Pizer, C., Clark, K., Howarth, J., Howell, A., Delano, J., Hayward, B.W., Litchfield, N., 2023, A 5000-year record of coastal uplift and subsidence reveals multiple source faults for past earthquakes on the central Hikurangi margin, New Zealand: GSA Bulletin, https://doi.org/10.1130/B36995.1.

Supplemental Material – File 1

1. CORE LOCATIONS

This section provides details of the cores and exposures used to construct a record of past earthquakes in the Pakuratahi Valley. Table S1 provides coordinates for each core/exposure, along with its fossil reference identification (GNS, 2003).

1.1 Core/outcrop details

TABLE S1 – Location of sediment cores and outcrops in the Pakuratahi Valley

Core/Outcrop	Easting (NZTM)	Northing (NZTM)
Pak-UV-V1	1935578	5636448
Pak-UV-V2	1935681	5636801
Pak-UV-O1	1936073	5637119
Pak-MV-O1	1936416	5636683
Pak-MV-O2	1936440	5636695
Pak-MV-O3	1936202	5636925
Pak-MV-O4	1936198	5636930
Pak-MV-O5	1936205	5636933
Pak-LV-V1	1936613	5636917
Pak-LV-V2	1936655	5637015
Pak-LV-V3	1936702	5637098
Pak-LV-V4	1936742	5637110
Pak-PK-V1	1936505	5637288
Pak-PK-V2	1936369	5637406

Coordinates are in New Zealand Transverse Mercator (2000).

1.2 Stratigraphic summary

The cores/outcrops at Pakuratahi can be grouped by geographic location. Here we provide figures summarising the sediment stratigraphy of each core within the Upper Valley (UV), Middle Valley (MV), Lower Valley (LV), and Pakuratahi Stream (PK). Full core descriptions, photographs and CT data can be found in Supplemental Material File 2.

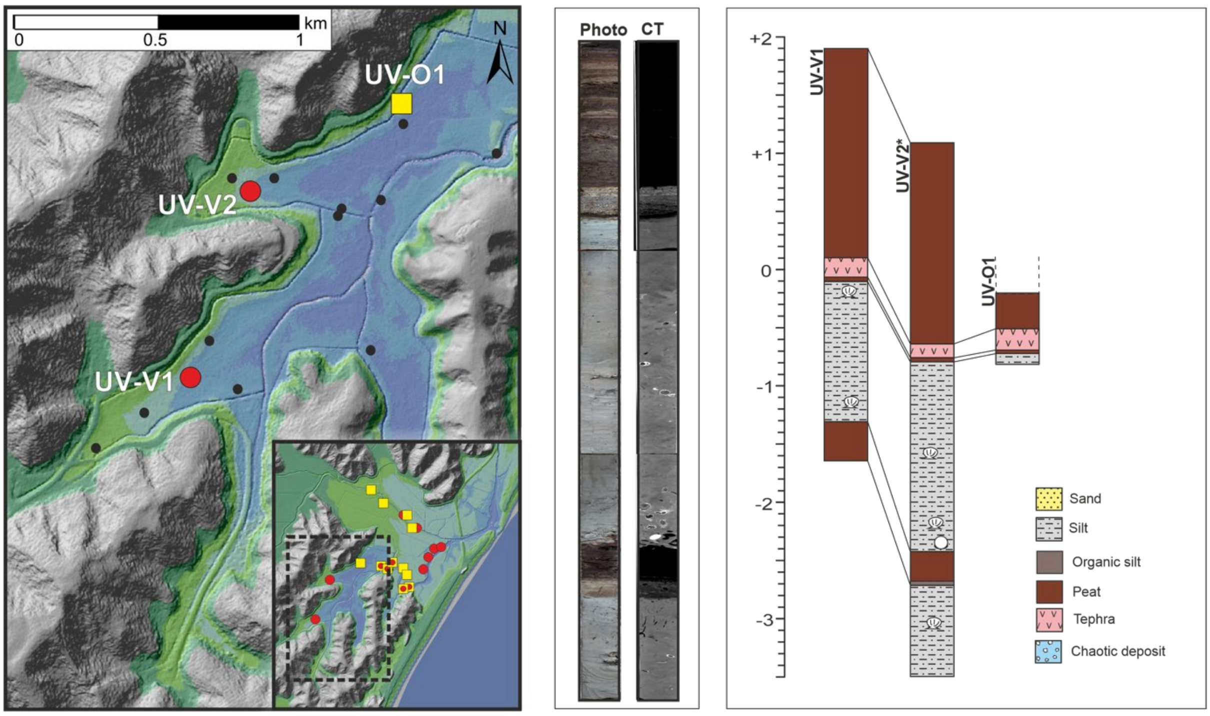


FIGURE S1 - Locations and stratigraphy of sediment cores in the Upper Valley at Pakuratahi.

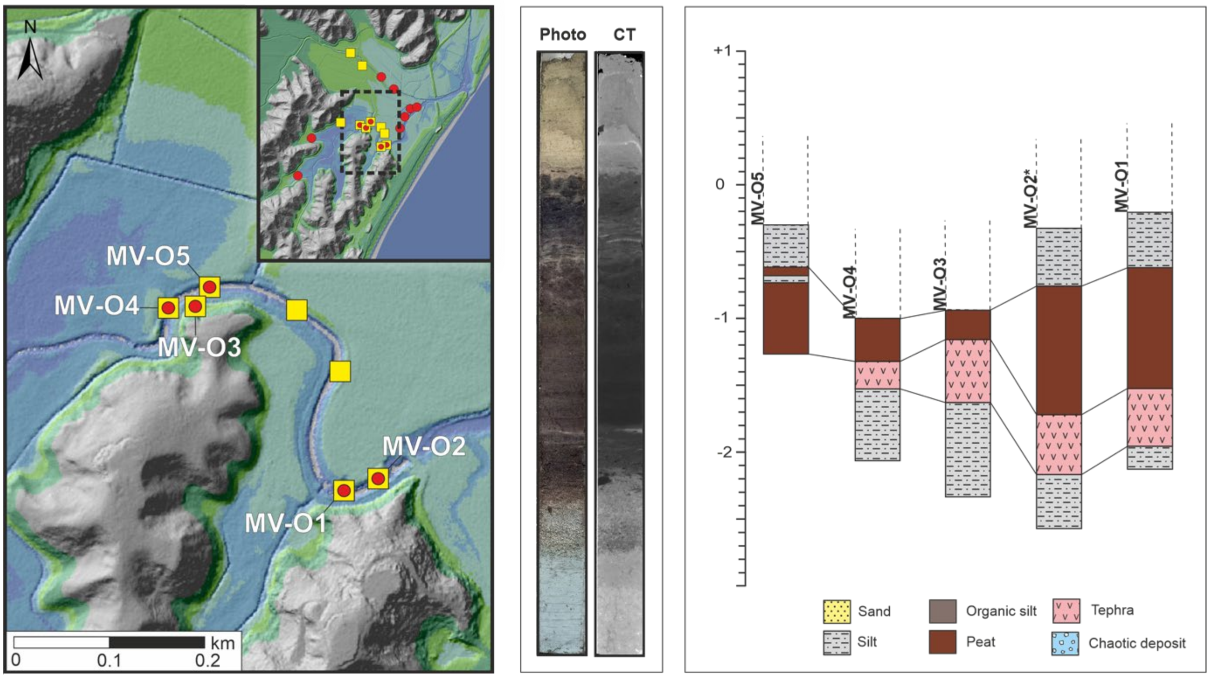


FIGURE S2 - Locations and stratigraphy of sediment cores in the Middle Valley at Pakuratahi.

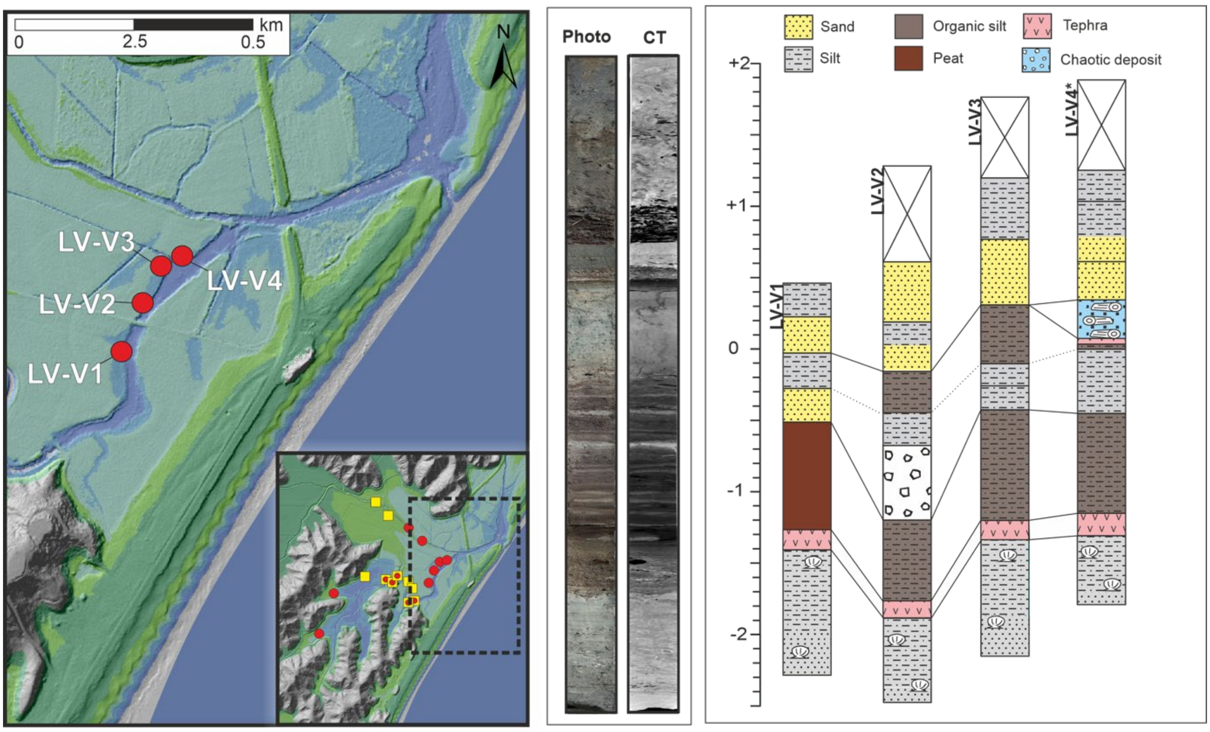


FIGURE S3 - Locations and stratigraphy of sediment cores in the Lower Valley at Pakuratahi.

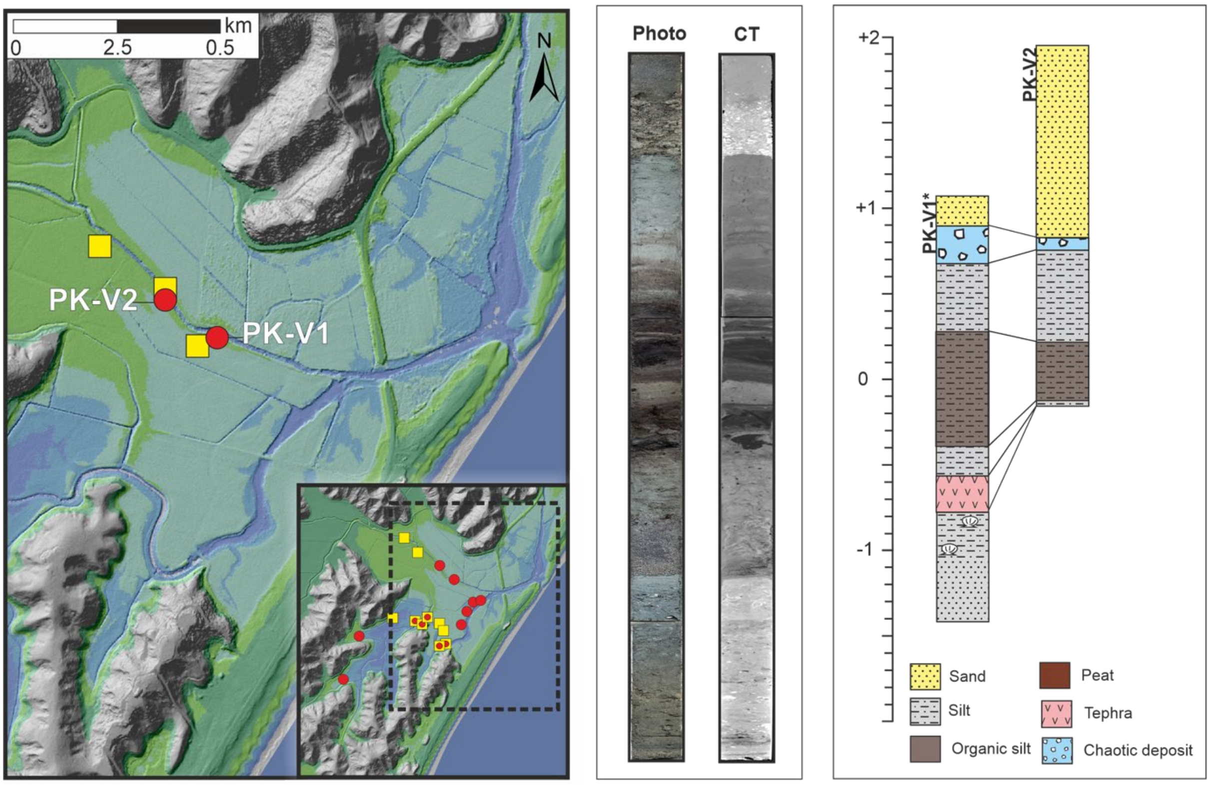


FIGURE S4 - Locations and stratigraphy of sediment cores in the Pakuratahi Stream area.

2. MICROFOSSIL RESULTS

Full raw counts of foraminifera and diatoms from the Pakuratahi cores are located in Supplemental Material File 3.

2.1 In situ foraminifera results

Previous work on Holocene sediments from the Pakuratahi Stream identified a significant number of reworked Pliocene foraminifera (Hayward et al., 2004). We identify an abundance of similar benthic and planktic species in our sediment cores (Supplemental Material File 3). With the problematic species removed, the low abundance of *in situ* Holocene foraminifera was too low (<50) to make quantitative inferences regarding paleo-sea level or salinity. Instead, we use the presence/absence of indicator species to aid paleoenvironmental interpretations that are mainly based on the sedimentology. In Figures S5 and S6, we show *in situ* results in the context of the earthquake evidence identified at Pakuratahi. Note that the reworked versus *in situ* status of some, or all, of the *Elphidium* species is uncertain. This does not impact our interpretations which are largely based on changes between estuarine sediments containing *Ammonia* and marsh sediments containing agglutinated species.

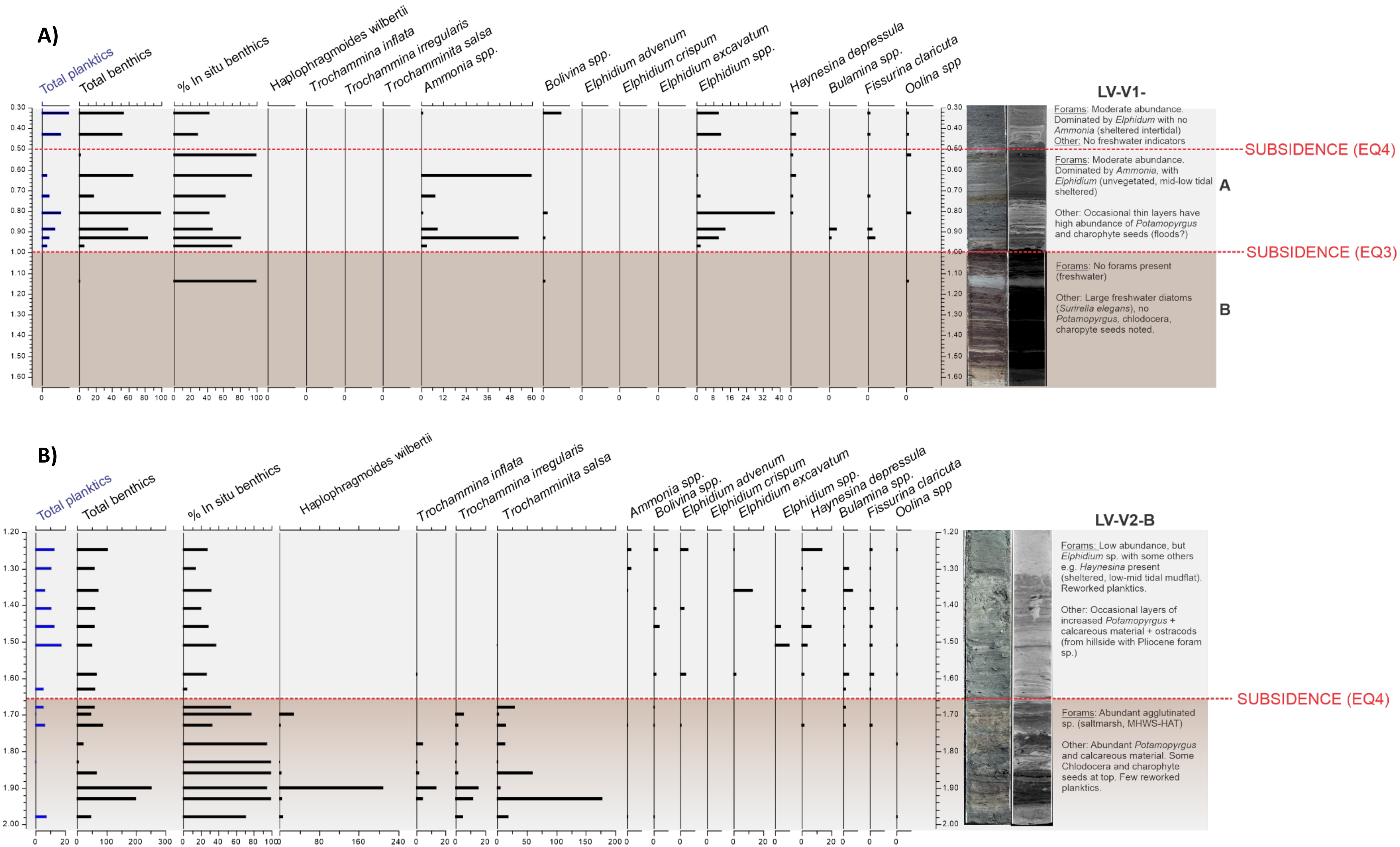


Figure S5 - In situ foraminifera in A) core LV-V1 and B) core LV-V2 at Pakuratahi.

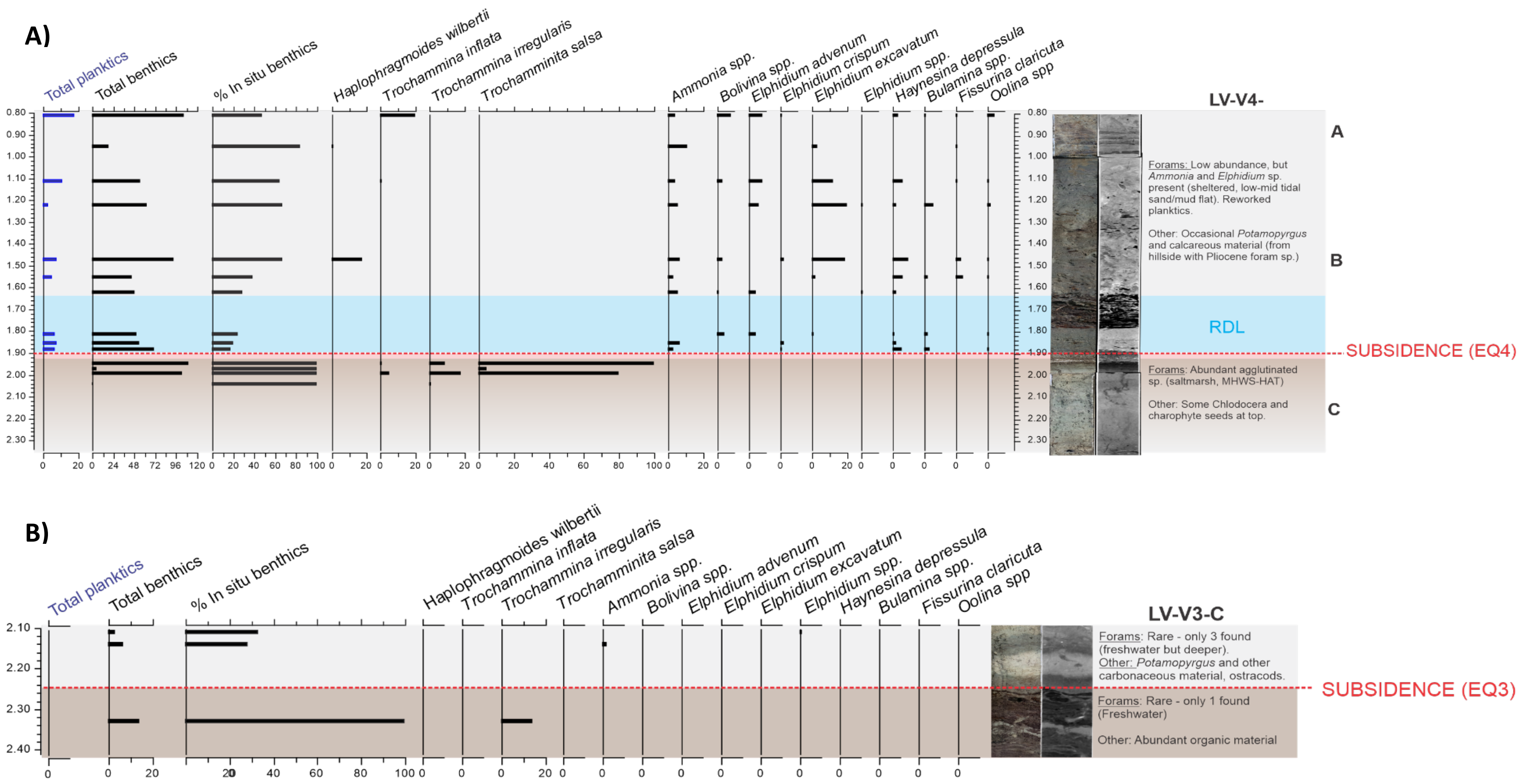


Figure S6 - In situ foraminifera in A) core LV-V4 and B) core LV-V3 at Pakuratahi.

3. PAKURATAHI EARTHQUAKE CHRONOLOGY

3.1 Radiocarbon results

Table S2 includes the results of all ^{14}C dating conducted in this study. The results are ordered according to their relevance for dating each earthquake. We also include ^{14}C dates on bark taken from in situ, submerged tree stumps within the Zone 5 peat in the Middle Valley. The ages from five different trees are remarkably similar, but do not correlate with the age of any other earthquake evidence at Pakuratahi, and therefore probably reflect an alternative climatic disturbance event e.g. flood.

TABLE S2 - Results of radiocarbon dating of earthquake evidence at Pakuratahi.

Sample ID	Lab. ID, NZA	Depth, m	Material	Context	CRA	$\delta^{13}C$, ‰	Calibrated age, cal yr BP
Dating Earthquake 1 (subsidence) at UV-V2 (n = 13)							
UV-V2-D 0.35	73871	-2.29	*D. cupressinum* seed	Zone 3 silt above PC-2	4149 ± 24	-26.38	4819-4522
UV-V2-D 0.40	73615	-2.34	*Juncacae* fragment	Rip-up clast above PC-2	4241 ± 25	-28.07	4849-4589
UV-V2-D 0.42	73616	-2.36	*Juncacae* fragment	Rip-up clast above PC-2	4229 ± 24	-27.99	4843- 4584
UV-V2-D 0.45A	73617	-2.39	*Juncacae* fragment	Rip-up clast above PC-2	4219 ± 24	-28.09	4839-4581
UV-V2-D 0.45B	73888	-2.39	*P. ferriginea* seed	Rip-up clast above PC-2	4193 ± 24	-28.40	4830- 4574
UV-V2-D 0.48	71688	-2.44	Woody fragment	Zone 2 below PC-2	4206 ± 22	-26.78	4833-4580
UV-V2-D 0.50	73768	-2.48	*Juncacae* fragment	Zone 2 peat	4354 ± 24	-27.50	4967-4835
UV-V2-D 0.54B	73876	-2.55	*Juncacae* fragment	Zone 2 peat	4278 ± 24	-27.70	4865-4646
UV-V2-D 0.61*	73891	-2.58	*P. ferriginea* seed	Zone 2 peat	4558 ± 24	-25.10	5311-5048
UV-V2-D 0.64	73889	-2.58	*Juncacae* fragment	Zone 2 above organic silt	4272 ± 24	-27.50	4863-4644
UV-V2-D 0.67	73612	-2.61	*Juncacae* fragment	Zone 2 organic silt	4324 ± 24	-27.37	4961-4737
UV-V2-D 0.72	73613	-2.66	*Juncacae* fragment	Zone 2 organic silt above PC-1	4401 ± 24	-28.14	5040-4851
UV-V2-D 0.76	73614	-2.80	*Juncacae* fragment	Zone 2 silt below PC-1	4386 ± 25	-	5035-4845
Dating Earthquake 2 (uplift) at UV-O1 (n = 21)							
UV-O1-19A	72880	-0.24	*Leptospermum* leaf	Zone 5 peat	3091 ± 21	-	3356-3171
UV-O1-20	72886	-0.29	*Leptospermum* leaf	Zone 5 peat	3050 ± 21	-28.40	3336-3076
UV-O1-16	72892	-0.32	*Leptospermum* leaf	Zone 5 peat	3045 ± 21	-28.90	3333-3075
UV-O1-15	72894	-0.34	*P. ferriginea* seed	Zone 5 peat	3084 ± 21	-26.60	3355-3166
UV-O1-14	72895	-0.39	*P. ferriginea* seed	Zone 5 peat	3133 ± 21	-26.00	3376-3219
UV-O1-13	72922	-0.40	*P. ferriginea* seed	Zone 5 peat	3132 ± 24	-26.20	3378-3214
UV-O1-11	72923	-0.44	*P. ferriginea* seed	Zone 5 peat	3105 ± 24	-27.10	3444-3248
UV-O1-12	72924	-0.45	*P. ferriginea* seed	Zone 5 peat	3179 ± 24	-24.80	3365-3175
UV-O1-10A	72925	-0.46	*P. ferriginea* seed	Zone 5 peat	3076 ± 24	-25.30	3356-3171
UV-O1-2C**	72882	-0.69	*Juncacae* fragment	Zone 4 peat beneath Waimihia	3152 ± 21	-32.10	3390-3235
UV-O1-2A	72917	-0.69	Bark fragment	Zone 4 peat beneath Waimihia	3367 ± 25	-27.90	3681-3482
UV-O1-2B	72881	-0.69	*Asteracaea* seeds	Zone 4 peat beneath Waimihia	3424 ± 21	-10.50	3712-3498
UV-O1-2D	72918	-0.69	Reed fragment	Zone 4 peat beneath Waimihia	3374 ± 25	-27.40	3684-3483
UV-O1-8A	72883	-0.70	*Asteracaea* seeds	Zone 4 peat beneath Waimihia	3383 ± 21	-10.20	3685-3487
UV-O1-5	72884	-0.70	*Leptospermum* leaf	Zone 4 peat beneath Waimihia	3367 ± 21	-	3680-3483
UV-O1-Block4	72885	-0.72	Leaf sp. 2 (rounded)	Zone 3 silt below PC-4	3400 ± 21	-	3692-3491
UV-O1-Block5	72887	-0.72	Leaf sp. 2 (rounded)	Zone 3 silt below PC-4	3397 ± 21	-	3690-3490
UV-O1-Block1	72888	-0.72	Leaf sp. 2 (rounded)	Zone 3 silt below PC-4	3422 ± 21	-	3712-3497
UV-O1-Block9	72919	-0.75	*P. ferriginea* seed	Zone 3 silt	3365 ± 25	-24.10	3680-3460
UV-O1-Block8*	72920	-0.76	*P. ferriginea* seed	Zone 3 silt	3327 ± 24	-24.50	3574-3411
UV-O1-Leaf	72890	-0.81	*Leptospermum* leaf	Zone 3 silt	3410 ± 22	-29.00	3695-3493
Dating Earthquake 3 (subsidence) at LV-V3, MV-O1, MV-O2, MV-O5 (n = 13)							
LV-V3-C 0.25	73920	-0.47	Reed fragment	Zone 6 organic silt above PC-5	2555 ± 21	-27.75	2740-2489
LV-V3-C 0.28	73921	-0.50	Woody fragment	Zone 5 peat below PC-5	2541 ± 21	-27.65	2735-2465
LV-V3-C 0.29	73922	-0.51	Woody fragment	Zone 5 peat below PC-5	2517 ± 21	-28.59	2722-2370
LV-V3-C 0.30	73923	-0.52	Woody fragment	Zone 5 peat below PC-5	2510 ± 21	-28.63	2717-2370
LV-V3-C 0.31	73924	-0.53	Woody fragment	Zone 5 peat below PC-5	2549 ± 21	-27.50	2738-2488
MV-O1-0.21A	72921	-0.41	*P. ferriginea* seed	Zone 5 peat below PC-5	2929 ± 20	-23.5	3157-2933
MV-O1-0.21B	72893	-0.41	*Asteracaea* seeds	Zone 5 peat below PC-5	2915 ± 21	-11.3	3146-2880
MV-O1-0.23	71686	-0.43	Leaf sp. 2 (rounded)	Zone 5 peat below PC-5	2918 ± 20	-25.89	3148-2822
MV-O2-0.24A	72891	-0.50	Unidentified leaf	Zone 5 peat below PC-5	2506 ± 20	-25.9	2714-2368
MV-O2-0.25	71687	-0.51	Woody fragment	Zone 5 peat below PC-5	2521 ± 20	-28.24	2723-2374
MV-O5-0.145	73925	-0.385	*P. ferriginea* seed	Zone 6 organic silt above PC-5	2302 ± 20	-21.99	2343-2147

