Lithologies

- Lime mudstone
- Dolomite
- Mudstone
- Breccia
- Claystone
- Shale
- Matrix-supported conglomerate
- Siltstone
- Sandstone

Symbols

- Current ripple cross-lamination
- Wave ripple cross-lamination
- Planar cross bedding
- Trough cross bedding
- Load casts
- Water structures
- Algae
- Stromatolites
- Nodules and concretions
- Intraclasts
- Mudclasts
- Synaeresis cracks
- Convolute lamination

Base Boundaries

- Gradational
- Erosion
- Sharp

East Fork Swimming Woman Canyon

SCALE (m)	FACIES	LITHOLOGY	STRUCTURES / FOSSILS	MUD / SAND / GRAVEL (clay, silt, vf, f, m, c, vc, gran, pebb, cobb, boul)	LIMESTONES (mud, wacke, pack, grain, rud & bound)	NOTES
	1					
53						to steep and dangerous to measure. pattern of thin calcarious bed and fissle shale continues from last measured bed at 33M for another 20 meters.
52	Fcs, Ibs					
51						
50						
49						
48						
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46						
45						
44						
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42						
41						
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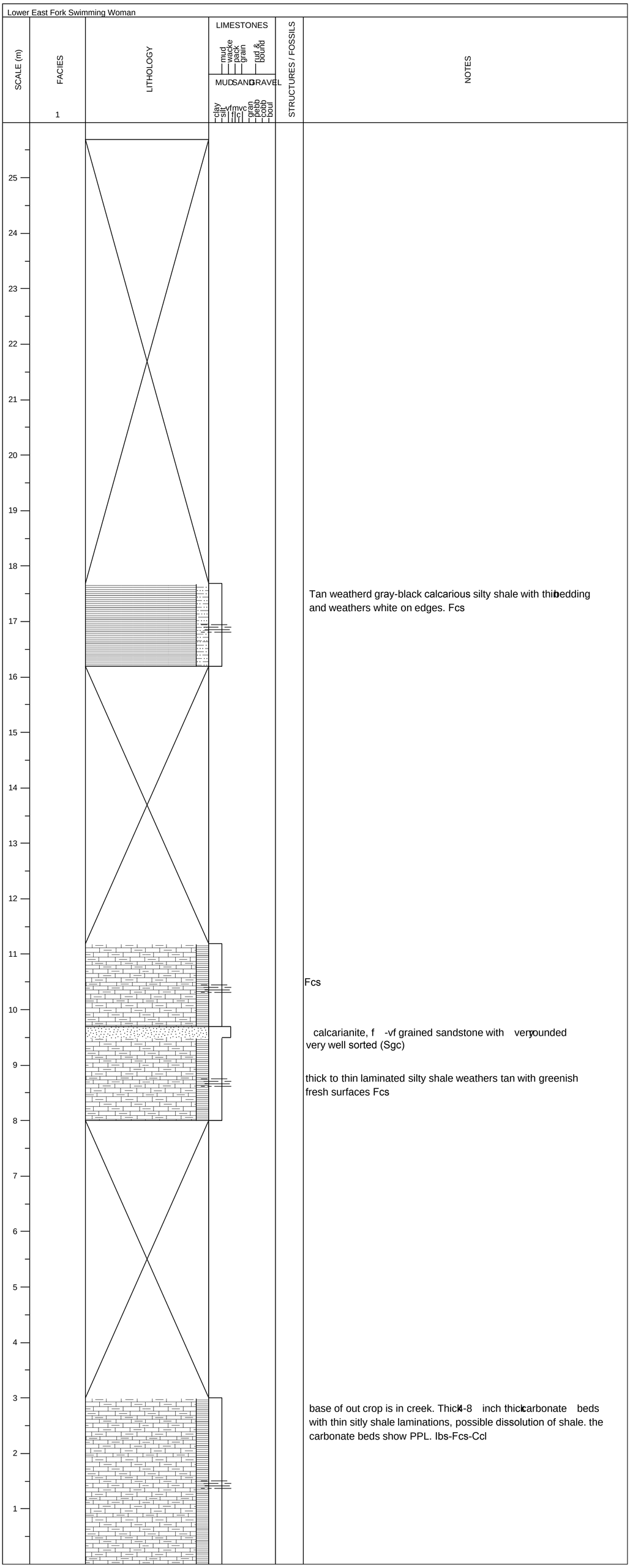
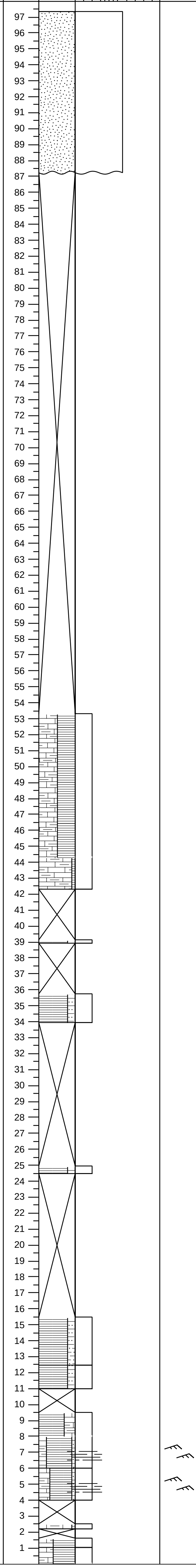
39						
38						
37						
36						
35						
34						
33						Fcs greenish gray fresh surfaces with tan weathering thin laminations Lower Newland! outcrop becoming to steep and dangers to continue. Cs continues for another 20 -30 feet . I don't see any additional carboante beds.
						Ccl
						Fcs
						Fcs
