laminated planar 1mm, often with marginal chlorite-pyrite alteration. Chlorite is mostly cross-cutting or breccia matrix. Breccia @ 232.85m has chlorite 0.5cm angular blocky clear chert clasts and rhombic or twinned, zoned calcite crystals (soft, rhombic cleavage, fizzed in 1N HCl) up to 5mm in matrix. Mafic rock has 1mm crystal size of chlorite, leucosene, and honey-brown grunerite? Often with marginal 1-2mm pyrite. Down-hole chlorite alteration changes to talc? (soft, pale yellow-green, greasy). Alteration cross-cuts and truncates black chert and magnetite. Forms up to 50% of the rock below 335.10m. Bedding angle shifts from vertical (35° oblique across the hole) to subparallel to hole @ ~236.05m. Somewhat brecciated at transition but not obviously a fault, takes ~1.5m for 90° shift in strike (fold?). Some limonitic alteration of pyrite? Cubes (now maghemite) @ 233.80m. Much of the mafic intrusive rock silicified to cream-green color in the middle of the unit, but green at start and finish.

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(69) 240.70m-241.87m (1.17m thick)

Massive green-grey tholeiitic metabasalt like (67), but amygdales 2% chloritic, no veins, chloritic alteration consistently ~50%, trace pyrite alteration 0.5mm.

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(70) 241.87m-243.71m (1.64m thick)

Interlayered black chert, grey chert, white chert, magnetite, and mafic intrusive rock like (68), but with calcite-pyrite alteration along margins of cross-cutting mafic rock. Mafic rock

0.5mm grain size green to cream, bedding varies from subparallel-to-hole to subhorizontal over 1.5m with gradual change and no evident brecciation therefore FOLD! (oriented).

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(71) 243.71m-245.64m (1.93m thick)

Massive green-grey metadolerite(?) like (63), but maximum crystal size of 1mm. Rare chlorite clots to 5mm possible amygdales, some 1-3mm irregular calcite veins.

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(72) 245.64m-246.04m (0.40m thick)

Interlayered black, grey, and white chert like (68). Brecciated by silicified metadolerite like (71). Chert lacks magnetite and chlorite, has 1mm pyrite alteration along contact with metadolerite, fragments blocky, angular to 10cm, calcite vein 5cm.

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(73) 246.04m-246.72m (0.68m thick)

Massive green-grey metadolerite(?) like (71), but more chloritized to 50%, no chlorite clots. Rare 1mm irregular calcite veins.

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(74) 246.72m-247.90m (1.18m thick)

Interlayered black, grey, and white chert like (68). Brecciated by chloritized metadolerite(?) like (73), up to 3% 5mm pyrite in metadolerite and along chert margins, chert fragments are blocky to irregular, angular to 10cm, no magnetite. White chert often massive, metadolerite veins silicified within chert fragments. Limonite in fractures.

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(75) 247.90m-249.52m (1.62m thick)

Massive green-grey metabasalt like (69), but with scattered massive white chert fragments angular to subrounded 5cm floating in igneous matrix, 1% 5mm chlorite amygdales.

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(76) 249.52m-251.51m (1.99m thick)

Interlayered black, grey, and white chert like (68), intruded and brecciated by chloritized metabasalt(?) like (75), but no obvious amygdales, grain size 0.5mm, chert fragments up to 20cm long.

- - - - -
(77) 251.51m-251.98m (0.47m thick)

Silicified and chloritized metabasalt(?) like (75), but no obvious amygdales, with rare 1cm white chert fragments, angular blocky.

- - - - -
(78) 251.98m-252.28m (0.30m thick)

Interlayered black chert, grey chert, white chert, magnetite, chlorite, and mafic rock like (68). Mafic rock is fine-grained 0.5mm, chloritized in intrusive veins > 10cm, silicified in smaller veins with 3-5% 5-10mm pyrite, bedding mostly subvertical dip E-W strike, but some brecciation by mafic rock and chlorite. Rare 3mm subplanar calcite veins and 1mm pyrite veins.

- - - - -
(79) 252.28m-253.24m (0.96m thick)

Chloritized and silicified metabasalt(?) like (75), but no obvious amygdales. Scattered 1-2cm white chert fragments (angular tabular). Silicified zones adjacent to underlying and overlying chert with 3% 5mm pyrite.

- - - - -
(80) 253.24m-254.43m (1.19m thick)

Interlayered black chert, grey chert, white chert, magnetite, chlorite, and mafic rock like (68). Mafic rock chloritized with magnetite and pyrite brecciating white chert. Bedding mostly E-W, subvertical.

- - - - -
(81) 254.43m-254.89m (0.46m thick)

Chloritized and silicified metabasalt(?) like (75), but no obvious amygdales. Silicified marginal to adjacent cherts, massive.

- - - - -
(82) 254.89m-255.19m (0.30m thick)

Interlayered black chert, grey chert, white chert, and magnetite like (80), but magnetite forms pure 1-5mm laminae and is not mixed with chlorite alteration.

- - - - -
(83) 255.19m-283.80m (28.61m thick)

Massive green-grey chloritized metabasalt. Grains 0.5mm, 50% chlorite, 50% plagioclase, with scattered white chert fragments with chlorite and calcite alteration up to 3cm across. Frequent 1-2mm planar calcite veins. Rare 3mm subspherical chloritic amygdales(?), some linear structures with zoned chloritization and silicification resembling pillow margins, but more likely differential semi-symmetric alteration zones around fractures. Rare calcite veins with 50% 3mm pyrite. Down-hole amygdales increase to 1% filled with chlorite-calcite-pyrite; also less chloritized, 40% chlorite, 30% plagioclase, 30% actinolite after ~262m (gradual change over ~2m), also grain size gradually increases to 0.8mm in same region but no distinct break in style. Some sections ~280m have 2% disseminated pyrite 1mm.

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(84) 283.80m-285.37m (1.57m thick)

Massive grey-green tholeiitic metadolerite(?). Grain size ~1mm, 5% leucoxene, 50% plagioclase, 30% pale green actinolite, 15% chlorite (high Ti), pervasive carbonate alteration, scattered 5-50mm calcite-chlorite-pyrite veins.

- - - - -
(85) 285.37m-290.33m (4.96m thick)

Massive green-grey chloritized metabasalt like (83), but with pervasive pyrite alteration 1% 1mm, scattered 1-10mm calcite-chlorite-pyrite veins subplanar. Rare 3mm subspheroidal chlorite-calcite-pyrite amygdales?

- - - - -
(86) 290.33m-293.94m (3.61m thick)

massive grey-green tholeiitic metadolerite like (84), but no carbonate alteration. 10% chlorite alteration, 1% 0.5mm pyrite, 3% white skeletal leucoxene, with abundant 1-10cm calcite veins with 1cm crystals; gradational into following unit over 10cm, grains 1.5mm.

- - - - -
(87) 293.94m-294.75m (0.81m thick)

Massive green-grey chloritized metabasalt like (83), scattered 3mm subspherical chlorite-pyrite amygdales. 1mm calcite veins. Gradational into next unit over 10cm.

- - - - -
(88) 294.75m-295.13m (0.38m thick)

Massive grey-green tholeiitic metadolerite like (84), but no carbonate alteration. 3% skeletal leucoxene, 1-2cm planar calcite veins.

(89) 295.13m-305.30m (10.17m thick)

Massive green-grey chloritized metabasalt like (83). 1% 3mm subspherical chlorite-pyrite amygdales, irregular 1-5mm calcite veins. Coarsens downwards down-hole into metadolerite after ~299.50m. Amygdales gradually disappear and increases to 2-2.5mm over ~1 meter, then further increases to ~4mm @ 303.75m gradually over 0.5m.

(90) 305.30m-306.12m (0.82m thick)

Massive porphyritic metadolerite, dark green (chloritized) with pale green blocky saussuritized(?) phenocrysts of actinolite-chlorite to 5mm, in felted matrix of 1-1.5mm laths of plagioclase in chlorite. Phenocryst-poor finer-grained chilled margins in either direction.

(91) 306.12m-321.10m (14.98m thick)

Massive green-grey chloritized metadolerite like bottom of (89). 2-3mm crystals of 40% plagioclase, 30% actinolite, 30% chlorite. Trace of pervasive pyrite 0.5mm, some 1-10mm planar calcite veins ± chlorite ± marginal pyrite. Occasionally 5mm pink carbonate crystals often rimmed by chlorite separating them from white calcite – rhodochrosite(?) or Fe-staining? E.g. @ 315.80m.

(92) 321.10m-321.72m (0.62m thick)

Massive grey-green tholeiitic metadolerite like (88), but more chloritic matrix to 25%, 1-2cm planar calcite veins with chlorite ± pink carbonate (rhodochrosite?) centrally.

(93) 321.72m-335.74m (14.02m thick)

Gradational contact to massive green-grey chloritized metadolerite like (91), but with 1-2mm crystals, 1-10mm planar to irregular calcite veins with larger containing central pink rhodochrosite(?). Some silicified patches to 10cm. Rare 3mm calcite-epidote and calcite-chlorite-pyrite veins.

(94) 335.74m-336.01m (0.27m thick)

Massive grey-green tholeiitic metadolerite like (88), but coarser grained to 2mm, 15% chlorite alteration and 3% epidote alteration. No calcite veining.

(95) 336.01m-336.44m (0.43m thick)

Massive green-grey chloritized metadolerite like (91), but with 2mm crystals, some 5mm planar calcite veins, no obvious chilled margin on contact with (94).

(96) 336.44m-336.90m (0.46m thick)

Massive fine-grained metadolerite, 1mm maximum crystal size, chilled margins above and below with <0.5mm crystals. 40% chlorite, 40% plagioclase, 20% actinolite. Some 1-3mm calcite-chlorite veins.

(97) 336.90m-347.90m (11.00m thick)

Massive green-grey chloritized metadolerite like (91), but with 1-2mm crystals. Some 2-10mm calcite veins and 10-20cm calcite-chlorite-epidote irregular veins. 40% plagioclase, 40% actinolite, 20% calcite, trace to 1% 0.5mm pyrite. Grain size coarsens downward down-hole to 2-3mm then starts fining downwards to 1mm @ ~345.50m.

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(98) 347.90m-348.26m (0.36m thick)

Silicified green chloritized metadolerite. Grain size 1mm (chilled margin?), massive, 1-2mm calcite veins subplanar subparallel. Sharp contact with adjacent chert with no obvious intrusive hypophyses but lower 1-2cm contains pure magnetite layers either resorbed into magma or intruded around (seds first then magma).

- - - - -
(99) 348.26m-349.39m (1.13m thick)

Interlayered grey chert, white chert, magnetite, and chlorite. Layers 0.5-5cm planar and parallel though magnetite layers have undulose contacts and may be folded and boudinaged. Grey chert is wavy laminated 1-10mm defined by abundance of chlorite impurities or 0.5mm wavy magnetite interlaminae. White chert is massive. Magnetite is massive, grain size 0.1mm, often with marginal chlorite layers. Chlorite layers usually concordant but some brecciate and truncate layers of magnetite and grey chert. Chlorite may contain 3-5% 1-2mm pyrite cubes. Some subplanar cross-cutting 1-2mm calcite-chlorite-pyrite veins. Thickest magnetite layers have internal 0.5mm planar laminae defined by magnetite concentration(?) or grain size(?).

- - - - -
(100) 349.39m-350.59m (1.20m thick)

Interlayered grey chert, white chert, and magnetite like (99), but no layered chlorite with talc(?) (cream-green, soft needle like crystals 0.2mm, slightly soapy feel). Chlorite veins join 1-2mm layers marginal to magnetite; intrusive.

- - - - -
(101) 350.59m-350.67m (0.08m thick)

Massive green-black chlorite rock, no evident internal lamination or compositional layering, no evident foliation, but possible equates to laminated foliated chloritic metapelite on surface. Marginal pyritic chloritic intrusive(?) rock with 5-10% 1mm pyrite, 70% chlorite compare with 100% chlorite in metapelite?

- - - - -
(102) 350.67m-351.51m (0.84m thick)

Interlayered grey chert, white chert, magnetite, and talc like (100), but with magnetite becoming coarser crystalline down-hole to 0.3mm.

- - - - -
(103) 351.51m-351.73m (0.22m thick)

Interlayered grey chert, white chert, magnetite, and talc like (102) but some magnetite layers have carbonate interlaminae planar parallel 1mm, fizzes strongly in 1N HCl (so largely calcite), Carbonate-bearing units up to 8cm thick with no cross-cutting chlorite or carbonate veins. No interlayered chlorite-carbonate intrusive layers and no marginal chlorite-carbonate-pyrite alteration. Sharp concordant boundaries with surrounding talc-chlorite-pyrite rock. Carbonate-magnetite rock has trace 0.1mm disseminated pyrite.

