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**PERMIAN AND SOME CARBONIFEROUS SECTIONS IN THE SURFACE
AND SUBSURFACE OF NORTHERN YUKON AND ADJACENT
NWT, AND MACKENZIE DELTA**

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Although every effort has been made to ensure accuracy, this Open File Report has not been edited for conformity with Geological Survey of Canada standards.

CONTENTS

Introduction	p.1
Field sections	P.1
Carboniferous and Permian in Mackenzie Delta wells	p.42
Geological Survey of Canada Paleontological Reports	p.48
References	P.48

LIST OF FIGURES

- Fig.1: Location of surface and subsurface sections with Carboniferous and Permian strata.
Fig. 2: Stratigraphic nomenclature

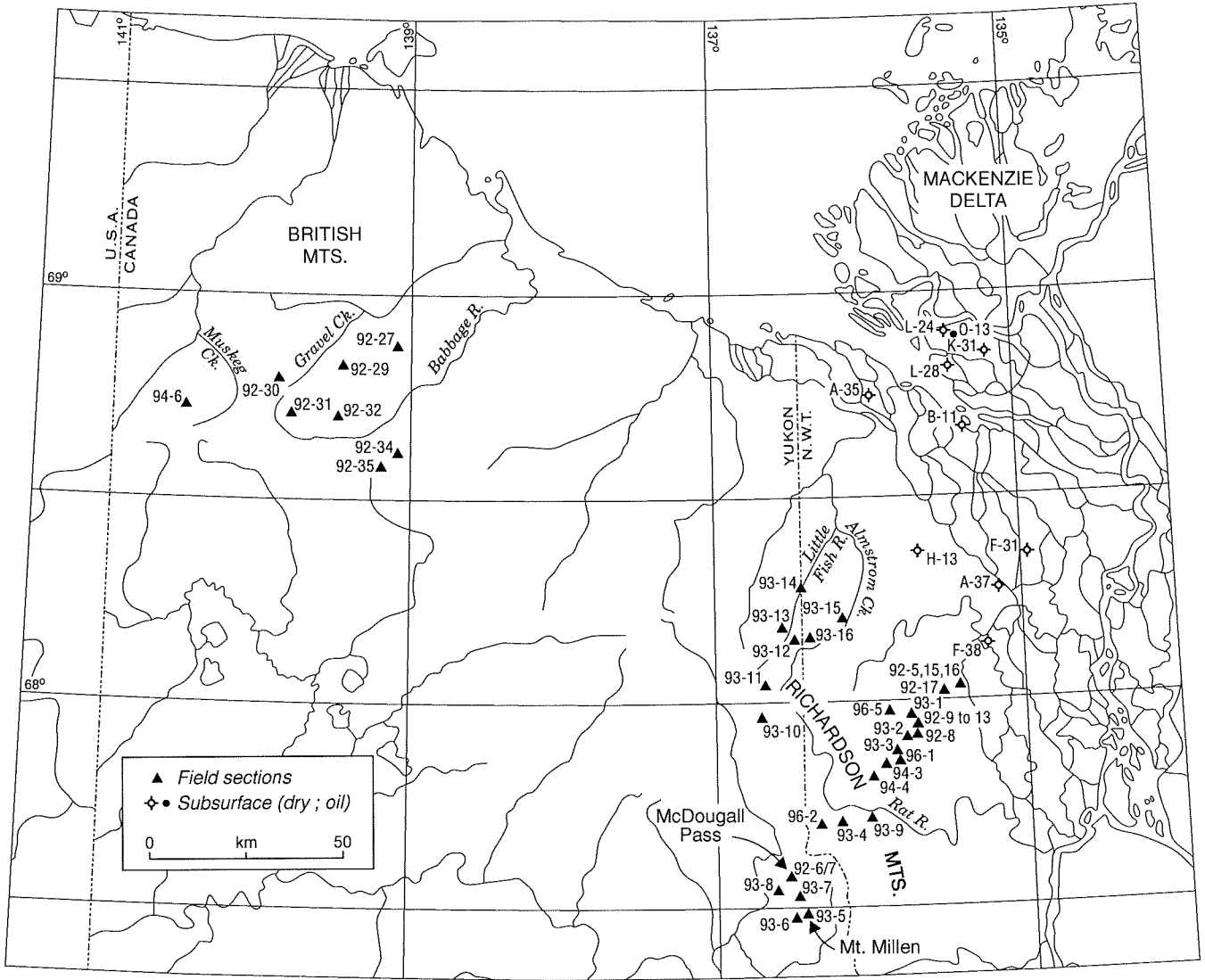


Figure 1. Location of surface and subsurface sections with Carboniferous and/or Permian strata.

INTRODUCTION

The following descriptions of field and subsurface sections, principally in Permian strata, but with some Carboniferous, were measured or examined by J. Dixon between 1992 and 1996 from the British and northern Richardson Mountains, and in the subsurface of southwestern Mackenzie Delta (Fig. 1). Details of the lithological successions in surface sections, descriptions of core from exploration wells in the Mackenzie Delta, and paleontological reports on samples from some of the sections are presented. The data presented here form part of the database for a study of Permian and Triassic strata by Dixon (in press).

The Permian rocks include the Echooka, Jungle Creek, and Longstick formations (Fig. 2). Echooka strata are present in the southern British Mountains, and Jungle Creek and Longstick formations are present in the northern Richardson Mountains and in the subsurface of southwest Mackenzie Delta. Echooka and Jungle Creek are well established formational names (Detterman et al., 1975, Bamber and Waterhouse, 1971), whereas Longstick Formation is a new term that has been defined by Dixon (in press). Carboniferous strata include the Lisburne Group.

FIELD SECTIONS

Field sections are designated by the author's GSC unique identifier code (DFA), the year, and the section number, e.g., DFA94-1, is a section first examined by J. Dixon in 1994 and it was section number 1. Samples from the section would be designated by a second field number, i.e., DFA94-1-1 etc., which would then be given a unique GSC C-number for curation purposes. All samples are stored at the Calgary office of the Geological Survey of Canada. All field sections retain the same year/number even if subsequently revisited. All the author's field notebooks are curated at the Calgary office of the Geological Survey of Canada and are available for viewing.

The latitude and longitude of most sections were obtained using the Global Positioning Satellite system with a receiver in a helicopter. All co-ordinates will be identified by the initials GPS if located in such a manner, otherwise the co-ordinates were obtained from the appropriate NTS map-sheet.

DFA92-5

Jurassic Butte, Aklavik Range, Richardson Mountains, NWT. Southeast spur off the butte.

Lat. 68° 01' 30"N Long. 135° 27' 45"W (GPS)

NTS: 107B/4

UTM: 7544400N 458600E

Strata: Road River Formation (lower Paleozoic); Lower member, Jungle Creek Formation (Permian); Bug Creek Group (Jurassic).

Unit Thickness Ht. above Description

(m) base (m)

Basal contact is covered but able to approach within a metre or so of contact with the black, fissile shales of the lower Paleozoic Road River Fm.

JUNGLE CREEK FM (PERMIAN) (rusty red or reddish brown colour throughout)

1	6.7	6.7	<u>Breccio-conglomerate</u> : small, subangular clasts of siliceous shale and chert (similar lithology to the underlying Road River Fm). Clast edges are rounded but clasts tend to be cuboid in shape, not spherical. Clasts generally < 2 cm. Clasts are generally matrix supported; matrix of clay. No apparent internal bedding within the breccio-conglomerate. Dark reddish brown weathering colour. Unit contains veins of gypsum.
2	10.5	17.2	<u>Mudstone</u> : dark reddish brown. Silty to sandy. Abrupt basal contact.
3	0.3	17.5	<u>Breccio-conglomerate</u> : similar to unit 1. Clasts up to 8 cm. Poorly sorted clasts; generally matrix supported with some clast contacts. Slight tendency for flatter clasts to be aligned subhorizontally.
4	0.4	17.9	<u>Red mudstone</u> :

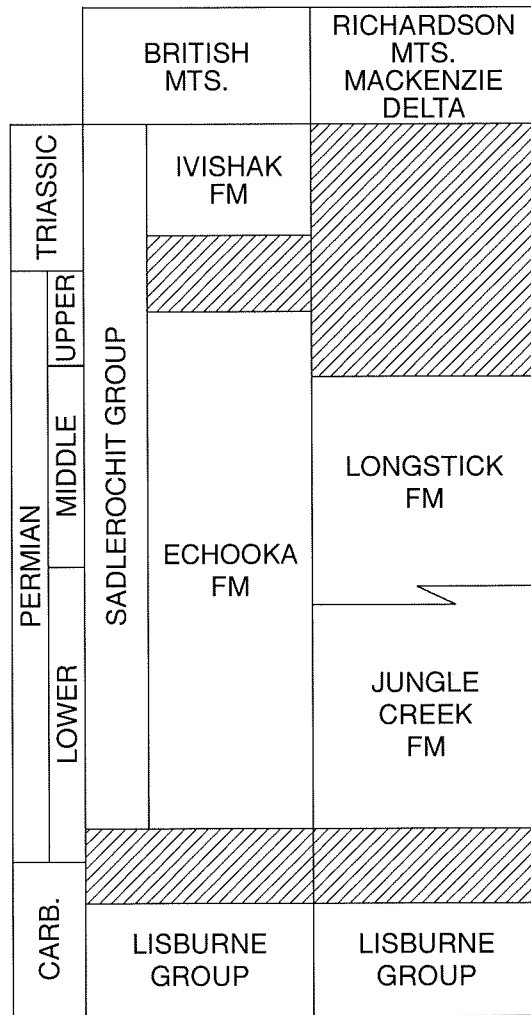


Figure 2. Stratigraphic nomenclature.

5	0.2	18.1	<u>Breccio-conglomerate:</u>
6	0.4	18.5	<u>Red mudstone:</u>
7	0.1	18.6	<u>Breccio-conglomerate:</u> small clasts.
8	5.7	24.3	<u>Red mudstone:</u> may contain some thin beds of breccio-conglomerate (much surface weathering masks outcrop).
9	1.2	25.5	<u>Breccio-conglomerate:</u> clasts up to 20 cm. Matrix to clast supported. Probable abrupt top/base (rapid lithology and cementation changes indicate abruptness). Clasts tend to be subhorizontally aligned. Matrix of clay to granules.
10	3.7	29.2	<u>Breccio-conglomerate:</u> matrix supported. Capped by a bleached (white) cap of material about 5-10 cm thick. Clasts generally <5 cm.
11	1.4	30.6	<u>Red mudstone:</u> capped by bleached layer 2-4 cm thick.
12	6.3	36.9	<u>Breccio-conglomerate:</u> varies from matrix to partially clast supported. Wide range of clast sizes; largest about 12 cm.
13	0.6	37.5	<u>Red mudstone</u>
14	1.0	38.5	<u>Breccio-conglomerate:</u> Clasts <10 cm.
15	0.1	38.6	<u>Red mudstone</u>
16	0.002	38.602	<u>Sandstone:</u> lense extending laterally about 1 m. Fine grained.
17	0.2	38.8	<u>Breccio-conglomerate:</u> matrix supported. Clasts <3 cm.
18	2.6	41.4	<u>Red mudstone</u>
19	1.5	42.9	<u>Calcareous nodules:</u> in red mudstone. Vary from "pea" size to 10 cm.
20	1.4	44.3	<u>Red mudstone</u>
21	0.2	44.5	<u>Calcareous nodules:</u> in red mudstone. Capped by bleached mudstone a few cm thick.
22	1.5	46.0	<u>Breccio-conglomerate:</u> <2 cm clasts. Matrix supported. Capped by bleached layer.
23	1.5	47.5	<u>Red mudstone</u>
24	3.0	50.5	<u>Breccio-conglomerate:</u> mostly matrix supported. Clasts generally <5 cm with a few larger. Irregular basal contact.
25	1.4	51.9	<u>Red mudstone</u>
26	0.6	52.5	<u>Breccio-conglomerate:</u> matrix supported.
27	0.6	53.5	<u>Red mudstone:</u>
28	0.7	53.8	<u>Breccio-conglomerate</u>
29	0.6	54.4	<u>Red mudstone</u>
30	4.0	58.4	<u>Breccio-conglomerate:</u> varies from matrix to clast supported. Flat clasts subhorizontally aligned. Capped by a 10-20 cm bleached layer.
31	1.3	59.7	<u>Red mudstone</u>
32	0.1	59.8	<u>Breccio-conglomerate:</u> bleached.
33	1.7	61.5	<u>Red mudstone</u>
34	0.3	61.8	<u>Breccio-conglomerate:</u> clasts <3 cm. Matrix supported.
35	0.2	62.0	<u>Red mudstone</u>
36	0.2	62.2	<u>Breccio-conglomerate</u>
37	0.6	62.8	<u>Red mudstone</u>
38	2.7	65.5	<u>Breccio-conglomerate:</u> clasts up to 10 cm. Top 20 cm bleached.
39	1.8	67.3	<u>Red mudstone</u>
40	1.2	68.5	<u>Breccio-conglomerate:</u> clasts up to 10 cm. Abrupt upper contact may be a minor fault offset - very irregular contact with unit 41.
41	3.7	71.2	<u>Red mudstone</u> top 2 cm bleached.
42	2.8	75.0	<u>Breccio-conglomerate:</u> clasts <10 cm.
43	0.2	75.2	<u>Red mudstone</u>
44	1.1	76.3	<u>Breccio-conglomerate:</u> matrix supported. Clasts generally <5 cm.
45	0.7	77.0	<u>Red mudstone</u>
46	2.4	79.4	<u>Breccio-conglomerate:</u> bleached top.
47	0.4	79.8	<u>Red mudstone</u>
48	1.0	80.8	<u>Breccio-conglomerate:</u> clasts <5 cm, a few larger clasts. Bleached top.

49	1.4	82.2	<u>Red mudstone</u> : lense within a breccio-conglomerate unit.
50	6.7	88.9	<u>Breccio-conglomerate</u> : where larger clasts are concentrated there are indications of crude bedding. Poorly sorted. Clasts generally <5 cm except on the crude bedding planes.
51	5.7	94.6	<u>Red mudstone</u> : interbedded with thin beds and lenses of breccio-conglomerate, generally <10 cm thick. Breccio-conglomerate layers commonly bleached.
52	2.8	97.4	<u>Breccio-conglomerate</u> : clasts <2 cm some scattered larger clasts.
53	3.3	100.7	<u>Red mudstone</u> : lenses of breccio-conglomerate.
54	1.3	102.0	<u>Breccio-conglomerate</u> : matrix-rich.
55	10.0	112.0	<u>Interbedded mudstone/breccio-conglomerate</u> : Beds/lenses are a few 10s of cm thick.
56	10.4	122.4	<u>Red mudstone</u>
BUG CREEK GP (JURASSIC)			
57	not measured		<u>Basal conglomerate grading up into sandstone</u> : Recycled clasts from the Permian redbeds and the Road River Fm. Clasts are well rounded, in contrast to the Permian redbed pebbles.

NOTE: the breccio-conglomerate units tend to be a maroon to rusty brown colour whereas the mudstone is lighter, more brick-red, in colour.

DFA92-6

Unnamed southern tributary of Bell River, about 15 km south of Summit Lake, McDougall Pass, Richardson Mountains, Yukon.

Lat. 67° 34.24'N Long. 136° 28.55'W (GPS) - this is the location of the campsite, the section base begins about 0.5 km to the west and follows a gully up the southern valley slope.

NTS: 116P/9

UTM: 7495100N 437100E

Strata: Jungle Creek and Longstick formations (Permian) - basal contact covered; Bug Creek Group (Jurassic).

Measurements begin at first exposure, approximately 500 m from the stream.

Unit Thickness Ht. above Description

	(m)	base (m)	
JUNGLE CREEK FM (PERMIAN)			
1	19.5	19.5	<u>Sandstone</u> : alternating beds of fine, medium and coarse grained sandstone with some granular beds. Silica cemented. Poor quality of exposure make internal structures and nature of interbedding difficult to distinguish. Most beds appear massive and are generally covered in lichen. A few examples of planar cross bedding seen, especially where coarse grained sand alternates with finer sand on cross beds. Individual bed thickness difficult to determine, most appear to be <50 cm. Where seen, the base of individual beds are abrupt.
2	10.5	30.0	<u>Covered</u> : recessive weathering. Silty shale in talus. Change from unit 1 to 2 marked by an abrupt slope change.
3	4.5	34.5	<u>Sandstone</u> : poorly exposed. Fine to medium grained sandstone interbedded with 20-50 cm beds of sandy bioclastic limestone/calcareous shelly sandstone. The calcareous beds are present in the upper 2 m of the interval and the beds have abrupt bases and tops. No internal sedimentary structures seen in any of lithology types. Lower contact with unit 2 covered; contact with unit 4 is abrupt to rapidly transitional over a short vertical (<50 cm) distance.
4	13.5	48.0	<u>Shale</u> : Medium grey; indurated. Abundant <i>Zoophycus</i> . About 9-10.5 m above base of interval there are two 50-70 cm thick, very fine grained, thoroughly bioturbated sandstone beds. Both beds appear to be lenticular; the lower bed has an outcrop length of about 3-4 m. Upper bed is exposed for length of outcrop (about 15 m).
5	6.0	54.0	<u>Covered</u> grass covered. Some shale seen in ground-squirrel burrows.

6	22.0	76.0	<u>Shale</u> : medium to dark grey; indurated. Blocky to fissile weathering. Silty to sandy in places. Talus material contains burrow mottled silty shales and <i>Zoophycus</i> . Some discoidal concretions. In top 5 m there are several 20-50 cm beds of thoroughly bioturbated, silty, very fine grained sandstone. Sandstone beds have abrupt bases/tops and some beds contain remnants of fine lamination.
7	2.6	78.6	<u>Sandstone</u> : first 50-70 cm consists of apparently thoroughly bioturbated, silty, fine grained sandstone. Lower contact not well exposed but appears to be transitional over a very narrow vertical distance. Remainder of interval consists of alternating beds of very coarse grained to granular, calcareous sandstone and silty, argillaceous, very fine grained calcareous sandstone. Coarse sandstones: beds few cm to 50 cm thick; erosional bases, abrupt tops. Contain scattered fragments of solitary corals and shell debris. No internal sedimentary structures seen. Very fine grained sandstone: beds usually only a few cm thick and commonly truncated by overlying coarse sandstone - giving appearance of lenticular beds.
8	2.7	81.3	<u>Sandstone</u> : very fine grained. Dark grey on fresh surfaces, rusty brown weathering colour. Thoroughly bioturbated. Abrupt basal contact; diffuse, transitional upper contact.
9	1.1	82.4	<u>Silty shale</u> : light to medium grey. Sandy and silty. Contains lenses and thin beds of finely laminated, very fine grained sandstone.
10	1.4	83.8	<u>Sandstone</u> : argillaceous, very fine grained. Thoroughly bioturbated. Transitional base, abrupt top.
11	4.5	88.3	<u>Shale with thin interbeds of sandstone</u> : Sandstone beds: few cm to 15 cm thick; very fine to fine grained; some beds thoroughly bioturbated, others contain fine subhorizontal laminae.
12	3.3	91.6	<u>Sandstone</u> : brown weathering colour. Abrupt basal contact. Very fine grained. Thoroughly bioturbated. Individual beds difficult to discern.
13	21.0	112.6	<u>Shale with sandstone interbeds</u> : Sandstone: 5-30 cm thick beds; abrupt bases/tops; very fine to fine grained; weathers brown. Transitional into unit 14.
14	6.0	118.6	<u>Sandstone</u> : very fine grained. Thin to medium beds. Apparently thoroughly bioturbated. Rusty weathering colour; dark grey fresh.
15	66.0	184.6	<u>Shale with sandstone interbeds</u> : Large ironstone concretions in first 4 m. Dark grey to black; brittle. First significant (20-30 cm thick) sandstone bed occurs 7 m above base of interval. Upper 30 m contains abundant sandstone interbeds; variable bed thickness up to 1 m. Commonly present in bundles 2-3 m thick. Access difficult therefore no details of internal sedimentary structures obtained.