32						Ccl 5 inches thick. Similar to first carbonate bed
						Fcs
31						
30						
29						
						Ccl
						Fcs
28						Ccl roughly 5 inches thick. Similar to first carbonate bed
						Fcs
						Ccl roughly 6 inches thick. Similar to first carbonate bed
						Fcs
27						
						Ccl roughly 2 inches thick.
26						Fcs
						Ccl roughly 5 inches thick. Similar to first carbonate bed
						Fcs
25						Ccl 6 inches thick. Similar to first carbonate bed
						Fcs
						Ccl several beds at 4 inches
						Fcs
24						
						Fcs and concreations
23						
						Ccl
22						
						Fcs
21						
						Ccl
20						Fcs
						Ccl
						Fcs
19						
18						
						Ccl
						Fcs
17						Ccl
						Fcs
						Ccl
						Fcs
16						Ccl
						Fcs
15						
						Ccl
14						Fcs
13						
						Ccl
						Fcs
						Ccl
						Fcs
12						Ccl
						Fcn and have small disk and conreations within bed.
11						Ccl
10						Fcn and have small disk and conreations within bed.
9						Ccl
						Fcs
8						
						Ccl
						Fcs
7						
6						
						calcareous silty shale bed roughly 6 inches thick Fcs. it is also gray to tan weathering but is much less fissle and more resistive to weathering. there are small reddish laminations within possible hematite, and calcareous beds black to grey fresh surface and darker then the calcareous shale beds.
						greenish gray fresh surfaces with tan weathering thin laminations calcarious Lower Newland! (Fcs)
5						Float
4						
3						
2						
1						

