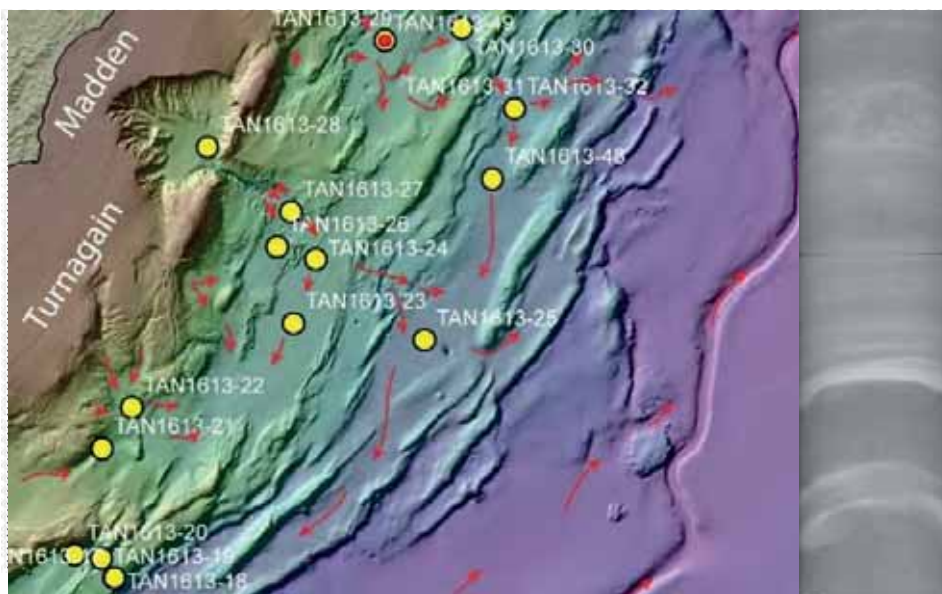


Tangaroa TAN1613 Voyage Report

Using Sedimentary Core Records to Unravel the Earthquake History of the Hikurangi Subduction Zone

MBIE Endeavour programme “Hikurangi subduction earthquakes and slip behaviour: Diagnosing peril posed by the Hikurangi subduction zone: New Zealand’s largest plate boundary fault”

November 10-22, 2016



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Cover page figure caption: Coring sites, central Hikurangi margin, and X-ray image of sediment core

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Executive summary

The primary objective of *Tangaroa* voyage TAN1613 was to recover sedimentary cores from the continental slope and Hikurangi Trough expected to deliver records of past earthquakes associated with the Hikurangi subduction zone.

Two secondary objectives developed during the survey in response to the 14th November M_w 7.8 Kaikoura Earthquake. The first involved sediment coring specifically to investigate if a seismically-triggered turbidity current associated with submarine landslides had occurred as a result of strong ground shaking. The second involved seafloor mapping on the continental shelf of coastal Marlborough in search of evidence of co-seismic faulting.

A total of 50 piston cores and 10 multicores were collected between eastern Marlborough and offshore of Poverty Bay, including those related to the Kaikoura Earthquake response work. The cores are individually up to 5 m length, and collectively represent about 140 m of total core material. Each core was cut to 1 m sections, split, photographed, logged manually on a standard template description sheet developed for this survey, X-rayed, measured for magnetic susceptibility, and packaged for storage in the NIWA core repository.

The cores contain layers of gravel, sand, mud and volcanic ash. Many layers are “turbidites”, rapidly transported and deposited (within hours and days) from past turbidity currents resulting from landslides. Some cores contain up to 25 individual turbidite layers. Based on inferred sedimentation rates in the area, we suspect the longer cores probably span the last ~5000-10,000 years. The suite of cores will be analysed post-voyage to determine their origin and age. Many but not all of the turbidites may have been triggered by strong shaking associated with past earthquakes (subduction “megathrust” and other coastal faults). Collectively the suite of cores looks encouraging in terms of providing future paleoseismic records, following the shore-based analyses and associated modelling.

A series of multicores collected provide strong evidence that the 14th November M_w 7.8 Kaikoura Earthquake triggered a turbidity current from submarine landslide sources near the earthquake. Unconsolidated turbidite silts and sands at the base of a muddy fluidised layer were observed in the Hikurangi Channel and on the basin floor east of Kaikoura, Cook Strait, and Wairarapa approximately 300 km down-system from the likely source area in the Kaikoura Canyon region. The turbidity current potentially flowed at least 500 km from source to offshore of Hawkes Bay. Our preliminary interpretations will require post-cruise validation from detailed sedimentological analyses of the cores and from chronology established using short lived radioisotopes.

Seafloor mapping on the continental shelf of coastal Marlborough is consistent with surface rupture on the submarine Needles Fault during the November 14th M_w 7.8 Kaikoura Earthquake. We mapped a fresh, almost continuous, 17 km along fault scarp and infer a total submarine rupture length of about 34 km. No evidence was seen for any co-seismic offset on the Chancet Fault or western end of the Boo Boo Fault, associated with this earthquake. This mapping will help to characterise the total network of faults that ruptured during the earthquake.

1 Introduction

1.1 The Hikurangi Subduction Margin

The east coast (Hikurangi margin) of the North Island and NE South Island straddles the boundary between the Pacific and Australian tectonic plates. This margin is characterized by the westward subduction of the Pacific Plate beneath the North Island and coastal Marlborough, at a rate of about 4.5-5.5 cm/yr (Figure 1-1). The 3000 m-deep Hikurangi Trough, off eastern Marlborough, Wairarapa, Hawkes Bay, and East Cape, marks the location where the Pacific Plate is thrusting beneath the eastern continental margin of the North Island.

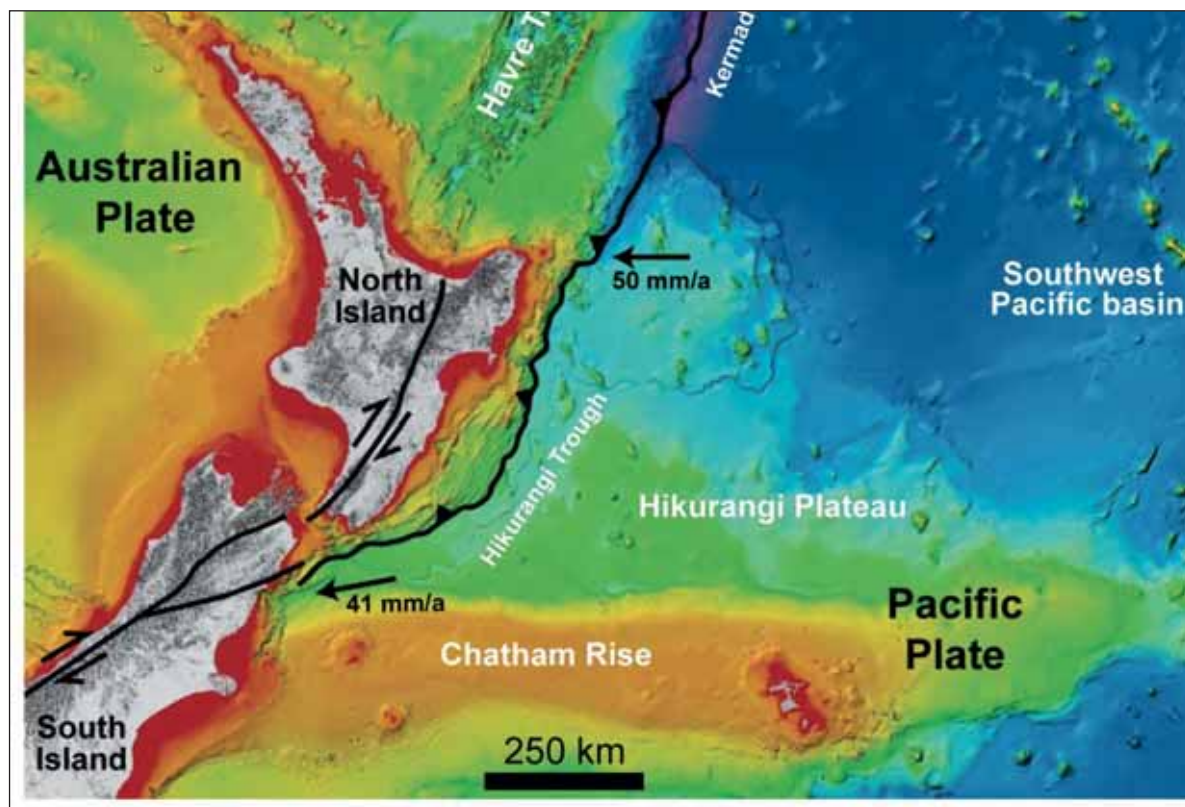


Figure 1-1: Regional tectonic setting of the Hikurangi subduction margin. Black lines are major plate boundary faults. Black arrows are the Pacific -Australian plate motion (mm/yr).

Other subduction margins similar to Hikurangi have generated the largest magnitude historical earthquakes and tsunami on Earth. Notable examples include the devastating M_w 9.2 Sumatra earthquake in December 2004, and the M_w 9.0 Tohoku-Oki Earthquake, Japan, in March 2011. Such great earthquakes break extraordinarily large faults that geoscientists refer to as “megathrusts.” On Figure 1-1, the black fault line shown east of North Island is where the Hikurangi megathrust intersects the seafloor. Arguably, this fault is New Zealand’s largest earthquake and tsunami hazard. However, for two primary reasons, it is also the largest source of uncertainty in our current national seismic and tsunami hazard models. Firstly, New Zealand has a very short historical record relative to the likely recurrence of great earthquakes and tsunami (Figure 1-2). Secondly, current interpretations of megathrust earthquake behaviour (magnitude, location, displacement, recurrence) are derived mainly from shore-based geological and geodetic investigations, despite the fact that many of the damaging earthquake and tsunami source processes are likely to be located offshore (Figure 1-3). To increase understanding of the hazard and risk posed by the Hikurangi margin, it is essential that we learn more about its pre-historic earthquake history.

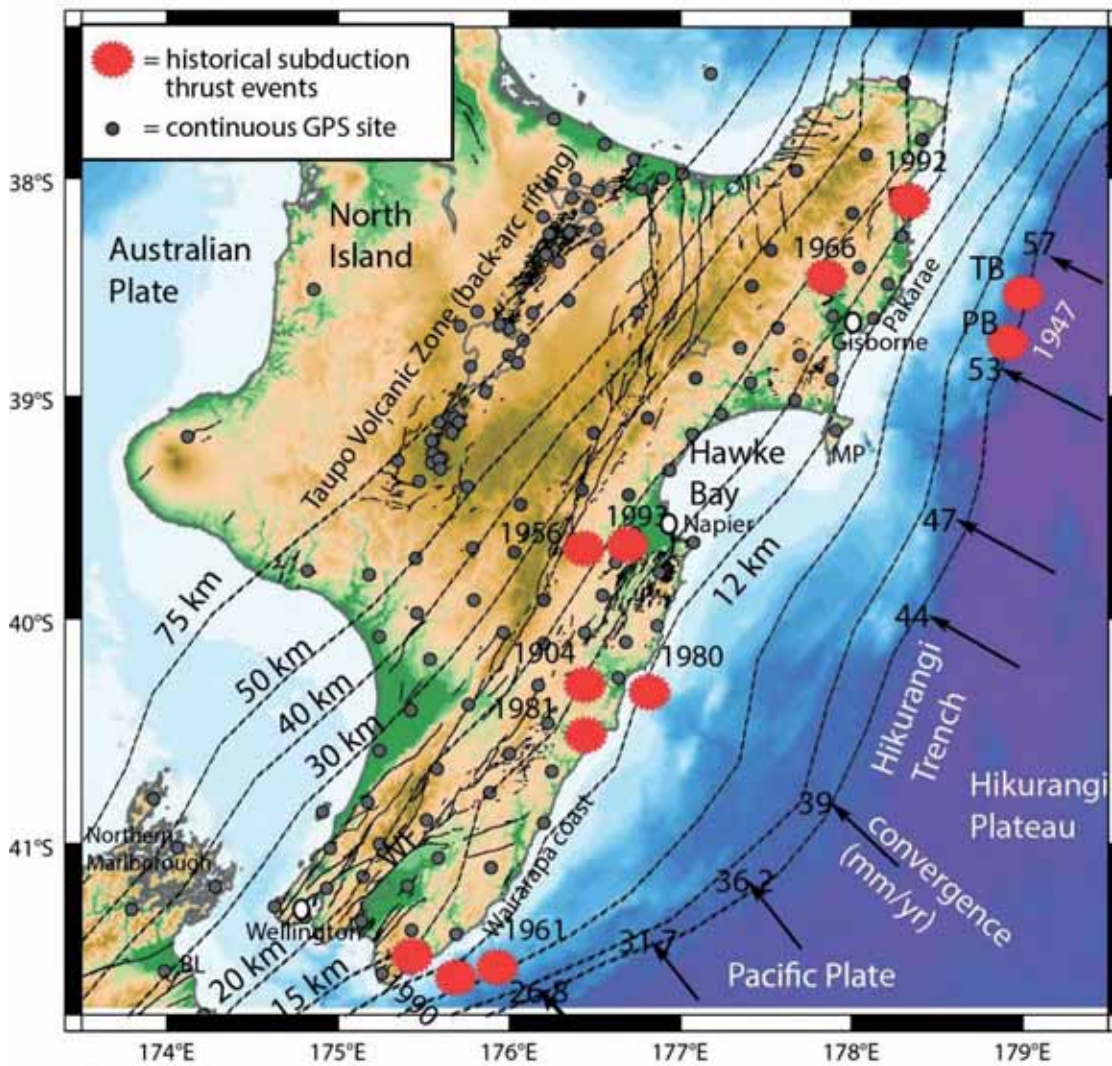


Figure 1-2: Historical subduction thrust earthquakes on the Hikurangi margin (red dots), from GNS Science. Tectonic shortening rates (mm/yr) and direction along the Hikurangi Trough are shown by the black arrows. Black contours show the approximate depth (km) to the top of the subducting Pacific Plate beneath North Island.

One of the intriguing aspects of the Hikurangi subduction margin is its variability along its length. Continuous global positioning system (cGPS) studies of current tectonic deformation (years to decades) show that the megathrust fault has patches that creep slowly whilst other parts of the fault are locked (Figure 1-4). Based on global datasets and historical earthquake locations, an interpretation is that locked areas may be the sites of future great earthquakes (magnitude $M > 8$), whereas creeping areas (where the fault moves slowly and episodically, and/or aseismically) may be more likely to generate relatively smaller ($M > 7$) but potentially more frequent earthquakes. These interpretations, and the possibility of very large earthquake ruptures spanning the entire margin length from Cook Strait to East Cape, remain to be tested. We hope to test if current deformation patterns derived from continuous GPS data are consistent with past earthquakes, and whether the size and location of these events are persistent.

Large earthquakes beneath subduction margins commonly leave tell-tale geological signatures that can be used to reconstruct where they have occurred in the past. These signatures include sudden vertical movement of the coast, and the deposition of marine "turbidites." Turbidites are rapidly emplaced layers of mud, sand, and gravel sediment that have been carried to depositional sites on the continental margin (such as basin floors) in turbidity currents. Some, but not necessarily all turbidity currents, are co-seismically triggered due to strong ground shaking and destabilisation of seafloor slopes.

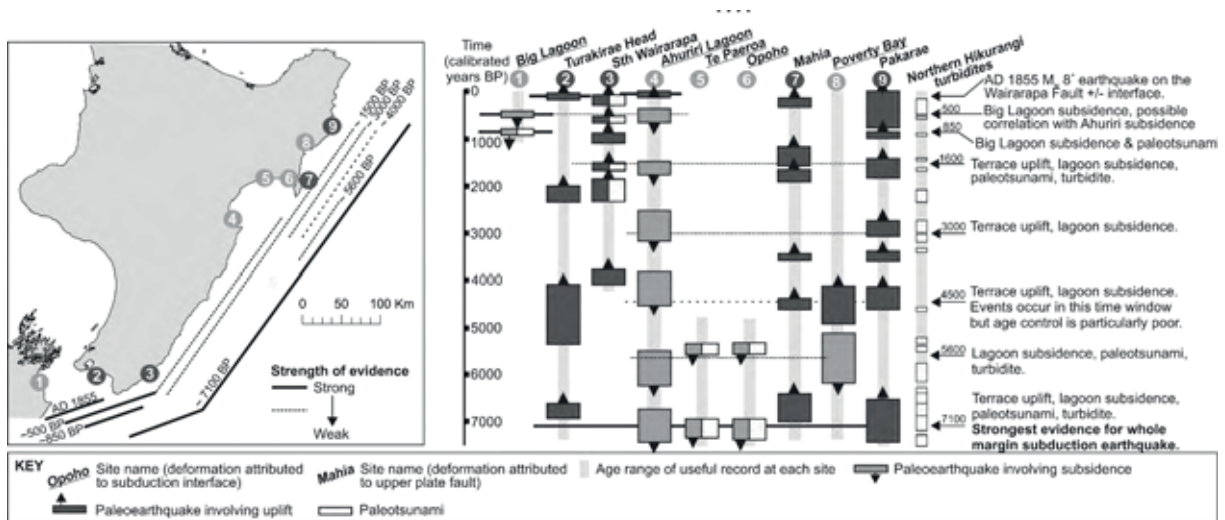


Figure 1-3: Terrestrial paleoseismic records from coseismically-uplifted Holocene terraces and coseismically subsided lagoons. Data from Clark et al. (2015) and Wallace et al. (2015). Results of a previous study of offshore earthquakes in the North Hikurangi margin (Poverty to East Cape region), derived from turbidite records, are shown on the right column (Pouderoux et al., 2011, 2012).

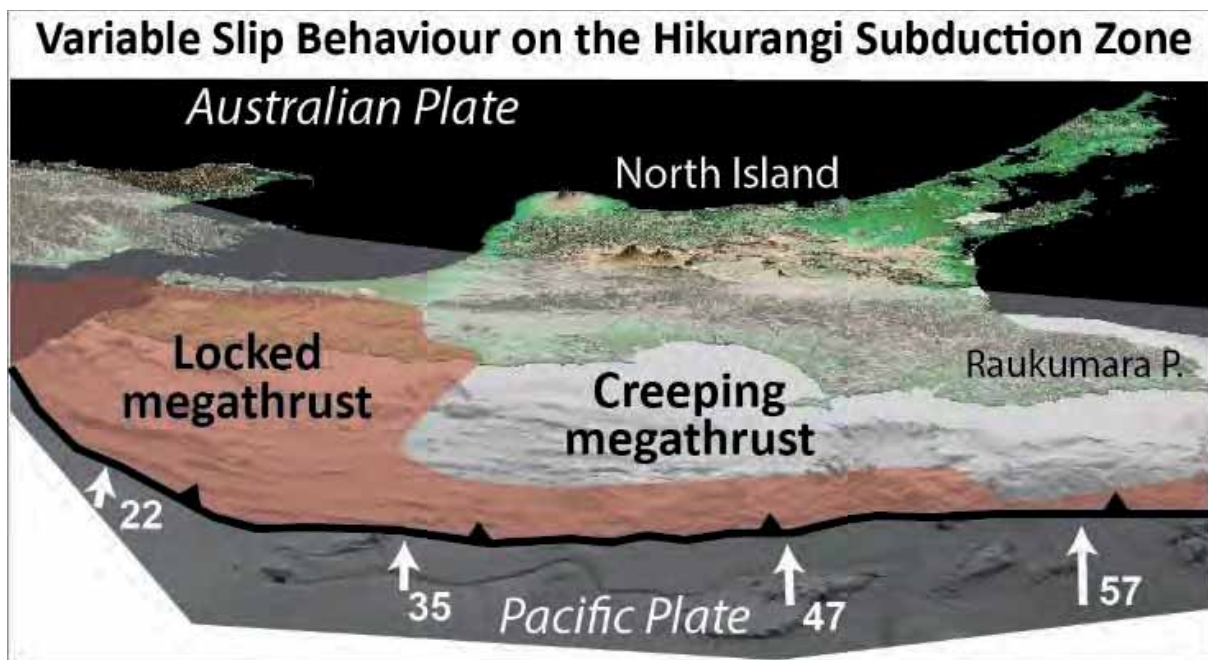


Figure 1-4: Oblique view of the Hikurangi megathrust. Black line with teeth marks show convergent movement of the Pacific plate relative to the Australian plate (white arrows in mm/yr). The transition between locked (red) versus creeping (white) patches of the megathrust are highlighted by colour shading.

Our plan is to identify coseismic turbidites, and generate a long (up to 10,000 year) time-series history of large earthquakes using records of synchronous marine deposits along the Hikurangi subduction zone.

Tangaroa voyage TAN1613 and associated research is part of a large multi-institutional study, involving New Zealand scientists from NIWA, GNS Science, University of Auckland, University of Otago, University of Canterbury, and Victoria University of Wellington, together with international scientists from France, Turkey, USA, and possibly Japan. The voyage was funded partly by a recently awarded 2016-2021 MBIE Endeavour-funded programme *Hikurangi subduction earthquakes and slip behaviour: Diagnosing peril posed by the Hikurangi subduction zone: New Zealand's largest plate boundary fault* (NIWA Project GNS17302), and NIWA-MBIE Core Coasts & Oceans Programme *Marine Physical Processes and Resources* (NIWA Project COPR1702).

The primary desired outcome of this research is to provide base-line earthquake data that will help to underpin improved assessments of hazard, risk and, ultimately, potential losses (lives, costs) due to great earthquakes on the Hikurangi subduction zone. This will ultimately be achieved by application of the underpinning data to improve: (i) better loss modelling by asset and insurance managers, (ii) informed coastal land development and emergency response procedures, and (iii) tailored engineering practices to improve earthquake and tsunami hazard mitigation, reducing the costs of economic recovery.

1.2 Voyage and science objectives

One key question of relevance to seismic and tsunami hazard and risk in New Zealand is whether or not the Hikurangi subduction margin is capable of producing great (Magnitude >8) or giant (M >9) earthquakes, and if so, in what regions and how often? We currently have sparse data on the past earthquake history and potential of this system.

To develop a robust record of past Hikurangi margin earthquakes we plan to develop and integrate margin-wide, long time-scale (c. 10,000 years) geological records of major paleo-earthquakes spanning many seismic cycles. The demonstrable synchronicity of widespread turbidites with coseismic coastal subsidence and uplift events, supported by modelling of surface displacements and earthquake shaking, will fingerprint the spatial and temporal distribution of past earthquakes associated with the subduction megathrust and other active faults. We aim to establish paleoseismic records along the plate boundary by identifying, dating, and correlating coseismically-triggered turbidites at multiple sites. From this we hope to constrain the location, magnitude, and recurrence of subduction earthquakes.

The primary objective of *Tangaroa* voyage TAN1613 was to recover sedimentary cores expected to sample turbidite successions and other possible co-seismically triggered deposits from the continental slope and Hikurangi Trough basin floor, between NE Marlborough and Poverty Bay.

A secondary objective developed during the survey in response to the November 14th M_w 7.8 Marlborough earthquake. By the evening of Thursday 17th November, following communications with NIWA Executive and GNS Science, a decision had been confirmed to abandon operations related to the paleoseismic objectives on the Wairarapa continental slope, and to commence specific operations in response to the November 14th earthquake. The response plan, although limited in time to the last 4.5 days of the survey, was designed to include:

1. Piston and multi-coring at selected sites off Marlborough and southern Wairarapa to test if landslide failures in canyons and slopes in the earthquake epicentral region had resulted in turbidity currents and an associated turbidite deposit in the southern Hikurangi Trough. If a widespread earthquake-triggered turbidite could be identified, it would be internationally significant, indicate submarine landslides in source regions, and would represent an important historical test for the ongoing paleoseismic investigations.
2. Seafloor surveying along the inner Marlborough coastal area using EM302 30 kHz multibeam bathymetry and PS18 TOPAS sub-bottom profiling in search of evidence for submarine co-seismic fault rupture. With limited time available, this work would focus on the Needles and Chancet faults beneath the northern Marlborough shelf immediately offshore of the Kekerengu Fault.

1.3 Core sampling strategy and site planning

We retrieved sediment samples using a piston corer designed to collect cores from the sea floor up to 6 m in length, and a multicore corer designed to sample the sediment water boundary. The core sites were selected using available multibeam bathymetric and backscatter data, sub-bottom acoustic profiles, archived sediment samples, and preliminary results from numerical modelling of turbidity currents. Prior to coring at each site, a single sub-bottom profile about 2 km in length was surveyed to provide a local sedimentary context. Details are provided in section 2.1.

The core sites fall into three general categories. One category targeted major turbidity current dispersal systems (canyons, gullies, and inter-connected sedimentary basins) on the continental slope. These sites were grouped by catchment and dispersal system, and were expected to encounter sand, silt and locally gravelly turbidites, volcanic ash, and layers of back-ground hemipelagic sediment. They included many high priority sites. A second category included a number of sites targeting relatively small isolated basins on the crests or flanks of middle to lower slope ridges, elevated above or sheltered from margin-wide clastic turbidity current distributary systems. These sites were expected to encounter predominantly mud and volcanic ash, with any co-seismic re-sedimentation events likely to be fine-grained and locally derived. These sites were mostly very high priority, as they have the potential to record strong ground shaking in mid-lower slope regions less influenced by multiple seismic sources and turbidity current triggering mechanisms. A third category included sites along the Hikurangi Trough, including the Hikurangi Channel, its levees, and the basin floor. These were generally ranked as low to very low priority sites. However, we hoped that if time permitted, several of these would be targeted on the southward return from Poverty, to provide improved understanding of the regional sedimentary dispersal system. These sites would potentially be of value to the paleoseismic studies, and were expected to encounter mainly sand-silt turbidites and ash, with gravel more common in the far south.

During this voyage, the 14th November 2016 M_w 7.8 Kaikoura Earthquake occurred. As data on the location, magnitude, and complexity of this earthquake trickled in to *Tangaroa* over the following days, a plan was developed to investigate if a seismically-triggered turbidity current associated with submarine landslides had occurred on November 14th. If so, sampling of the co-seismic turbidite would provide important calibration data for older turbidites in the Hikurangi Trough, as well as providing insights into ground-shaking and turbidity-current triggering thresholds. The planning of this work involved the re-identification of what were pre-cruise lower priority coring sites in the southern Hikurangi Trough as important targets in the earthquake response phase of the voyage. A second earthquake response objective was planned to undertake seafloor mapping on the continental shelf of coastal Marlborough in search of evidence of co-seismic faulting.

To achieve this redirection of work, some important multicore sites associated with the turbidite paleoseismology on the central and southern Wairarapa slope were abandoned. These multicores will require sampling on a future survey, yet to be determined.

2 Survey equipment and on-board data/sample processing

2.1 PS18 TOPAS sub-bottom profiler

We used a Kongsberg PS18 (TOPAS) sub-bottom profiler hull-mounted on R.V. *Tangaroa*. The PS18 profiler is a parametric system designed for generating very-high resolution seismic profiles. The system can operate in water depths from less than 20 meter to full ocean depths. Parametric systems generate a low frequency signal by linear interaction between two high frequency signals centred symmetrically around 18 kHz. Parametric sources have the advantage of generating a signal beam with

no distinct side-lobe structure. The transmitted beam is electronically stabilised in both roll, pitch and heave.

Essential real-time processing is performed at acquisition time, including but not limited to digital band pass filter, spiking deconvolution and time varying gain. The final echogram appears in envelope form.

A variety of pulses can be generated by the PS18. Chirp pulses, as opposed to CW pulses or Ricker wavelets, are favoured for deep water, and were used throughout this voyage. An output secondary frequency sweep of 2-6 kHz with a signal length of 30 ms in deep water and 15 ms on the shallow Marlborough shelf was used.

Penetration performance depends on sediment characteristics, water depth, transmitted signature, noise level etc. Penetration of 60-80 ms was mostly achieved beneath flat, soft sedimentary basin floors, with penetration of 150 ms in rare optimum situations (Figure 2-1). Much less penetration was achieved on hard, highly reflective seafloors. The signal was usually lost on steep sloping seafloor.

The TOPAS operations were led by Susi Woelz and Geoffroy Lamarche, and controlled from the multibeam laboratory. A 2 km long profile was collected at each core site prior to coring. The line extended over the core site, on a pre-planned bearing designed to image specific geomorphic features characteristic of the site, or across basin if possible. The objective of the profiles was to provide a broader stratigraphic context for each site about 1 km each side of the core location. Sub-bottom imagery varied greatly depending on seafloor substrate, as expected. At sites with narrow and sometimes challenging sediment targets that may be locally isolated, the sub-bottom profile was used if possible to refine the pre-voyage planned site location to a more preferred location with improved sedimentary sequence. A TOPAS sub-bottom profile was recorded on almost all transits between core sites.

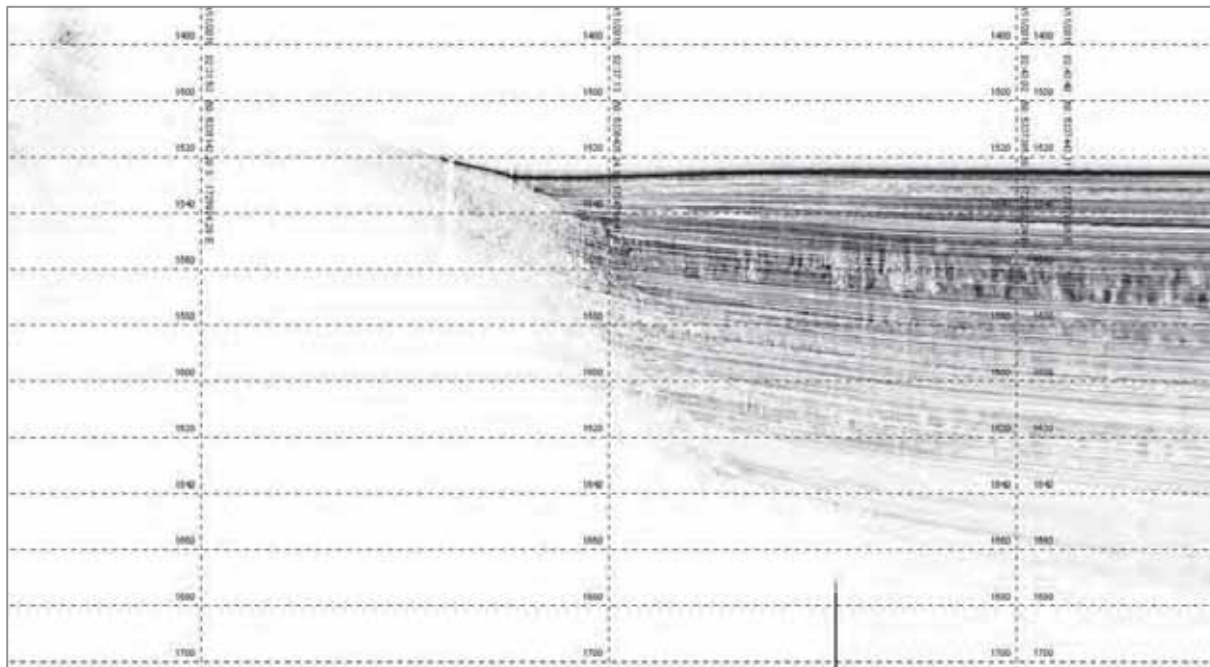


Figure 2-1: Example of PS18 TOPAS sub-bottom profile. Poor (left) and excellent (right) signal penetration of the parametric sub-bottom profile using TOPAS PS18. Line interval is 20 m.

2.2 Piston Corer

We operated an 8 hour watch team for coring operations with of the six science party (PG, WQ, AO, SD, JM, SB) working with vessel staff. The coring watch leaders were Peter Gerring, Alan Orpin and John Mitchell.

We used a Kullenberg piston corer comprising a coring weight assembly (core head), core barrel, catcher, core liner, piston, and trigger weight assembly (Figure 2-2). The piston corer is lowered to the seafloor and allowed to free fall under its own weight from about 3 m above the seafloor to allow penetration into the sediment. On each deployment, the trigger weight hit the bottom first, releasing the weight on the trigger arm and allowing the corer to "free-fall" ~3 m to the seafloor, resulting in the core barrel penetrating into the sediment. We deployed a 6 m long barrel, a head weight assembly of approximately 1000 kg, and triggered the corer with a lead weight. The cores collected inside the PVC liner are 7cm diameter and up to 5 m long.

We used HiPAP positioning, with a transponder attached generally to the winch wire above the corer, and we calibrated the instrument for speed of sound in water via a sound velocity profile (SVP) conducted at that start of the survey. The HiPAP positioning system allowed the officers to locate the corer on target to an acceptable level of precision for our objectives, without use of dynamic positioning.

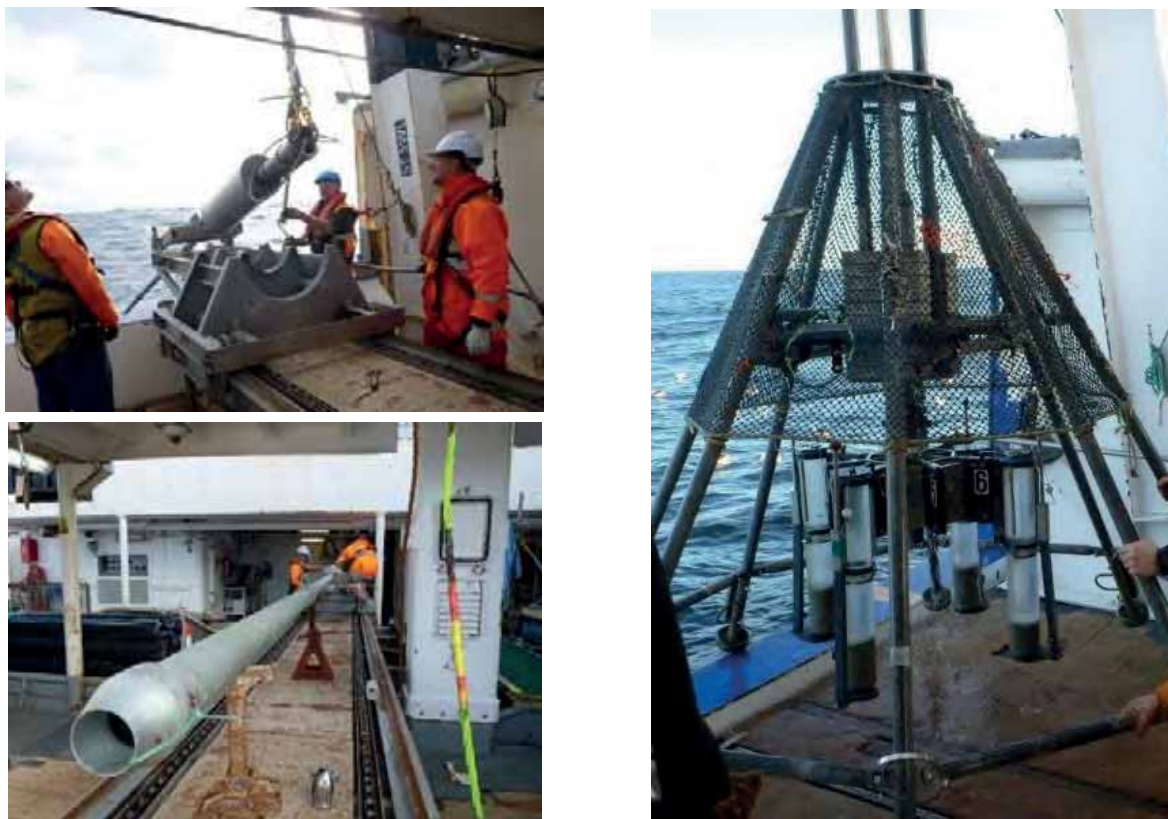


Figure 2-2: Piston corer (upper and lower left) and multi-corer (right) equipment used on *Tangaroa* voyage TAN1613.

2.3 Multicorer

The multicorer comprised a coring weight assembly, and a frame with four short core barrels (Figure 2-2). The core barrels were triggered once on the bottom, penetrating the sediment. A single drop of the multicorer resulted in up to four 10 cm diameter samples typically 0.2-0.6 m long.

If four successful samples were collected, one core was processed on deck, with progressive core extrusion, and sampling at 0.5-2.0 cm thick intervals for shore-based analysis. A second core was sampled with a 2 cm thick rectangular tray for X-ray radiography, whilst a third core was re-cored by hand with a standard 70 mm diameter piston core liner. The fourth core was sampled for biogeochemical analysis, with sample bags placed in the scientific freezer.

2.4 On-board core processing and data compilation

For this survey the portable 40 ft container was installed on the trawl deck to serve as an onboard core processing facility (Figure 2-3). A team of up to 6 personnel (JP, JH, JH, MM, AG, AO) were devoted to processing of the cores. The processing operations were led by Jay Patton and Jamie Howarth (core logging), and Alan Orpin (X-radiography and magnetic susceptibility).

The cores were initially stood vertically, and tied to the bulk head for about 24 hours to allow settling and removal of seawater on the top of the sample. Cores were then measured, cut to 1 m sections, split into archive (reference) and working halves, photographed, logged manually on a standard template description sheet developed for this survey, and packaged into standard NIWA repository card-board boxes. The core boxes were initially stacked in the cube fridge installed on deck, but after this failed they were moved to an un-refrigerated laboratory downstairs.

For this study, all length measurements drawn on the outside of core liners are measured from the top of the cut liner, not from the top of the sample, which may or may not sit flush to the liner top. This will allow consistency and ease of logging correlation during the various planned post-voyage core analyses, such as sediment texture and composition, and imaging by CT scanning, GeoTek multi-sensor logging, and possibly ITrax chemical analyser. At a later stage of analysis and data compilation, precise core depths will be corrected.

Onboard *Tangaroa*, visible tephra were separately photographed, catalogued and documented in more detail in the hydro wet lab by Jenni Hopkins.

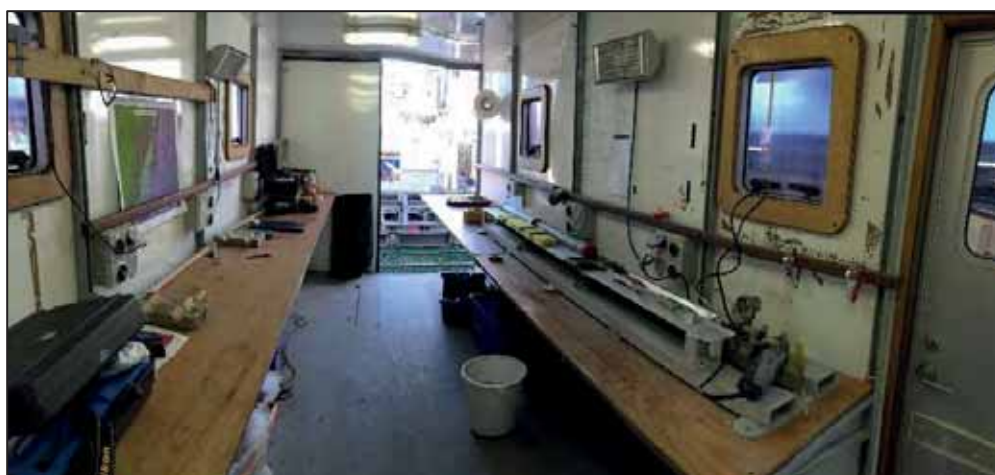


Figure 2-3: On-board core processing inside the portable 40 ft container installed on the trawl deck.

X-radiographs of 1-m long sections of split cores were collected using a Varian PaxScan 4030E flat panel digital imaging system and an Ecotron EPX-F2800 portable veterinary x-ray generator (Figure 2-4). In addition, rectangular slabs from the multicores (~8W x 2.5D x 60L cm) were collected. Exposure

type, grey-level mapping, and exposure window/level were controlled via proprietary Varian software (ViVA 2.0, Revision L.04), and typical generator settings were 75 kV and 10 mAs for split cores and 55 kV and 20 mAs for multicore slabs. X-radiography reveals changes in bulk density invisible to the naked eye; lighter grey represent higher-bulk-density material, typically from coarser-grained sediment (Figure 2-5). Images were further adjusted to maximize contrast between individual strata and laminae. As a result, while relative density changes might be visible within an individual core, comparison of absolute density between separate cores is not quantitative.

Vertical profiling of magnetic susceptibility was undertaken on all cores using a hand-held Bartington MS2F probe, with measurements taken at 2 cm intervals down-core (Figure 2-5).

Data from each core site, including multibeam bathymetry and backscatter, TOPAS sub-bottom profiles, and core logging data, were compiled on board largely by Geoffroy Lamarche, Philip Barnes and Susi Woelz. Appendix A contains data for each core site presented in a standardised template.



Figure 2-4: Set up of X-ray radiography scanning of split sediment cores aboard *Tangaroa*.

3 Summary of activities

The following is a brief summary of the survey activities.

The vessel was mobilized in Wellington on Wednesday 9th November, 2016. The science party of 14 personnel completed *Tangaroa* safety inductions on the same day, and several personnel remained onboard overnight. A toolbox operations meeting involving all voyage personnel was held on Thursday 10th November before departure from Wellington at 1045h (NZDS time). *Tangaroa* sailed to southern Cook Strait in settled weather, during which time the coring equipment was set up. We arrived on station TAN1613-01 at 1550 h over the southern regions of Cook Strait Canyon, where an SVP was

conducted. A TOPAS sub-bottom profile was collected over site TAN1613 -02, and sediment piston coring commenced at 1850 h. We completed the first two core stations before midnight.

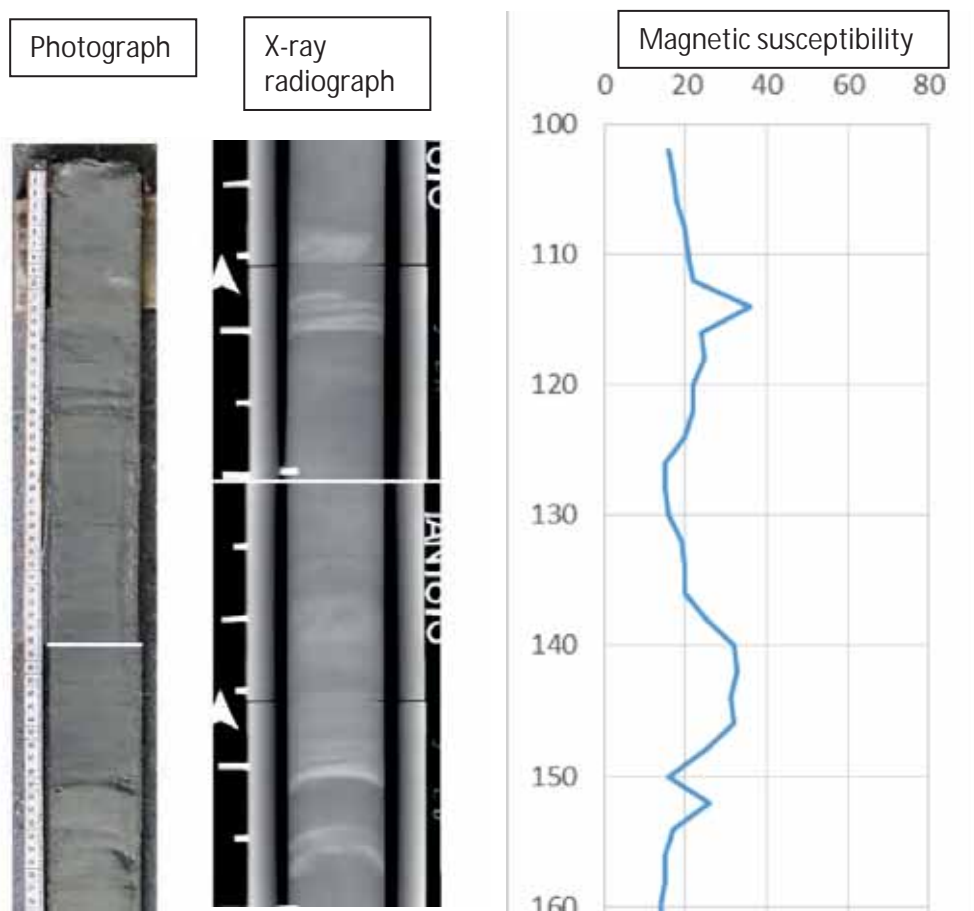


Figure 3-1: Example of core photograph (left), X-ray radiograph (centre) and magnetic susceptibility (right) measurements.

Friday 11th November progressed well in settled weather, with collection of TOPAS sub-bottom profiles and piston coring at sites TAN1613-04 to -10. These sites were located in the southern and central Cook Strait Canyon, at the mouth of Opouawe and Pahaoa canyons, and in a lower slope gully east of Opouawe Bank. Saturday 12th November progressed with TOPAS sub-bottom profiling and piston coring at sites TAN1613-11 to -18 located at the base of Honeycomb Canyon and on the crest of Pukeroro Ridge. The weather deteriorated late afternoon, with very rough sea state and moderate swells, but did not impact on the operations. Sea state had settled by the morning of Sunday 13th. Operations progressed well through Sunday 13th with light seas and warm weather. TOPAS sub-bottom profiles and piston coring were completed at sites TAN1613-19 to -25 located on Pukeroro Ridge, the lower reaches of Uruti Basin and Turnagain Seavalleys, and in Porangahau and Akitio troughs. The latter targets produced particularly good cores with clear successions of turbidites.

On morning of Monday 14th we were met with news of the Mw 7.8 Kaikoura Earthquake. Over the next few days this would lead to a chain of correspondence concerning possible response activities by *Tangaroa* during this voyage. Whilst earthquake information and response plans developed over the following days, we continued to progress with the paleoseismic programme as planned.

Monday 14th November progressed with *Tangaroa* moving progressively NE. We obtained seven piston cores from sites TAN1613-26 to -32 at the base of Madden Canyon, Madden Basin, Paoanui Trough,

and an un-named basin NE of Akitio Trough. These cores recovered generally excellent turbidite records, and the first signs of more significant volcanic ash.

Tuesday 15th November saw piston cores collected from Omakere Trough, upper Paoanui Trough, and perched lower slope basins east of Rock Garden and Ritchie Ridge (stations TAN1613-33 to –38). The perched basin cores are unfortunately all <1.5 m long, with the corer usually bottoming out on a very dense fine-grained rhyolitic volcanic ash layer. We continued NE along the offshore Hawkes Bay deformation front on Wednesday 16th November collecting six piston cores at similar sites in other perched slope basins east of Ritchie Ridge, in Poverty Canyon, and in a perched basin on the lower slope east of the Paritu Ridges off Poverty Bay (stations TAN1613-39 to –44). The latter site represented the most northerly location of the voyage. Heading SW back down the margin, the first multicore was collected east of Ritchie Ridge. On Thursday 17th, we collected samples from five stations (TAN1613-45 to –49). The weather during this day developed from slight to moderate seas, in the morning to rough conditions in the late evening. Multicores were recovered from a perched basin east of Rock Garden and from Paoanui Trough, and a piston core from Northern Akitio Trough. Two piston cores were collected from the Hikurangi Trough off southern Hawkes Bay, one from the channel axis, and one from the adjacent overbank basin floor.

Although important multicoring sites on the southern Hawkes Bay and Wairarapa slopes were yet to be completed at this stage of the voyage, the above coring in Paoanui Trough off southern Hawkes Bay at station TAN1613-49 represented the final paleoseismic work undertaken prior to initiating specific Kaikoura Earthquake response work.

Unfortunately, the late hours of Thursday 17th and early hours of Friday 18th saw rough seas and heavy swells, requiring reduced speed and 15 hours for the transit to the first coring site planned in response to the Kaikoura Earthquake. In improving weather on Friday 18th, this phase of the survey commenced with a piston core and multicores recovered successfully before midnight from the basin floor of the Hikurangi Trough off southern Wairarapa (TaAN1613-50 to -51).

With weather continuing to improve, Saturday 19th November saw the collection of piston cores and multicores from the Hikurangi channel and basin floor about 100km east of southern Cook Strait (stations TAN1613-52 to –56). Sunday 20th November progressed in good conditions with the collection of the last five piston and multicores from the southern Hikurangi Trough offshore of eastern Marlborough (stations TAN1613-57 to –61).

In excellent weather conditions in the late afternoon of Sunday 20th November, we transited to the outer Marlborough shelf to commence fault-mapping activities. After a water SVP was completed, *Tangaroa* commenced multibeam bathymetric and TOPAS sub-bottom profiling along the Chancet Fault. Our seafloor mapping continued through Monday 21st November, in excellent weather until 0230 h Tuesday 22nd November, at which all survey operations were terminated for the final transit to Wellington heads. During this time, a block of multibeam data and zig-zag set of reconnaissance sub-bottom profiles were successfully acquired along the Needles Fault trace. The multibeam bathymetric data were cleaned on board *Tangaroa* during the transit to Wellington, providing processed data for immediate preliminary interpretation by 0700 h Tuesday 22nd November.

Tangaroa returned to Aotea Wharf by 0800 h on Tuesday 22nd November. After MPI clearance was granted, equipment and cores were subsequently unloaded from *Tangaroa*. Preliminary results of the survey were immediately released via a NIWA Media release, and a Media briefing was held at NIWA at 1330 h.

4 Preliminary results

4.1 Cores and clastic sedimentation

4.1.1 Overview of sediment cores recovered

A total of 50 piston cores and 10 multicores were completed during the survey (Table 4-1, Stations TAN1613-02 to -61), including those related to the 14th November M_w 7.8 Kaikoura Earthquake response work (TAN1613-50 to -61).

The piston cores are individually up to 5 m length, and collectively represent about 140 m of total core material. Based on inferred sedimentation rates in the area, we suspect the longer cores probably span the last ~5000-10,000 years.

Figure 4-1 provides a summary overview map of their distribution. Figures 4-2 and 4-3 provide enlarged regional details of their locations together with inferred major turbidity current pathways interpreted from multibeam data and numerical modelling.

Appendix A provides details of each individual core site and core logging data.

Below, we summarise some of the major ship-board observations of event stratigraphy recognised in the sediment cores recovered from different geographic areas and sedimentary distributary systems. These largely fall into groups associated with major canyons, gullies, slope basins and ridges above the Hikurangi subduction megathrust, and sites in the Hikurangi Trough associated with the Hikurangi Channel and basin floor, outboard of the subduction accretionary wedge.

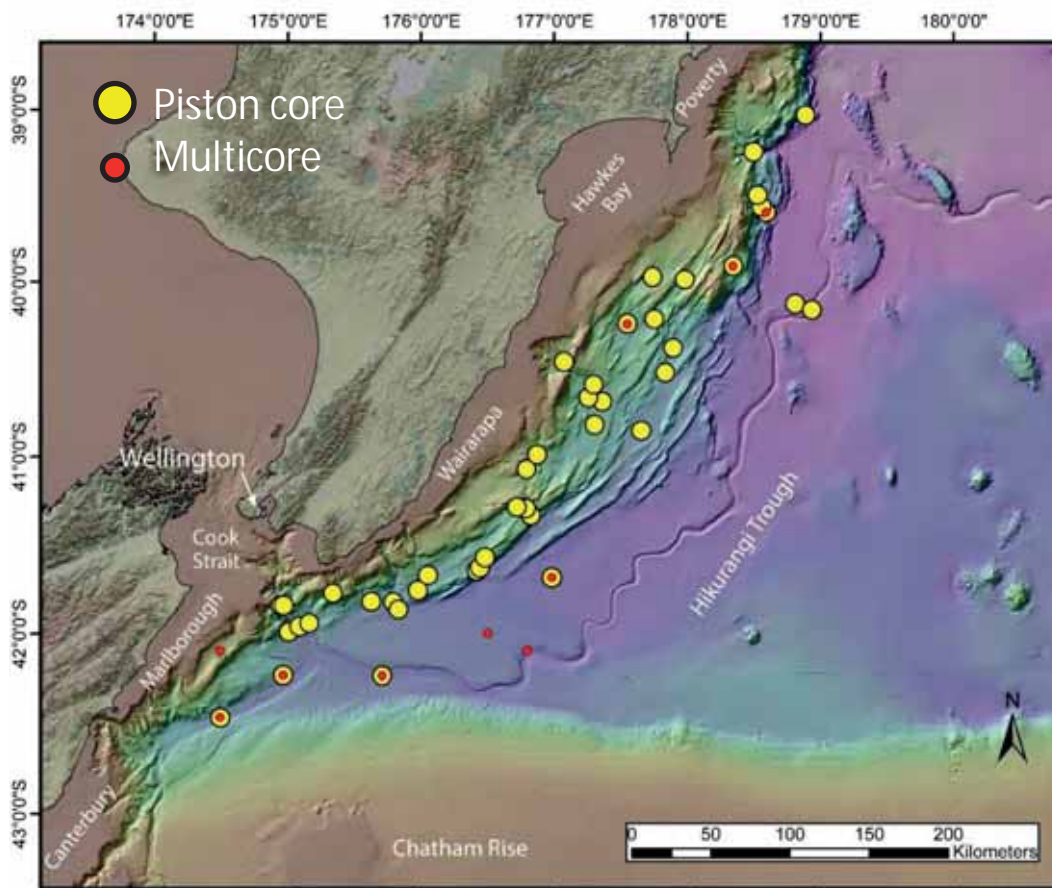


Figure 4-1: Map showing the distribution and type of sediment cores recovered on TAN1613 survey. See Figures 4-2 and 4-3, Table 1, and Appendix A and B for additional details.

Table 4-1: Summary information of sediment cores collected on voyage TAN1613.

Sample Number	Planned Core Site ID	Date - NZST	Time (NZST)	Lat_DD	Long_DD	Water Depth (m)	Gear Type	Core Length (m)	Number of core sections	Cutter catcher sample bags	Core Target	Core Description
TAN1613-01		10/11/2016	15:30	-41.99342	175.00552	2432	SVP		N/A			
TAN1613-02	Campbell 1	10/11/2016	18:40	-41.99285	175.00678	2417	Piston Core	1.87	2		Mouth of Campbell Canyon, above Hik Basin floor	Hemipelagic mud with variable structure. Alternating intervals of colour laminated, convoluted colour laminated, and massive.
TAN1613-03	Cook 6	10/11/2016	21:48	-41.96137	175.08787	2526	Piston Core	0.54	1	3	Mouth of Cook Strait Canyon, 300 m Nth of scour hole	Laminated hemipelagite over sand-gravel turbidite with shell fragments
TAN1613-04	Opouawe 2	11/11/2016	1:14	-41.94383	175.16383	2297	Piston Core	3.34	4		Mouth of Opouawe Canyon, offset Sth of strong Bkstr, above Hik Basin floor	Hemipelagic mud with variable structure. Alternating intervals of colour laminated, convoluted colour laminated, and massive. Thin sandy laminae below 2m, and lots of black smelly sulphur towards the base.
TAN1613-05	Cook 2	11/11/2016	4:54	-41.84278	174.94307	1889	Piston Core	0.71	1	1	Cook St Canyon outer bend terrace/slope, elevated 110 m above c. floor	Hemipelagite laminated mud over 2 gravel turbidites towards base
TAN1613-06	Cook 4	11/11/2016	7:26	-41.84358	174.96862	2007	Piston Core	1.12	2	1	Mid Cook Strait Canyon, above lower corner	Variably laminated hemipelagite over 3 stacked sand-gravel turbidites with shell fragments
TAN1613-07	Opouawe 1	11/11/2016	11:10	-41.77633	175.34000	1408	Piston Core	4.90	5		Upper Opouawe canyon, Sthn terrace	Interbedded hemipelagite and muddy/sandy turbidites. Turbidites generally, 5 cm thick.
TAN1613-08	Wai 7	11/11/2016	14:59	-41.82370	175.62760	2449	Piston Core	2.81	3		Mouth of lower slope gully system NE of Opouawe Bank, above Hik Basin floor	Interbedded ?hemipelagites, 140 cm thick ?debrite, and possible turbidites in section 1
TAN1613-09	Pahau 4	11/11/2016	18:06	-41.82522	175.79335	2525	Piston Core	3.74	4	1	Lower reaches of Pahaua Canyon, below confluence with Honeycomb Canyon sediment delivery	Interbedded hemipelagic mud and thin bedded sandy turbidites, plus one thick (decimeter scale) turbidite. Apparent coring deformation in section 3 & 4

TAN1613-10	Pahau 3	11/11/2016	21:06	-41.86775	175.83205	2569	Piston Core	4.83	5	1	Mouth of Pahaoa Canyon, sediment waves downstream of scour holes	Hemipelagic mud interbedded with sandy turbidites up to 5 cm thick.
TAN1613-11	Honey 2	12/11/2016	1:01	-41.75933	175.97750	2232	Piston Core	4.82	5		Mudwaves on the backlimb basin behind Glendhu Ridge, below Honeycomb Canyon	Hemipelagic mud interbedded with sandy turbidites up to 5 cm thick.
TAN1613-12	Honey 1	12/11/2016	21:06	-41.67437	176.05347	2106	Piston Core	3.47	4		Slope basin floor at the mouth of Honeycomb Canyon	Hemipelagic mud interbedded with sandy turbidites up to 5 cm thick.
TAN1613-13	Puke 7	12/11/2016	8:01	-41.65030	176.41735	1853	Piston Core	1.55	2		Small perched basin atop Sthn Pukeroro Ridge	Hemipelagic mud with slight increase in sand content at 43-48 cm. Abundant forams.
TAN1613-14	Puke 7 Repeat	12/11/2016	10:09	-41.64870	176.41932	1864	Piston Core	1.80	2		Small perched basin atop Sthn Pukeroro Ridge. Repeat of station TAN1613-13	Hemipelagic mud throughout. Disturbed in upper 20 cm.
TAN1613-15	Puke 8	12/11/2016	12:43	-41.63095	176.44058	1758	Piston Core	3.47	4		Small perched basin atop Sthn Pukeroro Ridge	Hemipelagic mud throughout. Strong methane small.
TAN1613-16	Puke 9	12/11/2016	15:22	-41.57257	176.48015	1830	Piston Core	4.92	5		Small perched basin atop Sthn Pukeroro Ridge	Hemipelagic mud with some colour laminations, mottling in section 5
TAN1613-17	Puke 2	12/11/2016	19:40	-41.33617	176.82550	1750	Piston Core			1	Small perched basin atop Nthn Pukeroro Ridge	Small bagged sample only of grey hemipelagic mud
TAN1613-18	Puke 2 Repeat	12/11/2016	21:40	-41.33673	176.82773	1754	Piston Core	1.15	2		Small perched basin atop Nthn Pukeroro Ridge	Hemipelagic mud with possible turbidite and multiple sand blebs in lower section
TAN1613-19	Puke 1	13/11/2016	0:43	-41.29767	176.79233	1839	Piston Core	1.52	2		Small perched basin atop Nthn Pukeroro Ridge	Thin and thick bedded turbidites interbedded with hemipelagic. This reddish grey lephra at 71cm.
TAN1613-20	Puke 4	13/11/2016	3:17	-41.29030	176.72107	1829	Piston Core	4.35	5		Northern end of Pukeroro Trough, under slope below Uruti Ridge	Mainly hemipelagic mud with rare turbidites
TAN1613-21	Uruti 2	13/11/2016	6:52	-41.07508	176.79460	1507	Piston Core	4.58	5		Lower channel draining northern Uruti Basin	Hemipelagic mud

TAN1613-22	Turn 1	13/11/2016	9:58	-40.99200	176.87350	1535	Piston Core	4.90	5	Lower slope in the mouth of Tumagain Seavalleys	Hemipelagic mud
TAN1613-23	MC 7	13/11/2016	14:53	-40.82193	177.30507	1984	Piston Core	4.23	5	Centre of Porangahau Basin	Turbidites interbedded with hemipelagite.
TAN1613-24	MC3	13/11/2016	17:52	-40.69005	177.36555	1952	Piston Core	4.42	5	Porangahau Basin, mouth of Madden Canyon	Turbidites interbedded with hemipelagite.
TAN1613-25	MC 1	13/11/2016	22:09	-40.85567	177.65550	2409	Piston Core	4.78	5	Centre of Akitio Trough	Hemipelagic mud interbedded with silty/sandy turbidites in basal 3m. 12cm thick ash at 1.39m.
TAN1613-26	MC 11	14/11/2016	3:27	-40.66477	177.26073	1809	Piston Core	4.15	5	Terrace on Sih side of lower Madden Canyon, NW Porangahau Basin	Hemipelagite with one sandy turbidite and some sandy blebs
TAN1613-27	MC 5	14/11/2016	5:57	-40.59385	177.29883	1950	Piston Core	4.10	5	Sediment waves in lower Madden Canyon	Interbedded sandy and muddy turbidites and ash bleb, and possible overlying volcanoclastic turbidite in section 5
TAN1613-28	MC 6	14/11/2016	9:29	-40.46218	177.07613	1398	Piston Core	4.80	5	Madden Basin, upper Madden Canyon system	Interbedded hemipelagite and turbidites. One volcanoclastic turbidite in section 5, one tephra at 2.48m
TAN1613-29	HB 4	14/11/2016	15:26	-40.24335	177.55080	1899	Piston Core	3.35	4	Inner Paoanui Basin	Hemipelagic mud interbedded with silty/sandy turbidites. Tephra in section 2 at 1.49 m
TAN1613-30	HB 3	14/11/2016	17:39	-40.21733	177.75540	2042	Piston Core	4.70	5	Central Paoanui Basin	Hemipelagite with some turbidites in section 3, 4 and 5. More than 4 tephra in sections 3, 5 and 5.
TAN1613-31	HB 2	14/11/2016	21:10	-40.38308	177.89562	2275	Piston Core	1.44	2	Un-named basin inside NW Akitio Trough	Hemipelagites with one turbidite. Tephra in section 2
TAN1613-32	HB 2 repeat	14/11/2016	23:15	-40.38350	177.89625	2264	Piston Core	1.56	2	Un-named basin inside NW Akitio Trough	Hemipelagites overlying thick tephra section at 1.42-1.56m
TAN1613-33	HB 5	15/11/2016	4:13	-39.97272	177.74065	1472	Piston Core	4.50	5	Omakere Trough, Sih Hawkes Bay	Hemipelagic mud interbedded with silty/sandy turbidites. One tephra bleb at 66 cm
TAN1613-34	HB 6	15/11/2016	7:39	-39.98885	177.98300	1508	Piston Core	1.71	2	Northern Paoanui Trough, east of Omakere Ridge	Hemipelagite with some laminated intervals (turbidites?)
TAN1613-35	Rock 1	15/11/2016	11:56	-39.90997	178.34648	1908	Piston Core	1.13	2	Lower slope mini-basin Nth of Rock Garden	Hemipelagites with at least 1 turbidite and a tephra at the base of section 2

TAN1613-36	Rock 1 Repeat	15/11/2016	15:01	-39.90985	178.34660	1902	Piston Core	1.43	2	Lower slope mini-basin Nth of Rock Garden	Hemipelagite with 3 turbidites (one possibly volcanoclastic) and at least 1 tephra in section 2
TAN1613-37	Ritchie 2	15/11/2016	19:13	-39.60077	178.59337	2662	Piston Core	0.94	1	Outer slope perched basin east of Ritchie Ridge	Hemipelagite with 2 tephra
TAN1613-38	Ritchie 2 Repeat	15/11/2016	22:05	-39.60107	178.59320	2663	Piston Core	1.26	2	Outer slope perched basin east of Ritchie Ridge	Hemipelagite with 2 tephra, one overlain by possible volcanoclastic turbidites
TAN1613-39	Ritchie 1	16/11/2016	1:26	-39.56663	178.55880	2506	Piston Core	1.21	2	Outer slope perched basin east of Ritchie Ridge	Hemipelagic mud interbedded with silty/sandy turbidites, one possible volcanoclastic turbidites, and 2 tephra
TAN1613-40	Ritchie 1 Repeat	16/11/2016	3:36	-39.56630	178.55903	2505	Piston Core	1.22	2	Outer slope perched basin east of Ritchie Ridge	Hemipelagite with 2-3 turbidites, and 2-3 tephra
TAN1613-41	Ritchie 3	16/11/2016	6:18	-39.50143	178.53057	2242	Piston Core	1.17	2	Outer slope perched basin east of Ritchie Ridge	Hemipelagites overlying one volcanoclastic turbidite and one tephra
TAN1613-42	Poverty 2	16/11/2016	10:43	-39.24550	178.49422	2340	Piston Core	1.82	2	Sth arm of Poverty Canyon, middle slope	Hemipelagic mud interbedded with silty/sandy turbidites.
TAN1613-43	Poverty 1	16/11/2016	15:54	-39.03490	178.88582	2785	Piston Core	1.53	2	Outer slope perched basin east of Paritu Ridge	Oxidised surficial sediment overlying hemipelagite
TAN1613-44	Ritchie 2	16/11/2016	21:54	-39.60060	178.59330	2685	Multicore	0.65		Outer slope perched basin east of Ritchie Ridge	Oxidised surficial sediment overlying hemipelagite
TAN1613-45	Rock 1	17/11/2016	1:46	-39.91018	178.34578	1915	Multicore	0.63		Lower slope mini-basin Nth of Rock Garden	Hemipelagite with one sandy layer (obs thru liner)
TAN1613-46	HIK 16	17/11/2016	6:34	-40.12770	178.81183	3219	Piston Core	4.30	5	Hikurangi Trough basin floor, outside channel, E of Rock Garden	A suite of interbedded muddy to sandy turbidites and hemipelagites. One tephra(283.5-285cm)
TAN1613-47	HIK 18	17/11/2016	10:24	-40.16283	178.93962	3415	Piston Core	3.13	4	Hikurangi Channel E of Rock Garden	Decimetre scale dark turbidites interbedded with cm scale hemipelagites. Unlike slope cores, here a clear colour difference between T and H

TAN1613-48	HB 1	17/11/2016	18:12	-40.52598	177.83665	2267	Piston Core	5.00	5	Un-named basin inside NW Akitia Trough	Very fine sandy silty hemipelagites interbedded with silty and fine to very fine sandy turbidities reworked tephra turbidite 52.5-62.5 cm
TAN1613-49	HB 4	17/11/2016	22:32	-40.24415	177.55075	1907	Multicore	0.65	1	Inner Paoanui Basin	Brown oxidised layer (7cm) overlying hemipelagite interbedded with dm scale turbidite?
TAN1613-50	HIK 9	18/11/2016	20:47	-41.68672	176.98278	2864	Multicore	0.63		Hikurangi basin floor east of southern Aorangi Ridge	Brown oxidised layer (7cm) overlying hemipelagite interbedded with dm scale turbidite
TAN1613-51	HIK 9	18/11/2016	23:33	-41.68612	176.98147	2848	Piston Core	4.37	5	Hikurangi basin floor east of southern Aorangi Ridge	Interbedded turbidities and hemipelagites
TAN1613-52	HIK 20	19/11/2016	4:49	-42.09625	176.80105	2969	Multicore	0.64		Hikurangi Channel, first major meander loop E of Cook Strait (site TAN1507-19)	0.5 m turbidite overlying hemipelagite or turbidite
TAN1613-53	HIK 21	19/11/2016	8:17	-41.99917	176.50097	2733	Multicore	-0.5?		Hikurangi basin floor east of Cook Strait (site TAN1507-12)	Sub-core taken from multicore but not yet described. Kept for scanning whole
TAN1613-54	HIK 7	19/11/2016	14:41	-42.23588	175.70825	2750	Multicore	0.27		Hikurangi Channel 40 km E of Cook Strait Canyon mouth	Fluid mud overlying fine sands and silts; disturbed due to air bubbling thru sample
TAN1613-55	HIK 7 Repeat	19/11/2016	16:47	-42.23600	175.70893	2749	Multicore			Hikurangi Channel 40 km E of Cook Strait canyon mouth	Fluid mud overlying fine sands and silts; disturbed due to air bubbling thru sample
TAN1613-56	HIK 7	19/11/2016	19:08	-42.23588	175.70847	2741	Piston core	1.36	2	Hikurangi Channel 40 km E of Cook Strait Canyon mouth	Sandy hemipelagite sequences with interbedded silty turbidities, organic layers for 55.5 to 59 severe core deformation from 70-136.5 cm
TAN1613-57	HIK 4	20/11/2016	1:16	-42.23283	174.96500	2439	Piston core	4.55	5	Mud waves on the flank of the Hikurangi Channel wall (site CR2055 S964)	Decimetre scale graded turbidities with possible interbedded with cm scale hemipelagites.
TAN1613-58	HIK 4	20/11/2016	1:16	-42.23283	174.96480	2446	Multicore	0.65		Mud waves on the flank of the Hikurangi Channel wall (site CR2055 S964)	Fluid mud overlying fine sands and bioturbated v. fine sandy silt with blebs of oxidised reddish brown sediment, overlying interbedded fine sands and silts

TAN1613-59	HIK 2	20/11/2015	8:16	-42.46913	174.49060	2386	Multicore	0.22		Turbidite depocentre half way along the Marlborough section of the Hikurangi Channel	Soupy turbidite over somewhat disturbed mud top of the underlying turbidite. Fresh but broken echinoderm within base of overlying turbidite. Brownish stain on the lower mud top, specifically around a worm tube hole (possible representing pre-EQ seafloor).
TAN1613-60	HIK 2	20/11/2016	11:15	-42.46963	174.49132	2376	Piston core	1.07	2	Turbidite depocentre half way along the Marlborough section of the Hikurangi Channel	Black very fine sand grading up throughout core. Upper soupy turbidite in Multicore not preserved in PC
TAN1613-61	Marl 2	20/11/2016	15:43	-42.09943	174.48862	1150	Multicore	0.40		Kekerengu Bank upper slope basin	
TAN1613-62		20/11/2016		-41.88500	174.52667		SVP				

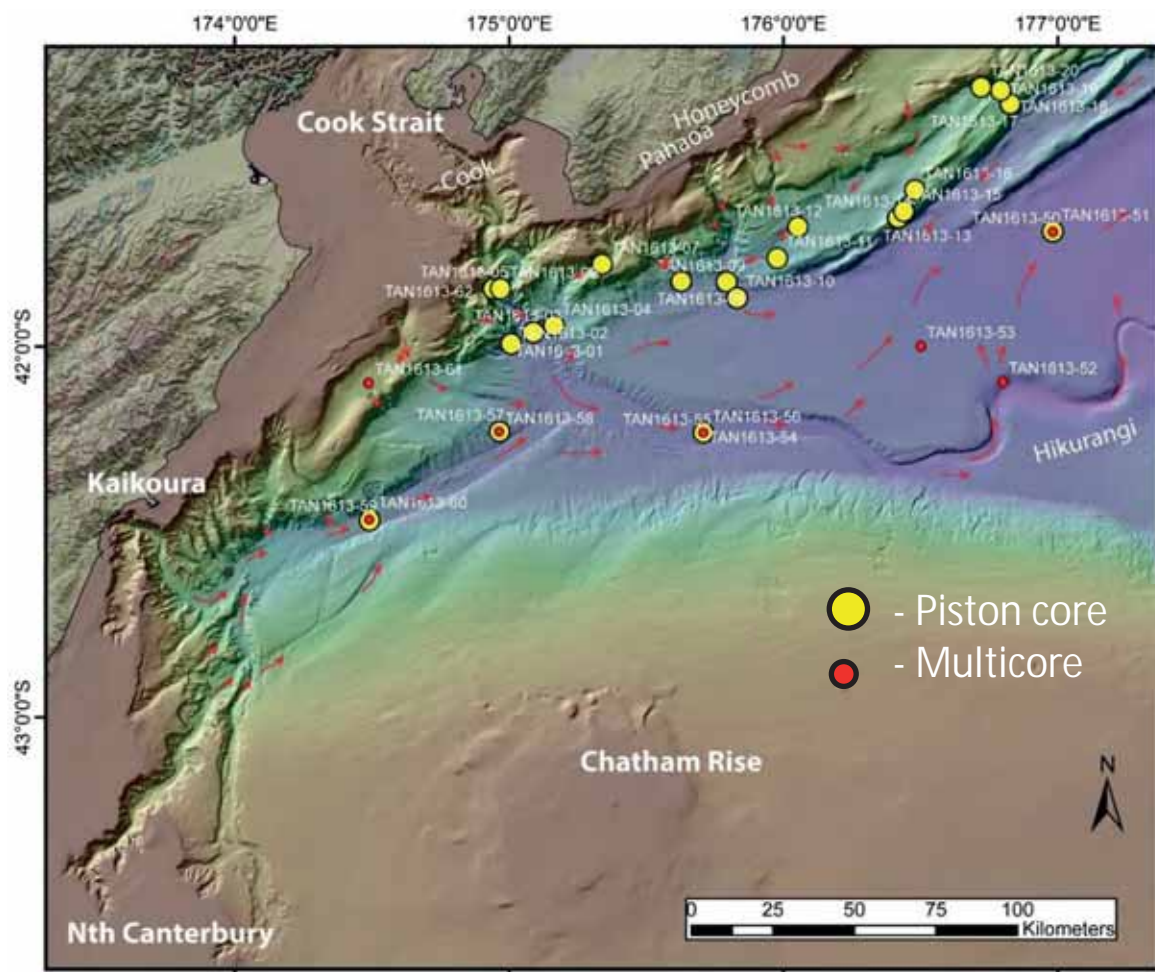


Figure 4-2: Map showing the distribution and type of core sites in the southern part of the region. Red arrows indicate inferred turbidity current dispersal pathways.

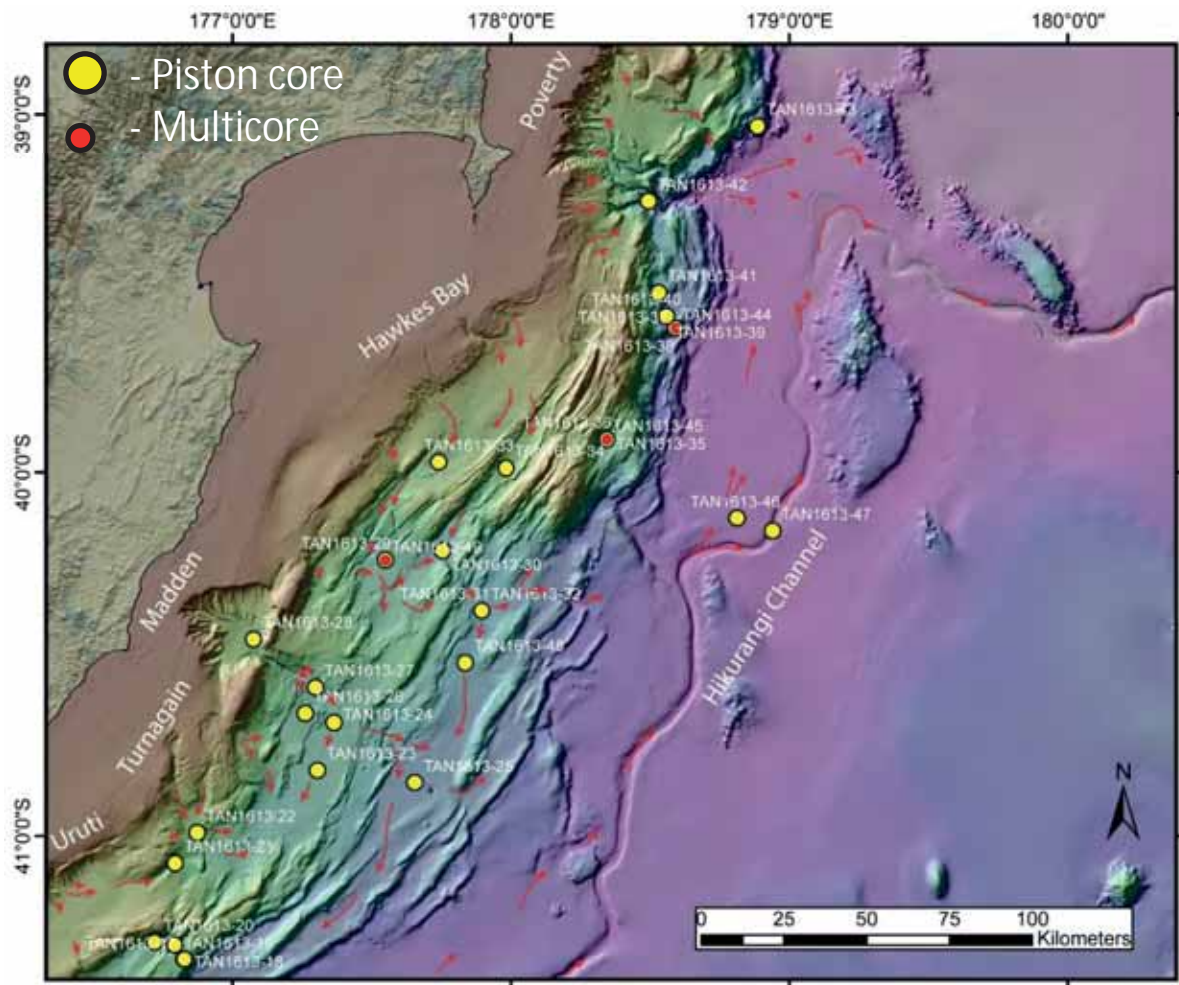


Figure 4-3: Map showing the distribution and type of core sites in the northern part of the region. Red arrows indicate inferred turbidity current dispersal pathways.

4.1.2 Cook Strait and Campbell canyons

Cores from Cook Strait Canyon where characterised by a similar sedimentary sequence containing a single gravelly turbidite that is up to 20 cm thick, overlain by hemipelagic very fine sandy silts (Figure 4-4). Gravelly turbidites are present in cores from the canyon floor (TAN1613-06 Cook 4), a terrace perched above the canyon floor (TAN1613-05 Cook2), and at the mouth of the canyon (TAN1613-03 Cook 6). The turbidite gravels contained abundant shell fragments and clasts that were sub-rounded and had long-axis diameters up to 10 mm. The core from the canyon floor contained a sequence of three fining upward beds. The hemipelagic sediments overlying the turbidite had a similar thickness in all cores and were composed of very fine sandy silt with abundant planar or convoluted dark colour laminations. A similar sequence of hemipelagite mud was retrieved in the core from the base of the Campbell Canyon (TAN1613-02), where it overlies consolidated very fine sandy silts that are massive or contain convoluted bedding.



Figure 4-4: True colour image and x-ray radiograph of a core from Cook Strait Canyon. TAN1613-05 (Cook 2) showing consolidated silts overlain by a gravelly turbidite and hemipelagite.

4.1.3 Southern Wairarapa canyons and slope basins

Cores from the Pahaoa and Honeycomb canyons were characterised by interbedded hemipelagic mud and sandy turbidites up to 5 cm thick (Figure 4-5). Each core from these systems contains between 10 and 20 turbidites depending on whether X-radiography and or visual logging were used to identify them. Turbidites were characterised by one or more massive to upward fining, black, fine- to very-fine sand beds. The sand beds may be overlain by silty turbidite tails. The hemipelagic intervals between turbidites were characterised by olive to dark greenish grey, very-fine sandy silt with isolated (generally convoluted) dark colour laminations. In most instances it was not possible to visually determine the boundary between the silty tail of turbidites and the overlying hemipelagite.

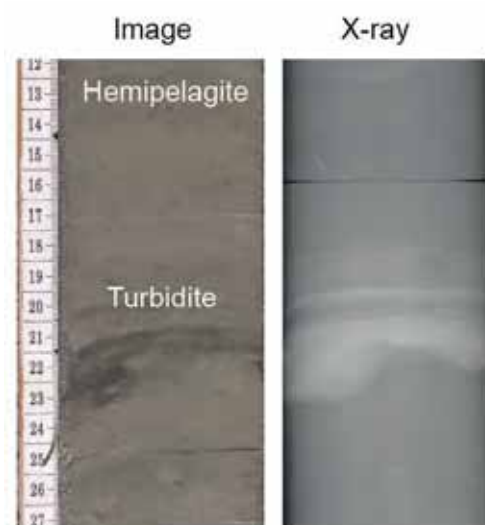


Figure 4-5: True colour image and X-ray radiograph of a core from the base of Pahaoa Canyon. TAN1613-10 (Pahau 3) showing a sandy turbidite interbedded with hemipelagite.

Cores from Opouawe Canyon (TAN1613-04 Opouawe 1; TAN1613-07 Opouawe 2) and immediately adjacent to the lower slope gully system NE of Opouawe Bank (TAN1613-08 Wai 7) had a lower number of turbidites per interval of depth than cores from the Pahaoa and Honeycomb systems. Hemipelagic sequences in these cores are similar to those from Cook Strait and are composed of dark olive grey, very-fine sandy silts with abundant dark planar and convoluted colour laminations. The core from the mouth of the Opouawe Canyon (Opouawe 2) contains a thin sequence of interbedded hemipelagite and turbidites (~60 cm) overlain by grey and bluish black very-fine sandy silt that has convoluted bedding and is interpreted as a debrite (Figure 4-6).

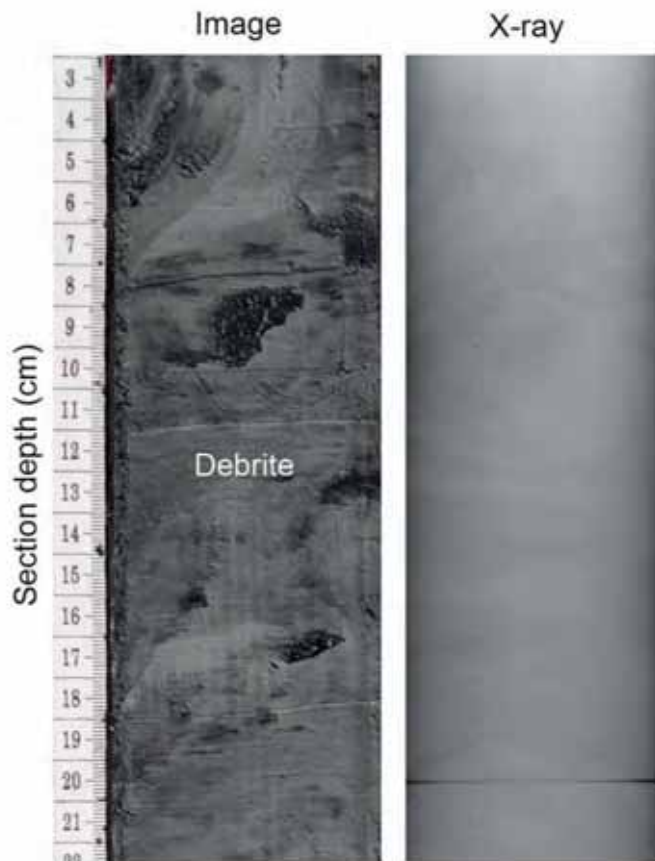


Figure 4-6: True colour image and X-ray radiograph of the debrite deposit in core TAN1613-04 from the base of Opouawe Canyon (Opouawe 2).

Core from the northern Pukeroro Trough also contains isolated sandy silt turbidites that have multiple coarse laminations at their base and are interbedded with hemipelagite sediments characterised by greenish grey very-fine sandy silt with few colour mottles or laminations (Figure 4-7).

Cores from the mouths of Turnagain Sea Valley and northern Uruti Basin are different from those of the other southern Wairarapa canyons and slope basin sites in that they are composed of near continuous hemipelagite sequences with no obvious turbidites. Hemipelagites in these cores were composed of dark greenish grey, very-fine sandy silt with a lower density of colour mottling and convoluted colour laminations compared to cores from further south along the margin.

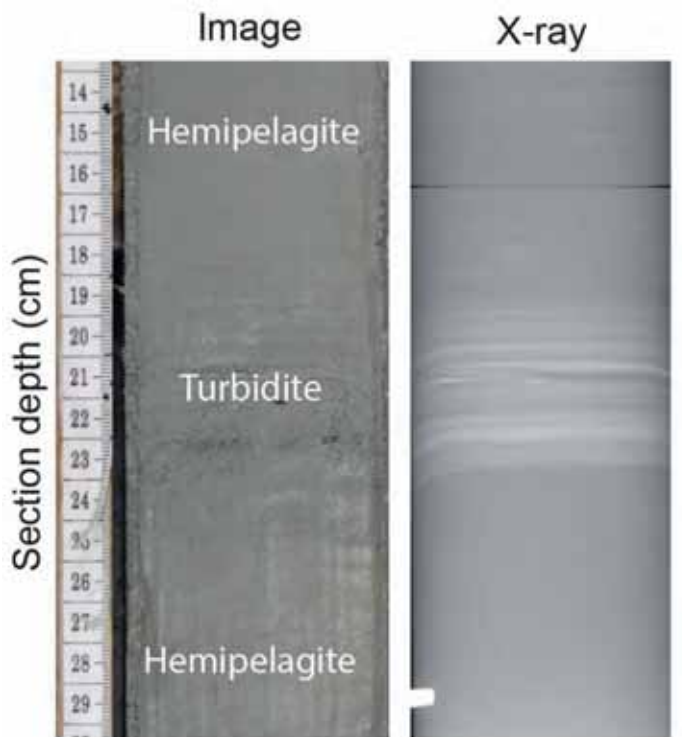


Figure 4-7: True colour image and X-ray radiograph of core TAN1613-20 (PUKE 4) from the northern Pukeroro Trough. Core shows hemipelagite mud interbedded with a sandy silt turbidite.

4.1.4 Northern Wairarapa canyons and slope basins

The cores from the Madden Canyon and the Porangahau Basin are characterised by interbedded hemipelagites, silty turbidites, and sandy turbidites. Hemipelagites are composed of dark greenish to greenish grey, very-fine sandy silts, with isolated darker colour mottles and convoluted colour laminations. Turbidite morphology ranges from silty turbidites with little structure to complex sandy turbidites with multiple upward fining units at their base (e.g., Figure 4-8). Turbidite numbers range from 15-30 turbidites per core. Only in isolated instances was it possible to visually distinguish hemipelagites from the tails of silty turbidites. The core from within Madden Basin at the head of the canyon (TAN1613-24; MC3) exhibited a higher number of silty turbidites compared to cores from the Madden Canyon mouth (TAN1613-27 MC5) or in the Porangahau Basin (TAN1613-23 MC7; TAN1613-24 MC3). The latter tended to have thicker and more structurally complex sandy bases, which is consistent with our pre-cruise turbidity current modelling.

Two cores from the Madden Canyon system and lower slope basins contain more subtle evidence of fine-grained turbidites. Core TAN1613-26 (MC11) located on a terrace on southern side of lower Madden Canyon was dominated by hemipelagite and contained few turbidites. The core located in the centre of Akitio Trough in the outer Madden distributary system (TAN1613-25 (MC1) was composed of apparent hemipelagite in the upper 1.5 m of the core and below this depth the frequency and structural complexity of turbidites increased towards the base of the core.

The cores from the upper slope off southern of Hawkes Bay, including Omakere Trough (TAN1613-33; HB5) and the inner Paoanui Basin (TAN1613-49; HB4), are characterised by interbedded hemipelagite, silty turbidites, and sandy turbidites. Hemipelagic sediments are characterised by dark greenish to greenish grey very-fine sandy silts that are generally massive and contain isolated convoluted colour laminations. Hemipelagic sediments dominate the upper 1 m of the cores from the upper slope and the frequency and structural complexity of turbidites increases below this depth

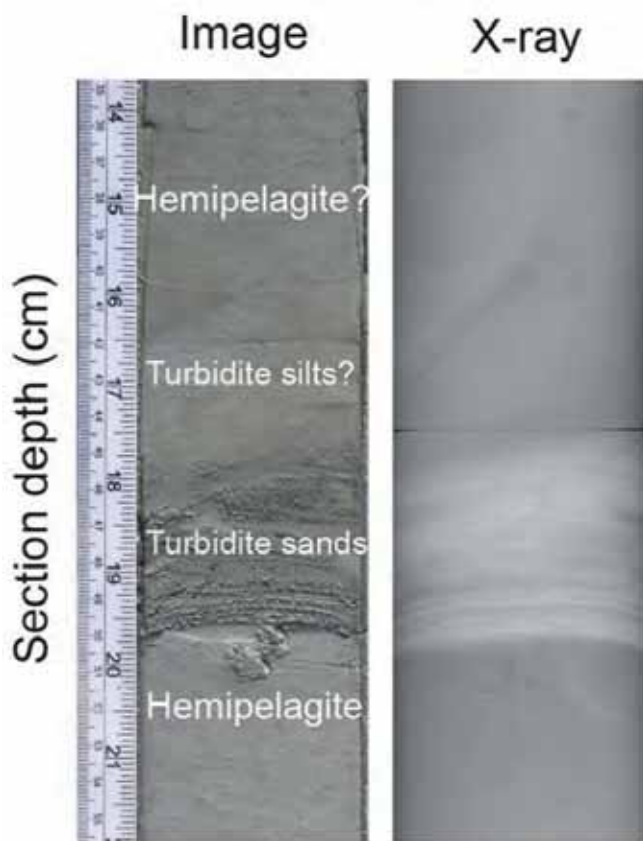


Figure 4-8: True colour image and X-ray radiograph of core TAN1613-23 (MC7 section 2) from the Porangahau Basin showing a structurally complex turbidite with a sandy base and multiple fining upward sandy layers.

(Figure 4-9). Turbidites in these cores range from structurally complex sandy turbidites with multiple fining upward units to structurally simple silty turbidites. In contrast the cores from the Paoanui Trough (TAN1613-34; HB6 and TAN1613-30; HB3) are dominated by hemipelagites and contain few visible turbidites. Similarly, the core from an un-named basin north of Akitio Trough, in the outer Hawkes Bay distributary system, was dominated by hemipelagite and contains no turbidites that can be identified visually by X-ray radiography.

4.1.5 Poverty Canyon

A single core was taken from a small basin in the mid-slope region of the Poverty Canyon's southern arm. The core was short (~1.5 m) and composed of hemipelagite interbedded with sandy turbidites up to 20 cm thick. Turbidite frequency and structural complexity increases toward the base of the core. No tephra was present in the core.

4.1.6 Perched mini-basins on thrust-faulted frontal ridges and slopes

Cores from relatively small basins perched on the southern and northern Pukeroro Ridge (TAN1613-14 to -19) are characterised by hemipelagic sequences overlying consolidated silty very fine sands. The hemipelagites are composed of greenish grey very-fine sandy silt that is generally massive with isolated convoluted darker colour laminations throughout. The absence of any structure in these cores suggest that they may represent continuous hemipelagic sequences ideal for quantifying the rate of hemipelagic deposition along this part of the Hikurangi margin.

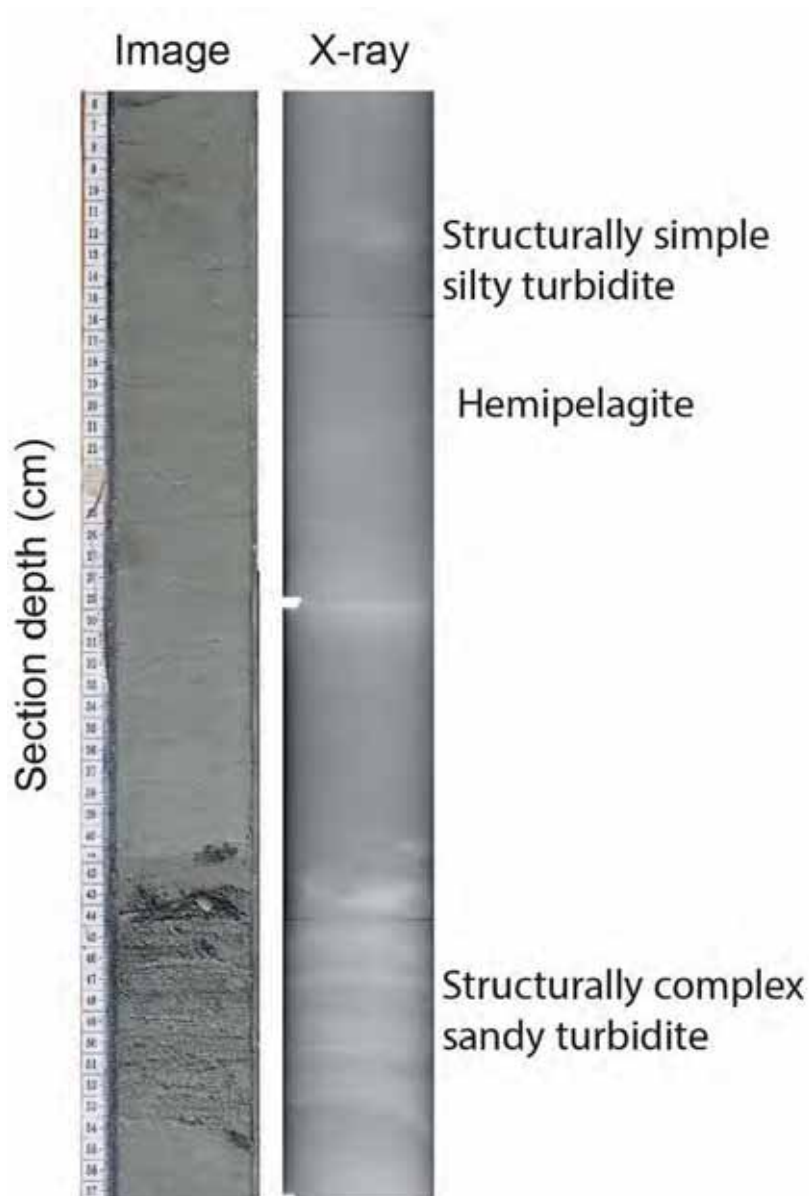


Figure 4-9: True colour image and X-ray radiograph of core TAN1613-33 (HB5) from the Omakere Trough, showing a structurally complex turbidite with a sandy base and multiple fining upward beds, and a structurally simple silty turbidite.

In contrast to the Pukeroro Ridge slope basins, the northern outer slope basin sites east of Rock Garden and Ritchie Ridge produced cores that contained hemipelagite interbedded with silty turbidites and/or tephra. Cores sited in all the slope basins were short (~1-1.2 m) and had a stiff tephra at their base that was impenetrable using R/V *Tangaroa's* piston coring system. Geophysical surveys of the sites demonstrate tens of meters of sedimentary fill in the basins beneath. Cores from the slope basin east of Rock Garden (TAN1613- 35-36; Rock1) and Ritchie Ridge each contain two silty turbidites and two tephra horizons. Basin sites east of Ritchie Ridge (TAN1613-37 and -38, Ritchie 2; TAN1613-41, Ritchie3) contain tephra beds but no turbidites.

The lower slope basin on the outer Poverty margin east of the Paritu Ridges also produced a short core (1.5 m) that had stiff tephra at its base. The sedimentary sequence overlying this tephra contained interbedded hemipelagite, silty turbidites, sandy turbidites, and tephra.

4.1.7 Hikurangi Trough

A series of piston and multi-cores were taken from within the Hikurangi Channel, levees and basin floor along the margin from southern Hawkes Bay to Kaikoura. The core from the floor of the channel east of Hawkes Bay (TAN1613-47; Hik18) contained a sequence to thick sandy turbidites interbedded with thin hemipelagite beds (Figure 4-10). Turbidites were up to 50 cm thick and structurally complex, generally containing multiple normally graded, very dark greenish grey to greenish black, fine to very fine sand beds, overlain by up to decimetre thick, very fine sandy silt tails.

Unlike many of the cores from continental slope, the silty tails of turbidites from the channel were easily distinguished from hemipelagite on the basis of colour and foraminifera content. Hemipelagites were composed of dark greenish grey, very fine sandy silt. The sedimentary sequences in cores from the channel floor east of Cook Strait (TAN1613-56, Hik 7) and off eastern Marlborough (TAN1613-59, Hik 2) demonstrate that turbidites on the channel floor thicken and become more structurally complex closer to the source region. Cores from channel levee and trough floor sites (TAN1613-46, Hik 16; TAN1613-51, Hik 9; TAN1613-57, Hik 4) had similar sedimentary sequence but with generally thinner, finer grained turbidites and thicker hemipelagic intervals.

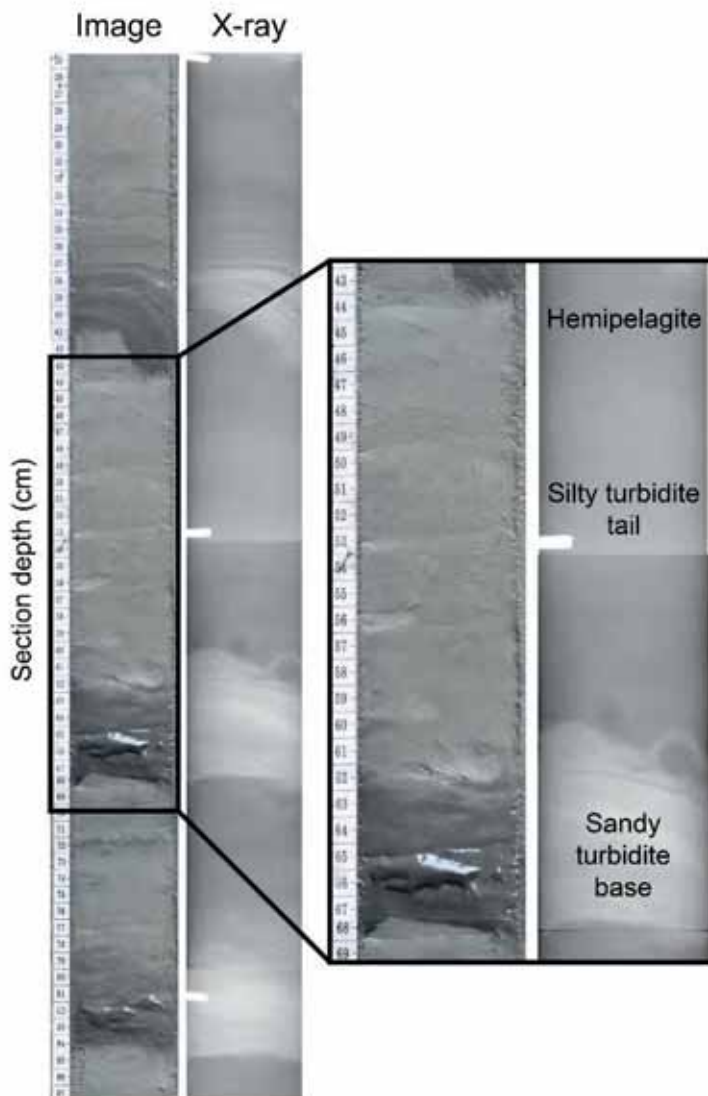


Figure 4-10: Real colour image and X-ray radiograph of core TAN1613-46 (Hik16) from the Hikurangi Channel levee east of Hawkes Bay. Example shows a sequence of sandy turbidites interbedded with hemipelagite. Enlargement shows a typical turbidite in more detail.

4.2 Volcanic Tephra

A total of 33 tephra deposits were identified within 17 cores from widely distributed sites between Poverty Bay and Cook Strait (Figures 4-11 and 4-12). Many of the cores from east of Hawkes Bay, and from the southern Hawkes Bay and Madden distributary systems, contain up to two macroscopic tephra horizons. There are also anomalous peaks in magnetic susceptibility that are not correlated with visual structures in the cores nor with increases in X-ray density and may indicate the presence of tephra's that have not been identified.

Selected observations of visible tephra are presented in Table 4-2.

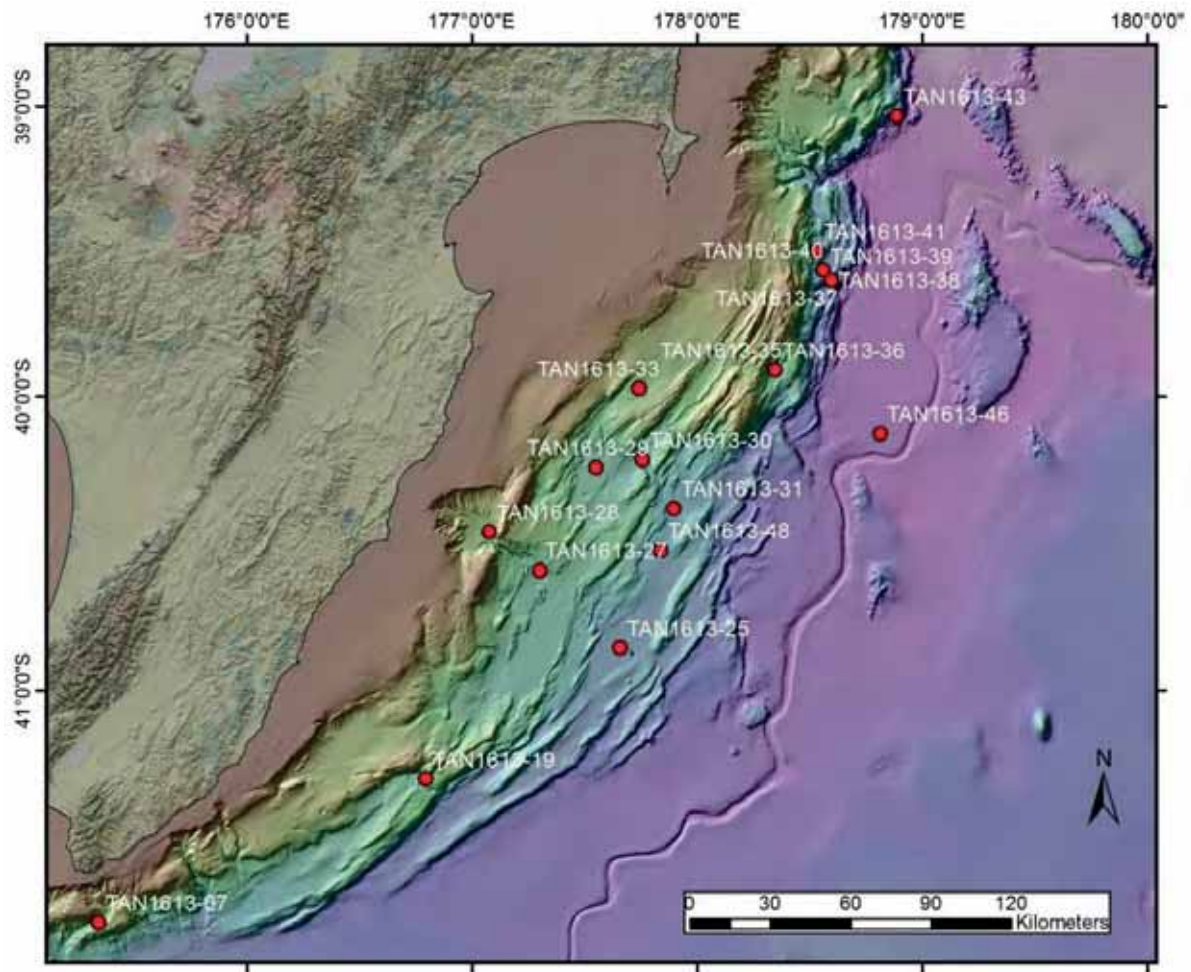


Figure 4-11: Map showing the distribution of cores containing visible volcanic tephra.

The tephra deposits comprised primary air fall horizons (18), reworked volcanoclastic rich turbidite flows (10), and small discontinuous “blebs” of probably bioturbated volcanoclastic rich material (5) (Fig. 4-13) (Table 4-2).

Primary air fall tephra (e.g., Figure 4-13a) was predominantly identified between 1-1.5 m depth in the cores found in the northern, distal sites east of Ritchie Ridge, Rock Garden, and Poverty (Fig. 4-11). These comprised of fine to very fine, light grey to pink ash, with no obvious additional minerals. In many cases the upper contacts were bioturbated and graded into the hemipelagic sediments. In some cases fining up was observed but most commonly these were massive homogeneous units. These tephra horizons were a common problem for the coring process, with all but one core unable to penetrate a particular deposit.

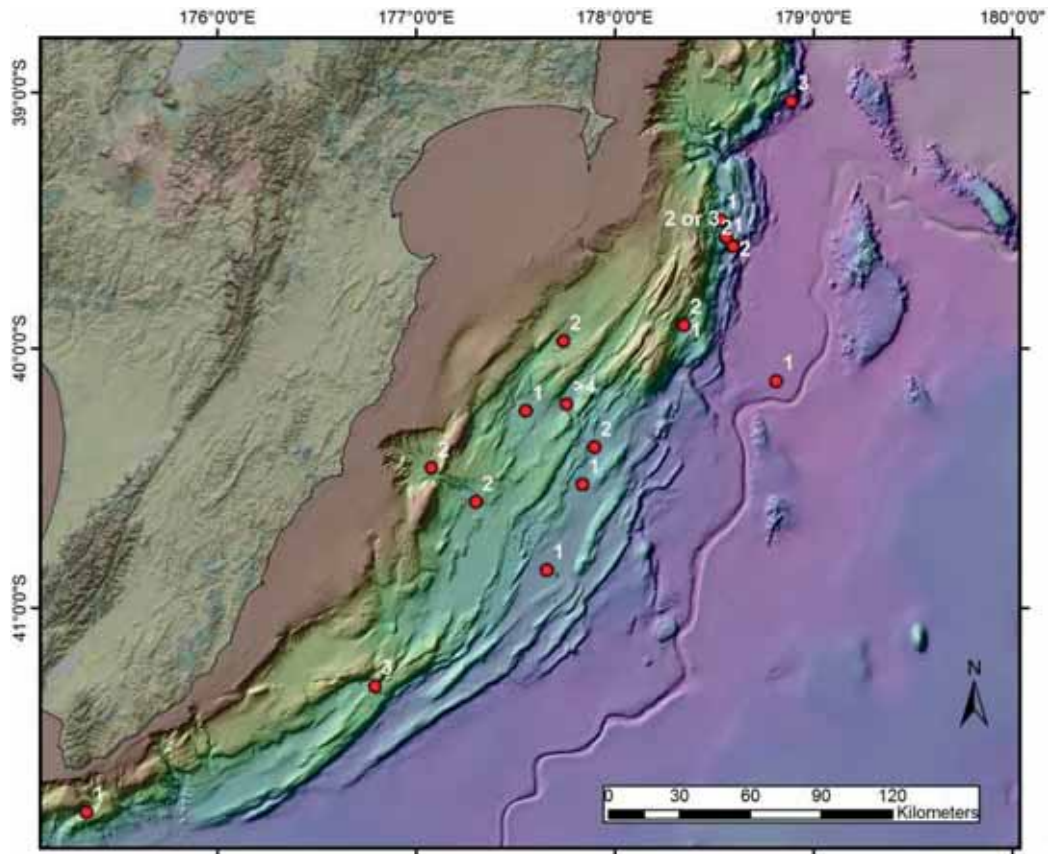


Figure 4-12: Map showing cores containing visible tephra, with the number of tephra labelled.

Volcanoclastic rich turbidites (e.g., Figure 4-13b) are found commonly overlying the primary horizons. They are identified by their coarser and more varied grain content, including a high concentration of glass shards, pumice clasts and minerals, with additional sediments and forams. They generally have a sharp erosional basal contact, with an extensive fining up sequence in which a high concentration of ash is found. In some cases these reworked deposits are not found in association with a primary air fall deposit, which is assumed to have not been preserved. If the glass content within the horizons not linked with a primary deposit can be fingerprinted and correlated to a single source these horizons could still be useful markers.

Small discontinuous blebs of volcanoclastic rich material (e.g., Figure 4-13c) are found within some of the cores. In many instances these are found overlying a volcanoclastic turbidite deposit, and are considered to be caused by bioturbation and reworking of the turbidite. In a number of unusual instances the blebs are the only volcanic deposit found in the core (e.g. TAN1613-t18 (HB-5) in TAN1613-33 (HB-1)).

Of note is deposit TAN1613-t13 found in TAN1613-30 (HB-3). It comprises a complex sequence of interbedded tephra deposits spanning just over 60 cm. The sequence overall has sharp upper and lower contacts, with multiple stacked fining up sequences. These are highlighted through darker to lighter colouration caused by an increase in dark, thin, platy minerals (biotite?) at the base and finer, lighter higher concentrations of glass shards at the top. Overlying this sequence is a coarse volcanoclastic rich turbidite deposit with a sharp erosional contact between the two.

Preliminary (on-board) correlations between the observed tephra horizons have been suggested using a combination of catchment location, sedimentation rates (including number of turbidite deposits), horizon characteristics and their depths within the cores (Figure 4-14). Further geochemical fingerprinting will allow these cross core correlations, and source correlations to be tested. In a number of cores (e.g. HB-5, MC-5) there was a surprising lack of tephra deposits. Occasionally, the magnetic susceptibility data show a number of peaks that are not identified visually or through X-ray. It is possible that these are highlighting areas of increased glass shard concentrations and would benefit by further investigation.

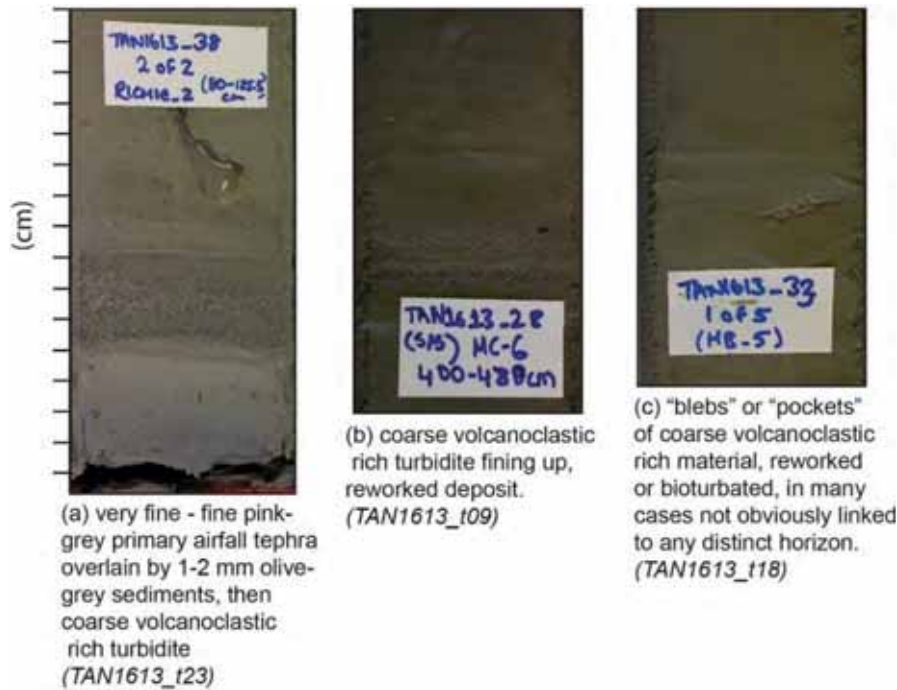


Figure 4-13: Examples of three types of tephra horizon observed.

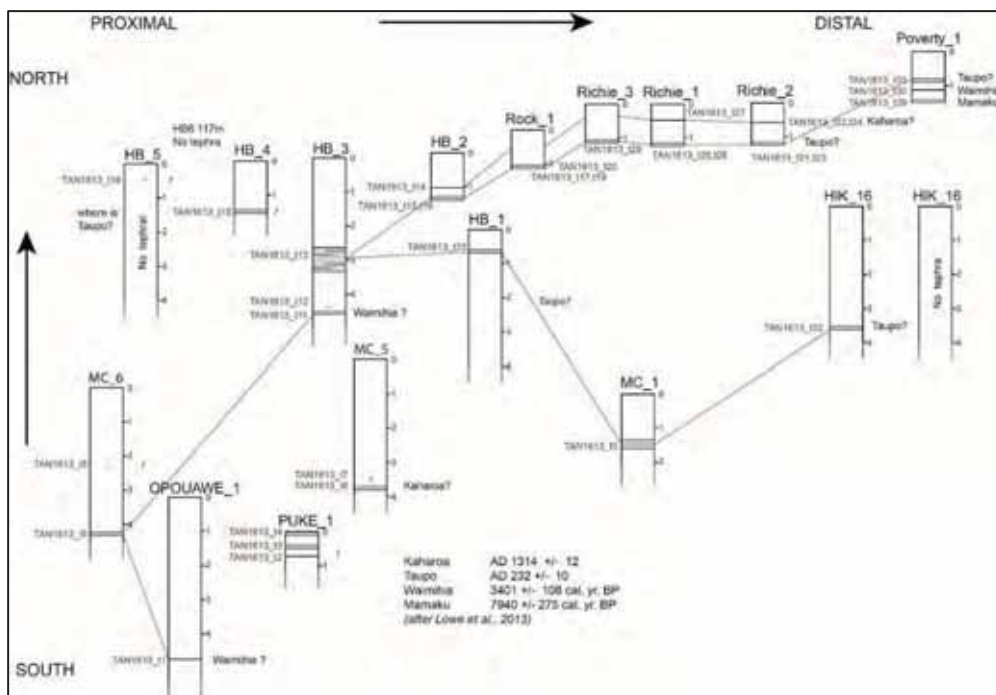


Figure 4-14: Preliminary tephra correlations. Cores are positioned relative to their geographical locations from south to north and proximal to distal from source (coast line).

Table 4-2: Summary table of selected volcanic tephra observations.

Tephra id. #	Core #	Core name	Depth (cm)	Thickness (mm)	Colour	Grainsize	Sorting	Structure	Mineral	Photo #	Correlation?	comments	Total for core section
TAN1613_101	Tan16_13_7	Opouawe_1	476.5	1-2	yellow-cream	very fine	n/a	n/a	n/a	46	Waimihia?		1
TAN1613_102	Tan16_13_19	Puke_1	71 - 74.5	1-4	pink-grey	fine-medium	n/a	n/a	n/a	156-157	Taupo?	One main continuous layer 2-4mm thick, two lower layers 1 mm thick discontinuous (reworked?)	1 (3)
TAN1613_103	Tan16_13_19	Puke_1	46-58	120	olive grey with white inclusions	med-coarse	bimodal	n/a	n/a	158	Reworked Taupo?	Turbidity current with high conc of forams and pumaceous material within background sediment	(1)
TAN1613_104	Tan16_13_19	Puke_1	0-30	30	olive grey to yellow grey with white inclusions	med-coarse	bimodal	n/a	n/a		Reworked, core suck?	Highly pumaceous section at the top of the core, suspect core suck, and highly reworked	(1)
TAN1613_105	TAN1_613_2_5	MC_1	139-151	120	pink-grey	coarse to fine	well sorted	normal graded fines up	base rich in dark, angular platy mineral (biotite?) -5-10%	236-237	Taupo?	Potentially disturbed through coring process (core sock wrapped around tephra deposit), lovely fining up structure indicative of primary air fall deposit, some coarse pumice at base and additional minerals, up to very fine ash at top of section.	1
TAN1613_106	Tan16_13_27	MC_5	325-327.5	20	grey	med-coarse	homogeneous	homogeneous	dark angular platy minerals (biotite?) -5%	273	Considered likely to be quite young. If sed rate is similar to that seen in HB_5 (very high), this is likely to be Kaharoa? In addition a high number of turbidities in this sequence which would remove a lot of sediment from the top of the core.	Two small blebs of tephritic material, separated by 4-6 mm of olive grey sediment, discontinuous across surface of the core slightly offset from the centre. Likely reworked through bioturbation (burrows?)	
TAN1613_107	TAN1_613_2_7	MC_5	316-319.5	35	light-darker grey	fine-coarse	bimodal	slight fining up	white, angular pumice -5-10%; dark angular, platy (biotite?) -5-10%, glass + marine sed -80-90%	274	Most likely linked through reworking to pervious deposit from this core section	Turbidity current with high conc of forams and pumaceous material within background sediment	(2)
TAN1613_108	TAN1_613_2_8	MC_6	248	3	light grey	fine	n/a	n/a	n/a	282	?	Small bleb to the left side of the core	(1)
TAN1613_109	TAN1_613_2_8	MC_6	426-431	20 (30 disco nimum us)	light grey - pink	coarse to fine		fining up sequence	dark angular, thin platy minerals (biotite) -5%, plus additional dark clasts (?) +glass	297	Waimihia? Based on sedimentation rates and proximity	Coarse horizontally bedded lower unit fining up from coarse to med, then 30 mm of discontinuous fine glass +minerals	1

TAN1613_110	TAN1613_613_2_9	HB_4	148-162	10 (140 minus)	light pink	coarse - fine	bimodal	coarse lower section (10 mm) followed by very fine discontinuous upper sections (140 mm)	dark angular, thin platy minerals (biotite) - 10 % plus additional dark clasts (?) + glass	298	Likely quite young as high in the core and also proximal. Kaharoa?	Coarse sub-horizontal discontinuous lower unit (10mm), then 140 mm of discontinuous fine glass +minerals	
TAN1613_111	TAN1613_613_3_0	HB_3	455-460	50	dark grey - olive grey	coarse - med	n/a	reverse grading (??)	some minor glass shards and biotite, forams	318	Based on sed rates and depth in the core potentially older? Waimihia?	Turbidite sequence with a med proportion of tephritic material	1(1)
TAN1613_112	TAN1613_613_3_0	HB_3	444.4	2-5	light grey	coarse	n/a	n/a	biotite, glass	319	?	Small blob to right side of the core, sharp upper and lower contacts, but discontinuous; Primary?	
TAN1613_113	TAN1613_613_3_0	HB_3	272-333	610	dark-light grey	range	range	multiple fining up sequences	biotite, glass, plus sediments	multiple	Based on thickness of deposit and depth in the core, likely to be Taupo? With either multiple events recorded or multiple reworking events?	Sequence of multiple tephritic units identified through colour grading, darker grey bases to lighter grey tops, some sections show slightly coarser grain sizes with a higher conc of darker minerals visible; difficult to distinguish primary vs. reworked events; 5x coarser units possibly represent primary air fall with graded section showing secondary flow deposits?; evidence for some bioturbation and disturbance in the upper sections (271-290 cm)	
TAN1613_114	TAN1613_613_3_1	HB_3	104	5-7	dark grey	med-coarse	homogeneous	n/a	high proportion of dark minerals	328	Linked to t22+t24 in RICHIE_2 cores? Taupo?	Discontinuous across core, but horizontally bedded, coarse unit with sharp lower contact and gradational upper contact, primary?	
TAN1613_115	TAN1613_613_3_1	HB_3	124 - base	min 100(?)	grey-beige	very fine	n/a	n/a	not visible	329	Same as deposit TAN1613_116; Taupo?	very fine ashy sediment, distorted and bioturbated, base of the core, possible the top of a large tephra sequence as drill core stopped here	1(1)
TAN1613_116	TAN1613_613_3_3	HB_3	142 - base	min 130	grey-beige	very fine	n/a	n/a	not visible	339	Same as deposit TAN1613_115; Taupo?	Repeat core of TAN1613_31 (HB_2) both times drill core stopped at this unit, unit TAN1613_114 seen in TAN1613_31 not seen here	1
TAN1613_117	TAN1613_613_3_5	ROCK_1	107 - base	min 60	grey-beige	med-very fine	n/a	fining up sequence	at base some minerals visible; minor black minerals (-1%) some pumice clasts	340	Same as deposits TAN1613_115 and 116; Taupo? Or Waimihia? Although if Waimihia, where is Taupo?	Similar visually to the previous two deposits, fining up sequence from base of core with obvious tephra horizon. Similar distance from shore, however Rock sites further north.	1
TAN1613_118	TAN1613_613_3_3	HB_5	64-66	10	light grey	med-coarse	homogeneous	n/a	dark blocky (1%), glass, pumice, forams	355	? Unknown where reworked from as no other tephra close to this deposit	Small discontinuous blob of coarse material, most likely reworked.	(1)
TAN1613_119	TAN1613_613_3_6	ROCK_1 (repeat)	138 - base	min 50	grey-beige	very fine	n/a	n/a	n/a	356	Same as TAN1613_117, same as 115&115? Taupo?	Very similar visually to all other deposits which have stopped the core process at base of the core, all at ca. 1-1.5 m. Glass shard concentrations wane, likely at some point glass shard conc < sediment conc	1
TAN1613_120	TAN1613_613_3_6	ROCK_1 (repeat)	132-133	10	light grey	med-coarse	homogeneous	n/a	dark blocky (1%), glass, pumice, forams	356	Liked with 115-117?; Taupo?	Likely a reworked deposit shortly (in time) after the main event.	(1)

TAN1613 _121	TAN1 613_3 7	RITCHIE_ 2	85- base	min 80	grey- beige-pink	very fine grained	n/a	n/a	372	Linked with t15-17+19? Taupo?	Similar visually to the previous deposits at the base of short cores, very fine ash grading into background sediments, highly bioturbated at the top with	
TAN1613 _122	TAN1 613_3 7	RITCHIE_ 2	30-32	20	light grey at base to darker grey at top	med-fine	obscure d	possibly fining up	373	Unsure if reworked from lower unit or primary deposit, evidence for more of the black minerals suggests maybe discrete deposit? Links to similar unit in Ritchie_2 repeat, if primary, younger than Taupo? Therefore potentially Kaharoa?	Obscured horizon, fining from light colours at base to darker coloured section towards the top, potential fining up observed but unclear, high proportion of background sediment obscures horizon	2
TAN1613 _123	TAN1 613_3 8	RITCHIE_ 2	122- base	min 30	light grey- pink	very fine	n/a	massive	374	Likely linked to t15-t17+t19, Taupo?	visually similar to previous basal tephra horizons, this is overlain by 2-4 mm olive grey horizon (likely background sediments) then, 200mm of turbidite with multiple flows all rich in volcanoclastic sediments, but also containing forams and shell hash, small proportion of dark blocky minerals. Base is high in volcanoclastics, then sediments become increasingly dominant towards the top of the deposit. Top is bioturbated.	1
TAN1613 _124	TAN1 613_3 8	RITCHIE_ 2	40-41	5-10	light grey	med-fine	obscure d	n/a	375	Same as t22 (repeat); Kaharoa?	Very similar unit to t22, slightly obscured and discontinuous across core, but considered to be primary? Base on continuity between cores and distance from lower unit.	(1)
TAN1613 _125	TAN1 613_3 9	RITCHIE_ 1	118- base	min 30	light grey- pink	very fine	n/a	n/a	382	Same as t15-17, 19, 23; Taupo?	Visually similar to previous basal tephra horizons	1
TAN1613 _126	TAN1 613_4 0	RITCHIE_ 1	120- base	min 20	light grey- pink	very fine	n/a	n/a	391	Same as t15-17, 19, 23, 25; Taupo?	repeat core of TAN1613_39 RITCHIE_1 site	1
TAN1613 _127	TAN1 613_4 0	RITCHIE_ 1	40-42	2 x 8- 10	light grey	med-fine	obscure d	2 concentrated horizons separated by 3-5 mm of sed	395	Linked to t22+t24 in RICHIE_2, and t14 in HB_2; Kaharoa?	repeat core of TAN1613_39 RITCHIE_1 site	1

TAN1613_128	TAN1 613_4 1	RTCHIE_ 3	111- base	min 60	light grey- pink	fine	n/a	multiple fining up sequences identified through colour change within unit from high conc of darker mineral content (darker) to more pure ash(lighter)	some sections more conc in black platy shiny mineral (biotite) -1%	396	Linked to I15-17,19,23,25,26; Taupo eruption?	More detail identified within this deposit than with those in the other RTCHIE and HB_2 cores, this looks similar to the sequence seen in full in HB_3 with multiple layers evident, overlain by a volcanoclastic rich turbidite sequence, with potentially erosional lower contact. This could explain the variability in thickness between this (primary?) ash, and the turbidite sequence. Visually this sequence of ash overlain by turbidite looks similar to the deposit in TAN1613_123	1
TAN1613_129	TAN1 613_4 3	Poverty_1	147 - base	min 55	light pink- grey	very fine	n/a	n/a	none (all glass)	405	Based on crude sedimentation rate estimates this could be Mamaku?	Location of this core is just off the shelf, much lower sedimentation rates and potentially much older deposits.	
TAN1613_130	TAN1 613_4 3	Poverty_1	109.2	1-2	med grey	med-fine	n/a	n/a	n/a	406	? Possibly linked to Waimihia, based on overlying deposit's link to Taupo? If so, possible link to I1, I9, I11,	Very thin and obscure deposit, easy to miss, identified through slightly lighter colour, and slightly coarser grains than surrounding sediment, unsure if tephra horizon	1(1)
TAN1613_131	TAN1 613_4 3	Poverty_1	88-93	25	light grey	med-fine	n/a	fining up sequence from med to fine ash	in total < 5% minerals made up of black platy shiny (biotite), black blocky (?) and red sub-sphericle minerals	407	Potentially Taupo?	Sub angular unit potentially disturbed by stuck core sock during coring process. Fining up sequence observed (primary?) followed by sharp contact (erosional?) and volcanoclastic rich turbidite.	1
TAN1613_132	TAN1 613_4 6	HIK_16	375- 392	~160	light grey	fine- coarse	n/a	Sequence of volcanoclastic rich deposits, none of which are primary airfall. Lower sequence of bioturbated pockets of very fine ash rich sediments, central volcanoclastic rich turbidite (~15-20 mm), followed by very light coloured fining up sequence of sediments with high glass content.	n/a for fine pockets and sequence, for coarser section obvious dark blocky minerals observed	463	Potentially Taupo? High number of turbidites within this core therefore the bulk sed rate is high...	Sequence of volcanoclastic rich material, unlikely any to be primary air fall, however, if this can be correlated it could provide a maximum age for this section. Would this are have a high sedimentation rate? If so this could be Taupo, if not, at 375 cm depth this would be a much older deposit.	(1)

TAN1613 _133	TAN1 613_4 8	HB_1	58.5- 61.5	15-25	light-mid grey	coarse- med	n/a	slight fining up	dark blocky minerals (grains?) 5-10% with glass, pumice, and lithics	477	Potentially Taupo when looked at wrt MC_1 and HB_2 however, very shallow in the core?	Volcanoclastic rich turbidite, coarse grained with sharp lower contact and gradational upper contact. Definitely a reworked deposit, but no evidence for primary air fall here so an important marker.	(1)
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4.3 14th November 2016 Mw 7.8 Marlborough earthquake co-seismic turbidite

In response to the 14th November M_w 7.8 earthquake the RV *Tangaroa* was diverted from coring operations in the northern part of the Hikurangi margin. As part of our response a series of piston and multicores were taken between the 16th and 20th November at sites along the Hikurangi Channel, its levee, and Hikurangi Trough floor to investigate if a turbidite was deposited as a result of the earthquake. The presence of a prominent dark reddish grey oxidized layer and redox front at the present sediment water interface provides a marker bed for a preliminary assessment of recent, overlying turbidite emplacement.

Unconsolidated turbidite silts and sands at the base of a muddy fluidised layer were observed in a series of cores from the channel floor east of Kaikoura, east of Cook Strait, and east of the Wairarapa coast. These core sites lie up to 300 km down-system from the likely source area in the Kaikoura Canyon (Figure 4-15). Evidence supporting the recent emplacement of the turbidite in the channel cores includes the presence of decimetres of unconsolidated turbidite sediments containing fresh biological material. This biological material included echinoderm with intact gut material (Table 4-3). Also along with the animals were some small twigs and scraps of wood. Post-cruise examination by Owen Anderson and Sadie Mills (NIWA) indicates there were two very fragile species in multicore TAN1613-59 (Hik 2), *Brissopsis oldhami* and *Holanthus expergitus*, which are often found together. The depth range for *Brissopsis oldhami* is quite broad ~150 to > ~2400 m, whilst there are no records for *Holanthus expergitus* shallower than about 500 m. The core sediment also contained *Ophiacantha richeri* which is a deeper water species usually found between 660–2199 m. The specimens are normally found at the seabed surface, not 14-16 cm below the surface, consistent with either coring damage or entrainment in the turbidity current.

Table 4-3: Summary of biological identifications made on material recovered in multicore TAN1613-59 (Hik 2) from the Hikurangi Channel off eastern Marlborough.

NIWA Cat. No.	Station ID	Phylum	Class	Order	Family	Genus	Species	Fraction
115642	TAN1613/59	Echinodermata	Echinoidea	Spatangoida	Brissidae	<i>Brissopsis</i>	<i>oldhami</i>	14-16 cm
115643	TAN1613/59	Echinodermata	Echinoidea	Spatangoida	Hemiasteridae	<i>Holanthus</i>	<i>expergitus</i>	16-18 cm
115644	TAN1613/59	Echinodermata	Ophiuroidea	Ophiurida	Ophiacanthidae	<i>Ophiacantha</i>	cf. <i>richeri</i>	14-16 cm

Further evidence for the recent emplacement of a 10-20 cm thick turbidite up to 300 km from Kaikoura was found in cores from the Hikurangi Channel levee and basin floor. At site TAN1613-53 (Hik 21) unconsolidated fluid mud overlies the oxidation layer characteristic of the sediment water interface, suggesting the turbidity current was sufficiently thick to overtop the channel wall and spill over the Hikurangi basin floor (Figure 4-17). The inferred seafloor prior to the earthquake, as preserved in the sediment stratigraphy, is represented by the blue line in Figure 4-17. The sedimentary deposit interpreted to be the result of the earthquake is above the blue line. The turbidite recovered was still settling on the seabed from the water column at the time of sampling. Final deposition would likely take many more days. Our preliminary interpretation requires validation from detailed sedimentological analyses of the cores and from chronology established using short lived radioisotopes ^7Be , ^{234}Th , ^{210}Pb , and ^{137}Cs .

No multicores were taken from the channel floor north of TAN1613-52 (Hik 20). Consequently, it is not possible to determine how far north along the channel the turbidity current progressed. However, poorly consolidated fine sands overlying reddish grey oxidized sediment at the top of piston core TAN1613-47 (Hik 18) may indicate the turbidity current progressed along the channel over 500 km from the source area.

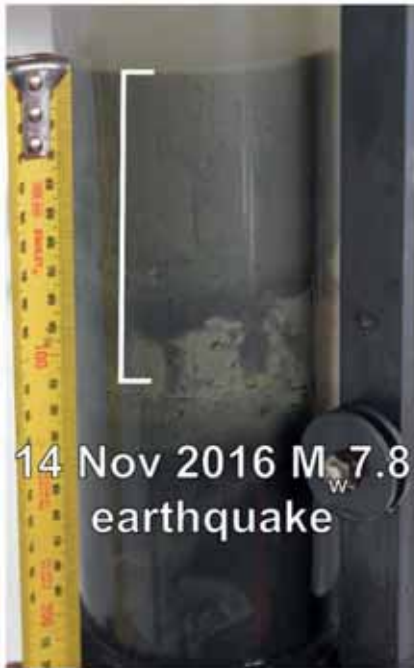


Figure 4-15: Example of recent turbidite deposit recovered in multicores from the southern Hikurangi Trough. Core TAN1613-59, site Hik 2. Note the fluidised upper layer indicating the deposit was still settling from the water column at the time of coring.

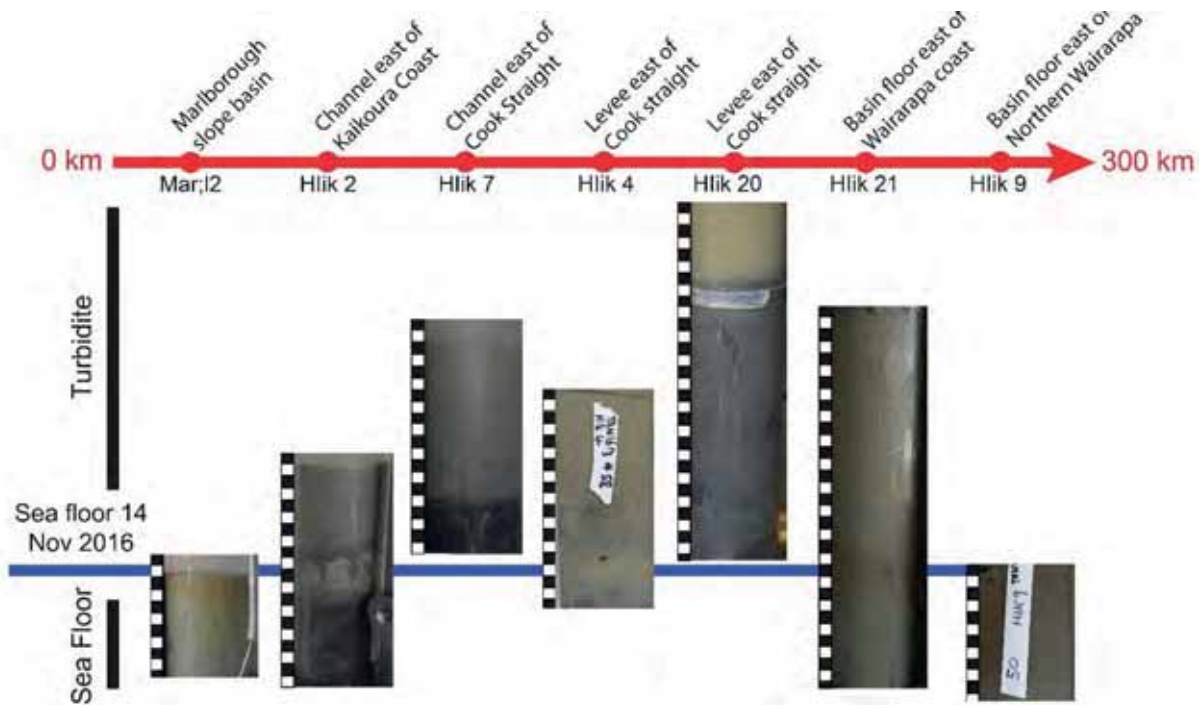


Figure 4-16: Inferred correlation of multicores taken from sites in the Hikurangi Channel, levees and basin floor showing emplacement of a recent turbidite.

4.4 Mapping of November 14th M_w 7.8 Marlborough Earthquake fault rupture

The last 1.5 days of the survey were devoted to seafloor mapping on the continental shelf of coastal Marlborough in search of evidence of co-seismic faulting associated with the 14th November M_w 7.8 Kaikoura Earthquake. This work would help to characterise the distribution and location of faults that ruptured during the earthquake. Our onboard planning was guided by preliminary information on the extent of the earthquake rupture provided by a community geoscience response and coordinated by GNS Science (Figure 4-17). This included preliminary field reconnaissance observations from helicopter flyers-overs, field teams, inversion of GPS and InSAR data, and seismology. In particular, at least three major faults were identified as having ruptured across the North Canterbury and Marlborough coast. These included the Hundalee Fault south of Kaikoura Peninsula, the Papatea Fault south of the Clarence River mouth, and the Kekerengu Fault. Widespread coastal uplift had been identified along the entire coast from south of Kaikoura Peninsula to Cape Campbell.

With the limited time available on this survey, and consideration of seafloor mapping rates in shallow coastal water (<100 m water depths, with multibeam bathymetry swath widths of c. 100-400 m), we selected to focus efforts from *Tangaroa* on the Needles and Chancet faults, which lie immediately offshore of the Kekerengu Fault (Figure 4-17). The Kekerengu Fault had been identified as having the largest right-lateral surface displacements associated with the earthquake, of up to 10 m inland, and about 5-6 m at the coast. Raised shore platforms indicated coastal uplift north of Kekerengu of the order of 2-3 m.

Our mapping included EM302 multibeam bathymetry and backscatter surveying, and contemporaneous PS18 TOPAS sub-bottom profiling. The extent of the surveying achieved is shown by the white profile lines and colour-shaded areas on Figure 4-18. The approach involved a single survey line along the previously mapped trace of the Chancet Fault, followed by an initial series of zig-zag reconnaissance lines across the Needles Fault. These lines extended from offshore of Kekerengu to NE of Cape Campbell, and included profiles across the western end of the Boo Boo Fault. It also included an initial rectangular block over the northern Needles Fault NE of Cape Campbell, which had been surveyed with the EM2040 multibeam echosounder on *Ikateri* in April 2016 as part of a NHRP project. Having identified what appeared to be recent surface breaks on the Needles Fault off Chancet Rocks using the TOPAS profiles (Figure 4-19, 4-20), a multibeam bathymetry block was then surveyed along a suspected corridor of surface rupture along the inner coast in about 30-50 m water depths from north of Kekerengu to east of Cape Campbell. The survey was completed with additional reconnaissance profiles east of the Cape Campbell, before final transit to Wellington commenced at about 0230 h on Tuesday 22nd November.

Our new mapping and profiling is consistent with surface rupture on the submarine Needles Fault during the November 14th M_w 7.8 Kaikoura Earthquake. We recognised an almost continuous fault scarp extending about 17 km along the coast between Cape Campbell and Needles Point, lying inside the previously known traces of the Needles Fault (e.g., Figure 4-21). In the profiles (Figures 4-19, 4-20) the newly mapped surface trace has evidence of previous (older) activity. The surface mapped trace can be seen to project SW towards the Kekerengu Fault, inside 30 m water depths. Our expectation onboard *Tangaroa* was that it continues SW, where a 16 km section of the trace could not be surveyed inside 30 water depth. If so, the offshore rupture potentially reaches 34 km. This would later be supported by Joshu Mountjoy and others from additional shallow water surveying along the southern reaches of the Needles Fault on *Ikateri* in January 2017.

No evidence was seen for any co-seismic offset on the Chancet Fault or western end of the Boo Boo Fault associated with the Kaikoura Earthquake.

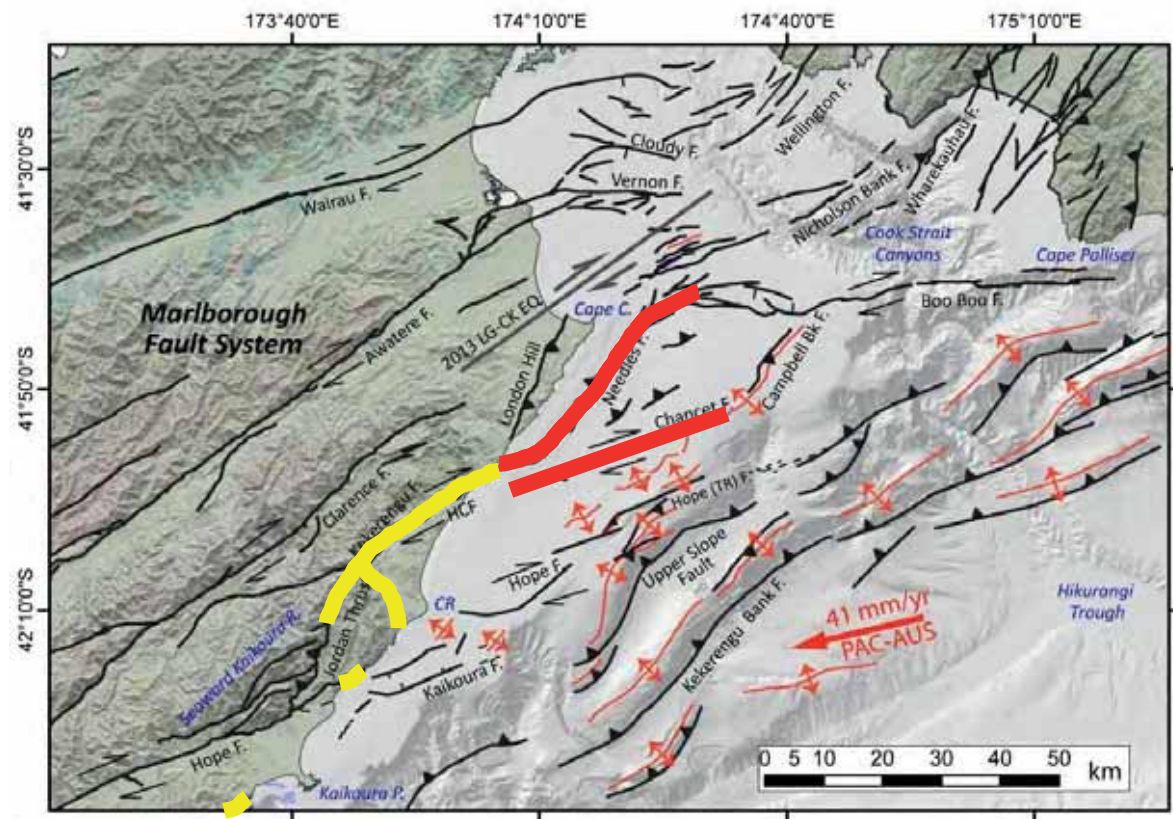


Figure 4-17: Map of active faults in the eastern Marlborough region, and specific faults investigated for surface rupture associated with the Nov. 14th M_w 7.8 Kaikoura Earthquake. Faults on land highlighted in yellow represent structures known to have ruptured at the time of the TAN1613 survey. The faults offshore highlighted in red (Needles and Chancet faults) were selected for marine mapping on this survey.

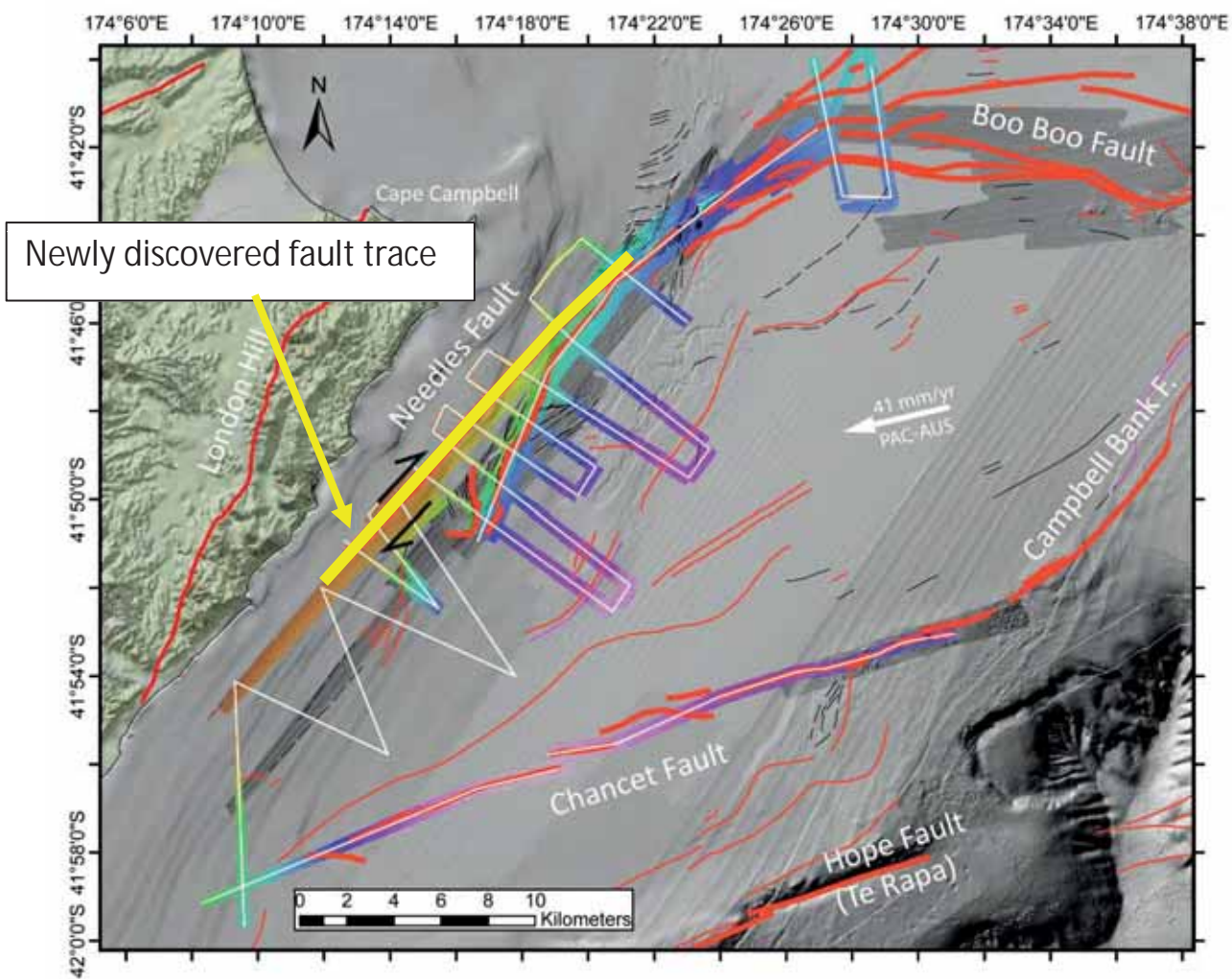


Figure 4-18: Map of the Needles and Chancet faults, and the survey undertaken on TAN1613 (coloured area). The bold yellow line is trace of the Needles Fault discovered on this survey, and thought to have ruptured during the Nov 14th Mw 7.8 Kaikoura Earthquake.