- - - - -
(104) 351.73m-352.10m (0.37m thick)

Interlayered grey chert, white chert, magnetite, and talc-chlorite like (103), but no carbonate. Magnetite finely crystalline 0.1mm. Rare 5mm cross-cutting talc-chlorite-pyrite veins.

- - - - -
(105) 352.10m-352.56m (0.46m thick)

***12001 (352.63m)**

***12002 (352.42m)**

***12003 (352.28m)**

Interlaminated magnetite and carbonate like similar layers in (103), but single thick bed. Laminae are planar parallel 1-2mm, alternating magnetite-carbonate, no all carbonate is fizzy (some dolomite, ankerite, or siderite?). Magnetite finely crystalline 0.1mm, carbonate is coarser (mostly 0.3-0.5mm), but scattered coarser patches to 2-3mm. Some carbonate laminae have 5% disseminated fine (0.2mm) pyrite. Rare cross-cutting carbonate-chlorite-pyrite veins 2mm but evidently no layer-parallel intrusions. Lower half of bed appears darker with a higher proportion of magnetite laminae; lamination consistently oriented obliquely across core concordant with overlying and underlying oriented chert. Can pretend fit and orientation from immediately underlying oriented core-block.

- - - - -
(106) 352.56m-354.34m (1.78m thick)

Interlayered grey chert, white chert, magnetite, and chlorite like (99), but also black chert. Chlorite rock is not massive, but is finely plane-laminated 0.5mm defined by concentrations of fine grained 0.1mm magnetite and pyrite, no carbonate. Chlorite and magnetite layers have 1-2mm flame and load structures on lower contacts with grey and white chert. Chlorite layers up to 15cm thick with no evident foliation.

- - - - -
(107) 354.34m-358.61m (4.27m thick)

Massive grey silicified tholeiitic metabasalt(?) with scattered (to 2%) 3-5mm subspherical amygdaloids(?) (have diffuse boundaries only 1 phase-chlorite-filling, but concentrated in 10cm zones). Grains 1mm, 50% plagioclase, 49% mafic, 1% leucoxene, variably silicified from cherty to mildly. Scattered 1mm chlorite veins, some 1cm calcite-chlorite veins.

- - - - -
(108) 358.61m-359.71m (1.10m thick)

Interlayered grey chert, white chert, magnetite, and talc-chlorite rock like (104), layers planar parallel 0.5-5cm, some carbonate in talc-chlorite rock, none in magnetite layers. Grey chert color-laminated 1mm. White chert has trace disseminated chlorite. Some 1-5mm cross-cutting calcite veins.

- - - - -
(109) 359.71m-362.44m (2.73m thick)

***12004 (360.62m)**

Interlayered grey chert, chlorite rock, and rare magnetite. Grey chert is plane to wavy laminated 1-2mm defined by opaque abundance, some laminae black. Chlorite rock massive to finely plane laminated 0.5mm defined by color (pale green to dark green). Flame and load structures on lower contact with grey chert to 3mm. <5% magnetite layers either massive or finely plane laminated 1-5mm defined by chlorite content (0-50%). Layering planar parallel 1-10cm, scattered 1-3mm irregular calcite veins, also large (10-15cm) massive white calcite veins clearly cross-cutting sedimentary layering with marginal chlorite-pyrite alteration. Chlorite rock probably metapelite.

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(110) 362.44m-364.46m (2.02m thick)

Interlayered grey chert, magnetite rock, and carbonate. Grey chert and magnetite rock like (109), but magnetite more abundant (30%). Carbonate massive to plane laminated 2-5mm without magnetite interlaminae (pale grey) ~10%, probably varying amounts of calcite and dolomite because different fizzing intensity. Some 1mm cross-cutting calcite veins, also 1-5cm veins of coarsely crystalline (5mm) white calcite.

(111) 364.46m-368.45m (3.99m thick)

Interbedding grey-green silicified metabasalt and blocks of interlayered white chert, grey chert, magnetite, and cream-green talc-chlorite rock like (108). Metabasalt fine grained 0.5mm massive with scattered 5mm amygdaloids(?) subspherical, chloritic, with diffuse margins. Chert blocks usually show consistent internal layering but some folded (90%), magnetite layers have secondary chloritic alteration (marginal). Scarce 1-5mm calcite veins.

(112) 368.45m-370.76m (2.31m thick)

Massive grey fine metabasalt or mafic tuff? Grains 0.1-0.5mm, not obviously crystalline, but equally not obviously granular. No amygdaloids or other volcanic structures, but no bedding, grading, or other sedimentary structures. 1% leucoxene (so tholeiitic), 50% plagioclase, 50% chlorite. Abundant irregular 1-10mm calcite-chlorite veins.

(113) 370.76m-371.52m (0.76m thick)

Interlayered white chert and silicified mafic tuff? Layers planar parallel 1-10cm, white chert mafic to weakly laminated 1-10mm defined by chlorite content. Silicified mafic tuff grey, plane laminated 2-10mm with texture like (112). Lamination defined by slight differences in grain size 0.2mm or 0.4mm, where more silicified becomes cream in color.

(114) 371.52m-374.17m (2.65m thick)

Silicified coarse mafic tuff, cream → green coarsening downwards down-hole from angular blocky fragments 3mm → 10mm. Some have 0.5mm spherical amygdaloids forming 10% of fragment which appear flattened perpendicular to bedding plane. Clast supported nearer top where finer grained but matrix proportion increases downward where coarser. May be matrix supported in places. Matrix is green, fine-grained tuff(?). Grain size 0.2mm like (113), mafic(?) with abundant chlorite-leucoxene. No pronounced bedding structures, some 1mm calcite veins and rare 3cm coarse calcite-chlorite veins.

(115) 374.17m-374.99m (0.82m thick)

Breccia of layered chert and hyaloclastite(?) fragments, clasts are angular blocky to irregular, chert 3-8cm, hyaloclastite 1-5cm, varying from clast supported at the top to matrix supported at base (more chert fragments towards top). Matrix is green fine tuff(?), grain size 0.2mm, mafic with abundant chlorite-leucoxene like (113). Weak bedding in matrix-supported lower section, some flattening of hyaloclastite clasts perpendicular to bedding. Hyaloclastite clasts have amorphous/mottled internal structure of chlorite-carbonate that look non-crystalline like devitrified sideromelane but no obvious internal amygdaloids. Chert fragments are interlayered black, grey, and white chert, layers 1-3cm

planar. Black and grey layers plane laminated 1mm defined by opaque percentage. Bedding defined by chlorite context, wispy.

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(116) 374.99m-378.80m (3.81m thick)

Massive green mottled fine-grained metamafic, no obvious amygdaloids or other volcanic structures. No obvious bedding, clasts, or other sedimentary structures. No obviously coarsely crystalline fabrics, so perhaps chilled metadolerite or massive mafic tuff. Mottles defined by variations in chlorite vs. plagioclase content. Minor carbonate alteration 1-5%, grain size 0.2-0.5mm. Vague crystalline fabric but may be metamorphic rather than relict igneous, scattered 1-10mm calcite and calcite-chlorite veins planar.

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EOH camera survey 378.80m, 51° N dip, azimuth 022°.

AIDP-2 (Ripon Hills Replicate)

Dips and strikes in Carawine Dolomite along track to drill pad, Yilgalong Creek 105° 12°N, 095° 10°N, 110° 15°N, 105° 14°N, 090° 13°N, 095° 12°N, 110° 12°N = **101.4° 12.5°N**

Hole orientation 191° azimuth, 77° plunge. 0275384, 7645330.

Hammer pre-collar to 1k m, water at ~ 25m, chips to 114m of cream chert, in dark grey mud – manganiferous Pinjian Chert Breccia?

- - - - -
(1) 113.90m-115.71m (1.81m thick)

Wavy to irregularly laminated pink and grey dolomite (moderate fizz with 1N HCl, laminated 1-2mm with flexures from 3mm to 5cm scale defined by color difference, grain size 0.5mm but original grains ~0.2mm, apparently fine dolarenite, scattered red-brown 1mm planar Feox veins, some 5mm laminae with original angular carbonate clasts blocky up to 2mm (coarse dolarenite).

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(2) 115.71m-116.32m (0.61m thick)

Wavy to wrinkly laminated grey-black fine dolarenite – dolosiltite, with abundant 1mm wavy bedding-subparallel stylolites bearing metallic soft non-platy pyrobitumen, black shiny; alternating silty arenitic layers 1-5mm thick, laterally variable over 10cm; pyrobitumen-bearing stylolites may amastomose around clear coarse dolomite lenses forming 5mm pyrobitumen clots; trace 0.1mm disseminated pyrite, some pink Mn alteration near fractures; rare quartz arenite laminae to 5mm with 2mm clear subspherical subangular grains in fine dolomite cement.

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(3) 116.32m-117.10m (0.78m thick)

Wavy to irregularly laminated pink grey dolarenite like (1), but fewer pink-red Fe/MnO_x veins, mottled in color, some weathered stylolites, scattered irregular coarse quartz arenite lenses to 5cm with siliceous(?) cement.

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(4) 117.10m-117.67m (0.57m thick)

Interlayered pink fine dolarenite and grey coarse quartz arenite, layers 1-2cm irregular lenticular to amorphous with sharp boundaries often showing stronger red oxidation.

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(5) 117.67m-122.82m (5.15m thick)

Weakly wavy laminated pale pink fine-medium dolarenite like (3), but pervasive pink weathering, abundant 1mm pink-red Fe/MnO_x veins, some with 5mm pink sparry dolomite crystals, laminar 1-5mm indistinct boundaries defined by original grain size(?) becomes pinker and more mottled downward as vein abundance increases.

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(6) 122.82m-123.92m (1.10m thick)

Wavy laminated grey medium dolarenite with pyrobitumen stylolites like (2), but all arenite not siltite, scarcer stylolites irregular not bedding parallel, pyrobitumen 1-2mm thick.

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(7) 123.92m-125.99m (2.07m thick)

Massive dark grey coarse dolarenite with very abundant pyrobitumen stylolites and pyrobitumen blebs and vughs, stylolites irregular to bedding parallel with pyrobitumen 1-5mm, pyrobitumen blebs and vughs subspheroidal to ellipsoidal 1-5mm, dolarenite grains 0.5-1mm in dolomite cement, pyrobitumen makes up to 10% of rocks.

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(8) 125.99m-131.71m (5.72m thick)

Stylolaminated pyrobituminous dark grey medium to coarse dolarenite, stylolamination 1-20mm defined by anastomosing to coalescing pyrobituminous bedding-parallel stylolites, wavy to planar, each 0.5-1mm thick, separating massive layers of dolarenite with grains 0.3-1mm, pyrobitumen black waxy soft metallic up to 15mm thick and internally massive, also some planar cross-cutting pyrobitumen veins to 1mm; dolarenite grains 0.4-1mm mid-grey, nebulous, apparently subspherical subangular, in clear dolomite cement. Vague tabular cross-lamination in places (may be stylolite bounded and thus false), laminae 2-5mm, mostly planar. Rare 2mm pyrite laminae with 0.1mm pyrite grains 50% in coalesced stylolites, scarce pyrite lenses in dolarenite to 5mm long.

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(9) 131.71m-132.76m (1.05m thick)

Plane-laminated grey fine dolarenite, laminae 1-2mm separated by black organic partings (may be stylolites), grains 0.1-0.2mm in clear dolomite cement. Pyrobituminous stylolites parallel to bedding 1mm.

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(10) 132.76m-133.46m (0.70m thick)

Massive to mottled coarse dolarenite pale irregular patches of coarse dolarenite to 3cm surrounded by irregular linear areas of dark medium-fine dolarenite. Abundant irregular 1mm veins with white sparry dolomite, some irregular to planar pyrobituminous stylolites to 2mm occasionally also pyrite, also cross-cutting.

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(11) 133.46m-133.55m (0.09m thick)

Massive black shungite (solid pyrobituminous) bounded above and below by subplanar stylolites, has vague internal lenticular structure implying coalesced stylolites by not

obvious (no lenticular inclusions etc.), soft, shiny, metallic luster on non-ground surfaces, dull black where ground, fractures parallel to bedding.

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(12) 133.55m-135.21m (1.66m thick)

Mottled to brecciated coarse dolarenite like (10), but clear breccia fabric in places, fragments angular 1-3cm bounded by stylocumulate(?) of dark grey fine dolarenite to 5mm thick. Abundant irregular stylolites some with 1mm pyrobitumen fill, some 1mm irregular veins with sparry dolomite fill.