Lower East Fork Swimming Woman



Swimming Woman Canyon West Fork

FACIES	SCALE (m)	LITHOLOGY	LIMESTONES (mud, wacke, pack, grain, rud & bound) / MUDSANDGRAVEL (clay, silt, vf, f, mvc, c, gran, pebb, cobb, boul)	STRUCTURES / FOSSILS	NOTES
1					



Flathead is unconfomably resting on Yn (angular unconformity)

Laminations become more wavey/crinckly with lenses of x laminationed silty, beds are primarily calcarious but intershale beds still weather white and reddish. lbs

Laminations become more wavey/crinckly with lenses of x laminationed Ccl and lbs

Carbonate beds with very thin laminated shale interbeds. <1cm. and again lacking pinch and swell structures. Fcs

White weathered silty shale with thin carbonate beds 2 cm above and below.(very small exposure in float. Fcs

Green silty shale weathered surfaces are darker gray, green then below and, PPl are seen and beds are thin. Ccl

small .5 m outcrop of green silty shale continues. Sample #3 taken from outcrop and has X lamination. with whitish weathering, Float around outcrop is again tan with potmarks.Fcs

Green silty shale continues with whitish weathering, Float around outcrop is again tan thin

Beds are thin 10 cm with Thin <1 cm laminations tan weathering to redsih and have (pot marks). when beds are removed form outcrop they tend to fracture in a platy manor and have pot marks

Stacking continues within float, moved 80ft N to get next exposed outcrop.

calcarious shale is thickening between carbonate bed, most likely dissolution up to 8 inchs. sample #2 taken @ 7.5 m (small 2 inch concretion.