Fault rupture

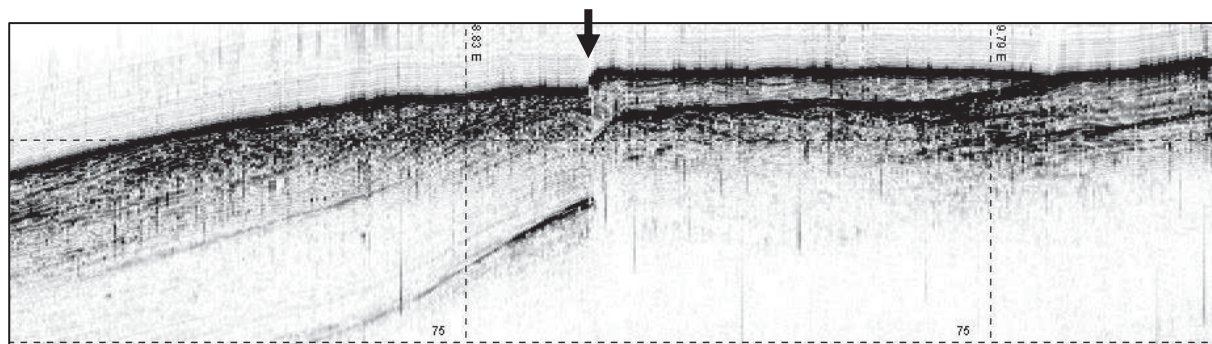


Figure 4-19: Example of TOPAS PS18 profile showing apparently recent surface rupture on the Needles Fault. The vertical displacement is downthrown to the SE (towards the left), away from the coast.

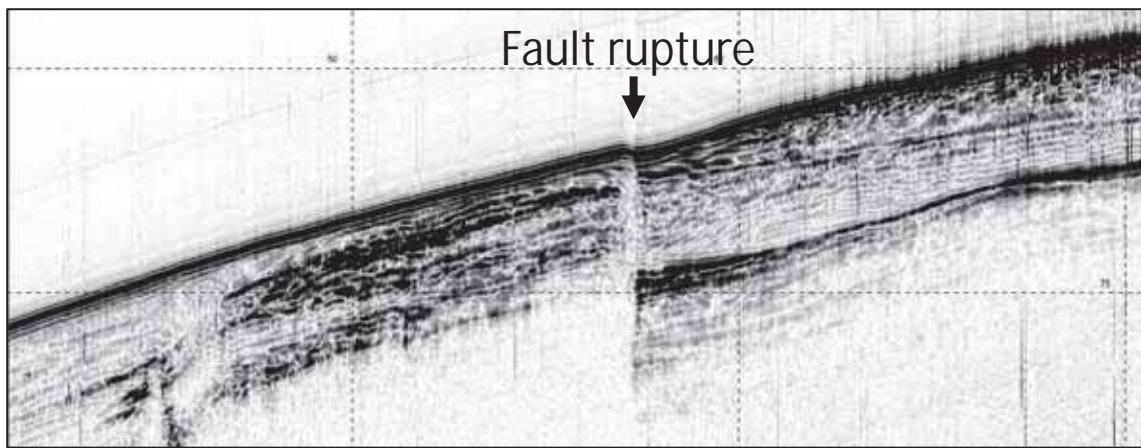


Figure 4-20: Example of TOPAS profile showing apparently recent surface rupture on a trace of the Needles Fault. This short trace is down-thrown towards the coast, and is separated from the main trace in Figure 4-19.

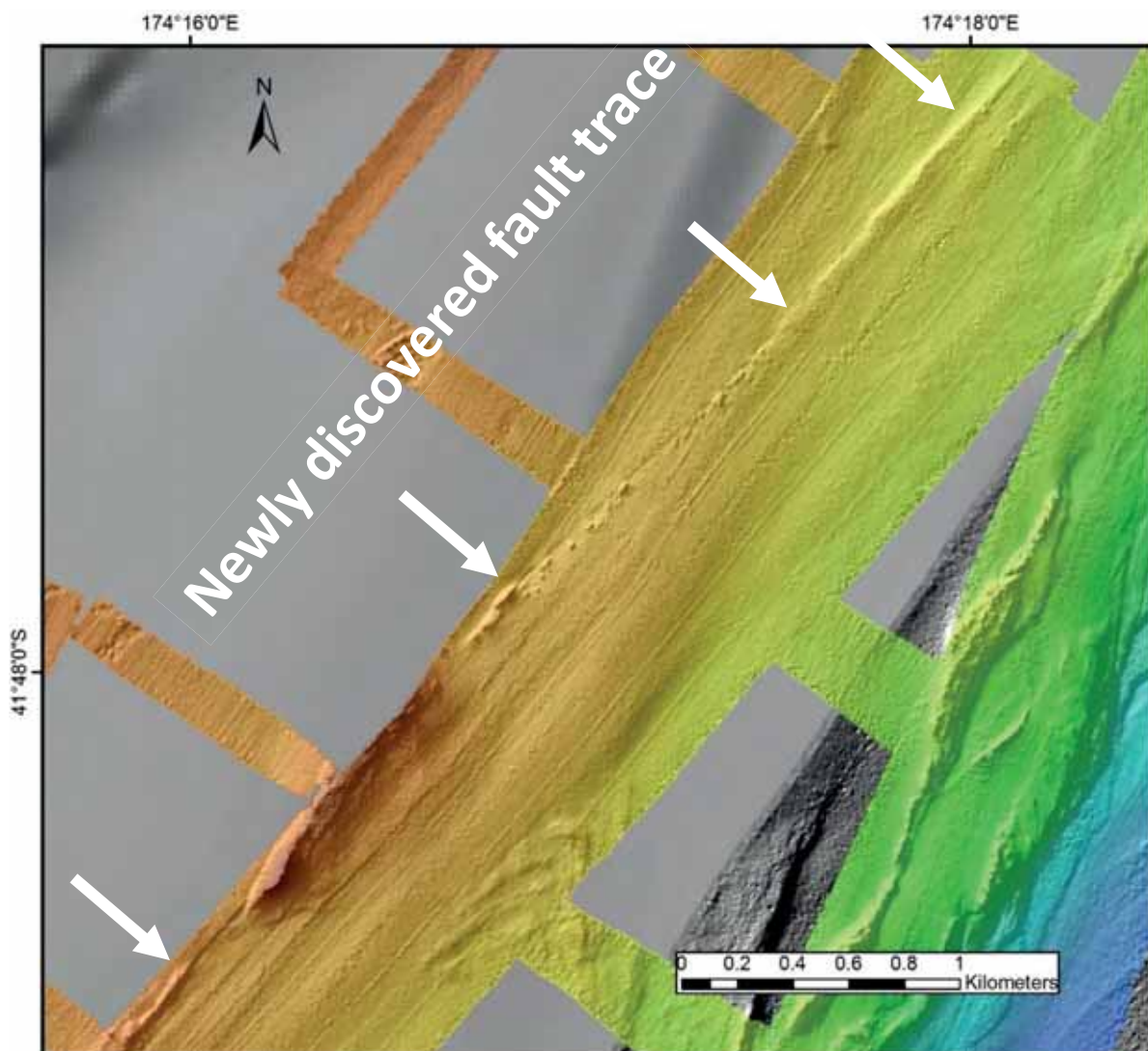


Figure 4-21: Example of coloured hillshade derived from multibeam bathymetry data showing newly discovered surface trace of the Needles Fault.

5 Acknowledgements

We would like to thank Captain Evan Solly, the officers, and all other personal on *Tangaroa* voyage TAN1613 for helping to make this voyage a success. Thanks also to Karen Keddy, NIWA Vessels, for coordinating the mobilisation and demobilisation changes overs.

The voyage was cofunded by MBIE Endeavour programme *Hikurangi subduction earthquakes and slip behaviour: Diagnosing peril posed by the Hikurangi subduction zone: New Zealand's largest plate boundary fault* (NIWA Project GNS17302), and by NIWA-MBIE Core Coasts & Oceans Programme *Marine Physical Processes and Resources* (NIWA Project COPR1702, Task *Tectonics and Volcanism*).

Appendix A Compilation of core site and core log data

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: **Campbell 1**

Latitude: -41.99285

Date/Time (NZST): 10/11/2016 18:40

Other ID: TAN1613-02

Longitude: 175.00678

Depth (m): **2417**

Sample Description

General Description

Mouth of Campbell Canyon, above Hik Basin flr

Hemipelagic mud with variable structure. Alternating intervals of colour laminated, convoluted colour laminated, and massive.

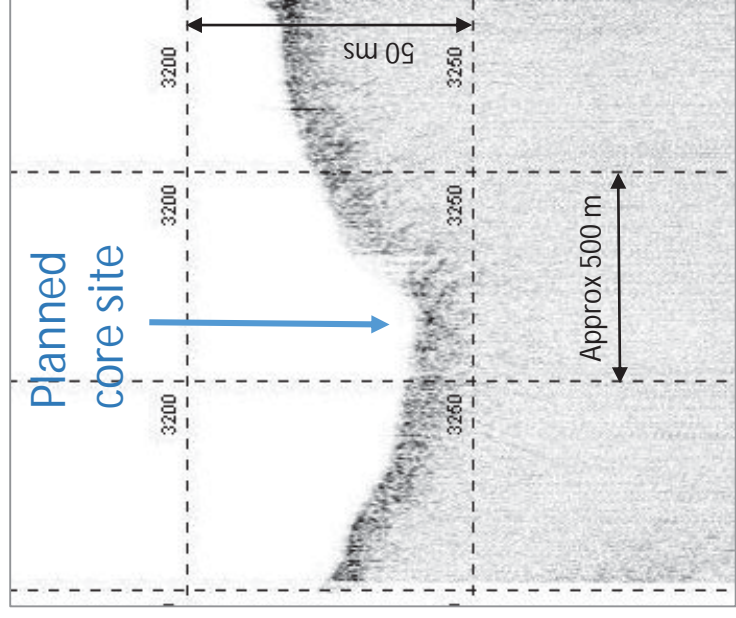
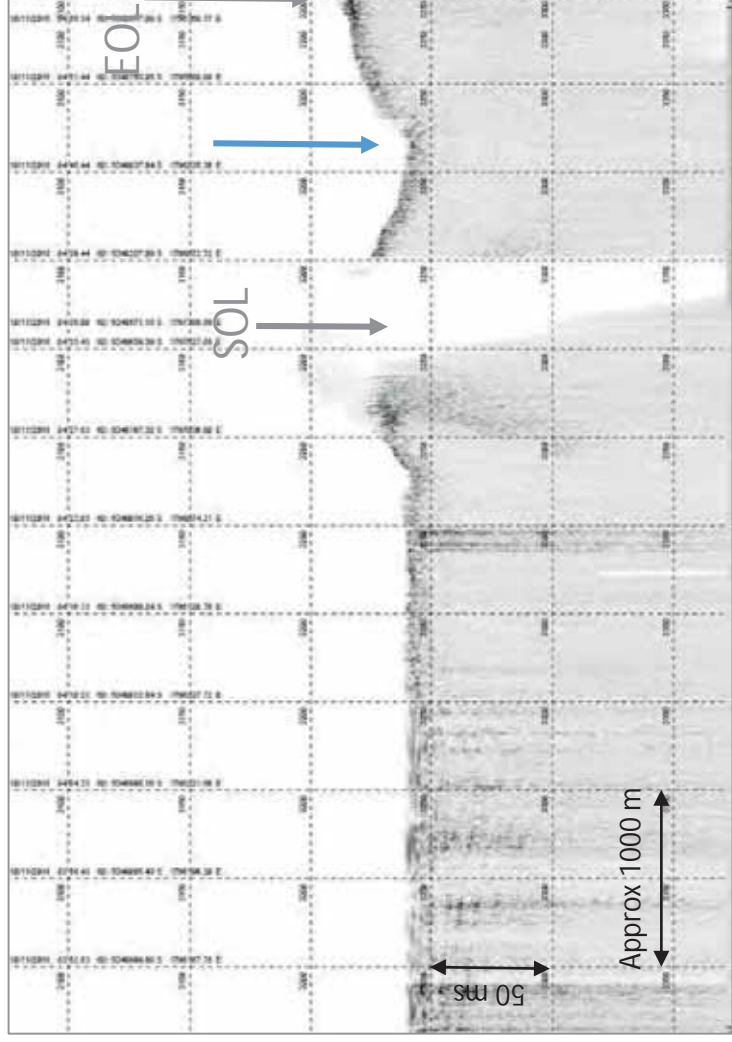
Gear type	Piston core	
Barrel Length (m)	6	Bent barrel
Penetration (m)	n/d	Catcher/Cutter bags
Core length (m)	1.868	Samples
Sections	2	Tephra
Fauna	n	Pull-out

Sample processing – core ID:

Section	Top depth (cm)	Btm depth (cm)	Logged	Phys Props	Summary
1	0	100	y	y	.
2	100	186	y	y	.
.
.
..
.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Campbell 1	Other ID TAN1613-02	Water Depth 2417
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Topas line including transit to the station. Grey arrows indicate start and end of the 2km survey line over the station. Blue arrow marks the planned core site.

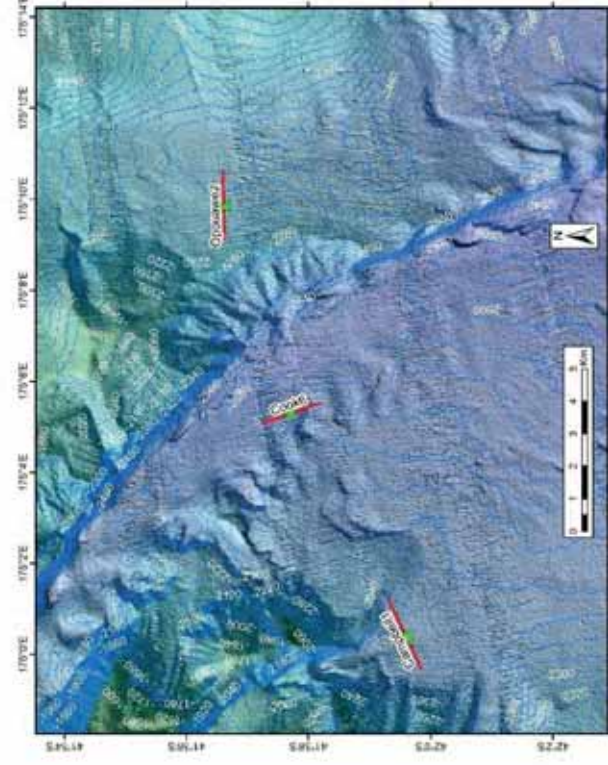
Zoom into 2km survey lines over planned core site.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

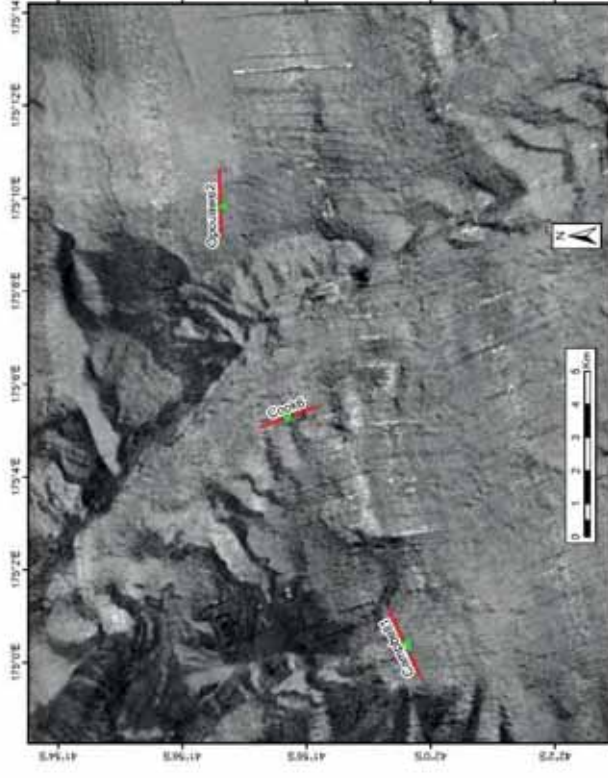
Core ID: Campbell 1

Other ID TAN1613-02

Water Depth 2417



Bathymetry at and around Campbell1 core site at the mouth of Campbell Canyon, above the Hikurangi Basin floor. Light blue lines are 20 m depth contours. Red lines show the 2 km TOPAS survey line over the station, green triangles indicate the actual core site.



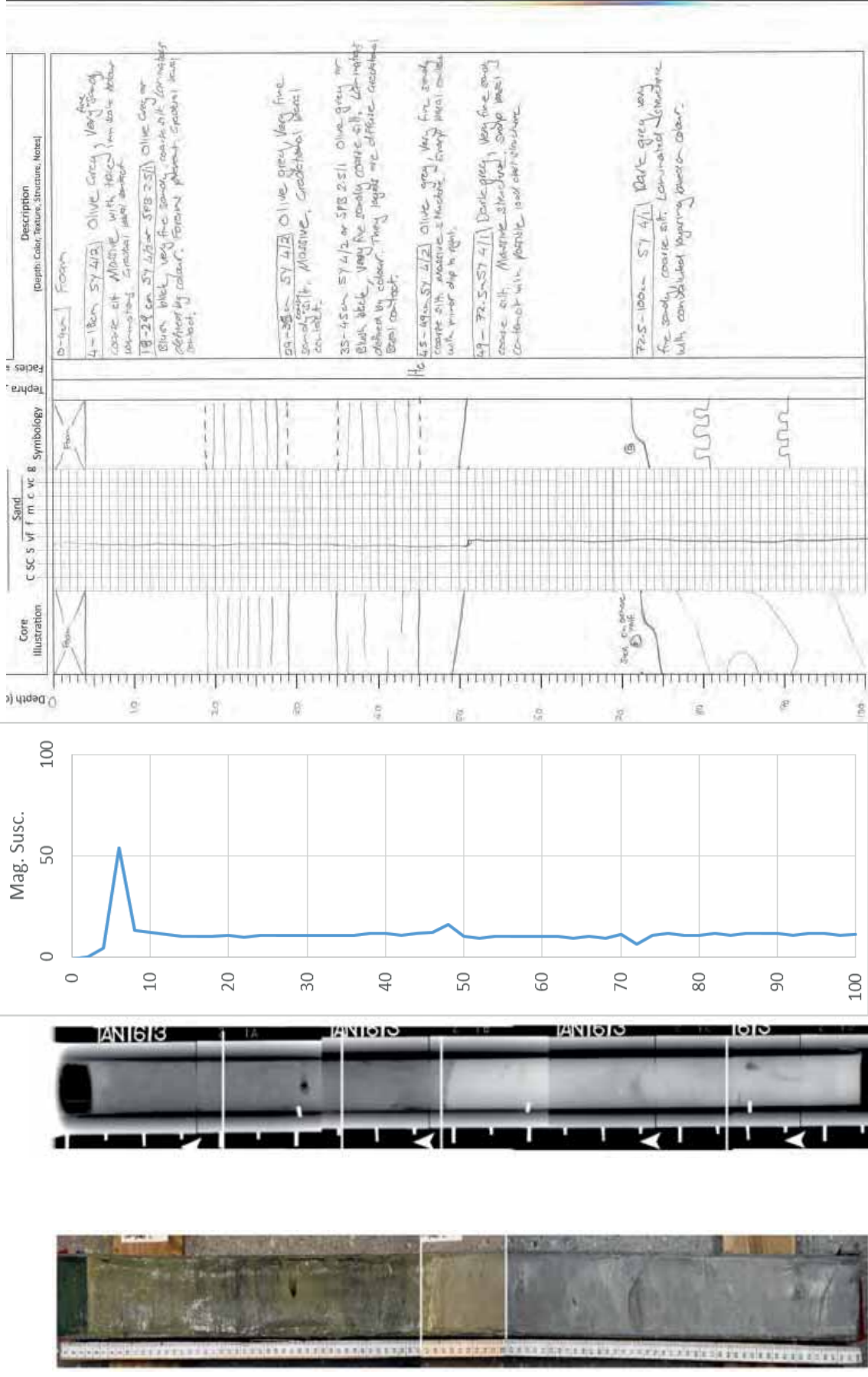
Backscatter data at and around Campbell1 core site at the mouth of Campbell Canyon, above the Hikurangi Basin floor. Light blue lines are 20 m depth contours. Red lines show the 2 km TOPAS survey line over the station, green triangles indicate the actual core site.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Campbell 1

Other ID TAN1613-01

Section 1 of 2

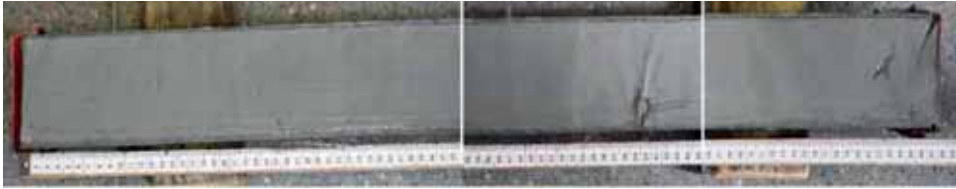
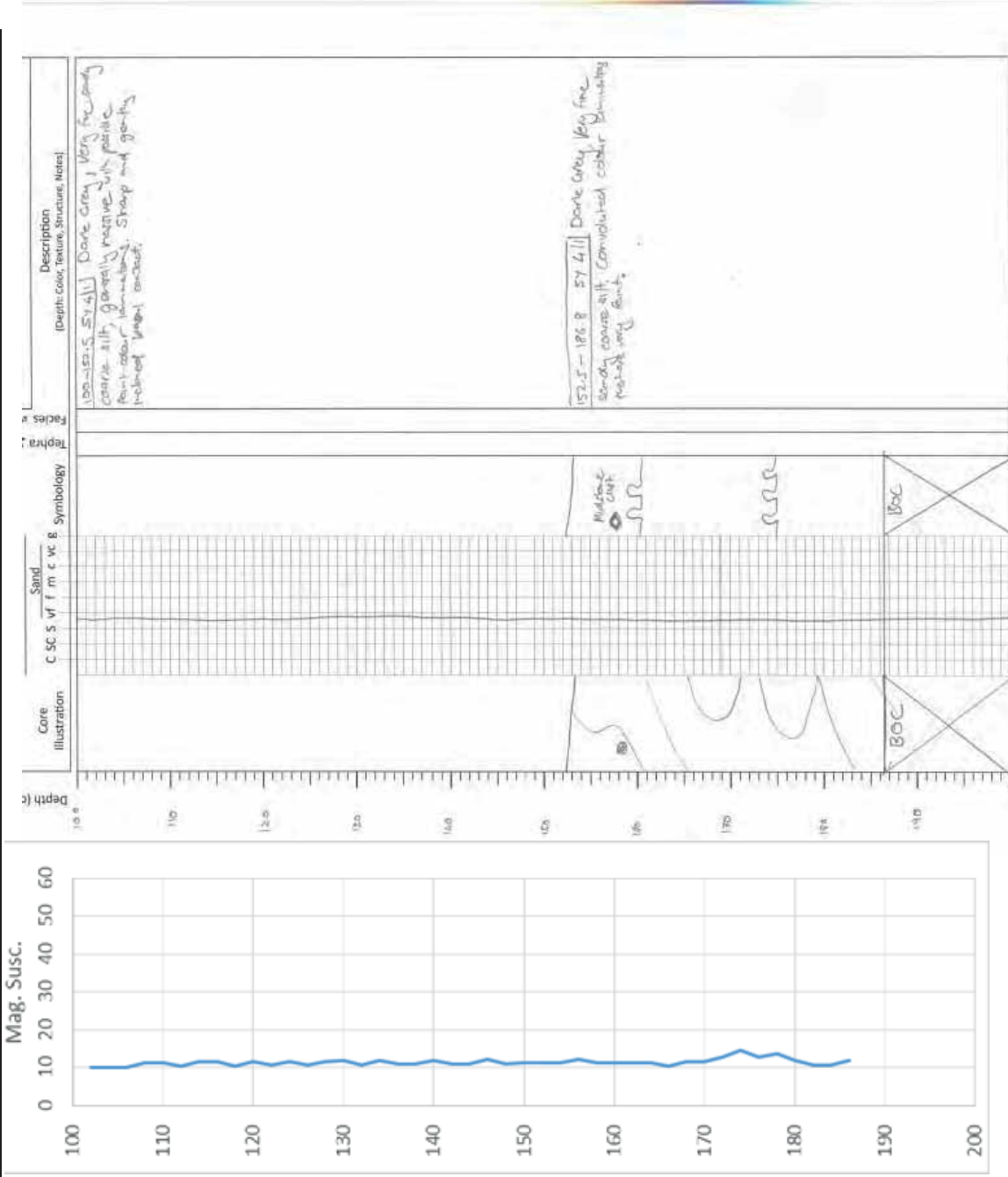


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Campbell 1

Other ID TAN1613-01

Section 2 of 2



TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: **Cook 6**

Latitude: -41.96137

Date/Time (NZST): 10/11/2016 21:48

Other ID: TAN1613-03

Longitude: 175.08787

Depth (m): **2526**

Sample Description

General Description

Mouth of Cook Strait Canyon, 300 m Nth of scour hole

Laminated hemipelagite over sand-gravel turbidite with shell fragments

Notes: foam in top and bottom of core

Gear type		Piston core	
Barrel Length (m)	6	Bent barrel	Y/N
Penetration (m)	n/d	Catcher/Cutter bags	3
Core length (m)	0.54	Samples	0
Sections	1	Tephra	Y/N
Fauna	n	Pull-out	4.2t

Sample processing – core ID:

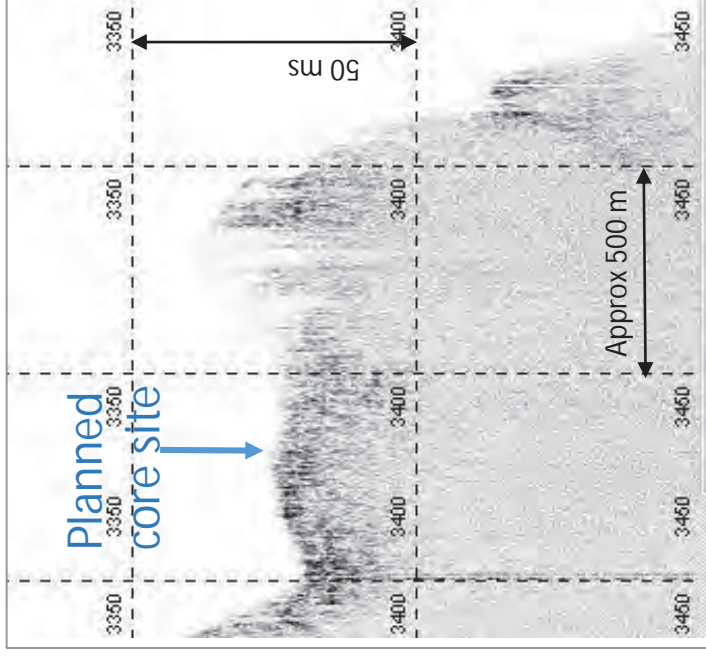
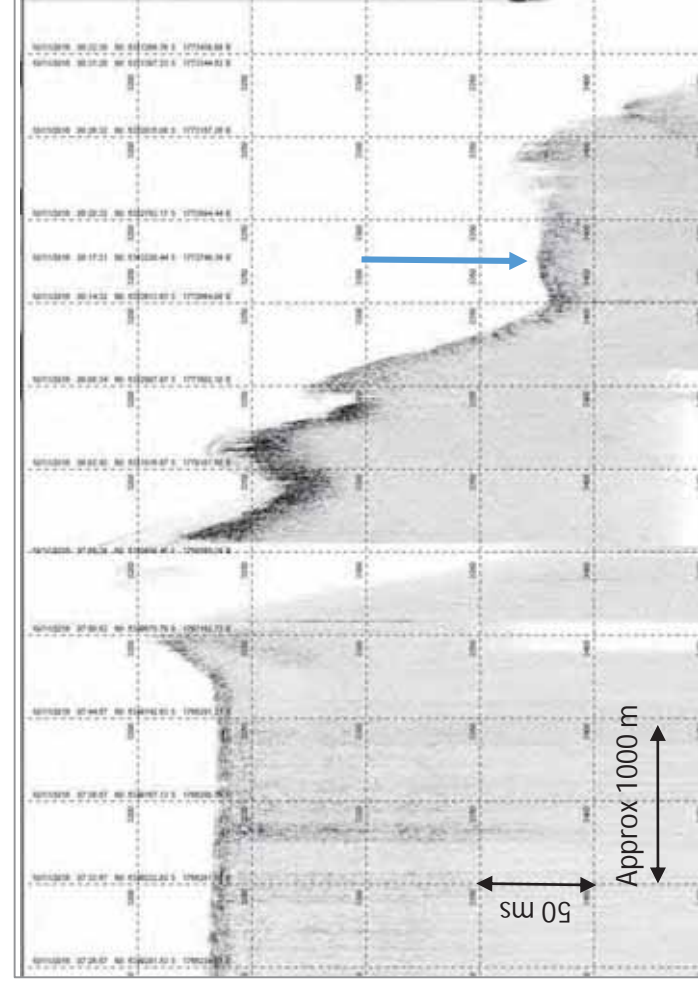
Section	Top depth (cm)	Btm depth (cm)	Logged	Phys Props	Summary
1	0	53.5	y	y	.
.	.	.			.
.	.	.			.
.	.	.			.
.	.	.			.
.	.	.			.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Cook 6

Other ID TAN1613-03

Water Depth 2526



Topas line including transit to the station. The blue arrow marks the planned core site.

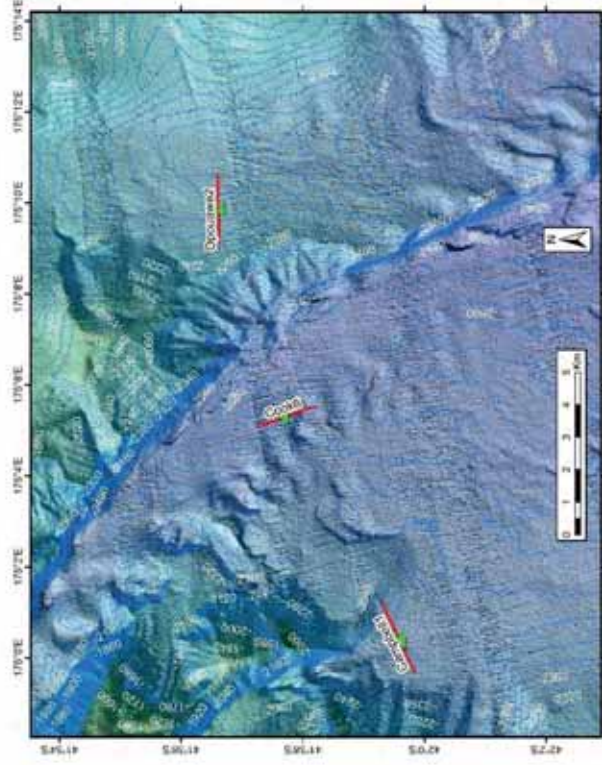
Zoom into 2km survey lines over planned core site.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

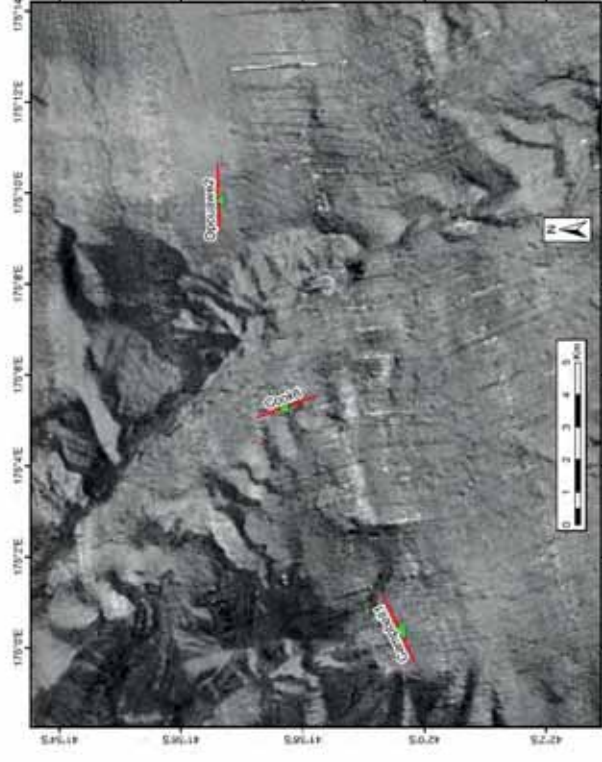
Core ID: Cook 6

Other ID TAN1613-03

Water Depth 2526



Bathymetry at and around Cook6 core site at the mouth of Cook Strait Canyon, 300m north of scour hole. Light blue lines are 20 m depth contours. Red lines show the 2 km TOPAS survey line over the station, green triangles indicate the actual core site.



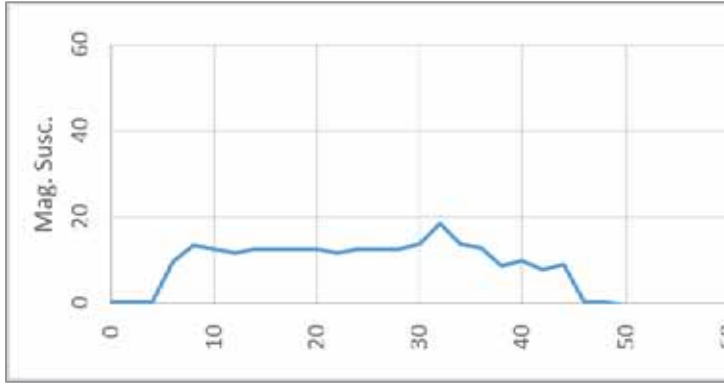
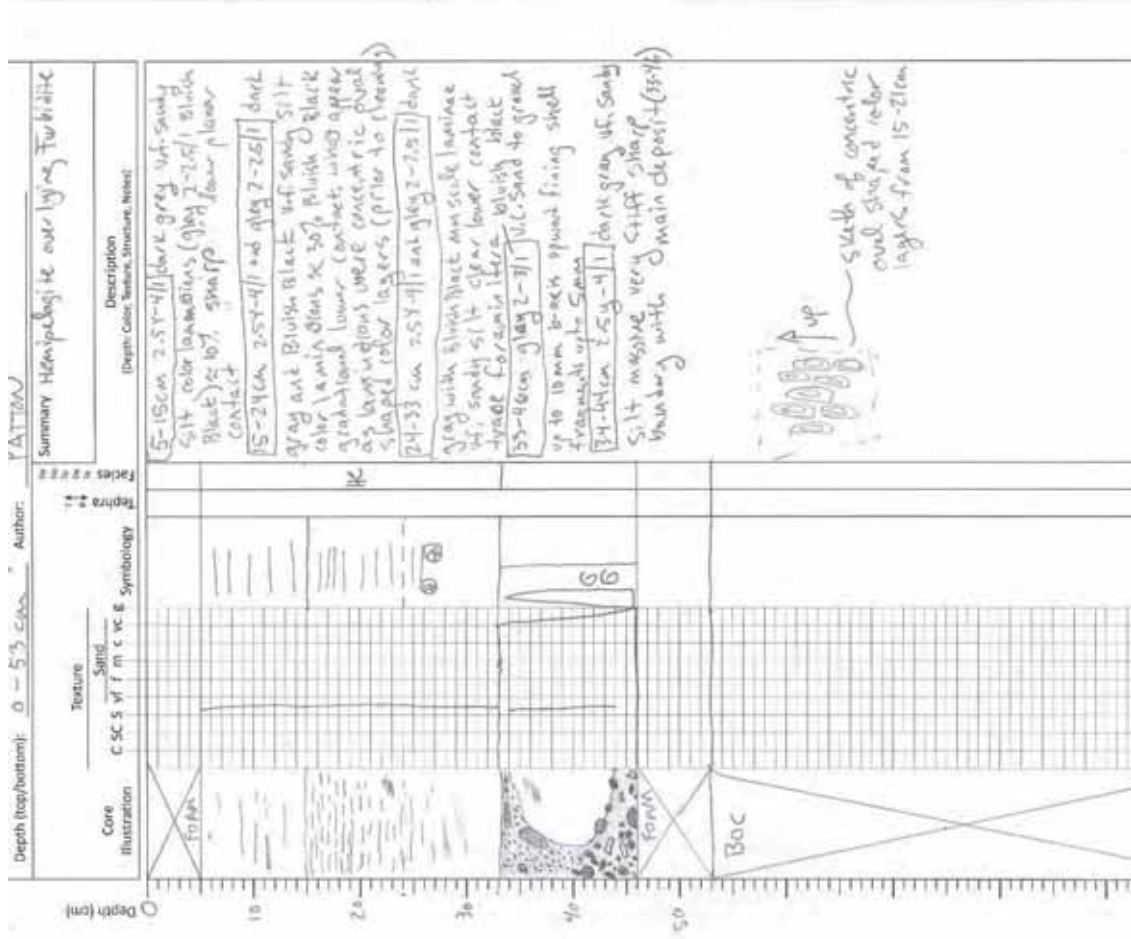
Backscatter data at and around Cook6 core site at the mouth of Cook Strait Canyon, 300m north of scour hole. Red lines show the 2 km TOPAS survey line over the station, green triangles indicate the actual core site.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Cook 6

Other ID TAN1613-03

Section 1 of 1



TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: **Opouawe 2**

Latitude: -41.94383

Date/Time (NZST): 11/11/2016 01:14

Other ID: TAN1613-04

Longitude: 175.16383

Depth (m): **2297**

Sample Description

General Description

Mouth of Opouawe Canyon - Offset South of strong Backscatter , above Hikurangi Basin floor

Hemipelagic mud with variable structure. Alternating intervals of colour laminated, convoluted colour laminated, and massive. Thin sandy laminae below 2m, and lots of black smelly sulphur towards the base.

Gear type		Piston core	
Barrel Length (m)	6	Bent barrel	N
Penetration (m)	n/d	Catcher/Cutter bags	Y/N
Core length (m)	3.4	Samples	0
Sections	4	Tephra	N
Fauna		Pull-out	3.5t

Sample processing – core ID:

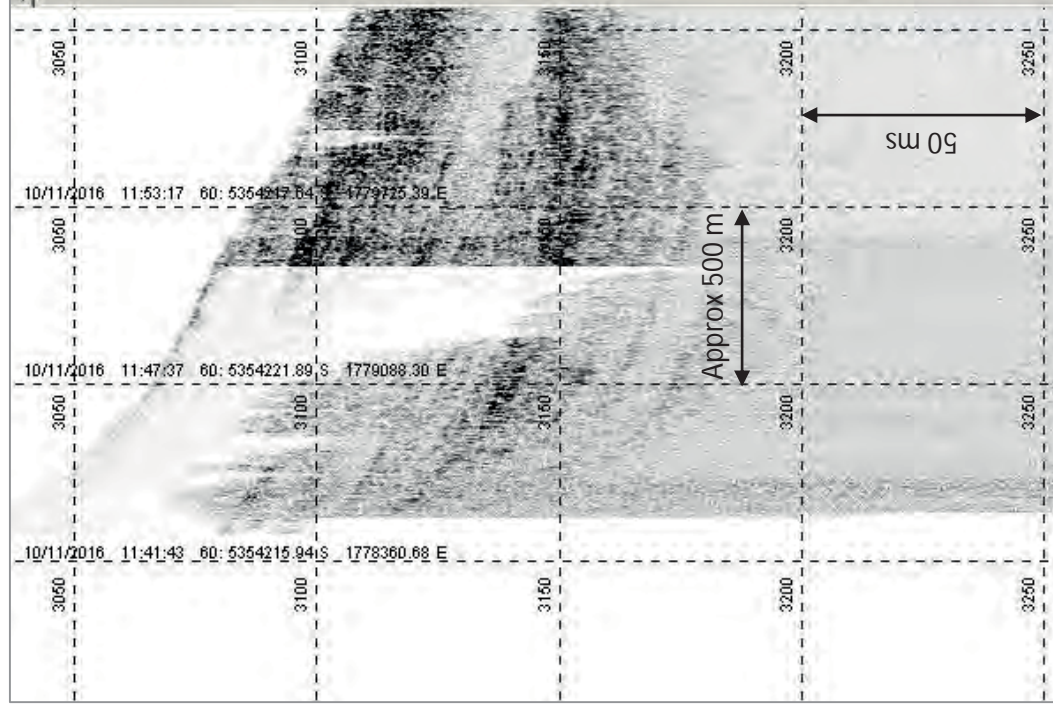
Section	Top depth (cm)	Btm depth (cm)	Logged	Phys Props	Summary
1	0	100	Y	Y	
2	100	200	Y	Y	
3	200	271	Y	Y	
4	271	335	Y	Y	
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TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Opouawe 2

Other ID TAN1613-04

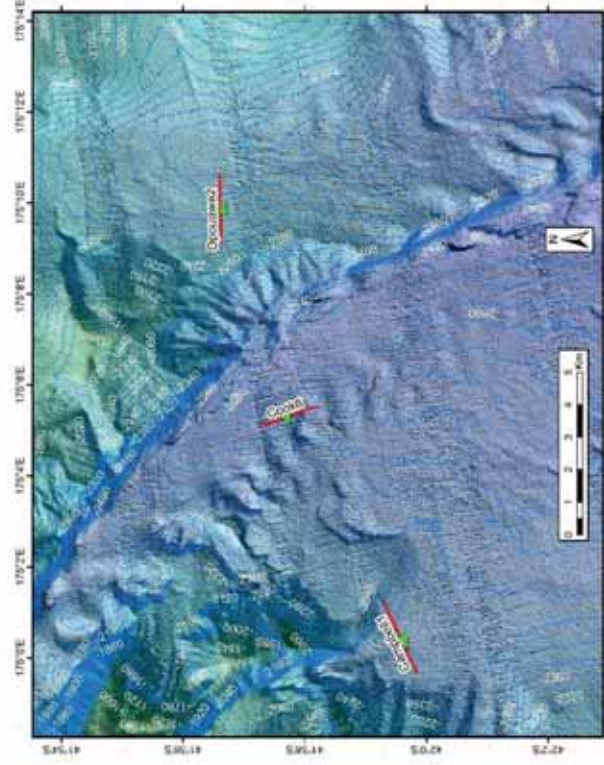
Water Depth 2297



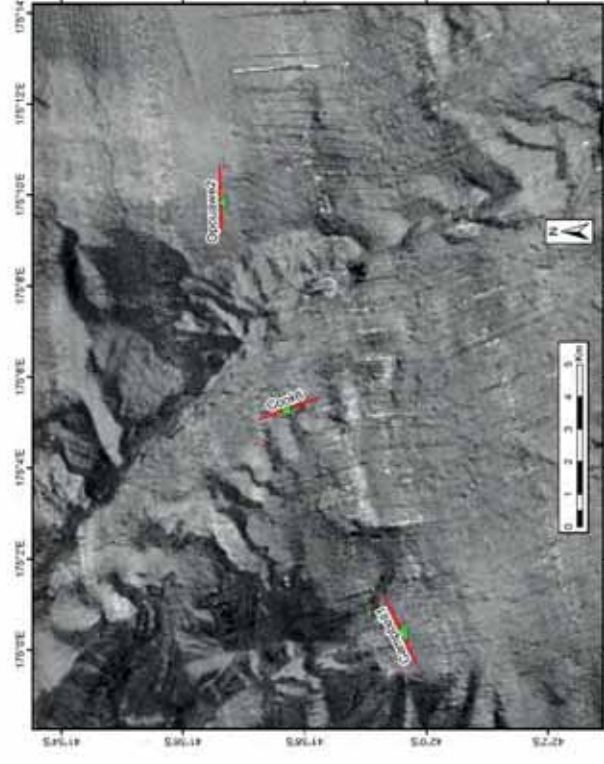
2km Topas survey line over planned core site.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Opuawe 2	Other ID TAN1613-04	Water Depth 2297
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Bathymetry at and around Opouawe 2 core site at the mouth of Opouawe Canyon, offset south of strong backscatter, above Hikurangi basin. Light blue lines are 20 m depth contours. Red lines show the 2 km TOPAS survey line over the station, green triangles indicate the actual core site.



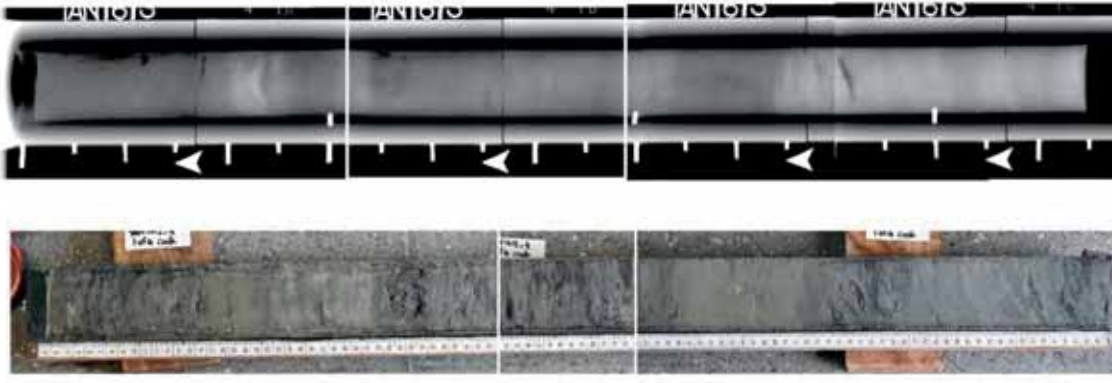
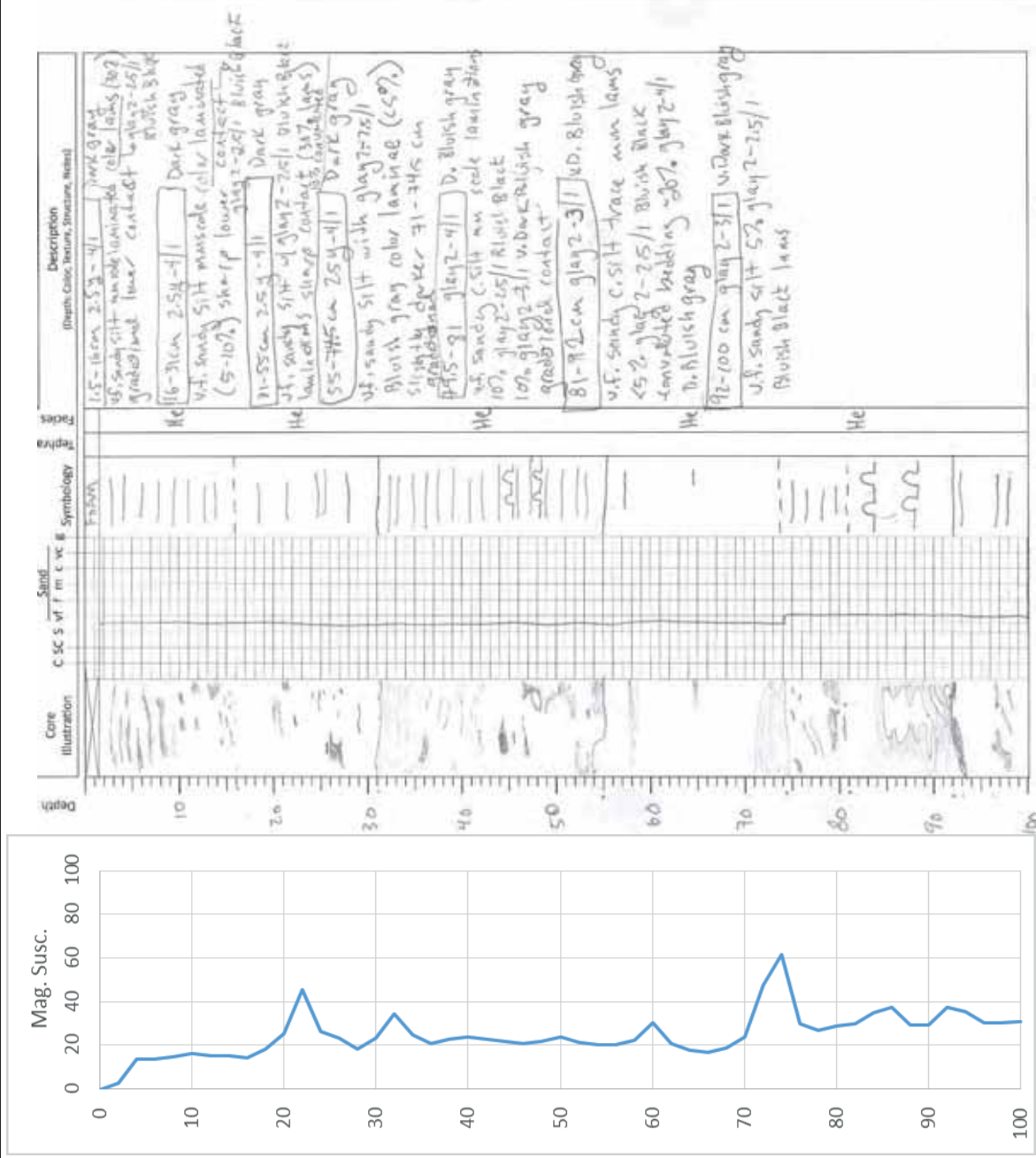
Backscatter data at and around Opouawe 2 core site at the mouth of Opouawe Canyon, offset south of strong backscatter, above Hikurangi basin. Red lines show the 2 km TOPAS survey line over the station, green triangles indicate the actual core site.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Opouawe 2

Other ID TAN1613-04

Section 1 of 4

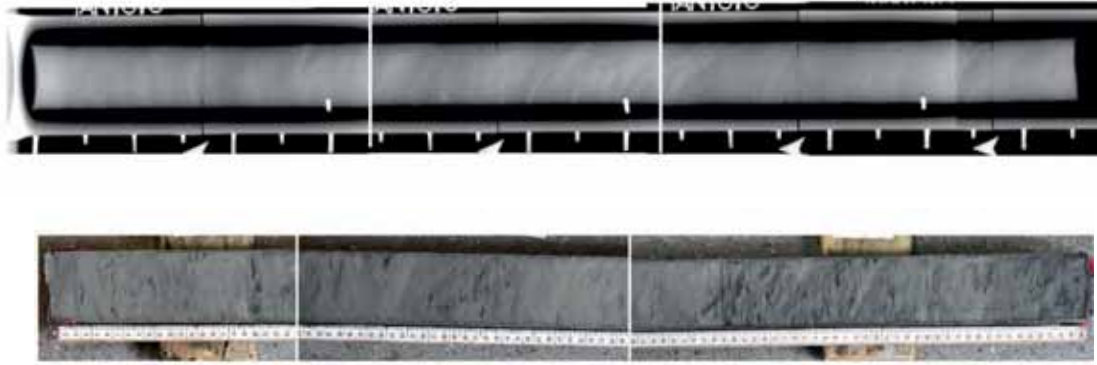
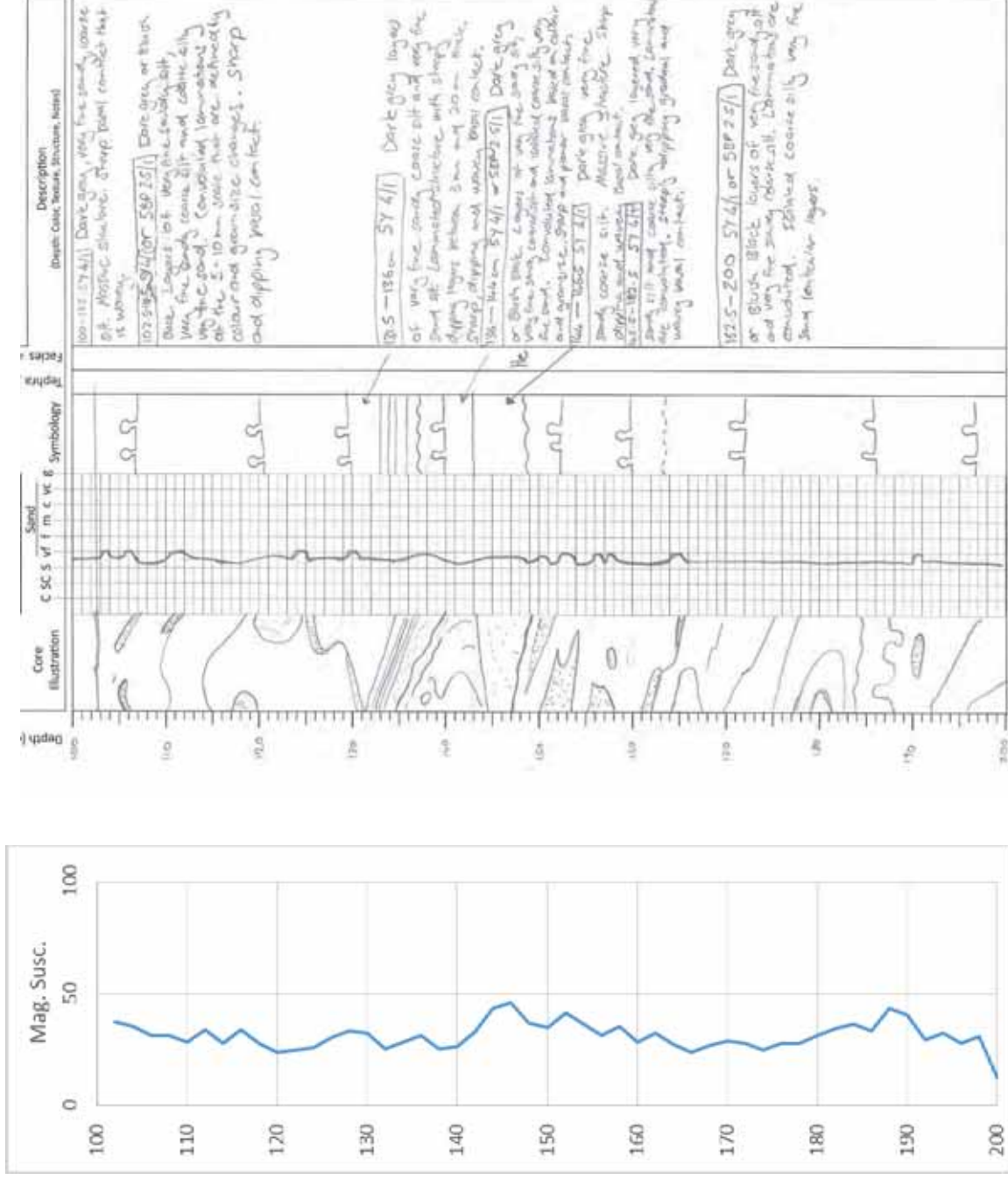


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Opouawe 2

Other ID TAN1613-04

Section 2 of 4

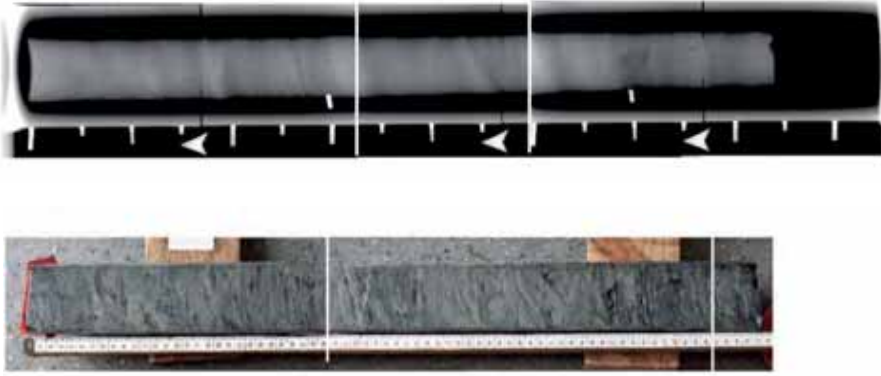
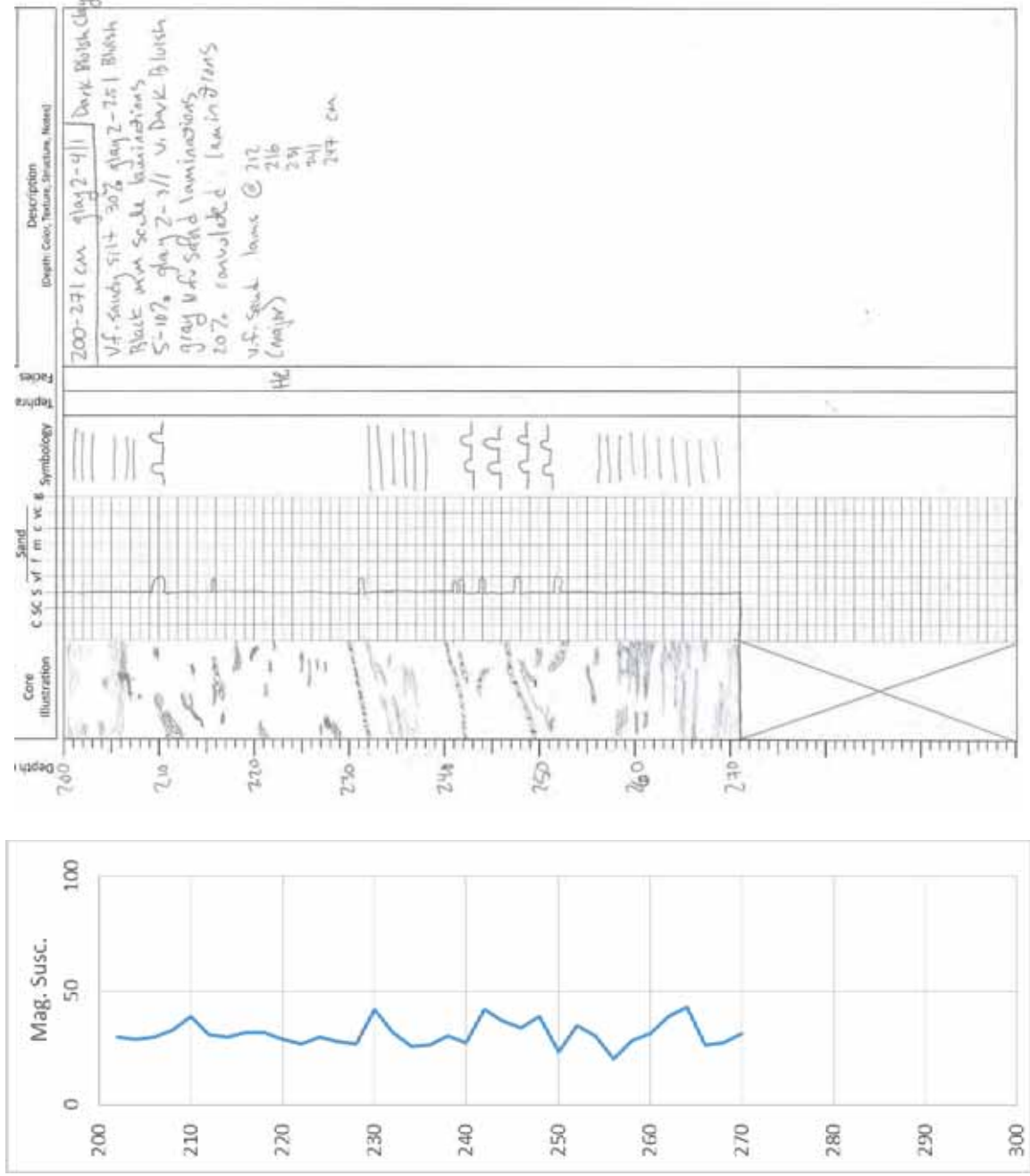


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Opouawe 2

Other ID TAN1613-04

Section 3 of 4

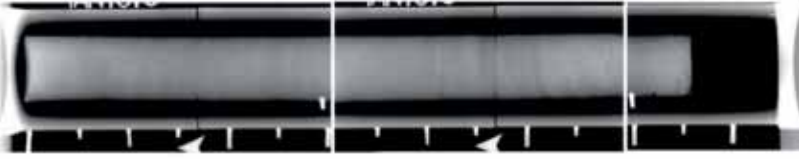
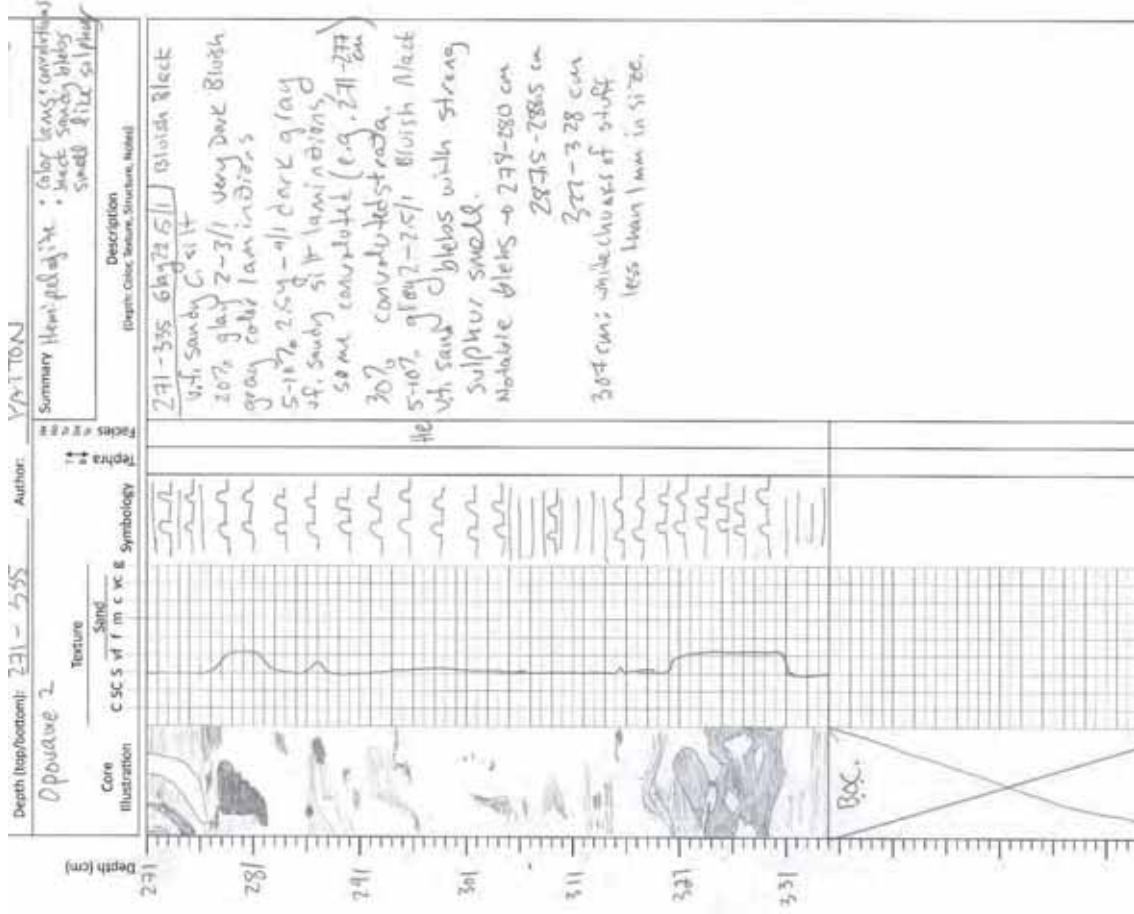


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Opouawe 2

Other ID TAN1613-04

Section 4 of 4



TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: **Cook 2**

Latitude: -41.84278

Date/Time (NZST): 11/11/2016 04:54

Other ID: TAN1613-05

Longitude: 174.94307

Depth (m): **1889**

Sample Description

General Description

Cook St Canyon outer bend terrace/slope, elevated 110 m above c. floor

Hemipelagite laminated mud over 2 gravel turbidites towards base

Gear type		Piston core	
Barrel Length (m)	6	Bent barrel	Y/N
Penetration (m)	N/D	Catcher/Cutter bags	1
Core length (m)	70.1	Samples	N
Sections	1	Tephra	N
Fauna	N	Pull-out	3.7t

Sample processing – core ID:

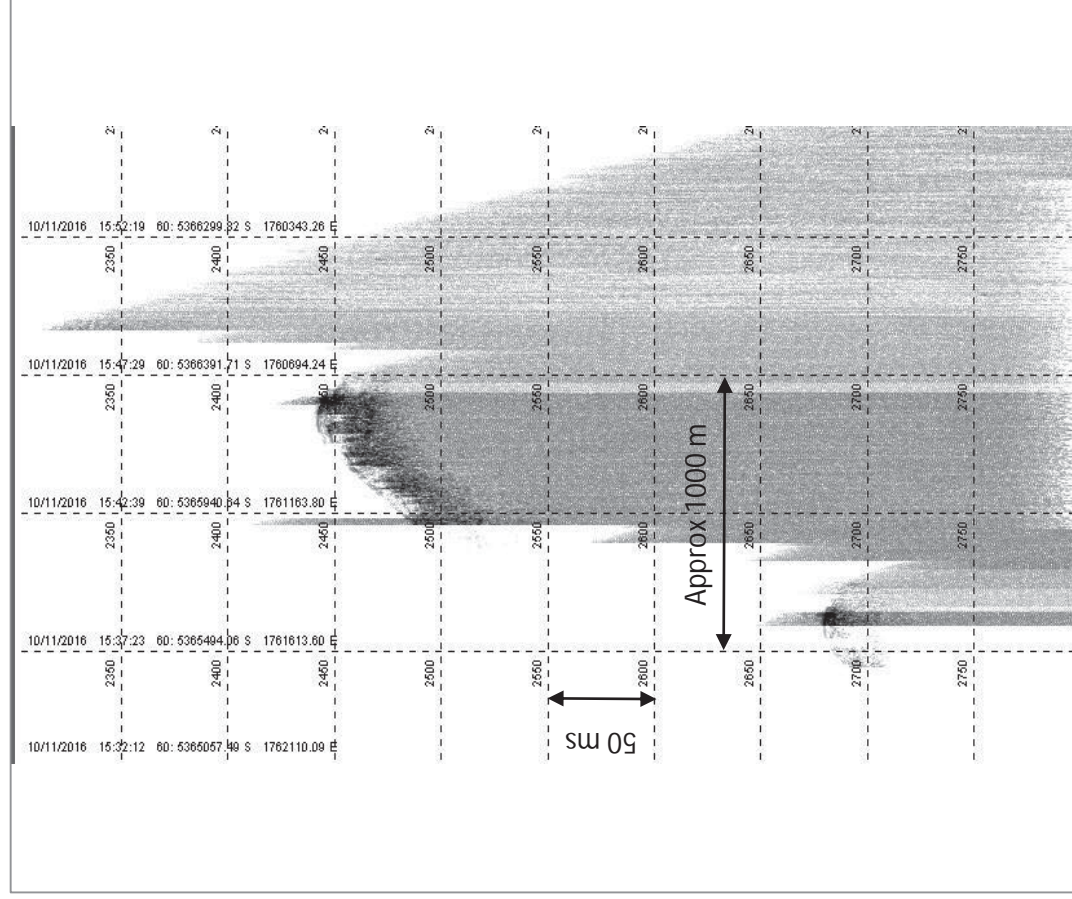
Section	Top depth (cm)	Btm depth (cm)	Logged	Phys Props	Summary
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TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

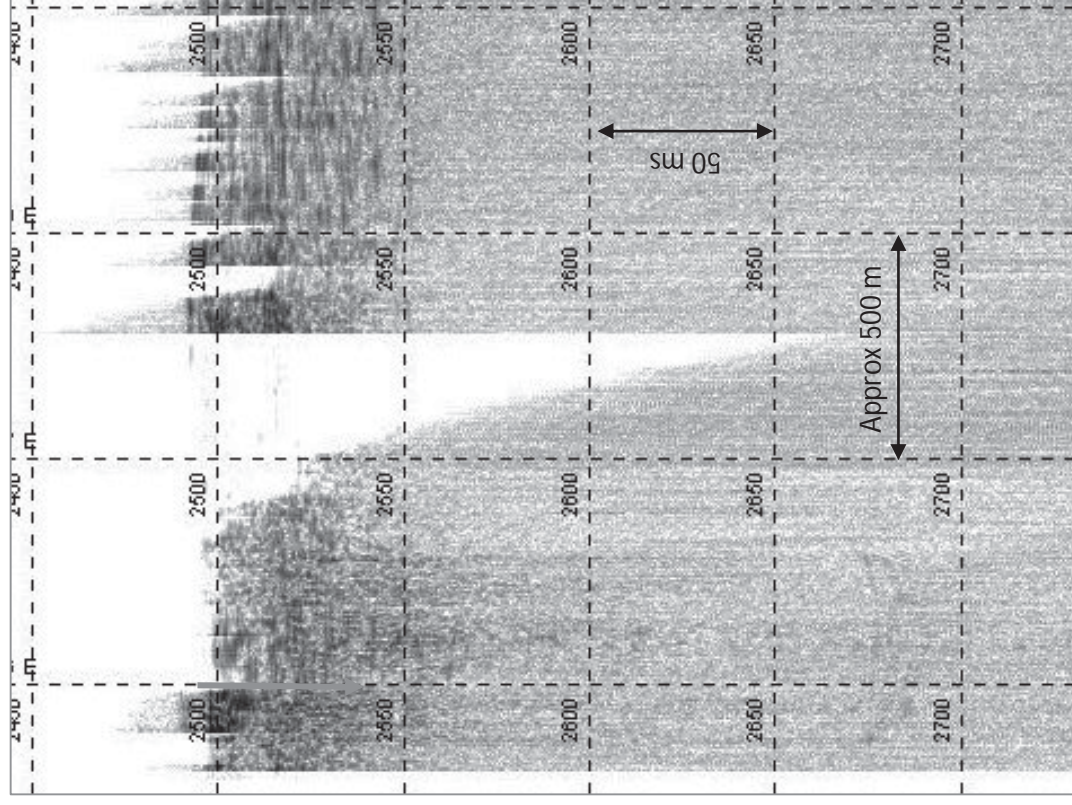
Core ID: COOK 2

Other ID TAN1613-05

Water Depth 1889



2km Topas survey line over planned core site.



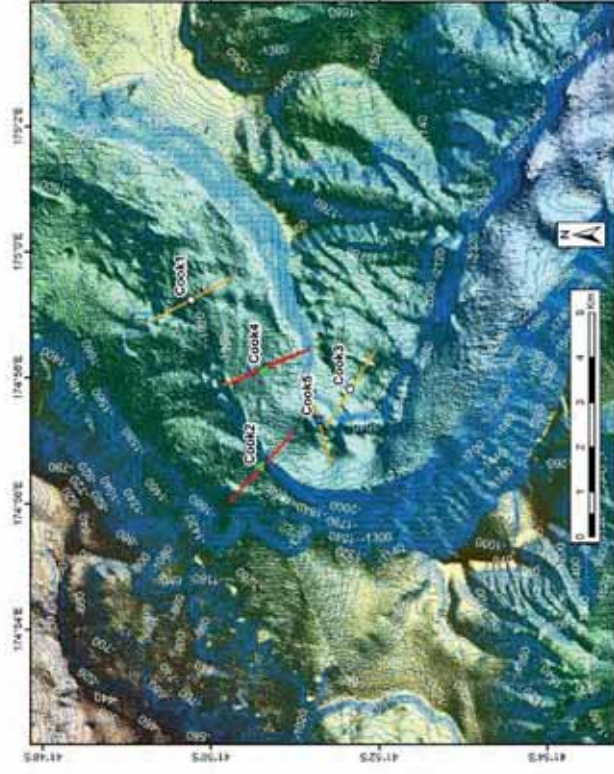
Drifting over planned core site.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

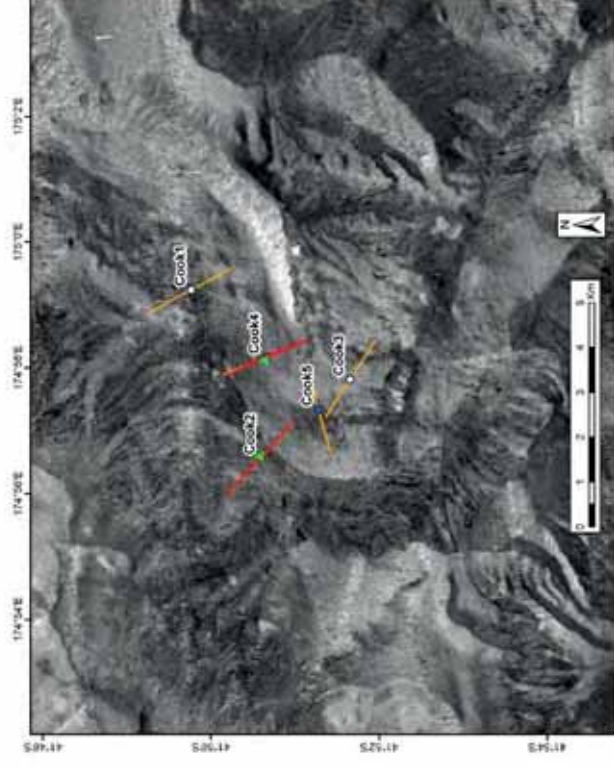
Core ID: COOK 2

Other ID TAN1613-05

Water Depth 1889



Bathymetry at and around Cook2 core site at the outer bend terrace/slope, elevated 110 above canyon floor. Light blue lines are 20 m depth contours. Red lines show the 2 km TOPAS survey line over the station, green triangles indicate the actual core site. Orange lines show planned Topas survey and coloured dots are stations not yet done.



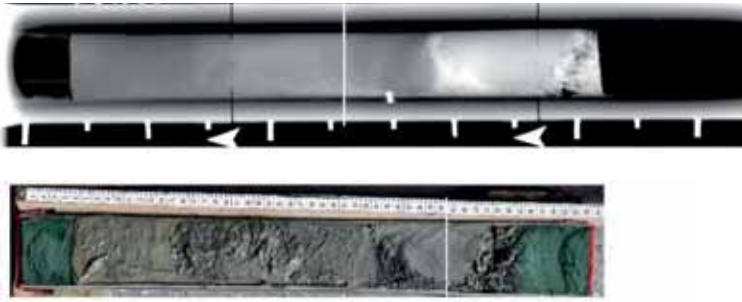
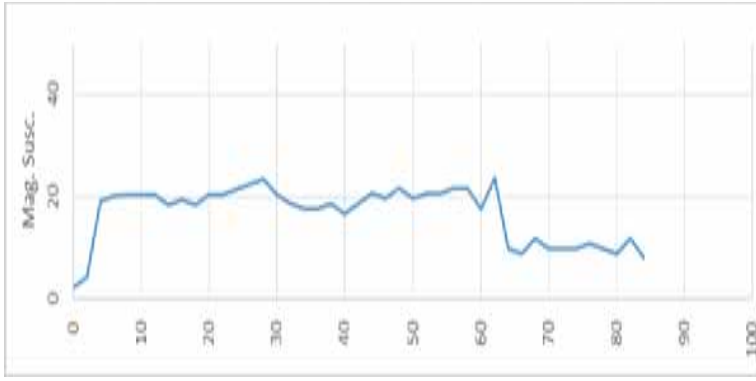
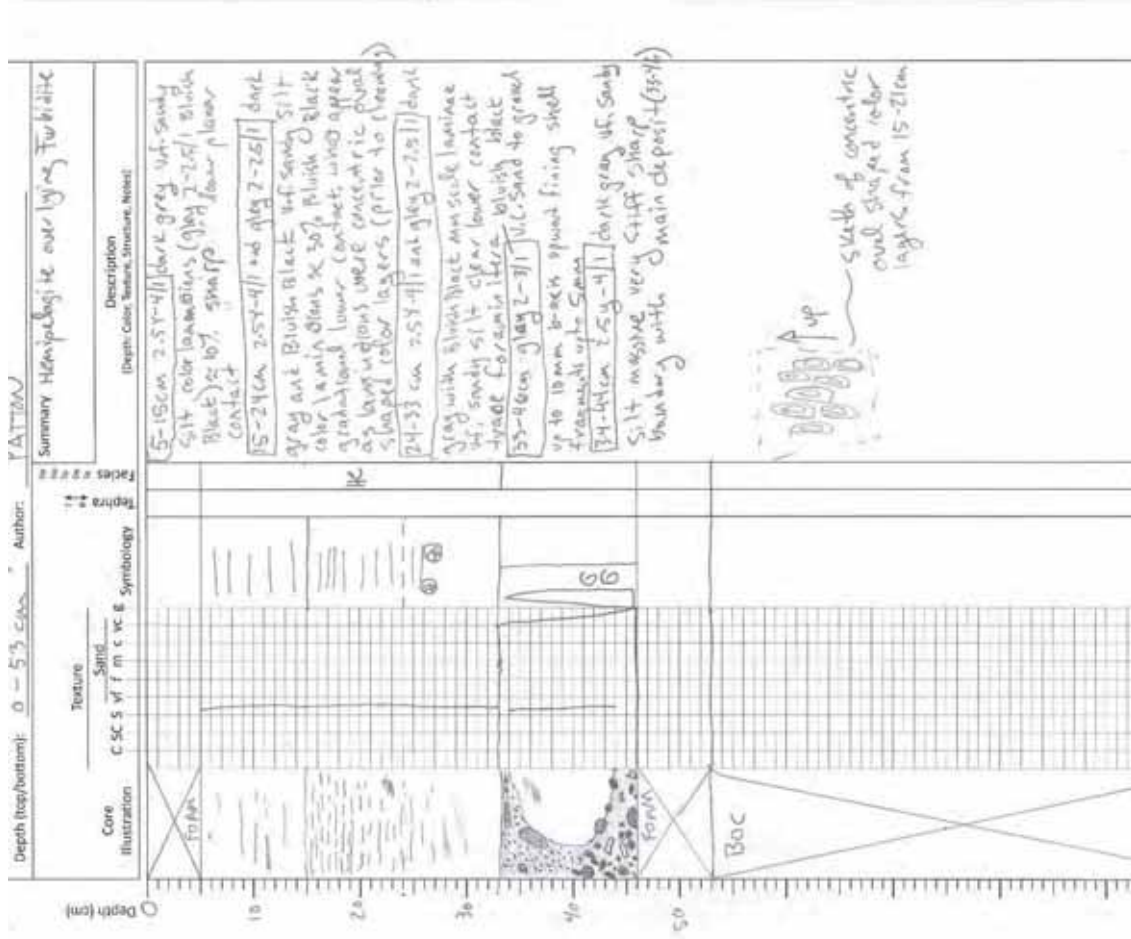
Backscatter data at and around Cook2 core site at the outer bend terrace/slope, elevated 110 above canyon floor. Red lines show the 2 km TOPAS survey line over the station, green triangles indicate the actual core site. Orange lines show planned Topas survey and coloured dots are stations not yet done.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: COOK 2

Other ID TAN1613-05

Section 1 of 1



TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: **Cook 4** Latitude: -41.84358 Date/Time (NZST): 11/11/2016 07:26

Other ID: TAN1613-06 Longitude: 174.96862 Depth (m): **2007**

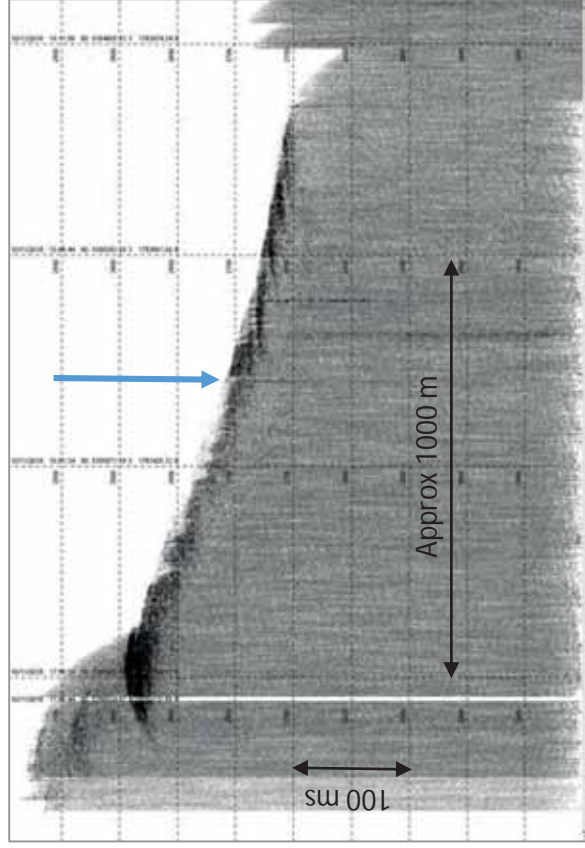
Sample Description	Gear type	Piston core
General Description Mid Cook Strait Canyon, above lower corner Variably laminated hemipelagite over 3 stacked sand-gravel turbidites with shell fragments	Barrel Length (m)	6 Bent barrel Y/N
	Penetration (m)	n/d Catcher/Cutter bags 1
	Core length (m)	1.12 Samples N
	Sections	2 Tephra N
	Fauna	n Pull-out 2.9t

Sample processing – core ID:

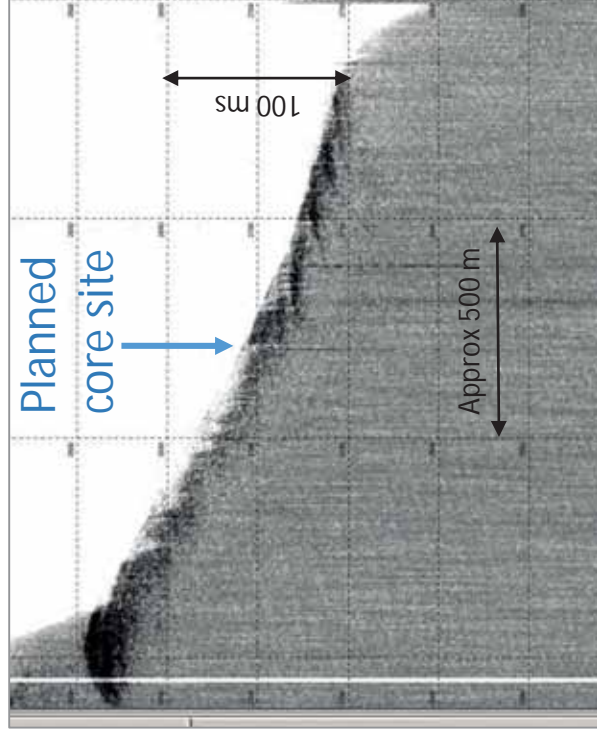
Section	Top depth (cm)	Btm depth (cm)	Logged	Phys Props	Summary
1	0	55	y	y	.
2	55	112	y	y	.
.
.
.
.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Cook 4	Other ID TAN1613-06	Water Depth 2007
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2 km long Topas line over core site indicated by blue arrow.



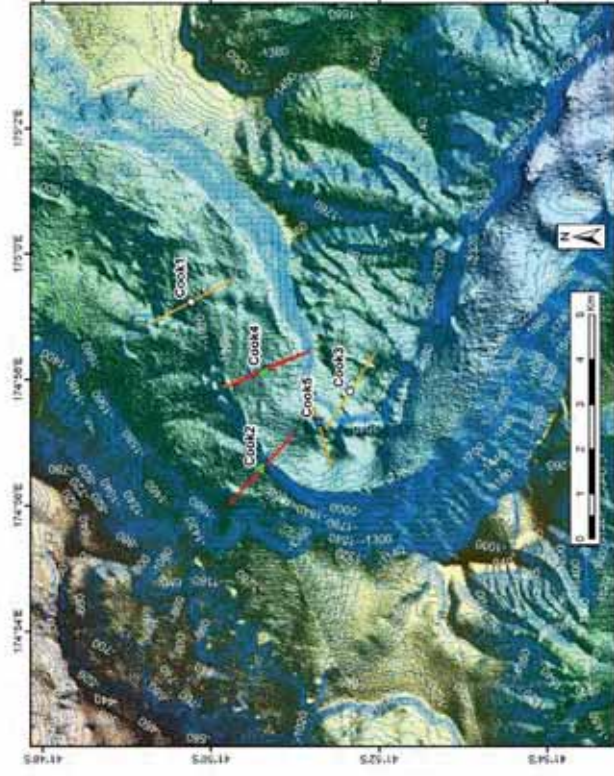
Same line slightly zoomed in.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

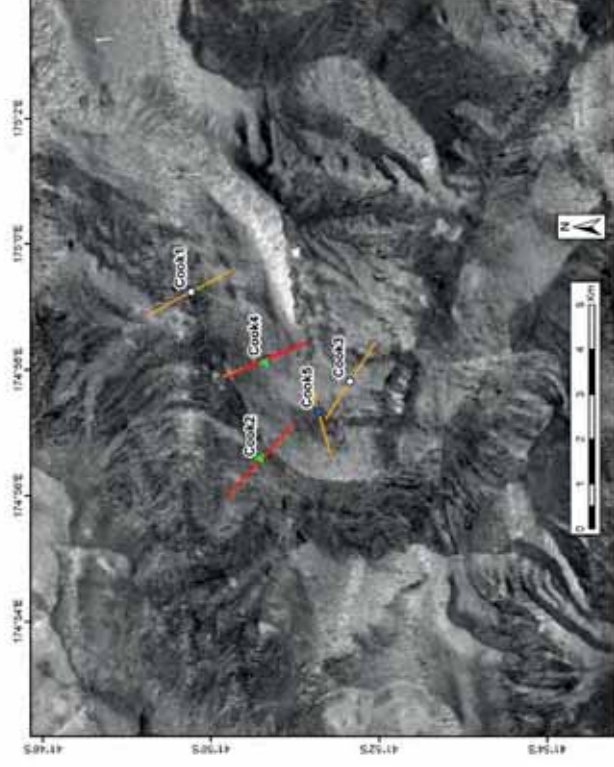
Core ID: Cook 4

Other ID TAN1613-06

Water Depth 2007



Bathymetry at and around Cook4 core site in the mid Cook Strait Canyon, above lower corner. Light blue lines are 20 m depth contours. Red lines show the 2 km TOPAS survey lines over the stations, green triangles indicate the actual core site. Orange lines show planned Topas surveys and coloured dots are stations not yet done.



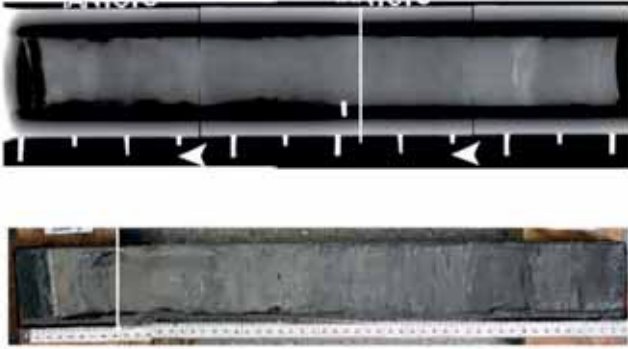
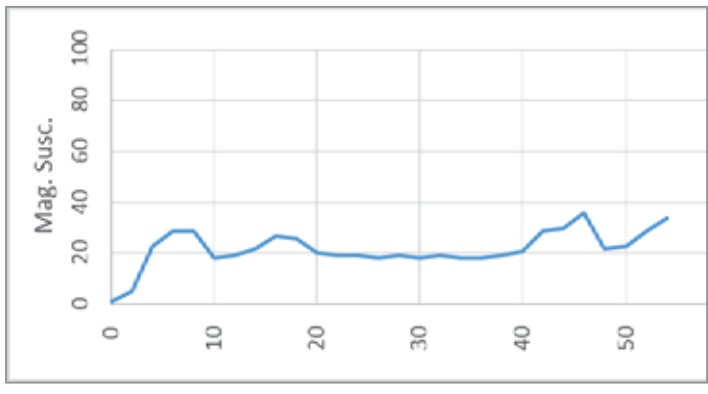
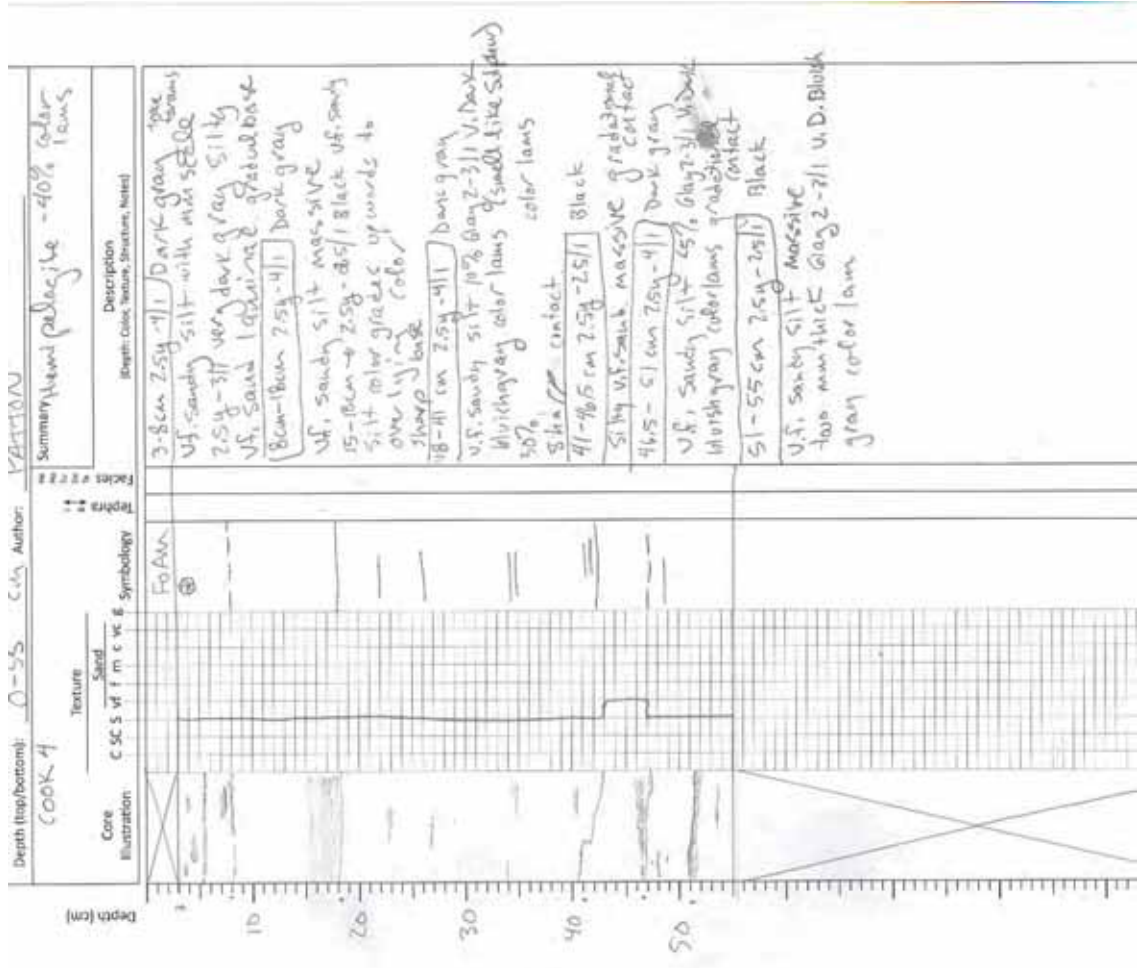
Backscatter data at and around Cook4 core site in the mid Cook Strait Canyon, above lower corner. Red lines show the 2 km TOPAS survey lines over the stations, green triangles indicate the actual core site. Orange lines show planned Topas survey and coloured dots are stations not yet done.

TAN1613 - Paleoseismicity of the Southern Hikurangi Margin

Core ID: Cook 4

Other ID TAN1613-06

Section 1 of 2

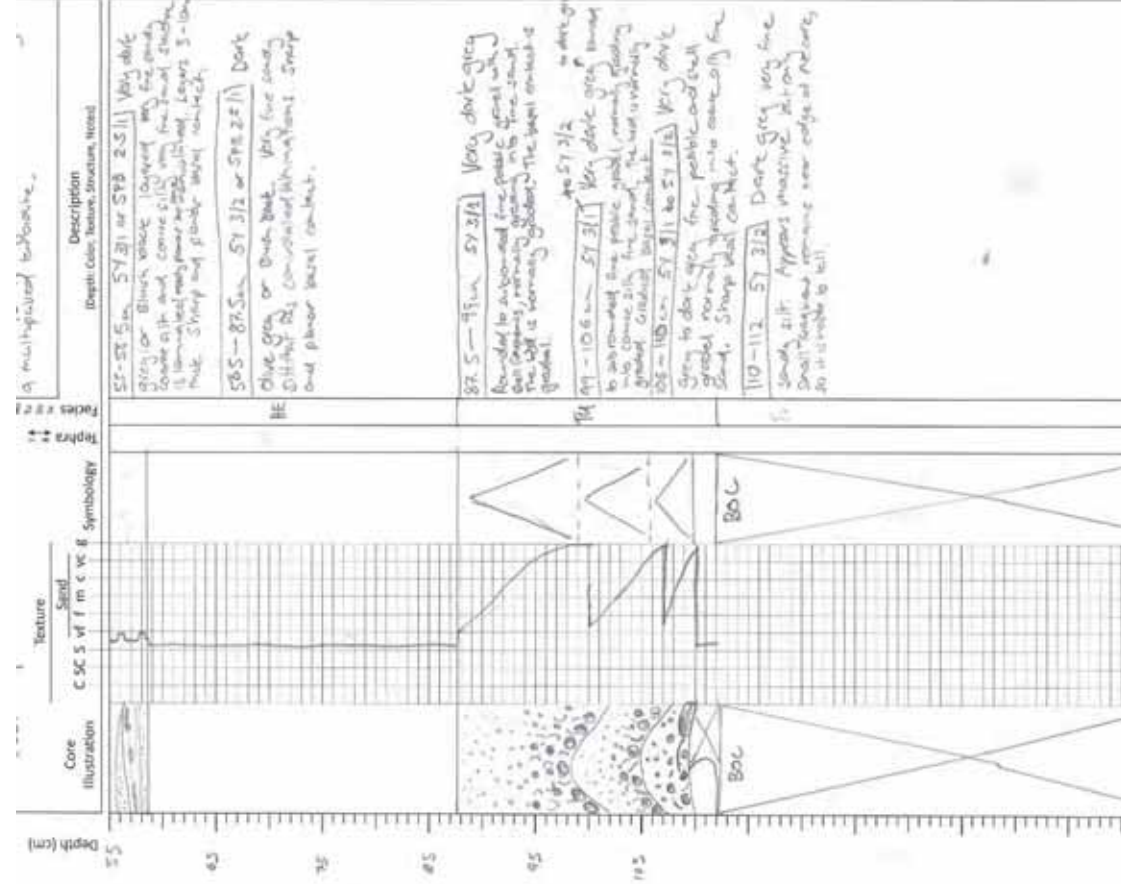
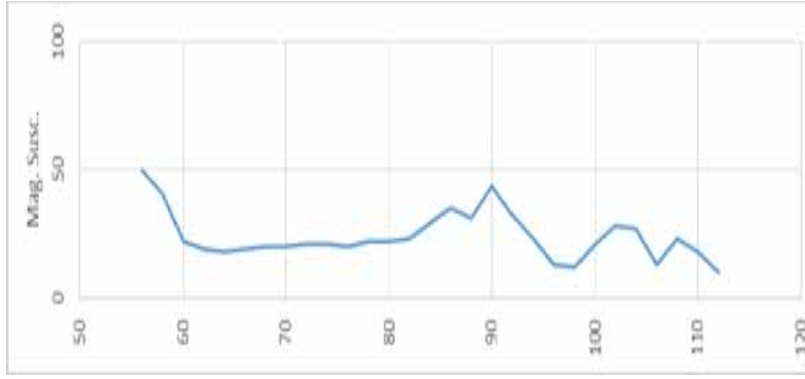


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Cook 4

Other ID TAN1613-06

Section 2 of 2



TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: **Opouawe 1**

Latitude: -41.77633

Date/Time (NZST): 11/11/2016 11:10

Other ID: TAN1613-07

Longitude: 175.34000

Depth (m): **1408**

Sample Description

General Description

Upper Opouawe canyon, Sthn terrace

Interbedded hemipelagite and muddy/sandy turbidites. Turbidites generally , 5 cm thick.

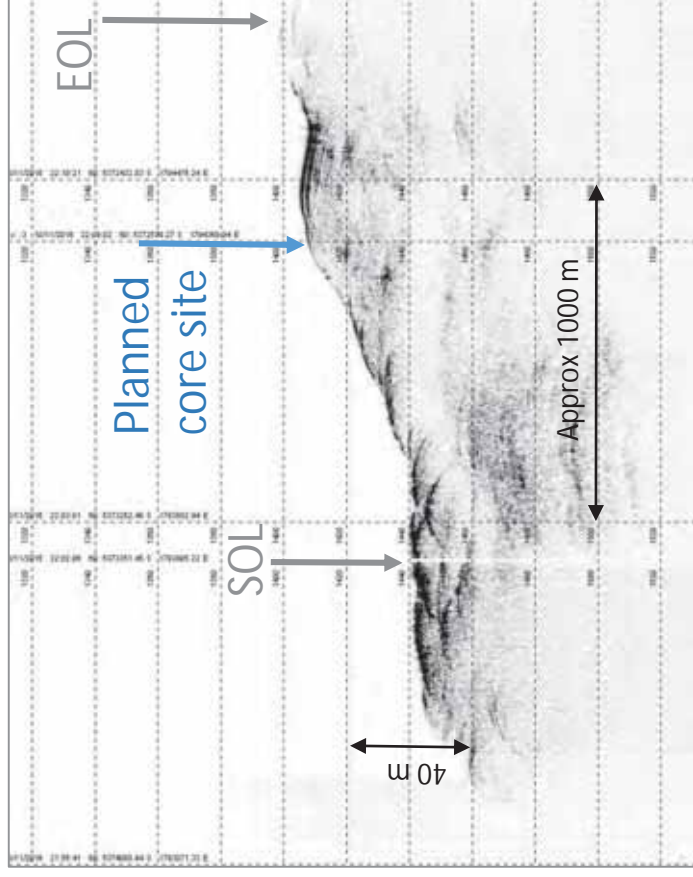
Gear type		Piston core	
Barrel Length (m)	6	Bent barrel	N
Penetration (m)	n/d	Catcher/Cutter bags	n
Core length (m)	4.90	Samples	n
Sections	5	Tephra	n
Fauna	n	.	.

Sample processing – core ID:

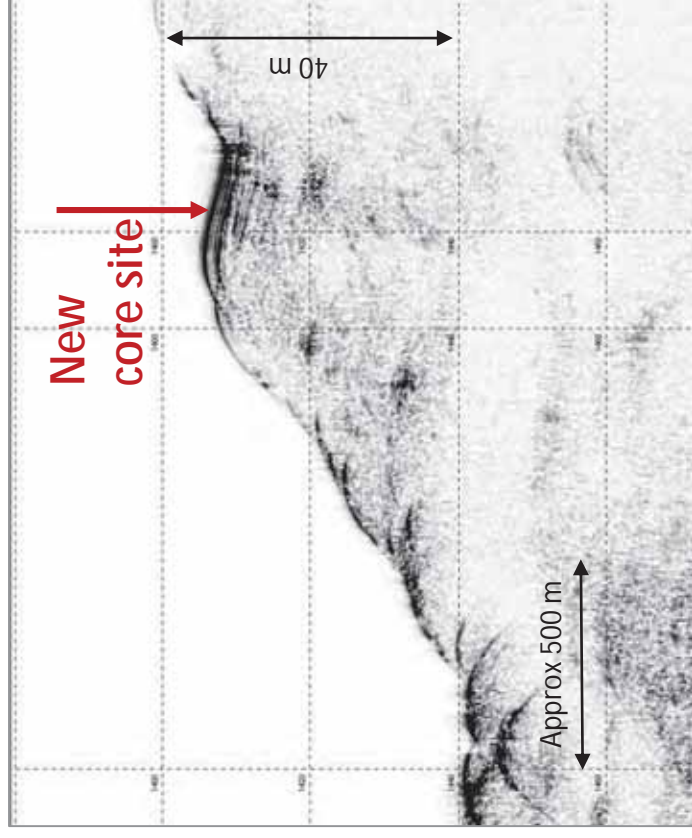
Section	Top depth (cm)	Btm depth (cm)	Logged	Phys Props	Summary
1	0	100	Y	Y	Hemipelagite ~70% laminated upper 7.5 cm chocolate brown
2	100	200	Y	Y	Mainly hemipelagite mud potentially interbedded with silty sandy turbidites
3	200	300	Y	Y	Hemipelagite with muddy + Sandy turbidites
4	300	400	Y	Y	hemipelagite mud
5	400	490	Y	Y	Hemipelagite with muddy turbidites ? tephra ? @476.5 cm
.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Opouawe 1	Other ID TAN1613-07	Water Depth 1408
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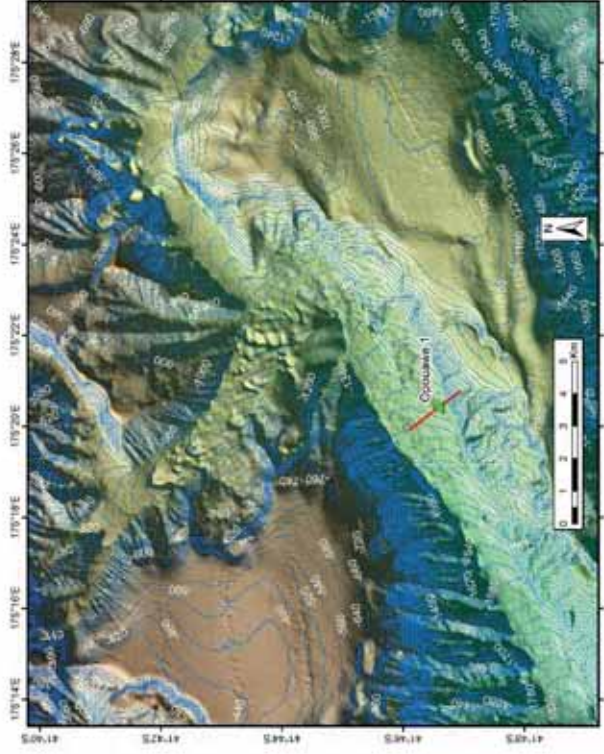
2 km long Topas line over core site. Grey arrows indicate start and end of the 2km survey line over the station. Blue arrow marks the planned core site.



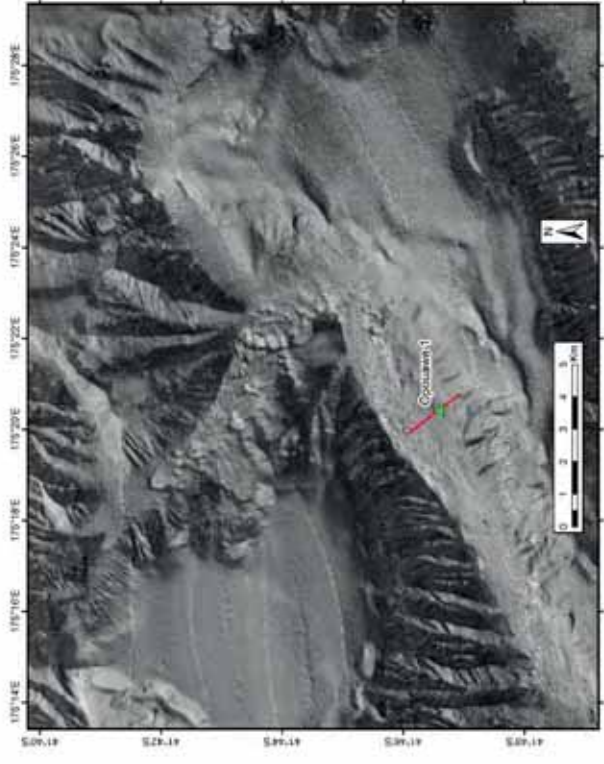
Same line slightly zoomed in, with new core site marked with red arrow.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Opuawe 1	Other ID TAN1613-07	Water Depth 1408
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Bathymetry at and around Opuawe1 core site at the upper Opuawe Canyon, southern terrace. Light blue lines are 20 m depth contours. Red lines show the 2 km TOPAS survey lines over the stations, green triangles indicate the actual core site.



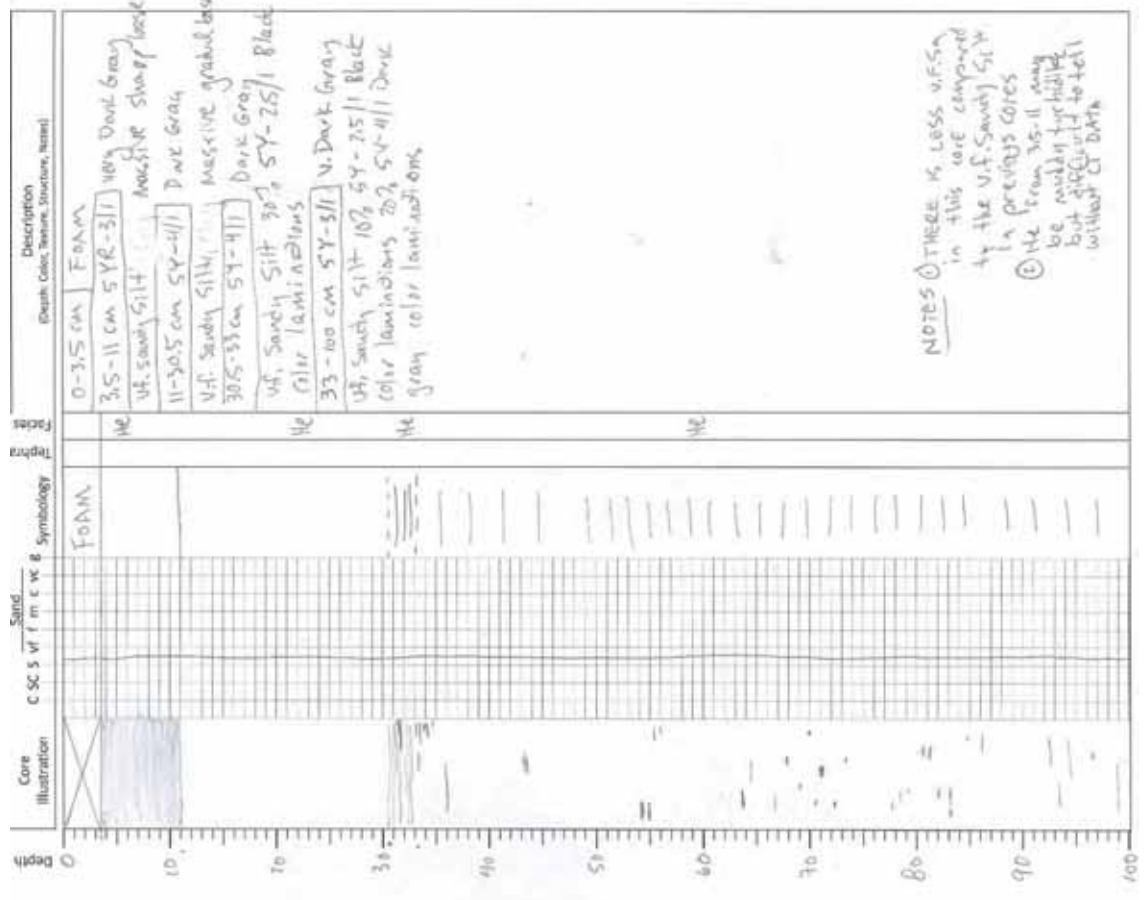
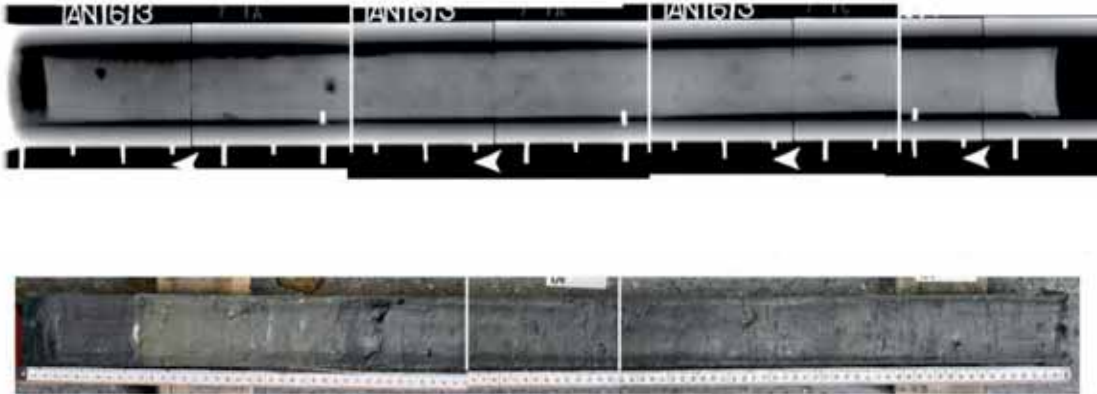
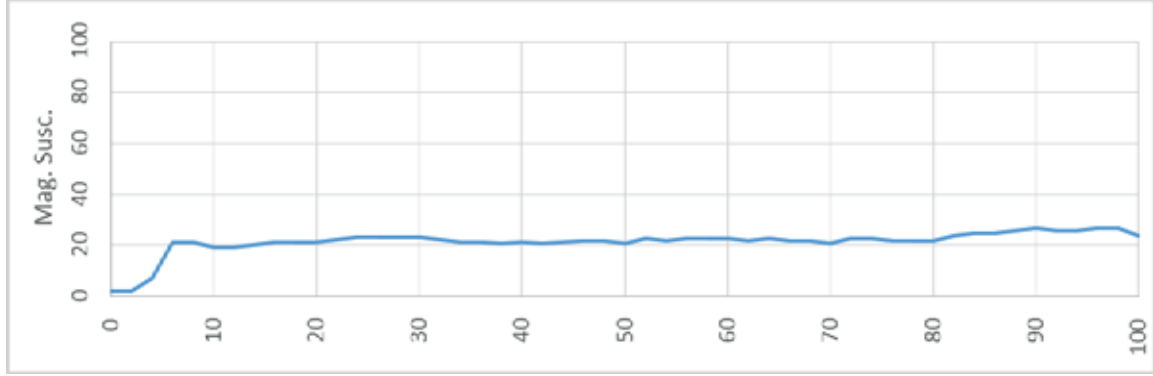
Backscatter at and around Opuawe1 core site at the upper Opuawe Canyon, southern terrace. Red lines show the 2 km TOPAS survey lines over the stations, green triangles indicate the actual core site.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Opouawe 1

Other ID TAN1613-07

Section 1 of 5

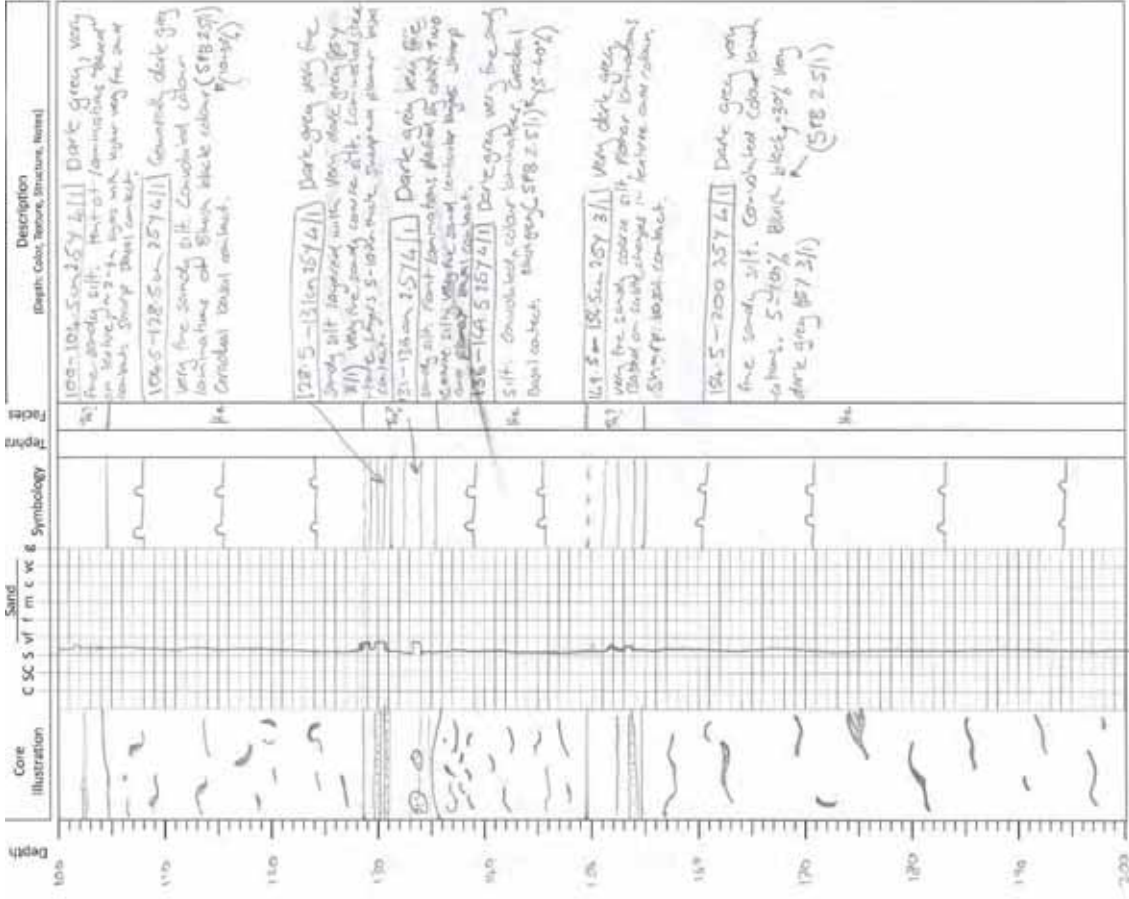
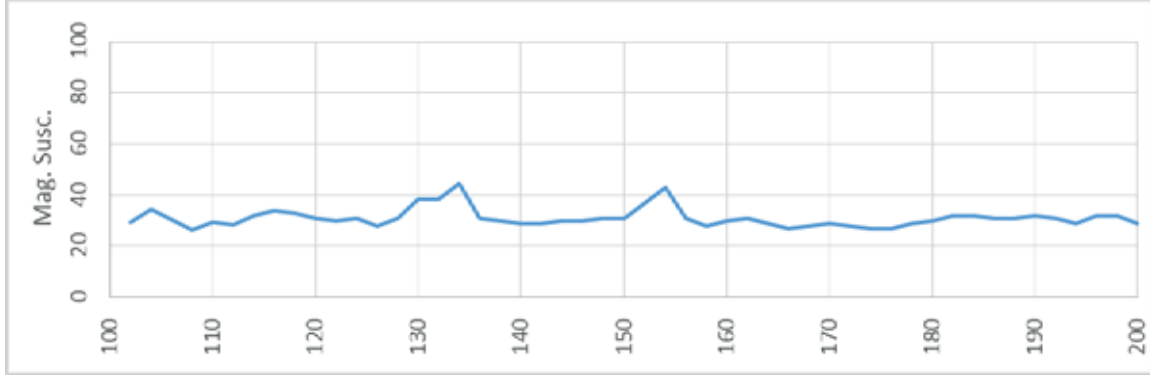


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Opouawe 1

Other ID TAN1613-07

Section 2 of 5

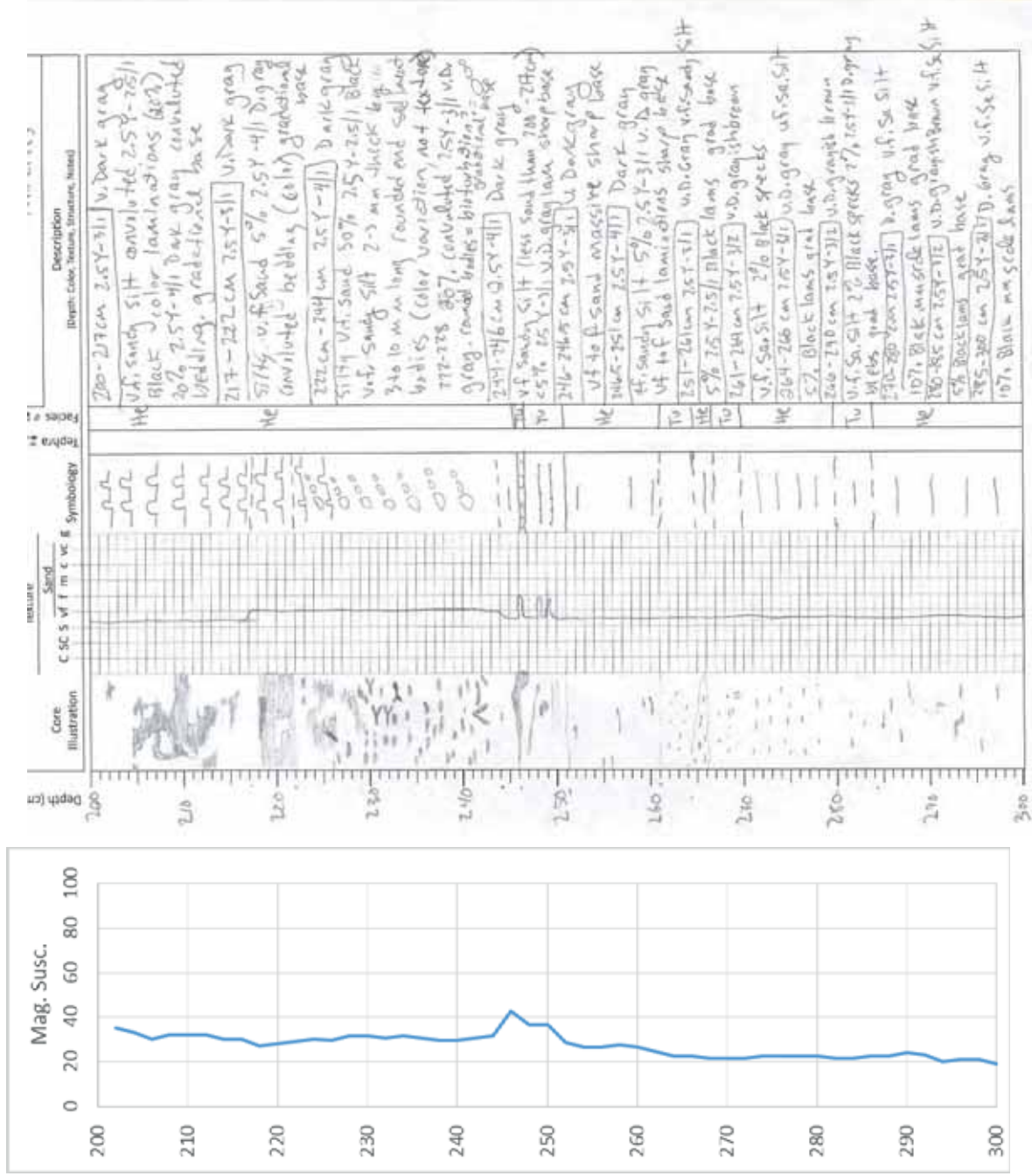


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Opouawe 1

Other ID TAN1613-07

Section 3 of 5

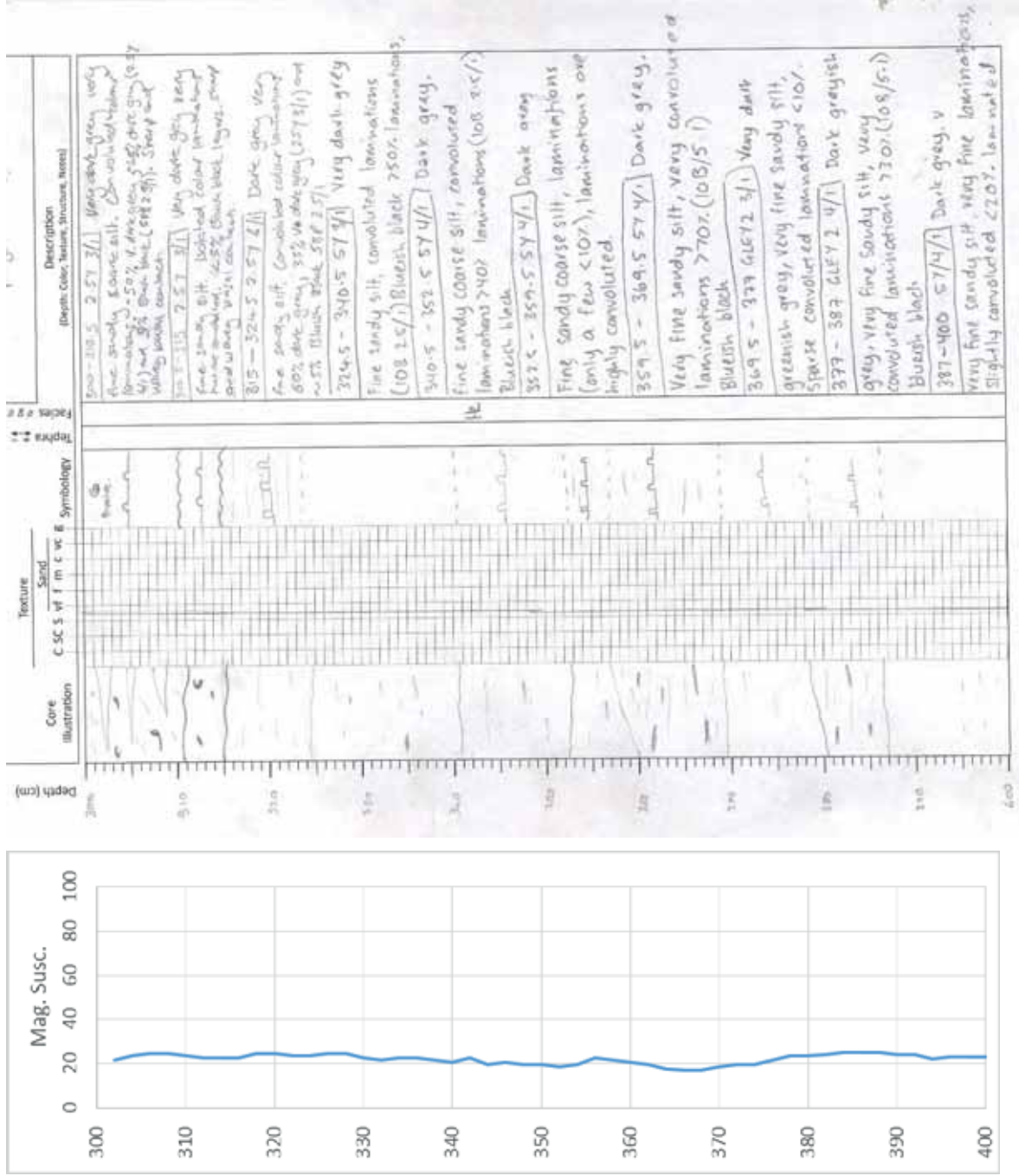


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Opouawe 1

Other ID TAN1613-07

Section 4 of 5

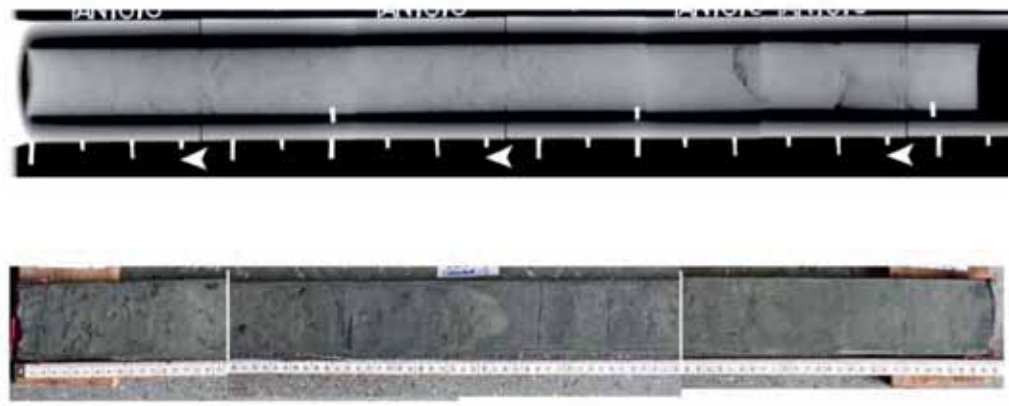
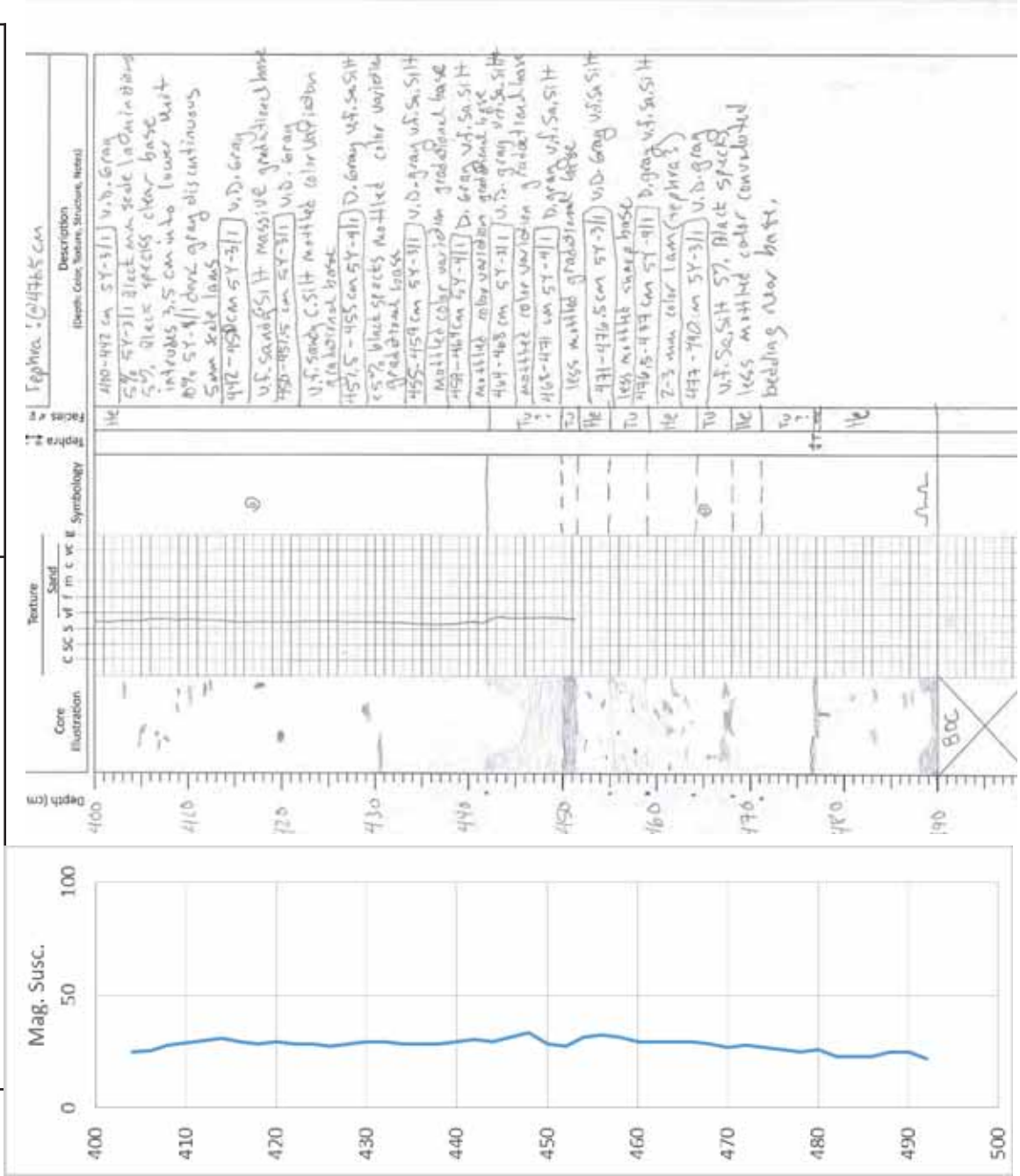


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Opouawe 1

Other ID TAN1613-07

Section 5 of 5



TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Wai 7	Latitude: -41.82370	Date/Time (NZST): 11/11/2016 14:59
Other ID: TAN1613-08	Longitude: 175.62760	Depth (m): 2449

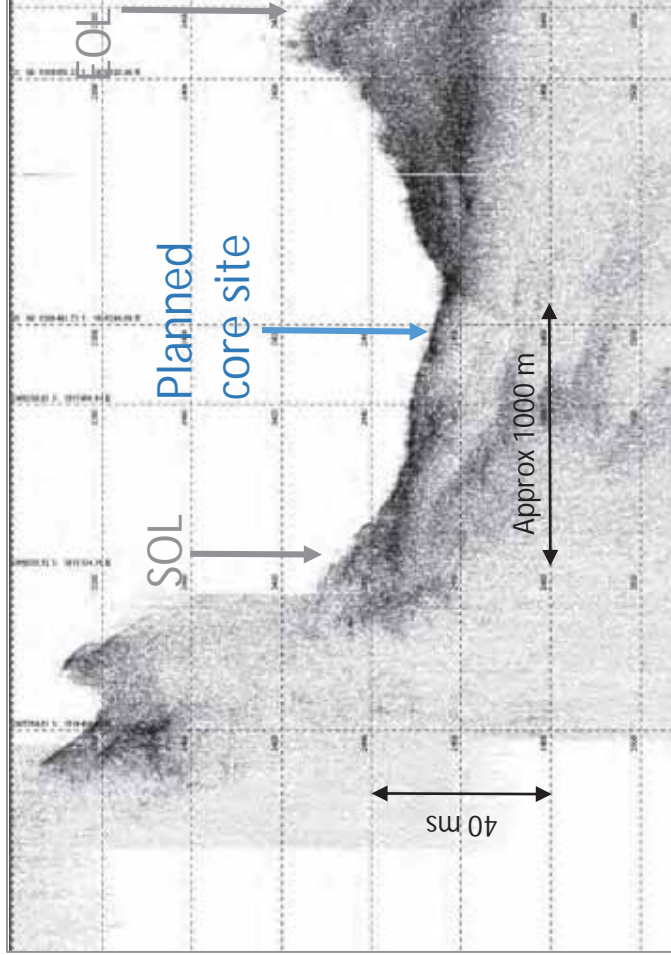
Sample Description	Gear type	Piston core
General Description Mouth of lower slope gully system NE of Opouawe Bank, above Hik Basin flr Interbedded ? Hemipelgites, 140 cm thick ?debrite, and possible turbidites in section 1	Barrel Length (m)	6 Bent barrel N
	Penetration (m)	n/d Catcher/Cutter bags N
	Core length (m)	2.81 Samples N
	Sections	3 Tephra N
	Fauna	N .

Sample processing – core ID:

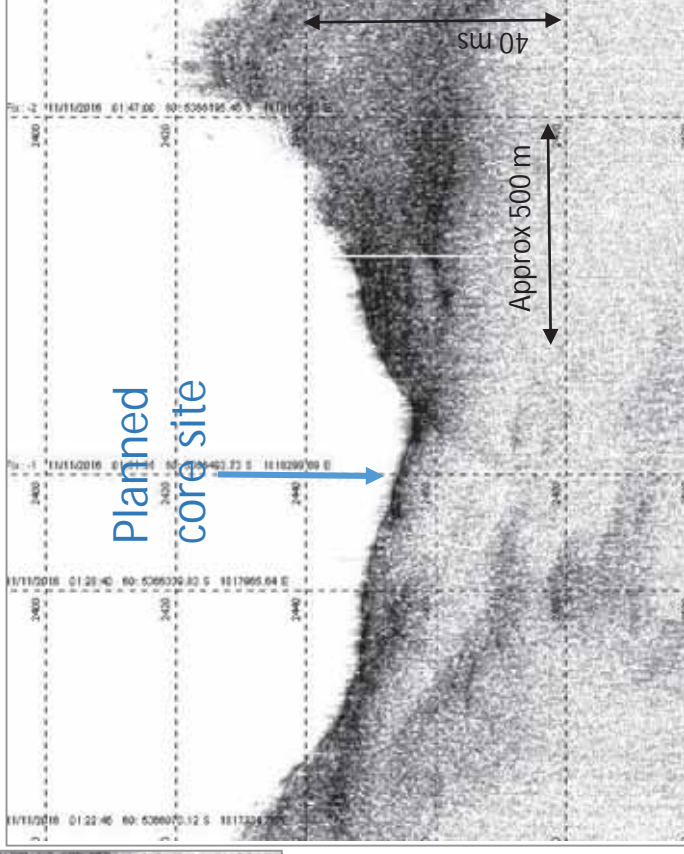
Section	Top depth (cm)	Btm depth (cm)	Logged	Phys Props	Summary
1	0	100	Y	Y	Interbedded hemipelgites and potential turbidites overlying stiff very fine silts
2	100	200	Y	Y	Debrites
3	200	281	Y	Y	Convolutd [??] of grey very fine sandy silt interposed as a debrite. Overlying planar laminated dark grey very fine sandy silt

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Wai 7	Other ID TAN1613-08	Water Depth 2249
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Topas line including transit to the station. Grey arrows indicate start and end of the 2km survey line over the station. Blue arrow marks the planned core site.



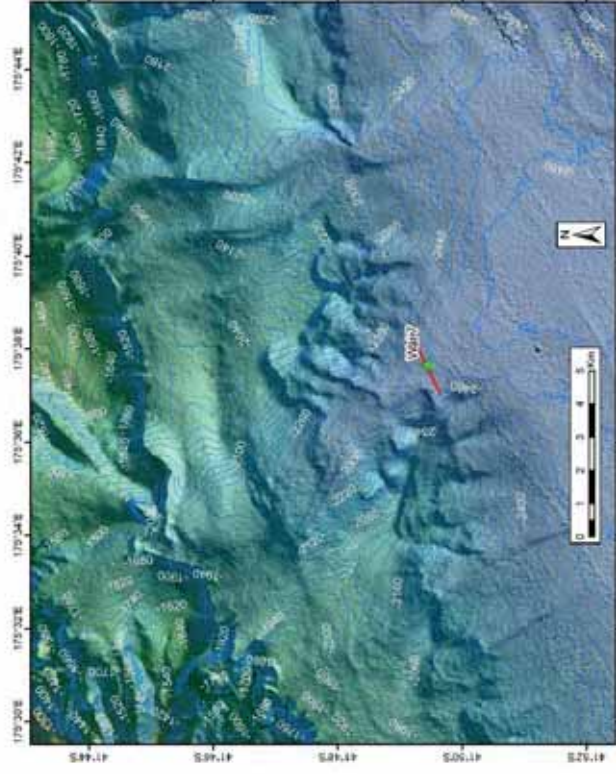
2km survey line, slightly zoomed in, over planned core site.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Wai 7

Other ID TAN1613-08

Water Depth 2249



Bathymetry at and around Wai7 core site at the mouth of the lower slope gully system NE of Opouawe Bank, above Hikurangi floor. Light blue lines are 20 m depth contours. The red line shows the 2 km TOPAS survey line over the station, green triangle indicates the actual core site.



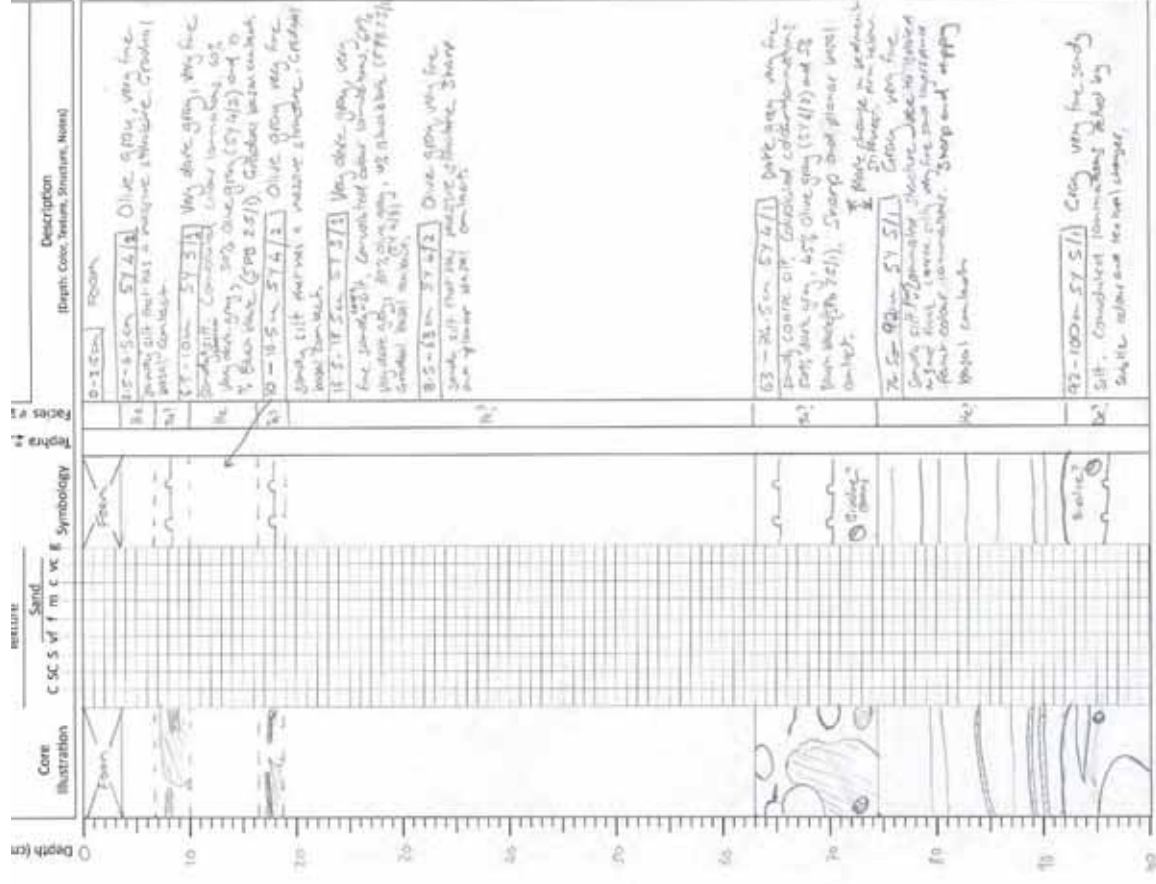
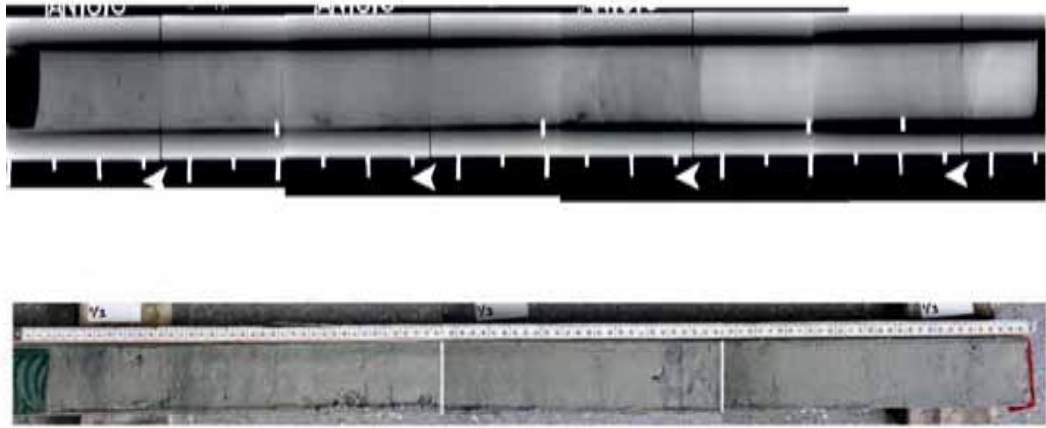
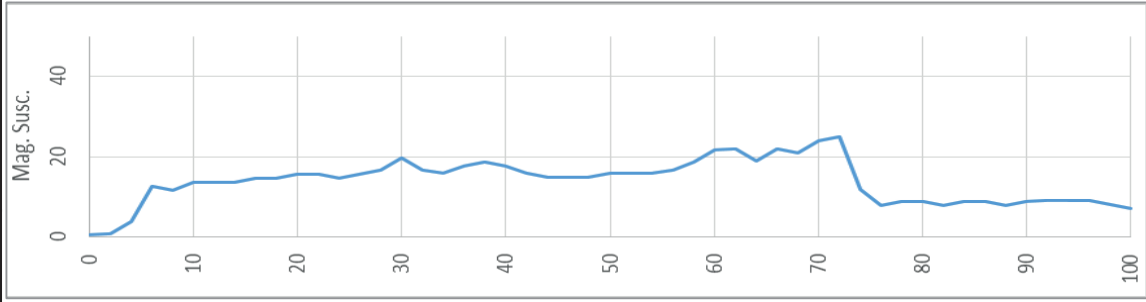
Backscatter at and around Wai7 core site at the mouth of the lower slope gully system NE of Opouawe Bank, above Hikurangi floor. The red line shows the 2 km TOPAS survey line over the station, green triangle indicates the actual core site.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Wai 7

Other ID TAN1613-08

Section 1 of 3

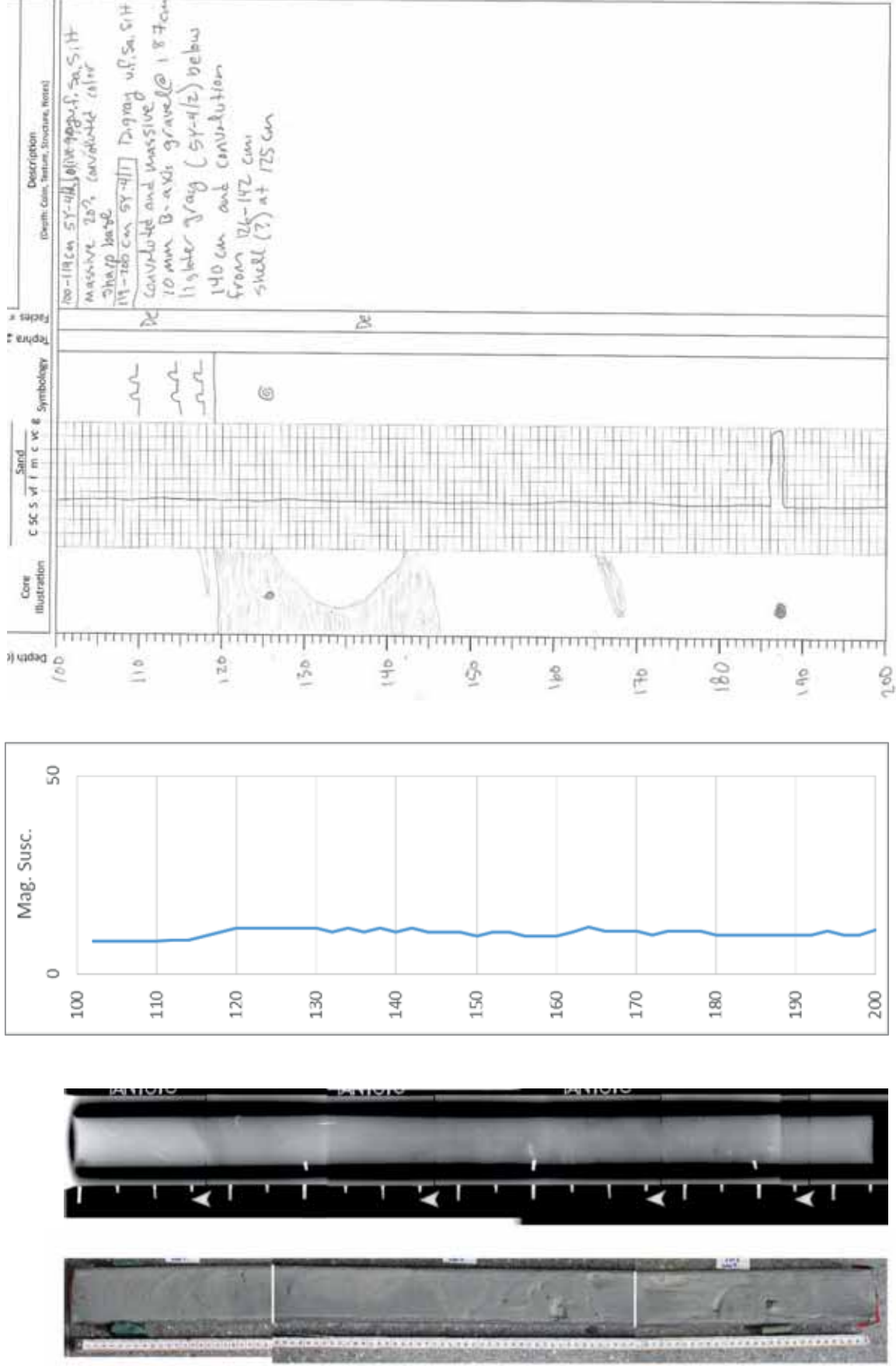


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Wai 7

Other ID TAN1613-08

Section 2 of 3

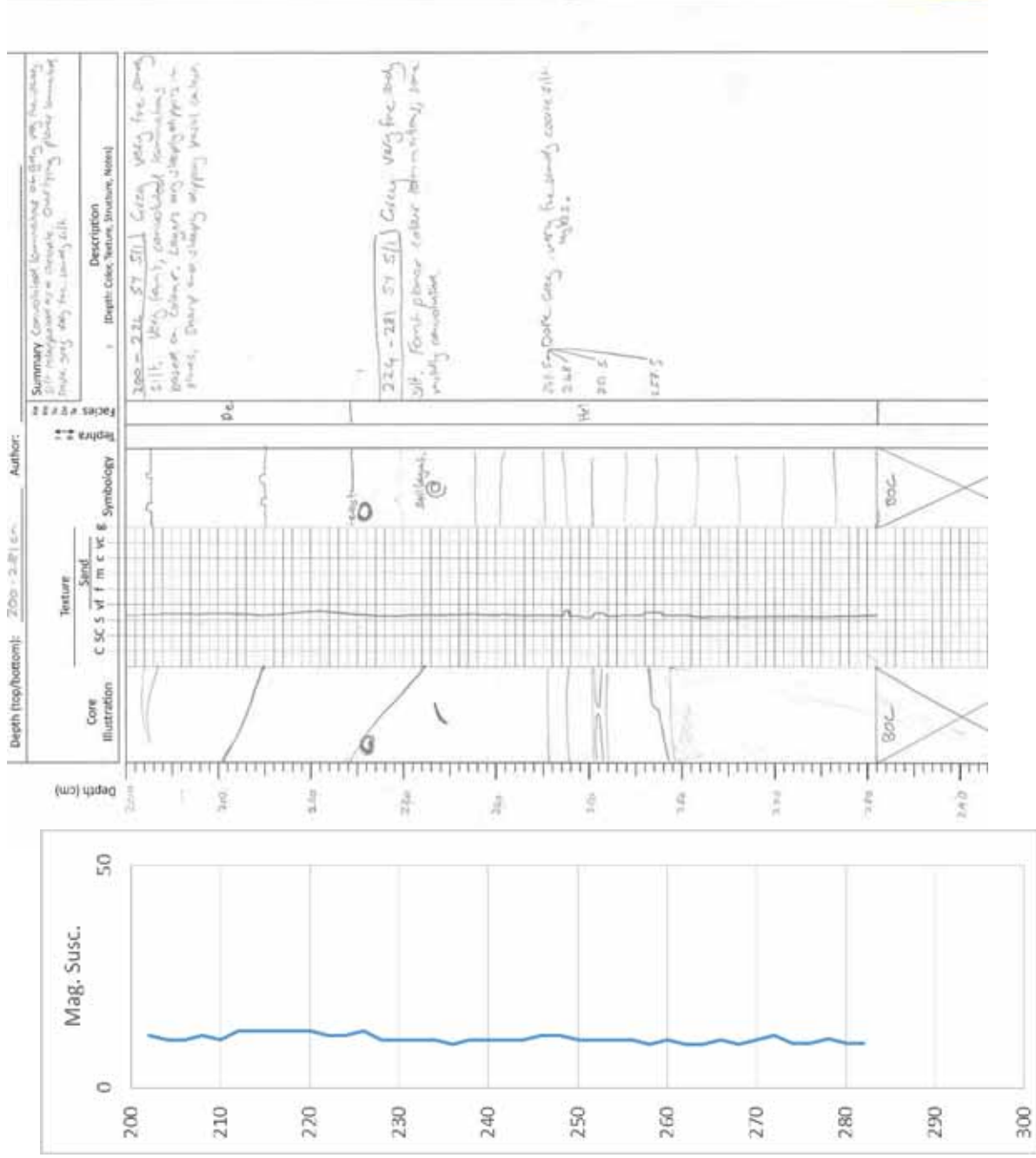


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Wai 7

Other ID TAN1613-08

Section 3 of 3



TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: **Pahau 4**

Latitude: -41.82522

Date/Time (NZST): 11/11/2016 18:06

Other ID: TAN1613-09

Longitude: 175.79335

Depth (m): 2525

Sample Description

General Description

Lower reaches of Pahaua Canyon, below confluence with Honeycomb Canyon sediment delivery

Interbedded hemipelagites and thin bedded sandy turbidites, plus one thick (decimetre scale) turbidite. Apparent coring deformation and associated sediment slumping (section ???)

