

ML 95-1

Target:	Mountain Lake Diatreme	Company:	Geological Survey of Canada
Drill Hole:	ML 95-1	Collar Azimuth:	N/A
Location:	454636E, 6145913N	Collar Incline:	-90°
Zone and Datum:	Zone 11, NAD 27	Core Diameter:	70 mm
Elevation:	~654 m asl	Geologist Logging:	D.A. Leckie, B.A. Kjarsgaard
Start - End Date:	12/05/1995 – 12/15/1995	End of Hole (EOH):	166.60 m

Logging from Top of core

0 to 5.8 m: no core; rotary drilled; no recovery

5.8 to 7.19 m: ultrabasic volcanic, weathered, oxidized, secondary calcite, moderate quartz-feldspar contamination, no obvious indicator minerals; pedogenic slickensides; vague bedding

AIRFALL

7.19 to 8.83: ultrabasic volcanic, moderate quartz-feldspar contamination, rare garnet; fractured at angles of 60°; weathered, oxidized zones extend up to 2 cm from fractures; poorly-sorted xenolithic clasts to 1 cm; black shale (Kaskapau?) and green siliciclasts (Wapiti?); minute, < 1 mm thick calcite veins at 50-60°; essentially massive; at 8 m is vertical fracture with manganese stain

AIRFALL

8.83 to 20.1 m: ultrabasic volcanic; moderate quartz-feldspar contamination; very vague bedding dipping at subhorizontal to ~40°; distinct olivine-rich beds at 16.80 - 17.10 and 18.70 - 19.50 m, olivine matrix (ash) supported, rare lapilli; clasts of Wapiti (green) are angular; wood debris disseminated throughout, very low percentage thereof; at 18.27 and 18.97 bedding dips at 30 °;
- at 16.17 m is a fine quartzose sandstone interval 4 cm thick (interpreted as a clast); is disturbed, microfaulted, but bedding continues across disturbance

ML 95-1

- at 20.1 to 20.34 m is a breccia of sandstone and siltstone clasts; wood debris; sandstone is fine grained and angular; siltstone is green; black shale clasts
- overall, unit is dominated by olivine, with rare lapilli and xenoliths; call it medium grained with clasts to 1 cm

AIRFALL

20.34 to 22.97: ultrabasic volcanic, medium grained, rare rounded and angular lapilli, but mostly olivine in a mudstone matrix; crystal supported at top, matrix supported at base; moderately well sorted; rare indicator minerals; limited crustal xenocryst contamination; calcite filled fractures dip at 60°

AIRFALL

22.97 to 26.42: ultrabasic volcanic, poorly-sorted, fine grained olivine, matrix supported; very ash-rich; grades to lower unit; slightly finer grained than overlying unit

AIRFALL

26.42 to 29.31: ultrabasic volcanic; granulestone at base; fines upwards to overlying unit, highly contaminated (quartz plus feldspar), matrix supported; clasts of Wapiti to 3 cm diameter; wood debris to 1 cm; basal 60 cm is very poorly sorted with clasts to 3 cm, average = 2 cm; abundant slickensides, fault contact

AIRFALL

29.31 to 41.35: ultrabasic volcanic, massive; medium grained ash-rich; poorly sorted; no structure; angular clasts of green Wapiti sandstone; angular clasts of green Wapiti Sandstone to 8 by 5 cm; strung out, not lithified; highly contaminated by quartz plus feldspar

- ultrabasic volcanic autolith at 33 m
- at 39.3 clasts (e.g. lower crustal xenoliths) are aligned; this is either bedding or natural dip of paleosurface; angular clasts; not water transported at all
- coalified wood debris to 1 cm

DEBRIS FLOW

41.35 to 43.5: breccia of Wapiti clasts; wood debris; siltstone, fine-grained sandstone, coal clasts; subtle, vague bedding, dipping at 55°; breccia conglomerate; clasts have alteration halos/rims around them

DEBRIS FLOW

43.5 to 46.89: ultrabasic volcanic: multiple graded beds 15 to 65 cm thick; beds dip at 50°; unit fines upwards overall; beds range from very coarse to medium grained, olivine dominated, matrix supported; clasts of Wapiti; coal clasts

DEBRIS FLOW (AIRFALL?)