Lenses of silty shale with isolated (nodular X laminations) and PPL within the silty lamination. Molar tooth structures are present but very small and isolated, up to 2 inches in length and <1cm in width. Look like tornado structures from SC12-112. Sample #1 taken at 4.5 m

Carbonate beds with very thin laminated shale interbeds. <1cm.

Float- tan weatherd thin bedded shale with occasional larger pieces of carbonate. Thin to thick laminated tan weathered, greenish fresh surface sitly shale. With

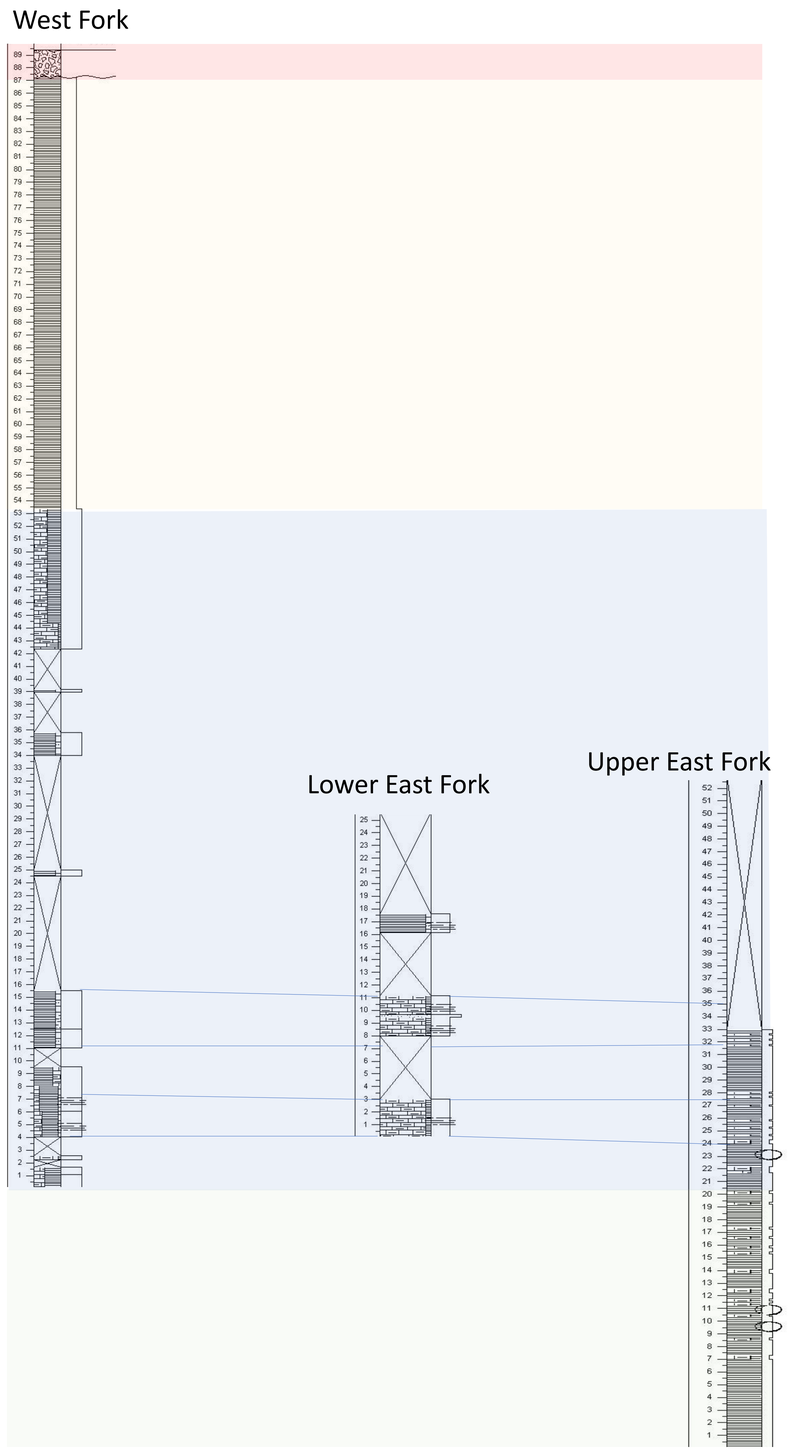
Checkerboard

FACIES	SCALE (m)	LITHOLOGY	STRUCTURES / FOSSILS	NOTES
1	81			Covered and beds have been decreasing in dip as we head east and there for can't measure the upper 10 meters of the out crop and the shale and cliff were near vertical. the folding within the carbonate beds continues and appears the same as directly below.
	80			sharp undulatory contact above barite sandy bed has sever interfomrational folding most lickly due to slumping within the sag basin during down to south movement of the norther block faults .
	79			
	78			
	77			
	76			Sharp undulatating contanct between a tan brown greenish lower silty unit and a dark massive carboante unit with vertical calcite veins. There is about .5 m of very fissle sitly shale below the contact. (unconformity or correlative conformity?) there is a small lense of sandstone that has been subjected to sulfides and Fe and shows Box structure, that look like vent fauna from the batire outcrop .
	75			transitions from primarily black micritic limestone with gray stipped silty laminations to all gray again. the gray to green is shales aren't calcarious buyt the thin laminae 1mm beween the sitly beds is calcarious.
	74			
	73			
	72			
	71			
	70			
	69			
	68			
	67			dark carbonate bed continues and Stripped shale becomes more apparent. these are described by scheiber as tempestites and the d and e portions of the Bouma sequance. the dark layers are the carboantious microbial mats followed by the gray silty layerssilty layers seem to be thickening up section. the shaly silty beds within this section gray. also within this unit we see the Newlandia diagenetic alteration of the carboantes. (dissolution and dolmoite presipitaitoon secondary diagenesis)
	66			
	65			
	64			dark Dark calcarious sandstone Gcs. the sandstone pinches ans swells along bedding and is composed of Qtz, and a dark black/gray calcarious matrix. Sgc
	63			
	62			fissle black paper shales and pyrite in in silty laminae. Thrust fault off set unknow dark massice carbonate bed continues and Stripped shale becomes more aparent. these are discribed by scheiber as tempestites and the d and e portions of the Bouma sequance.
	61			
	60			
	59			
	58			
	57			
	56			black very microspar, appears massive at outcrop scale but laminae can be seen on weatherd surfaces and has distince gray and balck couplets, Scheibers striped shale facies, thinly laminated gray and black "stripped Shale" also has wavy bedding as well as large vertical calcite veins up to 10 cm thick. (looks like unit in deep creek betweem 50 and 55 m we see vertical calcite veins and bed parallel calcite veins. The massive dark carbonate unit is composed of thin laminated beds within the massive beds. also lenses of silt with lamina tracking around lens looks to possibley have X stratta but need to look into False X strata from schiber also the present of mica flakes in bedding suggest a proximal source