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(13) 135.21m-137.94m (2.73m thick)

Massive stylobreccia of 1-5cm irregular subangular fragments of pale coarse dolarenite surrounded by 1-5mm thick stylocumulate(?) of fine dolarenite and sometimes pyritic pyrobitumen, swirly with nebulous boundaries. Fragments not fitted and not cemented so not dialational tectonic, not rounded out floating in matrix so not sedimentary, thus evidently stylobreccia, fragments in places fitted together along stylolites.

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(14) 137.94m-140.93m (2.99m thick)

Pale grey wavy-laminated medium to fine dolarenite, may be stylolaminate, laminae 1-5mm thick, grains 0.1-0.5mm, laminae defined by grain size, abundant irregular to bedding-parallel stylolites with 0.5mm pyrobitumen in places brecciating rock into 1cm irregular fragments. Finer laminae are darker and more organic(?).

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(15) 140.93m-141.49m (0.56m thick)

Dark grey-black wrinkly laminated kerogenous dolosiltite and fine dolarenite, laminae 1-5cm defined by organic content, become more planar downhole, not obviously stylolitic but some 1cm pyrobitumen layers (look like stylocumulate), 1% disseminated 0.1mm pyrite especially where more organic-rich. Evidently mostly kerogenous because no metallic luster on bedding planes, paler laminae contain coarse dolarenite to 1.5mm grain-size, angular subspheroidal grains, some laminae highly kerogenous >10% TOC(?) composed of dololutite/dolosiltite 1-10mm thick and up to 70% of rock but overall >50% organic poor.

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(16) 141.49m-142.06m (0.57m thick)

Plane-laminated kerogenous dololutite/dolosiltite, laminae 1-20mm, defined by organic content and grain-size, pale interlaminae of fine dolarenite, kerogenous laminae with 1% 0.1mm disseminated pyrite, >10% TOC, form ~80% of rock, not obviously stylolaminated but some bedding parallel pyrobituminous stylolites to 4mm thick.

- - - - -
(17) 142.06m-143.45m (0.99m thick)

Dark grey interlaminated kerogenous dolosiltite and pale grey fine dolarenite like (15). Dolarenite 80% of rock, laminae wrinkly (microbialite(?) or stylolite(?) – apparently primary bedding) 1-10mm, some 1-3mm bedding-parallel pyrobitumen veins (stylolites?).

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(18) 143.05m-143.50m (0.45m thick)

Plane-laminated kerogenous dololutite/dolosiltite like (16). High TOC layers up to 10cm, form 80% of rock, with planar fine dolarenite lenses and interlaminae 0.5mm with 1-2%

0.1mm pyrite, some 1-3mm bedding-parallel pyrobitumen veins with undulose surfaces (stylolites?).

- - - - -
(19) 143.50m-145.37m (1.87m thick)

Interlaminated pale grey fine dolarenite and black kerogenous dolosiltite like (15). Dolarenite 90% of rock, some laminae medium dolarenite grains 0.5mm. 1% 0.1mm disseminated pyrite in both laminae types, some bedding-parallel pyrobituminous stylolites 1-3mm.

- - - - -
(20) 145.37m-145.78m (0.41m thick)

Plane-laminated kerogenous dolosiltite/dololutite with interlayered pale grey fine dolarenite like (16). High TOC >10% layers form 80% of rock, some loading/flame structures to 3mm on interfaces between coarse and fine grained laminae.

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(21) 145.78m-146.79m (1.01m thick)

Interlayered fine dolarenite and black kerogenous dolosiltite like (15), some organic-rich layers to 7cm but most laminae 1-3mm planar, some coarse dolarenite lenses to 3x10mm, some pyrobituminous stylolites to 5mm.

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(22) 146.79m-148.18m (1.39m thick)

massive to wrinkly laminated coarse pale grey dolarenite, laminae 1-5cm, grains subspherical subangular 1-1.5mm dark grey, many with 0.1mm pyrite rims, grain supported in white sparry dolomite cement, some 1-5mm interlayers of kerogenous dolosiltite and 1-3mm pyrobituminous stylolites. Some cross-cutting 1mm pyrobitumen-pyrite veins.

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(23) 148.18m-148.68m (0.50m thick)

Vaguely wavy-laminated fine to medium mid-grey dolarenite with 1mm wavy-wrinkly parting of kerogenous dolosiltite. Some 1mm bedding-parallel pyrobituminous stylolites.

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(24) 148.68m-149.68m (1.00m thick)

Plane-laminated black kerogenous dolosiltite/dololutite with interlayered mid-grey fine dolarenite like (16). High TOC layers form 80% of rock. 1% 0.1mm disseminated pyrite. Some load(?) folding. Coarse layers have cross-laminated?

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(25) 149.68m-150.58m (0.90m thick)

Massive to weakly wrinkly laminated pale grey coarse dolarenite like (22), but grains 0.7-1.2mm, lack pyrite rims, pyrobituminous stylolites irregular.

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(26) 150.58m-155.50m (4.92m thick)

Interlayered pale grey coarse dolarenite like (25) and mid-grey fine dolarenite layers 1-20mm thick, fine layers laminated 1-3mm undulose (rippled?), with cross-laminae(?), some cross-cutting 1mm pyrobitumen-pyrite veins, rare wrinkly pyrobituminous stylolites 0.5mm bedding parallel, coarse layers dominate at top (75%) but coarse and fine equal (50%) lower, possibly cross-laminated sets 1-2cm thick with ripple(?) undulations 5mm amplitude, but fine laminae may also be wavy microbialite.

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(27) 155.50m-155.84m (0.34m thick)

Mottled to irregularly laminated pale grey coarse dolarenite and mid-grey medium dolarenite, boundaries fairly diffuse, patches 2-15mm thick, some lenticular others dominoid, some wrinkly pyrobituminous stylolites 1mm bounding domains.

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(28) 155.84m-158.39m (2.55m thick)

Interlayered pale grey coarse dolarenite and mid-grey fine dolarenite like (26). Fine layers wavy to wrinkly, some low domical structures to 1cm high (microbialite?), ripples and cross-laminae not obvious except in some fine grained sections, coarse dolarenite layers 5-10mm, fine dolarenite laminae 0.5-2mm. Rock is 50% coarse and fine. Rare undulose 0.5mm pyrobituminous stylolites bedding parallel, rock coarsely crystalline 1mm.

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(29) 158.39m-160.79m (2.40m thick)

Massive to weakly lenticular laminated pale grey coarse dolarenite with lenses and wavy laminae of mid-grey medium dolarenite, 95% coarse, lenticular layers 1-5mm thick. Coarse grains subrounded subspherical 1-1.5mm; medium grains 0.5-0.7mm. Coarsely crystalline 1mm.

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(30) 160.79m-161.98m (1.19m thick)

Interlayered dark grey kerogenous dolosiltite and mid-grey fine dolarenite. Laminae 1-10mm, wavy, some 1mm pyrobituminous stylolites undulose bedding parallel, kerogenous layers 50%, some lenticular coarser laminae in finer matrix.

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(31) 161.98m-163.77m (1.79m thick)

Interlayered pale grey coarse dolarenite and mid-grey fine dolarenite like (26), but some deformed sections (soft-sed deformation? Very irregular).

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(32) 163.77m-165.37m (1.60m thick)

Massive to weakly lenticularly laminated pale grey coarse dolarenite with mid-grey medium dolarenite like (29).

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(33) 165.37m-165.83m (0.46m thick)

Interlayered dark grey kerogenous dolosiltite and mid-grey fine dolarenite like (30), but kerogenous layers 20%.

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(34) 165.83m-170.32m (4.49m thick)

Plane-laminated black kerogenous dolosiltite with interlayered mid-grey fine dolarenite like (24), but kerogenous layers form 60% of rock, flame structures up to 5mm, some layers with 1cm pyrite nodules comprising 50%.

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(35) 170.32m-173.94m (3.62m thick)

Interlayered pale grey coarse dolarenite and mid-grey fine dolarenite, laminae 1-5mm, often deformed and brecciated by 0.5mm stylolites with saw-tooth aspect, laminite grades into breccia, perhaps some soft-sediment brecciation but definitely not syn-sedimentary.

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(36) 173.94m-175.29m (1.35m thick)

Interlayered pale grey coarse-medium dolarenite and dark grey fine dolarenite, layers 1-10mm, planar, some bedding-parallel 0.5mm stylolites.

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(37) 175.29m-175.61m (0.32m thick)

Irregularly laminated (stromatolitic?) coarse and fine dolarenite, laminae 1-3mm with laterally-linked domical flexures up to 3cm high, moderately good inheritance, much lamination diffuse and indistinct. Some wavy 1mm pyrobituminous stylolites.

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(38) 175.61m-176.55m (0.96m thick)

Plane-laminated black kerogenous dolosiltite with interlayered mid-grey fine dolarenite like (24), but kerogenous layers only 40%, some wrinkly laminated microbialite layers to 10cm. Rare 5mm pyritic layers of coalesced nodules.

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(39) 176.55m-179.99m (3.44m thick)

Plane-laminated black kerogenous dolosiltite and dark grey kerogenous fine dolarenite, laminae 1mm, with abundant 1cm horizon of 5mm rounded pyrite nodules associated with most kerogenous dolosiltites, some cross-cutting and bedding-parallel pyrobituminous stylolites, undulose 1mm.

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(40) 179.99m-181.43m (1.44m thick)

Massive breccia of black kerogenous dolosiltite, dark grey mildly kerogenous fine dolarenite, and pyrite nodules, in white sparry dolomite cement, fragments blocky to subspherical, angular to rounded 0.5-5cm, some vaguely plane laminated sections of similar material interlayered. Brecciation looks like soft-sediment deformation, some irregular 1mm pyrobituminous stylolites. No non-intraclastic fragments so obviously a syn-sedimentary breccia.

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(41) 181.43m-184.29m (2.86m thick)

Plane-laminated pale grey coarse dolarenite and mid-grey medium dolarenite, laminae 1-5mm, brecciated in places into tabular fragments in clear sparry dolomite cement. Scattered 1mm saw-tooth stylolites bedding parallel.

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(42) 184.29m-193.92m (9.63m thick)

Weakly lenticularly laminated pale grey coarse dolarenite like (29). Laminae 1-2cm, separated by diffuse 5-10mm layers of mid-grey medium dolarenite. Some irregular cross-cutting white sparry dolomite veins 1-5mm, rarely with 5mm open vughs. Some loading (5mm relief) on coarse-medium grained contacts. Rare 0.5mm irregular stylolites, rare brecciation by veins and stylolites with fragments blocky angular 1-2cm, grains in coarse dolarenite subspherical subrounded 1mm, in medium subspherical subrounded 0.5-0.7mm, in clear dolomite cement.

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(43) 193.92m-194.27m (0.35m thick)

Interlayered mid-grey medium dolarenite and dark grey kerogenous fine dolarenite. Laminae 1-2mm planar to wavy. Fine dolarenite has 1-5mm pyrite nodules spherical to laminoid up to 30% of rock, some irregular lamination (soft-sediment deformation?).

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(44) 194.27m-198.14m (3.87m thick)

Interlayered mid-grey medium dolarenite, dark-grey fine dolarenite and black kerogenous dolosiltite like (43), but with 0.5-10cm massive layers of kerogenous dolosiltite. Pyrite nodules along contacts with kerogenous layers and within dolosiltite. Fine dolarenite with 1mm planar to wavy lamination (cross-lamination, starved ripples?). Some 0.5mm bedding-parallel wrinkly stylolites with internal kerogen. Siltite ~30%, fine grained ~40%, medium grained ~30% of rock. Rare 1mm cross-cutting white sparry dolomite veins.

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(45) 198.14m-199.21m (1.07m thick)

Massive to plane-laminated black kerogenous dolosiltite to mudstone, laminae 0.5-1mm, mudstone more kerogenous. 0.5mm pyrite lenses and laminae abundant containing 0.1mm crystals. Kerogenous mudstone has scattered 1-5mm pyrite nodules spherical to ellipsoid.

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(46) 199.21m-199.77m (0.56m thick)

Interlayered mid-grey medium dolarenite, dark-grey fine dolarenite and black kerogenous dolosiltite, and mudstone like (44), but with 2-10cm layers of pyritic kerogenous mudstone with 5% pyrite nodules to 5mm. Pyrite nodules 1-15mm also along contacts of kerogenous lutites and in some fine arenites up to 20% of rock.