- sandstone injection dikes at 45.2 (2 cm wide), 45.5 (10 cm wide) and 45.95 m (0.5 to 1 cm wide); the later tapers downwards; contain chips of country rock (i.e., ultrabasic volcanic 1 mm to 1 cm in size, angular to subangular); dike at 45.5 m contains angular clasts to 6.5 x 8 cm in size; commonly see smaller injection dikes feeding off main dike; sandstone in dike is fine-grained upper; – indicate FLUIDIZED, OVERPRESSURED SANDS;

IMPLICATIONS ARE 1) SAND TRAPPED IN OR BELOW ULTRABASIC VOLCANIC, 2) SAND AND WATER IS OVERPRESSURED; SAND IN ULTRABASIC VOLCANIC IS NOT LI THIFIED

46.89 to 46.96: sandstone clast; fine grained, chloritic sandstone

ML 95-1

46.96 to 47.77: ultrabasic volcanic; massive; sandstone clasts; quartz plus feldspar
contamination moderate; minor mica; minor coal debris; massive

47.77 to 48.89: sandstone clast conglomerate; sandstone clasts to 43 cm at base; 7 cm
clast at top, sandstone is fine grained chloritic; smaller green siltstone and
sandstone clasts dispersed in poorly sorted, mediumgrained ultrabasic volcanic
matrix which is highly contaminated by quartz and feldspar xenocrysts

48.89 to 51.29: ultrabasic volcanic; medium to coarse grained; moderate sorting, matrix
rich with fine grained matrix; rare lapilli which are angular to rounded; granule
size clasts of Wapiti and Kaskapau shale clasts

- overall a graded bed from pebble conglomerate clasts at base to medium-grained
sandstone

51.29 to 51.99: ultrabasic volcanic; massive; medium grained, poorly-sorted, olivine rich,
rare lapilli which are angular to rounded

DEBRIS FLOW

51.99 to 53.64: ultrabasic volcanic; massive; olivine rich, matrix supported, medium
grained

DEBRIS FLOW

53.64 to 54.48: coarse grained ultrabasic volcanic fining up to fine grained ultrabasic
volcanic; at least 3 graded beds; top 35 cm (53.64-53.99) is faulted, hard to tell
structures;

- fault at 70°, 5 cm wide, calcite filled; millimetre-sized ultrabasic volcanic debris
in the calcite

- 53.95 to 54.25: granule size fines up to medium grained

- 54.25 to 54.48: coarse grained fines up to medium grained

- 54.48 to 54.84: very coarse grained fines up to fine grained

54.48 to 54.68: convolute, contorted, very poorly sorted ultrabasic volcanic; some clasts of Kaskapau; strung out fine-grained sandstone clasts to 8 x 3 cm; clasts average medium grained with pebbles of xenoliths from granules to cobbles; angular

DEBRIS FLOW

54.68 to 55.54: siliciclastic melange of green siltstone, very fine sandstone and carbonaceous debris; minor microfaulting, but contorted; clasts to 8 x 10 cm; comminuted carbonaceous debris, faulted lower contact at 35°

DEBRIS FLOW

55.54-60.25: ultrabasic volcanic; rare lapilli in the upper part of the bed; dominantly olivine, matrix supported; matrix contaminated by quartz plus feldspar; clasts of Kaskapau (black shale) and Wapiti (green); oversteepened beds at 60°; clasts are subangular to subrounded; fines upwards from coarse to fine grained;

faulted lower contact

60.26 to 66.75: massive melange of sediments of the Wapiti; green to black sandstone (very fine and fine) and siltstone; microfaulted; clasts with synsedimentary faults are evident; Wapiti in ultrabasic volcanic matrix (containing abundant quartz and feldspar xenocrysts) DEBRIS FLOW

66.75 to 70.06: pebbly, medium grained ultrabasic volcanic; massive; olivine poor at top, rich at base; minor lapilli - matrix supported (fine grained muddy matrix - highly contaminated by quartz and feldspar xenocrysts); abundant clasts of Wapiti and Kaskapau; angular to subangular 1 mm to 7 cm; wood debris;

DEBRIS FLOW

70.06 to 71.43: siltstone coarsens up to finely interbedded sandstone and siltstone; beds dip at 30° - in place? with minor deformation ? 71.43 to 73.43: ultrabasic volcanic; massive; highly contaminated; contains cored lapilli to 6 mm diameter; contorted stringers of very fine sandstone and siltstone; generally coarsens downwards; medium grained pebbly; angular clast of Kaskapau to 1 cm; micaceous with flakes to 3 mm; clasts are contorted
- calcite veined and calcite cemented at 70°

DEBRIS FLOW

73.43 to 75.31: sandstone; top 1.2 m is medium grained sandstone; balance is shale clast conglomerate with siltstone clasts to 2 cm, average is 1 cm –

FLOODPLAIN/FLUVIAL

75.31 to 75.37: interbedded very fine sandstone and siltstone; are 1 to 2.5 cm thick; parallel bedded

75.37 to 75.62: medium-grained sandstone within shale clast conglomerate; clasts to 8 cm

75.62 to 76.17: pebble conglomerate (shale clasts to 0.5 x 2 cm) and wood; coarse sandstone fines up to medium stones to

76.17 to 76.19 m: siltstone

76.19 to 75.56 m: coarse sandstone fines upwards to medium sandstone; crossbedded