	55			
	54			
	53			
	52			
	51			
	50			
	49			gray green shale with lenses of sitly layers and concreations within bedding also see Barite in beds (dark reddish oragne Fe oxide and . tan weathered and dark fresh surfaces.
	48			
	47			
	46			fissle black paper shales and pyrite in in silty laminae. Thrust fault off set unknow dark massive carbonate bed continues and Stripped shale becomes more aparent. these are discribed by scheiber as tempestites and the d and e portions of the Bouma sequance this study Fsn and Fcs.
	45			
	44			
	43			
	42			
	41			
	40			
	39			
	38			
	37			
	36			black limestone with microspar, black chert noduals distinctive of unit III folding in bed
	35			
	34			
	33			gray green shale with lenses of sitly layers and small slow flame structures. minor thrust faults within this area of outcrop. ovoid disks parallel to bedding plain suggesting microbial life
	32			
	31			
	30			
	29			
	28			gray green shale with lenses of sitly layers and small flame structures. everal minor thrust faults within this area of outcrop
	27			black very carbonaous micritic limestone with microspar, appears massive at outcrop scale but laminae can be seen on weatherd surfaces and has distinct gray and balck couplets
	26			
	25			
	24			
	23			
	22			
	21			
	20			gray green shale with 1-5 cm thick. carbonate beds are seen in the silty shale bedding, samples ch6-29-16 b and c were take from a maroon to red sitly sandy PPL layer
	19			gray red-maroon green shale silty with sandy plane parallel lamiantions
	18			gray green shale with 1-5 cm thick. carbonate beds are seen in the silty shale bedding, minor folds within the silty and microspar beds
	17			gray green shale with 1-5 cm thick. carbonate beds are seen in the silty shale bedding, gray black green very shale with 1-5 cm thick. and several large dark concreations are seen (dissolution of ca)
	16			gray green shale with 1-5 cm thick. carbonate beds are seen in the silty shale bedding,
	15			gray green shale with maroon silty lamina, and beds from 1-3 cm thick. carbonate concretions are seen in the silty shale bedding,
	14			gray black green very shale carbonaous with maroon micritic silty limestone lamina, with and m bedsicrospar from 1-3 cm thick. carbonate concretions are seen in the silty shale bedding, red maroon silty beds were sampled for bulk and elemental analysis
	13			gray black green shale with calcarious lamina, beds from 1-3 cm thick
	12			
	11			
	10			black very. micrpspar, carbonate beds are within the green shale and are a product of dissolutions and are not bedding lbs. laminations can be seen throughout the limestone beds and sometimes pich out or continue for long distances along the outcrop gray green shale with maroon silty lamina, and beds from 1-3 cm thick
	9			
	8			PPL black limestone with microspar gray green shale with maroon silty lamina, and beds from 1-3 cm thick
	7			
	6			fissile black laminations shale of green shale calcarious laminae on bedding surfaces
	5			PPL gray to green silty shale with carbonations interlaminations. A small thrust fault is seen in the bedding with a minor off set of .5 m
	4			black very microspar (shiny calcite crystals on fresh surface. the contact is shape and laminations /couplets are seen within the bed . shale light gray weathered surface and bedding plans are calcite and fizz.
	3			
	2			
	1			