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(47) 199.77m-200.08m (0.31m thick)

Massive to weakly wrinkly laminated pale grey coarse dolarenite like (29), but wrinkly laminae 1-5 mm defined by finer grained partings (stylolites(?), microbialites(?)) 0.5mm thick, kerogenous.

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(48) 200.08m-201.00m (0.92m thick)

Interlayered medium dolarenite, fine dolarenite and kerogenous dolosiltite, and mudstone like (46). Kerogenous mudstone massive to weakly plane-laminated 0.5mm up to 15cm thick with 3% pyrite laminoid nodules. Wavy lamination in medium dolarenite (microbialite?). Some wavy bedding-parallel stylolites.

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(49) 201.00m-201.32m (0.32m thick)

Weakly wrinkly laminated coarse dolarenite like (47), but laminae 1-5mm defined by 0.5mm kerogenous fine dolarenite/dolosiltite. Wrinkly partings (microbialite?) and wavy pyrobitumen partings (stylolites). Scattered 1-3mm pyrite nodules.

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(50) 201.32m-201.71m (0.39m thick)

Interlayered medium/fine dolarenite and black kerogenous dolosiltite/mudstone like (48), but mudstone layers 3cm with 30% pyrite nodules, 10% of rock; kerogenous dolosiltite 20%; fine dolarenite 10%; medium dolarenite 60%; with some microbial wavy lamination.

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(51) 201.71m-202.16m (0.45m thick)

Cross-bedded(?) pale grey coarse dolarenite. Angle of lamination changes by 30° through bed, lamination 1-10mm normally graded from coarse to medium.

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(52) 202.16m-204.42m (2.26m thick)

Interlayered medium/fine dolarenite, kerogenous dolosiltite/mudstone like (48), but mudstone layers 5cm with 10% pyrite nodules. Some tabular breccia in dolarenite layers with clear sparry dolomite cement (dewatering?), also vertical dewatering veins with similar cement.

(53) 204.42m-205.25m (0.83m thick)

Massive to plane-laminated kerogenous dolosiltite and mudstone with scattered 1-5mm plane laminae of fine dolarenite. 95% kerogenous dolosiltite with 1-15% 1-5mm pyrite nodules laminoid to subspherical, 5% kerogenous mudstone to 1cm thick.

(54) 205.25m-205.90m (0.65m thick)

Plane-laminated dark grey kerogenous fine dolarenite, laminae 0.5-5mm, sparse 0.5 pyritic laminae with 50% 0.1mm crystals. Lamination defined by kerogen content. Some irregular 1-2mm white sparry dolomite veins.

(55) 205.90m-206.24m (0.34m thick)

Interlaminated medium/fine dolarenite and black kerogenous dolosiltite/mudstone like (48) but layers 0.5-5cm, fine dolarenite with 30% 0.5-1cm spherical pyrite nodules. Layers often wrinkly with stylolitic contacts.

(56) 206.24m-207.24m (1.00m thick)

Massive breccia with blocky, tabular, or irregular subangular to subrounded fragments of pyritic fine dolarenite or pure pyrite in white sparry dolomite cement. Fragments 0.5-10cm often with stylolitic boundaries. Some wrinkly bedding-parallel pyrobituminous stylolites 1mm thick, some fragments with internal have close to jig-saw fit. Not obviously sedimentary breccia (all fragments intraclastic). Not obviously impact (not polymictic, not matrix supported). More likely diagenetic breccia (dewatering?)

(57) 207.24m-207.62m (0.38m thick)

Massive, plane-laminated, and vaguely brecciated pale grey coarse dolarenite with 1-1.5mm subspherical subrounded grains in sparry dolomite cement. Lamination 1-5mm. Brecciation look soft-sediment with fitted fragments. Some wavy pyrobituminous stylolites 1mm.

(58) 207.62m-229.23m (21.61m thick)

Massie polymictic breccia coarsening downwards. Fragments blocky to tabular, angular to subrounded, 0.5-10cm, some larger ones with stylolitic boundaries but most distinct, in coarse or medium dolarenite matrix. Fragments mostly coarse or medium dolarenite but some pyritic fine dolarenite. Rare pink-grey chert and white sparry dolomite. Largest tabular fragments show 1-5mm internal lamination. Abundant saw-tooth bedding-parallel stylolites, some bounding 10cm irregular black kerogenous mudstone domains (fragments?). In some parts no matrix but coarse 1-2mm white sparry pink-grey chert fragments have pink interior and grey margins.

(59) 229.23m-229.71m (0.48m thick)

swirly laminated medium and fine dolarenite, laminae 1-3mm, laterally varying thickness by 50%, soft-sediment convolution(?), bounded by irregular stylolites so not clear if a fragment.

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(60) 229.71m-230.40m (0.69m thick)

Irregularly mottled medium and fine dolarenite like (59), except more disrupted. Mottles irregular 5-10mm, bounded by stylolites so not clear if a fragment.

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(61) 230.40m-230.70m (0.30m thick)

Irregularly mottled medium and fine dolarenite like (60), but fine dolarenite is 50% pyritized, stylolite-bounded pyritic kerogenous black mudstone domains 5cm at either end, so not clear if a fragment.

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(62) 230.70m-232.53m (1.83m thick)

Interlayered plane-laminated medium dolarenite and polymictic breccia like (58). Laminated dolarenite domains up to 20cm, bounded by stylolites so not clear if fragments. Breccia has domains with all fragments showing cream calcitic(?) alteration (more fizzing than dolomite). Also some fragments pyritized. Some laminated dolarenite domains have finer laminae pyritized.

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(63) 232.53m-237.79m (5.26m thick)

Polymictic massive breccia like (58), but no chert fragments, with 10-15cm stylolite-bounded mottled medium-fine dolarenite domains, some with pyritic fine-grained patches. Abundant fragment-bounding pyrobituminous pyritic stylolites

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(64) 237.79m-238.22m (0.43m thick)

Massive to weakly plane-laminated coarse dolarenite, laminae 1-5mm defined by grain size, 5% of grains pyritized, some with 0.1mm pyrite rims, boundaries apparently sedimentary with surrounding breccia.

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(65) 238.22m-239.15m (0.93m thick)

Massive polymictic breccia like (58), but with dark grey matrix of kerogenous fine dolarenite/dolosiltite, fragments angular, blocky to tabular, medium and fine dolarenite, some 60% pyrite, no chert. In places matrix supported towards the base, bottom contact is sharp, irregular, apparently a pyritic pyrobituminous bedding-parallel stylolite 1-2mm thick.

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(66) 239.15m-239.45m (0.30m thick)

Massive white coarse dolarenite, grains 1-1.5mm, with black hair-line fractures in reticulate pattern. Some blocky vughs 1cm filled with dark sparry dolomite 2mm, with irregular lower contact with matrix-supported breccia like (65) in 3-15cm vein, boundaries sharp but evidently not stylolitic (no pyrobitumen).

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(67) 239.45m-239.79m (0.34m thick)

Massive mottled coarse and medium dolarenite like (60), upper and lower boundaries sharp and irregular against cross-cutting breccia veins like (65). Lower breccia has pyritic fragments to 2cm in vein 2-10mm.

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(68) 239.79m-240.19m (0.40m thick)

Massive mid-grey medium dolarenite with brecciated zones. Fragments 1-3cm blocky, nearly in situ, sometimes pyritized in kerogenous fine dolarenite/dolosiltite matrix.

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(69) 240.19m-240.84m (0.65m thick)

Plane to wavy laminated medium dolarenite, laminae 1-3mm, often finer grained one pyritic with 50% 0.1mm crystals.

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(70) 240.84m-241.53m (0.69m thick)

Interlayered coarse, medium, and fine dolarenite, wavy laminated 1mm. Units 1-20cm thick, medium and fine dolarenite often pyritic with laminae and nodules 1-5mm. Some convolute laminae in coarse dolarenite and soft-sediment brecciation.

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(71) 241.53m-245.12m (3.59m thick)

Massive, plane-laminated, and convolute laminated coarse and medium dolarenite. Laminae defined by grain-size 1-10mm. Convolute layers sometimes show soft-sediment brecciation. Occasional saw-tooth bedding-parallel stylolites with pyrite nodules. Some 1cm sparry veins.

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(72) 245.12m-245.89m (0.77m thick)

Interlayered medium dolarenite, fine dolarenite, and kerogenous dolosiltite. Layers 1-10cm planar. Fine dolarenite frequently with 5-15mm pyrite nodules. Laminae 60% medium, 30% fine, 10% dolosiltite.

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(73) 245.89m-246.27m (0.38m thick)

Interlayered fine dolarenite and kerogenous black dolosiltite. 65% dolosiltite, 35% fine dolarenite. Both with 1-5mm pyrite nodules. Some loading on contacts 5mm.

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(74) 246.27m-248.42m (2.15m thick)

Interlayered wavy laminated fine dolarenite and black kerogenous dolosiltite. Units 1-10cm thick, often with pyrite laminae and nodules along contacts. 90% fine dolarenite, 10% dolosiltite.

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(75) 248.42m-253.31m (4.89m thick)

Massive, weakly plane-laminated and brecciated medium dolarenite. Grains subrounded subspheroidal 0.5-0.7mm with laminae 1-5mm defined by slightly coarser or finer grain size, scattered pyritic laminae towards top, brecciated by coarse sparry white dolomite veins. Some 1mm pyrobituminous bedding-parallel stylolites.

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(76) 253.31m-253.77m (0.46m thick)

Interbedded black kerogenous dolosiltite and inversely graded (silt-fine-medium-coarse) dolarenite. Pyrite laminae along coarse/silt contact, disseminated 0.1mm pyrite in kerogenous dolosiltite.

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(77) 253.77m-255.17m (1.40m thick)

Massive to weakly plane-laminated black kerogenous dolosiltite and mudstone. Scattered 0.5mm pyritic laminae and nodules, otherwise pyrite poor. Mudstone soft clayey.

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(78) 255.17m-256.37m (1.20m thick)

Interlayered wavy laminated medium and fine dolarenite and black kerogenous dolosiltite like (74), but medium dolarenite forms 20%, fine 50%, dolosiltite 30%. Some wrinkly laminae 1mm in fine dolarenite (microbialite?). Pyritic laminae and nodules along kerogenous contacts and in some fine dolarenite layers.

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(79) 256.37m-259.65m (3.28m thick)

Interbedded black kerogenous dolosiltite, and medium and fine dolarenite. Units 5-30cm, dolosiltite 80%, fine 10%, medium 10%. Dolosiltite has 20% silt grains in kerogenous mud matrix. 1% 0.1mm disseminated pyrite and abundant 0.5-1mm pyrite laminae and nodules. Dolarenites have wavy to wrinkly laminae 1-2mm (microbialite?). Minor soft-sediment breccia.

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(80) 259.65m-263.27m (3.62m thick)

Interlayered wavy laminated fine dolarenite and dark grey kerogenous dolosiltite. Units 1-15cm thick, 60% fine dolarenite, 40% dolosiltite. Flame and load structures 1-5mm on contacts. Dolosiltite has 1% 0.1mm disseminated pyrite. Rare 1mm pyrite laminae and laminated nodules.

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(81) 263.27m-273.71m (10.44m thick)

Massive and convolute bedded mid-grey medium dolarenite, convolutions where slightly coarser and finer layers disturbed by 2mm irregular dewatering veins with white sparry dolomite. Abundant 1mm wavy pyrobituminous stylolites (bedding-parallel), some coalesced into 3-5mm pseudobeds. Rare crosscutting 1-2mm sparry dolomite veins.

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(82) 273.71m-275.36m (1.65m thick)

Interlayered dark-grey fine dolarenite and black kerogenous dolosiltite, 80% fine arenite, 20% siltite, in units 1-10cm thick. Fine dolarenite grains 0.2-0.4mm subspherical subrounded in dark cement or matrix, wavy laminae 1mm defined by grain size. Dolosiltite has 25% <0.1mm grains in black kerogenous matrix, 1% 0.1mm disseminated pyrite, rare 5mm pyrite nodules. Some 1cm ovoid sparry white dolomite nodules in arenite. Black dolosiltite wraps around some arenite fragments 1-3cm rounded. Load structures on unit contacts to 2cm, so probably soft-sediment deformation.

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(83) 275.36m-278.79m (3.43m thick)

Wrinkly laminated medium dolarenite. Laminae 1-5mm defined by 0.5mm wrinkly carbonaceous partings (Microbialites? Stylolites?).

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(84) 278.79m-280.93m (2.14m thick) Roy Hill Start? Carbonate mineralogy change.