MV-O5-0.15	73926	-0.39	Leaf sp. 2 (rounded)	Zone 6 organic silt above PC-5	2102 ± 20	-26.92	2091-1934
MV-O5-0.18	73927	-0.42	Reed fragment	Zone 5 peat below PC-5	2855 ± 21	-28.65	3056-2807
MV-O5-0.19	73928	-0.43	Reed fragment	Zone 5 peat below PC-5	2897 ± 21	-30.20	3075-2870
Dating Earthquake 4 (subsidence) at LV-V2 and LV-V4 (n = 6)							
LV-V2-B 0.69	73929	+0.04	*P. ferriginea* seed	Zone 6 silty peat below PC-7	1279 ± 20	-28.04	1261-1072
LV-V4-B 0.64	73930	+0.26	*P. ferriginea* seed	Zone 7 within RDL	1207 ± 20	-25.35	1179-980
LV-V4-B 0.75	73931	+0.15	*P. ferriginea* seed	Zone 7 within RDL	1361 ± 20	-29.00	1290-1177
LV-V4-B 0.80	73932	+0.10	*P. ferriginea* seed	Zone 7 within RDL	1262 ± 20	-24.19	1258-1065
LV-V4-B 0.85	73933	+0.05	*P. ferriginea* seed	Zone 7 within RDL	1275 ± 20	-22.48	1261-1070
LV-V4-B 0.945	73934	-0.05	Leaf sp. 2 (rounded)	Zone 6 silty peat below Taupo	1880 ± 20	-26.93	1828-1718
Other: Shells in Zone 3 silt below Waimihia (calibrated with Marine20 with ΔR -57 ± 80) at LV-V1, MV-O3, MV-O4							
UV-O1-Shell1	72645	-	*A. stutcburyi* (articulated)	Zone 3 below Waimihia (silt)	4433 ± 29	-5.94	4766-4210
MV-O4-Shell1	70883	-	*A. stutcburyi* (articulated)	Zone 3 below Waimihia (silt)	4268 ± 27	-5.63	4509-3990
MV-O4-Shell2	70884	-	*A. stutcburyi* (articulated)	Zone 3 below Waimihia (silt)	4268 ± 27	-6.89	4504-3982
MV-O4-Shell3	70885	-	*A. stutcburyi* (articulated)	Zone 3 below Waimihia (silt)	4198 ± 26	-5.38	4411-3897
MV-O4-Shell4	70886	-	*A. stutcburyi* (articulated)	Zone 3 below Waimihia (silt)	4221 ± 26	-5.21	4435-3915
MV-03-ShellA	71906	-	*A. stutcburyi* (articulated)	Zone 3 below Waimihia (silt)	4243 ± 28	-4.62	4478-3945
MV-03-ShellB	71905	-	*A. stutcburyi* (articulated)	Zone 3 below Waimihia (silt)	4287 ± 28	-3.87	4521-3998
MV-03-ShellC	71904	-	*A. stutcburyi* (articulated)	Zone 3 below Waimihia (silt)	4241 ± 28	-4.93	4481-3940
MV-04-ShellA	71899	-	*A. stutcburyi* (articulated)	Zone 3 below Waimihia (silt)	4286 ± 28	-5.87	4520-3993
LV-V1-B 0.365	71893	-	*A. stutcburyi* (articulated)	Zone 3 below Waimihia (silt)	4094 ± 28	-3.59	4288-3738
Other (bark of MV tree stumps in Zone 5 peat)							
MV-Stump1	70887	-	Bark of *D. dacrydioides*	Zone 5 peat (rooted at base)	3096 ± 21	-26.60	3359-3173
MV-Stump2	70888	-	Bark of *D. dacrydioides*	Zone 5 peat (rooted at base)	3088 ± 20	-25.70	3353-3170
MV-Stump3	70889	-	Bark of *D. dacrydioides*	Zone 5 peat (rooted at base)	3059 ± 20	-28.00	3341-3078
MV-Stump4	70890	-	Bark of *D. dacrydioides*	Zone 5 peat (rooted at base)	2997 ± 20	-26.70	3219-3000
MV-Stump5	70891	-	Bark of *D. dacrydioides*	Zone 5 peat (rooted at base)	3063 ± 20	-28.20	3344-3080

*Notes: Depths in Sample ID refer to depth within the core section. The depth column refers to the calculated depth of the sample relative to current mean sea level. Underlined samples mark those used within age models. CRA = conventional radiocarbon age. Uncertainty range of $\delta^{13}C$ is reported to ± 0.2. Terrestrial radiocarbon dates are calibrated using SHCal20 curve (Hogg et al., 2020). Marine carbonate dates are calibrated using Marine20 curve (Heaton et al., 2020) with a ΔR value of 32 ± 60 (mean ± 1σ; Clark et al., 2019). All calibrated ages are reported as the highest 95% probability density function (HPDF) ranges. * = Outliers of >5% identified and inversely weighted by the outlier model.*
*** = Erroneous sample excluded from age modelling.*

3.2 Results of testing the reliability of ^{14}C material

To ensure accurate earthquake ages, we compared the spread of ^{14}C ages of different organic material types sampled from the same stratigraphic horizon (beneath the Waimihia tephra isochron). In Test 1, we compared a coupled *Leptospermum* leaf (NZA72890) and *Austrovenus stutchburyi* shell (NZA72645) samples. With a marine reservoir correction value (ΔR) of 32 ± 60 (mean ± 1σ; Clark et al., 2019), the estuarine shell gave an age of 4781-4223 cal yr BP. The coupled leaf age was 600-900 years younger at 3695-3493 cal yr BP, closely matching the age of the Waimihia tephra isochron (3574-3478 cal yr BP; Pizer et al., 2023). The offset between the isochron and the shell age is consistent across 9 other shells from the same stratigraphic horizon in different parts of the valley (Figure S7). The most likely reason for this disagreement is that the suspension-feeding molluscs were incorporating dissolved inorganic carbon from the heavily carbonate-enriched estuarine waters. Our identification of tufa deposits close to the surface in the Upper Valley support this idea. As a result, we excluded carbonate material from our age models.

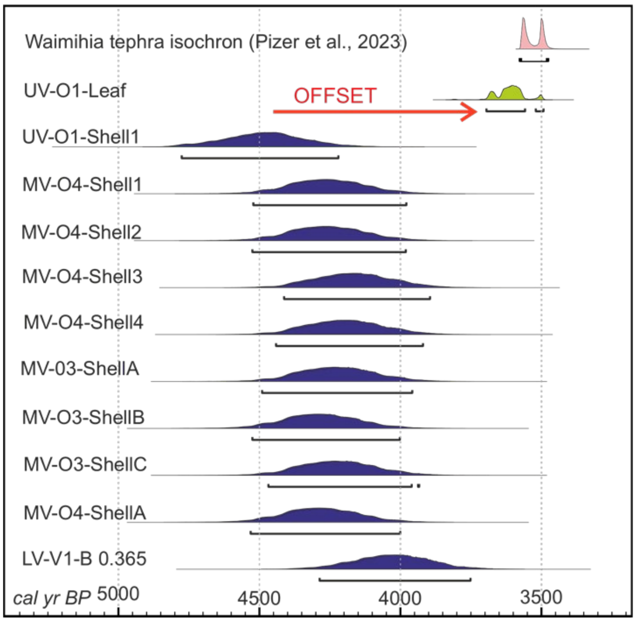


FIGURE S7 - Results of radiocarbon Test 1 showing the local carbon reservoir effect at Pakuratahi. Calibrated ages are shown as age probability density functions (PDFs) with the 95% range shown by the black bar beneath (generated using OxCal v4.4.4; Bronk Ramsey, 2009). Blue PDFs represent ages of estuarine shells sampled from directly beneath the Waimihia tephra isochron (pink PDF), calibrated using Marine20 (Heaton et al., 2020) and an east coast average ΔR of 32 ± 60 (updated from Clark et al., 2019). The green PDF represents a leaf sample attached to UV-O1-Shell1, calibrated with ShCal20 (Hogg et al., 2020).

Test 2 aimed to examine the spread of ages encountered when dating different terrestrial macrofossils from the same stratigraphic unit (again, below the Waimihia tephra isochron). The context of these samples and the results are discussed in Pizer et al. (2023), and repeated here in Figure S8. In summary, there is generally good agreement between most primary and secondary sample types (χ^2= 4.631; 5% 12.592, df 6), apart from one outlier (NZA72882, Table S2) which we determined to be contaminated and therefore excluded it from age models (not shown in Figure S8).

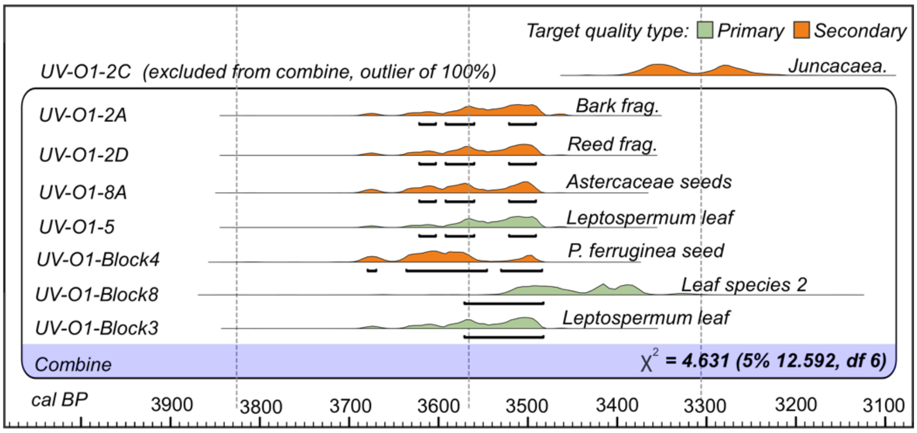


FIGURE S8 - Results of radiocarbon Test 2, showing the agreement between different terrestrial macrofossils from the same stratigraphic horizon (beneath the Waimihia tephra). Age probability density functions (PDFs) represent ^{14}C ages calibrated using SHCal20 (Hogg et al., 2020) in OxCal 4.4.4. Black bars represent the 95% highest PDF range. Figure adapted from Pizer et al., 2023.

3.3 Age model code

3.3.1 Earthquake 1

```
Plot()
 {
  Outlier_Model("General", T(5), U(0,4), "t");
  Curve("SHCal20","shcal20.14c");
  Sequence("FV2V2D")
  {
   Boundary("Base of sequence")
   {
    z=0.78;
   };
   R_Date("FV2-V2-D 0.76 (Arrow)", 4386, 25)
   {
    Outlier(0.05);
    z=0.76;
   };
   Boundary("Silt to Org. silt")
   {
    z=0.75;
   };
    R_Date("FV2-V2-D 0.72 (Arrow)", 4401, 24)
    {
     Outlier(0.05);
     z=0.72;
    };
    R_Date("FV2-V2-D 0.67 (Arrow)", 4324, 24)
    {
     Outlier(0.05);
     z=0.67;
    };
   Boundary("Org. silt to peat")
   {
    z=0.66;
   };
   P_Sequence("FV2D2 Lower peat",  1, 1, U(-2,2))
   {
    Boundary("Base of peat")
    {
     z=0.65;
    };
    R_Date("FV2-V2-D 0.64 A (Arrow)", 4272, 24)
    {
     Outlier(0.05);
     z=0.64;
    };
    R_Date("FV2-V2-D 0.61 (Miro)", 4558, 24)
    {
     Outlier(0.05);
     z=0.61;
    };
    R_Date("FV2-V2-D 0.54 (Arrow)", 4278, 24)
    {
     Outlier(0.05);
     z=0.54;
    };
    R_Date("FV2-V2-D 0.50 (Arrow)", 4354, 24)
    {
     Outlier(0.05);
     z=0.50;
    };
    R_Date("FV2-V2-D 0.48 (Wood)", 4206, 22)
    {
     Outlier(0.05);
     z=0.48;
    };
    Boundary("Top of peat")
    {
     z=0.475;
    };
   };
   Boundary("Peat to silt - subsidence")
   {
    z=0.47;
```

```
 };
 R_Date("FV2-V2-D 0.35 (Seed)", 4149, 24)
 {
  Outlier(0.05);
  z=0.35;
 };
 Boundary("Top of sequence")
 {
  z=0.34;
 };
};
};
```

3.3.2 Earthquake 2

The age model for Earthquake 2 includes a prior age distribution for the Waimihia tephra isochron. The age model used to produce the isochron age is available from Pizer et al. 2023 (and therefore not included here for simplicity).

```
Plot()
 {
 Curve("SHCal20","shcal20.14c");
 Outlier_Model("General", T(5), U(0,4),"t");
 Sequence("UV-O1")
 {
  Boundary("Base of UVO1 sequence")
  {
   z=83;
  };
  Sequence("UV-O1")
  {
   Boundary("Base of Zone 3 silt")
   {
    z=82;
   };
   R_Date("OT2-Shell1-A", 3410, 22)
   {
    Outlier(0.05);
    z=81;
   };
   R_Date("OT2BLOCK-3", 3374, 21)
   {
    Outlier(0.05);
    z=76.5;
   };
   R_Date("OT2BLOCK-8", 3327, 24)
   {
    Outlier(0.05);
    z=75.5;
   };
   R_Date("OT2BLOCK-9", 3365, 25)
   {
    Outlier(0.05);
    z=74.5;
   };
   R_Date("OT2BLOCK-1", 3422, 21)
   {
    Outlier(0.05);
    z=72;
   };
   R_Date("OT2BLOCK-5", 3397, 21)
   {
    Outlier(0.05);
    z=71.6;
   };
   R_Date("OT2BLOCK-4", 3400, 21)
   {
    Outlier(0.05);
    z=71.5;
   };
   Boundary("Silt to peat – Earthquake 2")
   {
    z=71;
```

```
  };
 };
 Phase("Zone 4 peat")
 {
  R_Date("OT2-5", 3367, 21)
  {
   Outlier(0.05);
   z=70;
  };
  R_Date("OT2-2-B", 3424, 21)
  {
   Outlier(0.05);
   z=69.4;
  };
  R_Date("OT2-8-A", 3383, 21)
  {
   Outlier(0.05);
   z=69.3;
  };
  R_Date("OT2-2-D", 3374, 21)
  {
   Outlier(0.05);
   z=69.2;
  };
  R_Date("OT2-2-A", 3367, 25)
  {
   Outlier(0.05);
   z=69;
  };
 };
 Prior("Waimihia_Pizer et al 2023"," Waimihia_Pizer et al 2023.prior");
 P_Sequence("Zone 5 peat", 1, 1, U(-2,2))
 {
  Boundary("Base zone 5
  {
   Outlier(0.05);
   z=67.9;
  };
  R_Date("OT2-10-A", 3076, 24)
  {
   Outlier(0.05);
   z=64;
  };
  R_Date("OT2-12", 3179, 24)
  {
   Outlier(0.05);
   z=63;
  };
  R_Date("OT2-11", 3105, 24)
  {
   Outlier(0.05);
   z=62;
  };
  R_Date("OT2-13", 3132, 24)
  {
   Outlier(0.05);
   z=58;
  };
  R_Date("OT2-14", 3133, 21)
  {
   Outlier(0.05);
   z=57;
  };
  R_Date("OT2-15", 3084, 21)
  {
   Outlier(0.05);
   z=52;
  };
  R_Date("OT2-16", 3045, 21)
  {
   Outlier(0.05);
   z=50;
  };
  R_Date("OT2-20", 3050, 21)
  {
```

```
    Outlier(0.05);
    z=47;
   };
   R_Date("OT2-19-A", 3091, 21)
   {
    Outlier(0.05);
    z=42;
   };
   Boundary("Top Post Waim Peat")
   {
    z=41;
   };
  };
  Boundary("Top of sequence")
  {
   z=40;
  };
 };
};
```

3.3.3 Earthquake 3

```
Plot()
 {
 Curve("SHCal20","shcal20.14c");
 Outlier_Model("General", T(5), U(0,4), "t");
 Sequence(LV-V3)
  {
  Boundary("Base of sequence");
  P_Sequence("Peat (Zone 5)", 1, 1, U(-2,2))
   {
   Boundary("Base of peat")
   {
    z=32;
   };
   R_Date("FSV2-C 0.31 (Terr.plant)", 2549, 21)
   {
    Outlier(0.05);
    z=31;
   };
   R_Date("FSV2-C 0.30 (Terr.plant)", 2510, 21)
   {
    Outlier(0.05);
    z=30;
   };
   R_Date("FSV2-C 0.29 (Terr. Plant)", 2517, 21)
   {
    Outlier(0.05);
    z=29;
   };
   R_Date("FSV2-C 0.28 (Reed)", 2541, 21)
   {
    Outlier(0.05);
    z=28;
   };
   Boundary("Top of peat")
   {
    z=27.5;
   };
  };
  Boundary("Peat to silt - Earthquake 3");
  R_Date("FSV2-C 0.25 (Reed)", 2555, 21)
  {
   Outlier(0.05);
  };
  Boundary("Top of sequence");
 };
};
```

3.3.4 Earthquake 4

```
Plot()
 {
 Curve("SHCal20","shcal20.14c");
 Outlier_Model("General", T(5), U(0,4), "t");
 Sequence ("LV-V4 pre-EQ4")
```

```
 {
  Boundary("Base of Zone 6 peat");
  R_Date("FSV3-B 0.945 (R.seeds)", 1880, 20)
  {
   Outlier(0.05);
  };
  Date("Taupo",N(calBP(1717),5));
  Boundary("=Earthquake4");
 };
 Sequence ("LV-V4 RDL")
 {
  Boundary ("Base of RDL");
  Phase("RDL")
  {
   R_Date("FSV3-B 0.75 (Seed?)", 1361, 20)
   {
    Outlier(0.05);
   };
   R_Date("FSV3-B 0.80 (Miro)", 1262, 20)
   {
    Outlier(0.05);
   };
   R_Date("FSV3-B 0.85 (Miro)", 1275, 20)
   {
    Outlier(0.05);
   };
   R_Date("FSV3-B 0.64 (Miro)", 1207, 20)
   {
    Outlier(0.05);
   };
  };
  Tau_Boundary("Earthquake4");
 };
 Sequence ("LV-V2")
 {
  Boundary("Base of sequence");
  R_Date("FSV1-B 0.69 (Seed)", 1279, 20)
  {
   Outlier(0.05);
  };
  Boundary("=Earthquake4");
 };
};
```

4. REWORKING PUBLISHED EARTHQUAKE AGE MODELS

This section contains details regarding the age modelling of earthquake ages in Hawke's Bay. Primarily, we adapted published age model codes in order to accommodate the most recent calibration curves SHCal20 (Hogg et al., 2020) and Marine20 (Heaton et al., 2020), and updated age of the Waimihia tephra isochron (Pizer et al., 2023). For the earthquake record at Ahuriri lagoon (Hayward et al., 2016), we also rework the age model code to better reflect the accuracy of the ^{14}C data.

4.1 Ahuriri Lagoon

For earthquake evidence at Ahuriri Lagoon (hereafter 'Ahuriri') (Clark et al., 2019; Hayward et al., 2016), we updated the age model for the most recent calibration curves (Heaton et al., 2020; Hogg et al., 2020) and re-calculated the average marine reservoir correction (ΔR; 32 ± 60) for datapoints on the east coast of the North Island, New Zealand (as in Clark et al., 2019). The resulting earthquake ages (Model 1) are displayed in Table S3 as 95% HPDF ranges.

TABLE S3 - Earthquake ages at Ahuriri Lagoon generated using revised age models.

Earthquakes (oldest to youngest)	Model 1: updated version of Clark et al., 2019 age model, cal yr BP	Model 2: Group 1 age model of 'moderate' and 'good' ^{14}C dates, cal yr BP
Ahu_EQ1	7261-6680	7285-6646
Ahu_EQ2	5338-4950	5336-4917
Ahu_EQ3	5140-4584	5109-3767
Ahu_EQ4	4195-3543	4714-3492
Ahu_EQ5	2826-2406	2759-1725
Ahu_EQ6	1725-1561	1724-1498
Ahu_EQ7	1480-1206	1477-1129
Ahu_EQ8	1016-811	1043-706
Ahu_EQ9	476-171	667-195

In a review of the Model 1 age model, we identified two main areas that could be revised to better account for the accuracy of the ^{14}C data used. This included (i) revisiting the validity of stratigraphic relationships used as prior constraints for the age model, and (ii) revaluating the quality of individual ^{14}C dates. Chronology from 17 cores was used to develop the earthquake ages at Ahuriri by Hayward et al (2016) and then by Clark et al (2019). However, when interrogated without prior knowledge of the ^{14}C results, the stratigraphic correlations between cores are too weak to warrant the combination of chronology within age models (Bronk Ramsey, 2009). We identified three geographic groups of cores with suitable relationships based on similar sequences of tephra isochrons, sedimentology and microfossil data (Group 1, Group 2 and Group 3). Within these groups, we then examined individual ^{14}C dates with regards to whether they provided accurate and precise chronologic information relevant to dating the earthquake evidence. The criteria included (i) quality of the target (i.e. bulk samples are low quality, fragile macrofossils are high quality), (ii) their location with regards to stratigraphic and biostratigraphic change (i.e. very close to sudden change, or located some distance from change horizon), and (iii) likelihood of reworking based on other ^{14}C ages or tephra in the same core. Each criterion was ranked 0-2, and the totals alongside comments informed whether a date was classed as 'good', 'moderate' or 'poor'. 'Poor' targets (n = 3) were not used in any further age models.

Using the stratigraphic information included in the logs by Hayward et al (2016), we reconstructed individual age models using the 'moderate' and 'good' ^{14}C dates (n = 30) for each separate Group. We introduced an outlier model to formally identify and inversely weigh any outliers. The models yielded earthquake ages that generally overlapped with earthquake ages from Model 1, but with much broader age uncertainties. Group 1 was the only model that yielded earthquake ages for all 9 events identified in the original study (Table S3). Figure S9 displays the age probability density functions (PDFs) for the Ahuriri earthquakes from Model 1 and Model 2 (Group 1). Also included, are the updated earthquake ages from the previous work at Pakuratahi (Table S4), demonstrating the dissimilarity with the Ahuriri record and the new Pakuratahi earthquake ages from this study.

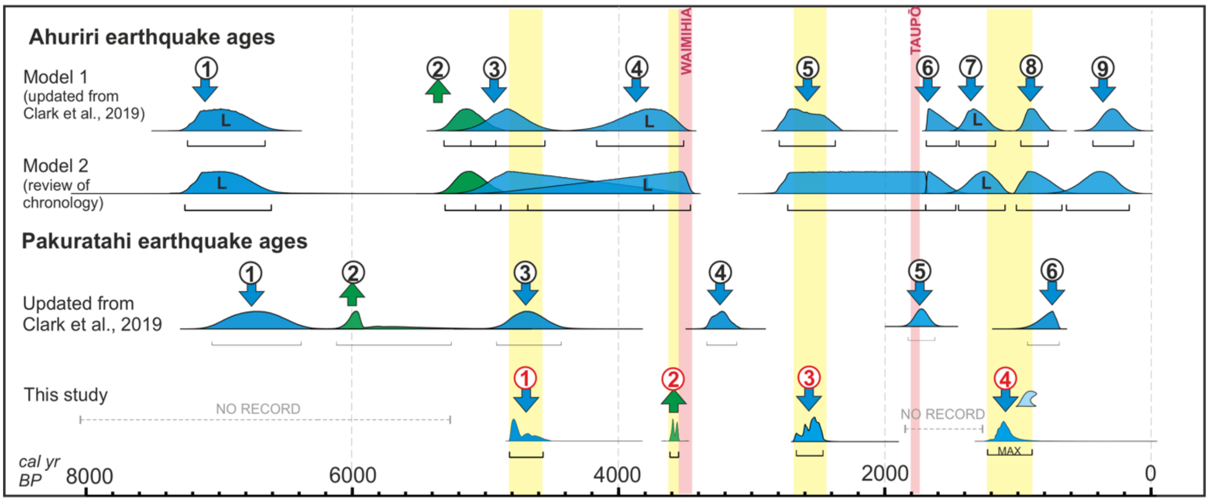


Figure S9– Modelled age probability density functions (PDFs; with 95% HPDF range) of earthquake ages from adapted age models at Ahuriri and Pakuratahi. 'L' indicates low confidence earthquake ranking by Clark et al. (2019). Blue PDFs and arrows indicate evidence of coseismic subsidence. Green PDFs and arrows indicate evidence of coseismic uplift. Yellow bands represent the 95% HPDF range for our Pakuratahi earthquakes. Pink bands represent the 95% HPDF range for the age of the Waimihia and Taupō tephra isochrons (Hogg et al., 2012, Pizer et al., 2023).