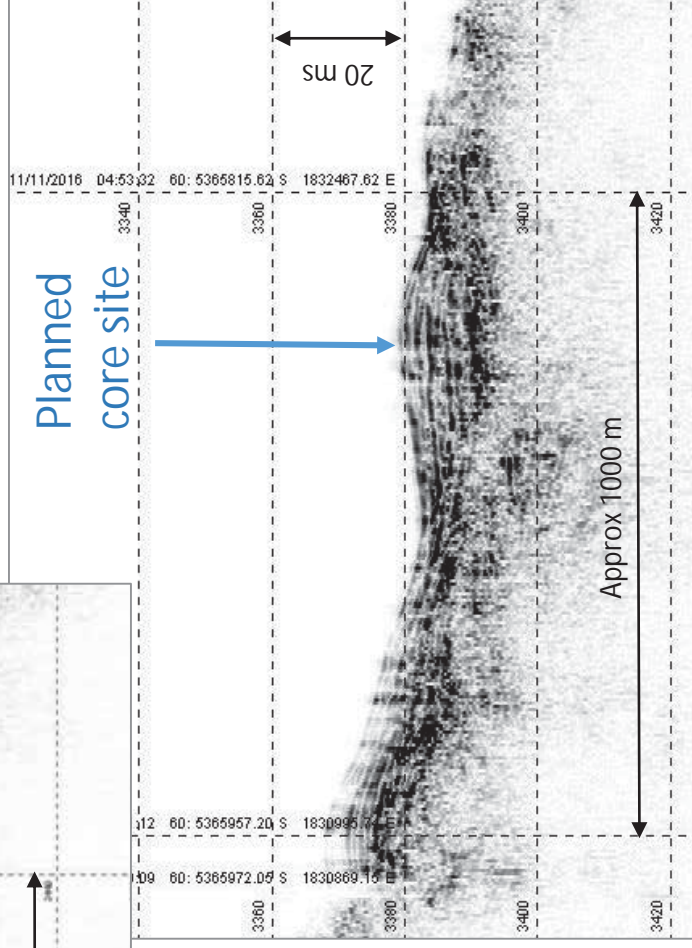
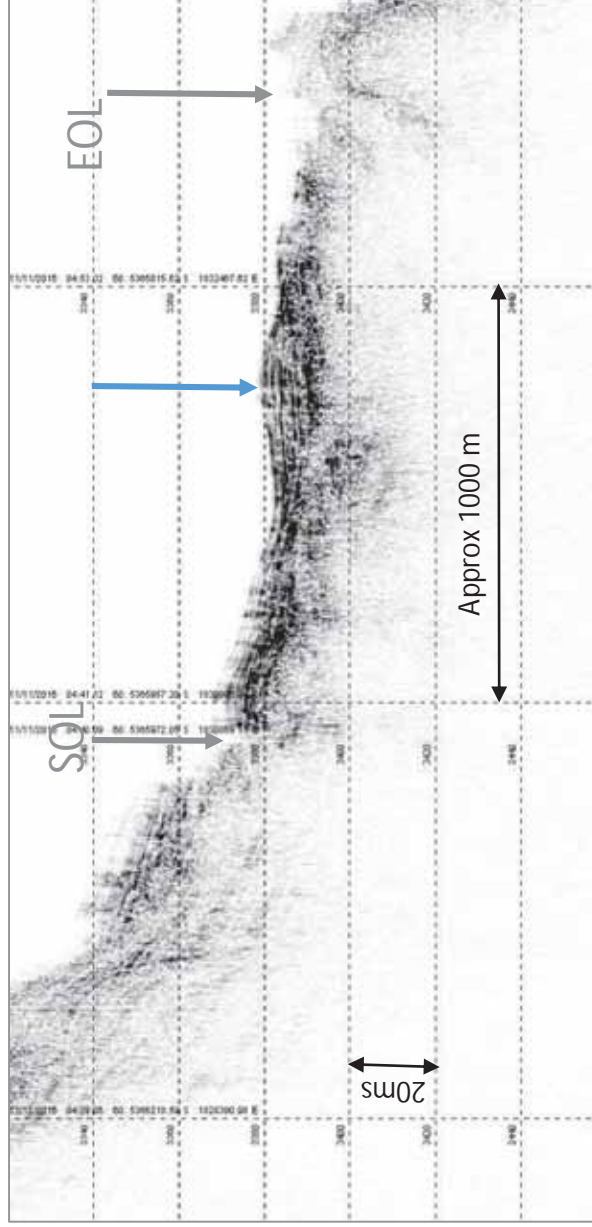
Gear type	Piston core	
Barrel Length (m)	6	Bent barrel
Penetration (m)	n/d	Catcher/Cutter bags
Core length (m)	3.74	Samples
Sections	4	Tephra
Fauna	N	

Sample processing – core ID:

Section	Top depth (cm)	Btm depth (cm)	Logged	Phys Props	Summary
1	0	100	Y	Y	.
2	100	200	Y	Y	.
3	200	300	Y	Y	.
4	300	374	Y	Y	.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Pahau 4	Other ID TAN1613-09	Water Depth 2525 m
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Topas line including short transit to the station. Grey arrows indicate start and end of the 2km survey line over the station, the blue arrow marks the planned core site.

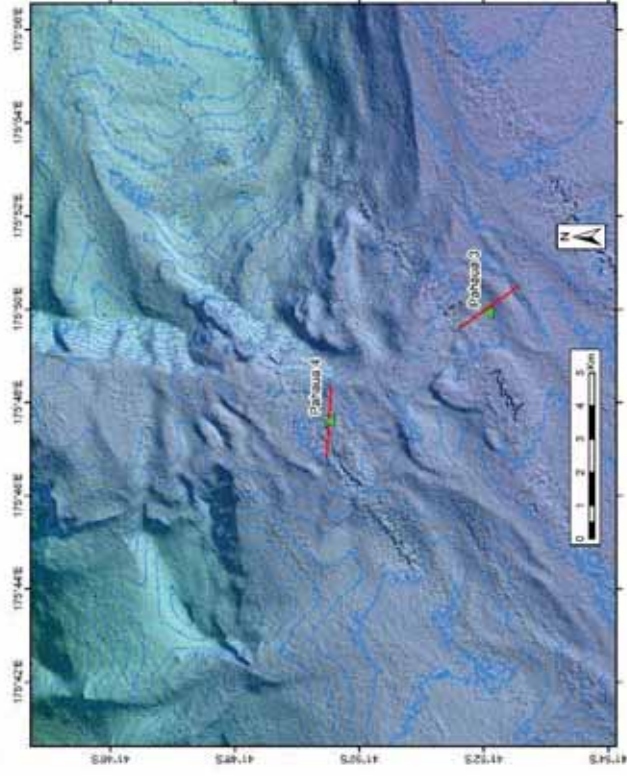
Zoom into 2km survey lines over planned core site.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

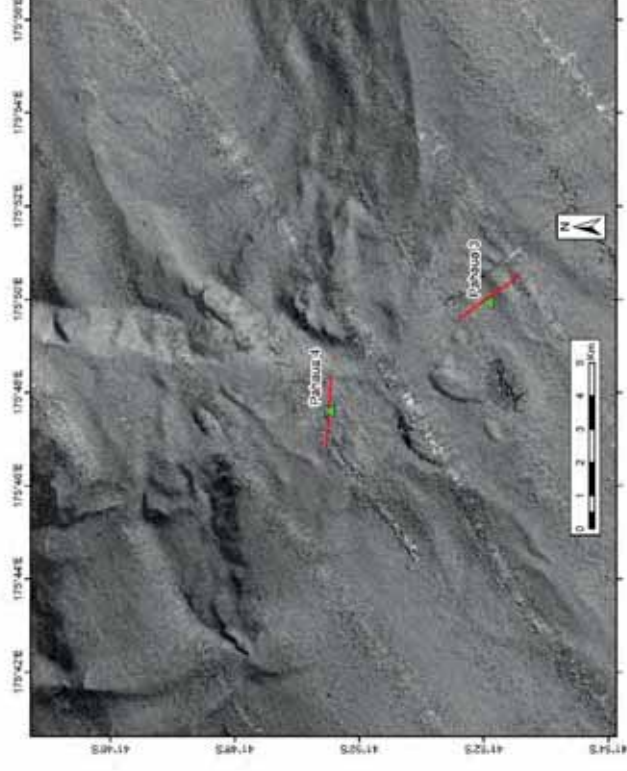
Core ID: Pahau 4

Other ID TAN1613-09

Water Depth 2525 m



Bathymetry at and around Pahau4 core site at the Lower reaches of Pahaoa Canyon, below confluence with Honeycomb Canyon sediment delivery. Light blue lines are 20 m depth contours. Red lines show the 2 km TOPAS survey lines over the stations, green triangles indicate the actual core site.



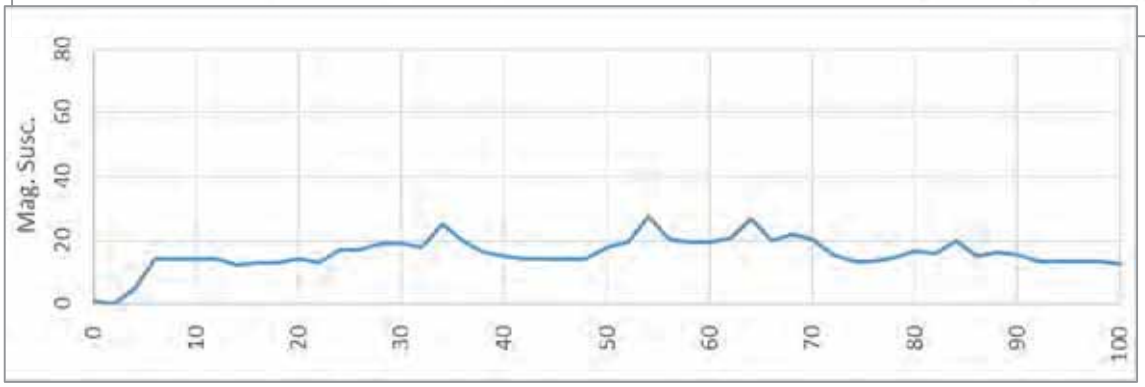
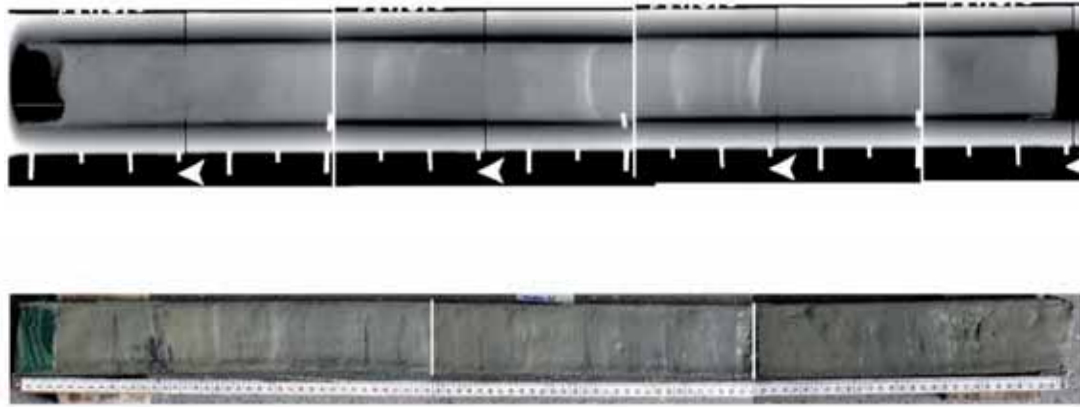
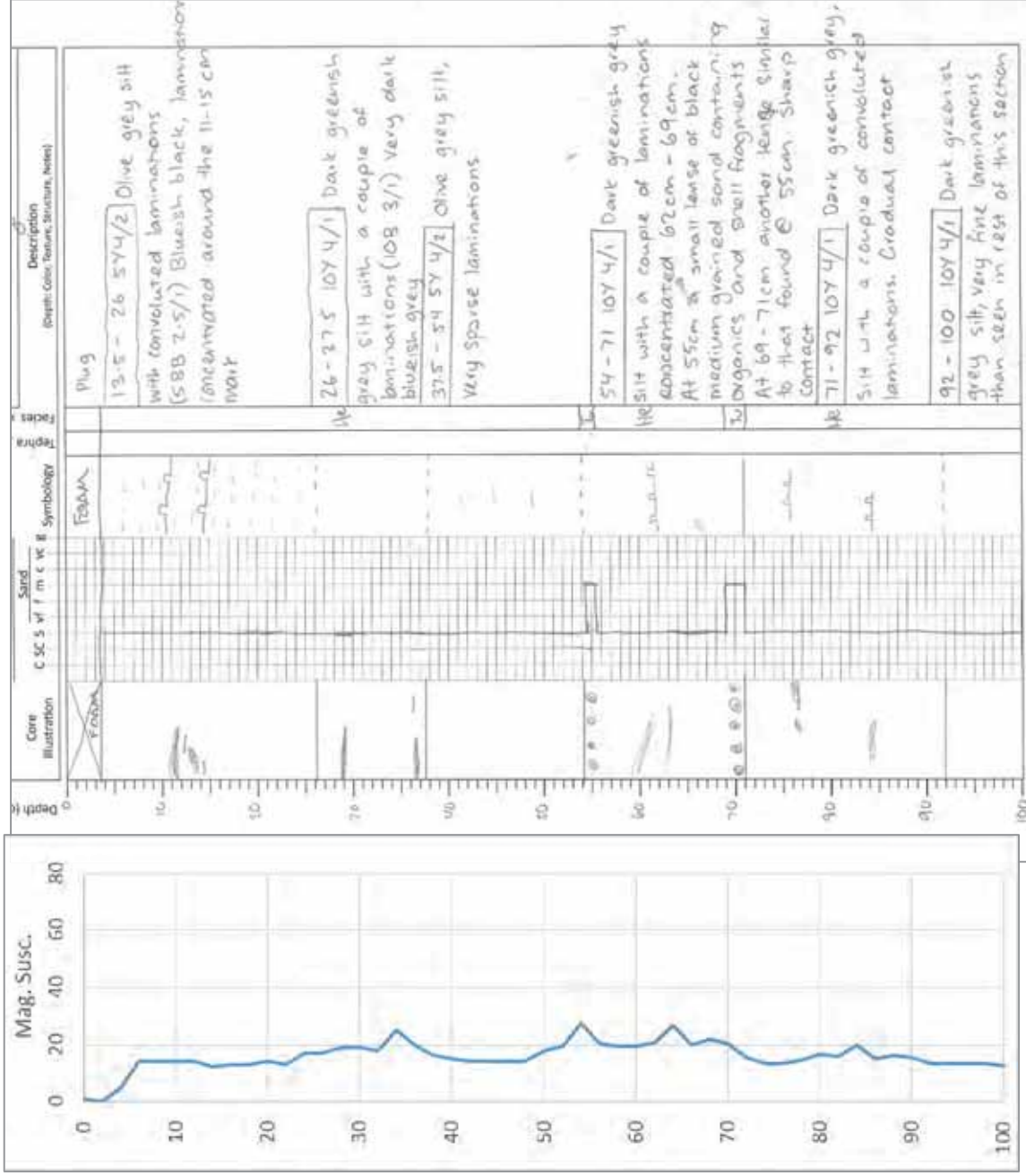
Backscatter data at and around Campbell1 core site at the Pahau4 core site at the Lower reaches of Pahaoa Canyon, below confluence with Honeycomb Canyon sediment delivery. Light blue lines are 20 m depth contours. Red lines show the 2 km TOPAS survey line over the station, green triangles indicate the actual core site.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Pahau 4

Other ID TAN1613-09

Section 1 of 4

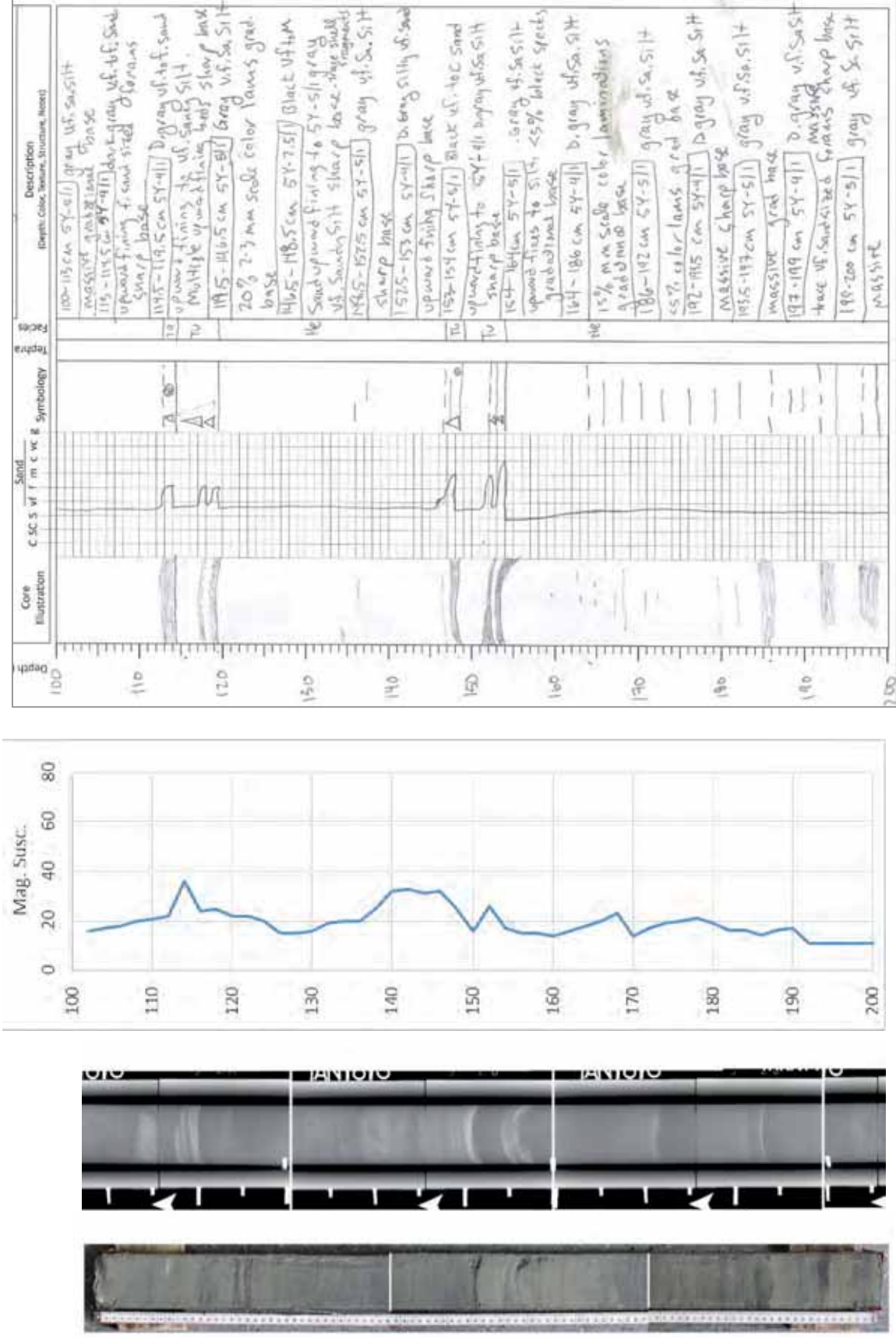


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Pahau 4

Other ID TAN1613-09

Section 2 of 4

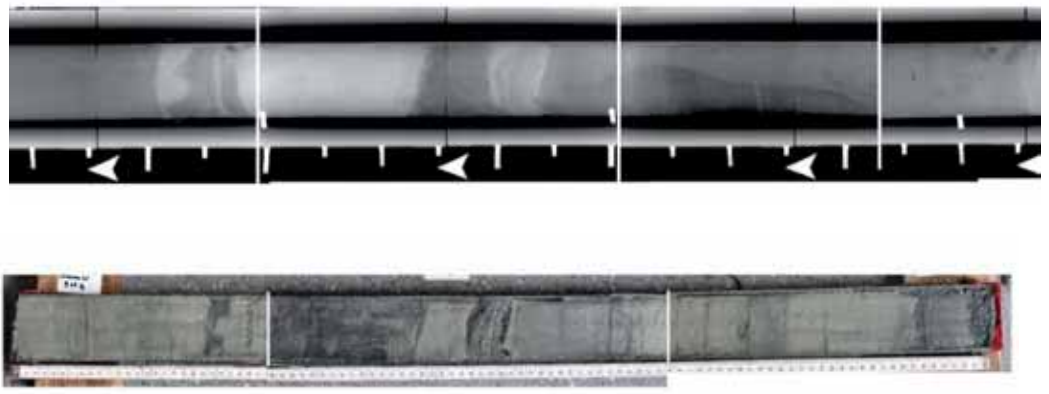
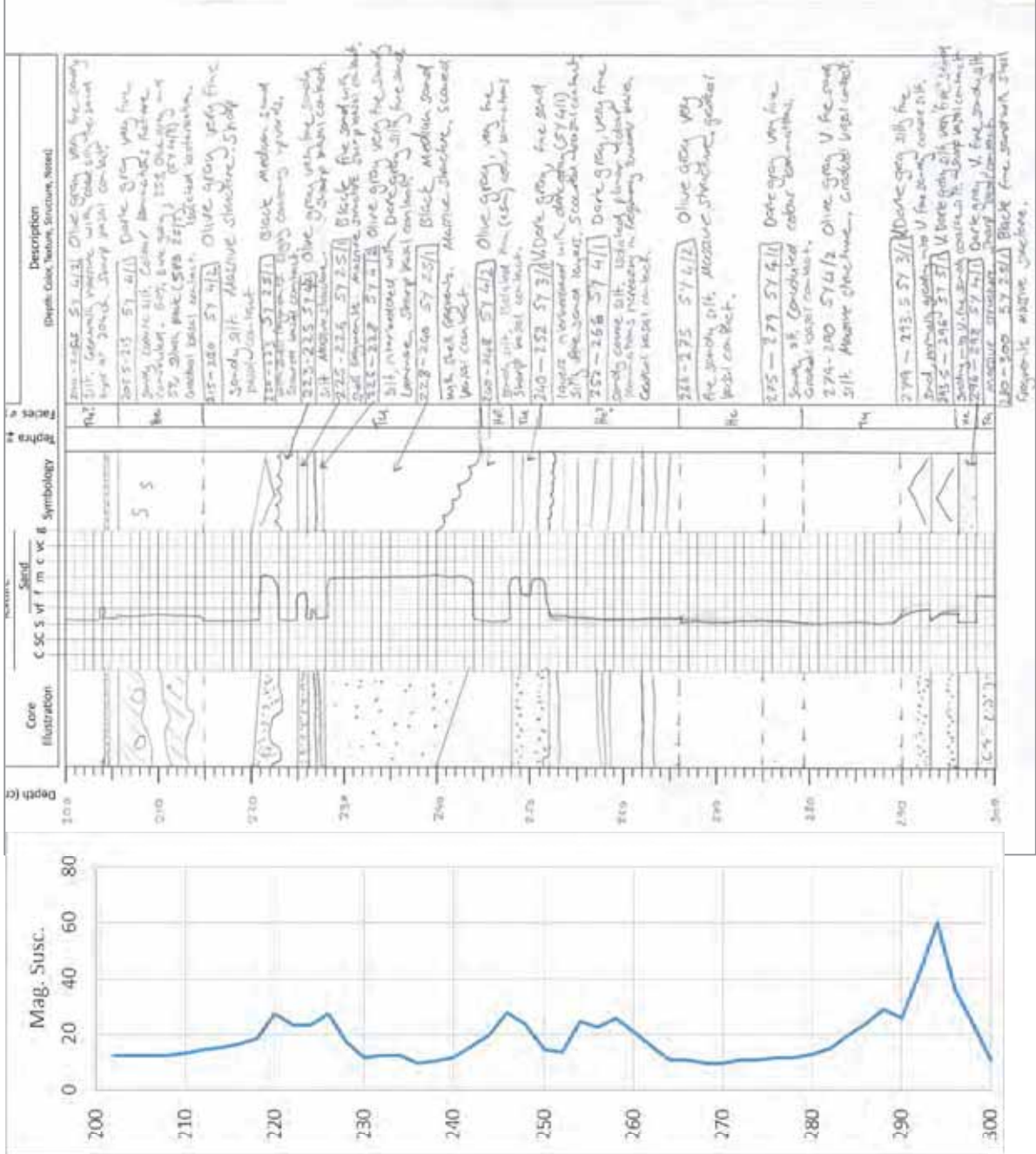


TAN1613 - Paleoseismicity of the Southern Hikurangi Margin

Core ID: Pahau 4

Other ID TAN1613-09

Section 3 of 4

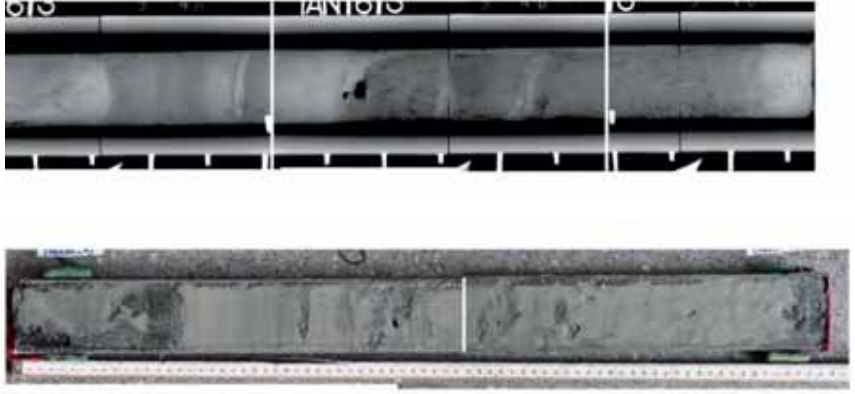
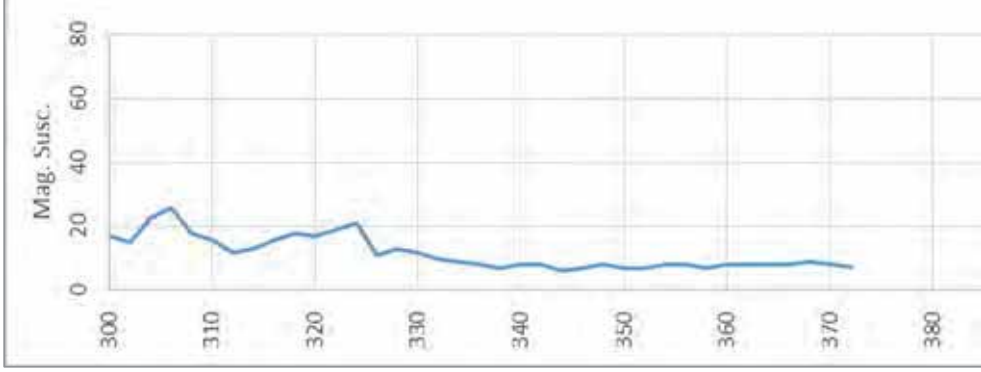
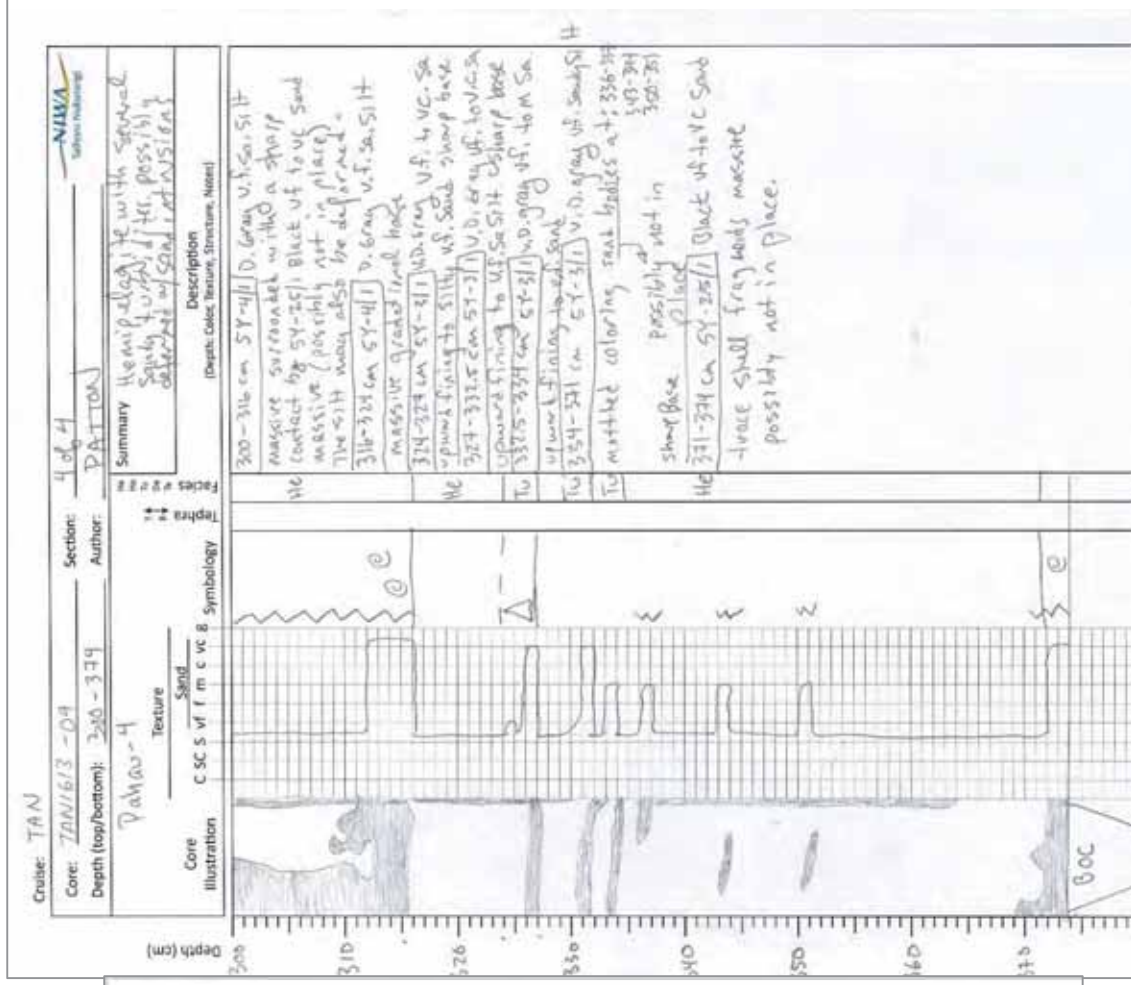


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Pahau 4

Other ID TAN1613-09

Section 4 of 4



TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: **Pahau 3**

Latitude: -41.86775

Date/Time (NZST): 12/11/2016 21:06

Other ID: TAN1613-10

Longitude: 175.83205

Depth (m): **2569**

Sample Description

General Description

Mouth of Pahaoa Canyon, sediment waves downstream of scour holes

Hemipelagite interbedded with sandy turbidites up to 5 cm thick.

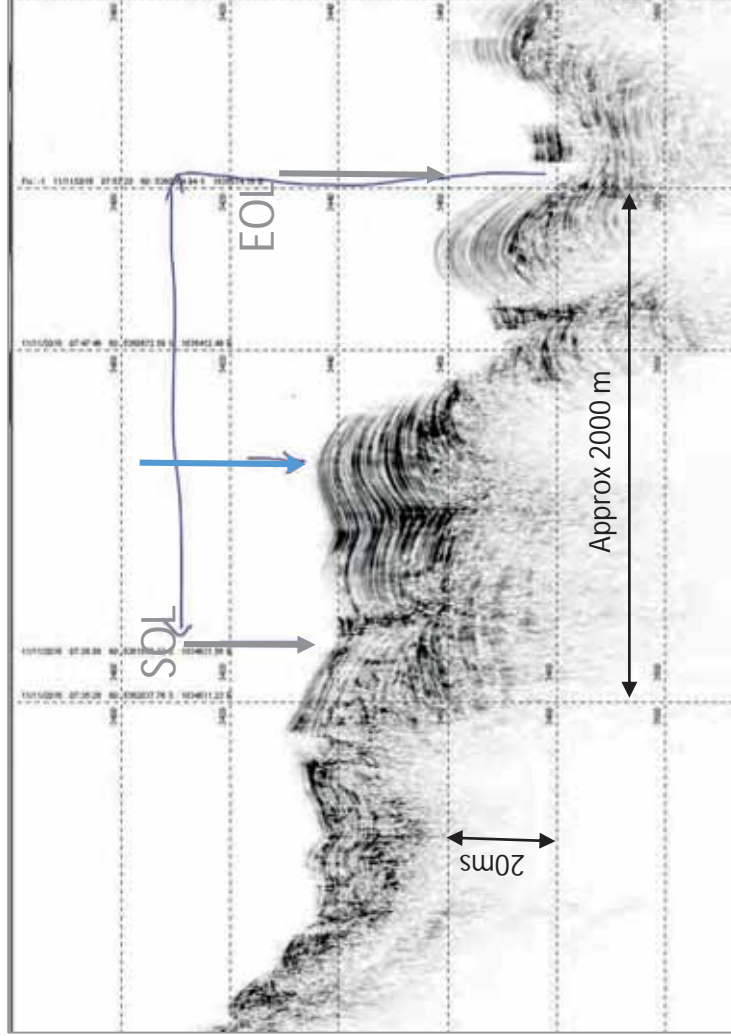
Gear type		Piston core	
Barrel Length (m)	6	Bent barrel	n
Penetration (m)	n/d	Catcher/Cutter bags	1
Core length (m)	4.83	Samples	
Sections	5	Tephra	
Fauna		Pull-out	3.6t

Sample processing – core ID:

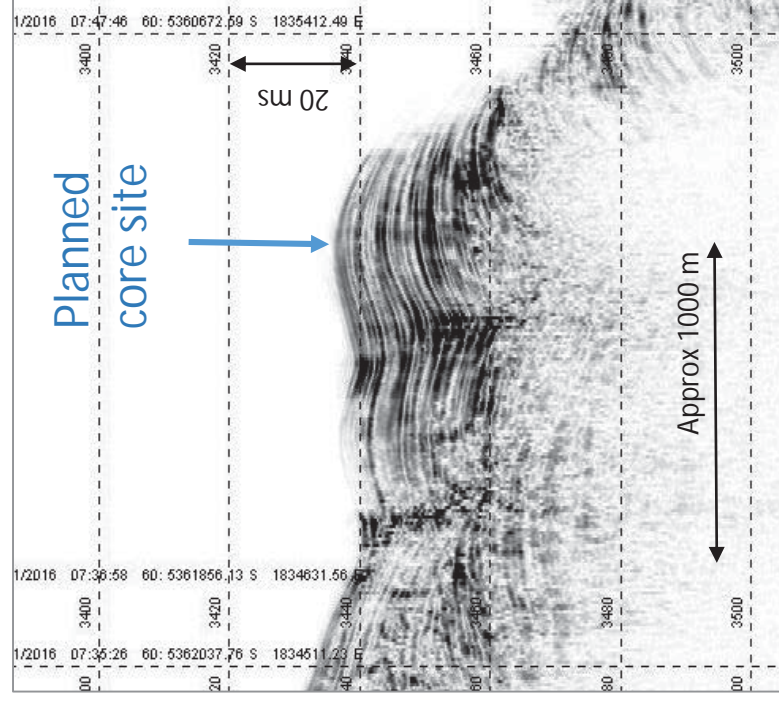
Section	Top depth (cm)	Btm depth (cm)	Logged	Phys Props	Summary
0	0	100	.Y	Y	.
2	100	200	Y	Y	.
2	200	300	Y	Y	.
4	300	400	Y	Y	.
5	400	483	Y	Y	.
.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Pahau 3	Other ID TAN1613-10	Water Depth 2569 m
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Zoom into 2km survey lines over planned core site.



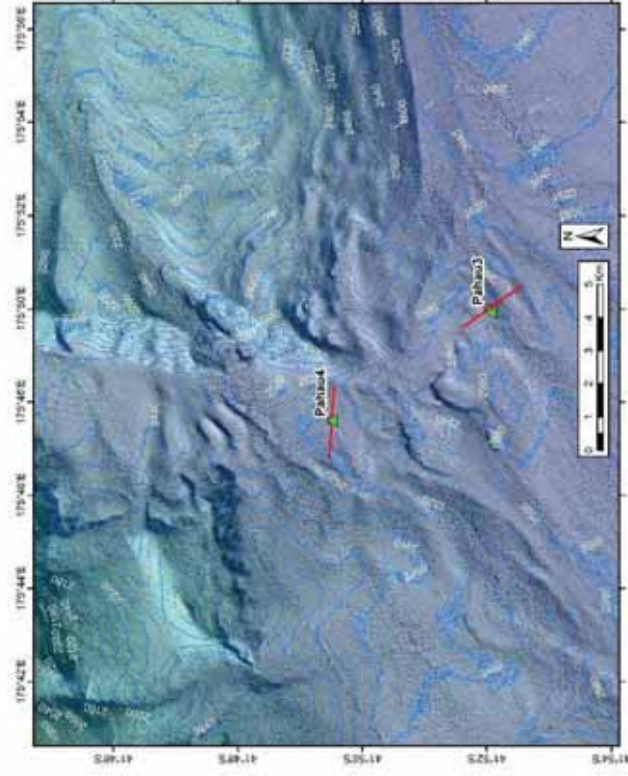
Topas line including short transit to the station. Grey arrows indicate start and end of the 2km survey line over the station, the blue arrow marks the planned core site.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

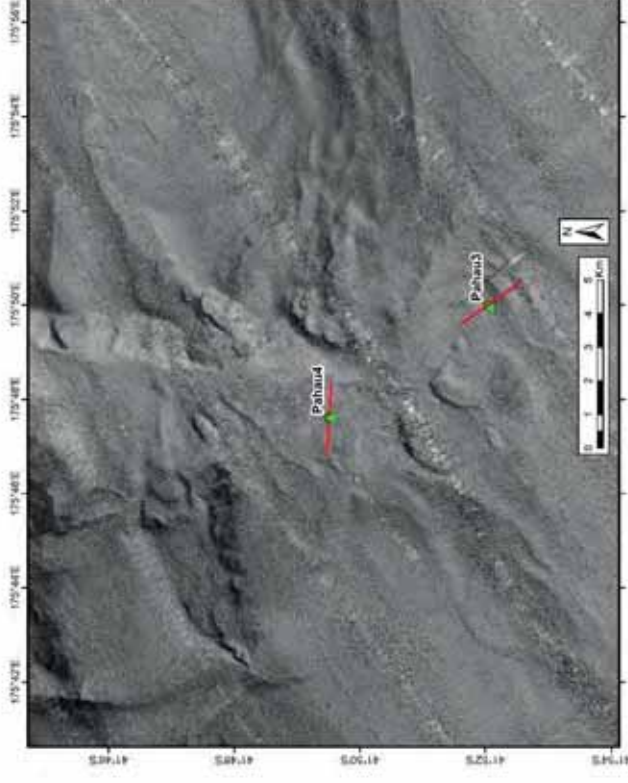
Core ID: Pahau 3

Other ID TAN1613-10

Water Depth 2569 m



Bathymetry at and around Pahau3 core site at the Mouth of Pahaoa Canyon, sediment waves downstream of scour holes. Light blue lines are 20 m depth contours. Red lines show the 2 km TOPAS survey lines over the stations, the green triangles indicate the actual core site.



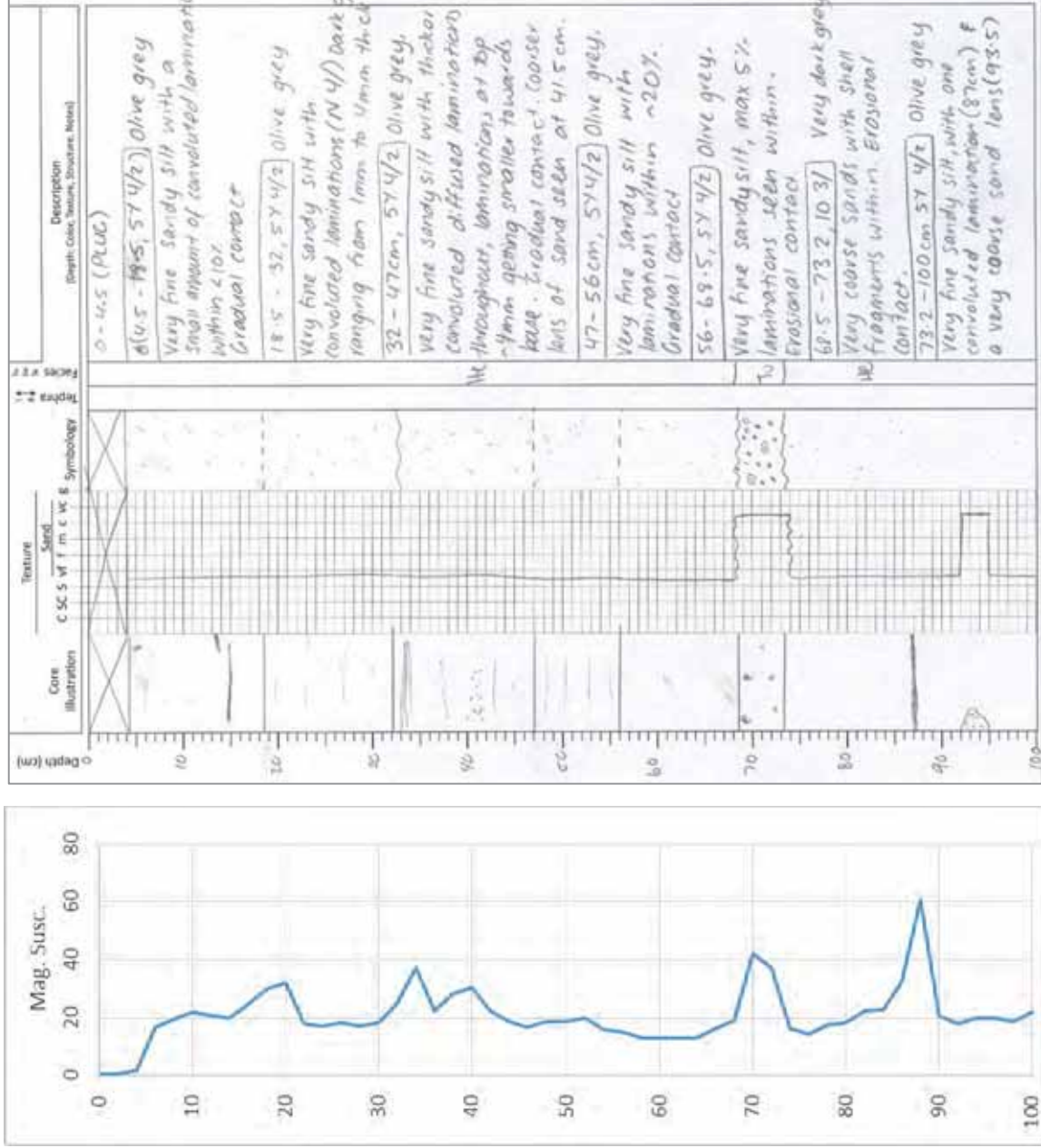
Backscatter at and around Pahau3 core site at the Mouth of Pahaoa Canyon, sediment waves downstream of scour holes. Light blue lines are 20 m depth contours. Red lines show the 2 km TOPAS survey lines over the stations, the green triangles indicate the actual core site.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Pahau 3

Other ID TAN1613-10

Section 1 of 5

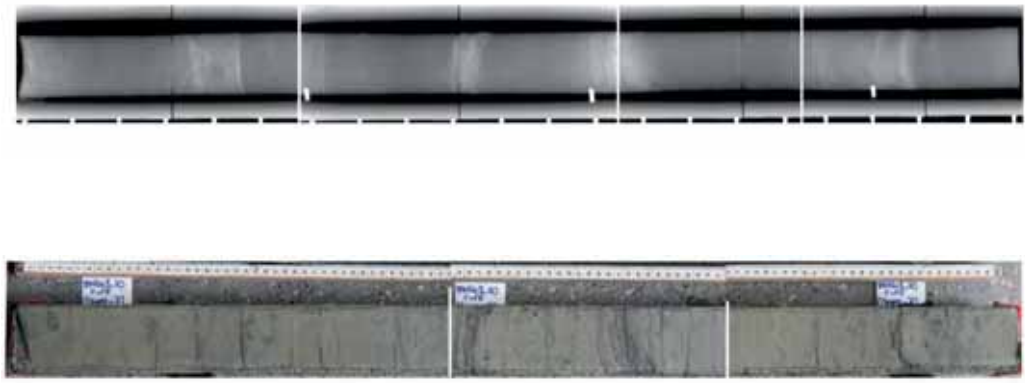
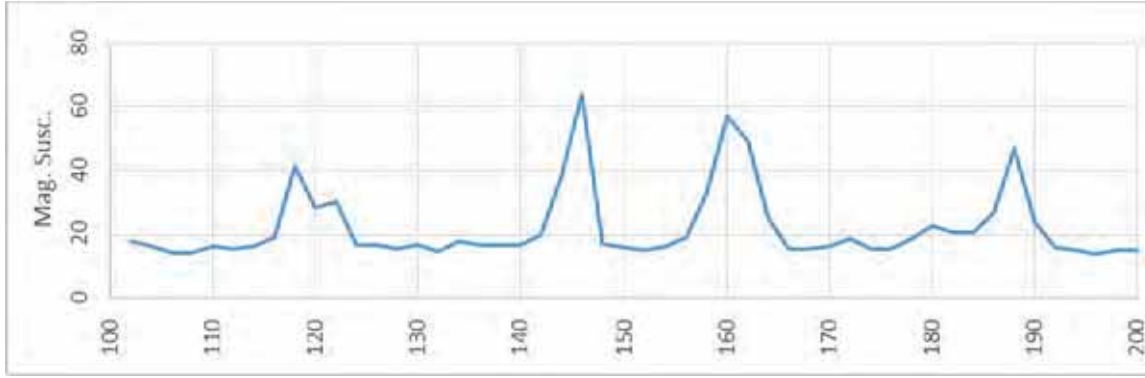


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Pahau 3

Other ID TAN1613-10

Section 2 of 5



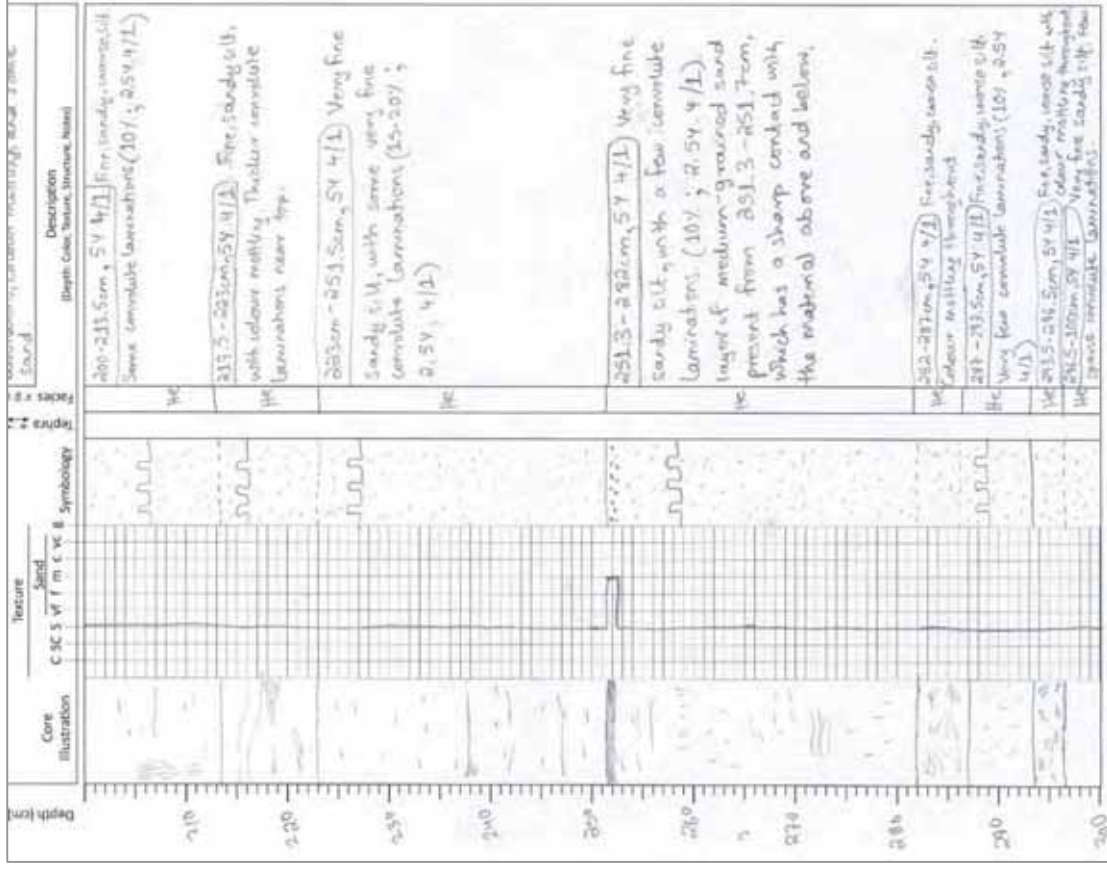
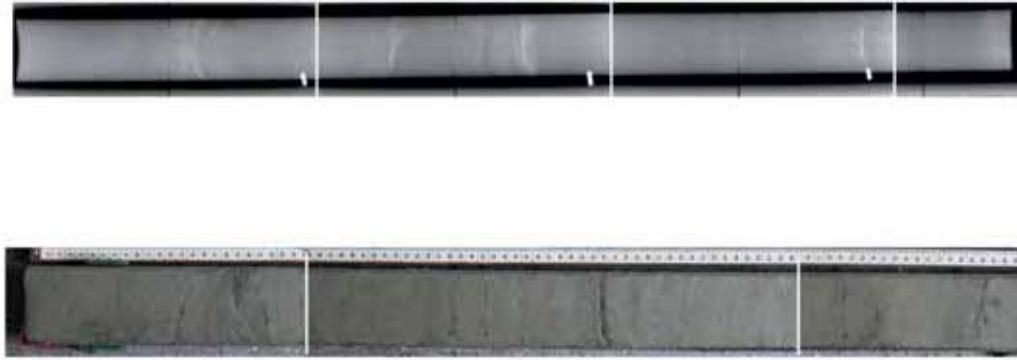
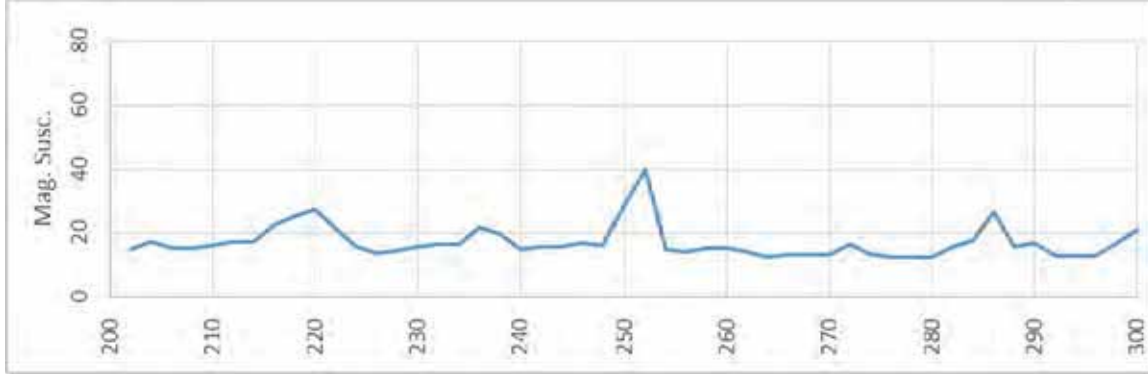
Depth (cm)	Core Illustration	Texture	Symbols	Description
100-114 cm	[Sketch]	C. S. S. V. f. m. c. v. e. B.	SY 421	Dilute, olive V. fine sand, silt, tabular, planar surface of fine sand and silt. Fine sand and silt. (100-114) color (tan) brownish brownish grey (SY 421)
115	[Sketch]			Silt. fine sand layer
115-120	[Sketch]			Medium sand layer
120-125	[Sketch]			Medium sand layer
125	[Sketch]			
125-140	[Sketch]			Lowland, white grey fine sand and olive grey (SY 421) V. fine sand, silt. 1-5 cm. Silt and fine sand layer. (125-140) color (tan) brownish brownish grey (SY 421)
140	[Sketch]			
140-158 cm	[Sketch]			Olive grey, V. fine sand, silt. (140-158) color (tan) brownish brownish grey (SY 421)
158	[Sketch]			
158-160	[Sketch]			Layered, V. olive grey fine sand, silt. (158-160) color (tan) brownish brownish grey (SY 421)
160	[Sketch]			
160-174	[Sketch]			Olive grey, V. fine sand, silt. (160-174) color (tan) brownish brownish grey (SY 421)
174	[Sketch]			
174-188	[Sketch]			Layered, V. olive grey fine sand, silt. (174-188) color (tan) brownish brownish grey (SY 421)
188	[Sketch]			
188-191	[Sketch]			Fine sand layer
191	[Sketch]			Fine sand layer

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Pahau 3

Other ID TAN1613-10

Section 3 of 5

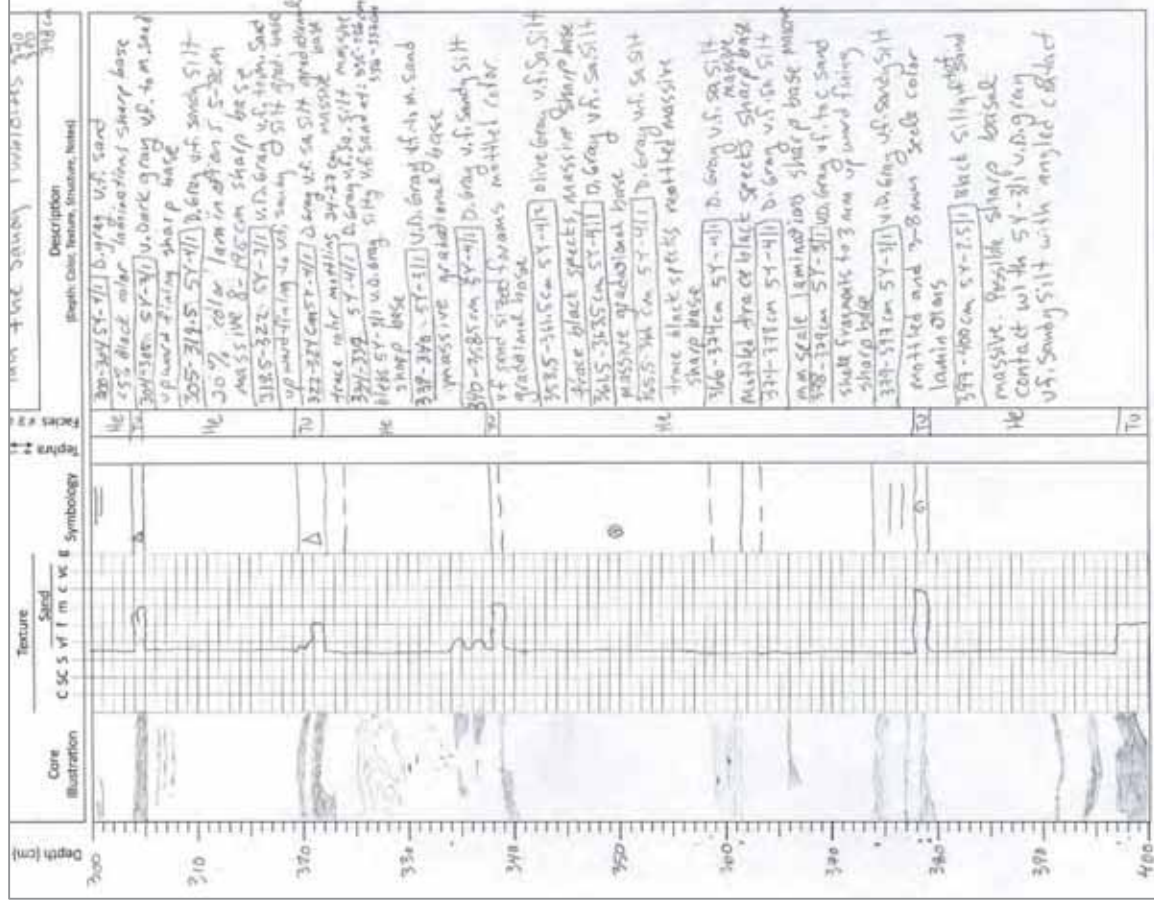
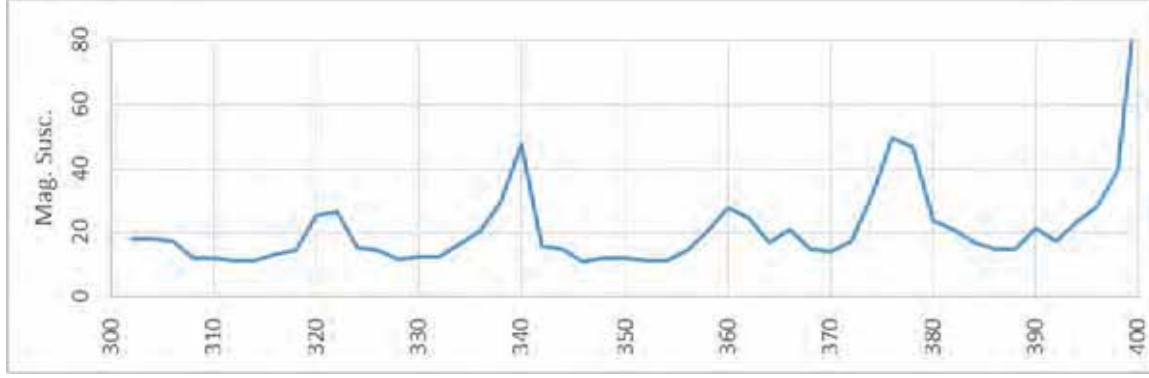


TAN1613 - Paleoseismicity of the Southern Hikurangi Margin

Core ID: Pahau 3

Other ID TAN1613-10

Section 4 of 5

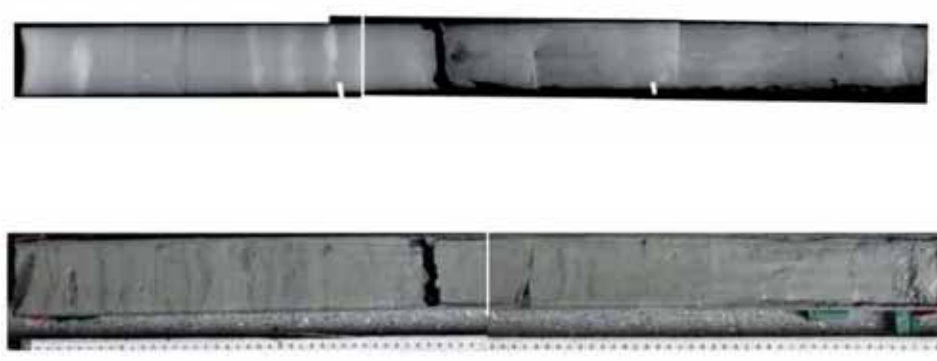
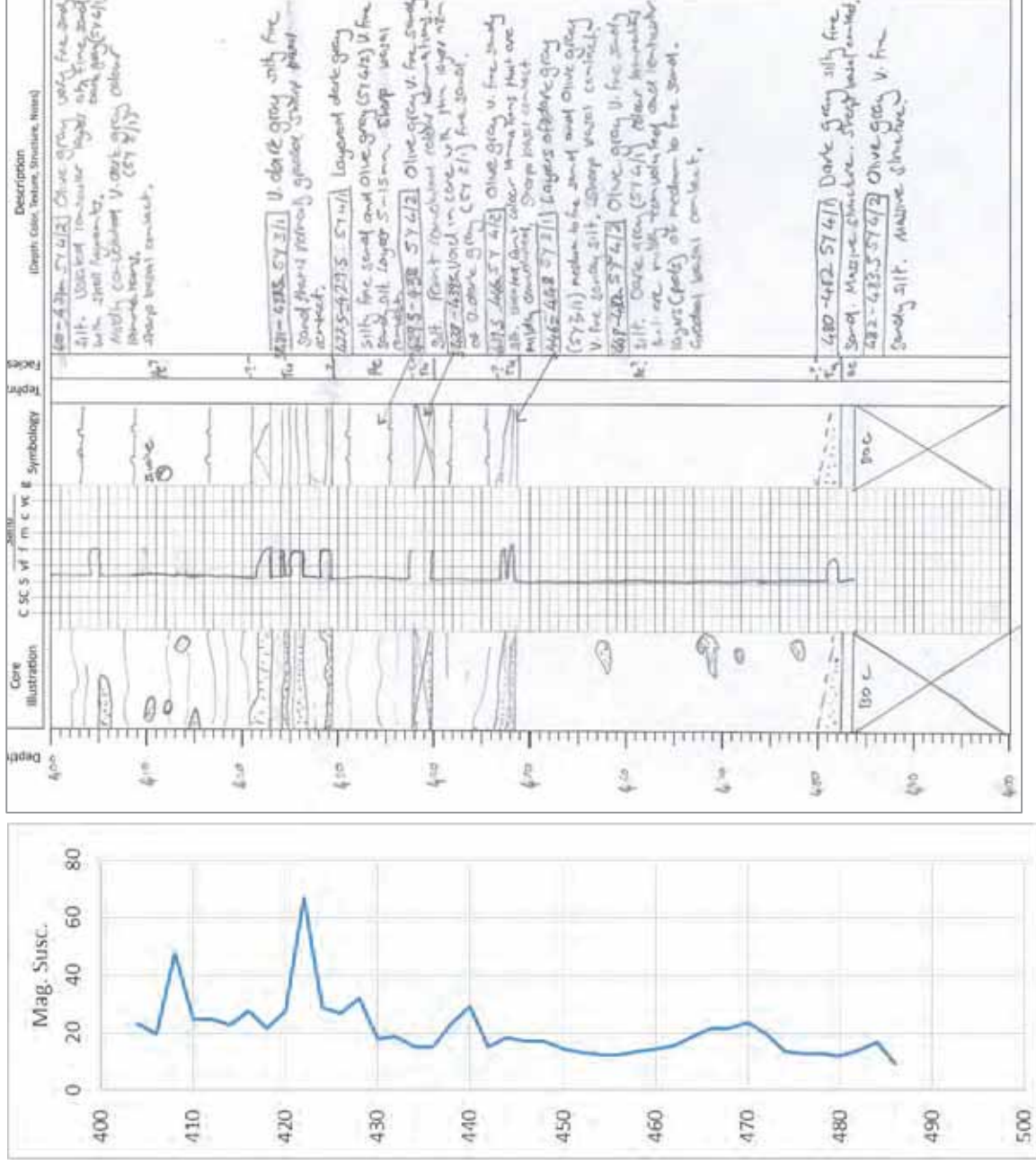


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Pahau 3

Other ID TAN1613-10

Section 5 of 5



TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: **Honey 2**

Latitude: -41.75933

Date/Time (NZST): 12/11/2016 01:01

Other ID: TAN1613-11

Longitude: 175.97750

Depth (m): 2232

Sample Description

General Description

Mudwaves on the backlimb basin behind Gledhu Ridge, below Honeycomb Canyon

Hemipelagic mud interbedded with sandy turbidites up to 5 cm thick.

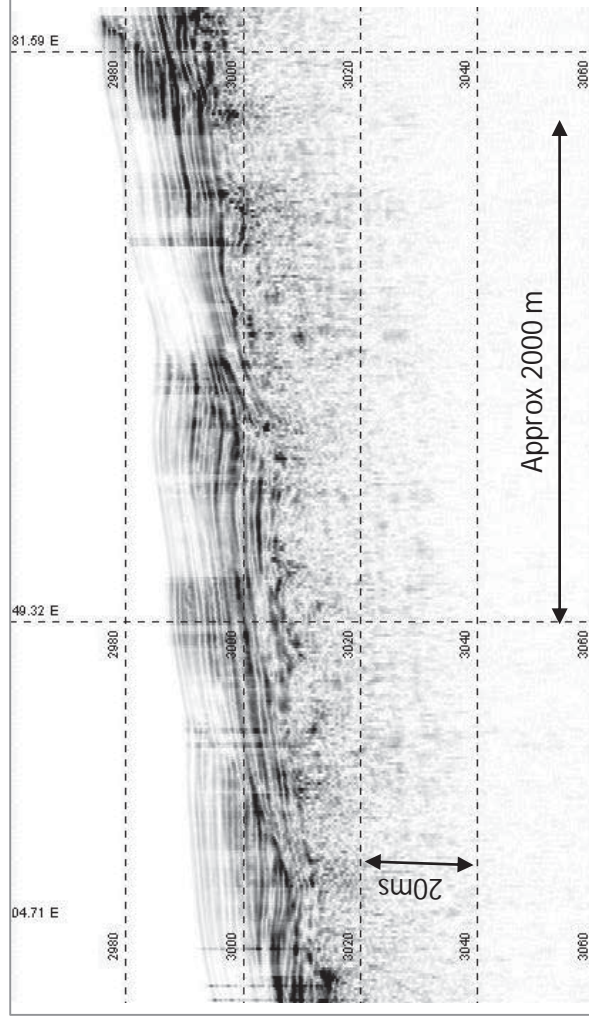
Gear type		Piston core	
Barrel Length (m)	6	Bent barrel	N
Penetration (m)	n/d	Catcher/Cutter bags	
Core length (m)	4.82	Samples	N
Sections	5	Tephra	
Fauna		Pull-out	N

Sample processing – core ID:

Section	Top depth (cm)	Btm depth (cm)	Logged	Phys Props	Summary
1	0	100	Y	Y	.
2	100	200	Y	Y	.
3	200	300	Y	Y	.
4	300	400	Y	Y	.
5	400	482	Y	Y	.
.	.	.	Y	Y	.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Honey 2	Other ID TAN1613-11	Water Depth 2232 m
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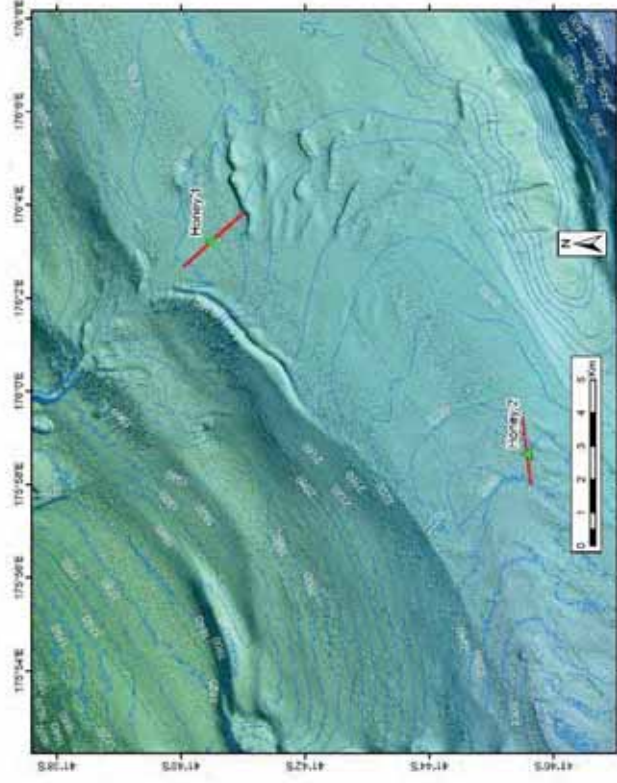
Topas line over the planed core station.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

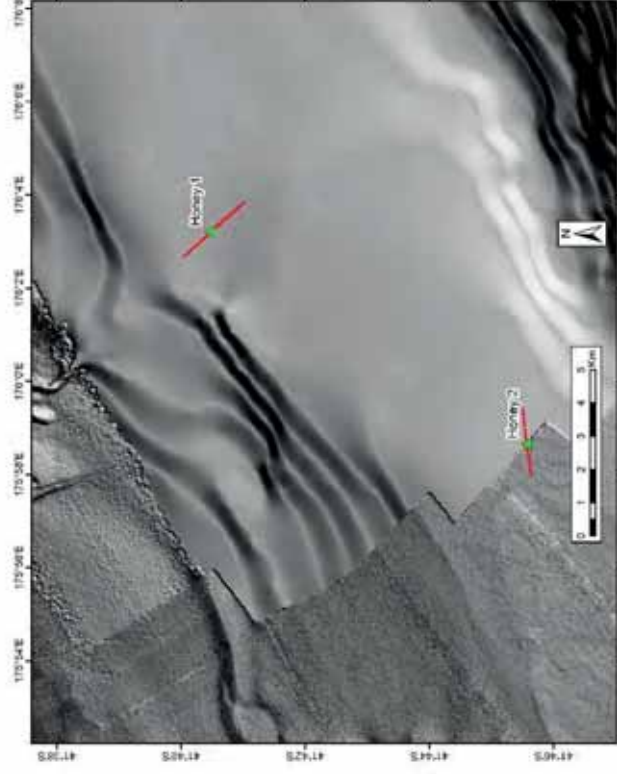
Core ID: Honey 2

Other ID TAN1613-11

Water Depth 2232 m



Bathymetry at and around Honey2 core site at the Mudwaves on the backlimb basin behind Gledhu Ridge, below Honeycomb Canyon. Light blue lines are 20 m depth contours. Red lines show the 2 km TOPAS survey lines over the stations, the green triangles indicate the actual core site.



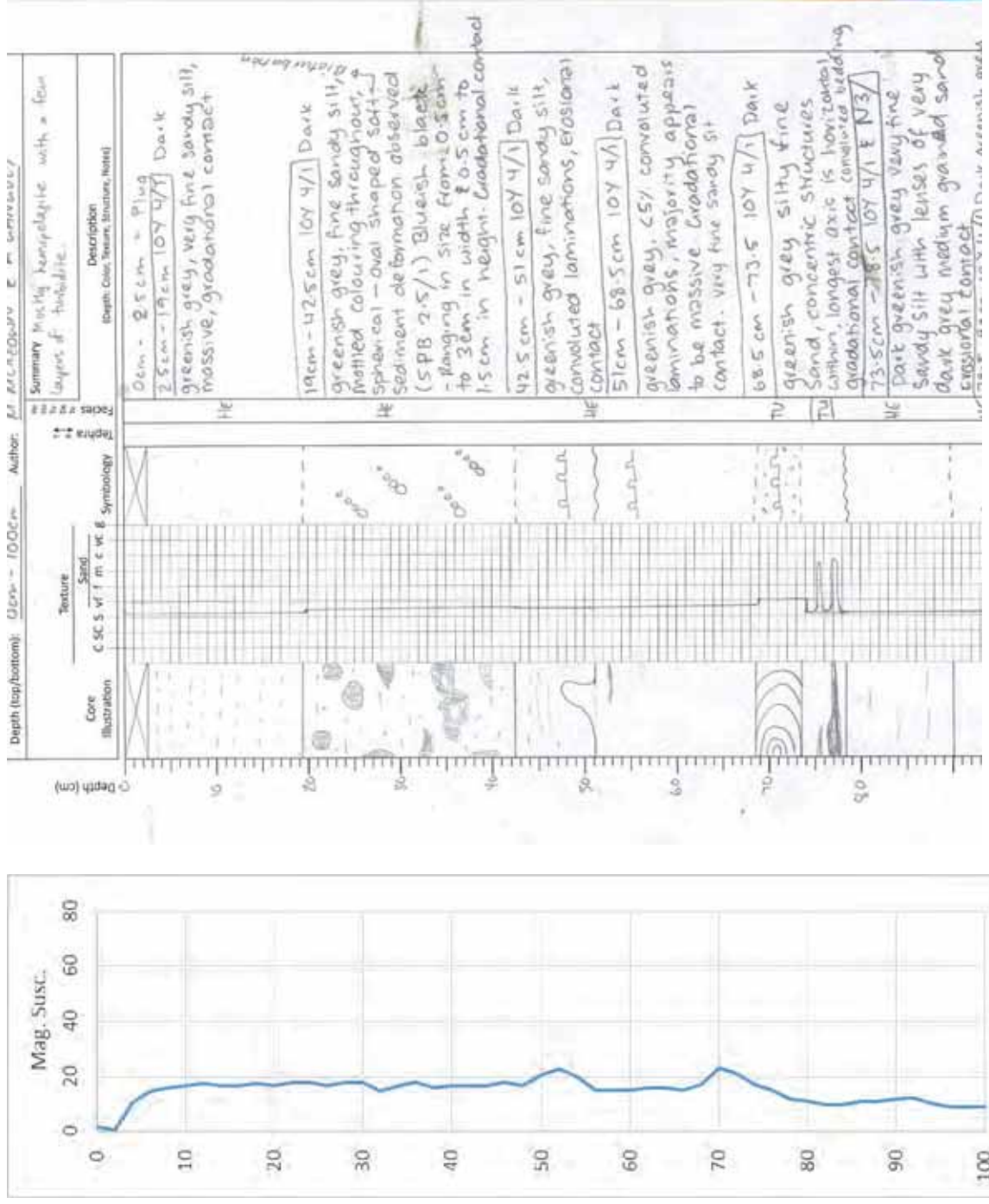
Backscatter at and around Honey2 core site at the Mudwaves on the backlimb basin behind Gledhu Ridge, below Honeycomb Canyon. Light blue lines are 20 m depth contours. Red lines show the 2 km TOPAS survey lines over the stations, the green triangles indicate the actual core site.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Honey 2

Other ID TAN1613-11

Section 1 of 5

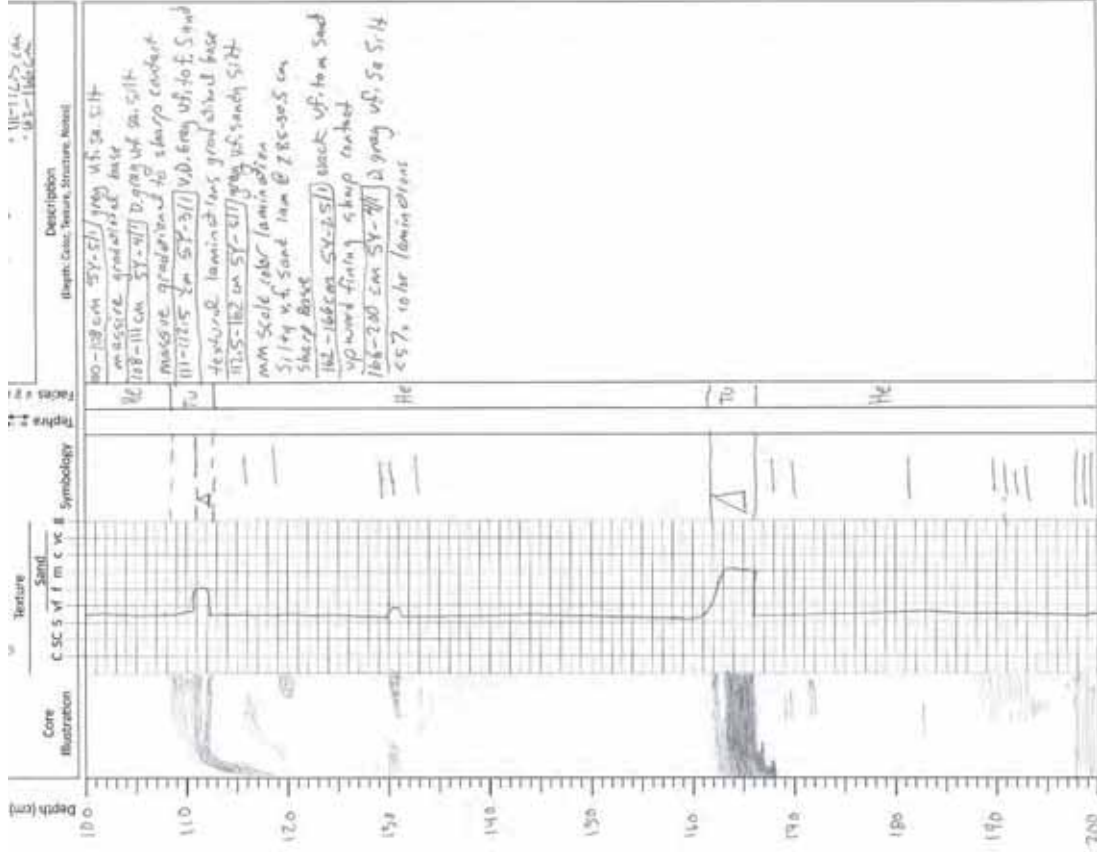
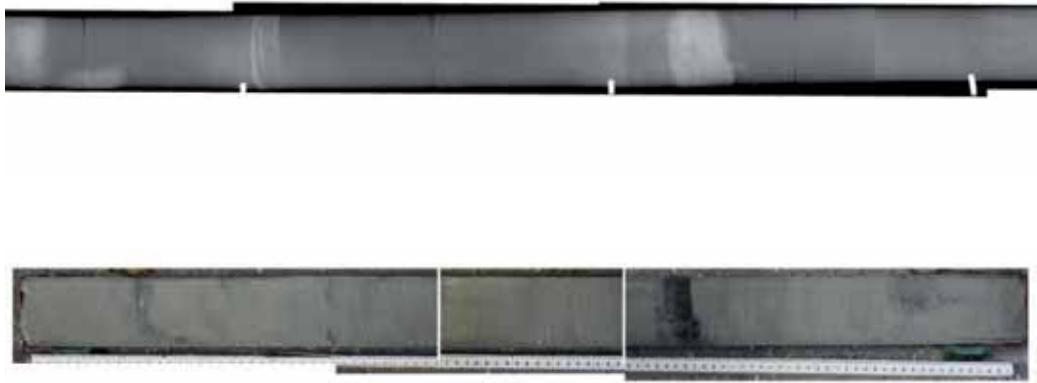
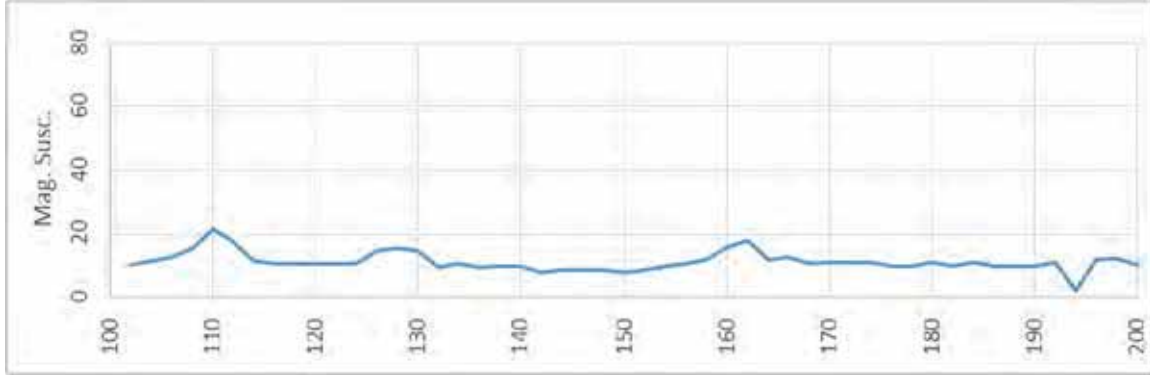


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Honey 2

Other ID TAN1613-11

Section 2 of 5

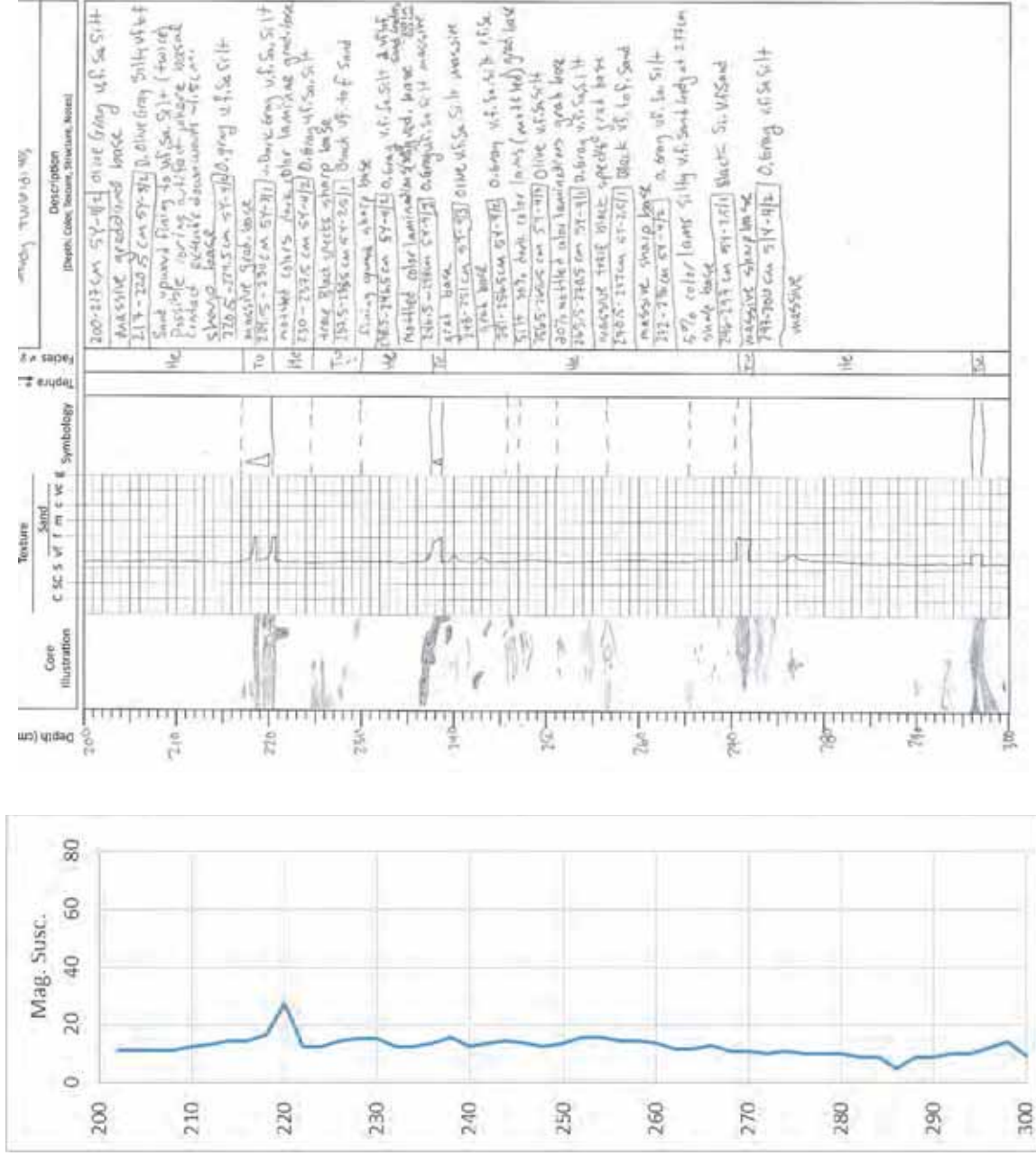


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Honey 2

Other ID TAN1613-11

Section 3 of 5

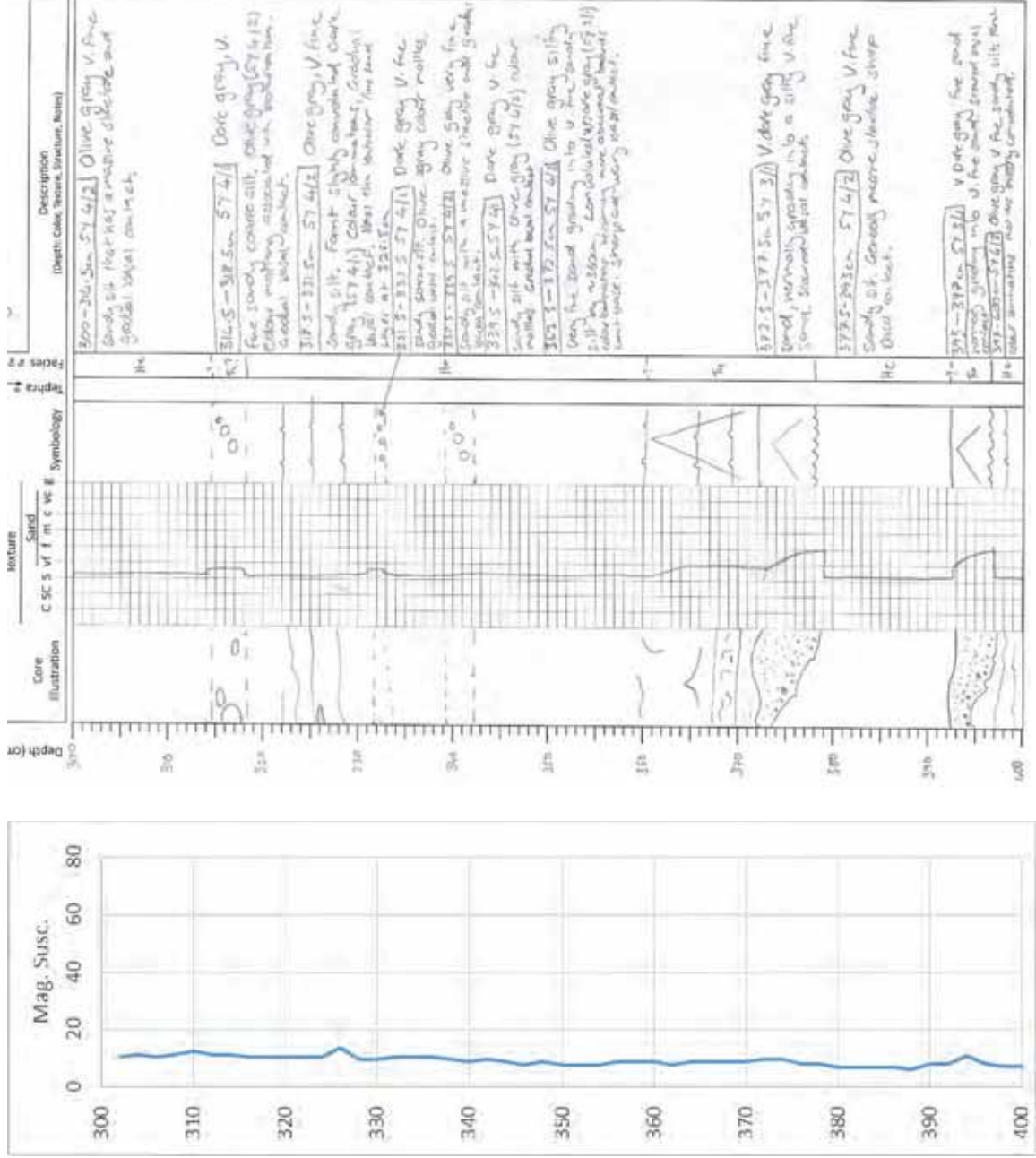


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Honey 2

Other ID TAN1613-11

Section 4 of 5

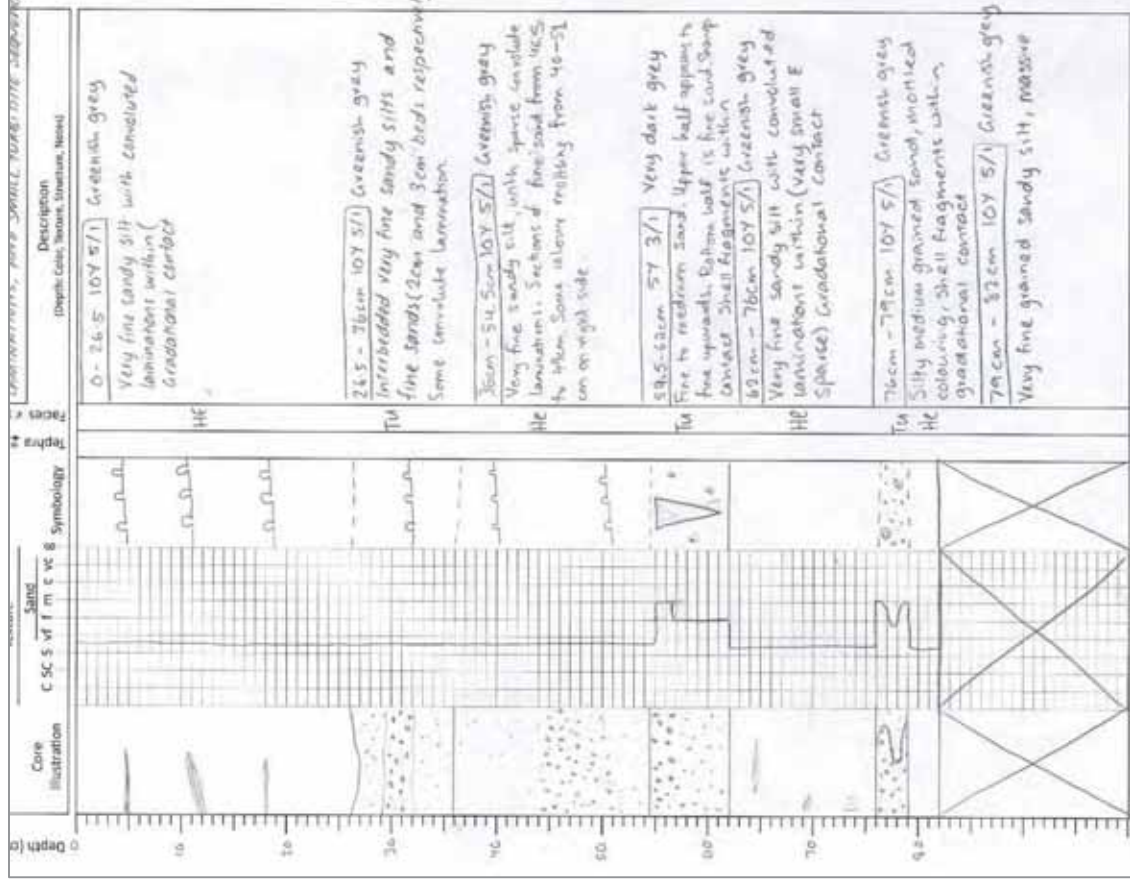
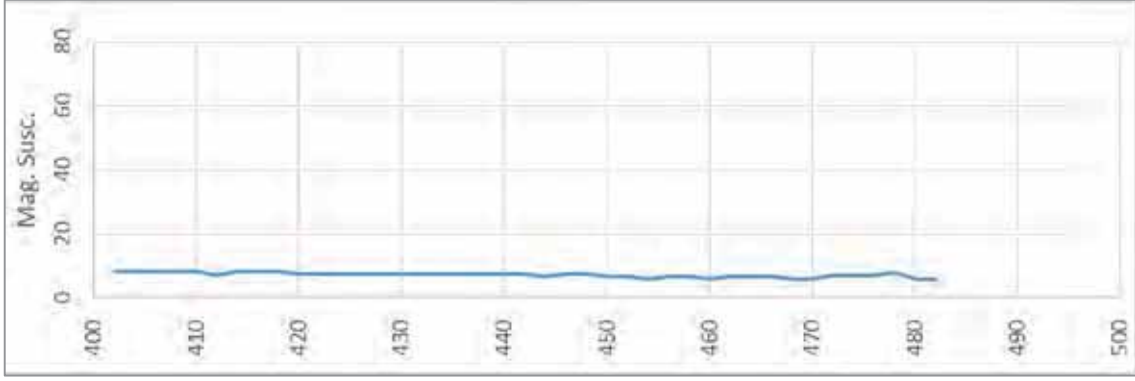


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Honey 2

Other ID TAN1613-11

Section 5 of 5



TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: **Honey 1**

Latitude: -41.67437

Date/Time (NZST): 12/11/2016 21:06

Other ID: TAN1613-12

Longitude: 176.05347

Depth (m): **2106**

Sample Description

General Description

Slope basin floor at the mouth of Honeycomb Canyon

Hemipelagic mud interbedded with sandy turbidites up to 5 cm thick.

Gear type		Piston core	
Barrel Length (m)	6	Bent barrel	N
Penetration (m)		Catcher/Cutter bags	
Core length (m)	3.47	Samples	N
Sections	4	Tephra	
Fauna		Pull-out	3.1t

Sample processing – core ID:

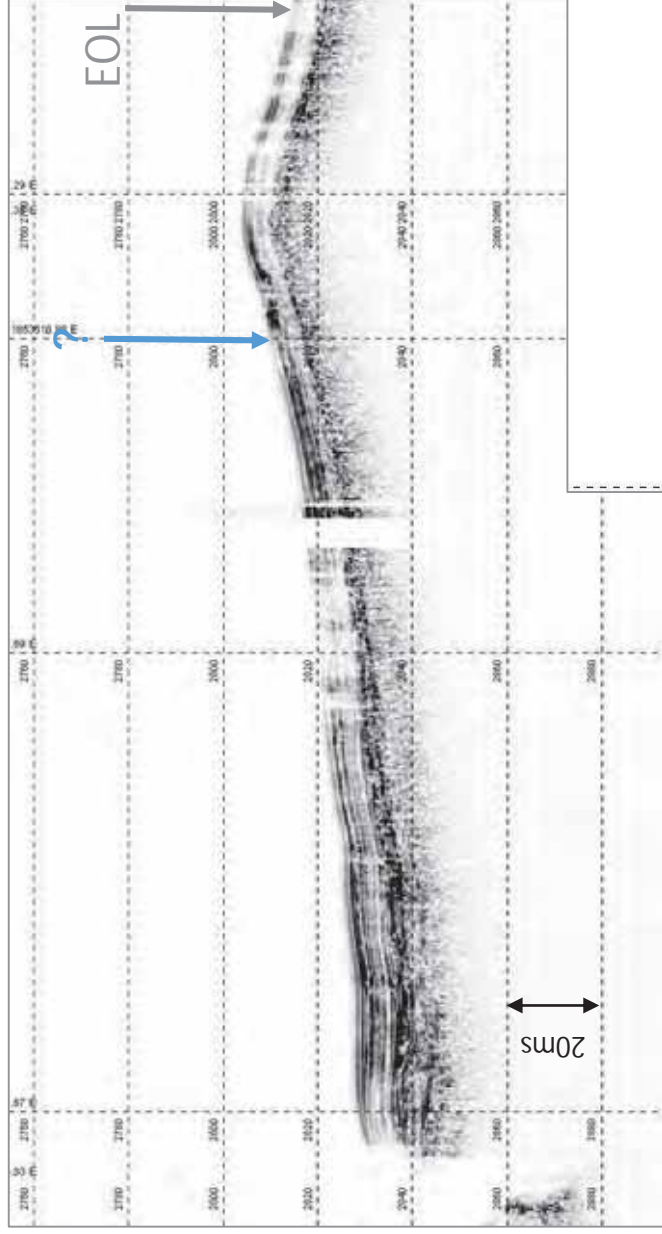
Section	Top depth (cm)	Btm depth (cm)	Logged	Phys Props	Summary
1	0	100	Y	Y	
2	100	200	Y	Y	
3	200	300	Y	Y	
4	300	347	Y	Y	
.	
.	

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

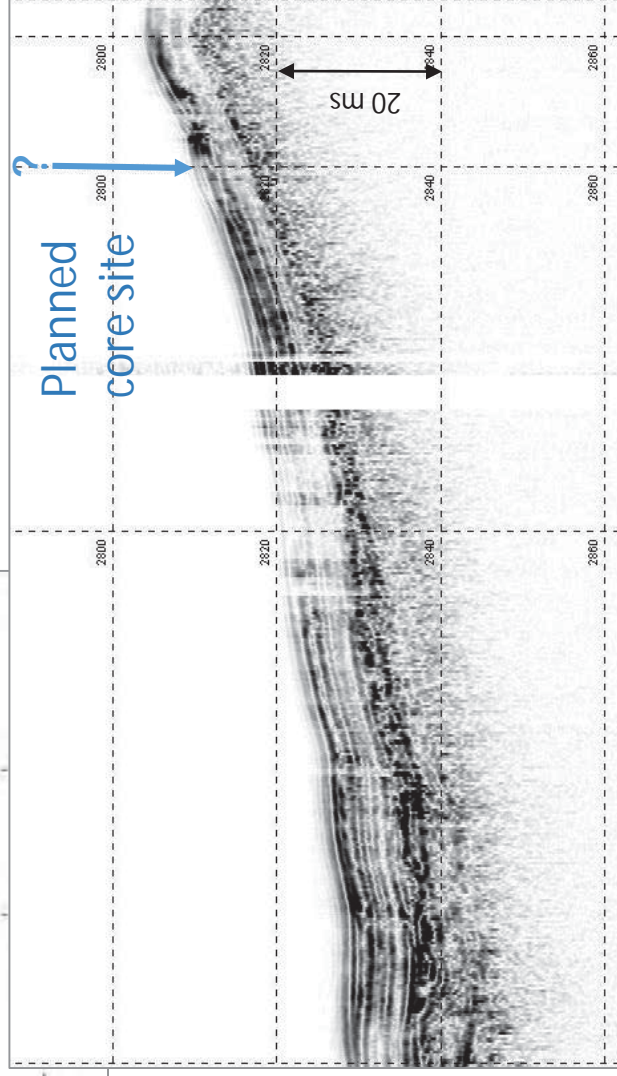
Core ID: Honey 1

Other ID TAN1613-12

Water Depth 2106 m



Topas line including short transit to the station. Grey arrows indicate start and end of the 2km survey line over the station, the blue arrow marks the planned core site.



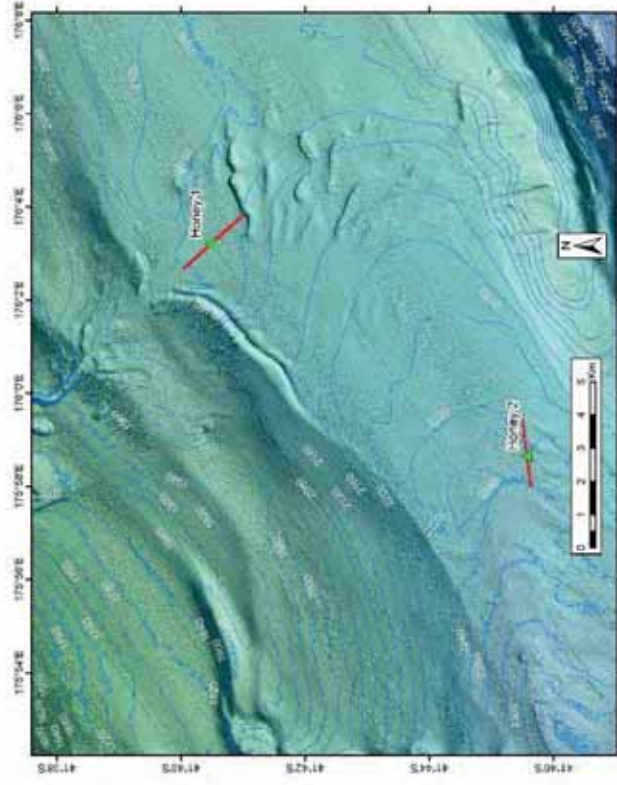
Zoom into 2km survey lines over planned core site.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

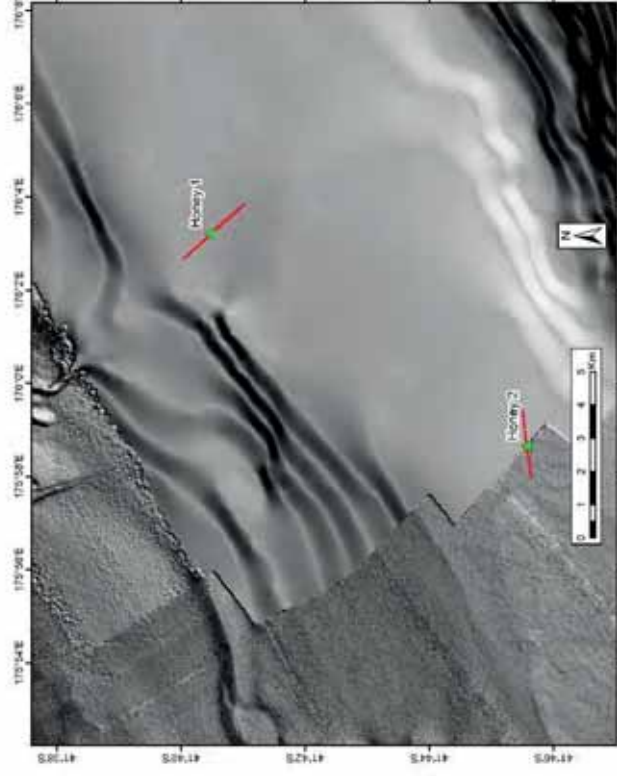
Core ID: Honey 1

Other ID TAN1613-12

Water Depth 2106 m



Bathymetry at and around Honey1 core site at the sloped basin floor at the mouth of Honeycomb Canyon. Light blue lines are 20 m depth contours. Red lines show the 2 km TOPAS survey lines over the stations, the green triangles indicate the actual core site.



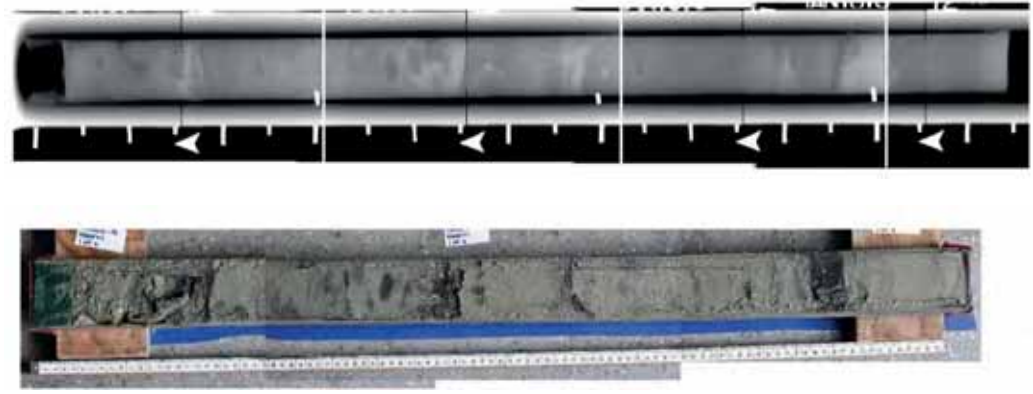
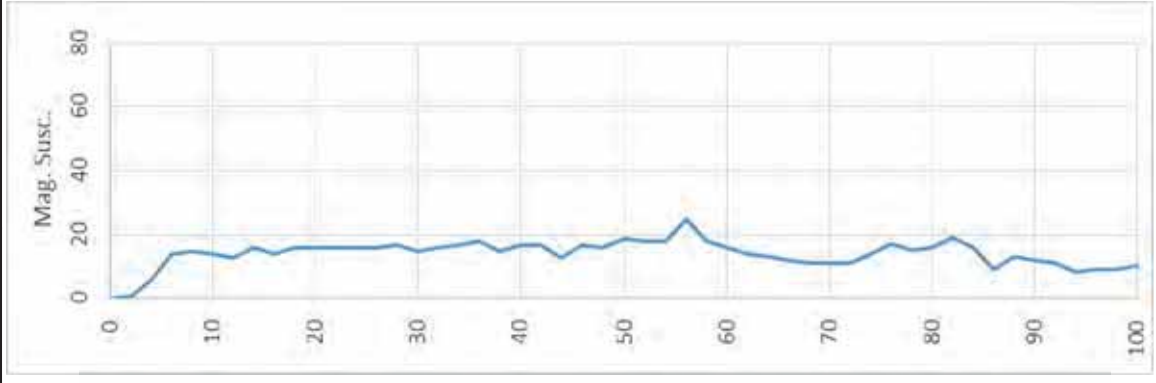
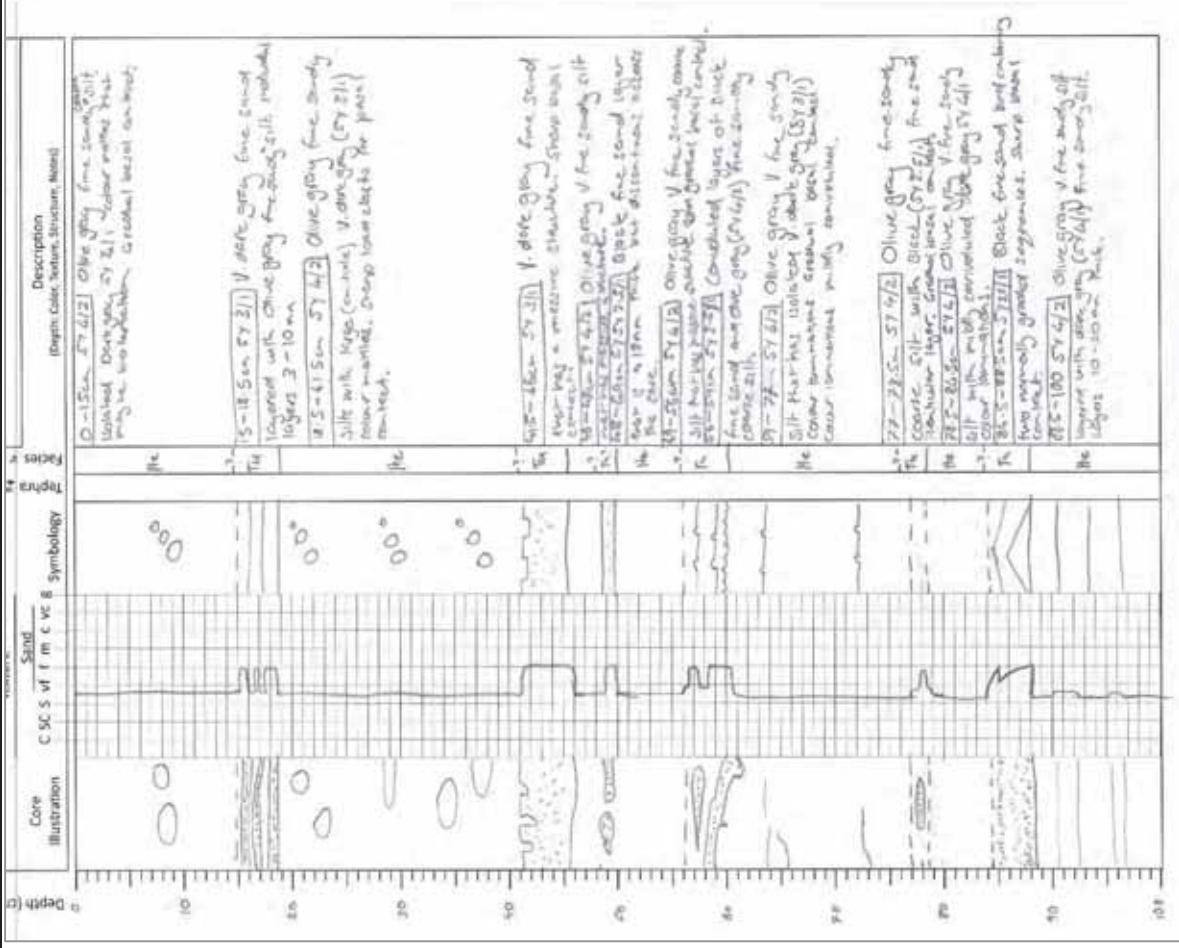
Backscatter at and around Honey1 core site at the sloped basin floor at the mouth of Honeycomb Canyon. Light blue lines are 20 m depth contours. Red lines show the 2 km TOPAS survey lines over the stations, the green triangles indicate the actual core site.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Honey 1

Other ID TAN1613-12

Section 1 of 4

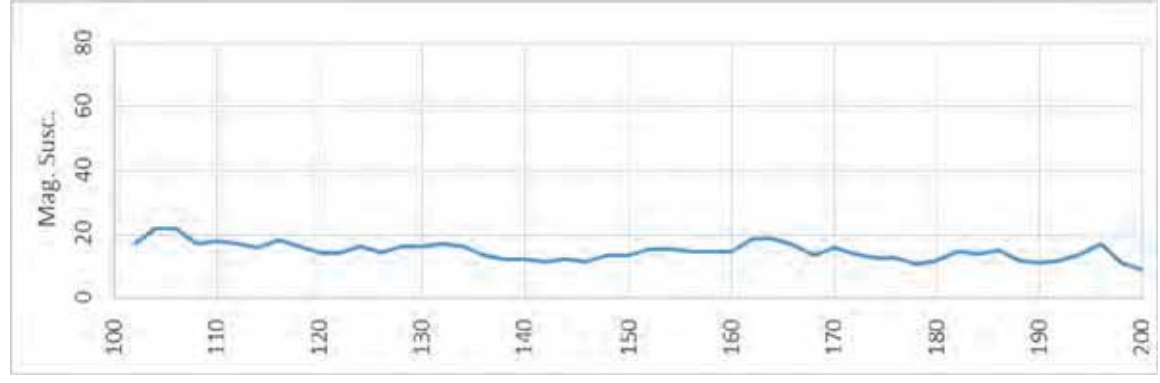
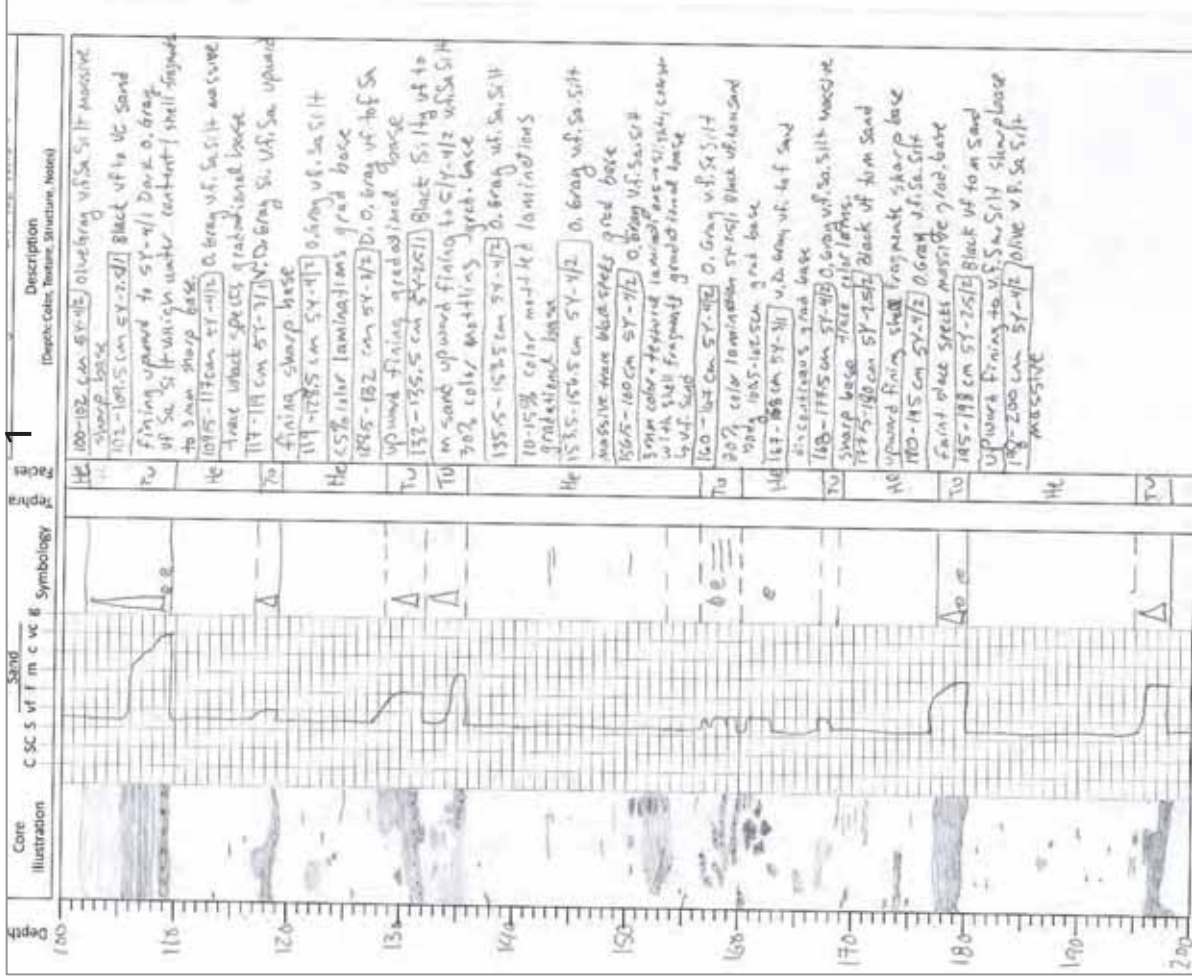


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Honey 1

Other ID TAN1613-12

Section 2 of 4

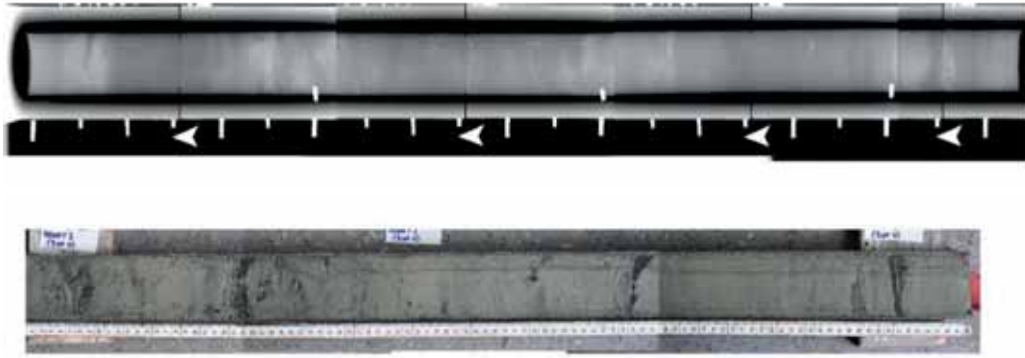
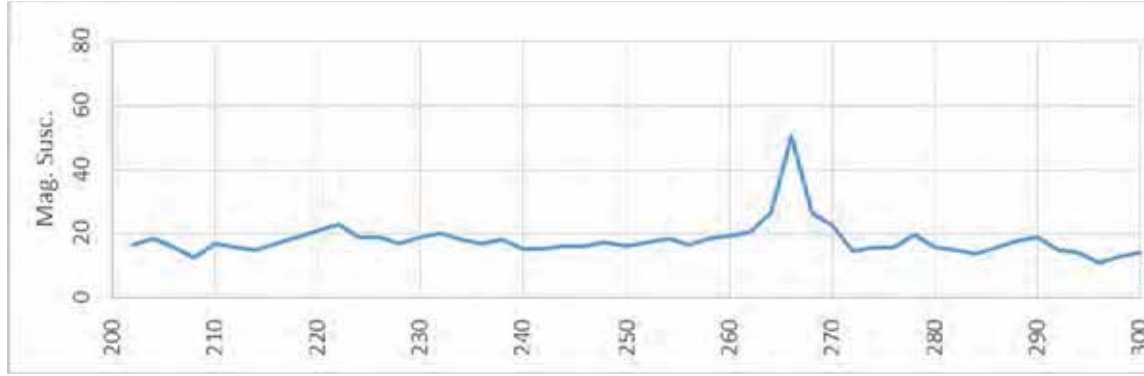
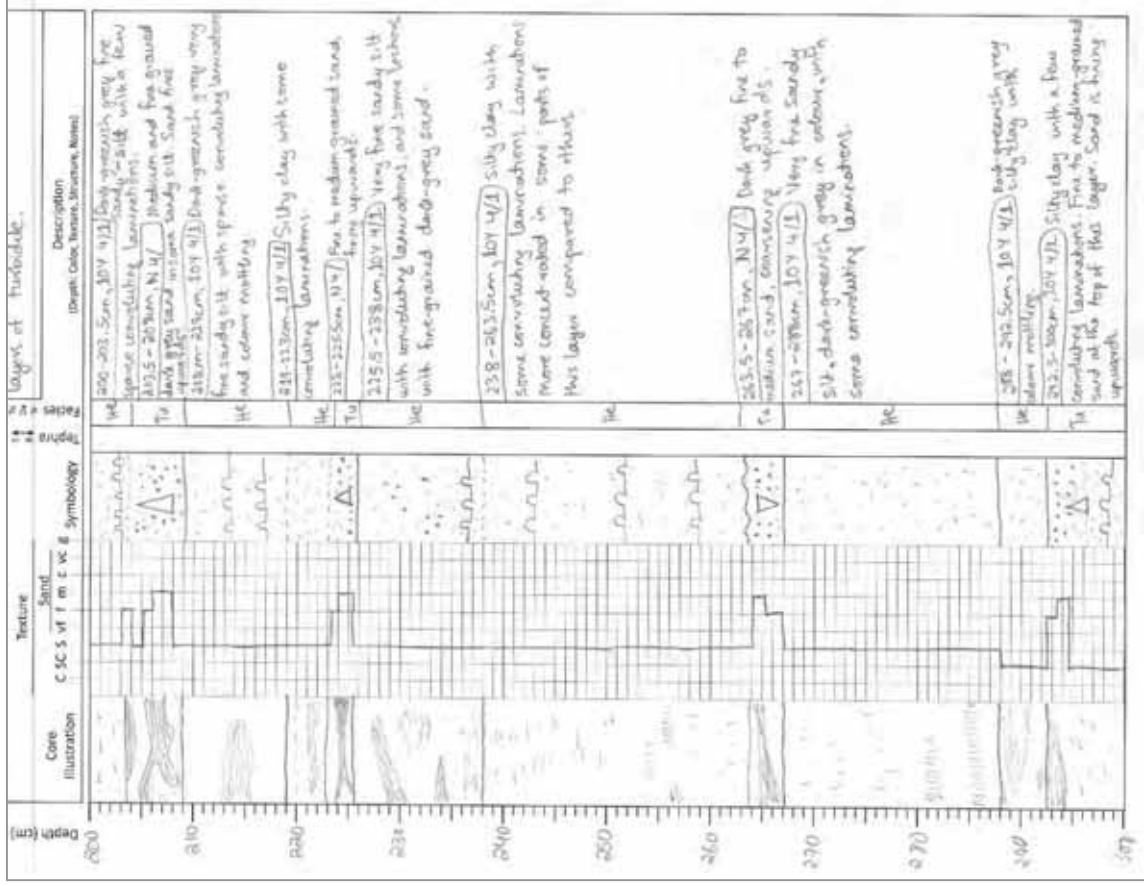


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Honey 1

Other ID TAN1613-12

Section 3 of 4

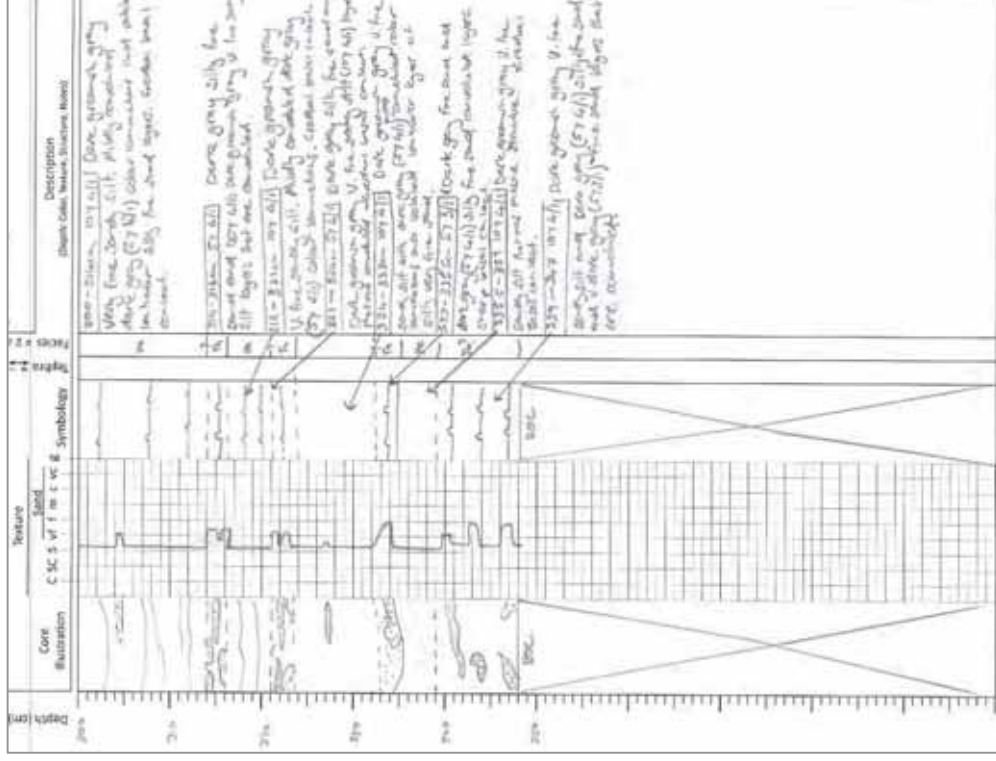
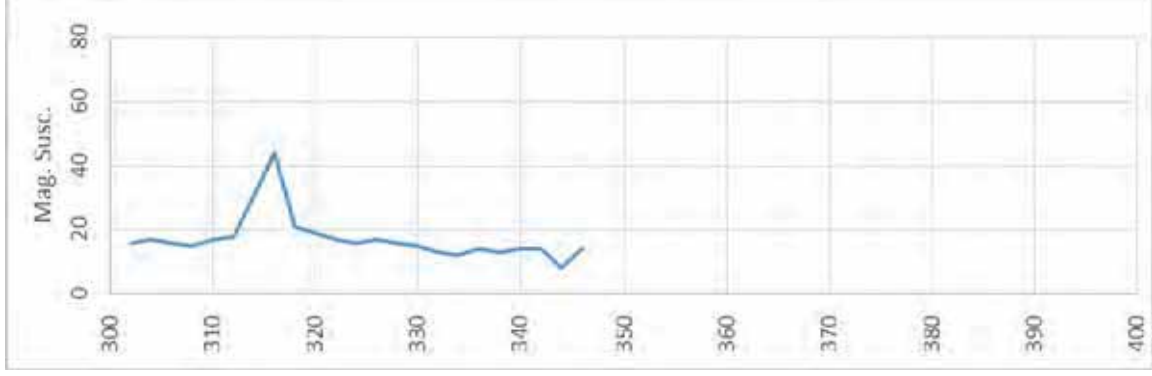
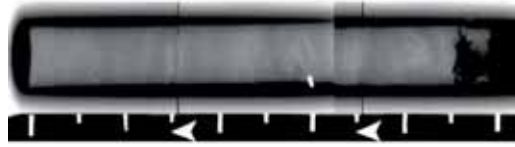


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Honey 1

Other ID TAN1613-12

Section 4 of 4



TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: **Puke 7**

Latitude: -41.65030

Date/Time (NZST): 12/11/2016 08:01

Other ID: TAN1613-13

Longitude: 176.41735

Depth (m): **1853**

Sample Description

General Description

Small perched basin atop Sthn Pukeroro Ridge

Hemipelagic mud with slight increase in sand content at 43-48 cm. Abundant forams.

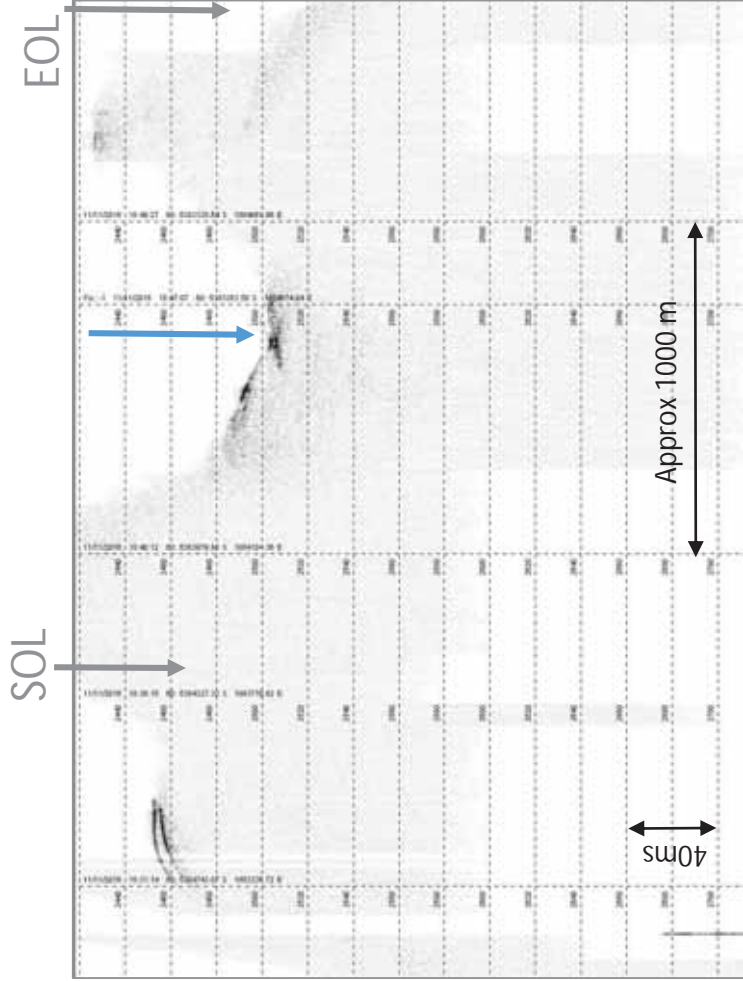
Gear type	Piston core	
Barrel Length (m)	6	Bent barrel
Penetration (m)		Catcher/Cutter bags
Core length (m)	1.55	Samples
Sections	2	Tephra
Fauna	n	Pull-out
		3.4t

Sample processing – core ID:

Section	Top depth (cm)	Btm depth (cm)	Logged	Phys Props	Summary
1	0	100	Y	Y	
2	100	155	Y	Y	
.	
.	
.	
.	

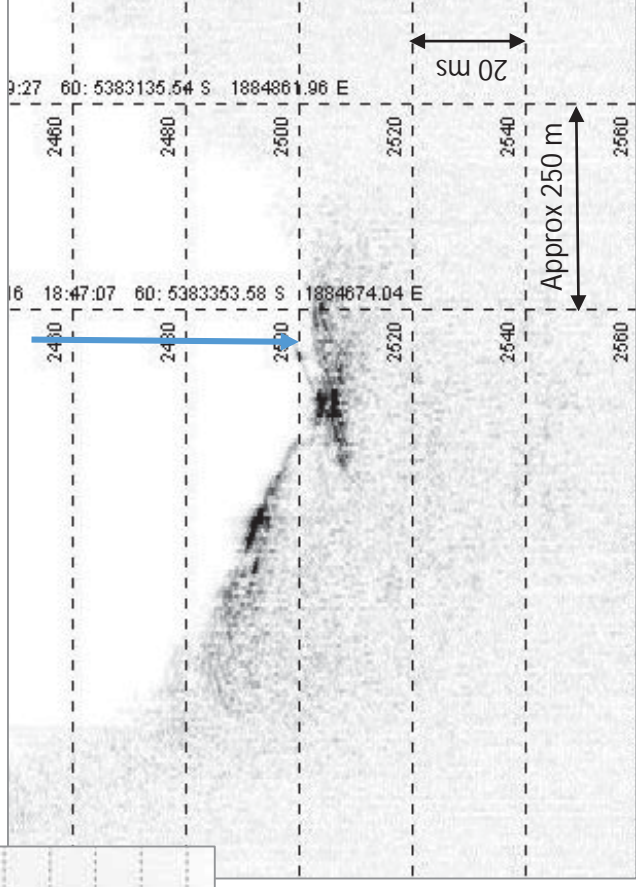
TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Puke 7	Other ID TAN1613-13	Water Depth 1853 m
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Topas line including short transit to the station. Grey arrows indicate start and end of the 2km survey line over the station, the blue arrow marks the planned core site.

Planned core site



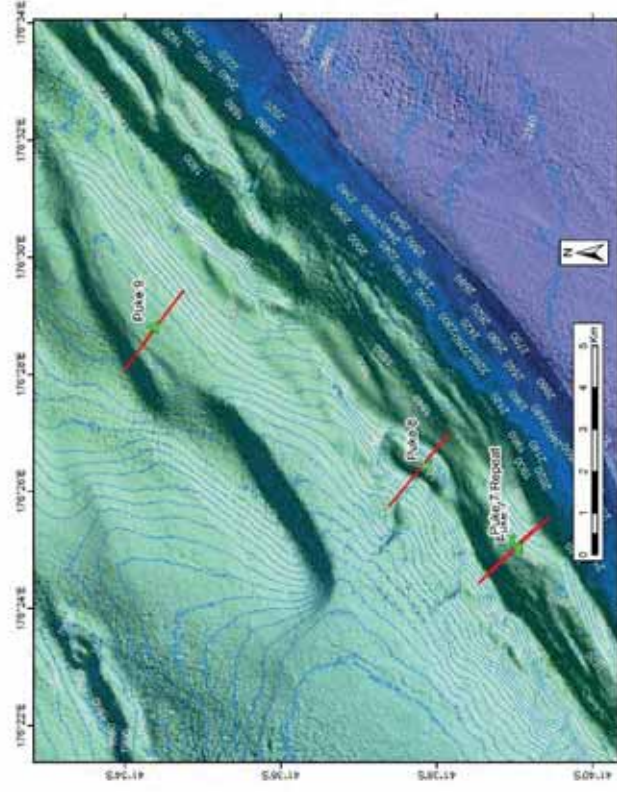
Zoom into 2km survey lines over planned core site.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

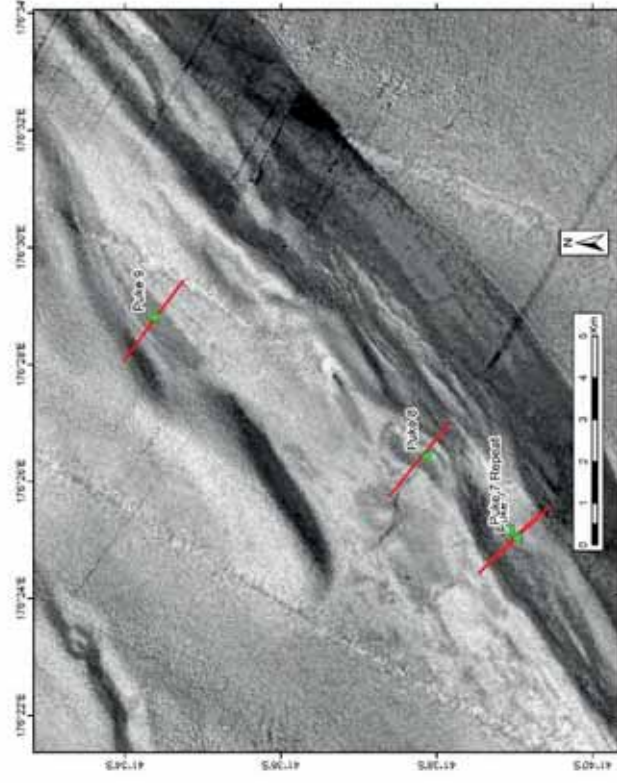
Core ID: Puke 7

Other ID TAN1613-13

Water Depth 1853 m



Bathymetry at and around Puke7 core site in a small perched basin atop Southern Pukeroro Ridge. Light blue lines are 20 m depth contours. Red lines show the 2 km TOPAS survey lines over the stations, green triangles indicate the actual core site.



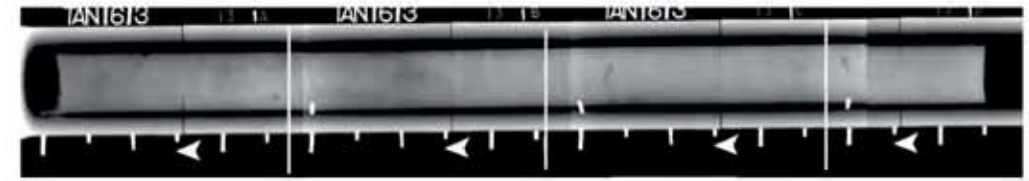
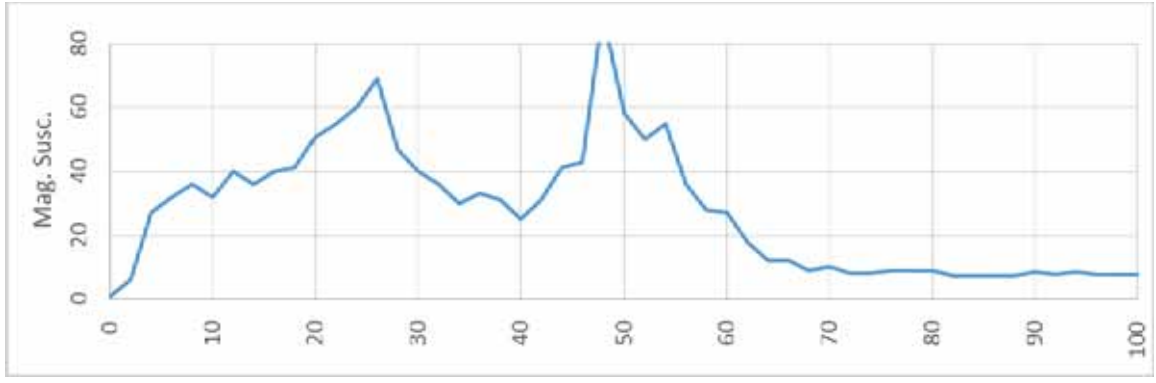
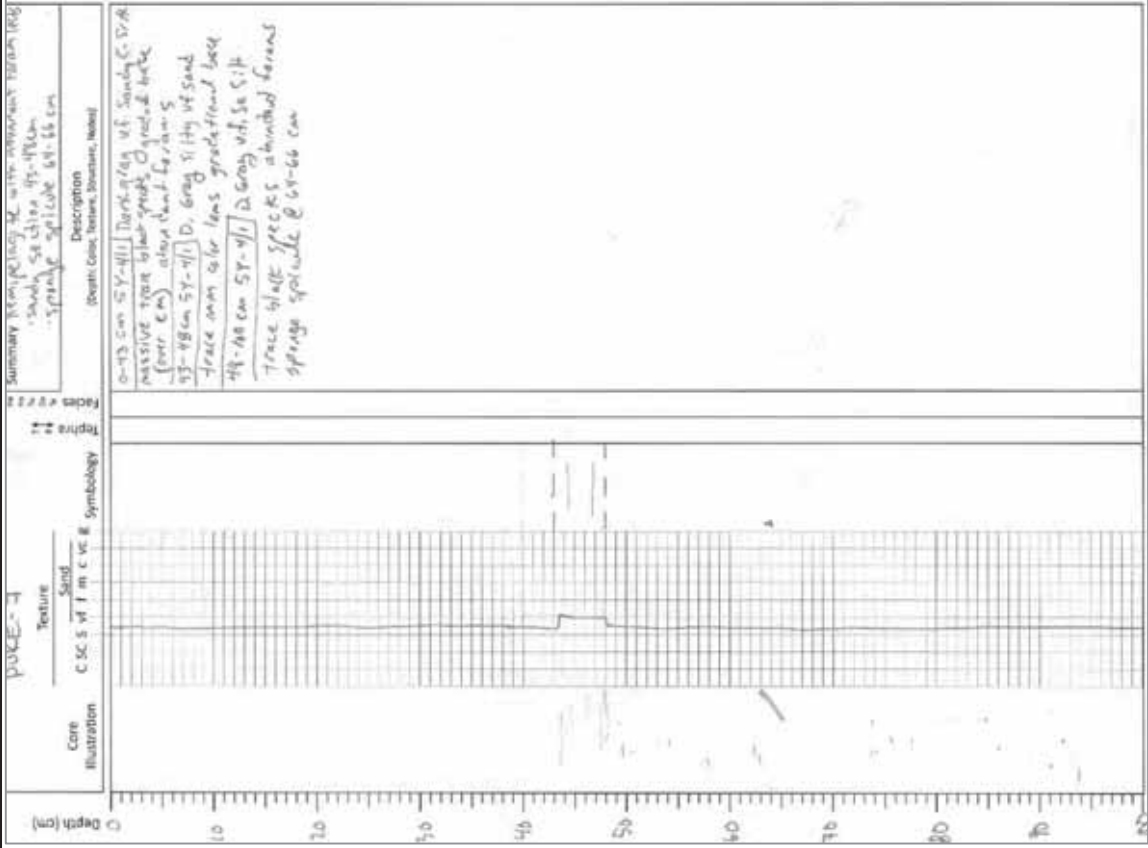
Backscatter at and around Puke7 core site in a small perched basin atop Southern Pukeroro Ridge. Light blue lines are 20 m depth contours. Red lines show the 2 km TOPAS survey lines over the stations, green triangles indicate the actual core site.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Puke 7

Other ID TAN1613-13

Section 1 of 2

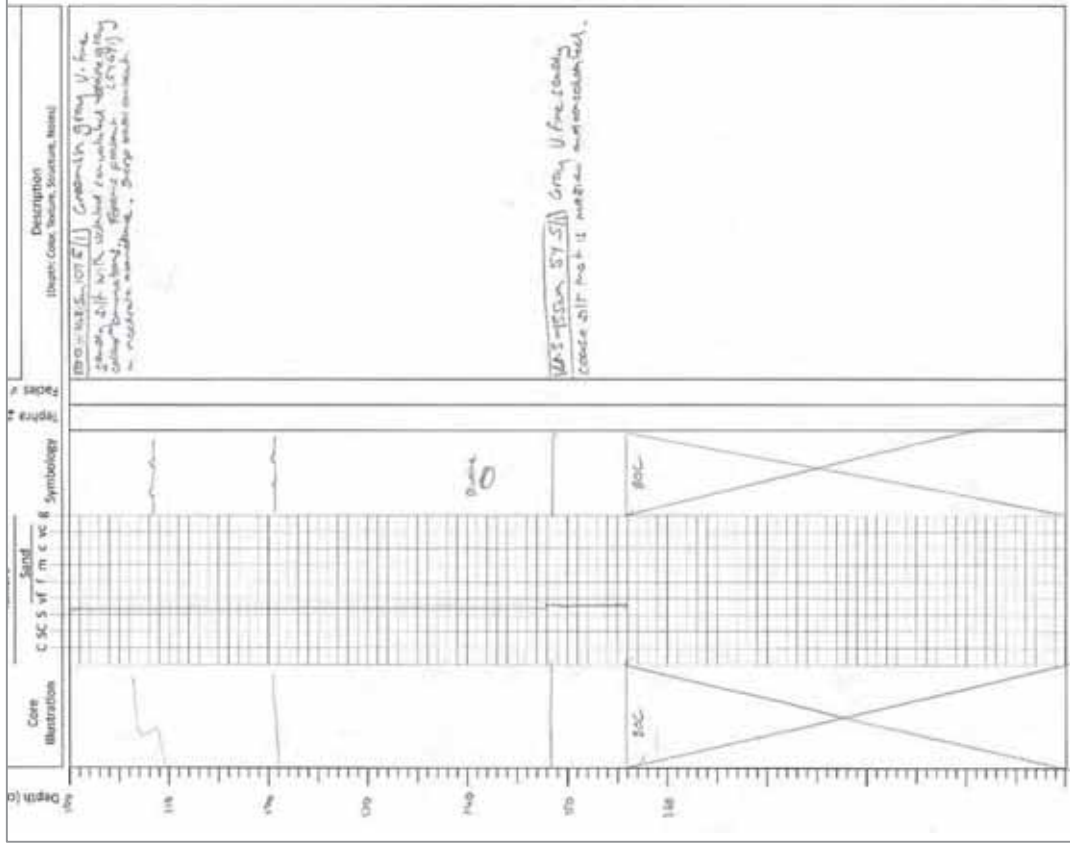
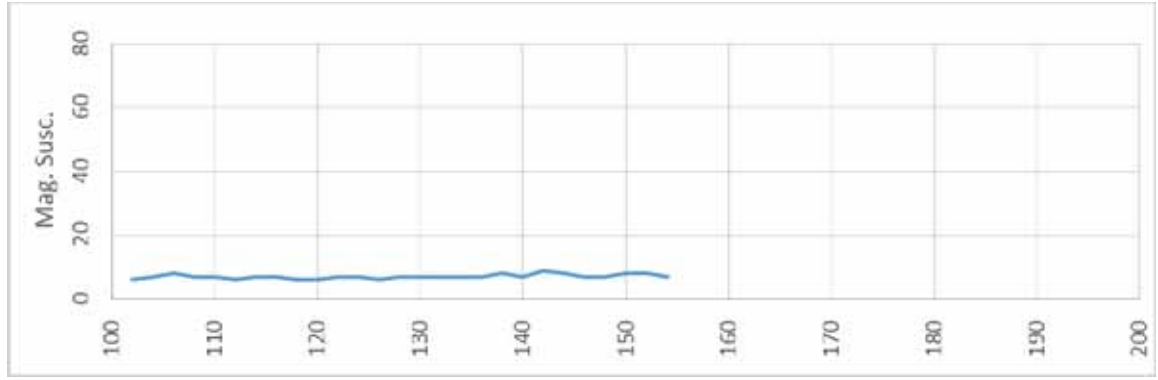


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Puke 7

Other ID TAN1613-13

Section 2 of 2



TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: **Puke 7 (repeat)**

Latitude: -41.64870

Date/Time (NZST): 12/11/2016 10:09

Other ID: TAN1613-14

Longitude: 176.41932

Depth (m): 1864

Sample Description

General Description

Small perched basin atop Sthn Pukeroro Ridge

Hemipelagic mud throughout. Disturbed in upper 20 cm.