LITHOLOGY: LIMESTONES — mud, wackstone, pack, grain, rud & bound; MUD SAND GRAVEL — clay, silt, vf, f, m, c, vc, gran, pebb, cobb, boul

sc12-112

FACIES	SCALE (m)	LITHOLOGY	LIMESTONES (mud, wacke, pack, grain, rud & bound; MUD: clay, silt; SAND: vf, f, m, c, vc; GRAVEL: gran, pebb, cobb, boul)	STRUCTURES / FOSSILS	NOTES
1	1–9				Debris flow conglomerate with thin to very thin laminations for silty shale and dolo-shale. conglomerate is poorly sorted and sub angular and matrix supported
	10–11				thin to thick lamianted of dark gray shale with micro faults and soft sed deformation. oxidation is present in laminations.
	12–16				light dark gray deformed shale and interclasts of shale and silty shale, dolo shale . debris flow shows fuildized matrix.
	17–28				Debris flow conglomerate with thin to very thin laminations for silty shale and dolo-shale. conglomerate is poorly sorted and sub angular and matrix supported
	29–36				light to medium gray dolostone and shaley with deformed and chaotic bedding, sltylolits are common and thin and silica veins perpendicular to bedding.
	37–41				dolomitic shale with less dolomite then above and flame structures are present, and chaotic bedding angles. clasts are dolomite adn shale
	42–54				soft sediment deformation and micro faults within thin to very laminations. Shale, dolomite
	55–65				Dolomitic shale with frequant micro faults and stylolits with folded or Slumping within laminations and bedding.
	62–64				thin to very thin laminations of brown to black shale
	65–66				conglomerate dolstone fluidized flow .
	67–76				conglomerate of dolomitic shale and shale. see micro turbidites. blocks of Dolomite within the shaley dolomite. debris flows, slumping
	77–83				thin bedded deformed unit with thin laminations of silty shale and dolo has silty lenes 2mm thick and silica veins, parallel and perpendicular to beding.
	84–86				silty dolo, dolo shale, 3-4 cm beds and folding occuring, soft sed deformation.
	87–93				silicified section decreasing tawords base. Conglomerate silty dolostone and stylolites. siltyshale, Dolo. conglomerate is matrix supported and has sub angular clasts.
	94–106				Thin lmainated silty shale and weakly dolomitic shale. several beds of thin laminated black shale. at base the section is composed of weakly stylolitic silty gray dolostone and less silt. has a sharp contact with lower bed. and wavy laminations of Dolomite
	107–117				Silty shale and silty dolomite. some inter slightly disturbed and has micro faults, small sone of intercalsts and softs sed deformation.
	118–121				weakly deformed beds of silty gray shale and thin laminated dolomitic shale. seveal zones have wispy (tornado type) dolomite fomation and interclast conglomerates
	122–125				debris flow conglomerate between two liquified beds. Debris flow is composed of silty shale and dolo-shale, original bedding looks like (stripped shale) and conglomeritic shale is composed of intrabasinal newland.
	126–140				highly deformed , soft sed deformations, within very thin lmainated grey shale and dark gray silty shale, some silty lenses are also seen in bedding and. laminations are wavy (microbial) and chaotic.
	141–147				THinly laminated listy shale and silty dolomite , with znes of folding and high angle to bedding faults. with increasing dolomite veins.
	148–156				Folded bedding, composed of dark shale and light silt stone, very thin laminations, disturbed sections,
	157–164				conglomeritic silty dolostone,stylolites are present within unit and and are more numerouse at top and less at base.
	165–172				Off white parallel veins in greenish silty shale with greenish clay decreasing with depth. primarily silty shlae and some silty dolomite, with very planar laminatiions tawords the base.
	173–184				Dolomitic shale and black shale . slitly more silty then above and with very thin laminations. soft sediment slumping is seen with folding in core. clasts(breccia) show
	185–190				silty shale black with some gray lams. disseminated pyrite
	191–195				transition to dolomite dark gray silty shale. and bedding becoms indestinguishable towards base from dolomite alteration.
	196–208				Dark black dolomitic shale with wispy dolomite alteration (looks like tornado structures or molartooth structures. and run horizontal to vertical within core.
	209–214				black shale with several zones of gouge and the micro faults filled silica.
	215–221				Hanging wall dolomite/ silicified. has many stylolites and bedding shows folding has a sharp contact with sheared zone.
	222–229				Sheard zone with silica megacrysts.
	230–234				very dark fault gouge with Silica mega cryss up to 3cm, and several larger Py "blebs" (zeig)
	235–243				steeply dipping thin laminations of dolomitic silty shale and silty dark gray shale . with dolomite veins up to 1cm thick. perpendicular to bedding.
	244–256				less dolomitic then above and thinly bedded shale. several minor dolomitic beds are steep at base
	257–274				Striped shlae with dolo filled veins oblique to bedding towards the the top with several micro faults. becoming less dolomitiitc down hole and more distinct stripping of beds.
	275–306				beds decreas anlge down hole and have Py within the laminations. Contact is sharp and the color changes from striped shale below to dark Black shale with minor Py laminations and dolomite filled veiins (dark black).
	307–339				striped shale, with micro faulting in beds perpendicular to bedding ofset of 3 cm. several thick laminations of silty dolomite. Bedding and lams are primarily PPL, but one zone at 297 has very wavy Black laminations with the gray dolomite.
	340–379				thick to thin laminated of silty shale with interlaminations of dark black shale, slightly Dolo (zeig). Very dark black shale @ 314-315, steepening bedding angle