4.2 Pakuratahi Valley

The results of previous ^{14}C dating of earthquake evidence at Pakuratahi are published by Clark et al. (2019). We made minor edits to age this age model to update it for the most recent calibration curves (Heaton et al., 2020; Hogg et al., 2020) and ΔR value of 32 ± 60 (east coast average as for Ahuriri), as well as the updated age for the Waimihia tephra isochron (Pizer et al., 2023). Modelled earthquake ages are shown in Table S4 and Figure S9 as 95% HPDF ranges.

TABLE S4 - Earthquake ages from previous work at Pakuratahi using revised age models.

Earthquakes (youngest to oldest)	**Updated version of Clark et al., 2019 age model, cal yr BP**
Clark_Pak_EQ1	7045-6376
Clark_Pak_EQ2	6110-5249
Clark_Pak_EQ3	4909-4423
Clark_Pak_EQ4	3331-3106
Clark_Pak_EQ5	1819-1619
Clark_Pak_EQ6	923-685

4.3 Mahia Peninsula

Berryman et al. (2018) use ^{14}C dating and tephra to obtain earthquake ages from uplifted marine terraces at Mahia Peninsula. We made minor edits to the age model published in Clark et al. (2019) to update it for the most recent calibration curves (Heaton et al., 2020; Hogg et al., 2020) and ΔR value of 18 ± 56 (average of data points from Ahuriri and Gisborne) as well as the updated age for the Waimihia tephra isochron (Pizer et al., 2023).

TABLE S5 - Earthquake ages from Mahia Peninsula generated using revised age models.

Earthquakes (youngest to oldest)	**Updated version of Clark et al., 2019 age model, cal yr BP**
Mahia_T1	5024-3680
Mahia_T2	3636-3468
Mahia_T3	1864-1710
Mahia_T4	1378-1088
Mahia_T5	54- -17

4.4 Southern Hawke's Bay Terraces

Litchfield et al. (2022) use ^{14}C dating and tephra to obtain earthquake ages from uplifted marine terraces at Cape Kidnappers, Waimārama and Aramoana on the Kidnappers-Kairākau coastline. In this instance, the youngest date (calibrated, 95% HPDF range) for each terrace is used to reflect the earthquake age, rather than a modelled sequence. The ^{14}C dates are already calibrated using the most recent calibration curves, so we did not make any adaptations to the published earthquake ages.

5. AGREEMENT OF EARTHQUAKE AGES

Comparing the modelled age probability density functions (PDFs) provides a useful method to test the synchronicity between earthquake ages. We tested for significant differences between earthquake age PDFs using a chi-squared (χ^2) test at 5% associated with the 'Combine' function in OxCal v.4.4.4 (Bronk Ramsey, 1995). We compare each Pakuratahi earthquake age with evidence from elsewhere on the central Hikurangi margin that may correlate and report the χ^2 value in Table S6 (5% 3.841, df 1 unless otherwise stated).

TABLE S6 - Results of χ^2 test for agreement between earthquake ages in Hawke's Bay.

5% 3.841, Df = 1,	**Pakuratahi earthquake ages: This study**			
Alternative Pakuratahi ages:	**Pak_EQ1**	**Pak_EQ2**	**Pak_EQ3**	**Pak_EQ4**
Pak_EQ1: combine of rip up clast dates	0.255			
Pak_EQ3: date below contact in MV-O2			0.609	
Revised Pakuratahi ages: Previous work (Clark et al., 2019)				
Clark_Pak_EQ3	1.081			
Clark_Pak_EQ6				7.822
Revised Ahuriri ages: Model 1 (Clark et al., 2019)				
Ahu_EQ3 Model 1	0.293			
Ahu_EQ5 Model 1			0.564	
Ahu_EQ7 Model 1				7.742
Ahu_EQ8 Model 1				3.404
Revised Ahuriri ages: Model 2 (14C review)				
Ahu_EQ3 Model 2	0.064			
Ahu_EQ5 Model 2			0.074	
Ahu_EQ7 Model 2				2.853
Ahu_EQ8 Model 2				4.219*
Revised Mahia terrace ages (Berryman et al., 2018)				
Mahia_T1 (Auroa)	9.322			
Mahia_T2		3.257		
Mahia_T4				3.064
Kidnappers-Kairakau coastline terrace ages (Litchfield et al., 2022)				
Kidnappers_T1			2.654	
Waimarama_T1	0.026			
Waimarama_T2			11.707	
Aramoana_T1	15.750			
Aramoana_T2			2.398	
Aramoana_T3				6.892
Multi-earthquake comparison *(5% 5.991, Df 2; 5% 7.815, Df 3)*				
Pak_EQ1, AhuEQ3Model2, WaiT21	0.383			
Pak_EQ3, AraT2, KidT2			4.838	
Pak_EQ3, AhuEQ5Model1, AraT2, KidT			5.458	

*Reported values represent results of χ^2 test at 5%, performed by the Combine function in OxCal v4.4.4. Blue = pass, orange = fail. Df = degrees of freedom. *Marks the ages used for the combined age calculation for Pak_EQ4 and Ahu_EQ8 = 1067-760 cal yr BP.*

6. COMBINING PAKURATAHI AND AHURIRI RECORDS

6.1 Non-correlation between Ahuriri and Pakuratahi

With a high likelihood that the Pakuratahi and Ahuriri share common rupture sources, it is troubling that there is still considerable mismatch between the earthquake records. Most miscorrelation is within the period following the Taupō tephra isochron (hereafter 'post-Taupō), where the frequency of earthquakes at Ahuriri is much higher, implying a shorter recurrence interval in more recent times. Because we are now confident that the Pakuratahi chronology is robust, we are better placed to explore possible reasons for the disparity between the two sites. We explore the most plausible explanations which include the possibilities that (1) the recording potential of Pakuratahi is not sensitive enough in places, and (2) combining microfossil interpretations and/or inaccurate dating from cores with inconsistent stratigraphy leads to overrepresentation of subsidence events at Ahuriri.

It is possible that there is a difference in preservation potential between the sites causing inconsistencies in the identifiable earthquake evidence (Reason 1). The local sea level trend has a direct impact on the preservation of coseismic deformation evidence at the coast (Kelsey et al., 2015). Although sea level is falling in the last 2-3 ka of the earthquake record (disadvantaging the preservation of coseismic subsidence signatures), the study sites are located so close to one another that this cannot be the main driver of the disparity in preservation. However, local geomorphological differences may have meant that Ahuriri maintained a longer period of sensitivity to vertical deformation because of its wide, sheltered embayment. While this cannot explain the lack of evidence for Ahu_EQ4 at Pakuratahi, it could explain the absence of strong evidence for the younger subsidence events. This is particularly plausible for Ahu_EQ9 as sea level fall was more rapid from ~900 cal BP (Clement et al., 2016; Hayward et al., 2016) and if Pakuratahi was already less sensitive than Ahuriri, subsidence signals would be very difficult to identify.

Alternatively, some of the Ahuriri earthquakes could correlate with more subtle paleoenvironmental changes at Pakuratahi where we do not define strong enough evidence to attribute coseismic deformation as a causal mechanism. For example, PC-3 at Pakuratahi may be the correlative of Ahu_EQ4 but with a much weaker bio- and stratigraphic signature. A similar scenario has been experienced at other subduction zones such as Cascadia and Alaska, where 0.5 m of vertical change has been suggested as a minimum threshold for the detection of coseismic subsidence within coastal sediments (Nelson et al., 2020; Shennan et al., 2016). Because the magnitudes of vertical deformation associated some of the Ahuriri earthquakes are close to this threshold and have large uncertainties, it may be that the equivalent paleoearthquake evidence at Pakuratahi is undetectable.

The presence of two known erosional unconformities in the Pakuratahi stratigraphy demonstrate the susceptibility of the coastal environment to erosion during the period in which it was also sensitive to recording coseismic vertical deformation. Our ^{14}C dating of Pak_EQ3 in Middle Valley shows that this erosion was also spatially variable. For the unconformity associated with Pak_EQ4, the ^{14}C dates and presence of the Taupō tephra isochron (LV-V4) indicate that up to 600 years of sediment accumulation was removed. This process would explain the lack of evidence for Ahu_EQ6 but is unlikely to be responsible for all points of miscorrelation between the sites.

Misidentification of Ahuriri earthquake evidence is also a possible reason for inconsistency between paleoearthquake records. Many of the additional subsidence signatures in the post-Taupo record at Ahuriri are derived from changes to the foraminifera assemblage. However, the cores display such inconsistent lithological and biostratigraphic changes that it would be difficult to infer (with confidence) any synchronicity attributable to coseismic displacements. Thus, reporting the sum total of local changes in foraminifera assemblages would result in overrepresentation of subsidence events. Distinguishing whether the reported subsidence signals are truly asynchronous is difficult because the existing chronologic tie-points are too sporadic. Some of the Ahuriri earthquake age models also use

^{14}C dates on estuarine shells which we demonstrate have an inbuilt local reservoir offset at Pakuratahi, most likely due to precipitation from the carbonaceous bedrock. The bedrock at Ahuriri is the same so earthquake ages derived by shell dates are probably skewed older. These factors may explain why the only subsidence event occurring within this period at Pakuratahi (Pak_EQ4) does not have a direct temporal correlation with earthquake evidence at Ahuriri.

We have outlined a number of processes that may explain the reduced number of earthquakes at Pakuratahi compared to Ahuriri, summarised in Table 3. Repercussions of the falling sea level trend such as decreased sensitivity and increased erosion is a sensible explanation for most of the miscorrelation in the post-Taupo record. Whether or not all of the additional subsidence events at Ahuriri represent coseismic displacements is difficult to assess due to the heterogeneous stratigraphy and variable robustness of the chronology. For the purpose of calculating recurrence intervals from a combined record, we made this judgement based on the strength of evidence at Ahuriri. This meant we included Ahu_EQ1, Ahu_EQ2, Ahu_EQ6 and Ahu_EQ9 because they presented high-confidence evidence at Ahuriri, despite the low confidence temporal correlation with Pakuratahi. We excluded Ahu_EQ4 and Ahu_EQ7 due to weak evidence at Ahuriri, in addition to no temporal correlation with Pakuratahi. Despite failing the χ^2 test, we also trusted our correlation of evidence for Pak_EQ4 (skewed older by its maximum age) and Ahu_EQ8 enough to implement a statistically combined age for this event (1067-760 cal yr BP). The resulting sequence of earthquakes compiled from both sites was used to calculate recurrence intervals, as explained below.

6.2 Recurrence Intervals

We calculated the recurrence intervals between earthquakes in the Napier area using a sequence of prior distributions representing our modelled earthquake ages in OxCal v4.4.4 (Lienkaemper and Ramsey, 2009). For earthquake events that correlated between Pakuratahi and Ahuriri, we used our new, more precise earthquake ages generated in this study. We excluded Ahu_EQ7 due to low confidence expressed by Clark et al. (2019) and the lack of evidence at Pakuratahi. We used a combined age for the correlated event of Ahu_EQ8 and Pak_EQ4 (1067-760 cal yr BP).

TABLE S7 - Recurrence intervals for the combined paleoearthquake record at Ahuriri and Pakuratahi

All earthquakes		**Interevent time**	**Mean**	**± 1σ**
Ahu_EQ1 (7285-6646 cal yr BP)				
	Interval	971-2289	1749	317
Ahu_EQ2 (5536-4917 cal yr BP)				
	Interval	142-661	400	130
Pak_EQ1 (4839-4601 cal yr BP)				
	Interval	976-1257	1139	81
Pak_EQ2 (3630-3564 cal yr BP)				
	Interval	908-1172	1042	69
Pak_EQ3 (2687-2439 cal yr BP)				
	Interval	756-1126	937	93
Ahu_EQ6 (1724-1498 cal yr BP)				
	Interval	466-876	669	99
Combine: PakEQ4_AhuEQ8 (1067-760 cal yr BP)				
	Interval	246-805	534	141
Ahu_EQ9 (667-195 cal yr BP)				
	Interval	175-649	407	119
1931 CE Hawke's Bay Earthquake				
Total = 9 earthquakes in 7000 yrs				
	Average	-	859	454

TABLE S8 - Recurrence intervals for earthquakes causing subsidence at Ahuriri and Pakuratahi

All earthquakes		**Interevent time**	**Mean**	**± 1σ**
Ahu_EQ1 (7285-6646 cal yr BP)				
	Interval	1675-2670	2184	268

Pak_EQ1 (4839-4601 cal yr BP)			
Interval	1963-2360	2182	103
Pak_EQ3 (2687-2439 cal yr BP)			
Interval	758-1124	928	93
Ahu_EQ6 (1724-1498 cal yr BP)			
Interval	465-875	669	99
Combine: PakEQ4_AhuEQ8 (1067-760 cal yr BP)			
Interval	230-795	520	142
Ahu_EQ9 (667-195 cal yr BP)			
Total = 6 earthquakes in 7000 yrs			
Average	-	1296	752

TABLE S9 - Recurrence intervals for earthquakes causing uplift at Ahuriri and Pakuratahi

All earthquakes	**Interevent time**	**Mean**	**± 1σ**
Ahu_EQ2 (5536-4917 cal yr BP)			
Interval	1303-1739	1525	126
Pak_EQ2 (3630-3564 cal yr BP)			
Interval	3543-3611	3580	19
1931 CE Hawke's Bay Earthquake			
Total = 3 earthquakes in 7000 yrs			
Average	-	2552	1031

7. REFERENCES

Berryman, K., Clark, K., Cochran, U., Beu, A., and Irwin, S., 2018, A geomorphic and tectonic model for the formation of the flight of Holocene marine terraces at Mahia Peninsula, New Zealand: Geomorphology, v. 307, p. 77-92. DOI: 10.1016/j.geomorph.2017.10.014

Bronk Ramsey, C., 1995, Radiocarbon Calibration and Analysis of Stratigraphy: The OxCal Program: Radiocarbon, v. 37, no. 2, p. 425-430. DOI: 10.1017/S0033822200030903

Bronk Ramsey, C., 2009, Dealing with Outliers and Offsets in Radiocarbon Dating: Radiocarbon, v. 51, no. 3, p. 1023-1045. DOI: 10.1017/S0033822200034093

Clark, K., Howarth, J., Litchfield, N., Cochran, U., Turnbull, J., Dowling, L., Howell, A., Berryman, K., and Wolfe, F., 2019, Geological evidence for past large earthquakes and tsunamis along the Hikurangi subduction margin, New Zealand: Marine Geology, v. 412, p. 139-172. DOI: 10.1016/j.margeo.2019.03.004

GNS Science & Geoscience Society of New Zealand., 2003. New Zealand Fossil Record File [Data set]. GNS Science. DOI: https://doi.org/10.21420/JQQB-NK89

Hayward, B., Daymond-King, R., Matthews, A., and Morley, M., 2004, Foraminifera and other biogenic material in samples from Pakuratahi cores, PK04-1, 2, 3, Hawkes Bay.

Hayward, B. W., Grenfell, H. R., Sabaa, A. T., Cochran, U. A., Clark, K. J., Wallace, L., and Palmer, A. S., 2016, Salt-marsh foraminiferal record of 10 large Holocene (last 7500 yr) earthquakes on a subducting plate margin, Hawkes Bay, New Zealand: Geological Society of America Bulletin, v. 128, no. 5-6, p. 896-915. DOI: 10.1130/B31295.1

Heaton, T. J., Köhler, P., Butzin, M., Bard, E., Reimer, R. W., Austin, W. E. N., Bronk Ramsey, C., Grootes, P. M., Hughen, K. A., Kromer, B., Reimer, P. J., Adkins, J., Burke, A., Cook, M. S., Olsen, J., and Skinner, L. C., 2020, Marine20—The Marine Radiocarbon Age Calibration Curve (0–55,000 cal BP): Radiocarbon, v. 62, no. 4, p. 779-820. DOI: 10.1017/RDC.2020.68

Hogg, A. G., Heaton, T. J., Hua, Q., Palmer, J. G., Turney, C. S., Southon, J., Bayliss, A., Blackwell, P. G., Boswijk, G., and Bronk Ramsey, C., 2020, SHCal20 Southern Hemisphere calibration, 0–55,000 years cal BP: Radiocarbon, v. 62, no. 4, p. 759-778. DOI: 10.1017/RDC.2020.59

Kelsey, H. M., Engelhart, S. E., Pilarczyk, J. E., Horton, B. P., Rubin, C., Daryono, M., Ismail, N., Hawkes, A. D., Bernhardt, C. E., and Cahill, N., 2015, Accommodation space, relative sea level, and the archiving of paleo-earthquakes along subduction zones: Geology, v. 43, no. 8, p. 675-678. DOI: 10.1130/G36706.1

Lienkaemper, J. J., & Ramsey, C. B. (2009). OxCal: Versatile Tool for Developing Paleoearthquake Chronologies–A Primer. Seismological Research Letters, 80(3), 431–434. https://doi.org/10.1785/gssrl.80.3.431

Litchfield, N., Morgenstern, R., Clark, k., Howell, A., Grant, G., and turnbull, J., 2022, Holocene marine terraces as recorders of earthquake uplift: Insights from a rocky coast in southern Hawke's Bay, New Zealand: Earth Surface Processes and Landforms. DOI: https://doi.org/10.1002/esp.5496

Nelson, A. R., Hawkes, A. D., Sawai, Y., Horton, B. P., Witter, R. C., Bradley, L.-A., and Cahill, N., 2020, Minimal stratigraphic evidence for coseismic coastal subsidence during 2000 yr of megathrust earthquakes at the central Cascadia subduction zone: Geosphere, v. 17, no. 1, p. 171-200. DOI: 10.1130/ges02254.1

Pizer, C., Howarth, J., Clark, K., Wilson, C. J. N., Dahl, J., and Hopkins, J., 2023, An integrated proximal-distal radiocarbon dating approach provides improved age constraints for a key Holocene tephra isochron: Quaternary Science Reviews, v. 307, p. 108069. DOI: 10.1016/j.quascirev.2023.108069

Shennan, I., Garrett, E., and Barlow, N., 2016, Detection limits of tidal-wetland sequences to identify variable rupture modes of megathrust earthquakes: Quaternary Science Reviews, v. 150, p. 1-30. DOI: 10.1016/j.quascirev.2016.08.003

Pizer, C., Clark, K., Howarth, J., Howell, A., Delano, J., Hayward, B.W., Litchfield, N., 2023, A 5000-year record of coastal uplift and subsidence reveals multiple source faults for past earthquakes on the central Hikurangi margin: GSA Bulletin, https://doi.org/10.1130/B36995.1.

Supplemental Material - File 2

CORE LOGS

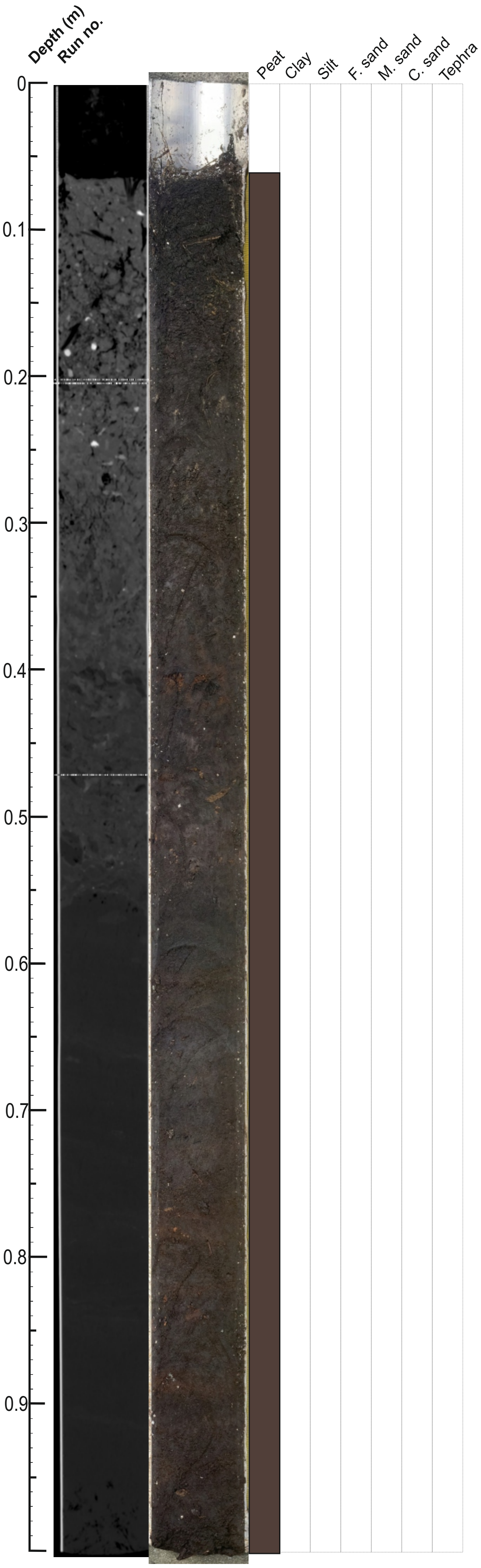
This section contains the full core logs for each 1 m section of sediment cores taken in the Pakuratahi Valley. Descriptions follow an adapted Troels-Smith (1955) format. Depths are relative to 0 m at the top of each core barrel section. Current surface elevation for each core location is also given in metres above sea level (m ASL).

Abbreviations:

UC = upper contact
LC = lower contact
OM = organic matter/material
CT = x-ray computed tomography
GP = growth position
Macro-org. = microscopic organisms
Calc. = calcareous
Bioturb. = bioturbation
Potamo. = Potamopyrgus sp.

Key:
Tephra
Sand
Silt
Organic silt
Silty peat
Peat

Core: **UV-V1 (FV-V3)**	Section: **A**	Coordinates (NZTM): **1935578 E 5636448 N**	Surface (m ASL): +1.87
Location: Midway up the second ‘finger valley’			

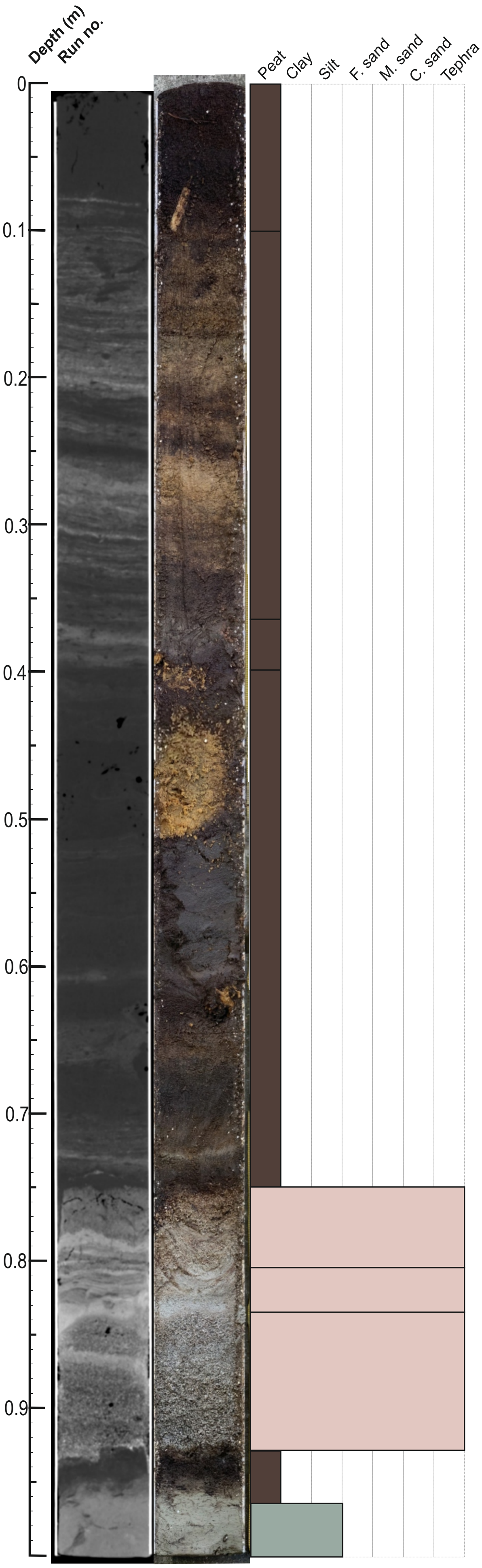


Description (e.g. nature of contact, colour, grain size, bedding, organic content)

0.0-0.06 = EMPTY

0.06 - 1.0 Sh2 Th/Tl/Dh/Dl + 4.1.2.1.0
Dark brown (10YR 2/2) peat.
Not saltmarsh-like in texture. Much more terrestrial - some woody roots. Some variations in organic content - increases in root-mat like material (more orange colour). Some layers have more silt content. In general silt increases from 0.6 m upwards. Colour gets darker upwards. Texture becomes crumbly (dry) from 0.4 m as transitions to top soil (bioturbated). Wood chunk at 0.4 m.

Core: **UV-V1 (FV-V3)**	Section: **B**	Coordinates (NZTM): **1935578 E 5636448 N**	Surface (m ASL): +1.87
Location: Midway up the second 'finger valley'			



Description (e.g. nature of contact, colour, grain size, bedding, organic content)

0.0-0.10 Sh4 Dl+ Tl+ 3.0.1.1.-
Medium brown (10YR 4/2) peaty soil to dark brown peat (10YR 2/2) (from 0.07). Colour change gradational, increase in dark OM texture looks crumbly. Root or branch at 0.06-0.10. Gradational LC. UC matches next run.

0.10-0.36 Sh3 Ag1 3.3.2.1.0
Dark brown (10YR 2/2) peat with interfingered light brown (10YR 6/3) organic soil or peat. Very light but clearly made up of un-ID organic matter (fibrous). Well humified. No large OM. Thick section 0.28-0.26. Mixed below here. Dark peat at base. Fewer laminations above 0.20, becomes more dry and medium brown (less silt, crumbly).

0.36 - 0.40 Sh2 Ag2 3.2.2.0.1
Dark brown (10YR 2/2) peat to grey (10YR 5/1) organic silt.
Macro OM within. Lower 1 cm is predominantly humus with increasing silt content at 0.39 m. Unit then mixed, with gradational UC back to more peat, less silt as below uni.

0.40-0.75 Sh4 Tl+ Dl+ 4.2.3.1.1
Dark brown (10YR 2/2) peat.
Well humified and quite fine in general. Some lenses are siltier (e.g. ~0.73, 0.60 = 0.5 cm thick, grey and gradational). Some more organic lenses - look root mat-like and more orange in colour (0.725 and 0.66 m). Macro OM visible 0.66-0.56 m - looks rooty. Large root/branch 2x2 cm at 0.61-0.63. Large round branch (yellow colour 0.44-0.51 m) - well humified, little structure left, unsure if bark still present on outside. Rooty OM visible above this but very fine.