75.56 to 76.66 m: siltstone

76.66 to 76.78 m: sandstone, medium grained

76.78 to 76.87 m: siltstone

76.87 to 77.04 m: sandstone, coarse grained, cross bedded

77.04 to 77.14 m : siltstone

ML 95-1

77.14 to 79.18 m: sandstone; coarse grained fining up to medium grained; cross bedded;
carbonaceous debris

79.18 to 80 m: convoluted, carbonaceous sandstone; abundant coalified debris

80 to 80.92 m: sandstone, medium grained; carbonaceous debris - core barrel jammed

80.92 to 82.73 m: ultrabasic volcanic; massive; abundant clasts/xenoliths; large clasts of
Wapiti to 8 x 8 cm; smaller clasts of Kaskapau; micaceous; rare cored
lapilli/autoliths to 1 cm; olivine matrix supported - fine/medium grained matrix;
secondary calcite

DEBRIS FLOWS

82.73 to 84.73 m: grey green; questionable root; carbonaceous debris disseminated
throughout

84.73 to 85.63 m: ultrabasic volcanic; massive; calcareous; minor horizontal veining of
calcite material; breccia at 85.06; 3 to 5 mm Kaskapau shale chips; Wapiti
siltstone and sandstone (very fine grained) clasts disseminated; medium grained
matrix

DEBRIS FLOW

85.63 to 86.13 m: sandstone; fine grained fining to interbedded sandstone and siltstone;
green; minor disturbance

86.13 to 86.26 m: siltstone, sandy; carbonaceous; comminuted carbonaceous debris in
basal 20 cm

86.26 to 86.68 m: sandstone, fine-grained; massive 86.68 to 86.93 m: green siltstone

86.93 to 87.06 m: sandstone, fine grained, massive; sandstone clast at base –

MAY BE INJECTED

87.06 to 87.21 m: green siltstone

87.21 to 87.35 m: fine-grained sandstone; massive, shale chips 1 x 7 cm in middle
carbonaceous

87.35 to 90.48 m: siltstone, green, slightly carbonaceous; roots, carbonaceous debris
– FLOODPLAIN

90.48 to 93.18 m: ultrabasic volcanic - sediment mixture; xenoliths of Wapiti
siltstone and shale; clasts to 8 cm; strung out and swirled; chips to 1 cm of
Kaskapau (average 3 mm); fine grained matrix, highly contaminated (quartz
+ feldspar) matrix; minor olivine, rare lapilli to 1 mm diameter; overall
fining upwards; fewer clasts upwards; basal 30 cm is highly convoluted
sandstone (fine grained), siltstone, shale mixture of clasts; call it xenolith
conglomerate at base fining upwards to medium grained ultrabasic volcanic
DEBRIS FLOW

93.18 to 93.5 m: very fine sandstone with abundant clasts of siltstone and sandstone
2 mm to 2 cm diameter; organic debris; silty very poorly sorted, 4 cm
stringer of fine sand at top; 1 cm stringer 3 cm from base 93.5 to 93.88 m:
siltstone, green; stringers of fine sandstone; coarsens downwards to fine
siltstone

93.88 to 94.1 m: ultrabasic volcanic with clasts to 3 cm of sandstone cored lapilli;
medium grained overall

93.88 to 98.02 m: ultrabasic volcanic; graded bed fining upwards, angular clasts;
some very angular; clasts to 2 cm at base; olivine rich, rare lapilli; basal part
has increased quartz + feldspar xenocryst contamination;
medium pebbly ultrabasic volcanic
DEBRIS FLOW

98.02 to 99.71 m: ultrabasic volcanic; graded bed, angular clasts; some very
angular; clasts to 2 cm at base; fines upwards; top is highly

contaminated with carbonaceous material, quartz and feldspar - little olivine;
medium pebbly ultrabasic volcanic

DEBRIS FLOW

99.71 to 101.96 m: ultrabasic volcanic, olivine rich, matrix supported; graded bed,
angular clasts; some very angular; clasts to 2 cm at base; fines upwards; medium
pebbly ultrabasic volcanic; several vertical delicate clasts; several calcite veined
fractures at 50°

DEBRIS FLOW

101.96 to 103.30 m: ultrabasic volcanic; massive, highly contaminated by quartz and
feldspar; calcite veins at 50 to 60°

DEBRIS FLOW

103.30 to 103.56 m: pebbly, sandy siltstone; carbonaceous debris; massive 103.56 to
103.72 m: siltstone, green; beds dip at 50° - TOP OF FLUVIAL POINT BAR

104.14 to 104.89 m: fine-grained sandstone fines up to green siltstone - FLUVIAL
POINT BAR

104.89 to 106.24 m: siltstone, carbonaceous debris; big wood fragments to 1 x 6 cm;
probably ultrabasic volcanic detritus

106.24 to 106.37 m: fine-grained sandstone 106.37 to 106.51 m: siltstone; very
carbonaceous 106.51 to 106.91 m: rippled, very fine-grained sandstone;
carbonaceous debris on foresets