Plane laminated pale-grey fine calcarenite with black kerogenous dolosiltite partings 1mm and interbeds 1-3cm, also wrinkly to planar 0.5mm pyrobitumen partings (stylolites?). Some stylobrecciation adjacent to coalesced 5mm pyrobitumen stylolites. Kerogenous partings closely spaced, fracturing core into 1-2cm distes.

(85) 280.93m-287.72m (6.79m thick)

Interlayered pale-grey fine calcarenite (calcite – very fizzy in 1N HCl) and black kerogenous marly calcisiltite and mudstone (no silt, no carbonate). 80% calcarenite, 20% lutite. Calcarenite occasionally medium-grained 0.5mm, with undulose (ripple cross-laminae?) laminae 1mm. Kerogenous lutite has some large 1cm pyrite nodules associated with 0.5-1mm silty laminae but no disseminated fine pyrite. Calcarenite lenses to 1cm isolated within lutite (starved ripples rounded by soft-sediment deformation?). No dolomite anywhere apparent, scattered cross-cutting 0.5mm calcite veins. Some true ripple-cross-lamination preserved with sets 1cm, laminae 1-2mm. Also soft-sediment load structures to 1cm on contacts between arenite over lutite.

(86) 287.72m-291.72m (4.00m thick)

Interlayered black kerogenous marly calcisiltite, mudstone, and mid-grey medium calcarenite. 60% lutite, 40% arenite. Mudstones have <5% silt, >1% 0.1mm disseminated pyrite. Abundant 1-3cm thick pyrite nodules, lenses, and laminae. Mudstone predominates over marly calcisiltite in lutite fraction by 3:1. Calcarenites have some undulose to saw-tooth clayey and pyrobituminous bedding-parallel stylolites (clays cream, soft, flakey, not reactive in acid) 1-3mm. Some 1-5mm load structures on arenite-lutite contacts. Some isolated arenite nodules to 1cm in lutite. Rare cream/green non-kerogenous marl, massive, fizzy. Some calcarenite units have ripple cross-lamination sets 2cm, laminae 1-3mm.

(87) 291.72m-295.60m (3.88m thick)

Interlayered pale-grey fine calcarenite and black kerogenous mudstone like (84), but no marly siltite. Mudstones lack fine disseminated pyrite but have rare 1cm pyrite nodules and lenses. Some cream/green non-kerogenous marl layers to 1cm. Rare breccia beds in calcarenite with angular blocky fragments 0.5-2cm. Abundant wavy pyrobituminous stylolites 0.5mm.

(88) 295.60m-296.26m (0.66m thick)

Convolute-bedded mottled and massive medium calcarenite. Laminae wavy 1-3mm defined by grain size. Grains 0.3-0.8mm. Mottling and convolution by white sparry calcite veins 1-5mm laminoid and cross-cutting (dewatering?). Some 0.5mm wavy pyrobituminous stylolites bedding-parallel.

(89) 296.26m-298.95m (2.69m thick)

Interlayered pale-grey fine calcarenite and black kerogenous mudstone like (87), but mudstones lack pyrite nodules and lenses, have <1% 0.1 disseminated pyrite, <5% calcite silt. Calcarenite has 0.1mm planar kerogenous partings (shiny, perhaps pyrobitumen), also wrinkly 0.1mm kerogenous stylolites.

(90) 298.95m-315.93m (16.98m thick)

302.70m: HQ → NQ 309.90m: Orientation starts

313.77m: Jumbled cores to 315.60m

318.90m: Camera shot for orientation → 80°S 206°

Massive to weakly plane-laminated black kerogenous mudstone, 1% 0.1mm disseminated pyrite, but very few cm-sized pyrite nodules and lenses. <5% calcite silt mostly in 0.5-1mm plane laminae. Rare 1-10mm medium calcarenite plane laminae often with 30% black blocky angular grains (mudstone intraclasts?) and some 1cm pyrite nodules and lenses. Rare 5-10cm isolated lenses of finer calcarenite within black mudstone (starved ripples deformed by soft-sediment deformation? But no cross-laminae). Some beds have 1x10mm lenses of finer calcarenite in black mudstone (starved ripples). Gets more pyritic downhole downwards with abundant 1cm pyrite lenses. Nodules and laminae not obviously replacing calcarenite below 306.0m. Some folding and brecciation of 5mm pyrite laminae between 312-313m (soft-sediment deformation as it affects adjacent mudstone laminae to a lesser extent). Rare massive 5cm beds of graded non-calcareous fine greywacke to mudstone after 309.0m. Clasts angular blocky, clear, white or black (quartz, lithics, and intraclasts?) in cream muddy matrix.

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(91) 315.93m-317.46m (1.53m thick)

Interlayered black kerogenous mudstone (70%) and cream normally graded fine greywacke to non-kerogenous mudstone (30%). Kerogenous mudstone 0.5-5cm thick. Internally massive to weakly plane-laminated 1mm, with 1% 0.1mm disseminated pyrite, <5% calcite silt. Graded units 0.5-10cm, fine greywacke bases have angular blocky grains 0.3mm either white, clear, or black in cream muddy matrix. Grading up through silt to non-kerogenous non-calcareous claystone. Some units have 2-4mm euhedral calcite crystals poikilitic incorporating all graded facies. Also some medium → coarse calcarenite preferentially hosting 1cm pyrite nodules and lenses, not graded, scattered 1mm calcite veins cross-cutting (graded units felsic tuffs?).

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(92) 317.46m-330.69m (13.23m thick)

Massive to weakly plane-laminated black kerogenous mudstone like (90), but with abundant (5%) 1cm pyrite nodules, lenses, and laminae throughout, most but not all associated with graded fine greywacke → non-kerogenous non-calcareous cream claystone units (5% 0.5-3cm), some with poikilitic calcite crystals 3-5mm overgrowing coarse facies (greywacke → claystone units felsic tuff?). Some isolated lenses and nodules of greywacke → mudstone (load balls, starved ripples?). Rare drag folds of pyritic, clastic, and kerogenous laminae adjacent to small thrust. Shiny metallic pyrobitumen or graphite film on 50% of bedding-parallel fracture surfaces. Rare 1-5cm beds of fine to medium calcarenite, massive pyritic with 2mm poikilitic calcite overgrowth.

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(93) 330.69m-334.71m (4.02m thick)

Interlayered massive to weakly plane-laminated black kerogenous pyritic mudstone like (92) (80%) and normally graded pale grey-cream fine greywacke → non-kerogenous non-calcareous claystone like in (91) and (92) (20%). Layers tabular 0.5-3cm, thicker graded units have 50% 2-5mm poikilitic calcite crystals overgrowing coarser base of 0.3-0.5 mm

blocky angular grains of clear (quartz?), white (lithics?), and black (intraclasts?) material in cream clay matrix. Kerogenous mudstone slightly less black than (92) (lower TOC?). Higher silt content (5-10%). 1% 0.1mm disseminated pyrite but 1cm-sized nodules, lenses, and laminae are rare. Some 3cm lenses of 5mm sparry calcite in black mudstone layers forming weak lamination above and below.

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(94) 334.71m-335.52m (0.81m thick)

Massive mid-grey medium calcarenite with 1cm interbeds of black kerogenous mudstone (5%). Calcarenite has 2-5mm poikilitic calcite crystals cementing 0.3-0.6mm subspherical subrounded calcite grains. Some 1-3mm flame structures on contact. Planar shiny metallic black pyrobitumen or graphite partings on bedding-parallel fractures.

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(95) 335.52m-337.30m (1.78m thick)

Interlayered 1-3cm plane beds of pale grey/cream graded greywacke → non-kerogenous claystone (50%), and massive kerogenous pyritic mudstone (50%), like (93) but 50:50.

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(96) 337.30m-337.93m (0.63m thick)

Massive black kerogenous silty mudstone, lower TOC (paler) and more silt (calcite 5% like (93) black mudstone. Rare 1mm pyrite laminae. Rare 1mm claystone laminae. Shiny pyrobitumen or graphite partings.

- - - - -
(97) 337.93m-338.37m (0.44m thick)

Massive to convolute to brecciated dark grey fine calcitic wackestone. Clasts 0.2-0.4mm subspheroidal subangular calcite in dark muddy matrix. Breccia has fragments to 2cm of slightly differing grain size. Convolute layers similar 1cm thick.

- - - - -
(98) 338.37m-342.15m (3.78m thick)

Interlayered 1-3cm beds of massive black kerogenous pyritic mudstone (65%) and pale grey/cream graded greywacke → claystone (35%) like (93), but more non-kerogenous siliciclastics.

- - - - -
(99) 342.15m-344.36m (2.21m thick)

Massive black kerogenous pyritic mudstone with abundant (3%) 1-2cm pyrite nodules like (92), but non-kerogenous units only 2%, mostly pyritic.

- - - - -
(100) 344.36m-344.57m (0.21m thick)

Massive to normally graded dark grey fine calc-wacke to marly calcisiltite with several bedding-parallel 1-2cm calcite-pyrite veins. Cross lamination in 1cm sets. 0.5mm laminae. Wacke has black kerogenous mud matrix. Rare 1cm black mudstone interbeds.

- - - - -
(101) 344.57m-345.24m (0.67m thick)

Massive black kerogenous mudstone like (92), but 1cm pyrite nodules, lenses, and laminae rare. 1% 0.1mm disseminated pyrite throughout.

- - - - -
(102) 345.24m-345.43m (0.19m thick)

Plane-laminated (5mm) dark grey medium (0.3-0.8mm) calcwacke with interlaminae of black kerogenous mudstone. Wacke grains white blocky angular with 2-3% 0.1mm disseminated pyrite. Soft-sediment deformation at base with 2cm load structures and black mudstone intraclast breccia.

(103) 345.43m-351.86m (6.43m thick)

Massive black kerogenous pyritic mudstone like (92) with 10% 1-5cm planar interbeds of massive graded pale grey medium (0.2-0.7mm) calcarenite and calcwacke. Mudstone pyritic with 3% 1cm pyrite lenses, nodules, and laminae mostly associated with calcarenite contacts. Some 2mm white calcite veins cross-cutting.

(104) 351.86m-356.84m (4.98m thick)

Massive black kerogenous pyritic mudstone like (92) with 3% 1cm pyrite nodules, lenses, and laminae associated with 1-2mm planar calcite veins. No coarser clastic or carbonate interbeds.

(105) 356.84m-357.23m (0.39m thick)

Massive to weakly graded fine calcwacke, grains 0.2-0.5mm blocky subangular, in black kerogenous mud matrix. 1cm pyrite lenses and laminae. 1-5cm layers defined by matrix content.

(106) 357.23m-360.56m (3.33m thick)

Massive black kerogenous pyritic mudstone like (92) with 2% 1-2cm pyrite nodule, lenses, and laminae mostly associated with 1mm white calcite veins. No coarse clastic or carbonate interbeds.

(107) 360.56m-364.27m (3.71m thick)

Interlayered massive black kerogenous pyritic mudstone like (92) (80%) and massive to weakly graded medium-fine calcwacke like (105) (20%) in beds 1-10cm. Grading mostly in increasing matrix content upwards. 2% 0.1mm pyrite disseminated in calcwacke. 1cm pyrite nodules, lenses, and laminae on lithological contacts.

(108) 364.27m-364.85m (0.58m thick)

Normally graded coarse to fine lithic arenite, beds planar 1-3cm, coarse grains 1-2mm, angular, blocky hyaloclastite? (green glassy interior, white altered margin) subellipsoidal scoria? (white with round internal amygdales), and tabular intraclasts (black massive), in calcite cement. Rare black kerogenous mudstone interbeds 1cm. Rare 1cm pyrite nodules, poikilitic calcite 5mm.

(109) 364.85m-374.90m (10.05m thick)

Massive black kerogenous pyritic mudstone like (92) with 1% 1-2cm coarse pyrite nodules, lenses, and laminae. 2% 0.1mm disseminated pyrite. No coarse clastic interbeds. Rare (<1%) fine calcarenite/calcwacke interbeds 2-3cm like (108).

(110) 374.90m-375.13m (0.13m thick)

Grey cross-bedded and graded coarse lithic sandstone → cream claystone (felsic tuff?). Coarse grains 1-2mm cream angular blocky fragments with dark internal linear amygdales? (pumice?). Wavy flattened angular cream fragments (fiamme?). Rounded subspherical clear crystals (B-Quartz?) in very poorly sorted fine –medium (0.1-0.8mm) matrix and poikilitic (3mm) calcite cement. Cross-sets 2-3cm with laminae 3mm, clear angular erosive discordance between sets, cream claystone non-calcareous.

- - - - -
(111) 375.13m-375.51m (0.38m thick)

Massive black kerogenous pyritic mudstone like (92) but no coarse clastic or calcareous interbeds.