NB: LONGSTICK FM BEGINS AT ABOUT 230-235 m, WITHIN UNIT 16

16	100.5	285.1	<u>Covered</u> : talus and grass. A break in slope about 45-50 m above base of interval may coincide with a change to a sandstone dominant interval. Talus is mostly large blocks of sandstone.
17	10.0	295.1	<u>Sandstone</u> : isolated outcrop in a talus slope. Fine grained; grey fresh surface; rusty brown weathered colour. Highly fractured and indurated (silica cement). Traces of fine, low-angle cross laminations.
18	86.0	381.1	<u>Talus</u> : large blocks of sandstone. Scattered exposures of sandstone. Very fine to fine grained; finely cross laminated. Scattered occurrences of thin beds or coquinas of brachiopod shell debris. Shells mostly half-shells and generally aligned with bedding although some are vertical. Abundant Liesegang rings in sandstones.

- | | | | |
|----|-------|-------|---|
| 19 | 24.0 | 405.1 | <p><u>Sandstone</u>: very fine to fine grained.
Highly indurated because of silica cement. Generally lichen covered. Forms first prominent outcrop near upper part of valley slope. Top of outcrop marked by a grass-covered bench. Poor quality exposure, some indications of fine cross laminae and thoroughly bioturbated beds.</p> |
| | | | ?BUG CREEK GP |
| 20 | 114.0 | 519.1 | <p><u>Talus</u>: large blocks of sandstone.
Similar to unit 18. Scattered outcrops of lichen-covered sandstone. Rusty brown colour on blocks. Very fine to fine grained; silica cemented. Few sedimentary structures seen - a few examples of fine, low-angle cross and subhorizontal laminae. Some belemnites noted in talus.</p> |
| 21 | 30.0 | 549.1 | <p><u>Sandstone</u>: cliff-forming at top of ridge.
White to light grey weathering colour. Fine grained; silica cemented; thickly bedded. Some beds display very low-angle cross laminae. Wave ripples noted on some bedding planes.
A very distinct unit compared with underlying sandstones.</p> <p>---- End measurements at top of valley slope ----</p> |

NOTE: Much of the sandstone talus contains fine, low-angle cross laminae and brachiopod coquinas or contain shell debris.
Several blocks showed a distinct vertical arrangement of facies - a basal scour overlain by a shelly layer 2-4 cm thick, in turn overlain by cross laminated sandstone. This facies arrangement was seen to be repeated in beds 15-30 cm thick. Such beds are typical of storm deposition.

Unit 20 may be the basal beds of the Bug Creek Grp.

DFA92-7

Unnamed southern tributary of Bell River, about 15 km south of Summit Lake, McDougall Pass, Richardson Mountains, Yukon. Approximately 1-1.5 km southeast of DFA92-6.

Lat. 67° 34.22'N Long. 135° 28.5'W

NTS: 116P/9

UTM: 7494900N 437300E

Strata: Imperial Formation (Devonian); Lower member, Jungle Creek Formation (Permian).

Unit Thickness Ht. above Description
(m) base (m)

	IMPERIAL FM (DEVONIAN)		
	<i>(m)</i>	<i>base (m)</i>	
1	9.0	9.0	<p><u>Conglomerate-Sandstone</u>: Conglomerate prevalent - granule to large cobble-size clasts; poorly sorted; matrix to clast supported. Clasts of chert, quartzite and vein quartz. Sandstone - coarse grained to granular, some scattered small pebbles. Difficult to discern bedding.</p>
2	5.5	14.5	<p><u>Interbedded shale-sandstone</u>: Mostly covered to recessive weathering with talus of shale and argillaceous, fine grained sandstone.</p>
3	7.5	22.0	<p><u>Conglomerate-sandstone</u>: similar to unit 1. Clast size up to small boulder.</p>
4	11.5	33.5	<p><u>Talus</u>: sandstone, shale and conglomerate in talus - suspect interbedded nature of interval. Clasts up to small boulder size.</p>
5	6.0	39.5	<p><u>Sandstone-conglomerate</u>: Mostly very fine to granular sandstone beds with some minor amounts of small-pebble conglomerate. Difficult to discern bedding. Pockets of shale talus suggest presence of thin</p>

			shale interbeds.
----	Shear zone at top of unit 5 could indicate a small fault, however assumed minor offset and continued measurements		
6	4.5	44.0	<u>Sandstone</u> : very fine to coarse grained. 50-75 cm thick beds. No internal sedimentary structures seen.
7	6.0	50.0	<u>Talus</u> : with some minor exposure. Silty shale and argillaceous sandstone talus with at least two exposed sandstone beds. Lower sandstone is 15 cm thick; upper sandstone 75 cm thick. Both beds are highly fractured, almost a crude cleavage.
8	4.0	54.0	<u>Sandstone</u> : very fine grained. argillaceous. Rusty brown weathering colour; highly fractured/cleaved.
9	3.0	57.0	<u>Talus</u> : shale and sandstone talus.
10	4.5	61.5	<u>Sandstone</u> : very fine grained. Highly fractured/cleaved.
11	6.0	67.5	<u>Talus</u> : poor exposure. Shale and silty, argillaceous sandstone.
	----Unconformity overlain by Permian strata with opposing dip direction -----		
	Contact not exposed but able to approach within a few 10s of cm.		
	JUNGLE CREEK FM (PERMIAN)		
12	4.5	72.0	<u>Sandstone</u> : coarse grained to granular. Silica cemented. Grains of black chert and quartz. Fine, subhorizontal laminae in first 2 m, remainder of interval mostly talus blocks and a few scattered outcrops.
13	7.5	79.5	<u>Talus</u> : large blocks of sandstone.
14	1.5	81.0	<u>Conglomerate-sandstone</u> : First unit of cliff-forming strata and mostly hidden by large talus blocks from above. Very coarse grained to granular sandstone containing a cobbly, granular sandstone mid-way through interval.
15	est.3.0	84.0	<u>Talus</u> : large blocks from above.
16	7.0	91.0	<u>Sandstone</u> : Basal 2-3 m predominantly very coarse grained to granular sandstone with low-angle cross bedding. Overlain, apparently abruptly, by a pebble- to cobble-bearing coarse grained sandstone unit. Pebbles are not very abundant in the latter and tend to occur along cross beds. Upper 4-5 m consists of fine to coarse grained, cross bedded sandstone. Cross bed sets - low-angle cross bedding. Individual beds 30-50 cm thick. Each bed tends to have an erosional base. Three dimensional aspect of cross beds difficult to ascertain. Most of cliff-face is covered by lichen.
17	2.1	93.1	<u>Sandstone-conglomerate</u> : Multiple beds of variable thickness but most are <30 cm. Each beds consists of a basal scour overlain by coarse grained to granular, locally pebbly (black chert), sandstone, in turn succeeded by fine to medium grained sandstone. Trough cross bedding in the finer sandstones is very prominent but cross bedding in the coarser sandstones is not always visible. The coarser sandstones are calcite cemented, whereas the finer sandstones are less calcareous. Lenses of coarser sandstone occur along the cross beds of the finer sandstones. Apparently abruptly overlies unit 16A and is abruptly overlain by unit 18.
18	6.5	99.6	<u>Sandstone</u> : light grey weathering colour. Medium grained to granular. Silica cement. Low angle cross beds seen on a few surfaces; otherwise hidden by lichen. Cross bedding appears to be trough cross stratification. Multiple beds.
19	2.1	101.7	<u>Sandstone</u> : brown weathering colour. Abruptly overlies unit 18. Fine to medium grained with some layers and laminae of coarser sand. Massive appearing, some cross bedding.
20	4.0	105.7	<u>Sandstone</u> : brown weathering colour. Transitional change from unit 19. Similar to unit 17. Some of the coarser beds are

- lenticular.
- 21 Not measured Recessive: top of sandstone cliff. forms a grass covered bench. Corresponds to the shale in unit 2 of section DFA92-6.
----- End of measurements/observations -----

DFA92-8

Headwaters of East Bear Creek, Richardson Mountains, NWT. This section is located in close proximity to section 7 on D.K. Norris' (1981c) geological map (GSC map 1520A).

Lat. 67° 51' 48"N Long. 135° 47' 12" (GPS) - location of campsite, section begins about 0.5 km to the west in a prominent gully.

NTS: 116M/13

UTM: 7527400N 466800E

Strata: Jungle Creek and Longstick formations (Permian); Bug Creek Group (Jurassic).

Unit Thickness Ht. above Description

	(m)	base (m)	Description
JUNGLE CREEK FM (PERMIAN)			
1	15 incomplete		<u>Red beds</u> : poorly exposed, talus covered. Red coloured breccia and mudstone with some green coloured beds. Angular to subangular clasts of black chert; varies from clast to matrix supported. Clast size from granule to cobble but most are 1-3 cm. Breccias are crudely bedded with no apparent internal fabric. Matrix-supported breccias tend to be green coloured. Base not exposed but there are underlying Devonian black shales and chert in nearby outcrops. Top not exposed.
2	Not measured		<u>Covered</u> : vegetated and some local talus and small exposures of shale. Estimate about 190 m of Jungle Creek Fm.

Measurements begin at first sandstone exposure in the gully and continues primarily on the west (right) side of the gully until near the top of the section.

LONGSTICK FM (PERMIAN)			
3	7.2	7.2	<u>Sandstone</u> : fine grained, siliceous. Poor quality exposure. Low-angle cross stratification. Small, oxidized mudstone clasts at the base of some beds; few mm to 4 cm.; well rounded; flat. Slight pinkish hue - commonly giving banded appearance. Bedding difficult to see.
4	0.5	7.7	<u>Sandstone</u> : thin bedded. Very fine to fine grained. Slightly recessive. Shaly partings between beds. Poorly exposed.
5	17.0	24.7	<u>Sandstone</u> : cf. unit 3.
6	28.5	53.2	<u>Recessive</u> : scattered outcrops of thin bedded, argillaceous, very fine grained sandstone and thin shaly/silty beds. Gradual upward increase in sandstone content. Thoroughly bioturbated sandstone. Trace of cross laminae. Talus contains an abundance of <i>Zoophycus</i> trace fossil.
7	6.7	59.9	<u>Sandstone</u> : Irregularly bedded. Dirty brown colour. Very fine grained. Argillaceous. Thoroughly bioturbated. Abundant <i>Zoophycus</i> . Upper part of interval mostly talus covered.
8	16.0	75.9	<u>Sandstone</u> : gradational change from unit 7 into the sandstone-dominant interval of unit 8. Beds tend to be thicker and less irregularly bedded than in unit 7. Thoroughly bioturbated. Abundant <i>Zoophycus</i> in talus and some long, thin vertical burrows. A few beds contain cross laminae. There is a prominent 1 m thick laminated bed about 8.5 m above base of unit.
9	39.0	114.9	<u>Sandstone</u> : massive appearance; "clean", fine grained. Slight reddish hue and oxidation banding. About 32 m above base there are in situ <i>Zoophycus</i> within "clean" sandstone. At about 37 m above base of unit there are abundant long, narrow vertical burrows that predominate in the uppermost 2 m. Generally poor quality outcrop. Difficult to see sedimentary structures in most of interval.

Some beds of fine, low-angle cross laminae. In at least one interval, approximately within the middle of unit 9, there are 20-30 cm thick beds, each bed consisting of a basal scour overlain by 2-5 cm of granules and scattered pebbles (chert, sandstone, quartzite), in turn overlain by finely cross laminated sandstone.

10	1.5	116.4	<u>Bioturbated sandstone</u> : grey colour. Argillaceous. Abundant vertical burrows and <i>Zoophycus</i> . Base not exposed.
11	3.0	119.4	<u>Burrowed sandstone</u> : "cleaner" than unit 10. Dominated by vertical burrows with some <i>Zoophycus</i> . Abrupt, uneven base. Grey weathering colour.
12	10.5	129.9	<u>Talus</u> : with a few outcrops of burrowed, very fine to fine grained sandstone containing long, narrow, vertical burrows and some <i>Zoophycus</i> .
13	16.5	146.4	<u>Sandstone</u> : very fine to fine grained. Indistinct bedding. Abundant long, narrow, vertical burrows in all beds but more abundant in beds with low abundance of <i>Zoophycus</i> . Intervals with a low abundance of <i>Zoophycus</i> alternating with intervals richer in <i>Zoophycus</i> .
14	0.8	147.2	<u>Sandstone</u> : very fine grained. Fine subhorizontal and low-angle cross laminae. Capped by <i>Zoophycus</i> -bioturbated bed.
15	2.2	149.6	<u>Sandstone</u> : very fine to fine grained. Vertical burrows and <i>Zoophycus</i> . Some remnant laminae.

BUG CREEK GP (JURASSIC)

Abrupt, unconformity surface.

16	6.0	155.6	<u>Conglomerate</u> : dark reddish brown weathering. Crudely bedded. Pebbles of chert, red mudstone, sandstone and vein quartz. Clasts up to large pebble/small cobble grade; mostly pebble size.
17	27.0	182.6	<u>Talus</u> : distinct, orange-brown weathering sandstone with some beds of grey granulestone/small-pebble conglomerate.
18	4.5	187.1	<u>Granulestone-conglomerate</u> : Small pebbles. Pebbles mostly chert with some oxidized mud clasts. Matrix of fine to granular sand. Subhorizontal bedding with at least one 50 cm thick planar cross-stratified bed. Slight reddish hue.
20	Not measured		Talus slope.

----- End of measurements/observations -----

Bug Creek strata are reasonably well exposed at the top of the ridge and consist of mostly sandstone. Base of Bug Creek Grp at least 200 m below crest of ridge - this contrasts with Norris' (1981c) map (GSC map 1520A) where the contact is placed at the top of the ridge.

DFA92-9

Headwaters of East Bear Creek, Richardson Mountains, NWT. 1.5 to 2 km northeast of DFA92-8.

Lat. 67° 52'N Long. 135° 47'W

NTS: 106M/13

UTM: 752850N 467000E

Strata: Lower member, Jungle Creek Formation (Permian).

Local faulting has juxtaposed Permian red beds against lower Paleozoic black chert/siliceous shale. Latter outcrops on small hillock immediately NW of red beds. Contact between the two units is not exposed.

Unit Thickness Ht. above Description
(m) base (m)

			JUNGLE CREEK FM (PERMIAN) - base not exposed.
1	14.5	14.5	<u>Breccio-conglomerate</u> : reddish brown colour. Readily weathers into component particles. Black chert and siliceous shale clasts predominant (similar to underlying lower Paleozoic lithology). Angular to subangular, cuboid shaped clasts. Poorly sorted clasts and matrix. Matrix of clay to granules. Clast size generally 5 mm to 3 cm but some up to 15 cm.

Generally no obvious internal fabric although there are vague layers or bands with flat clasts aligned subparallel to bedding. Bedding not readily identified although some individual beds can be distinguished (clast-size variation or slight differences in weathering) and are 20-30 cm thick.

2	7.3	21.8	<u>Recessive</u> : forms bench.
3	10.5	32.3	<u>Breccio-conglomerate</u> : cf. unit 1. Slightly more matrix-rich than unit 1.
4	5.5	37.8	<u>Recessive</u>
5	4.0	41.8	<u>Breccio-conglomerate</u> : cf. unit 1. Individual beds more readily seen due to differential weathering caused by varying mud matrix content. Bed thickness ranges from 40-70 cm.
6	5.4	47.2	<u>Recessive</u>
7	0.12	47.32	<u>Breccia</u> : matrix-supported. Base not exposed.
8	0.5	47.82	<u>Breccio-conglomerate</u> : Abrupt base/top. Very crude cross beds dipping approximately to 071° at 30° dip. Largest pebbles tend to be at top of bed. Pebbles up to 10 cm and generally more rounded than in underlying beds.
9	0.37	48.19	<u>Sandstone</u> : coarse to very coarse grained. Some granules and small pebbles. Grey colour. Subhorizontal bedding. Possibly contains 3 beds: lower two about 8-10 cm thick and mostly sandstone; upper bed pebblier than lower two. Unit thickens laterally to about 42 cm, mostly taken up in lower two beds. Abrupt tops/bases for all beds.
10	2.2	50.39	<u>Conglomerate</u> : grey colour. Subrounded to rounded clasts of black/white chert, quartzite and vein quartz. Multiple beds (but not very well defined) - detected by variation in grain size and matrix content. Beds are horizontal, few cm to 15 cm thick. Clast supported with a few matrix supported beds. Note the difference in colour and clast content and roundness with the underlying red breccio-conglomerates.
11	Not measured		<u>Vegetated</u> : a few scattered outcrops. Conglomerate and sandstone. At a prominent change-in-slope there is an outcrop of conglomerate abruptly overlain by a pebbly, fine grained sandstone. In the latter outcrop the beds contain no recognizable sedimentary structures and are highly fractured. Clasts mostly black chert and generally <4 cm. Clast supported.

----- End of observations/measurements -----

Overlying beds are very poorly exposed but are part of a contiguous belt along the ridge slope connecting to section DFA92-8.

DFA92-10

Headwaters of East Bear Creek, Richardson Mountains, NWT. 0.5 km south of DFA92-9.

Lat. 67° 51'N Long. 135° 47'W

NTS: 106M/13

UTM: 7528100N 467200E

Strata: Lower member, Jungle Creek Formation (Permian).

Unit Thickness Ht. above Description
(m) base (m)

			ROAD RIVER FM (LOWER PALEOZOIC)
1	Not measured		<u>Chert/siliceous shale</u> : black. Finely laminated; thinly bedded.
			JUNGLE CREEK FM (PERMIAN)
2	7.2	7.2	<u>Breccio-conglomerate</u> : red colour.

			Basal contact covered but can get to within a few 10s of cm. Clasts mostly black chert; angular to subangular; predominantly flat and aligned subhorizontally, some slight imbrication in a few places. Beds are a few cm to 20 cm thick. Contains 15-20 cm lenses of red, very fine grained, muddy, laminated sandstone.
3	3.0	10.2	<u>Interbedded breccio-conglomerate and sandstone</u> : Complex arrangement of channelized deposits of conglomerate grading up into sandstone, or laterally grading into sandstone. Beds range in thickness from 15 to 60 cm - but highly variable due to channelized nature of deposits. Flat clasts tend to be aligned subhorizontally with some imbrication locally present and "shadow structures" behind larger clasts.
4	1.3	11.5	<u>Pebbly sandstone</u> : very fine to fine grained with scattered chert clasts up to large pebble grade. Poorly sorted sandstone. Abrupt, erosional base. Laterally passes into interdigitating lenses of sandstone and conglomerate. The sandstone bed could be laterally equivalent to a number of thinner beds but view of lateral change is hindered by being at the top of the cliff and not readily accessible.
5	?		<u>Breccio-conglomerate</u> : cf. unit 2. A thin cap on top of unit 4.
6	Not measured		<u>Vegetated</u> : at least one outcrop of red beds near base of main talus slope.

----- End measurements/observations -----

DFA92-11

Headwaters of East Bear Creek, Richardson Mountains, NWT. 0.5 km north of DFA92-12.

Lat. 67° 51'N Long. 135° 47'W

NTS: 106M/13

UTM: 7527900N 467100E

Strata: Lower member, Jungle Creek Formation (Permian).

Contact with underlying lower Paleozoic strata not exposed. Measurements begin at first exposure and follows a grassy gully on outcrop.

Unit Thickness Ht. above Description

	<i>(m)</i>	<i>base (m)</i>	
JUNGLE CREEK FM (PERMIAN)			
1	14.9	14.9	<u>Breccio-conglomerate</u> : typical breccio-conglomerate of the Permian red beds from this area. Angular to subangular clasts of black chert. Predominantly flat clasts with some cuboid clasts. Flat clasts generally aligned subhorizontally but in a few places are inclined or near vertical. Individual beds generally difficult to identify, although when noted are 50-70 cm thick, and identified on basis of clast size variation. Clasts mostly in small-pebble grade although can be up to 15 cm. Clast supported.
2	21.8	36.7	<u>Complexly interbedded to interdigitating sandstone and breccio-conglomerate</u> : Abrupt basal contact. Bed thickness varies from few cm to about 70 cm. Beds generally have erosional bases and are channelized; there is lateral pinchout of many beds. Sandstone beds are crudely bedded or may contain low-angle cross laminae. Conglomerate beds vary from clast-supported, debris-flow-like deposits lacking internal fabric to those with very strongly aligned clasts in low-angle cross beds. In the latter case many of these beds grade up into pebbly sandstone with low-angle cross laminae.