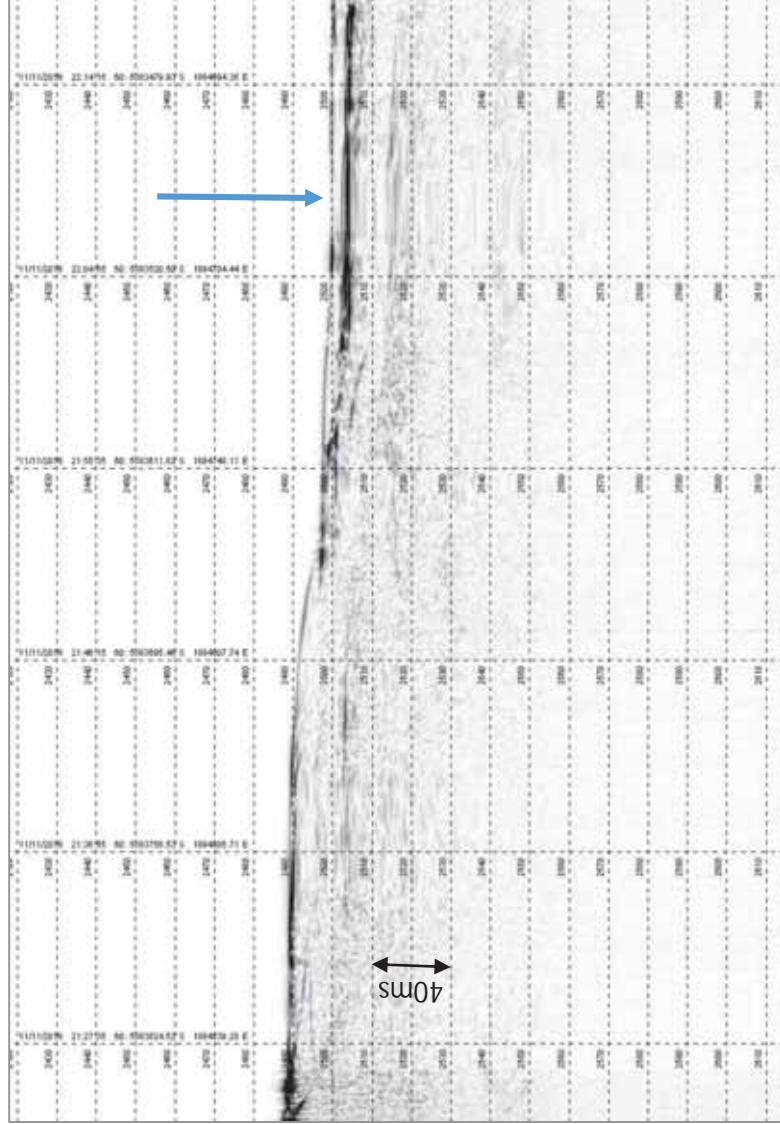
Gear type	Piston core	
Barrel Length (m)	6	Bent barrel
Penetration (m)		Catcher/Cutter bags
Core length (m)	180	Samples
Sections	2	Tephra
Fauna	N	Pull-out
		3.2t

Sample processing – core ID:

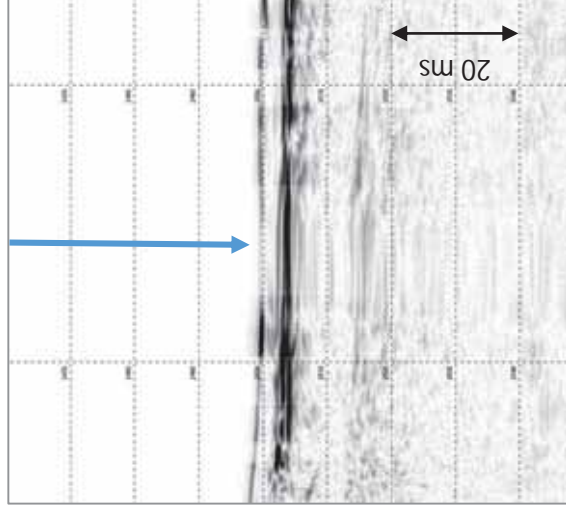
Section	Top depth (cm)	Btm depth (cm)	Logged	Phys Props	Summary
1	0	100	Y	Y	
2	200	179.5	Y	Y	
.	
.	
.	
.	

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Puke 7 (repeat)	Other ID TAN1613-14	Water Depth 1864 m
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Call on bottom



Topas drifting over the station while repeating the site. The blue arrow marks the location for the call on bottom.

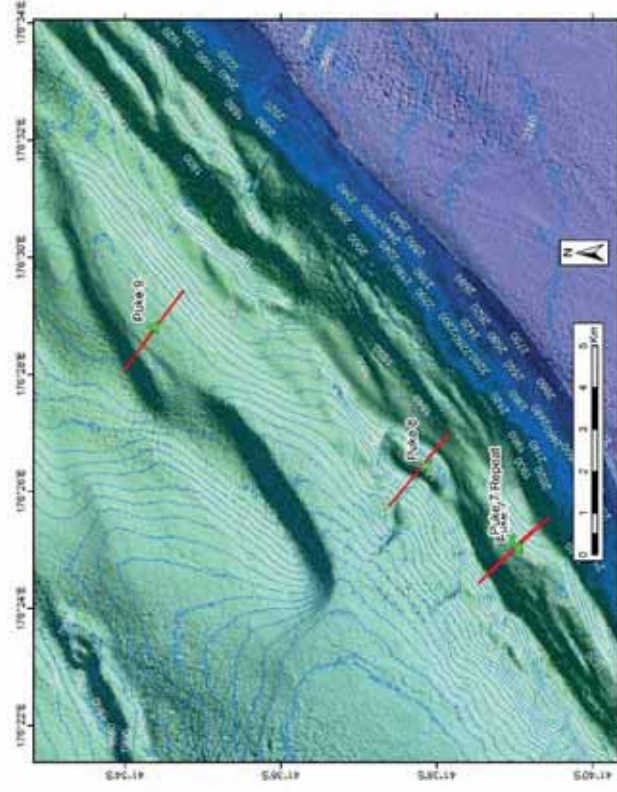
Zoom in and around the call on bottom.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

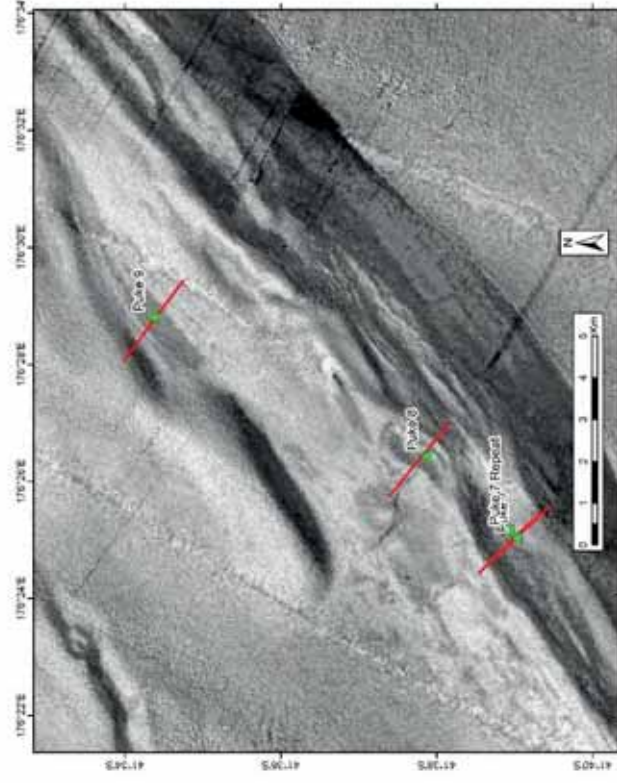
Core ID: Puke 7 (repeat)

Other ID TAN1613-14

Water Depth 1864 m



Bathymetry at and around Puke7 core site in a small perched basin atop Southern Pukeroro Ridge. Light blue lines are 20 m depth contours. Red lines show the 2 km TOPAS survey lines over the stations, green triangles indicate the actual core site.



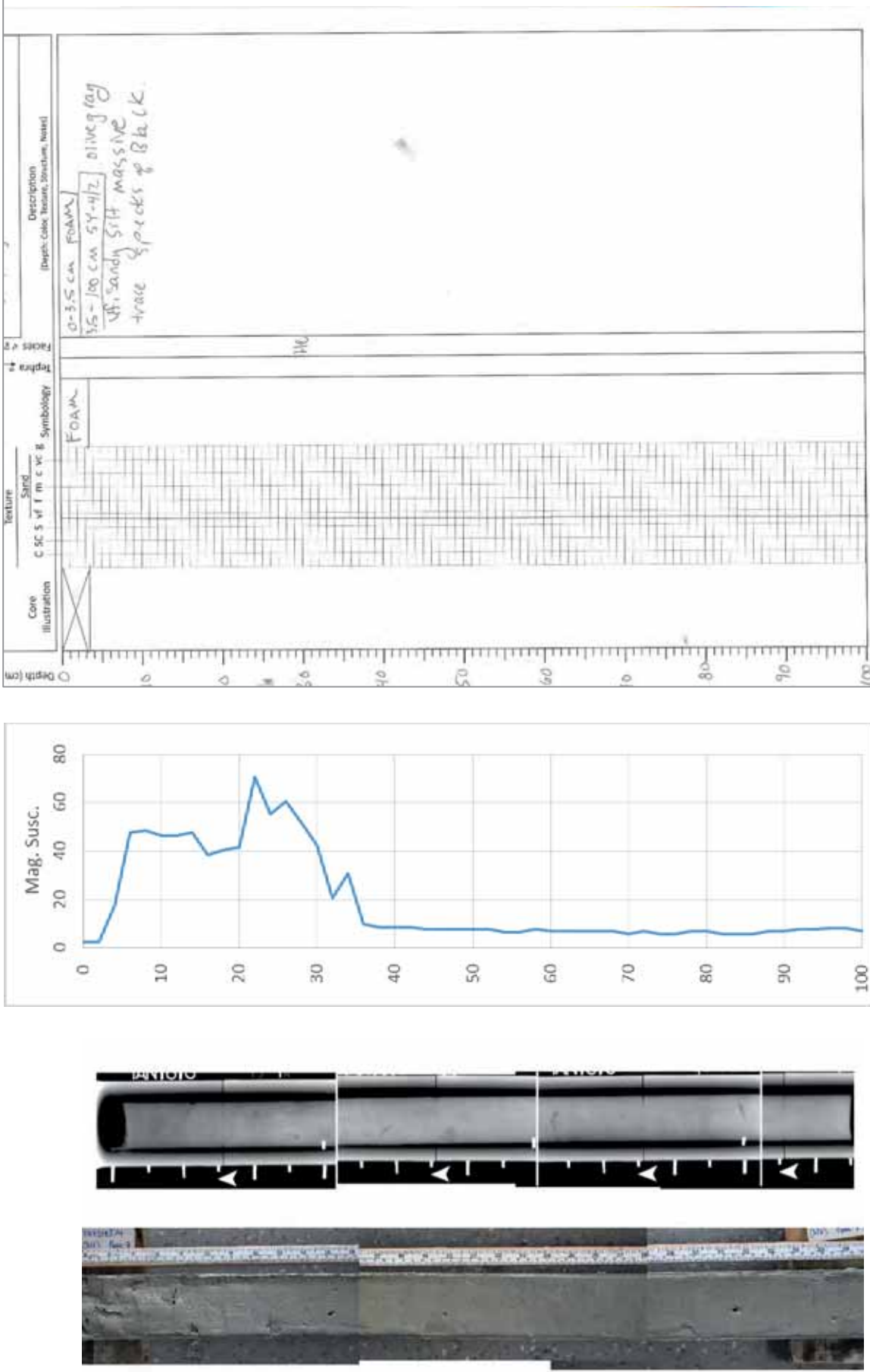
Bathymetry at and around Puke7 core site in a small perched basin atop Southern Pukeroro Ridge. Light blue lines are 20 m depth contours. Red lines show the 2 km TOPAS survey lines over the stations, green triangles indicate the actual core site.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Puke 7 (repeat)

Other ID TAN1613-14

Section 1 of 2

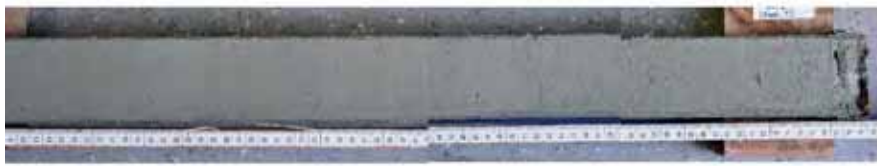
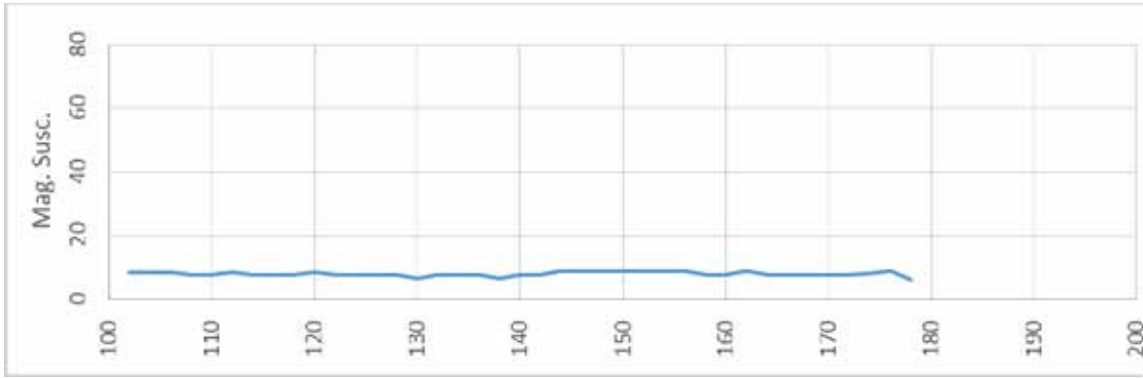
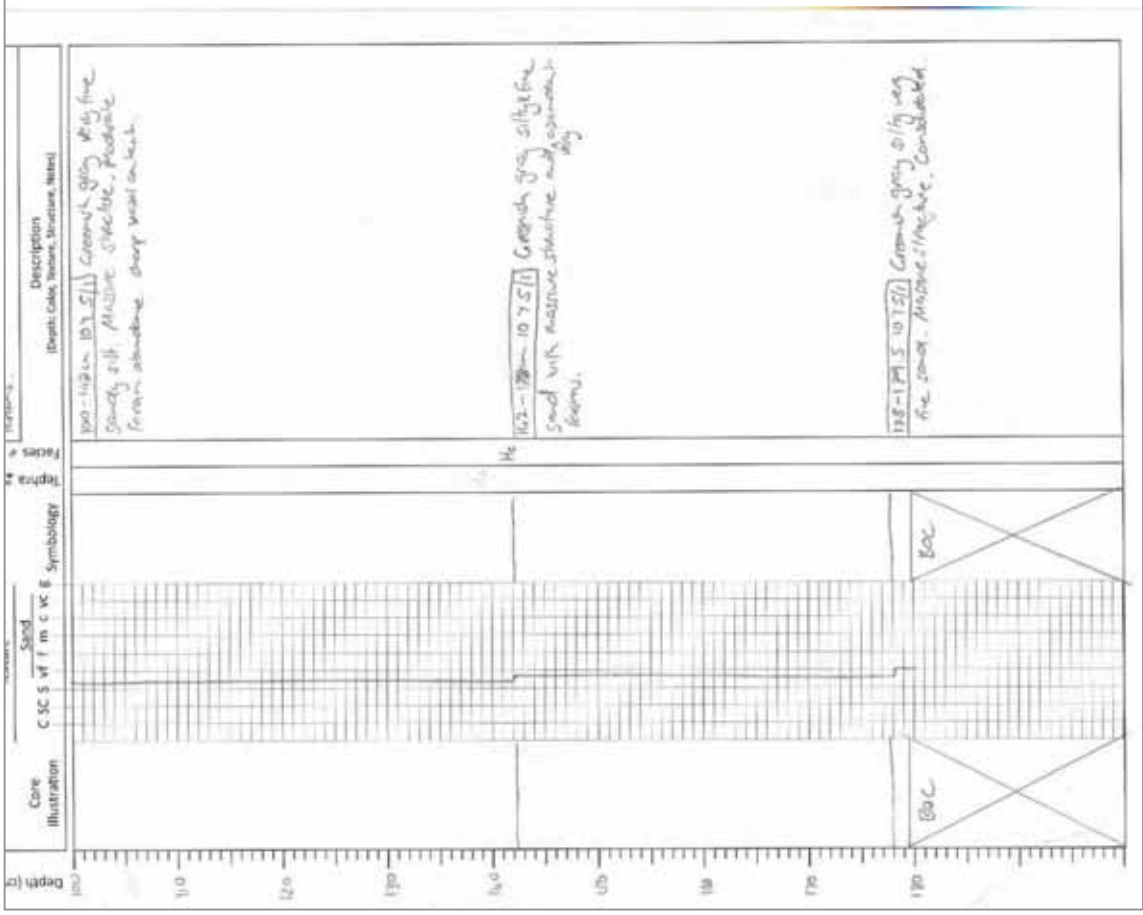


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Puke 7 (repeat)

Other ID TAN1613-14

Section 2 of 2



TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: **Puke 8**

Latitude: -41.63095

Date/Time (NZST): 12/11/2016 12:43

Other ID: TAN1613-15

Longitude: 176.44058

Depth (m): 1758

Sample Description

General Description

Small perched basin atop Stihh Pukeroro Ridge

Hemipelagic mud throughout. Strong methane small...

Gear type	Piston core	
Barrel Length (m)	6	Bent barrel
Penetration (m)		Catcher/Cutter bags
Core length (m)	3.47	Samples
Sections	4	Tephra
Fauna		

Sample processing – core ID:

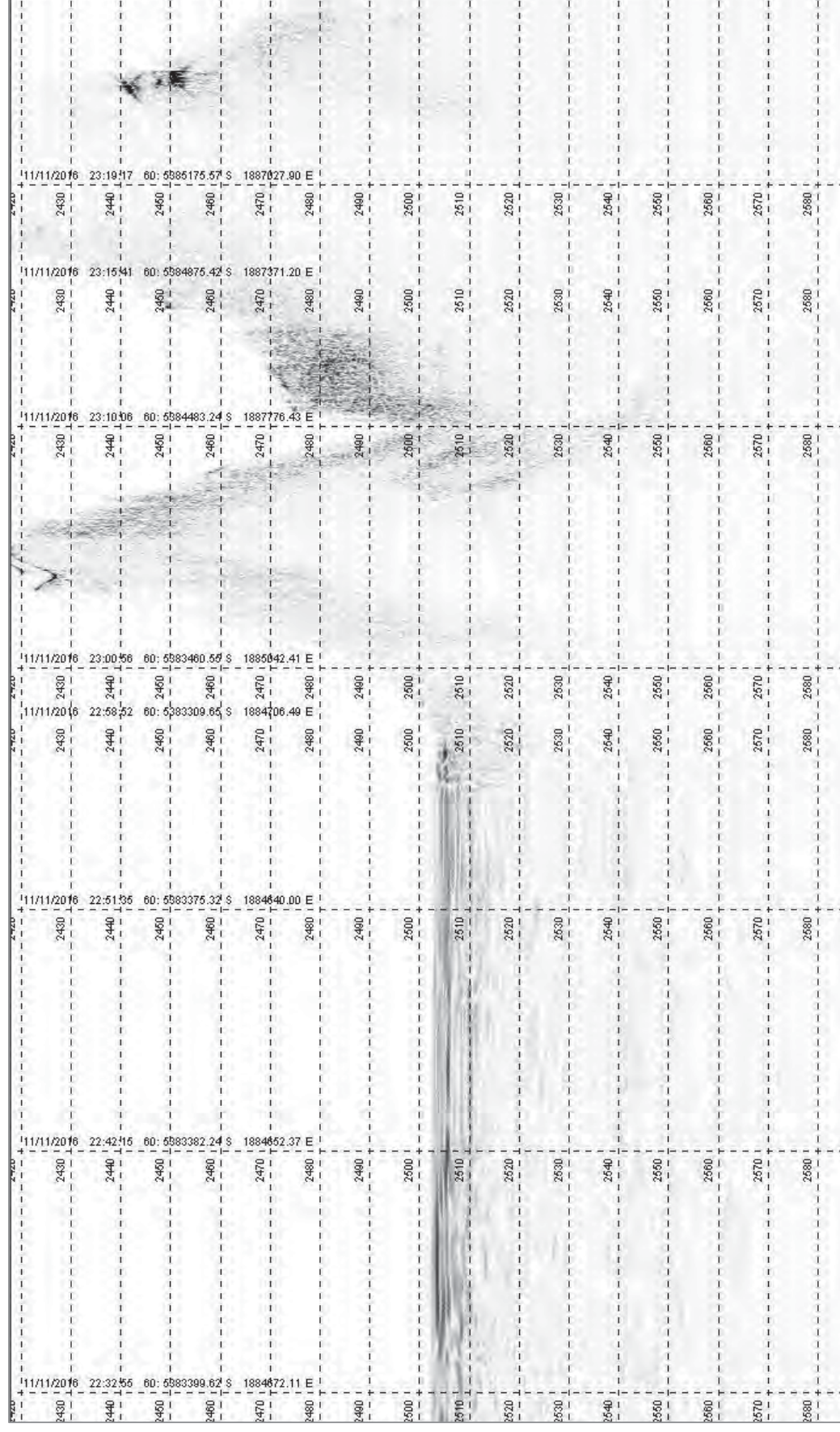
Section	Top depth (cm)	Btm depth (cm)	Logged	Phys Props	Summary
1	0	100	Y	Y	
2	100	.	Y	Y	
.	
.	
.	
.	

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Puke 8

Other ID TAN1613-15

Water Depth 1758 m



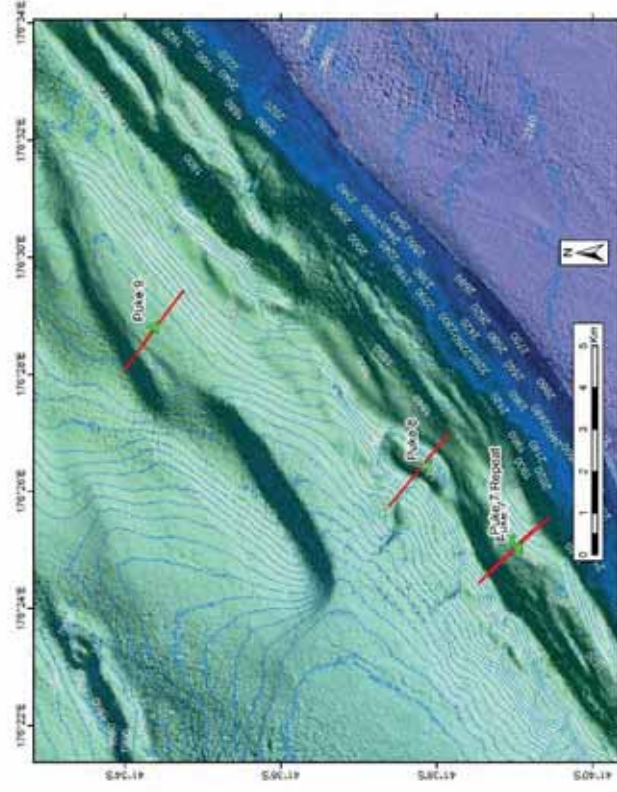
Topas line over the station.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

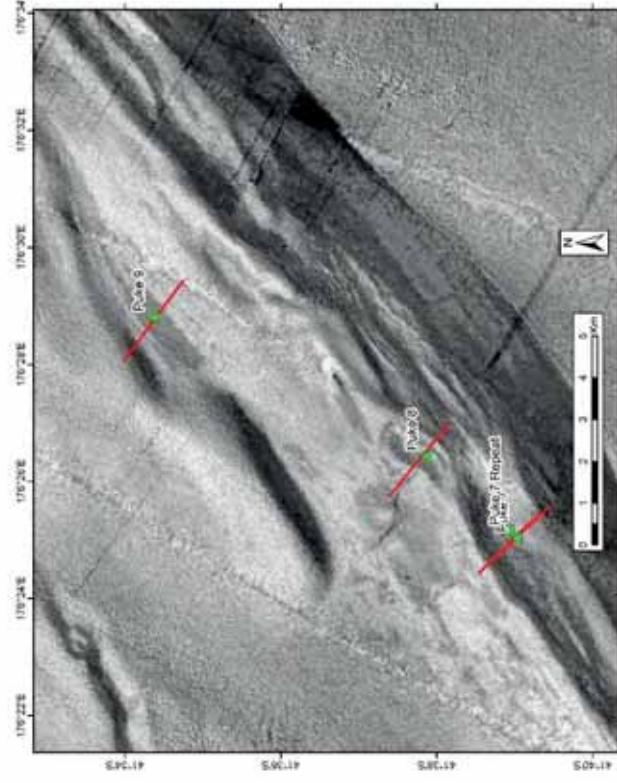
Core ID: Puke 8

Other ID TAN1613-15

Water Depth 1758 m



Bathymetry at and around Puke8 core site in a small perched basin atop Southern Pukeroro Ridge. Light blue lines are 20 m depth contours. Red lines show the 2 km TOPAS survey lines over the stations, green triangles indicate the actual core site.



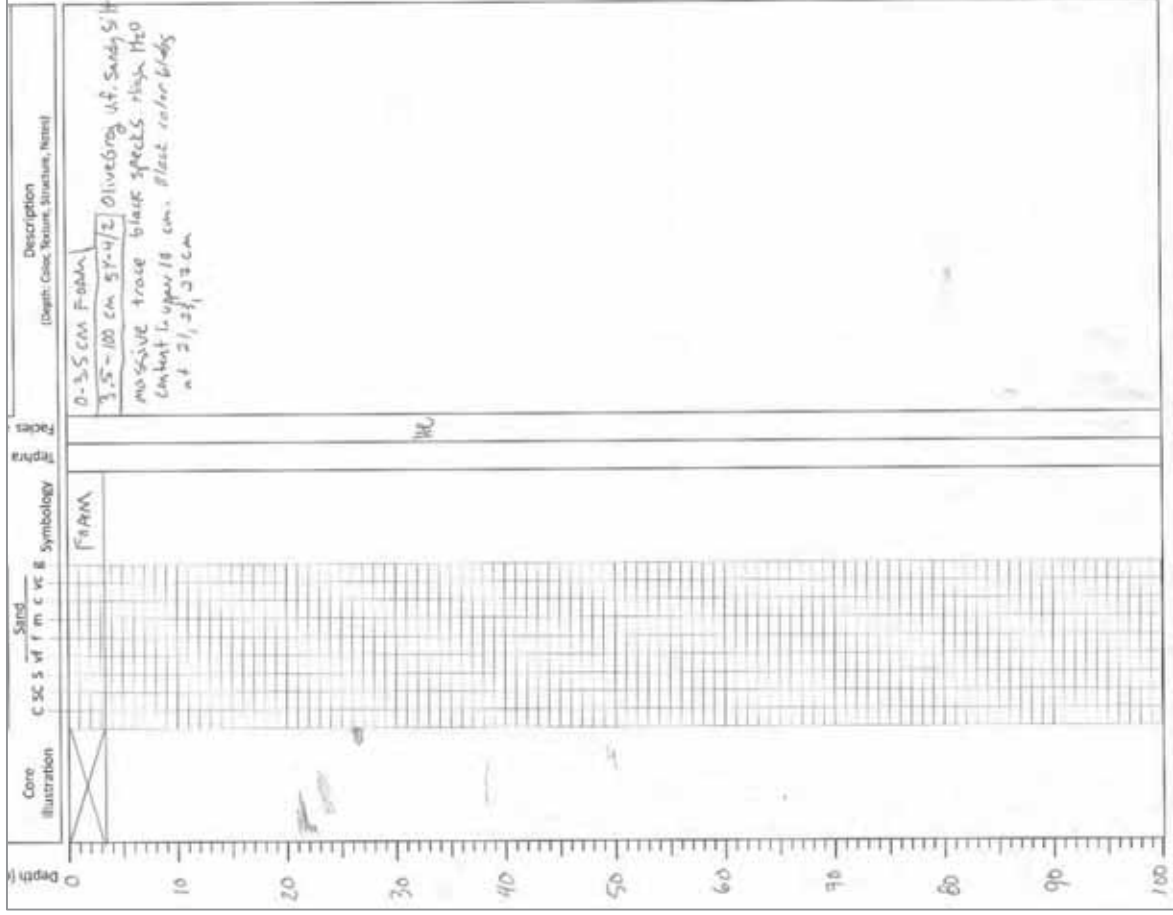
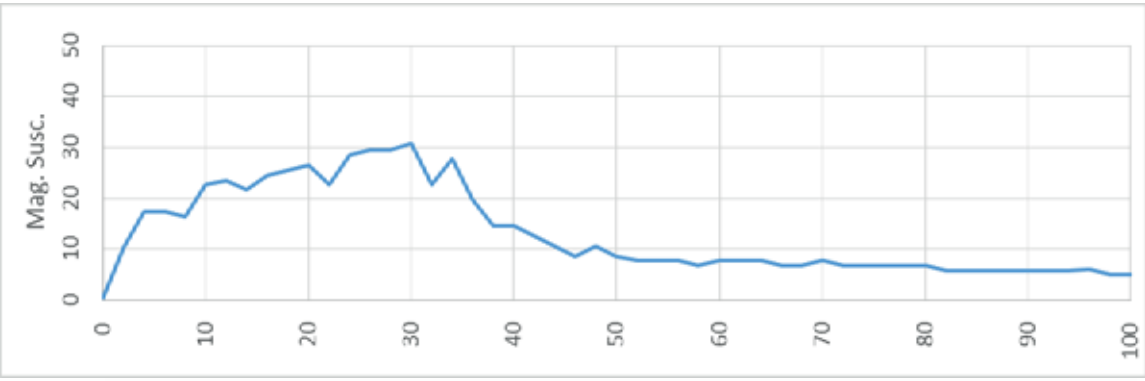
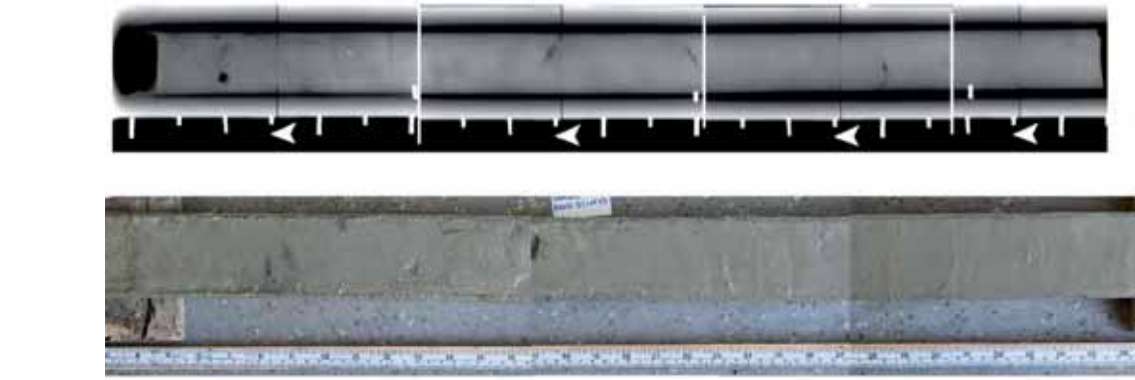
Backscatter at and around Puke8 core site in a small perched basin atop Southern Pukeroro Ridge. Light blue lines are 20 m depth contours. Red lines show the 2 km TOPAS survey lines over the stations, green triangles indicate the actual core site.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Puke 8

Other ID TAN1613-15

Section 1 of 4

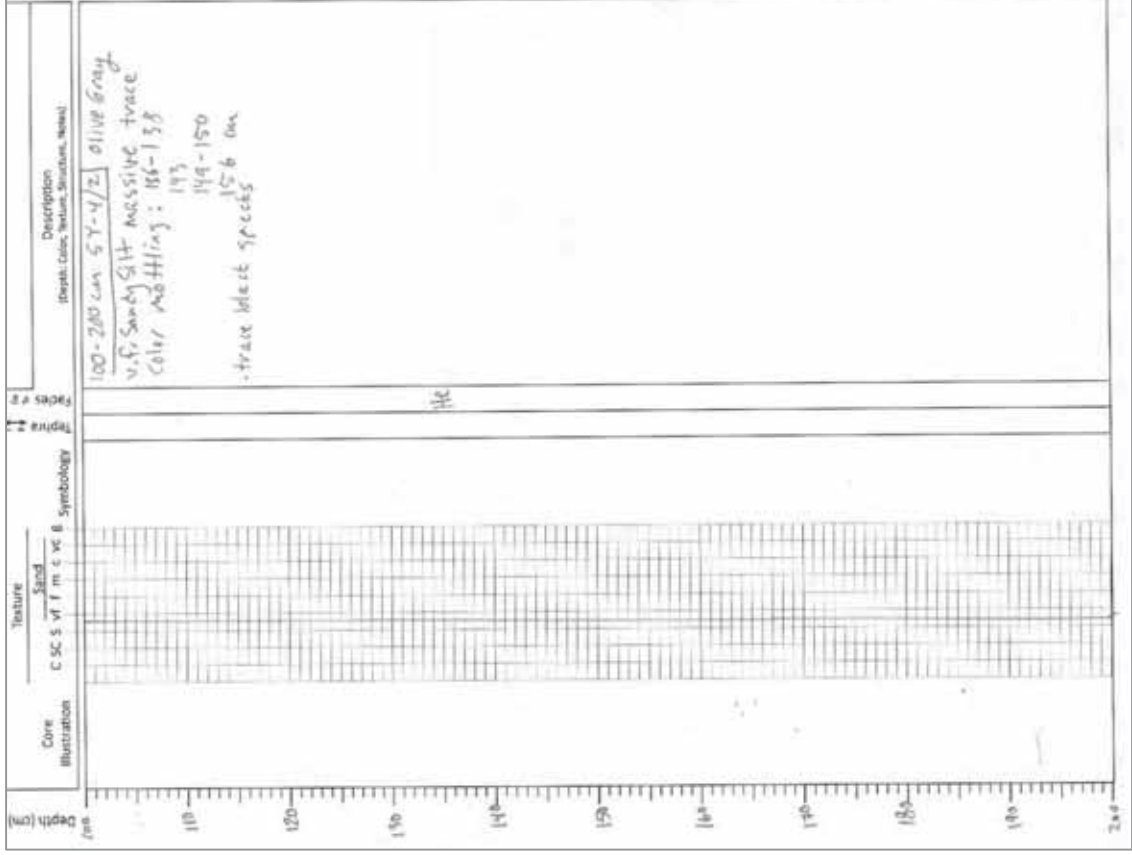
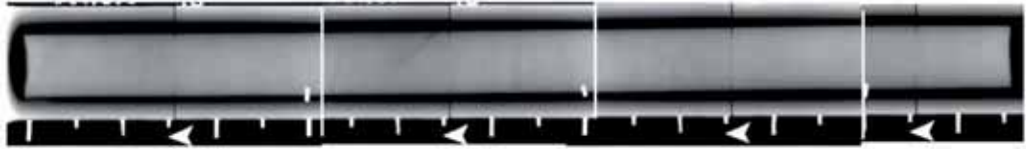


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Puke 8

Other ID TAN1613-15

Section 2 of 4

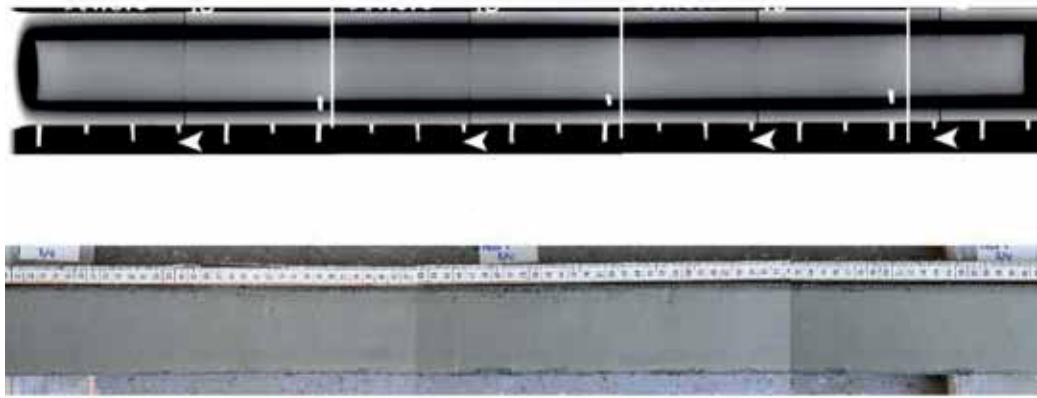
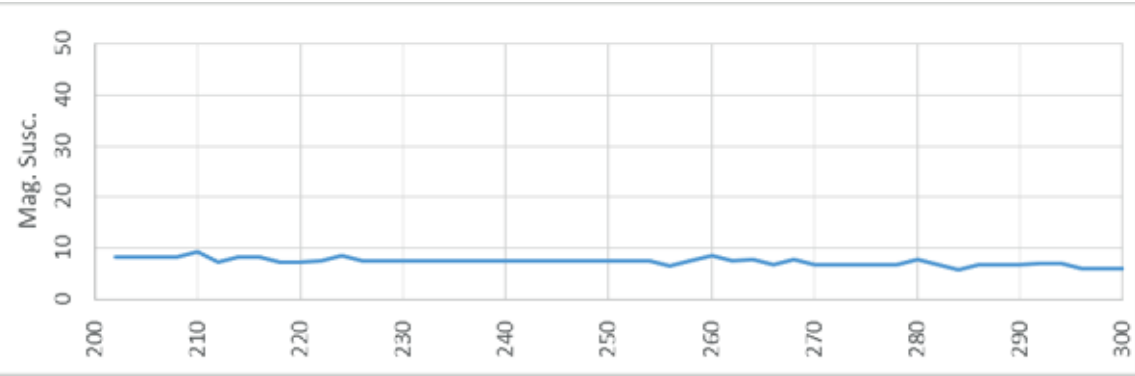
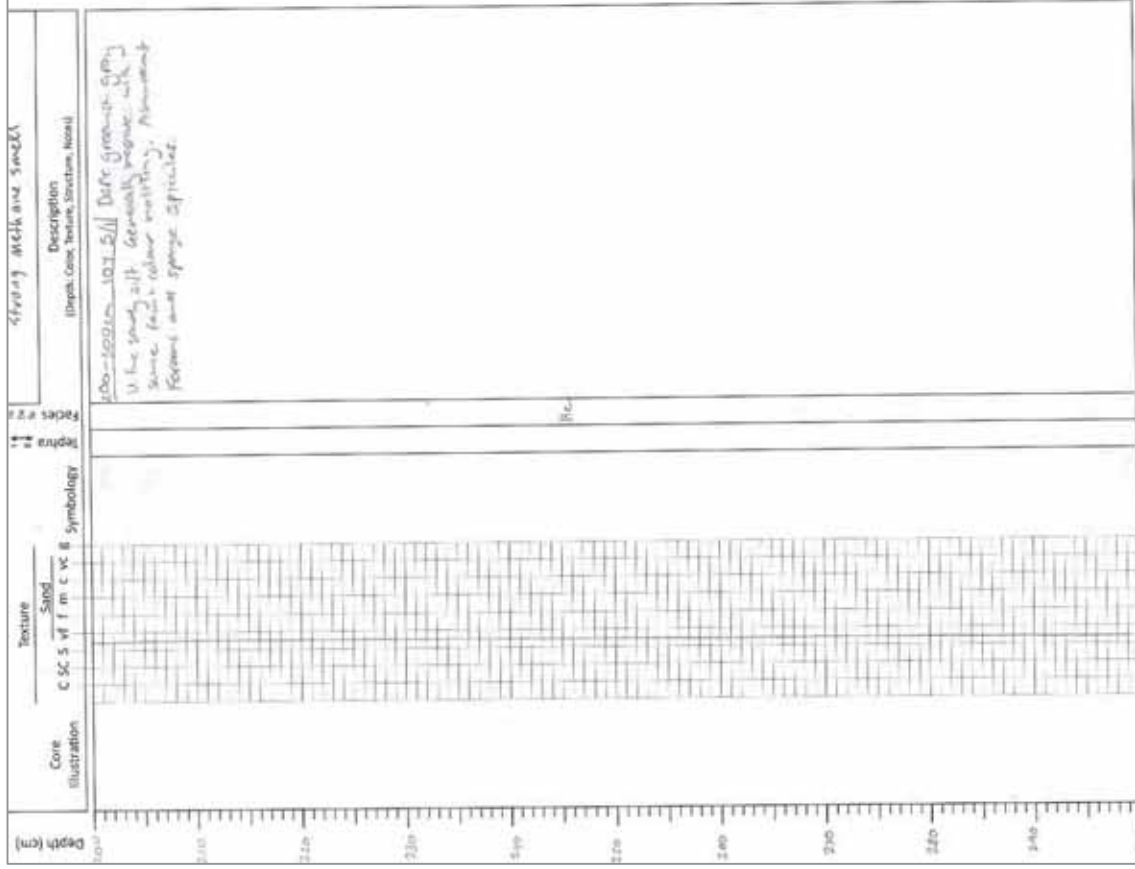


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Puke 8

Other ID TAN1613-15

Section 3 of 4

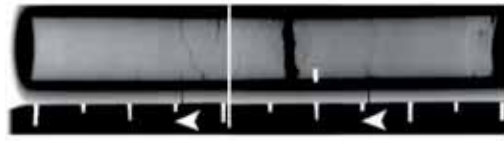
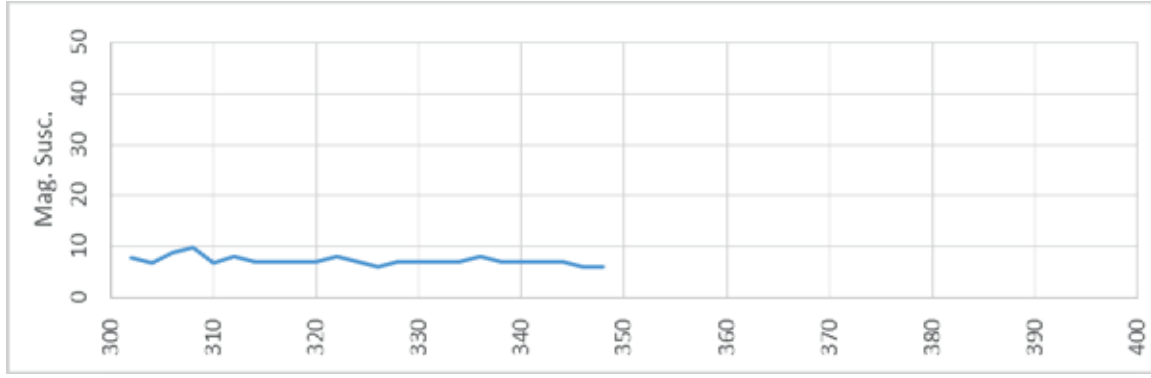
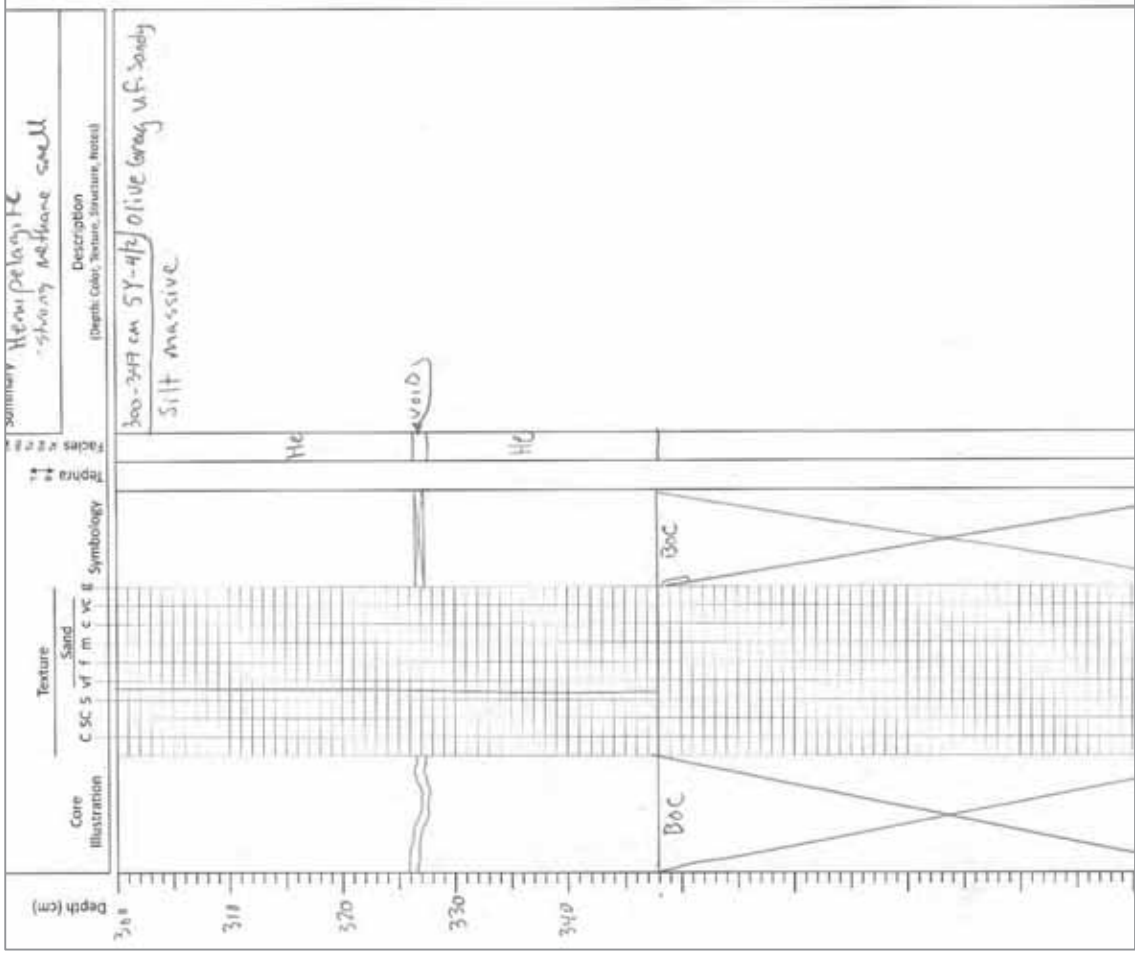


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Puke 8

Other ID TAN1613-15

Section 4 of 4



TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: **Puke 9** Latitude: -41.57257 Date/Time (NZST): 12/11/2016 15:22

Other ID: TAN1613-16 Longitude: 176.48015 Depth (m): **1830**

Sample Description

General Description

Small perched basin atop Sthn Pukeroro Ridge

Hemipelagic mud with some colour laminations, mottling in section 5

Gear type	Piston core	
Barrel Length (m)	6	Bent barrel
Penetration (m)		Catcher/Cutter bags
Core length (m)	4.92	Samples
Sections	5	Tephra
Fauna		

Sample processing – core ID:

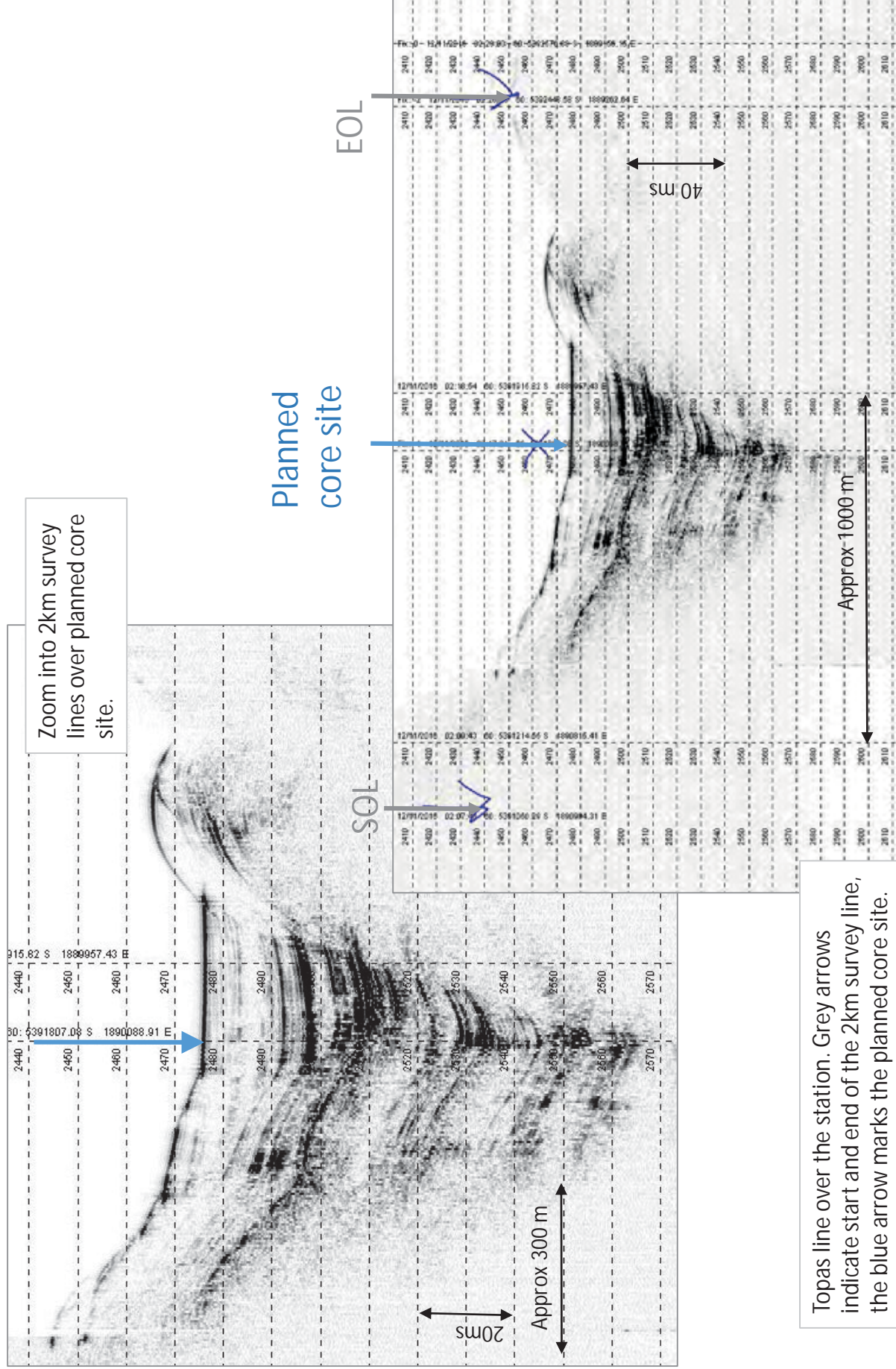
Section	Top depth (cm)	Btm depth (cm)	Logged	Phys Props	Summary
1	0	100	Y	Y	
2	100	200	Y	Y	
3	200	300	Y	Y	
4	300	400	Y	Y	
5	400	492	Y	Y	
.	

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Puke 9

Other ID TAN1613-16

Water Depth 1830 m

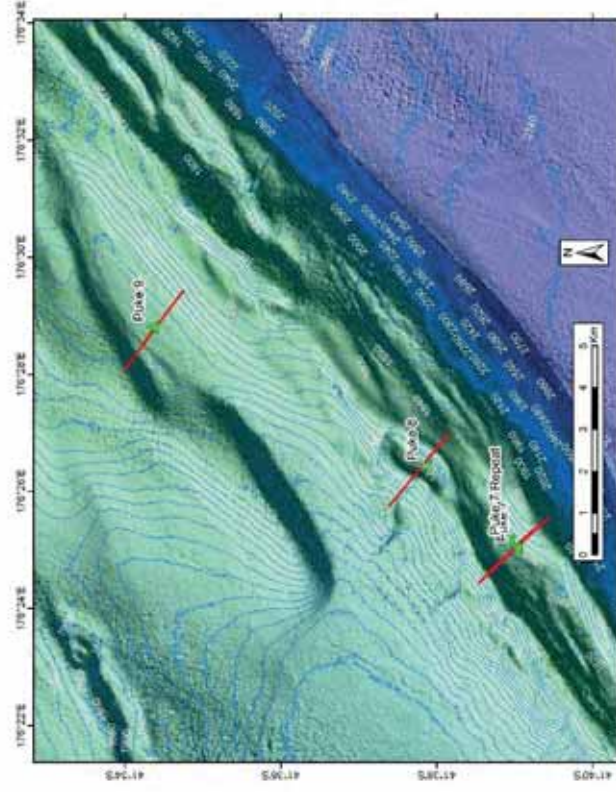


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

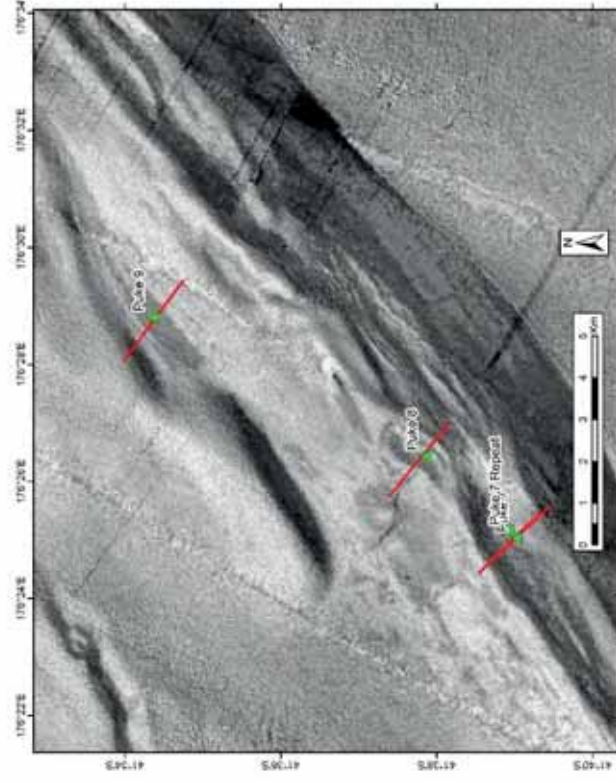
Core ID: Puke 9

Other ID TAN1613-16

Water Depth 1830 m



Bathymetry at and around Puke9 core site in a small perched basin atop Southern Pukeroro Ridge. Light blue lines are 20 m depth contours. Red lines show the 2 km TOPAS survey lines over the stations, green triangles indicate the actual core site.



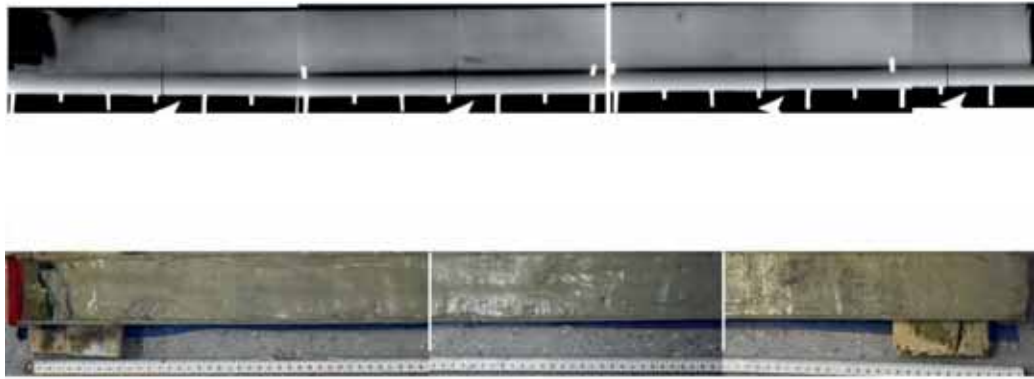
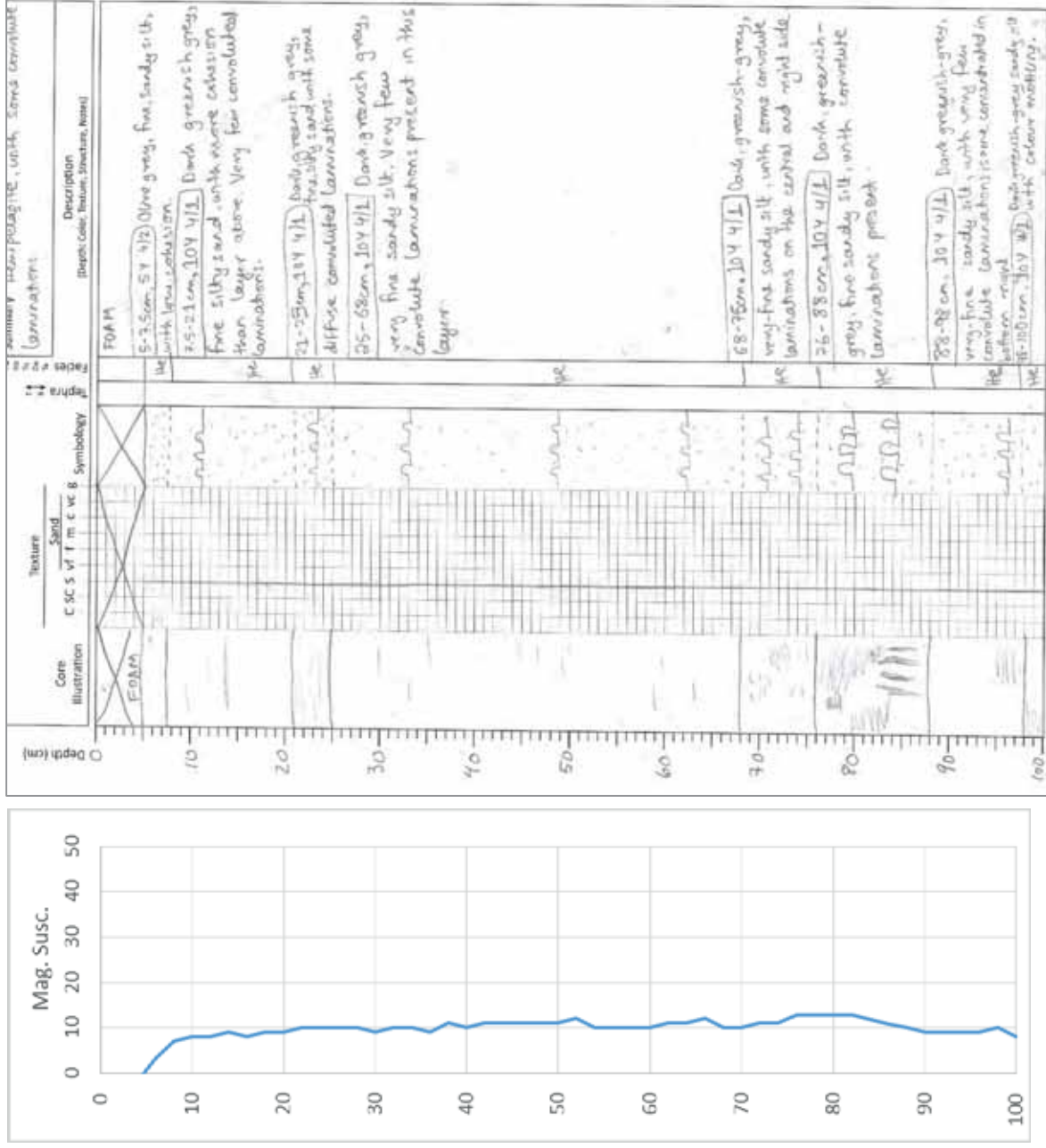
Backscatter at and around Puke9 core site in a small perched basin atop Southern Pukeroro Ridge. Light blue lines are 20 m depth contours. Red lines show the 2 km TOPAS survey lines over the stations, green triangles indicate the actual core site.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Puke 9

Other ID TAN1613-16

Section 1 of 5

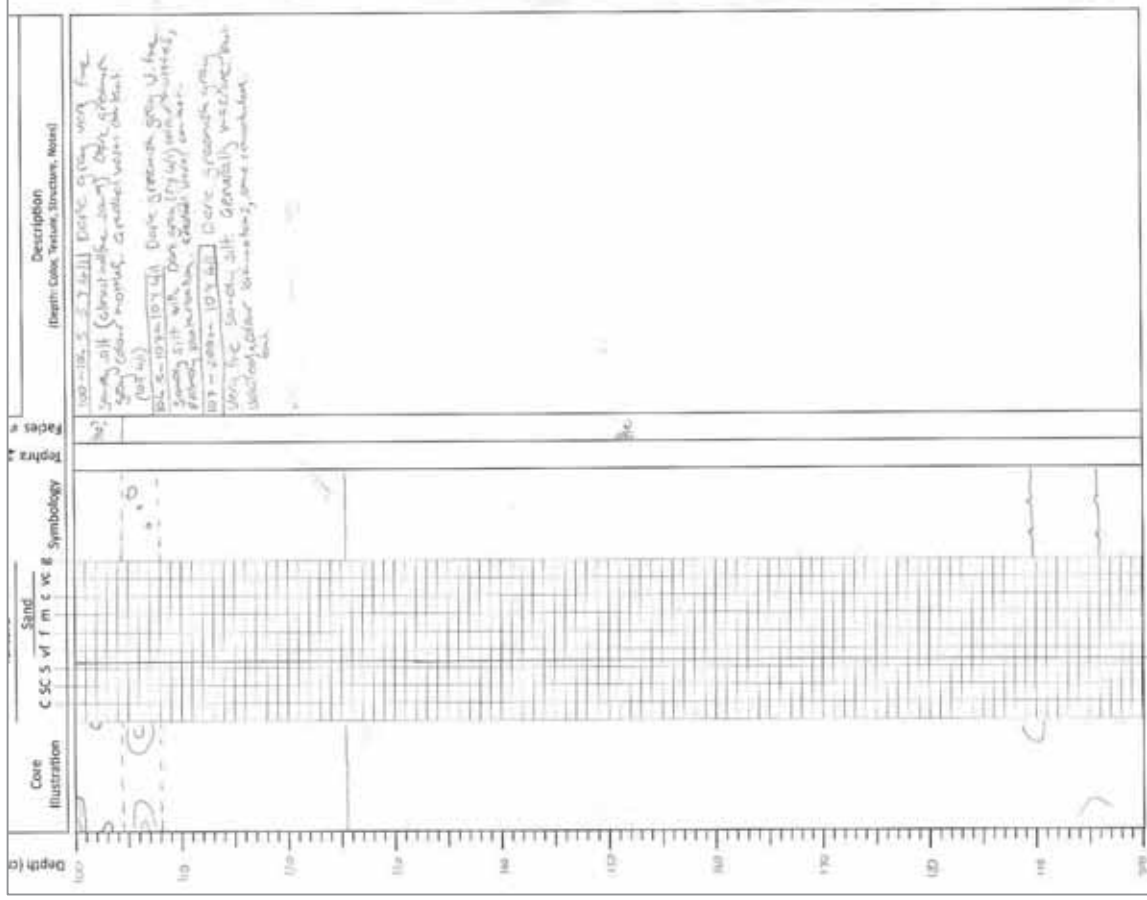
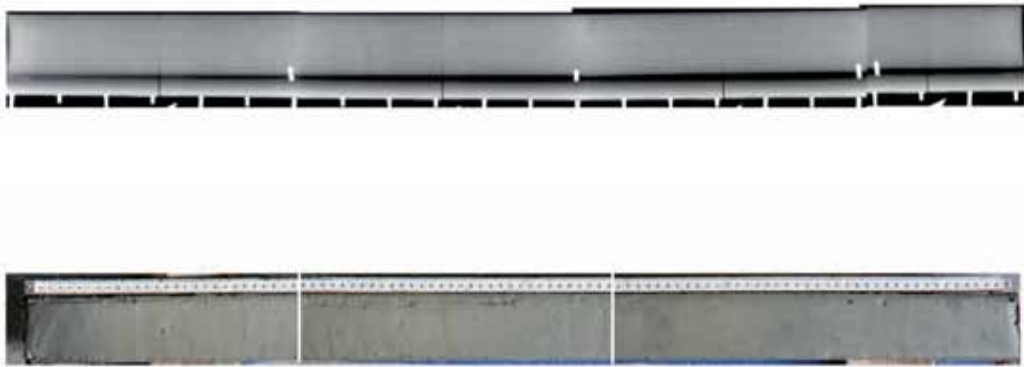
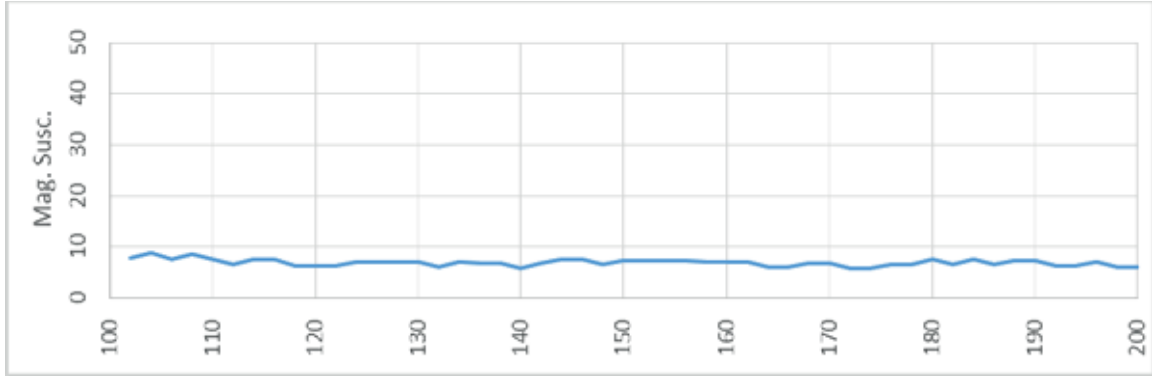


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Puke 9

Other ID TAN1613-16

Section 2 of 5

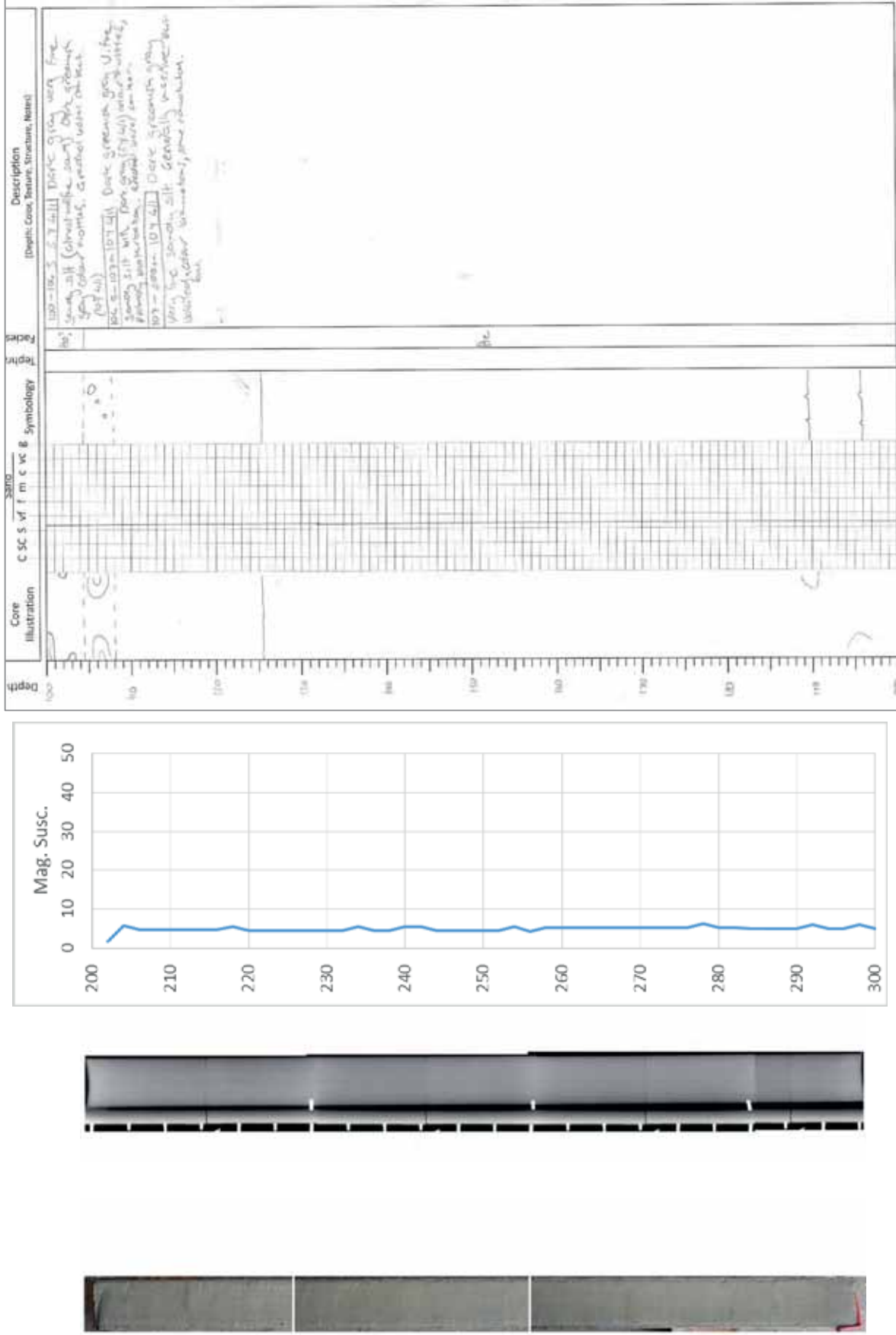


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Puke 9

Other ID TAN1613-16

Section 3 of 5

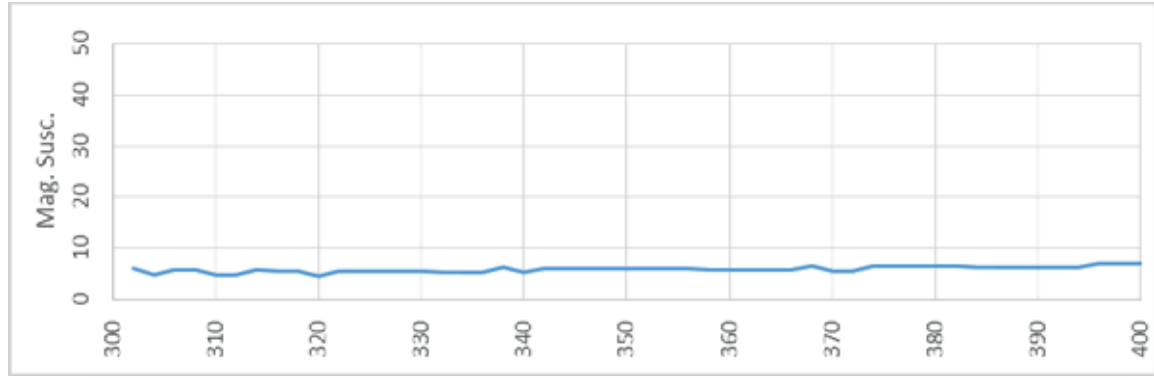
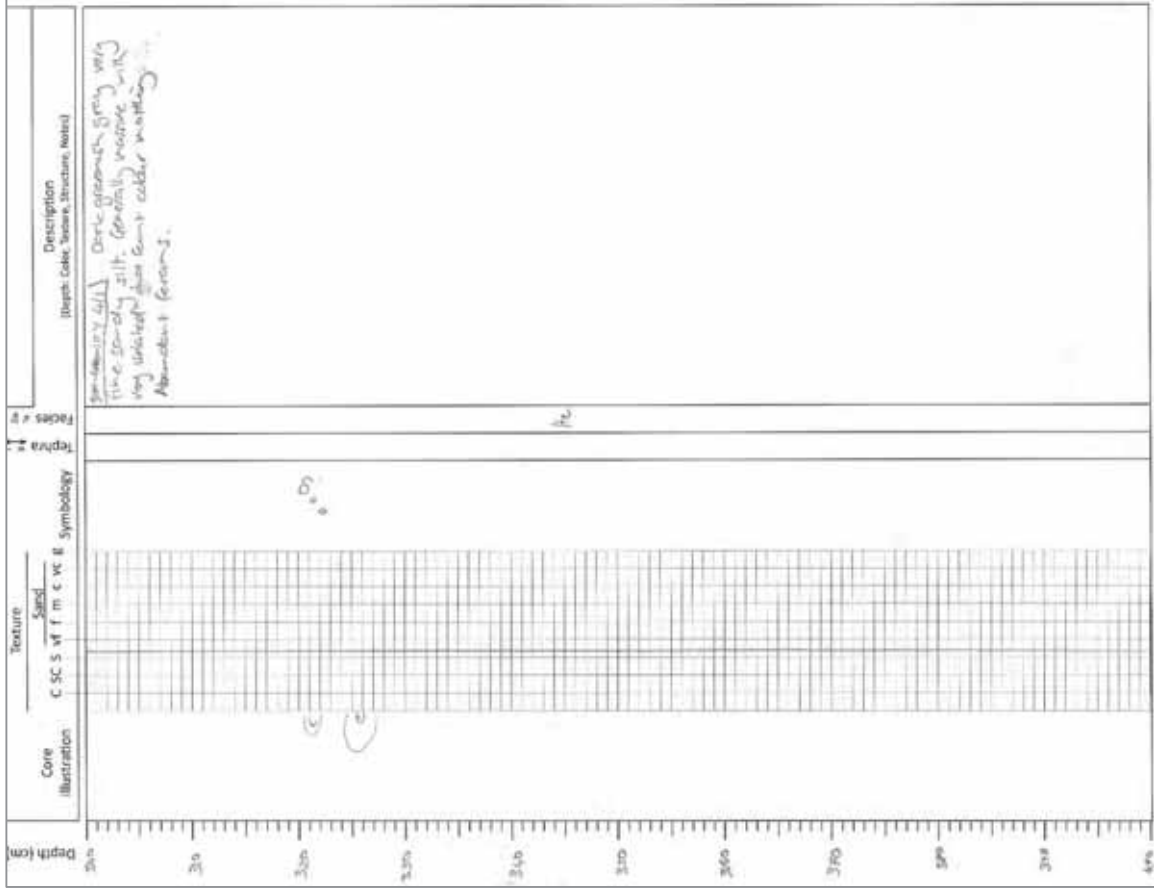


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Puke 9

Other ID TAN1613-16

Section 4 of 5

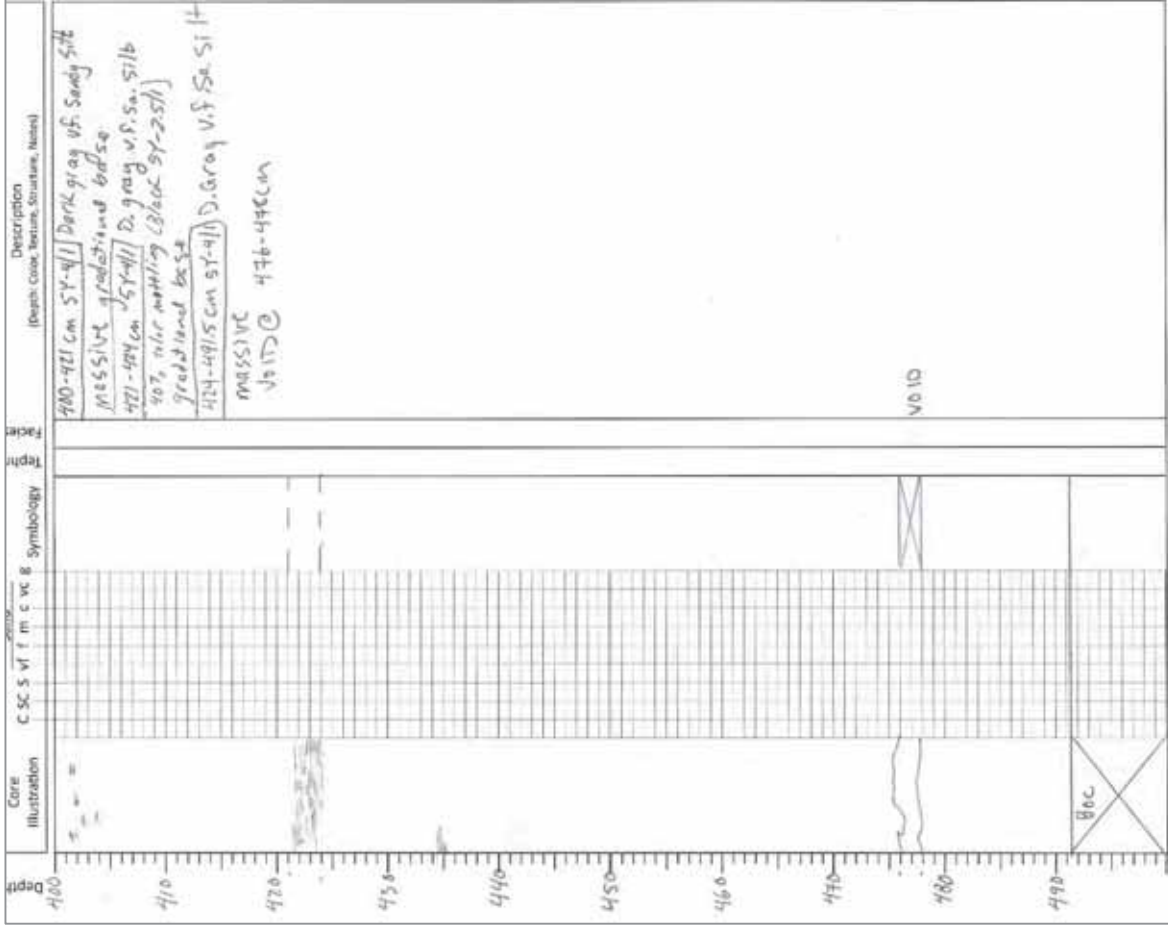
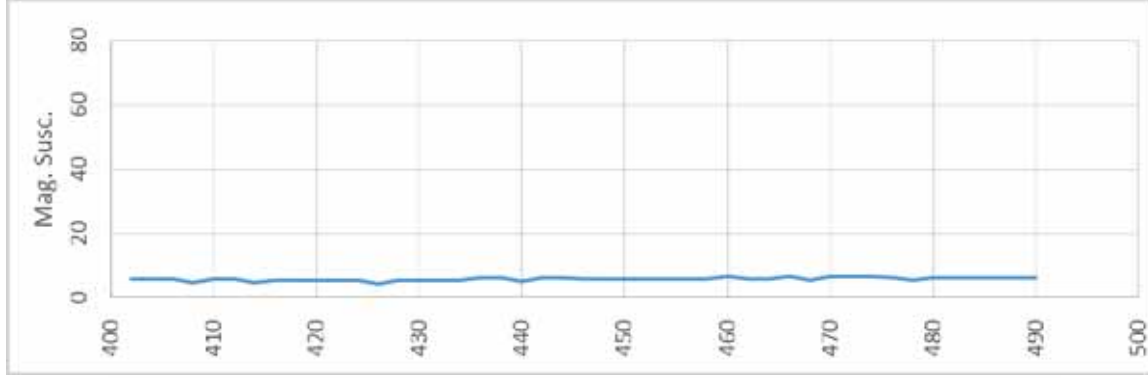


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Puke 9

Other ID TAN1613-16

Section 5 of 5



TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: **TAN1613-18**

Latitude: -41.33673

Date/Time (NZST): 12/11/2016 21:40

Other ID: Puke 2 (repeat)

Longitude: 176.82773

Depth (m): **1754**

Sample Description

General Description

Small perched basin atop Nthn Pukeroro Ridge

Hemipelagic mud with possible turbidite and multiple sand blebs in lower section

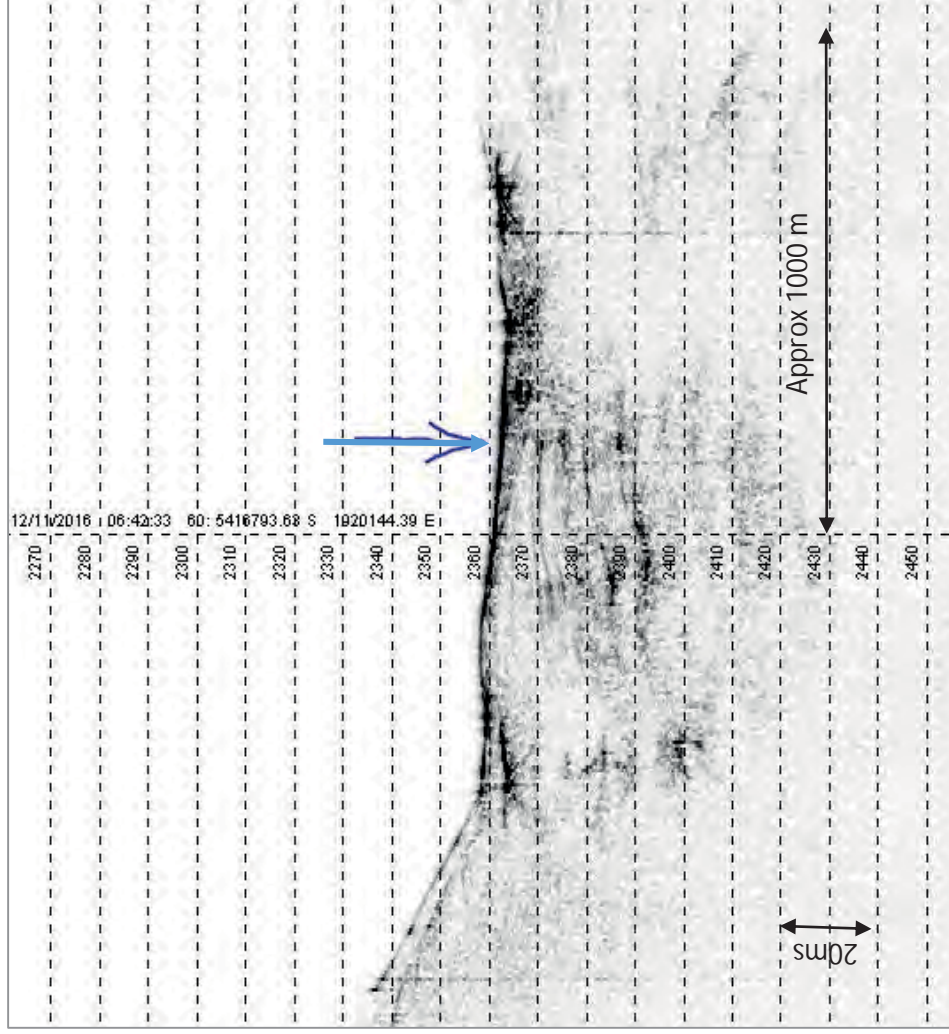
Gear type	Piston core
Barrel Length (m)	6 Bent barrel
Penetration (m)	Catcher/Cutter bags
Core length (m)	1.15 Samples
Sections	2 Tephra
Fauna	

Sample processing – core ID:

Section	Top depth (cm)	Btm depth (cm)	Logged	Phys Props	Summary
1	0	60	Y	Y	
2	60	115	Y	Y	

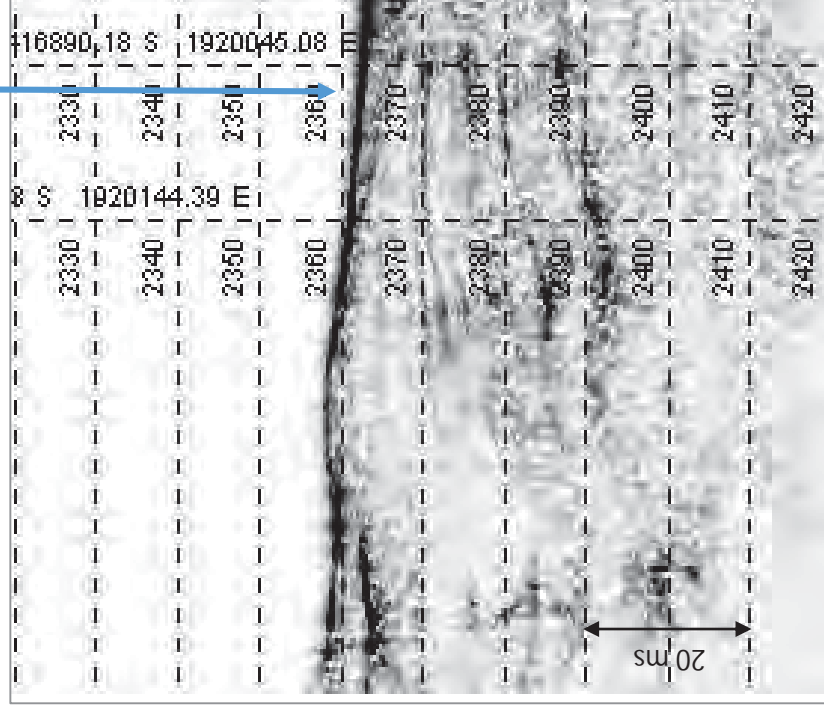
TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Puke 2 (repeat)	Other ID TAN1613-18	Water Depth 1754 m
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2km Topas line over the station. The blue arrow marks the planned core site.

Planned core site



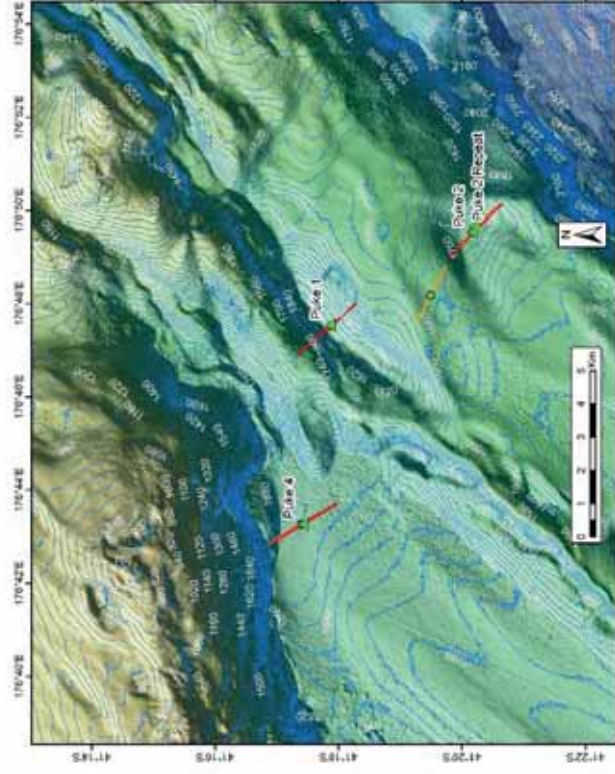
Zoom into 2km survey lines over planned core site.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

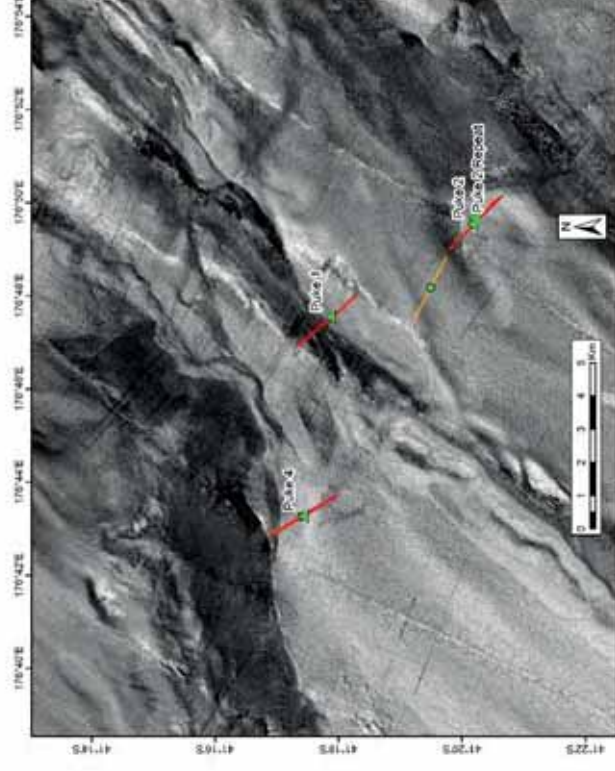
Core ID: Puke 2 (repeat)

Other ID TAN1613-18

Water Depth 1754 m



Bathymetry at and around Puke2 and Puke2 Repeat core sites in a small perched basin atop Northern Pukekoe Ridge. Light blue lines are 20 m depth contours. Red lines show the 2 km TOPAS survey lines over the stations, green triangles indicate the actual core sites.



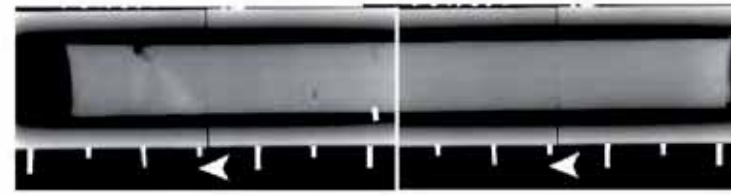
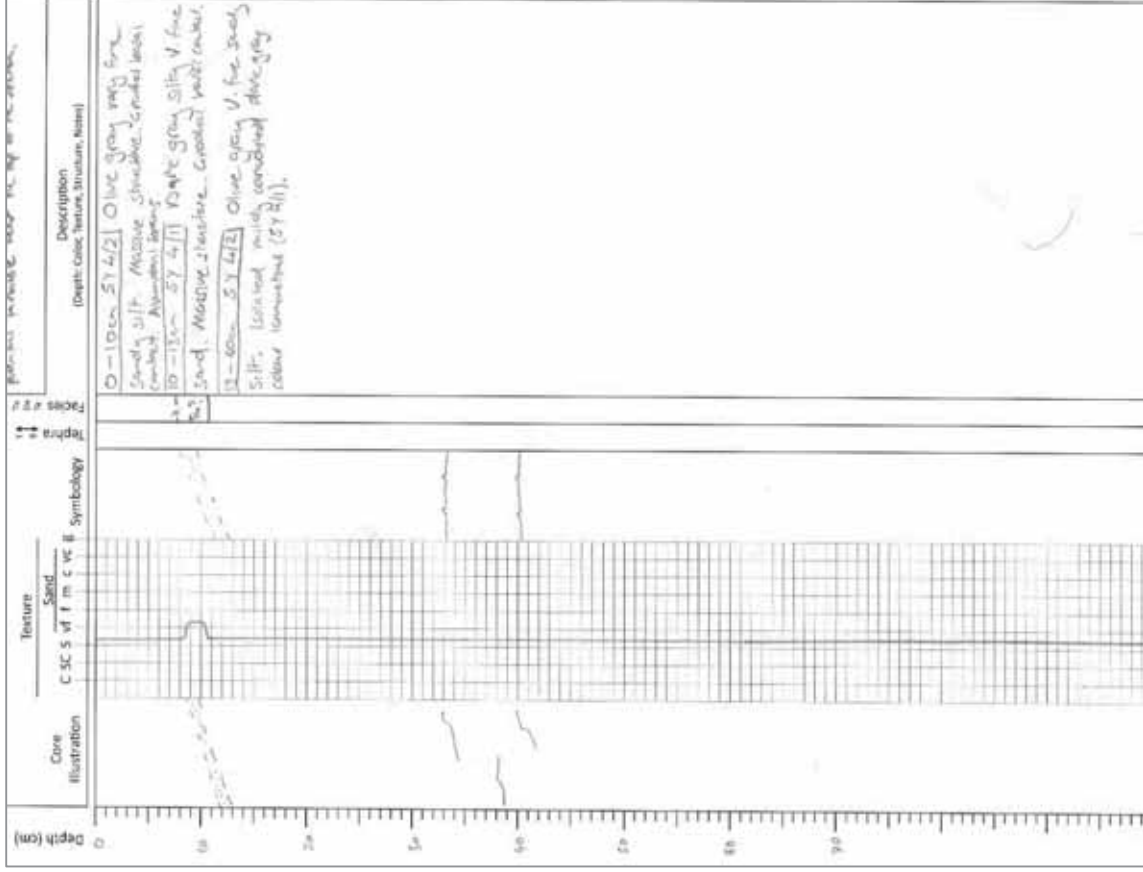
Backscatter at and around Puke2 and Puke2 Repeat core sites in a small perched basin atop Northern Pukekoe Ridge. Light blue lines are 20 m depth contours. Red lines show the 2 km TOPAS survey lines over the stations, green triangles indicate the actual core sites.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Puke 2 (repeat)

Other ID TAN1613-18

Section 1 of 2

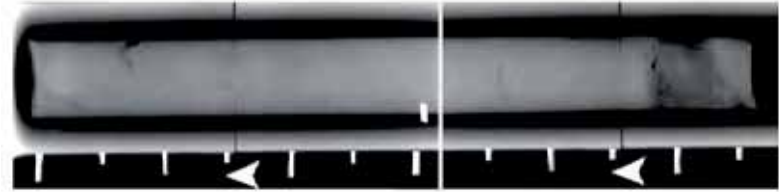
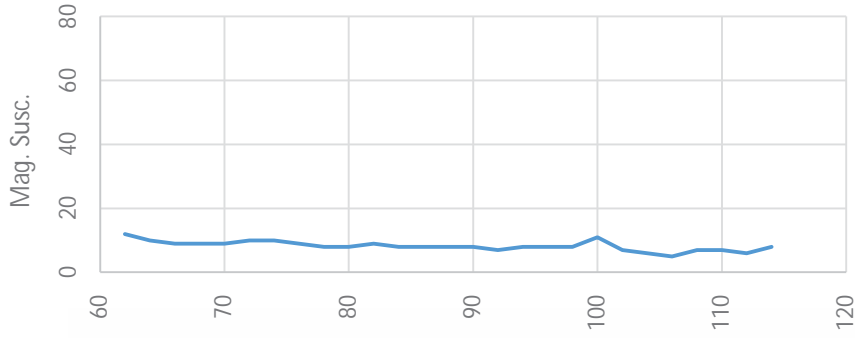
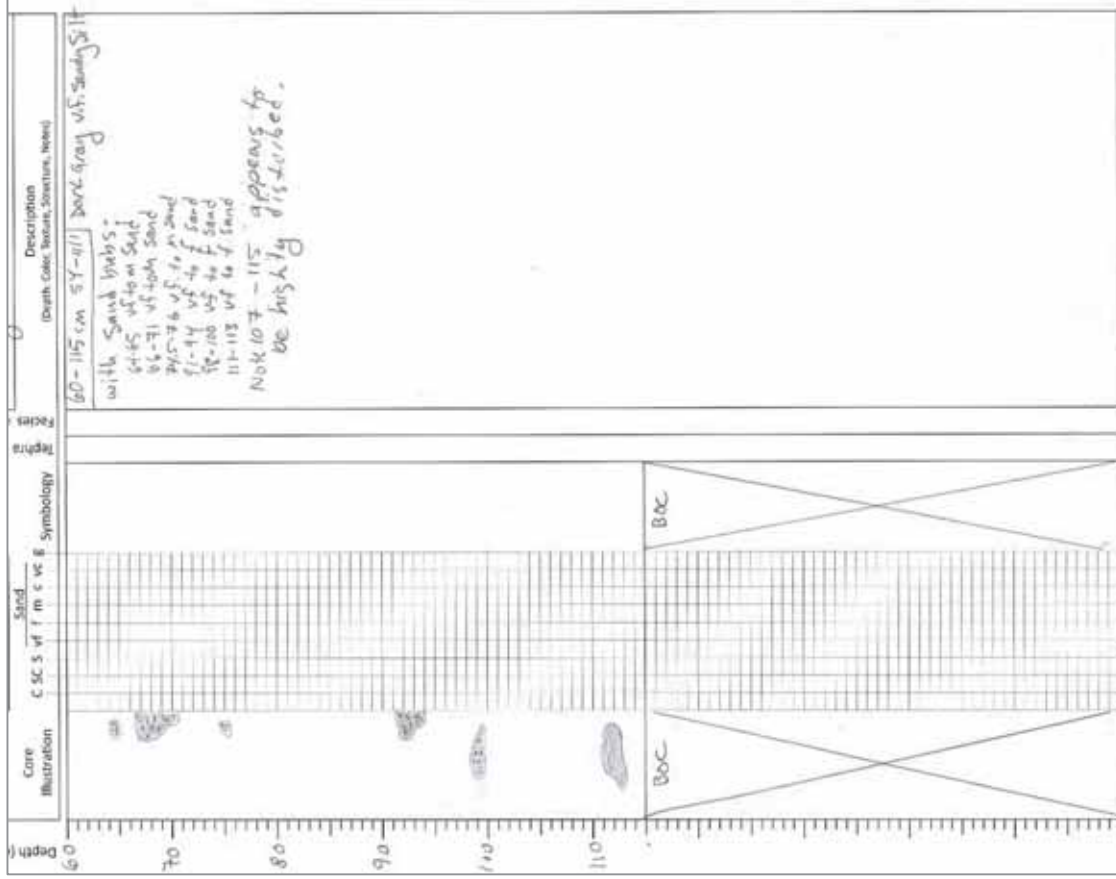


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Puke 2 (repeat)

Other ID TAN1613-18

Section 2 of 2



TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: **Puke 1**

Latitude: -41.29767

Date/Time (NZST): 13/11/2016 00:43

Other ID: TAN1613-19

Longitude: 176.79233

Depth (m): **1839**

Sample Description

General Description

Small perched basin atop Nthn Pukeroro Ridge

Thin and thick bedded turbidites interbedded with hemipelagite. This reddish grey tephra at 71cm.

Gear type	Piston core
Barrel Length (m)	Bent barrel
Penetration (m)	Catcher/Cutter bags
Core length (m)	1.52
Sections	2
Fauna	Tephra

Sample processing – core ID:

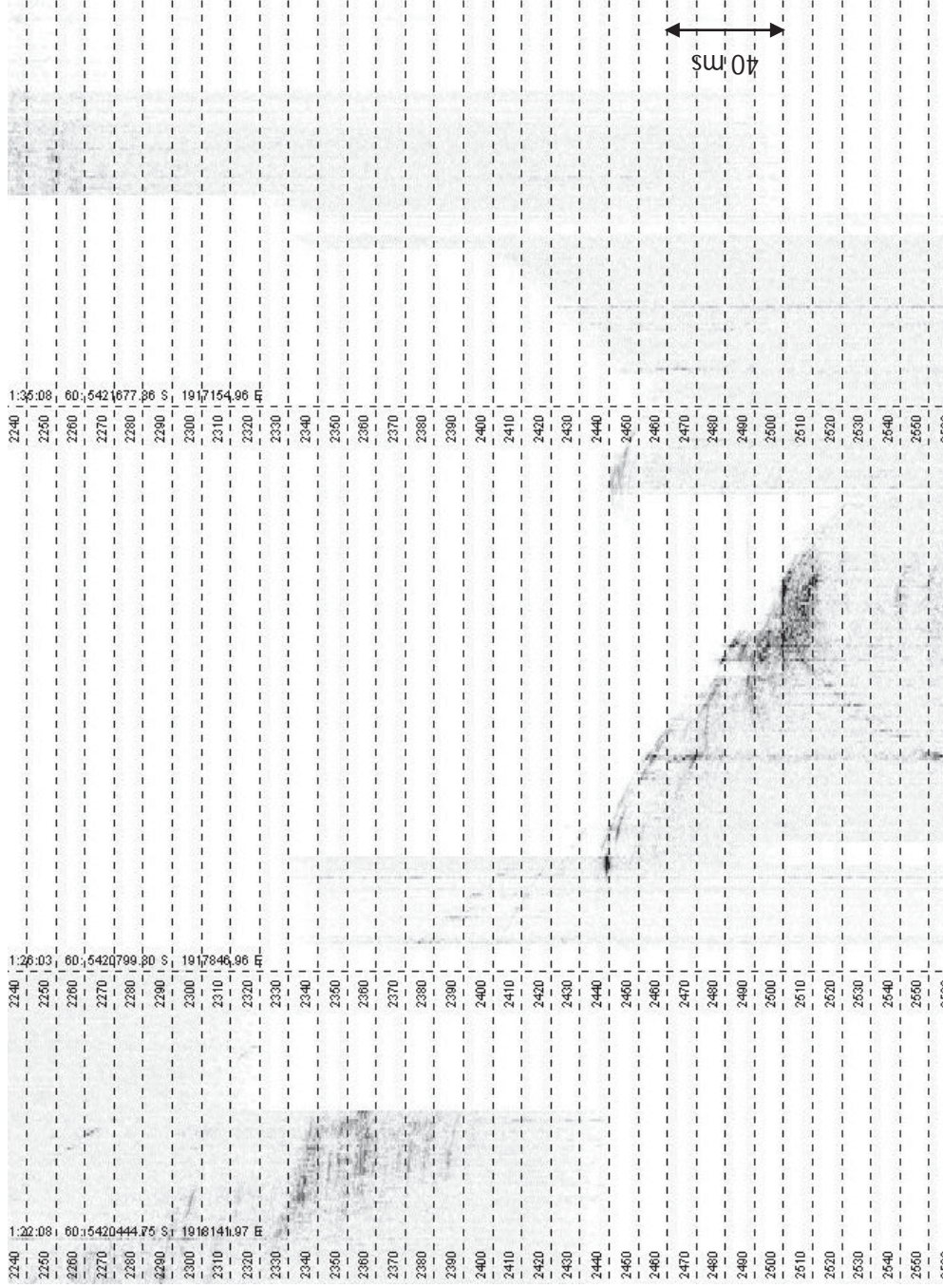
Section	Top depth (cm)	Btm depth (cm)	Logged	Phys Props	Summary
1	0	100	Y	Y	.
2	100	152	Y	Y	.
.
.
.
.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Puke 1

Other ID TAN1613-19

Water Depth 1839 m



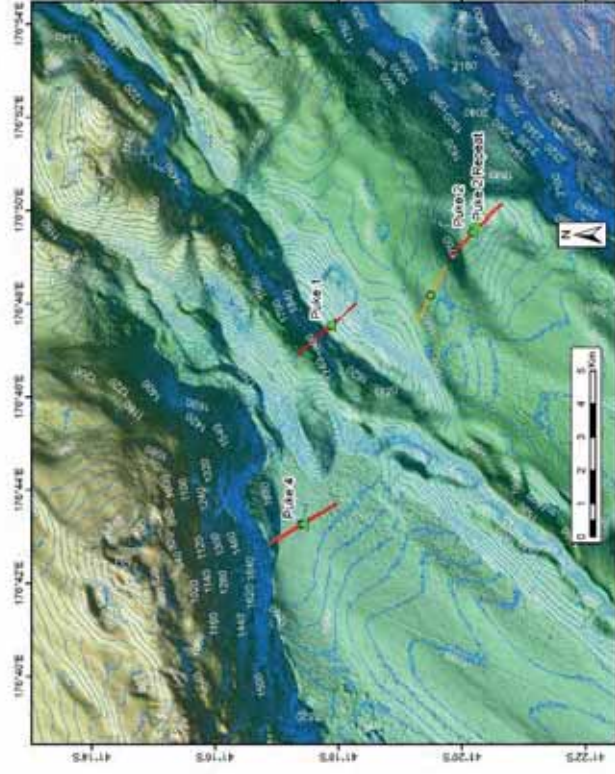
Topas line over the station..

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

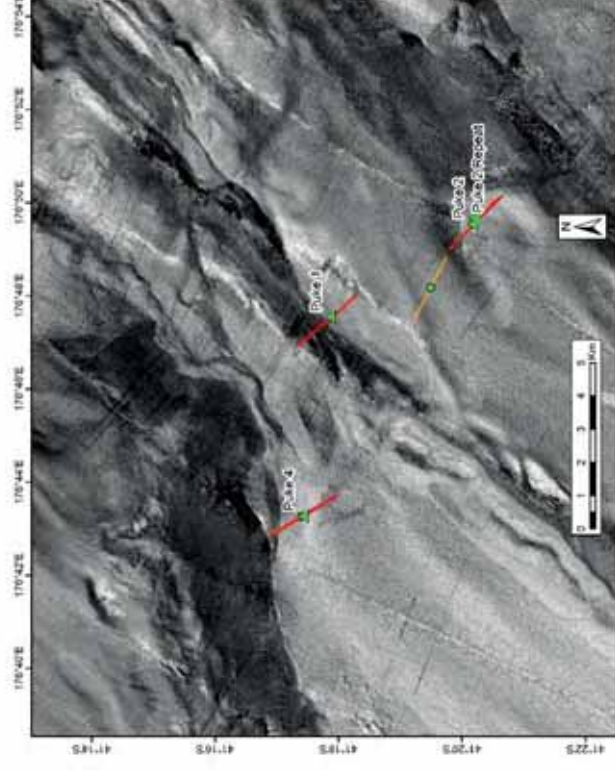
Core ID: Puke 1

Other ID TAN1613-19

Water Depth 1839 m



Bathymetry at and around Puke1 core site in a small perched basin atop Northern Pukeroro Ridge. Light blue lines are 20 m depth contours. Red lines show the 2 km TOPAS survey lines over the stations, green triangles indicate the actual core site.



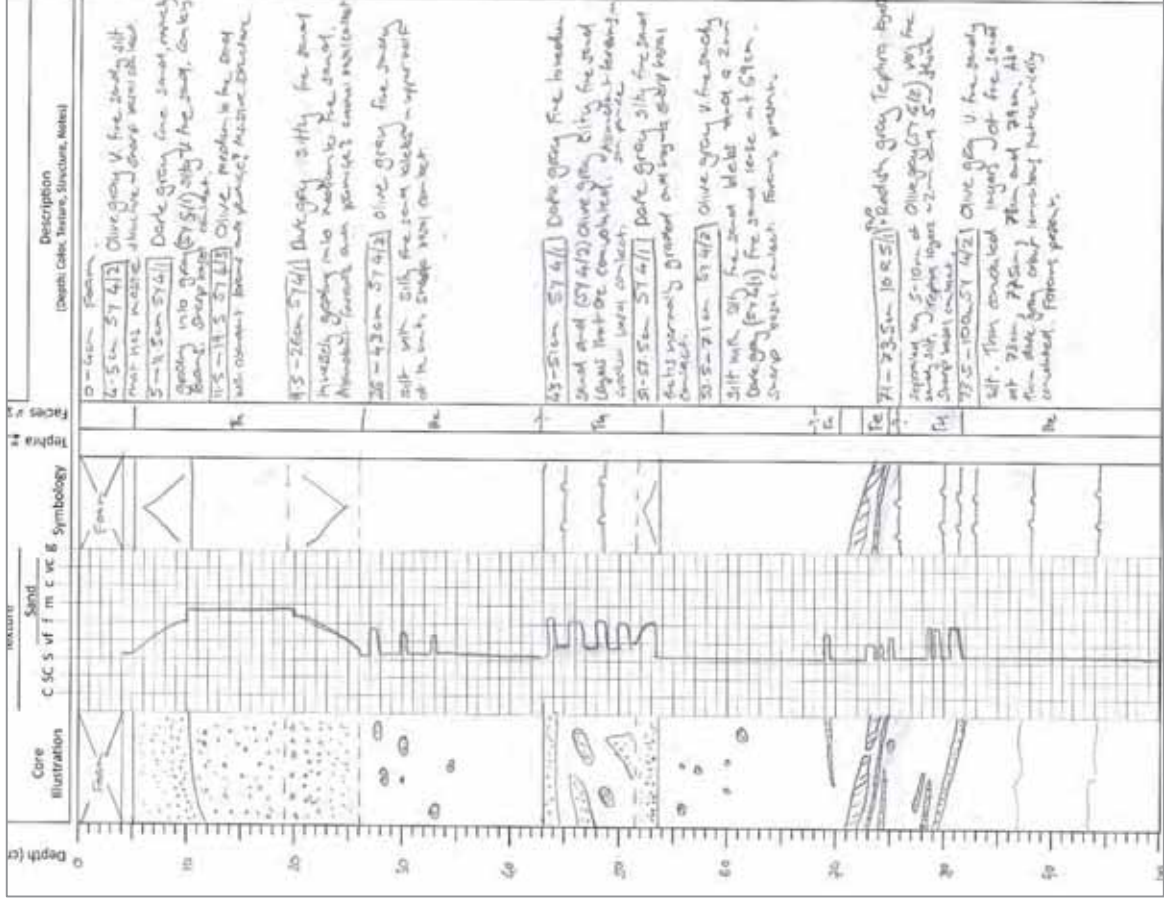
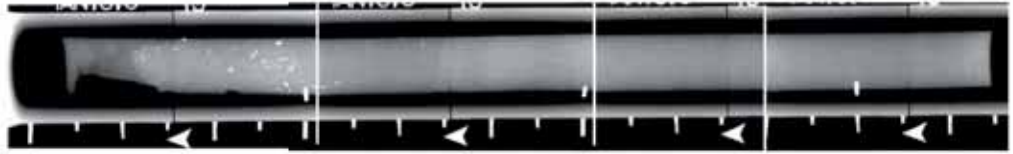
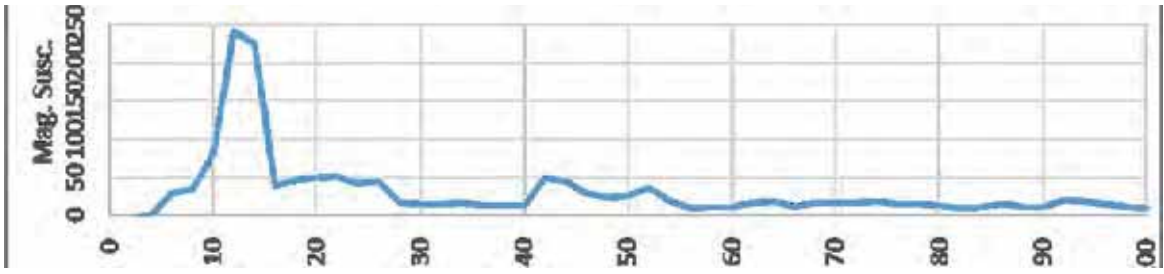
Backscatter at and around Puke1 core site in a small perched basin atop Northern Pukeroro Ridge. Light blue lines are 20 m depth contours. Red lines show the 2 km TOPAS survey lines over the stations, green triangles indicate the actual core site.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Puke 1

Other ID TAN1613-19

Section 1 of 2

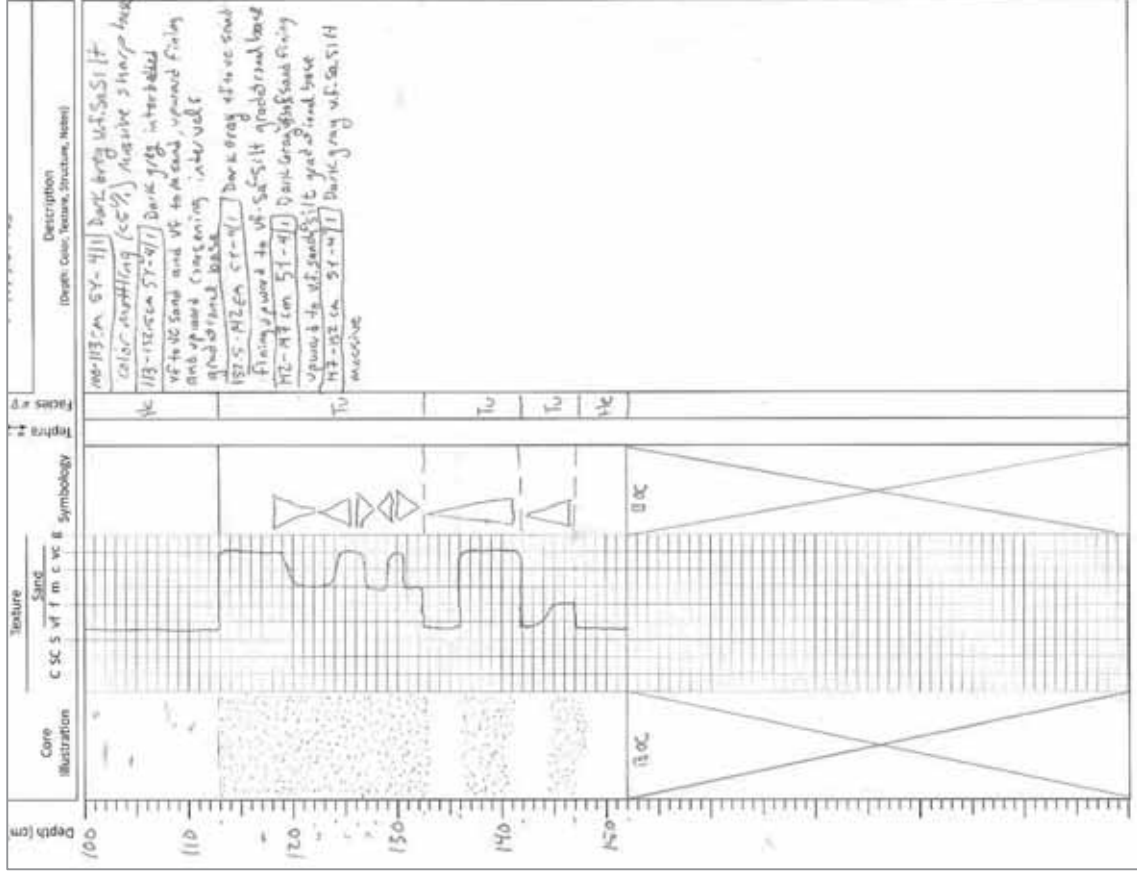
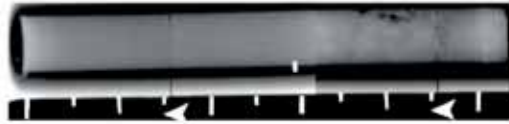


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Puke 1

Other ID TAN1613-19

Section 2 of 2



TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: **Puke 4** Latitude: -41.29030 Date/Time (NZST): 13/11/2016 03:17

Other ID: TAN1613-20 Longitude: 176.72107 Depth (m): **1829**

Sample Description	Gear type	Piston core
General Description Northern end of Pukeroro Trough, under slope below Uruti Ridge Mainly hemipelagic mud with rare turbidites	Barrel Length (m)	6 Bent barrel
	Penetration (m)	Catcher/Cutter bags
	Core length (m)	4.35 Samples
	Sections	5 Tephra
	Fauna	Pull-out
		2.8t

Sample processing – core ID:

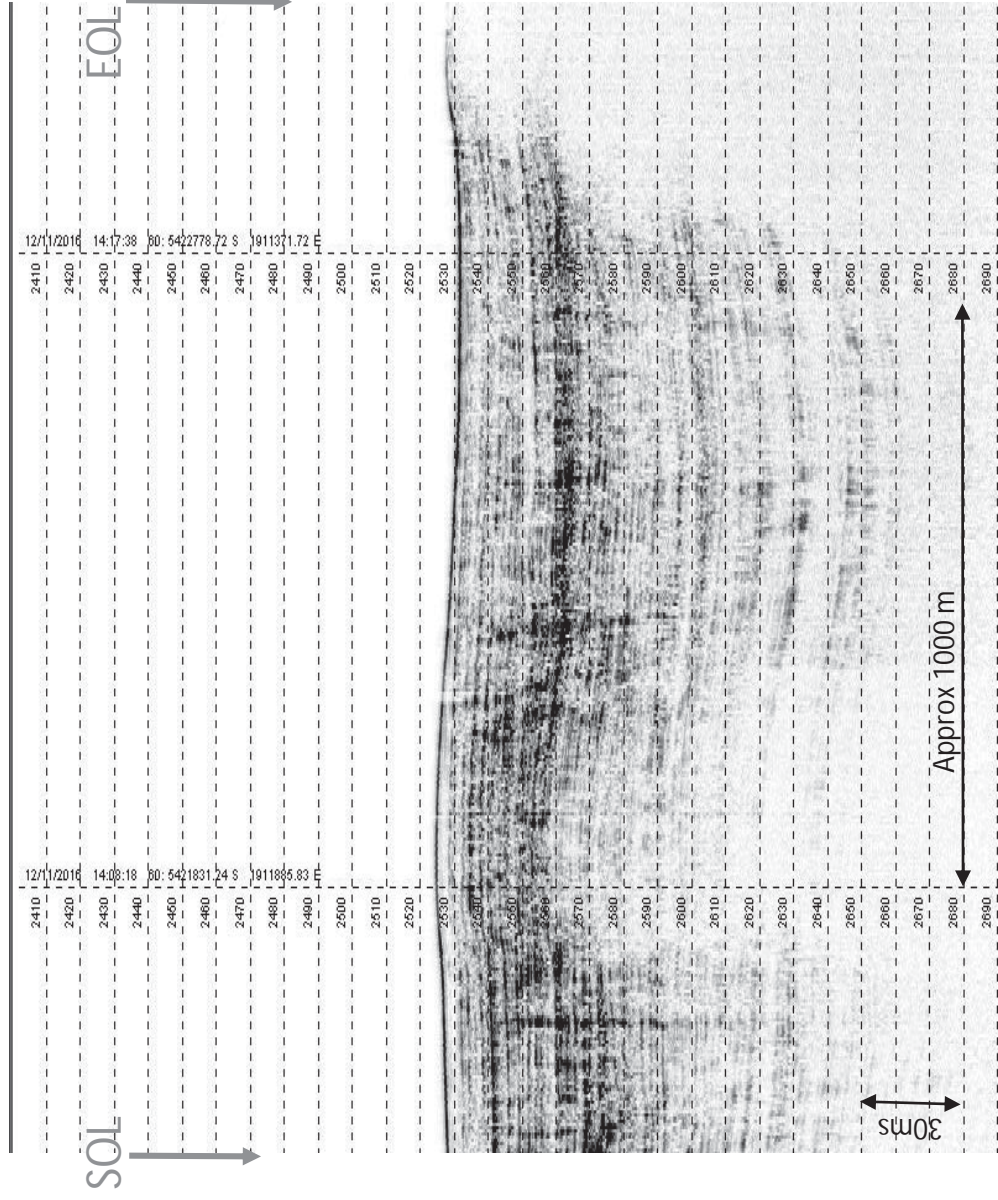
Section	Top depth (cm)	Btm depth (cm)	Logged	Phys Props	Summary
1	0	100	Y	Y	.
2	100	200	Y	Y	.
3	200	300	Y	Y	.
4	300	400	Y	Y	.
5	400	435	Y	Y	.
.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Puke 4

Other ID TAN1613-20

Water Depth 1829 m



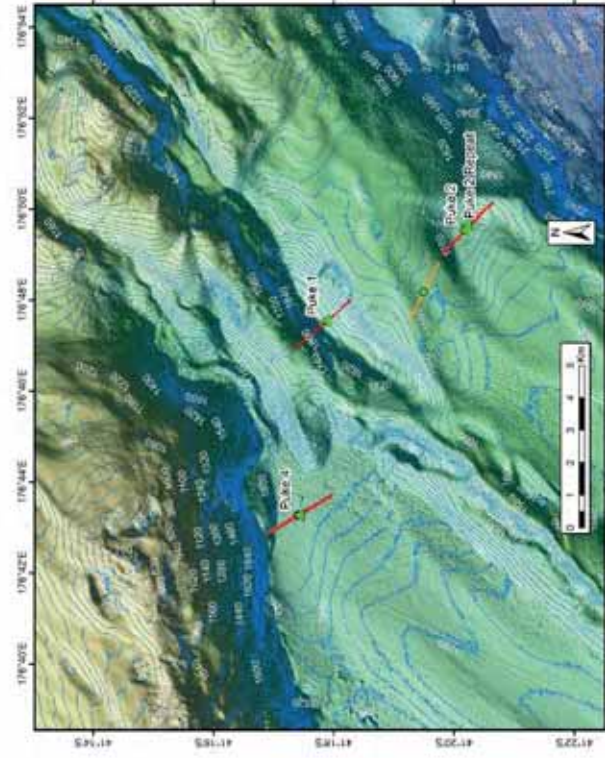
Topas line over the station. Grey arrows indicate start and end of the 2km survey line over the station, the planned core site is not marked, but lies approximately midway.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

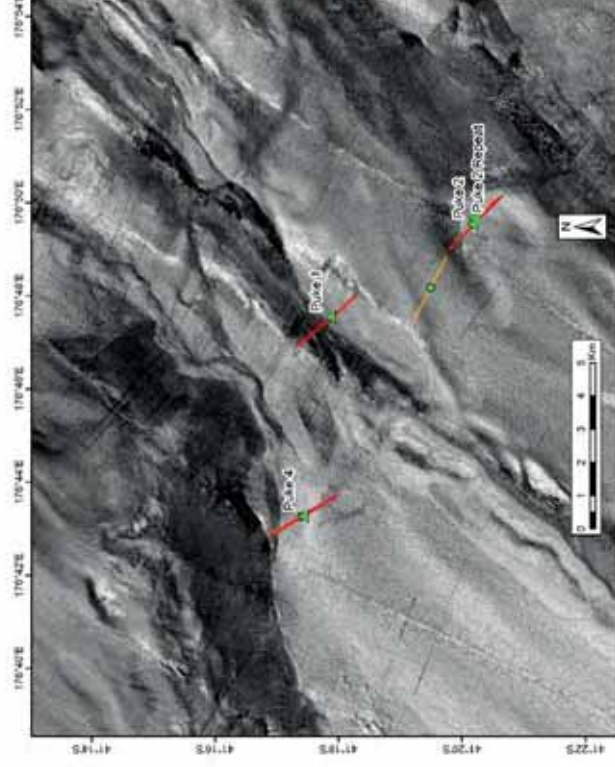
Core ID: Puke 4

Other ID TAN1613-20

Water Depth 1829 m



Bathymetry at and around Puke4 core site at the Northern end of Pukeroro Trough, under slope below Uruti Ridge. Light blue lines are 20 m depth contours. Red lines show the 2 km TOPAS survey lines over the stations, green triangles indicate the actual core site. Orange lines and green circle marks a station not yet done.



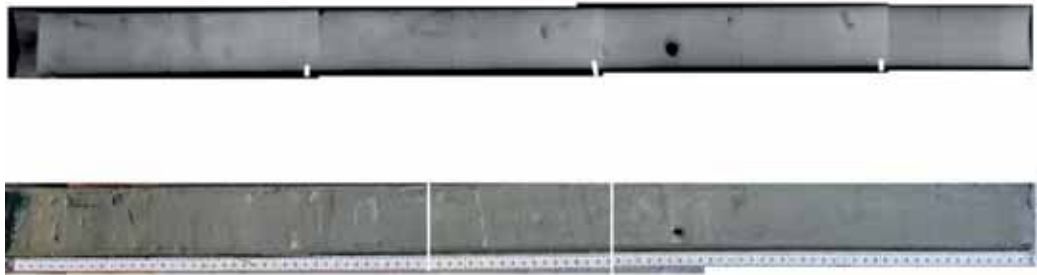
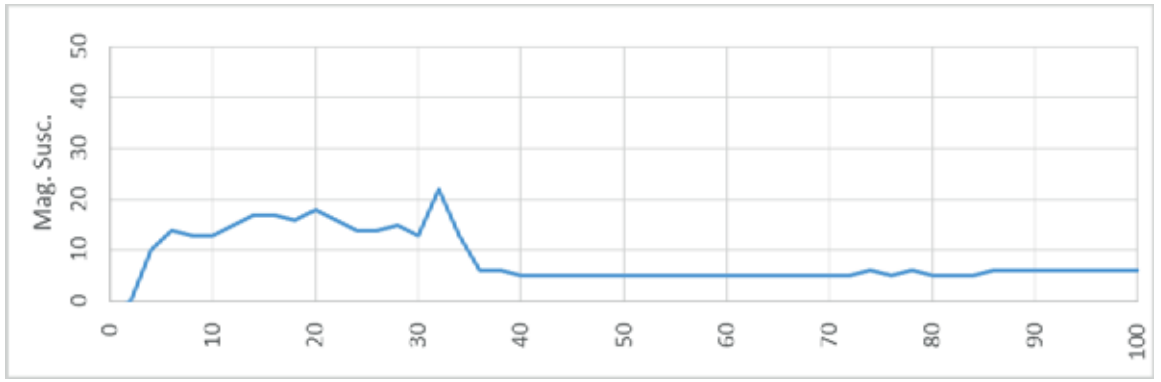
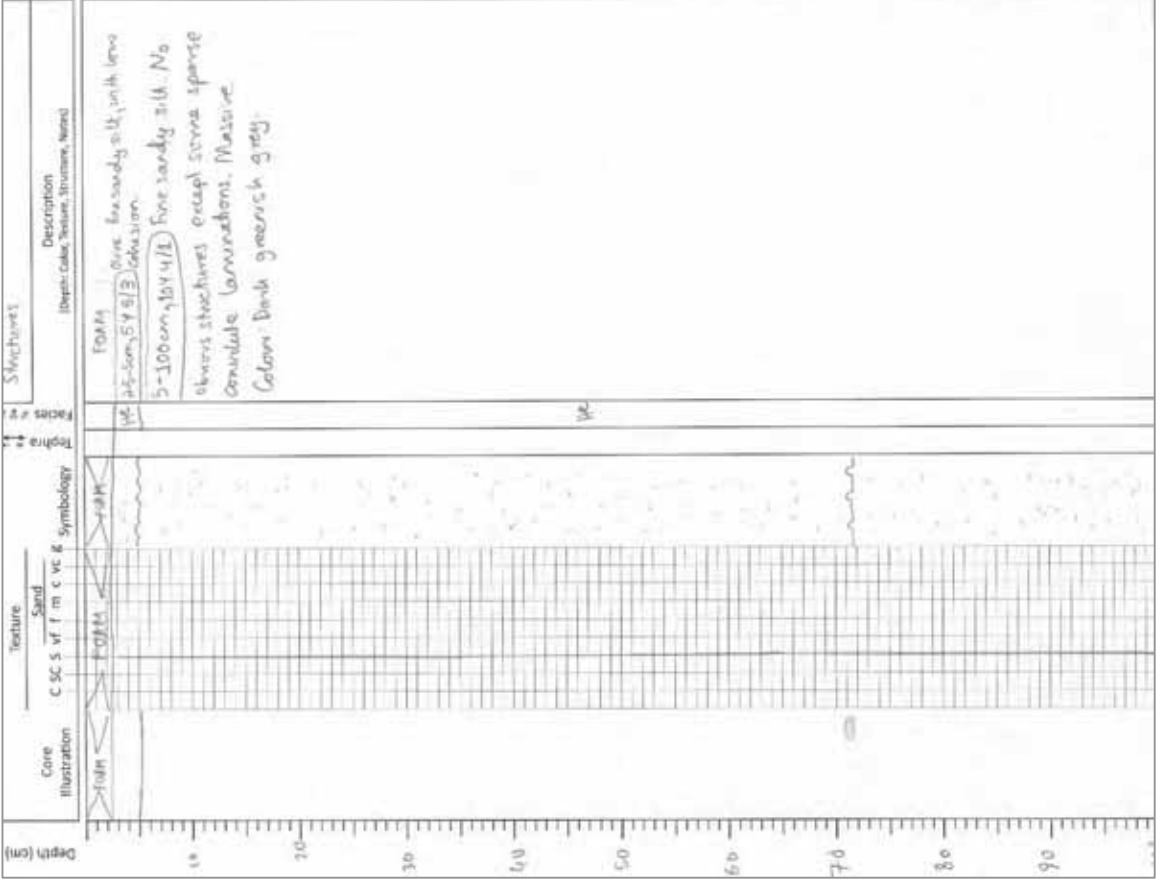
Backscatter at and around Puke4 core site at the Northern end of Pukeroro Trough, under slope below Uruti Ridge. Light blue lines are 20 m depth contours. Red lines show the 2 km TOPAS survey lines over the stations, green triangles indicate the actual core site. Orange line and green circle marks a station not yet done.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Puke 4

Other ID TAN1613-20

Section 1 of 5

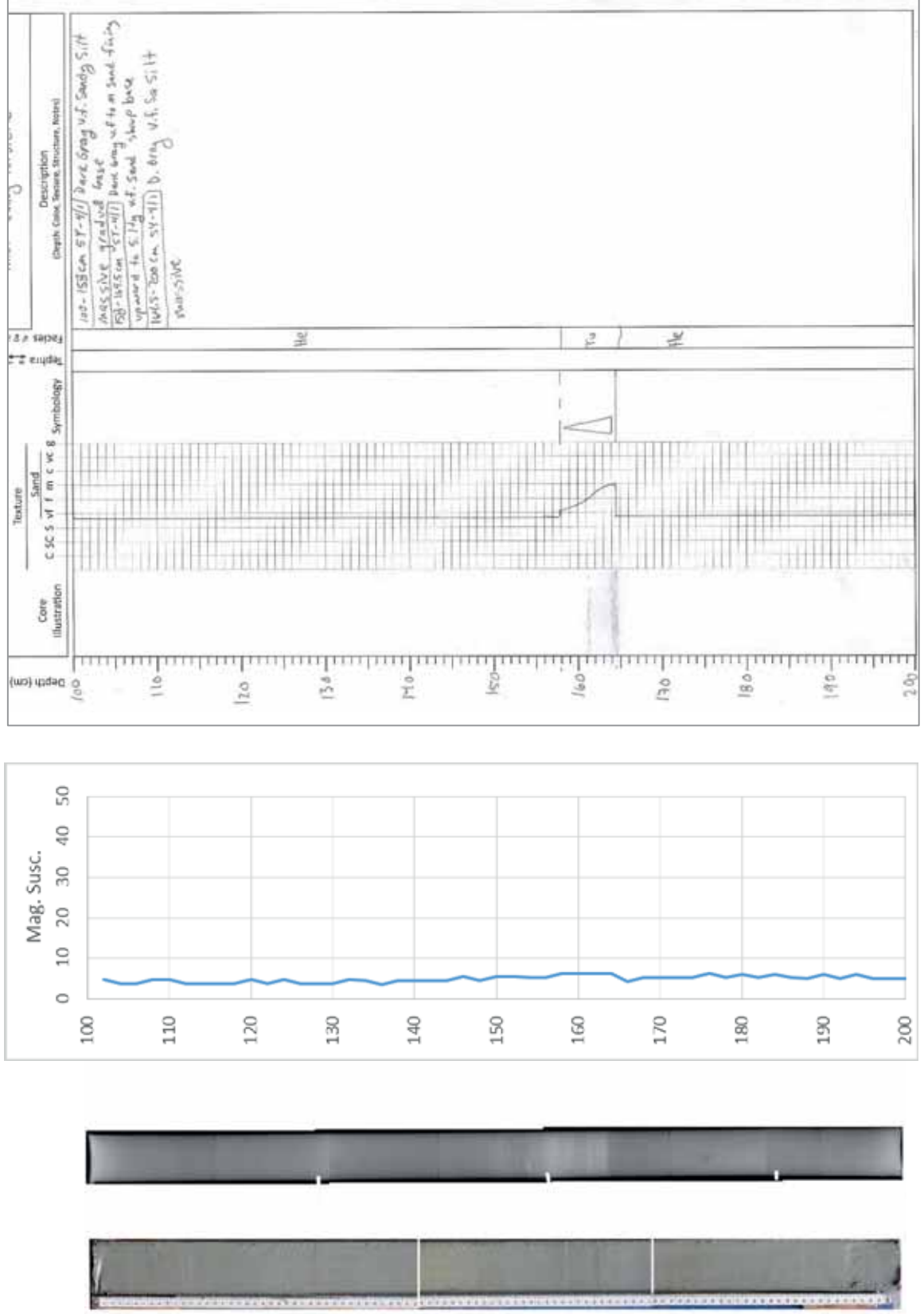


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Puke 4

Other ID TAN1613-20

Section 2 of 5

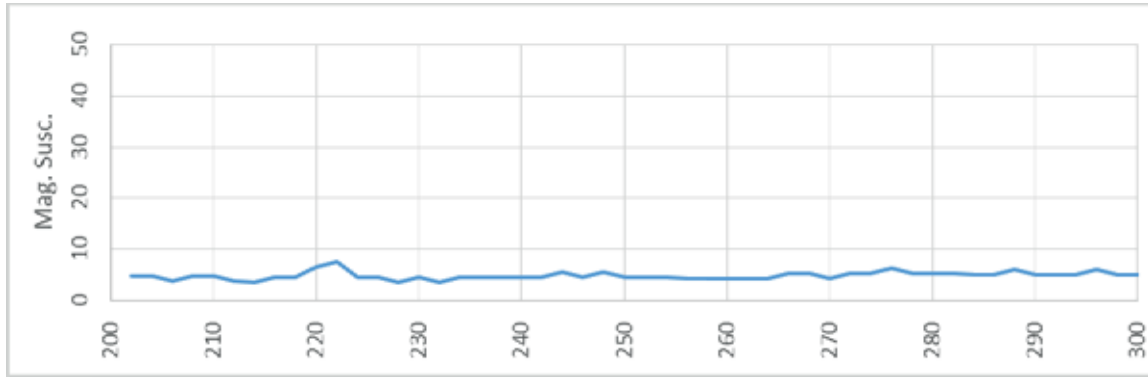
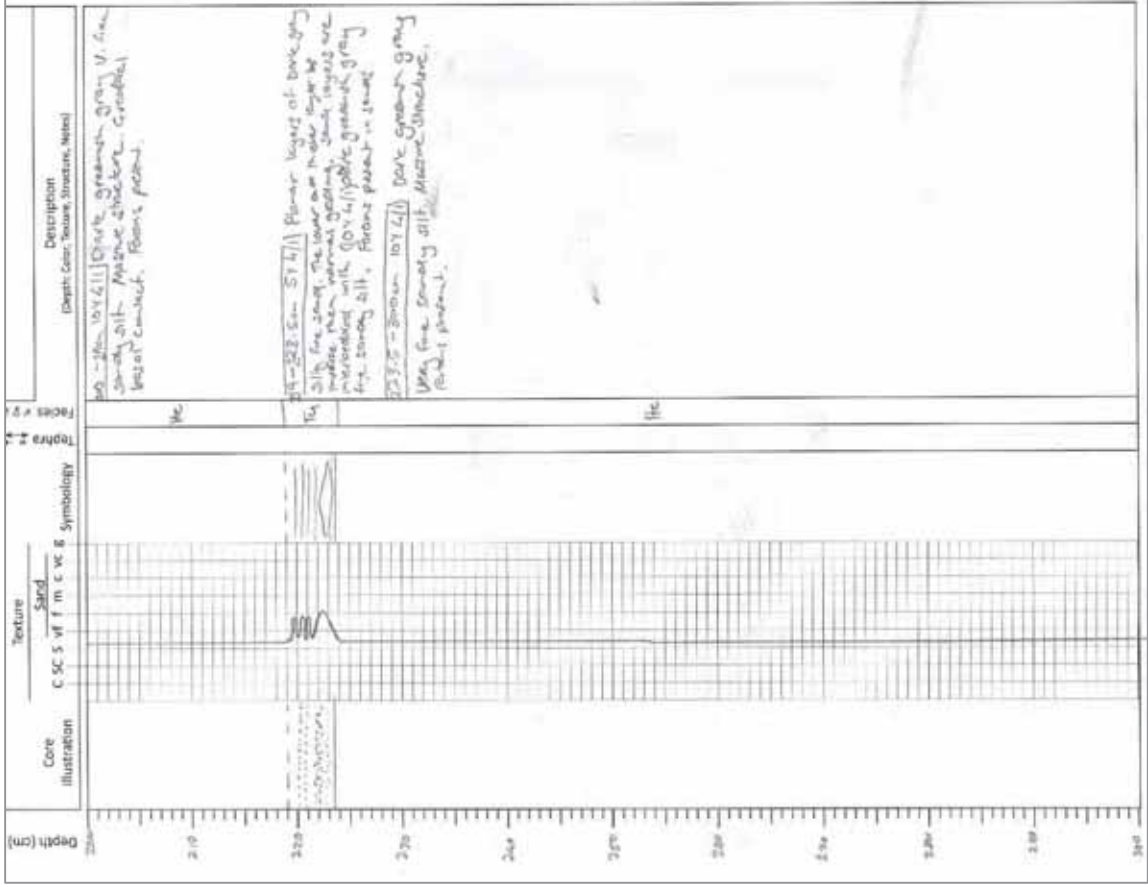


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Puke 4

Other ID TAN1613-20

Section 3 of 5

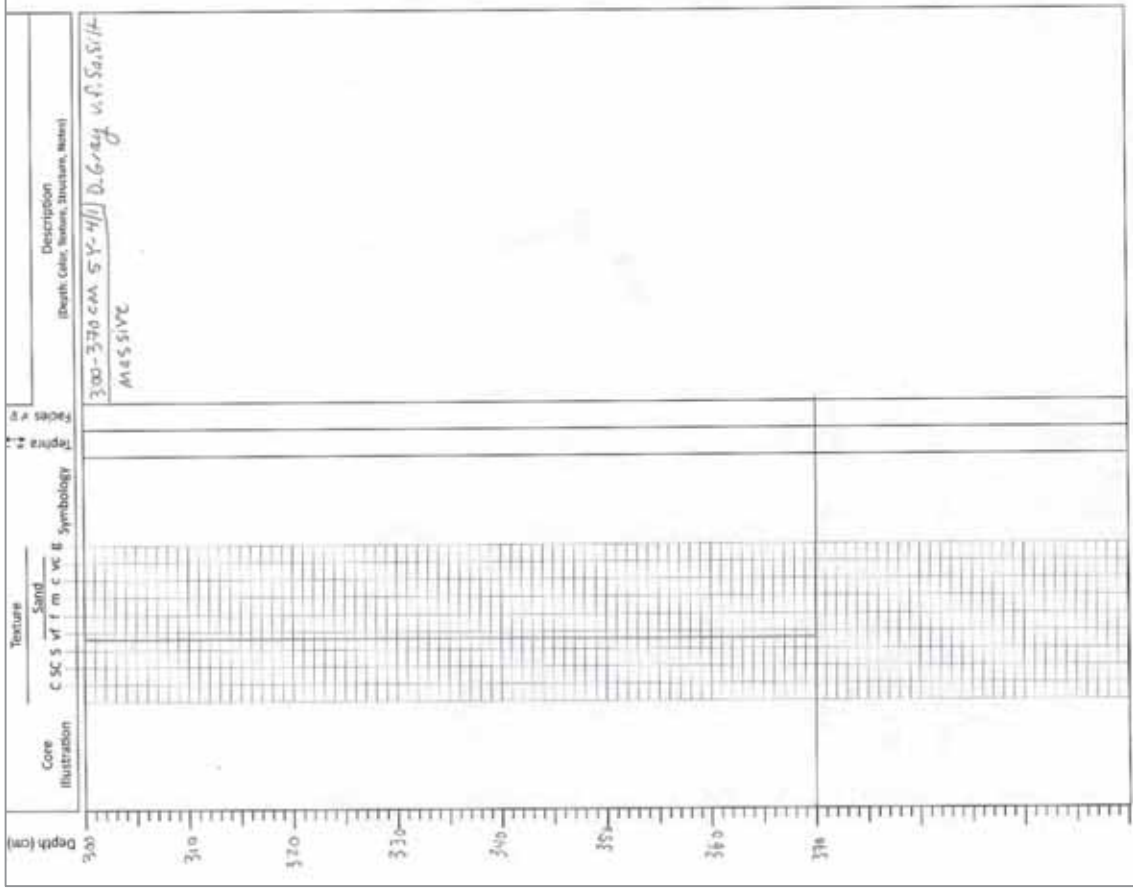
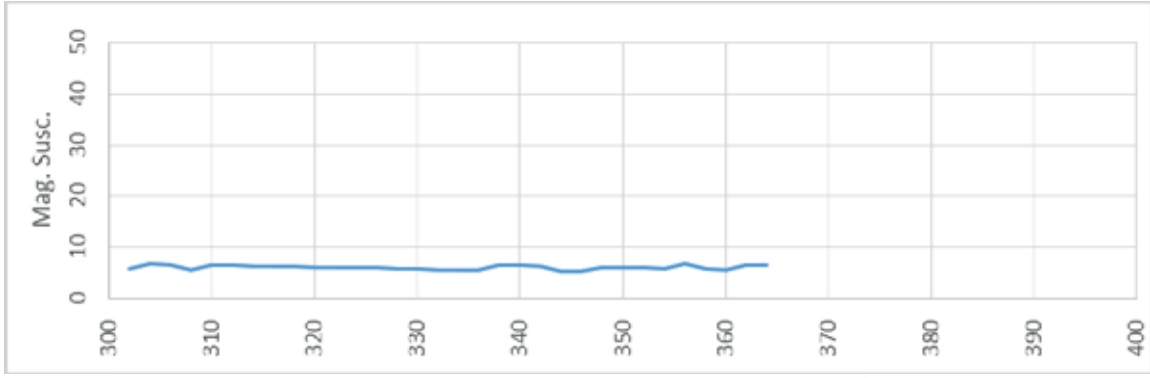


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Puke 4

Other ID TAN1613-20

Section 4 of 5

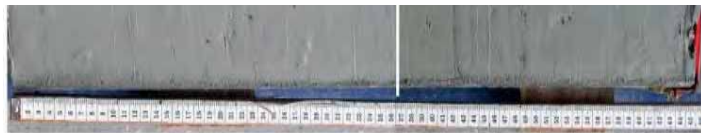
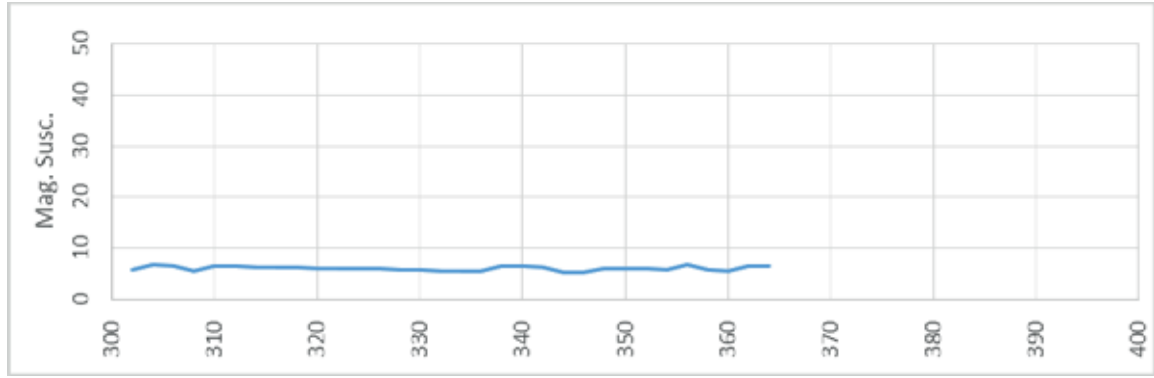
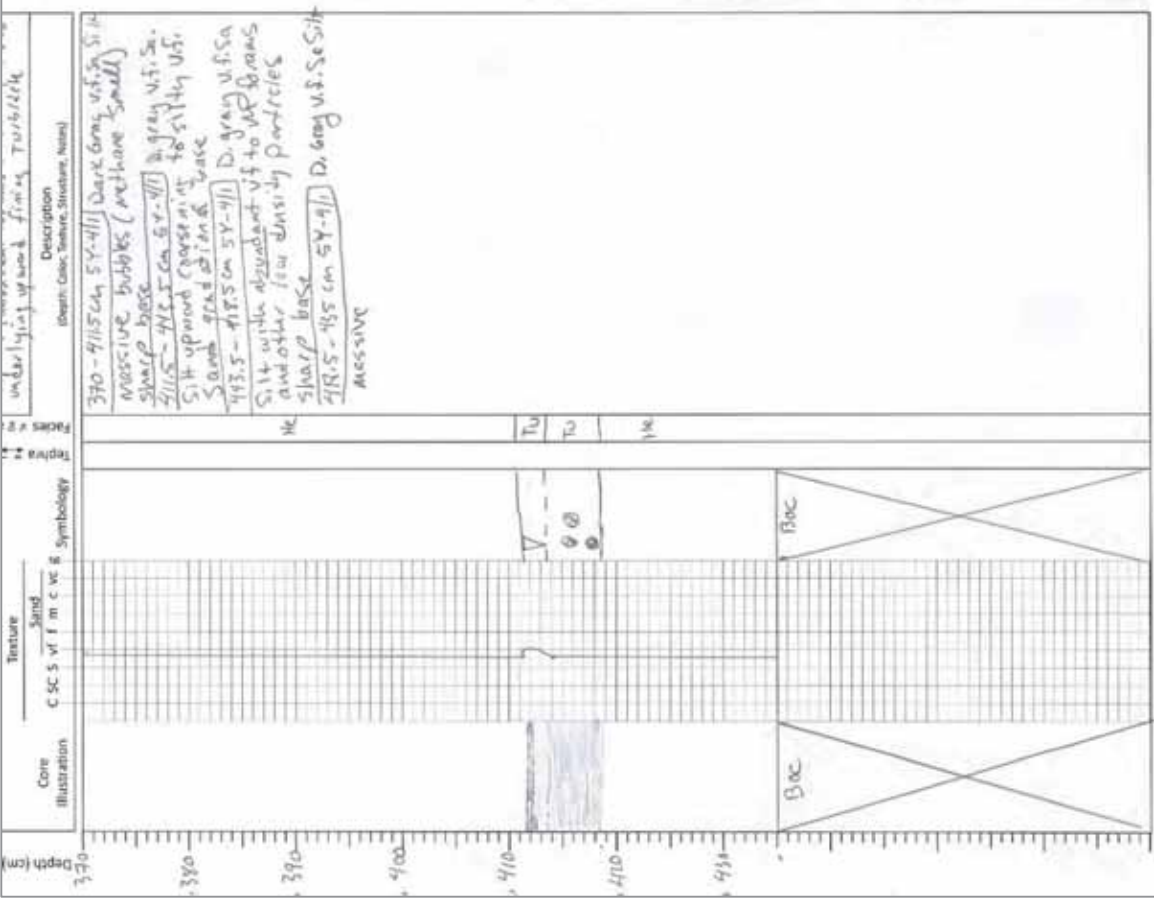


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Puke 4

Other ID TAN1613-20

Section 5 of 5



TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: **Uruti 2**

Latitude: -41.07508

Date/Time (NZST): 13/11/2016 06:52

Other ID: TAN1613-21

Longitude: 176.79460

Depth (m): **1507**

Sample Description

General Description

Lower channel draining northern Uruti Basin

Hemipelagic mud

Gear type	Piston core
Barrel Length (m)	6 Bent barrel
Penetration (m)	Catcher/Cutter bags
Core length (m)	4.58 Samples
Sections	5 Tephra
Fauna	n

Sample processing – core ID:

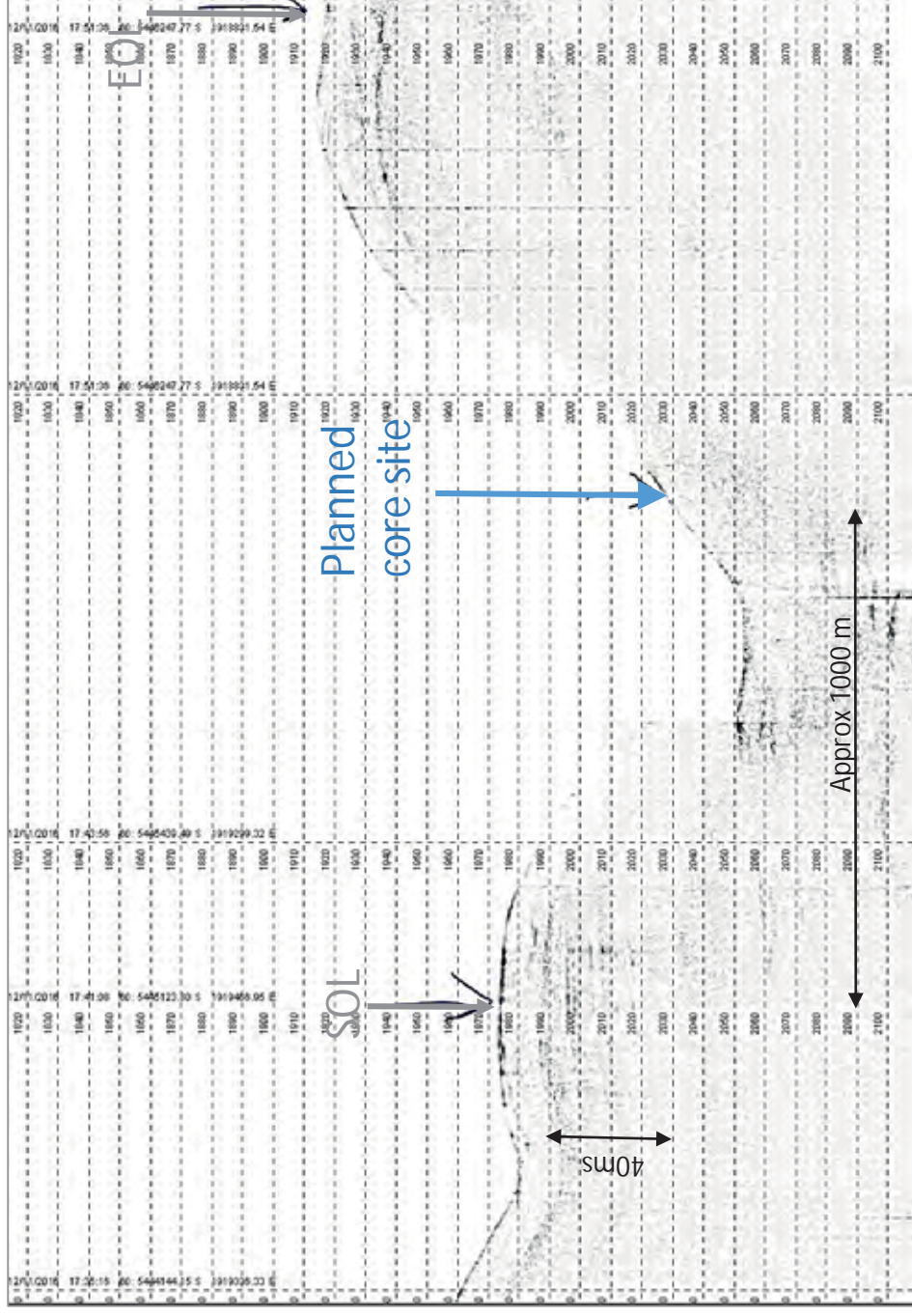
Section	Top depth (cm)	Btm depth (cm)	Logged	Phys Props	Summary
1	0	100	Y	Y	.
2	100	200	Y	Y	.
3	200	300	Y	Y	.
4	300	400	Y	Y	.
5	400	458	Y	Y	.
.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Uruti 2

Other ID TAN1613-21

Water Depth 1507 m



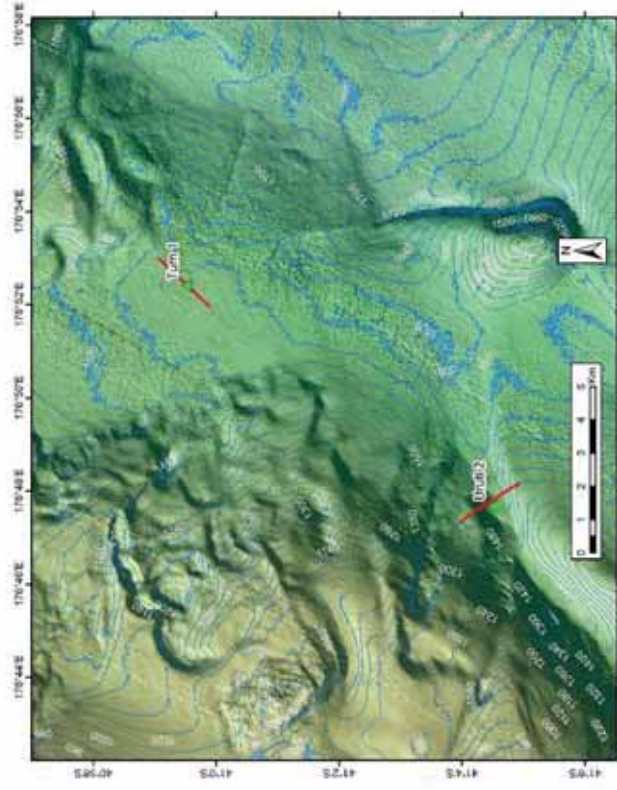
Topas line over Uruti2 core site. Grey arrows indicate start and end of the 2km survey line over the station. Blue arrow marks the planned core site.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

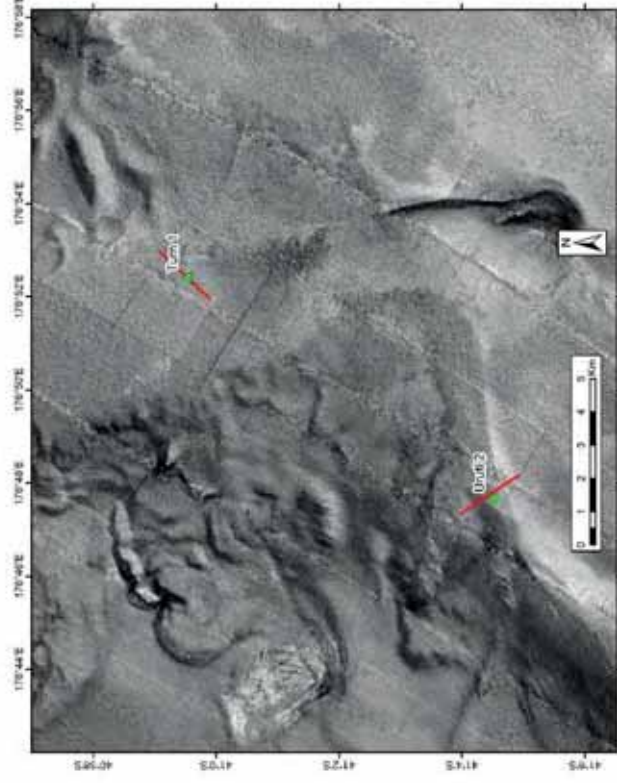
Core ID: Uruti 2

Other ID TAN1613-21

Water Depth 1507 m



Bathymetry at and around Uruti2 core site at the lower channel draining northern Uruti Basin. Light blue lines are 20 m depth contours. Red lines show the 2 km TOPAS survey line over the station, green triangles indicate the actual core site.