	380–410				Similar stirped pattern in beds but with less silt and more black shale. small zone of black shale clasts, and slightly fractured above clasts.
	411–423				Sharp faulted contact with gouge (1nch). up hole above gauge, Fault breccia is seen for 10 cm and then starts, getting into Schiebers stripped shale. black carbonate shale with gray dolomite. beds are steeply dipping and show micro faulitng within the beds.
	424–427				thin laminated black shale With Mlcro turbiditess and pyrite, Micro tubidites micro turbidites are gray silt fining up to black shale.
	428–429				ppl shale that shows increased angle of bedding and fluid flow . Sharp almost breccia like texture within the bedding . alos has desimianated pyrite up to samll pebble size Very sulfide rich with potential vent fauna(zieg)
	430–439				Fault gauge and shale with Py laminations
	440–449				several shear zones within thin laminated balck shale and dark gray shale Qtz and Dolomite veins are perpendiculare to bedding
	450–455				Very disturbed bedding, and sof sediment deformation.shale goes from greenish to primarily black and thick silty sandy lams. Tornado structures are seen within bedding and are white silty filled cracks accosiated with compation and fluidization. also are dolomatized in this unit. (the Yn contact is gradationally within this area but i don't see hummocks) 40% silt - 20% black shale -40 % VFs. wavy Laminations but do not see hummocky X strat
	456–518				Partially lithified clasts within slumps (similar to chamberline creek to the northClasts show very thin to thick lamiantions of silt and sand with very thin black shale
	519–528				Similar dark black to green shale with silty wavey laminations. the beds are very steep and convoluted. possibly due to slumping along shelf.
	529–532				Similar dark black to green shale with silty wavey laminations. the beds are very steep and convoluted. possibly due to slumping along shelf.
	533–534				fining up packages from F ss to silt and black shale beds are 1 -.5 inchs thick
	535–536				fining up packages from F ss to silt and black shale beds are 1 -.5 inchs thick
	537–549				fining up packages from F ss to silt and blakc shale shale beds are 1 -.5 inchs thick
	550–605				Cave in shale with sand lenses in middle several rip up clasts and
	606–608				Vertical faults and fault brecca . similar pattern and hematitie staining in bedding and along fault
	609–612				less carbonate laminations then 1898-1895 feet with rip up clasts followed by wavey laminations and black wavey laminations. Sand lenses have ripple laminations and apear in ovals parallel to bedding. wavy bedding has X lams
	613–614				zone of dark carbonate chips (microbial)
	615–618				Dark black Laminations of silt/vfss less dark laminaitons then bleow and less shale. more silty sandy with wavey bedding normal graiding to thin laminated black shale. black ovals on end cap of core shows evidance of microbial life
	619–621				Dark black Laminations of silt/vfss and load structures into silty layers minor folding and doming of laminations
	622–624				Dark black Laminations of silt/vfss and load structures into silty layers
	625–627				Wavy bedding continues with vf sand and vertical fractures/ Hematite staining. rip up clasts at base
	628–629				Wavy bedding continues with silty carbonate laminations and flame structures
	630–633				Black carbonate wavy laminations appear to be microbial mats (stromatolites in legand) with Py mineralization.
	634–637				red hematitie staining in vf sand with balck sitly shale wavy bedding, gradational contact but looks like a depositional event Contact between Ycm and Ych
	638–641				Wavy bedding continues with silty carbonate laminations and flame structures with ripples and black ripup clasts movng up hole fluid escape structures are seen as whisps of sand intruding overlying shale beds, looks similar to chamberlane shale
	642–644				silt/shale ripup clasts and x laminations. rip up clasts are red and green shale,
	645–646				redish hematitie satining, with greenish laminations below
	647–649				sharp contact at the base of bedding, (Regression or increase in Sed Supply white and green wavey bedding. with increasing sand up section
	650–652				Silty sand unit. redish/ oxidized, ripple laminations, coursening up (silty decresing up section) Flaiser bedding and fluid escape structures are seen in bed, and sand lenses are greenish
	653–654				Green silt with PPL, Flodding event
	655–657				Hematite staining above green wavey silty bedding. with clay ripup clasts.
	658–660				green sitly with PPL
	661–663				grains are fining and several silty lenses of tan whiteish silt
	664–666				Cave in
	667–669				Clay rip up clasts above cave in
	670–672				green sitly with PPL
	673–675				Clay rip up clasts above cave in
	676–678				Clay rip up clasts above cave in
	679–681				Cave in
	682–684				grains are fining and several silty lenses of tan whiteish silt
	685–687				x bedding, PPL and trough X bedding grains coursen up
	688–690				Dark black Laminations of silt/vfss less dark laminaitons then bleow and less shale. more silty sandy with wavey bedding normal graiding to thin laminated black shale. black ovals on end cap of core shows evidance of microbial life
	691–693				grains are fining and several silty lenses of tan whiteish silt
	694–696				Neihart Quartzite - hematite staining in vertical veins and bedding, alternating x laminations and PPL. Grains are very well rounded and opague /frosted



Cambrian Flathead

Cs-Fs lithofacies (Unit 2)– Mostly seen as float with little to no calcareous beds

Mcl-Ibs (Unit I – Onset of thick carbonate beds larger then shale interbeds

Cs-Ibs lithofacies (Lower Newland)–carbonate beds are present up to 6 inches, shale interbeds thicker then carbonate beds