----- Section in fault contact with lower Paleozoic chert ----

DFA92-12

Headwaters of East Bear Creek, Richardson Mountains, NWT.

Lat. 67° 51' 48"N Long. 135° 47' 12" (GPS) - location of campsite; section located on north side of stream.

NTS: 116M/13

UTM: 7527800N 467100E

Strata: Road River Formation (lower Paleozoic); Lower member, Jungle Creek Formation (Permian).

Section begins in stream bed and proceeds along base of cliff-face.

<i>Unit</i>	<i>Thickness (m)</i>	<i>Ht. above base (m)</i>	<i>Description</i>
			ROAD RIVER FM (LOWER PALEOZOIC)
1	Not measured		<u>Chert</u> : black; thinly bedded. Exposed in stream bed. Dip about 20°SE.
			JUNGLE CREEK FM (PERMIAN)
2	16.2	16.2	<u>Breccio-conglomerate</u> : reddish-grey colour. Clasts are mostly black chert with some grey chert and vein quartz. Mostly matrix supported with some clast-supported beds. Clasts generally <10 cm although there are a few scattered larger clasts (up to small boulder size). Most clasts are flat, although larger ones tend to be cuboid. Flat clasts tend to be aligned subhorizontally although random orientations are also common. Bed thickness varies from a few cm to about 30 cm, but individual beds are difficult to distinguish.
3	0.6	16.8	<u>Pebbly sandstone</u> : orange weathering. Fine to coarse grained. Lack of visible sedimentary structures. Wedge-like shape over 10-20 m distance of the cliff-face and terminates abruptly on up-slope face of cliff. Viewed from across the stream valley this unit appears to occupy a shallow, lenticular channel with the eastern margin (against the grassy slope) a near vertical margin and the western one more shallow dipping.
4	3.0	19.8	<u>Breccio-conglomerate</u> : cf. unit 1.
5	0.9	20.7	<u>Breccio-conglomerate</u> : differs from underlying breccio-conglomerate by having a sand-matrix and lower clast-density. Abrupt basal contact.
6	1.5	22.2	<u>Breccio-conglomerate</u> : similar to unit 5. Abrupt basal contact. Grades up from sand-matrix breccia to a clast-supported breccia.
7	11.0	32.2	<u>Interbedded/interdigitating conglomerate and sandstone</u> : Complex lateral and vertical facies changes. Individual beds commonly have erosional bases overlain by breccio-conglomerate in turn grading up into a pebbly, fine grained, muddy, red sandstone. Clasts aligned on crudely defined low-angle planar cross beds or show irregular imbrication. Highly variable bed thicknesses, from 20 cm to about 1 m. Conglomerate/sandstone ratio also highly variable. ---- End measurements at top of cliff -----

DFA92-13

Headwaters of East Bear Creek, Richardson Mountains, NWT.

Lat. 67° 51' 48"N Long. 135° 47' 12" (GPS) - location of campsite; section located on south side of stream.

NTS: 116M/13

UTM: 7527700N 467200E

Strata: Lower member, Jungle Creek Formation (Permian).

<i>Unit</i>	<i>Thickness (m)</i>	<i>Ht. above base (m)</i>	<i>Description</i>
			JUNGLE CREEK FM (PERMIAN)
1	14.5	14.5	<u>Breccio-conglomerate</u> : similar to those described from base of section 92-12.
2	10.0	24.5	<u>Complexly interdigitating/interbedded breccio-conglomerate and sandstone</u> : cf., section 92-12. The cliff-face contains at least one thick sandstone bed (1.5 m) that is channelized and

laterally pinches out. Channel cuts down into conglomerate and sandstone beds.

Top of unit 2 forms bench on which camp was located.

Upstream from the campsite and from sections 12 and 13 there are a few exposures of red breccias in the stream-bank near a fault zone. The presence of a fault-breccia makes it difficult to distinguish Permian sedimentary breccias from the fault breccia. There are undisturbed beds of interbedded shale and siltstone but the stratigraphic relationship between these and the Permian red beds is obscured.

NOTES ON SECTIONS 92-9 TO 92-13

Sections 92-9 to 92-13 contain a thick basal interval dominated by breccio-conglomerates and an upper interval of more varied lithology and character. The upper interval has many indicators of water-laid deposition, as well as debris-flow-type deposits. One important difference between the upper and lower intervals at section 9 is the presence of well rounded clasts in the upper interval. This feature was not noted in the other sections. However, at the other sections the uppermost beds are invariable covered by vegetation.

DFA92-14

Jurassic Butte, Aklavik Range, Richardson Mountains, NWT. First spur to the northeast of the butte.

Lat. 68° 03' 30"N Long. 135° 28'W

NTS: 107B/4

UTM: 7546800N 480000E

Strata: Road River Formation (lower Paleozoic); Lower member, Jungle Creek Formation (Permian).

Unit Thickness Ht. above Description

	<i>(m)</i>	<i>base (m)</i>	
ROAD RIVER FM (LOWER PALEOZOIC)			
1	Not measured		<u>Chert</u> : thinly bedded. Black, weathering rusty brown. Underlain by fissile siliceous shale. Chert unit thickens to north of Jurassic Butte. Angular discordance between Road River and Permian is readily seen in this area.
JUNGLE CREEK FM (PERMIAN)			
2	7.5	7.5	<u>Breccio-conglomerate</u> : red colour. Poorly sorted; subangular to subrounded clasts of chert and siliceous shale; tabular to cuboid shapes. Generally clast-supported; mud to coarse sand matrix. No sedimentary structures - generally a "disorganized" fabric although there are some subhorizontally aligned flat-clasts. Clasts generally <4 cm with some up to 20 cm. Basal contact covered but can get to within a few 10s of cm. Top is abrupt and marked by a bleached zone a few cm thick.
3	3.3	10.8	<u>Mudstone</u> : brick red colour. Abrupt base/top. Contains at least two layers of breccio-conglomerate. Mudstone is very friable and silty, and contains a few scattered, very small clasts of chert.
4	3.0	13.8	<u>Breccio-conglomerate</u> : cf. unit 2
5	1.1	14.9	<u>Red mudstone</u> : cf. unit 3
6	3.8	18.7	<u>Breccio-conglomerate</u> : cf. unit 2 Local fabric of oriented flat clasts -perhaps an internal "shear zone" formed during deposition.
7	0.9	19.6	<u>Red Mudstone</u> : cf. unit 3
8	3.8	23.4	<u>Breccio-conglomerate</u> : cf. unit 2
9	0.3	23.7	<u>Red mudstone</u> : cf. unit 3
10	15.2	38.9	<u>Breccio-conglomerate</u> : cf. unit 2. Flat clasts more prevalent than in unit 2 and tend to be subhorizontally aligned.
11	2.7	41.6	<u>Red mudstone</u> : cf. unit 3

12	17.3	48.9	<u>Breccio-conglomerate</u> : cf. unit 2. Approximately 9 m above base of unit there are two thin lenses of medium to coarse grained sandstone 3 to 6 cm thick which are laterally discontinuous and can be traced for only a few 10s of cm. Top 20-30 cm of unit is bleached.
13	2.5	51.4	<u>Red mudstone</u> : cf. unit 3. Contains three layers of calcareous nodules in the first 1 m of unit - nodules up to 15 cm in diameter and red coloured.
14	3.8	55.2	<u>Breccio-conglomerate</u> : poorly exposed.
15	2.1	57.3	<u>Red mudstone</u>
16	1.3	58.6	<u>Breccio-conglomerate</u> : poorly exposed.
17	5.0	63.6	<u>Interbedded breccio-conglomerate and red mudstone</u> : Uppermost breccio-conglomerate bed is bleached.
18	2.4	66.0	<u>Red mudstone</u> :
19	85.5	151.5	<u>Breccio-conglomerate</u> : cf. unit 2 34.5 m to top of rocky ridge where it is replaced by a grassy incline. Traverse along cliff-grassy slope edge where 52 m of section were measured. Outcrop is poor.

----- End measurements where outcrop declines and difficult to follow the stratigraphy -----

NOTE: The breccio-conglomerate units are very similar throughout the section - poorly sorted and clast supported; bedding is difficult to discern within the breccio-conglomerates, consequently individual bed thicknesses could not be determined. Slight variations in clast sizes gave vague hints of individual beds

DFA92-15

Jurassic Butte, Aklavik Range, Richardson Mountains, NWT. Lower slopes on the east face of the butte.

Lat. 68° 03'N Long. 135° 28'W

NTS: 107B/4

UTM: 7546500N 479700E

Strata: Jungle Creek Formation (Permian).

Two poorly exposed coarsening-upward units.

Lowermost exposed beds below the lower coarsening-upward unit consist of about 2-3 m of finely laminated, fine grained sandstone abruptly overlain by shale of the lower coarsening-upward unit.

Lower Coarsening-Upward Unit

Interbedded shale and sandstone (about 1-2 m of exposed interbedded sandstone-shale) capped abruptly by about 8 m of very coarse grained to granular sandstone. Latter contains a few pebbly beds. Sandstone beds capped abruptly by rusty coloured, orange weathering medium to coarse grained sandstone.

Upper Coarsening-Upward Unit

Interbedded sandstone and shale interval abruptly overlies lower coarsening-upward unit. Sandstone beds are 5 to 20 cm thick and are thoroughly bioturbated or faintly laminated. Shale layers 5-50 cm thick and some contain concretions. Estimate about 3:1 shale/sandstone ratio. Sample DFA92-15-1 (C-231761) for micropaleontology/palynology from shale - Permian palynomorphs recovered, possibly Sakmarian to Roadian (Paleo. Rept. 3-JU-94).

Abruptly overlain by about 4-5 m of very fine grained, slightly calcareous sandstone that contains pebbly layers and scattered crinoid ossicles. Sandstone abruptly overlain by shale.

Zoophycus-like trace fossils seen in talus block near upper coarsening-upward unit.

DFA92-16

Jurassic Butte, Aklavik Range, Richardson Mountains, NWT. Second major southeast spur off the butte.

Lat. 68° 02' 30N Long. 135° 26' 45"W (GPS)

NTS: 107B/4

UTM: 7545900N 481000E

Strata: Road River Formation (lower Paleozoic); Lower member, Jungle Creek Formation (Permian); Bug Creek Group (Jurassic).

NOTE: characteristics of the breccio-conglomerate and mudstone beds are similar to those seen in section 92-14, consequently full descriptions are not given for this section.

Unit	Thickness (m)	Ht. above base (m)	Description
ROAD RIVER FM (LOWER PALEOZOIC)			
1		Not measured	<u>Shale</u> : black, fissile.
2	9.4	9.4	<u>Shale</u> : red stained; contains layers of light green and red chert nodules. Layers spaced 20 cm to 1 m apart. Red and green colours can occur in the same nodule.
JUNGLE CREEK FM (PERMIAN) - abrupt unconformable contact			
3	33.0	42.4	<u>Breccio-conglomerate</u> : Similar in character to those in section 92-14. Contains thin interbeds of red mudstone in upper 5-8 m.
4	30.0	72.4	<u>Interbedded red mudstone and breccio-conglomerate</u> : Individual breccio-conglomerate beds vary from 0.5 to 2 m thick.
5	11.5	83.9	<u>Breccio-conglomerate</u> : some possible thin red mudstone interbeds.
6	31.0	114.9	<u>Interbedded red mudstone and breccio-conglomerate</u> : latter more abundant.
7	7.0	121.9	<u>Breccio-conglomerate</u>
8	2.2	124.1	<u>Red mudstone</u>
9	2.6	126.7	<u>Breccio-conglomerate</u>
10	3.0	129.7	<u>Red mudstone</u>
11	3.6	133.3	<u>Breccio-conglomerate</u>
12	4.1	137.4	<u>Red mudstone</u>
13	0.4	137.8	<u>Breccio-conglomerate</u>
14	2.0	139.8	<u>Red mudstone</u>
15	4.2	144.0	<u>Breccio-conglomerate</u>
16	1.5	145.5	<u>Red mudstone</u>
17	6.7	152.2	<u>Breccio-conglomerate</u> : with 1 or 2 thin red mudstone interbeds.
18	0.7	152.9	<u>Red mudstone</u>
19	5.6	158.5	<u>Breccio-conglomerate</u>
20	1.5	160.0	<u>Red mudstone</u>
BUG CREEK GP (JURASSIC) - abrupt unconformable contact			
21	Not measured		<u>Conglomerate</u> : well rounded clasts in a sand matrix. A collection of 4 ammonite fragments made from the basal 5 m of the Bug Creek Grp (92-16-1; C-231760)
----- End measurements -----			

NOTE: a sample from the Road River shale containing possible solid bitumen was collected from below the first observations made on section 16.

DFA92-17

4 km southwest of Jurassic Butte, Aklavik Range, Richardson Mountains, NWT.

Lat. 68° 00' 42N Long. 135° 32' 24"W (GPS)

NTS: 107B/4

UTM: 7545000N 477700E

Strata: Lower member, Jungle Creek Formation (Permian).

Scattered outcrops on the plateau to the SW of Jurassic Butte. Only general observations made in 1992. Interbedded red beds and greyish brown, very fine to fine grained sandstone. *Zoophycus* and other burrow structures seen in the brown sandstone beds as well as fine, low-angle cross laminae. Red beds consist of breccio-conglomerate and mudstone.

Appears to be a succession of mixed non-marine and marine strata - if this succession is relatively in situ then the paleogeographic implications are that the Permian shoreline was located between this location and Jurassic Butte.

Revisited 1993 and measured.

Unit Thickness Ht. above Description

	<i>(m)</i>	<i>base (m)</i>	<i>Description</i>
JUNGLE CREEK FM (PERMIAN)			
1	not measured		<u>Talus</u> : brick-red colour suggests Permian equivalency.
2	21	21	<u>Sandstone</u> : rusty brown colour. Fine grained; siliceous. Highly fractured. Where bedding seen it has a platy to flaggy weathering character. Mostly frost shattered rubble.
3	4.5	25.5	<u>Felsenmeer</u> : brick-red muddy to silty felsenmeer with some layers of weathered out chert clasts.
4	1.5	27	<u>Breccia</u> : badly weathered. Small, black chert clasts (<2 cm). Clast supported.
5	2	29	<u>Felsenmeer</u> : fine to medium grained sandstone and red mudstone.
6	6	35	<u>Conglomerate</u> : subrounded to rounded clasts of black chert in a fine to medium sand matrix. Both matrix and clast supported conglomerates present. Massive to moderately well bedded. Some alignment of flat clasts subparallel to bedding. Clasts up to 6 cm; most are 2-4 cm. Dark grey colour on weathered surface.
7	40.5	75.5	<u>Felsenmeer</u> : alternating bands of red and blackish red felsenmeer. Rubble appears to be mostly breccio-conglomerate and the redder bands appear to be mudstone rich (these observations are based on a few scattered outcrops).
8	12	87.5	<u>Sandstone</u> : dark weathering colour. Fine grained. Weathers into thick slabs - possibly reflecting subhorizontal bedding.
9	4.5	92	<u>Felsenmeer</u> : brick-red colour. Possibly underlain by mudstone and/or mudstone-rich breccia beds.
10	3	95	<u>Two breccia beds and a mudstone bed</u> : Breccias are dark coloured; mudstone is red. Subrounded, small clasts of chert in a grey mud matrix. Clasts generally <2 cm. Clast supported. Mudstone is located between the two breccia beds.
11	4	99	<u>Felsenmeer</u> : brick-red colour. Mudstone and mud-rich, small-clast breccia.
12	6	105	<u>Sandstone</u> : dark grey weathering colour. Argillaceous, very fine grained. Possibly completely bioturbated.
13	39	144	<u>Recessive interval</u> : brick-red coloured layers alternating with reddish tinged, dark grey layers. A few scattered outcrops of small-clast chert breccia in the dark layers. Red layers probably dominated by mudstone.
14	10.5	154.5	<u>Interbedded sandstone-conglomerate</u> : Fine to medium grained sandstone and small-pebble conglomerate. Clasts are well rounded; generally matrix supported - matrix of fine to coarse sand. Beds range in thickness from about 6 cm to about 1 m. Most sandstone beds are finely laminated. Conglomerate beds tend to have erosional bases but have no discernible internal fabric. A few flat clasts appear to be subhorizontally aligned.
15	6	160.5	<u>Recessive</u> : brick red coloured talus. Talus of weathered chert breccia. A few dark grey coloured outcrops of breccia.
16	12	172.5	<u>Sandstone</u> : fine to medium grained with a few scattered pebbles in lower couple of metres. Mostly rubble. Some crude bedding seen.
17	9	181.5	<u>Rubble</u> : orange-brown weathering colour. Talus of fine grained, thinly bedded sandstone.

- | | | | |
|----|---------|-------|---|
| 18 | 6 | 187.5 | <u>Sandstone</u> : medium to coarse grained; locally granular. Mostly frost heaved rubble; some outcrops. A few examples of shallow trough cross stratification seen. |
| 19 | est. 30 | 217.5 | <u>Poor exposure</u> : brick-red coloured talus.
Appears to be underlain by a mud-rich chert breccia that is deeply weathered. |

----- End measurements due to poor exposure -----

Base of section is not exposed and may be faulted against Cretaceous strata.

Strata above the topmost measured strata are hidden by talus on a slope that leads up to a cliff-forming sandstone. The latter is probably part of the Bug Creek Group. There may be more Permian strata under the talus slope

DFA92-18

Ridge between Malcolm River and Fish Creek, British Mountains, Yukon.

Lat. 69° 22' 33"N Long. 140° 34' 09"W (GPS)

NTS: 117C

UTM: 7695000N 518000E

Strata: a thin succession of sandstone that may be either the basal beds of a Permian or Triassic succession. The sandstone rests abruptly on Lisburne limestone (Carboniferous).

Two separate areas of frost shattered outcrop on ridge crest. Most of ridge is underlain by Lisburne limestone.

1st Outcrop

Rusty brown weathering, very fine to fine grained sandstone. Medium grey fresh colour. Weathers into slabs and blocks. Estimate 5-7 m of exposure. Rests abruptly on Lisburne limestone. *Zoophycus* noted on some slabs.

2nd Outcrop

Approximately 0.5 to 0.75 km west of first outcrop. Basal beds are similar to those seen in first outcrop (estimated to be 7-9 m thick). Abruptly overlain by light to medium grey fissile shale that contains thin interbeds of very fine to coarse grained sandstone. Shale estimated to be 15-20 m thick. Upper contact is a fault and shale is juxtaposed against Lisburne limestone.

Sedimentary structures were not readily seen in either outcrop.

DFA92-27

Ridge between Trail River and Philip Creek, British Mountains, Yukon.

Lat. 68° 48' 04"N Long. 138° 57' 30"W (GPS)

NTS: 117A

UTM: 7633000N 576000E

Strata: mapped by Norris (1981a, GSC map 1516A) as Triassic Shublik Formation. However, the strata consists of at least 60-100 m of very fine-grained sandstone resting on Lisburne limestone (Carboniferous) which are very atypical of the Shublik in this area. I suspect these are either a Permian or Triassic succession older than the nearby Norian strata.

Abrupt slope and lithological change between the Lisburne limestone and the overlying sandstone that was mapped as Triassic but is probably Permian. Sandstone present as large boulders and blocks on a rubble strewn slope, with some in situ outcrops. Very fine grained, siliceous; medium to dark grey. A few impressions of brachiopods were noted. No visible sedimentary structures.

Even with a shallow 10° dip, the wide extent of the boulder field suggests that there is 60-100 m of section (assuming no fault repeat). This would be much thicker than the presumed Triassic at 92-26.