106.97 to 107.89 m: rippled, fine grained sandstone; abundant carbonaceous debris on
foresets

107.89 to 108.27 m: medium-grained sandstone, massive

108.27 to 108.52 m: very carbonaceous, cross bedded sandstone; comminuted
carbonaceous material on foresets; fine grained

108.27 to 119.1 m: sandstone; medium grained lower at 108.62; trough crossbedded, carbonaceous debris

- 111.71 m: medium-grained upper

-117.8 m: medium-grained, pebbly; shale clasts to 1 cm –

FLUVIAL POINT BAR

119.1 to 119.4 m: shale clast conglomerate – LAG AT BASE OF CHANNEL

119.4 to 120.45 m: green siltstone; very green; WHY?; IS IT REWORKED

ULTRABASIC VOLCANIC; micaceous; questionable roots; clasts derived from ultrabasic volcanic; fines upwards slightly; pedogenic slickensides; gets sandier upward – PEDOGENICALLY ALTERED 120.45 to 121.05 m: silty sandstone; coarsens down to fine-grained sandstone; contorted - SOFT SEDIMENT DEFORMATION

121.05 to 121.54 m: siltstone; abundant slickensides – COULD BE A BANK COLLAPSE FEATURE

121.54 to 122.5 m: sandstone, fine-grained, contorted, convolute; siltstone clasts

122.5 to 122.65 m: sandstone; coarse-grained; trough cross beds

122.65 to 123.65 m: interbedded sandstone and siltstone; beds 10 to 15 cm thick; sandstone is fine-grained – SOFT SEDIMENT DEFORMATION FEATURES; SPLAY; FLOODPLAIN?

123.65 to 123.71 m: shale clast conglomerate; clasts to 1 cm; in fine sandstone matrix – STORM EVENT

123.7 to 123.78 m: siltstone

123.78 to 124.11 m: shale clast conglomerate in fine sandstone matrix; clasts to 2 cm; subangular clasts to 1 x 5 cm

124.11 to 124.17 m: sandstone, fine grained, massive

124.17 to 124.29 m: siltstone

ML 95-1

124.29 to 124.92 m: very fine silty sandstone, massive, carbonaceous debris; 2 stringers of fine sandstone to 2 cm thick at 40 cm from top; deformed slightly

124.92 to 125.17 m: fine grained sandstone; stringers of 1 to 2 cm sandstone 125.17 to 125.67 m: sandstone, coarse grained, fines up to medium grained 125.67 to 127.3 m: sandstone, fine grained, cross bedded, carbonaceous debris;

coffee grounds on foresets; 13 cm from base is a 5 cm shale clast conglomerate; bit of a shale lag and coarser debris 21 cm from base 127.3 to 127.5 m: siltstone, green

127.5 to 127.6 m: fine sandstone, carbonaceous

127.56 to 127.92 m: siltstone and sandstone, fine grained; several beds ~10 cm thick; some are shale clasts – LEVEE /FLOODPLAIN

127.92 to 128.93 m: siltstone, green; becomes grey downwards as it grades into underlying unit

128.93 to 131.35 m: ultrabasic volcanic, matrix highly carbonaceous and and contaminated by quartz and feldspar; graded beds, sandstone clasts in lower 1.03 m, highly contorted, convolute; clasts get smaller and fewer upwards; grades to fine-grained material upwards; calcite veins at 80 and 90°; calcareous; clasts of wood; clasts of Kaskapau to 5 cm; angular

DEBRIS FLOW

131.35 to 141.42 m: ultrabasic volcanic; massive with varying grain size; olivine rich, matrix supported; rare lapilli; matrix contamination (quartz plus feldspar) highly variable; clasts of Wapiti to 10 cm; several coarser grained olivine rich beds e.g. 138.2 - 138.9 m; basal 2.3 m dip at 40 to 50°; flatten upwards to 25°

DEBRIS FLOW

141.42 to 146.86 m: ultrabasic volcanic/ sediment mixture; massive; clasts to 60 cm long, angular to subrounded; strung out; green Wapiti siltstone and sandstone clasts; in a finer muddier matrix; small clasts of Wapiti –

DEBRIS FLOW

146.86 to 156.54 m: massive ultrabasic volcanic; medium grained; clasts (pebbles to cobbles) to 33 cm dispersed throughout include: Wapiti, shale chips; coal detritus; microfaulted; deformed

DEBRIS FLOW

156.54 to 159.00 m: sandstone, medium grained pebbly at base; sharp base, fines up to fine grained; pebbles to 1 cm at base; cross bedded at base; fines upwards to fine grained – FLUVIAL CHANNEL

159.00 to 161.47 m: ultrabasic volcanic; poorly sorted; minor olivine (matrix supported), matrix rich; matrix highly contaminated (quartz plus feldspar); Wapiti clasts to 8 cm; Kaskapau clasts to 5 x 3 cm; coarse grained, vague bedding?