0.75-0.805 Te4 Sh+ 2.1.0.4.3
Brown/grey (2.5Y 6/2) tephric medium sand.
Unit seems mixed. Grey at base. Fine silty lens ~0.78 m (fine cap?). Above 0.82 m = colour stained brown from peat above, and back to medium sand but looks reworked. Sharp LC. Sharp UC where tephra stops.

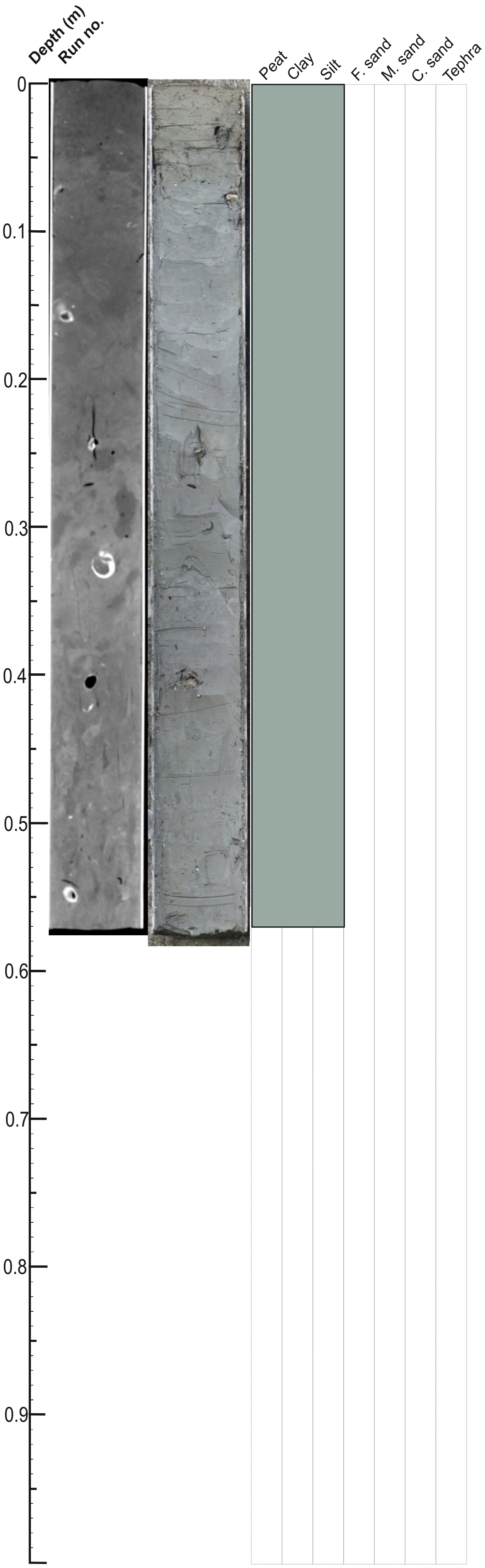
0.805 -0.84 Te4 Sh+ 1.1.0.4.4
Light grey (2.5Y 7/1) tephric sand. Distinct texture change above and below. Composed of medium/fine sand with few darker bands in 0.82-0.83 m (finer too). Irregular LC. Regular UC. Both sharp.

0.84-0.93 Te4 1.0.0.4.4
Medium grey (2.5Y 2.5/1) tephric sand.
Very coarse (<3 mm) at base, fining to coarse/medium sand sized at top. Homogenous colour with light grains and dark grains. Very sharp lower and upper.

0.93 - 0.965 Sh4 4.0.2.1.4
Dark brown (10YR 2/1) peat. No large OM. Looks more herbaceous than woody - very fine. Some bioturbation into unit below = slightly gradational boundary in places over ~0.5 cm. UC very sharp and irregular. Very wet. Still think sharp enough to be earthquake.

0.965 - 1.00 Ag4 2.0.0.3 ½
Grey (5Y 6/1) smooth silt. Dark brown filament-like material from above makes it seem kind of mottled/veined (fine roots - not in situ in silt). Tiny white flecks could be forams. Slightly browner in colour than green silt that is deeper in this core. No shell. Black flecks could be seeds.

Core: **UV-V1 (FV-V3)**	Section: **C**	Coordinates (NZTM): **1935578 E 5636448 N**	Surface (m ASL): +1.87
Location: Midway up the second ‘finger valley’			



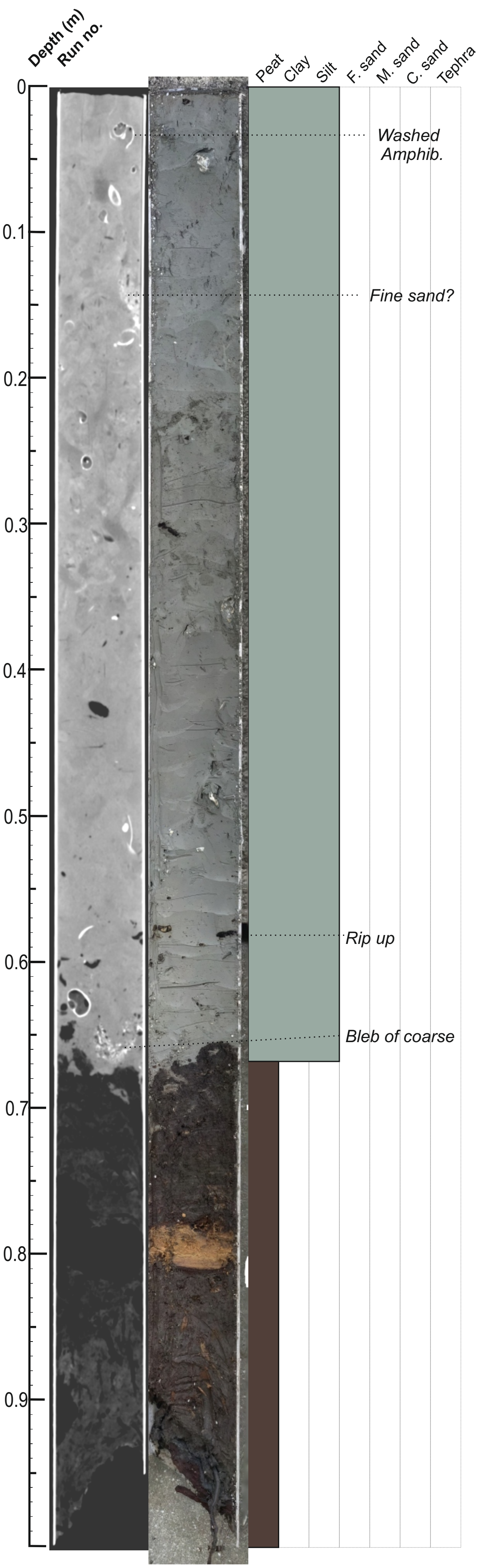
Description (e.g. nature of contact, colour, grain size, bedding, organic content)

0.0-0.06 Ag4 3.0.3.0.-
Browny grey (5Y 5/1) silt with increased organic content compared to below (mostly roots from visible bioturbation marks on the surface). White and black flecks. Most likely *Potamo* within. No visible large shells. No obvious OM for dating. Homogenous colour and texture. Lower contact gradational (biotrub).
(NB: base of section B is slightly different?)

0.06 - 0.57 Ag3 As1 Tm+ 3.0.3.0.0
Light/medium grey (10Y 5/1) silt (silky texture).
Firmness increases down-core. Lighter coloured biotrubations increase in frequency up-core (from unit above). Some *Amphibola* visible at surface (0.31-0.33 m and 0.57 m). Odd piece of OM but not much. Homogenous colour and texture.

(NB: section ends at 0.57 m)

Core: **UV-V1 (FV-V3)**	Section: **D**	Coordinates (NZTM): **1935578 E 5636448 N**	Surface (m ASL): +1.87
Location: Midway up the second 'finger valley'			



Description (e.g. nature of contact, colour, grain size, bedding, organic content)

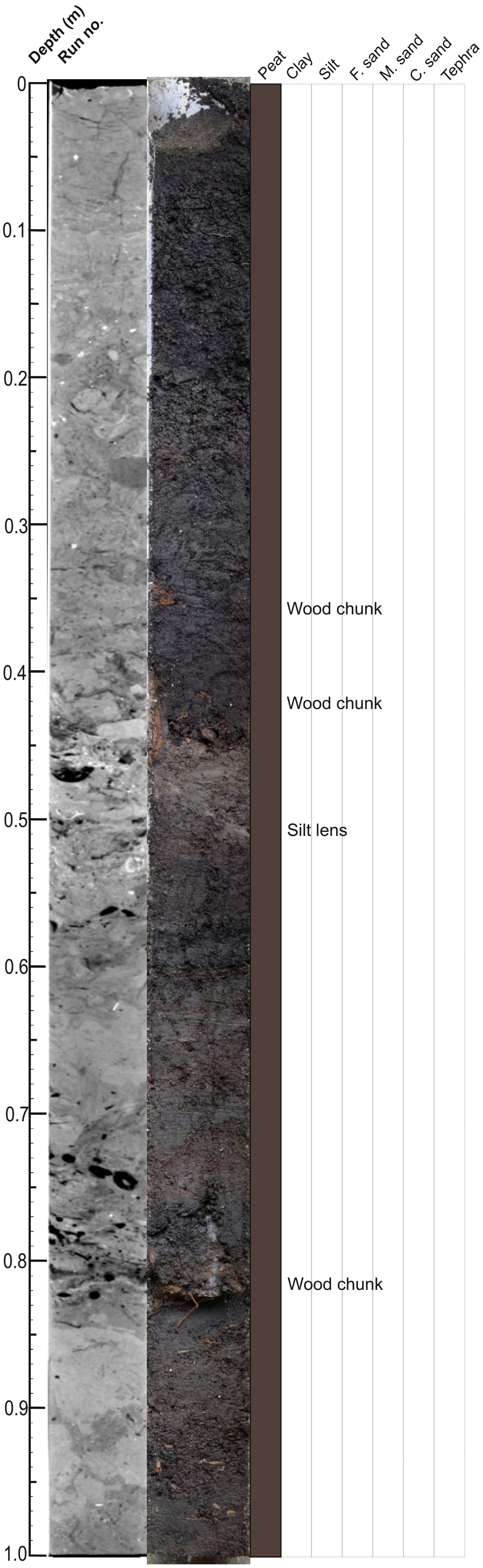
0.0-0.67 Ag4 Ptm+ ™+ 2.0.0.3 -
Grey (5GY 5/1) silt with estuarine shells.
Homogeneous colour and texture. Potamo present in silt, particularly at base. Tiny black flecks. Shells that are identifiable from the surface are mainly Amphibola. Some fragmented due to coring/splitting. Most whole and 0.7-3 cm. Chunks of peaty material/dark black organics like wood/twig are present/scattered throughout the silt and look like rip up clasts (sharp contacts) - definitely not in situ. Bioturbation causing slight mottling 0-0.4. 0.645-0.66 = bleb of coarse material - fine sand with shell fragments and whole *Potamo.*
Lower contact is extremely sharp and irregular. UC contd in next run.

0.67-1.00 Sh4 Dl+ Tl+ 4.0.1.1.4
Dark brown (10YR 2/1) peat with maco-organics (woody).

- 0.88-1.0 = large macro organic fragments - rooty
- 0.78-0.81 = 3 cm thick, full barrel width wood chunk (orange/brown colour). Other macro mostly looks like roots, especially at base. Roots are ~5 mm thick.
- 0.67-0.78 = much finer detritus, mainly humus with few twig/roots (few mm) sticking out of surface. Very firm and well packed, not spongey - more silty than fresh peaty.

Homogenous colour. Upper contact extremely sharp and uneven - erosional? sharp and irregular. UC contd in next run.

Core: **UV-V2 (FV-V2)**	Section: **A**	Coordinates (NZTM): **1935681 E, 5636801 N**	Surface (m ASL): +1.08
Location: At the top of the third ‘finger-valley’ , duplicate core to reach base of lower peat.			



Description (e.g. nature of contact, colour, grain size, bedding, organic content)

0.0-0.05 EMPTY CORE

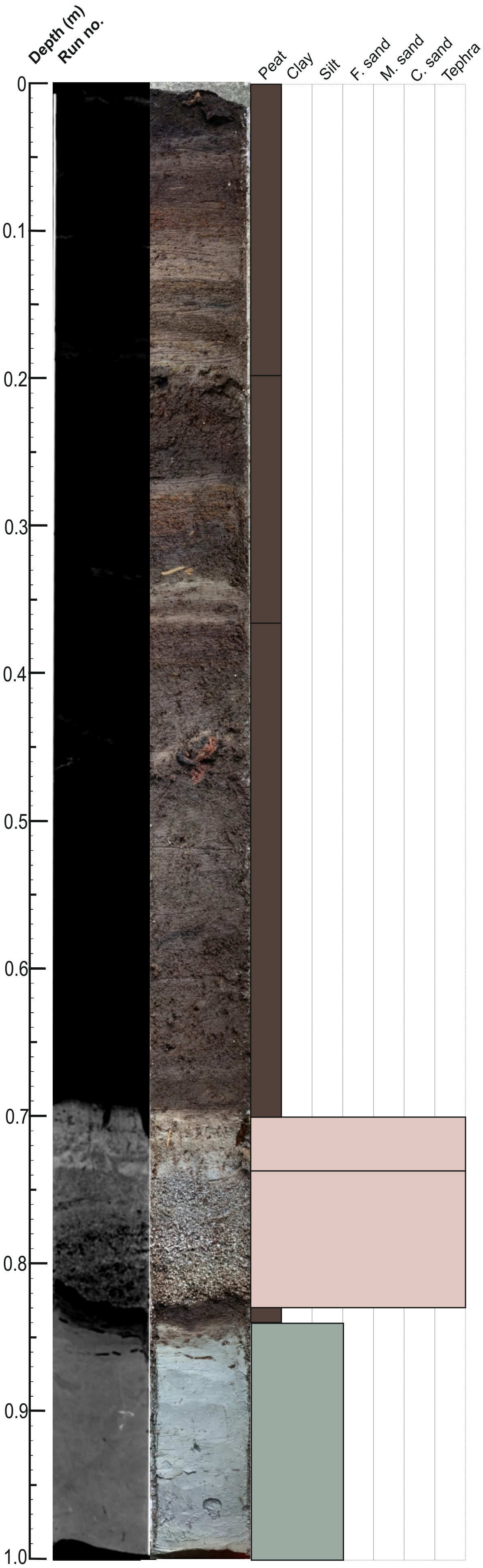
0.05 1.0 Sh2 Th/Tl/Dh/Dl + 4.1.2.1.0
Dark brown/black (10YR 2/1) humified peat.
0.0 - 0.27 Crumbly texture like modern soil.

0.0 - 0.5 Increased silt content and much firmer texture than below, 0.7 cm thick band of very light grey silt with decreasing OM up to 0.45 m, then back to densely packed peat/soil.

0.5 - 1.0 Looser packed peat with macro-OM visible - unclear if in GP or not. Slightly springy in texture - fresh. Possibly mostly root material. Large wood chunk at 0.80-0.83 m. Colour change in CT ~0.85 not visible as change in texture - maybe just increased OM above?

NB:
- No Taupo tephra visible
- Textural changes in CT are changes in large OM vs humified soil

Core: **UV-V2 (FV-V2)**	Section: **B**	Coordinates (NZTM): **1935681 E, 5636801 N**	Surface (m ASL): +1.08
Location: At the top of the third 'finger-valley' , duplicate core to reach base of lower peat.			



Description (e.g. nature of contact, colour, grain size, bedding, organic content)

0.0 - 0.20 Sh2 Ld1 Ag1 3.4.2.0.0
Medium brown (10YR 3/2) peat with silty and increased OM lenses.
Main component of entire unit is peat. Lenses are gradational into one another and represent different phases of silt content. Frequency of silt lenses increases upwards.
Colours vary with lenses. Some contacts are sharp. Some layers of increased OM are orange in colour (root mass). No large macro-org.

0.20 - 0.37 Sh3 Ld1 4.3.2.1.0
Dark brown (10YR 3/2) peat w few silty lenses.
Lower silt lenses are grey-ish brown in colour - not just organic.
Very orange organic lens at 0.28-0.30 m (root mass).
Peat with siltier matrix 0.26-0.28 m with silt component decreasing upwards, OM increasing upwards to include visible roots/twigs (black in colour), unsure if in GP or not.

0.37 - 0.70 Sh4 Tl + Dl+ Th+ Dh+ 4.0.2.1.0.
Dark brown/black (10YR 2/1) humified peat (fresh looking).
Homogenous in colour apart from siltier lens at 0.45-0.46 m, around the red/brown chunk of wood.
Thin/fine rootlets abundant throughout.

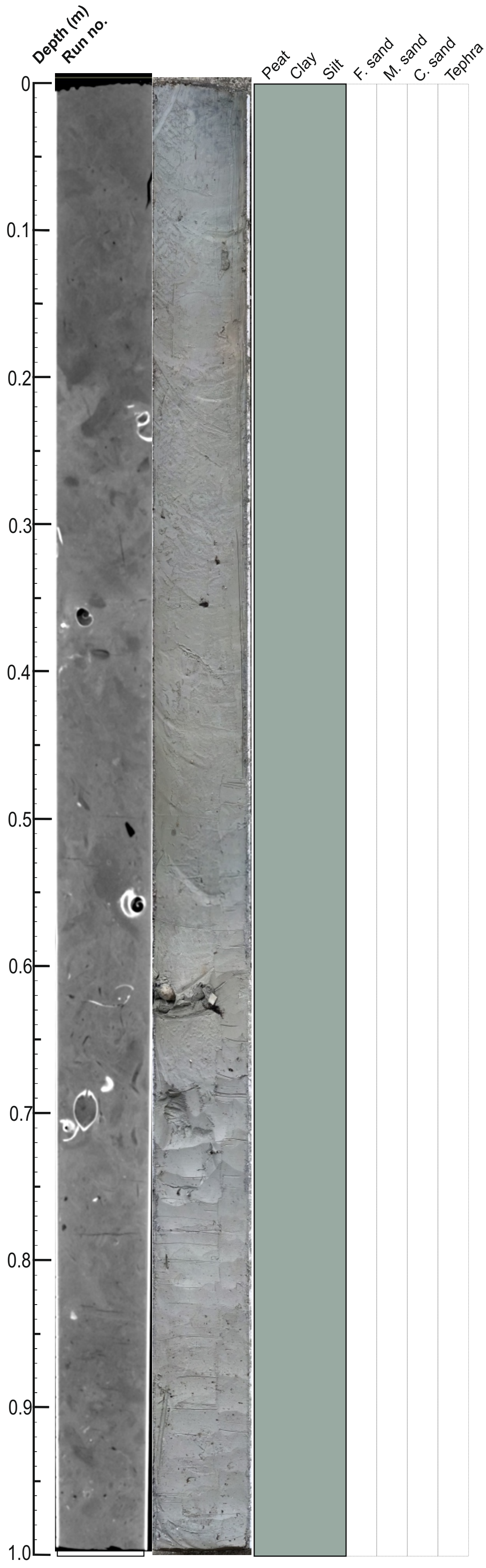
0.70 - 0.74 Te4 2.0.4.0.3
Light grey (10YR 7/1) tephric sand.
Slightly colour stained from peat above.
Fines upwards from medium sand to fine sand to silt.
0.7 cm thick root/twig within but clearly dragged down from peat.
LC gradational, UC sharp (bioturbated) ~1 cm with roots penetrating.

0.74 - 0.83 Te4 1.2.4.0.1
Grayish brown (2.5Y 5/2) coarse tephric sand.
Max grain size ~2-3 mm. Fines upwards to less coarse (not med.). Composed of white grains and smaller grey grains. Stained brown from peat above. No visible macro-org.
LC sharp. UC gradational over 0.5 cm.

0.83 - 0.84 Sh4 4.0.2.0.4
Dark brown (10YR 2/1) humified peat - smooth and damp in texture.
Homogenous in colour and texture. No visible macro-org.
Very sharp LC where intact and not bioturb. Irregular LC (erosional?). Regular very sharp UC.

0.84 - 1.0 Ag4 2.0.3.0.3
Grey (5Y 5/1) silt - smooth and damp in texture.
Homogenous in colour and texture apart from slightly darker areas due to bioturb. No textural change.
Few calc. flecks < 1mm (*potamo?),* no visible macro-orgs.
Organic peat looking fine lens at 0.865 m.
Interfingering of unit above possible 0.84-0.86 m but upper contact with peat very sharp. LC not present - ctd. from previous run.

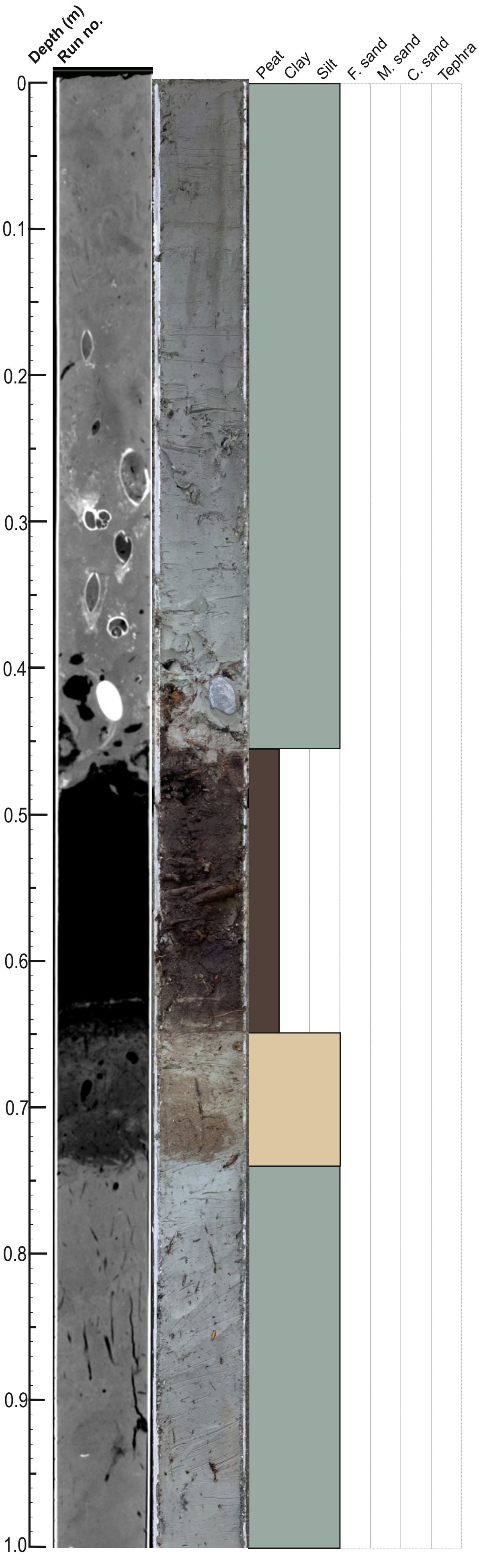
Core: **UV-V2 (FV-V2)**	Section: **C**	Coordinates (NZTM): **1935681 E, 5636801 N**	Surface (m ASL): +1.08
Location: At the top of the third 'finger-valley' , duplicate core to reach base of lower peat.			



Description (e.g. nature of contact, colour, grain size, bedding, organic content)

0.0 - 1.0 Ag4 Tm+ Ptm+ 2.0.3.0.0
Grey (5Y 5/1) silt - slightly sticky, smooth texture, homogenous throughout. Only variation in colour is lighter/darker shapes due to bioturb from molluscs - most prominent from 0.6 m upwards but very subtle. Boundary at 0.2 m in CT not visible when scraped.
Whole and fragments of shells - *Amphibola* at 0.63-0.64 m. Fragments at 0.10 m. Other shells not ID from surface but bivalves present.
Organic material that looks like pods of peat (0.7 x 0.3 cm) at 0.36 m and surrounding shells at 0.64 m. Root material at 0.9 m (1.5 cm visible). Black flecks (same as top of previous run) present at the base, decreasing in frequency upwards to 0.8 m, then sparse. Only a few white flecks ~ *Potamo* at the base.
Surface of image is misleading - no changes throughout once scraped well.

Core: **UV-V2 (FV-V2)**	Section: **D.1**	Coordinates (NZTM): **1935681 E 5636801 N**	Surface (m ASL): +1.08
Location: At the top of the third 'finger-valley' , duplicate core to reach base of lower peat.			



Description (e.g. nature of contact, colour, grain size, bedding, organic content)

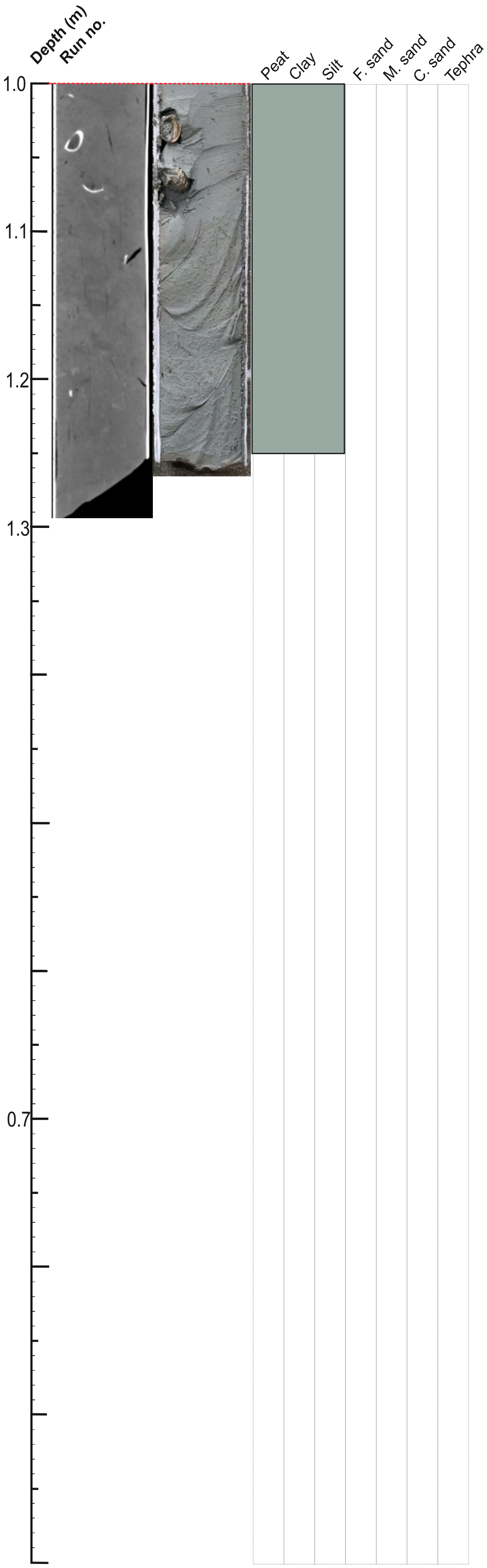
0.0 - 0.46 Ag3 As1 Tm+ Ptm+ 2.0.3.0.1
Grey (5Y 5/1) silt - smooth and sticky in texture.
Homogenous in colour and texture. Finger-like extension of slightly darker silt looks like mollusc burrow (bioturb). Black flecks (<1 mm) increased abundance upwards.
Whole *Amphibola* partially visible at 0.38 m. Many other frags. frequent - likely fragmented due to coring/splitting (appear whole in CT). Without sampling - small visible (~1 mm) shell fragments throughout.
Possible sand grains (or small calc. frags) present in pods (concentrated with sharp edges at the base of whole shells (visible in CT) at 0.43-0.46 m.
Large (4x3 cm), rounded greywacke pebble at 0.41-0.44 m - seems to be rip up peat around upper edge.
Extremely sharp and irregular LC - appears erosional w rip up clasts of peat to 0.40 m.