- - - - -
(112) 375.51m-375.78m (0.27m thick)

Chert breccia with tabular angular fragments of clear chert with white margins 1cm x 5cm in pale green silicified mud(?) matrix with scattered 2mm calcite rhombs and 1-3mm pyrite crystals.

- - - - -
(113) 375.78m-378.27m (2.49m thick)

Massive black kerogenous pyritic mudstone like (92), but no coarse clastic or calcareous interbeds like (111).

- - - - -
(114) 378.27m-379.94m (1.67m thick)

Plane-laminated (1-5mm) cream and pale green cherty silicified mudstone(?) brecciated at top in black kerogenous mudstone matrix with 1-2cm x 1 x 5cm tabular subangular to subrounded fragments. Some saw-tooth bedding-parallel stylolites. Some green laminae with 20% 1mm pyrite crystals. Cream laminae have up to 50% white calcite rhombs 1-2mm. Rare 1cm black mudstone interbeds.

- - - - -
(115) 379.94m-383.72m (3.78m thick)

Massive black kerogenous pyritic mudstone with no coarse interbeds like (111). Rare 3cm graded fine calcwacke → calcisiltite interbeds.

- - - - -
(116) 383.72m-358.36m (1.64m thick)

Interlayered black kerogenous pyritic mudstone like (111), but with 10% calcisiltite grains (60%) and planar 1-5cm fine calcarenite/calcwacke with 5% 0.5mm pyrite crystals (40%).

- - - - -
(117) 385.36m-387.24m (1.88m thick)

Massive black kerogenous pyritic mudstone like (111), but 5% calcisiltite grains. Little disseminated 0.1mm pyrite. Rare (2%) fine calcarenite/wacke interbeds.

- - - - -
(118) 387.24m-388.32m (1.08m thick)

Weakly normally graded very coarse→fine mafic tuff wacke, grains 3.0→0.2mm like (108) hyaloclastite, scoria. Rare black intraclasts. Rare 1mm white calcite veins.

- - - - -
(119) 388.32m-389.66m (1.34m thick)

Interlayered black kerogenous pyritic mudstone like (117) and normally graded very coarse → fine mafic tuff like (118). Mudstone: tuff 50%: 50% beds 1-30cm thick. Tuff cross-laminated with 5cm sets, 1cm laminae.

- - - - -
(120) 389.66m-389.92m (0.26m thick)

Plane-laminated cherty silicified mudstone(?) like (114), but no upper breccia. Some 1-2cm black kerogenous mudstone interbeds.

- - - - -
(121) 389.92m-390.18m (0.26m thick)

Interbedded kerogenous mudstone and tuff like (119).

- - - - -
(122) 390.18m-390.36m (0.18m thick)

Plane-laminated chert like (114), but no upper breccia. Some 1cm unsilicified black kerogenous mudstone interbeds.

- - - - -
(123) 390.36m-394.74m (4.38m thick)

Interlayered black kerogenous pyritic mudstone (60%) and normally graded coarse→fine mafic tuff wacke (40%) like (119), but no very coarse veins. Some calcite cement in tuff (not all wacke) becoming more muddy (90% mudstone) downhole.

- - - - -
(124) 394.74m-395.81m (1.07m thick)

Normally graded and cross-laminated mid grey mafic tuff gravel→claystone beds up to 30cm. Sets in finer parts to 3cm thick, laminae 1-5mm, grains hyaloclastite, scoria, rare black intraclasts. Loaded base 0.5cm, load balls 2cm near top. Gravel up to 7mm.

- - - - -
(125) 395.81m-397.19m (1.38m thick)

Interlayered black kerogenous pyritic mudstone (60%) and coarse→fine mafic tuff wacke (40%) like (119), but no very coarse grains.

- - - - -
(126) 397.19m-401.66m (4.47m thick)

Interlayered and plane laminated chert like (114), black kerogenous mudstone like (117), vein carbonate breccia, massive green coarse hyaloclastic arenite, and graded coarse→fine angular intraclastic (black soft) arenite with calcite cement. Beds 5-30cm. Sharp boundaries between silicified and unsilicified. Arenites often brecciated by calcite veins.

- - - - -
(127) 401.66m-404.86m (3.20m thick)

Like (126), but no plane-laminated chert. Hyaloclastic arenite graded from 2-0.2mm, intraclastic arenite rare pure but with 50% hyaloclastite/lithic clasts.

- - - - -
(128) 404.86m-405.66m (0.80m thick)

Graded green coarse→claystone hyaloclastic-intraclastic-scoria arenite/wacke. Units 1-10cm thick, frequently brecciated by white calcite veins.

- - - - -
(129) 405.66m-407.46m (1.80m thick)

Massive to brecciated grey tuffaceous(?) claystone. Abundant white calcite veins 1-2cm. Claystone looks like cap-rock of graded mafic arenites above stilpnomelane needles (2%).

- - - - -
(130) 407.46m-415.30m (7.84m thick)

Graded green coarse→claystone hyaloclastic-intraclastic-lithic mafic arenite/wacke like (128). Units 3-30cm with abundant 1-3cm white calcite veins (bedding-parallel). Green-grey massive claystone has 2% randomly oriented stilpnomelane (red-brown) needles.

- - - - -
(131) 415.30m-418.25m (2.95m thick)

Massive black kerogenous mudstone with <1% calcisiltite. Trace 0.1mm disseminated pyrite. Sparse (1%) 1cm pyrite nodules, lenses, and laminae. Scarce (1%) graded (1-3cm) hyaloclastite-intraclastic-lithic medium→fine arenite/wacke. Arenite has calcite cement, wacke has kerogenous mud matrix.

- - - - -
(132) 418.25m-419.22m (0.97m thick)

Plane-laminated chert with black kerogenous mudstone interbeds (10%) like (114), but no brecciation. 10% 1-2mm pyrite crystals along contacts. Cream chert laminae have 20% 1mm calcite rhombs.

- - - - -
(133) 419.22m-421.09m (1.87m thick)

Massive black kerogenous mudstone like (131), but rare (<1%) 1cm pyrite laminae. No coarse clastic interbeds, but some (2%) 1-30mm blebs and nodules of fine (0.2mm) calcarenite increasing in abundance downwards. Scattered irregular 1-10mm white calcite veins. No fine disseminated pyrite.

- - - - -
(134) 421.09m-421.47m (0.38m thick)

Normally graded coarse-fine intraclastic arenite/wacke, grains 1.5-0.1mm, mostly (80%) tabular to ovoid rounded black mudstone(?) flakes with white internal calcisiltite, frequently (30%) pyritized where coarse white calcite cement in coarse arenites. Black mud matrix in fine wackes. Some (20%) white lithic(?) grains blocky subangular.

- - - - -
(135) 421.47m-426.02m (4.55m thick)

Massive black kerogenous mudstone with rare (<1%) 1cm pyrite nodules and laminae like (133), but fine calcarenite nodules and blebs increasing downwards to 20% and becoming finer (3cm→3mm) gradational contact with (136).

- - - - -
(136) 426.02m-426.94m (0.92m thick)

Gradational contact from (135) into massive black kerogenous mudstone like (135), but lacking fine calcarenite nodules, only blebs 1-3mm and an increasing abundance downward of 1mm hyaloclastic-lithic-intraclastic sand grains, grading down from sandy mudstone to muddy sandstone.

- - - - -
(137) 426.94m-438.93m (11.99m thick)

Massive black kerogenous mudstone like (133) with no fine disseminated pyrite. Rare (<1%) 1cm pyrite laminae, lenses, and nodules. 3% 0.2mm white inclusions, look like diagenetic carbonate rhombs or nodules but don't fizz. Rare 0.5-1cm bedding-parallel calcite veins. White inclusions become whispy lenticular downwards (flattened shards?).

- - - - -

(138) 438.93m-439.11m (0.18m thick)

Brecciated and convoluted black kerogenous mudstone like (137) and fine calcwacke. Grains 0.2mm with black mud matrix. Convolution by loading, brecciated by 0.5cm white calcite veins. Fine pyrite in calcwacke.

- - - - -

(139) 439.11m-441.90m (2.79m thick) EOH

Massive pale grey basalt, crystals ranging from 0.5mm at contact to 1.5mm downwards, of pale grey plagioclase (60%), pale green amphibole(?) (20%), dark green chlorite (20%) with scattered 1mm spherical amygdales forming 1-2% of rock, also pale and dark alteration patches to 1cm of calcite-pyrite (marginal) and chlorite (downwards). Metamorphic grade prehnite-actinolite facies? Composition between tholeiitic and magnesian (no leucoxene, but no ocelli/varioles or skeletal pyroxenes). Some 0.5-2cm white calcite veins.

AIDP-3 Ripon Hills duplicate (deeper facies)

E 0558753 N 7591713

Ballyeerina Creek, Thoomina Bore Marra Mamba dip and strike 350° 3°E, 045° 2°SE, 340° 4°W (much pinch and swell).

Outcrop of Marra Mamba @ ~6m depth under coffee-rock (2m), clayey river gravel (2m), and hard-packed clay (2m). Water from water bore WARP-15 20m N of collar, flows abundantly from ~15m, Ballyeerina Ck dry. Because of angle 86°, orientation problem. Hole orientation 86° towards 035°. HQ3 collar because of unconsolidated material for first ~20m, very poor core recovery (<10%) until 9.20m (creek gravel discarded).

***Change to NQ using HQ casing at 47.70m because of hole cave-ins**

***Orientation starts at 59.00m**

***Head oil leak into sump? ~100ml @ 147.0m (sampled)**

***Camera shot EOH 262.3m 022°, 86°**

- - - - -

(1) 9.20m-18.40m (9.20m thick)

Plane-laminated orange-brown limonite with rare pale-grey plane laminated chert, layering 1cm, chert non-magnetic, limited to 3-7cm intervals. <25% core recovery.

- - - - -

(2) 18.40m-25.60m (7.20m thick)

Massive red-brown clay with some pale-grey plane-laminated chert. Layering 1cm, limited to 3-7cm intervals. <25% core recovery.

- - - - -

(3) 25.60m-44.60m (19.00m thick)

Weathered massive red-brown hematite & clay, chert laminae defined by opaque content, mostly dark but up to 1% 0.2mm pyrite cubes. Hematitic layers sometimes coherent. <35% core recovery, cavities where iron-rich layers are preferentially weathered.

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(4) 44.60m-45.00m (0.40m thick)

Plane-laminated dark and pale grey chert like (3), and massive black kerogenous mudstone, no silt. Rare 1-2mm planar red iron-oxide laminae perhaps after pyrite.

- - - - -
(5) 45.00m-45.60m (0.60m thick)

Massive conglomerate of tabular rounded clasts of pale grey chert up to 2cm x 10cm in matrix of limonite-hematite with weathering, cavities, smaller angular blocky fragments of massive hematite and angular tabular fragments of coarse (1-1.5mm) sandstone/wacke with subangular clear quartz grains. Not clear whether sedimentary or tectonic, but polymictic composition hints sed.

- - - - -
(6) 45.60m-47.25m (1.65m thick)

Massive to plane-laminated pale grey chert interlayered with red massive hematite, sharp contacts, weathering cavities in both, trace 0.1mm pyrite in darker grey chert.

- - - - -
(7) 47.25m 47.70m (0.45m thick)

Massive black kerogenous mudstone, no silt, no pyrite, no cherty interbeds, hematite staining but evidently superficial. 90% recovery.

- - - - -
(8) 47.70m-51.70m (4.00m thick)

Interlayered massive to plane-laminated pale grey chert and massive earthy hematite like (6). Units 1-5cm, weathering cavities to 2cm abundant. 50% recovery.

- - - - -
(9) 51.70m-55.08m (3.38m thick)

Massive black kerogenous mudstone like (7) with rare 1cm laminated pale grey chert and massive hematite interbeds. Mudstone becomes pyritic downhole downwards developing 2-5mm nodules, lenses, and laminae of 1mm crystals. Trace 0.1mm disseminated pyrite. 90% recovery.

- - - - -
(10) 55.08m-59.54m (4.46m thick)

Interlayered black kerogenous mudstone like (7) and mid-grey massive to laminated chert. Laminae in chert 5-10mm planar, some mudstone finely laminated planar 0.5-1mm defined by pyrite and hematite contents. 1-5mm pyrite cubes along contacts. Mudstone with 1cm pyrite nodules. Some chert brecciated with kerogenous mudstone matrix. Weather cavities to 1cm present in chert. 95% recovery. Some non-magnetic BIF beds to 10cm. Planar to undulose hematite-chert laminae 1-5mm with chert nodules 1x3cm deforming laminae.