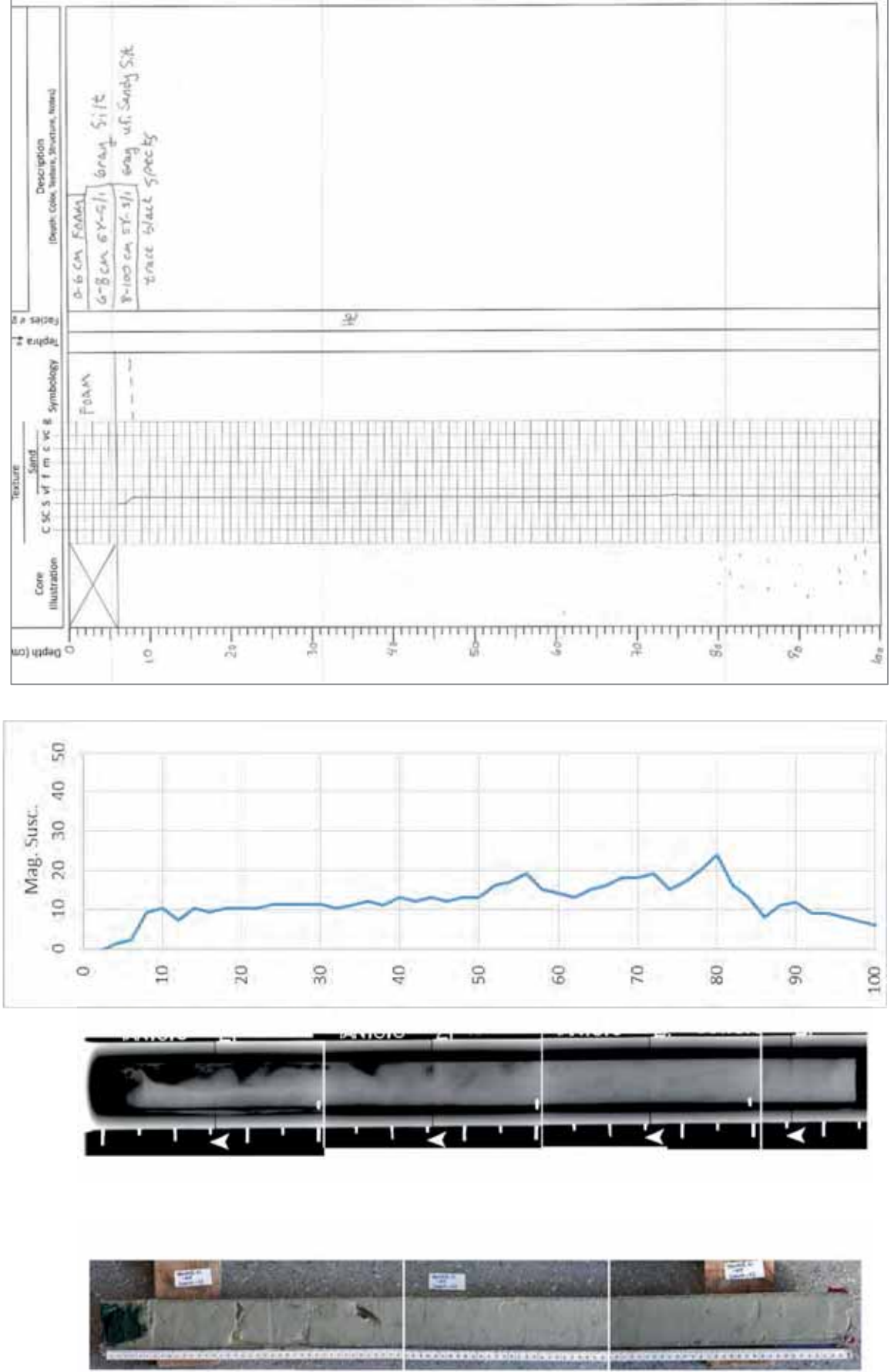
Backscatter at and around Uruti2 core site at the lower channel draining northern Uruti Basin. Light blue lines are 20 m depth contours. Red lines show the 2 km TOPAS survey line over the station, green triangles indicate the actual core site.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Uruti 2

Other ID TAN1613-21

Section 1 of 5

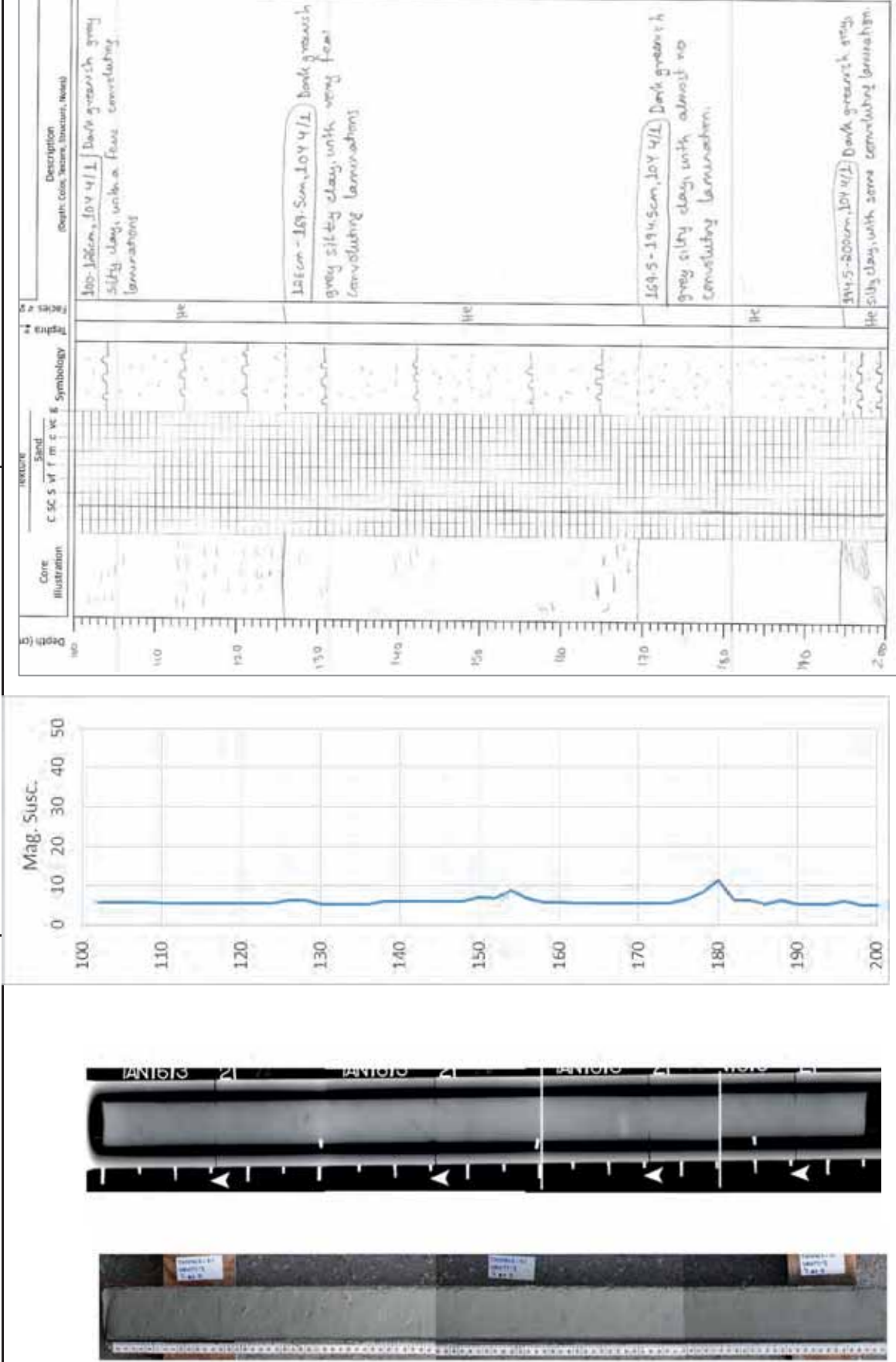


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Uruti 2

Other ID TAN1613-21

Section 2 of 5

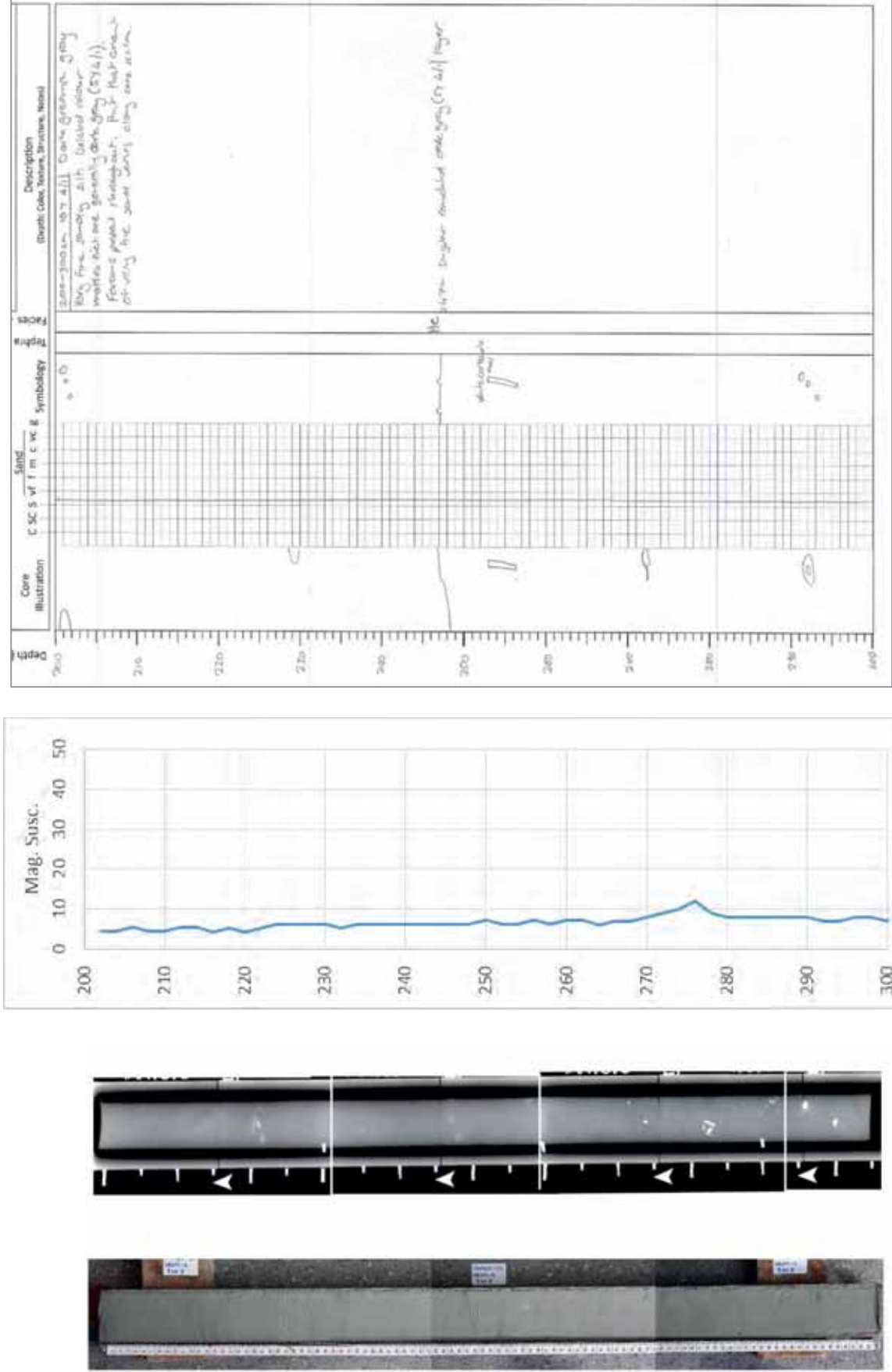


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Uruti 2

Other ID TAN1613-21

Section 3 of 5

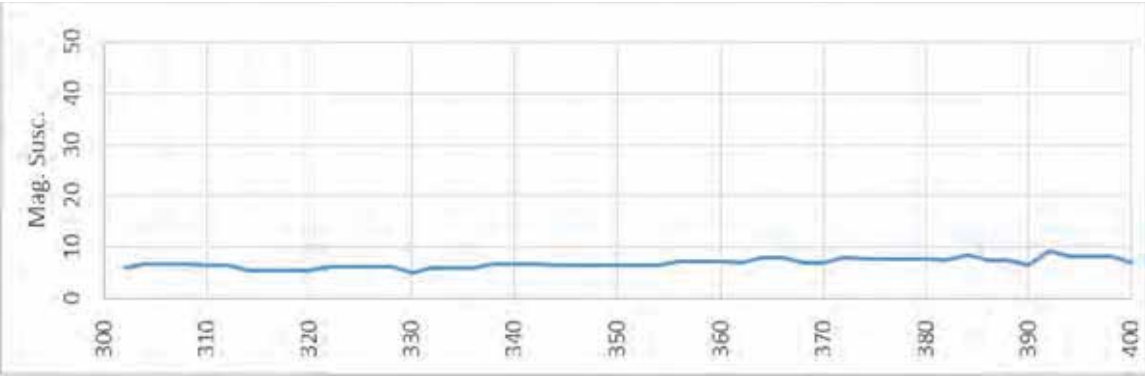
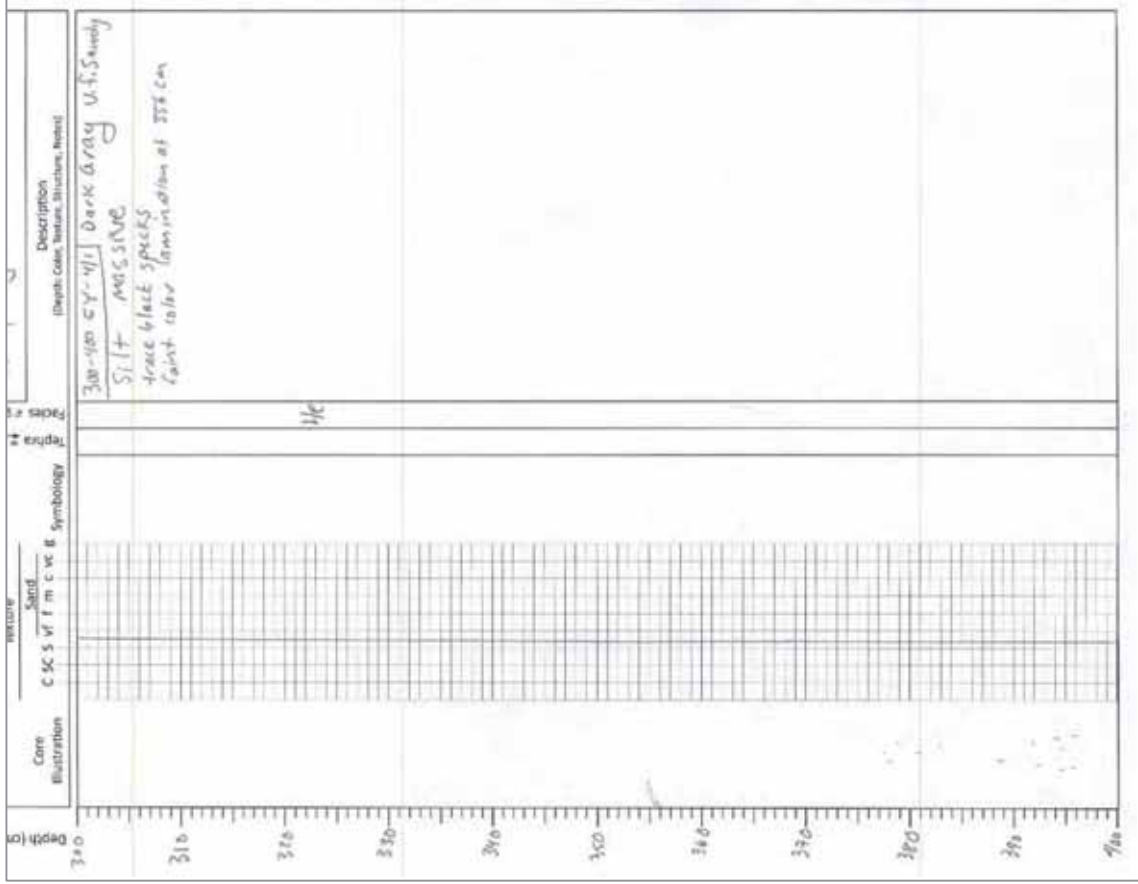


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Uruti 2

Other ID TAN1613-21

Section 4 of 5

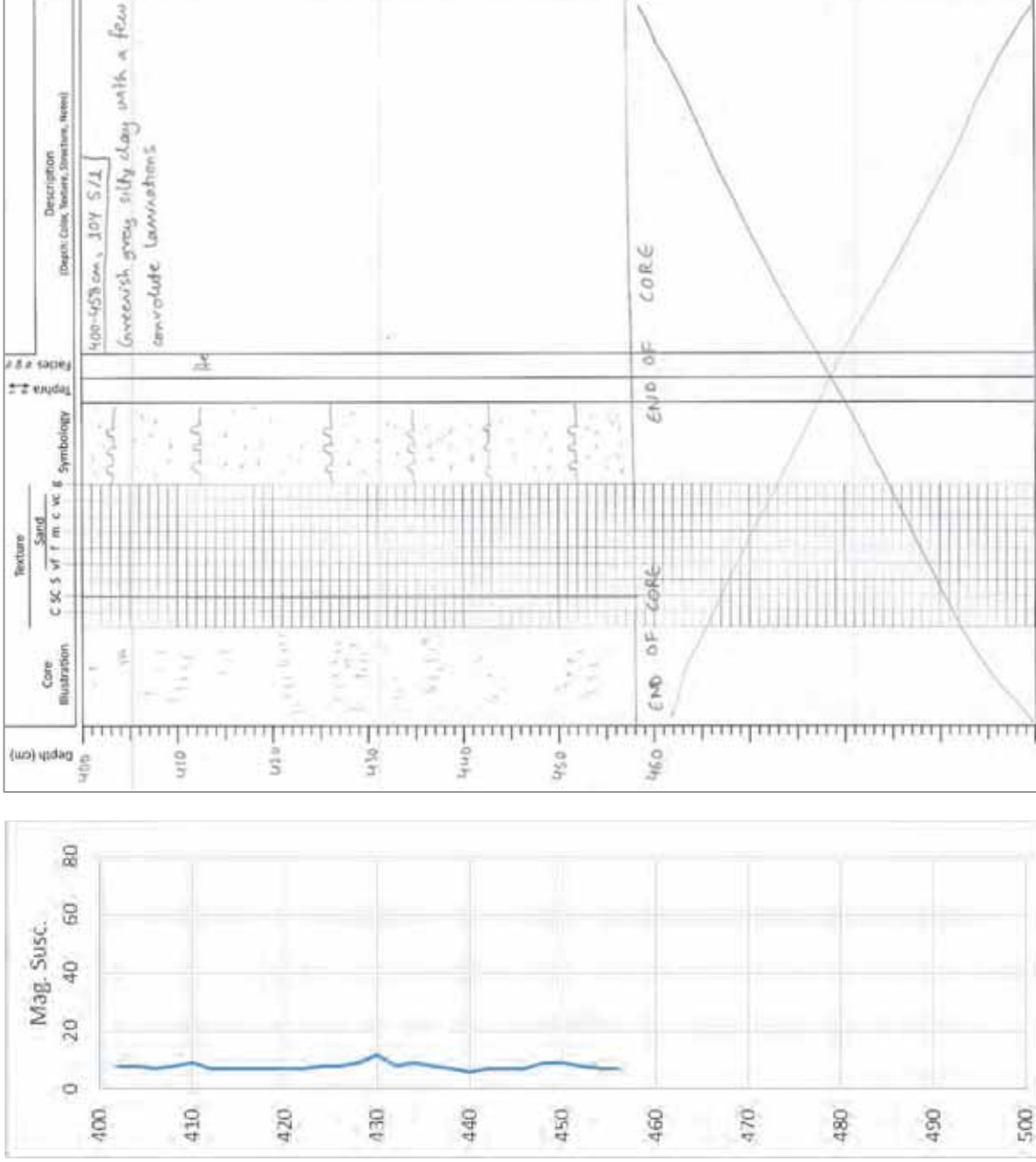


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Uruti 2

Other ID TAN1613-21

Section 5 of 5



TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: **Turn 1**

Latitude: -40.99200

Date/Time (NZST): 13/11/2016 09:58

Other ID: TAN1613-22

Longitude: 176.87350

Depth (m): **1535**

Sample Description

General Description

Lower slope in the mouth of Turnagain Seavalleys

Hemipelagic mud

Gear type	Piston core	
Barrel Length (m)	6	Bent barrel
Penetration (m)		Catcher/Cutter bags
Core length (m)	4.9	Samples
Sections	5	Tephra
Fauna		Pull-out
		2.7t

Sample processing – core ID:

Section	Top depth (cm)	Btm depth (cm)	Logged	Phys Props	Summary
1	0	100	Y	Y	.
2	100	200	Y	Y	.
3	200	300	Y	Y	.
4	300	400	Y	Y	.
5	400	490	Y	Y	.
.

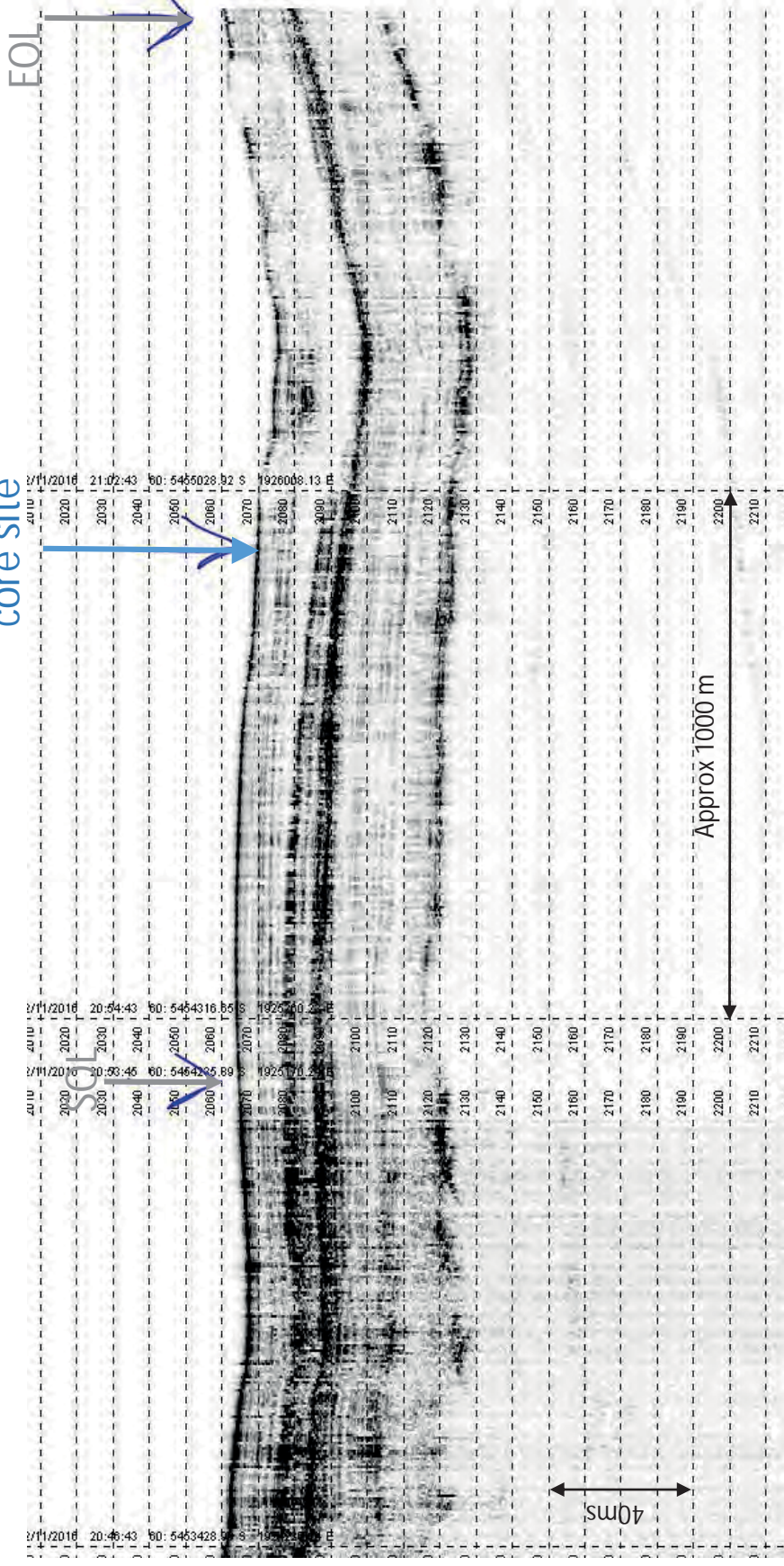
TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Turn 1

Other ID TAN1613-22

Water Depth 1535 m

Planned
core site



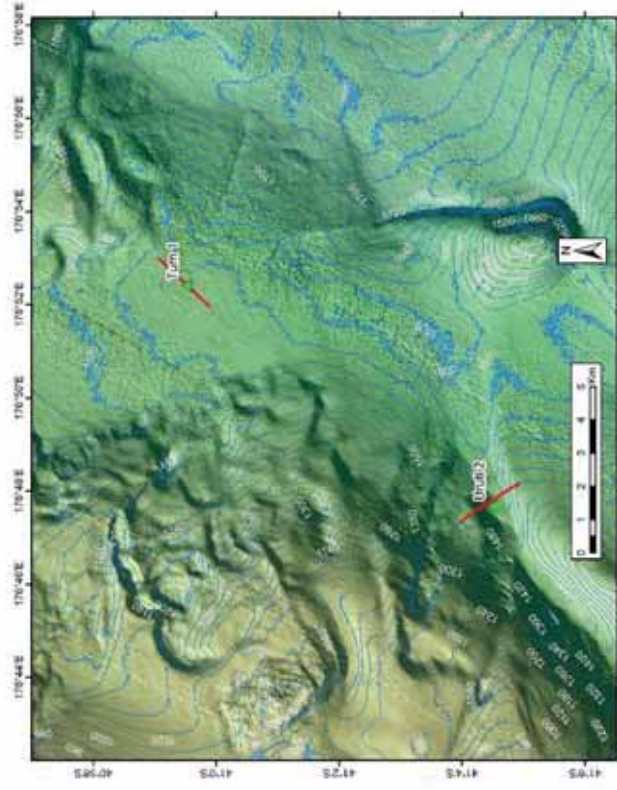
Topas line including transit short to the station. Grey arrows indicate start and end of the 2km survey line over the station. Blue arrow marks the planned core site.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

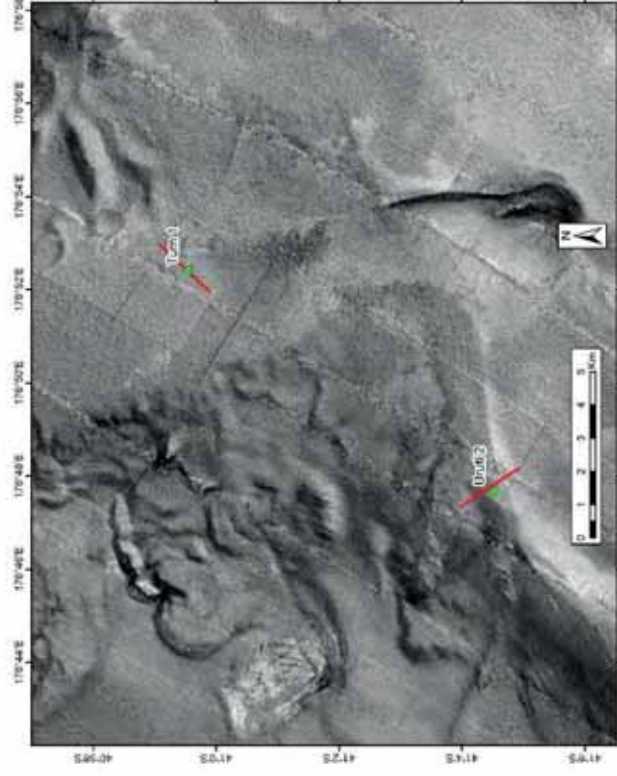
Core ID: Turn 1

Other ID TAN1613-22

Water Depth 1535 m



Bathymetry at and around Turn1 core site at the lower slope in the mouth of Turnagain Seavalleys. Light blue lines are 20 m depth contours. Red lines show the 2 km TOPAS survey line over the station, green triangles indicate the actual core site.



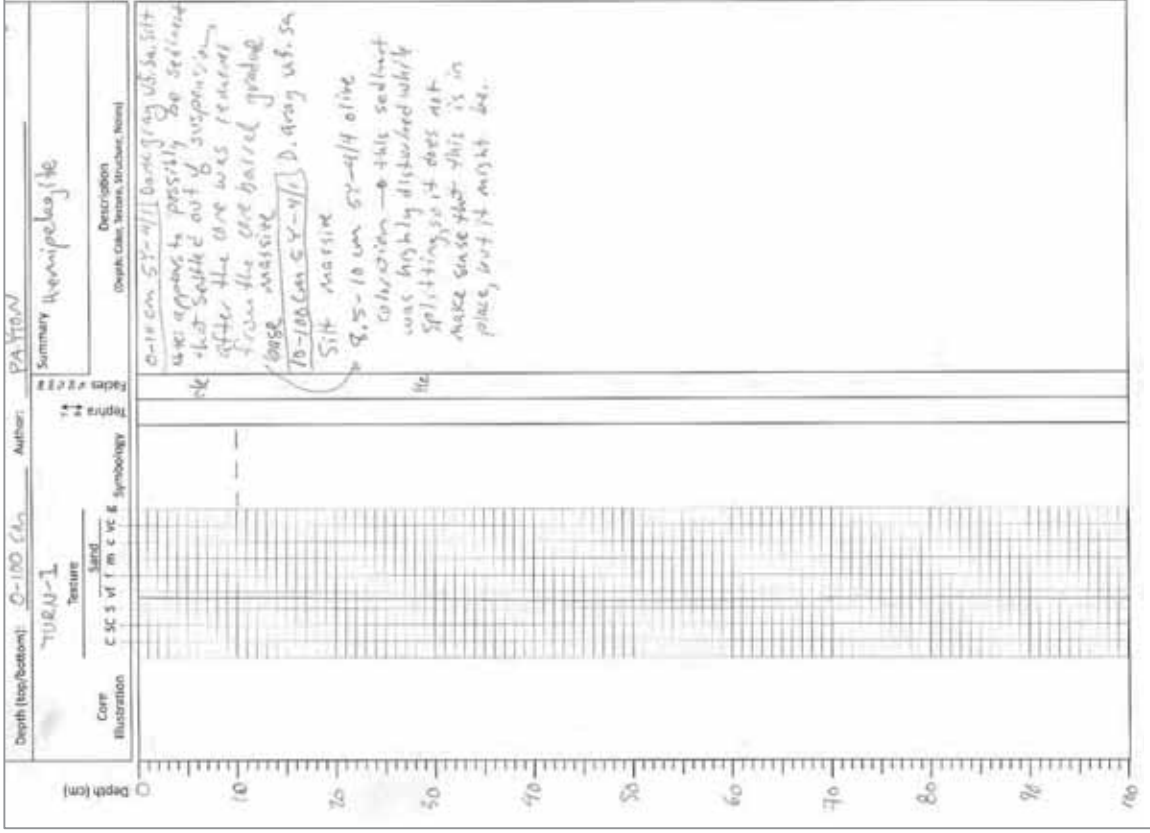
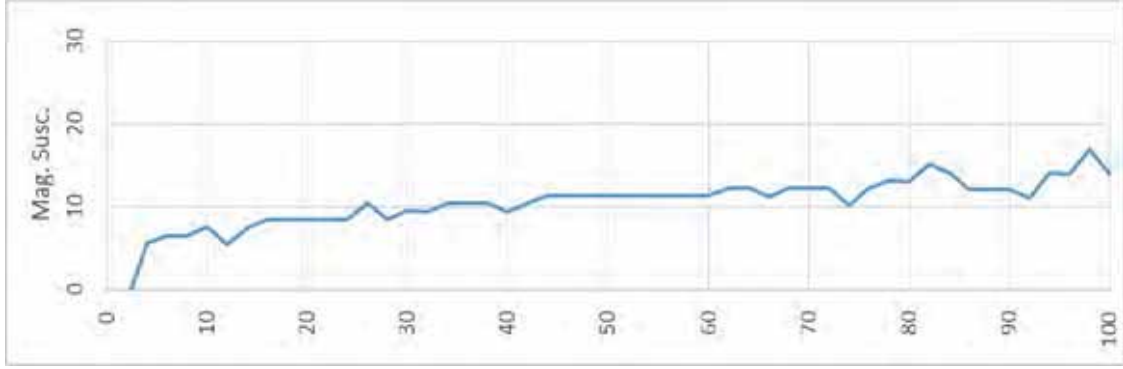
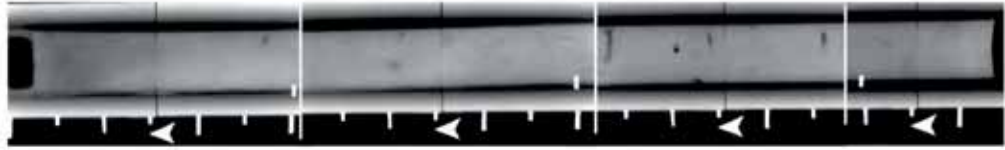
Backscatter at and around Turn1 core site at the lower slope in the mouth of Turnagain Seavalleys. Light blue lines are 20 m depth contours. Red lines show the 2 km TOPAS survey line over the station, green triangles indicate the actual core site.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Turn 1

Other ID TAN1613-22

Section 1 of 5

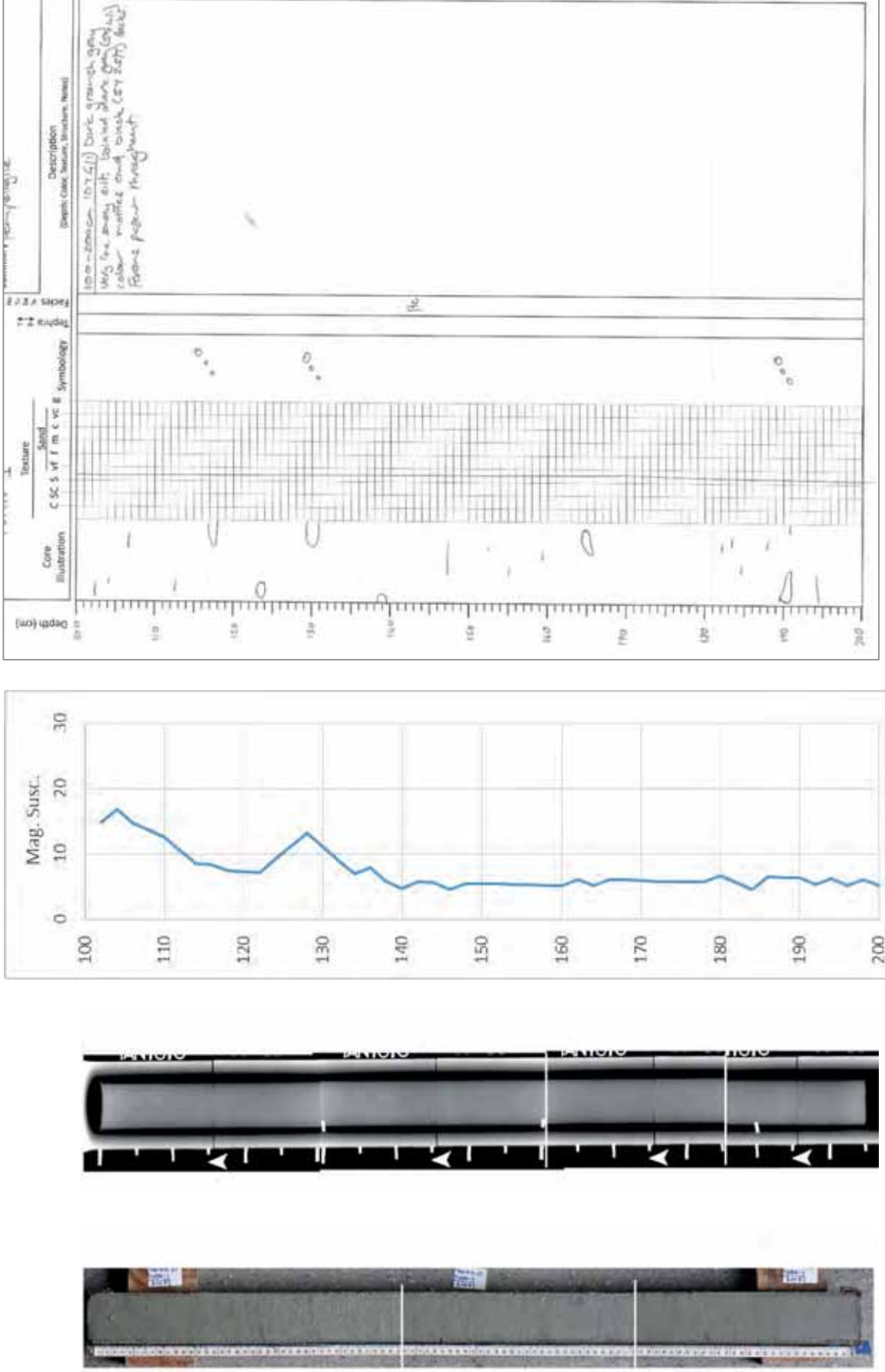


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Turn 1

Other ID TAN1613-22

Section 2 of 5

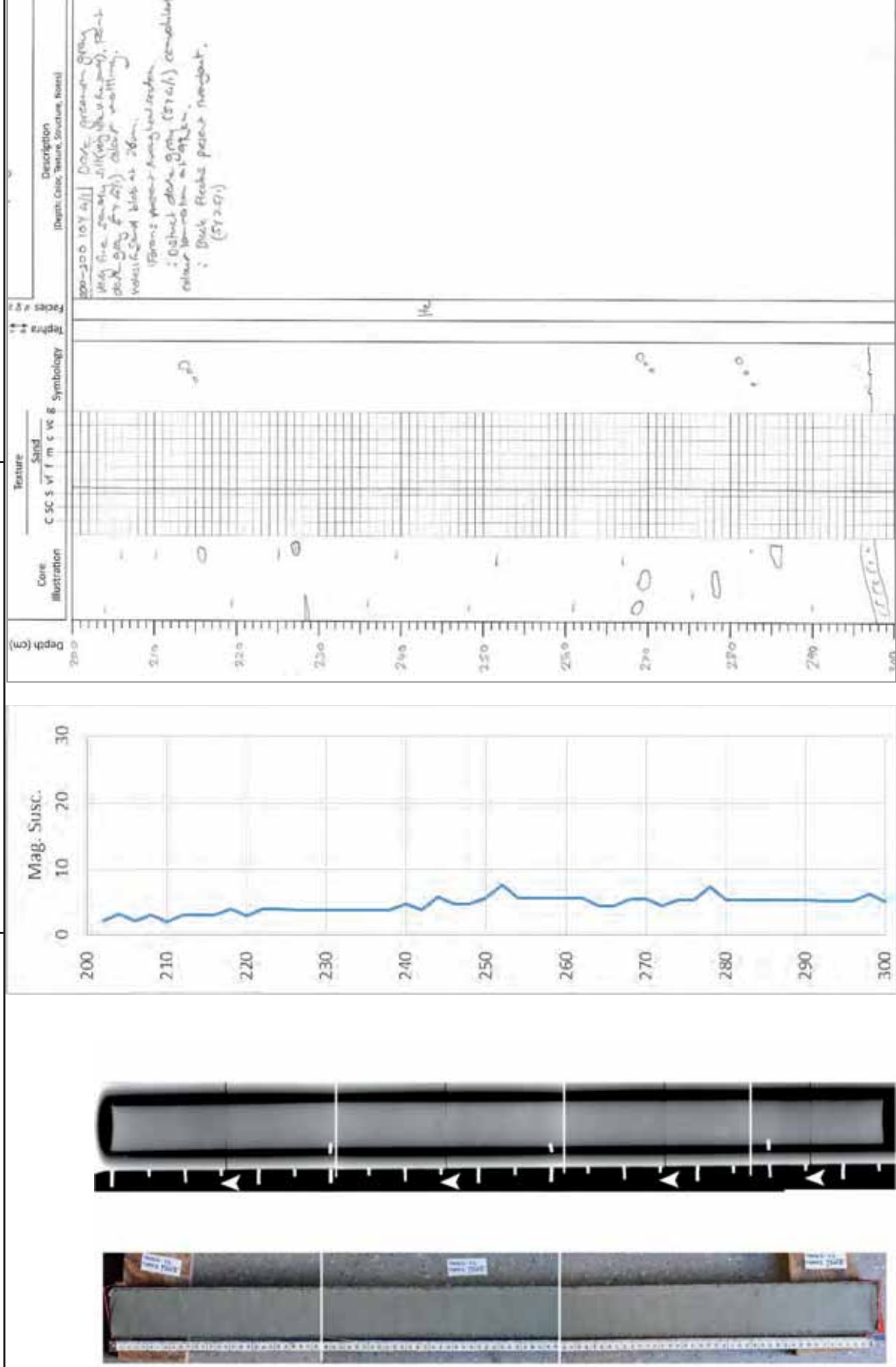


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Turn 1

Other ID TAN1613-22

Section 3 of 5

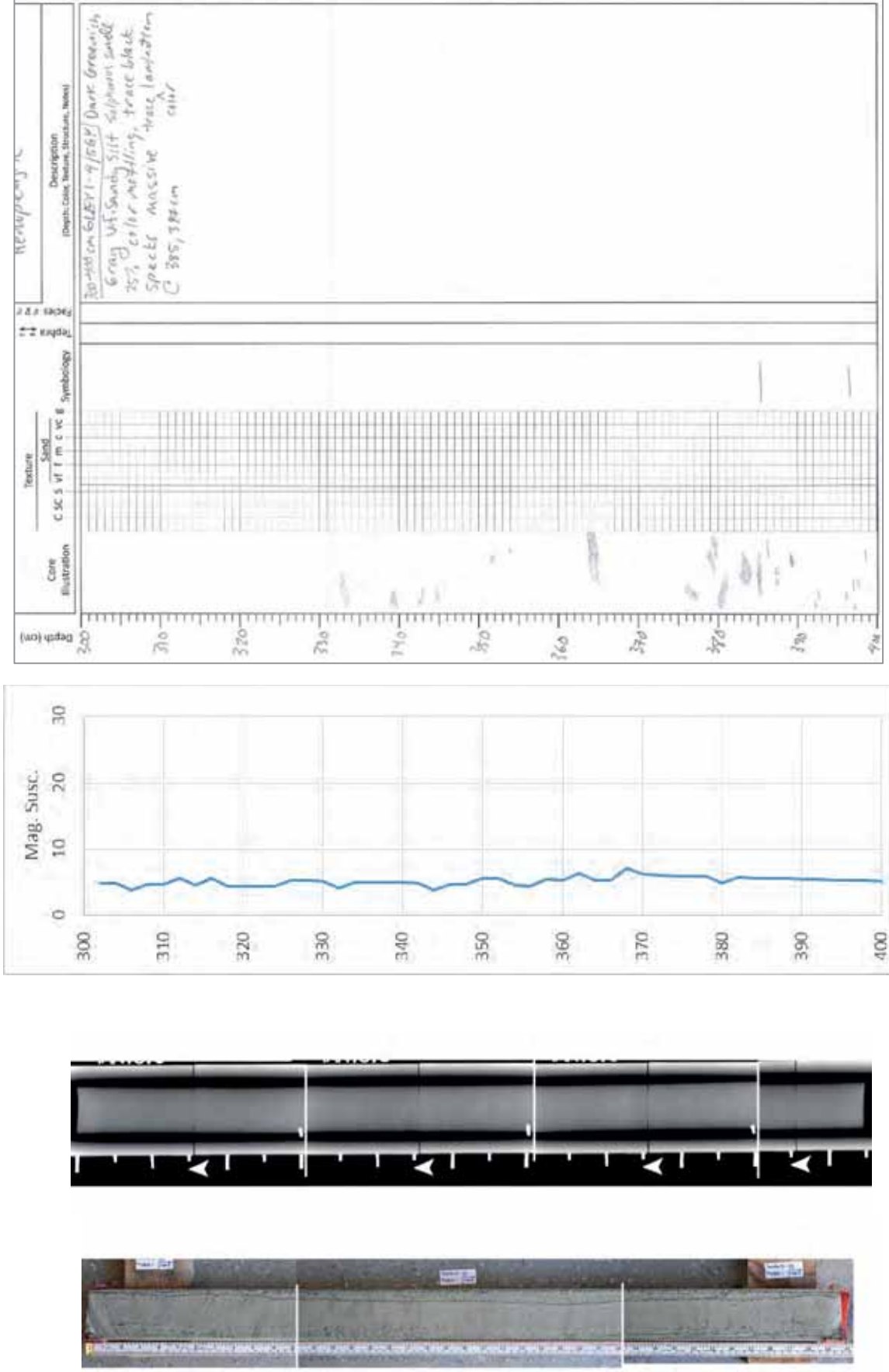


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Turn 1

Other ID TAN1613-22

Section 4 of 5

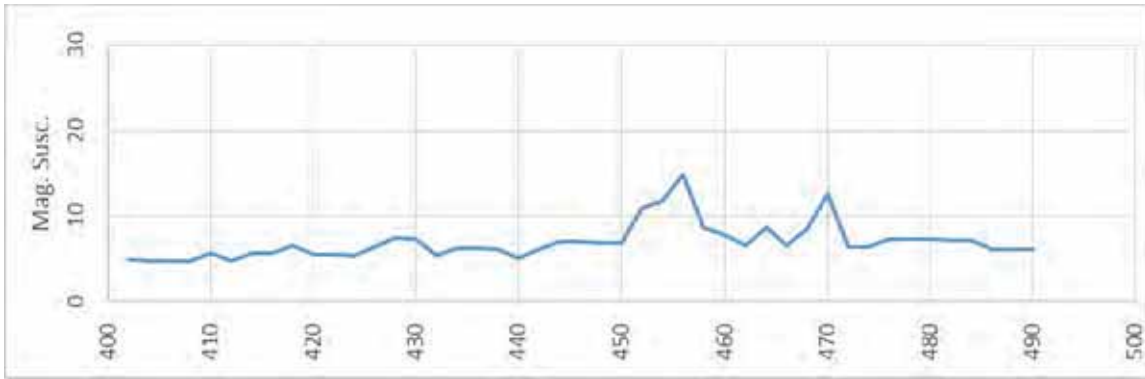
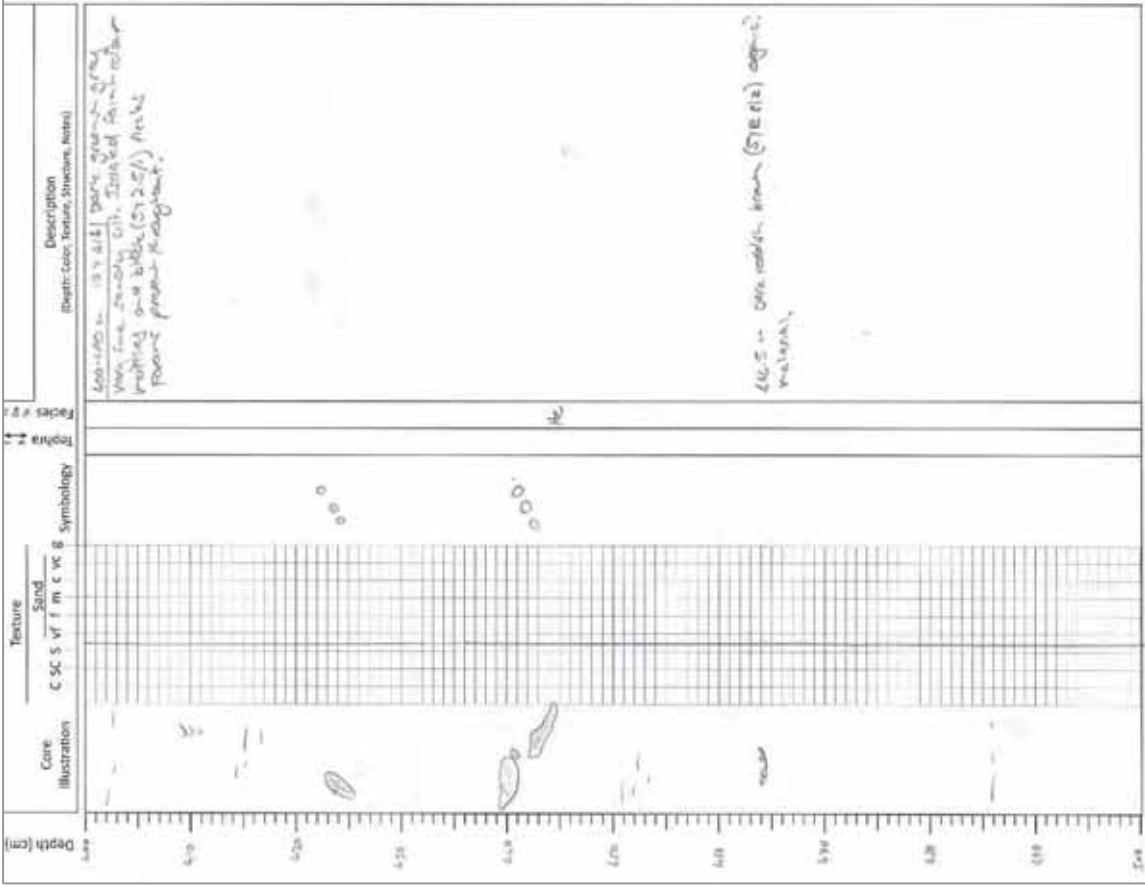


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Turn 1

Other ID TAN1613-22

Section 5 of 5



TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: **MC 7**
Other ID: **TAN1613-23**

Latitude: **-40.82193**
Longitude: **177.30507**

Date/Time (NZST): **13/11/2016 14:53**
Depth (m): **1984**

Sample Description

General Description

Centre of Porangahau Basin

Turbidites interbedded with hemipelagite

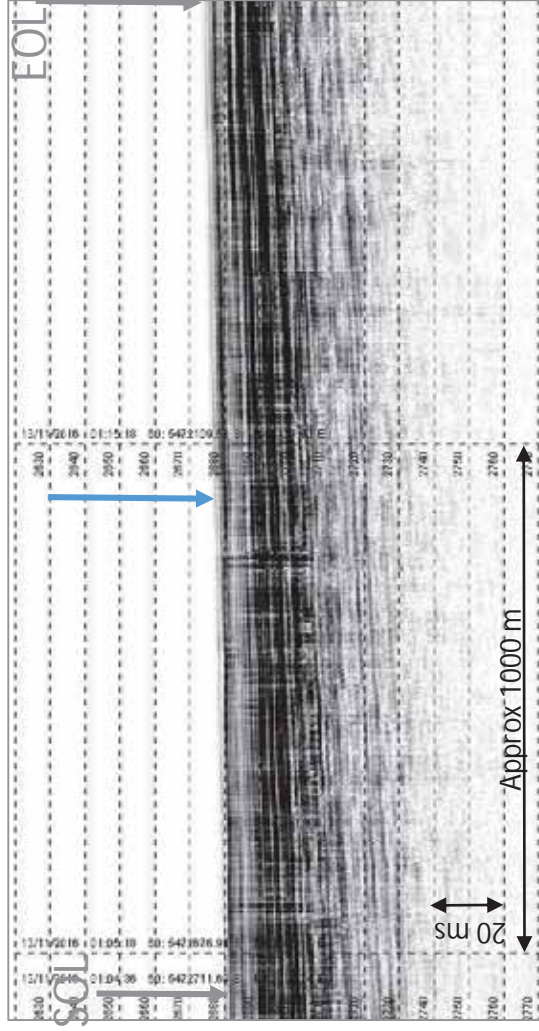
Gear type	Piston core	
Barrel Length (m)	6	Bent barrel
Penetration (m)	N	Catcher/Cutter bags
Core length (m)	4.23	Samples
Sections	5	Tephra
Fauna		.

Sample processing – core ID:

Section	Top depth (cm)	Btm depth (cm)	Logged	Phys Props	Summary
1	0	100	Y	Y	.
2	100	200	Y	Y	.
3	200	300	Y	Y	.
4	300	400	Y	Y	.
5	400	423	Y	Y	.
.

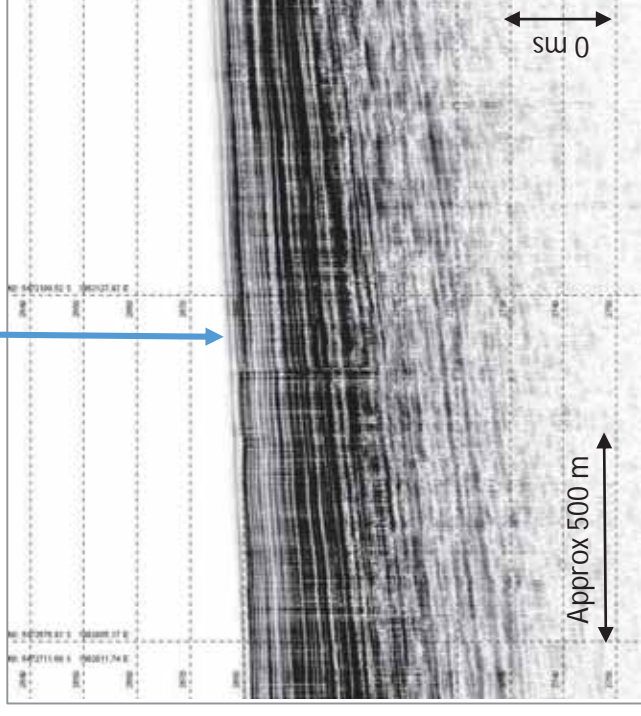
TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: MC 7	Other ID TAN1613-23	Water Depth 1984 m
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Topas line over MC7 core location. Grey arrows indicate start and end of the 2km survey line over the station. The blue arrow marks the planned core site.

Planned core site



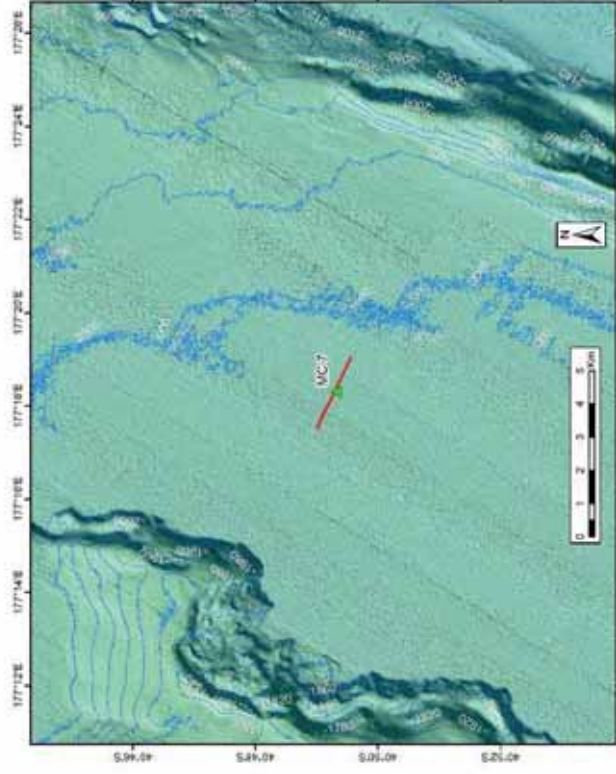
Zoom into 2km survey lines over planned core site

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: MC 7

Other ID TAN1613-23

Water Depth 1984 m



Bathymetry at and around MC7 core site at the centre of Porangahau Basin. Light blue lines are 20 m depth contours. Red lines show the 2 km TOPAS survey line over the station, green triangles indicate the actual core site.



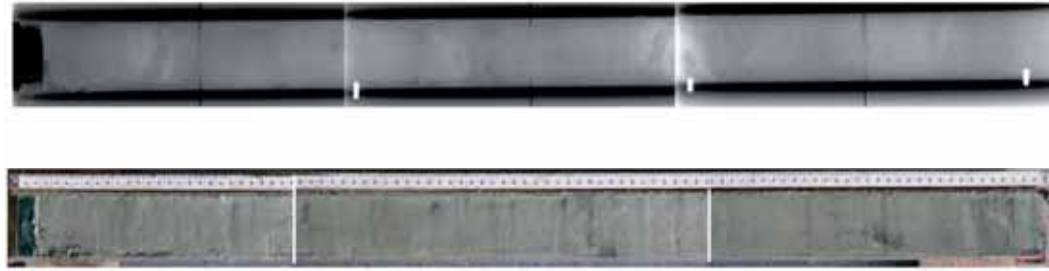
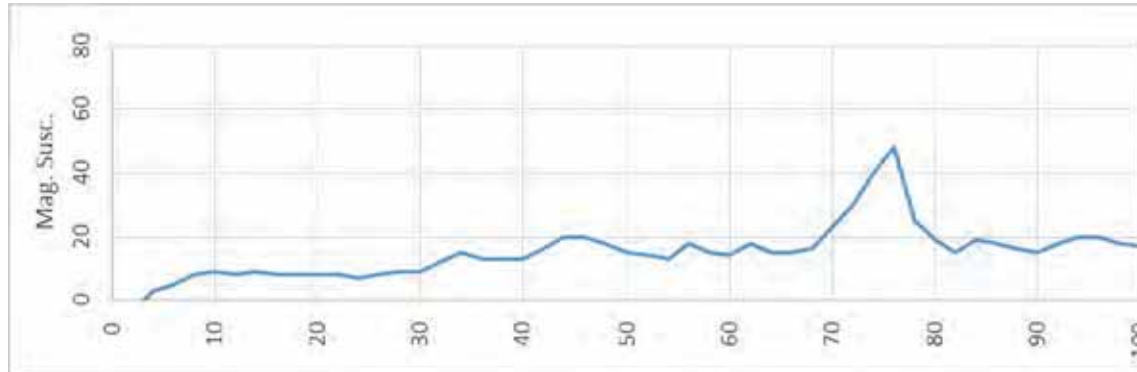
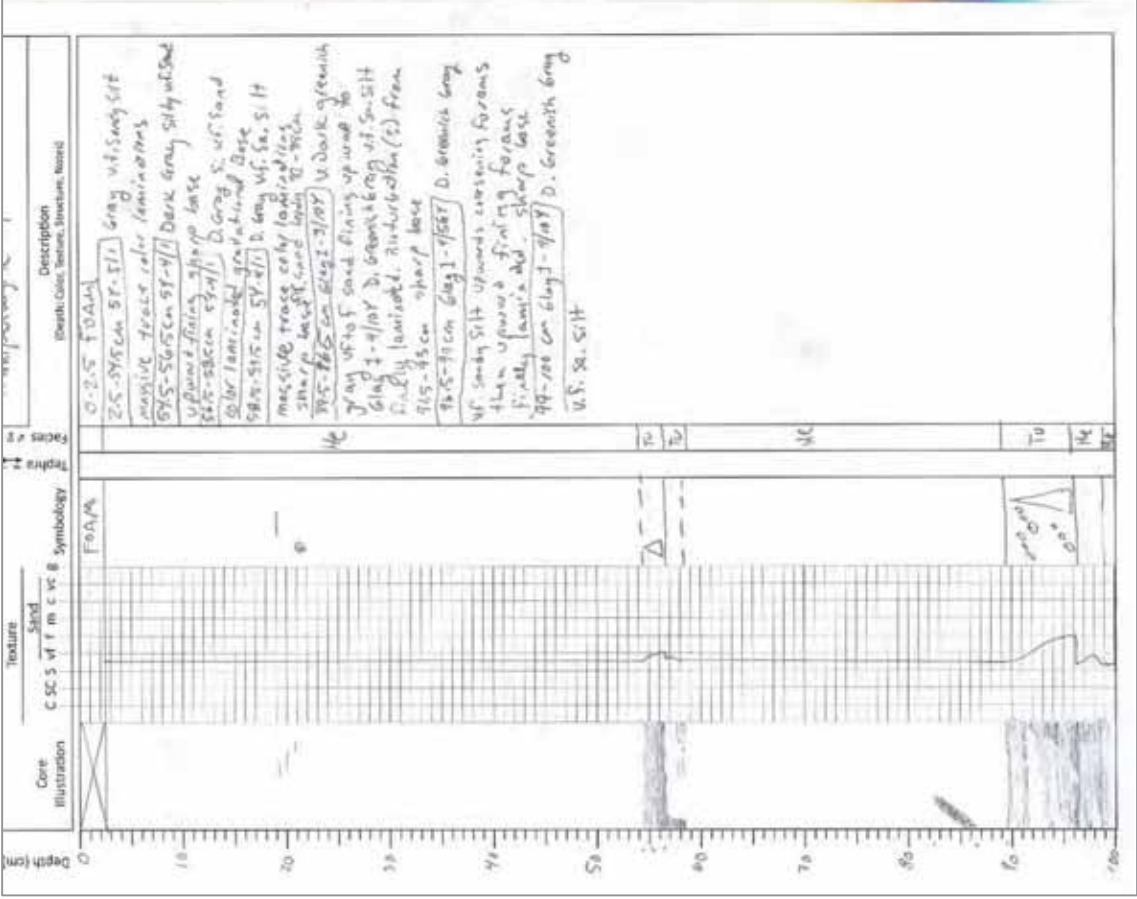
Backscatter at and around MC7 core site at the centre of Porangahau Basin. Light blue lines are 20 m depth contours. Red lines show the 2 km TOPAS survey line over the station, green triangles indicate the actual core site.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: MC 7

Other ID TAN1613-23

Section 1 of 5

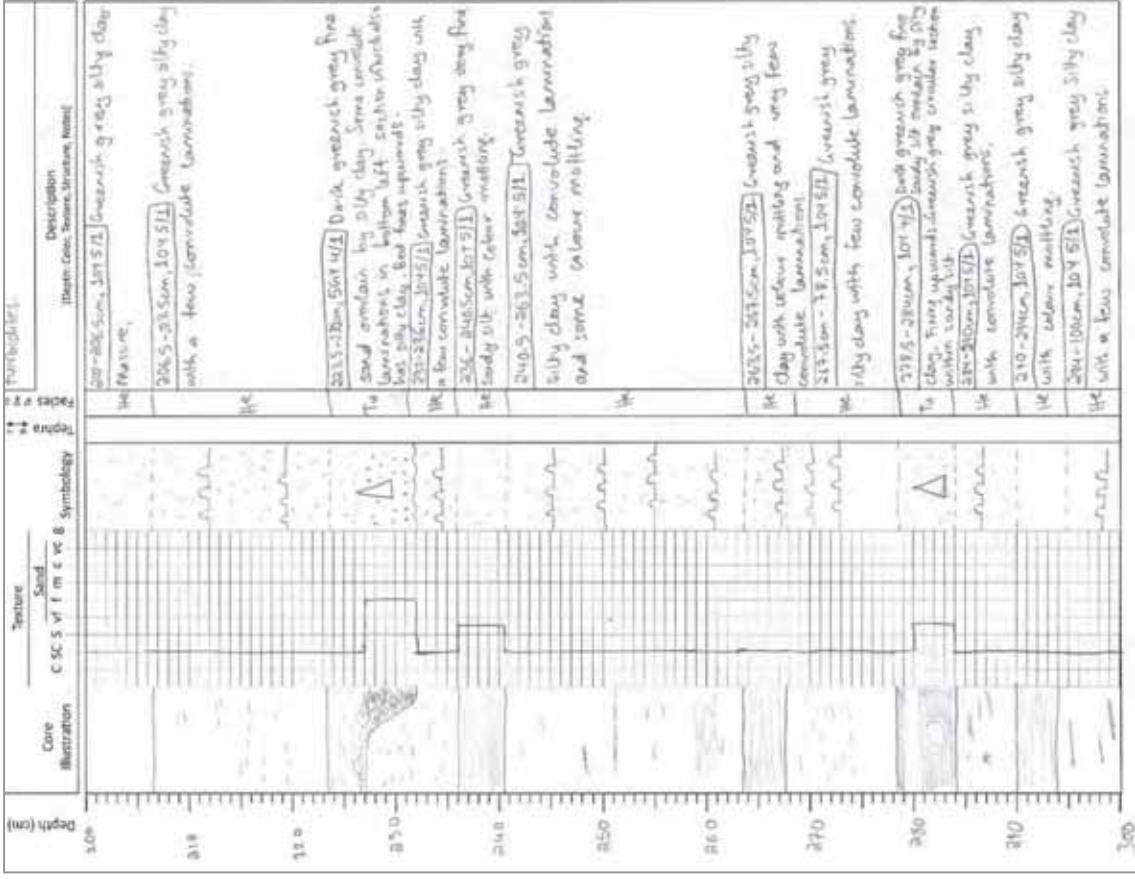
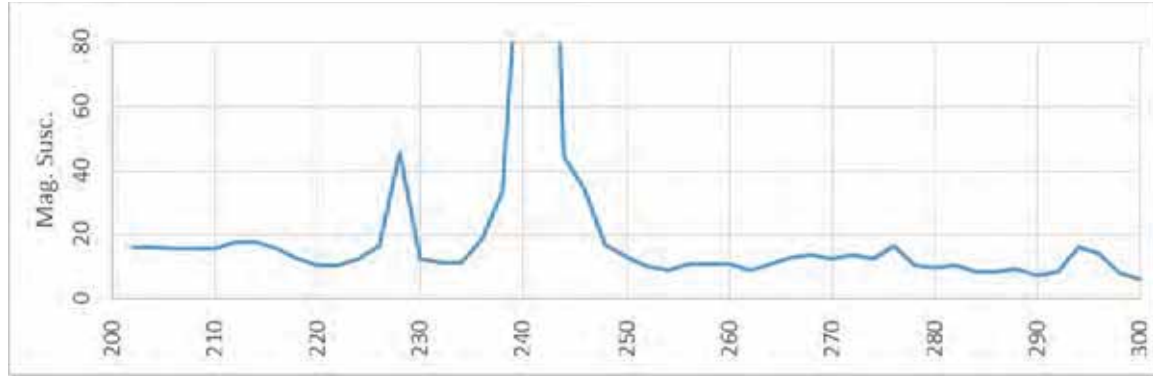


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: MC 7

Other ID TAN1613-23

Section 3 of 5

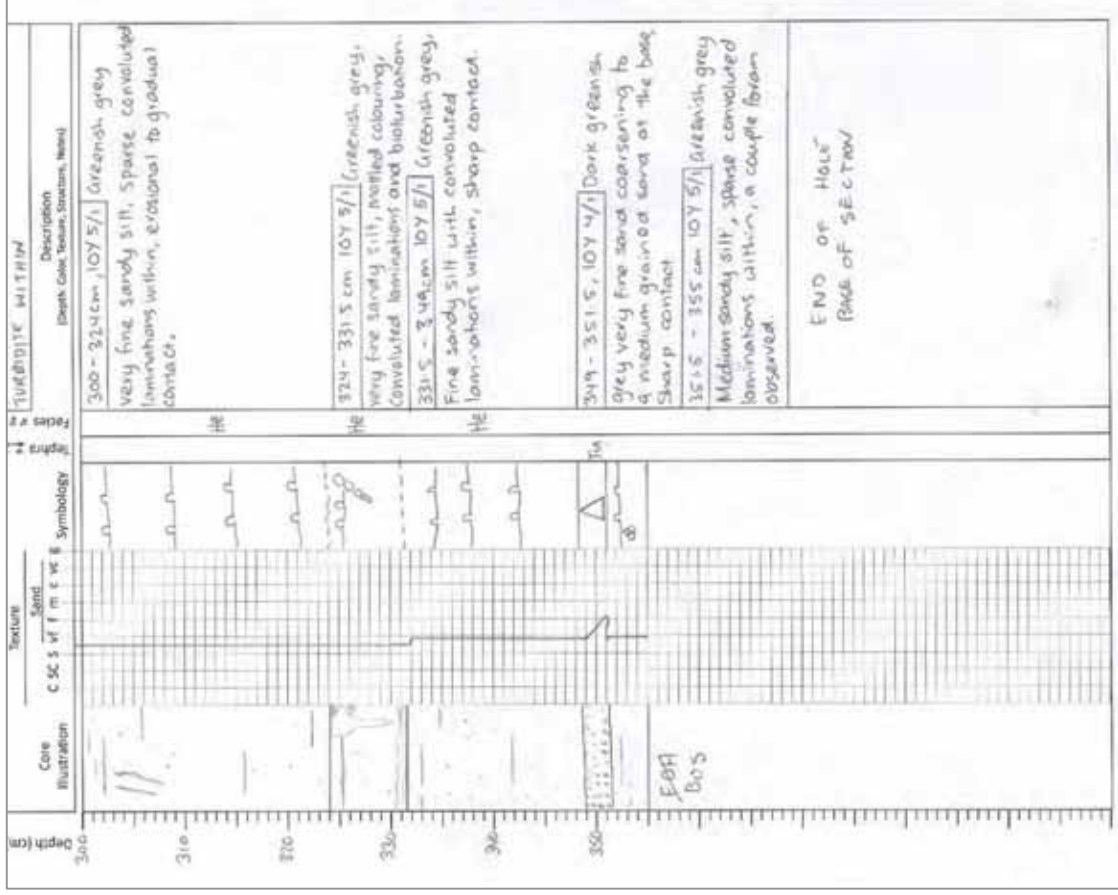
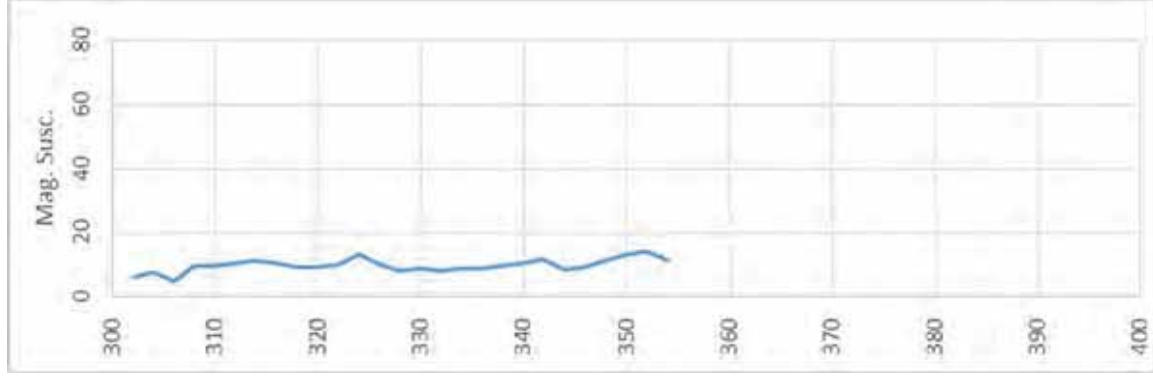


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: MC 7

Other ID TAN1613-23

Section 4 of 5

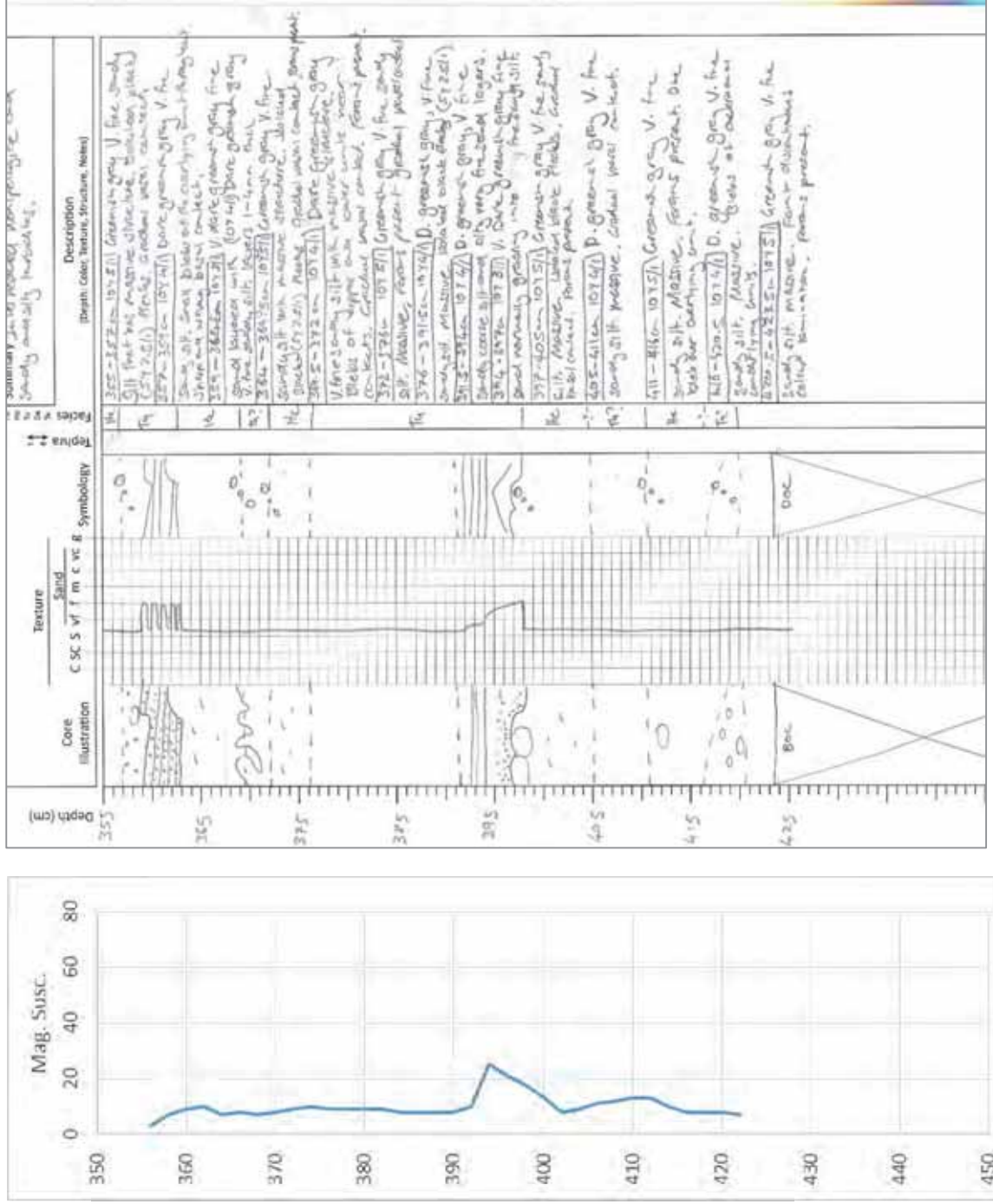


TAN1613 - Paleoseismicity of the Southern Hikurangi Margin

Core ID: MC 7

Other ID TAN1613-23

Section 5 of 5



TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: **MC 3**

Latitude: -40.69005

Date/Time (NZST): 13/11/2016 17:52

Other ID: TAN1613-24

Longitude: 177.36555

Depth (m): **1952**

Sample Description

General Description

Porangahau Basin, mouth of Madden Canyon

Turbidites interbedded with hemipelagite

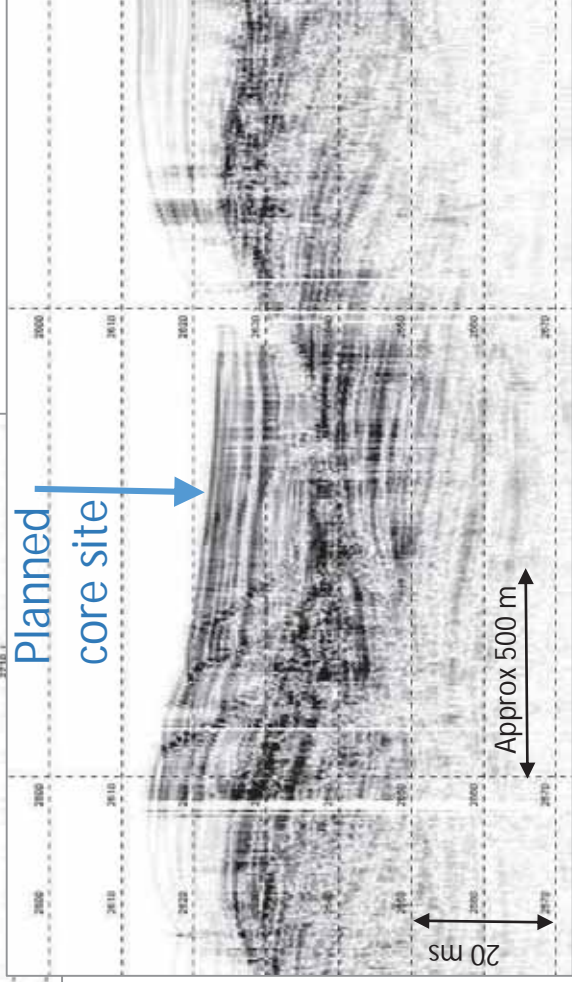
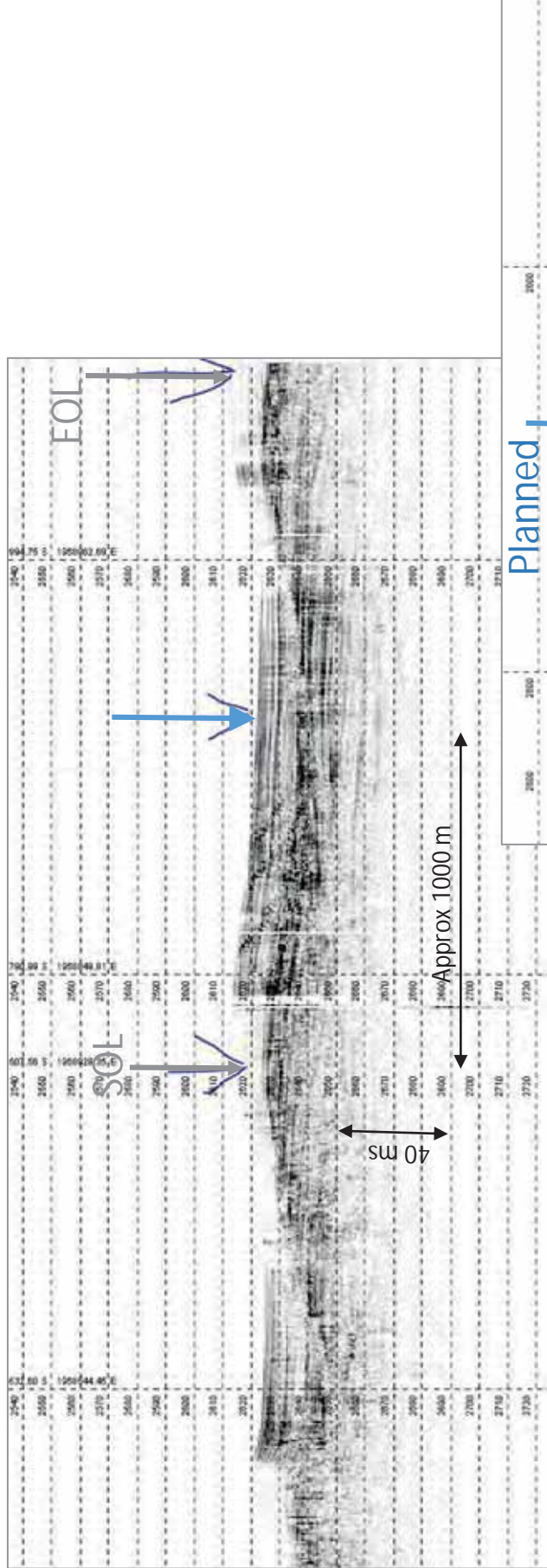
Gear type		Piston core	
Barrel Length (m)		Bent barrel	
Penetration (m)		Catcher/Cutter bags	
Core length (m)	4.42	Samples	.
Sections	5	Tephra	
Fauna		.	

Sample processing – core ID:

Section	Top depth (cm)	Btm depth (cm)	Logged	Phys Props	Summary
1	0	100	Y	Y	.
2	100	200	Y	Y	.
3	200	300	Y	Y	.
4	300	400	Y	Y	.
5	400	442	Y	Y	.
.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: MC 3	Other ID TAN1613-24	Water Depth 1952 m
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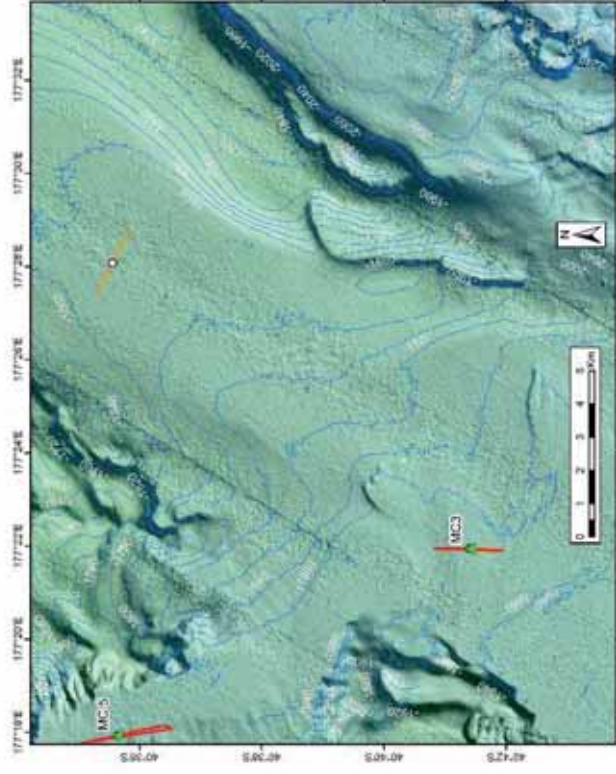


Topas line including short transit to the station. Grey arrows indicate start and end of the 2km survey line over the station. Blue arrow marks the planned core site.

Zoom into 2km survey lines over planned core site

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: MC 3	Other ID TAN1613-24	Water Depth 1952 m
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Bathymetry at and around MC3 core site in the Porangahau Basin, mouth of Madden Canyon. Light blue lines are 20 m depth contours. Red lines show the 2 km TOPAS survey line over the station, green triangles indicate the actual core site. Orange line and white circle are planned Topas line and core location not yet done.



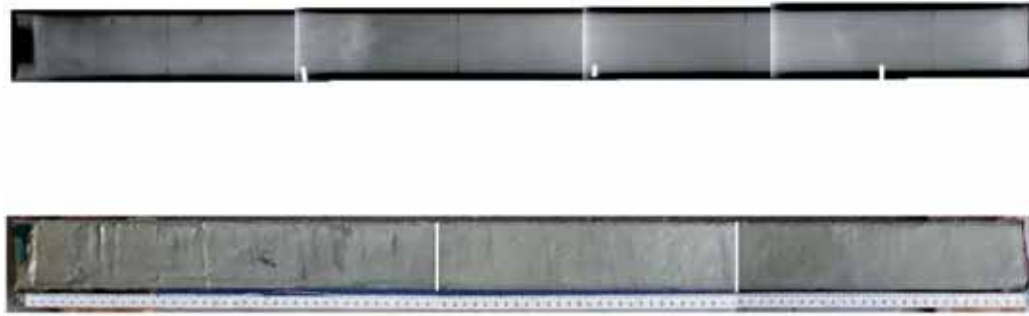
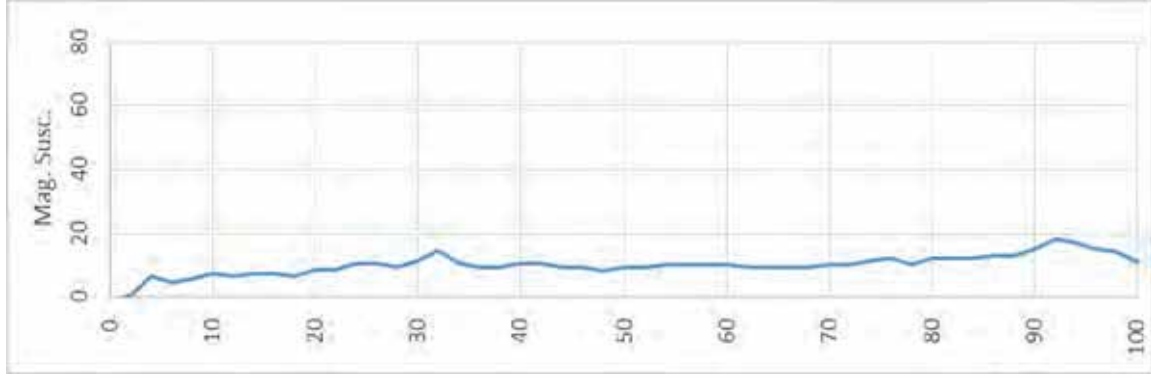
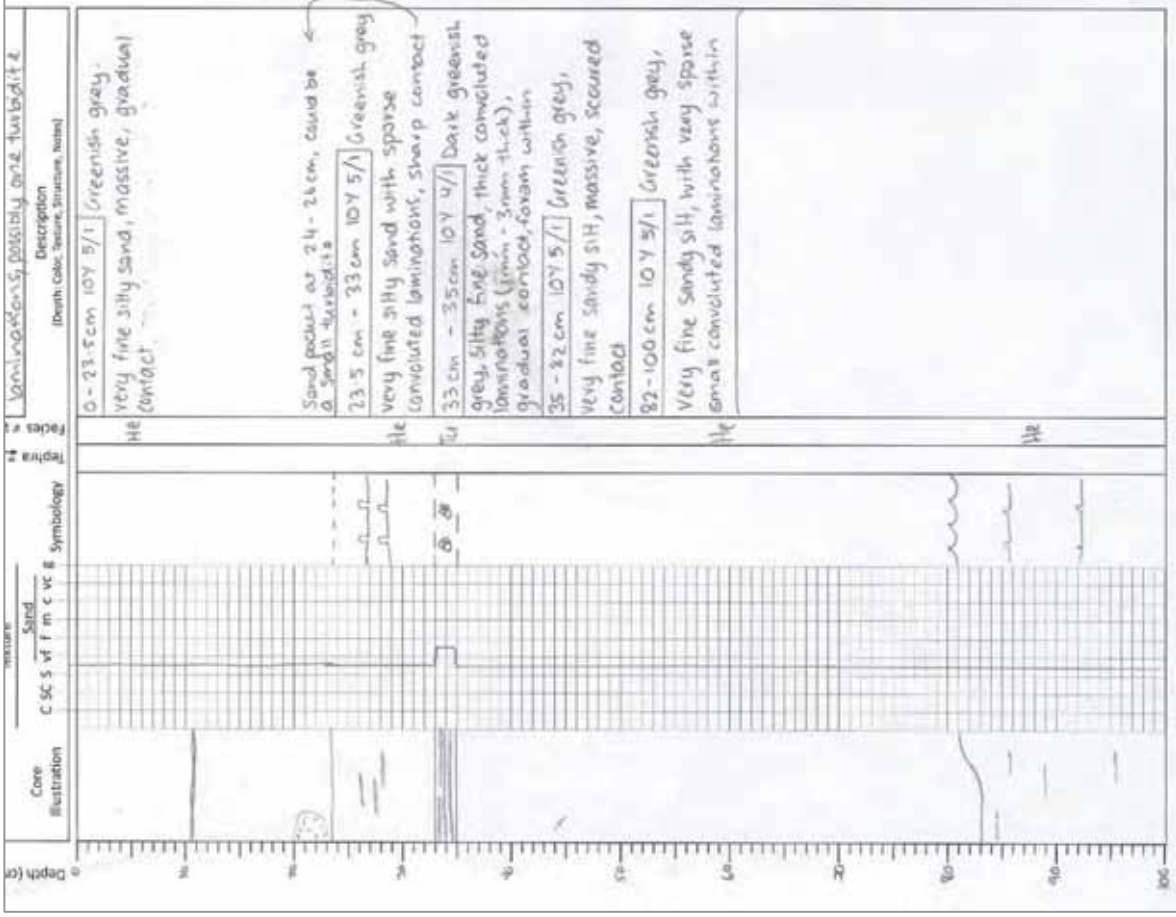
Backscatter at and around MC3 core site in the Porangahau Basin, mouth of Madden Canyon. Light blue lines are 20 m depth contours. Red lines show the 2 km TOPAS survey line over the station, green triangles indicate the actual core site. Orange line and white circle are planned Topas line and core location not yet done.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: MC 3

Other ID TAN1613-24

Section 1 of 5

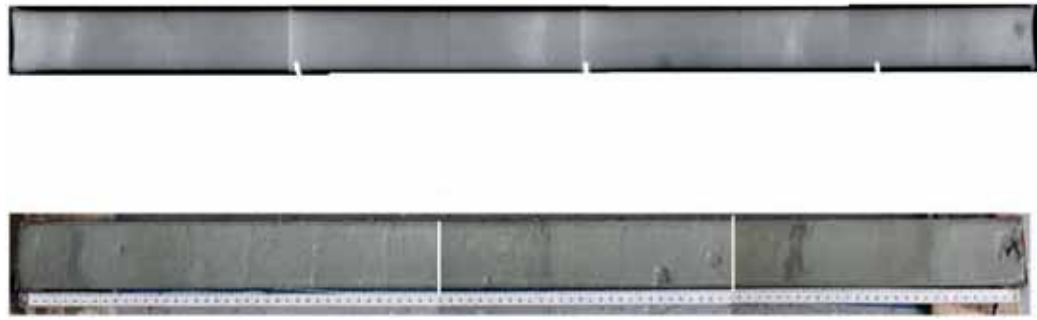
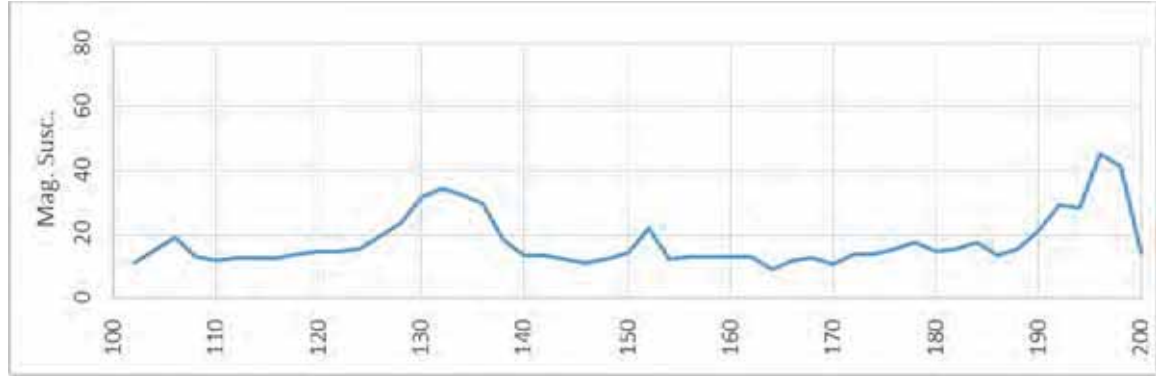
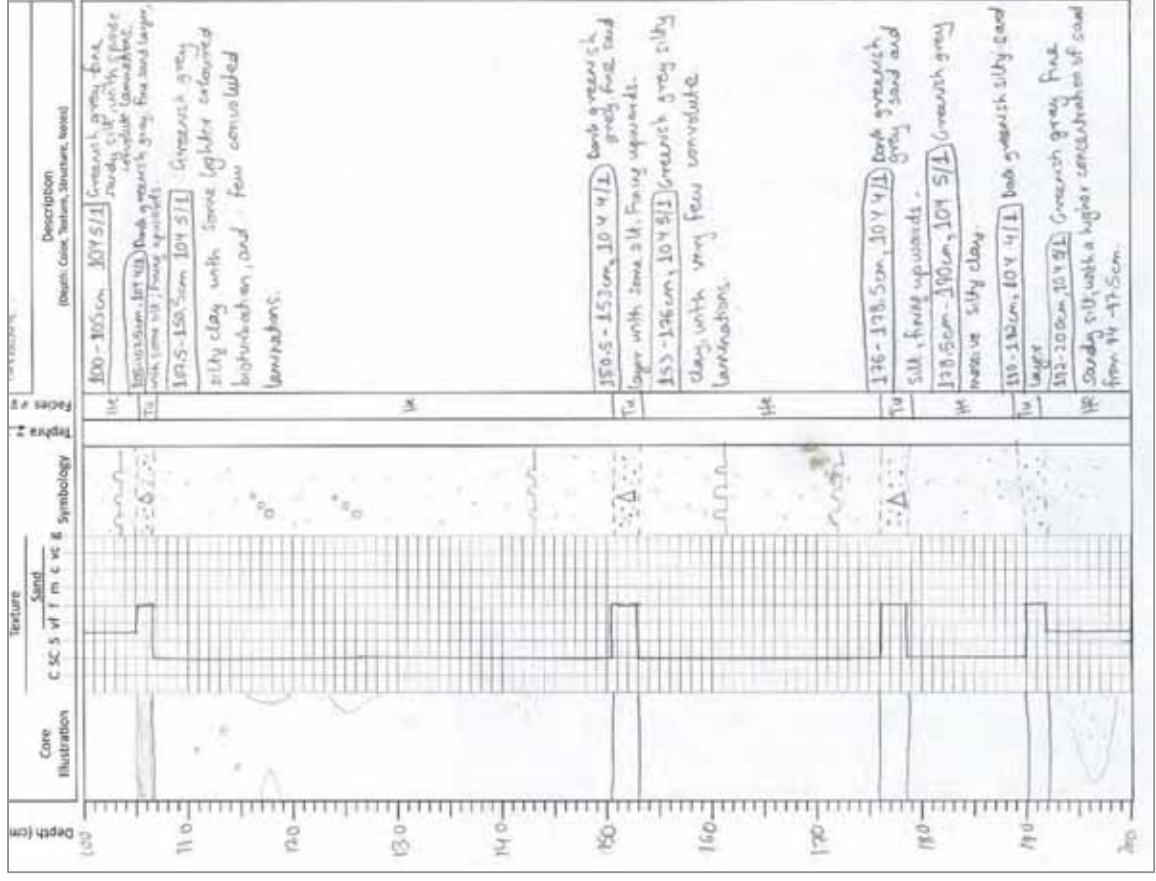


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: MC 3

Other ID TAN1613-24

Section 2 of 5

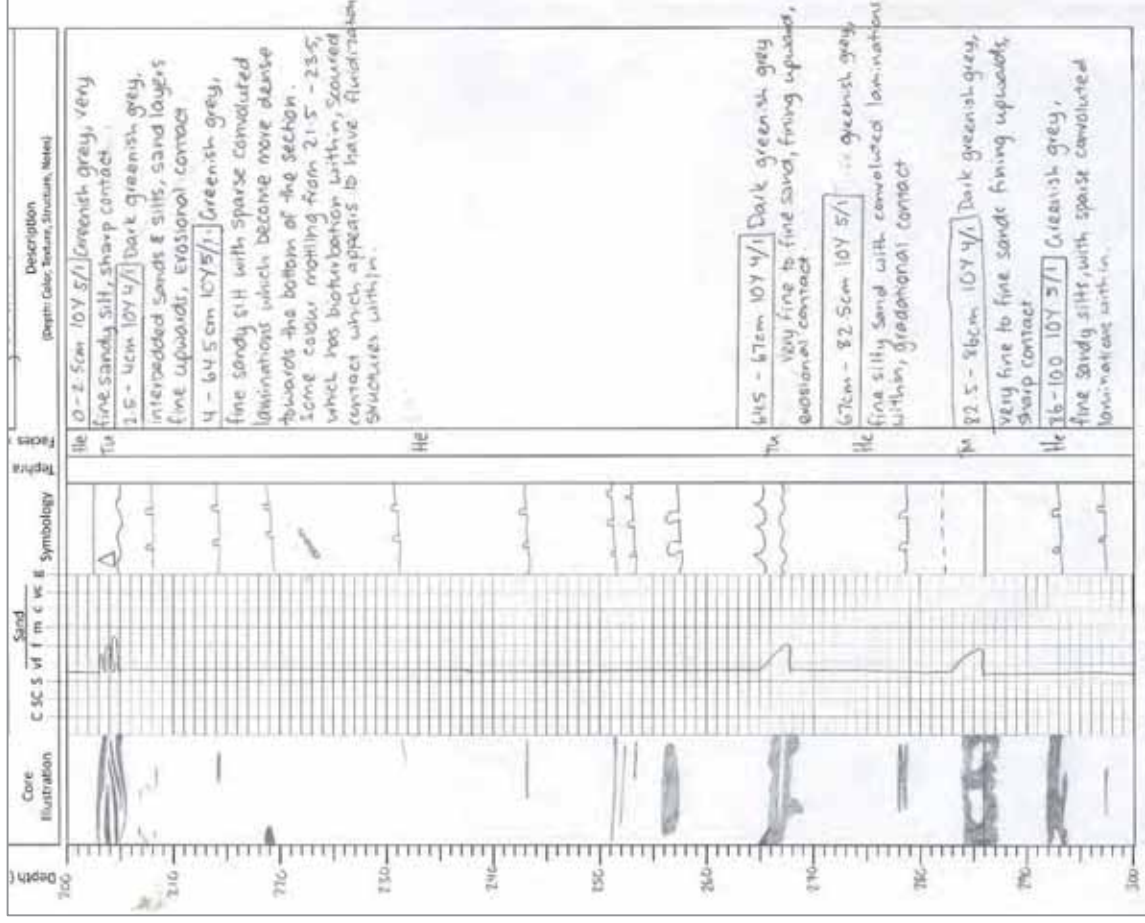
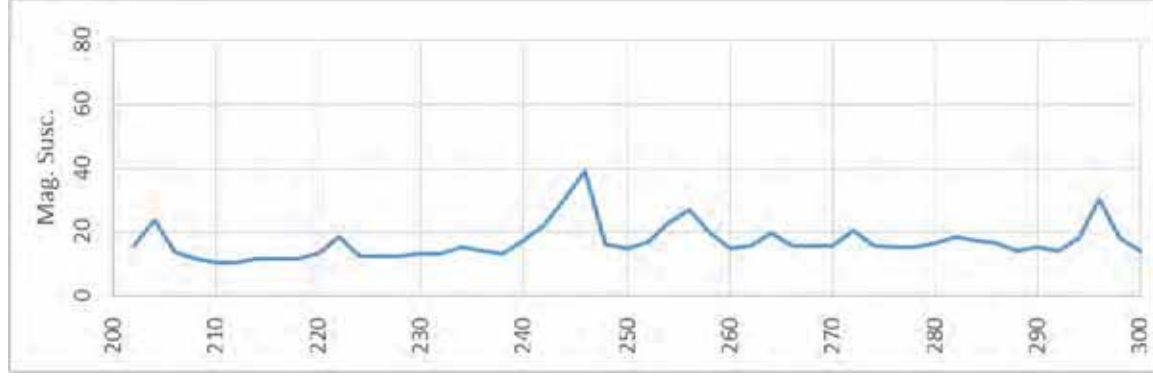


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: MC 3

Other ID TAN1613-24

Section 3 of 5

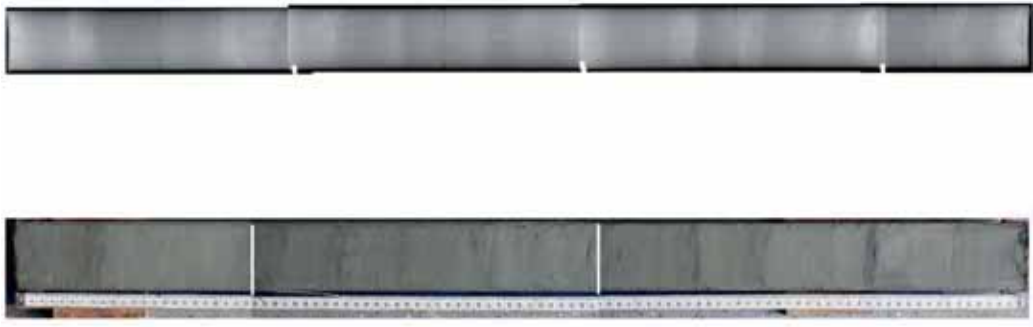
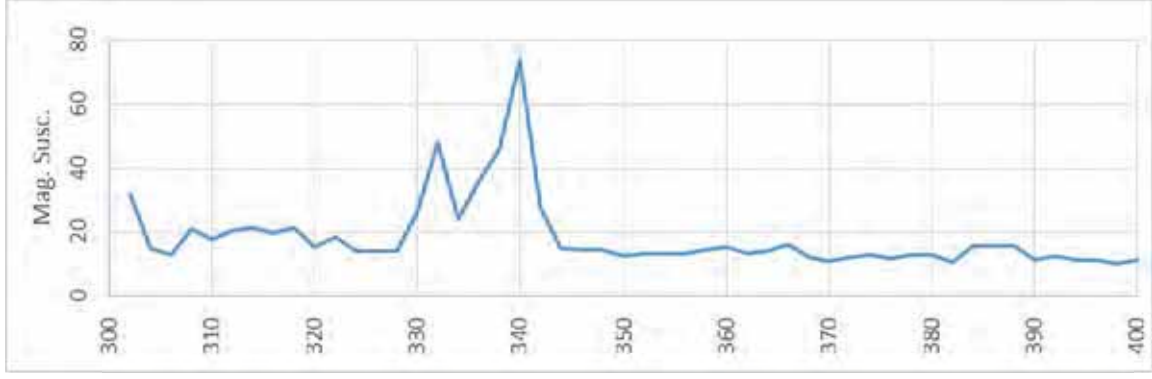
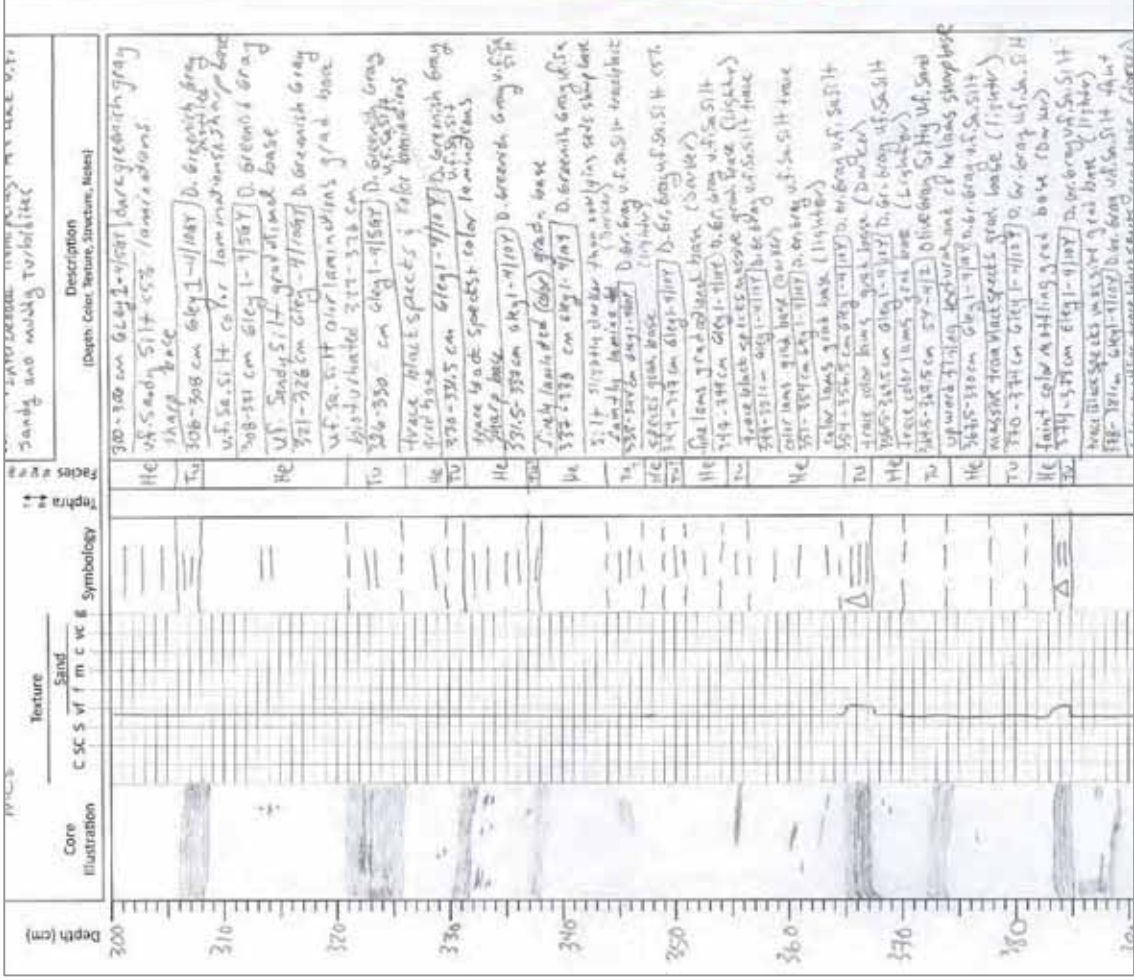


TAN1613 - Paleoseismicity of the Southern Hikurangi Margin

Core ID: MC 3

Other ID TAN1613-24

Section 4 of 5

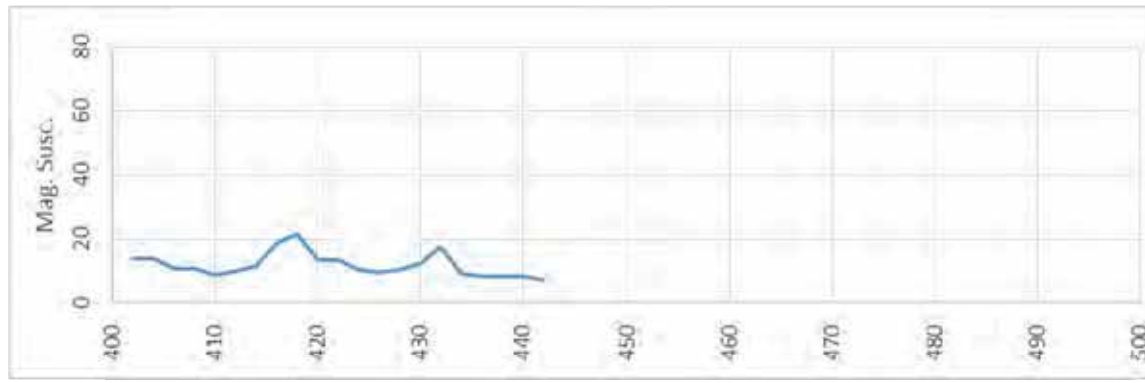
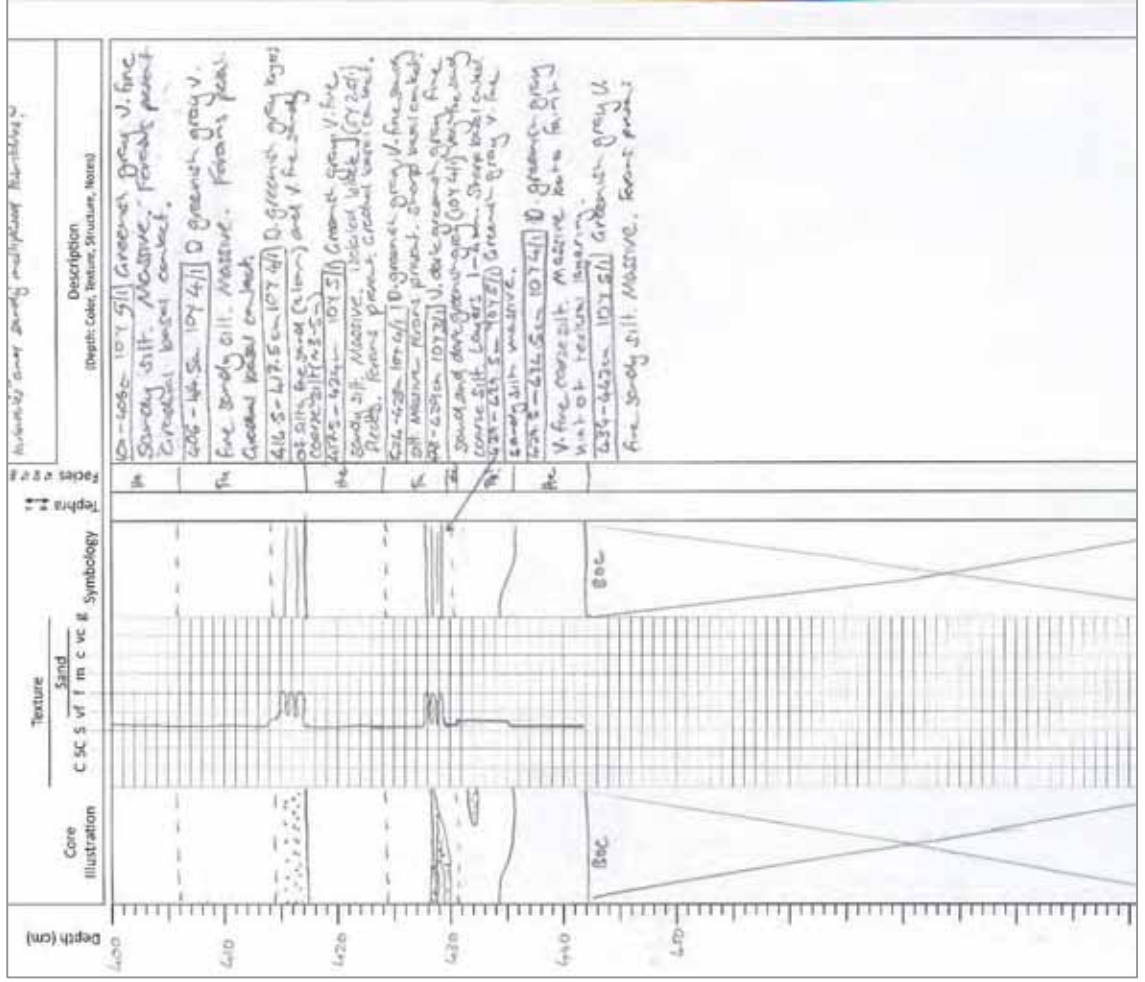


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: MC 3

Other ID TAN1613-24

Section 5 of 5



TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: MC 1	Latitude: -40.85567	Date/Time (NZST): 13/11/2016 22:09
Other ID: TAN1613-25	Longitude: 177.65550	Depth (m): 2409

Sample Description	Gear type	Piston core
General Description Centre of Akitio Trough Hemipelagic mud interbedded with silty/sandy turbidites in basal 3m. 12cm thick ash at 1.39m.	Barrel Length (m)	6 Bent barrel
	Penetration (m)	Catcher/Cutter bags
	Core length (m)	4.78 Samples
	Sections	5 Tephra
	Fauna	.

Sample processing – core ID:

Section	Top depth (cm)	Btm depth (cm)	Logged	Phys Props	Summary
1	0	100	Y	Y	.
2	100	200	Y	Y	.
3	200	300	Y	Y	.
4	300	400	Y	Y	.
5	400	478	Y	Y	.
.

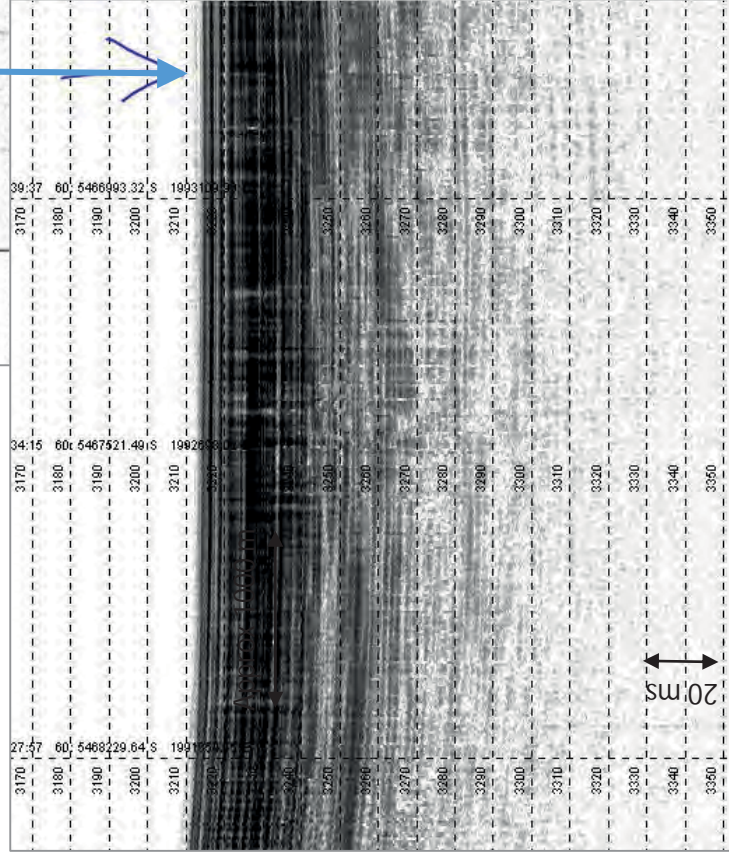
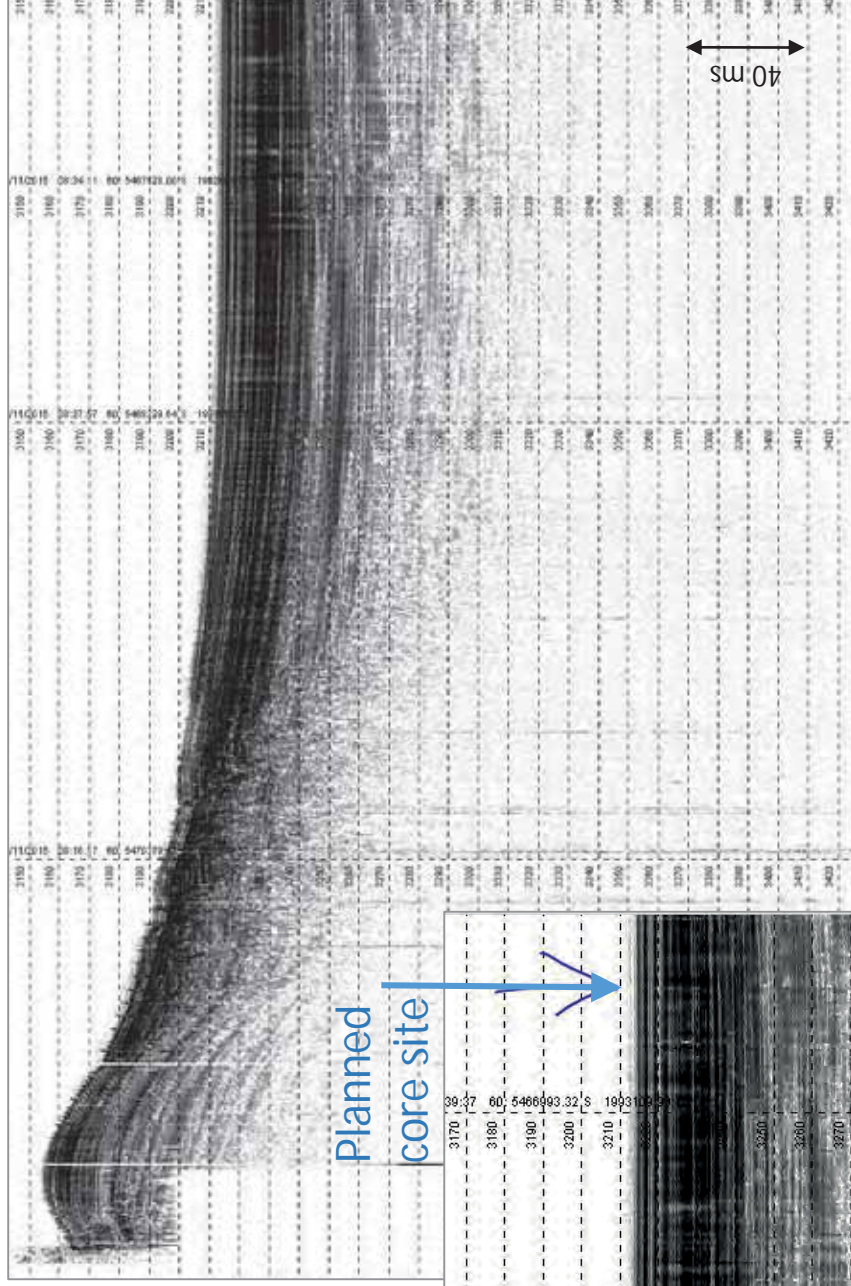
TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: MC 1

Other ID TAN1613-25

Water Depth 2409 m

Topas line including transit to the station. Blue arrow marks the planned core site.



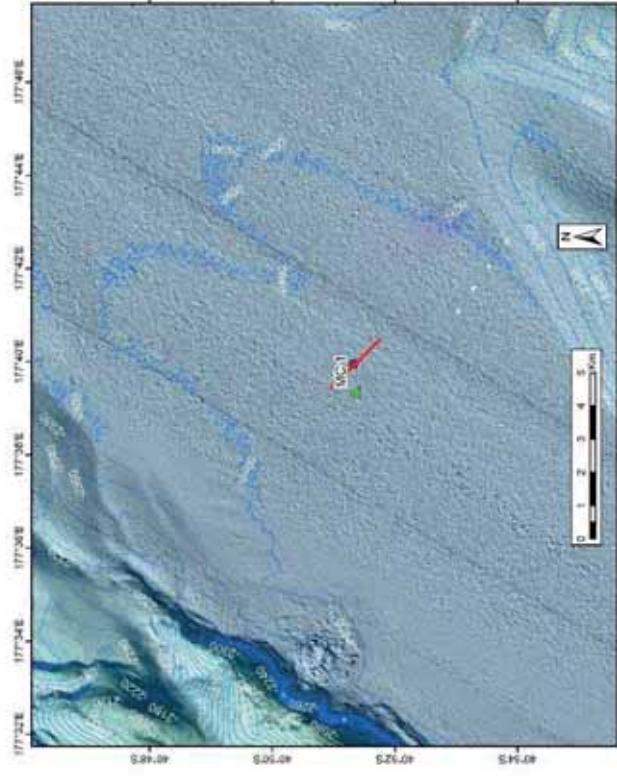
Zoom into 2km survey lines over planned core site

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

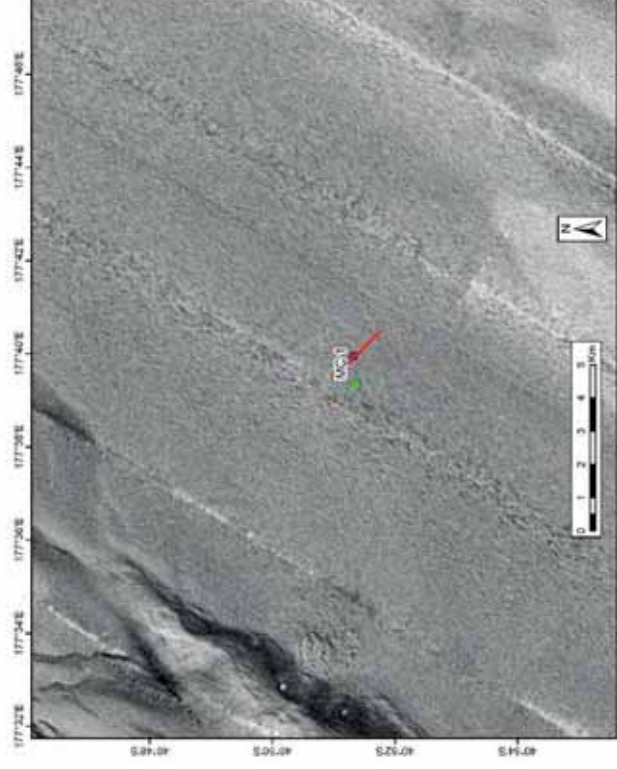
Core ID: MC 1

Other ID TAN1613-25

Water Depth 2409 m



Bathymetry at and around MC1 core site at the centre of Akitio Trough. Light blue lines are 20 m depth contours. Red line shows the 2 km TOPAS survey line over the station, the green triangle indicates the actual core site.



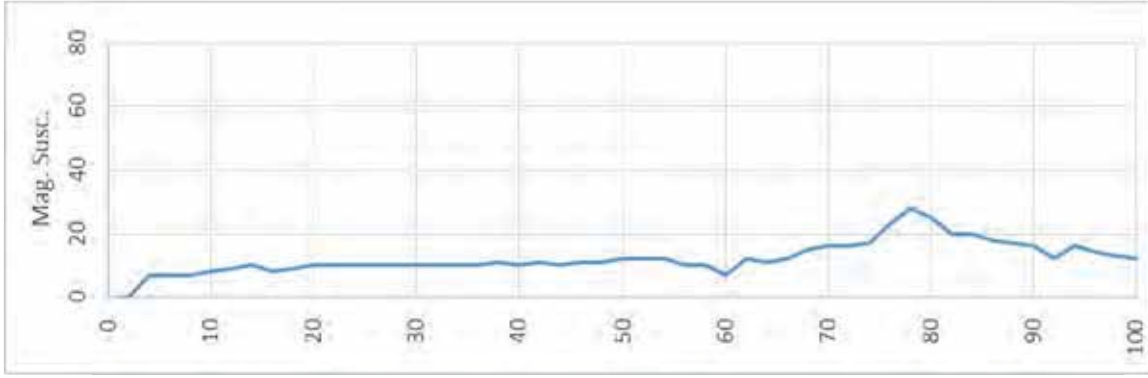
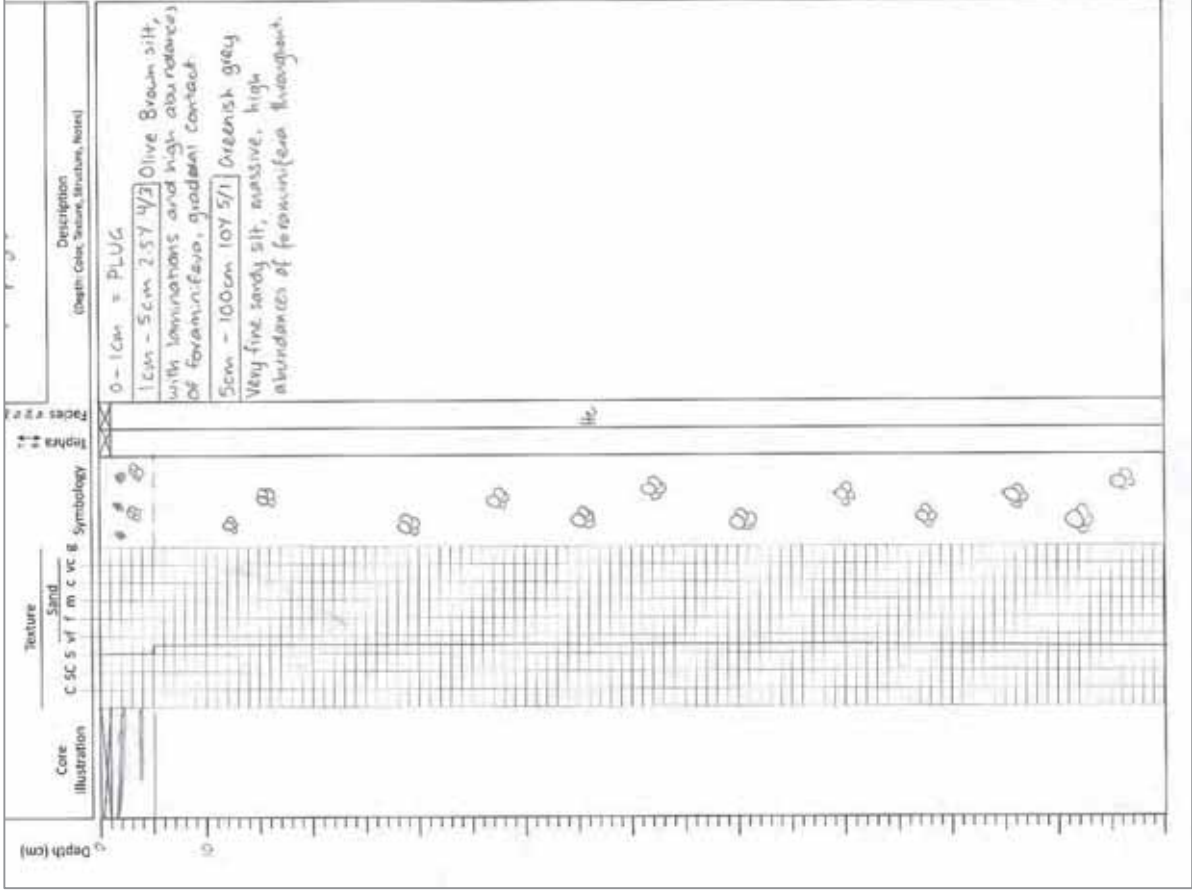
Backscatter at and around MC1 core site at the centre of Akitio Trough. Light blue lines are 20 m depth contours. Red line shows the 2 km TOPAS survey line over the station, the green triangle indicates the actual core site.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: MC 1

Other ID TAN1613-25

Section 1 of 5

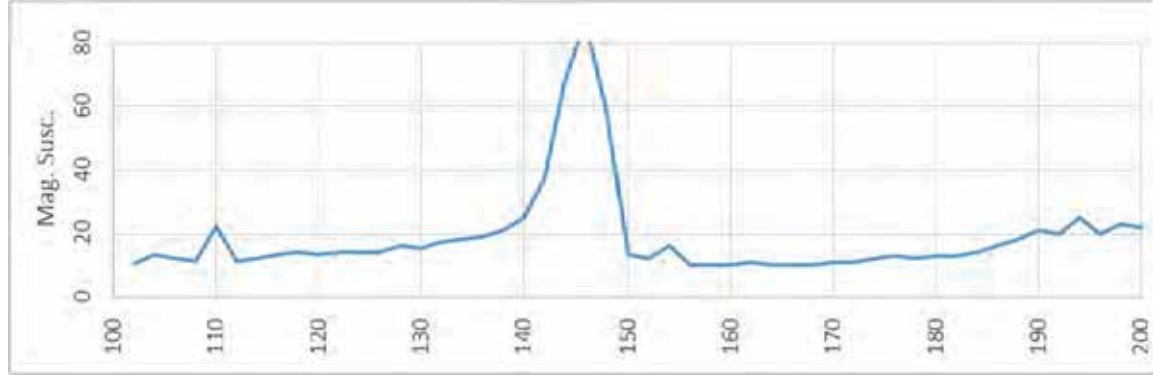
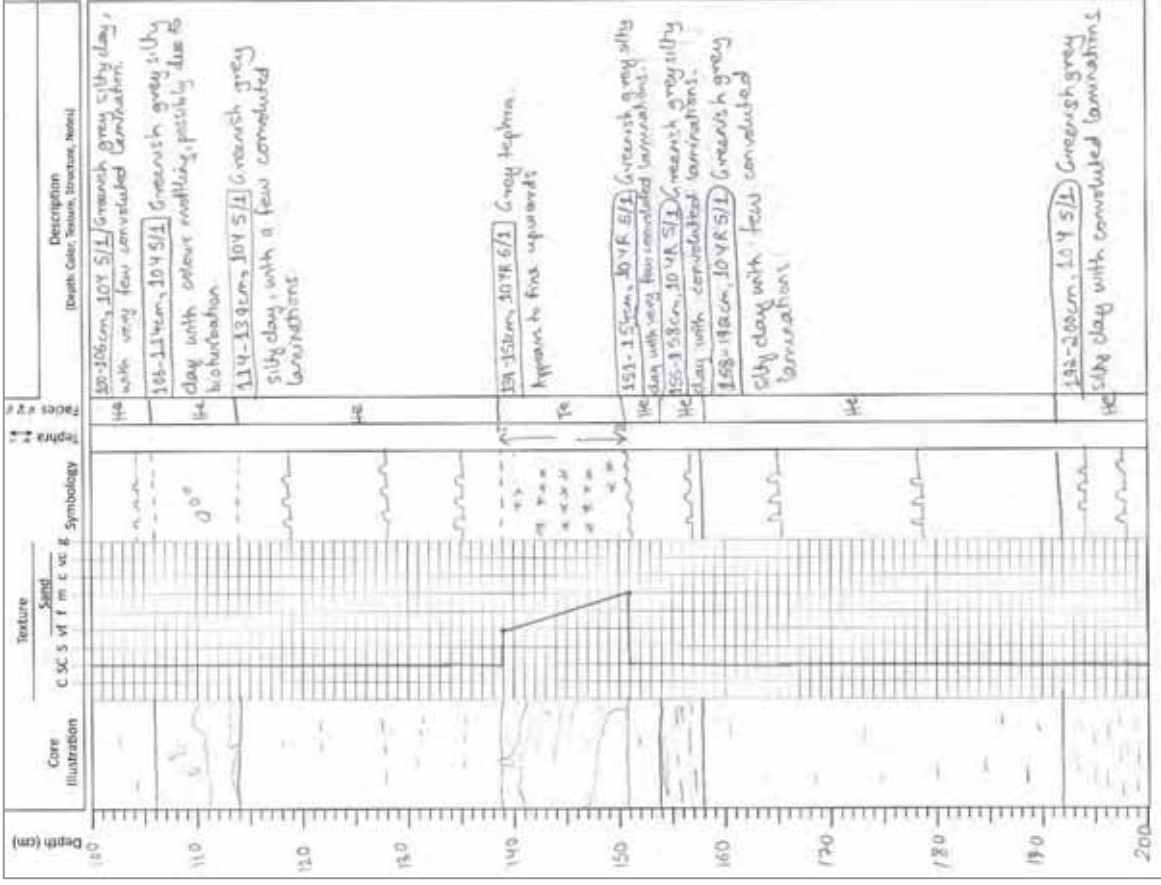


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: MC 1

Other ID TAN1613-25

Section 2 of 5

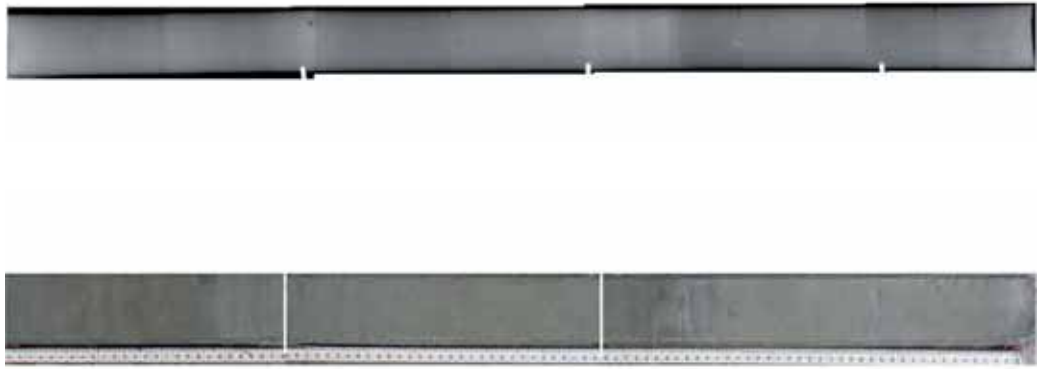
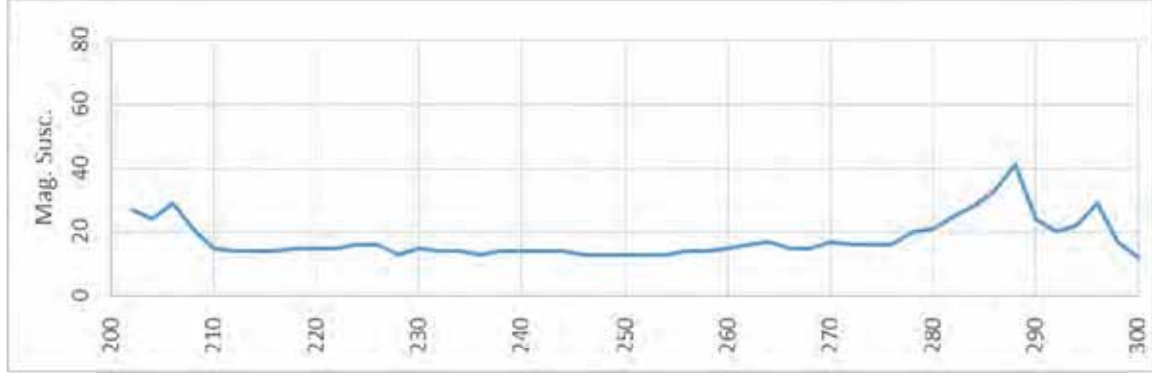
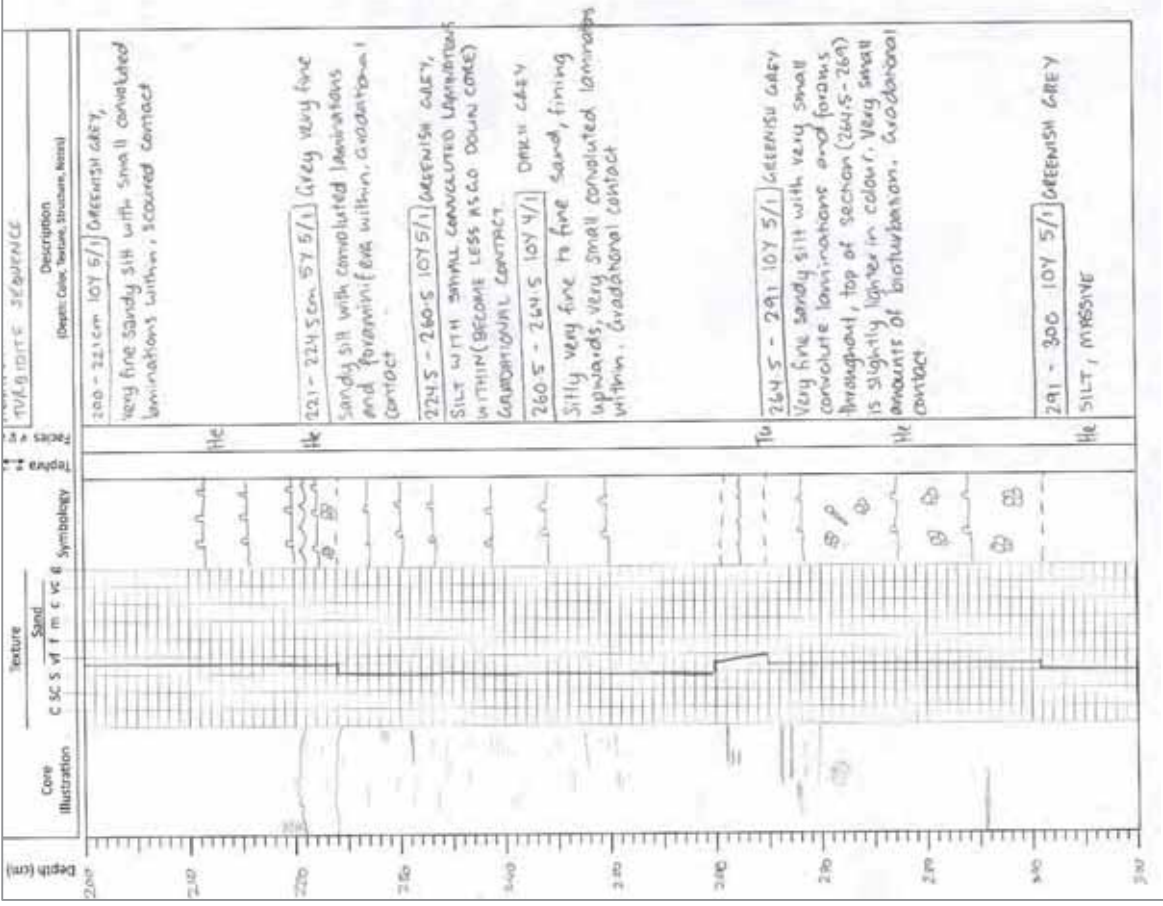


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: MC 1

Other ID TAN1613-25

Section 3 of 5

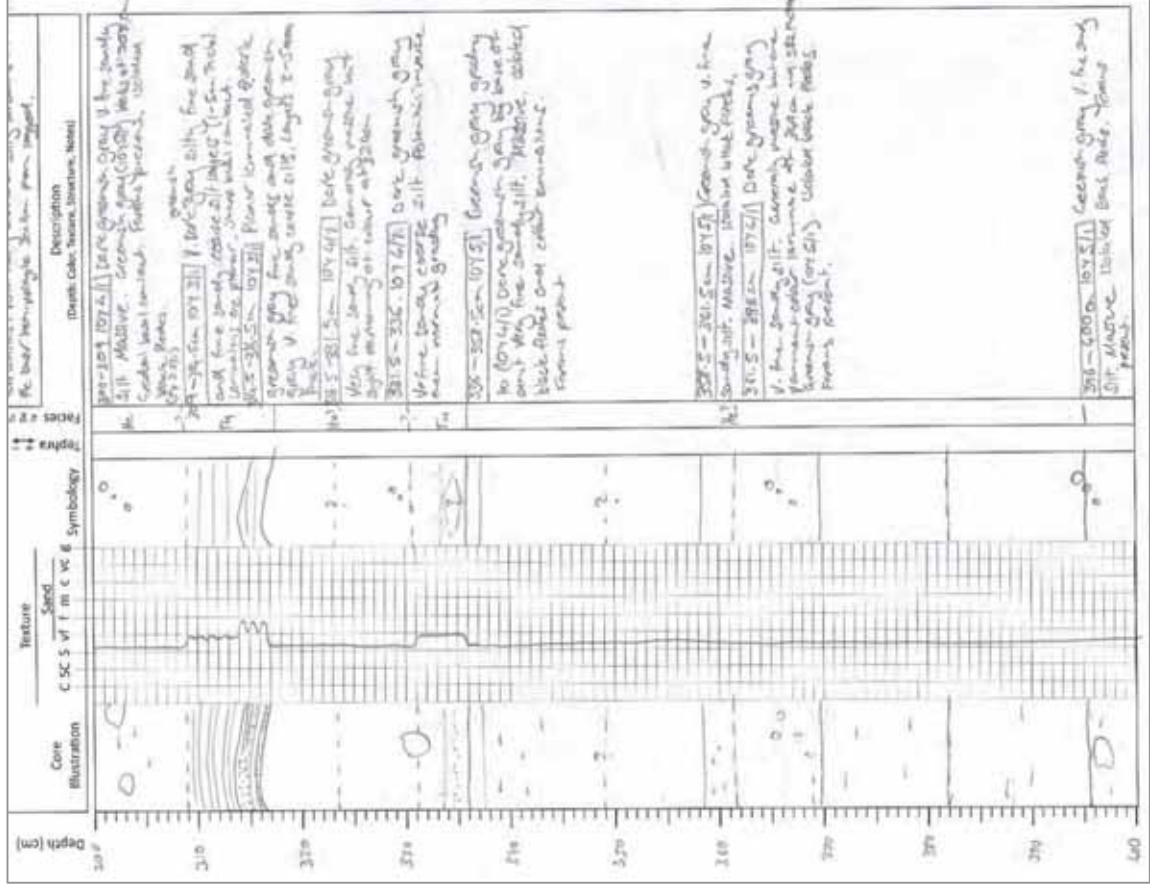
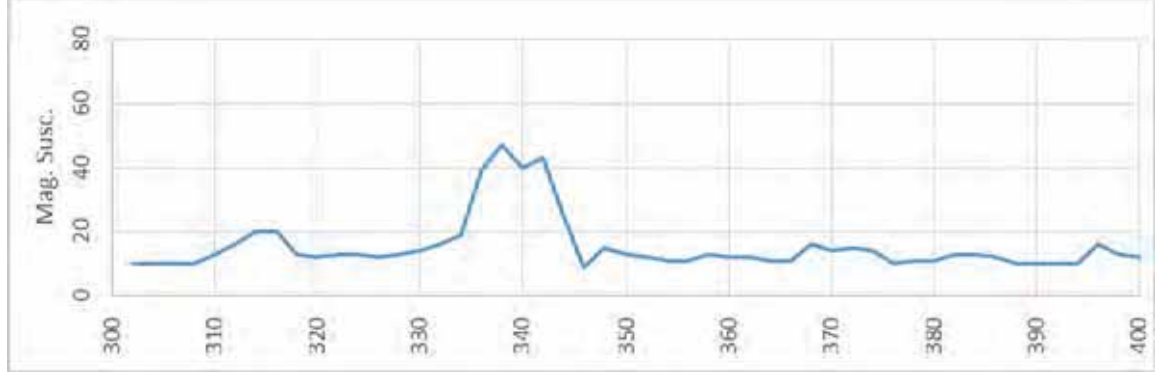


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: MC 1

Other ID TAN1613-25

Section 4 of 5

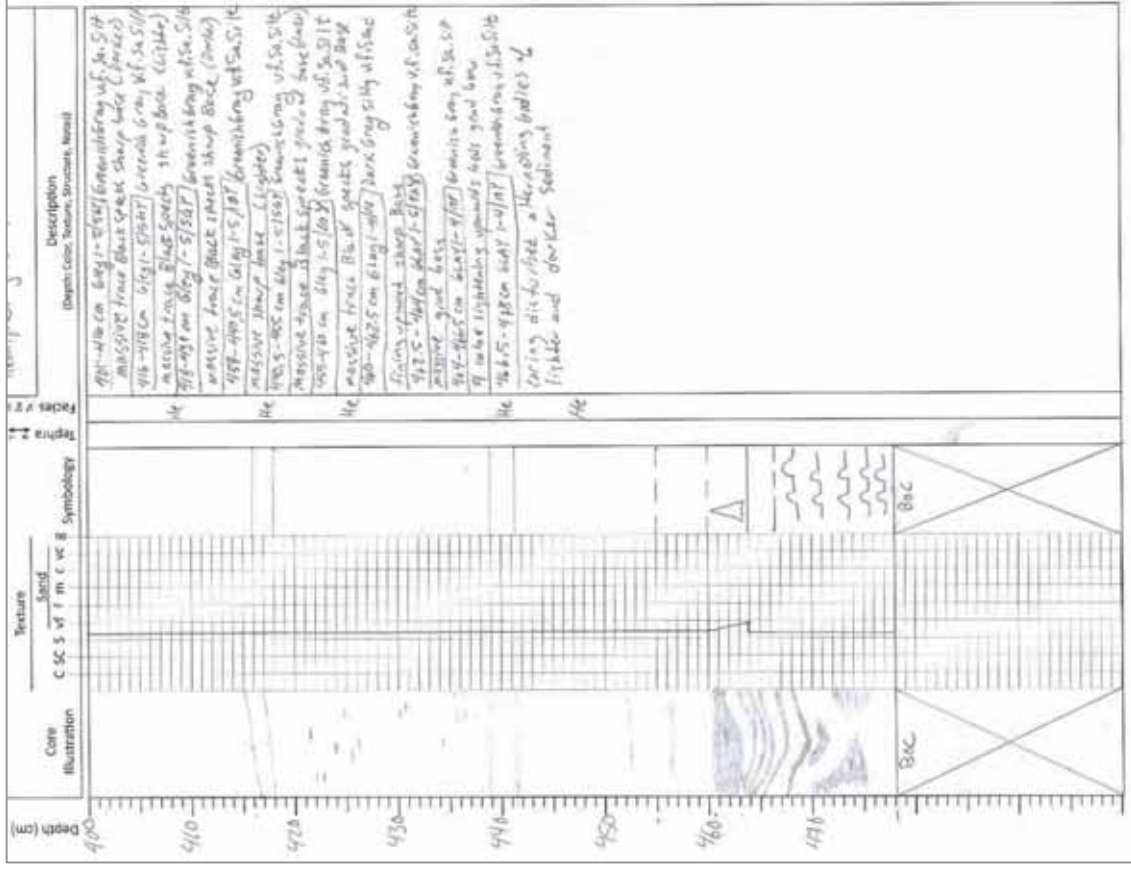
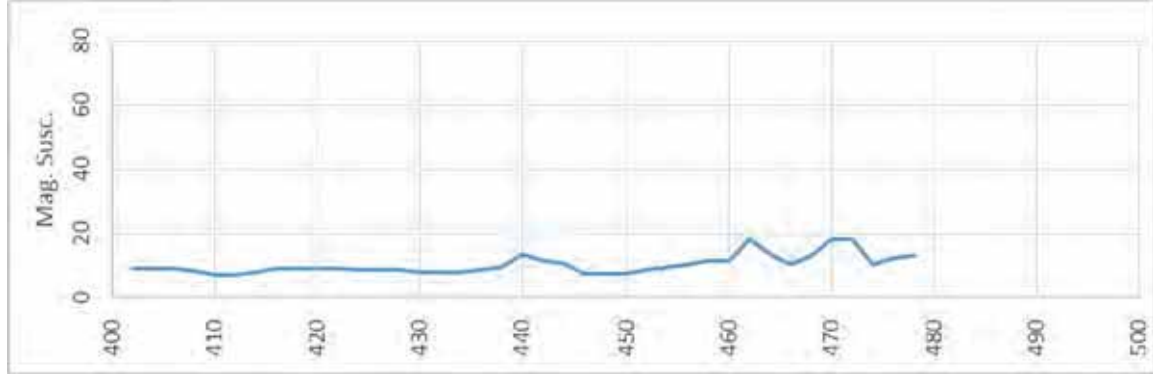


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: MC 1

Other ID TAN1613-25

Section 5 of 5



TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: **MC 11**

Latitude: -40.66477

Date/Time (NZST): 14/11/2016 03:27

Other ID: TAN1613-26

Longitude: 177.26073

Depth (m): 1809

Sample Description

General Description

Terrace on Sth side of lower Madden Canyon, NW Porangahau Basin

Hemipelagite with one sandy turbidite and some sandy blebs

Gear type		Piston core	
Barrel Length (m)		Bent barrel	
Penetration (m)		Catcher/Cutter bags	
Core length (m)	4.15	Samples	N
Sections	5	Tephra	
Fauna		.	