0.46 - 0.65 Sh4 Tl+ Th+ Dl+ Dh+ 4.1.2.0.4
Dark brown (10YR 2/1) humified peat with whole, large (0.7 cm) fragments of woody plants (roots, twigs). Many horizontal, so possible in GP. Lots of fine OM (roots). Siltier texture at base - slight interfingering from unit below (transitional?). Detritus makes up majority of matrix from 0.58 upwards.Top 1 cm has white grain sized flecks(from unit above?). LC is sharp but bioturbated and slightly interfingered. UC extremely sharp and appears erosional.

0.65 - 0.73 Ag4 Sh+ Tl+ 2.0.3.0.1
Greyish brown (2.5Y 5/2) silt.
Homogenous in texture. Unit bioturbated so boundaries/extent of the brown pod is unclear. ~5 mm roots extend into silt from peat unit above. Visible calc. material from frequent than in unit below (Potamo? Forams?). If LC of brown to grey silt is true then sharp but no bioturbated so <1 cm.

0.73 - 1.0 Ag3 As1 Tl+ 2.0.3.0.1
Grey (5Y 5/1) silt - smooth in texture (ctd. from below).
Homogenous in colour and texture. Slight shading possible due to bioturbation from roots. Increased organic content compared to unit below - some orange/brown fibres visible (in CT too) - vertical so in GP but penetrating from unit above (largest diam. ~ 5 mm).
UC w brown pod/lens is sharp. LC = continuous.

Core: **UV-V2 (FV-V2)**	Section: **D.2**	Coordinates (NZTM): **1935681 E, 5636801 N**	Surface (m ASL): +1.08
Location: At the top of the third 'finger-valley' , duplicate core to reach base of lower peat.			

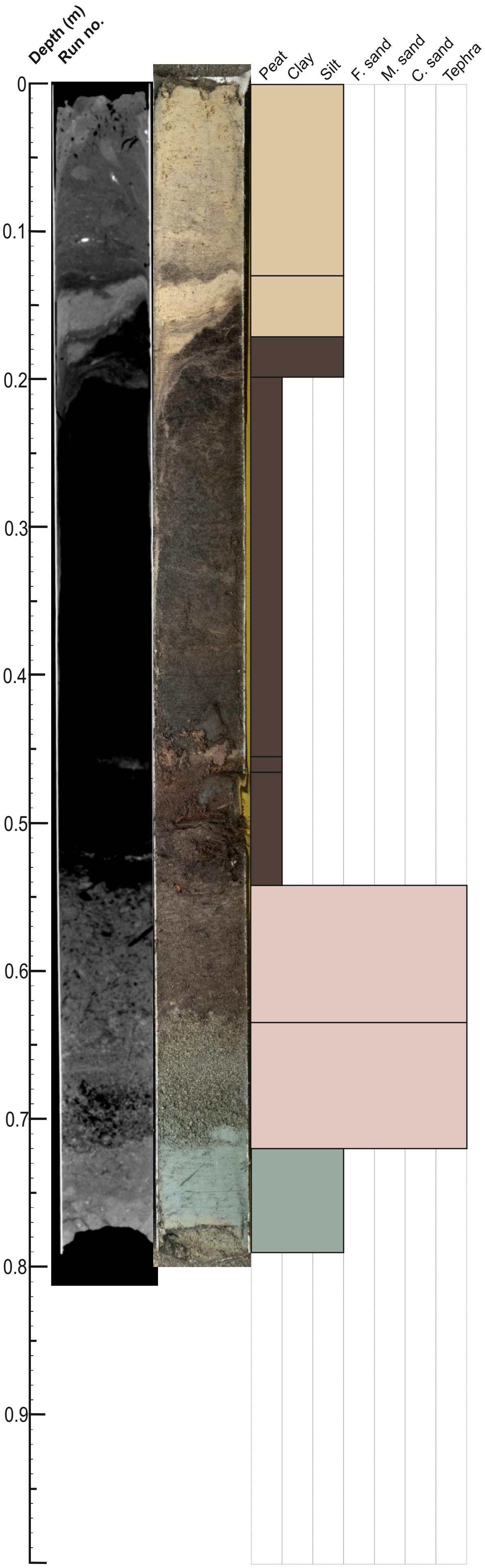


Description (e.g. nature of contact, colour, grain size, bedding, organic content)

1.0 - 1.25 Ag3 As1 Tm+ 2.0.3.0.0
Grey (5Y 5/1) silt - very smooth, silky texture.
Homogenous colour and texture. Light white/beige grains (< 1 mm) common visibly and texturally (forams?). Dark black/brown flecks (organic, <1 mm). Visible *Amphibola* 1.05-1.07 m (2x2 cm), well-preserved, whole. Visible single valve of *Austrovenus* (1.7x1.5 cm) at 1.02-1.035 m (other half may be within core - check CT), well preserved (outer rings present)

END OF CORE (apex o section at 1.25)

Core: **MV-O1 (SO1)**	Section: **-**	Coordinates (NZTM): **1936416 E 5636683 N**	Surface (m ASL): -0.20
Location: main outcrop in the Middle Valley, with large tree stump exposed			



Description (e.g. nature of contact, colour, grain size, bedding, organic content)

0 - 0.13 Ag3As1 1.1.3.0.2
Medium grey/beige (2.5Y 5/2 to 2.5Y 6/2) silt.
Darker band at base with more OM, contacts ~0.5 cm, no visible macro-org.
Lightens upwards in colour w orange mottling at top. Visible white (calcareous) flecks abundant (forams?). Black flecks (seeds?). Small (0.3 x 0.5 cm) rounded gravel clast in silt at 0.10 m.

0.13 - ~0.17 Ag4 1.2.3.0.2
Light grey/beige (2.5Y 7/2) silt.
Band (1 cm) of slightly darker at 0.16 m (increased OM?) - contacts gradual. Visible white (calcareous) flecks abundant (forams?). Black flecks (seeds?). LC very sharp w orange/brown flecks of OM.

~0.17 - ~0.20 Ag/Ld3 Sh1 2.3.2.0.4
Greyish brown (5YR 4/1) organic silt with interfingered increased OM (rep. unit below). Similar to below with increased silt. No visible macro-org. Very sharp UC+LC but deformed by coring.

~0.20 - 0.453 Sh3 Ld1 4.1.2.0.2
Blacky brown (10YR 2/1) humified soil/peat.
Very organic with some silt - smooth texture. No visible macro-org (un-ID detritus). Possible siltier lenses within but not well defined LC contact sharp (1-2 mm)

0.453 - 0.46 As2 Ag3 1.1.2.0.3
Light grey/beige (5Y 7/1) silt lens or pod?
No visible macrofos. UC+LC sharp.

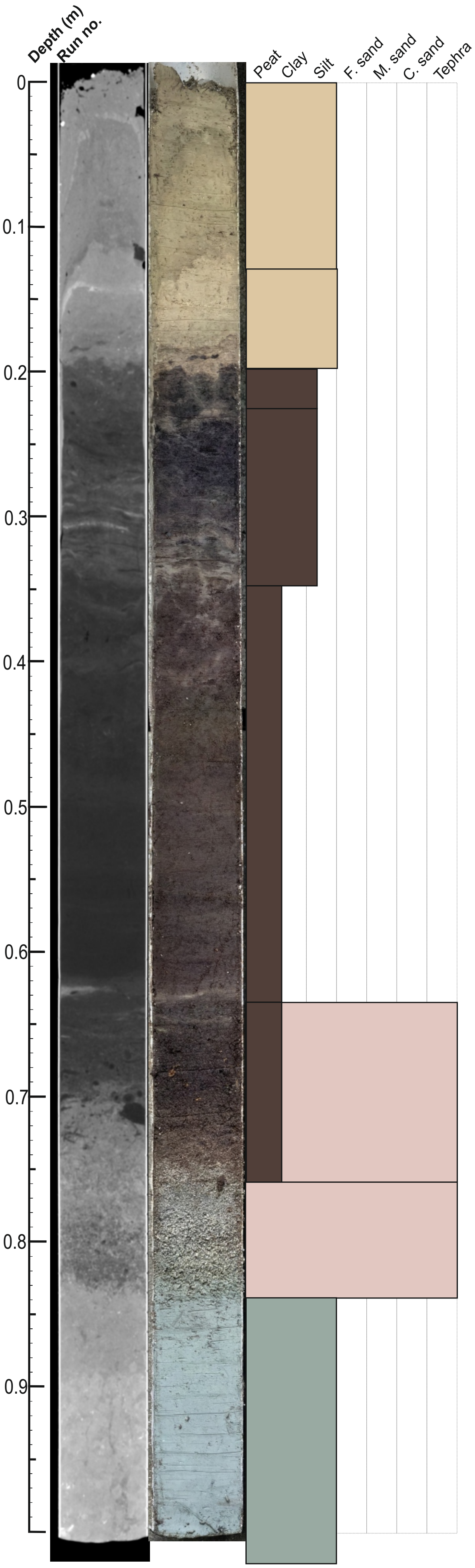
0.46 - 0.54 Ld1 Sh3 Tl/Dl+ 4.0.2.0.3
Dark brown (10YR 2/1) humified peat with some silt (silky texture when dry).
Large (6 x 4 cm) wood chunk, likely branch (or root), possible bark intact. Smaller (0.5-2 mm) organic material e.g. roots also abundant - some appear in GP. LC sharp but bioturbated.

0.54 - 0.635 Ld2 Ag1 Te1 3.0.2.0.2
Dark greyish/brown (10YR 3/1) silty organic mud w medium/fine sand-sized tephra. Mottled with darker brown (bioturb?). Sand/tephra fines upwards w increasing organics/decreasing coarse grains. Visible root/twig (0.3 mm) at 0.55 m. LC bioturbated.

0.635 - ~0.72 Te4 1.2.4.0.3
Greyish/brown (2.5Y 5/2) tephric sand.
Coarse (~1 mm) at base, fining upwards to medium. Finer lens 0.66-0.67 m. Light beige lapilli with black/dark grey grains - homogenous in colour.LC extremely sharp, non-uniform, appears erosional. No visible macrofos.

~~0.72 - 0.79 As1 Ag3 1.0.2.0.4
Grey (5GY 6/1) clayey silt (wet/sticky).
Slightly darker fine mottles. Homogenous texture. Small shell frags visible at base. No whole shells or visible macro-org.

Core: **MV-O2 (SO2)**	Section: **-**	Coordinates (NZTM): **1936440 E 5636695 N**	Surface (m ASL): -0.25
Location: Outcrop closest to the drain in the Middle Valley			



Description (e.g. nature of contact, colour, grain size, bedding, organic content)

0 - 0.13 Ag3 Ld1 1.1.3.0.-
Darker beige (2.5Y 6/2) silt.
Organic flecks (orange), white flecks, black flecks present throughout. Homogenous texture and colour. LC = sharp colour change only.

~0.13 - 0.20 Ag3 Ld1 1.1.3.0.4
Light beige (2.5Y 7/2) organic silt.
Lightening slightly upwards. Homogenous texture. Lens at ~0.15 m of medium sand sized grains (under microscope = tiny shell frags). LC disturbed. UC v sharp colour change.

0. 20- 0.36 Sh2 Ld2 4.1.2.0.1
Dark brown (10YR 3/1) organic silt/soil.
Interfingered pure silt lenses - clearly bioturbated - unit completely mixed - not confident in any stratification. Increased silt content 0.30-0.35 m is significant. No obvious organic material but organic content is increased in pod at 0.23-0.28 m. LC is gradational. UC and LC are disturbed.

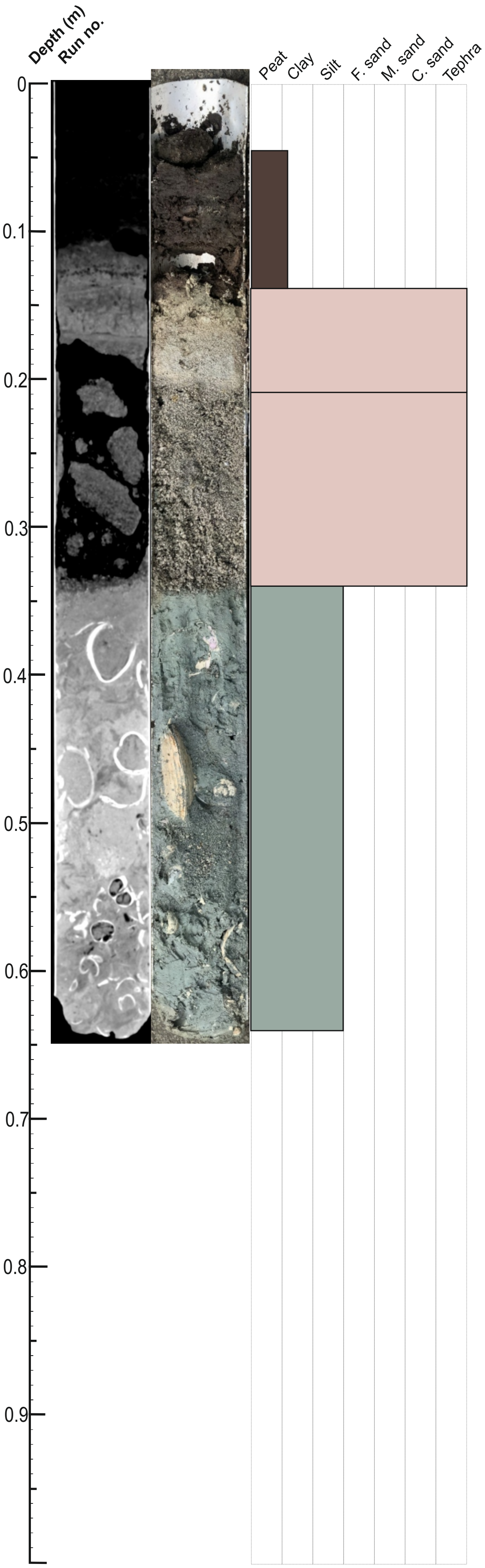
0.36 - 0.64 Ld1 Sh3 4.1.2.1.1
Dark brown (10YR 2/1) humified peat.
Very fine silt texture - well humified. Silt lens at 0.625 m (flood?). No visible microorgs on surface. Colour gets slightly more red upwards and less densely packed. From 0.42 m silt content increases and there is visible bioturbation. LC is gradational. UC is gradational but bioturbated.

0.64 - 0.76 Te2 Sh2 Dl+ 4.0.2.0.1
Dark brown (10YR 2/1) humified peat with tephric sand.
Sand fining and thinning into pure peat at the top. Colour likely due to draining from peat above. Large root-like macro-orgs visible on surface. LC is gradational ~1 cm. IC gradational ~ 1 cm (textural changes).

0.76 - 0.84 Te4 1.1.4.0.1
Greyish brown (2.5Y 5/2) tephric sand.
Coarse (~2 mm) grains at base, fining upwards to med. sand size. Colour darkens slightly (more dark grains). UC gradational based on colour change.

0.84 - 1.03 As1 Ag3 1.0.2.0.4
Grey (5GY 6/1) clayey silt. Homogenous wet/smooth in texture. Homogenous in colour. No visible shell or macroorgs. UC sharp (distorted by large grains)
No evidence of peat below tephra

Core: **MV-O3 (So3)**	Section: **-**	Coordinates (NZTM): **1936202 E 5636925 N**	Surface (m ASL): -0.55
Location: Outcrop near oak tree on bend in the Middle Valley			



Description (e.g. nature of contact, colour, grain size, bedding, organic content)

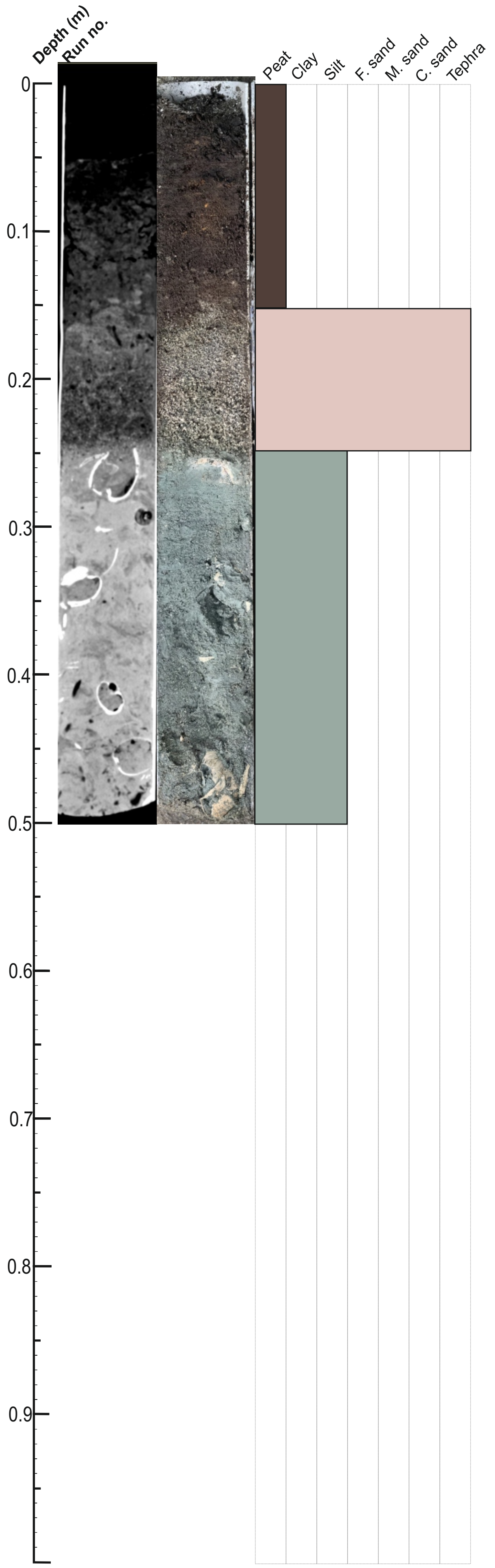
0.05 - 0.14 Sh2 Dl2 4.0.2.0.-
Dark black/brown (10YR 2/2) humified peat.
Matrix is mainly fine, humified organics with large visible macroorganics. Mostly woody looking but unlikely in GP because very large (~4cm) twig/bracnh/root at right at the contact. Smaller piece removed. LC distorted by large wood, but appears sharp where intact.

0.14 - 0.21 Te4 1.2.3.0.3
Light grey (10YR 7/2) tephric sand.
medium sand sized fining up to silt at top. 0.21-0.20 = grey colour, 0.20-0.18 = beige/grey colour, 0.18-0.14 = brown/ grey colour. Colour changes have distinct boundaries but are not necessarily changes in grain size (but probably different phases). few large grains ~ mm in top 1 cm.

0.21 - 0.34 Te4 1.0.3.0.1
Grey (5Y 6/1) tephric sand.
Fine upwards from grains <5 mm to coarse sand sized. Largest grain are visibly pumice. Darker grains are smaller. very loosely packed - (liquified by coring?). LC very sharp and uniform. UC ~0.5 - 1 cm where intact.

0.34 - 0.64 Ag2 Ga2 1.0.2.0.4
Greenish-grey (5GY 6/1) sandy silt.
Matrix is silt with fine sand. Large, whole, articulated shells within silt include *Mactra, A.stutchburyi, Amphibola.* Think in GP from 0.54 upwards, beneath this shells seem more squashed/chaotic. Lots of fragments but suspected due to coring/splitting. No large terrestrial material. Top 2 cm is pure silt with no shells.
Large pod of medium sand (darker colour) and shells at ~0.54-0.42 m
- sand contains shell fragments (looks like beach sand)
- Identifiable pieces look like *Austrovenus*
- Contact between coarse pod and silt is sharp where visible

Core: **MV-O4 (So4)**	Section: **-**	Coordinates (NZTM): **1936198 E 5636930 N**	Surface (m ASL): -0.58
Location: Outcrop near oak tree on bend in the Middle Valley			



Description (e.g. nature of contact, colour, grain size, bedding, organic content)

0 - 0.155 Sh3 Dl1 Te+ 4.0.2.0. -
Dark brown (10YR 2/2) humified peat.
very organic (wet, mushy) peat with visible organic material but no large pieces like So3. Think material is woody but looks like roots. Tephric sand extends up into peat and thins out until full peat established - unclear where this is from surface but visible in CT scan. Seems like a mixed layer at the boundary - bioturbated - LC is gradational and mainly present at colour change only.

0.155 - 0.25 Te4 1.1.3.0.0
Grey (5Y 6/1) tephric sand.
Coarse at base (~3 mm) fining up to coarse sand sized. Grain size change visible at 0.20 m - below is loosely packed, above is densely packed and finer. No visible fine fraction at the top. LC is sharp. UC is gradational, maybe bioturbated (irregular)

0.25 - 0.50 Ga3 Ag1 1.0.2.0.4
greenish grey (5GY 6/1) silty sand.
Homogenous colour. Upper 2 cm slightly more silty than below. Large shells frequent and present right up to UC - *A.stutchburyi* whole and articulated. Quite thick shells walls and appear to be in GP. *Amphibola* also whole. Possible *Mactra* present but unclear without removal. Fragmentation seems high but likely due to coring/splitting. Some woody organic bits as seen by black pods on CT - seems washed in, not in GP. Sand seems like intertidal estuarine sand - come coarser bits have very small shell fragments like the sand pod in So3.

Core: **MV-O5 (So5)**	Section: **-**	Coordinates (NZTM): **1936205 E 5636933 N**	Surface (m ASL): -0.24
Location: Outcrop near oak tree on bend in the Middle Valley			

Description (e.g. nature of contact, colour, grain size, bedding, organic content)

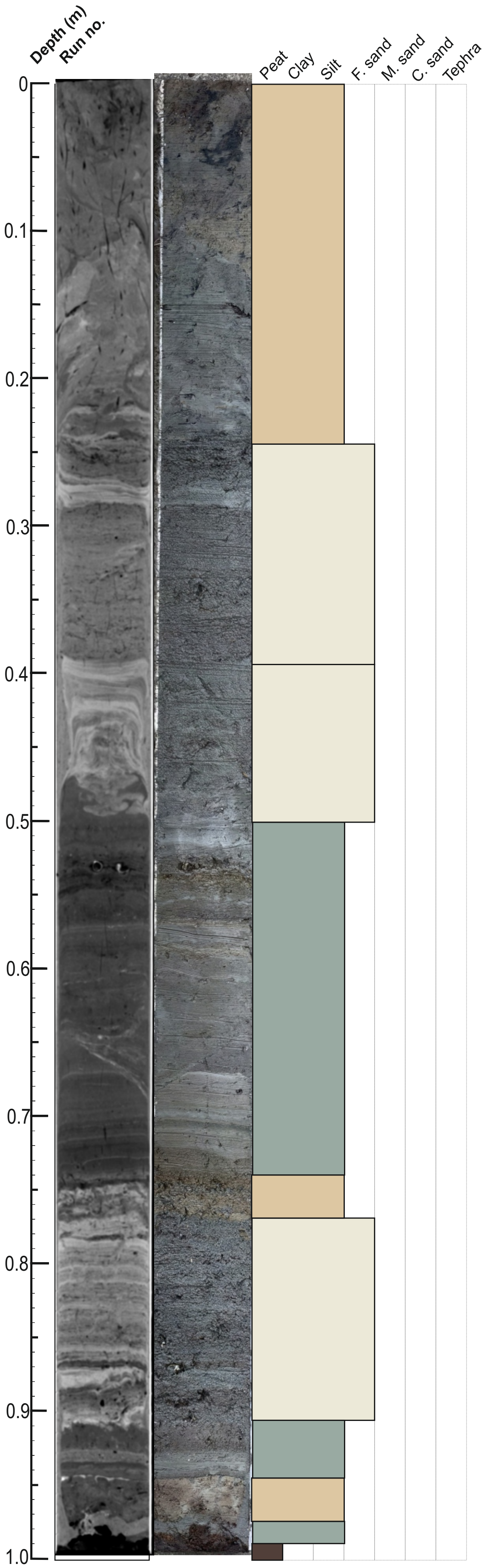
0 - 0.18 Ld1 Ag2 As1 1.0.3.0.-
Greyish-brown (10YR 5/2) organic clayey silt.
Very mixed - heavily bioturbated, mottled unit with some microscopic organic bits, some orange mottling, silty blobs of the same unit as 2x below. No shell or large macroorganics. Burrows not visible on surface but are in CT. Quite dry texture (like So11). LC unclear.

0.18 - 0.21 Ld2 Ag2 3.0.2.0.0
Dark brown (10YR 3/2) organic silt.
Crumbly texture seems like paleosol not peat. Lighter brown than below - more silty. Also seems mixed/bioturbated. Could be reworked pod (check microfossils). Some darker bits, some lighter. No visible OM. LC very sharp. UC gradational.

0.21 - 0.23 Ag3 As1 1.0.2.1.4
Light grey (10YR 7/2) clayey silt.
Smooth texture. Colour is mixed - perhaps bioturbated? - darker at the base, lighter at the top (more orange). No visible OM within. LC is sharp and dips into peat - erosional? UC very sharp.

0.23 - 0.48 Sh3 Ag1 4.4.2.1.4
Dark brown/black (10YR 2/1) humified peat.
Very densely packed peat with clear stratification/layers of varying OM (some increased, some more orange), and varying silt content. Overall colour gets more orange/ less dark upwards.
Silt lens/layer ~3 mm thick at 0.38. 0.35, 0.29 m.
Siltier peat at 0.24 - 0.23 m but still showing stratification.
No large visible OM (well humfiied) - unsure if soil or peat.

Core: **LV-V1 (SS1)**	Section: **A**	Coordinates (NZTM): **1936613 E, 5636917 N**	Surface (m ASL): +0.47
Location: Front section of side stream, near house, gouge core with sand unit at EQ horiz.			



Description (e.g. nature of contact, colour, grain size, bedding, organic content)

0.0-0.25 Ag4 Th+ 3.0.2.0.-
Browny-grey (2.5Y 4/1) silt.
Bioturbated throughout. Roots penetrating. Om increases upwards. Brown colour increases upwards to top and becomes more crumbly in texture. Includes calcareous material - shells? Potamo throughout. Maybe more clayey at base, more silty at top. Sharp lower contact.