161.47 to 164.07 m: ultrabasic volcanic; olivine rich, minor lapilli; vague bedding - defined by variation in olivine content; abundant 1-2 mm green clasts (Wapiti) and 2 to 5 mm chips of black clasts (Kaskapau) 164.07 to 166.6 m: ultrabasic volcanic (highly contaminated); massive; rare olivine; large bombs of Wapiti; fractured, disrupted; vertically fractured; TEREDO WOOD OR VASCULAR SYSTEM OF PALM TREE DEBRIS FLOW

GENERAL OBSERVATIONS

- very rare basement gneiss xenoliths - most country rock clasts are Wapiti
- xenolith population is not mixed (mantle, lower crustal, upper crustal)
- all ultrabasic volcanic rocks are moderately to highly contaminated by quartz and feldspar xenocrysts (presumably derived from the Wapiti Fm) in the matrix
- the majority of the ultrabasic volcanic rocks consist of massive bedded deposits
- indicator minerals are quite rare
- ultrabasic volcanic rocks commonly contain highly convoluted sedimentary rock (sandstones and shales) xenoliths indicating debris flow with high shear strength
- ultrabasic volcanic rocks are extremely matrix rich, have rare to minimal contents of lapilli, and moderate olivine contents
- compared to ultrabasic volcanic rocks from 95-3 drill core there is much lower contents of olivine and juvenile material (in general much less magmatic material) in volcanogenic rocks in drill core 95-1.
- fluvial channel at 156.3 to 159 has a sharp base, fines upwards with a lag at the base; it is not a clast, but in situ siliciclastic deposits interbedded with the ultrabasic volcanic rocks
- conformable contacts between sediments and the volcanogenic rocks
- very subtle vague bedding at, 13.4 m, 17 m, 160 m and 162 m
- debris flow interpretation made on following criteria:
 - vertical clasts
 - strung out, swirled clasts; probably sheared when semiconsolidated
 - large clasts

- delicate clasts indicate no traction transport
 - muddy matrix, finer than air fall deposits
 - poorly sorted
- debris flow deposits have a lighter color than airfall deposits which is a function of lithology of matrix
- air fall interpretation made in part on following criteria
- coarser grained
 - fewer clasts, finer clasts
 - few to no sheared clasts
 - ash matrix

ML 95-3

Target:	Mountain Lake Diatreme	Company:	Geological Survey of Canada
Drill Hole:	ML 95-1	Collar Azimuth:	N/A
Location:	454636E, 6145913N	Collar Incline:	-90°
Zone and Datum:	Zone 11, NAD 27	Core Diameter:	70 mm
Elevation:	~654 m asl	Geologist Logging:	D.A. Leckie, B.A. Kjarsgaard
Start - End Date:	12/05/1995 – 12/15/1995	End of Hole (EOH):	166.60 m

Logging from Top of core

0 to 5.5 m: no core; rotary drilled; no recovery

5.5 to 6.25 m: ultrabasic volcanic; altered - weathered and oxidized; lapilli <10%; rare indicator mineral; minor shale, wood and sandstone clasts; rare autoliths; medium grain size 1 mm.

6.25 to 10.6 m: ultrabasic volcanic; altered (2 cm wide) around fractures at top, relatively fresh at base of bed; large Wapiti sandstone clasts at base; rare autoliths; bedding (clast versus matrix supported olivine; < 10% lapilli; rare indicator minerals; very coarse grained grading to medium grained top

10.6 to 12.3 m: ultrabasic volcanic; lapilli-olivine-ash mix, matrix supported; common shale and sandstone crustal clasts; silica alteration (white specks); medium/coarse grained

12.3 to 18.2 m: ultrabasic volcanic; minor wood, sedimentary clasts and autoliths; very rare fracturing with silica infill; lapilli <25% and olivine, matrix supported; a few 10 - 20 cm thick beds (low angle, vague bedding) with clast supported olivine and lower lapilli contents (<15%)

18.2 to 20.5 m: ultrabasic volcanic; matrix supported olivine, lapilli < 20%; rare autoliths; abundant sedimentary xenoliths, wood fragments to 8 cm in size; rare silica filled fractures; coarse/very coarse grained

20.5 to 26.0 m: ultrabasic volcanic; medium/coarse grained; mixed clasts of olivine and lapilli; bedded; clast and matrix supported ; rare shale and sandstone crustal