- - - - -
(11) 59.54m-61.23m (1.69m thick)

Interbedded massive kerogenous mudstone, massive to plane-laminated chert, and hematite BIF like (10), but with abundant 2mm cross-cutting planar pyrite veins (crystals 0.3mm). Also 3mm pyrite beds along contacts. Some 1-3mm pyrite nodules, lenses, and laminae in black mudstone, units 1-2cm thick.

- - - - -
(12) 61.23m-64.59m (3.36m thick)

Interbedded massive black kerogenous mudstone, massive to plane-laminated grey chert, and hematite BIF like (10), but mudstone has some 1-5mm pyrite nodules, lenses, and

laminae. Chert has rare breccia layers to 10cm with angular tabular fragments up to 2x8cm. BIF has 1% o.1mm disseminated pyrite in some laminae.

- - - - -
(13) 64.59m-66.47m (1.88m thick)

Massive black kerogenous pyritic mudstone, 1% silt, 1% 0.1mm disseminated pyrite. Moderately abundant 1-10mm pyrite nodules, lenses, and laminae. Laminae have associated carbonate (mild fizz in 1N HCl). Occasional 1-5mm planar laminae of soft non-carbonate graded fine wacke to claystone, grey-cream, grains angular glassy(?), felsic or intermediate air-fall tuff(?), zircons(?).

- - - - -
(14) 66.47m-66.99m (0.52m thick)

Plane to undulose laminated hematite BIF with block kerogenous pyritic mudstone interbeds 1-5cm (15%). BIF laminae 1-3mm defined by hematite-chert proportions. Some laminae pyritic with .5% 1mm pyrite associated with calcite (strong acid fizz).

- - - - -
(15) 66.99m-74.37m (7.38m thick)

Massive black kerogenous pyritic mudstone like (13), but abundant (3%) 1-20mm pyrite nodules, lenses, and laminae. Some look like pyritized breccia with tabular angular fragments in mudstone matrix. Rare 1-10mm soft creamy-grey graded fine wacke → claystone, felsic tuff(?), some partly pyritized with 0.3mm disseminated crystals and 5mm nodules. At 70.92m 3mm layer with irregular (1mm) base and smooth top containing 1mm spherical white grains with very consistent diameters, very perfect sphericity, 50% angular core clear, white, green, black, sometimes pyritic; 50% outer cortex white, no obvious concentric microlamination, vague radial fabric to some grading within layer based on spherule abundance with grain-support at base, matrix-support towards top, impact spherules or accretionary lapilli(?) (if radial fabric real, then perhaps impact spherules), matrix of fine sand grains 0.1mm white angular and black mud. Rare cross-cutting 0.5-1cm veins of fibrous white calcite (fizzed freely in dilute acid) or clinochlore(?). Also rare pale grey chert interbeds 2-5cm, pyritized calcitic nodules to 3cm.

- - - - -
(16) 74.37m-76.30m (1.93m thick)

Interbedded hematite BIF, massive to plane-laminated grey chert, and black kerogenous pyritic mudstone like (12), but chert is nodular rather than brecciated in places to 3cm x 3cm. BIF frequently pyritic with associated calcite dissemination and 0.5mm cross-cutting calcite veins. 40% BIF up to 5cm, 35% mudstone up to 3cm, 25% chert up to 5cm. Undulose contacts.

- - - - -
(17) 76.30m-106.10m (29.80m thick)

Massive black kerogenous pyrite mudstone like (15) with abundant pyrite nodules, lenses, and laminae to 3cm, but also abundant 0.5-2cm graded cream-grey fine wacke → claystone plane beds, felsic tuff(?) often with pyritic contacts and internal pyrite lenses. **No** obvious shiny metallic pyrobitumen partings (unlike Yilgalong Ck), some 1-5mm irregular cross-cutting clinochlore/riebeckite(??) veins (soft, fibrous, no acid reaction, white-clear, fibers oriented transverse to vein margins). Some soft-sediment folding to 10cm and 0.5cm loading on tuff → mudstone contacts, more folding and loading downhole. Fibrous mineral rims pyrite nodules to 1mm in fine wacke layers (clinochlore reaction between ash and

pyrite), on fracture surfaces in pale green/yellow and blocky-prehnite(?). Rare 1-5cm grey chert interbeds downward, pyrite breccia.

- - - - -
(18) 106.10m-106.45m (0.35m thick)

Plane-laminated grey chert with breccia lenses, laminae 1-3mm, often with 10% 1mm calcite rhombs, some dark with hematite? Breccia fragments are angular blocky 0.5-3cm in black mudstone matrix. Chert with 3% 3mm pyrite cubes often associated with calcitic laminae. Rare 1-3mm pyrite laminae.

- - - - -
(19) 106.45m-110.23m (3.78m thick)

Massive black kerogenous pyritic mudstone like (15), but poor in pyrite nodules and lenses (<1%), trace 0.1mm disseminated pyrite, <1% silt, some 0.5-5cm plane beds of medium arenite → fine wacke. Grains angular 0.1-0.7mm, coarsest ones white or clear, blocky. White grains have dark subspherical inclusions (scoria), volcanoclastic mafic(?). Frequently pyritic with 10% 0.3mm crystals. Arenite-wacke units with graded laminae 5-10mm thick.

- - - - -
(20) 110.23m-112.55m (2.32m thick)

Interlayered fine volcanogenic(?) arenite/wacke and black kerogenous mudstone. Layers planar 0.5-5cm. Arenite/wacke grains 0.7-0.1mm angular blocky white or clear. Weak grading with finer wacke uppermost. Some associated pyrite nodules. Mudstone is pyrite poor with few 1-2mm lenses and laminae, gradational contacts with upper wacke beds. 60% arenite/wacke, 40% mudstone. Rare breccia of angular blocky black mudstone fragments in fine arenite matrix.

- - - - -
(21) 112.55m-114.18m (1.63m thick)

Massive to weakly normally graded (coarse → fine) volcanogenic arenite/wacke, grains 1.5-0.2mm, angular blocky, white with dark subspherical spots (scoria?), pale green (hyaloclastic glass?), grey (lithic?). Graded units 5cm thick, fine upwards but more matrix-rich downwards. Rare units of highly tabular pyrite breccia. Angular fragments 0.1x5cm, appear to have replaced wacke clasts.

- - - - -
(22) 114.18m-114.36m (0.18m thick)

Plane to undulose laminated hematite BIF with laminae and nodules of medium volcanogenic arenite with calcite cement. BIF laminae 0.5-5mm chert or hematite. Volcanogenic arenite like fine (21), but cement has strong acid reactions. Nodules to 5cm deform adjacent BIF laminae.

- - - - -
(23) 114.36m-115.15m (0.79m thick)

Interlayered black kerogenous mudstone and fine volcanogenic arenite. Mudstone 70%, little pyrite, beds 1-5cm. Arenite grains angular blocky 0.2-0.5m in cement or black mud matrix, laminae planar 0.5-3cm, frequently pyritic with 3% 0.2mm crystals.

- - - - -
(24) 115.15m-115.30m (0.15m thick)

Massive medium volcanogenic wacke, grains 0.2-0.8mm angular blocky in black mudstone matrix 2% 0.5mm pyrite crystals, slightly silicified(?).

(25) 115.30m-117.57m (2.27m thick)

Massive black kerogenous mudstone like (19), poor in pyrite with rare (<1%) 1cm lenses and laminae, trace silt, trace 0.1mm disseminated pyrite, occasional 1cm planar laminae of fine volcanogenic arenite with scattered 0.2mm pyrite crystals.

(26) 117.57m-117.98m (0.41m thick)

Massive to weakly reverse graded volcanogenic arenite/wacke like (21), but with 30% accretionary lapilli, grains spherical to ovoid (flattened during compaction) with one or several cortical lamellae 0.1mm concentric composed of very fine (<0.1mm) ash coating angular blocky nucleus resembling other volcanogenic grains, accretionary lapilli 0.5-4mm, very different to impact spherules(?) in (15), clearly soft, very variable in size, cortex dominant and multi-lamellate.

(27) 117.98m-121.91m (3.93m thick)

Massive black kerogenous mudstone like (25). Pyrite poor with rare 0.5-3cm pyrite nodules, lenses, and laminae. Some 0.5-5cm laminae of fine volcanogenic arenite/wacke with 1-5% 0.2mm pyrite crystals.

(28) 121.91m-122.71m (0.80m thick)

Interlayered fine volcanogenic arenite/wacke (50%) and black kerogenous mudstone (50%). Layers 0.5-10cm, mostly planar but some with loaded bases to 1cm. Volcanogenic arenites often have calcite cement (strong acid reaction), some are markedly pyritic with 3% 0.2mm crystals.

(29) 122.71m-124.00m (1.29m thick)

Massive black kerogenous mudstone like (25), pyrite poor, scattered 0.5-5cm interbeds of fine volcanogenic arenite/wacke with 10% black mudstone intraclasts, 3% 0.3mm pyrite crystals.

(30) 124.00m-124.21m (0.21m thick)

Plane-laminated pale to dark grey chert, layers 0.5-2cm, weakly brecciated in places, with laminoid vugs 0.5x5cm lined with 0.5mm pyrobitumen, 0.5mm fine calcite, and then filled with sparry calcite. 1mm pyrite layers associated with sparry calcite.

(31) 124.21m-126.28m (2.07m thick)

Massive black kerogenous mudstone like (25), pyrite poor, <1% 0.5-3cm pyrite nodules, lenses, and laminae. Rare 1mm fine volcanogenic arenite lenses and laminae.

(32) 126.28m-127.02m (0.74m thick)

Wavy laminated grey-green chert, laminae 1-3mm, defined by color and original grain size, some with 30% 1mm calcite rhombs, others with 5% 0.3mm pyrite crystals.

(33) 127.02m-128.91m (1.89m thick)

Massive black kerogenous mudstone like (25), pyrite poor, with rare 1-3cm chert interbeds, few fine volcanogenic arenite laminae 1-3mm.

(34) 128.91m-129.21m (0.30m thick)

Wavy laminated grey-green chert like (32), but no pyrobituminous vughs but abundant 1-5mm sparry calcite veins mostly subparallel to bedding.

(35) 129.21m-136.31m (7.10m thick)

Massive black kerogenous mudstone like (25). Quite pyrite poor with ~1% 0.3-3cm pyrite nodules, lenses, and laminae. Rare 2-5cm wavy laminated chert interbeds like (32) with pyritic contacts.

(36) 136.31m-137.31m (1.00m thick)

Wavy laminated grey-green chert like (32), but no pyrobituminous vughs, some 1-3mm sparry calcite veins. Abundant (3%) 0.5mm pyrite crystals along some contacts. Chert looks like silicified fine-medium volcanogenic arenite.

(37) 137.31m-147.16m (9.85m thick)

Massive black kerogenous mudstone like (25), pyrite poor <1% 0.1-0.5cm pyrite nodules, lenses, and laminae. Rare 5-10cm wavy laminated grey chert interbeds like (32), 1% silt, trace 0.1mm disseminated pyrite. Chert with 20% 1mm calcite rhombs, 1mm pyrite crystals along contacts. Rare 1-3mm bedding-parallel veins of fibrous calcite(?) (soft, moderate acid reaction, clear/white).

(38) 147.16m-147.49m (0.33m thick)

Interbedded wavy laminated grey-green chert like (36) and massive black kerogenous mudstone like (25). Chert 80%, mudstone 20%. Contacts loaded with mudstone apparently intruding into fractures penetrating chert.

(39) 147.49m-157.09m (9.60m thick)

Massive black kerogenous pyritic mudstone, 2% 0.5-4cm pyrite nodules, lenses, and laminae composed of aggregated 0.2mm pyrite crystals, 1% 0.1mm disseminated pyrite, 1% white silt. Rare 0.1-1cm bedding-parallel veins of white/pale green fibrous soft crystals transverse to vein margins, no acid reaction (clinochlore?). Rare 1-4cm graded interbeds of coarse → fine volcanogenic wacke. No pyrobituminous partings.

(40) 157.09m-157.31m (0.22m thick)

Plane-laminated pale and dark grey chert, laminae 1-3mm, pale grey have 10-30% white calcite rhombs 1-1.5mm (moderate acid reaction). Dark grey look like silicified tuffaceous lutite. Pyritic laminae along contact with kerogenous mudstone.

(41) 157.31m-161.80m (4.49m thick)

Massive black kerogenous pyritic mudstone like (39). Rare 8cm interbeds of coarse → fine volcanogenic wacke and plane-laminated grey chert with pyritic contacts. Rare bedding-parallel 1-10mm veins of fibrous white clinochlore(?).