0.25-0.40 Ag1 Ga3 Th+ 3.0.3.0.4
Grey (5GY 4/1) medium/fine sand.
Homogenous colour and texture. Roots throughout but unclear where from - not obviously from unit above - so maybe in situ. Sediment is similar to darker/coarser sand from below with organic material introduced. Unsure if all is bioturbated. Texture is siltier than unit below. OM increases upwards. 0.28-0.295 = finely laminated sand with no OM. No shells throughout. Sharp UC and LC.

0.40-0.50 Ga4 3.3.3.0.3
Grey (5GY 5/1) interfingering medium and fine sands (gradational).
Structure attributed to deformation during coring. Texture like beach/estuary sand. No OM terrestrial or shell. Colour is slightly variable between layers. Sharp UC and LC.

0.50-0.74 Ag4 3.4.2.0.4
Medium grey (2.5Y 4/1) interfingering silt layers of variable thickness (1mm - 7 cm). Black flecks throughout. White flecks - forams or Potamo? ~ 0.53-0.60. 0.55-0.53 = more yellow colour and more coarse organic layer including white flecks (snails) and larger freshwater snails (brown un-ID spp.). Sharp contacts but texture not sandy. Overall lower contact of unit unclear (bioturb). UC very sharp (maybe slightly ripped up into unit above).

0.74-0.77 Ag1 Sh1 Ga2 3.1.3.0.1
Brown/grey (2.5Y 4/2) sandy organic silt.
Mixture of above and below unit (organic silt and med/fien sand). No visible OM. Unit looks bioturbated or mixed - no structures. UC is unclear - possibly sharp before biortubation? LC gradational.

0.77-0.91 Ga4 Ag+ 3.3.3.0.1
Grey (2.5Y 4/1) medium and fine sand.
Some stratification 0.88-0.85. Bottom 2 cm is medium sand (coarser than rest of unit) and may have tiny shell fragments within. Very small gastropods visible. Twig at 0.90 m - reworked. Less obvious stratification 0.85 m upwards. Black flecks throughout. Sharp LC and UC (~0.5 cm).

0.91-0.95 Ag3 Ga1 3.2.3.0.3
Grey (2.5Y 4/1) pure silt lenses interfingered with fine sandy silt lenses.
Pure silt at the base (lighter in colour). Sandier section is darker in colour (looks mixed?). Small white fragments visible. Potamo throughout. Sharp UC and LC.

0.95-0.99 Ag2 Sh1 Ga1 3.1.3.0.4
Grey/brown (2.5Y 4/1) organic silt with fine sand.
Possible fine lens of sand at top and bottom of the unit. Visible OM within - probably ripped up from below. Bottom 1 cm not organic = pure silt. Shell sampled at 0.98 m right on top of contact - ID as freshwater mussel? Very sharp UC and LC.

0.99-*1*.0 Sh4 4.0.3.0.4
Dark brown (2.5Y 2.5/1) peat.
Some visible large fractions right at the base (dateable) - sampled wood chunk (more in Archive half of core). Upper contact = extremely sharp and irregular.

Core: **LV-V1 (SS1)**	Section: **B**	Coordinates (NZTM): **1936613 E, 5636917 N**	Surface (m ASL): +0.47
Location: Front section of side stream, near house, gouge core with sand unit at EQ horiz.			

Description (e.g. nature of contact, colour, grain size, bedding, organic content)

0 - 0.12 Ag1 Sh3 3.1.2.0.-
Medium brown (2.5Y 3/2) silty peat.
Silt content decreasing upwards to full peat by 0.04 m. Not many obvious 14C targets (perhaps right at the top) - all very fine. LC is gradational. UC matches base of next run.

0.12 - 0.17 Ag4 Sh + 2.0.2.0.0
Grey (2.5Y 5/1) silty - very smooth texture.
Some organic material (well humified). LC is sharp. UC is gradational - looks like a mixing of this unit and the one above.

0.17-0.525 Ag1 Sh3 4.4.2.1.2
Dark brown (2.5Y 3/1) peat.
Well humified, very fine - almost silt-like. No clear terrestrial material. Interfingered with lenses of increased and decreased organic material vs silt. Silt lenses are grey. Most lenses are ~ 1 mm - 4 cm thick. Largest 14C targets identified at 0.38 and 0.22 m. Upper 3 cm has increased silt content. Sharp UC with silt unit above.

0.525 - 0.57 Ag2 Sh2 2.2.2.0.4
Medium brown (2.5Y 4/2) organic silt. Increased organics compared to unit below. More humus than silt here. Some stratification of darker clayey silt. Dark flecks within but no clear targets for dating. Seems like the start of laminated sequence above but more silty overall. UC is sharp.

0.57 - 0.615 Ag3 Sh1 2.0.2.0.2
Brownish beige (2.5Y 4/2) organic silt. Homogenous brown colour, darker than below (increased organics). In frequent small terrestrial fragments. Homogenous texture (dry feeling). Few white flecks. No shells. No stratification. Colour changes above and below. UC ~1-2 mm but slightly irregular.

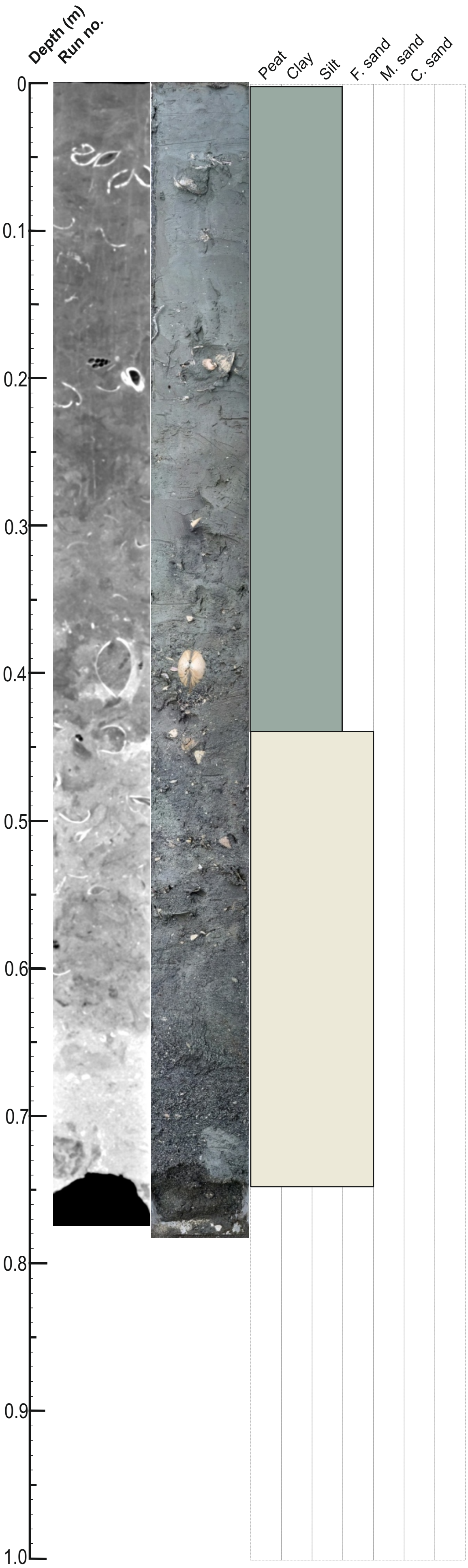
0.615 - 0.75 Ag2 As2 Te+ Sh+ 2.0.3.0.1
Beige (2.5Y 6/2) clayey silt with tephric sand within, fining out by 0.70 m. Some infrequent visible terrestrial material. Black flecks - probably seeds. More organic material in the top 2 cm. Homogenous colour. No stratification. UC marks gradational colour change ~ 0.75 cm (increasing organic content - same texture).

0.75 - 0.88 Te4 (Ga4) Ag+ 2.0.3.0.0
Mixed grey (5GY 6/1) overall, dark black and light white grains ~1 mm size. Possible fining upwards but unclear - no stratification - does not look like primary tephra. 0.82-0.88 = rounded pods of very light grey silt (possible fine cap of tephra that settled first in blobs?)LC very sharp. UC gradational visually (silt content increasing).

0.88 - 0.905 Ag4 2.0.3.0.4
Lighter grey (10Y 6/1) almost fine sand sized silt. Dry texture. Tiny white flecks within look like Potamo or large forams. Possible light brown organic pieces within. LC is very sharp but irregular (bioturbated? - can see burrows but no shells). UC very sharp.

0.905 - 1.0 Ag3 As1 Ptm+ Tm+ 2.0.2.03
Light grey (5GY 6/1) silty with whole and shell fragments. Identifiable from surface = articulated *A. stutchburyi.* Sediment is homogenous in texture and colour - smooth. No visible terrestrial material. UC sharp and irregular.

Core: **LV-V1 (SS1)**	Section: **C**	Coordinates (NZTM): **1936613 E, 5636917 N**	Surface (m ASL): +0.47
Location: Front section of side stream, near house, gouge core with sand unit at EQ horiz.			



Description (e.g. nature of contact, colour, grain size, bedding, organic content)

0.0 - 0.44 Ag4 Ptm+ 2.0.2.0.0
Light/medium grey (5GY 6/1) silt with shells. Some fine sand present at base but fines out to pure silt by 0.28 m. No visible terrestrial material.

- 0.28-0.44 Grey silt with fine sand, some coarse pods around the large and articulated bivalve in the centre (lots of frags too). Shell fragments present throughout, unclear whether from coring or in situ.
- 0.18-0.22 Whole shells including *Austrovenus* and a large gastropod. Very smooth silt surrounding. Homogenous texture and colour.
- 0.04-0.07 Another group of shells - mainly *A. stutchburyi* identifiable from surface (articulated)

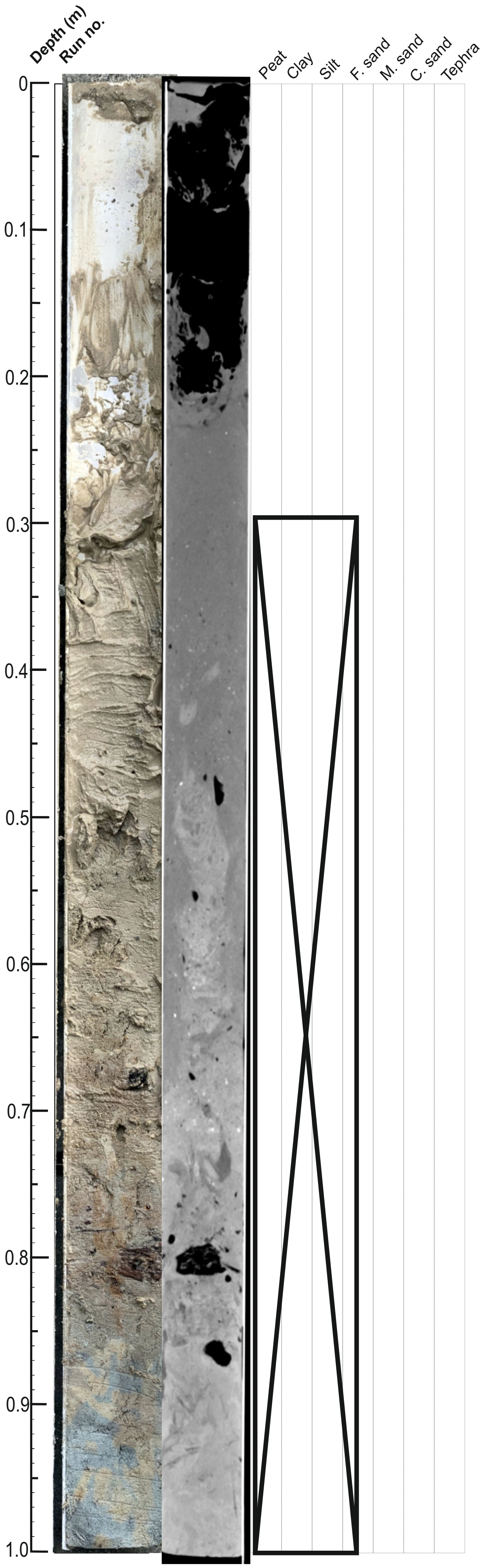
Lower contact gradational (sand fraction fining out). Upper contact continued in next run.

0.44 - 0.655 Ga4 Ag+ Ptm+ 2.0.3.0.0
Medium grey (5GY 5/1) fine sand with some silt. Unit seems mixed (bioturbated?) - Pods of siltier sediment within the sand (possibly dragged down from above). Pockets of coarse sand present around shells. Shell fragments infrequent 0.55-0.65 m. Frequent from 0.55 m upwards. Visible species are mostly *Austrovenus* (whole, articulated and fragments) of mixed sizes. Another bivalve species (possible *Mactra)* small and fragile. Possible *Amphibola* at ~0.52. No visible terrestrial material. UC and LC gradational over 1-1.5 cm. Upper contact present because increased silt content.

0.655 - 0.75 Ga4 3.0.3.0.0
Dark grey (10GY 4/1) poorly sorted medium-coarse sand with very small (~2 mm) shell fragments. Some, large, light, almost gravel sized grains but not rounded like beach gravel. Looks like intertidal sand. Some large shell fragments (~6 mm) are *Austrovenus* (hinges). 0.71-0.75 = 3 cm circular (ish) pod of clay with fine sand (definitely not a lens) - lighter grey in colour. No large shells visible. Sand is homogeneous in texture and colour. UC is gradational visibly (~1 cm) and not uniform.

NB: Core barrel ends 0.78 m and sed starts 0.75 m
No clear events - possible ~0.65 m otherwise gradational

Core: **LV-V2 (FSV1)**	Section: **A**	Coordinates (NZTM): **1936655 E, 5637015 N**	Surface (m ASL): +1.30
Location: Cores on other side of front stream section, closest core to road			

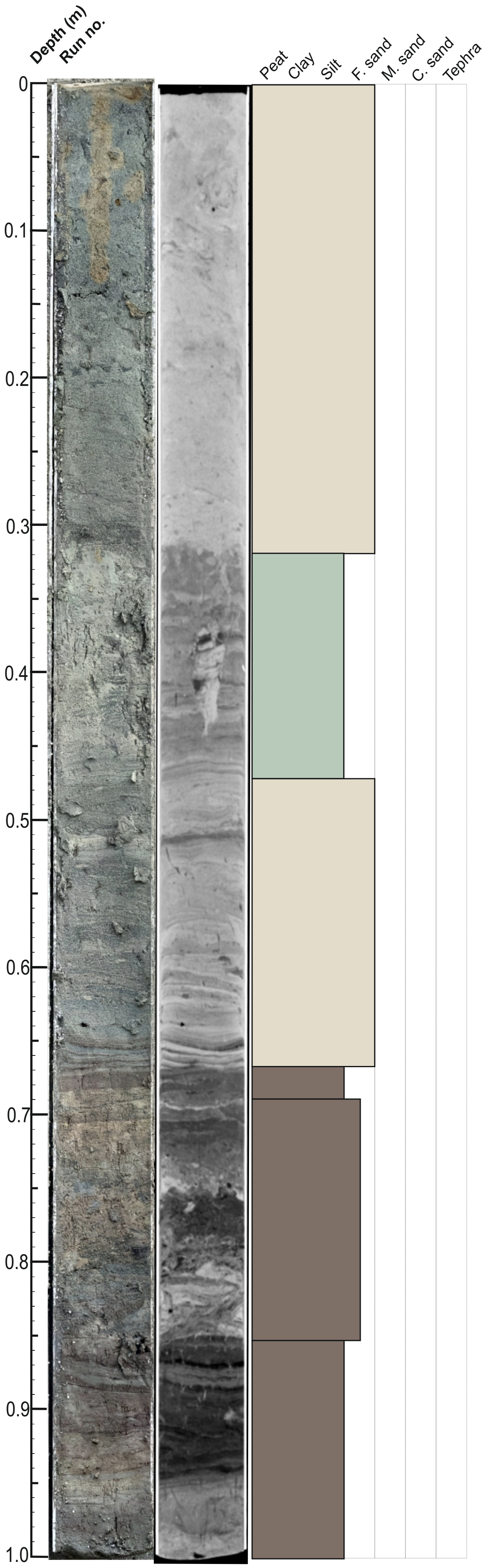


Description (e.g. nature of contact, colour, grain size, bedding, organic content)

0.00-0.30
EMPTY CORE

0.30-1.00
REWORKED SURFACE SEDIMENTS (not in situ - excluded from logs)

Core: **LV-V2 (FSV1)**	Section: **B**	Coordinates (NZTM): **1936655 E, 5637015 N**	Surface (m ASL): +1.30
Location: Cores on other side of front stream section, closest core to road			



Description (e.g. nature of contact, colour, grain size, bedding, organic content)

0.00-0.32 Ga4 2.0.3.0.-
Grey (5GY 4/1) fine sand.
Orange oxidisation at top - in patterns from burrows so clearly bioturbated. No visible shell at surface. No structure.

0.32-0.48 Ga2 Ag2 2.2.3.0.3
Grey (2.5Y 4/1), sandy silt.
Looks like mix of sand from unit below or just a silty bed within the bounding, overall sand unit. No visible macros. UC = sharp but irregular (textural only).

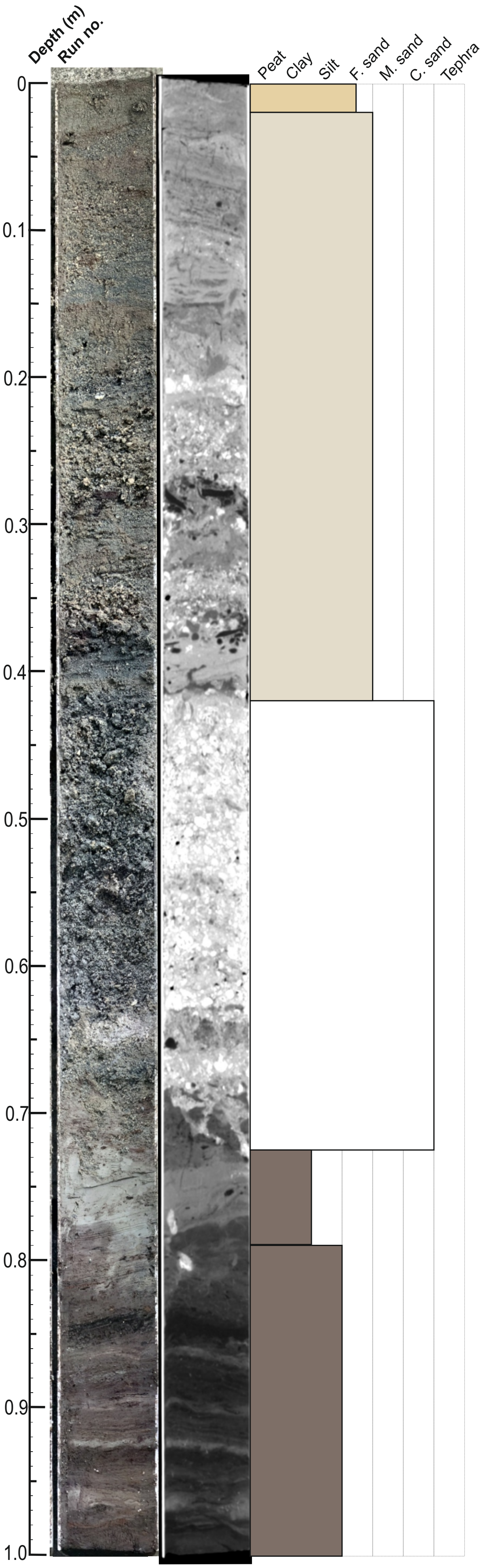
0.48-0.675 Ag4 3.0.2.1.4
Grey (5GY 4/1), medium-fine sand.
Laminations at base show fine peat layers interbedded with fine sand. Statigraphy within the sand fines upwards with increasing silt content. No visible shell. Silty at 0.52 m. UC = gradational or erosional/irregular (textural)

0.675-0.69 Ag4 3.0.2.1.4
Medium brown (10YR 5/2), homogenous silt with very sharp, uniform UC and LC. No sand. No visible OM.

0.69-0.86 Ag2 Ga2 3.2.3.0.4
Grey silt and brown sand mixed (10YR 5/2)- but not laminar - maybe bioturbated? Visible OM but nothing ID at surface - likely roots. No shell. Very sharp UC.

0.86 - 1.00 Ag3 Ga1 3.3.3.1.3
Brown (10YR 5/2) interbedded sandy silt and silt. Varying OM. Laminations are wavy. UC = sharp and textural (increased sand)

Core: **LV-V2 (FSV1)**	Section: **C**	Coordinates (NZTM): **1936655 E, 5637015 N**	Surface (m ASL): +1.30
Location: Cores on other side of front stream section, closest core to road			



Description (e.g. nature of contact, colour, grain size, bedding, organic content)

0.00-0.04 As1 Ag3 2.1.3.4.-
Brown/grey (10YR 5/2) organic-looking sandy silt.
No visible macro-org. Gradational LC.

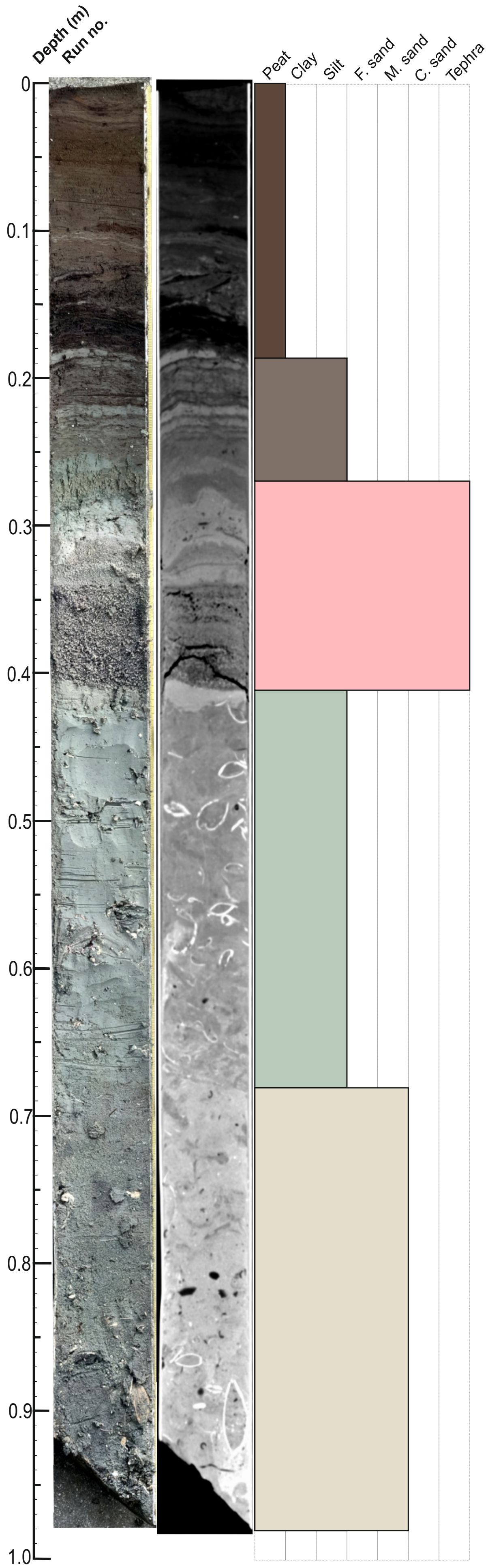
0.04-0.42 Ga3 Ggmin1 3.3.3.1.0
Grey and brown (10YR 5/2) interbedded sandy and silty sands.
Siltier bands = brown. Lower sand units = coarse. finer towards the top. Coarse sand bands look like same sediment as below unit. Generally not rounded grains. Definitely stratigraphy within the beds. Light cream coloured coarse sand/fine gravel sized may be broken tufa (?) or limestime. Not all shell or pumice. 0.38 m and 0.28 m = very dark reworked wood chunks (thought charcoal). Overall still chaotic like below. UC signifies increased silt content.

0.42-0.72 Ga2 Ggmin2 3.3.3.0.1
Grey (5GY 6/1) sand matrix with large, gravel sized (< 1 cm) clasts in chaotic mix. Clasts seem mostly mixture of limestone chunks, rounded greywacke. Fine shell material but un-ID sp. - very fragmented and rounded. Unclear whether pumice is present (CW inspected). 0.63 - 0.65 m = pod of reworked tephra (ash), light grey colour, could be Waim OR Taupo. No sign of primary, fine Taupo ash as seen in other cores. Unit above has increased silt content. LC sharp and non-uniform, looks erosional.

0.72-0.79 Ag4 2.1.2.1.3
Grey/brown silt (2.5Y 4/1), organic with macrofossils within. UC irregular - signs of erosion as planar bedding of organic brown silt resumes at the top. Possible bioturb - burrow structures from unit above.

0.79-1.00 Sh3 Ag1 4.3.2.2.0
Dark brown (10YR 5/2), silty peat interbedded with siltier organic rich layers. Darker layers = increased organics. Terr. macros (twigs/reeds). UC = distorted - probably gradational.

Core: **LV-V2 (FSV1)**	Section: **D**	Coordinates (NZTM): **1936655 E, 5637015 N**	Surface (m ASL): +1.30
Location: Cores on other side of front stream section, closest core to road			



Description (e.g. nature of contact, colour, grain size, bedding, organic content)

0.00-0.18 Ag1 Sh3 3.1.2.0.-
Medium brown (2.5& 3/2) silty peat with darker brown 4 cm at base with increased organic material (more dense). Internal stratigraphy present. No bioturb. No large macro-org or shells. UC is gradational, LC is sharp.

0.18-0.265

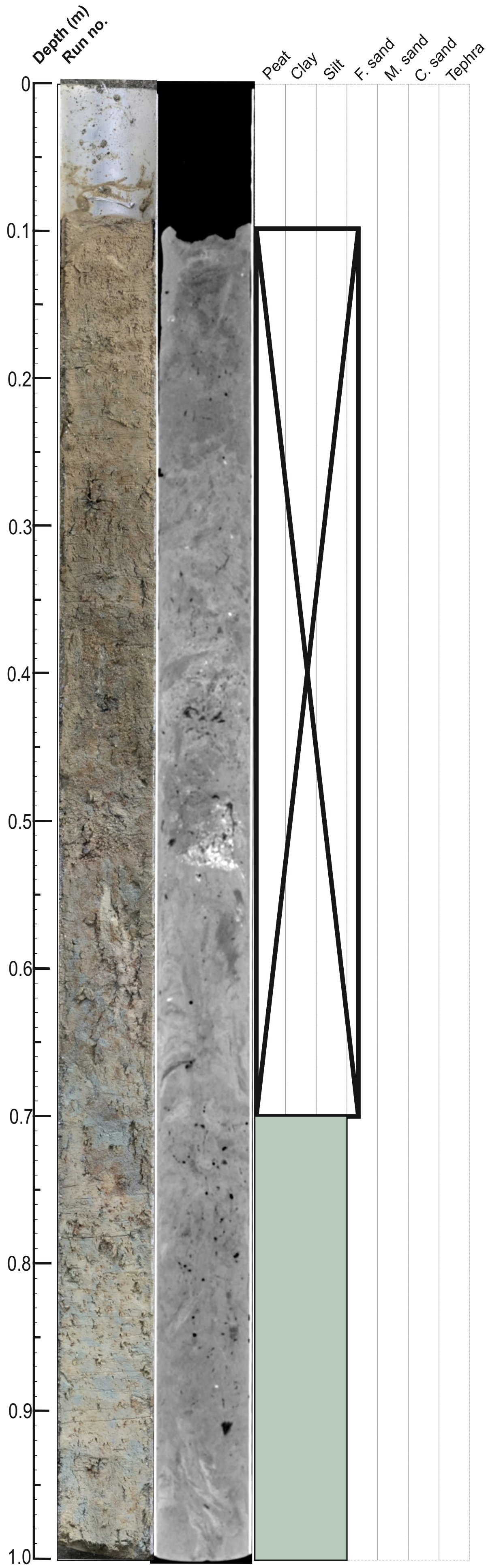
0.265-0.41 Te4 2.0.3.0.0
Grey (5GY 6/1) tephric sand with some lighter and darker grains.
Coarse 0.41-0.34 then fine, light cap above. Top ash mixes into overlying silt.
UC = gradational, LC is very sharp.