- xenoliths; autoliths to 3 cm; rare fractures with silica infill; very rare indicator minerals; top half of bed fining up sequence
- 26.0 to 28.6 m: ultrabasic volcanic; coarse grained; wood, shale, sandstone clasts to 1 cm common; autoliths to 2 cm; bedding is subhorizontal ($<10^\circ$), olivine rich and olivine plus lapilli rich beds; indicator minerals rare
- 28.6 to 29.2 m: ultrabasic volcanic; massive bed; well sorted, fine/medium grained, very rare crustal clasts
- 29.2 to 32.5 m: ultrabasic volcanic; poorly sorted, coarse/very coarse grained; abundant shale and sandstone clasts; rare autoliths to 4 cm; matrix rich, matrix supported olivine; $<20\%$ lapilli; low angle bedding ($<15^\circ$)
- 32.5 to 35.8 m: ultrabasic volcanic; olivine rich base grading into a mixed lapilli - olivine top; matrix supported; common shale and sandstone to 1 cm; indicator minerals absent; common wood fragments
- 35.8 to 37.7 m: ultrabasic volcanic; base highly fractured and brecciated (with silica infill) indicator minerals absent, coarse to very coarse grained; lapilli and olivine are matrix supported; olivine commonly have thin selvages (i.e. lapilli which are olivine cored); lapilli and olivine in subequal proportion
- 37.7 to 42.0 m: ultrabasic volcanic; matrix supported olivine dominated; lapilli moderate (mainly olivine with thin selvage); coarse grained; rare crustal xenoliths, mostly shale chips to 1 cm, rare sandstone clasts to 5 cm; rare indicator minerals; rare autoliths to 2 cm; coarse grained; very coarse middle of bed and then fining up
- 42.0 to 44.8 m: ultrabasic volcanic; massive; basement xenoliths to 2 cm; sedimentary clasts to 5 cm; indicator minerals; olivine dominated with rare lapilli; matrix supported; rare selvages in olivine; coarse grained

- 44.8 to 50.6: ultrabasic volcanic; minor shale and sandstone clasts, most 1 cm, to 3 cm; autoliths to 3 cm; ; matrix supported clasts of olivine and lapilli (subequal); medium grained; with vague ?low angle beds of coarse grained material
- 50.6 to 54.85 m: ultrabasic volcanic; massive; matrix supported olivine, <20% lapilli; abundant, large coalified plant debris and shale and sandstone clasts (1 - 5 cm); high angle fractures with white silica infill; indicator minerals very rare; Fining up coarse to medium grained
- 54.85 m to 59.0 m: ultrabasic volcanic; massive; matrix supported olivine, quite ash - rich; selvages on olivine, lapilli moderately common; sedimentary xenolith clasts to 1 cm; shale forms cores of autoliths to 2 cm; abundant fractures at high angle with white silica infill, plus slickensides; large (10 cm) siltstone clast at base of bed; medium/coarse grained
- 59.0 to 61.20 m: ultrabasic volcanic; poorly sorted at base, with abundant sedimentary xenolith clasts to 1 cm, cored autoliths to 1 cm; irregular autoliths to 6 cm; alteration (white silica); indicator minerals very rare; top of bed moderately sorted; coarse grained
- 61.2 to 62.60 m: ultrabasic volcanic; massive; matrix supported olivine, , relatively matrix rich, minor lapilli contents (<15%); rare clasts of sedimentary material; fine/medium grained; indicator minerals absent; white silica alteration
- 62.60 to 63.35 m: ultrabasic volcanic; massive; well sorted; moderate contents of shale and sandstone clasts; numerous slickensides; matrix supported olivine, good selvages on some olivine i.e. lapilli (<15%); coarse grained
- 63.35 to 70.30 m: ultrabasic volcanic; massive; matrix supported olivine, , relatively matrix rich, minor lapilli contents (<15%); rare clasts of sedimentary material; fine/medium grained; indicator minerals absent; abundant slickensides and secondary silica (vein filling and white specks)

- 70.30 to 70.80 m: ultrabasic volcanic; subequal olivine and lapilli; moderate quartz and feldspar contamination, reverse graded bed
- 70.80 to 73.50 m: ultrabasic volcanic; massive; matrix supported olivine; matrix rich; lapilli <20%; moderately well sorted; medium grained; rare shale and sandstone clasts to .5 cm; autoliths to 5 cm;
- 73.50 to 84.0 m: ultrabasic volcanic; massive, but slight fining upwards from very coarse to coarse; subequal olivine and lapilli; most lapilli are olivine cored with selvages; autoliths to 1 cm; poor/moderate sorting; Wapiti sandstone clasts to 6 cm, shale and wood fragments to 1 cm; variable slickensides throughout the interval
- 84.0 to 87.1 m: ultrabasic volcanic; massive; olivine rich, clast supported; well sorted; selvages common on olivine giving subequal proportions of lapilli and olivine; autoliths to 5 cm; wood fragments to 1 cm; rare shale (to 3 mm) and Wapiti sandstone (to 3 cm) clasts; ; indicator minerals absent
- 87.1 to 95.05 m: ultrabasic volcanic; massive, coarse grained; subequal olivine and lapilli; common basement xenoliths, shale and Wapiti sandstone clasts; no indicator minerals; moderate/poor sorting
- 95.05 to 97.05 m: ultrabasic volcanic; massive, but highly disrupted, slickensides common, large clasts (to 6 cm) of earlier formed ultrabasic volcanic in this bed, plus common Wapiti sandstone, shale and wood fragments to 2 cm; moderately well sorted; medium coarse grained mostly other than large clasts
- 97.05 to 98.65 m: ultrabasic volcanic; massive; mixed olivine and lapilli tuff, richer in olivine at base, grading to more lapilli and ash-rich at the top; Wapiti and shale clasts to 2 cm; coarse grained
- 98.65 to 99.50 m: ultrabasic volcanic; massive; poorly sorted, clast supported, mixed olivine and lapilli; rare autoliths to 3 cm, contains large (to 8 cm) fragments of