DFA92-29

Gravel Creek, British Mountains, Yukon.

Lat. 68° 44' 47"N Long. 139° 30' 20"W (GPS)

NTS: 117A

UTM: 7627000N 560000E

Strata: area of frost-heaved sandstone talus mapped as Permian overlain by Triassic (Norris, 1981a, GSC map 1516A).

Area consists of frost heaved rubble. Very fine grained, siliceous sandstone. A few brachiopod impressions seen and numerous straight (presumably vertical) burrows. Unable to recognize whether Permian and Triassic are separable, or if only one unit is present.

A few kilometres ESE and SE of this location, Norris (1981a, GSC map 1516A) has Norian fossil localities (GSC #55143 and T1179).

DFA92-30

Headwaters of Gravel Creek, British Mountains, Yukon (revisited 1994).

Lat. 68° 44' 01"N Long. 139° 47' 09"W (GPS)

NTS: 117A/12

UTM: 7625300N 549000E

Strata: Lisburne Group (Carboniferous); ?Sadlerochit Group (Permian-Triassic); overthrust by Lisburne Group.

Poorly exposed; mostly frost-shattered debris.

Unit Thickness Ht. above Description

	<i>(m)</i>	<i>base (m)</i>	<i>Description</i>
LISBURNE GP (CARBONIFEROUS)			
1	Not measured		<u>Limestone</u> : light grey to white rubble. Some crinoidal beds noted.
?ECHOOKA FM (PERMIAN)			
2	34.5	34.5	<u>Interbedded sandstone-shale</u> : Sandstone: thin bedded; rusty brown colour; platy weathering very fine grained sandstone. <i>Zoophycus</i> noted in talus as well as very fine laminae. Shale: light to medium grey; fissile.
3	10.5	45.0	<u>Shale</u> : medium to dark grey. Interbeds of rusty brown, platy weathering, very fine to fine grained sandstone. Sample DFA92-30-1 (C-231837) from near top of interval in a frost boil.
4	9.0	54.0	<u>Sandstone</u> : rusty brown; very fine to fine grained. Hints of cross laminae seen in talus and the few outcrops. Along strike from line of section some beds of pebbly sandstone are present. Some limestone beds. DFA92-30-5 (C-231841) from a limestone bed near base of interval.
5	30.0	84.0	<u>Sandstone</u> : dark grey colour. Very fine grained. Siliceous. Some rust-coloured weathering zones. Some <i>Zoophycus</i> seen in talus. Some light yellowish grey bioclastic limestone beds near base of interval.
6	39.0	123.0	<u>Sandstone</u> : alternating bands of rust-coloured and dark grey, very fine grained sandstone. Becomes increasingly argillaceous up-section.
?IVISHAK FM (TRIASSIC)			
7	19.5	142.5	<u>Shale</u> : fissile; medium grey. Thin interbeds of sandstone. Mostly rubble with vegetated upper part of interval. Sample DFA92-30-2 (C-231838) from near base of interval.
8	39.0	181.5	<u>Covered</u> : vegetated; little indication of underlying lithology.
9	48	229.5	<u>Sandstone</u> : dark grey; blocky talus. Possibly thoroughly bioturbated. Some shell impressions seen.

- 10 44 273.5 Shale: black; fissile. Rests abruptly on unit 9. Upper two-thirds covered by vegetation. Sample DFA92-30-3 (C-231839) within 2 m of the base. DFA92-30-4 (C-231840) about half-way through interval.
 ---- Thrust fault ----
 LISBURNE GP (CARBONIFEROUS)
- 11 Not measured Limestone: light grey to white.

DFA92-31

Headwaters of Babbage River, British Mountains, Yukon (Revisited 1994). Same section as Norris' A29 (1981b, GSC map 1519A).

Lat. 68° 28' 44"N Long. 139° 50' 52"W (GPS)

NTS: 117A

UTM: 7623000N 547000E

Strata: Lisburne Group (Carboniferous); Sadlerochit Group (Permian-Triassic); thin succession of Norian (Triassic) sandstone.

North of landing site (on Unit 1) there is a vegetated valley with virtually no exposures which rises northward onto the dip slope of the Lisburne limestone. This covered area is presumed to be underlain by shale

Unit 1: ridge-forming sandstone. Very fine to fine grained; dark grey to rusty brown. Possibly bioturbated. Some beds rich in brachiopods. Lower to middle slope on north-side of ridge has some mudstone/shale beds.

Unit 2: limestone on dip-slope of unit 1. Rusty brown weathering colour. Medium crystalline. Rich in brachiopods.

Unit 2 separated from unit 3 by a grass covered valley and slopes. Presumed to be underlain by shale.

Unit 3: sandstone. Light grey weathering colour; dark grey fresh. Very fine grained. Probably thoroughly bioturbated.

Norris (in press) gives more details of his section A29. Unit 1 contains Kungurian (lower part of the Upper Permian) brachiopods. Norian fossils that were collected by Norris came from a 5 m thick limestone and sandstone unit above unit 3 (on the dip slope of the ridge formed by unit 3). These would be equivalent to the typical "Shublik Fm" of the northwesternmost Yukon. Units 2, 1 and the underlying strata above the Lisburne would be part of his Echooka Fm, and units above #2 to the dip slope of unit 3 he would tentatively incorporate in the Ivishak Fm (Triassic). However, there is no age data to confirm the Ivishak correlation. In 1994 I revisited this site to try and find exposures between units 2 and 3, unfortunately none were noted, therefore the age of the rocks underlying this interval are still unknown.

Mamet and Mason (1970) date the uppermost Lisburne beds, 15 km to the NW of 92-31, as Morrowan-Atokan (late Bashkirian to early Moscovian).

DFA92-32

Ridge between Babbage River and Cottonwood Creek, British Mountains, Yukon. Revisited 1994.

Lat. 68° 40' 47"N Long. 139° 26' 42"W (GPS)

NTS: 117A/12

UTM: 7619300N 563000E

Strata: Lisburne Group (Carboniferous); Echooka Formation (Permian)

Unit Thickness *Ht. above* *Description*
 (m) base (m)
 ECHOOKA FM (PERMIAN)

1	Not measured		<u>Shale</u> : black with some rust-coloured patches; fissile. Sample DFA92-32-1 (C-231842)
2	0.6	0.6	<u>Limestone</u> : basal contact covered but lithological change is rapid. Sandy, finely bioclastic limestone. Alternating beds/lenses of finely cross laminated and thoroughly bioturbated beds. Horizontal burrows most prevalent in latter. Some argillaceous partings. Cross laminae appear to be HCS and there appears to be some soft-sediment deformation of the laminae.
3	0.7	1.3	<u>Limestone</u> : alternations of medium grained, thoroughly bioturbated bioclastic limestone and cross laminated bioclastic limestone (similar to that in unit 2. Sample DFA92-32-2: C-231843). Bioturbated beds contain large fragments of brachiopod shell debris. Normal size- grading in some beds.
4	1.9	3.2	<u>Conglomerate-sandstone-bioclastic rudstone</u> : multiple beds of pebbly, bioclastic sandy limestone. Most prominent feature is the abundance of large, thick-shelled brachiopods (bioclasts). Other clasts are mostly black and grey chert. Pebbles are well rounded. Also contains tabular mudstone clasts. Individual beds appear to be normally graded and 10-20 cm thick. Upper third is less conglomeratic and dominated by coarse grained bioclastic limestone. Unit rests erosionally on unit 3.
5	0.05	3.25	<u>Calcareous siltstone</u> : very abrupt base/top. Rusty to greenish weathering colour; dark greyish brown fresh.
6	1.5	4.75	<u>Bioclastic limestone</u> : coarse grained.
7	0.04	4.79	<u>Limestone</u> : very finely crystalline. Rusty weathering. Argillaceous. Scattered small chert pebbles.
8	0.6	5.39	<u>Bioclastic limestone</u> : coarse grained. Large fragments of brachiopod shells.
9	1.8	7.19	<u>Limestone</u> : very finely crystalline. Dark grey. Possibly argillaceous. Thin uneven beds. Some large fragments of brachiopod shell.
10	10.5	17.59	<u>Calcareous siltstone</u> : Abrupt basal contact. Mostly talus covered with scattered outcrops. Distinct rusty weathering colour; dark grey fresh. Indurated; brittle. No visible sedimentary structures.
11	3.7	21.29	<u>Sandstone and bioclastic limestone</u> : Sandstone: very fine grained; indurated; calcareous. Light brownish grey weathering; dark grey fresh. Sample DFA92-32-3; C-231844) Basal contact covered. <i>Zoophycus</i> present.
12	Not measured		<u>Sandstone</u> : very fine grained. Rusty colour. Very fossiliferous - contains solitary corals, brachiopods, and bryozoa.

---- Measurements end at top of ridge ----

NOTE: area to north of section 92-32 was mapped by Norris (1981a, GSC map 1516A) as containing Triassic strata. Area consists of talus of siliceous sandstone. No fossils were seen on inspecting this talus.

DFA92-34

Southeastern tributary of Babbage River, northern Yukon.

Lat. 68° 34' 30"N Long. 139° 08' 22"W (GPS)

NTS: 117A

UTM: 760800N 577000E

Strata: mapped as possibly Triassic by Norris (1981a, GSC map 1516A) but strata is atypical of the local Norian (Triassic) strata. Rubble of very fine grained sandstone adjacent to Lisburne limestone. A few brachiopod molds were noted. Seems probable that the sandstone may be Permian or pre-Norian Triassic.

DFA92-35

Approximately 6 km west of section DFA92-34, northern Yukon.

Lat. 69° 34' 16"N Long. 139° 16' 15" (GPS)

NTS: 117A
 UTM: 760700N 571000E
 Strata: similar to section DFA92-34 but no fossils seen.

DFA93-1

Headwaters of East Bear Creek, Richardson Mountains, NWT.
 Lat. 67° 52' 59"N Long. 135° 48' 20"W
 NTS: 106M/13
 UTM: 7529000N 467000E
 Strata: Road River Formation (lower Paleozoic); Lower member, Jungle Creek Formation (Permian).

<i>Unit</i>	<i>Thickness (m)</i>	<i>Ht. above base (m)</i>	<i>Description</i>
ROAD RIVER FM (LOWER PALEOZOIC)			
1	not measured		<u>Chert-Silicified shale</u> : black; thinly bedded. Contact with Permian is generally covered by talus or vegetation but usually can get to within a few decimetres.
JUNGLE CREEK FM (PERMIAN)			
2	13.5	13.5	<u>Breccia</u> : subangular to angular chert and silicified shale clasts comparable to the underlying Road River Fm. Clasts up to 5 cm long but most are <2 cm. Reasonably well sorted. Matrix of maroon to brick-red coloured clay and silt. Slight tendency for average clast size to decrease upward. Massive appearance; well jointed; bedding is difficult to discern.
3	10.5	24	<u>Covered</u> : vegetated with some nearly in situ talus. Based on weathering character underlying rocks may be a muddier breccia than unit 1.
4	1.8	25.8	<u>Breccia</u> : (dip flattens to 22°). Similar to unit 1 although clasts tend to be much larger, up to 40 cm and matrix consists of coarse to very coarse sand. Dark maroon colour.
5	1.0	26.8	<u>Series of fining-upward beds</u> : Beds 8-15 cm thick. Each beds consists of a basal breccio-conglomerate grading up into medium to coarse grained sandstone. No internal sedimentary structures seen. Clasts up to 3 cm; most are <2 cm, and generally rounded. Tabular clasts are subhorizontally aligned. Yellow to tan colour.
6	15	41.8	<u>Covered</u> : cf. unit 2.
7	1.5	43.3	<u>Breccia</u> : capped by about 30 cm of medium to coarse grained sandstone. Chert clasts up to 4 cm but most are <2 cm, in a fine sand matrix. Clasts subangular to subrounded. Fabric is more open than unit 1.
8	7.5	50.8	<u>Covered</u> : Lowest 2-3 m consists of brick-red muddy talus; remainder consists of yellowish tan coloured rubble of coarse grained sandstone and small-pebble conglomerate. Conglomerate clasts consist of black chert, quartzite and some vein quartz. Well rounded, well sorted clasts are generally <1 cm although there are locally larger clasts.

-----End measurements at base of vegetated slope -----

DFA93-2

Headwaters of East Bear Creek, Richardson Mountains, NWT.
 Lat. 67° 51' 30"N Long. 135° 49' 04"W (GPS)
 NTS: 106M/13
 UTM: 7526200N Long. 465900E
 Strata: Road River Formation (lower Paleozoic); Lower member, Jungle Creek Formation (Permian).

Unit Thickness Ht. above Description
 (m) base (m)

ROAD RIVER FM (LOWER PALEOZOIC)		
1	not measured	<u>Chert</u> : Black, well bedded chert and/or silicified shale.
JUNGLE CREEK FM (PERMIAN)		
2	10.5	10.5 <u>Breccia</u> : maroon coloured. Poorly exposed. Mostly talus and weathered debris. Black chert clasts up to 5 cm, most are <2 cm, in a maroon matrix of clay and silt. Mostly clast supported.
3	13.5	24 <u>Breccia</u> : similar to unit 2 but with ledges of outcropping breccia.
4	6	30 <u>Covered</u> : vegetated. (Traverse shifted to west by about 50 m).
5	25.5	55.5 <u>Breccia grading upward to conglomerate</u> : Scattered outcrops and near-in situ talus. Maroon coloured; some breccias are bleached to a grey colour. Clasts mostly chert and tend to be <2 cm. Both matrix and clast supported breccias present. Towards the top of the interval the talus contains granulestone and very small-pebble conglomerate whose colour is tan rather than maroon.
6	not measured	<u>Covered</u> : slight change in slope. Loss of maroon colour in talus material.

----End of measurements on covered ground----

Traversed about 0.75 km to west, to location 67, 51' 04"N 135, 48' 41" W (GPS), near to section 91-13, where there are well exposed beds of breccia. The top of the breccia-rich interval is marked by a topographic bench, above which there is a change in the lithological succession to medium and coarse grained sandstone, granulestone and very small-pebble conglomerate with only sporadic occurrences of breccia. Exposure of the upper beds is poor; it is mostly talus and a few scattered outcrops. Few sedimentary structures were noted in the upper strata. A talus block of medium grained sandstone contained fine laminae. Possibly 12 m or more of these upper beds.

DFA93-3

Headwaters of East Bear Creek, Richardson Mountains, NWT.

Lat. 67° 49' 32"N Long. 135° 50' 39"W (GPS)

NTS: 106M/13

UTM: 7523400N 464900E

Strata: Lower member, Jungle Creek Formation (Permian)

Unit Thickness Ht. above Description
(m) base (m)

JUNGLE CREEK FM (PERMIAN)		
1	112.5	112.5 <u>Breccia</u> : contact with underlying Road River Fm covered but estimated to be where there is a slope change and a lack of maroon coloured talus. First 30-35 m is mostly covered with a few small outcrops of breccia and some near-in situ talus. Primarily black chert clasts in a red silty matrix. Subangular to angular clasts; most are <2 cm. Mostly clast supported although a few matrix supported breccias were seen.
2	7.5	120 <u>Covered</u> : a flat bench area on the slope. Reddish coloured talus consisting of blocks of breccia and coarse grained sandstone in a red mud.
3	24	144 <u>Sandstone</u> : mostly loose weathered material with a few larger blocks. Medium to coarse grained with some granulestone layers. Weathers medium to dark grey and is brownish on broken surfaces. Sedimentary structures not readily discernible.
4	4.5	148.5 <u>Conglomerate</u> : mostly loosely weathered material with a few large blocks. Small, rounded pebbles of quartzite, chert and vein quartz in a sand matrix. Pebbles generally <1 cm. Mostly matrix supported. No sedimentary structures seen.
5	6	154.5 <u>Sandstone</u> : coarse grained. Brownish grey colour. Some interbeds of small-pebble conglomerate. No sedimentary structures seen.

6	6	160.5	<u>Felsenmeer</u> : reddish brown colour. Appears to be disaggregated small-pebble conglomerate.
7	9	169.5	<u>Granulestone to Small-pebble Conglomerate</u> : Poorly exposed. Rusty brown colour. Some scattered large pebbles and some possible mudstone clasts.
8	18	187.5	<u>Sandstone</u> : Rusty brown colour. Generally fines upward from coarse to medium grained. Flaggy weathering may reflect subhorizontal sedimentary structures.

----- End measurements at prominent slope break, above which slope is mostly grass covered. This area of slope change appears to be the top of the Lower member, Jungle Creek Formation -----

DFA93-4

Symmetry Mountain, south side of McDougall Pass, Richardson Mountains, NWT.

Lat. 67° 42' 12"N Long. 136° 12' 59"W

NTS: 116P/9

UTM: 7510300N 448300E

Strata: transition between the Upper member, Jungle Creek Formation and the Longstick Formation (Permian).

Unit	Thickness (m)	Ht. above base (m)	Description
JUNGLE CREEK FM (PERMIAN)			
1	not measured		Interbedded units of sandstone-shale of varying thickness.
2	27	27	<u>Sandstone</u> : light to medium grey weathering colour; dark grey on fresh surfaces. Very fine grained; siliceous. Thickly bedded to massive. Very poor quality outcrop. Some vague indications of laminae.
3	4	31	<u>Shale</u> : recessive - brought to surface by frost heave. DFA93-4-1 (C-231763) for palynology (barren) and microfossils.
4	1.5	32.5	<u>Sandstone</u> : orange-brown to rusty brown weathering colour; grey on fresh surfaces. Very fine grained; siliceous. Flaggy weathering. Poor quality outcrop. Abrupt top. A slab of talus contains small mud clasts. A few trace fossils located, one identified as a U-shape burrow; most are rather nondescript horizontal burrows. Traces of possible <i>Zoophycus</i> .
5	6	38.5	<u>Shale</u> : recessive. Contains a thin sandstone bed about 1 m below top of interval: rusty brown colour, platy weathering, very fine grained. DFA93-4-2 (C-231764) for palynology (some Late Carboniferous to Permian pollens/spores; abundant reworked Early Carboniferous spores) microfossils.
6	1.5	40	<u>Sandstone</u> : light to medium grey weathering colour; medium to dark grey on fresh surfaces. Platy to thick parting planes. No discernible sedimentary structures. Contains <i>Zoophycus</i> . Abrupt top.
7	25.5	65.5	<u>Shale</u> : recessive. Becomes siltier in upper 3-4 m and appears to grade into overlying sandstone. Talus contains sandstone blocks suggesting presence of thin sandstone interbeds. DFA93-4-3 (C-231765) for palynology (some Late Carboniferous to Permian pollen/spores) and microfossils.
8	6	71.5	<u>Sandstone</u> : very poorly exposed. Medium grey weathering colour; medium to dark grey on fresh surfaces. Very fine grained and argillaceous in lower two-thirds, becoming "cleaner" in top 1 m. Argillaceous part appears to be thoroughly bioturbated and is densely jointed. Fragments of fine-ribbed brachiopods present in a distinct rusty coloured part of the interval. Whole shells also noted. Abrupt upper contact.
9	13.5	85	<u>Shale</u> : recessive. Contains a few thin sandstone interbeds. DFA93-4-4 (C-231766) for palynology (some Late Carboniferous to Permian pollen/spores) and microfossils; collected about 1 m above base of interval.
10	5.5	90.5	<u>Sandstone</u> : poor quality outcrop.

Medium to dark grey weathering and fresh colour with some rusty brown patches. A few fine-ribbed brachiopods and some bryozoa are present. Very fine grained; argillaceous. No visible sedimentary structures; possibly thoroughly bioturbated.

11 99 189.5 Shale: forms slope leading up to the prominent cliffs of Symmetry Mountain. Light to medium grey; fissile; slightly silty in places.
 DFA93-4-5 (C-231767) 1 m above base of unit for palynology (barren) and microfossils.
 DFA93-4-6 (C-231768) 54 m above base of unit for palynology (rare reworked Late Carboniferous spores) and microfossils.
 DFA93-4-7 (C-231769) 96 m above base of unit for palynology (rare reworked Late Carboniferous spores) and microfossils.