0.41-0.68
Blue-grey (5GY 6/1) pure homogenous silt.
Top 2 cm is lighter in colour and does not contain shells. Below *A. stutchburyi* and *Mactra* shells - whole, articulated and in GP. UC is sharp, LC is gradational (texture)

0.68-0.98
Blue-grey (5GY 6/1) silty medium sand.
Homogenous with some bioturbation from in situ articulated bivalves (same sp. as above). UC is gradational into more silt.

END OF CORE

Core: **LV-V3 (FSV2)**	Section: **A**	Coordinates (NZTM): **1936702 E, 5637098 N**	Surface (m ASL): +1.80
Location: Cores on other side of front stream section, core in middle of paddock (in line with orchard break/corner)			



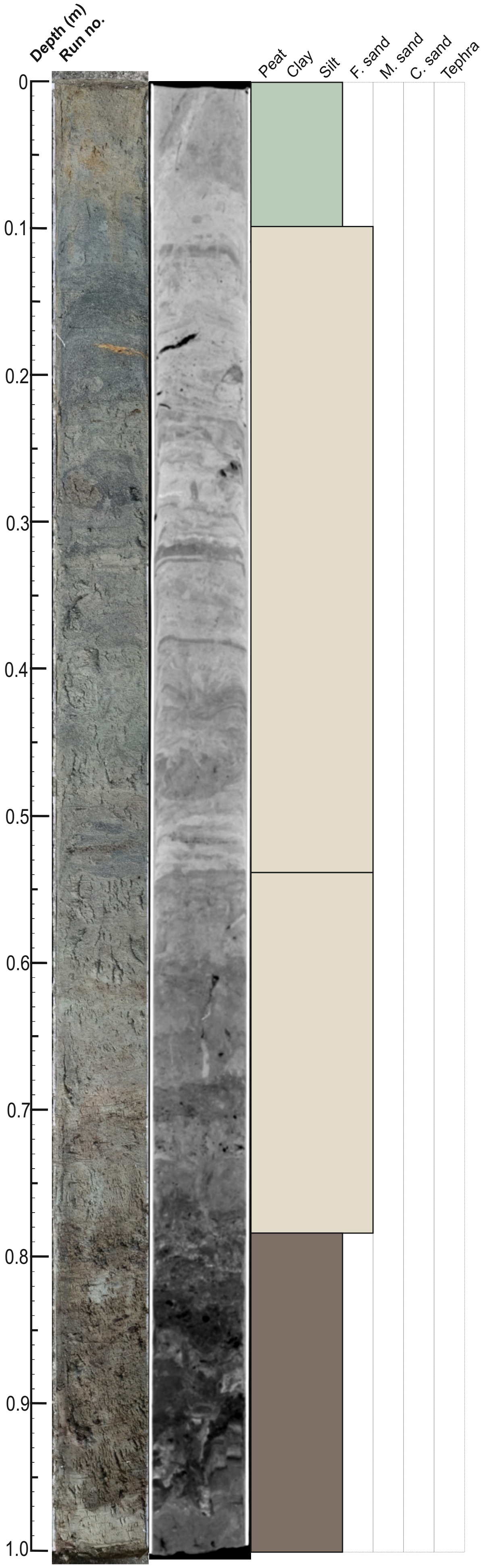
Description (e.g. nature of contact, colour, grain size, bedding, organic content)

0.00-0.10
EMPTY CORE

0.10-0.70
REWORKED SURFACE SEDIMENT - excluded from log

0.70-1.00 Ag4 1.0.3.1.0
Grey (2.5Y 4/1) silt, with brown mottles from oxidation. Mottles are in shape of burrows so unit clearly bioturbated. No shells or macro-org. UC gradational.

Core: **LV-V3 (FSV2)**	Section: **B**	Coordinates (NZTM): **1936702 E, 5637098 N**	Surface (m ASL): +1.80
Location: Cores on other side of front stream section, core in middle of paddock (in line with orchard break/corner)			



Description (e.g. nature of contact, colour, grain size, bedding, organic content)

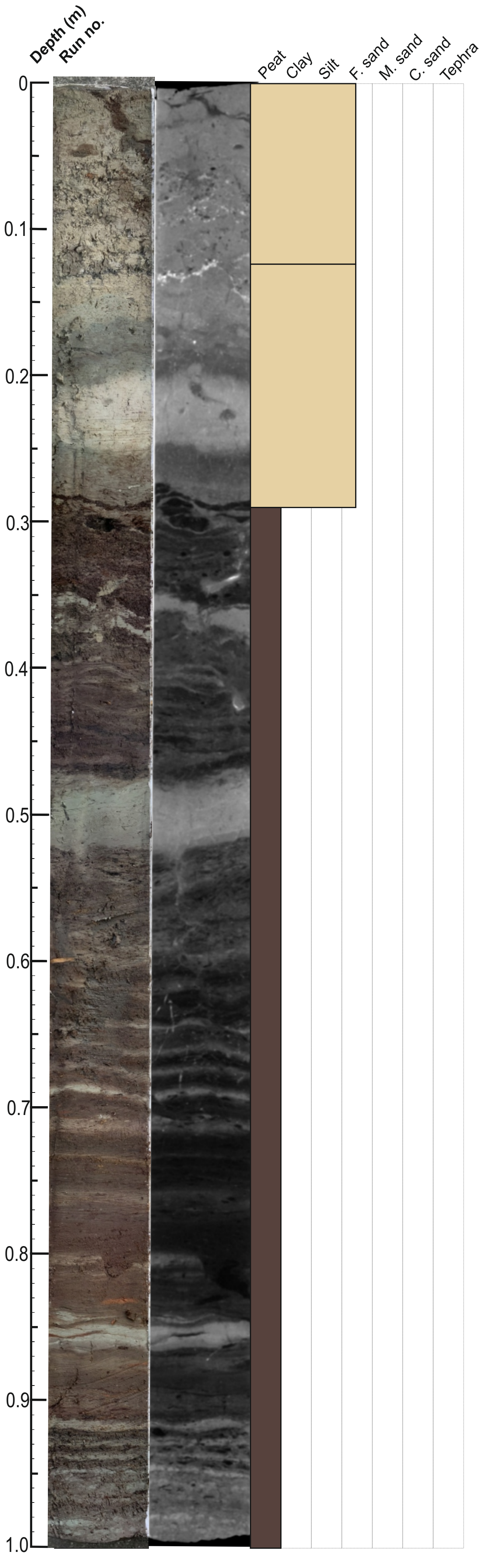
0.00-0.10 Ag3 Ga1 1.0.3.1.-
Grey (2.5Y 4/1) sandy silt, with brown mottles from oxidation. Mottles are in shape of burrows so unit clearly bioturbated. No shells or macro-org. LC moderate.

0.10-0.55 Ga3 Ag1 1.4.3.0.2
Grey (2.5Y 4/1) silty sand overall. Interbedded layers of silt and sand. Clear stratification, layers not even thicknesses. Macro-org (root?) at 0.18 m. UC is moderate sharpness. LC is sharp (texture).

0.55-0.78 Ag3 Ga1 1.0.3.1.2
Grey (2.5Y 4/1) sandy silt overall. Not organic like silt below, not sandy like silt above. Has no distinct stratification like above, maybe bioturbated. No shell. UC is sharp, LC is unclear - distorted.

0.78-1.00 Ag4 Dl+ 2.0.3.2.0
Brown/grey (10YR 5/2) organic silt. No structures present, clearly been reworked, maybe bioturbation. No large macro-org on surface. UC is unclear.

Core: **LV-V3 (FSV2)**	Section: **C**	Coordinates (NZTM): **1936702 E, 5637098 N**	Surface (m ASL): +1.80
Location: Cores on other side of front stream section, core in middle of paddock (in line with orchard break/corner)			



Description (e.g. nature of contact, colour, grain size, bedding, organic content)

0.0-0.16 Ag4. Ga+ Te+ 1.0.3.0.-
Light beige (2.5Y 6/1) organic silt. Slightly gritty texture compared to below (more coarse). Tephra/pumice from 0.13 m with sharp LC as shown in CT, then becomes mixed into above silt to 0.06 m, the absent (must be Taupo)

0.16-0.30. Ag4. 1.0.3 0.1
Light beige (2.5Y 6/1 & 2.5Y 7/1) silt. Dry texture. No obvious OM. Burrows in CT - may have mixed up LC. Only slight density/texture change above. Sharp LC and gradational UC (colour change not texture).

0.30-0.38 Sh2 Ag2 2.0.2.1.2
Medium/dark brown peat (10YR 2/2 with grey silt. Seems like laid down then mixed two sediment types up. Thin peat layers above ripped up? 0.35-0.38 m very organic with sharp LC at 0.36 m. Very peaty above this. No large OM. Very sharp UC (think ~1 cm twig at UC).

0.38-0.475 Sh2 Ag2 2.3.2.1.0
Medium brown (10YR 2/1) well humidified/fine peat with silt. Siltier laminations/organic layers are alternate. Laminations decrease in frequency upwards and become more wavy. No large OM. Gradational UC.

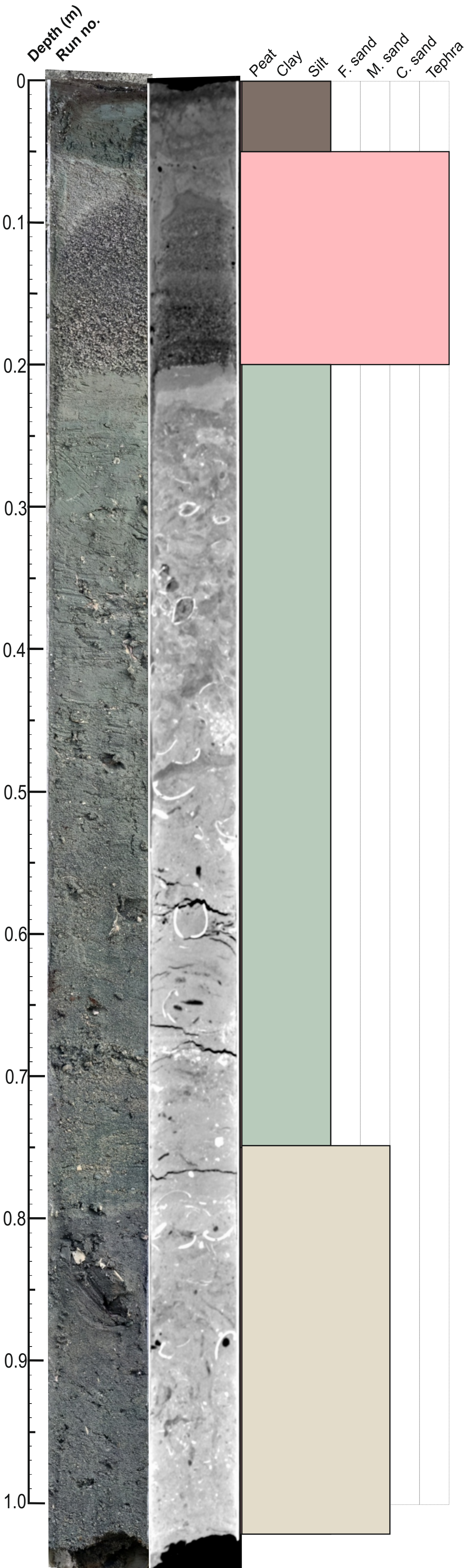
0.475-0.53 Ag4 1.0.3.0.0
Medium grey-is brown (10YR 5/1) silt. Homogenous texture and colour. No OM or shell. Sharp-ish, planar UC, gradational LC.

0.53-0.72 Sh2 Ag2 2.3.2.1.1
Grey/brown (10YR 3/1) silty peat. 0.5-1 cm laminations at base, decreasing frequency upwards to 0.63 m. Mixed with no structure from 0.61 m upwards with increased silt content. No large OM. Fairly sharp UC.

0.72-0.92 Sh3 Ag1 3.2.2.1.0
Dark brown (10YR 2/1) well humidified, fine peat. Less stratification than below - more organic. No large OM. 1.5 cm silt lens with stratifications above and within at 0.36-0.375 m. Gradational-is UC (slight change in env but not sharp or erosional)

0.92-1.00 Sh2 Ag2. 2.4.2.1.1
Grey/brown (10YR 4/1) silty peat. Thin ~0.5 cm laminations alternating silt content/increased organics. More peaty lenses increase in OM upwards. No large OM or shell. UC sharp.

Core: **LV-V3 (FSV2)**	Section: **D**	Coordinates (NZTM): **1936702 E, 5637098 N**	Surface (m ASL): +1.80
Location: Cores on other side of front stream section, core in middle of paddock (in line with orchard break/corner)			



Description (e.g. nature of contact, colour, grain size, bedding, organic content)

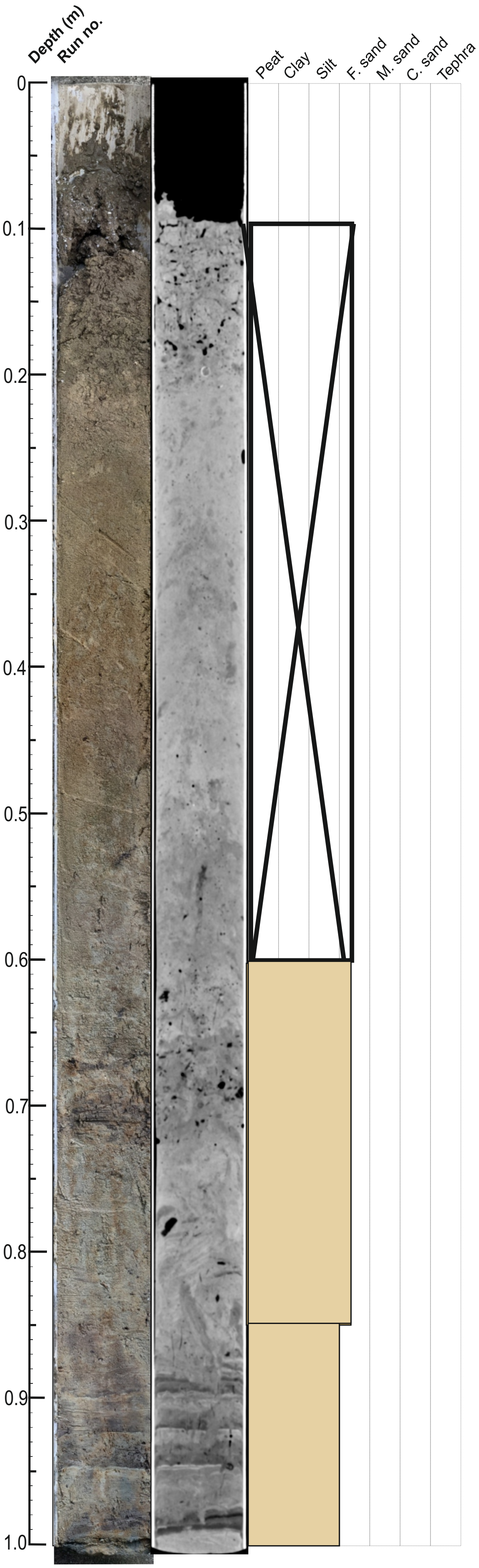
0.00-0.05 Ag1 Sh3 3.1.2.0.-
Medium brown (2.5& 3/2) silty peat. Looks reworked. No large macro-org or shells. UC is gradational, LC is moderate - unclear.

0.05-0.20 Te4 2.0.3.0.0
Grey (5GY 6/1) tephric sand with some lighter and darker grains.
Fine, light cap 0.05-0.10. Top ash mixes into overlying silt. UC = gradational, LC is very sharp.

0.20-0.75 Ag4 Ptm+ 2.0.2.0.0
Blue-grey (5GY 6/1) pure homogenous silt.
Top 2 cm is lighter in colour and does not contain shells. Below *A. stutchburyi* and *Mactra* shells - whole, articulated and in GP. Smaller than in sand below. UC is sharp, LC is gradational (texture)

0.75-1.04 Ga4 Ag+ Ptm+ 3.0.3.0.0
Blue-grey (5GY 6/1) silty medium sand.
Homogenous with some bioturbation from in situ articulated bivalves - same sp. as above but very large *Mactra* and some *Amphibola.* UC is gradational into more silt.

Core: **LV-V4 (FSV3)**	Section: **A**	Coordinates (NZTM): **1936742 E, 5637110 N**	Surface (m ASL): +1.90
Location: Cores on other side of front stream section, core closest to the stream			



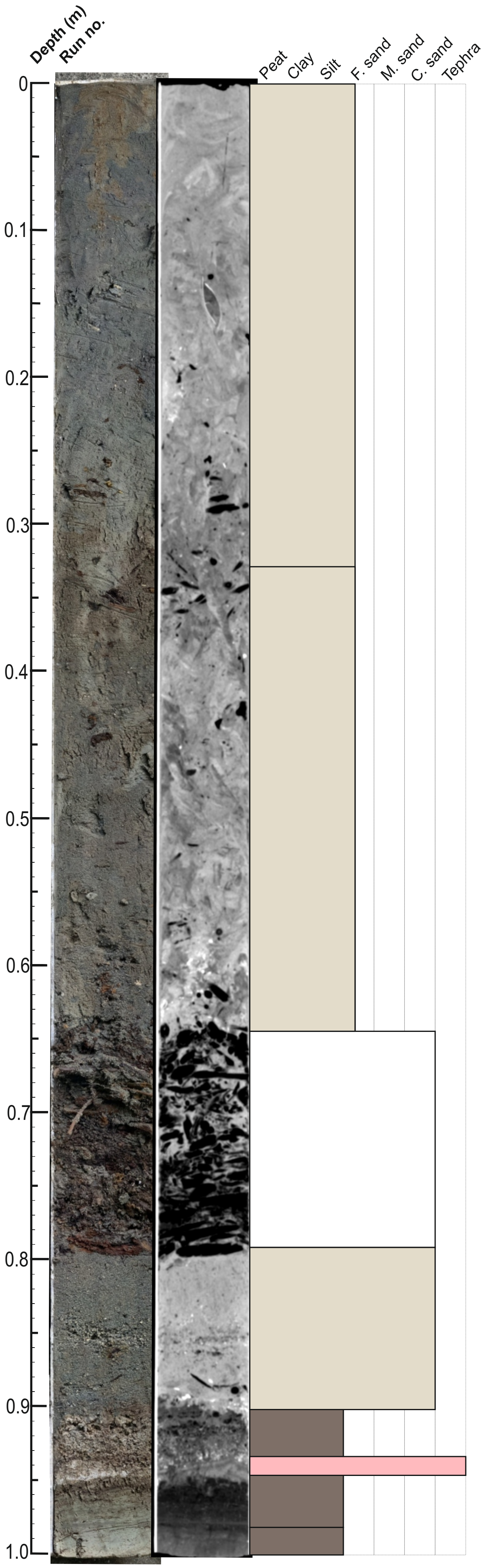
Description (e.g. nature of contact, colour, grain size, bedding, organic content)

0.00-0.10
EMPTY CORE

0.10-0.60
REWORKED SURFACE SEDIMENTS - not included in logs

0.60-1.00 Ag4 2.3.3.2.1
Grey/brown (10YR 5/2) sandy organic silt.
Increased organic content at 0.70 m. Clear stratification at 0.88-1.00 (darker at sharp base)
No clear textural changes. UC gradational.

Core: **LV-V4 (FSV3)**	Section: **B**	Coordinates (NZTM): **1936742 E, 5637110 N**	Surface (m ASL): +1.90
Location: Cores on other side of front stream section, core closest to the stream			



Description (e.g. nature of contact, colour, grain size, bedding, organic content)

0.00-0.37 Ag2 Ga2 2.0.3.0.0
Medium grey sandy silt. Orange mottle at top - clearly dragged down from above. Om scattered. Cyclomactra at 0.15 m (articulated). LC very unclear/gradational.

0.37-0.63 Ag2 Ga2 2.0.3.0.0
Medium grey sandy silt/silty sand below and silt above mixed together. Slight brown colour. Upper contact is diffuse - clear bioturbation from above. Scattered OM and pumice. No visible shell

0.63-0.80 Ga1 Dl3 3.0.4.0.0
Fragments of woody material/detritus, some quite large (branch). Matrix is same sand as below. UC is distrubed by non-lateral organics. Wood is random/chaoticlly deposited and seems to mostly be lying horizontally. Some thin bits look like barky reed as seen elsewhere. Seeds throughout - miro-like. The sand above this is siltier than the sand below - think there is actually a contact here. OBS: rafted material within sand, with a change to silt above = sequence = organic silt > taupo > mixed pumice >subsidence > tsunami sand with rafted wood on top > silty sand resumes above

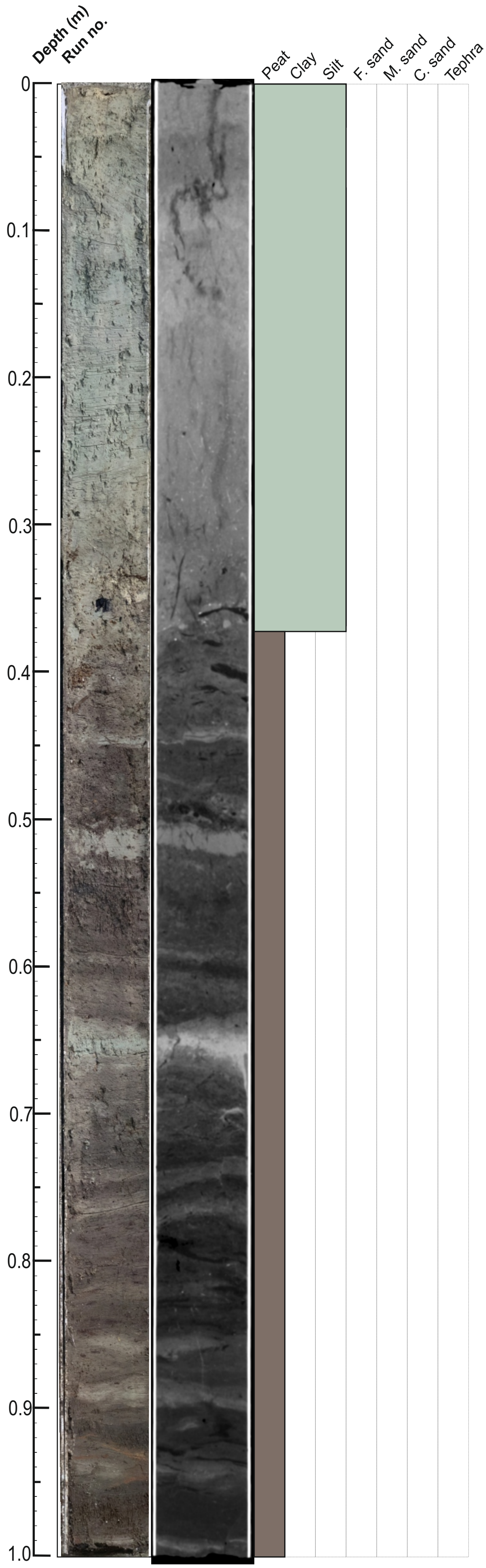
0.80-0.91 Ga4 2.1.4.0.3
medium grey medium/fine sand - very well sorted, visible very small shell frags, coarser band at 0.84-0.86 (pumice - sampled). Potamo visible throughout. Sharp UC.

0.91-0.945 Te3 Ag1 1.0.4.0.4
Coarse pumice (~3 mm) mixed sizes, light grey colour in matrix of organic brown silt like below. Sharp and irregular UC.

0.945-0.95 Te4 0.0.4.0.1
Light grey/white fine sand sized tephra (mushroom cloud?), sharp base, diffuse pper, looks like org. silt resumes above.

0.95-1.00 Ag4 1.1.3.0.3
Grey/brown silt, brown increasing upwards with one or two darker laminations.

Core: **LV-V4 (FSV3)**	Section: **C**	Coordinates (NZTM): **1936742 E, 5637110 N**	Surface (m ASL): +1.90
Location: Cores on other side of front stream section, core closest to the stream			

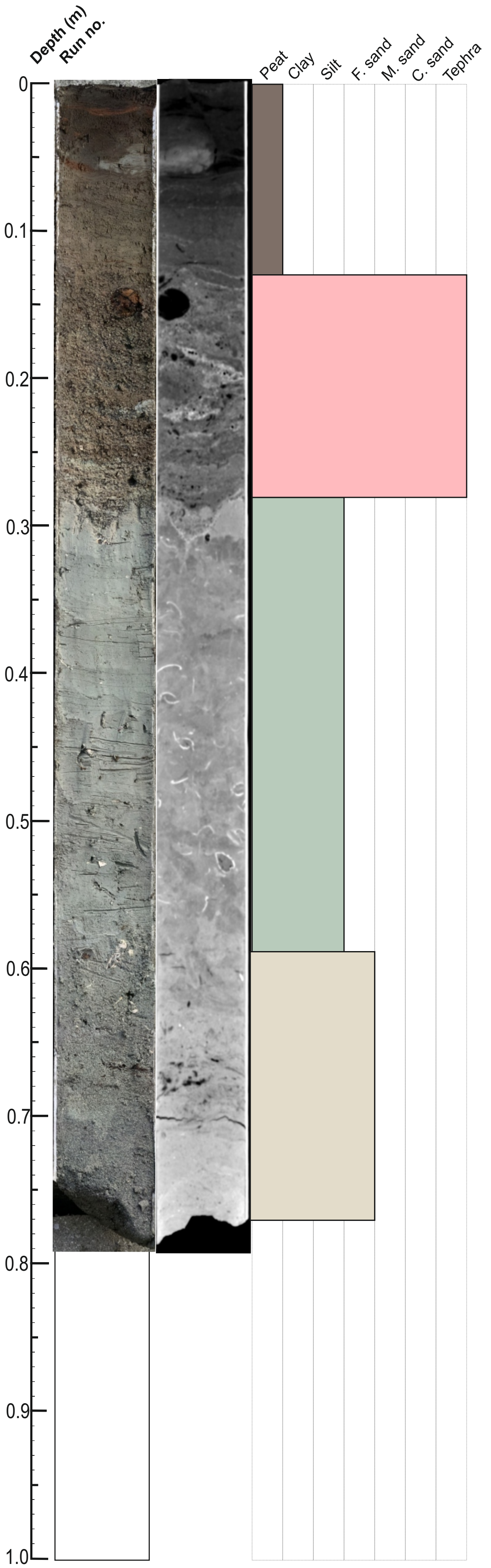


Description (e.g. nature of contact, colour, grain size, bedding, organic content)

0.00-0.37 Ag2 As2 1.0.3.0.-
Light grey/green (2.5Y 4/1) clayey silt.
More firm/drier/more clay at the top (from 0.28 m). 0.03-0.00 = even lighter and continuous with the base of B. No shells visible. Sharp LC in person - not so visible from the CT/photo.