(42) 161.80m-162.02m (0.22m thick)

Plane-laminated pale and dark grey chert like (40), with some interbedded fine volcanogenic wacke and black kerogenous mudstone with pyritic contacts.

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(43) 162.02m-163.43m (1.41m thick)

Massive black kerogenous pyritic mudstone like (39), but with abundant bedding-parallel veins 1-10mm of fibrous white soft clinocllore(?).

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(44) 163.43m-166.90m (3.47m thick)

Interbedded massive black kerogenous pyritic mudstone and massive to reverse-graded medium → fine calcarenite/calcwacke. Mudstone like (39) (60%). Calcarenite/calcwacke has diffuse calcite grains subspherical subangular in either calcite cement or black mudstone matrix. Beds 1-8cm with 2% pyrite near contacts. Irregular veins with 1cm white calcite crystals near base.

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(45) 166.90m-168.40m (1.50m thick)

Plane to wavy laminated cream, grey, and pale green chert. Laminae 1-5mm. Cream have 50% 1mm dolomite(?) rhombs (moderate acid reaction), pale green look like silicified volcanogenic lutite, iminar brecciation into tabular angular fragments. Some more silicified nodules to 10cm.

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(46) 168.40m-168.90m (0.50m thick)

Cross-laminated medium → fine calcarenite/calcwacke, sets 1-5cm, with 2-5mm trough cross-laminae. Sets graded in size with matrix content increasing upwards. Grains subspherical, subangular, 0.7-0.2mm. 10% black mudstone intraclasts, 30% green volcanic glass(?), 60% white calcite. Some 1-5cm green chert layers. Scattered 3mm pyrite cubes.

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(47) 168.90m-170.09m (1.19m thick)

Weakly plane-laminated dark grey tuffaceous silty mudstone, low TOC%, rare pyrite, rare graded laminae of fine tuff arenite/wacke 1-3mm, no acid reaction, pyrite in 3mm lenses with coarser fraction but none in fine fraction, 5% white silt.

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(48) 170.09m-177.08m (6.99m thick)

Trough cross-laminated and graded fine tuff arenite → wacke → silty mudstone. Sets 1-5cm, laminae 1-5mm. Grains indistinct 0.4-0.1mm white, mudstone with 2% white silt, no pyrite, arenites have 1% 0.2mm pyrite. Rare 1-2mm load structures on bases of coarse beds. Some soft sediment brecciation with deformed layering around 1-10cm angular fragments, brecciation also caused by white calcite veins to 1cm.

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(49) 177.08m-184.99m (7.91m thick)

Massive to weakly plane laminated dark grey tuffaceous silty mudstone with abundant 1mm lenses of fine calcarenite (grains indistinct, white, 0.2mm, strong acid reaction from grains or cement) with 1% pyrite 0.2mm and internal 0.1mm black cross-laminae (starved ripples, maybe tuffaceous). Some soft sediment deformation causing mottling. Rare 3mm load structures. Occasional 1-3cm pyrite nodules. Some 1-3cm graded fine calcarenite/calcwacke interbeds sometimes showing internal trough cross-lamination.

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(50) 184.99m-188.86m (3.87m thick)

Trough cross-laminated and graded fine tuff arenite → wacke → silty mudstone like (48). Arenites have strong acid reaction (cement?) and 2% 0.2mm pyrite. Silty mudstones lack pyrite. Low TOC?

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(51) 188.86m-197.54m (8.68m thick)

Massive to weakly plane-laminated dark grey tuffaceous(?) silty mudstone like (49) with occasional lenses of fine calcarenite. Some 1-3cm trough cross-laminated beds of fine calcarenite/calcwacke. Rare 1-3cm pyrite nodules in fine facies. Scattered cross-cutting 1-5mm white calcite veins. Turbidites with starved ripples(?), graded beds(?), trough cross-laminae (C-D-E).

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(52) 197.54m-200.76m (3.22m thick)

Trough cross-laminated and graded tuffaceous(?) fine arenite → wacke → silty mudstone like (50). Some 2mm basal load structures on arenite beds. Rare 1-2cm pyrite nodules.

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(53) 200.76m-213.89m (13.13m thick)

Massive to weakly plane-laminated dark grey tuffaceous(?) silty mudstone like (49). 1-3mm laminae and lenses of fine arenite/wacke. Some 11-4cm trough cross-laminated beds of fine arenite/wacke. Rare 1-2cm pyrite nodules. Some soft sediment deformation. C-D-E turbidites?

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(54) 213.89m-216.10m (2.21m thick)

Graded tuffaceous(?) fine arenite → wacke → silty mudstone, planar beds 1-8cm, arenite grains white indistinct 0.1-0.2mm, no acid reaction, no cross-lamination evident.

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(55) 216.10m-223.40m (7.30m thick)

Massive or weakly cross-laminated medium tuffaceous arenite-wacke. Grains 0.3-0.7mm angular blocky white or green. Arenite has calcite cement. Wacke has dark ashy(?) matrix. Cross-laminae tabular 2-4m, defined by grain size and matrix content. Sets 5-10cm. Massive beds up to 1m thick.

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(56) 223.40m-223.87m (0.47m thick)

Massive to weakly plane-laminated dark grey tuffaceous(?) silty mudstone like (49). Rare lenses and laminae 1-2mm of fine tuff(?) arenite/wacke. No acid reaction. Grains indistinct white 0.1-0.2mm.

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(57) 223.87m-225.23m (1.36m thick)

Massive to weakly cross-laminated medium tuffaceous arenite-wacke like (55). Grains subspherical subangular 0.3-0.6mm. Trace 0.3mm disseminated pyrite.

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(58) 225.23m-227.62m (2.39m thick)

Massive to weakly plane-laminated dark grey tuffaceous(?) silty mudstone like (49). Scattered 0.5-2cm lenses and laminae of fine tuffaceous(?) arenite-wacke. Some trough cross-laminated 1mm. Slight acid reaction (calcite cement?).

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(59) 227.62m-228.80m (1.18m thick)

Thick graded beds of pale to dark grey medium tuff arenite → fine tuff → wacke → silty mudstone. Units 2-20cm thick. Coarse grains 0.3-0.6mm white or green subspherical subangular. Trace pyrite. Rare cross-lamination in thinner units.

(60) 228.80m-229.55m (0.75m thick)

Massive to weakly graded dark grey tuffaceous(?) silty mudstone. Graded units fine tuff wacke → silty mudstone over 3cm. Coarse fraction has 1% 0.2mm pyrite. Silty mudstone has 5% white silt, no pyrite.

(61) 229.55m-229.86m (0.31m thick)

Graded coarse quartz arenite with calcite cement. Grains 1-1.5mm subspherical subrounded clear single crystals with scattered irregular intraclasts to 1cm of fine tuffaceous wacke and silty mudstone, angular, some lenses of medium tuff arenite, grading by grain size with tuff mud matrix appear near top.

(62) 229.86m-232.73m (2.87m thick)

Massive to flaser-laminated coarse-medium tuffaceous arenite-wacke. Grains subrounded subspherical 0.3-0.8mm. Some 1-2mm accretionary lapilli and 5-10mm silty mudstone intraclasts. Flasers lenticular to wavy, dark grey tuffaceous silty mudstone 1-3mm, grouped in clusters separated by 0.5-1cm coarse beds. Some obviously associated with ripples. Rare bedding parallel pyrobitumen partings 1mm.

(63) 232.73m-233.00m (0.27m thick)

Graded coarse quartz arenite like (61), but 30%-90% medium tuffaceous. Accretionary lapilli and intraclastic grains. Grading defined by quartz content. Gets coarser and more quartzose upward.

(64) 233.00m-236.20m (3.20m thick)

Massive to weakly graded coarse → medium tuffaceous arenite-wacke. Grading in grain size and matrix content over 20cm, normal grading, some beds with 40% 0.5-1cm subrounded intraclasts of tuffaceous silty mudstone. Arenite has calcite cement, wacke has tuffaceous silty mud matrix.

(65) 236.20m-237.28m (1.08m thick)

Massive to weakly graded dark grey tuffaceous(?) silt mudstone like (60). Some 1-5cm units of coarse quartz-intraclastic-volcanogenic arenite-wacke, grains 1-2mm in calcite cement or tuff mud matrix. Rare 0.5cm pyrite nodules.

(66) 237.28m-238.11m (0.83m thick)

graded fine tuff arenite → wacke → siltstone. Units 2-10cm with 1% 0.1mm pyrite. Some horizons of 0.5-3cm tabular rounded chert nodules replacing intraclasts? Siltstone mid-grey. Low TOC.

(67) 238.11m-238.60m (0.49m thick)

Massive dark grey chert with 1% 0.5mm pyrite crystals, with some 5cm interbeds of massive dark grey tuffaceous silty mudstone. No pyrite.

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(68) 238.60m-241.58m (2.98m thick)

Massive medium tuffaceous wacke, mid grey. Grains 0.3-0.6mm, green-grey and white subangular subspherical, in dark grey tuffaceous mud matrix. Scattered 1x10mm tabular angular intraclasts of tuffaceous siltstone. Some 1mm flaser lenses and laminae of tuffaceous mudstone.

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(69) 241.58m-241.69m (0.11m thick)

Coarse tuffaceous wacke with pyrobitumen partings. Grains 0.4-1mm subspherical subangular in tuffaceous mud matrix. Pyrobitumen partings 0.5mm wavy anastomosing and coalescing, stylolites?

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(70) 241.69m-246.68m (4.99m thick)

Massive medium tuffaceous wacke like (68). Frequently mottled by paler patches 1-2cm irregular of calcite alteration (strong acid reaction). Rare 0.5mm flaser laminae of tuffaceous mudstone. Rare 1-2mm pyritic laminae.

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(71) 246.68m-247.38m (0.70m thick)

Weakly trough cross-laminated medium tuff arenite and wacke, sets 1cm, laminae 1mm, grains 0.2-0.8mm. Arenite has calcite cement, wacke has tuffaceous mud matrix.

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(72) 247.38m-248.55m (1.17m thick)

Flaser laminated ripple cross-bedded medium tuffaceous wacke and tuffaceous silty mudstone, sets 1-2cm, laminae 0.5-5mm, no pyrite, no calcite alteration.

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(73) 248.55m-250.78m (2.23m thick)

Massive mid-grey medium tuff wacke and dark grey tuffaceous silty mudstone. Beds 5-30cm thick. Some flaser inter-lamination but generally massive. Silty mudstone has 1% 0.2mm disseminated pyrite wacke has scattered white chert-pyrite replaced intraclasts(?) or nodules(?) (white, tabular to irregular, subparallel to bedding).

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(74) 250.78m-250.88m (0.10m thick)

Mixed coarse tuffaceous wacke and scoriaceous basalt, wacke like (73), but grains 0.5-1mm. Scoriaceous basalt has perlitic chlorite fine fracturing, frothy amygdaloids to 1cm, ellipsoidal, sometimes filled with quartz, sometimes filled with tuffaceous wacke.

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(75) 250.88m-251.74m (0.86m thick)

Scoriaceous basalt, 50% 1cm ellipsoidal amygdaloids filled with quartz, calcite, chlorite, or epidote (yellow-green blocky crystals), matrix has very fine perlitic fractures in blue-grey matrix, some amygdaloids amalgamated, become more spherical downwards.

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(76) 251.74m-252.81m (1.07m thick)

Scoriaceous basalt with alteration spherulites, 1-2cm amygdaloids 30% with quartz, calcite, or epidote filling, some amalgamated but most subspherical. Spherulites pale grey in a dark green matrix with radial fibrous fabric, 1-3mm, some green cores.

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(77) 252.81m-260.12m (7.31m thick)

Amygdaloidal basalt, amygdales subspherical, 0.5-1cm, 5-20%, filled with chlorite, quartz, or epidote in crystalline matrix of 1-2mm blocky plagioclase 50%, 1mm bladed chlorite 40%, white irregular leucoxene 5% 1mm (tholeiitic?), texture looks gabbroic (crystals 1-2mm) but amygdales clearly evident(zoned, with botryoidal in-fill).

(78) 260.12m-262.30m (2.18m thick)

Gradational contact with spherulites, sparsely amygdaloidal basalt, amygdales spherical 1-5mm, filled by calcite then chlorite. Pale spherulites 1-3mm with radial fibrous fabric 50%, in dark green massive matrix 45%, white skeletal leucoxene 2%, amygdales 2%, gabbroic texture with 1-3mm grains but amygdales present.

EOH camera survey 022°, 86°