wood, Wapiti sandstone and shale, plus possible basement xenoliths, very coarse grained

99.50 to 101.0 m: ultrabasic volcanic; massive; autoliths to 2 cm, no crustal xenoliths, matrix supported lapilli abundant; olivine commonly have variable thickness selvages (i.e. olivine cored lapilli); coarse grained

101.0 to 101.65 m: ultrabasic volcanic; reverse graded - coarse to very coarse grained; common basement, ?mantle? Wapiti xenoliths; very abundant shale clasts; olivine rich, <15% lapilli

101.65 to 120.4 m; ultrabasic volcanic; low angle bedding (<15°), with multiple beds of variable grain size, typically 1 cm at base and 1 mm at the top; mainly clast supported; basement and ?mantle? xenoliths (<1 cm) common; Wapiti and shale clast more abundant (1 - 5 cm); common autoliths and earlier blocks of ultrabasic volcanic (to 10 cm) in basal 30 cm - extremely coarse grained; majority of bed very coarse/coarse grained

120.4 to 122.5 m: ultrabasic volcanic; low angle bedding; mixed olivine and lapilli tuff; clast supported; moderately well sorted ; indicator minerals absent; autoliths to 5 cm coarse/very coarse grained; very olivine rich interval at 120.95 m

122.5 to 127.6 m: ultrabasic volcanic; alternating beds of clast supported olivine rich and mixed lapilli and olivine tuffs; six olivine rich beds (10 - 20 cm thick) tend to be coarser grained, with common indicator minerals; bedding at approximately 45°, reverse graded beds?; large autolith to 20 cm very minor content of Wapiti and shale clasts

127.6 to 133.5 m: ultrabasic volcanic; moderate angle bedding (30°); mixed olivine and lapilli tuff; moderately well sorted; dominantly matrix supported, with olivine rich parts clast supported; rare indicator minerals (up to 3 mm); large (to 5 cm) Wapiti clasts irregularly distributed; shale clasts (<1 cm) more common and regularly distributed; autoliths to 5 cm; medium/coarse grained overall

133.5 to 134.90 m: ultrabasic volcanic; massive; poorly sorted; olivine rich, both clast and matrix supported (variable matrix content); coarse/very coarse grained; indicator minerals to 6 mm (moderately common); autoliths to 4 cm, common; wood fragments to 10 cm; shale and Wapiti clasts to 3 cm;

134.9 to 136.6 m: ultrabasic volcanic; massive bed; ash matrix, olivine poor; indicator minerals, crustal xenoliths are absent to very rare; medium grained

DEBRIS FLOW?

136.6 to 139.25 m: Wapiti sandstone clast; either a bomb or SLUMPED material, most likely the latter (see unit below)

DEBRIS FLOW?

139.25 to 140.4 m: ultrabasic volcanic /Wapiti mix; base of bed about 20% olivine and remainder is matrix, this grades up to no olivine and only matrix; very rare lapilli present; matrix is highly contaminated by quartz and feldspar (Wapiti derived); numerous cm scale Wapiti clasts; silty and shaly lenses also present; low angle bedding at base, 30° at contact with overlying Wapiti clast

DEBRIS FLOW?

140.4 to 141.6 m: ultrabasic volcanic; moderately well sorted, olivine rich tuff with rare lapilli; indicator minerals rare; subtle low angle bedding displayed by contrast with more olivine rich sections; ; medium/coarse grained

141.6 to 147.9 m; ultrabasic volcanic; quite variable section of mixed tuffs, i.e. olivine crystal tuffs, lapilli tuffs and mixed olivine plus lapilli tuffs; autoliths to 4 cm; subtle low angle bedding; subtle breaks in either grain size or lithology; however,

four 10-20 cm thick very coarse grained, clast supported olivine rich beds at 147, 146.4, 146.1 and 142.2 m which contain basement and crustal xenoliths to 2 cm 147.9 to 148.95 m: ultrabasic volcanic; normal graded bed; olivine rich at base, clast supported, very coarse grained grading to a coarse grained, mixed olivine plus

lapilli tuff at top; basal 30 cm very poorly sorted, common indicator minerals, autoliths, crustal xenoliths