Sample processing – core ID:

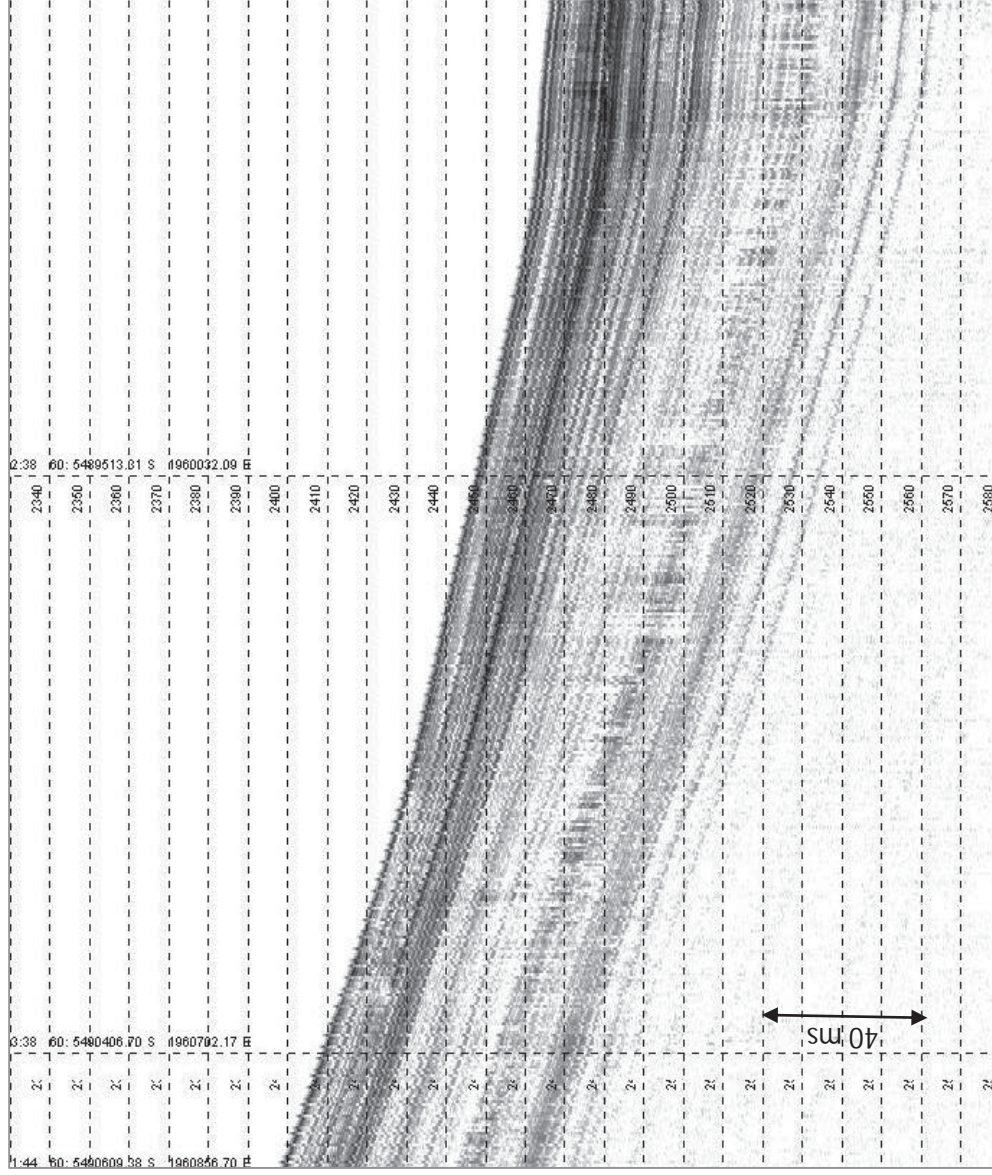
Section	Top depth (cm)	Btm depth (cm)	Logged	Phys Props	Summary
1	0	100	Y	Y	.
2	100	200	Y	Y	.
3	200	300	Y	Y	.
4	300	347	Y	Y	.
5	347	415	Y	Y	.
.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: MC 11

Other ID TAN1613-26

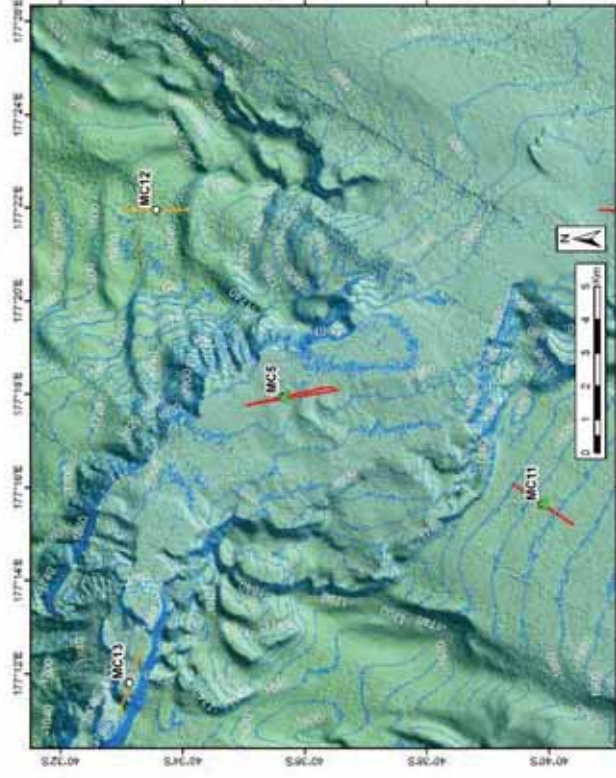
Water Depth 1809 m



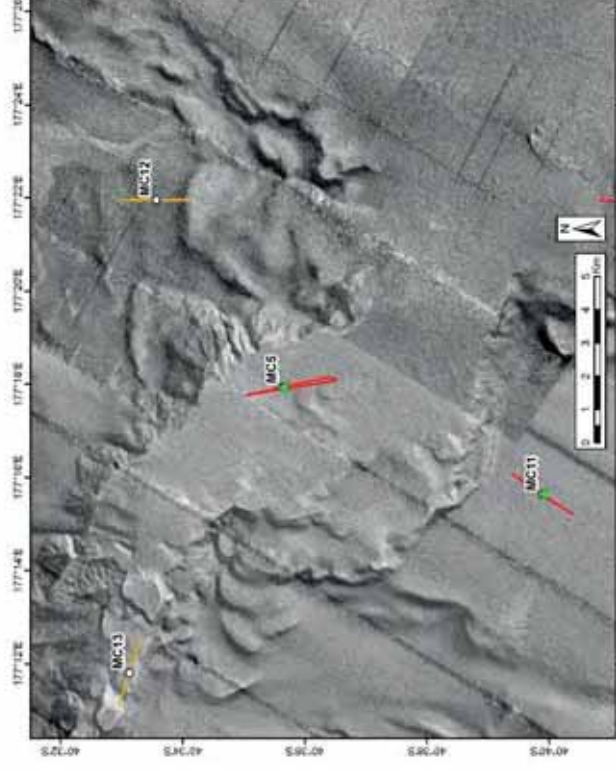
Topas line over the station.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: MC 11	Other ID TAN1613-26	Water Depth 1809 m
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Bathymetry at and around MC11 core site at the terrace on Southern side of lower Madden Canyon, NW Porangahau Basin. Light blue lines are 20 m depth contours. Red lines show the 2 km TOPAS survey line over the stations, green triangles indicate the actual core site. The orange line and white circle are the planned Topas line and core location for another station not yet done.



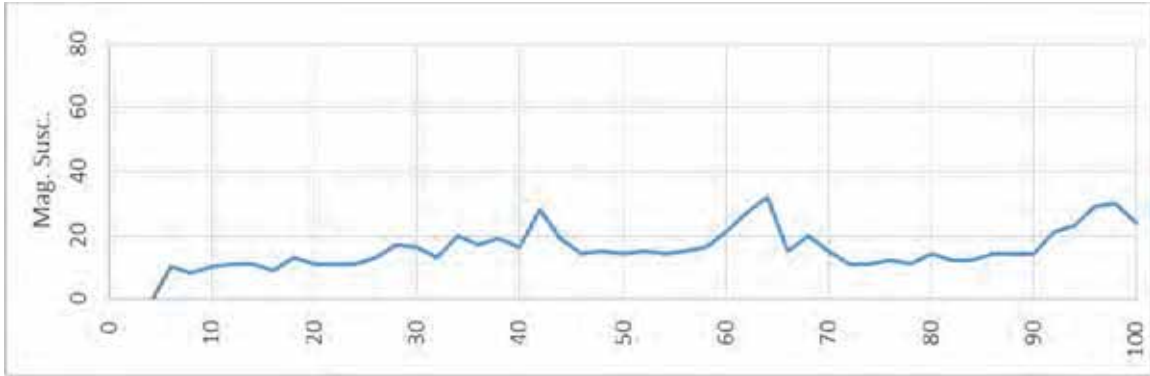
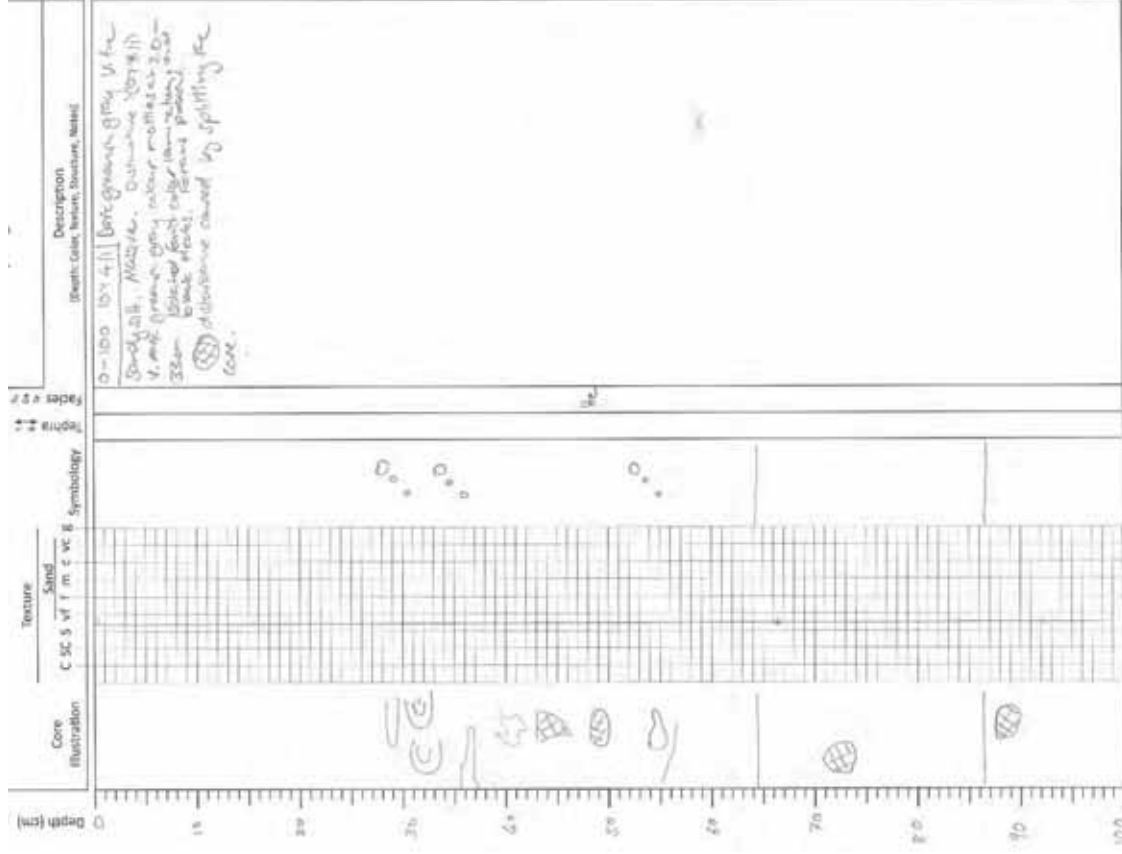
Backscatter at and around MC11 core site at the terrace on Southern side of lower Madden Canyon, NW Porangahau Basin. Light blue lines are 20 m depth contours. Red lines show the 2 km TOPAS survey line over the stations, green triangles indicate the actual core site. The orange line and white circle are the planned Topas line and core location for another station not yet done.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: MC 11

Other ID

Section 1 of 5

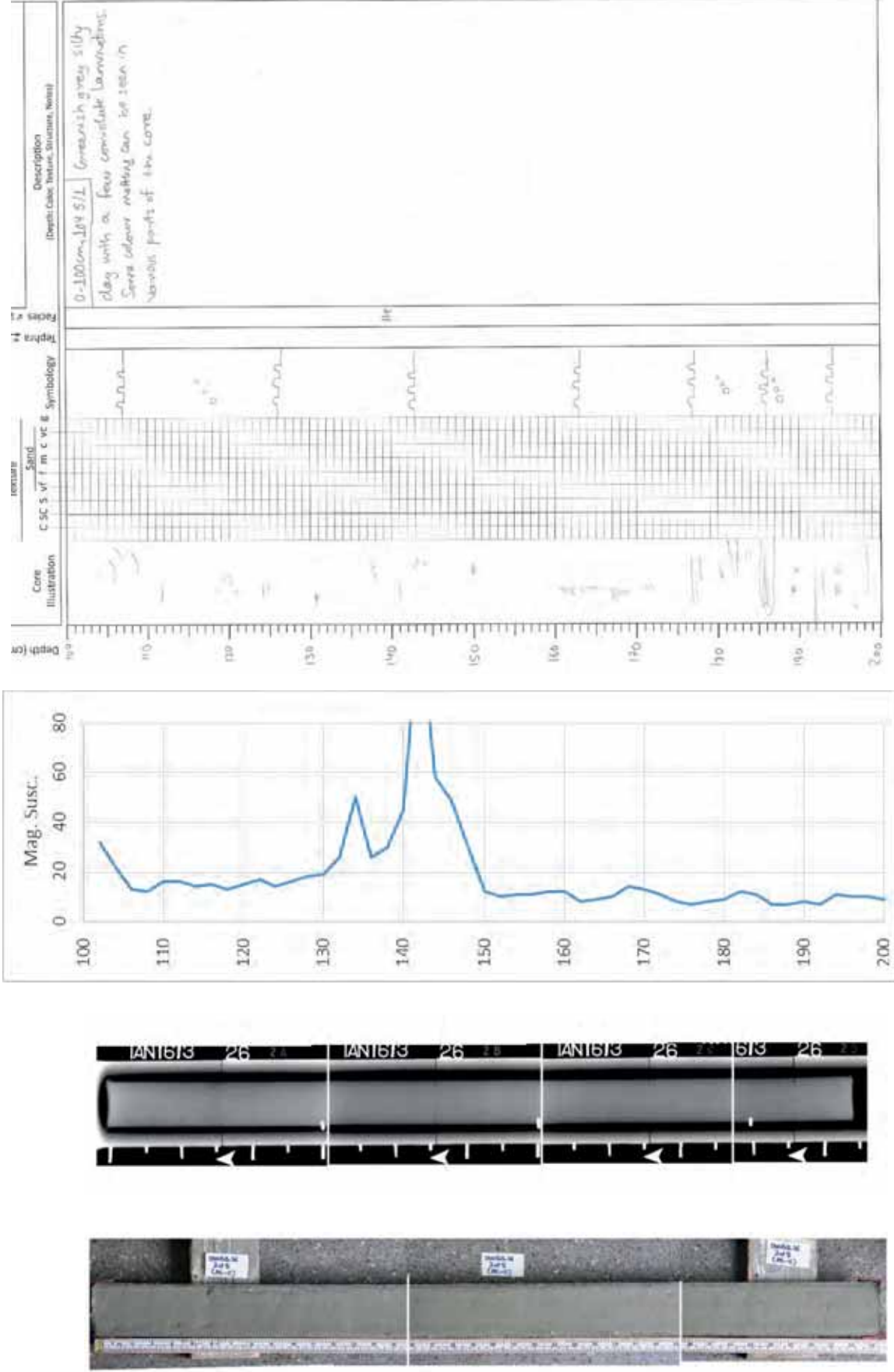


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: MC 11

Other ID TAN1613-26

Section 2 of 5

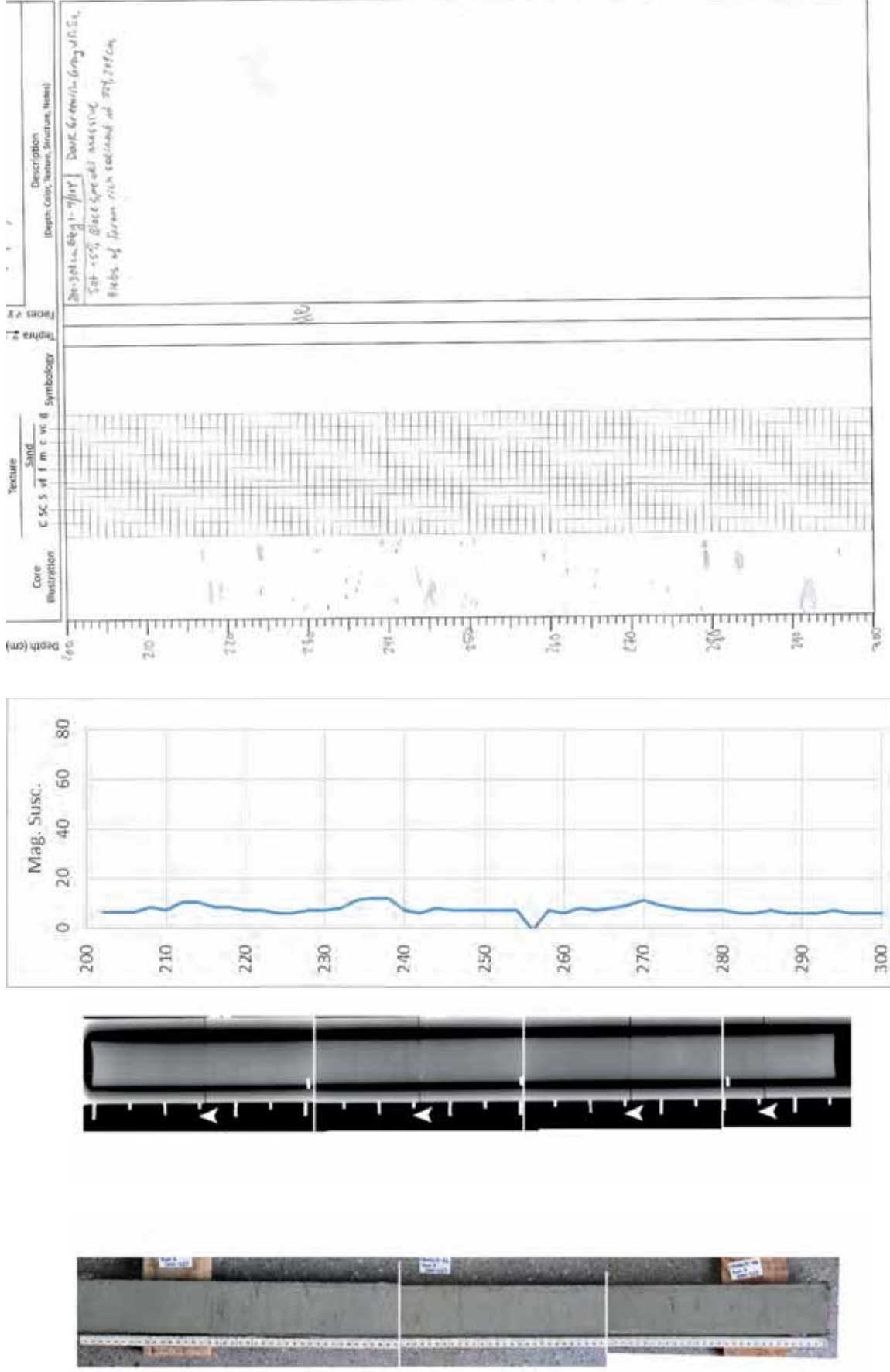


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: MC 11

Other ID TAN1613-26

Section 3 of 5

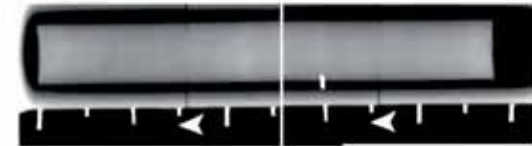
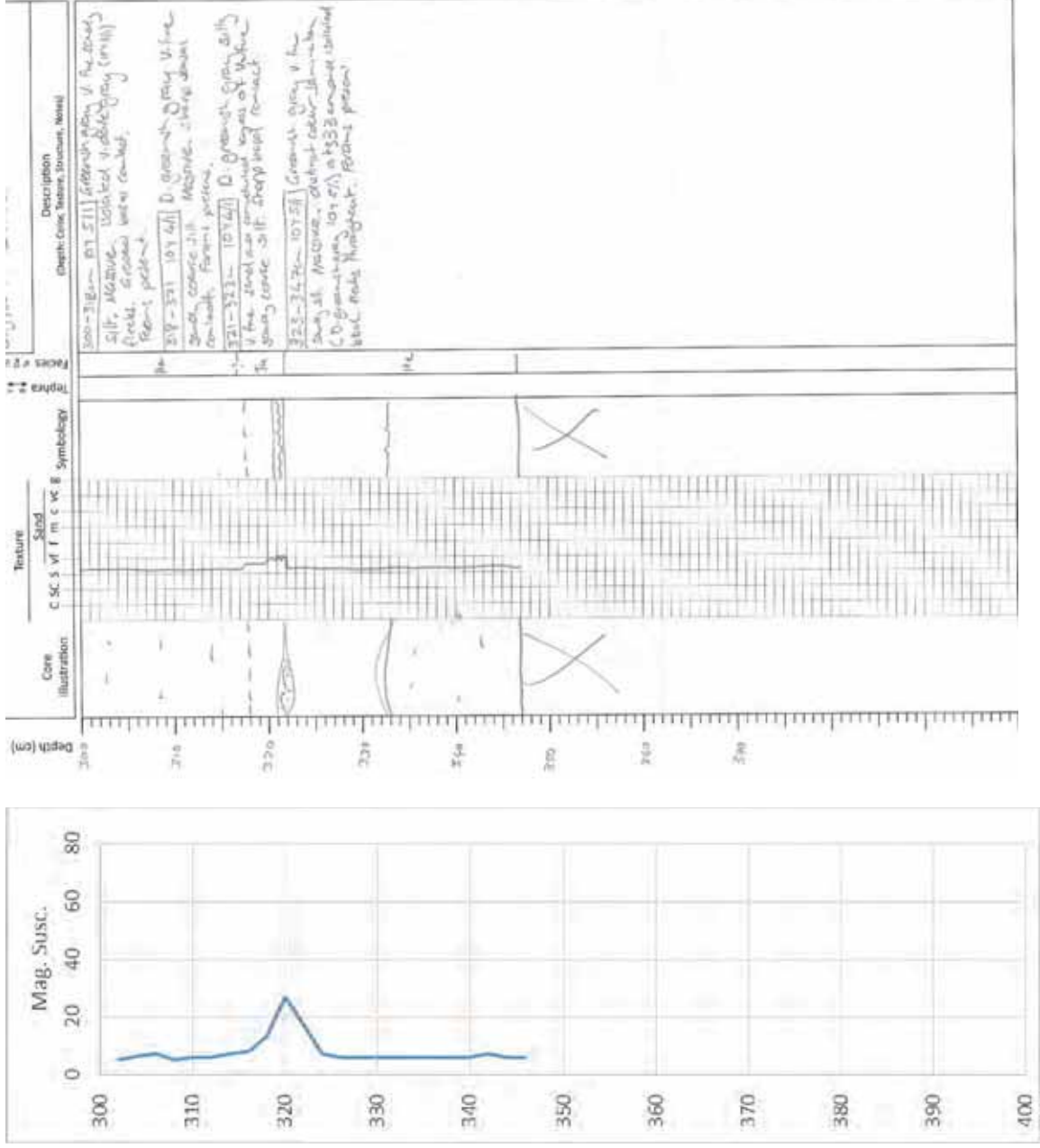


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: MC 11

Other ID TAN1613-26

Section 4 of 5

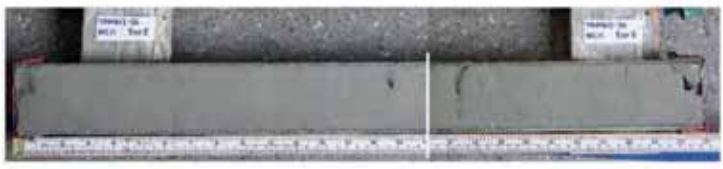
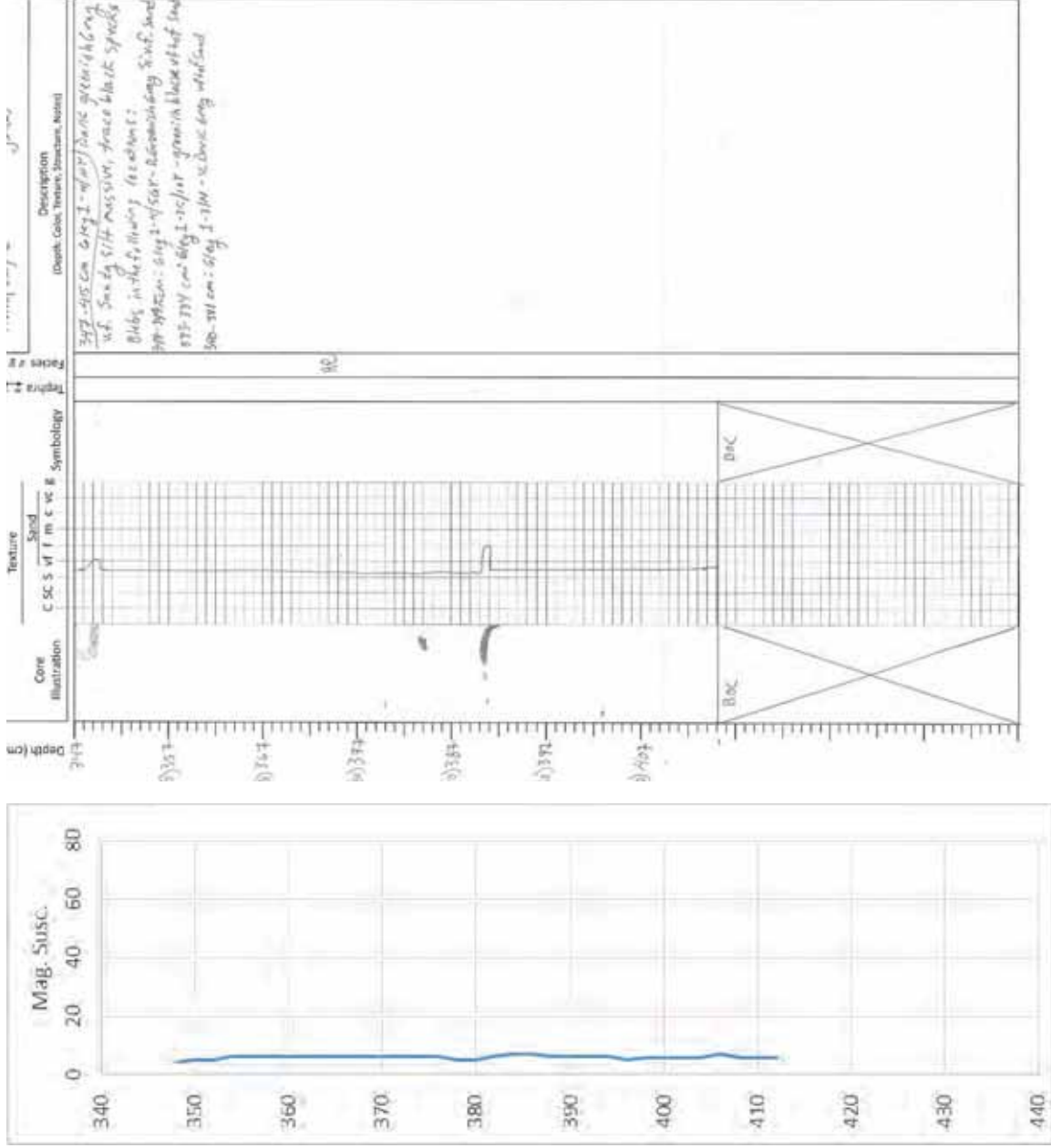


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: MC 11

Other ID TAN1613-26

Section 5 of 5



TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: **MC 5** Latitude: -40.59385 Date/Time (NZST): 14/11/2016 05:57

Other ID: **TAN1613-27** Longitude: 177.29883 Depth (m): **1950**

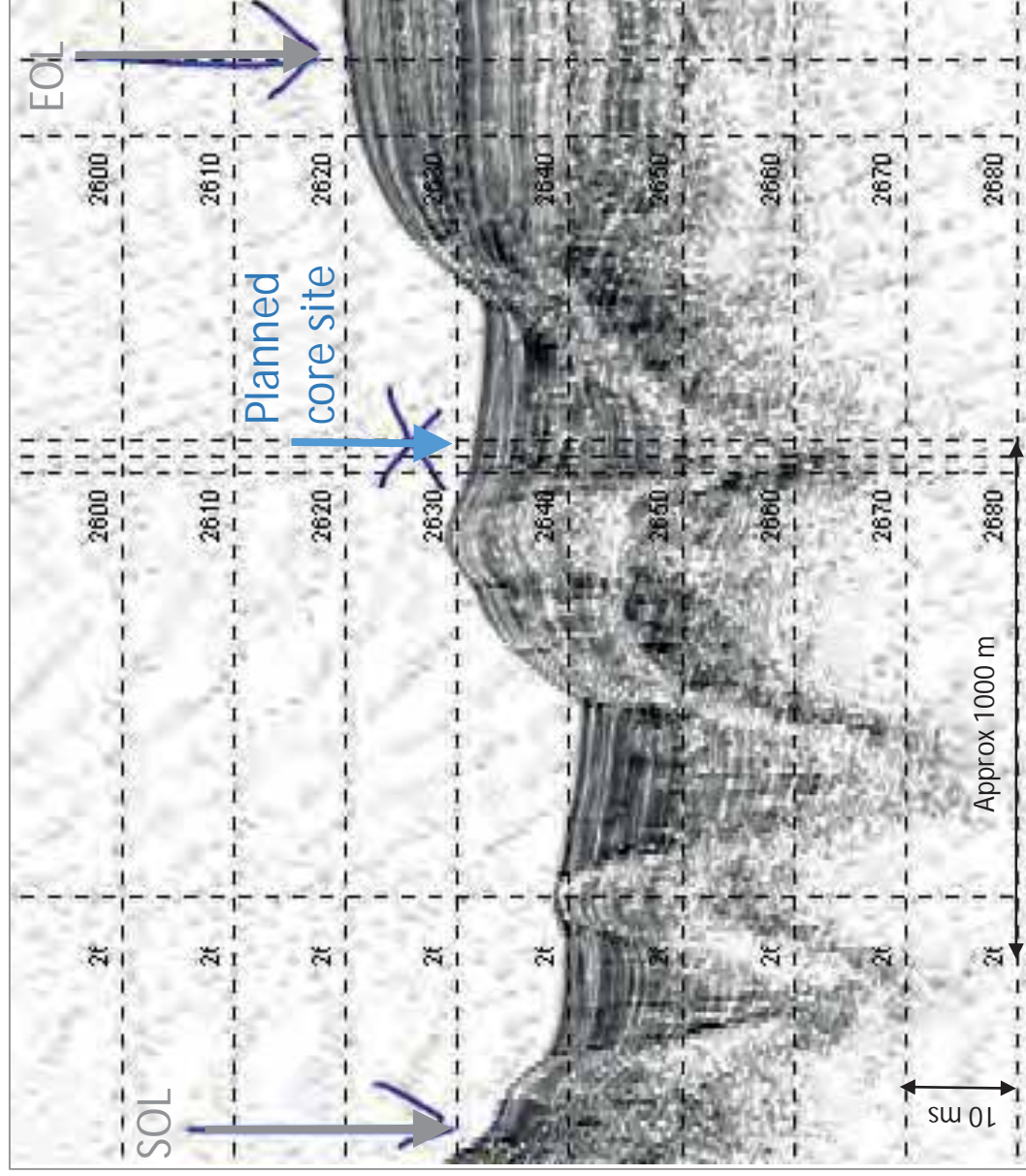
Sample Description	Gear type	Piston core
General Description Sediment waves in lower Madden Canyon Interbedded sandy and muddy turbidites and ash bleb, and possible overlying volcaniclastic turbidite in section 5	Barrel Length (m)	Bent barrel
	Penetration (m)	Catcher/Cutter bags
	Core length (m)	4.1
	Sections	5
	Fauna	Tephra
		1
		2.7t

Sample processing – core ID:

Section	Top depth (cm)	Btm depth (cm)	Logged	Phys Props	Summary
1	0	100	Y	Y	.
2	100	200	Y	Y	.
3	200	300	Y	Y	.
4	300	350	Y	Y	.
5	350	410	Y	Y	.
.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

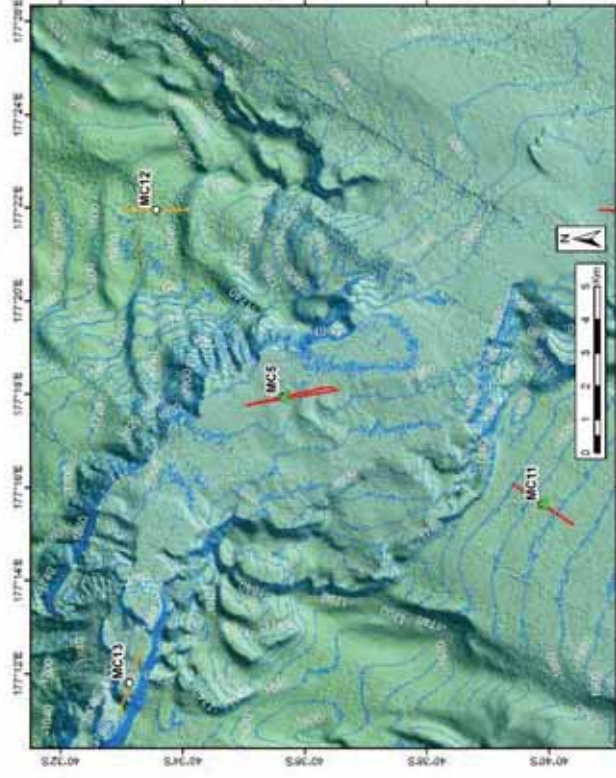
Core ID: MC 5	Other ID TAN1613-27	Water Depth 1950 m
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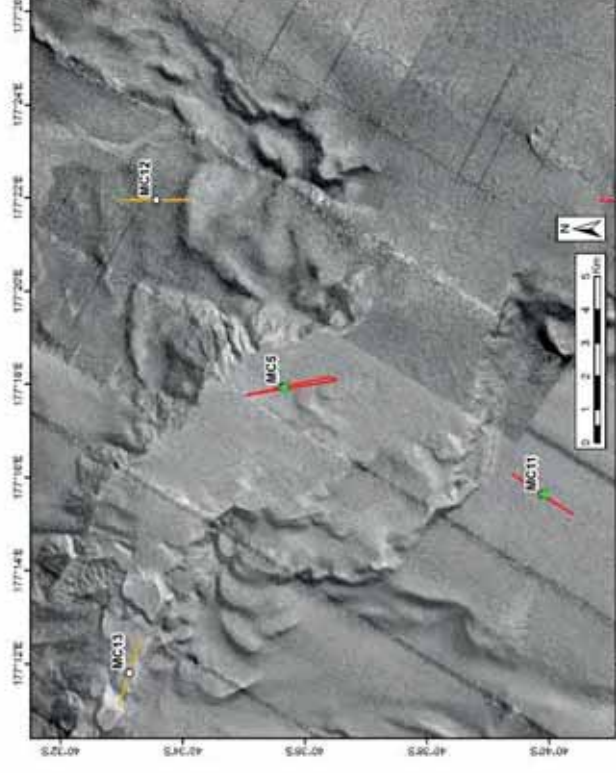
Topas line over the planned core site. Grey arrows indicate start and end of the 2km survey line over the station. Blue arrow marks the planned core site.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: MC 5	Other ID TAN1613-27	Water Depth 1950 m
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Bathymetry at and around MC5 core site at the sediment waves in lower Madden Canyon. Light blue lines are 20 m depth contours. Red lines show the 2 km TOPAS survey line over the stations, green triangles indicate the actual core site. The orange line and white circle are the planned Topas line and core location for another station not yet done.



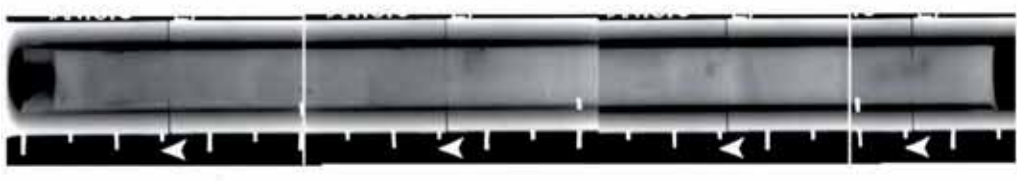
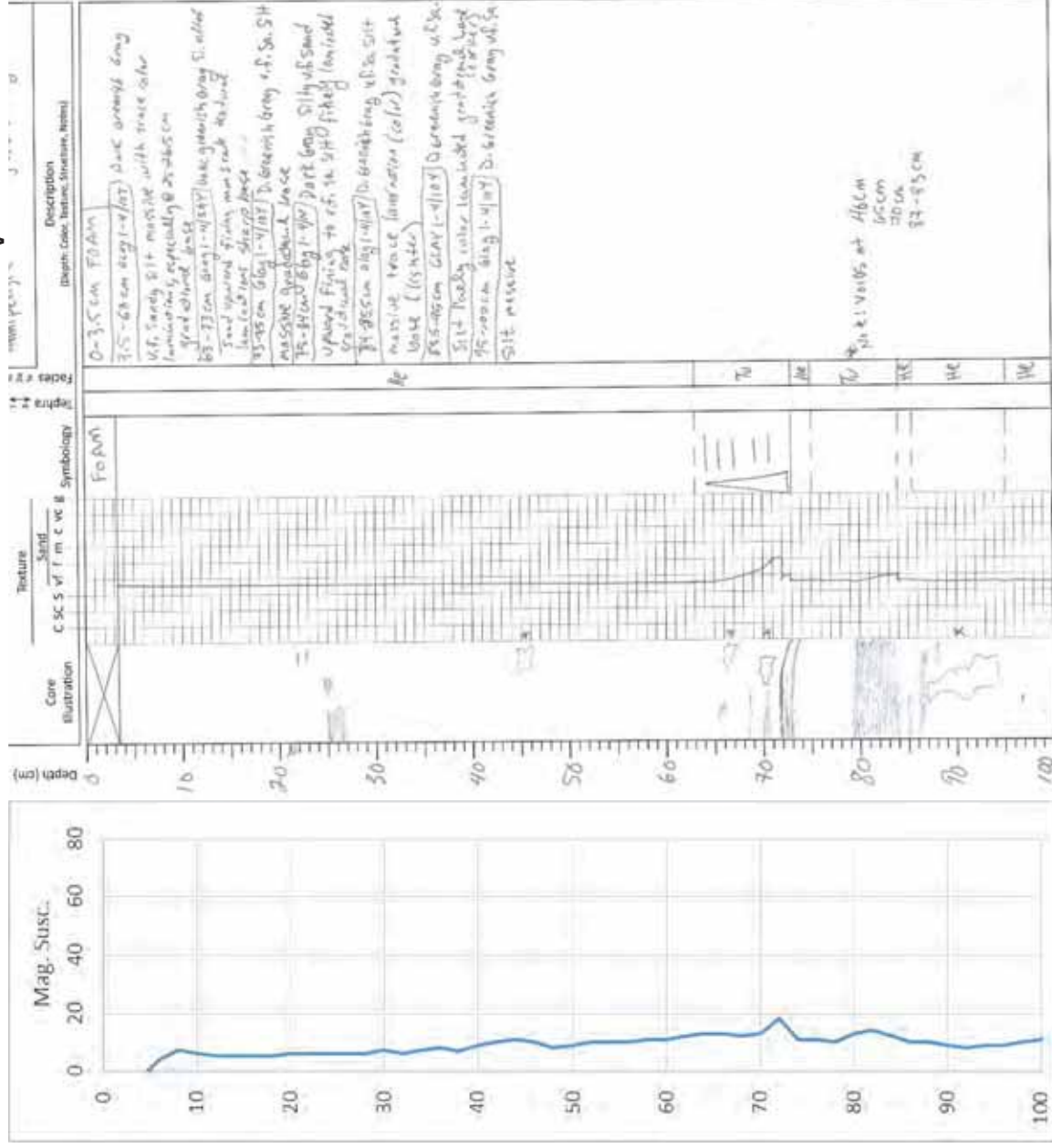
Backscatter at and around MC5 core site at the sediment waves in lower Madden Canyon. Light blue lines are 20 m depth contours. Red lines show the 2 km TOPAS survey line over the stations, green triangles indicate the actual core site. The orange line and white circle are the planned Topas line and core location for another station not yet done.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: MC 5

Other ID TAN1613-27

Section 1 of 5

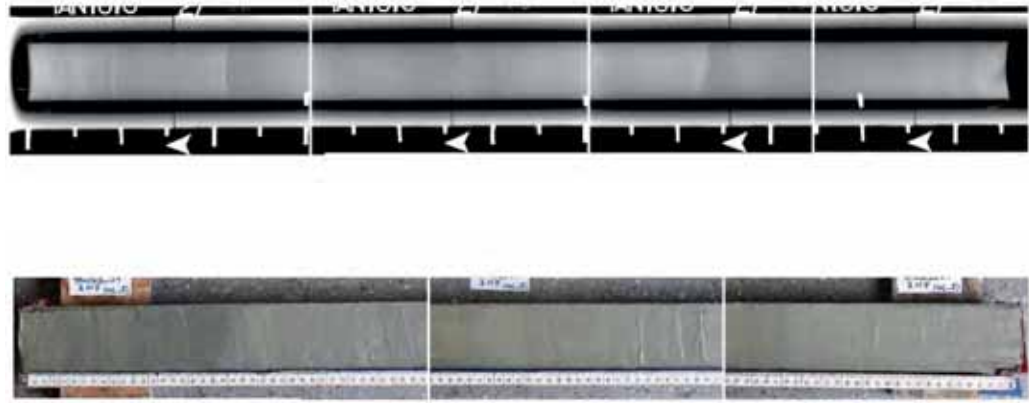
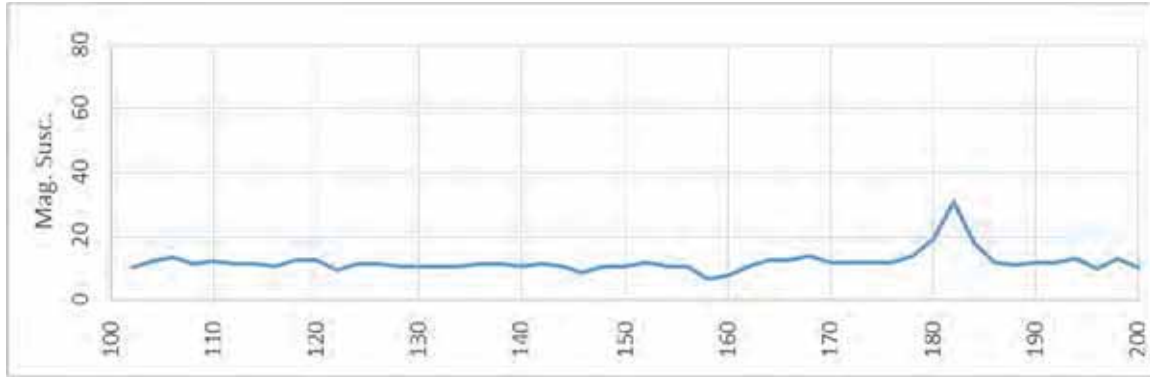
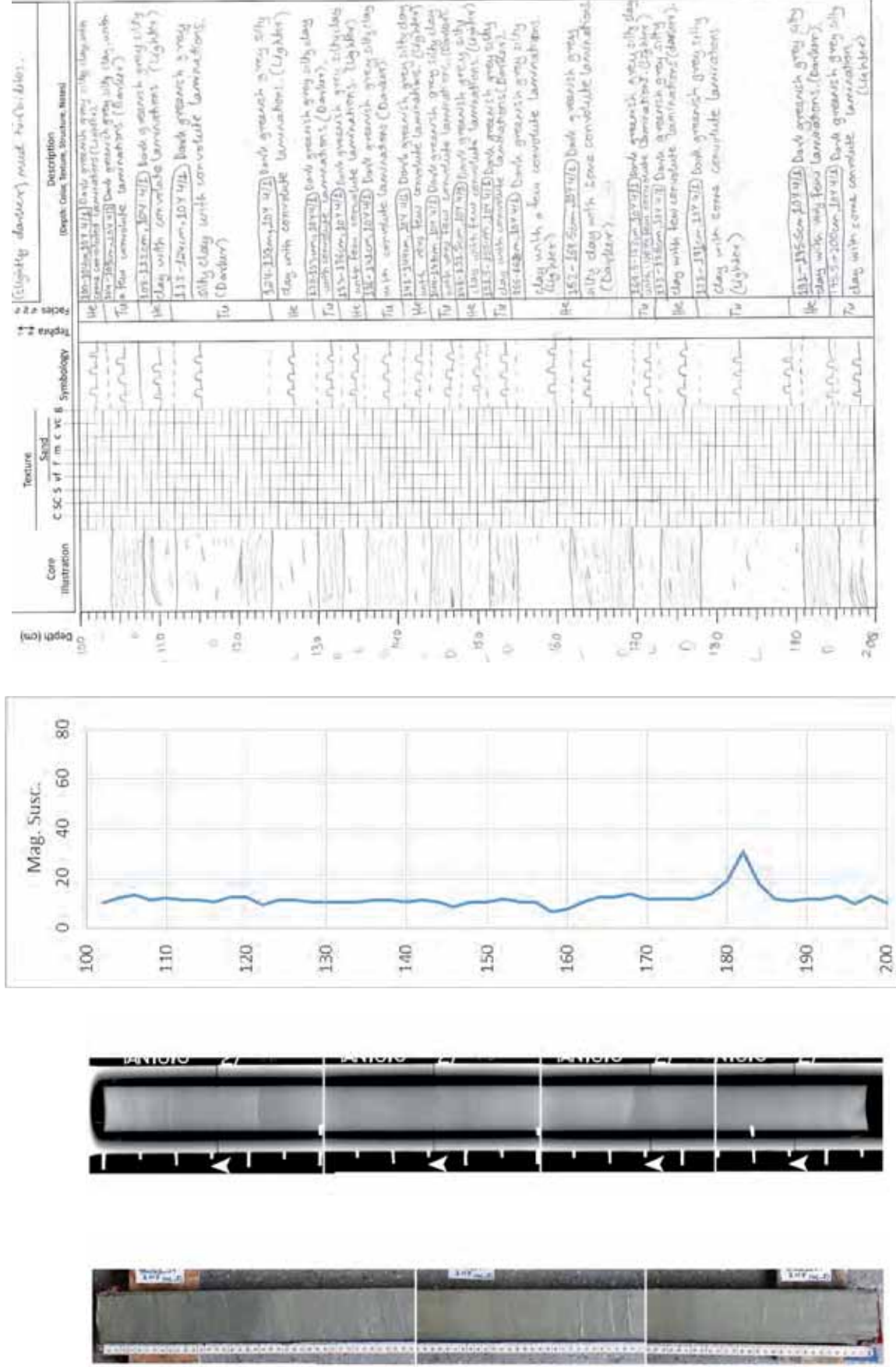


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: MC 5

Other ID TAN1613-27

Section 2 of 5

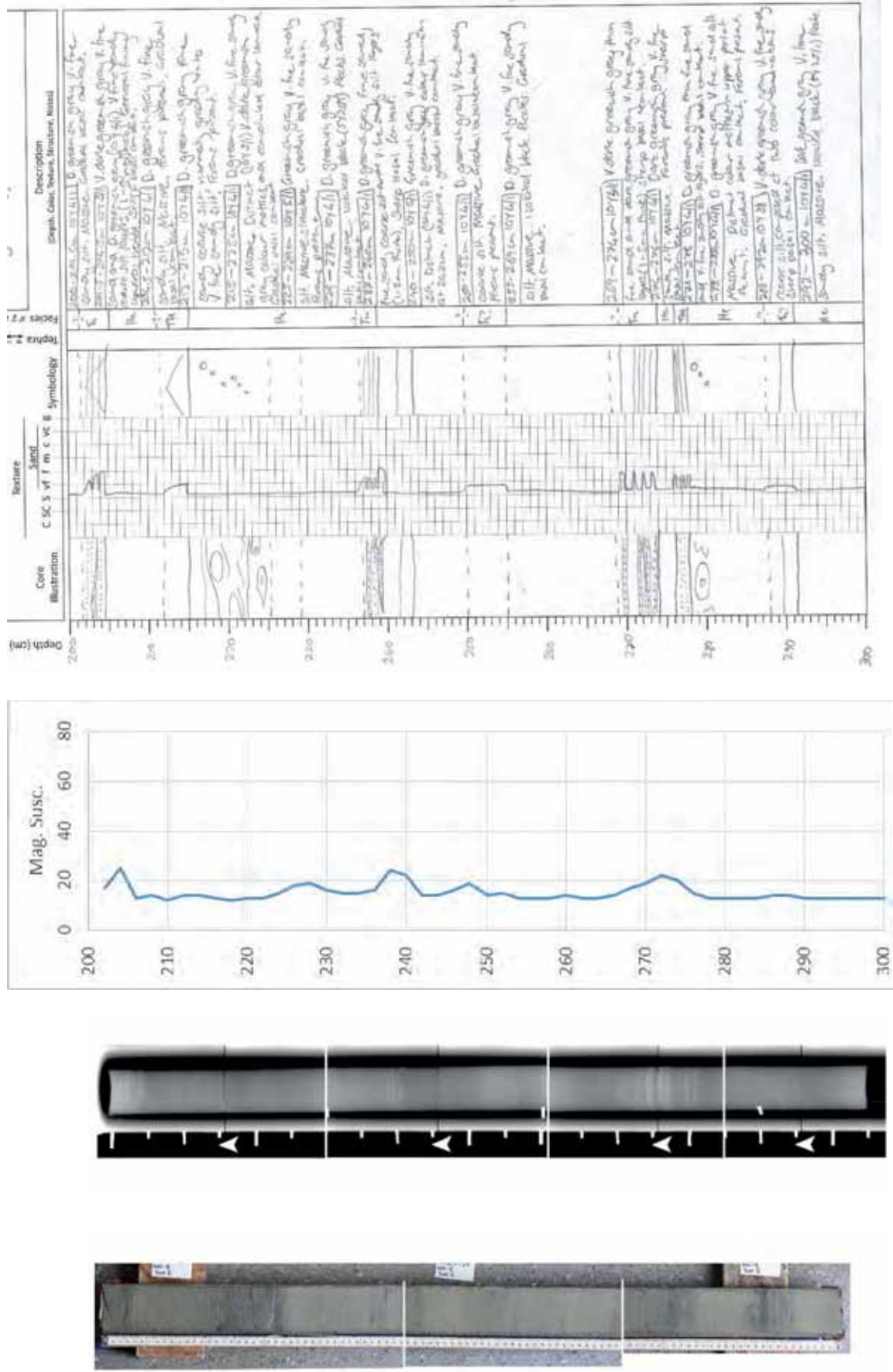


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: MC 5

Other ID TAN1613-27

Section 3 of 5

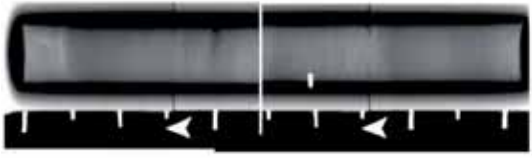
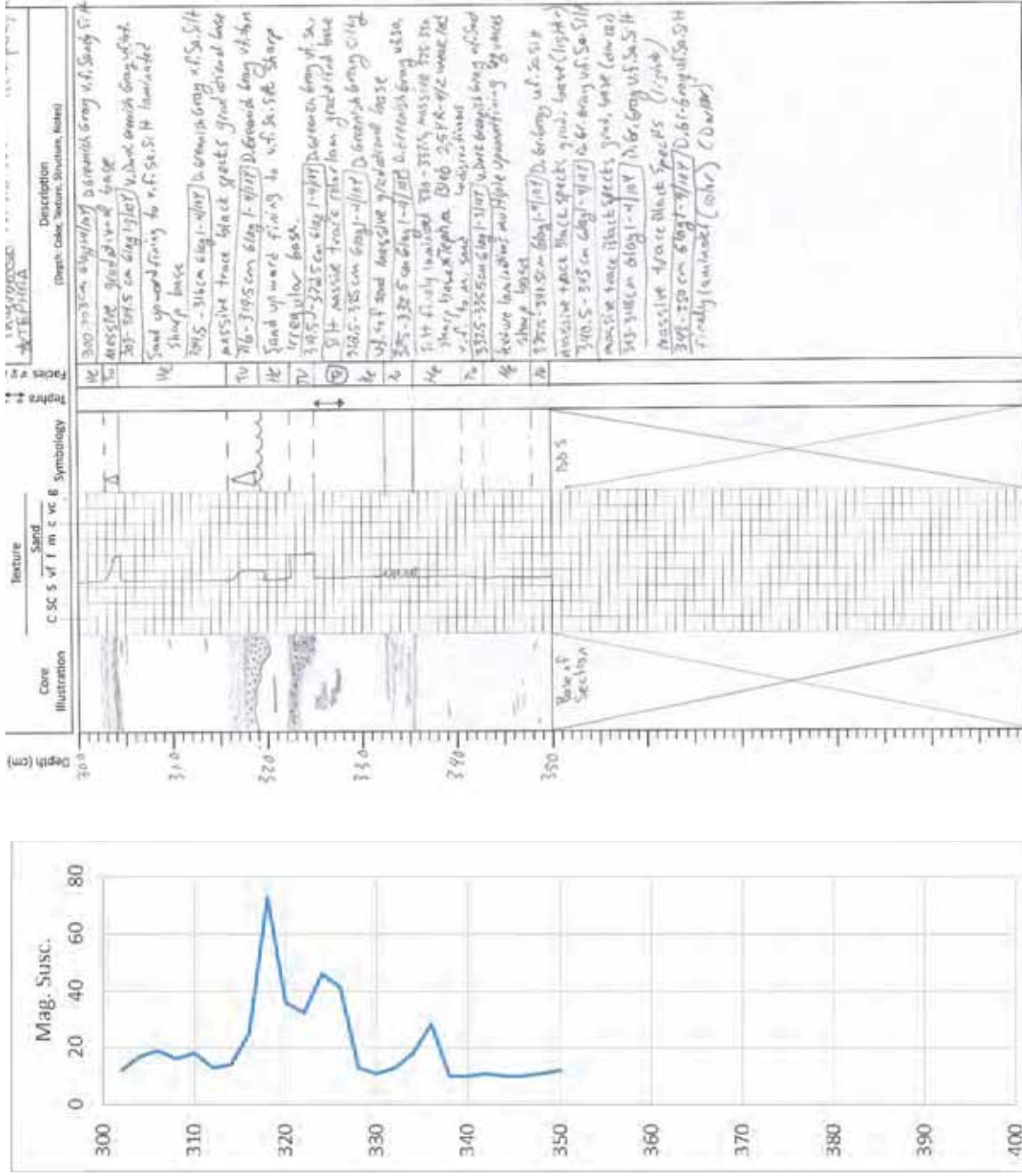


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: MC 5

Other ID TAN1613-27

Section 4 of 5

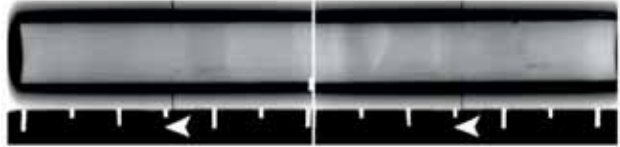
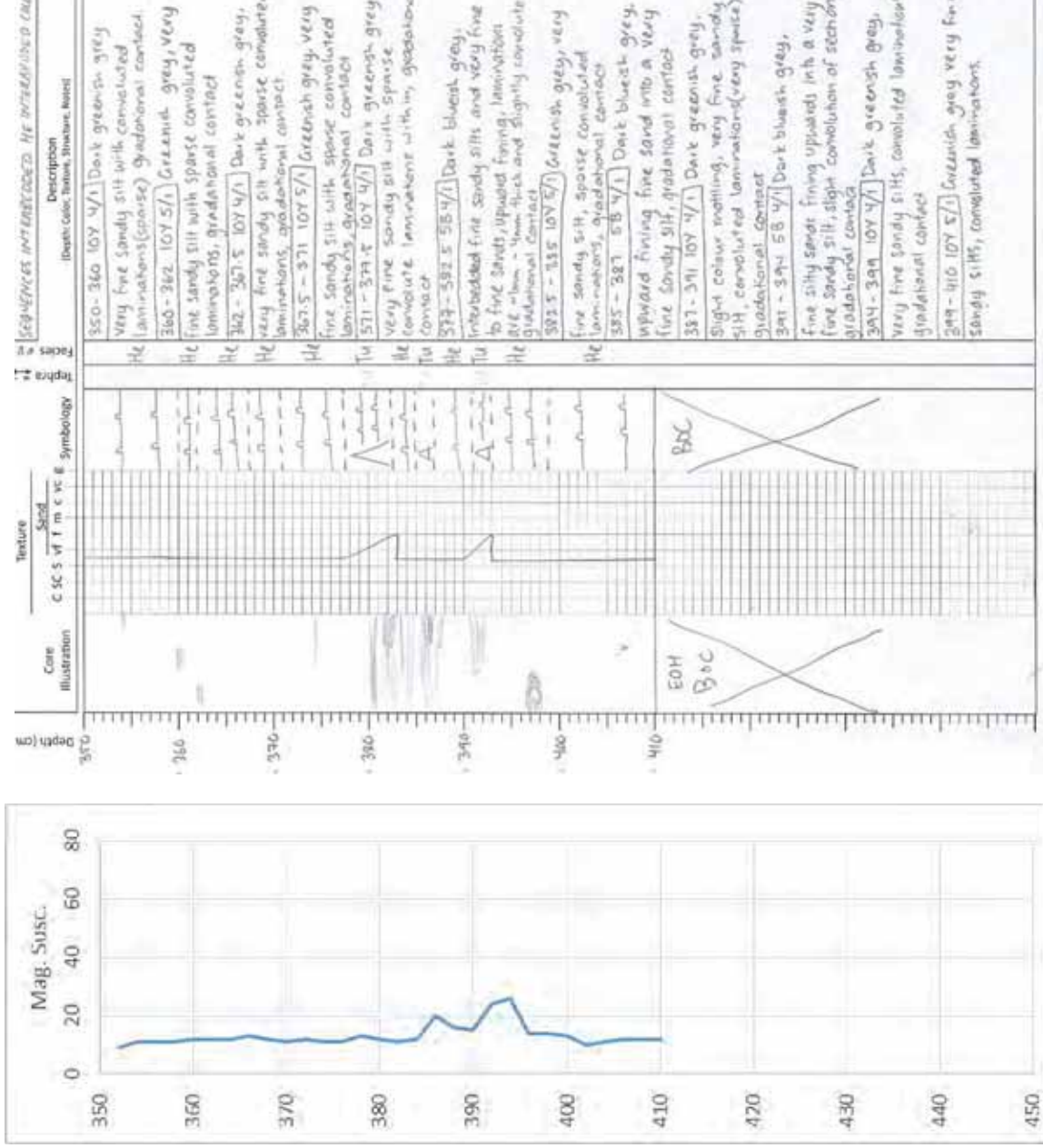


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: MC 5

Other ID TAN1613-27

Section 5 of 5



TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: **MC 6**

Latitude: -40.46218

Date/Time (NZST): 14/11/2016 09:29

Other ID: TAN1613-28

Longitude: 177.07613

Depth (m): **1398**

Sample Description

General Description

Madden Basin, upper Madden Canyon system

Interbedded hemipelgite and turbidites. One volcanioclastic turbidite in section 5. one tephra at 2.48m

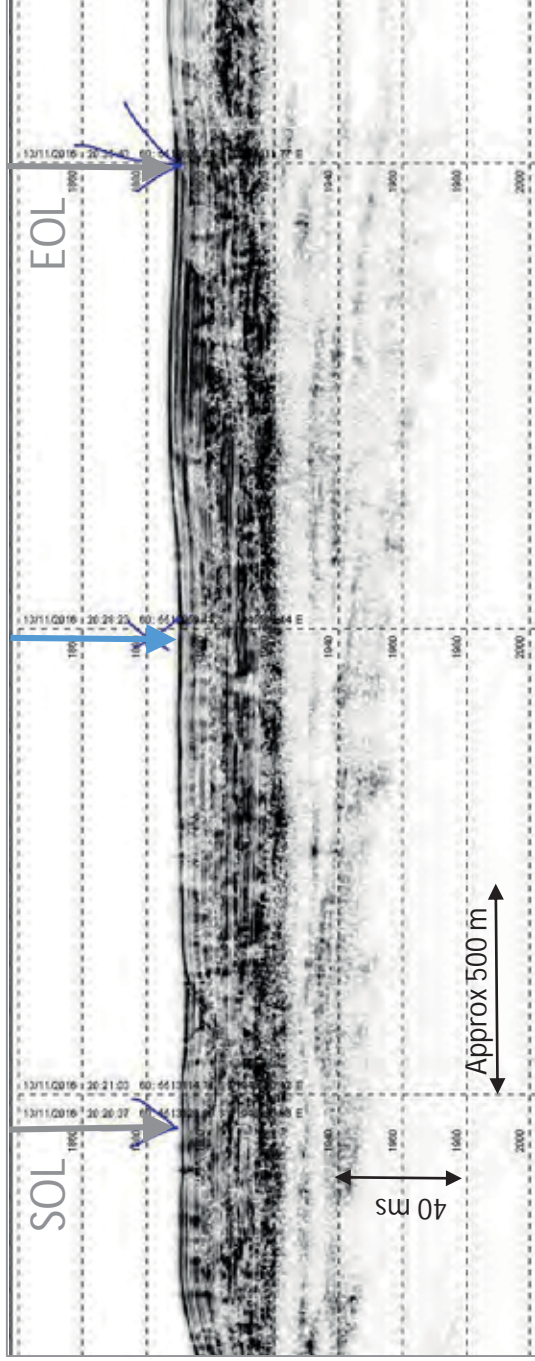
Gear type		Piston core	
Barrel Length (m)	6	Bent barrel	N
Penetration (m)		Catcher/Cutter bags	
Core length (m)	4.8	Samples	N
Sections	5	Tephra	1
Fauna	N	.	.

Sample processing – core ID:

Section	Top depth (cm)	Btm depth (cm)	Logged	Phys Props	Summary
1	0	100	Y	Y	.
2	100	200	Y	Y	.
3	300	400	Y	Y	.
4	500	500	Y	Y	.
5	400	480	Y	Y	.
.

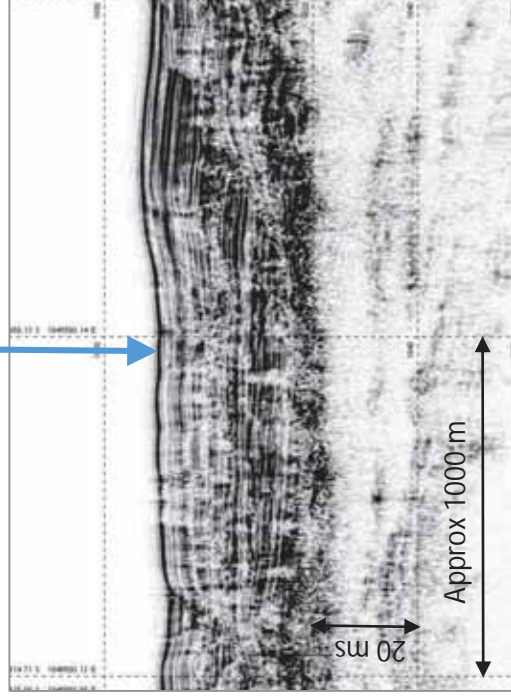
TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: MC 6	Other ID TAN1613-28	Water Depth 1809 m
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Topas line including transit to the station. Grey arrows indicate start and end of the 2km survey line over the station. Blue arrow marks the planned core site.

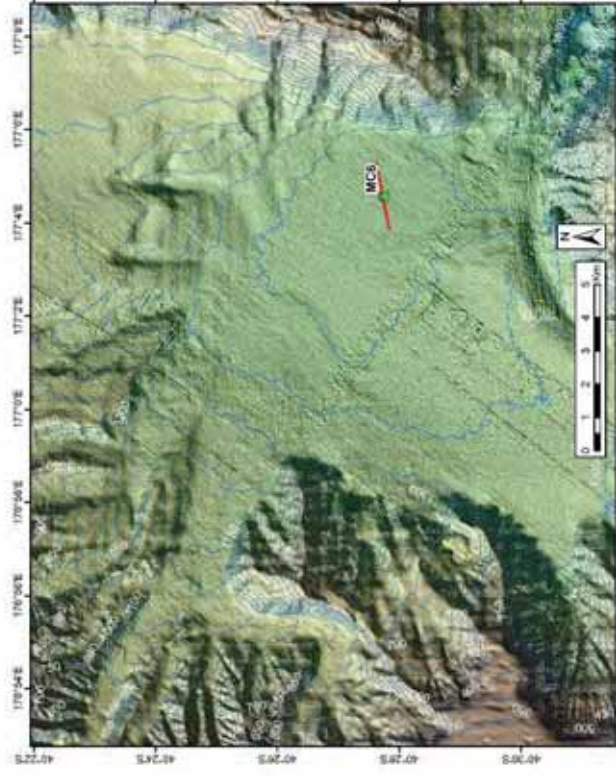
Planned core site



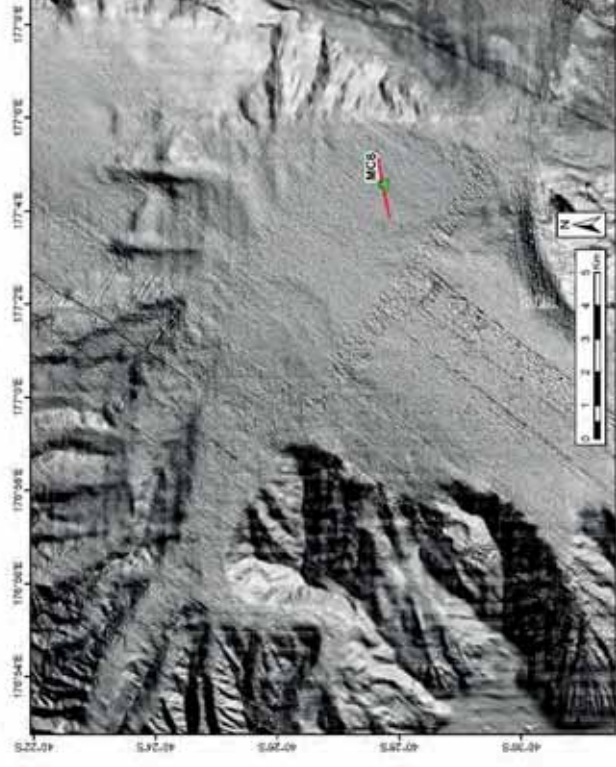
Zoom into 2km survey lines over planned core site

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: MC 6	Other ID TAN1613-28	Water Depth 1809 m
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Bathymetry at and around MC6 core site in the Madden Basin, upper Madden Canyon system. Light blue lines are 50 m depth contours. Red lines show the 2 km TOPAS survey line over the station, green triangles indicate the actual core site.



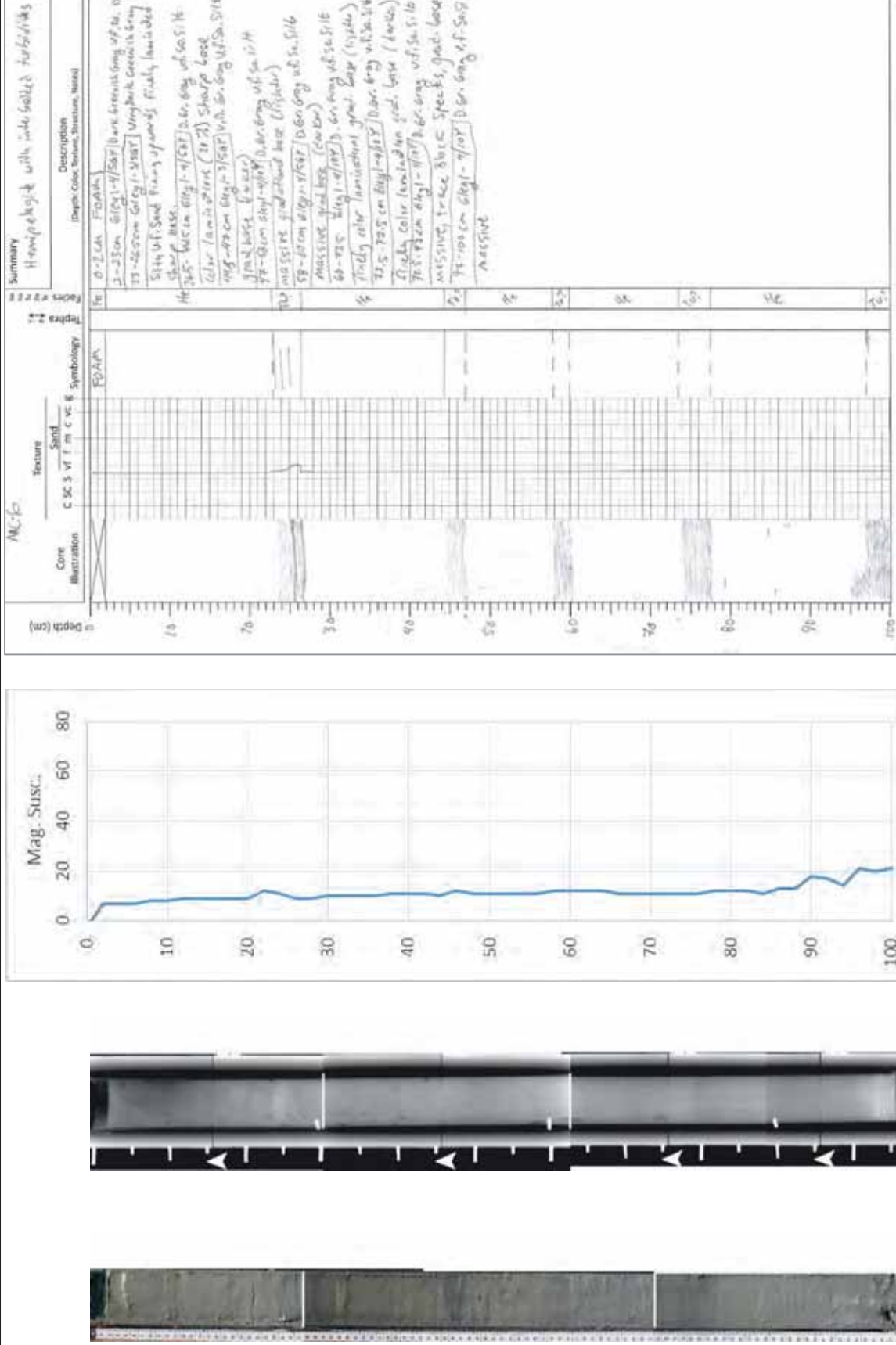
Backscatter at and around MC6 core site in the Madden Basin, upper Madden Canyon system. Light blue lines are 50 m depth contours. Red lines show the 2 km TOPAS survey line over the station, green triangles indicate the actual core site.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: MC 6

Other ID TAN1613-28

Section 1 of 5

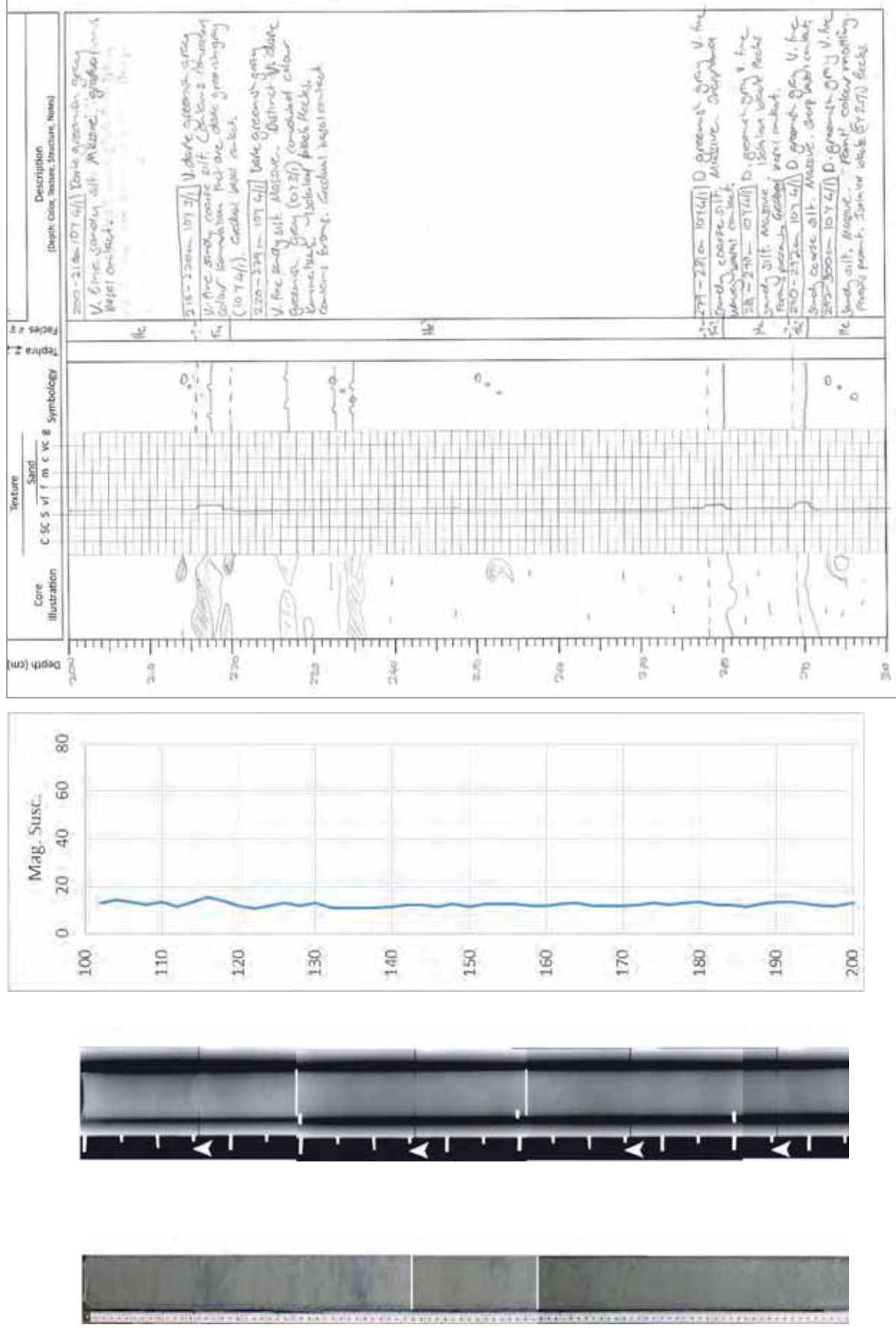


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: MC 6

Other ID TAN1613-28

Section 2 of 5

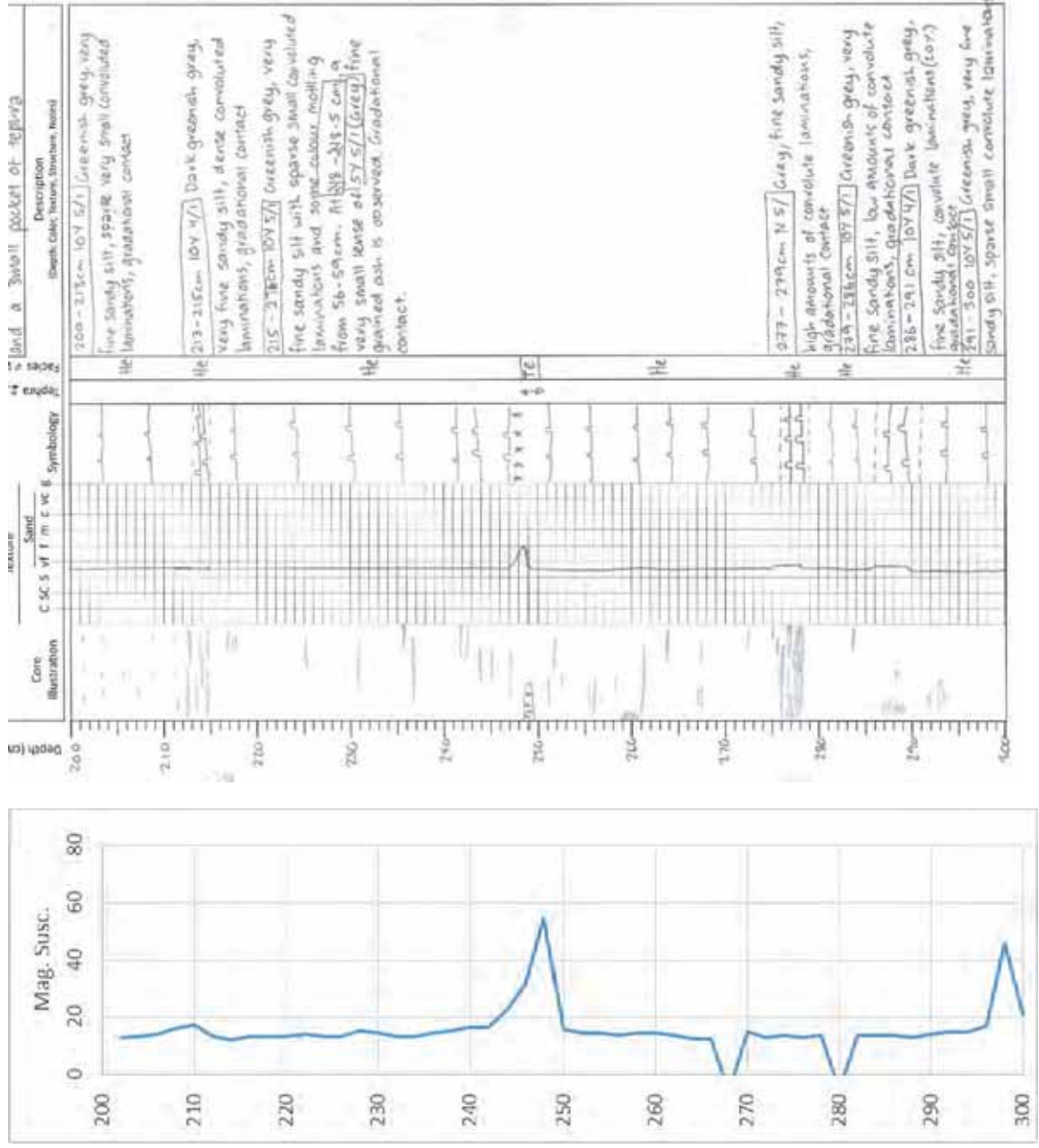


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: MC 6

Other ID TAN1613-28

Section 3 of 5

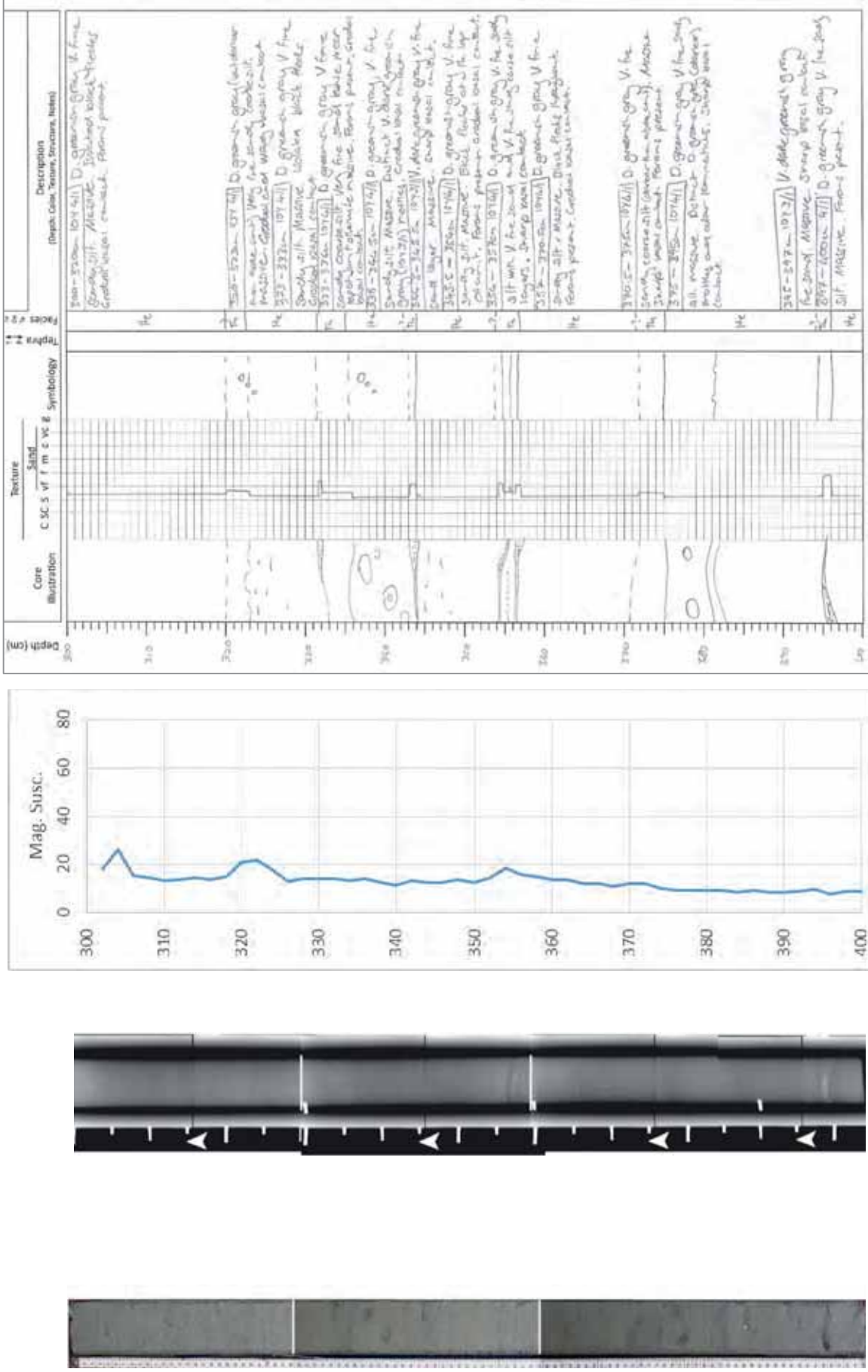


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: MC 6

Other ID TAN1613-28

Section 4 of 5

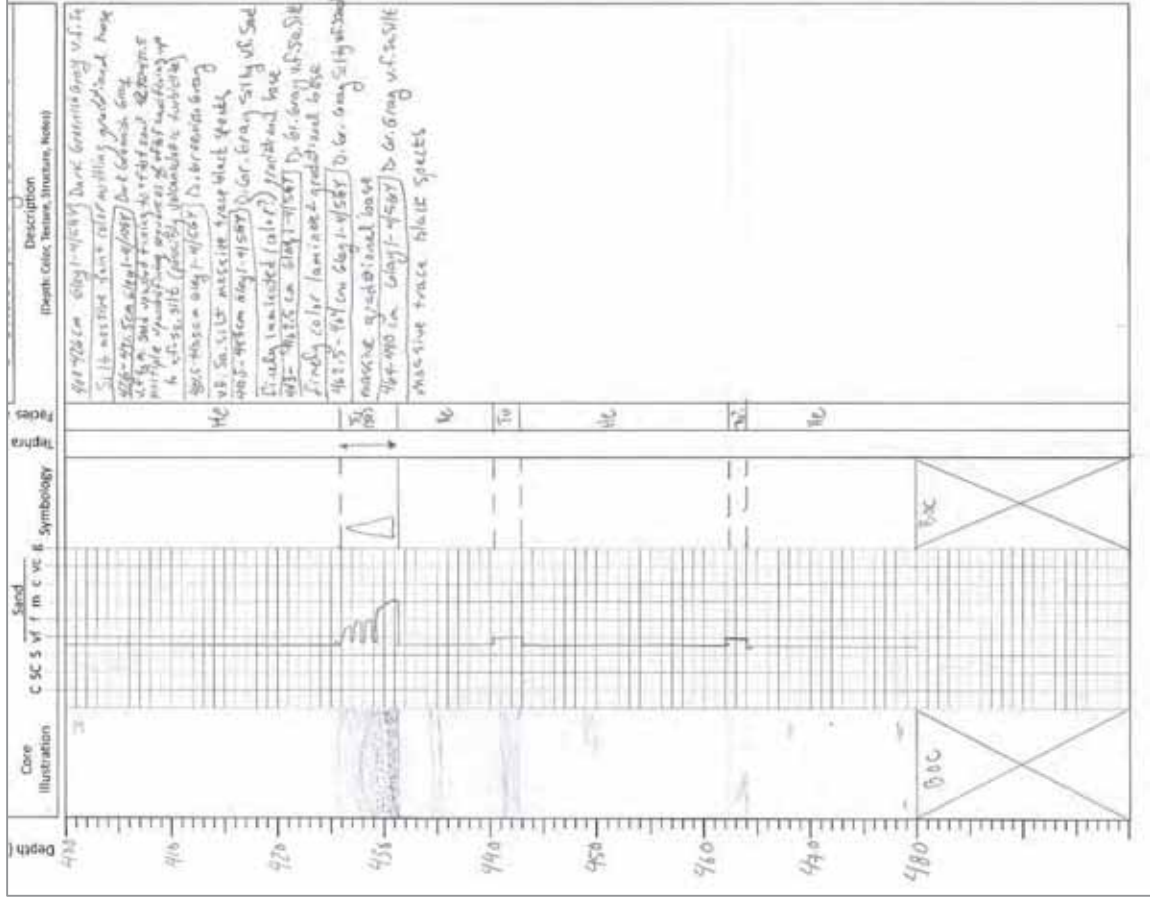
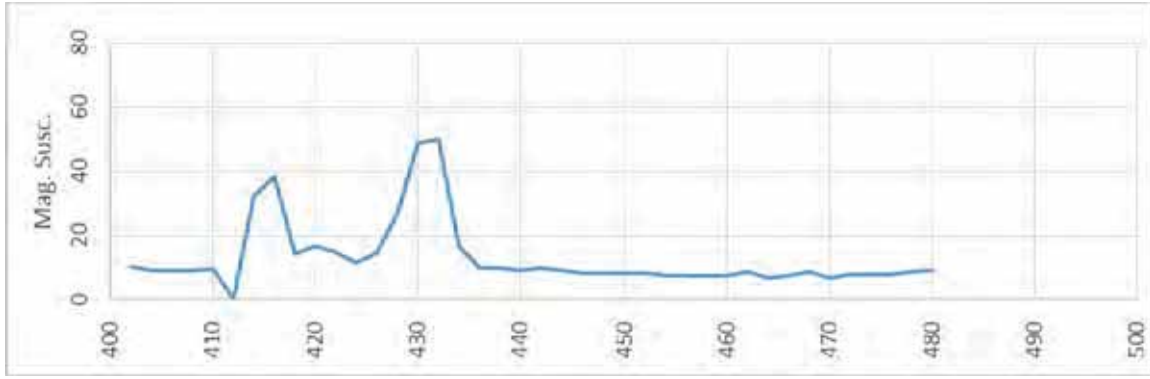


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: MC 6

Other ID TAN1613-28

Section 5 of 5



TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: HB 4	Latitude: -40.24335	Date/Time (NZST): 14/11/2016 15:26
Other ID: TAN1613-29	Longitude: 177.55080	Depth (m): 1899

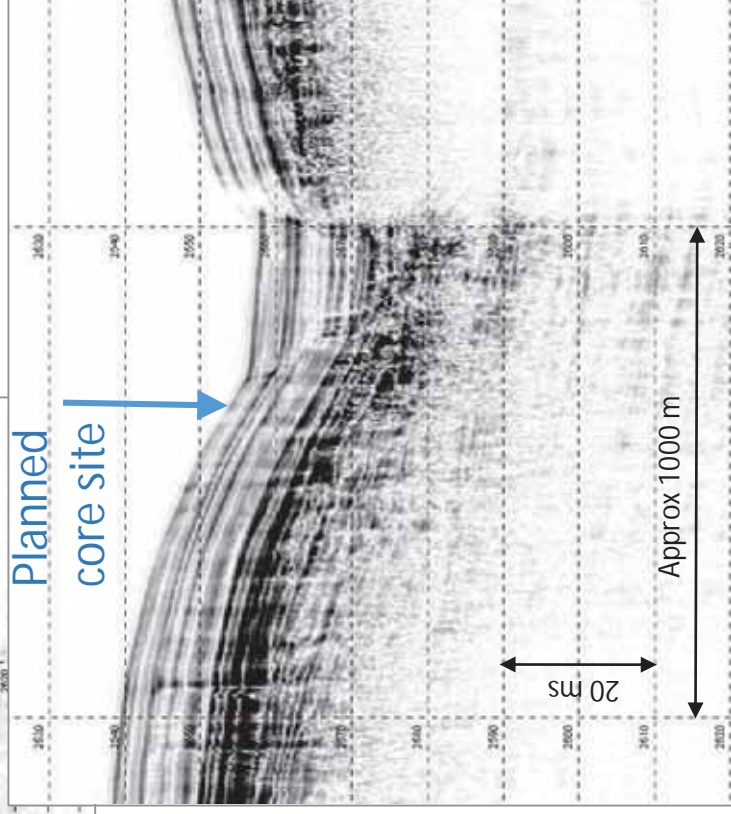
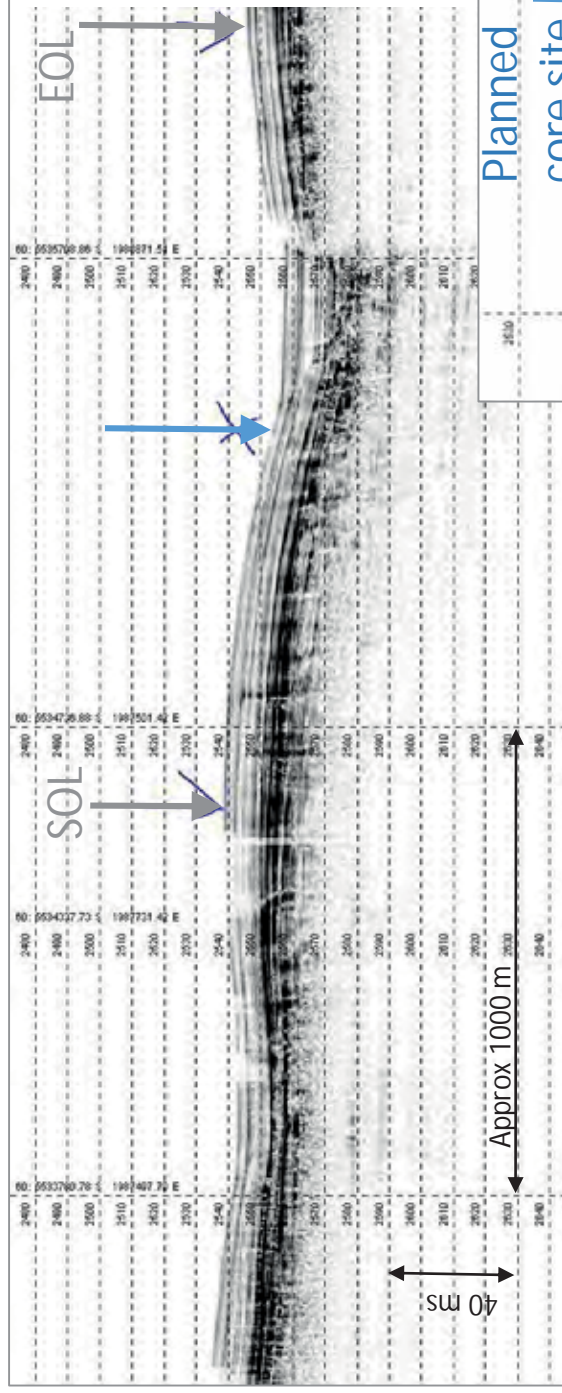
Sample Description	Gear type	Piston core
General Description Inner Paoanui Basin Hemipelagic mud interbedded with silty/sandy turbidites. Tephra in section 2 at 1.49 m	Barrel Length (m)	6 Bent barrel n
	Penetration (m)	Catcher/Cutter bags
	Core length (m)	3.35 Samples n
	Sections	4 Tephra 1
	Fauna	.

Sample processing – core ID:

Section	Top depth (cm)	Btm depth (cm)	Logged	Phys Props	Summary
1	0	100	Y	Y	.
2	100	200	Y	Y	.
3	200	280	Y	Y	.
4	280	335	Y	Y	.
.
.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: HB 4	Other ID TAN1613-29	Water Depth 1899 m
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Topas line including short transit to the station. Grey arrows indicate start and end of the 2km survey line over the station, the blue arrow marks the planned core site.

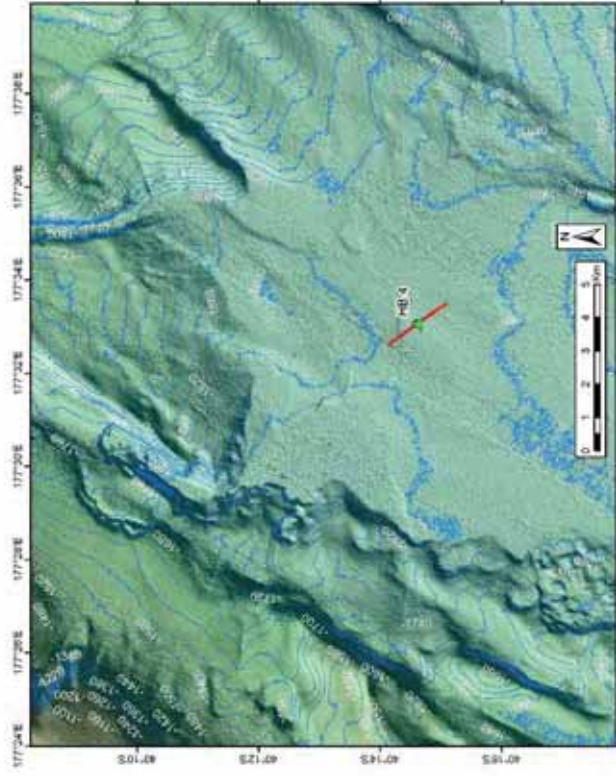
Zoom into 2km survey lines over planned core site.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

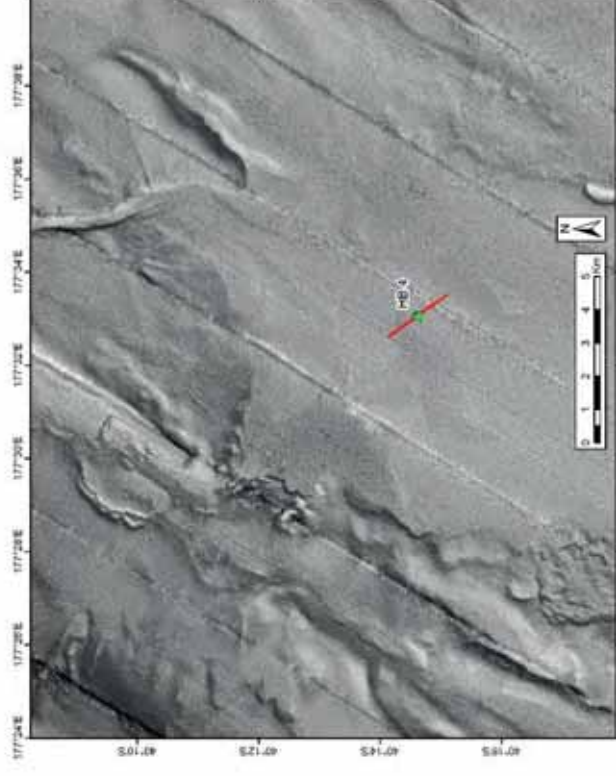
Core ID: HB 4

Other ID TAN1613-29

Water Depth 1899



Bathymetry at and around HB4 core site at the inner Paoanui Basin. Light blue lines are 20 m depth contours. Red lines show the 2 km TOPAS survey line over the station, green triangles indicate the actual core site.



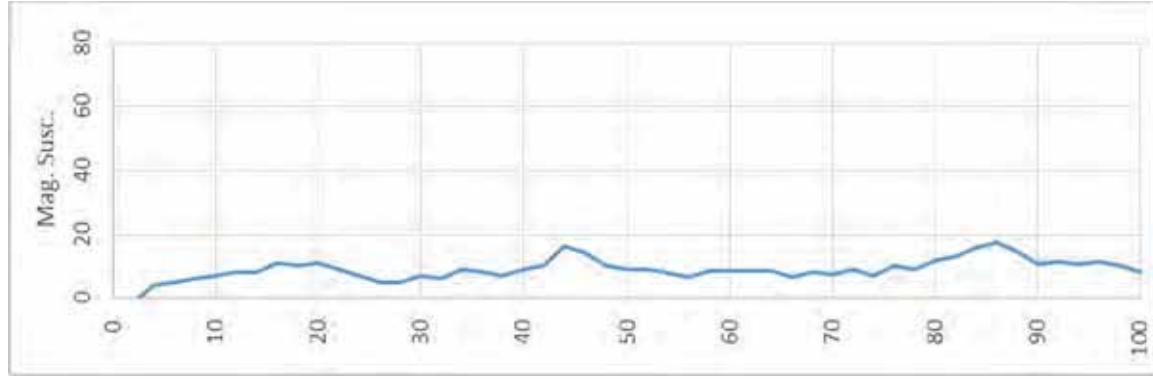
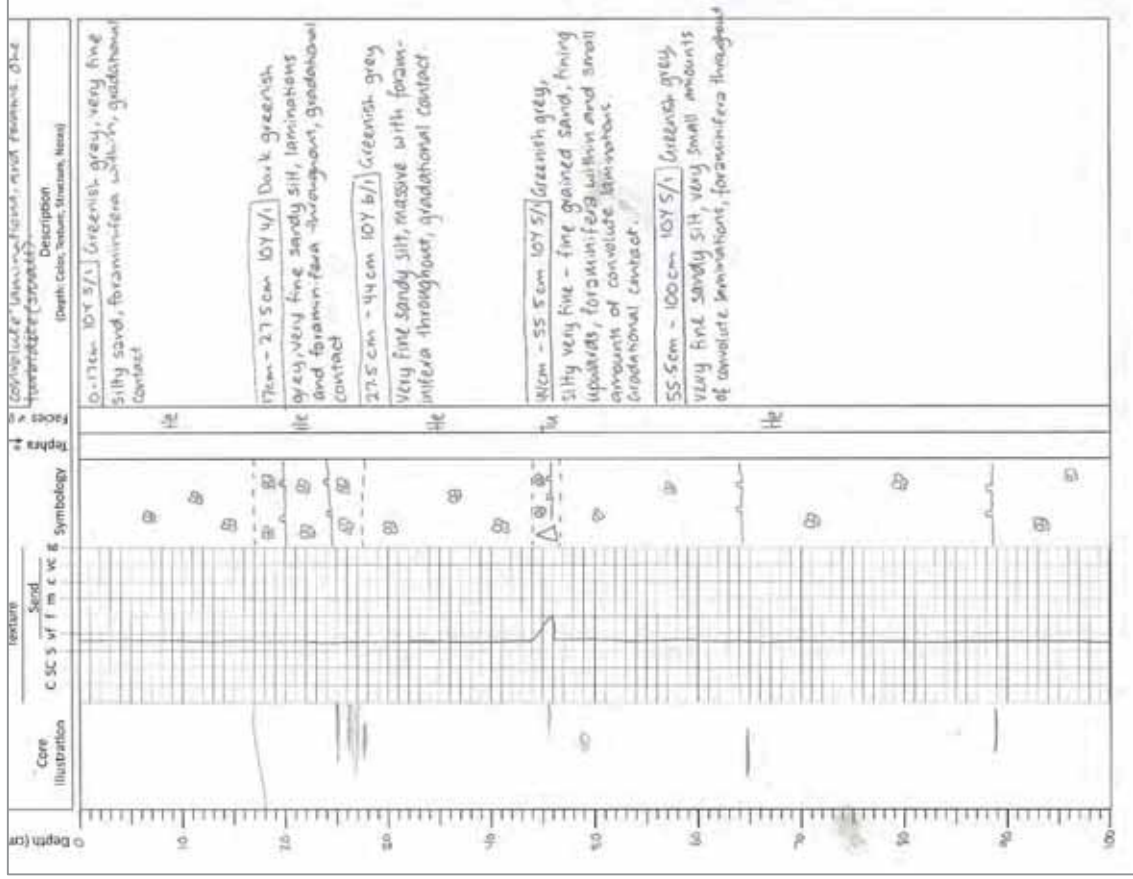
Backscatter at and around HB4 core site at the inner Paoanui Basin. Red lines show the 2 km TOPAS survey line over the station, green triangles indicate the actual core site.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: HB 4

Other ID TAN1613-29

Section 1 of 4

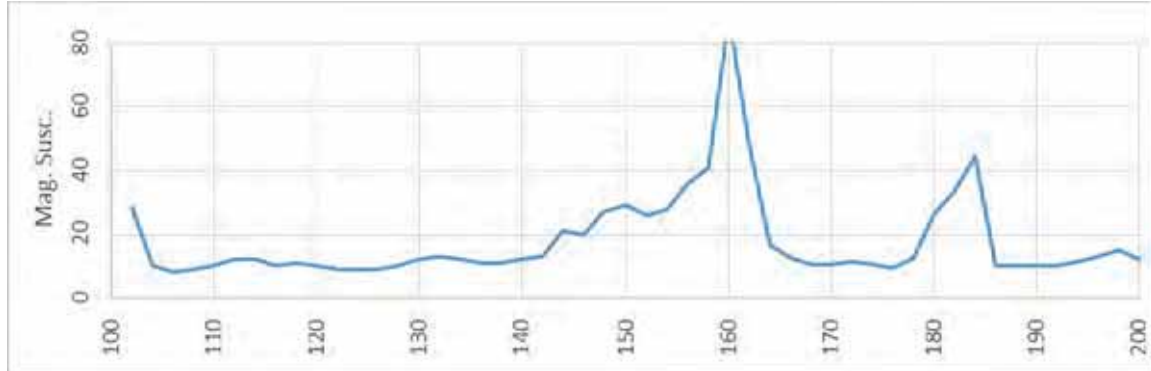
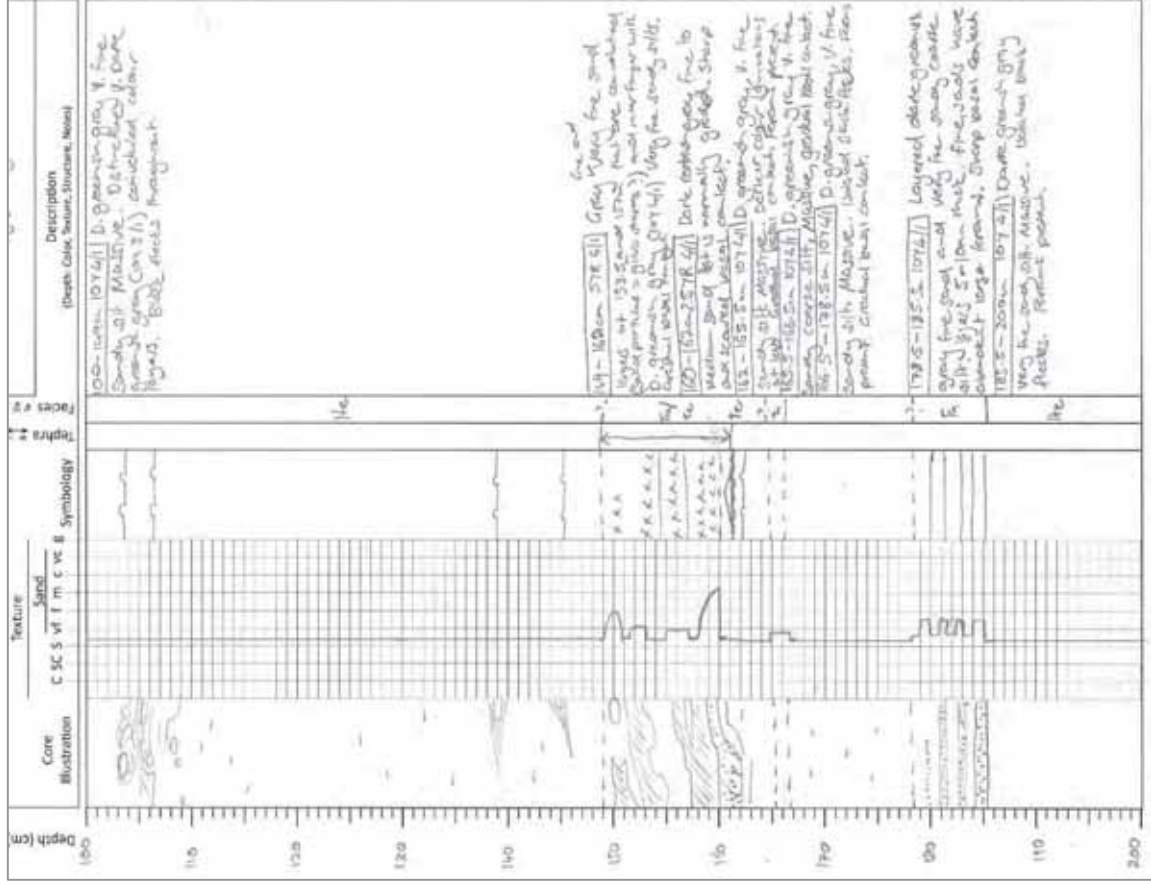


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: HB 4

Other ID TAN1613-29

Section 2 of 4

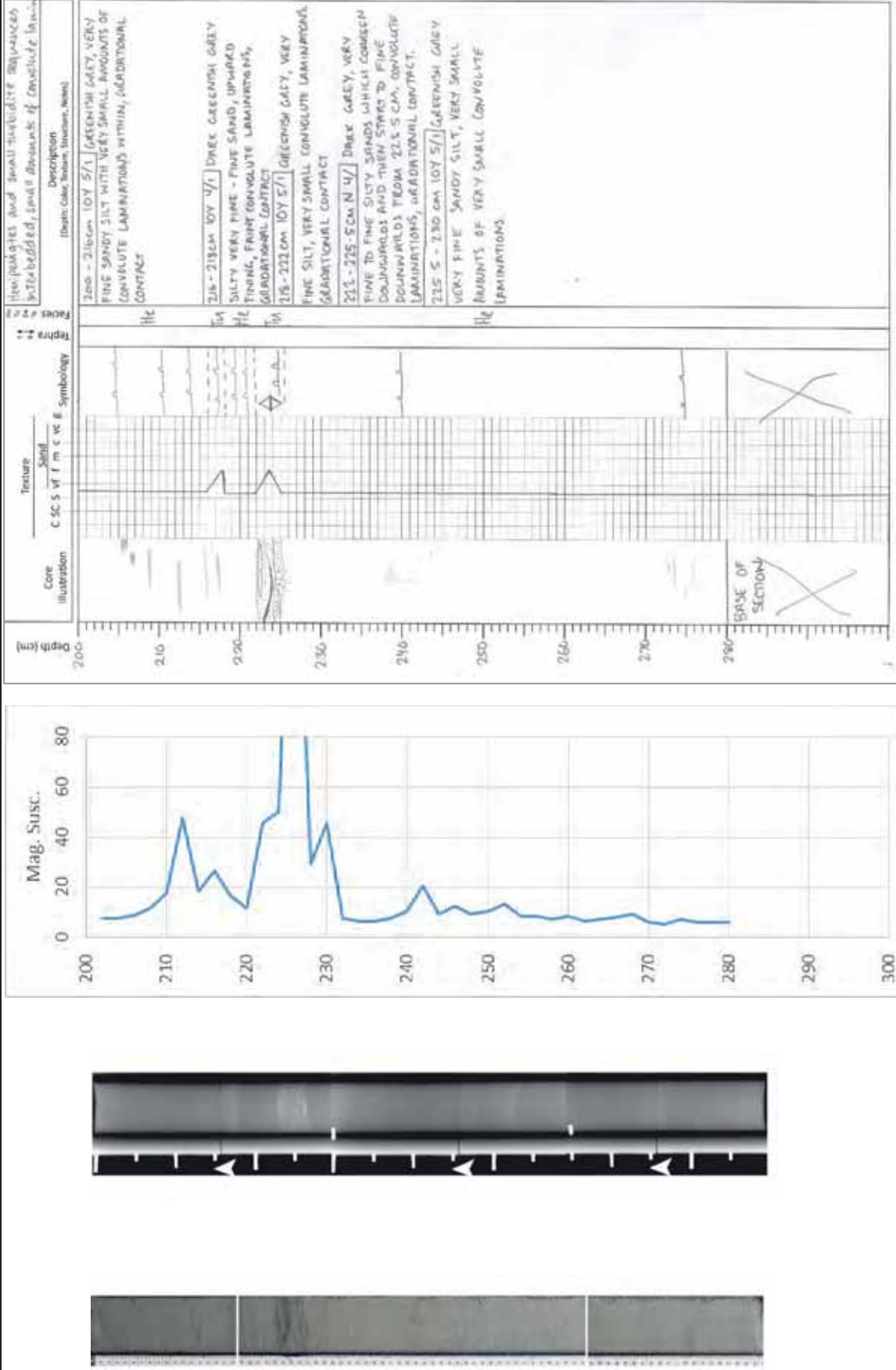


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: HB 4

Other ID TAN1613-29

Section 3 of 4

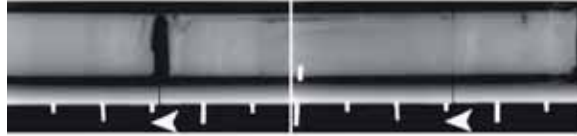
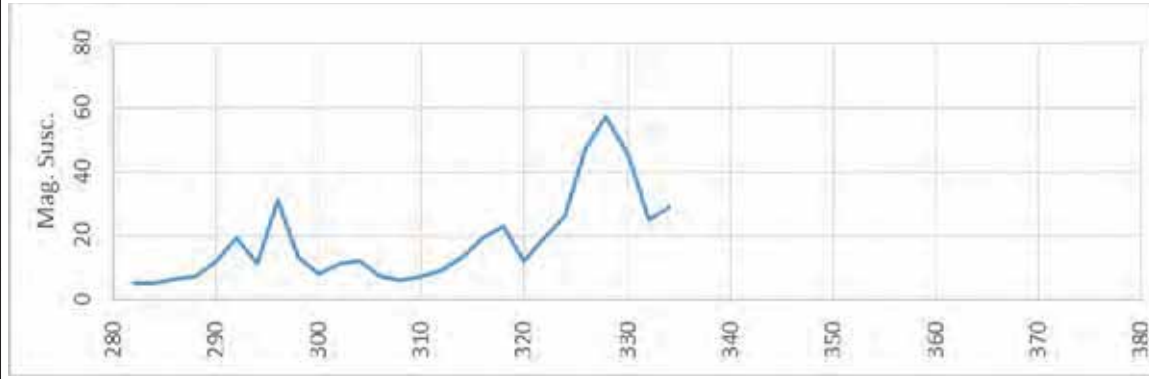
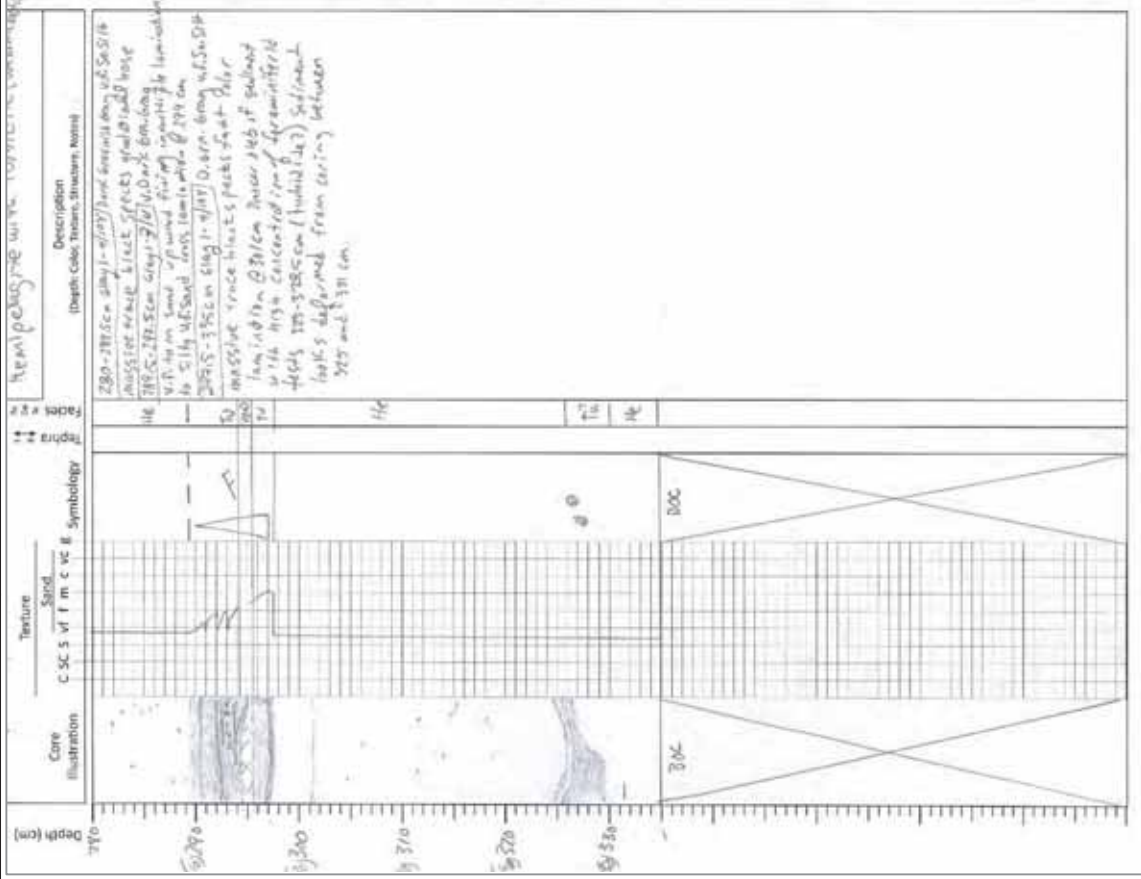


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: HB 4

Other ID TAN1613-29

Section 4 of 4



TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: **HB 3** Latitude: -40.21733 Date/Time (NZST): 14/11/2016 17:39

Other ID: **TAN1613-30** Longitude: 177.75540 Depth (m): **2042**

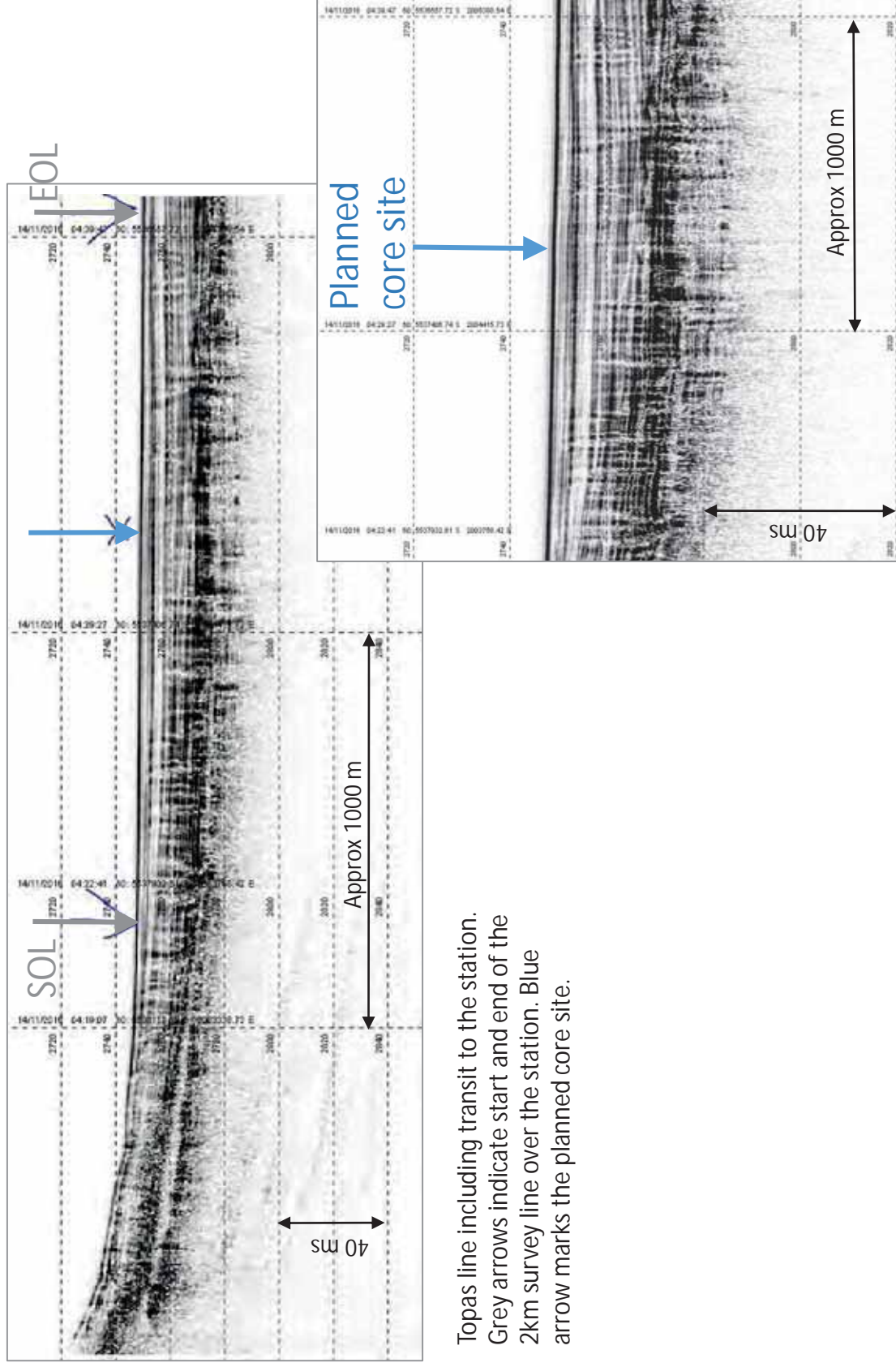
Sample Description	Gear type	Piston core
General Description Central Paoanui Basin Hemipelagite with some turbidites in section 3, 4 and 5. more than 4 tephra in sections 3, 5 and 5. Entire section 1 was split using spatula and is highly and distorted – described using archive	Barrel Length (m)	6 Bent barrel
	Penetration (m)	Catcher/Cutter bags
	Core length (m)	4.70 Samples
	Sections	5 Tephra
	Fauna	>4

Sample processing – core ID:

Section	Top depth (cm)	Btm depth (cm)	Logged	Phys Props	Summary
1	0	100	Y	Y	
2	100	200	Y	Y	
3	200	300	Y	Y	
4	300	400	Y	Y	
5	400	470	Y	Y	
.	

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: HB 3	Other ID TAN1613-30	Water Depth 2042 m
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Topas line including transit to the station.
Grey arrows indicate start and end of the 2km survey line over the station. Blue arrow marks the planned core site.

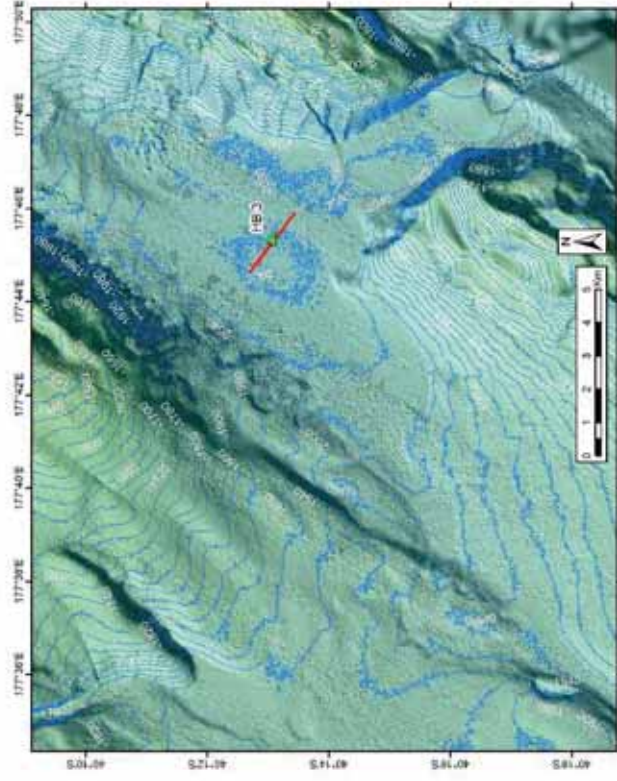
Zoom into 2km survey lines over planned core site.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

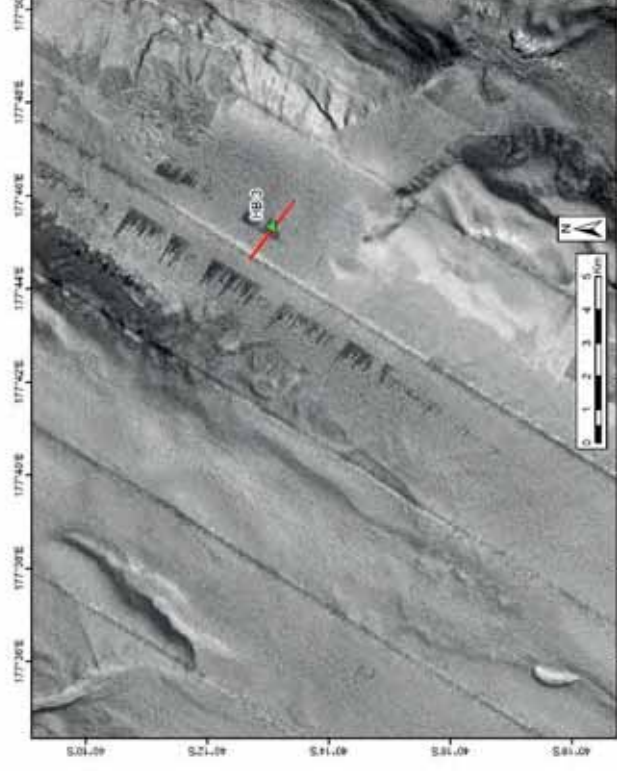
Core ID: HB 3

Other ID TAN1613-30

Water Depth 2042 m



Bathymetry at and around HB3 core site in the Central Paoanui Basin. Light blue lines are 20 m depth contours. Red lines show the 2 km TOPAS survey line over the station, green triangles indicate the actual core site.