LONGSTICK FM (PERMIAN)

12 not measured Interbedded limestone-sandstone:
 These form the lower cliffs of Symmetry Mountain. A gradational contact with underlying shale. 10-50 cm thick beds of micritic limestone and some calcareous very fine grained sandstone. Contains scattered, but common, brachiopods (fine and coarse ribbed varieties) and bivalves. The lower cliffs appear to consist of 6-10 m thick coarsening-upward cycles (or liming-upward!).

The thickness of the visible lower cycles is estimated to be about 100 m but the northern dip slope of Symmetry Mountain contains a considerable thickness of Permian strata.

DFA93-5

North-facing scarp of Mount Millen, Richardson Mountains, Yukon.

Lat. 67° 28' 07"N Long. 136° 22' 12"N (GPS)

NTS: 116P/8

UTM: 7484100N 439800E

Strata: Imperial Formation (Devonian); Lower member, Jungle Creek Formation (Permian); Bug Creek Group (Jurassic).

Unit Thickness Ht. above Description
 (m) base (m)

IMPERIAL FM (UPPER DEVONIAN)

1 not measured Thick units of shale alternating with units of sandstone and conglomerate.

Contact between Devonian and Permian is covered by talus. Measurements began at first outcrop of Permian strata.

JUNGLE CREEK FM (PERMIAN)

2 63 63 Conglomerate and Granulestone:

Coarse granulestone to small-pebble conglomerate. Poor quality outcrop - extensive lichen cover. Massive, poorly bedded; well jointed. No discernible stratification features. Deeply weathered. Rounded clasts of black, grey and light green chert and some quartzitic sandstone. Pebbles up to 1 cm. Generally matrix supported - matrix of silt to sand sized material. The unit is capped by a medium to coarse grained, well cemented sandstone (thickness indeterminate). Top contact is very abrupt.

3 24 87 Conglomerate: probable erosional base.

Pebbles up to cobble grade but pebble size rapidly declines up-section to small pebbles and granules. Nature of vertical character changes not readily seen. Internal structures not discernible. Top of interval forms a topographic bench.

4 unknown thickness Topographic Bench: first third of bench covered in conglomerate talus, similar to unit 3. Remainder is covered with sandstone talus derived from the cliffs capping Mount Millen.

BUG CREEK GP (JURASSIC)

5 not measured Sandstone: Very fine to fine grained sandstone with some intercalations of siltstone and mudstone. Finely laminated. Contains belemnites in the bases of some sandstone beds. Caps Mount Millen.

DFA93-6

North-facing scarp 1 km west of Mount Millen, Richardson Mountains, Yukon.

Lat. 67° 21' 27"N Long. 136° 26' 37"W (GPS)

NTS: 116P/8

UTM: 7482900N 438200E

Strata: Imperial Formation (Devonian); Lower member, Jungle Creek Formation (Permian). Apparently capped by Bug Creek Group (Jurassic) - however, access to upper cliffs is difficult.

Unit definitions are rather arbitrary due to the difficulty in seeing internal fabrics. The units represent intervals with grossly similar lithological characteristics. Measurement may be inaccurate by up to 15% due to steep dips, dip changes and the traverse orientation on a steep outcrop.

Unit Thickness Ht. above Description

	<i>(m)</i>	<i>base (m)</i>	
			IMPERIAL FM (UPPER DEVONIAN)
1	not measured		Interbedded units of sandstone and shale.
			JUNGLE CREEK FM (PERMIAN)
Contact between the Permian and Devonian is covered but generally can get to within 1 to 2 m of the contact.			
2	4.5	4.5	<u>Conglomerate</u> ; crudely bedded to massive. Clast and matrix supported conglomerates. Alternations of pebble conglomerate and granulestone define crude subhorizontal bedding. Clasts up to 10 cm long; the larger clasts tend to be discoidal or tabular; smaller clasts tend to be subspherical. Well rounded clasts. The flat clasts tend to be aligned subparallel to bedding. Clasts consist of mostly light grey coloured quartzite or quartzose sandstone.
3	3	7.5	<u>Granulestone with layers of conglomerate</u> ;
4	4.5	12	<u>Conglomerate</u> ; clasts up to cobble grade.
5	9	21	<u>Granulestone and Conglomerate</u> ; Pockets of trough cross bedded, very coarse grained sandstone and granulestone in an otherwise massive looking interval. Upper part of interval is poorly exposed.
6	6	27	<u>Conglomerate</u> ; clasts up to small boulder size but most are pebble and cobble grade. Generally matrix supported - very coarse to granular matrix.
7	4.5	31.5	<u>Sandstone and Granulestone alternating with Conglomerate</u> ; Very coarse grained to granular sandstone containing some scattered pebbles. There may be some locally occurring trough cross beds - curvilinear weathering surfaces could reflect stratification.
8	22	53.5	<u>Conglomerate</u> ; 50 cm to 1 m thick beds of conglomerate alternating with granulestone and some sporadically developed lenses of coarse grained sandstone - the latter commonly with low- angle cross bedding or planar bedding. Clasts - small pebbles to cobbles or small boulders. Interval capped by about 1.5 to 2 m of fine grained sandstone that contains very low-angle, wedge-like, cross stratification.
9	4.5	58	<u>Conglomerate</u> ; erosional base, locally downcutting into sandstone. Clast size ranges from small pebble to small cobble grade.
10	0.5	58.5	<u>Conglomerate</u> ; medium to coarse grained. Very low angle, wedge-like cross stratification.
11	30.5+	89+	<u>Conglomerate</u> ; 7.5 m to base of a cliff; estimated 23 m of exposure in cliff face - section continues above cliff face but is inaccessible. Varies from coarse granulestone with scattered pebbles to matrix supported small-pebble conglomerate with scattered larger clasts up to small boulder size. Crude subhorizontal layering, but individual beds are difficult to discern. Scattered small lenses of medium grained sandstone. Flat clasts are aligned subparallel to bedding.

----- End measurements due to inaccessibility -----

There is probably at least another 100-120 m of section to top of peak, a significant amount of which could be Permian. Based on ISPG photo 4150-10 it seems likely that there is between 30-50 m of Permian above the last measured unit in section DFA93-6.

DFA93-7

About 6 km NNW of Mount Millen, Richardson Mountains, Yukon.

Lat. 67° 30' 50"N Long. 136° 28' 14"W (GPS)

NTS: 116P/9

UTM: 7489300N 437200E

Strata: Imperial Formation (Devonian); Lower member, Jungle Creek Formation (Permian).

Unit Thickness Ht. above Description

	(m)	base (m)	Description
			IMPERIAL FM (UPPER DEVONIAN)
1	not measured		Thick interbeds of conglomerate, sandstone and shale.
			JUNGLE CREEK FM (PERMIAN)
Contact covered but unit 1 is probably within a few metres			
2	1.5	1.5	<u>Sandstone</u> : medium to very coarse grained. Lenses of pebbly sandstone. Fine, very low-angle cross laminae.
3	9	10.5	<u>Sandstone</u> : very fine to fine grained. Argillaceous. Thoroughly bioturbated - abundant <i>Zoophycus</i> and vertical burrows. Weathers rusty brown.
4	44 approx.	54.5	<u>Sandstone</u> : very fine to fine grained. Fine, very low-angle cross laminae. A "clean" sandstone. Abrupt basal contact. Mostly rubble.
5	10(est.)	64.5	<u>Shale and sandstone</u> : poor quality outcrop. Abruptly overlies unit 4. Dark grey shale with thin silty sandstone interbeds that are rich in <i>Zoophycus</i> . Sandstone beds are rusty brown colour.
6	9 est.	73.5	<u>Sandstone</u> : Fine grained. Rusty brown. Thoroughly bioturbated. Gradational base (forms coarsening-upward interval with unit 5). Abrupt top.
7	not measured		<u>Shale-sandstone</u> : similar to unit 5.

----- End measurements due to poor quality of outcrop---

DFA93-8

About 10 km NNW of Mount Millen, Richardson Mountains, Yukon.

Lat. 67° 32' 12N Long. 136° 31' 50"W (GPS)

NTS: 116P/9

UTM: 7491800N 434800E

Strata: Imperial Formation (Devonian); Jungle Creek and Longstick formations (Permian).

Norris (1981b, GSC map 1519A) mapped the Bug Creek Grp resting directly on Imperial Fm with the Permian absent, having pinched out from the north and south. However, a ground check showed that brachiopod- and bryozoan-bearing Permian strata are present. The local structure is that of westerly and steeply dipping strata on the eastern slopes increasing to near vertical strata on the ridge summit and the western slopes. There may be a small-offset fault within the eastern slope.

DFA93-9A/B

South side of Rat River in MacDougall Pass, about 2 km due south of Horn Lake, Richardson Mountains, NWT.
 Lat. 67° 43' 26"N Long. 136° 02' 06" (GPS) - base of section.

NTS: 116P/9

UTM: 7512300N 456400E

Strata: Road River Formation (lower Paleozoic), Jungle Creek and Longstick formations (Permian).

DFA93-9A

Measured from east to west and first part of section measured on the north side of the old channel-cut then switched to south side where exposure is better for upper part of 9A. Much of the Permian section is characterized by a maroon to brick red colour.

Unit Thickness Ht. above Description

	<i>(m)</i>	<i>base (m)</i>	
			ROAD RIVER FM (LOWER PALEOZOIC)
1	not measured		<u>Shale</u> : Greenish-grey fissile shale. Very poorly exposed.
			JUNGLE CREEK FM (PERMIAN)
2	12	12	<u>Sandstone</u> : maroon coloured. Medium to coarse grained; some scattered granules. a few scattered thin lenses of conglomerate. Beds 30-50 cm thick. Very low-angle cross bedding and planar laminae.
3	4.5	16.5	<u>Covered</u>
4	10.5	27	<u>Sandstone</u> : medium to coarse grained. Scattered small pebbles. Maroon. Clay matrix. No visible sedimentary structures.
5	3	30	<u>Conglomerate</u> : Maroon. Poorly sorted, well rounded clasts up to cobble grade. Silt to coarse sand matrix; some clay. Flattened clasts aligned subhorizontally. Clasts mostly of very fine to fine grained sandstone.
6	7.5	37.5	<u>Sandstone</u> : poorly exposed. Similar to unit 2. Talus indicates presence of thin mudstone layers. No visible sedimentary structures.
7	73	110.5	<u>Sandstone</u> : with scattered lenses of conglomerate. Medium to coarse grained; some beds contain scattered granules and/or small pebbles. A number of beds have conglomeratic basal layers a few cm thick. Beds 30-70 cm thick; lateral extent indeterminable. Platy to flaggy weathering character suggests presence of planar laminae or very low-angle cross beds. Conglomerates - well rounded small pebbles to cobbles in a sand/mud matrix; clast and matrix supported examples. Commonly occur in lenses only a few metres in horizontal extent and up to 1 m thick. Interval capped by a 1.2 m thick conglomerate bed.

N.B. traverse shifted to south side of valley and dip varies from 40° steepening to 65°.

8	9(est)	119.5	<u>Talus</u> : sandstone (cf. unit 7)
9	2	121.5	<u>Conglomerate</u> : well rounded, poorly sorted, clasts up to cobble grade, in a sand/mud matrix. Matrix supported. Abrupt base and top. Clasts of greyish green chert and some sandstone. Matrix is maroon coloured.
10	3.5	125	<u>Sandstone</u> : cf. unit 7.
11	4.5	129.5	<u>Conglomerate</u> : cf. unit 9. Interval is capped by a pebbly sandstone - appears to be part of a rapidly fining-upward unit. Abrupt base and top.
12	0.8	130.3	<u>Conglomerate</u> : cf. unit 2, with clasts up to small boulders (20-30 cm) present in the basal zone. Abrupt base and top. Overall fining-upward trend. Top 20-39 cm consists of crudely interstratified conglomerate and sandstone layers.
13	1.5	131.8	<u>Sandstone</u> : cf. unit 7.
14	1.5	133.3	<u>Conglomerate</u> : similar to other conglomerate units. Also contains some green mudstone

			clasts as well as the usual chert and sandstone. Abrupt base and top.
15	1.5	134.8	<u>Sandstone</u> : cf. unit 7. Grades up into silty mudstone.
16	0.8	135.6	<u>Conglomerate</u> : cf. unit 12. Fines upward. Basal 40 cm contains large pebbles to cobble grade clasts, rapidly grading up into crudely interstratified coarse sandstone, granulestone and small-pebble conglomeratic sandstone. Abrupt base and top.
17	1.0	136.6	<u>Conglomerate</u> : small to large flat pebbles in a silt/sand matrix. Poorly exposed. Erosional base.
18	2.5	139.1	<u>Sandstone grading to siltstone</u> : poorly exposed.
19	2.0	141.1	<u>Conglomerate</u> : Basal 1 m is clast supported and grades up into matrix supported. Clasts up to small boulder size. Generally poorly sorted. Matrix of maroon coloured sand and mud. There is an overall fining-upward trend, although large cobbles still present in upper part of interval. It is possible that there may be two beds within this interval.
20	1.5	142.6	<u>Sandstone-mudstone</u> : recessive.
21	1.0	143.6	<u>Conglomerate</u> : up to cobble grade. Clast supported. Poorly sorted.
22	3.0	146.6	<u>Recessive</u> : talus of sandstone and silty mudstone.
23	2.5	149.1	<u>Conglomerate</u> : up to cobble grade. Noted at least one clast of a chert-pebble conglomerate. Fines upward into a pebbly coarse grained sandstone. Grades up from clast supported through matrix supported. No sedimentary structures seen.
24	12.0	161.1	<u>Recessive</u> : Talus of sandstone and silty to sandy mudstone.
25	2.1	163.2	<u>Conglomerate</u> : up to cobble grade. Abrupt base and top. Clast supported in basal 1.5 m grading up into matrix supported.
26	1.5	164.7	<u>Recessive</u> : sandstone and siltstone talus
27	2.2	166.9	<u>Conglomerate</u> : matrix supported. Up to large pebble grade.
28	1.5	168.4	<u>Recessive</u> : sandstone talus.
29	2.2	170.6	<u>Conglomerate</u> : matrix supported. Up to small cobble grade. Poorly sorted.
30	2.0	172.6	<u>Sandstone</u> : Medium to coarse grained. Variegated colour - maroon and greyish green. Appears to be argillaceous.
31	0.5	173.1	<u>Conglomerate</u> : matrix supported. Up to small cobble grade.
32	1.8	175.9	<u>Sandstone</u> : coarse grained grading up to silty, medium grained sandstone.
33	4.5	180.4	<u>Conglomerate</u> : undulatory, erosional base. Up to cobble grade with an overall fining-upward trend. Clast supported, grading up to matrix supported.

--- End measurements at last exposure before a long interval of vegetation cover ----

About 30-40 m west of unit 33 there is a mound of frost-heaved debris containing red-coloured shale/mudstone and thin fragments of sandstone and conglomerate.

The vegetated area between section 9A and 9B is 150-200 m wide and if the underlying strata dip at about 60-65° the calculated thickness of strata is 130-170 m. The recessive and covered character of this interval, plus the occurrence of shale near the base and at the beginning of section 9B indicate this area is underlain primarily by shale.

DFA93-9B

Unit Thickness Ht. above Description

	<i>(m)</i>	<i>base (m)</i>	<i>Description</i>
JUNGLE CREEK FM (PERMIAN)			
1	not measured		<u>Talus</u> : yellowish brown weathering silty shale and sandstone derived from up-slope.
2	2.0	2.0	<u>Sandstone</u> : fine to medium grained. Yellowish brown weathering; medium grey fresh. Well bedded and well jointed. Difficult to see internal structures.
3	3.5	5.5	<u>Sandstone</u> : yellowish brown to maroon.

			Rubbly weathering. Appears to be thoroughly bioturbated. Contact with unit 2 appears to be rapidly gradational.
4	11.5	17.0	<u>Shale</u> : mostly talus. Greenish brown to greenish grey. Silty mudstone to siltstone. Contains a few resistant ribs - possibly siltier beds. DFA93-9B-1 (C-231770) from 6 m above base for palynology (barren).
LONGSTICK FM (PERMIAN)			
5	1.0	18.0	<u>Sandstone</u> : rusty red colour. Coarse grained. Platy to flaggy. Poorly exposed.
6	6.0	24.0	<u>Shale</u> : mostly covered, cf. unit 4.
7	10.3	34.3	<u>Sandstone</u> : maroon to tan coloured. 0-0.2 m bioturbated, fine grained. 0.2-1.7 m cross laminated and ripple laminated, fine to medium grained. 1.7-2.8 m 3-4 cm thick sandstone beds separated by shaly partings. 2.8-10.3 m bioturbated, a few scattered cm-thick non-bioturbated beds. Yellowish brown colour. Very fine grained. Argillaceous.
8	4.5	38.8	<u>Coarsening-upward unit</u> : basal 50-70 cm consists of flaggy weathering, grey sandstone with shaly partings grading up into thoroughly bioturbated, grey to rusty grey, very fine grained, argillaceous sandstone. Some remnants of cm-thick beds within the bioturbated interval.
9	7.5	46.3	<u>Silty mudstone-argillaceous siltstone</u> : Rusty grey colour. Appears to be bioturbated. Some thin interbeds of bioturbated very fine grained sandstone.
10	4.0	50.3	<u>Conglomerate</u> : grades up into coarse grained sandstone. Erosional base cuts into unit 9 with up to 1 m of relief. Basal 10 cm contains small pebbles and granules that rapidly grades up into granulestone and then into coarse grained sandstone. No sedimentary structures seen. Abrupt top.
11	1.3	51.6	<u>Mudstone-shale</u> : greenish and brownish grey; silty.
12	0.7	52.3	<u>Sandstone</u> : very fine grained. Abrupt top and base. Rusty colour. Low angle intersecting sets of fine cross laminae.
13	6.0	58.3	<u>Shale</u> : greenish grey/brown. Interbeds (few cm to 20 cm thick) of very fine grained, finely laminated sandstone.
14	6.0	64.3	<u>Sandstone</u> : very fine grained. Well bedded; platy to slabby weathering. Subhorizontal laminae and some possible low-amplitude HCS. Abrupt top.
15	1.0	65.3	<u>Shale</u> : cf. other shale units.
16	1.5	66.8	<u>Sandstone</u> : variable thickness due to erosional base. Trough-like scours infilled with very fine grained sandstone. Bedding within troughs subparallel to trough margins.
17	6.0	72.8	<u>Conglomerate</u> : erosionally truncates unit 16. Consists of multiple, scour-based beds of small-pebble conglomerate, granulestone and very coarse grained sandstone. Crudely cross bedded - very low angle. Clasts dominated by black chert with some sandstone pebbles. Well rounded, well sorted clasts; both clast and matrix supported. Abrupt top.
18	2.2	75.0	<u>Sandstone</u> : very fine to fine grained. About 1 m of silty, bioturbated sandstone rapidly grading up into well bedded, laminated sandstone. Abrupt top.
19	6.0	81.0	<u>Shale</u> : some interbeds (20-40 cm thick) of very fine to fine grained sandstone.
20	2.2	83.2	<u>Sandstone</u> : very fine grained. Well bedded.
21	10.5	93.7	<u>Shale-mudstone</u> : bioturbated silty mudstone in basal 1 m grading up into shale. DFA93-9B-2 (C-231771) from 4 m above base for palynology (poorly preserved Permian palynomorphs).
22	1.5	95.2	<u>Sandstone</u> : very fine grained. Well bedded - shaly partings. No sedimentary structures seen.
23	1.5	96.7	<u>Granulestone-sandstone</u> : very coarse grained sandstone. Erosional base; abrupt top. No internal structures seen.
24	9.7	106.4	<u>Sandstone-shale</u> : thin to thick beds of sandstone with thin shaly partings. Sandstone beds are a few cm to 70 cm thick. Finely laminated. Interval thickness varies because of erosional base of overlying unit.
25	1.8	107.2	<u>Granulestone-conglomerate-sandstone</u> :