0.37-1.00 Ag2 Ld 2 4.4.3.1.
Light brown (2.5Y 3/2) layers of silty peat.
Clear layers, some high silty content (grey) some higher organic content/well humified peat (dark brown). Unclear if macro-org at top of unit is in situ or not. UC is unclear - reworked. NB: in person notes that true contact is stronger at 0.45 cm.

Core: **LV-V4 (FSV3)**	Section: **D**	Coordinates (NZTM): **1936742 E, 5637110 N**	Surface (m ASL): +1.90
Location: Cores on other side of front stream section, core closest to the stream			



Description (e.g. nature of contact, colour, grain size, bedding, organic content)

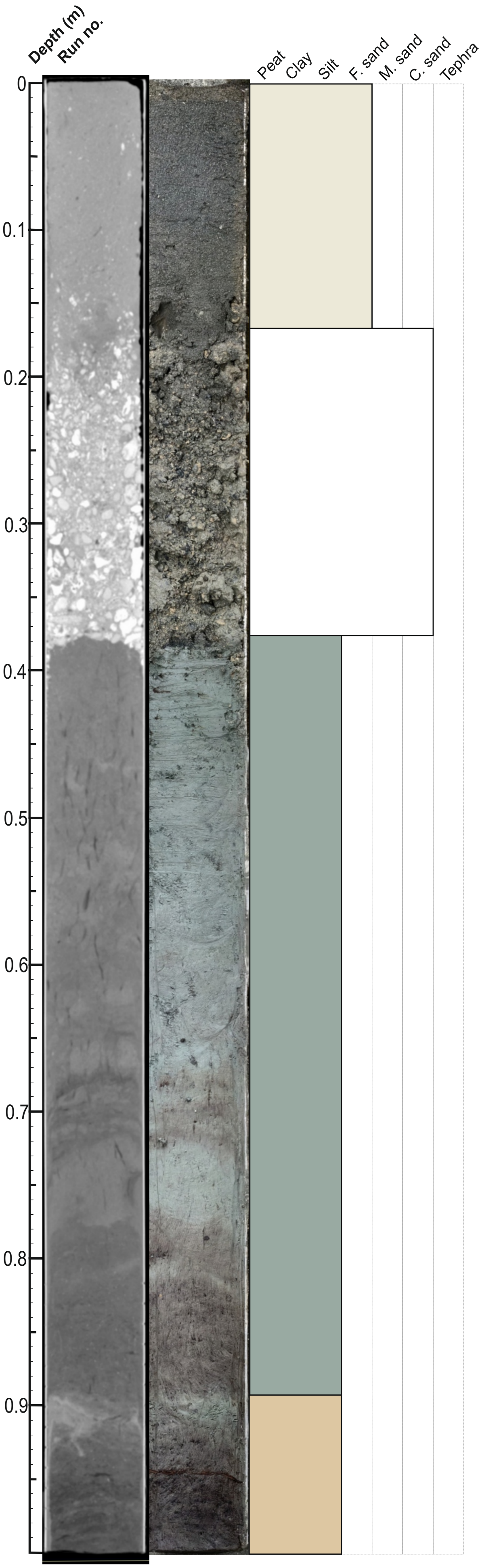
0.00-0.13 Ag1 Sh3 3.1.2.0.-
Medium brown (2.5& 3/2) silty peat. No large macro-org or shells. UC is gradational, LC is gradational.

0.13-0.29 Te4 2.0.3.0.0
Brown (2.5& 3/2) tephric sand mixed with organic silt.
Unit is reworked and does not have the same primary stratigraphy as the tephra elsewhere. Clearly discoloured by sediment accumulating above. Some grey, fine tephra within may be the ash cap. Large 2 cm thick branch within, looks like other macro-org too. LC is sharp and irregular. UC is gradational as tephra fines out of silt.

0.29-0.59 Ag4 Ptm+ 2.0.2.0.0
Blue-grey (5GY 6/1) pure homogenous silt.
Top 2 cm is lighter in colour and does not contain shells. Below *A. stutchburyi* and *Mactra* shells - whole, articulated and in GP. UC is sharp, LC is gradational (texture)

0.59-0.75 Ga4 Ag+ Ptm+ 3.0.3.0.0
Blue-grey (5GY 6/1) silty medium sand.
Homogenous with in situ articulated bivalves - same sp. as above and some *Amphibola.* UC is gradational into more silt.

Core: **PK-V1 (Pk1)**	Section: **A**	Coordinates (NZTM): **1936505 E 5637288 N**	Surface (m ASL): +1.10
Location: Main Pakuratahi Stream, close to where the stump push core was taken at furthest seaward outcrop			



Description (e.g. nature of contact, colour, grain size, bedding, organic content)

0 - 0.17 Ga4 2.0.2.0.0.
Medium grey (5Y 5/1) medium-fine sand (looks like beach/intertidal). Densely packed and slightly wet. Homogenous in texture and colour. No visible whole shells or macro-org. Shell frags frequent but <0.5 cm. LC distorted by large clasts.

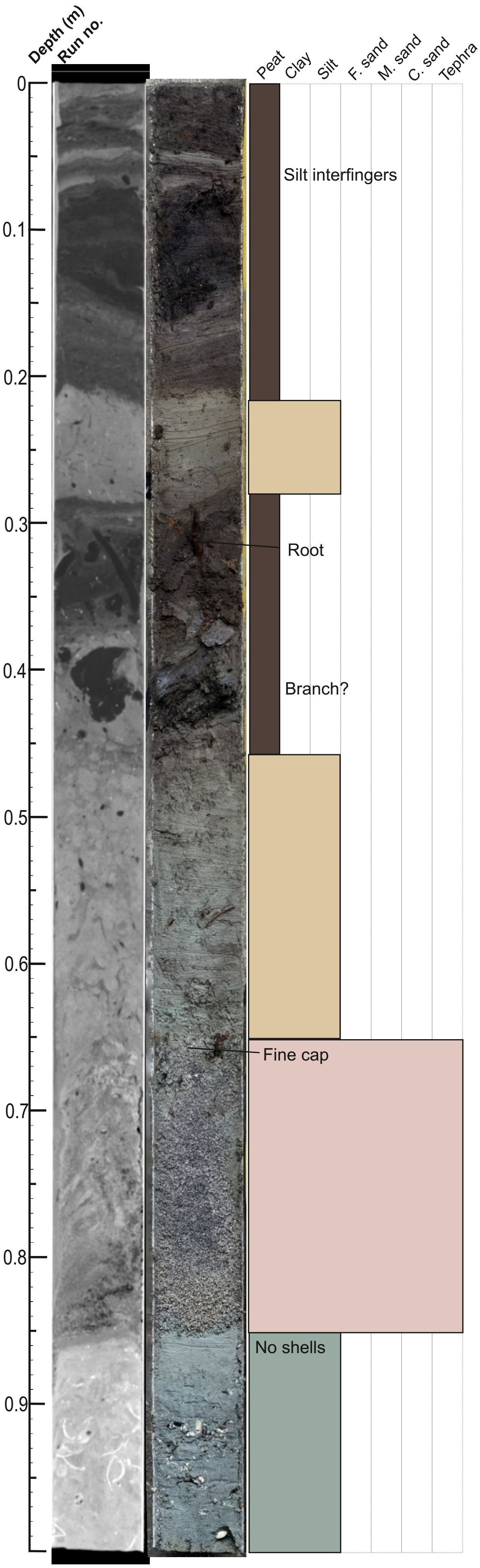
0.17 - 0.38 Ga1 Ggmin2 Ggmaj2 Ptm+ 1.0.4.0.¼
Coarse, overall (5Y 6/1) unit consisting of rounded greywacke pebbles (>2x2 cm and smaller), coarse sand (some tephra - lapilli), shell fragments > 1cm (un-ID), pumice clasts (2 mm - 4 cm), tufa, limestone clasts (~ 2-3 cm). Other clasts present but un-ID at surface. LC extremely sharp. UC distorted by large clasts.

0.38 - 0.78 Ag3 As1 1.1.2.0.4
Bluey-grey (5GY 6/1) clayey silt.
Densely packed and firm at the top. Clay content and blue colour increases upwards. Brown colour decreases upwards. Slightly browner mottling (like at top of unit below) at 0.67-0.72 m (more organic). No visible macro-org or shell material on surface. Very similar to unit sequence in PK2B.

0.78 - 0.90 Ag3 Ld1 3.0.2.0.0
Grey/brown organic silt, gradually decreasing in organic content and colour from 5Y 4/1 to 5Y 5/1. Colour and OM change very gradual. No visible macro-org, just black flecks. No shell. LC and UC gradational over 1 cm.

0.90 - 1.0 Ld2 Ag2 Dl+ 3.1.2.0.1
Greyish/brown (10YR 3/1 organic silt, fading up with decreased organic content to grey (5Y 5/1) silt with no organics. Unit is continuation of siltier part of unit below. Organic orange/brown lens/horizontal bedded fraction at 0.95 m. Colour and OM lightens above this. UC = gradational over 1 cm - contact based on colour and OM - texture seems the same - could be gradational.

Core: **PK-V1 (Pk1)**	Section: **B**	Coordinates (NZTM): **1936505 E 5637288 N**	Surface (m ASL): +1.10
Location: Main Pakuratahi Stream, close to where the stump push core was taken at furthest seaward outcrop			



Description (e.g. nature of contact, colour, grain size, bedding, organic content)

0 - 0.21 Ld3 Ag1 Dl+ 4.2.2.1.0
Dark brown (10YR 2/2) organic silty peat interfingered with grey silt and more organic (not silty) peat. Organic content increases from 0.15 m upwards to 0.08 m but un-ID material (well decomposed, not in GP). No macro-org in silt ~0.21 - 0.15 m.

0.21 - 0.28 Ag2 Ld2 2.0.2.0.1
Brown/grey (5Y 4/1) organic silt, mottled with lighter grey (bioturb).
Small fibrous root ends exposed. LC very sharp. UC ~0.7 cm. (all changes post tephra based on silt vs organic content - clearly very reworked)

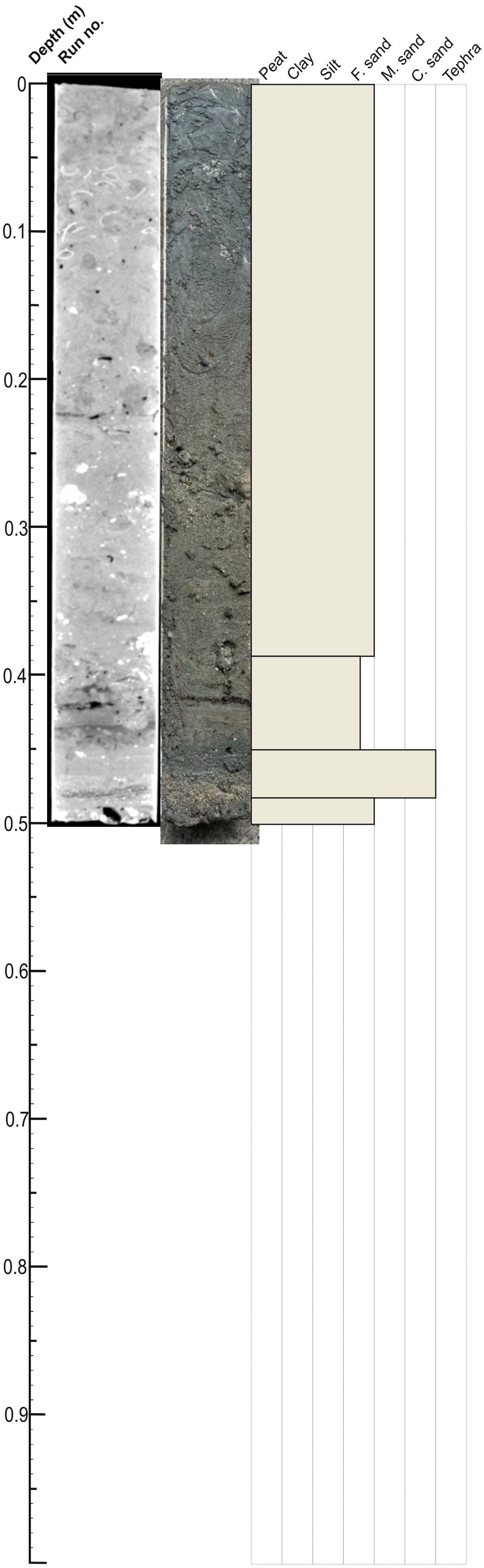
0.28 - 0.36 Ld4 Ag+ Dh+ 3.0.2.1.3.
Dark brown (10YR 2/2) humified peat with increasing silt content up to top.
Roots/woody material present e.g. ~0.32 m = 0.5 cm (diam) root sticking out in GP. Silt content and lightness of colour increases upwards. UC sharp.

0.46 - 0.65 Ag3 Ld1 Dl+ 2.0.2.0.0
Brown-ish grey (5Y 5/1) organic silt (slightly crumbly texture).
Grey silt mottled with browner organic silt. Organic component increases upwards. Brown fibrous root material present e.g. ~0.58 m. LC gradational because distortion. UC gradational. Texture homogenous - just OM and colour that changes upwards.

0.65 - 0.85 Ga/Te4 2.0.4.0.0
Light grey (5Y 6/1) tephric sand.
Fines upwards from very coarse (~2 mm) to coarse/medium at top. Lighter grey fine sand cap distorted by coring - dragged down side/mixed in with silt. Cap visible in come places. Wood dragged down into tephra from above (roots or twigs). Possible contact ~0.81 m, below = very coarse and light, above = finer and darker. UC = gradational because distorted. LC extremely sharp.

0.85 - 1.0 Ag2 Ga2 Tm+ Ptm+ 2.0.2.0.4
Grey (5GY 6/1) sandy silt with estuarine shells (whole and fragments).
Macamona and *Austrovenus* present.
Colour lightens slightly upwards. Silt content increases to pure silt at top ~ 0.87 m with no shells present within pure silt. Shells heavily fragmented (coring/splitting? - crushed not dispersed). Unit continues unit within run below. Extremely sharp UC.

Core: **PK-V1 (Pk1)**	Section: **C**	Coordinates (NZTM): **1936505 E 5637288 N**	Surface (m ASL): +1.10
Location: Main Pakuratahi Stream, close to where the stump push core was taken at furthest seaward outcrop			



Description (e.g. nature of contact, colour, grain size, bedding, organic content)

0 - 0.39 Ag1 Ga3 Ptm+ Ggmin + Bone+ 3.0.2.0.0
Grey sand fining upwards with increasing silt content from medium sand (5GY 4/1) to fine sand with silt (5GY 6/1). Lower contact gradational ~ 1cm. No contacts so classed as one unit. Subtle changes:
- 0.39-0.3 Darker med. sand, shell frags rare but some visible, no macro-org.
- 0.3-0.2 Slightly lighter sand but coarser grains
- 0.25-0.3 Rounded greywacke clast partially exposed (>2 cm). Visible pumice clasts ~ 1 cm. Shell frags < 1 cm are few. Large (3x3 cm) bone (removed and washed), heavy. No sharp contacts to the chaotic mix.
- 0 - 0.2 Gradational change to fine sand with silt (lighter), whole and frag shell present from 0.13 m upwards. Unclear if in GP - broken from coring?

0.39 - 0.45 Ag3 Ga1 Sh+ 3.1.2.0.0
Brown-grey (5Y 5/1) silty sand (chaotic?).
Irregular UC+LC suggest silt worked in randomly - flood? Sand is fine with silt matrix. brown organic lens at 0.415 m. Twig or root at 0.405 m. Gradational UC into medium sand. Think unit is bioturb. Colour changes between units are subtle.

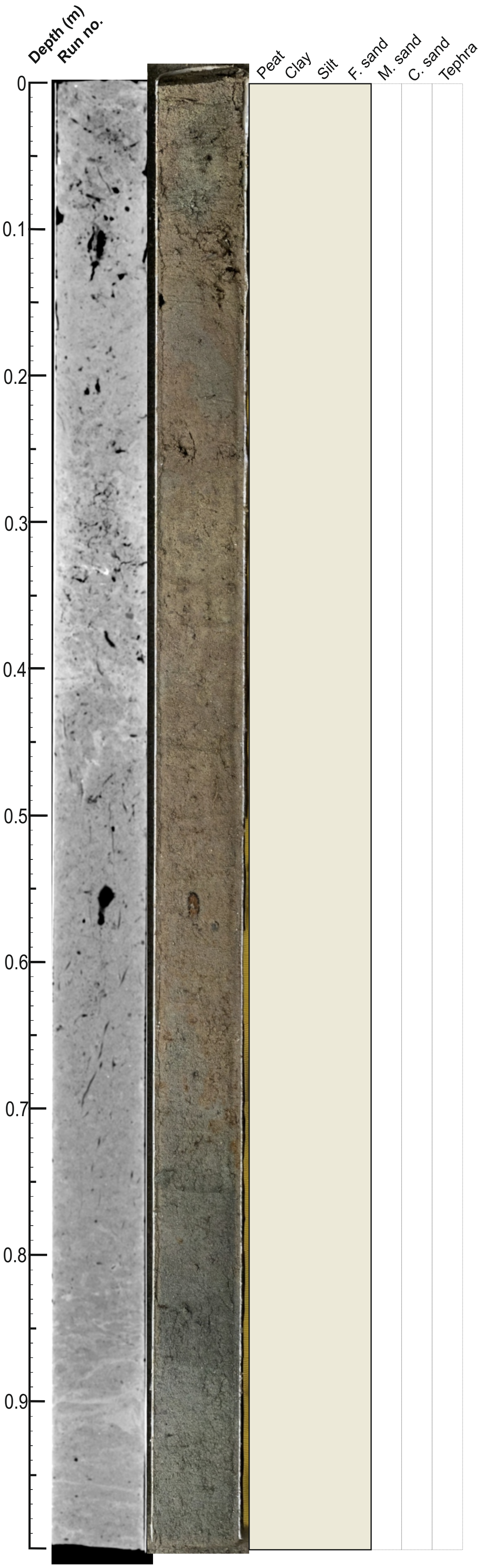
0.45-0.47 Ga 4 3.0.2.0.1
Grey (5GY 4/1) medium sand, well sorted, homogenous texture and colour. Some lighter grain (look like lapilli, or shell frag). No visible macro-org. Looks like beach/intertidal sand (wet).

0.47 - 0.49 Ga4 2.0.4.0.0
Grey/beige (5Y 6/1) coarse sand with <1 mm shell frag/pumice/tephra. Fines upwards to medium sand. Colour gets more grey as fades into unit above. No macro-org. Gradational LC ~0.5 cm. Gradational UC ~0.7 cm

0.49 - 0.50 Ag2 Ga2 3.0.2.0.1
Dark ‘greenish’ grey (5GY 4/1) fine/medium sand with grey silt matrix.
Right at the base so difficult to assess. UC ~0.5 cm. Visible OM and larger grains like above. Homogenous colour and texture. No shell to ID frags.

END OF CORE

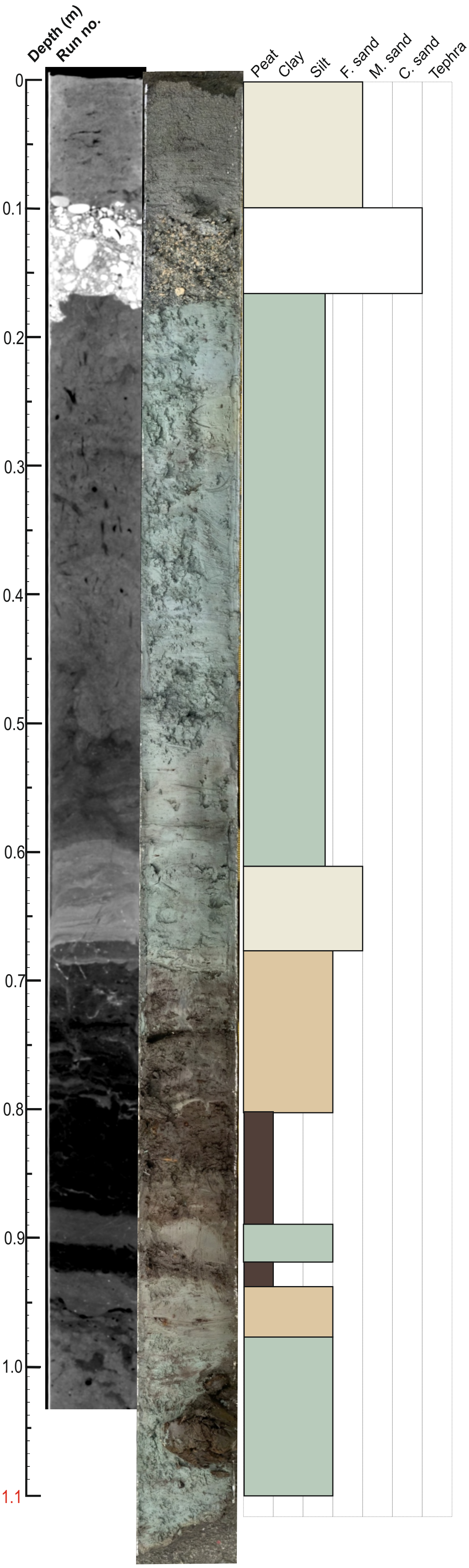
Core: **PK-V2 (Pk2)**	Section: **A**	Coordinates (NZTM): **1936369 E 5637406 N**	Surface (m ASL): +1.10
Location: Main Pakuratahi Stream, further upstream, cored from bank opposite big outcrop with exposed deposit			



Description (e.g. nature of contact, colour, grain size, bedding, organic content)

0 - 1.0 Ga3 Ag1 2.0.3.0.-
Medium/fine sand with slight silt matrix to bind.
No sharp boundaries therefore one unit.
Subtle changes:
- Dense at the base, increasing air pockets upwards due to increasing organic content and bioturbation
- Bioturbation increases upwards from ~0.7 m - visible orange mottles
- Colour changes from grey (5Y 4/1) to grey with orange (7.5YR 4/6) ~0.7 m and into more brown colour (10YR 4/2) ~0.55 m
- Large (0.7 x 2 cm) wood chunk at 0.55-0.58 m
- Very fine < 1 mm roots from 0.6 m upwards
- No stratification even at base (matches unit in run below)

Core: **PK-V2 (Pk2)**	Section: **B**	Coordinates (NZTM): **1936369 E 5637406 N**	Surface (m ASL): +1.10
Location: Main Pakuratahi Stream, further upstream, cored from bank opposite big outcrop with exposed deposit			



Description (e.g. nature of contact, colour, grain size, bedding, organic content)

0.0 - 0.10 Ga4 Ag+ 2.0.2.0.0.
Medium grey (5Y 5/1) fine sand grading up into medium sand to top (possible transition ~0.08). No visible whole shells - possible microscopic fragments. Some grains from unit below mixed in. Homogenous in colour. Silt component as binding matrix. Thin pieces of organic material (black?) btu un-ID.

0.10 - 0.17 Ga2 Ggmin2 Ggmaj+ 1.0.4.0.4
Overall light grey (5Y 6/1) coarse deposit consisting of rounded greywacke pebbles ~0.5-1.0 cm, rounded pumice clasts, small (<0.5 cm) shell frags (only just visible). Other clasts too but not visible on scraped surface. Sand fraction is coarse size - unclear whether grading. Pumice throughout (Taupo?). No visible macro-org. LC extremely sharp and irregular - erosional? UC sharp but disorted by large gravel.

0.17 - 0.61 As3 Ag1 1.0.3.0.0
Blue grey (5GY 6/1) clay.
Slightly siltier and browner in colour at the base, fading up into more blue/grey, pure clay to top. Crumbly (dry) when scraped. Few visible maco-org - root/wood - seems to be worked in randomly (not in GP). No visible shell or frags or flecks. LC sharp textural change but subtle colour change. UC extremely sharp.

0.61 - 0.68 Ga3 Ag1 1.0.3.0.0
Blue-ish grey (5GY 5/1) fine sand.
Possible fining upwards. Thin 1-3 mm laminations of lighter and darker sands - flow structures (wavy)? One browner ~ 2 mm layer ~0.65 m. No visible macro-org or shell or flecks. Very sharp lower contact signifying textural change. Gradual UC into silt unit, sand fraction decreases.

0.68 - 0.80 Ag2 Ld2 Dl+ 2.1.3.0.3
Greyish brown (5Y 4/1) organic silt interfingered with silty peat.
Seems very mixed - maybe once stratification but bioturbated? Silt content increases upwards. Grey pure silt lens (~0.3 cm) at base. Thin (~2 mm) grey/blue silt lenses x2 `0.695 m. Above this is grey-brown silt with increase organic content (visible fractions rare). 1x1 cm wood chunk at 0.79 m. Very sharp UC and LC.

0.80 - 0.89 Ld2 Sh2 Dl+ 3.2.2.0.2
Dark brown (10YR 2/2) silty peat with maco-organics e.g. wood twigs/roots not in GP. Lower 3 cm = grey silty interfingered with brown silty peat. Increased organics 0.80 - 0.85 m - causes darkening upwards of colour. Very sharp UC with the grey silt lens.

0.89 - 0.92 Ag3 Ld1 2.0.2.0.2
Brown-ish grey (5Y 4/1) silt.
Looks organic (brown colour) but no visible macro-org. Homogenous colour and texture. Could be rip up pod/pocket of same colour material from below - deformed by coring? Unsure if extends whole way across barrel. Sharp UC and LC.

0.92 - 0.94 Ag2 Ld2 Dl+ 3.0.2.0.1
Dark brown (10YR 2/2) organic silt with macro-org partially decomposed (twigs/roots - woody). LC sharp (bioturb) - looks like the start of true peat unit above the silt pod.

0.94 - 0.98 Ag3 As1 2.1.2.0.1
Brownish grey (5Y 4/1) soft organic silt with pods of OM, possible roots. Darker grey fading up into lighter shade. Homogenous texture. Gradational ~ 1 cm LC. Sharp and irregular UC.

0.98 - 1.11 As3 Ag1 1.1.3.0.0 Tl/Dl+
Blue-ish grey (5GY 6/1) clay with large wood chunk within (at 1.03-1.09 m) - possibly thick root as lateral orientation, but also could be brach (bark-like material on outer). Well decomposed. Possibly dragged down from unit above (smeared down side). Other small patches of brown silt shows bioturbation (from roots?). No visible shell or frags. Base in grainy in texture - forams or just on top of WAIM.

END OF CORE
(Depths aligned by 0 m at top of barrel, 1.11 at apex.