148.95 to 150.1 m: ultrabasic volcanic; massive bed; slickensides common; indicator minerals to 6 mm; autoliths to 1 cm; olivine rich, clast supported; coarse/very coarse grained

150.1 to 151.8 m: ultrabasic volcanic; basal 30 cm coarse grained; middle section has low angle (10°) bedding (mm scale) in coarse grained material; top massive, coarse grained; indicator minerals rare/absent; olivine rich, clast supported and mixed matrix supported olivine plus lapilli tuffs;

151.8 to 153.0 m: ultrabasic volcanic; massive bed; fine/medium grained with shale clasts to 4 mm; olivine is matrix supported, <10% lapilli, an ash rich bed; well sorted

153.0 to 157.1 m: ultrabasic volcanic; multiple (>20) normal graded beds, low angle (<20°, mostly 10°) ranging from mm - 20 cm thickness; basal parts of beds are coarse grained poor to moderately sorted mixed olivine-lapilli-ash lithology; top of bed moderate to well sorted ash-olivine lithology with minor lapilli; crustal xenoliths and indicator minerals present in basal part of bed

157.1 to 158.3 m: ultrabasic volcanic; massive bed; medium/coarse grained ash rich matrix supported olivine tuff with minor lapilli

158.3 to 159.8 m: ultrabasic volcanic; reverse graded bed, coarse grained at base, very coarse grained at top; top is poorly sorted mixed clast assemblage (autoliths, mantle, basement, crustal xenoliths, olivine; base moderately sorted, and more ash

159.8 to 162.05 m: ultrabasic volcanic; good bedding, mostly at 25-30°, to 45°; both normal and reverse graded beds; indicator minerals rare; Wapiti clasts to 5 cm; moderate sorting; bedding defined by variation of olivine to matrix, and the

olivine grain size; range in grain size is coarse to medium grained; olivine rich beds
clast supported

162.05 to 166.35 m: ultrabasic volcanic: massive bed; moderate sorting, coarse grained,
matrix supported olivine and lapilli; odd olivine crystals to 1 cm 166.35 to 166.70
m: ultrabasic volcanic; poorly sorted, very coarse grained heterolithic assemblage of
wood, shale, wapiti. basement clasts and indicator minerals; coarse olivine;
autoliths to 20 cm; bed grades up - to very coarse grained

166.7 to 168.65 m: ultrabasic volcanic; massive bed; olivine rich; clast supported; <10%
lapilli; shale and Wapiti clasts to 1 cm; olivine to 1 cm; autoliths to 3 cm;
medium/coarse grained

168.65 to 170.60 m: ultrabasic volcanic; low angle bedding, defined by variation in olivine
and matrix; olivine rich beds are clast supported; autoliths to 1 cm; rare indicator
minerals; rare shale (3 - 4 mm) and Wapiti (1 cm) clasts; medium grained

170.60 to 174.30 m; ultrabasic volcanic; massive, with vague bedding (subhorizontal);
ash-rich matrix, supporting olivine; well sorted, medium grained; <15% lapilli, to 1
cm; minor selvages around some olivine; no indicator minerals; minor quartz and
feldspar contamination

GENERAL OBSERVATIONS

- the entire package of ultrabasic volcanic rocks in the drill core are interpreted to be PYROCLASTIC AIRFALLS, other than the interval from 136.6 -140.4 m which is suggested to be slumped material, i.e. a DEBRIS FLOW
- there is a general paucity of "kimberlite" indicator minerals (garnet, ilmenite, pyroxene), and when present, they are small, typically <1mm
- ilmenite appears to be absent from the indicator suite
- mantle xenoliths are extremely rare, and when observed are highly altered
- more commonly observed are small (<2 cm) phlogopite-diopside xenoliths; it is unclear if they are of mantle derivation or are cumulates
- basement xenoliths are rare, small (<4 cm); feldspathic gneisses
- there is very little carbonate (calcite) in the core; portions of the core which are highly fractured or contain slickensides have an infilling of white silica, and not carbonate
- juvenile material in the core consists dominantly of ash, olivine, and lapilli; clinopyroxene (euhedral, magmatic) is ubiquitous, but not common; autoliths, typically 1 -2 cm, occasionally reach up to 10 cm in size
- the majority of the magmatic clasts (olivine, lapilli) are matrix supported - olivine rich portions tend to be clast supported
- lapilli rich beds are extremely rare, most beds are mixtures of clasts of olivine and lapilli, with olivine > lapilli
- contamination of magmatic material is variable, and dominated by clasts of sandstone (Wapiti?) and shale (Kaskapau?); there is extremely little xenocryst contamination, e.g. quartz and feldspar, as observed in drill core 95-1
- massive beds are quite common, and of variable thickness
- for regions of the core which have good bedding, individual beds are generally mm to cm scale, occasionally to 20 cm

- bedding dips are quite variable, dominantly less than 20° ; but in parts of the core are quite steep, $30-45^\circ$