			Very small-pebble conglomerate to granulestone capped by about 70 cm of thinly bedded, argillaceous, very fine to fine grained sandstone. No sedimentary structures seen.
26	6.0	113.2	<u>Shale-sandstone</u> : thoroughly bioturbated.
27	4.5	117.7	<u>Sandstone</u> : granulestone at base, rapidly grading up into medium and then fine grained sandstone. Top 1 m is mostly fine grained sandstone. Massive with a few indications of planar laminae. Erosional base; abrupt top.
28	6.0	123.7	<u>Coarsening-upward unit</u> : grades up from a silty shale into a thoroughly bioturbated, argillaceous sandstone and capped by 70 cm of well bedded, laminated, fine grained sandstone. Bioturbated interval contains some traces of horizontal burrows.
29	1.0	124.7	<u>Shale-silty shale-argillaceous sandstone</u> : Bioturbated. Fissile to platy weathering.
30	6.0	130.7	<u>Sandstone</u> : fine to coarse grained. Well bedded. No sedimentary structures seen.
31	2.0	132.7	<u>Sandstone</u> : platy to flaggy weathering. Shaly-silty partings.
32	5.5	138.2	<u>Sandstone</u> : very coarse grained. Massive to very thickly bedded. Grades up into fine grained sandstone. No sedimentary structures seen.
33	6.0	144.2	<u>Sandstone</u> : argillaceous; bioturbated. Medium grey. Rubbly weathering.
34	4.5	148.7	<u>Granulestone-very coarse grained sandstone</u> : deeply erosive base with up to 1 m of relief. Clasts mostly of black chert. Grades up into well bedded very fine to fine grained sandstone.
35	1.5	150.2	<u>Sandstone</u> : argillaceous, bioturbated, very fine grained. Light brownish grey. Mostly talus.
36	4.5	154.7	<u>Sandstone</u> : very fine grained. Rubbly weathering. There may be a shaly unit between two sandstones in this interval.
37	6.0	160.7	<u>Recessive</u> : talus of silty shale and argillaceous, very fine grained sandstone. Brachiopod impression. Wood (logs and twigs) impressions noted in talus.
38	5.0	165.7	<u>Sandstone</u> : light grey. Very fine grained. Rubbly weathering. Upper contact is abrupt and forms a large bedding plane cliff.
39	9.0	174.7	<u>Recessive</u> : talus of silty to sandy mudstone grading up into bioturbated, argillaceous sandstone, finally into an upper 1 m of 10-20 cm thick sandstone beds separated by shaly partings.
			?BUG CREEK GP (JURASSIC)
40	7.5	182.2	<u>Sandstone-granulestone</u> : basal 1 m consists of small-pebble conglomerate and granulestone abruptly overlain by fine grained sandstone. Clasts are mostly black chert. Erosional base. Grey colour. No sedimentary structures seen in the conglomerate. Sandstone - massive to thickly bedded in mid part of interval becoming thickly bedded in top part.
41	42.0	224.2	<u>Recessive</u> : grass covered. A few frost boils near the base containing silty, argillaceous, very fine grained sandstone and silty mudstone. Looking up-slope, to the south, there is some shaly talus within this interval. DFA93-9B-3 (C-231772) from frost boils (paleontological sample: barren of palynomorphs).
42	not measured		<u>Sandstone</u> : very fine grained. Very abrupt basal contact.

---- End measurements -----

A series of sandstone and shale intervals continue to the west as prominent ribs and recessive intervals. However, unsure of stratigraphic position of these beds, it is probable that they are Jurassic. There is a colour change in the rocks from brownish coloured to grey at about unit 38 and a brachiopod impression as well as wood impressions were noted in unit 37. It is possible that the Permian-Jurassic contact falls somewhere between units 38 and 40.

DFA93-10

South valley slope of unnamed stream south of Vunta Creek, Richardson Mountains, Yukon.

Lat. 67° 53' 58"N Long. 136° 40' 07"W (GPS)

NTS: 116P

UTM: 7533000N 430000E

Strata: Upper member, Jungle Creek Formation and lower part of Longstick Formation (Permian).

This section is close to section 116P5 on Norris'(1981b) map 1519A (described in Bamber's GSC Open File 861 and measured by Larry Dyke).

Section begins on a col, northwest of which is lower Paleozoic limestone with an outcrop faulted against Permian shale. On the col and to the southeast are Permian strata. There is no exposed base to the Permian succession.

The Permian section starts in dark grey to black fissile shale and extends for about 130 m where the first of several sandstone intervals occurs. Above 130 m the number and thickness of sandstone intervals increases up-section, occurring as part of coarsening-upward units. The sandstones are very fine grained, commonly argillaceous and contain abundant *Zoophycus* trace fossils. Most of the sandstones appear to be thoroughly bioturbated although there are occurrences of fossiliferous sandstone and limestone, rich in brachiopod and bryozoan debris. These latter beds appear to be storm deposits.

240 m of section was sampled although the section continued to the top of the peak, primarily in sandstone. There is an estimated 50 m of section to top of the peak.

Section was sampled for shale every 30 m (for palynomorph and microfossil examination).

DFA93-10-1 at 0 m (C-231773): barren of palynomorphs

DFA93-10-2 at 30 m (C-231774): rare reworked Carboniferous spores

DFA93-10-3 at 60 m (C-231775): rare reworked Carboniferous spores

DFA93-10-4 at 90 m (C-231776): rare reworked Carboniferous spores

DFA93-10-5 at 120 m (C-231777): rare reworked Carboniferous spores

DFA93-10-6 at 150 m (C-231778): rare reworked Carboniferous spores

DFA93-10-7 at 180 m (C-231779): rare reworked Carboniferous spores

DFA93-10-8 at 210 m (C-231780): rare reworked Carboniferous spores

DFA93-10-9 at 240 m (C-231781): some Permian pollen.

Very high levels of thermal alteration.

DFA93-11

Headwaters of Little Fish River, Richardson Mountains, Yukon.

Lat. 68° 04' 33"N Long. 136° 35' 26"W (GPS)

NTS: 117A/1

UTM: 7550900N 433700E

Strata: upper part of Upper member, Jungle Creek Formation (Permian). Contains a prominent grey-weathering limestone bed.

Traversed up-slope towards the Jurassic Bug Creek Group. Permian section is faulted at the base and consists of a shale dominant lower part grading up into a series of coarsening-upward cycles in the upper part of the exposed succession. The sandstone/limestone components of the coarsening-upward cycles form prominent ribs in the slope. Also, the Permian succession has a very distinct rusty brown to reddish brown colour.

Succession consists of predominantly shale and silty shale with resistant weathering ribs of very fine grained, argillaceous sandstone. The sandy units are completely bioturbated and *Zoophycus* is abundant. There are a few scattered beds of micritic limestone with one very prominent, grey weathering rib of limestone about 100 m below top of succession. This is about 3-4 m thick and is a highly fractured limestone band.

Sample DFA93-11-1 (C-231782) collected for conodonts. Barren of foraminifers.

Sandstone beds in the upper part of the succession are in units 1-4 m thick.

DFA93-12

Eastern valley slope on upper reaches of Little Fish River, close to the NWT/YT boundary, Richardson Mountains.
Lat. 68° 08' 29"N Long. 136° 30' 26"W (GPS)

NTS: 117A/1

UTM: 7559100N 437300E

Strata: beginning at a grey-weathering limestone bed within the upper part of the Upper member, Jungle Creek Formation.

1. PERMIAN

Typical rusty brown to reddish brown colour except for a light-grey weathering band of limestone (landing site). The limestone is in a similar stratigraphic position to the limestone at 93-11 and it is highly likely that they are correlatable. However, the thickness of overlying strata at 93-12 appears to have increased dramatically compared to that at 93-11 (estimated to be about 200 m at 93-12). The strata above the limestone band at 93-12 appears to be contiguous and not faulted, therefore the thickness increase is stratigraphic and not a fault repeat.

The limestone bed is about 4-5 m thick, has a gradational basal contact with the underlying shale but abruptly overlain by a 30-50 cm thick sandstone bed, in turn apparently abruptly overlain by shale (not well exposed). The top 50 cm of the limestone unit is yellow weathering and highly fossiliferous (mostly large-ribbed brachiopods). The limestone forms part of a coarsening-up cycle.

Sample DFA93-12-1 (C-231783) collected for conodonts. Barren of foraminifers.

Sample DFA93-12-2 (C-231784) collected from shale about 1.5 to 2 m above the limestone (palynology: poorly preserved Permian palynomorphs).

The overlying shale grades up into a sandstone unit that is completely bioturbated and contains an abundance of *Zoophycus*.

To top of slope the Permian consists of a series of shale-dominant coarsening-upward cycles.

2. ?BUG CREEK GROUP OR ?TRIASSIC

Capping the peak is a thick interval of interbedded quartzose, very fine to fine grained sandstone and shale. These strata are grey in colour, in contrast to the reddish brown of the underlying strata.

There is a distinct slope change between the reddish coloured Permian beds and the grey coloured sandstone-shale succession. Also, the sandstones within the two successions differ, the Permian sandstones are rusty coloured, commonly argillaceous and generally thoroughly bioturbated, whereas the ?Jurassic sandstones are grey, "clean" and contains very low angle cross laminae.

Sample DFA93-12-3 (C-231785) from a shale unit between the sandstone-capping cliffs and the red-coloured Permian succession (possible Scythian to Anisian flora).

Sample DFA93-12-4 (C-231786) from about 10-15 m above the uppermost, Permian sandstone and below the first grey coloured sandstone (Probable Triassic palynomorphs).

DFA93-13

Western valley slope on upper reaches of Little Fish River, Richardson Mountains, Yukon.

Lat. 68° 09' 50"N Long. 136° 37' 45"W (GPS)

NTS: 117A/1

UTM: 7562800N 432900E

Strata: a prominent grey-weathering limestone bed within the upper part of the Upper member, Jungle Creek Formation (Permian). Correlative to limestone unit in sections DFA93-11 and 12.

DFA93-14

Middle reaches of Little Fish River near where the NWT-YT boundary intersects the river; Richardson Mountains. A ridge between a prominent loop of the river.

Lat. 68° 15' 04"N Long. 136° 25' 59"W (GPS)

NTS: 117A/8

UTM: 757137N 440743E (determined on GPS)

Strata: Devonian limestone faulted against Carboniferous strata, which are overlain by the Lower member, Jungle Creek Formation, in turn overlain by shale of the Upper member.

Unit Thickness Ht. above Description

	(m)	base (m)	
			LOWER PALEOZOIC
1	not measured		<u>Limestone</u> : Light grey to white; highly fractured; bedding difficult to distinguish - appears to be near vertical. Forms prominent resistant rib. Contact with beds to the east is a near vertical face, suggesting either a fault and/or vertical bedding.
			LISBURNE GP (CARBONIFEROUS) (fault contact)
2	not measured		Talus of medium grey, quartzose sandstone. No dip obtainable.
3 and 4	not measured		<u>Interbedded limestone-sandstone</u> : Outcrops/talus begin about 15 m horizontally from the lower Paleozoic limestone. Dips to the west to northwest at first occurrence but a few metres east dips in the opposite direction, to the east, then farther upslope another dip reversal (due to small-scale folding). Rusty brown weathering colour; medium grey fresh. Bioclastic limestone with crinoids, brachiopods and bryozoa. Traces of <i>?Zoophycus</i> . Medium crystalline. Commonly contains low-angle intersecting sets of cross strata. Up-section, sandstone becomes more common and these beds commonly contain bioclastic debris in the basal zones. Also contain low-angle cross stratification. Sandstone-limestone beds 20-70 cm thick.

Above unit 2 the dip appears to be constantly to the southeast until unit 16 when another small-scale fold repeats section.

Units 2 to 4 are repeated due to folding

2	20(est)	20.0	<u>Sandstone talus</u> : recessive. Very fine to fine grained.
3	4.5	24.5	<u>Sandstone</u> : forms upstanding rib. Dip about 56°SE. Thickly bedded. Very fine to fine grained; light grey to brownish grey. No sedimentary structures seen.
4	3.0	27.5	<u>Bioclastic limestone</u> : rusty brown. Coarsely crystalline. Mostly crinoidal debris (cf. previous description). DFA93-14-1 (C-231787) for conodonts. Contains late Bashkirian-early Moscovian foraminifers.
5	3.0	30.5	<u>Recessive</u> : sandstone talus.
6	1.5	32.0	<u>Limestone</u> : Rusty brown weathering; dark grey to black fresh. Micritic. Contains poorly preserved <i>?Paleoaplysina</i> (tentative identification) DFA93-14-2 (C-231788) for conodonts. Contains possible Gshelian foraminifers.
7	3.5	35.5	<u>Recessive</u> : sandstone/siltstone talus.
8	4.5	40.0	<u>Limestone</u> : rusty brown. Poor exposure. Bioclastic - mostly crinoidal. Well bedded. Traces of <i>?Zoophycus</i> . <i>?Paleoaplysina</i> (tentative

			identification) present in rubble of upper part of unit.
9	7.5	47.5	<u>Recessive</u> : sandstone/shale talus
10	4.5	52.0	<u>Bioclastic limestone</u> : crinoid and brachiopod debris dominant ("shell hash"). Low-angle cross beds.
11	9.0	61.0	<u>Recessive</u> : sandstone/shale talus.
JUNGLE CREEK FM (PERMIAN)			
12	16.5	77.5	<u>Sandstone-limestone</u> : prominent rib. Dip decreases to about 50°. Basal 2-3 m consists of very fine to fine grained, thickly bedded sandstone. Contains shallow trough cross stratification. Thinner beds appear to contain some HCS. A few of the sandstone beds contain bioclastic debris in their basal 20-80 cm and the limestone part is commonly finely laminated. Upper 12-13 m consists of rusty brown, fine to coarsely crystalline, cross bedded, bioclastic limestone.
13	9.0	86.5	<u>Recessive</u>
14	12.0	98.5	<u>Sandstone-limestone</u> : mostly very fine grained sandstone with scattered beds of bioclastic limestone. Fine undulatory laminae - possibly low amplitude HCS. Medium to thickly bedded. Brachiopod-rich limestone more common in top 2 m.
15	10.0	108.5	<u>Limestone</u> : prominent rib. Light grey; massive to unevenly flaggy weathering. Contains possible <i>Paleoaplysina</i> . Abrupt basal contact; upper contact covered. No internal structures seen. DFA93-14-3 (C-231789) for conodonts. Permian foraminifers (possibly Sakmarian).

NB units 16 to 19 are a repeat of unit 15 and unit 20 and above.

16	20.0		<u>Recessive</u> : shale talus, some outcrop. DFA93-14-4 (C-231790) for palynology (barren).
17	4.0		<u>Interbedded sandstone-limestone-shale</u> : 10-50 cm thick beds of sandstone and limestone separated by shaly partings and thin (few cm) shale beds. Bioclastic limestone. Very fine grained sandstone. Forms a minor rib.
18	18.0		<u>Recessive</u> : shale and sandstone talus.
19	9.0		(repeat of unit 15) <u>Bioclastic limestone</u> : rusty brown to light grey. Medium crystalline. Massive; poor bed definition. Abrupt upper contact - forms steep bedding plane cliff. DFA93-14-5 (C-231791) for conodonts. Contains unidentifiable foraminifers.

20	5.0	113.5	<u>Shale</u> : a few thin sandstone interbeds near top of interval. DFA93-14-6 (C-231792) collected 1.5 m above base for palynomorphs (Permian pollen) and microfossil.
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Dip increase to 70°SE

21	4.0	117.5	<u>Interbedded sandstone-shale</u> : 10-30 cm thick beds of very fine grained sandstone separated by 20-70 cm thick shale intervals. Six sandstone beds - all have abrupt bases/tops. No sedimentary structures seen.
22	7.0	124.5	<u>Shale</u> : contains at least three, thin, platy weathering beds of very fine grained sandstone in upper 2 m.
23	87.0	211.5	<u>Shale</u> : Scattered very thin beds of platy to flaggy weathering, very fine grained sandstone. Some ironstone-rich horizons. Samples collected for palynology and microfossils: DFA93-14-7 (C-231793) 27 m above base of unit. Permian pollen. DFA93-14-8 (C-231794) 43 m above base of unit. Permian pollen. DFA93-14-9 (C-231795) 86 m above base of unit. Permian pollen.
24	0.7	212.2	<u>Sandstone</u> : very fine grained. Brownish grey. Platy to flaggy.
25	1.0	213.2	<u>Shale</u> :
26	0.2	213.4	<u>Sandstone</u> :
27	15.0	228.4	<u>Shale</u> : a few thin sandstone interbeds. Rich in ironstone concretions in lower 3 m. DFA93-14-10 (C-231796) 9 m above base of unit (palynology and microfossils).

			Palynomorphs of Asselian to Artinskian range.
28	1.0	229.4	<u>Sandstone</u> : mostly rubble. Very fine grained. Brownish grey.
29	4.5	233.9	<u>Shale</u> : poorly exposed
30	not measured		<u>Sandstone</u> : mostly rubble

----- End measurements -----

Measurements stopped where the ground becomes densely vegetated. South and east of the end of 93-14 there is a prominent river bend in which is exposed a sandstone unit at the base overlain by a thick section of shale - this section appears to be contiguous with 93-14. However the amount of intervening strata is unknown and a calculation would be inaccurate because the dip flattens towards the river-cut. An estimate of 120 to 150 m of covered section may be in the right order of magnitude. The outcrop in the river bend is estimated to have about 50 m of exposed strata.

Nassichuk and Bamber's (1978) choice of the Carboniferous-Permian boundary (based on fossil collections) would be within my unit 11 (a recessive interval) - the choice is based on comparing their figure 45 with my own photographs and measurements. This interval is identified as a possible fault contact between Pennsylvanian and Permian strata by Nassichuk and Bamber (op. cit.) but there is very little physical evidence to support this interpretation.

DFA93-15

West bank of the middle reaches of Almstrom Creek, Richardson Mountains, NWT.

Lat. 68° 12' 08"N Long. 136° 06' 57"W (GPS)

NTS: 117A/1

UTM: 7565654N 453732E (GPS)

Strata: grey-weathering calcareous sandstone within the Upper member, Jungle Creek Formation (Permian). This bed is equivalent to the limestone bed at DFA93-11, 12 and 13.

DFA93-16

Begins on a prominent ridge separating the headwaters of Cache Creek from Little Fish River, extending eastward to another prominent ridge on the north side of Almstrom Creek. Revisited in 1994.

Lat. 68° 08' 24"N Long. 136° 28' 54"W (GPS) - base of section.

NTS: 117A/1

UTM: 7558900N 438300E

Strata: Lisburne Grp, Jungle Creek and Longstick formations (Carboniferous to Permian).

Unit Thickness Ht. above Description
(m) base (m)

First traverse begins on north side of prominent gully. Base of the Carbo-Permian succession is covered by talus. Presumed to overlie lower Paleozoic strata unconformably. Measurements begin at first true outcrop.

LISBURNE GP (CARBONIFEROUS)

1	27.5	27.5	<u>Interbedded conglomerate-sandstone.</u> 0-7.5 m: mostly medium to coarse grained, pebbly to granular sandstone with layers of pebbles and granules. Large granules to very small pebbles with a few isolated large pebbles. Most of coarser fraction occurs as 1-5 cm thick basal layers to sandstone beds, with some occurring within sandstone beds. Generally these pebbly layers are abruptly, but non-erosionally, overlain by sandstone. Sandstone is cross bedded - ranging from subhorizontal laminae, current ripple laminae and megaripple (25-50 cm high) laminae. Some deep, trough-like scours also present. Beds vary from 10 to 60 cm thick. Orientation of crossbeds varies from bed to bed. Subrounded to rounded grains/pebbles. Pebbles mostly grey, white and black chert; sand grains also include quartz. Some green chert grains noted. Sample DFA93-16-5A (C-231822) collected about 1 m above base of interval. 7.5-13.75 m: contains thick beds (up to 1 m) of small-pebble conglomerate separated by
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sandstone beds. Generally lacking in crossbeds, although some crude crossbedding is visible in a few beds.