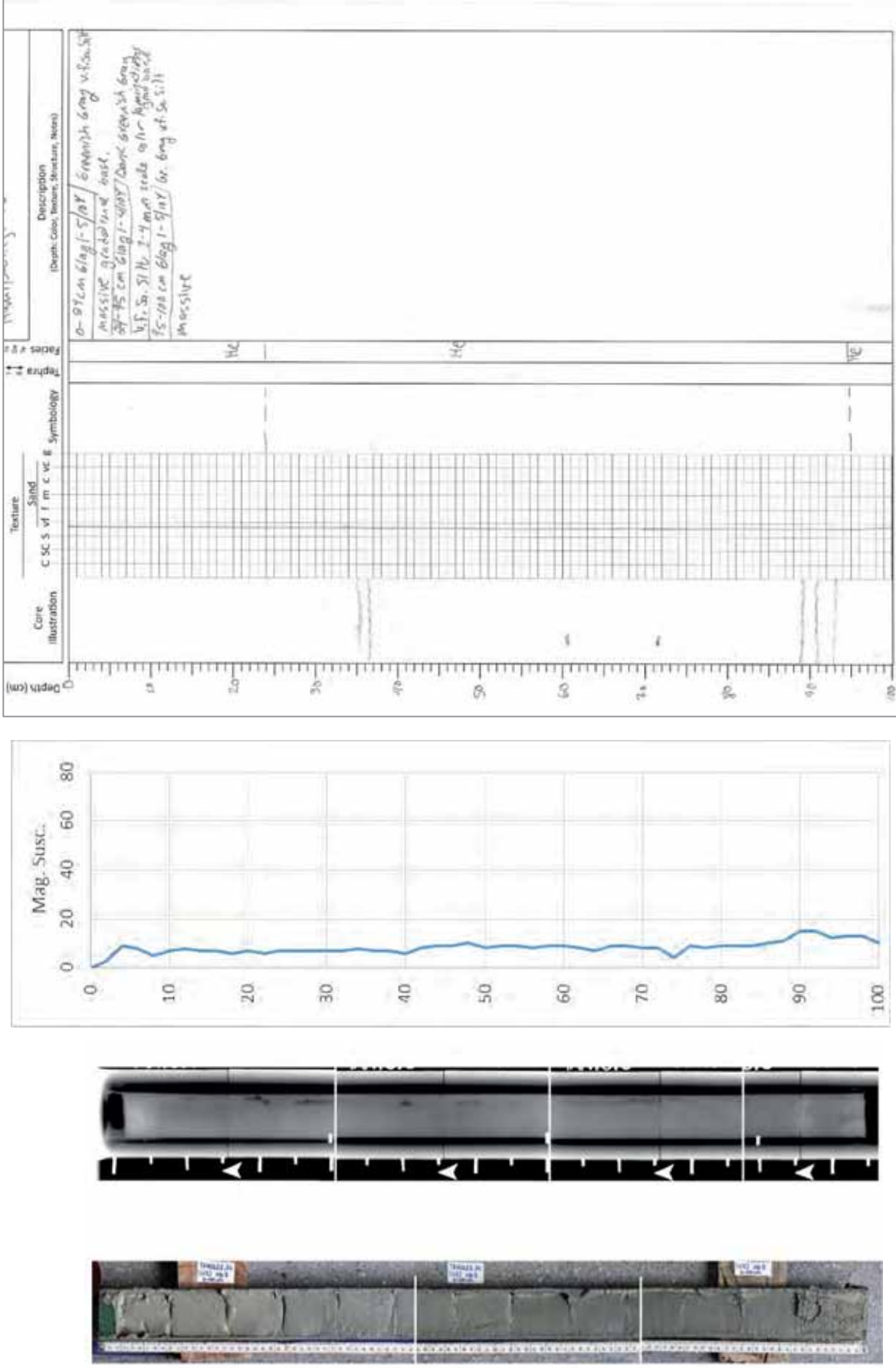
Backscatter at and around HB3 core site in the Central Paoanui Basin. Red lines show the 2 km TOPAS survey line over the station, green triangles indicate the actual core site.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: HB 3

Other ID TAN1613-30

Section 1 of 5

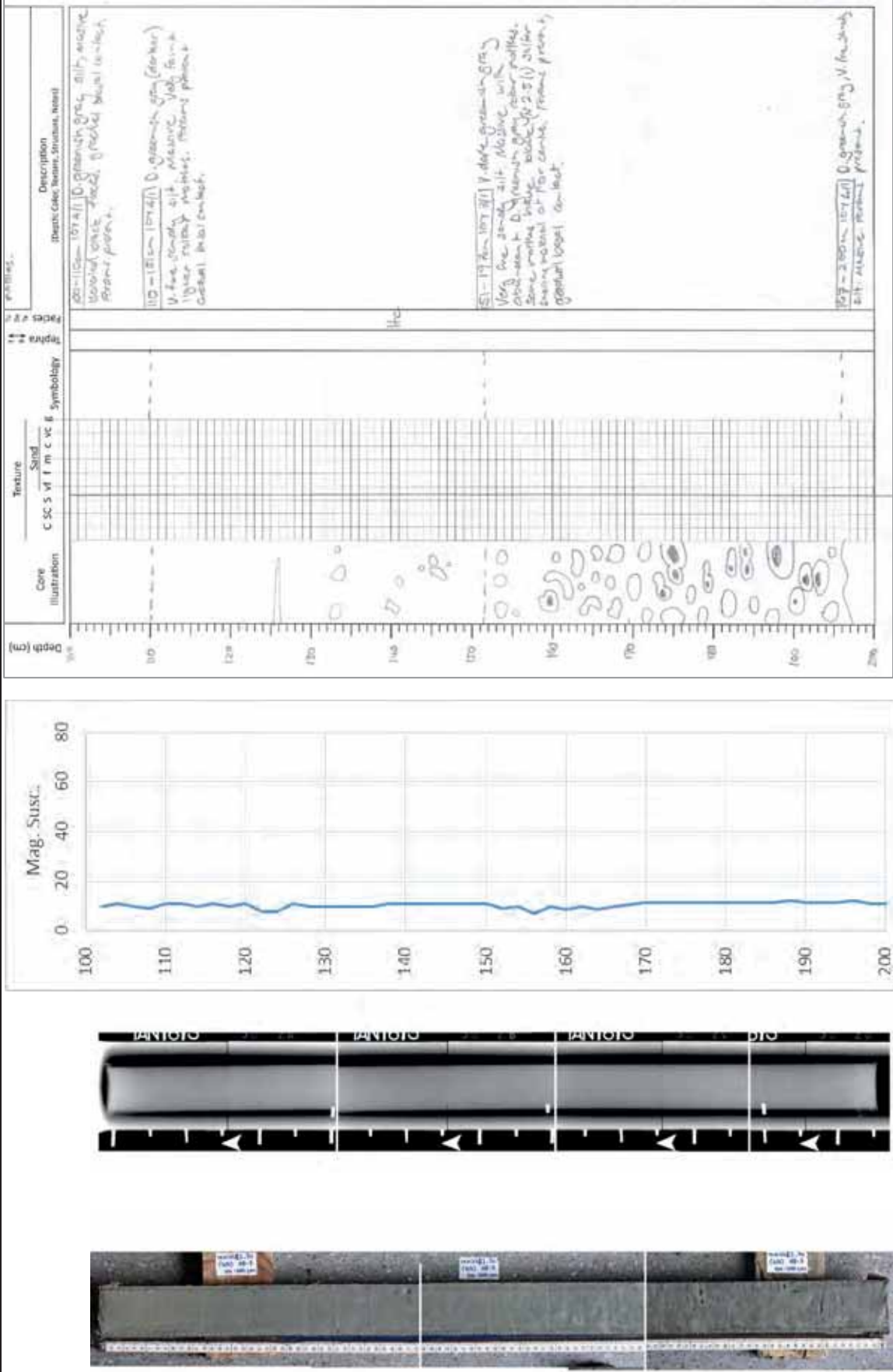


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: HB 3

Other ID TAN1613-30

Section 2 of 5

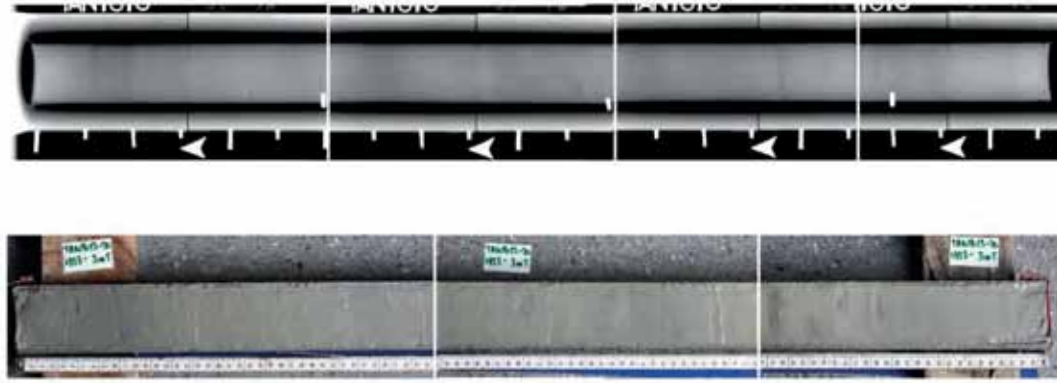
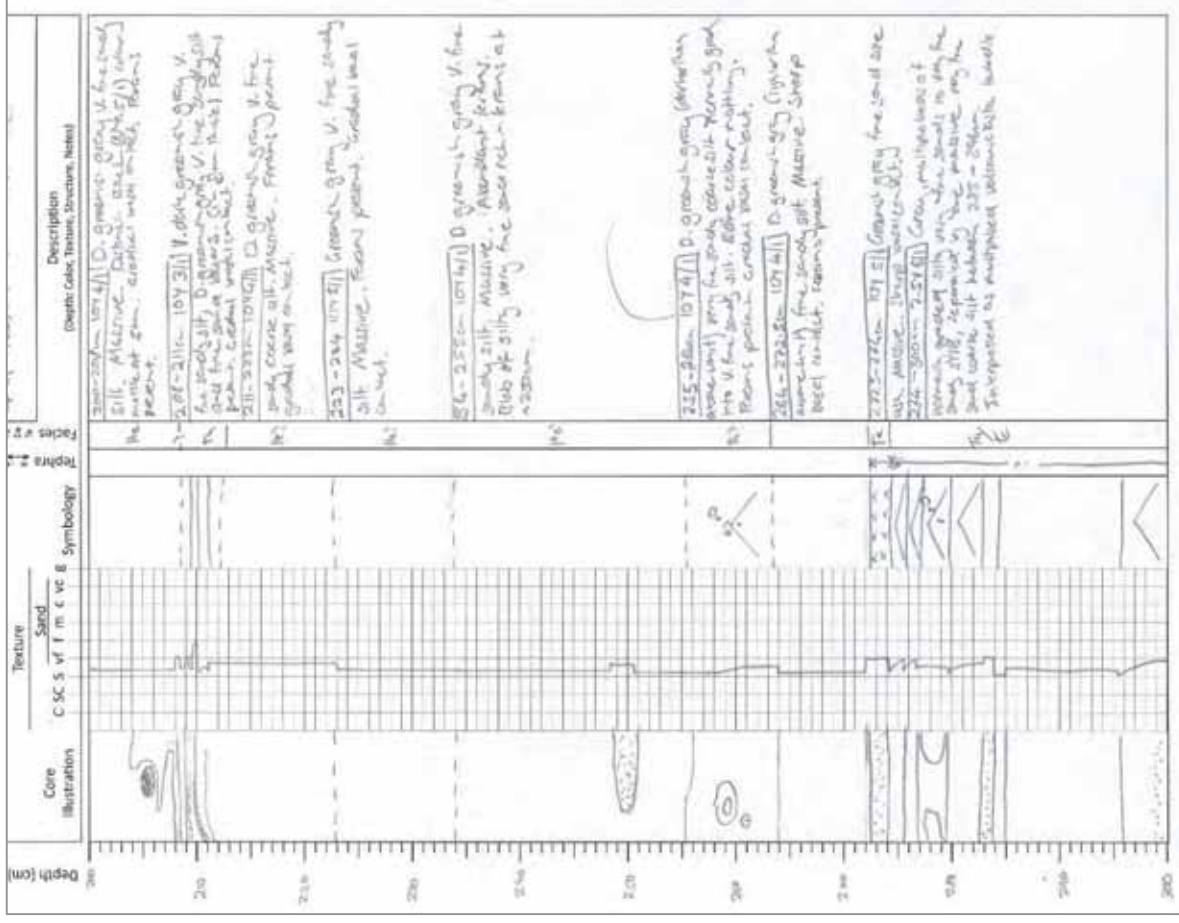
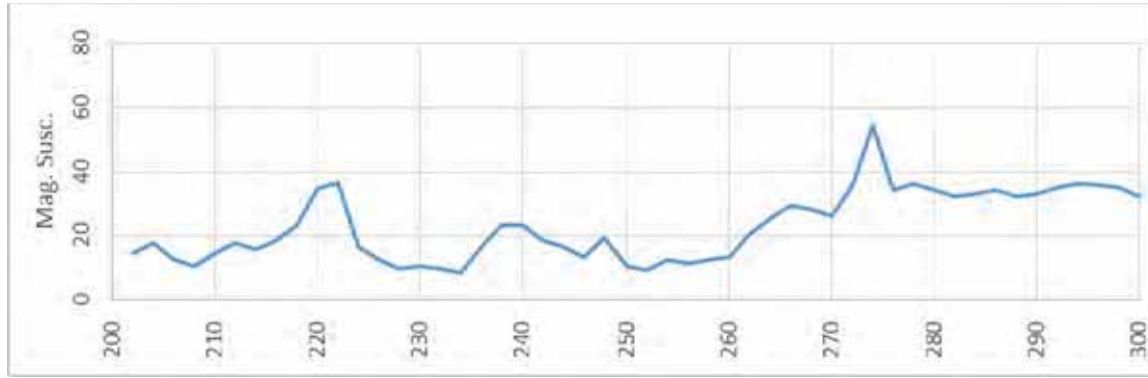


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: HB 3

Other ID TAN1613-30

Section 3 of 5

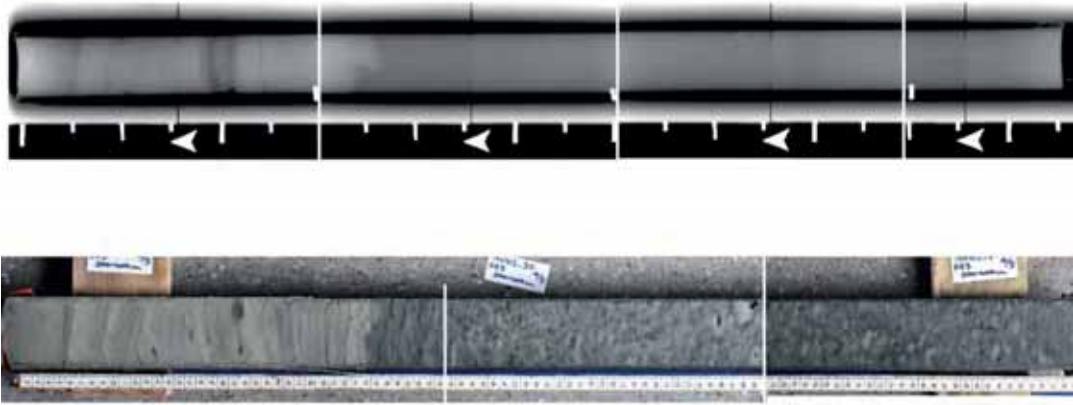
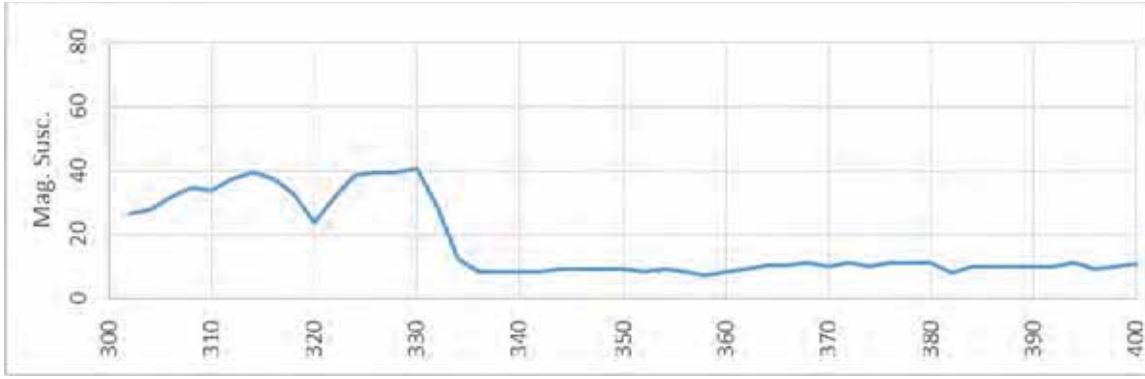
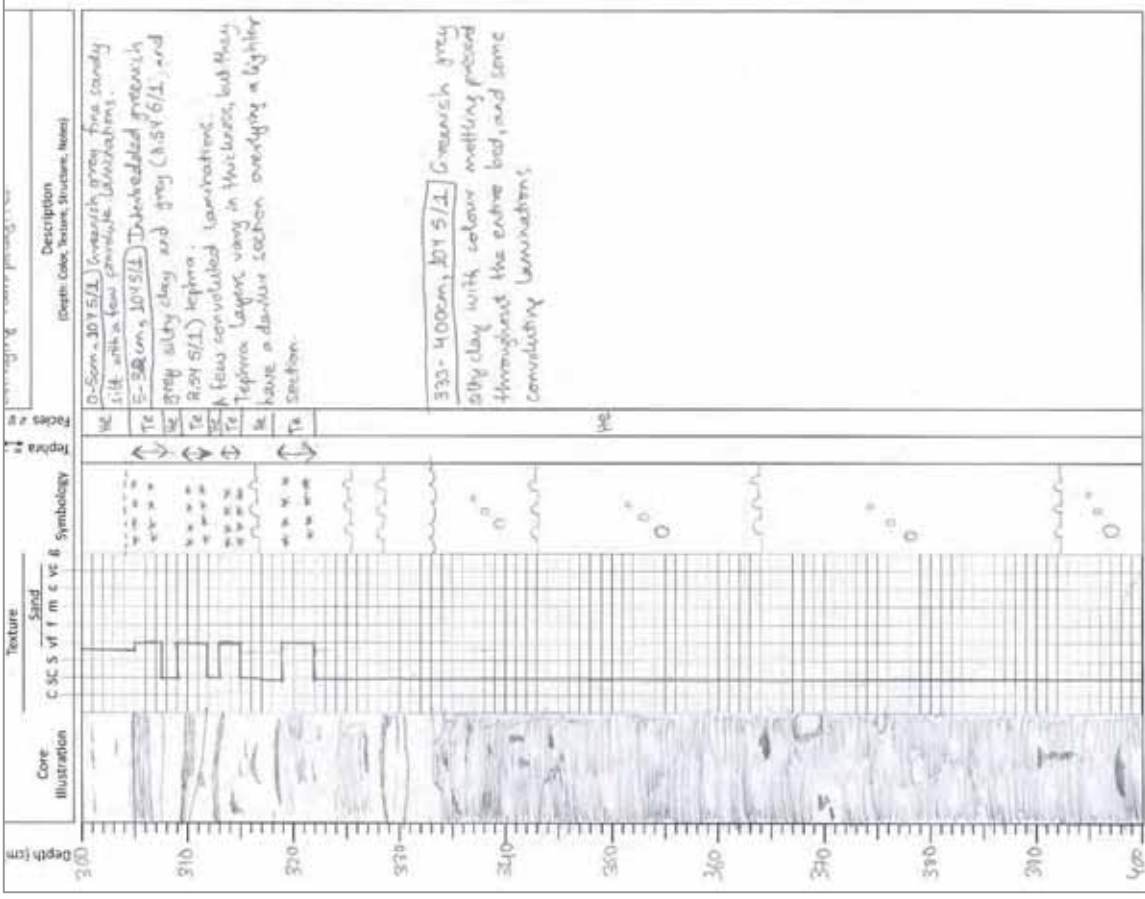


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: HB 3

Other ID TAN1613-30

Section 4 of 5

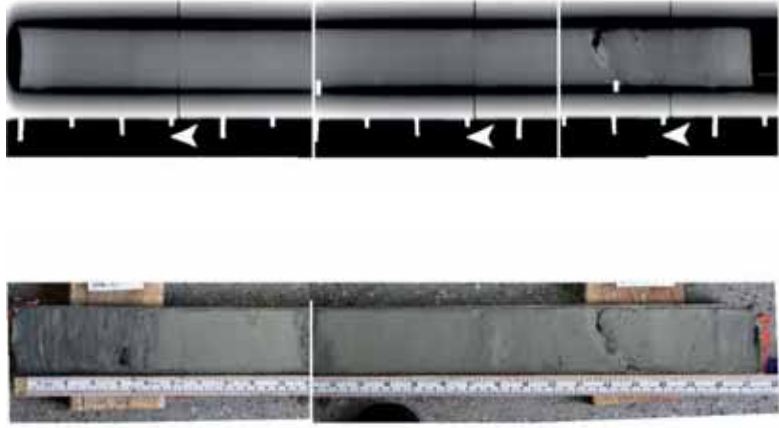
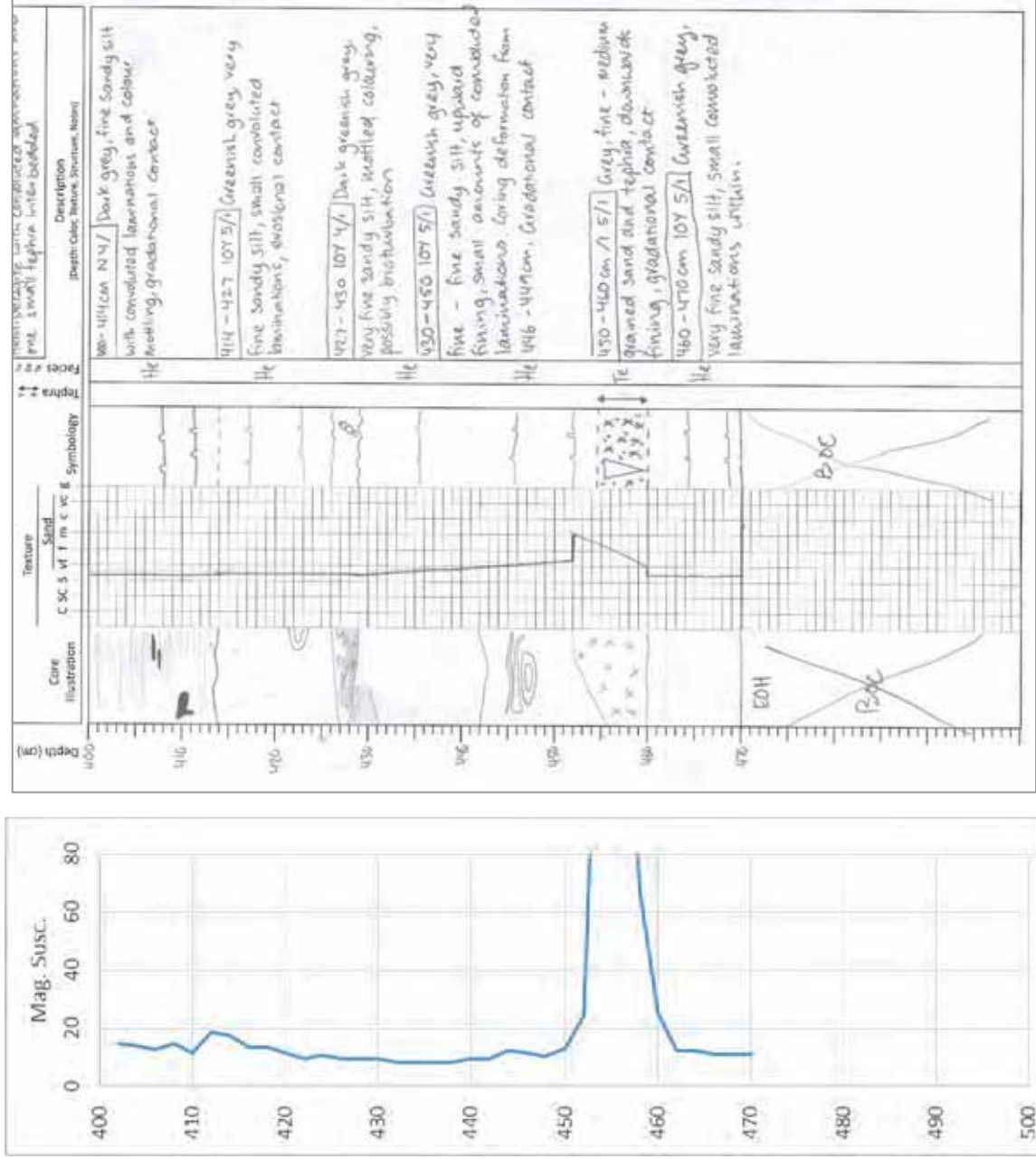


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: HB 3

Other ID TAN1613-30

Section 5 of 5



TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: HB 2	Latitude: -40.38308	Date/Time (NZST): 14/11/2016 21:10
Other ID: TAN1613-31	Longitude: 177.89562	Depth (m): 2275

Sample Description	Gear type	Piston core
General Description Un-named basin inside NW Akitio Trough Hemipelagites with one turbidite. Tephra in section 2	Barrel Length (m)	6 Bent barrel N
	Penetration (m)	Catcher/Cutter bags
	Core length (m)	1.44 Samples
	Sections	2 Tephra 2
	Fauna	

Sample processing – core ID:

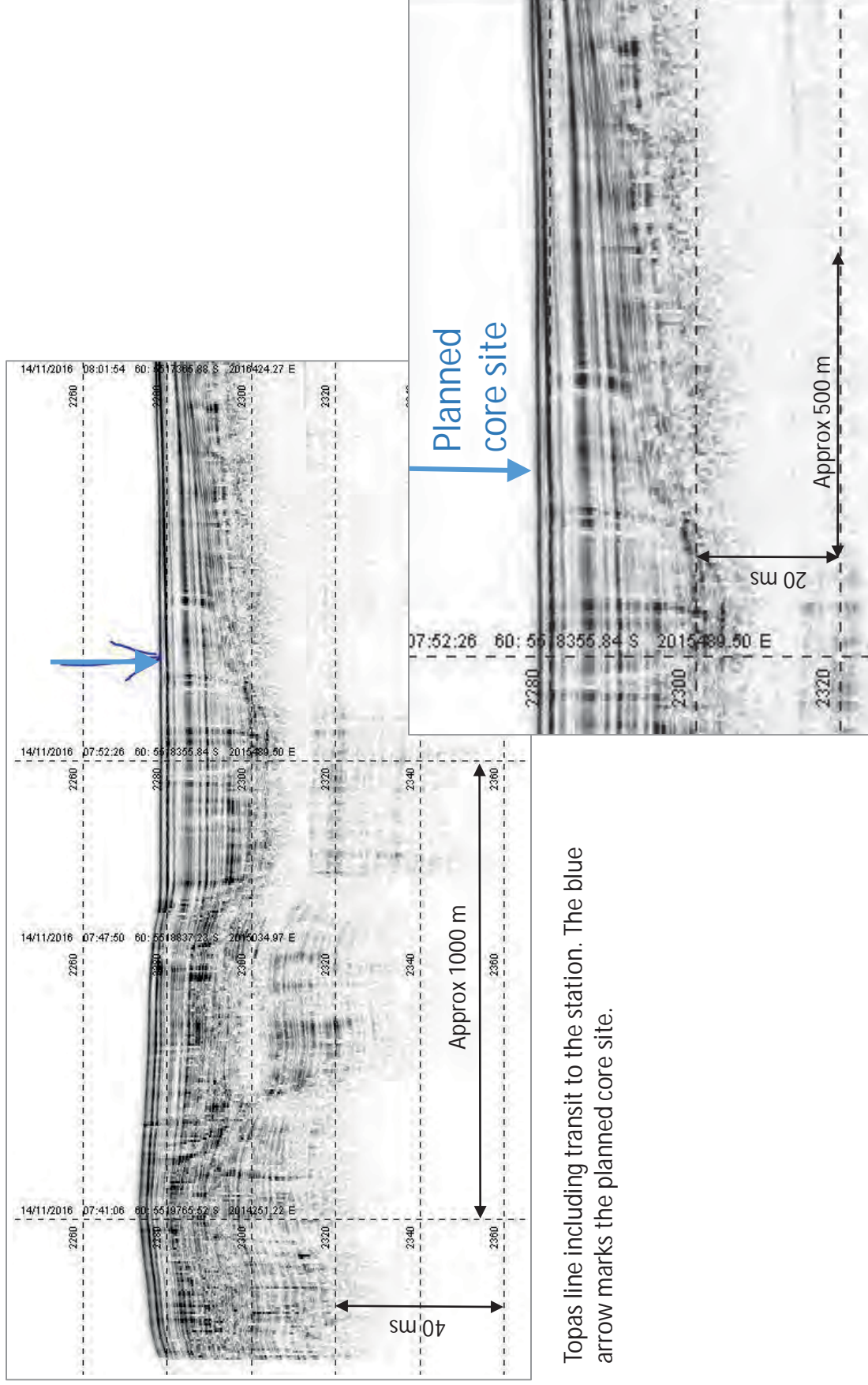
Section	Top depth (cm)	Btm depth (cm)	Logged	Phys Props	Summary
1	0	90	y	y	
2	90	144	y	y	

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: HB 2

Other ID TAN1613-31

Water Depth 2275 m



Topas line including transit to the station. The blue arrow marks the planned core site.

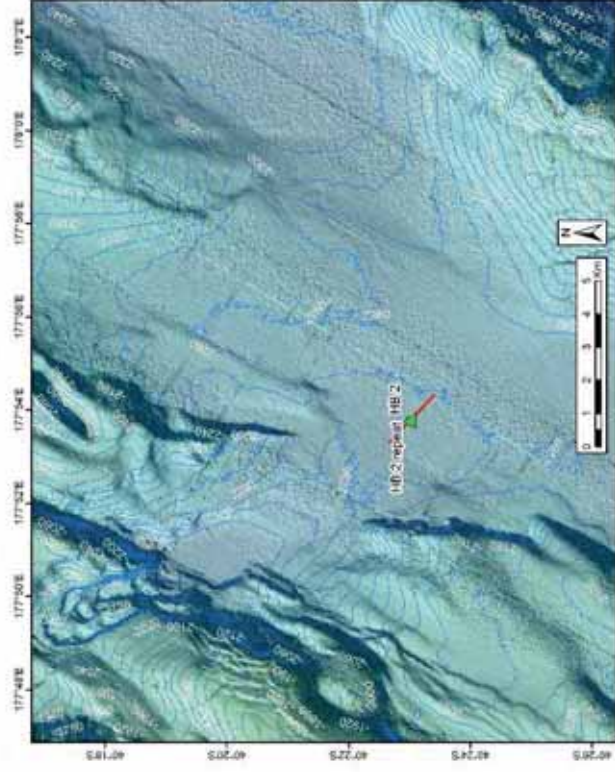
Zoom into 2km survey line over planned core site.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

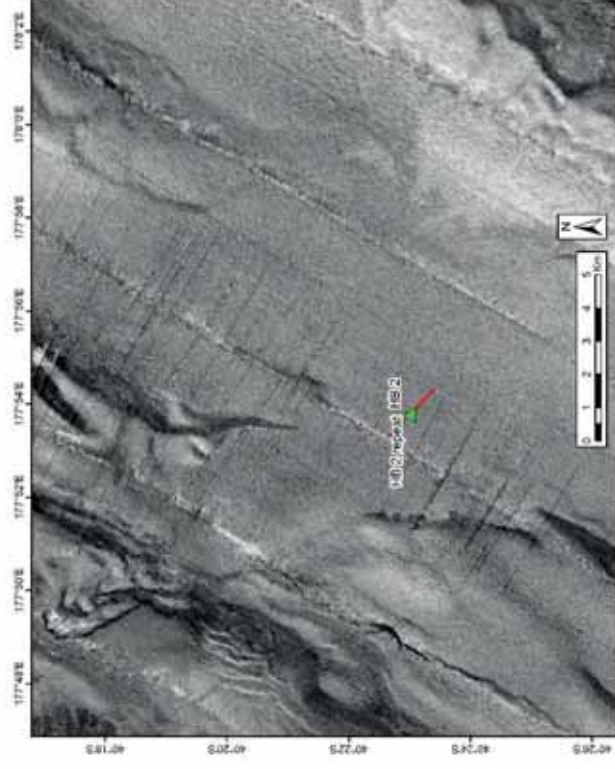
Core ID: HB 2

Other ID TAN1613-31

Water Depth 2275 m



Bathymetry at and around HB2 core site at an un-named basin inside NW Akitio Trough. Light blue lines are 20 m depth contours. Red lines show the 2 km TOPAS survey line over the station, green triangles indicate the actual core site.



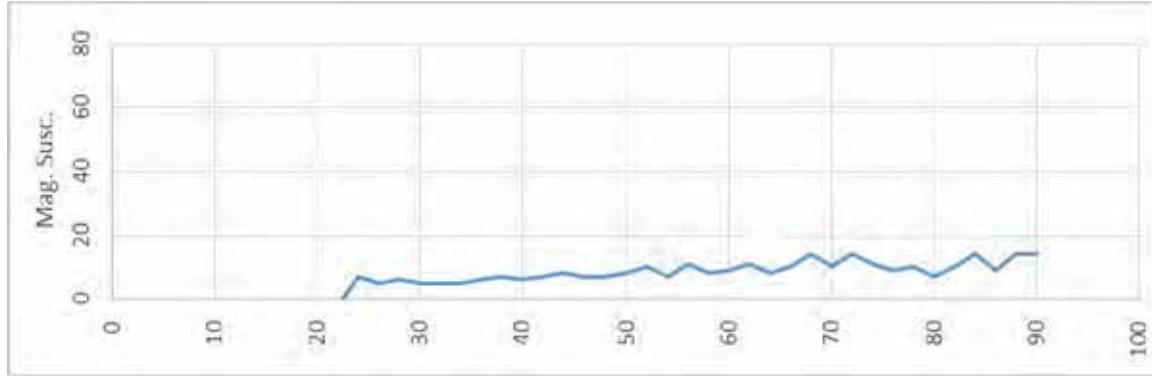
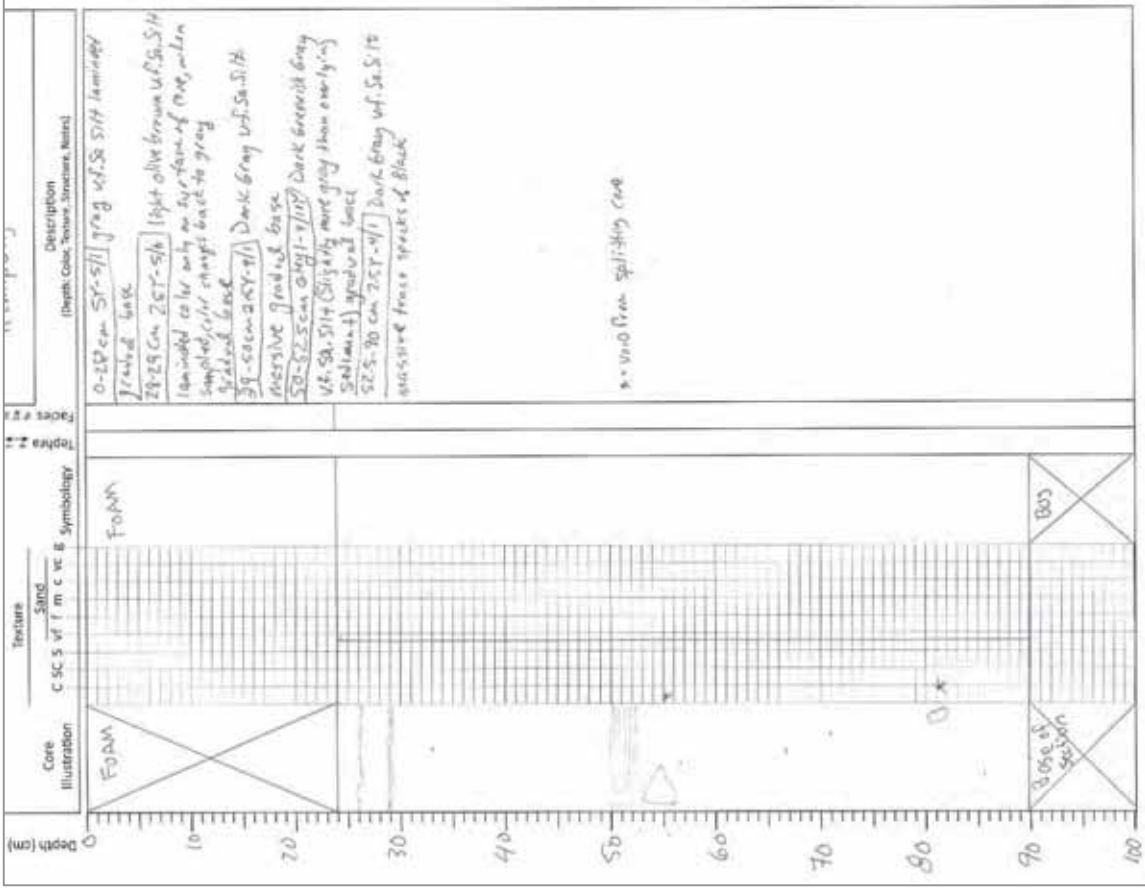
Bathymetry at and around HB2 core site at an un-named basin inside NW Akitio Trough. Red lines show the 2 km TOPAS survey line over the station, green triangles indicate the actual core site.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: HB 2

Other ID TAN1613-31

Section 1 of 2



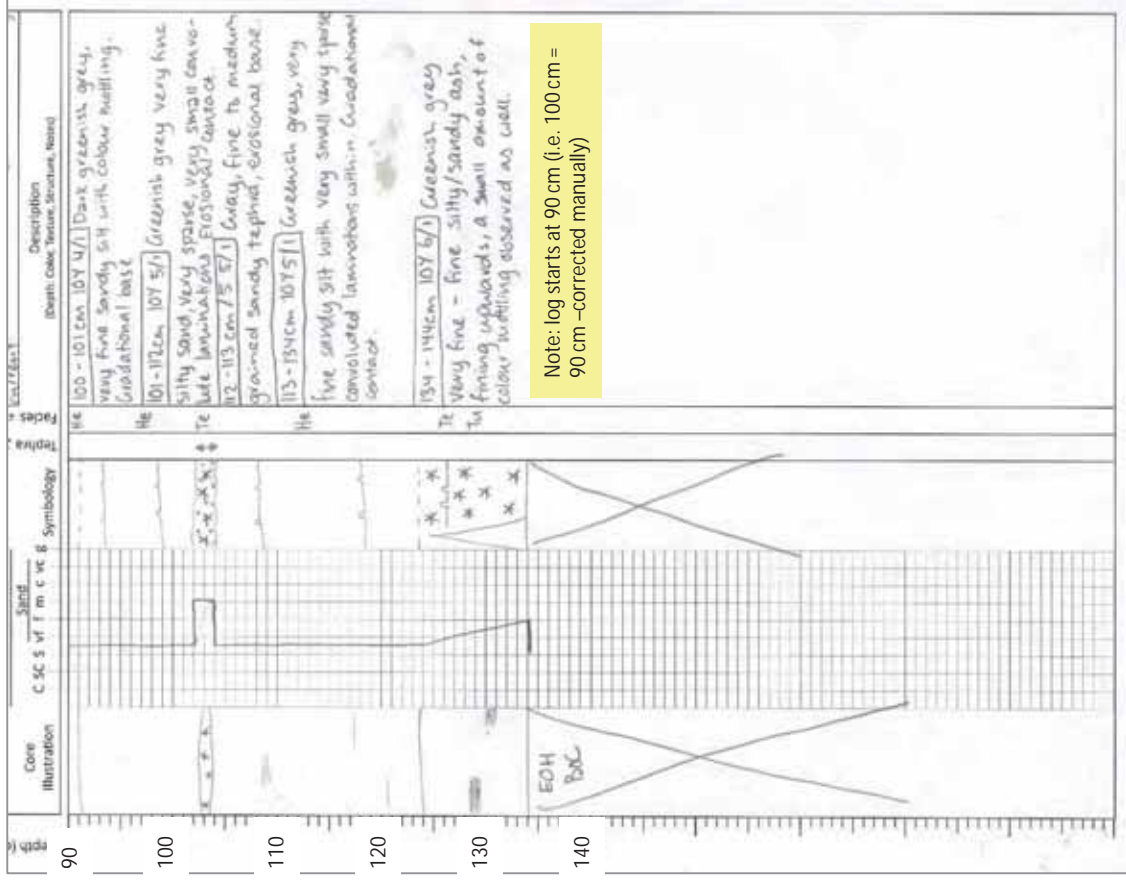
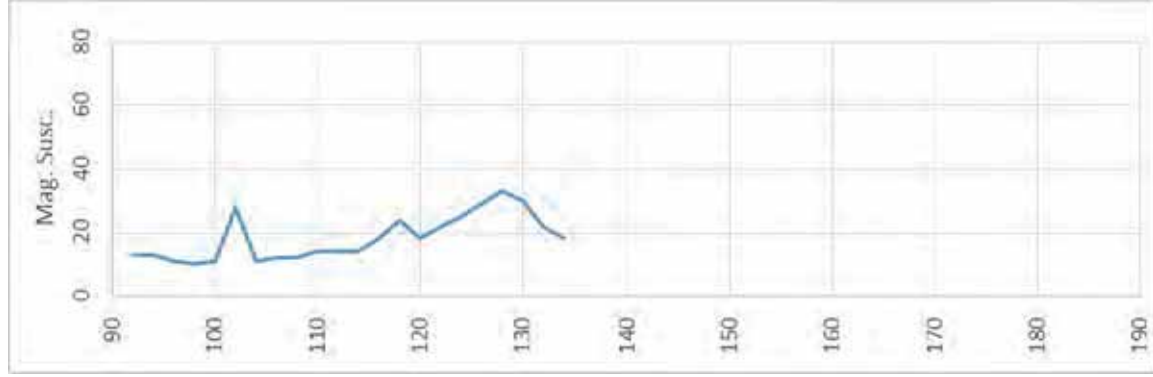
0-100 from splitting core

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: HB 2

Other ID TAN1613-31

Section 2 of 2



Note: log starts at 90 cm (i.e. 100 cm = 90 cm - corrected manually)

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: **HB 2 (repeat)**

Latitude: -40.38350

Date/Time (NZST): 14/11/2016 23:15

Other ID: TAN1613-32

Longitude: 177.89625

Depth (m): 2264

Sample Description

General Description

Un-named basin inside NW Akitio Trough

Hemipelagites overlying thick tephra section at 1.42-1.56m

Gear type		Piston core	
Barrel Length (m)	6	Bent barrel	n
Penetration (m)		Catcher/Cutter bags	
Core length (m)	1.56	Samples	
Sections	2	Tephra	1
Fauna			

Sample processing – core ID:

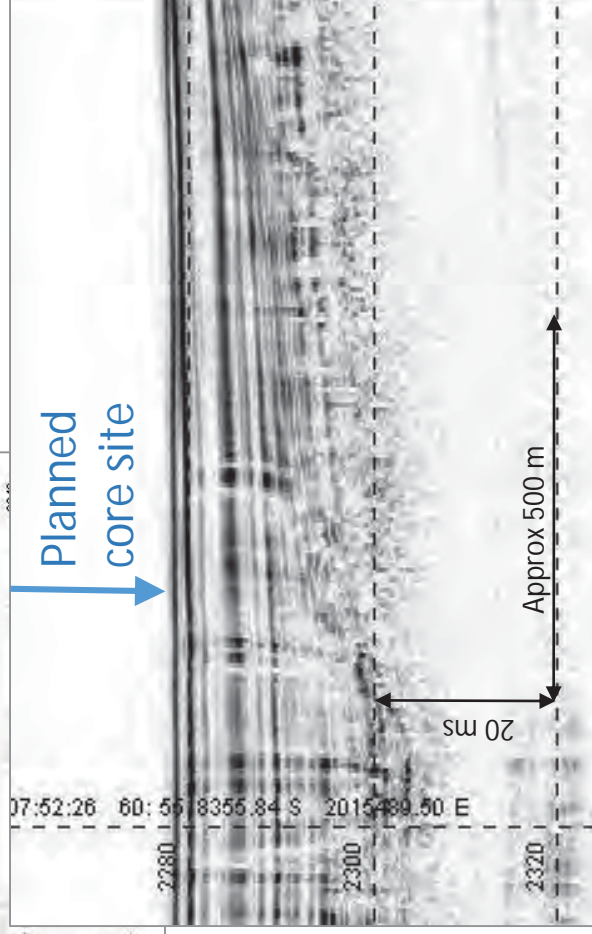
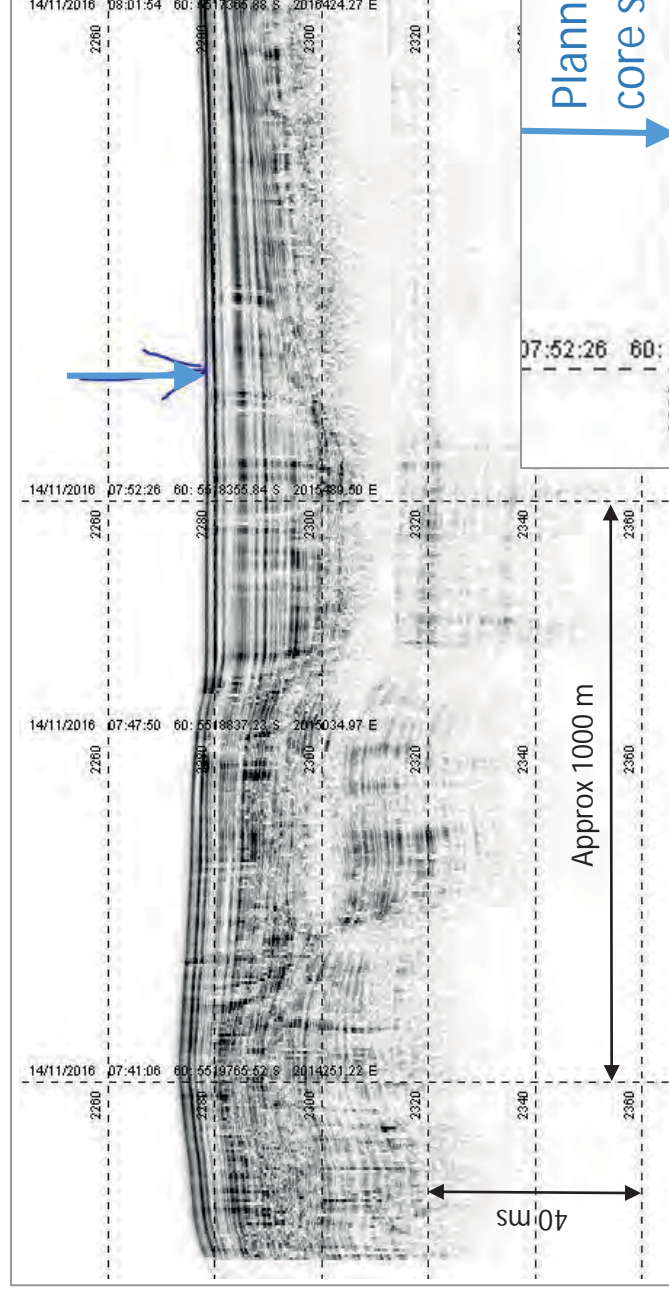
Section	Top depth (cm)	Btm depth (cm)	Logged	Phys Props	Summary
1	0	100	Y	Y	.
2	100	156	Y	Y	.
.	.	.	Y	Y	.
.	.	.	Y	Y	.
.	.	.	Y	Y	.
.	.	.	Y	Y	.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: HB 2 (repeat)

Other ID TAN1613-32

Water Depth 2264 m



Topas line including transit to the station. The blue arrow marks the planned core site.

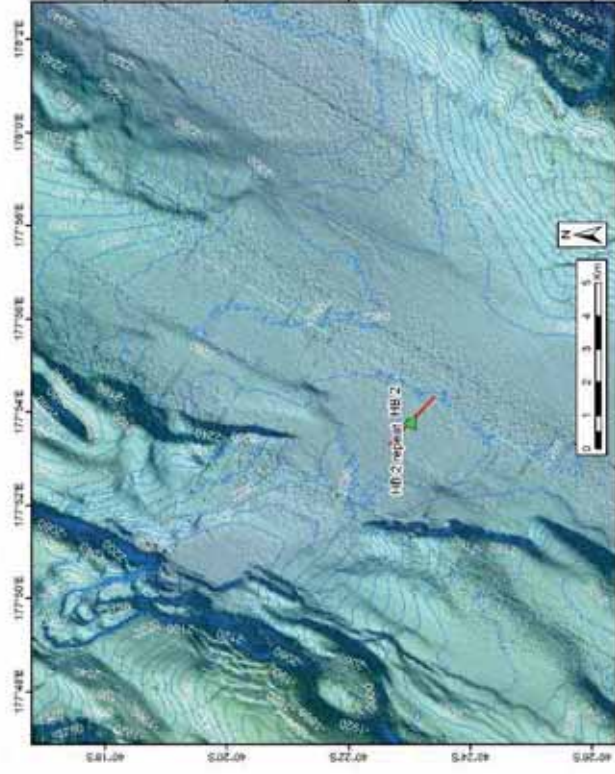
Zoom into 2km survey line over planned core site.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

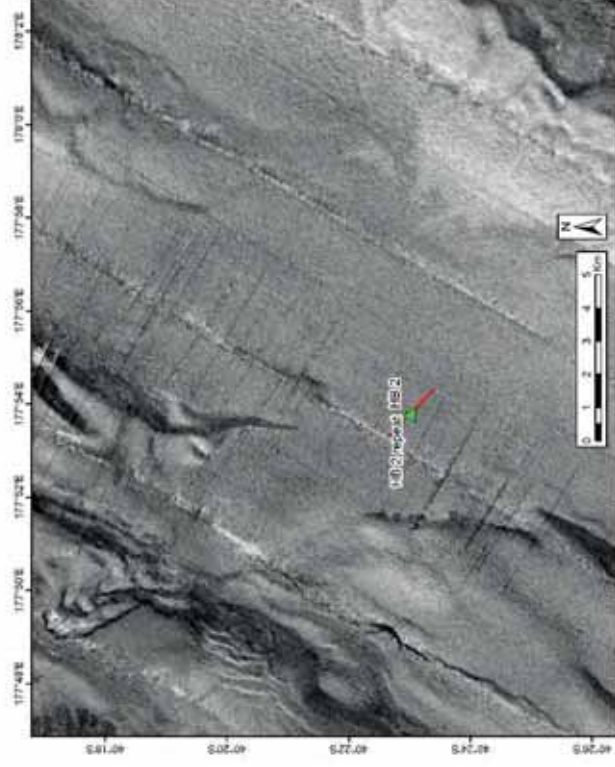
Core ID: HB 2 (repeat)

Other ID TAN1613-32

Water Depth 2264 m



Bathymetry at and around HB2 core site at an un-named basin inside NW Akitio Trough. Light blue lines are 20 m depth contours. Red lines show the 2 km TOPAS survey line over the station, green triangles indicate the actual core site.



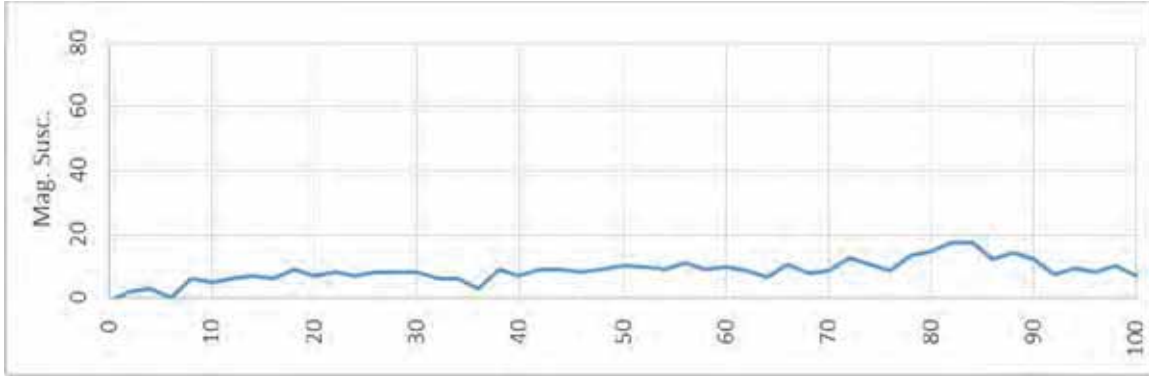
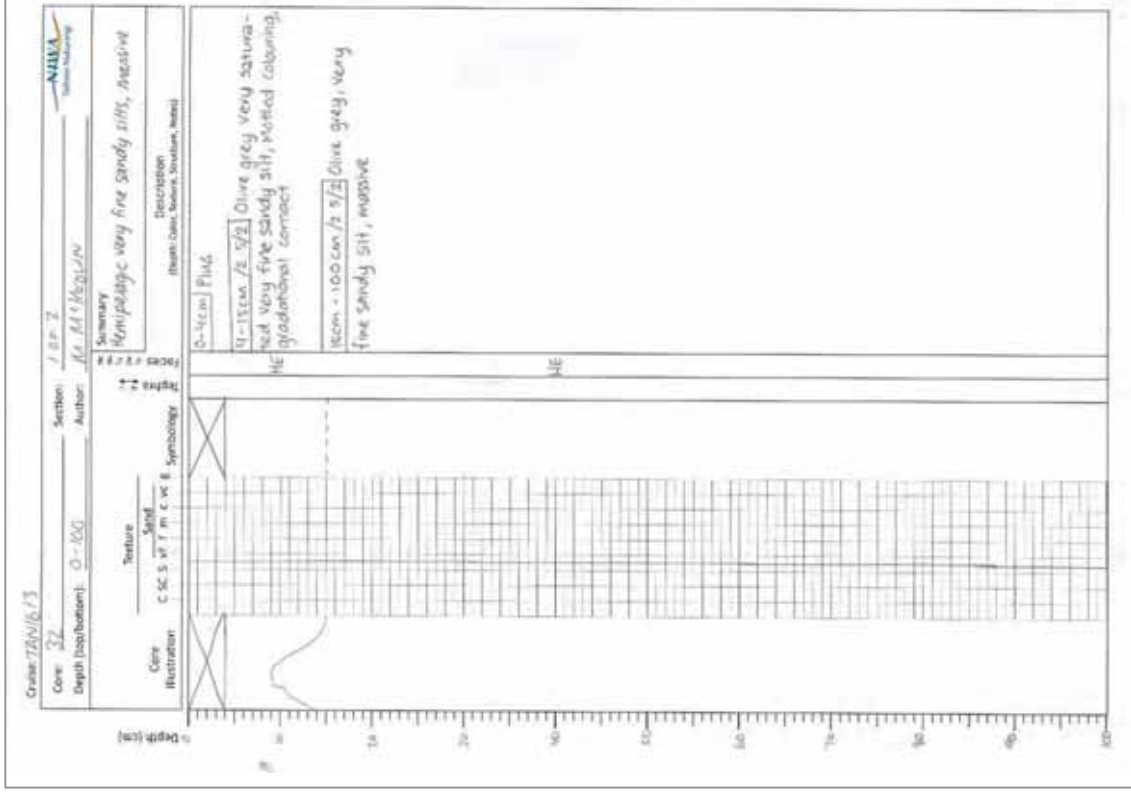
Backscatter at and around HB2 core site at an un-named basin inside NW Akitio Trough. Red lines show the 2 km TOPAS survey line over the station, green triangles indicate the actual core site.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: HB 2 (repeat)

Other ID TAN1613-32

Section 1 of 2

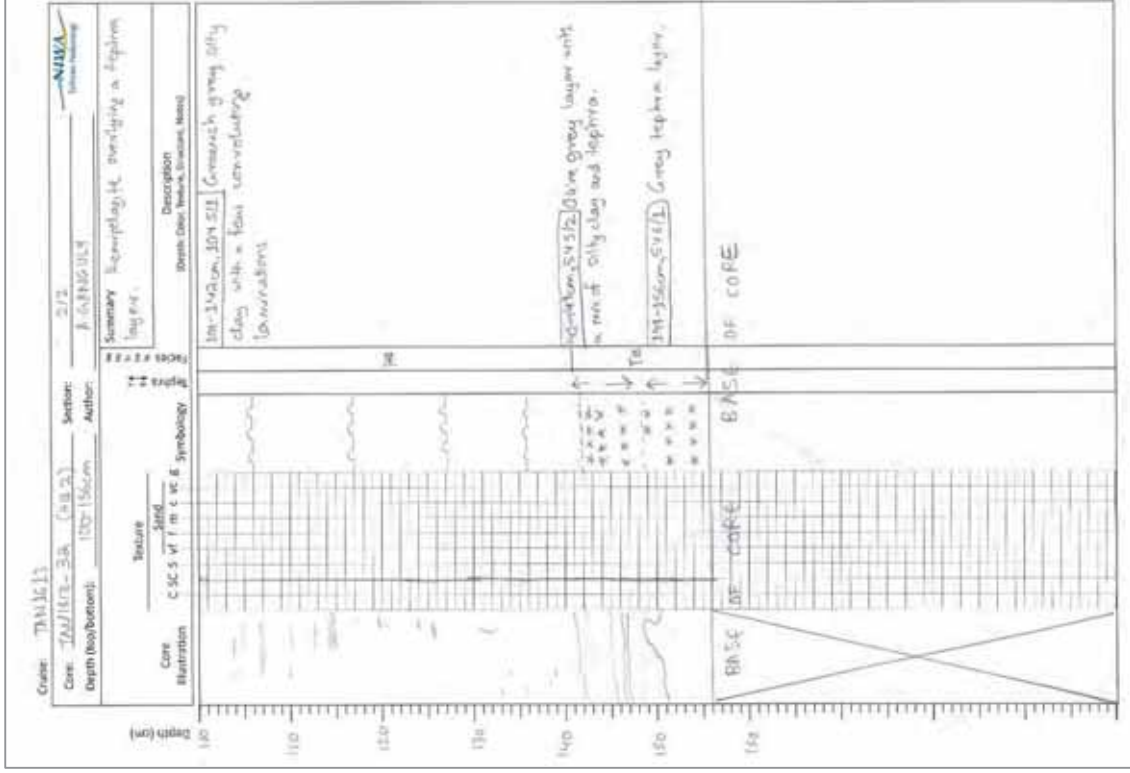
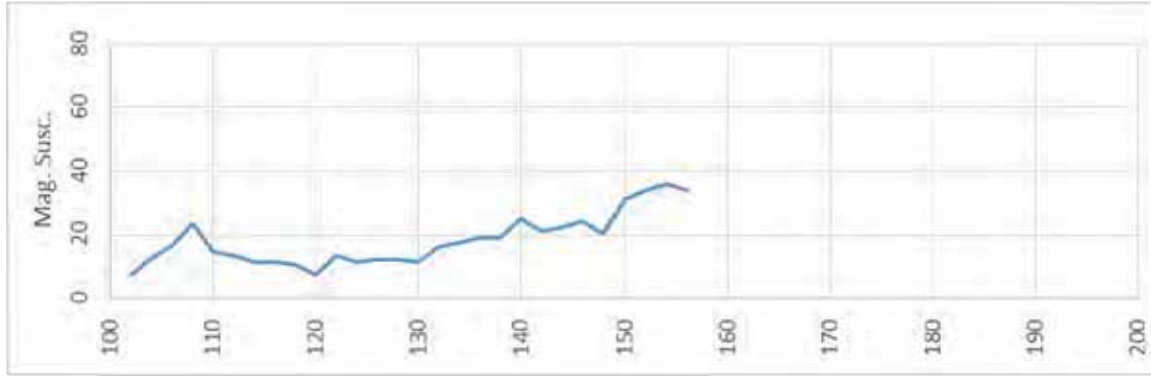


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: HB 2 (repeat)

Other ID TAN1613-32

Section 2 of 2



TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: **HB 5** Latitude: -39.97272 Date/Time (NZST): 15/11/2016 04:13

Other ID: TAN1613-33 Longitude: 177.74065 Depth (m): **1472**

Sample Description

General Description

Omakere Trough, Sthn Hawkes Bay

Hemipelagic mud interbedded with silty/sandy turbidites. One tephra bleb at 66 cm

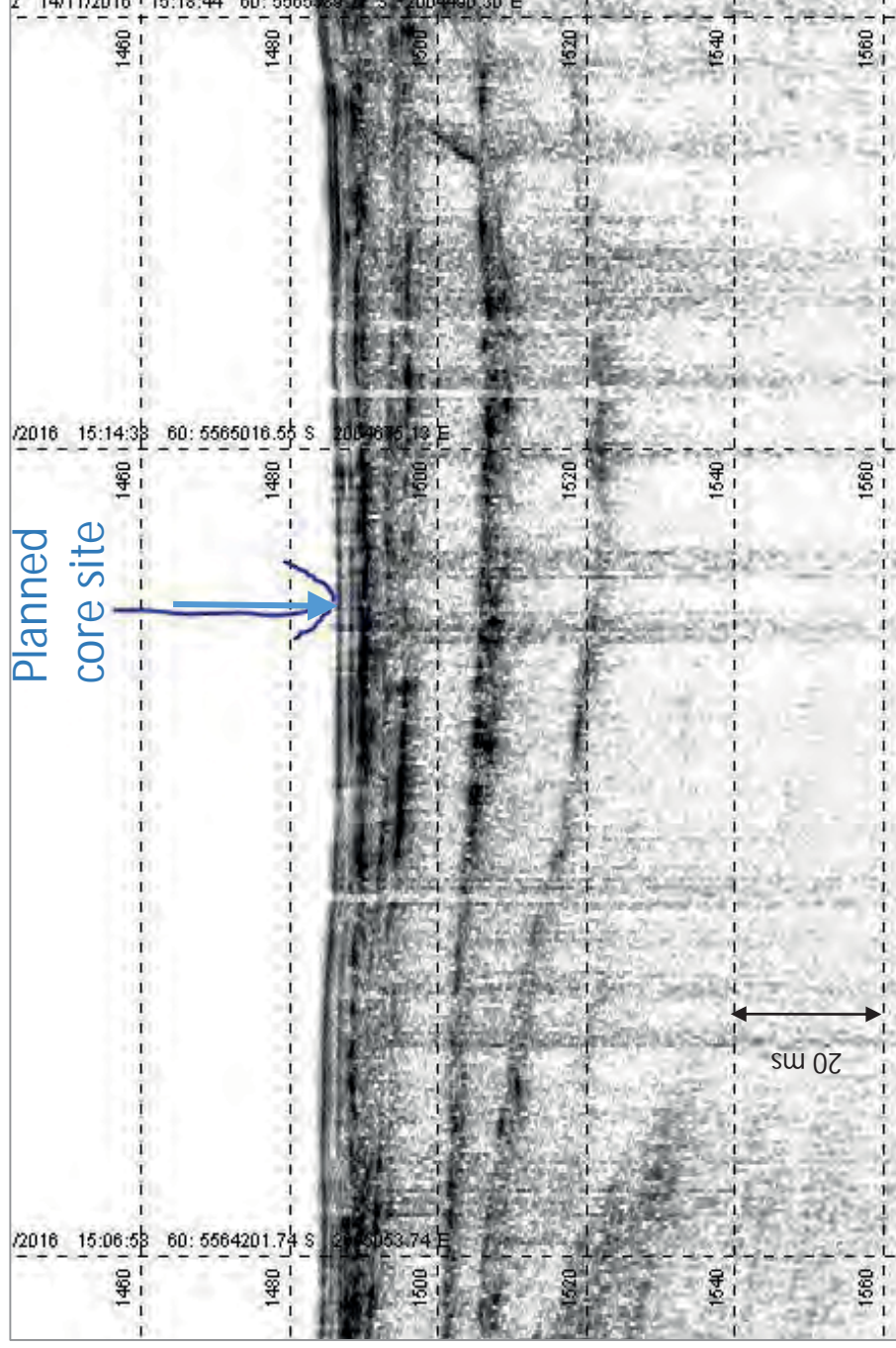
Gear type		Piston core	
Barrel Length (m)	6	Bent barrel	n
Penetration (m)		Catcher/Cutter bags	
Core length (m)	4.5	Samples	
Sections	5	Tephra	1
Fauna	N	.	.

Sample processing – core ID:

Section	Top depth (cm)	Btm depth (cm)	Logged	Phys Props	Summary
1	0	100	Y	Y	.
2	100	200	Y	Y	.
3	200	300	Y	Y	.
4	300	400	Y	Y	.
5	400	450	Y	Y	.
.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

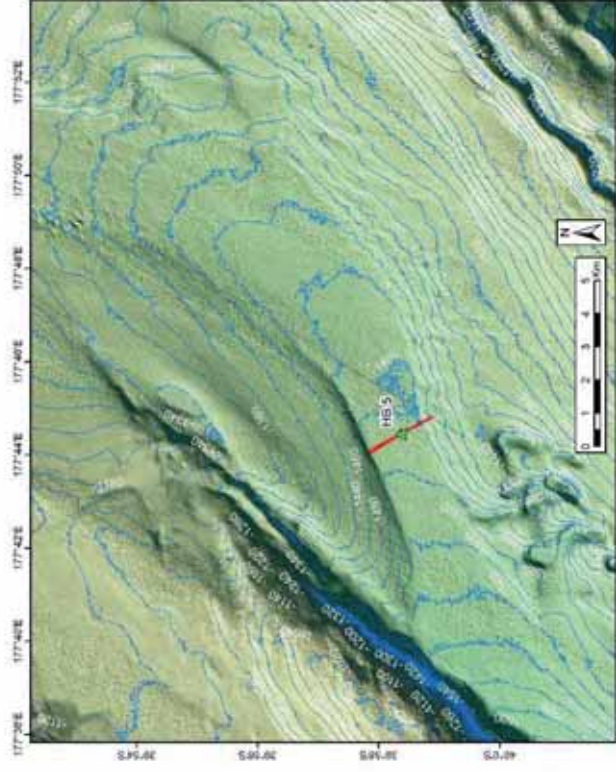
Core ID: HB 5	Other ID TAN1613-33	Water Depth 1472 m
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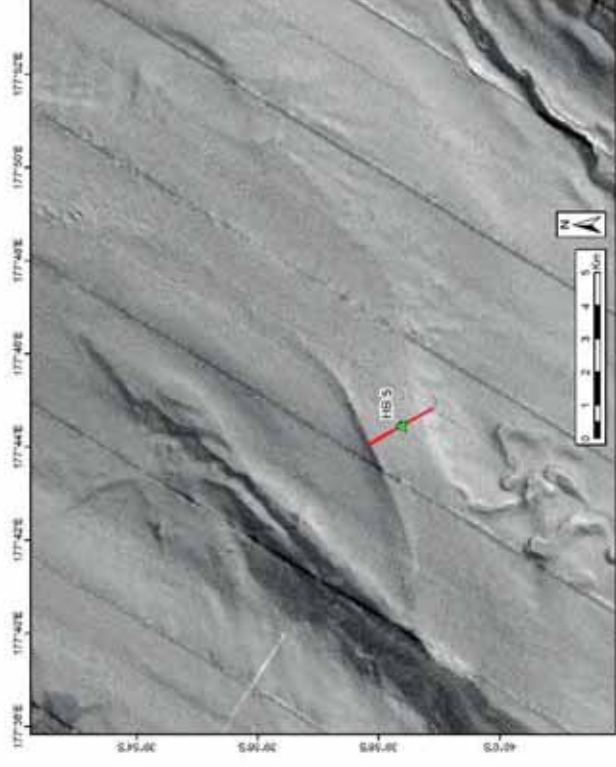
2km Topas line over the station. The blue arrow marks the planned core site.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: HB5	Other ID TAN1613-33	Water Depth 1472 m
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Bathymetry at and around HB5 core site in the Omakere Trough, Southern Hawkes Bay. Light blue lines are 20 m depth contours. Red lines show the 2 km TOPAS survey line over the station, green triangles indicate the actual core site.



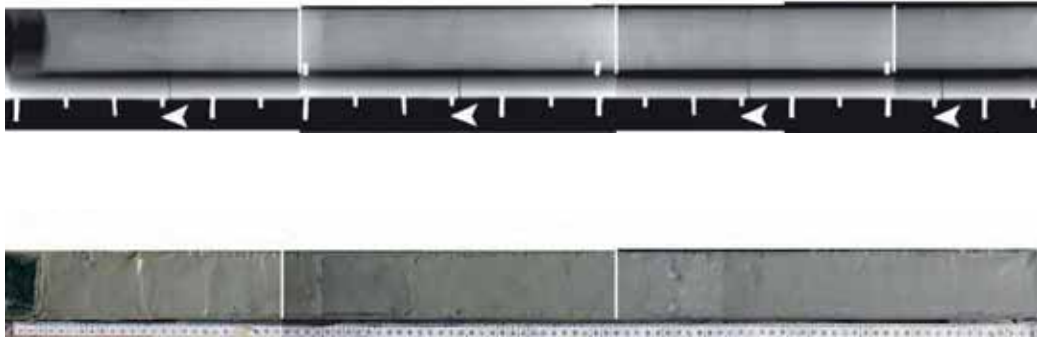
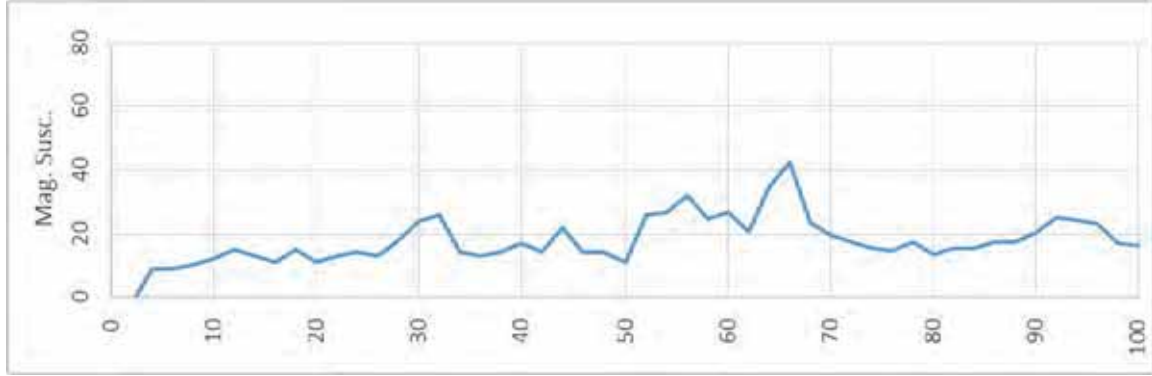
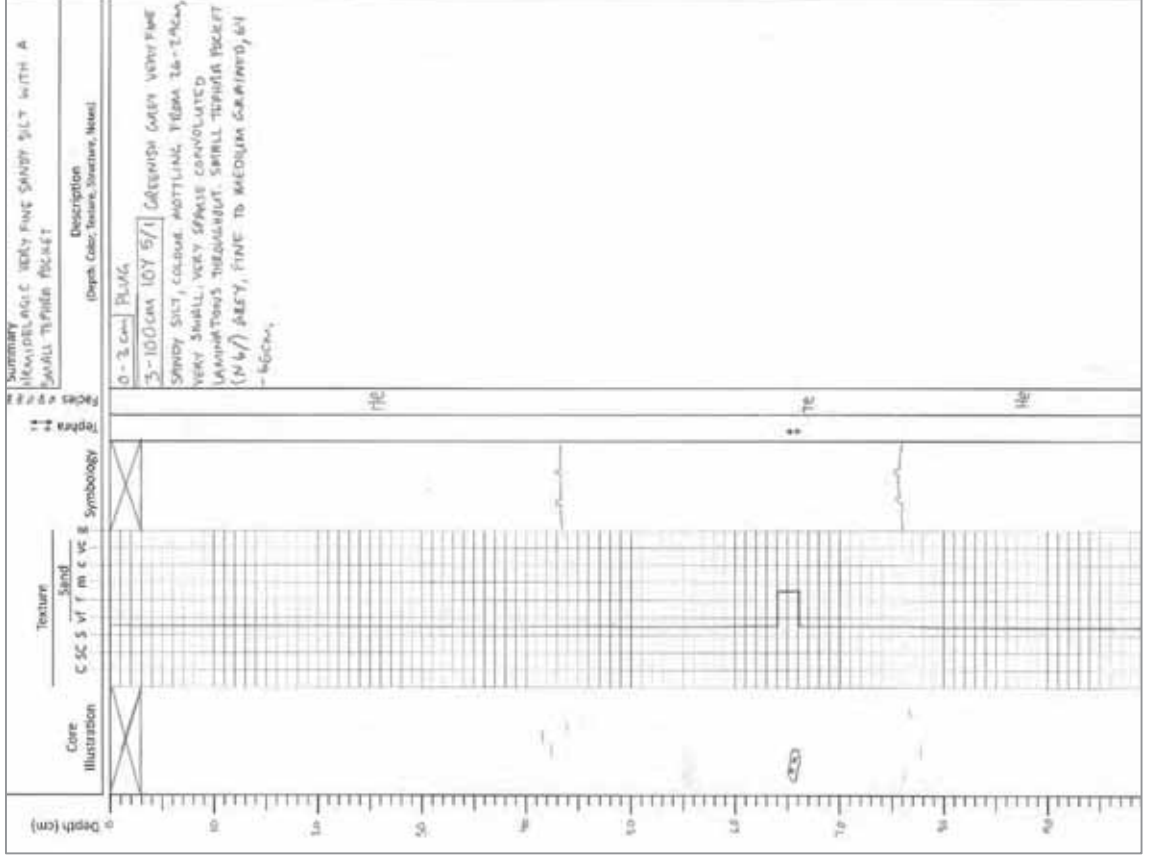
Backscatter at and around HB5 core site in the Omakere Trough, Southern Hawkes Bay. Red lines show the 2 km TOPAS survey line over the station, green triangles indicate the actual core site.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: HB 5

Other ID TAN1613-33

Section 1 of 5

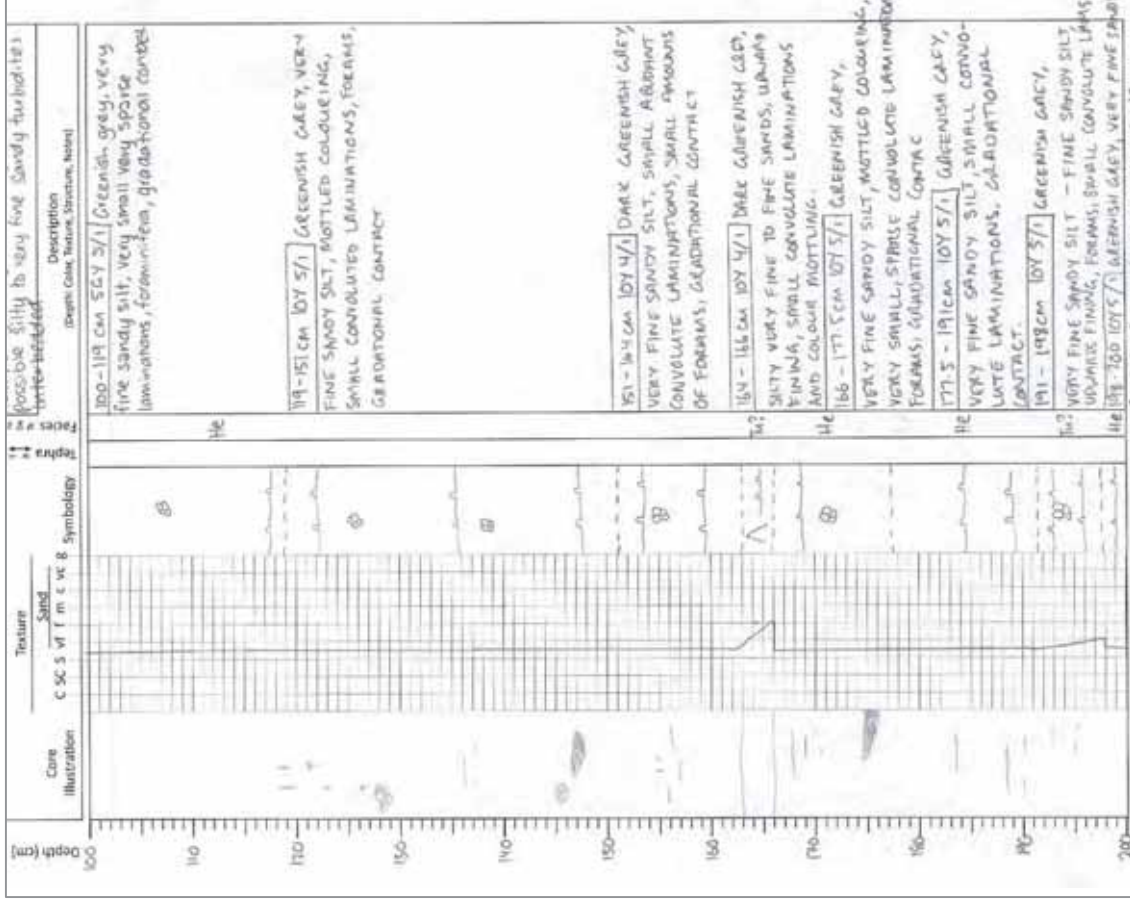
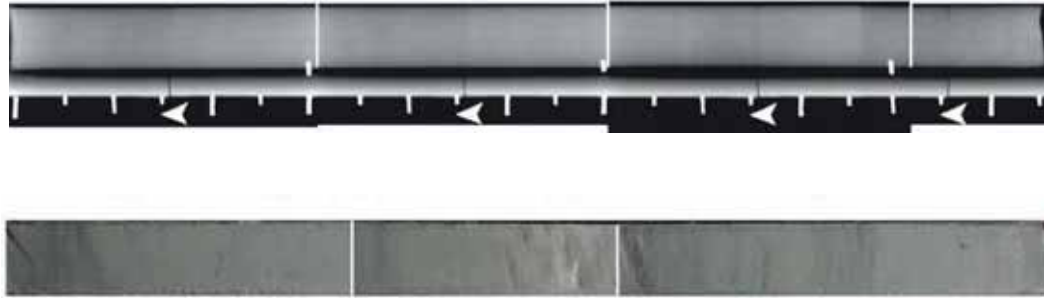
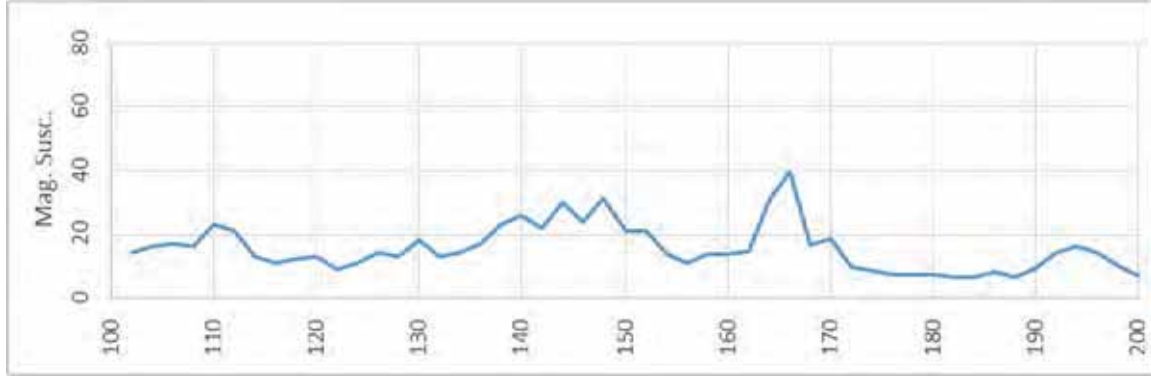


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: HB 5

Other ID TAN1613-33

Section 2 of 5

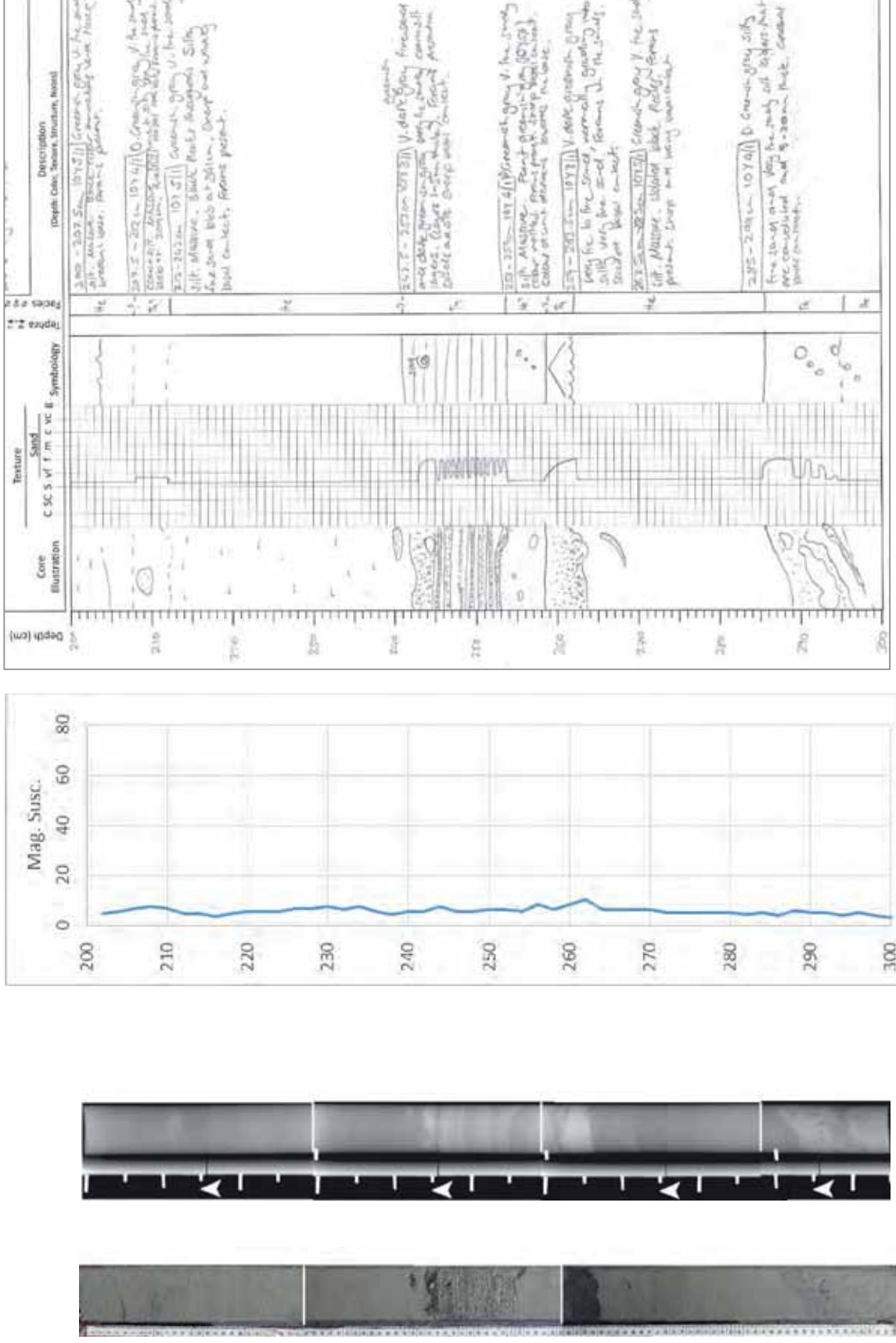


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: HB 5

Other ID TAN1613-33

Section 3 of 5

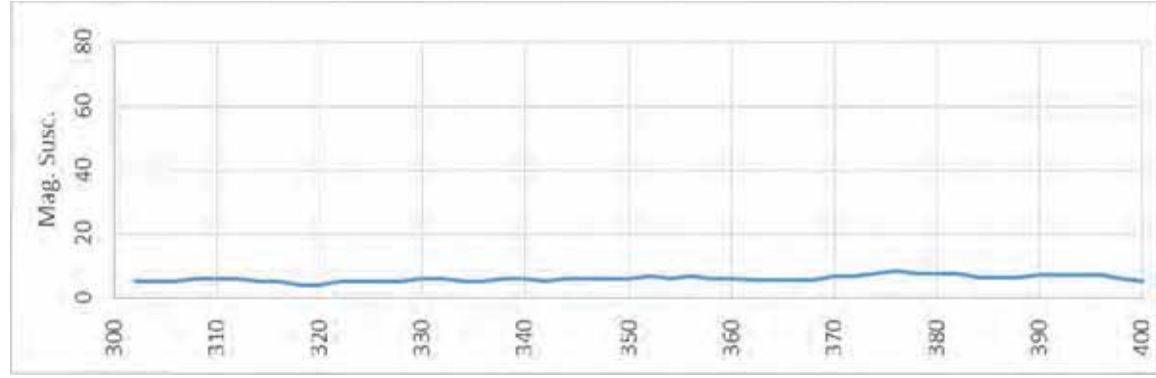
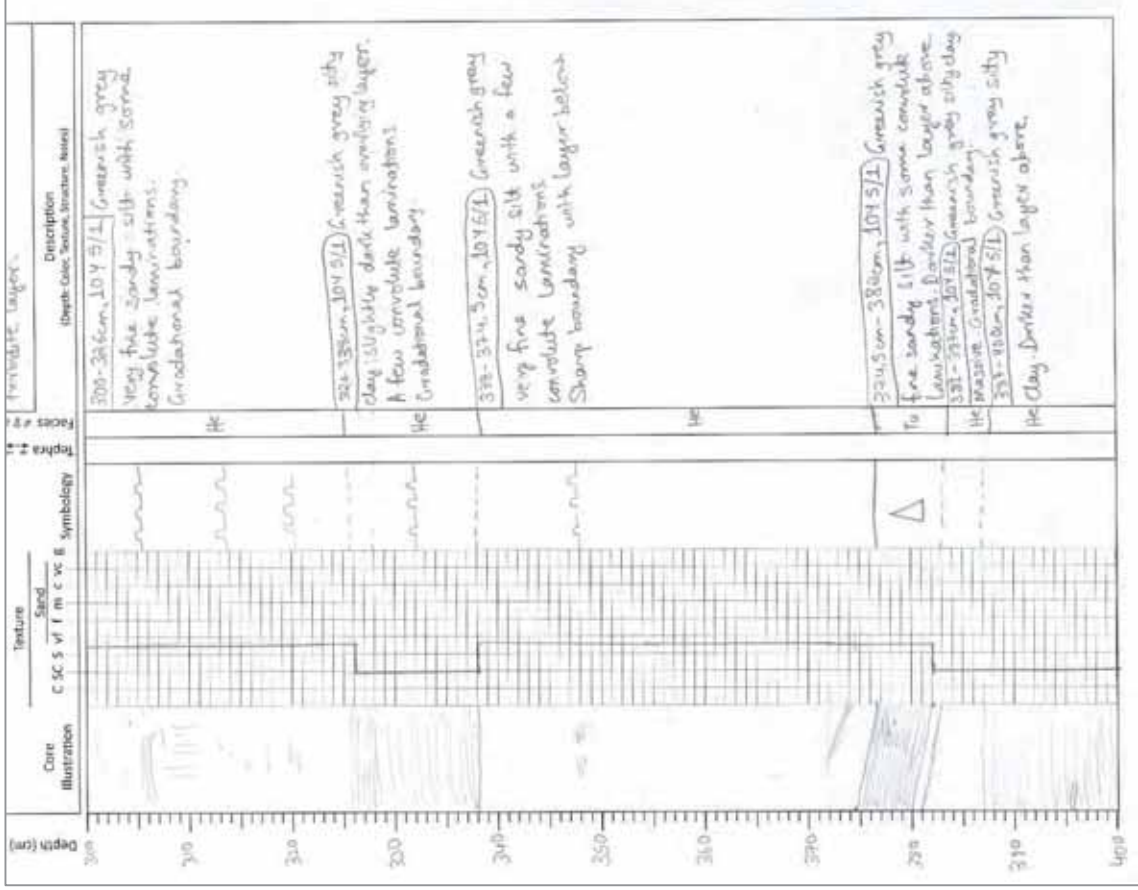


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: HB 5

Other ID TAN1613-33

Section 4 of 5

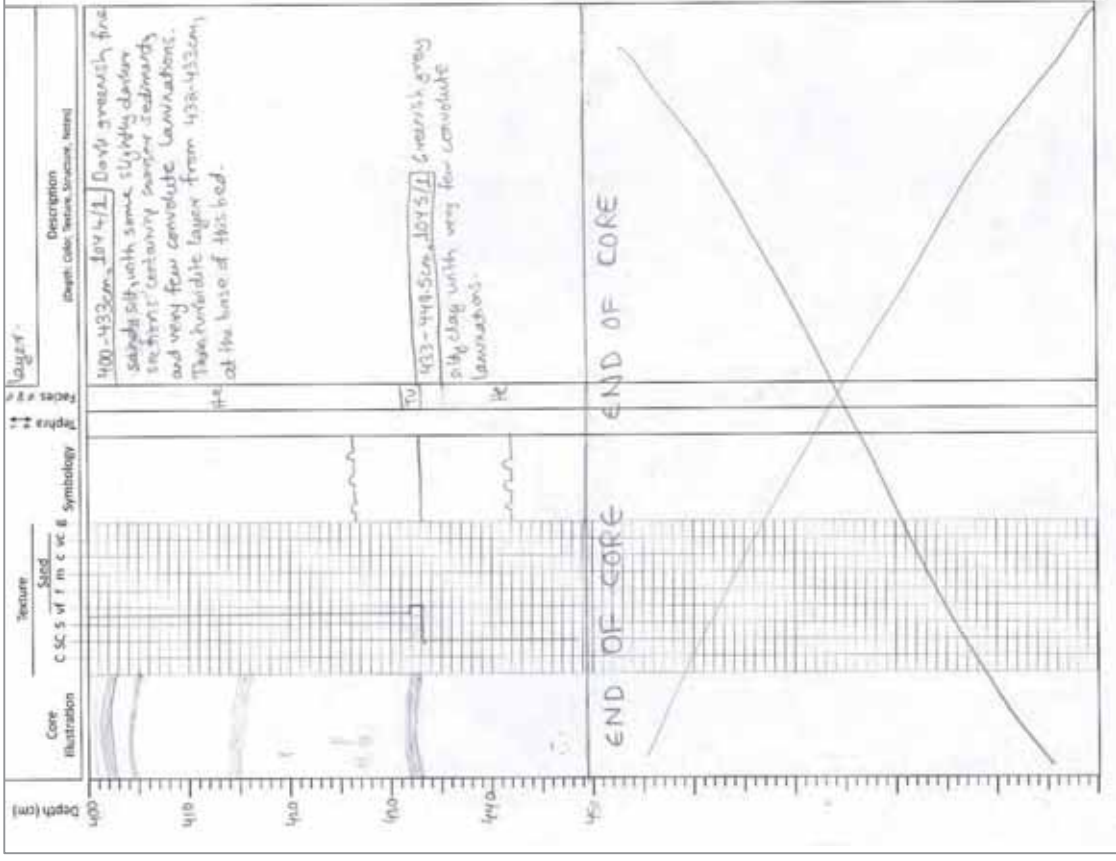
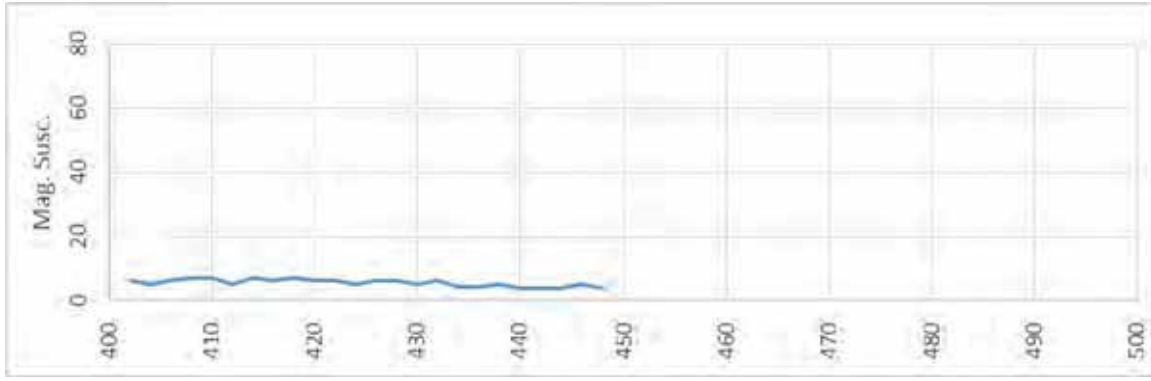


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: HB 5

Other ID TAN1613-33

Section 5 of 5



TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: HB 6	Latitude: -39.98885	Date/Time (NZST): 15/11/2016 07:39
Other ID: TAN1613-34	Longitude: 177.98300	Depth (m): 1508

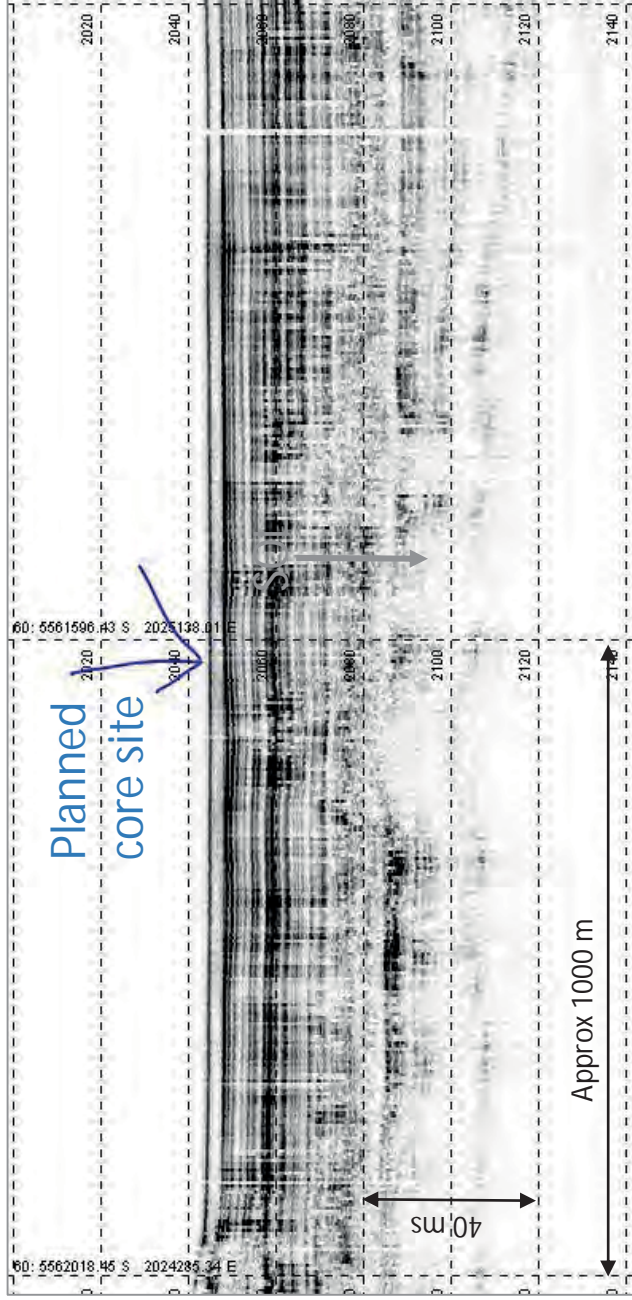
Sample Description	Gear type	Piston core
General Description Northern Paoanui Trough, east of Omakere Ridge Hemipelagite with some laminated intervals (turbidites?)	Barrel Length (m)	6 Bent barrel n
	Penetration (m)	Catcher/Cutter bags N
	Core length (m)	1.71 Samples N
	Sections	2 Tephra N
	Fauna	N .

Sample processing – core ID:

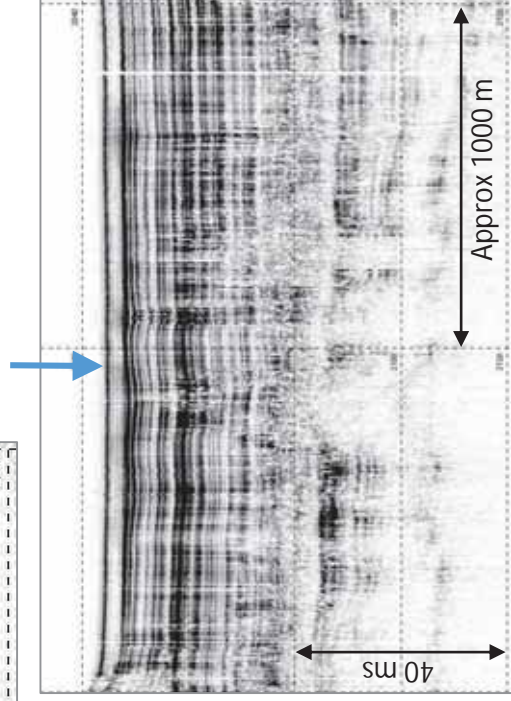
Section	Top depth (cm)	Btm depth (cm)	Logged	Phys Props	Summary
1	0	100	Y	Y .	
2	100	171	Y	Y .	
.	
.	
.	
.	

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: HB 6	Other ID TAN1613-34	Water Depth 1508 m
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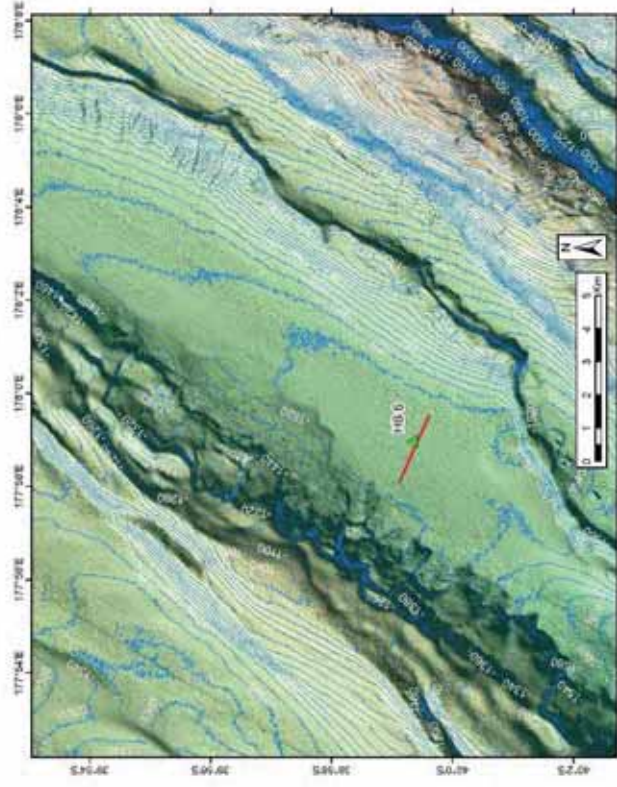
Topas line including transit to the station. Grey arrows indicate start and end of the 2km survey line over the station. Blue arrow marks the planned core site.



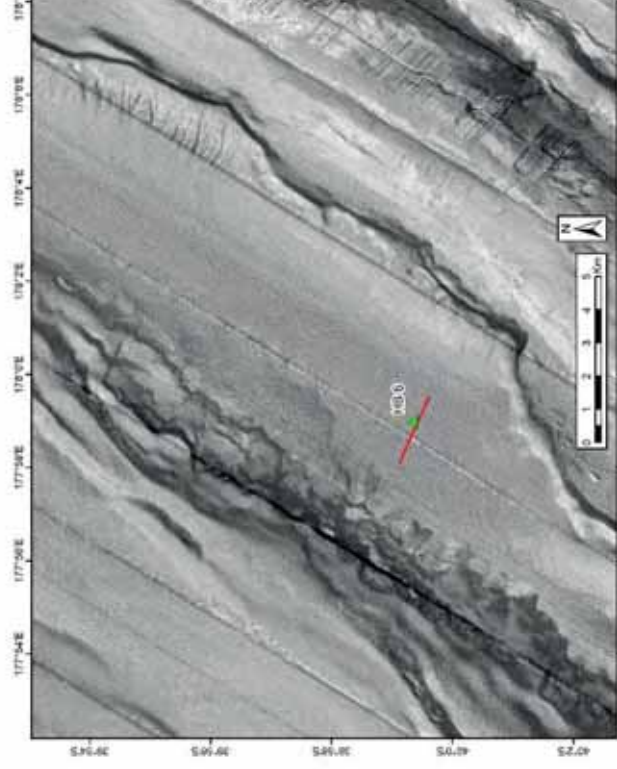
Zoom into 2km survey lines over planned core site.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: HB 6	Other ID TAN1613-34	Water Depth 1508 m
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Bathymetry at and around HB6 core site in the Northern Paoanui Trough, east of Omakere Ridge. Light blue lines are 20 m depth contours. Red lines show the 2 km TOPAS survey line over the station, green triangles indicate the actual core site.



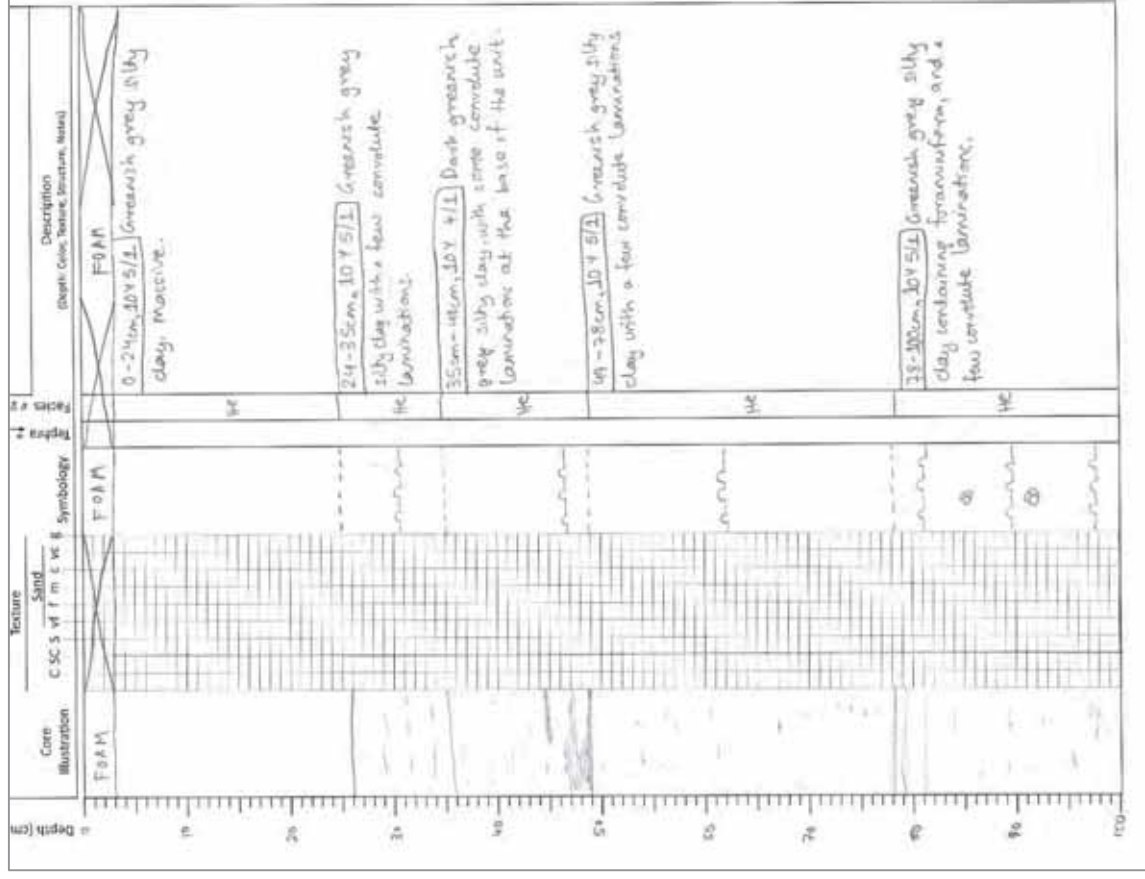
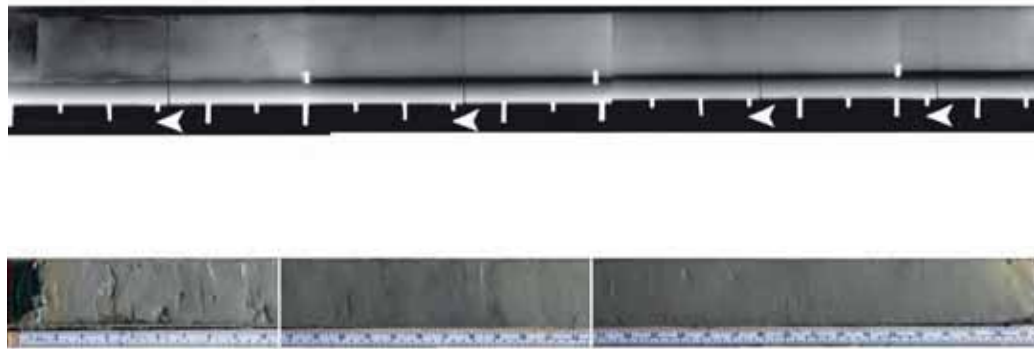
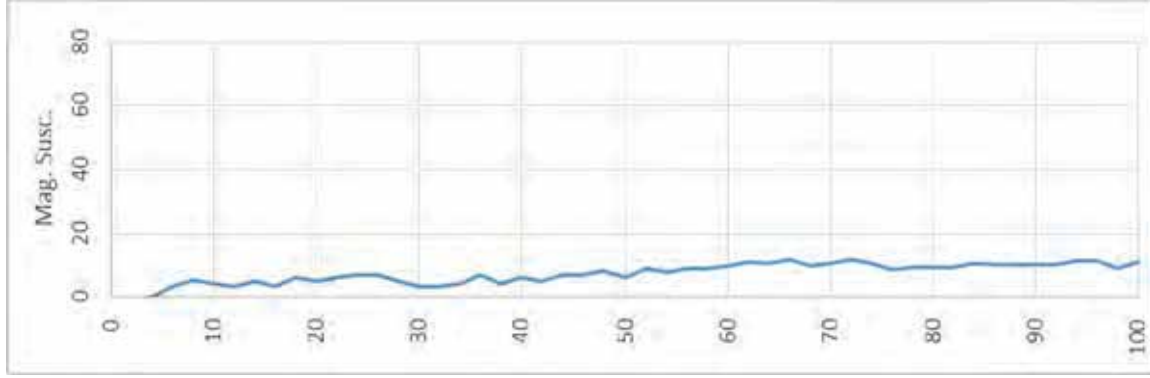
Backscatter at and around HB6 core site in the Northern Paoanui Trough, east of Omakere Ridge. Red lines show the 2 km TOPAS survey line over the station, green triangles indicate the actual core site.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: HB 6

Other ID TAN1613-34

Section 1 of 2

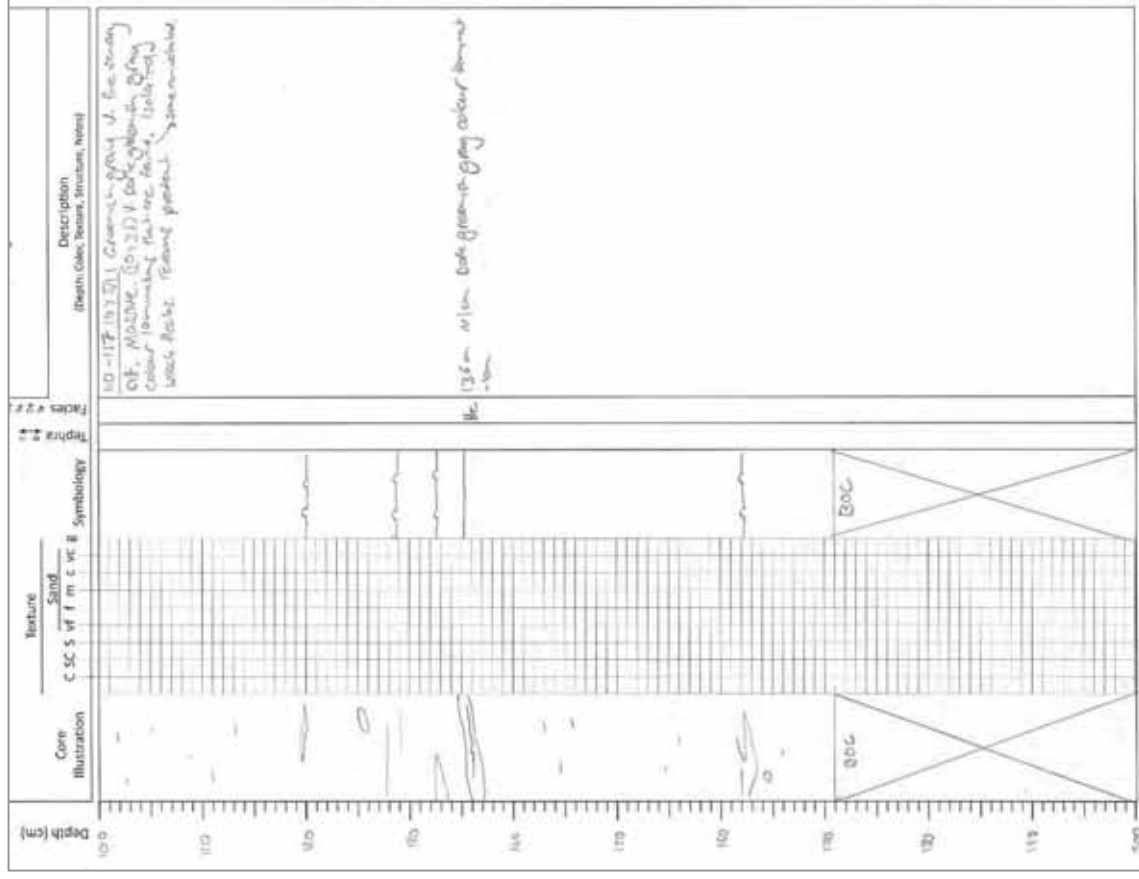
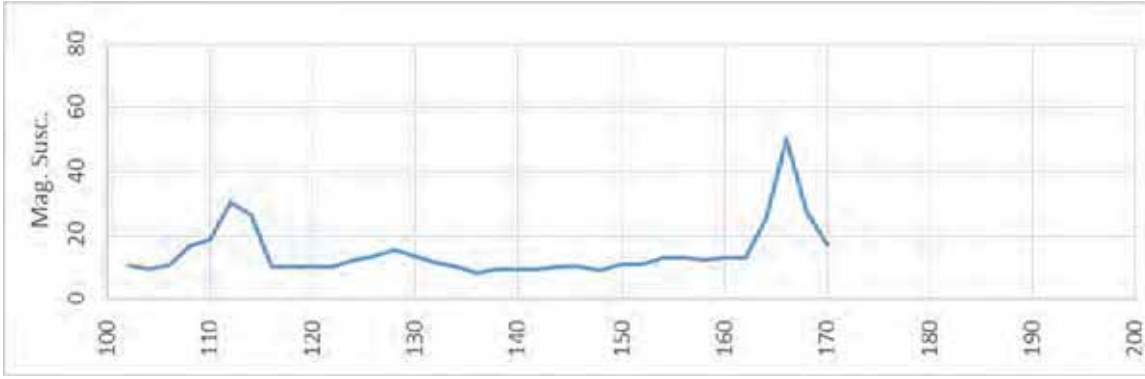
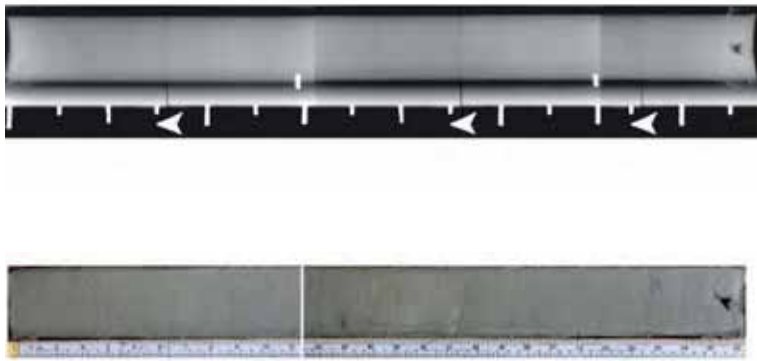


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: HB 6

Other ID TAN1613-34

Section 2 of 2



TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: **Rock 1**

Latitude: -39.90997

Date/Time (NZST): 15/11/2016 11:56

Other ID: TAN1613-35

Longitude: 178.34648

Depth (m): **1908**

Sample Description

General Description

Lower slope mini-basin Nth of Rock Garden

Hemipelagites with at least 1 turbidite and a tephra at the base of section 2

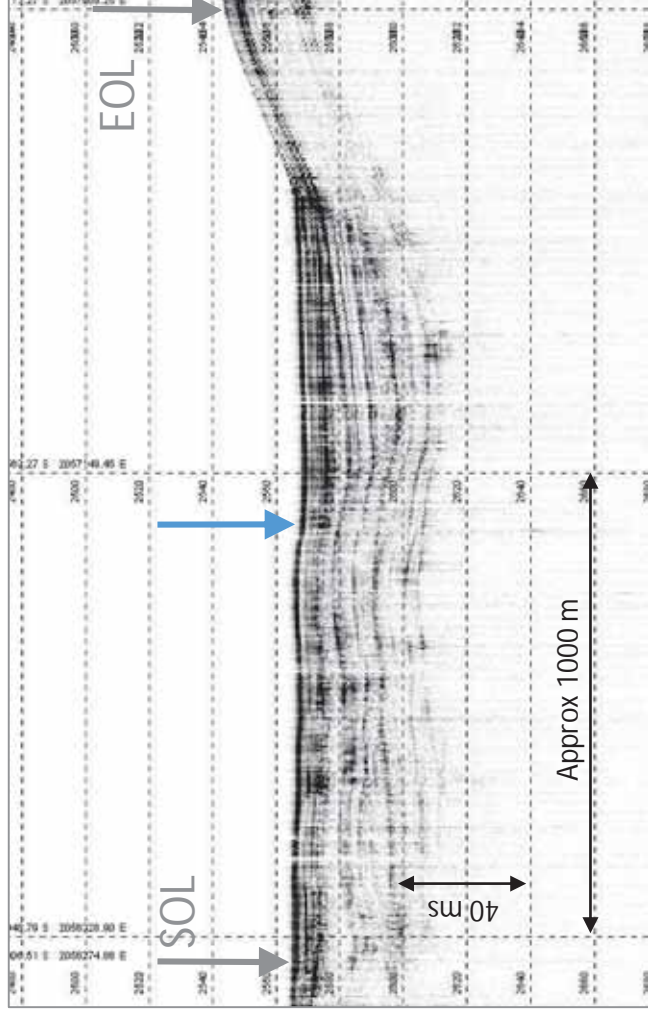
Gear type		Piston core	
Barrel Length (m)	6	Bent barrel	n
Penetration (m)		Catcher/Cutter bags	N
Core length (m)	1.13	Samples	N
Sections	2	Tephra	1
Fauna	.		

Sample processing – core ID:

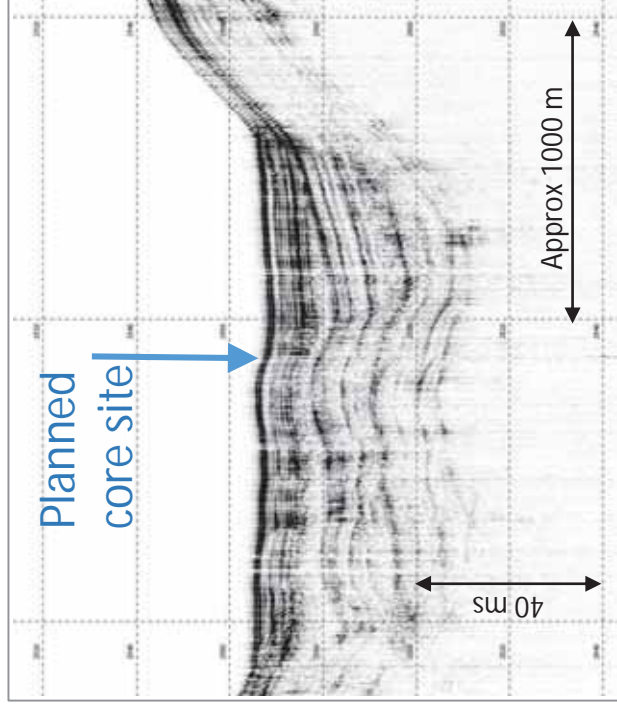
Section	Top depth (cm)	Btm depth (cm)	Logged	Phys Props	Summary
1	0	60	Y	Y	.
2	60	113	Y	Y	.
.
.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Rock 1	Other ID TAN1613-35	Water Depth 1908
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2km Topas line over the planned core station. Grey arrows indicate start and end of the 2km survey line over the station. Blue arrow marks the planned core site.



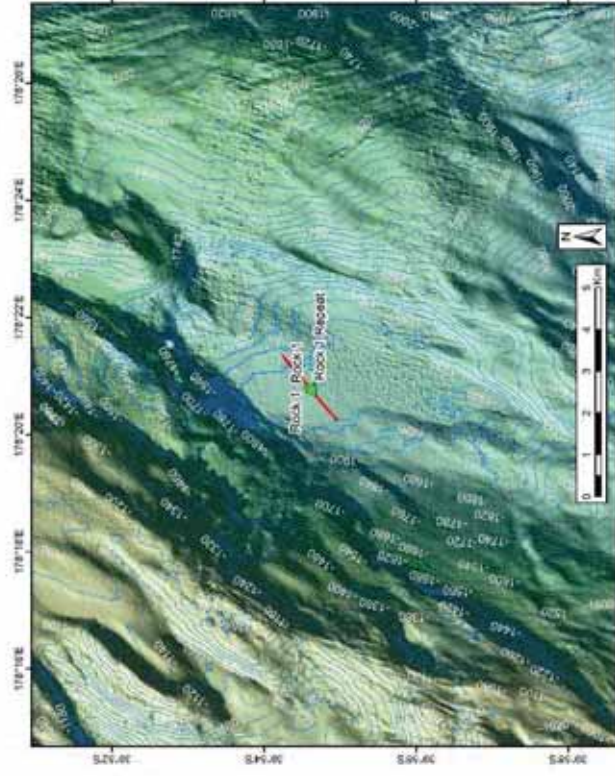
Vertical exaggerated survey lines over planned core site.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

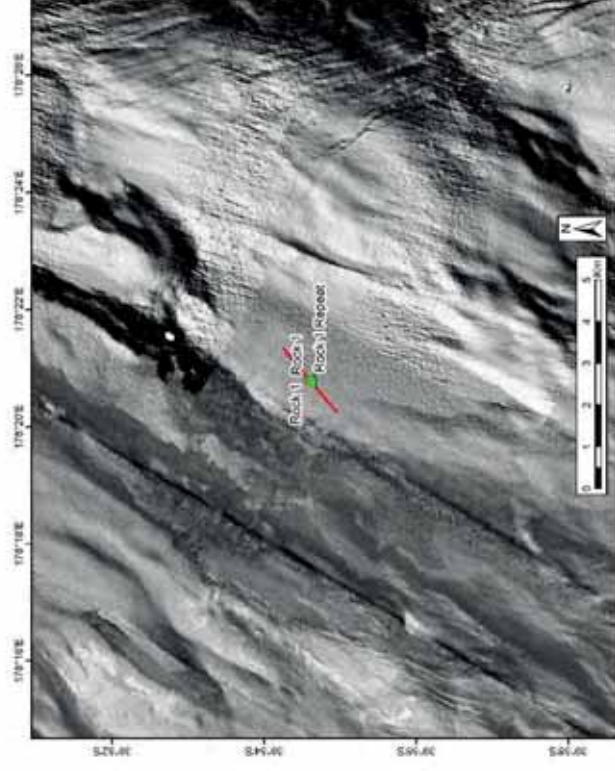
Core ID: **Rock 1**

Other ID **TAN1613-35**

Water Depth **1908**



Bathymetry at and around Rock1 core site at the lower slope of a mini-basin North of Rock Garden. Light blue lines are 20 m depth contours. Red lines show the 2 km TOPAS survey line over the station, green triangles indicate the actual core site. Multi-label indicate a repeated core and a multicore.



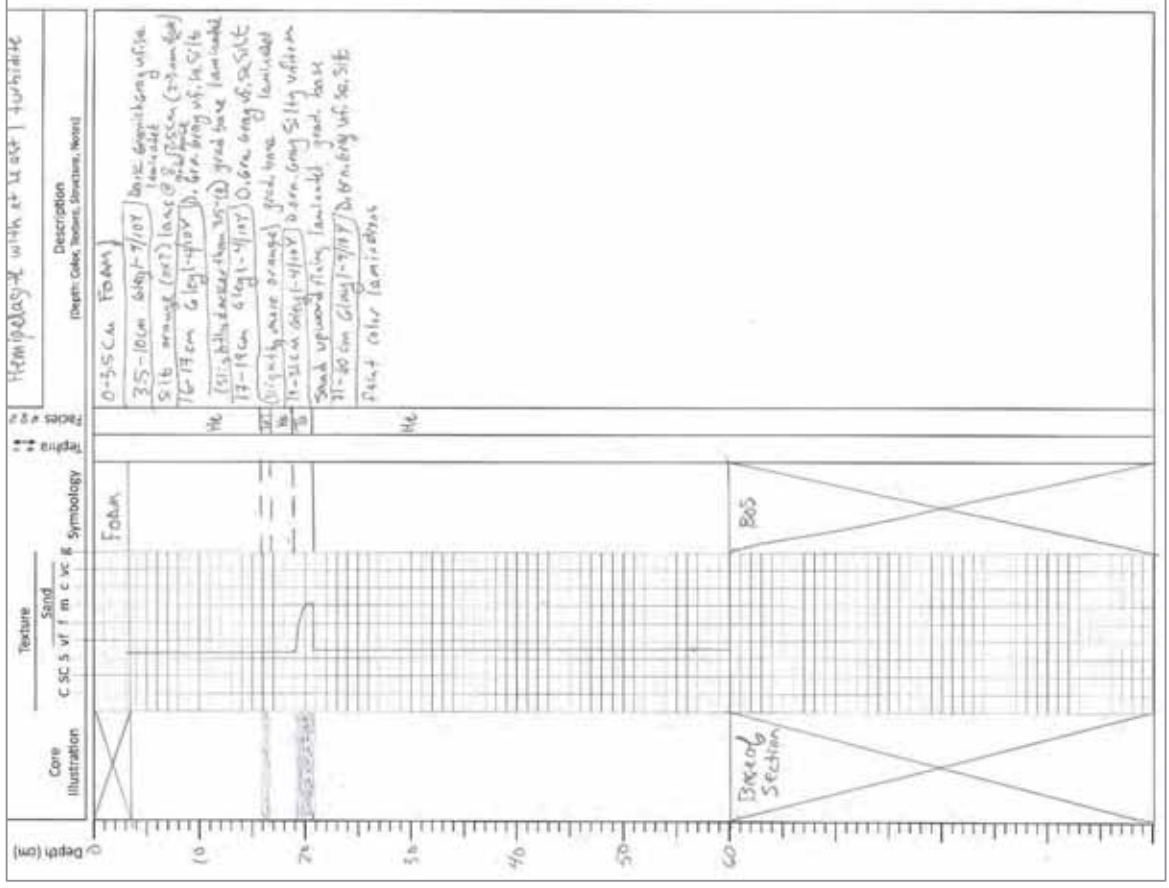
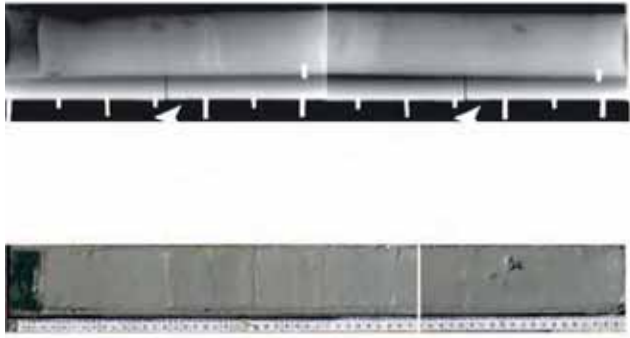
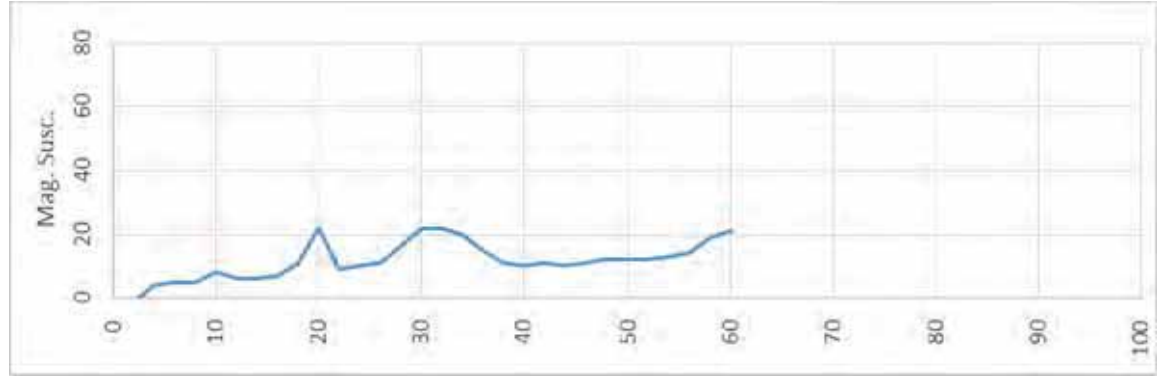
Backscatter at and around Rock1 core site at the lower slope of a mini-basin North of Rock Garden. Red lines show the 2 km TOPAS survey line over the station, green triangles indicate the actual core site. Multi-label indicate a repeated core and a multicore.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Rock 1

Other ID TAN1613-35

Section 1 of 2

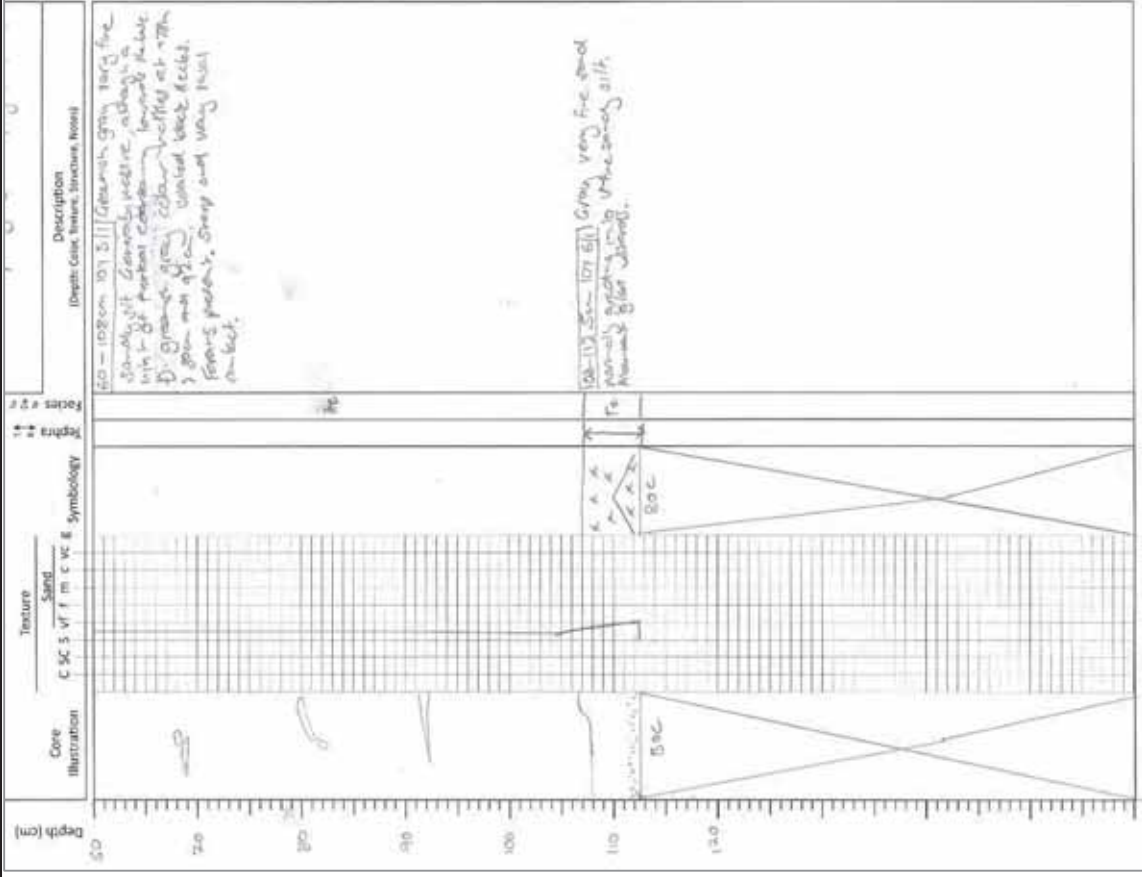
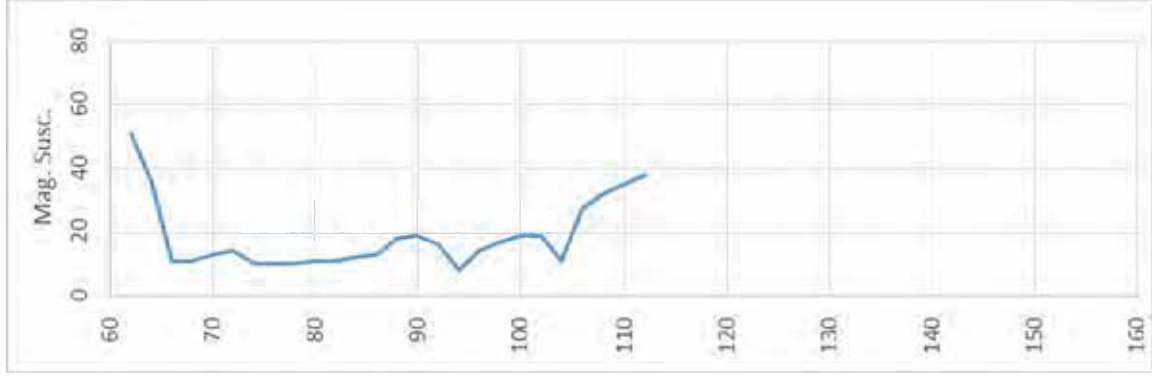


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Rock 1

Other ID TAN1613-35

Section 2 of 2



TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: **Rock 1 (repeat)**

Latitude: -39.90985

Date/Time (NZST): 15/11/2016 15:01

Other ID: Tan1613-36

Longitude: 178.34660

Depth (m): **1902**

Sample Description

General Description

Lower slope mini-basin Nth of Rock Garden

Hemipelagite with 3 turbidites (one possibly volcanoclastic) and at least 1 tephra in section 2

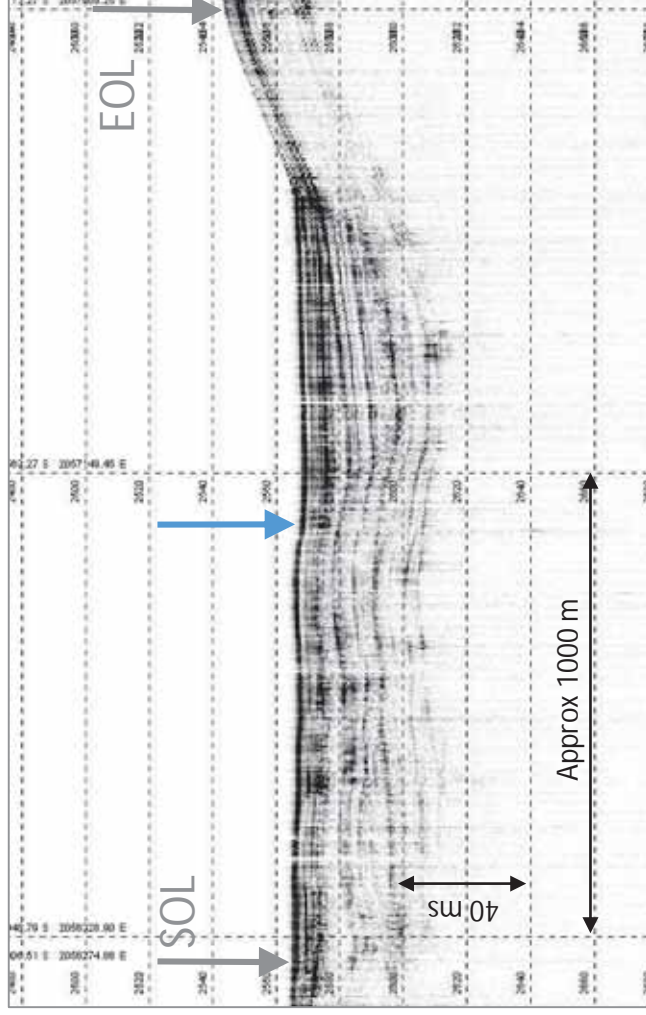
Gear type	Piston core	
Barrel Length (m)	6	Bent barrel
Penetration (m)		Catcher/Cutter bags
Core length (m)	1.43	Samples
Sections		Tephra
Fauna		

Sample processing – core ID:

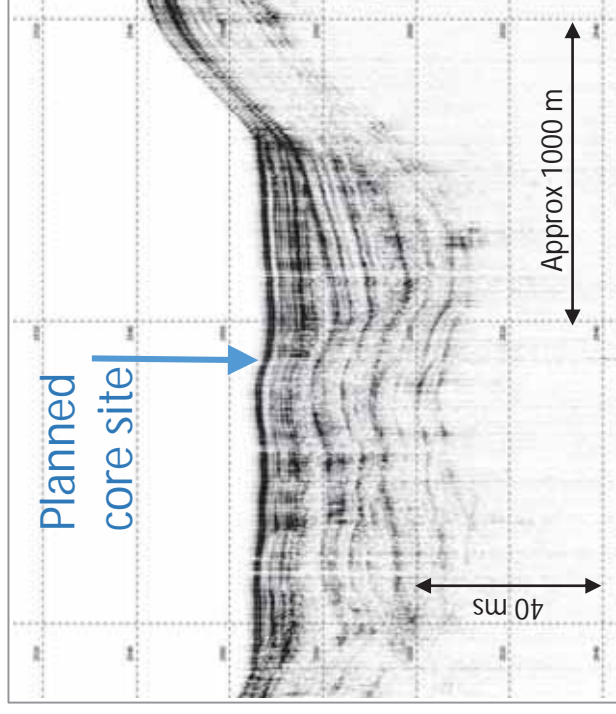
Section	Top depth (cm)	Btm depth (cm)	Logged	Phys Props	Summary
1	0	100	y	y	
2	100	143	y	y	

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Rock 1 (repeat)	Other ID Tan1613-36	Water Depth 1902
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2km Topas line over the planned core station. Grey arrows indicate start and end of the 2km survey line over the station. Blue arrow marks the planned core site.



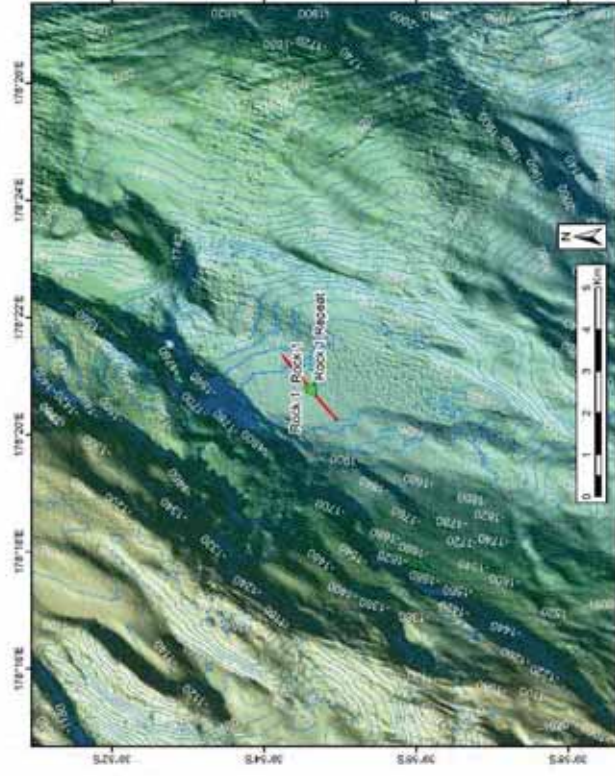
Vertical exaggerated survey lines over planned core site.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

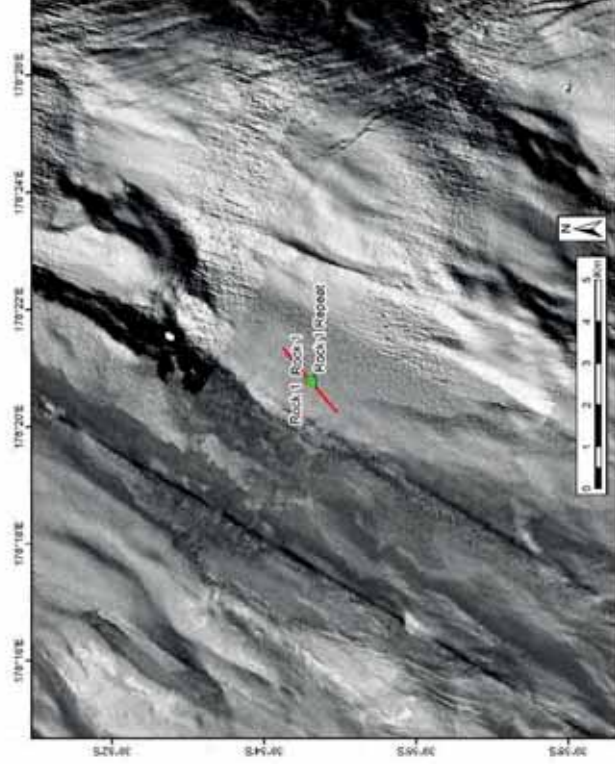
Core ID: **Rock 1 (repeat)**

Other ID **Tan1613-36**

Water Depth **1902**



Bathymetry at and around Rock1 core site at the lower slope of a mini-basin North of Rock Garden. Light blue lines are 20 m depth contours. Red lines show the 2 km TOPAS survey line over the station, green triangles indicate the actual core site. Multi-label indicate a repeated core and a multicore.



Backscatter at and around Rock1 core site at the lower slope of a mini-basin North of Rock Garden. Red lines show the 2 km TOPAS survey line over the station, green triangles indicate the actual core site. Multi-label indicate a repeated core and a multicore.

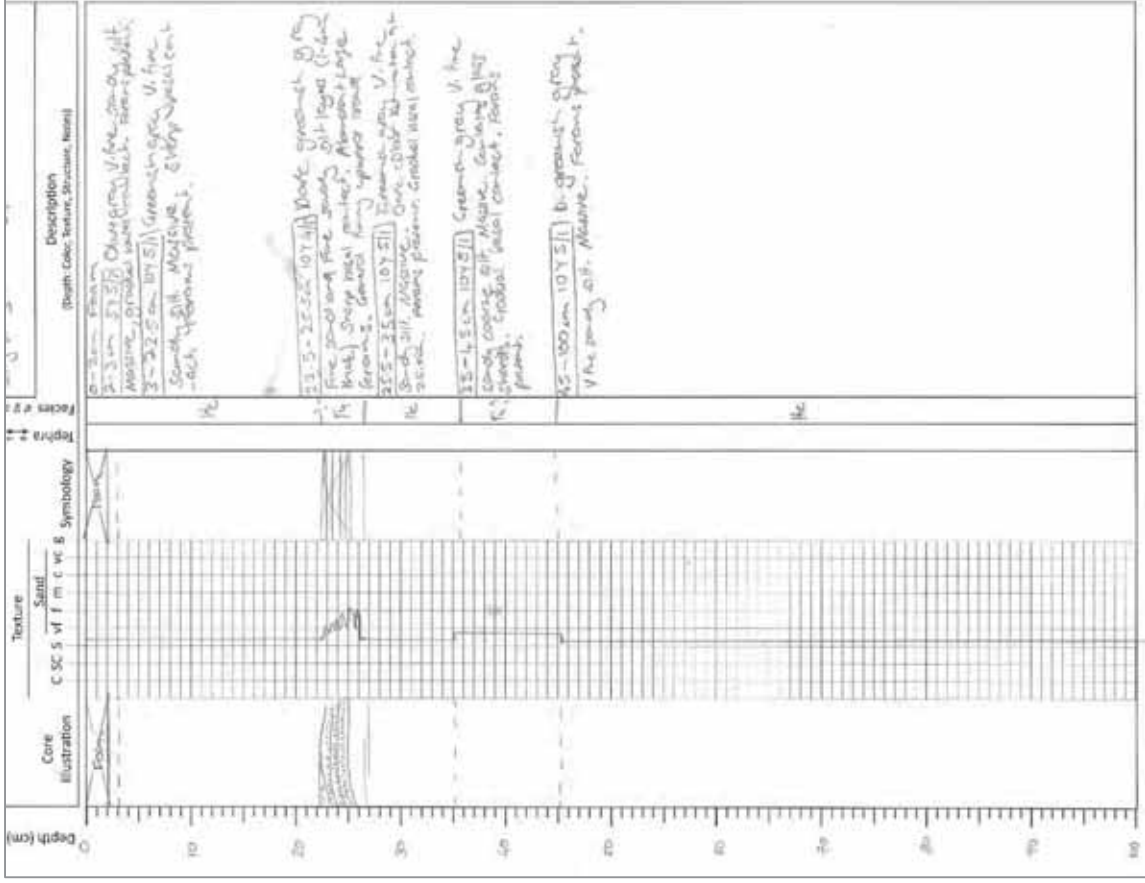
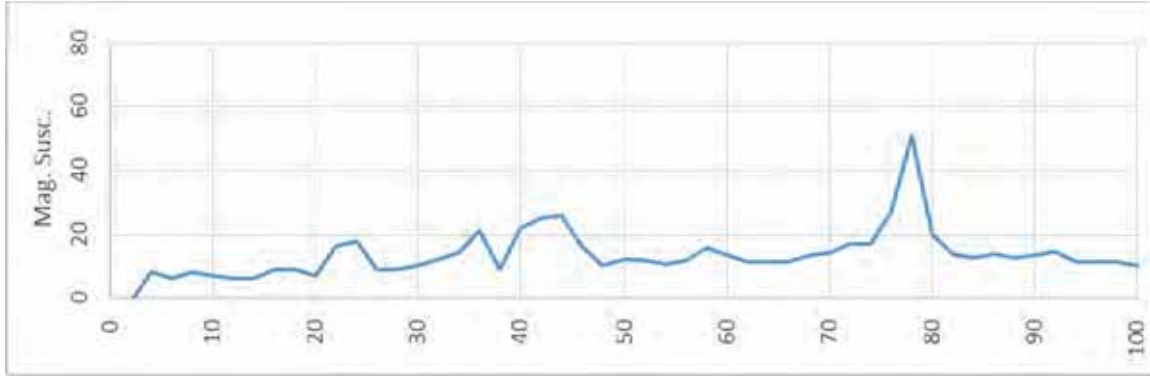
TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Rock 1 (repeat)

Other ID Tan1613-36

Section

of

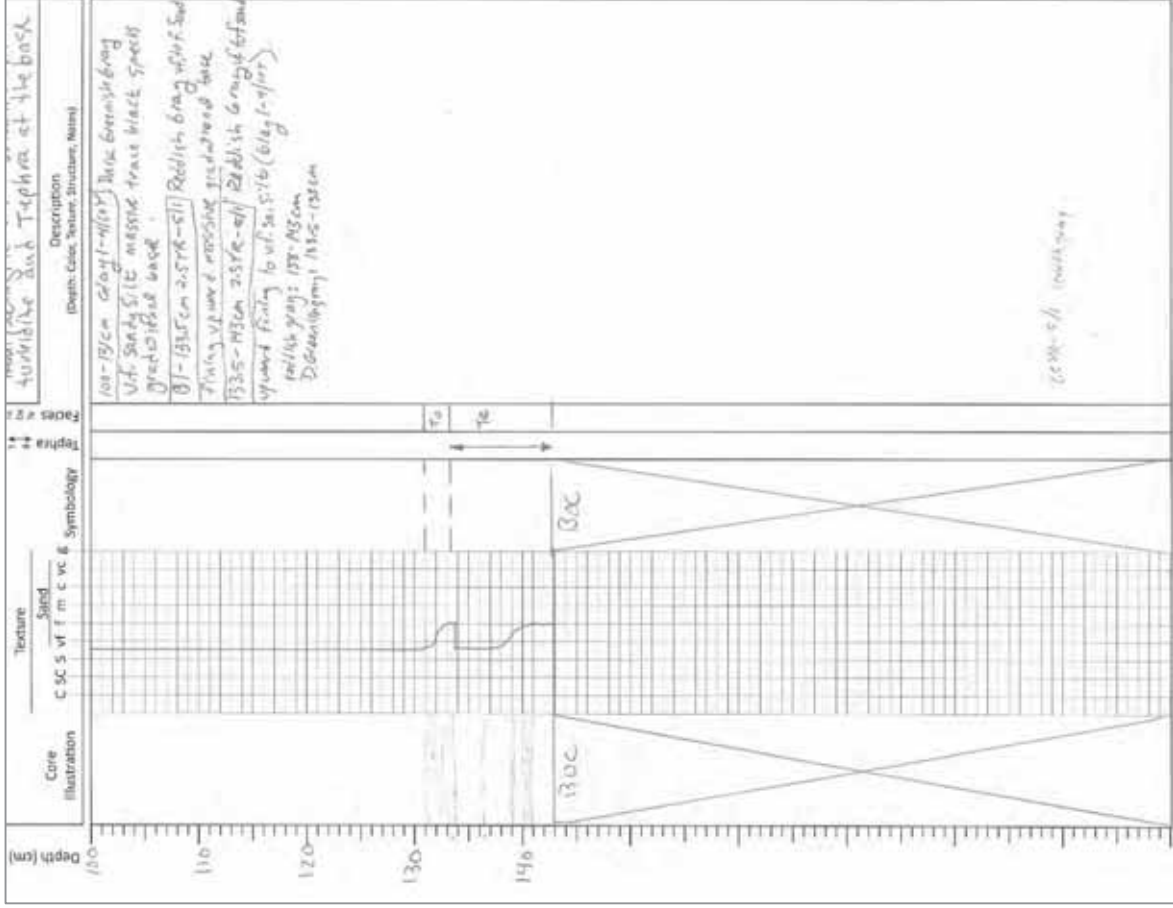
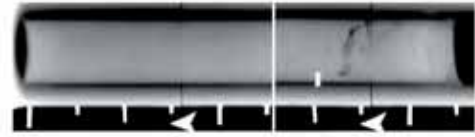
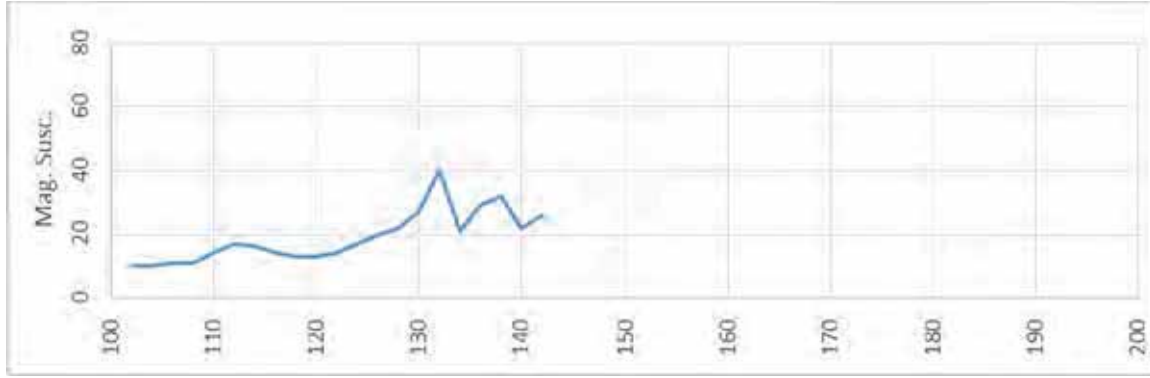


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Rock 1 (repeat)

Other ID Tan1613-36

Section 2 of 2



TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: **Ritchie 2**

Latitude: -39.60077

Date/Time (NZST): 15/11/2016 19:13

Other ID: TAN1613-37

Longitude: 178.59337

Depth (m): **2662**

Sample Description

General Description

Outer slope perched basin east of Ritchie Ridge

Hemipelagite with 2 tephra

Gear type	Piston core
Barrel Length (m)	6 Bent barrel
Penetration (m)	Catcher/Cutter bags
Core length (m)	0.94 Samples
Sections	1 Tephra
Fauna	2

Sample processing – core ID:

Section	Top depth (cm)	Btm depth (cm)	Logged	Phys Props	Summary
1	0	0.94	t	t	

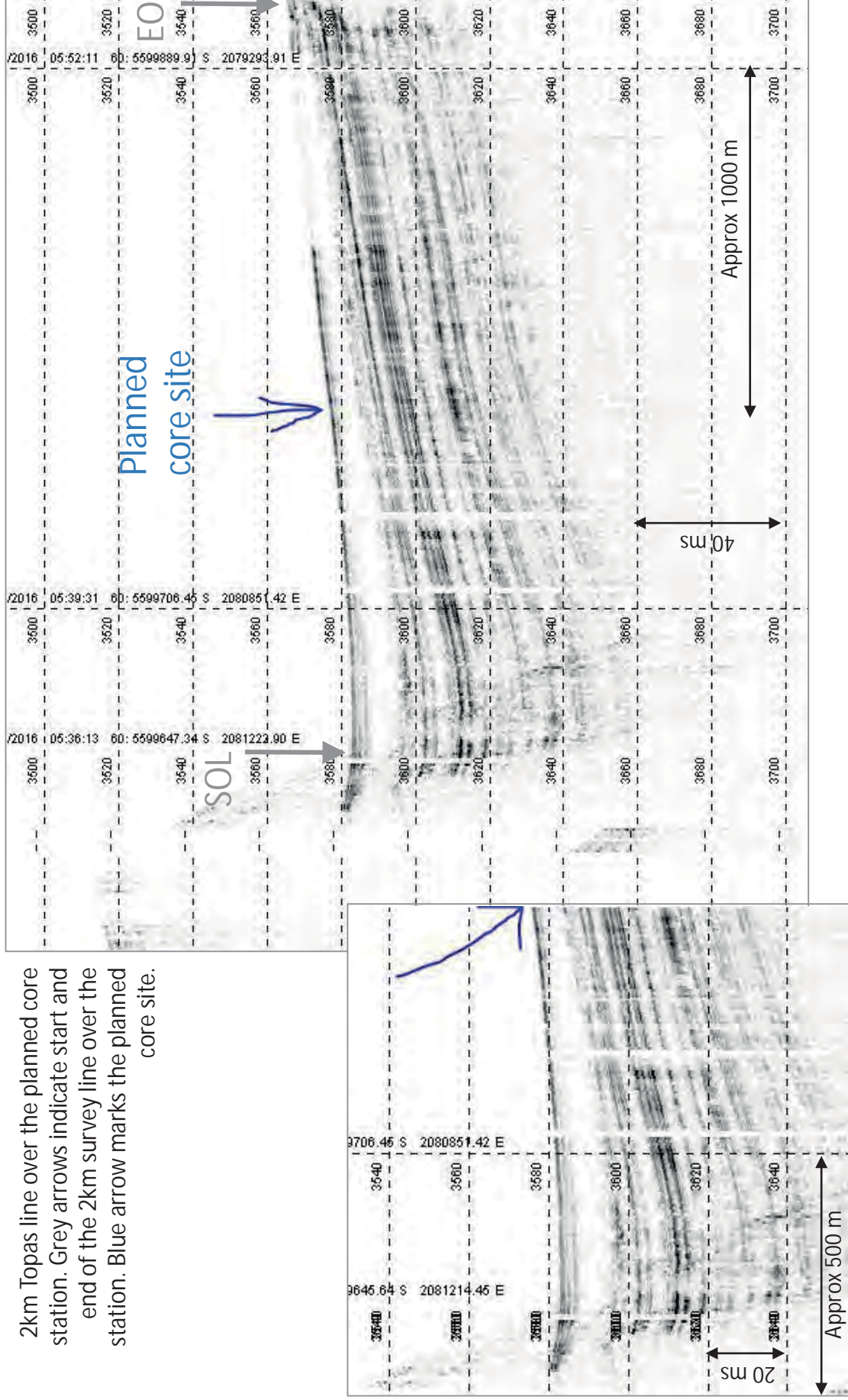
TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: **Ritchie 2**

Other ID **TAN1613-37**

Water Depth **2662 m**

2km Topas line over the planned core station. Grey arrows indicate start and end of the 2km survey line over the station. Blue arrow marks the planned core site.