13.75-27.5 m: similar to lower third of interval but with some thick conglomerate beds similar to middle third.

- | | | | |
|---|-----|----|--|
| 2 | 4.5 | 32 | <u>Limestone</u> : light to medium grey; slight yellowish weathering colour. Bioclastic; medium to coarsely crystalline. Fragments of corals are identifiable, especially common in basal 1 m. Basal contact is uneven and there appears to local relief of up to 50 cm. Sample DFA93-16-6 (C-231823) - composite of the interval. |
|---|-----|----|--|

Line of traverse moved to south side of gully and measurements started at zero.

- | | | | |
|----|------|-------|---|
| 1 | 25.5 | 25.5 | <u>Sandstone-conglomerate</u> : similar to basal unit in first traverse. Sample DFA93-16-7 (C-231824) 14 m above base. First 20 m dominated by fine to medium grained sandstone with some layers of granules and small pebbles, generally occurring at the base of sandstone beds. Crossbedding is abundant - current ripple and megaripples; shallow trough crossbeds and subhorizontal laminae.
At about 20 m there is a thick (40 cm) conglomerate in an otherwise sandstone-dominant interval - mostly small pebbles with some up to small cobbles; well rounded clasts; poorly to moderately well sorted.
Above 20 m there are more and thicker pebble-conglomerate intervals than in the lower 20 m. |
| 2 | 4.5 | 30 | <u>Limestone</u> : bioclastic, pebbly. Scattered small pebbles. Medium grey. Contains coral fragments. Appears to be equivalent to unit 2 in first traverse. Sample DFA993-16-8 (C-231825). |
| 3 | 7.5 | 37.5 | <u>Talus</u> |
| 4 | 1.5 | 39 | <u>Sandstone</u> : cf. unit 1. Low-angle cross beds composed of alternating layers of fine and medium grained sand. |
| 5 | 2 | 41 | <u>Talus</u> |
| 6 | 1 | 42 | <u>Limestone</u> : base not exposed. Light grey to yellowish weathering. Brownish grey fresh. Micritic. Abrupt upper contact. DFA93-16-9 (C-231826) |
| 7 | 1 | 43 | <u>Sandstone</u> : very fine grained. Subhorizontal bedding. |
| 8 | 1 | 44 | <u>Limestone</u> : bioclastic (abundant shell debris). Abrupt base and top. Overlain by medium grained sandstone. DFA93-16-10 (C-231827) |
| 9 | 4.5 | 48.5 | <u>Talus</u> : mostly sandstone |
| 10 | 3.5 | 52 | <u>Sandstone</u> : fine to medium grained. Calcareous. Low-angle cross beds. Ripple laminae. Within the top 50 cm there are pebbly layers. Abrupt top. |
| 11 | 7.5 | 59.5 | <u>Limestone-sandy limestone</u> : Abruptly overlies unit 10. Bioclastic. Thickly bedded. Subhorizontal bedding. DFA93-16-11 (C-231828). |
| 12 | 5.5 | 65 | <u>Sandstone</u> : platy to flaggy weathering. Rusty brown colour. Very fine grained. Grades up into blocky weathering limestone. Poorly exposed. |
| 13 | 0.5 | 65.5 | <u>Limestone</u> : bioclastic. Light grey. Base not seen. Abrupt top. |
| 14 | 1 | 66.5 | <u>Sandstone</u> : very fine grained. Rusty brown. Subhorizontal bedding and some small scours infilled with shallowly inclined beds. |
| 15 | 36 | 102.5 | <u>Talus</u> : mostly rubble with scattered outcrops. Immediately overlying unit 14 there is about 1-3 m of talus containing limestone blocks but the bulk of the talus and outcrops are composed of flaggy to blocky, rusty brown, very fine to fine grained, siliceous sandstone. <i>Zoophycus</i> noted in talus blocks. This unit was measured to the beginning of the flat-topped ridge. The Carboniferous colonial coral collected in 1993 was relocated and sampled (DFA93-16-14; C-231831 from base of colony) - it was collected from near the top of the western slope, just before the flat-top of the ridge. It occurs as a colony within a sandstone succession - resting on the uppermost bedding surface of a pebbly sandstone and surrounded by very fine grained sandstone. The colony is 45 cm high and the preserved part is 45 cm across. |

JUNGLE CREEK FM (PERMIAN) (contact position approximate)

- 16 35 137.5 Top of ridge and some of dip-slope: mostly rubble and some outcrops of sandstone with some limestone beds. Very fine to fine grained sandstone; flaggy weathering; brownish grey. Trace fossils noted in talus blocks - small horizontal traces. At the west side of the ridge top, very close to the beginning of the western slope there is a light yellowish brown weathering limestone bed that contains corals (DFA93-16-12: C-231829) - estimated to be about 4-6 m above base of interval. Along strike, but just below sample 93-16-12 found a horn coral in very fine grained sandstone (DFA93-16-13: C-231830). The western lip of the ridge-top consists of interbedded limestone and sandstone which contain coral fragments and brachiopod shells.
- 17 2-3 140.5 Limestone: a prominent light grey to white limestone bed that covers much of the eastern dip slope. This is a ?*Paleoaplysina*-bearing limestone. Limestone is approximately 15-20 m above the last sandstone/limestone outcrop on the ridge top; the intervening area is covered. Immediately, and abruptly, underlying the limestone is a sandstone. Walking down the dip slope a colonial coral was found within the limestone bed (DFA93-16-15; C-231832).

NOTE: dip slope is slightly steeper than dip of beds in many places hence the discontinuous outcropping of the limestone bed and the occurrence of sandstone outcrops in some places. However, near the base of the dip slope there are scattered outcrops of shale that overlie the limestone. The contact between the limestone and the immediately overlying beds is not exposed.

- 18 17 157.5 Covered: vegetated except near top of interval where shale outcrops in a small stream-cut. Grades upwards into unit 19.
- 19 2-3 160.5 Sandstone: forms a minor ridge near base of dip slope. Very fine grained; argillaceous; thoroughly bioturbated. Abrupt top.
- 20 254 414.5 Covered: vegetated to Cache Creek. On east side of creek 24 m of shale crops out which grades up into sandstone of unit 21. DFA93-16-16 (C-231833) from shale outcrop. The bulk of the covered interval is presumed to be underlain by predominantly shale.
- 21 6 420.5 Sandstone: caps the first ridge immediately east of Cache Creek. Rapidly gradational base; abrupt topographic break at top suggesting abrupt lithological change (not seen). Very fine to fine grained; argillaceous in lower part becoming "cleaner" up-section. Grey to rusty weathering; dark grey fresh. At least one 1 m-thick shale/siltstone within the sandstone interval. No visible sedimentary structures.
- 22 147 567.5 Mostly covered: minor outcrops near top of interval, immediately underlying 2nd ridge east of Cache Creek. Outcrops consist of dark grey to black silty shale. Sample DFA93-16-17 (C-231834) collected about 1 m below unit 23.
- 23 2 569.5 Sandstone: forms second ridge east of Cache Creek. Very fine grained; argillaceous. Rubby weathering. Appears to be thoroughly bioturbated.
- 24 191 760.5 Covered: mostly vegetated. No outcrops encountered along line of traverse or within sight of traverse. Presumed to be underlain by predominantly shale. Leads up to third ridge.
- 25 22.5 783 Sandstone: underlies third ridge east of Cache Creek. Two small outcrops separated by a grassy ledge. Platy to flaggy weathering; brownish grey weathering; dark grey to black fresh; very fine to fine grained; argillaceous. Appears to be thoroughly bioturbated. The grassy ledge appears to be underlain by argillaceous siltstone and/or silty shale. This interval may consist of two coarsening-upward cycles. The upper sandstone is blockier and thicker bedded than lower sandstone. Upper sandstone abruptly overlain by silty shale.
- 26 33 816 Covered: vegetated, some minor talus of shale and thin sandstone beds near base.
- 27 4.5 820.5 Interbedded sandstone and argillaceous sandstone/sandy siltstone: thin beds. Poorly exposed. Rusty brown weathering. All beds are thoroughly bioturbated.
- 28 1.5 822 Sandstone: thinly bedded; thinly parted; very fine grained; argillaceous. Abruptly overlies an underlying thicker bedded sandstone but gradational into overlying beds.
- 29 3 825 Sandstone: forms 3rd prominent ridge east of Cache Creek. Very fine grained; brownish grey weathering; dark grey fresh. Varies from thinly to medium parted. Calcareous. Sample

			DFA93-16-18 (C-231835). Appears to be bioturbated. Brachiopods noted in talus. Gradational base; an apparent abrupt top. Has a long dip slope.
30	120	945	<u>Mostly covered:</u> (especially upper beds) first 4-6 m (on dip slope of unit 29) consists of interbedded shale, argillaceous sandstone or siltstone and very fine grained sandstone. Some thin beds of brachiopod-bearing sandstone seen in talus. Some beds contain abundant shell debris. Dip slope leads to small stream and 30 m beyond stream the ground is densely vegetated.
31	21	966	<u>Shale-sandstone:</u> two ribs of poorly exposed sandstone east of small stream. Mostly very argillaceous, very fine grained sandstone or siltstone. Consists of mostly frost-heaved talus that is near to in-place position. Some <i>Zoophycus</i> traces noted.
32	338	1304	<u>Covered:</u> vegetated.
	calculated		
33	6	1310	<u>Sandstone:</u> forms small ledge on upper estimate slopes of valley. Thoroughly bioturbated, argillaceous, very fine grained sandstone. Base/top not exposed. Dip flattens to about 15°.
34	6	1316	<u>Covered:</u> talus and grass
	estimate		
35	7.5	1323.5	<u>Limestone:</u> light yellowish grey weathering; dark grey fresh. <i>Zoophycus</i> and small-diameter horizontal burrows are common. Platy to flaggy partings. Base/top covered. Forms cliff on upper slopes. DFA93-16-19 (C-23186).
36	90	1413.5	<u>Talus and grass:</u> lower part grass covered, upper part contains sandstone talus derived from sandstone-forming cliffs at top of hill.
	estimate		
			?BUG CREEK GP (JURASSIC)
37	70	1483.5	<u>Sandstone:</u> forms cliffs at top of slope and caps the prominent N-S ridge east of Cache Creek. Abundant trace fossils (horizontal burrows). Very fine to fine grained; brownish grey to rusty weathering colour; blocky to thickly parted. Contains thin beds of shell debris.
	estimate		

----- End of measurements/observations-----

DFA94-1

"Brat Creek" (sensu Jeletzky, 1967) - a southern tributary of Rat River, located on the plateau at the eastern entrance to McDougall Pass, Richardson Mountains, NWT.

Lat. 67° 30'N Long. 135° 43' 13"W (GPS)

NTS: 106M/12

UTM: 7505300N 469500E

Strata: Tentatively identified as Triassic by Jeletzky (1967) but the facies are more comparable to the Permian in the McDougall Pass area.

A quick examination of the "Brat Creek Fm", identified by Jeletzky (1967) as a possible Triassic unit. Exposed in the river valley, on the south bank. Alternating ridges of conglomerate, sandstone and a few intervals of coaly shale (these latter intervals tend to be covered by vegetation and lack exposures). All the outcrops are deeply weathered and the conglomerate/sandstone units are almost completely disaggregated, with only small areas of cemented rock.

Conglomerate: poorly sorted; sand to granule matrix. Mostly rounded pebbles of black, grey and white chert, with some sandstone pebbles. Weathers light yellow and grey with rusty red streaks. Pebbles up to cobble size. Some layers of subangular pebbles were noted. A few iron-stained cemented horizons. The upper conglomerates examined tend to be grey in colour, rather than light yellow - due to predominance of white/grey chert pebbles and absence of iron-stained cement.

Sandstone: coarse grained to granular; contains layers and lenses of pebbles. Some scattered outcrops of cemented sandstone with very low-angle cross bedding. Medium grey in colour.

Jeletzky (1967) identified these beds as Triassic (based on some tenuous paleontological data), however, the lithofacies

and general character of the succession are very similar to those seen in the Permian near Horn Lake, only a few kilometres to the northwest. I strongly suspect that these Brat Creek beds are Permian.

Jeletzky, J.A. 1967. Geological Survey of Canada, Paper 66-50.

DFA94-3

Headwaters of Bear Creek, Richardson Mountains, NWT.

Lat. 67° 48' N Long. 135° 56' 43" W (GPS)

NTS: 106M/3

UTM: 7521200N 460200E

Strata: Road River Formation (lower Paleozoic); Lower member, Jungle Creek Formation (Permian).

Permian: Rubble-strewn slope contains talus of granulestone, medium to coarse grained sandstone (the more prevalent lithotypes) and some small-pebble conglomerate. Reddish brown colour. Very little real outcrop and in those seen there were no obvious sedimentary structures.

Rounded to subrounded pebbles in a coarse sand to granular matrix.

Near base of rubble-strewn slope there is an outcrop of black chert of the Road River Formation.

This locality helps to confirm the continuous nature and coarse clastic character of the basal Permian between East Bear and Bear creeks.

DFA94-4

Valley slope north of Horn Lake, McDougall Pass, Richardson Mountains, NWT. Section 9 on Norris's map (1981b, GSC map 1519A; originally measured by E.W. Bamber [in Bamber, 1972] as section 116P-9).

Lat. 67° 47' 35" N Long. 136° 01' 29" W

NTS: 116P/16

UTM: 7517900N 456800E

Strata: Lower member, in fault contact with the Upper member, Jungle Creek Formation (Permian).

This area was examined because in Bamber's description of this section the thickness he measured seemed anomalously thin and lacking in a basal redbed succession. I made a tentative conclusion, based on his descriptions, that he had started his measurements at a sandstone within the shale of the Upper member, Jungle Creek Formation, rather than at the true base of the Permian succession. I examined this area to check my suspicions.

Observations: there are redbeds at the base of this section but the dip and strike of these beds differs from the overlying shale-to-sandstone Permian succession, implying that there is a fault separating the redbeds from the structurally (and presumably stratigraphically) overlying Permian strata.

The redbeds consist of fine to coarse grained sandstone, some conglomerate and possibly some mudstone units (within recessive intervals between the knolls of sandstone). These beds are very similar to basal Permian redbeds seen within the immediate vicinity and tends to confirm my suspicion that Bamber's section did not begin at the true base of the Permian.

DFA94-6

Muskeg Creek, southern slopes of the British Mountains, Yukon.

Lat. 68° 42' 17" N Long. 140° 27' 30" W (GPS)

NTS: 117B/9

UTM: 7621300N 522600E

Strata: Lisburne Group (Carboniferous), Sadlerochit Group (Permian-Triassic).

Outcrop is very poor and obtaining a reliable dip measurement was difficult. Most of area is covered by vegetation. Observational traverse from south to north, up-section.

Carboniferous

Mostly frost-heaved talus of Lisburne limestone. Light grey to white.

Permian

Two lithological successions noted, a lower, thick shale-dominated interval and an upper sandstone-rich interval.

The lower shale interval is mostly covered by vegetation and the upper interval forms the cap to a hill. Outcrop quality in the sandstone interval also is poor, due largely to abundant talus.

Sample DFA94-6-1 (C-231811), a brown, silty shale from near the Lisburne-Permian contact (within 10-20 m horizontal distance).

Sample DFA94-6-2 (C-231812), a black, fissile shale, collected 50-60 m horizontally from Lisburne contact.

Sample DFA94-6-3 (C-231813), a medium grey, blocky, shale collected about 150 m horizontally from the Lisburne contact.

Succession in areas of samples 2 and 3 contain thin sandstone interbeds.

Sample DFA94-6-4 (C-231814) collected from base of conical, sandstone-capped hill. Silty shale.

Sandstone interval: caps a low, conical hill. Very fine to fine grained; very siliceous. Highly fractured. Some vague bedding seen in a few outcrops. Molds of brachiopods were noted in the talus low in the interval.

Calculated minimum thickness based on outcrop width of 750 m (from topographic map): 130 to 194 m (using 10 and 15° dips).

Calculated maximum thickness based on a 1000 m outcrop width: 174 to 259 m (using 10 and 15° dips).

DFA96-1

Location: North slope of East Bear Creek, northern Richardson Mountains, NWT. Approximately 1 km south of the type section of the Longstick Formation (DFA92-8).

Latitude: 67° 50.85'N Longitude: 135° 46.98'W (GPS located)

NTS:

UTM:

Strata: Upper member of the Jungle Creek Fm and Longstick Fm.

Observations: the contact between the Jungle Creek and Longstick formations is poorly exposed at section DFA92-8, the type section of the Longstick Formation, consequently the East Bear Creek valley was re-examined to find an exposed section. The contact is well exposed at 96-1. Here the contact is a transition zone about 8-10 m thick in which there is an overall coarsening-upward aspect. Shale/mudstone of the Jungle Creek Formation grade up into interbedded sandstone and shale beds in fining-upward couplets about 1-2 m thick. The amount of interbedded shale/mudstone gradually declines and thins in each successive bed. Each couplet begins with at an abrupt basal contact overlain by thoroughly bioturbated, very fine to fine grained sandstone that grades up into equally thoroughly bioturbated sandy mudstone. *Zoophycus* is a common component, as well as thin (5-10 mm diameter) subvertical burrows (a few 10s of cm long). Some beds contain layers of shell debris, commonly present at, or near the base of each couplet. The sandstone part of each couplet is dominant. The base of the Longstick Formation is chosen at the base of a prominent, resistant weathering sandstone unit, above which sandstone is the dominant lithology. The Longstick and Bug Creek sandstones form the cliffs of the middle to upper slope.

The bulk of the lower Longstick Fm consists of bioturbated very fine to fine grained sandstone contains abundant examples of *Zoophycus* and vertical burrows. Upper beds of the formation are less argillaceous, very fine to fine grained, and contains low-angle cross laminae. Burrows are less common than in lower beds.

OBSERVATIONS AT SHEEP CREEK

NTS: 116P/9 (1:50 000 scale)

UTM: 7509600 N 446800E

Formations: informally named Coral Unit between the Devonian Imperial Fm and the Permian Jungle Creek Fm.

Visited to check Mattner's (PhD thesis, 1990) premise that there is a distinct unit between the Devonian Imperial Fm and typical beds of the Lower member, Jungle Creek Formation. These he informally called the Coral Unit. There is indeed a distinct unit that is muddier, generally finer grained than the more typical basal beds of the Permian Jungle Creek Formation, as well as containing a few limestone beds. The latter are rarely present in the Lower member, Jungle Creek Fm, within this part of their occurrence. Also, Mattner collected some corals from this unit, a fossil type rarely found in the Lower member, (Jungle Creek Formation), in the immediate vicinity. The contact with the more typical Permian beds is abrupt and apparently erosional. There is an abrupt change to coarse grained to granular sandstone beds above the upper contact of the Coral Unit.

The Coral Unit has a distinct yellowish hue and appears to be extensively bioturbated; in contrast to the basal Permian beds which are generally grey in colour, contain few, or no burrows, and are extensively cross-bedded.

Although Mattner was unable to obtain an age determination from the corals, the Coral Unit appears to be such a different entity that it is more likely to be Carboniferous than Permian, based on regional considerations, marine origin, and lithological character.

DFA96-2

Location: 2.2 km SW of Sheep Creek observation site. Located on prominent SE spur leading from major peak. Landed helicopter about mid-way up the slope. Northern Richardson Mountains, NWT.

NTS: 116P/9

UTM: 7508000N 445400E

Formations: Lower member, Jungle Creek Fm.

Base of Jungle Creek Fm covered; however failed to spot any indications that the "Coral Unit" seen at nearby Sheep Creek is present between the Devonian and Permian beds.

Made some observations and thickness estimates on the Lower member, Jungle Creek Fm.

Lower member, Jungle Creek Fm.

Estimated to be 80-100 m thick.

Lower 60-80 m consists of trough cross bedded fine grained to granular sandstone beds.

Next 10-15 m: a distinct rusty brown colour distinguishes this interval. Thin bedded, cross bedded, fine to medium grained sandstone. HCS is abundant throughout this interval; commonly as a large-scale bedform. Towards top of interval some beds are bioturbated. Base of this interval is abrupt and HCS bed rests directly on a trough cross bedded, fine to medium grained, locally coarse-grained, sandstone. The latter beds are lighter coloured and more massive in appearance. This contact could be a surface of marine erosion formed as the Permian transgression progressed, resulting in truncation of shoreface to possibly nonmarine beds below.

Uppermost 15-20 m: three ribs of sandstone separated by shaley beds apparently in coarsening-upward cycles. Sandstone are very fine to fine grained and weather into platy fragments. Uppermost sandstone bed abruptly overlain by a thick shale succession (Upper member, Jungle Creek Formation).

The Upper member contains a prominent sandstone interval that caps a coarsening-upward succession in lower third of the Upper member. It in turn is abruptly overlain by another thick interval of shale that grades up into sandstones of the Longstick Formation.

DFA96-5

Location: north side of East Bear Creek valley; gully on talus covered slope. Northern Richardson Mountains, NWT.

Latitude: 67° 52.6'N Longitude: 135° 49.8'N (GPS located)

NTS: 106M/13 (1:50 000 scale)

UTM: 7529400N 464600E

Formation: Longstick, Jungle Creek and Road River formations.

Observations aimed primarily at the Lower member of the Jungle Creek Formation, in order to compare with facies on south side of East Bear Creek.

Most of slope is talus covered, principally by sandstone blocks derived from the Longstick Formation and Bug Creek Group which are poorly exposed in the upper slopes.

Longstick Fm: very poorly exposed. Some lower beds are exposed and consist of thoroughly bioturbated, very fine to fine grained sandstone.

Jungle Creek Fm: Upper, shale-rich, member is almost entirely covered by talus. Lower member is not well exposed but there is a small outcrop of very fine to fine grained sandstone with some beds that are thoroughly bioturbated (contains abundant *Zoophycus*), and others that contain very low-angle cross beds (?HCS). Some layers present that are rich in brachiopod debris.

Road River Fm: poorly exposed, dark grey to black cherty shale and shale with thin siltstone interbeds. Contact between Jungle Creek and Road River formations not exposed.

The Lower member of the Jungle Creek Fm is obviously a marine deposit, in sharp contrast to correlative beds on the south side of the valley where nonmarine redbeds are present (2-2.5 km away).

CARBONIFEROUS AND PERMIAN STRATA IN MACKENZIE DELTA WELLS

Aklavik A-37

Jungle Creek Formation:

Lower member 5750-6048 ft.

Thickness:

Jungle Creek Formation (Lower member): 298 ft; 90.8 m

Paleoservices report (unpublished GSC report PS200) identifies fusulinids from 5750 ft indicative of a Permian age.

Aklavik F-38

Jungle Creek Formation:

Lower member: 5337-6045 ft.

Thickness:

Jungle Creek Formation (Lower member): 708 ft; 215.8 m

Very similar succession to that seen in Aklavik A-37 and compares well with the Lower member, Jungle Creek Formation, that outcrops at Jurassic Butte in the nearby Aklavik Range, although the latter has no limestone beds (however, a few calcretes have been noted).

Beaverhouse Creek H-13

Longstick Formation: 3760-4878 ft

Jungle Creek Formation

Upper member: 4878-5589 ft

Lower member: 5589-5915 ft

Thickness:

Total: 2155 ft; 656.8 m

Longstick Fm: 1180 ft; 340.8 m

Jungle Creek Fm: 1037 ft; 316.1 m

Upper member: 711 ft; 216.7 m

Lower member: 326 ft; 99.4 m

Paleoservices report (Geological Survey of Canada paleontological report PS202) has conflicting age determinations based on palynomorphs vs. microfossil/ostracods. 3800-5050 ft a probable Middle Permian age is given, based on palynomorphs; below 5050 ft Middle Permian vs Middle Devonian conflict (probably due to abundance of reworked fossils).

Core 1: (4852.1-4881.8 ft)

Contains Permian palynomorphs (Rept. 6-JU-89) Transition zone between Jungle Creek and Longstick formations.

Mudstone/limestone: dark grey to black, highly calcareous (could even be classified as a very argillaceous limestone in parts); no apparent sedimentary structures. Contains broken, half and whole, thin-walled brachiopod shells (?spiriferid type). Large calcite-filled vugs and fractures in parts of core.

Interpretation: marine, shelf mud.

Kugpik L-24

Jungle Creek Formation

Upper member: 8080-8958 ft

Lower member: 8958-TD (9242 ft)

Thickness:

Jungle Creek Fm: 1162 ft; 354.2 m (incomplete)

Upper member: 878 ft; 267.6 m

Lower member: 284 ft; 86.6 m (incomplete)

Cores 3 and 4: (8185-8221 ft)

20-30 degrees dip relative to core's horizontal axis.

Jungle Creek Formation, Upper member.

8185-8187.5 ft Sandstone: very fine grained. Alternations of bioturbated argillaceous sandstone and massive sandstone (latter in 5-20 cm thick units).

8187.5-8190 ft Sandstone: very fine grained; massive; shaley intercalations and fine laminae in lowest 5 cm.
8190-8194.5 ft Sandstone: very fine grained; extensively bioturbated; argillaceous; a few interbeds of laminated sandstone.

8194.5-8221 ft Sandstone: very fine grained; massive to finely laminated/cross bedded with at least three bioturbated zones. A thin beds of intraclasts at about 8204 ft. Massive and laminated beds grade into each other. Lamination is parallel to subparallel, no apparent cross cutting laminae. traces of pyrite.

Interpretation: marine, generally slow sedimentation, intermittent current activity.

Kugpik O-13

Jungle Creek Formation:

Upper member: 9695-10630 ft

Lower member: 10630-11355 ft

Carboniferous: 11355-TD(12101 ft)

Thickness:

Total: 2406 ft; 733.3 m (incomplete)

Jungle Creek Fm: 1660 ft; 506 m

Upper member: 935 ft; 285 m

Lower member: 725 ft; 221 m

Carboniferous: 746 ft; 227.4 m (incomplete)

Austin and Cummings' paleontological report (Geological Survey of Canada paleontological report PS220) suggested a very tentative age of Carboniferous for interval 9695-11,672 ft based on very poor fossil control (one identified palynomorph from 10,600 ft) - correlations with Unak L-28 indicate that only strata below 11355 ft are Carboniferous.

Core 5: 10,155-10,178 ft

No in situ palynomorphs recovered; abundant reworked Lower Carboniferous material. Core contains numerous brachiopods.

25-30 degree dip relative to core's horizontal axis.

Jungle Creek Formation, Upper member.

Bioturbated, very fine grained, argillaceous sandstone to sandy-silty mudstone. A 40 cm thick unit of laminated, very fine grained sandstone in central part of core. Subvertical fractures.

Interpretation: marine, generally slow sedimentation.

Core 6: 11980-11990 ft

Carboniferous

11980-11981 ft Shale: silty; mottled maroon-grey; indurated.

11981-11990 ft Interbedded sandstone and chert/siliceous sandstone.

Sandstone: light grey to white; very fine to fine grained; quartzitic. Massive appearance.

Contact between overlying shale and underlying sandstone marked by a 3-4 cm thick brecciated zone.

Base of sandstone uneven due to loading.

Chert/siliceous sandstone: light grey; microcrystalline; fine to coarsely laminated. Contact with sandstone is gradational over a short interval.

Interpretation: uncertain. The siliceous bed could be a silcrete. Core from an interval characterized by red-beds and the presence of an abundance of chert. Possibly could have been deposited in a non-marine or marginal marine environment.

Napoiak F-31

Jungle Creek Formation

Lower member: 3802-4428 ft

Carboniferous 4428-TD (5015 ft)

Thickness:

Total: 1213 ft; 366.7 m (incomplete)

Jungle Creek Fm (Lower member): 626 ft: 190.8 m

Carboniferous: 587 ft: 178.9 m (incomplete)

Palynology report in well history file indicates Permian age for these strata.

Cores 2 and 3: 4061-4091, 4091-4132 ft

Cores 2 and 3 contain Early Permian palynomorphs and scolecodonts (Geological Survey of Canada paleontological report 6-JU-89).

Jungle Creek Formation, Lower member.

4061-4068 ft Sandstone: very fine grained; predominantly massive with a few thin horizons of laminae. Abrupt basal contact.

4068-4070 ft Mudstone and argillaceous sandstone: thoroughly bioturbated throughout. laminae are rare (some in top 1 m). Mudstone is very silty to sandy. Contains one shell-rich horizon. Gradational lower contact.

4070-4100 ft Interbedded sandstone-argillaceous sandstone-mudstone: all units are thoroughly bioturbated. A few distinct vertical burrows and some very fine tubular burrows. Several shell-rich horizons. Gradational lower contact.

4100-4130 ft Sandstone: thoroughly bioturbated; very fine grained; argillaceous. Several shell-rich horizons. Some of the shelly horizons have an abrupt upper surface, probably indicating a short period of non-deposition or minor erosion. Abundant leaf fragments. Base of interval marked by a 3-4 cm thick zone of mudstone pebbles. Abrupt lower contact.

4130-4131.5 ft Mudstone: bioturbated.

Interpretation: marine. Generally slow sedimentation interrupted by periods of more rapid deposition.

Succession between 4070-4130 ft appears to be a channel-fill - ?marine, tidal flat or estuarine?

Core 4: 4970-5005 ft

20 degree dip relative to core's horizontal axis.

Carboniferous.

4960-4976.67 ft Limestone: dark grey to black; micritic. Highly fractured and stylolitic. Small sand-size clasts of indeterminate nature (?intraclasts or bioclasts? - appear to be former). Calcareous nodules present in upper 50 cm and they consist of light grey to white, very finely crystalline calcite; variable in size and irregularly spherical with uneven outer surface. Some nodules have crude laminae. Lower contact is gradational - basal 12-15 cm consists of irregularly and unevenly bedded limestone (1-3 cm beds) separated by argillaceous seams/laminae.

4976.67-4982.4 ft Limestone: light grey to creamy; bioclastic; sparry cement. Contains well rounded quartz grains, especially in upper half of interval. Bioclasts of fine to medium sand-size. Abrupt lower contact.

4982.4-4983.2 ft Sandstone: light to medium grey; very fine grained; calcite cement. Irregularly spaced bedding planes a few mm to 2 cm apart. Lower contact not well preserved but rapid lithological changes suggests abrupt contact.

4983.2-4988.2 ft Limestone: bioclastic; sparry cement; light grey to creamy colour. Fine to medium sand-size clasts, with some large foraminiferal tests preserved (contain geopetal fill). A poorly preserved brachiopod shell seen.

- 4988.2-4998.4 ft Mudstone: mostly red/maroon; top 15 cm greyish green grading down into maroon colour. Basal 15 cm grades upward from greyish colour into finely alternating red and grey beds. Top 125 cm indistinctly to irregularly bedded. Bulk of interval consists of finely laminated mudstone units separated by beds of massive mudstone. Some ripple laminae. Laminae are calcareous. Massive mudstones generally non-calcareous, suggesting that laminae are composed of silt- to very fine sand-sized calcareous material.
- 4998.4-5000.08 ft Sandstone: very fine grained; calcite cement. Greyish green colour. Fine, irregular laminae. gradational upper contact; basal contact abrupt but uneven.
- 5000.08-5005 ft Mudstone with calcareous concretions. Red/maroon mudstone. Calcareous concretions few cm to 90 cm thick (latter is a band between 4999-5002 ft). Fractures with slickensides are abundant and irregularly distributed - giving rise to a highly broken core in this interval. Concretions are white, irregular in shape, except the smaller ones, and have a rough and uneven outer surface.

Interpretation: presence of limestone with foraminifers and shells suggests a marine influence. Nodular features in the upper limestone have some similarities to anhydrite nodules and they could be calcite-replaced anhydrite nodules. The concretions in the lowermost mudstone have features similar to caliche, suggesting subaerial exposure. The combination of marine fossils, possible pseudomorphs of anhydrite nodules and caliche deposits suggests a marginal marine environment such as a lagoonal setting, where marine conditions and subaerial exposure could co-exist. Alternatively the limestone beds could represent a marine transgression over non-marine beds.

Tullugak K-31

Jungle Creek Formation:

Upper member: 8410-9460 ft

Lower member: 9460-TD(9600 ft)

Thickness:

Jungle Creek Formation: 1190 ft; 362.7 m (incomplete)

Upper member: 1050 ft; 320 m

Lower member: 140 ft; 42.7 m (incomplete)

Ulu A-35 (True Vertical Depth logs used)

Longstick Formation: 9020-10200 ft

Jungle Creek Formation: 10200-TD(12,860 ft)

Upper member: 10200-?11950 ft*

?Lower member: ?11950-TD(12860 ft)

Thickness:

Total: 3840 ft; 1170.4 m (incomplete)

Longstick Formation: 1180 ft; 359.7 m

Jungle Creek: 2660 ft; 810.7 m (incomplete)

Upper member: 1750 ft 533.4 m*

?Lower member: 910 ft; 277.4 m (incomplete)

* It is possible that there may be a thrust repeat in the Upper member, accounting for the very thick Upper member.

Core 4: 9643-9674 ft

Palynomorphs indicate Permian age (Geological Survey of Canada paleontological report 6-JU-89).

Longstick Formation.

Mudstone: medium to dark grey; silty; well indurated. Calcite-filled subhorizontal to horizontal fractures and

parting planes (few mm thick). Faint trace of remnant horizontal bedding. Appears to be bioturbated.

Interpretation: probably marine.

Unak B-11

Longstick Formation: 7990-9128 ft

Jungle Creek Formation: 9128-TD(10975 ft)

Upper member: 9128-?10455

?Lower member: ?10455-TD (10975 ft)

Thickness:

Total: 2985 ft; 909.8 m (incomplete)

Longstick Formation: 1138 ft; 346.9 m

Jungle Creek Formation: 1847 ft; 563 m (incomplete)

Upper member: 1327 ft; 404.5 m

?Lower member: 520 ft; 158.5 m

Geological Survey of Canada paleontological report PS213 (cutting samples): palynological samples identified as Triassic to Jurassic in age! No age-diagnostic microfossils. Geological Survey of Canada paleontological report 6-JU-89 indicates that Early Permian palynomorphs were recovered from core 5.

Core 5: 9495-9525 ft

Palynomorphs indicate Permian age (Geological Survey of Canada paleontological report 6-JU-89).

Jungle Creek Formation, Upper member.

Mudstone: black. Breaks into small blocky fragments. Carbon and calcite lined fractures and shear planes (latter contain slickensides). No visible sedimentary structures.

Interpretation: probably marine.

Unak L-28

Jungle Creek Formation: 2470-2969 m

Upper member: 2470-2745 m

Lower member: 2745-2969 m

Carboniferous: 2969-3190 m

Thickness:

Total: 710 m (faulted base)

Jungle Creek Formation: 499 m

Upper member: 275 m

Lower member: 224 m

Carboniferous: 221 m (faulted base)

Permian strata are overlain by Jurassic or Lower Cretaceous shale (Husky Formation) and are thrust over Jurassic (Husky Formation) strata.

Well history report cites Mississippian-age for near the base of Lisburne section. Mamet (pers. comm., 1995) indicates that the basal limestone-sandstone interval contains Carboniferous and Permian microfossils, with Carboniferous below 2969 m.

D. McNeil (Geological Survey of Canada paleontological report 1-DHM-1987) reported Jurassic microfossils (Husky Fm.) are present in a cored interval below the Lisburne limestone. J. Wall (pers. comm., 1995) indicates that microfossils from 2475-2745 m are very similar to assemblages from Permian outcrop (dated by

macrofossils) in the Richardson Mountains, and although not age definitive they are sufficiently distinct from the immediately overlying Mesozoic assemblage that a Permian age is fairly certain.

GEOLOGICAL SURVEY OF CANADA PALEONTOLOGICAL REPORTS

Listed below, by author(s) and report number, are the unpublished Geological Survey of Canada paleontological reports based mostly on samples collected by J. Dixon (unless otherwise indicated). A brief description of their contents is given.

E.W. Bamber

Report C6-EWB-1993: Carboniferous coral from section DFA93-16.

D.H. McNeil

Report 1-DHM-1987: Jurassic foraminifers from the Unak L-28 core which is below dated Carboniferous strata.

M.J. Orchard

Report MJO-1994-23: Triassic conodonts from sections measured by J. Dixon in the northern Yukon.

Report MJO-1995-6: Carboniferous, Permian, and Triassic conodonts from several sections measured by J. Dixon in the northern Yukon.

S. Pinard

Report SP-1-93: Carboniferous small foraminifers from section DFA93-16.

Report SP-2-93: Carboniferous and Permian small foraminifers from outcrops in the northern Richardson Mountains.

Report SP-3-93: Permian small foraminifers from upper reaches of Cache Creek, Richardson Mountains. Identifications for samples collected by D.K. Norris. Same section as Dixon's DFA93-16.

L. Rui

Report Rui-6-1993: Carboniferous fusulinaceans from section DFA93-16.

Report Rui-7-93: Carboniferous and Permian fusulinaceans from outcrops in the northern Richardson Mountains.

Report Rui-8-93: Permian fusulinaceans from upper reaches of Cache Creek, Richardson Mountains. Identifications for samples collected by D.K. Norris. Same section as Dixon's DFA93-16.

J. Utting

Report 6-JU-89: Permian palynomorphs from core material in Beaverhouse Creek H-13, Ulu A-35, and Unak B-11 wells.

Report 3-JU-1994: Includes identification of Permian palynomorphs from Jurassic Butte.

Report 6-JU-1994: Carboniferous, Permian and Triassic palynomorphs from the northern Richardson Mountains.

J.H. Wall

Report 1-JHW-1995: Foraminifers from sidewall cores in Unak L-28: although not age-specific the assemblage is similar to foraminifers from the Permian in the northern Richardson Mountains.

Report 2-JHW-1995: Foraminifers from the Shale member, Jungle Creek Formation, in the northern Richardson Mountains.

REFERENCES

- Bamber, E.W.
1972: Descriptions of Carboniferous and Permian stratigraphic sections, northern Yukon Territory and northwestern District of Mackenzie (N.T.S. 106M; 116C, F, G, H, I, J, P; 117A, B, C). Geological Survey of Canada, Paper 72-19, 161p.
- Bamber, E.W. and Waterhouse, J.B.
1971: Carboniferous and Permian stratigraphy and paleontology, northern Yukon Territory, Canada. Bulletin of Canadian Petroleum Geology, v.19, p.29-250.
- Detterman, R.L., Reiser, H.N., Brosge, W.P., and Dutro, J.T. Jr.
1975: Post-Carboniferous stratigraphy, northeastern Alaska. U.S. Geological Survey, Professional Paper 886, 46p.
- Dixon, J.
in press: Permian and Triassic stratigraphy of Mackenzie Delta, and the British, Barn, and Richardson Mountains, Yukon and Northwest Territories. Geological Survey of Canada, Bulletin.
- Jeletzky, J.A.
1967: Jurassic and (?)Triassic rocks of the eastern slope of Richardson Mountains, northwestern District of Mackenzie, 106M and 106B (parts of). Geological Survey of Canada, Paper 66-50, 171p.
- Nassichuk, W.W. and Bamber, E.W.
1978: Site 8: Pennsylvanian and Permian stratigraphy at Little Fish Creek. *In* Geological and Geographic Guide to the Mackenzie Delta Area, F.G. Young (ed.). Canadian Society of Petroleum Geologists, p.85-89.
- Norris, D.K.
1981a: Blow River and Davidson Mountains. Geological Survey of Canada, Map 1516A, 1:250 000 scale.
1981b: Bell River. Geological Survey of Canada, Map 1519A, 1:250 000 scale.
1981c: Fort McPherson. Geological Survey of Canada, Map 1520A, 1:250 000 scale.
in press: Triassic. *In* The geology, mineral and hydrocarbon potential of northern Yukon Territory and northwestern District of Mackenzie, D.K. Norris (ed.). Geological Survey of Canada, Bulletin