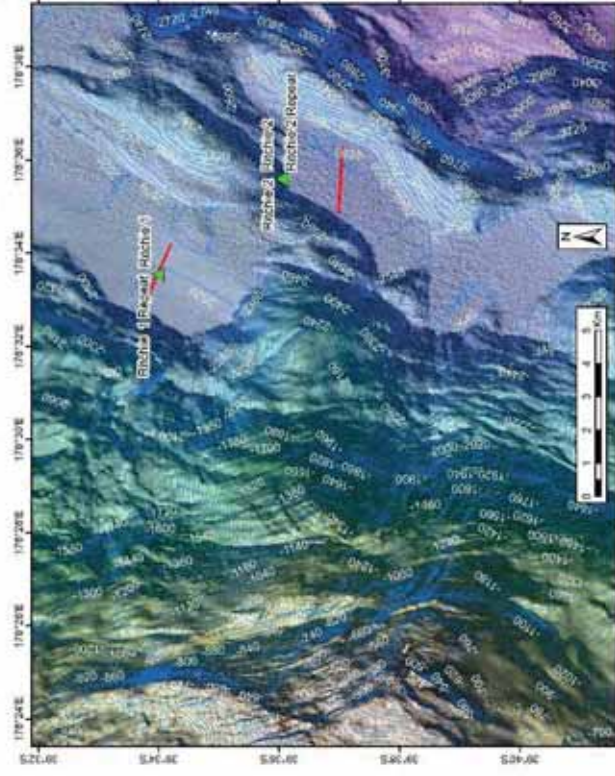
Zoom into the survey lines over planned core site.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

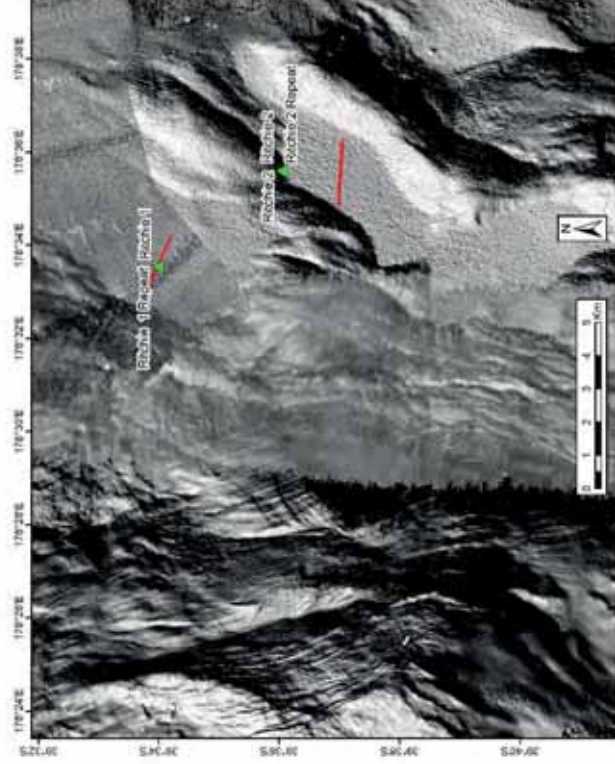
Core ID: **Ritchie 2**

Other ID **TAN1613-37**

Water Depth **2662 m**



Bathymetry at and around Ritchie2 core site at the outer slope perched basin, east of Ritchie Ridge. Light blue lines are 20 m depth contours. Red lines show the 2 km TOPAS survey line over the station, green triangles indicate the actual core site. Multi-label indicate a repeated core and/or a multicore.



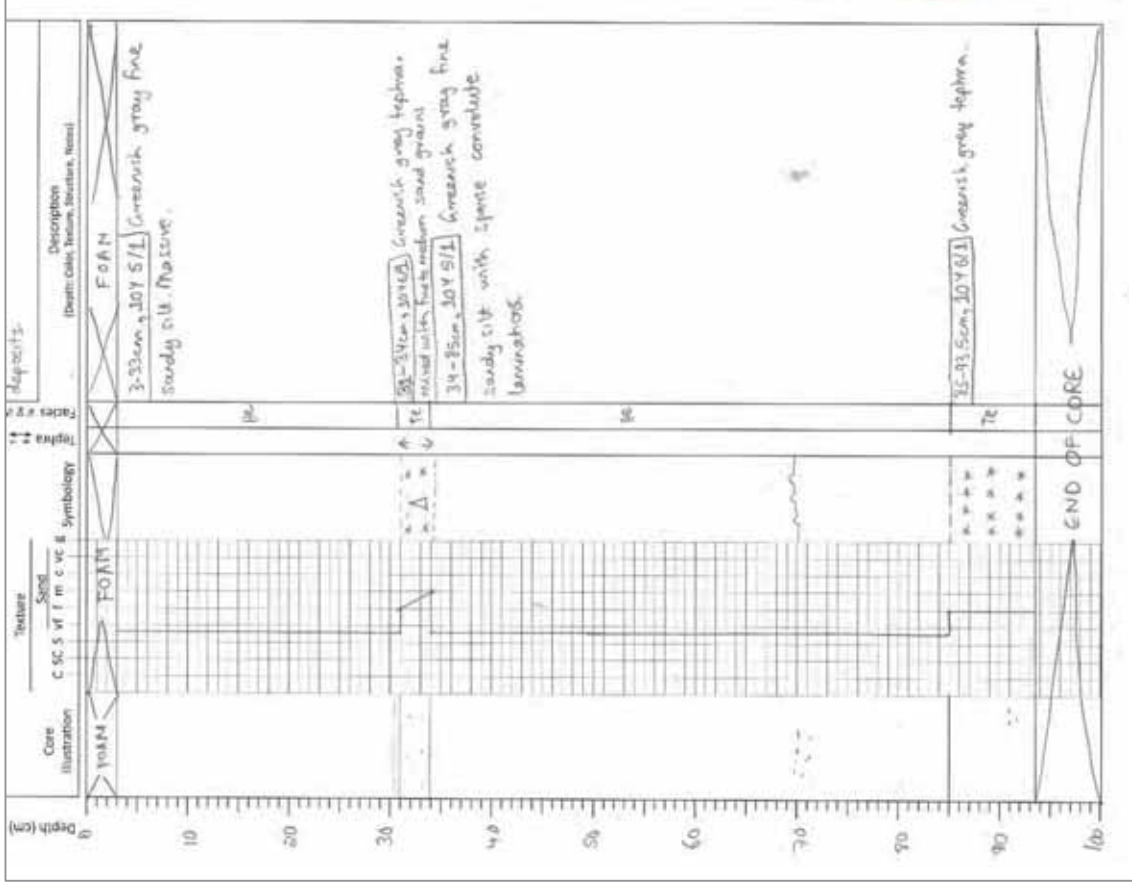
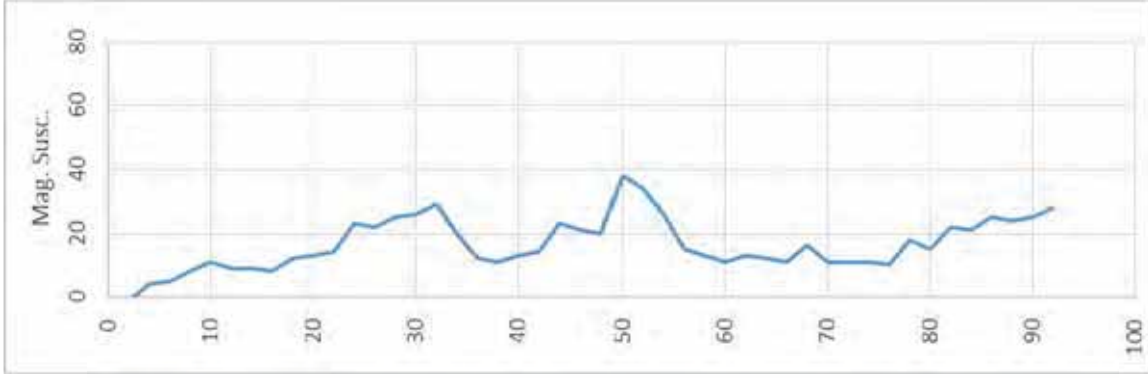
Backscatter at and around Ritchie2 core site at the outer slope perched basin, east of Ritchie Ridge. Red lines show the 2 km TOPAS survey line over the station, green triangles indicate the actual core site. Multi-label indicate a repeated core and a multicore.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Ritchie 2

Other ID TAN1613-37

Section 1 of 1



TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: **Ritchie 2 repeat**

Latitude: -39.60107

Date/Time (NZST): 15/11/2016 22:05

Other ID: TAN1613-38

Longitude: 178.59320

Depth (m): **2663**

Sample Description

General Description

Outer slope perched basin east of Ritchie Ridge

Hemipelagite with 2 tephra, one overlain by possible volcanoclastic turbidites overlying tephra in section 2

Gear type	Piston core	
Barrel Length (m)	6	Bent barrel
Penetration (m)		Catcher/Cutter bags
Core length (m)	1.26	Samples
Sections	2	Tephra
Fauna		

Sample processing – core ID:

Section	Top depth (cm)	Btm depth (cm)	Logged	Phys Props	Summary
1	0	80	Y	Y	
2	80	126	Y	Y	

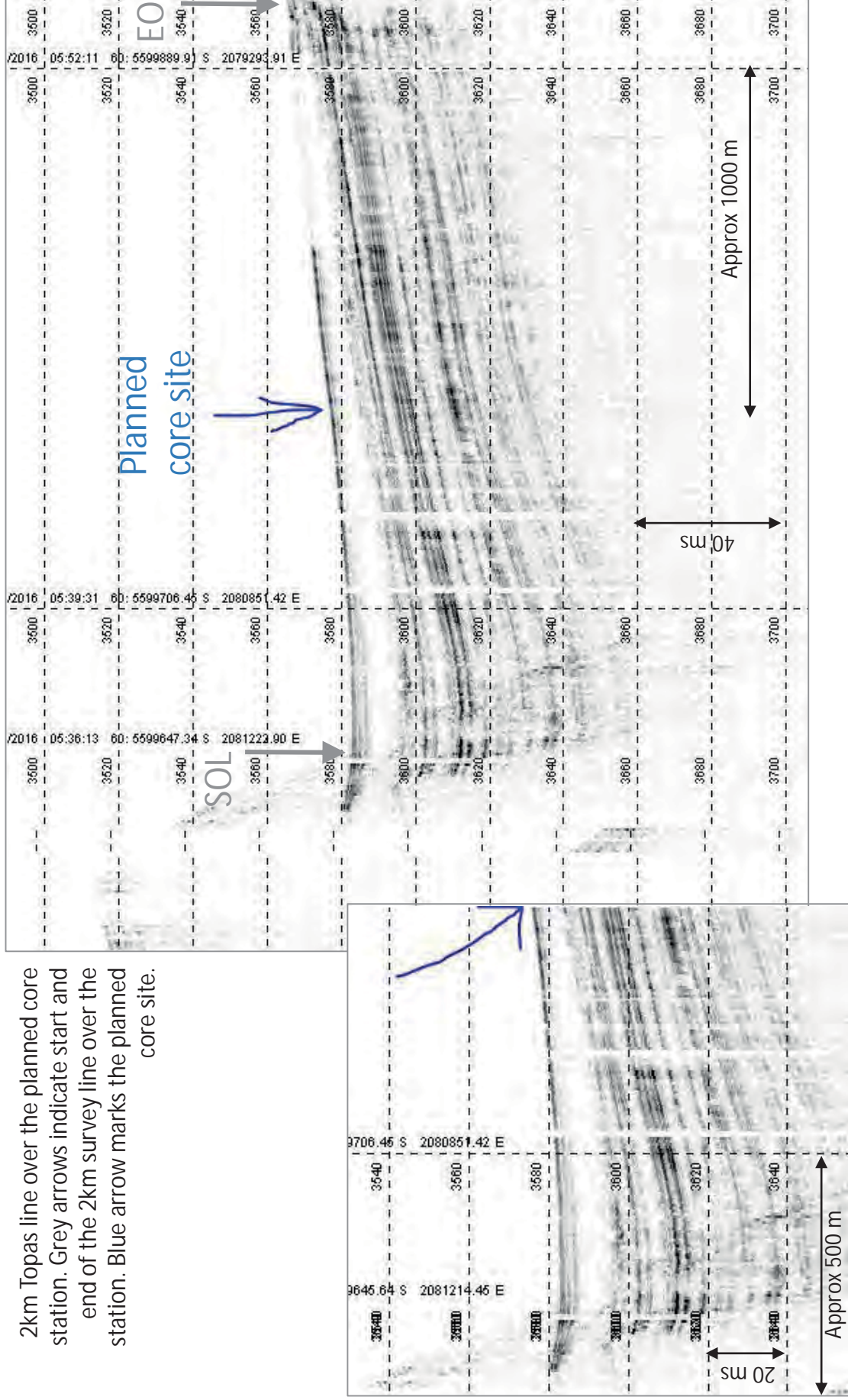
TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: **Ritchie 2 repeat**

Other ID **TAN1613-38**

Water Depth **2663 m**

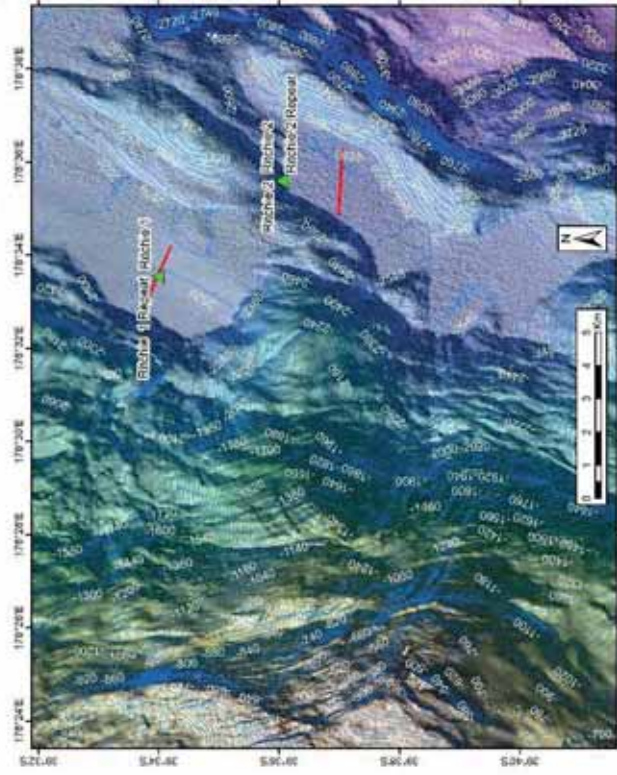
2km Topas line over the planned core station. Grey arrows indicate start and end of the 2km survey line over the station. Blue arrow marks the planned core site.



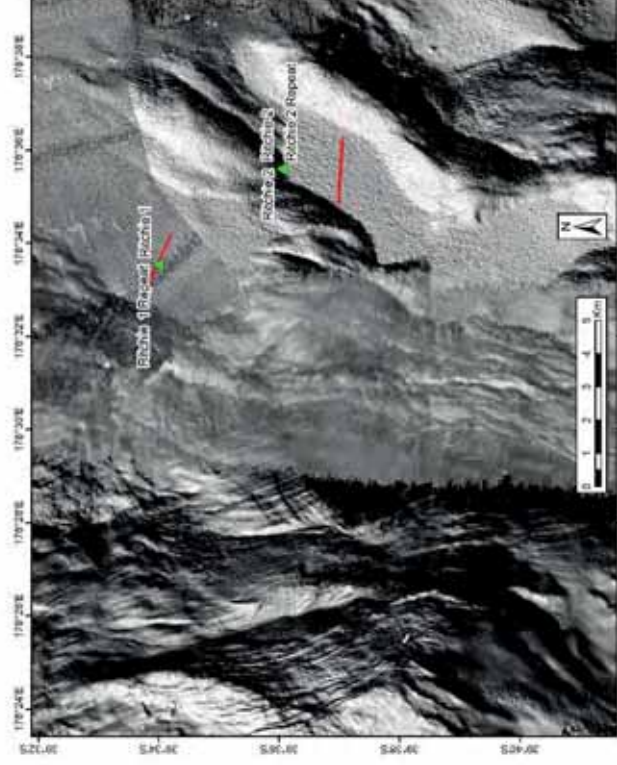
Zoom into the survey lines over planned core site.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Ritchie 2 repeat	Other ID TAN1613-38	Water Depth 2663 m
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Bathymetry at and around Ritchie2 core site at the outer slope perched basin, east of Ritchie Ridge. Light blue lines are 20 m depth contours. Red lines show the 2 km TOPAS survey line over the station, green triangles indicate the actual core site. Multi-label indicate a repeated core and/or a multicore.



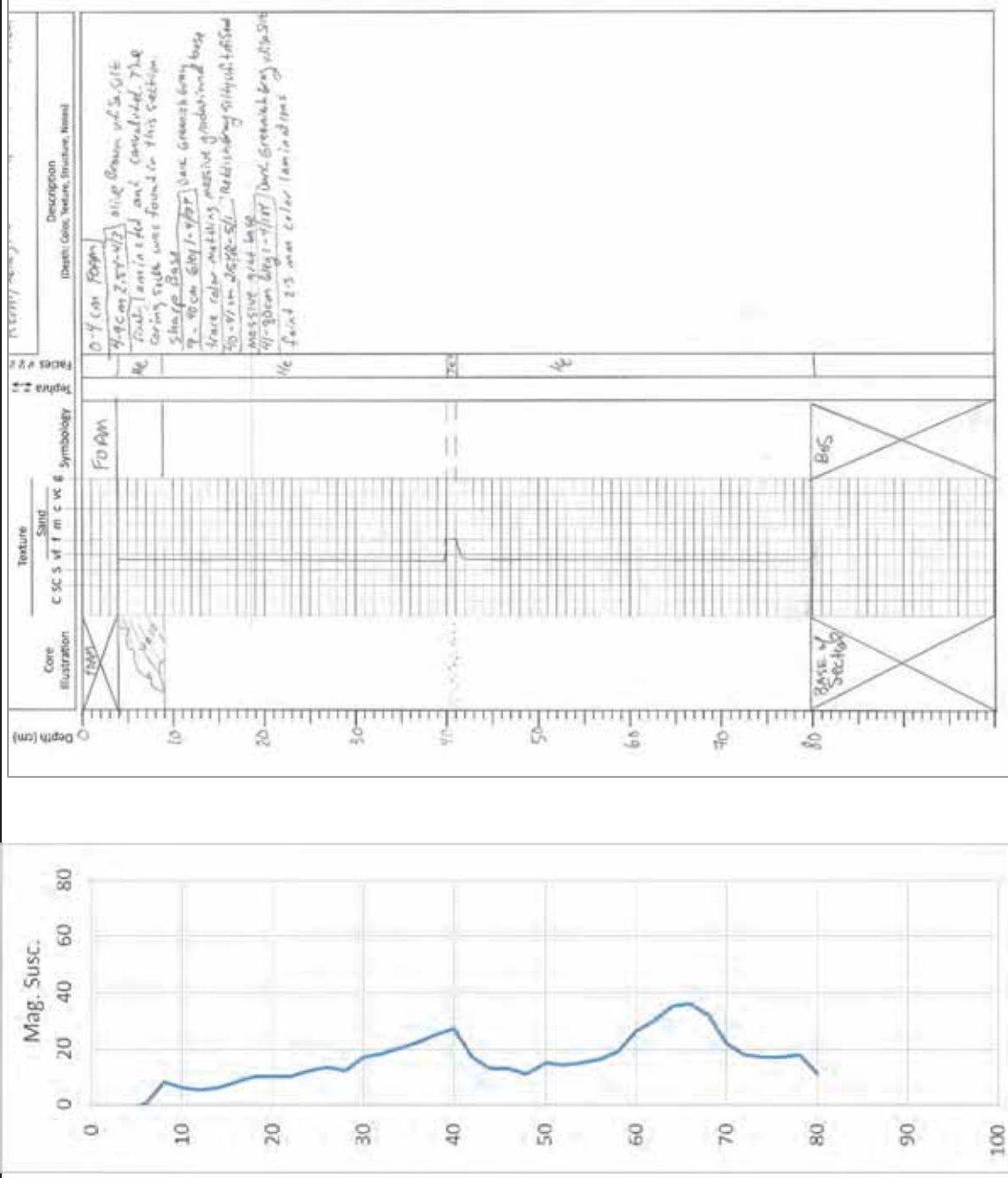
Backscatter at and around Ritchie2 core site at the outer slope perched basin, east of Ritchie Ridge. Red lines show the 2 km TOPAS survey line over the station, green triangles indicate the actual core site. Multi-label indicate a repeated core and a multicore.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Ritchie 2 repeat

Other ID TAN1613-38

Section 1 of 2

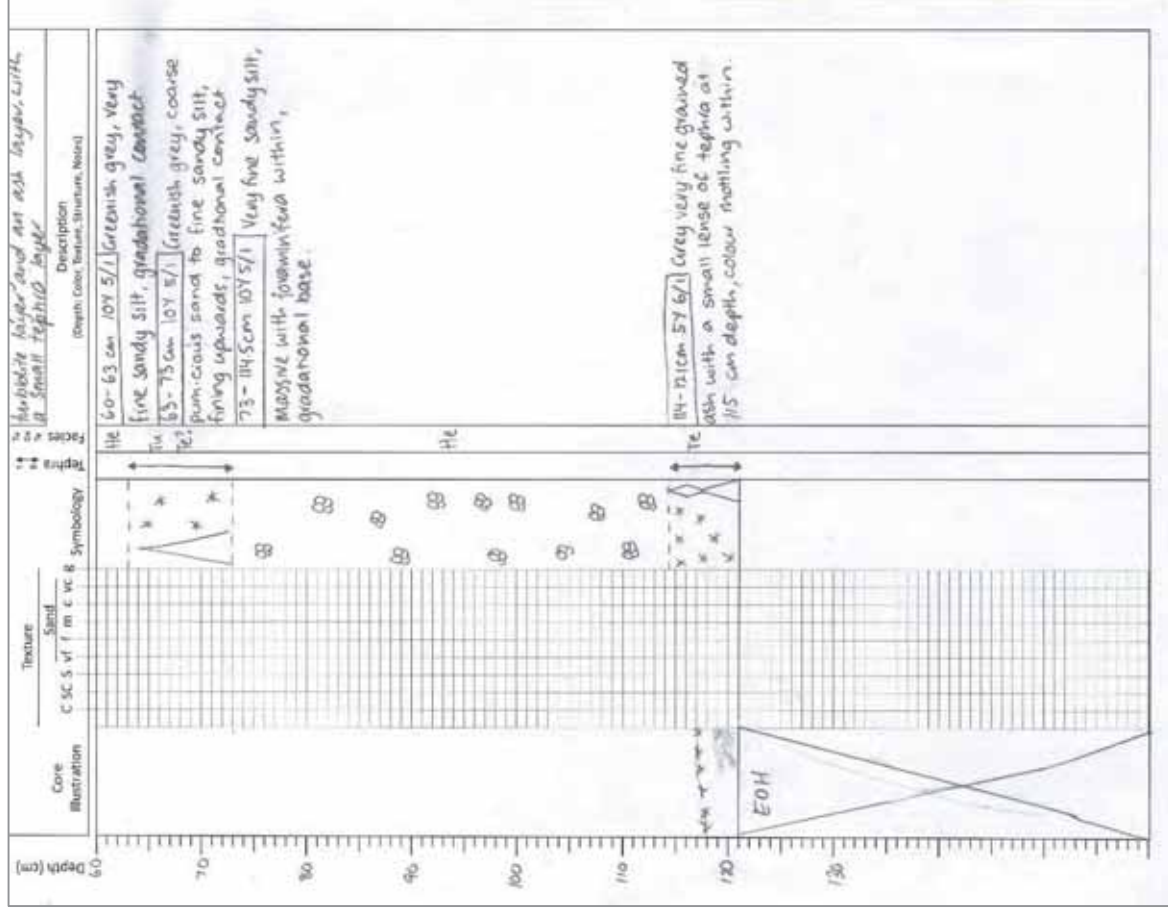
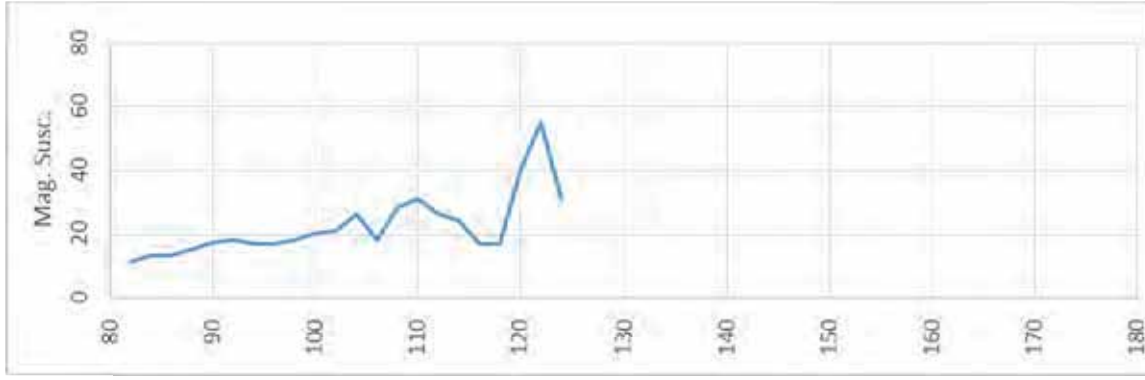


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Ritchie 2 repeat

Other ID TAN1613-38

Section 2 of 2



TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: **Ritchie 1**

Latitude: -39.56663

Date/Time (NZST): 16/11/2016 01:26

Other ID: TAN1613-39

Longitude: 178.55880

Depth (m): **2506**

Sample Description

General Description

Outer slope perched basin east of Ritchie Ridge

Hemipelagic mud interbedded with silty/sandy turbidites, one possible volcanoclastic turbidites, and 2 tephra

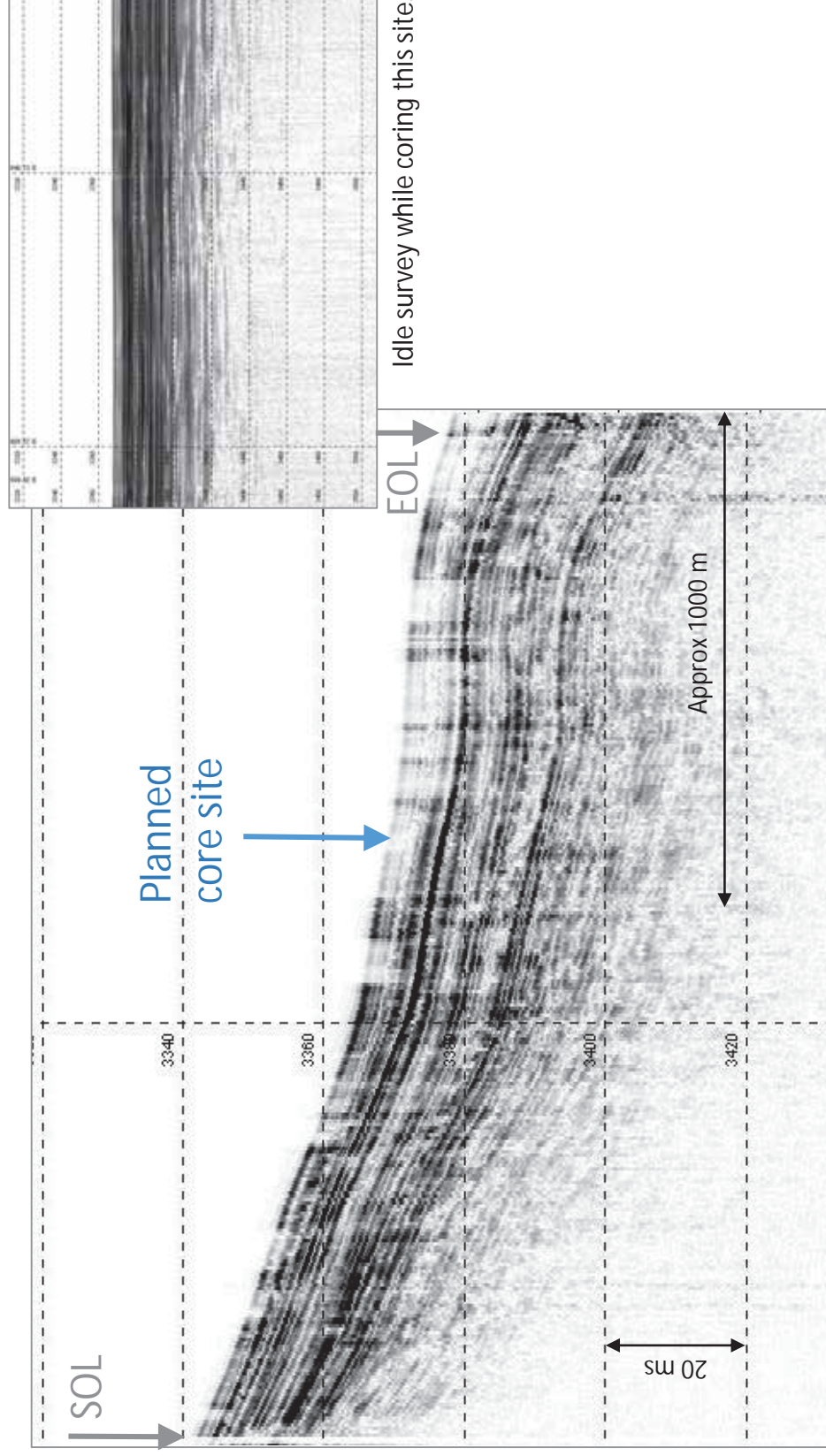
Gear type	Piston core	
Barrel Length (m)	6	Bent barrel
Penetration (m)		Catcher/Cutter bags
Core length (m)	1.21	Samples
Sections	2	Tephra
Fauna		

Sample processing – core ID:

Section	Top depth (cm)	Btm depth (cm)	Logged	Phys Props	Summary
1	0	60	Y	Y	.
2	60	121	Y	Y	.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Ritchie 1	Other ID TAN1613-39	Water Depth 2506 m
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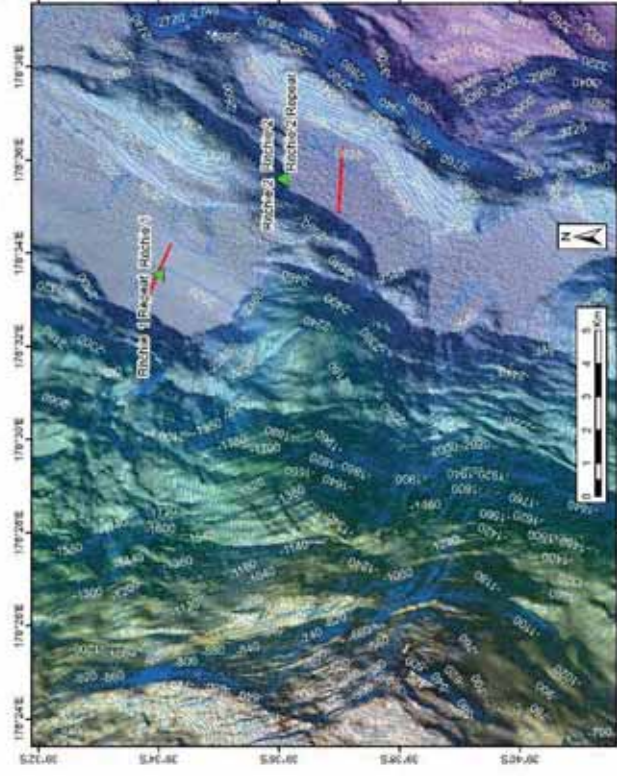
2km Topas line over the planned core station. Grey arrows indicate start and end of the 2km survey line over the station. Blue arrow marks the planned core site.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

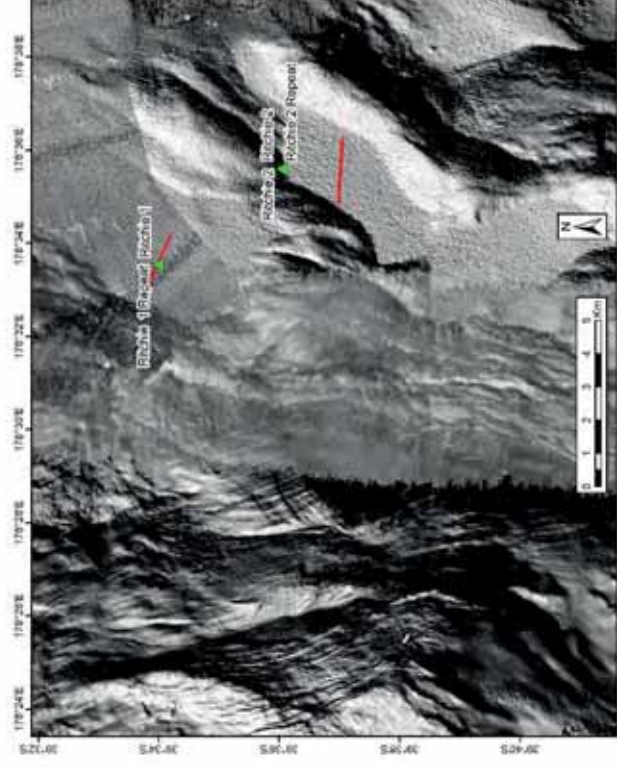
Core ID: **Ritchie 1**

Other ID **TAN1613-39**

Water Depth **2506 m**



Bathymetry at and around Ritchie1 core site at the outer slope perched basin, east of Ritchie Ridge. Light blue lines are 20 m depth contours. Red lines show the 2 km TOPAS survey line over the station, green triangles indicate the actual core site. Multi-label indicate a repeated core and a multicore.



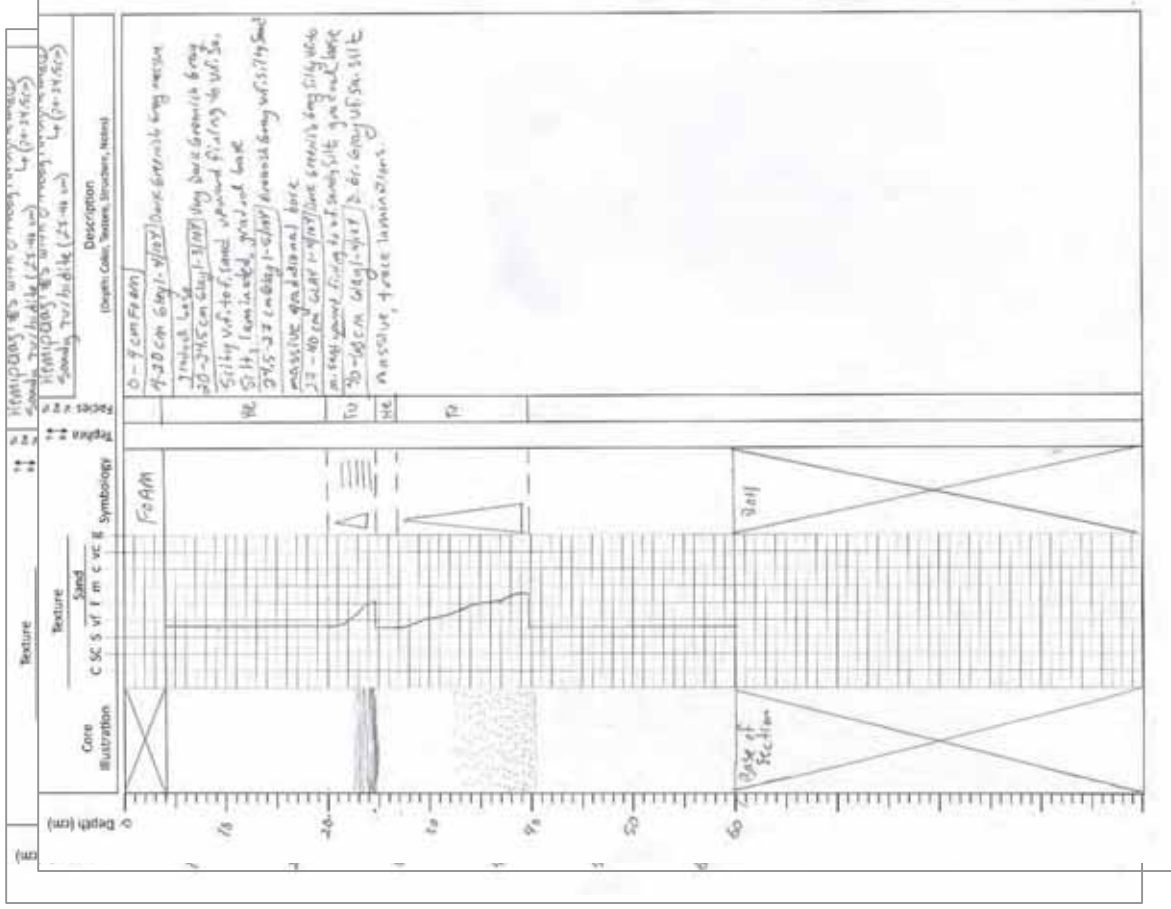
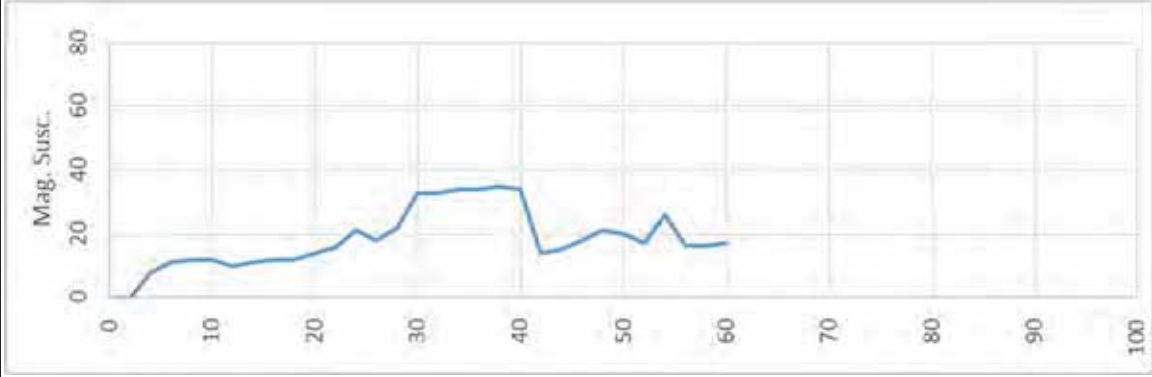
Backscatter at and around Ritchie1 core site at the outer slope perched basin, east of Ritchie Ridge. Red lines show the 2 km TOPAS survey line over the station, green triangles indicate the actual core site. Multi-label indicate a repeated core and a multicore.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Ritchie 1

Other ID TAN1613-39

Section 1 of 2

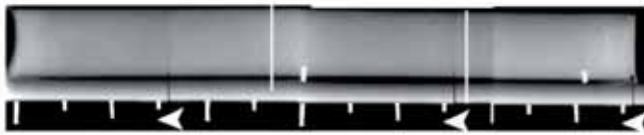
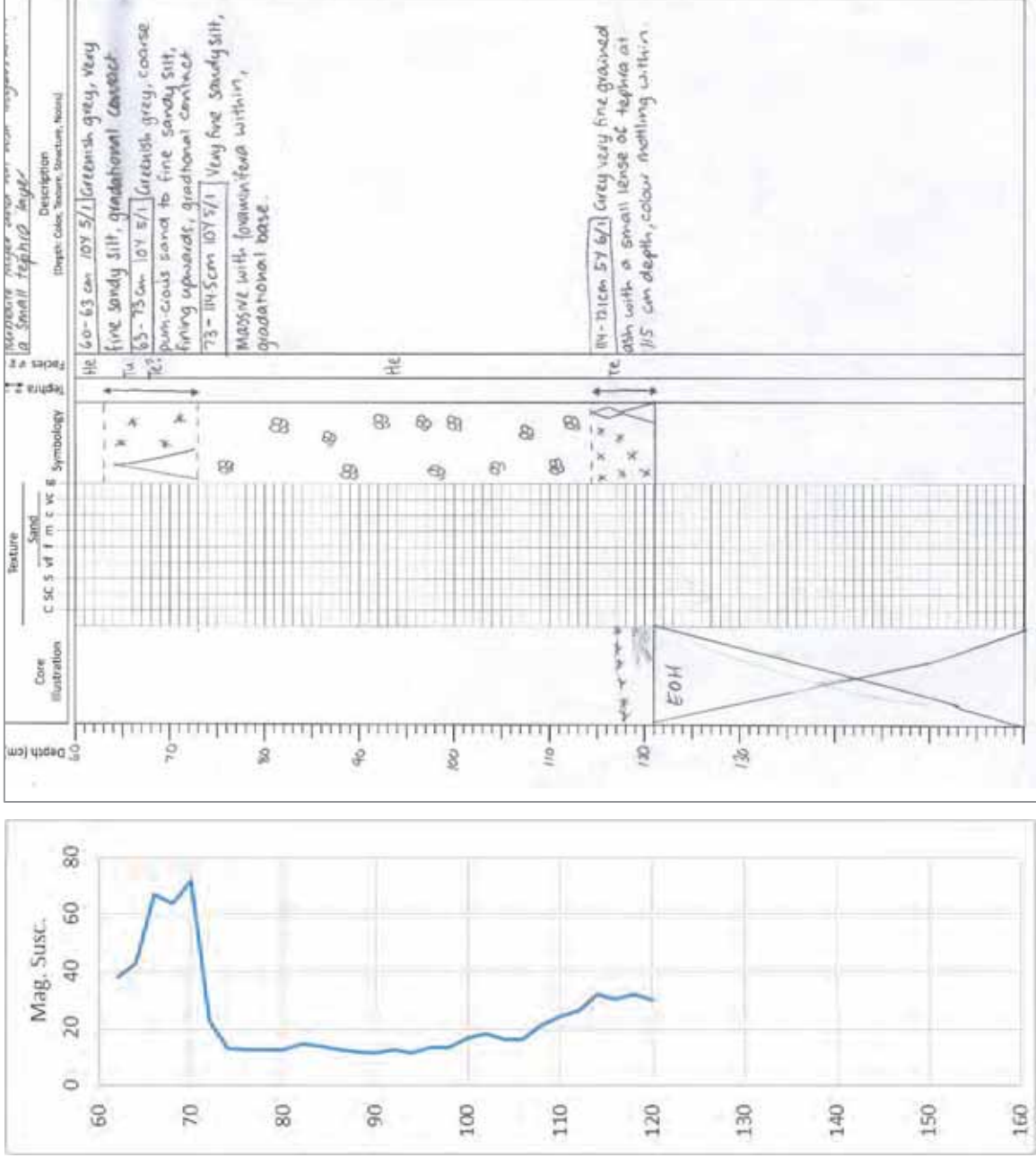


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Ritchie 1

Other ID TAN1613-39

Section 2 of 2



TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: **Ritchie 1 repeat**

Latitude: -39.56630

Date/Time (NZST): 16/11/2016 03:36

Other ID: TAN1613-40

Longitude: 178.55903

Depth (m): 2505

Sample Description

General Description

Outer slope perched basin east of Ritchie Ridge

Hemipelagite with 2-3 turbidites, and 2-3 tephra

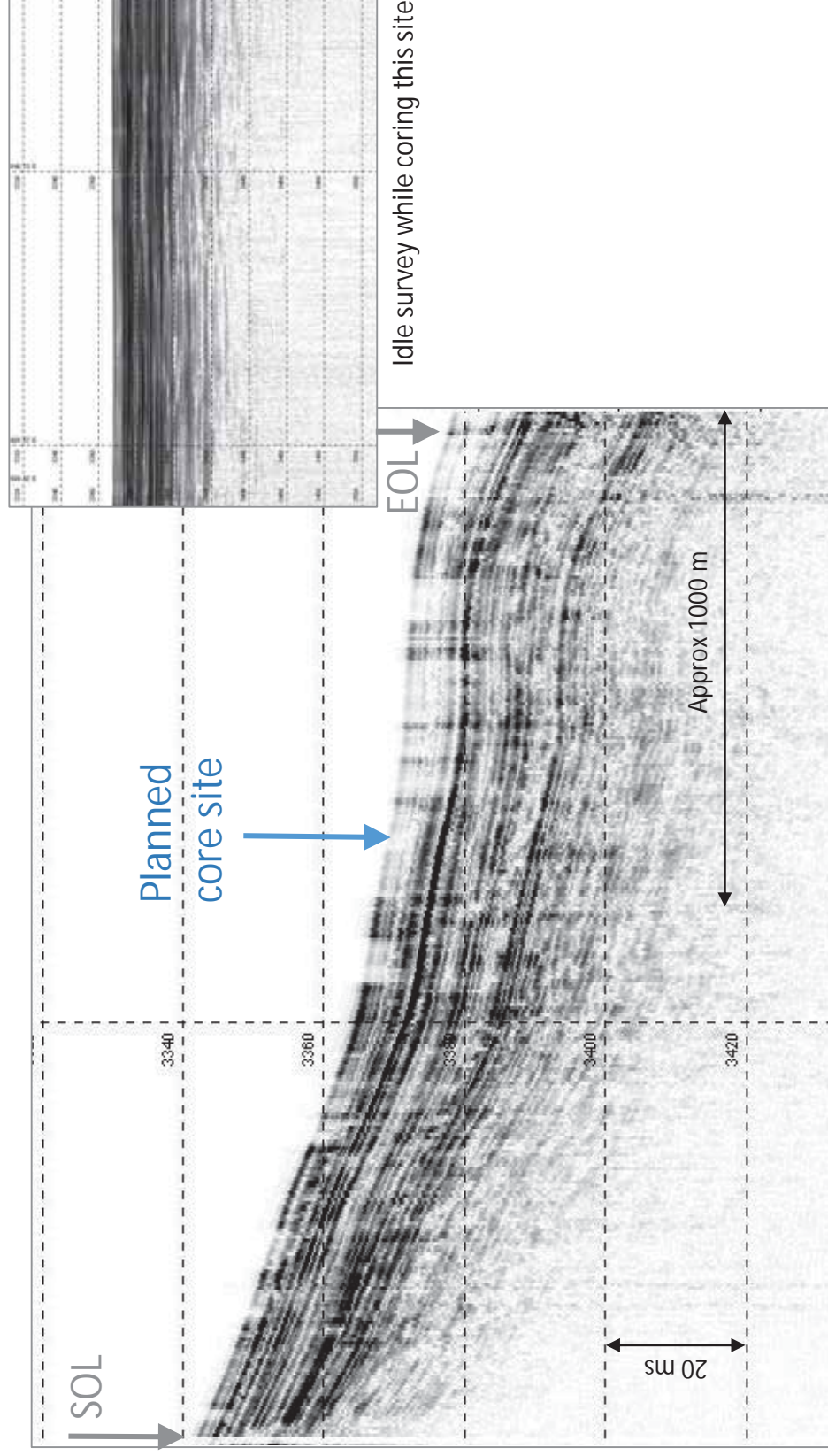
Gear type	Piston core	
Barrel Length (m)	6	Bent barrel
Penetration (m)		Catcher/Cutter bags
Core length (m)	1.22	Samples
Sections	2	Tephra
Fauna		

Sample processing – core ID:

Section	Top depth (cm)	Btm depth (cm)	Logged	Phys Props	Summary
1	0	60	Y	Y	
2	60	122	Y	Y	
.	
.	
.	
.	

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

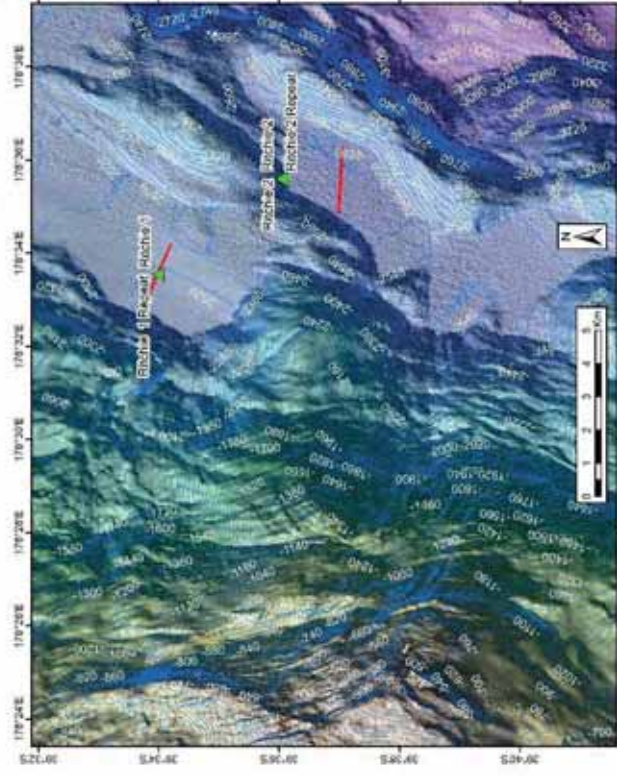
Core ID: Ritchie 1 repeat	Other ID TAN1613-40	Water Depth 2505 m
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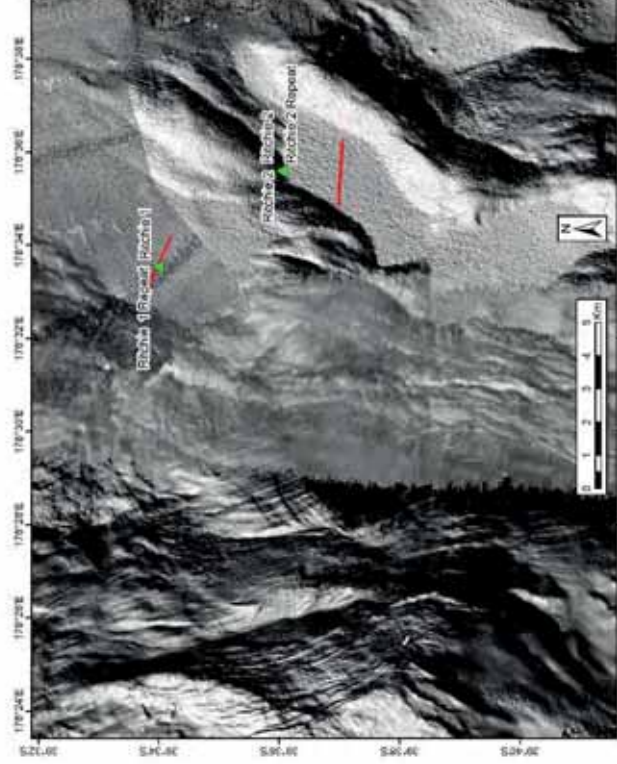
2km Topas line over the planned core station. Grey arrows indicate start and end of the 2km survey line over the station. Blue arrow marks the planned core site.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Ritchie 1 repeat	Other ID TAN1613-40	Water Depth 2505 m
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Bathymetry at and around Ritchie1 core site at the outer slope perched basin, east of Ritchie Ridge. Light blue lines are 20 m depth contours. Red lines show the 2 km TOPAS survey line over the station, green triangles indicate the actual core site. Multi-label indicate a repeated core and a multicore.



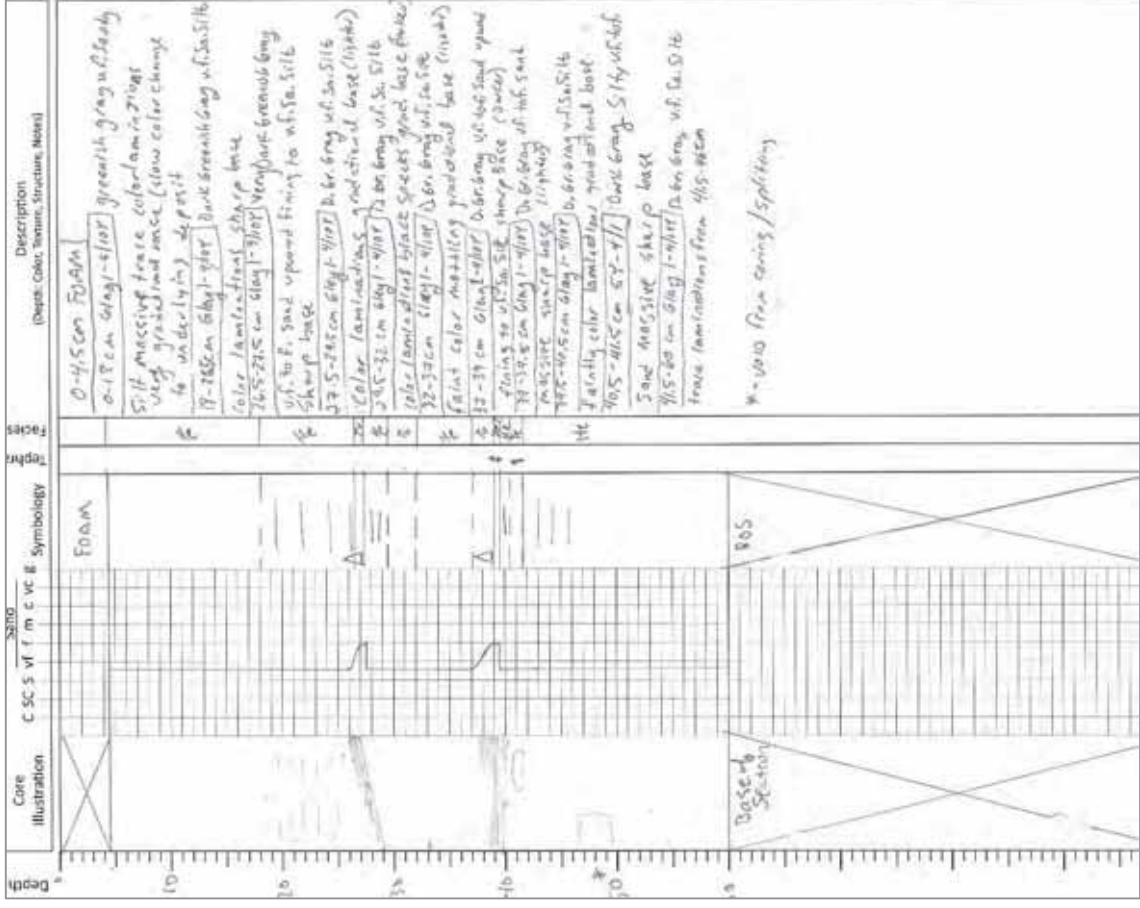
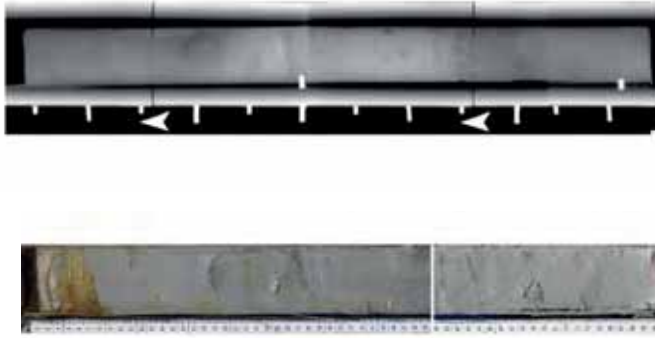
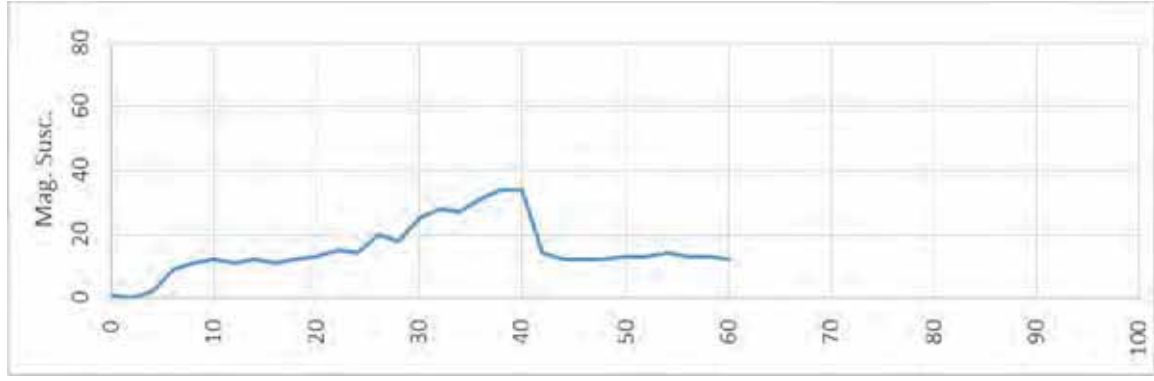
Backscatter at and around Ritchie1 core site at the outer slope perched basin, east of Ritchie Ridge. Red lines show the 2 km TOPAS survey line over the station, green triangles indicate the actual core site. Multi-label indicate a repeated core and a multicore.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Ritchie 1 repeat

Other ID TAN1613-40

Section 1 of 2

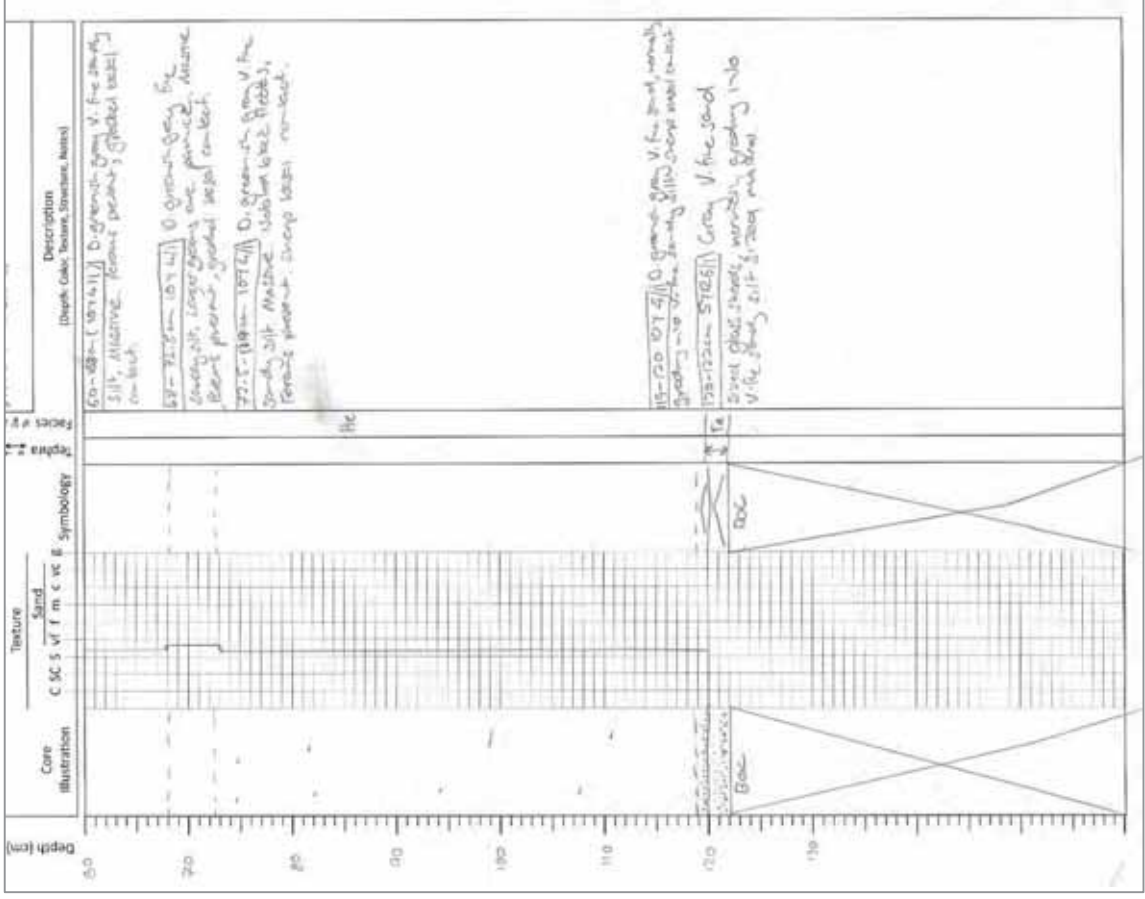
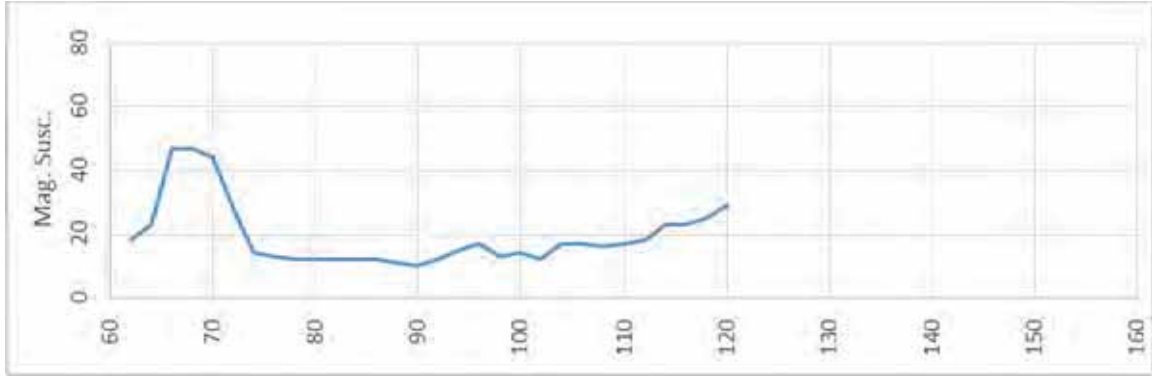


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Ritchie 1 repeat

Other ID TAN1613-40

Section 2 of 2



TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: **Ritchie 3**

Latitude: -39.50143

Date/Time (NZST): 16/11/2016 06:18

Other ID: TAN1613-41

Longitude: 178.53057

Depth (m): 2242

Sample Description

General Description

Outer slope perched basin east of Ritchie Ridge

Hemipelagites overlying one volcanoclastic turbidite and one tephra

Gear type	Piston core	
Barrel Length (m)	6	Bent barrel
Penetration (m)		Catcher/Cutter bags
Core length (m)	1.17	Samples
Sections	2	Tephra
Fauna		

Sample processing – core ID:

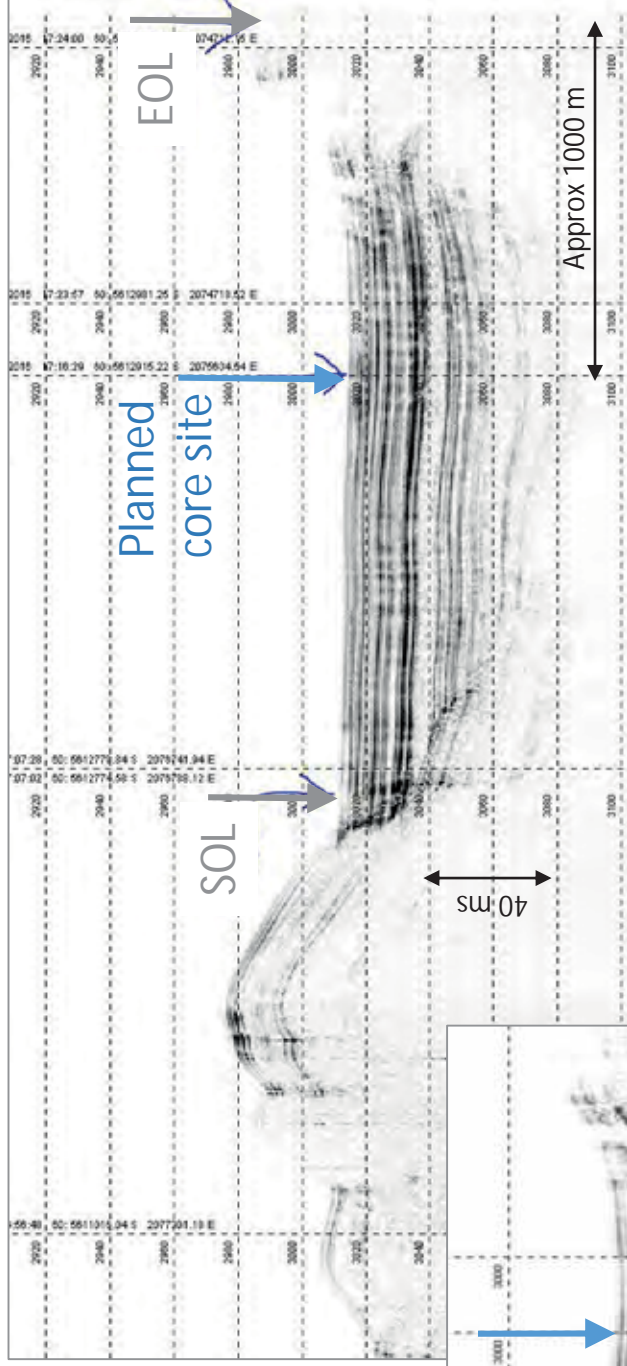
Section	Top depth (cm)	Btm depth (cm)	Logged	Phys Props	Summary
1	0	60	y	y	
2	60	117	y	y	

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

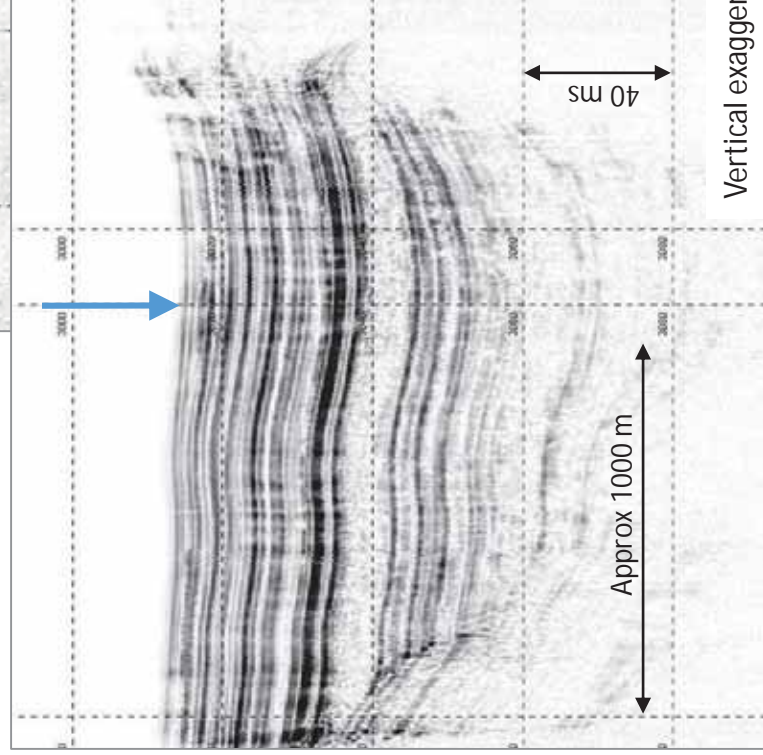
Core ID: Ritchie 3

Other ID TAN1613-41

Water Depth 2242 m



Topas line to and over the planned core station. Grey arrows indicate start and end of the 2km survey line over the station. Blue arrow marks the planned core site.



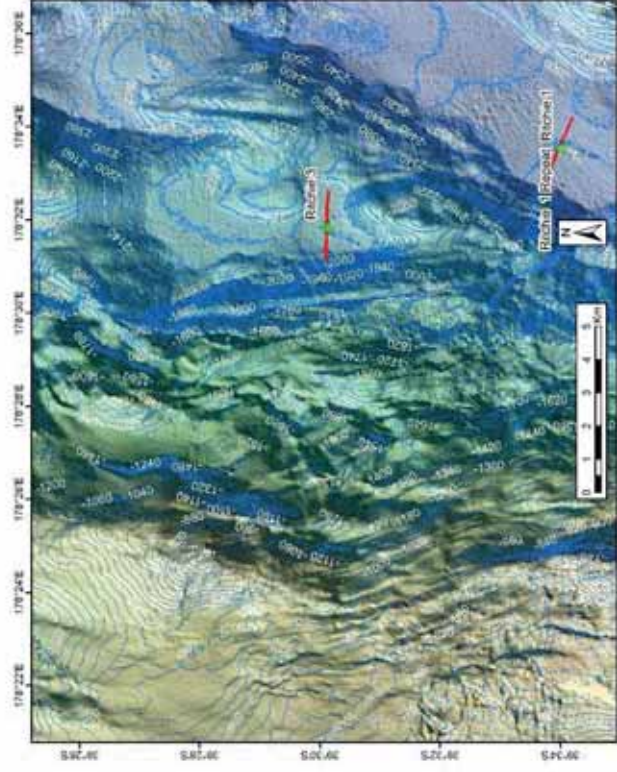
Vertical exaggerated survey lines over planned core site.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

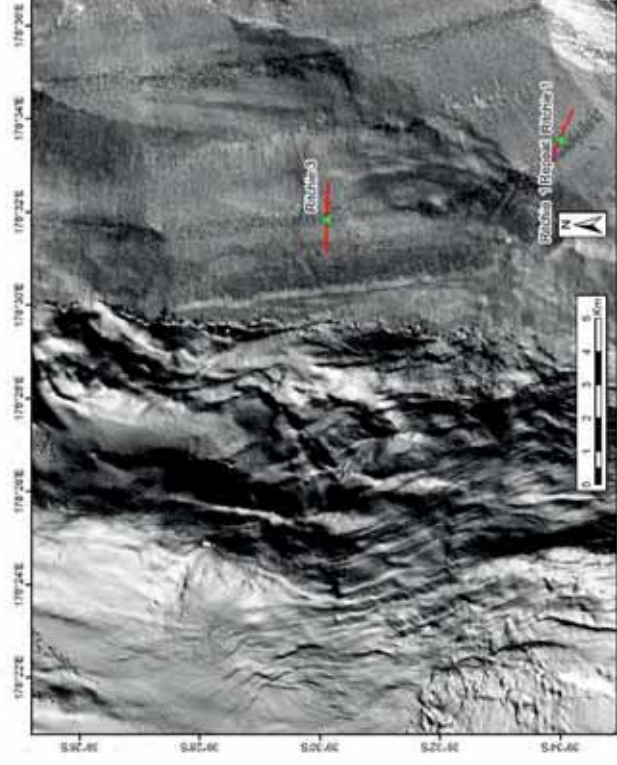
Core ID: **Ritchie 3**

Other ID **TAN1613-41**

Water Depth **2242 m**



Bathymetry at and around Ritchie3 core site at the outer slope perched basin, east of Ritchie Ridge. Light blue lines are 20 m depth contours. Red lines show the 2 km TOPAS survey line over the station, green triangles indicate the actual core site. Multi-label indicate a repeated core and a multicore.



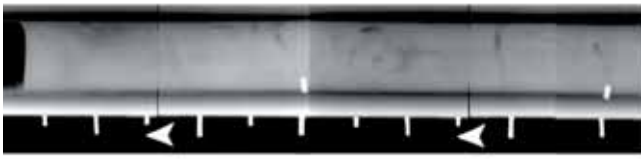
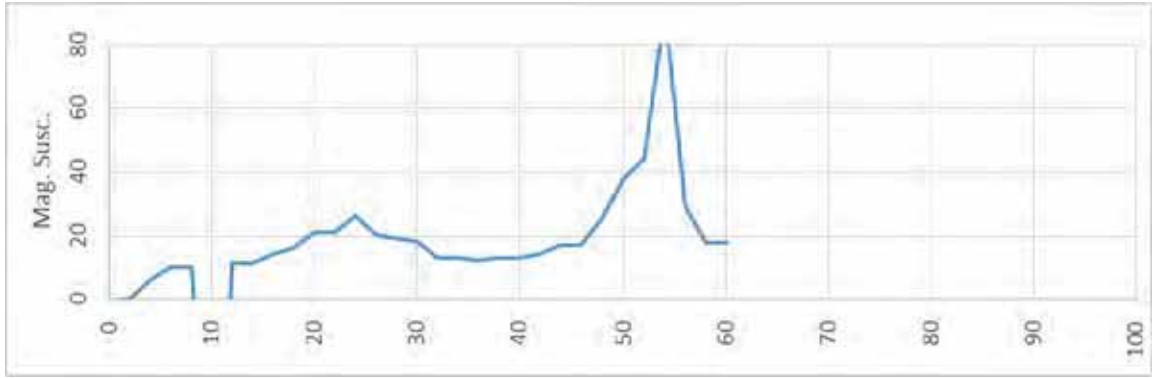
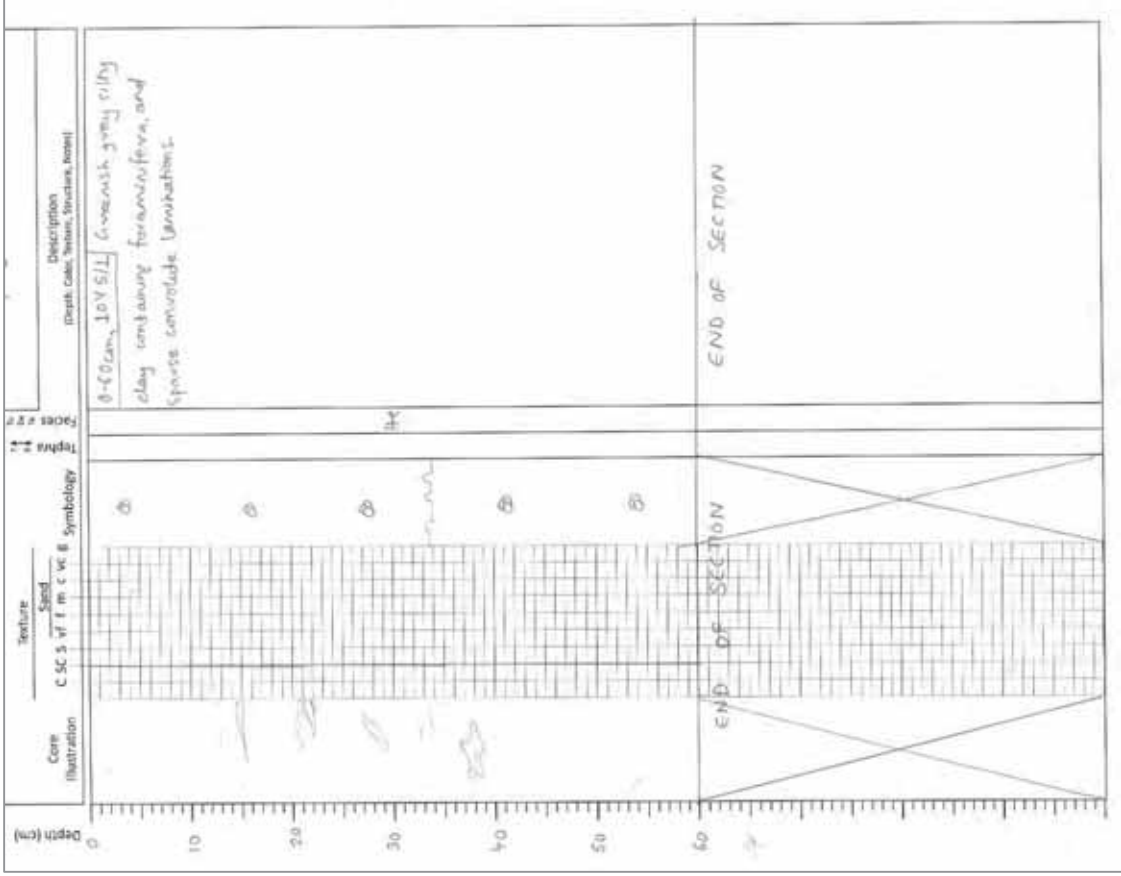
Backscatter at and Ritchie3 core site at the outer slope perched basin, east of Ritchie Ridge. Red lines show the 2 km TOPAS survey line over the station, green triangles indicate the actual core site. Multi-label indicate a repeated core and a multicore.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Ritchie 3

Other ID TAN1613-41

Section 1 of 2

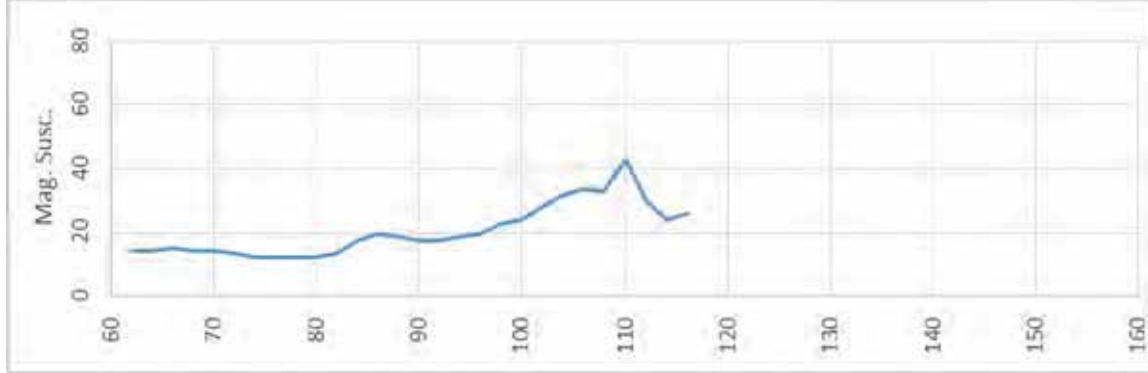
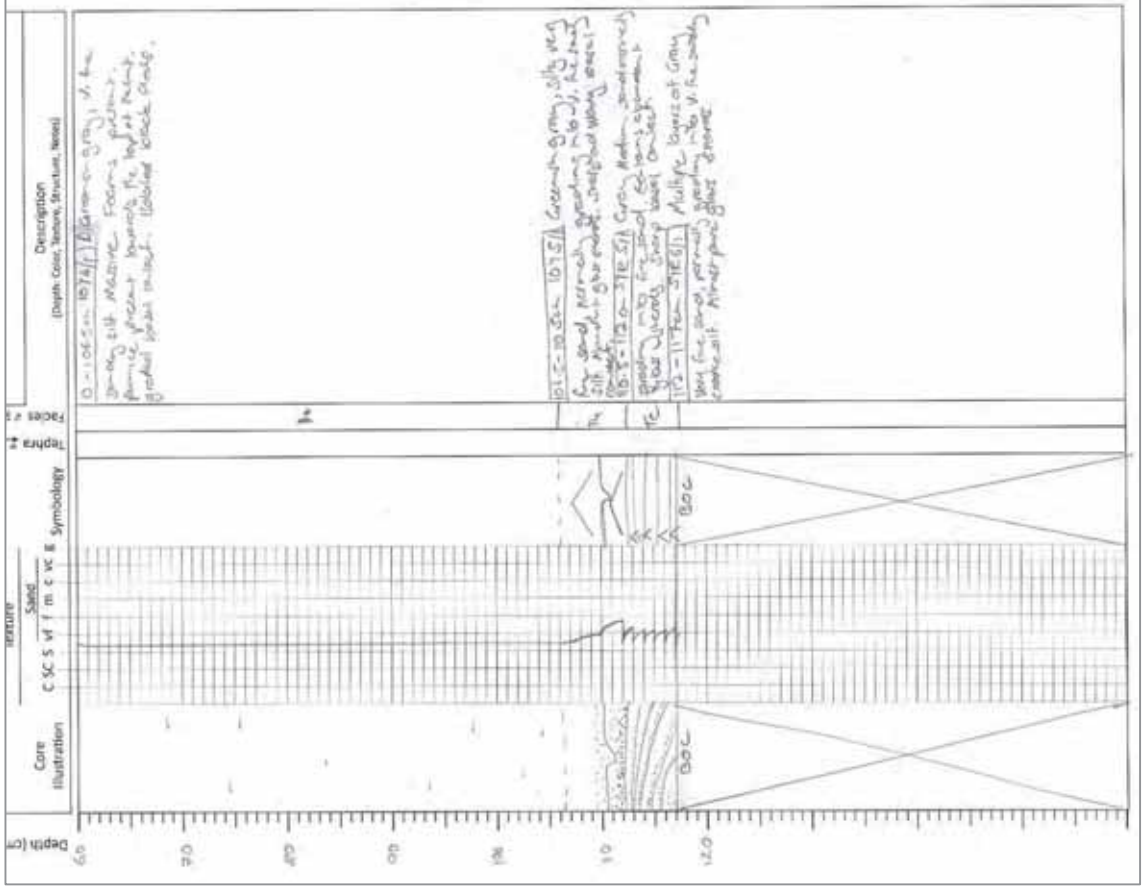


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Ritchie 3

Other ID TAN1613-41

Section 2 of 2



TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: **Poverty 2**

Latitude: -39.24550

Date/Time (NZST): 16/11/2016 10:43

Other ID: TAN1613-42

Longitude: 178.49422

Depth (m): **2340**

Sample Description

General Description

Sthn arm of Poverty Canyon, middle slope

Hemipelagic mud interbedded with silty/sandy turbidites.

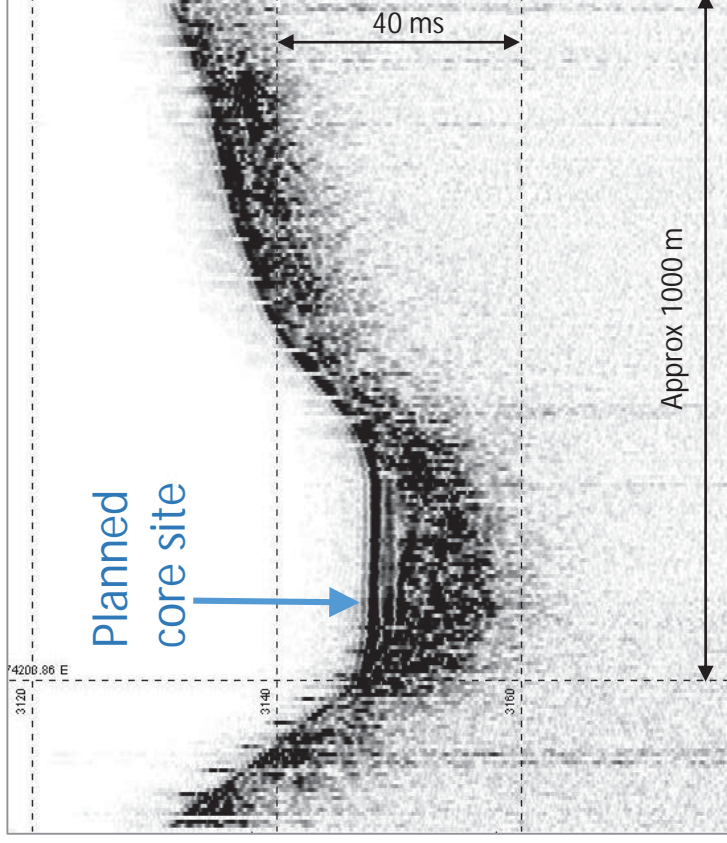
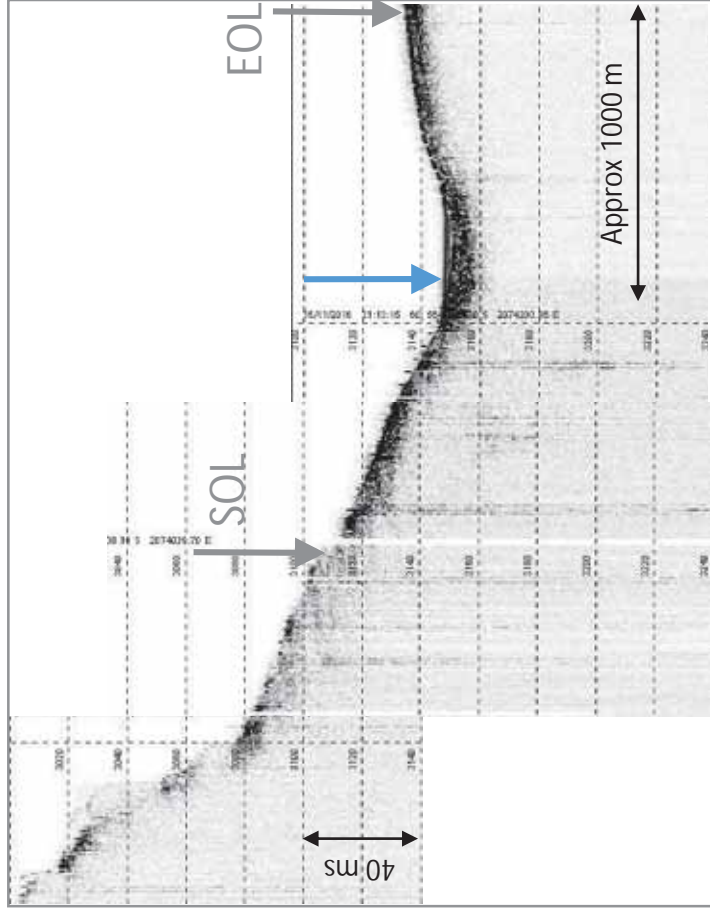
Gear type	Piston core	
Barrel Length (m)	6	Bent barrel
Penetration (m)		Catcher/Cutter bags
Core length (m)	1.82	Samples
Sections	2	Tephra
Fauna		Pull-out
		3.7t

Sample processing – core ID:

Section	Top depth (cm)	Btm depth (cm)	Logged	Phys Props	Summary
1	0	100	Y	Y	.
2	100	182	Y	Y	.
					.
					.
					.
					.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Poverty 2	Other ID TAN1613-42	Water Depth 2340 m
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2km Topas line to and over the planned core station. Grey arrows indicate start and end of the 2km survey line over the station. The blue arrow marks the planned core site.

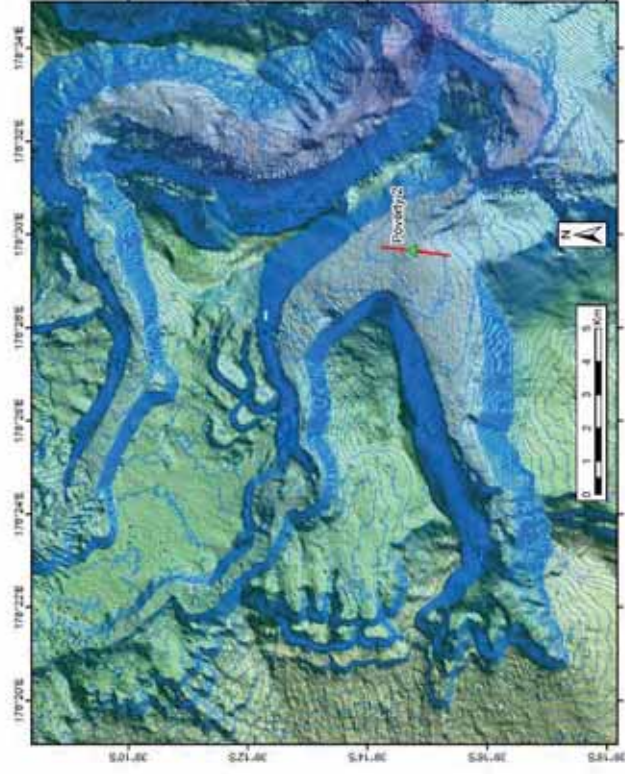
Zoom into survey line over planned core site.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Poverty 2

Other ID TAN1613-42

Water Depth 2340 m



Bathymetry at and around Poverty2 core site at the southern arm of Poverty Canyon, middle slope. Light blue lines are 20 m depth contours. Red lines show the 2 km TOPAS survey line over the station, green triangles indicate the actual core site.



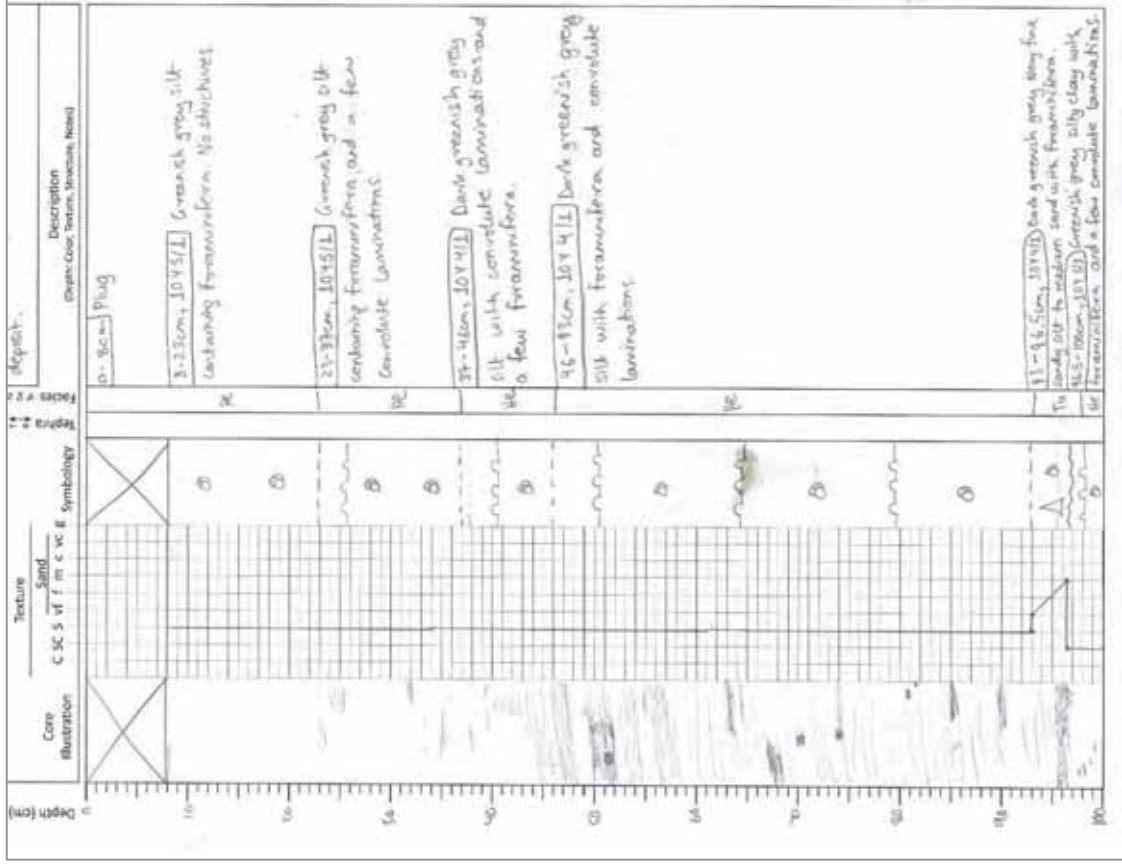
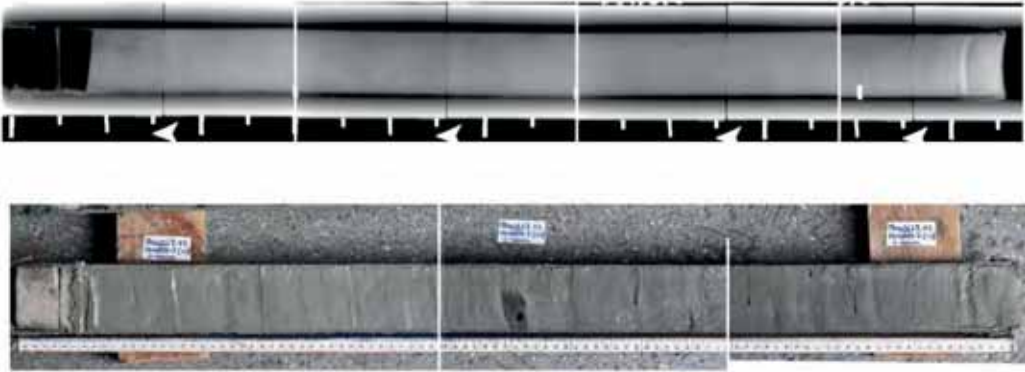
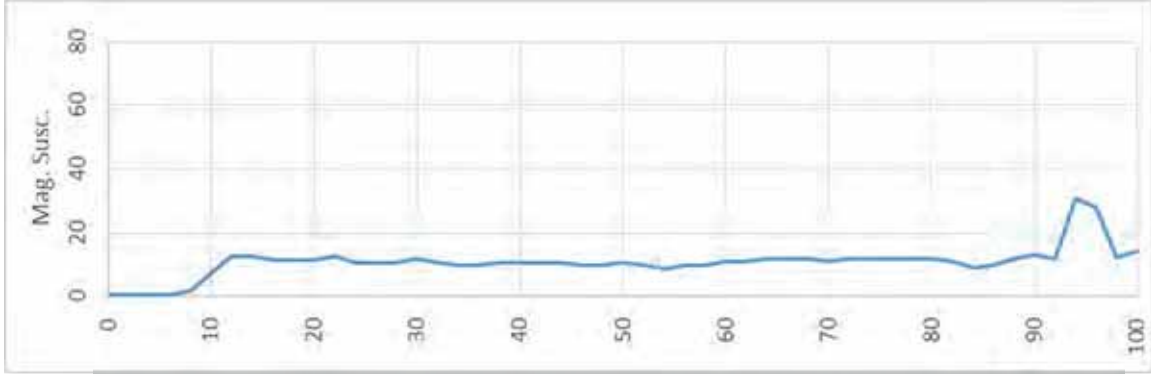
Backscatter at and around Poverty2 core site at the southern arm of Poverty Canyon, middle slope. Red lines show the 2 km TOPAS survey line over the station, green triangles indicate the actual core site.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Poverty 2

Other ID TAN1613-42

Section 1 of 2

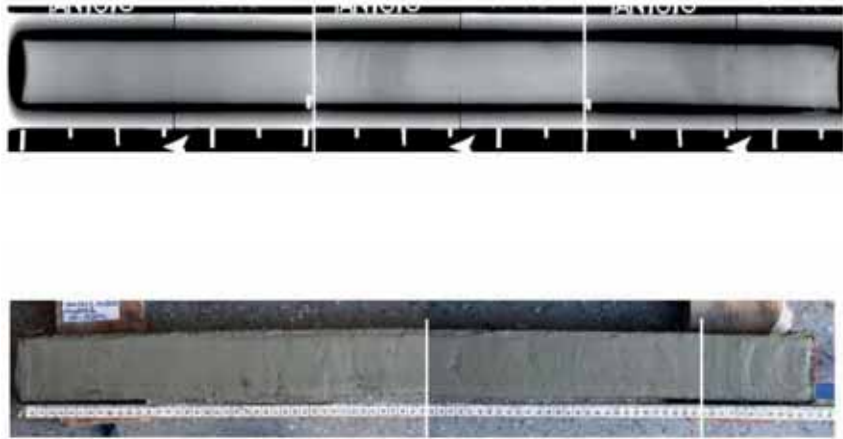
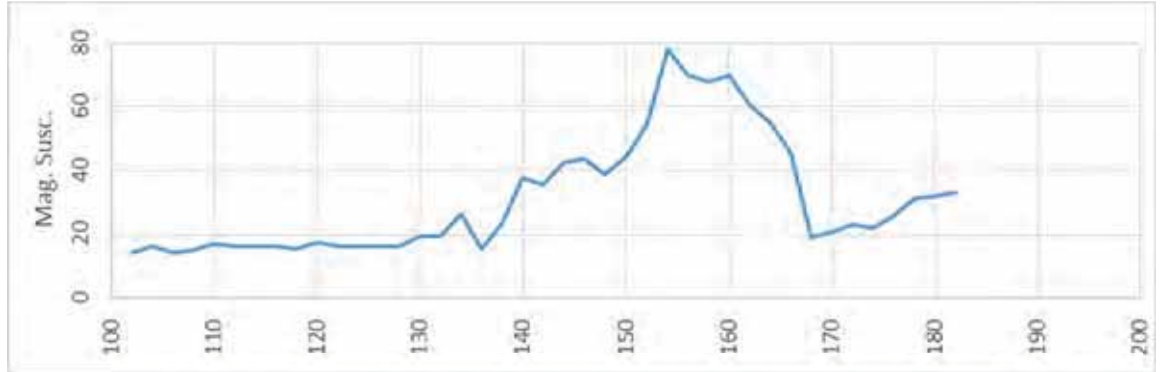
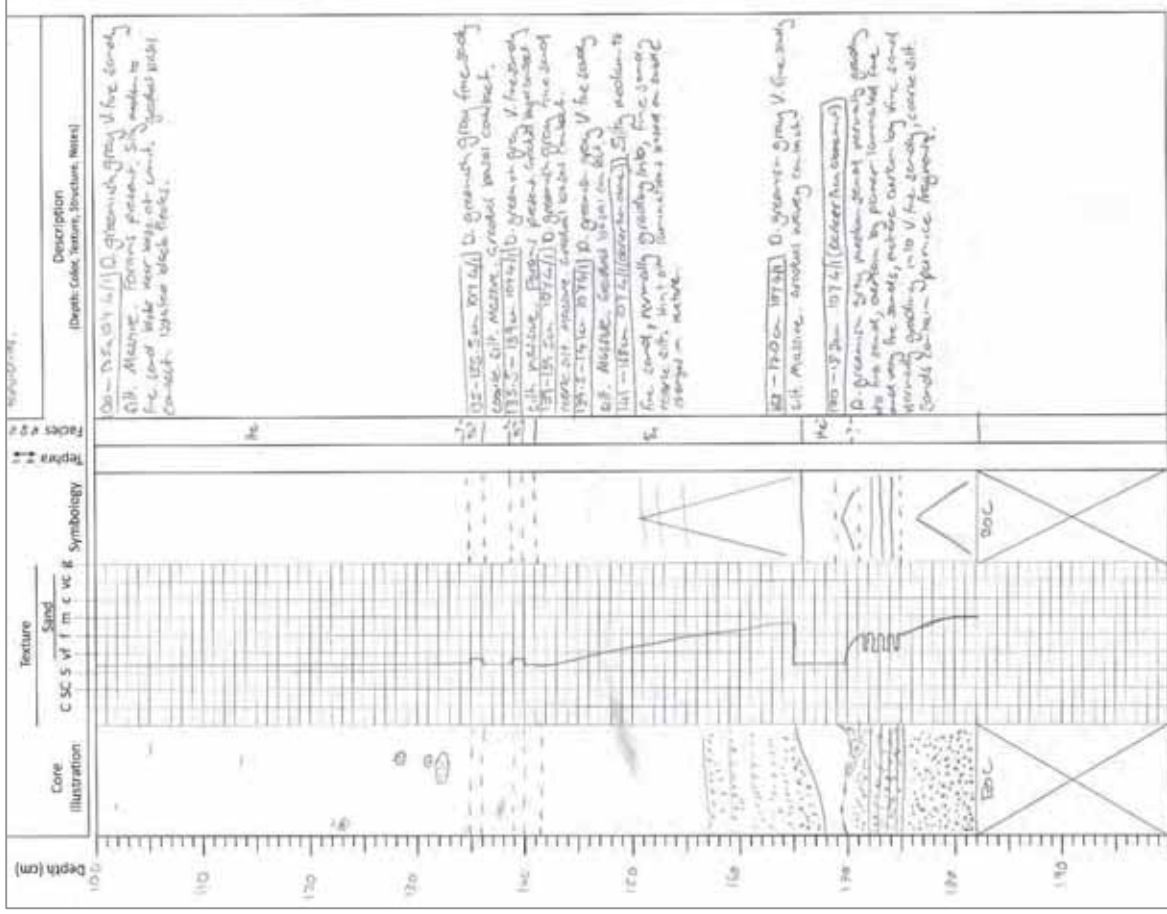


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Poverty 2

Other ID TAN1613-42

Section 2 of 2



TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: **Poverty 1**

Latitude: -39.03490

Date/Time (NZST): 16/11/2016 15:54

Other ID: TAN1613-43

Longitude: 178.88582

Depth (m): 2785

Sample Description

General Description

Outer slope perched basin east of Paritu Ridge

Oxidised surficial sediment overlying hemipelagite

Tephra in section 1 (89.5-92.5) and 2 (145-152 cm)

Upper part of section 1 split by spatula; Coring sock got stuck in the lower 10 cm of core. It appears that the tephra/pumice deposit caught the sock – had to remove deposit with sock wrap around it and replace deposit in core ½ section

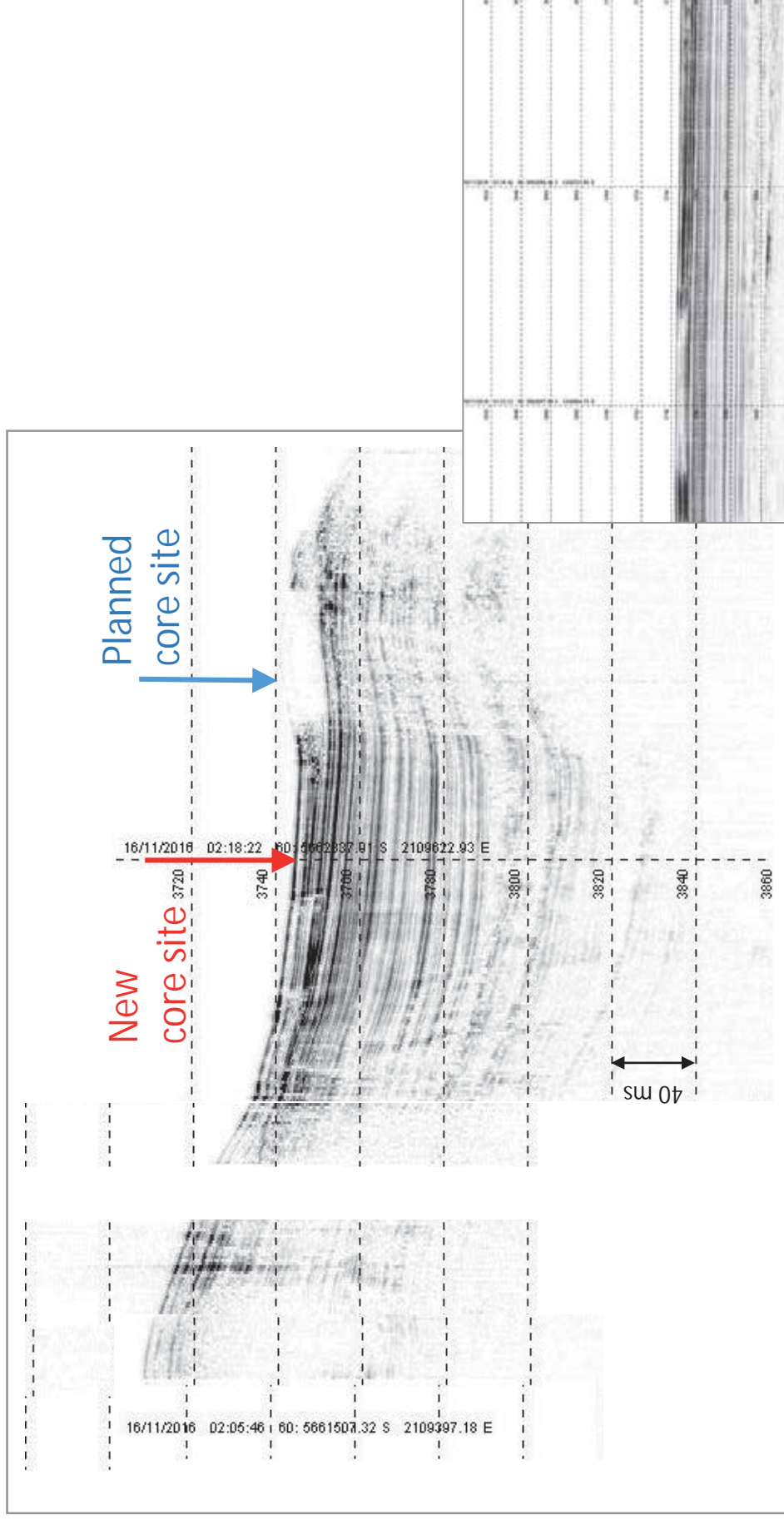
Gear type	Piston core	
Barrel Length (m)	6	Bent barrel
Penetration (m)		Catcher/Cutter bags
Core length (m)	1.59	Samples
Sections	2	Tephra
Fauna		

Sample processing – core ID:

Section	Top depth (cm)	Btm depth (cm)	Logged	Phys Props	Summary
1	0	100	Y	Y	
2	100	153	Y	Y	

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Poverty 1	Other ID TAN1613-43	Water Depth 2785 m
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2km Topas line over the planned core station. The blue arrow marks the planned core site. The actual site was shifted and it now located at the red arrow.

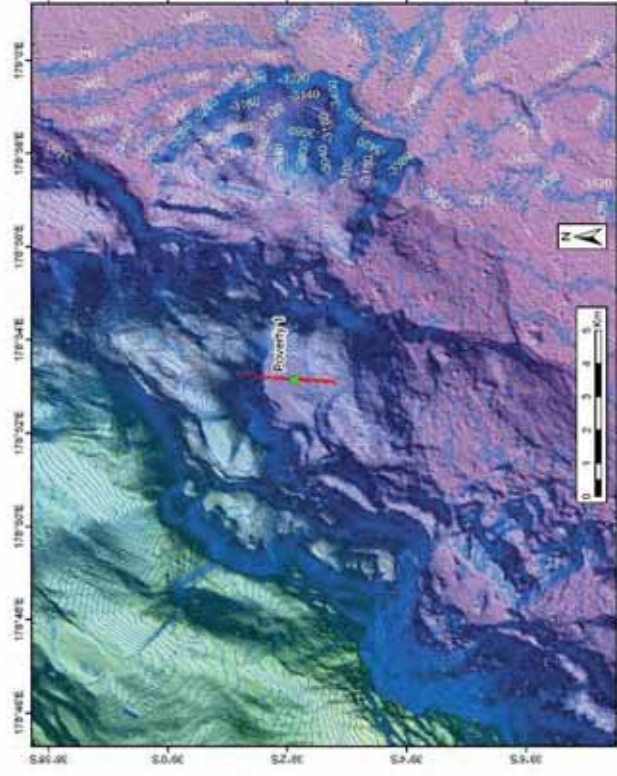
Idle survey while coring new location.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Poverty 1

Other ID TAN1613-43

Water Depth 2785 m



Bathymetry at and around Poverty1 core site at the outer slope perched basin, east of Paritu Ridge. Light blue lines are 20 m depth contours. Red lines show the 2 km TOPAS survey line over the station, green triangles indicate the actual core site.



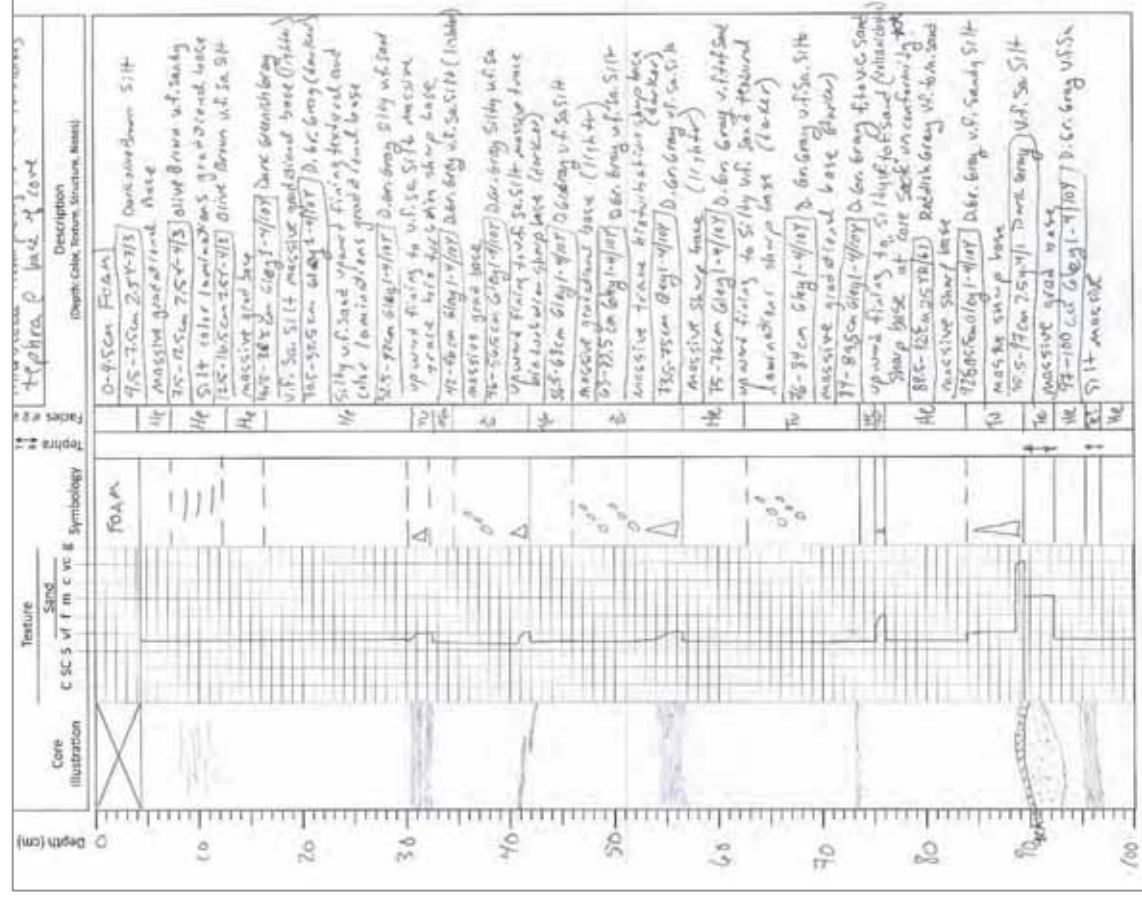
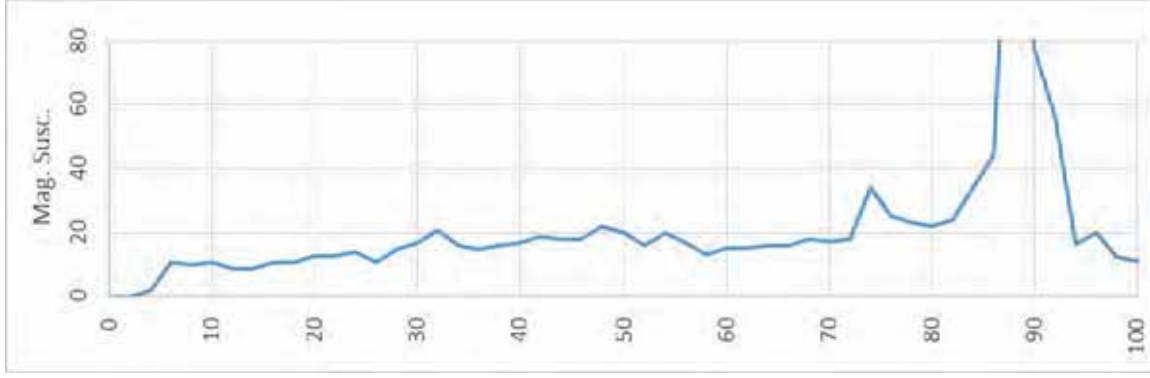
Backscatter at and around Poverty1 core site at the outer slope perched basin, east of Paritu Ridge. Red lines show the 2 km TOPAS survey line over the station, green triangles indicate the actual core site.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Poverty 1

Other ID TAN1613-43

Section 1 of 2

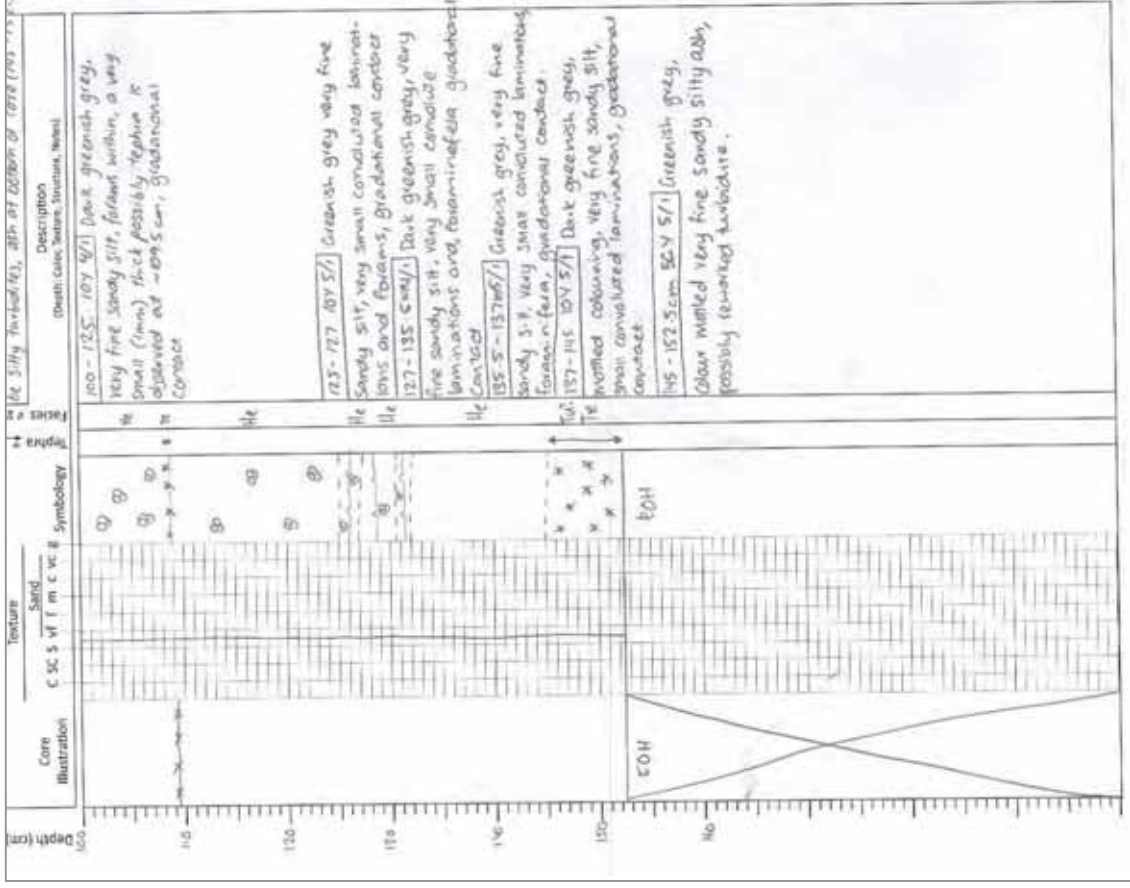
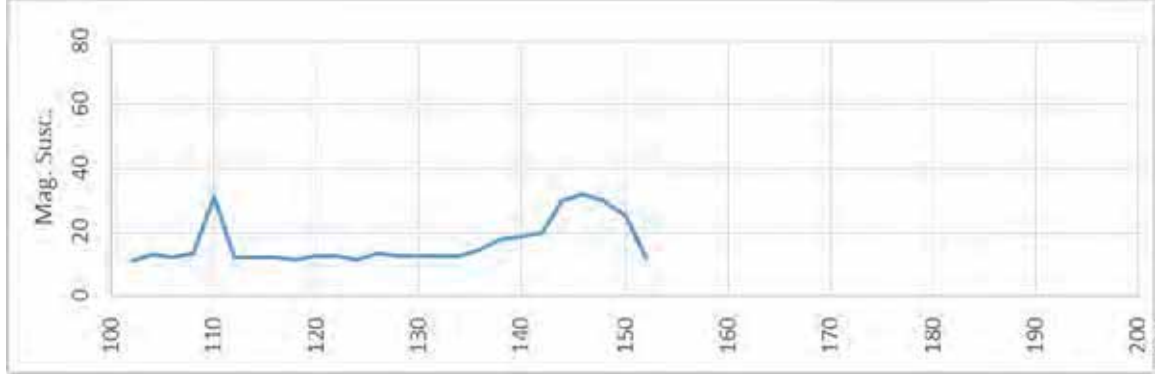


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Poverty 1

Other ID TAN1613-43

Section 2 of 2



TAN1613 – Paleoseismicity of the Southern Hikurangi Margin - Multicore data sheet

Core ID: Ritchie 2	Latitude: -39.60060	Date/Time (NZST): 16/11/2016 21:54
Other ID: TAN1613-44	Longitude: 178.59330	Depth (m): 2685

Length (cm)	65
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Sample Description

General Description

Outer slope perched basin east of Ritchie Ridge

Oxidised surficial sediment overlying hemipelagite

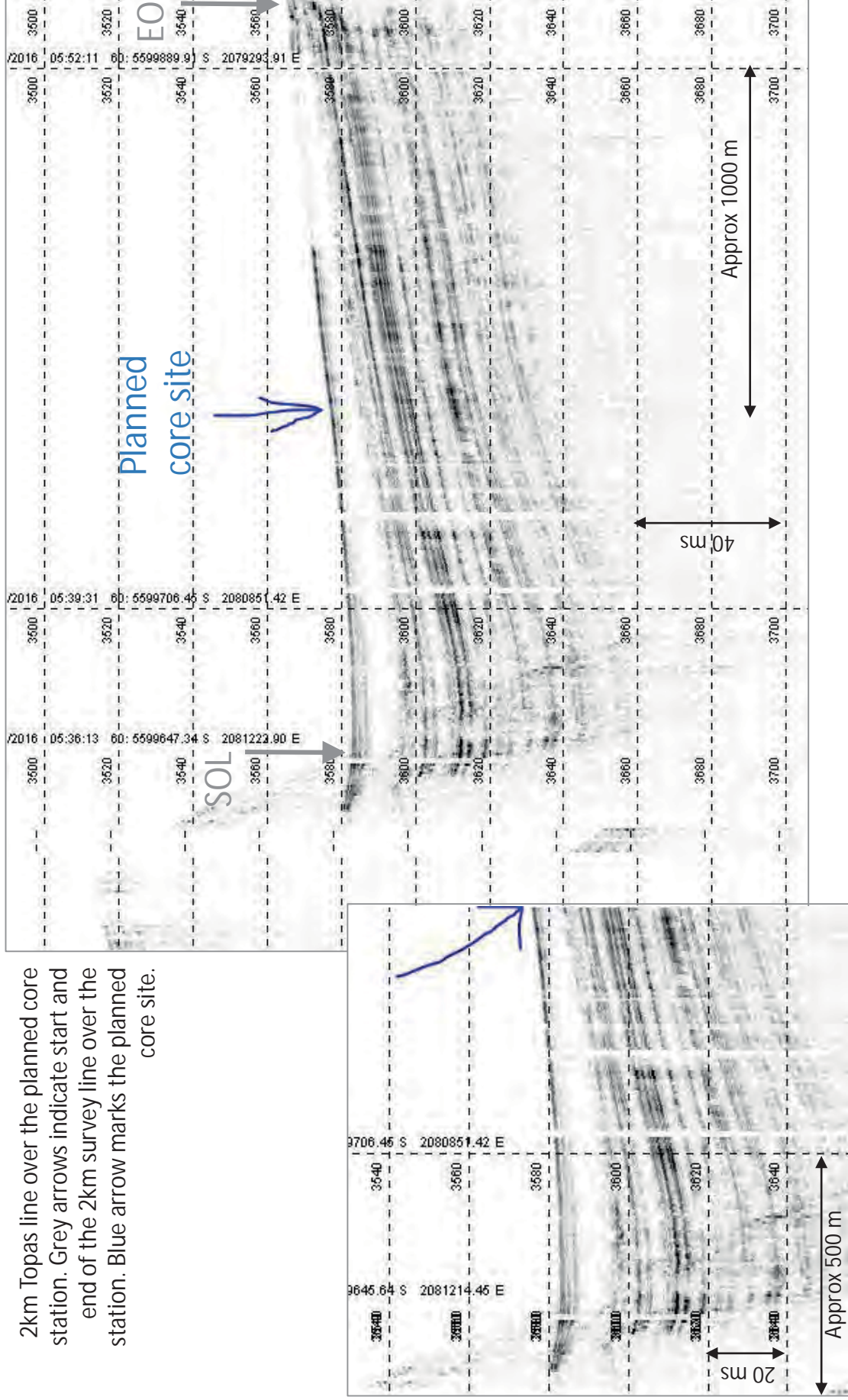
TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: **Ritchie 2**

Other ID **TAN1613-44**

Water Depth **2685 m**

2km Topas line over the planned core station. Grey arrows indicate start and end of the 2km survey line over the station. Blue arrow marks the planned core site.



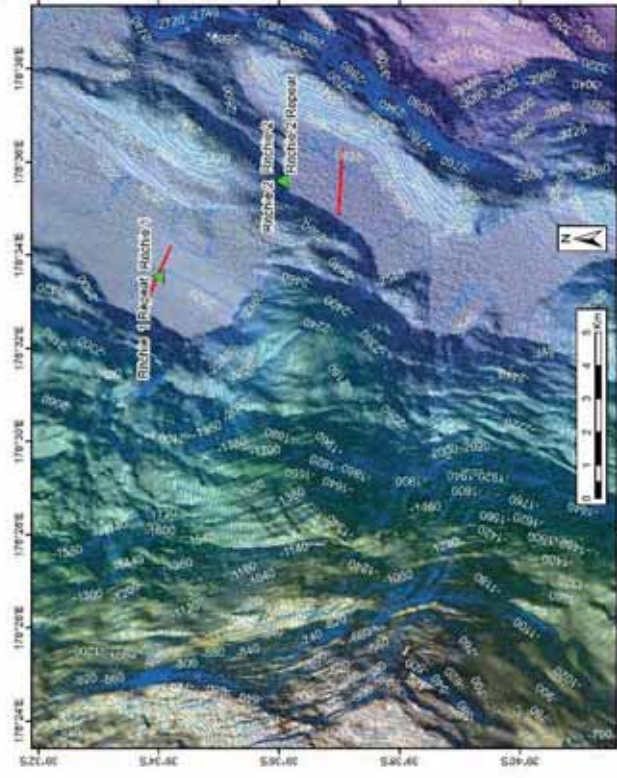
Zoom into the survey lines over planned core site.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

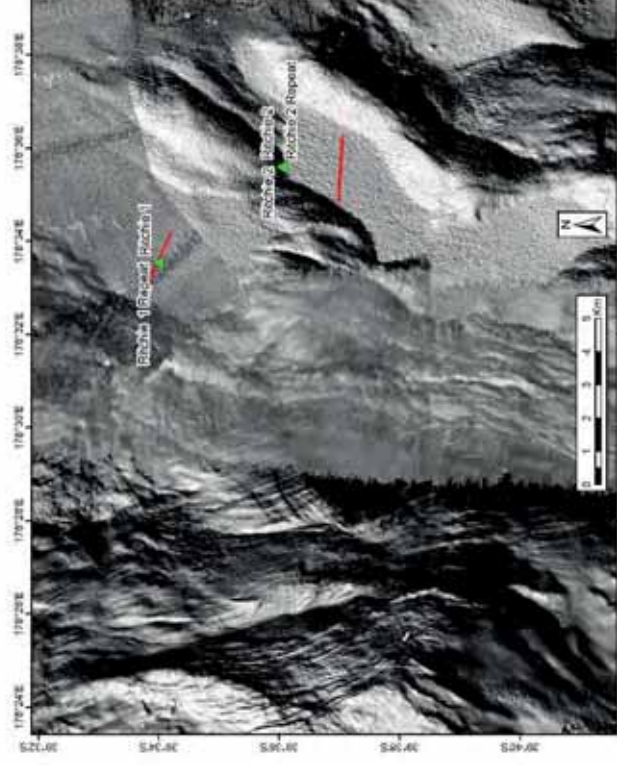
Core ID: **Ritchie 2**

Other ID **TAN1613-44**

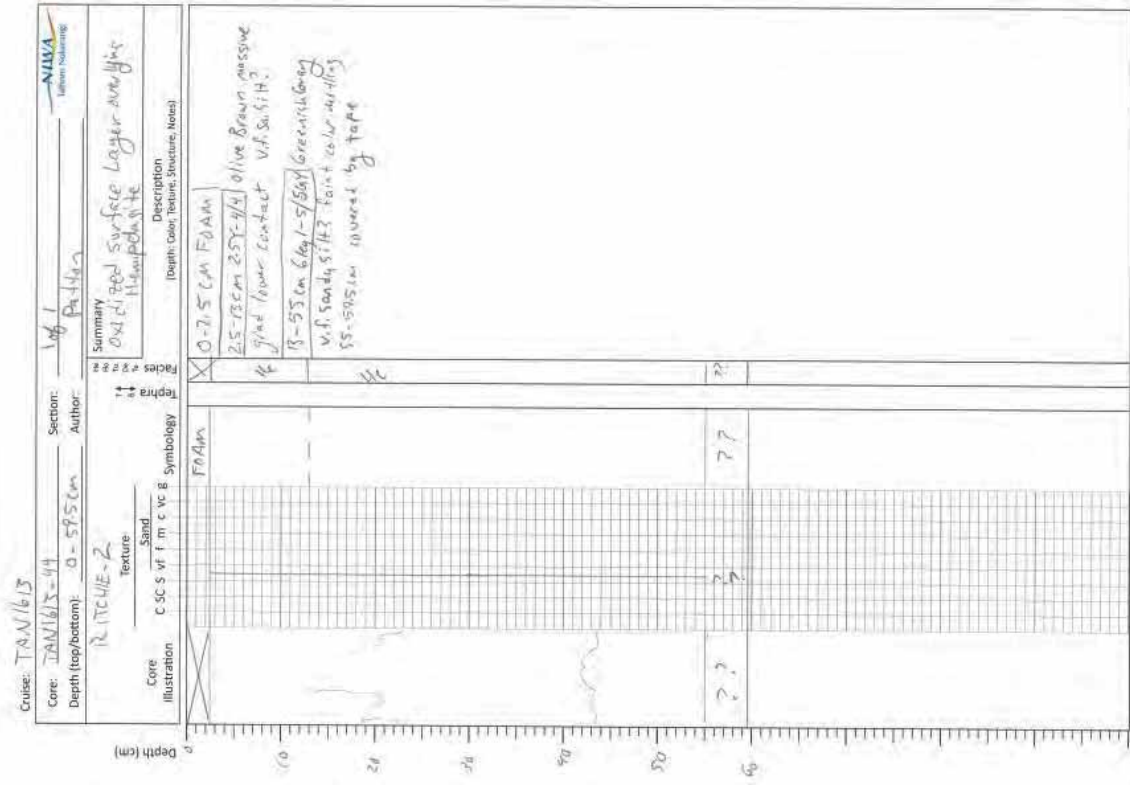
Water Depth **2685 m**



Bathymetry at and around Ritchie2 core site at the outer slope perched basin, east of Ritchie Ridge. Light blue lines are 20 m depth contours. Red lines show the 2 km TOPAS survey line over the station, green triangles indicate the actual core site. Multi-label indicate a repeated core and/or a multicore.



Backscatter at and around Ritchie2 core site at the outer slope perched basin, east of Ritchie Ridge. Red lines show the 2 km TOPAS survey line over the station, green triangles indicate the actual core site. Multi-label indicate a repeated core and a multicore.



TAN1613 – Paleoseismicity of the Southern Hikurangi Margin - Multicore data sheet

Core ID: **Rock 1** Latitude: -39.91018 Date/Time (NZST): 17/11/2016 01:46

Other ID: TAN1613-45 Longitude: 178.34578 Depth (m): 1915

Length (cm) 63

Sample Description

General Description

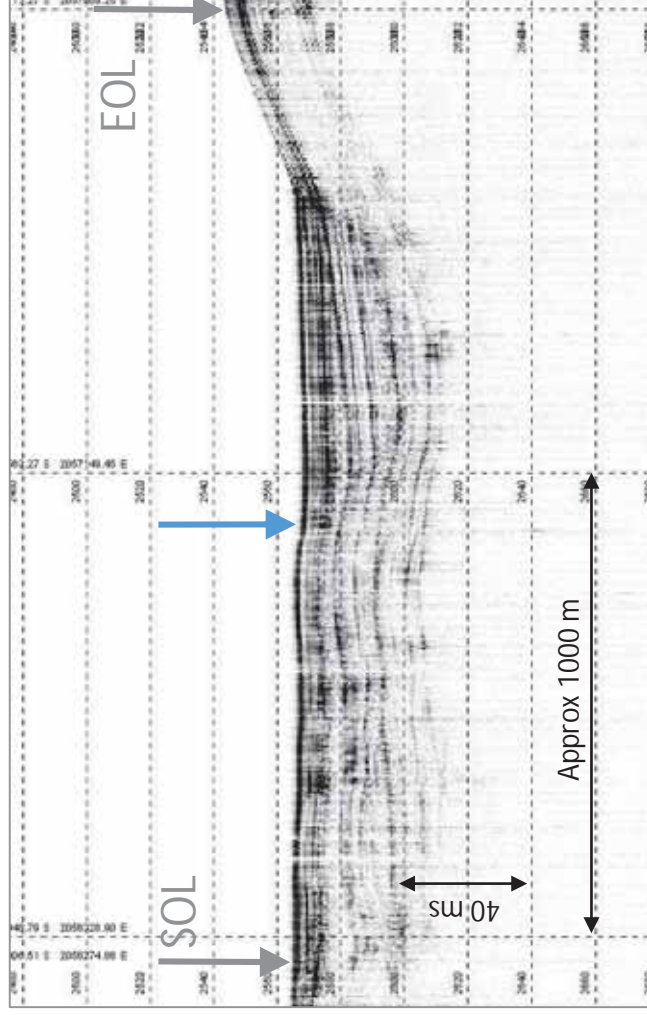
Lower slope mini-basin Nth of Rock Garden

Hemipelagite with one sandy layer (obs thru liner)

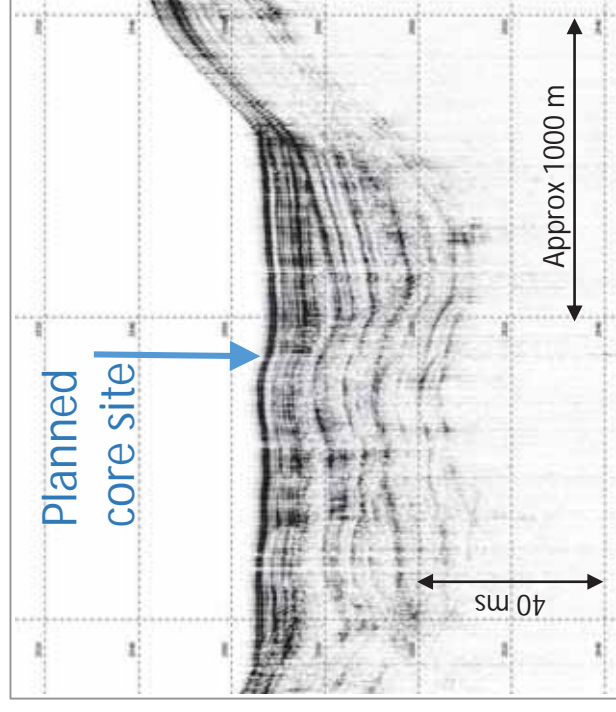
Surficial oxidation layer overlying hemipelagite with one sandy turbidite

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Rock 1	Other ID TAN1613-45	Water Depth 1915
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2km Topas line over the planned core station. Grey arrows indicate start and end of the 2km survey line over the station. Blue arrow marks the planned core site.



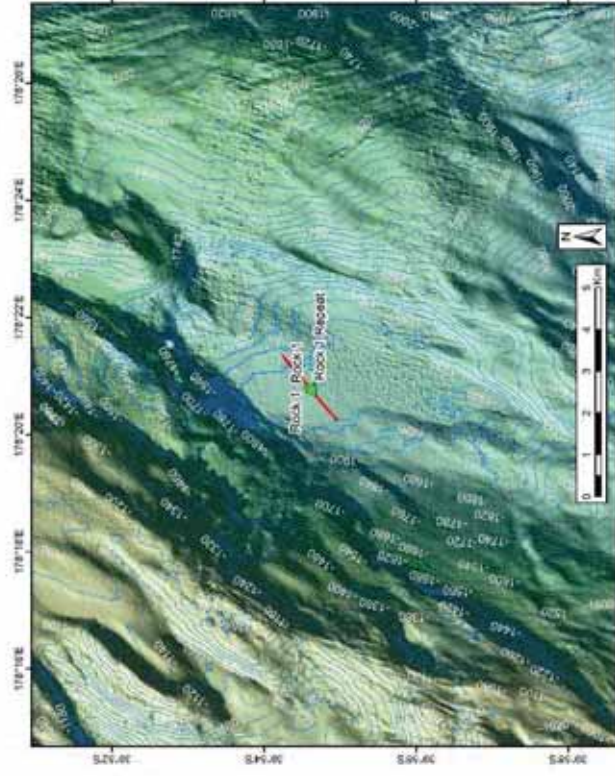
Vertical exaggerated survey lines over planned core site.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

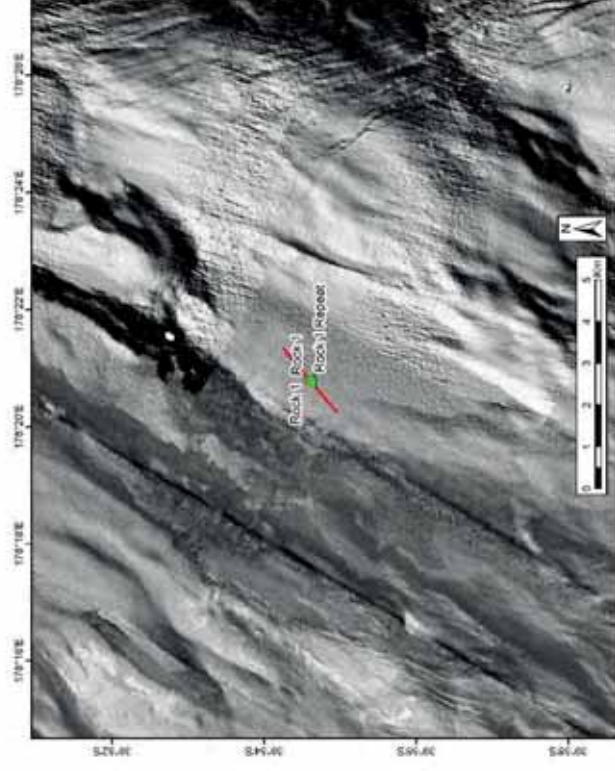
Core ID: **Rock 1**

Other ID **TAN1613-45**

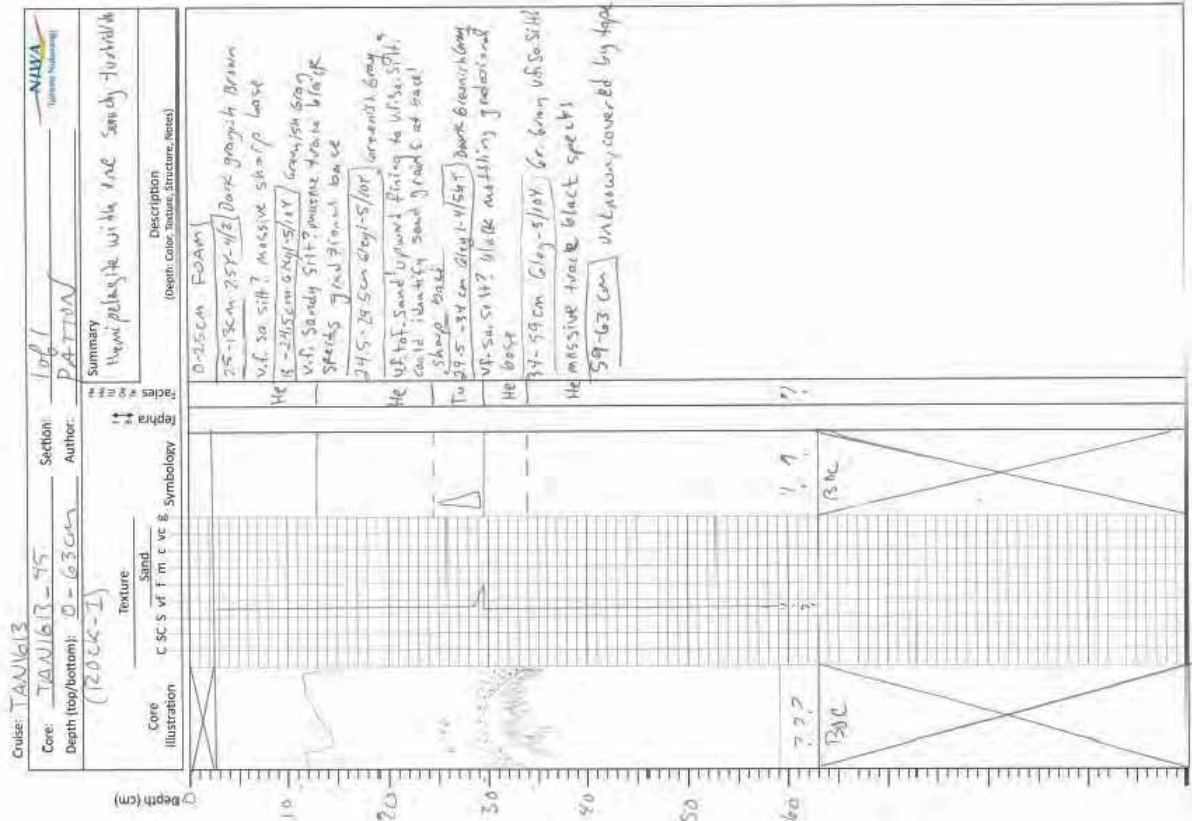
Water Depth **1915**



Bathymetry at and around Rock1 core site at the lower slope of a mini-basin North of Rock Garden. Light blue lines are 20 m depth contours. Red lines show the 2 km TOPAS survey line over the station, green triangles indicate the actual core site. Multi-label indicate a repeated core and a multicore.



Backscatter at and around Rock1 core site at the lower slope of a mini-basin North of Rock Garden. Red lines show the 2 km TOPAS survey line over the station, green triangles indicate the actual core site. Multi-label indicate a repeated core and a multicore.



TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: **Hik 16** Latitude: -40.12770 Date/Time (NZST): 17/11/2016 06:34

Other ID: TAN1613-46 Longitude: 178.81183 Depth (m): **3219**

Sample Description	Gear type	Piston core
General Description Hikurangi Trough basin floor, outside channel, E of Rock Garden a suite of interbedded muddy to sandy turbidites and hemipelagites. One tephra(283.5-285cm)	Barrel Length (m)	6 Bent barrel n
	Penetration (m)	Catcher/Cutter bags N
	Core length (m)	4.3 Samples
	Sections	5 Tephra 1
	Fauna	

Sample processing – core ID:

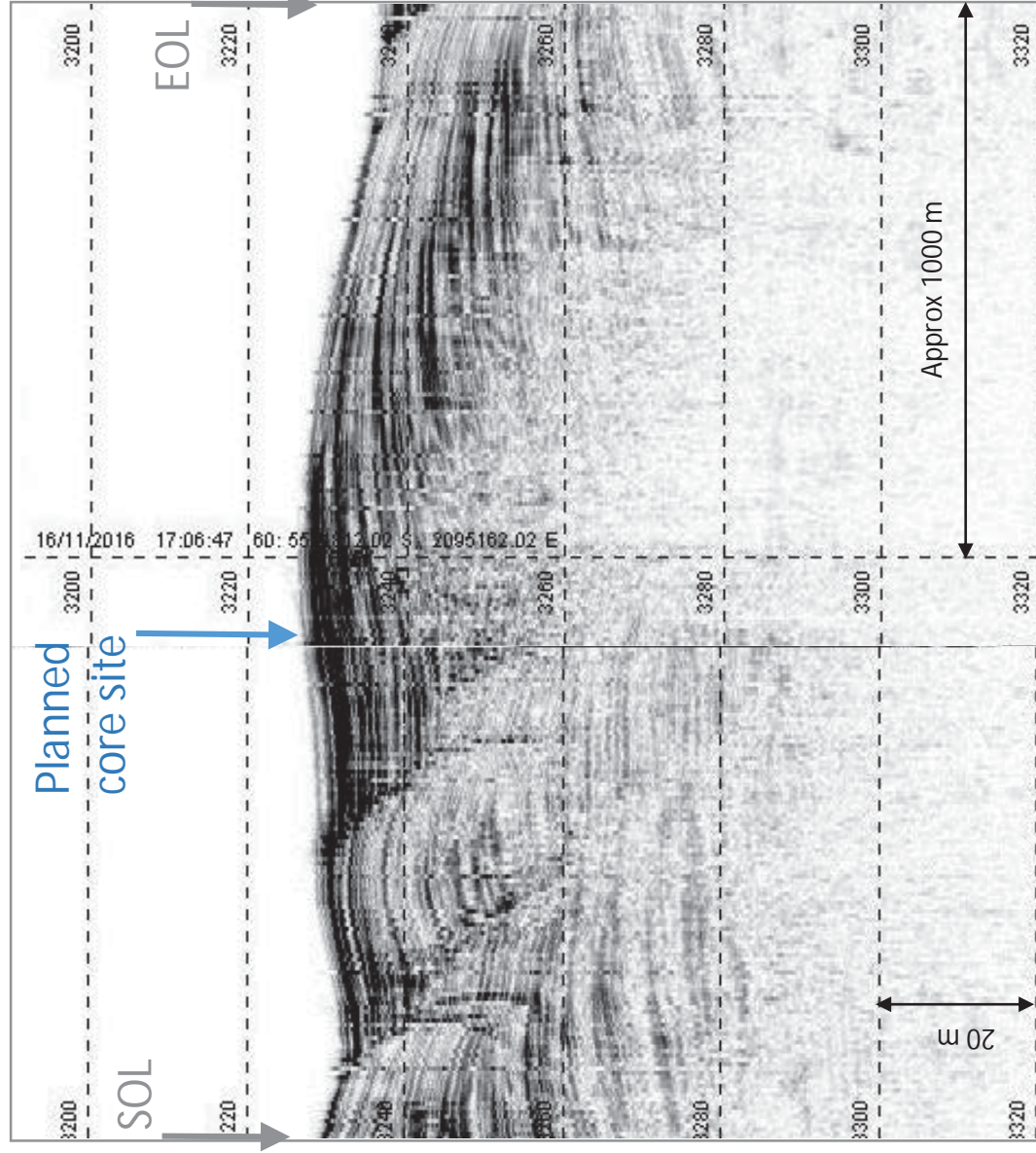
Section	Top depth (cm)	Btm depth (cm)	Logged	Phys Props	Summary
1	0	100	Y	Y	.
2	100	200	Y	Y	.
3	200	300	Y	Y	.
4	300	370	Y	Y	.
5	370	430	Y	Y	.
.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Hik 16

Other ID TAN1613-46

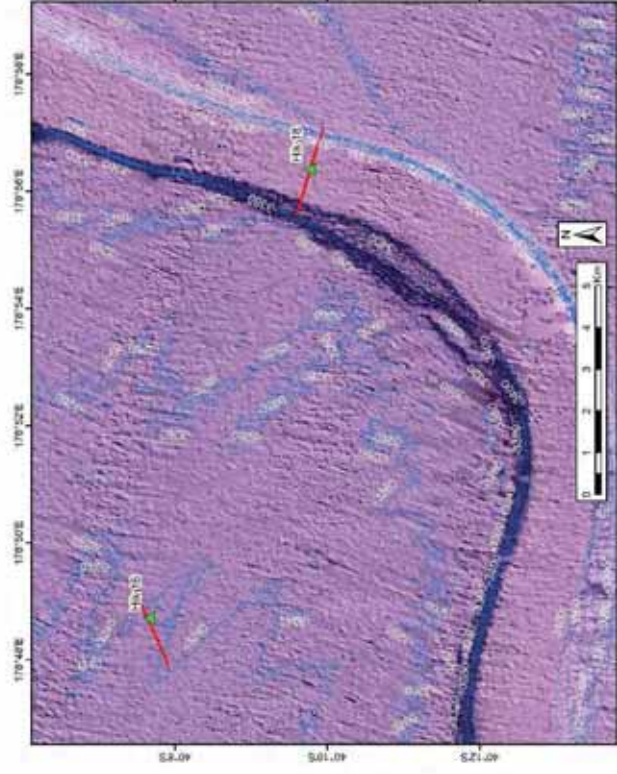
Water Depth 3219 m



2km Topas line over the planned core station. Grey arrows indicate start and end of the 2km survey line over the station. Blue arrow marks the planned core site.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Hik 16	Other ID TAN1613-46	Water Depth 3219 m
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No backscatter image!

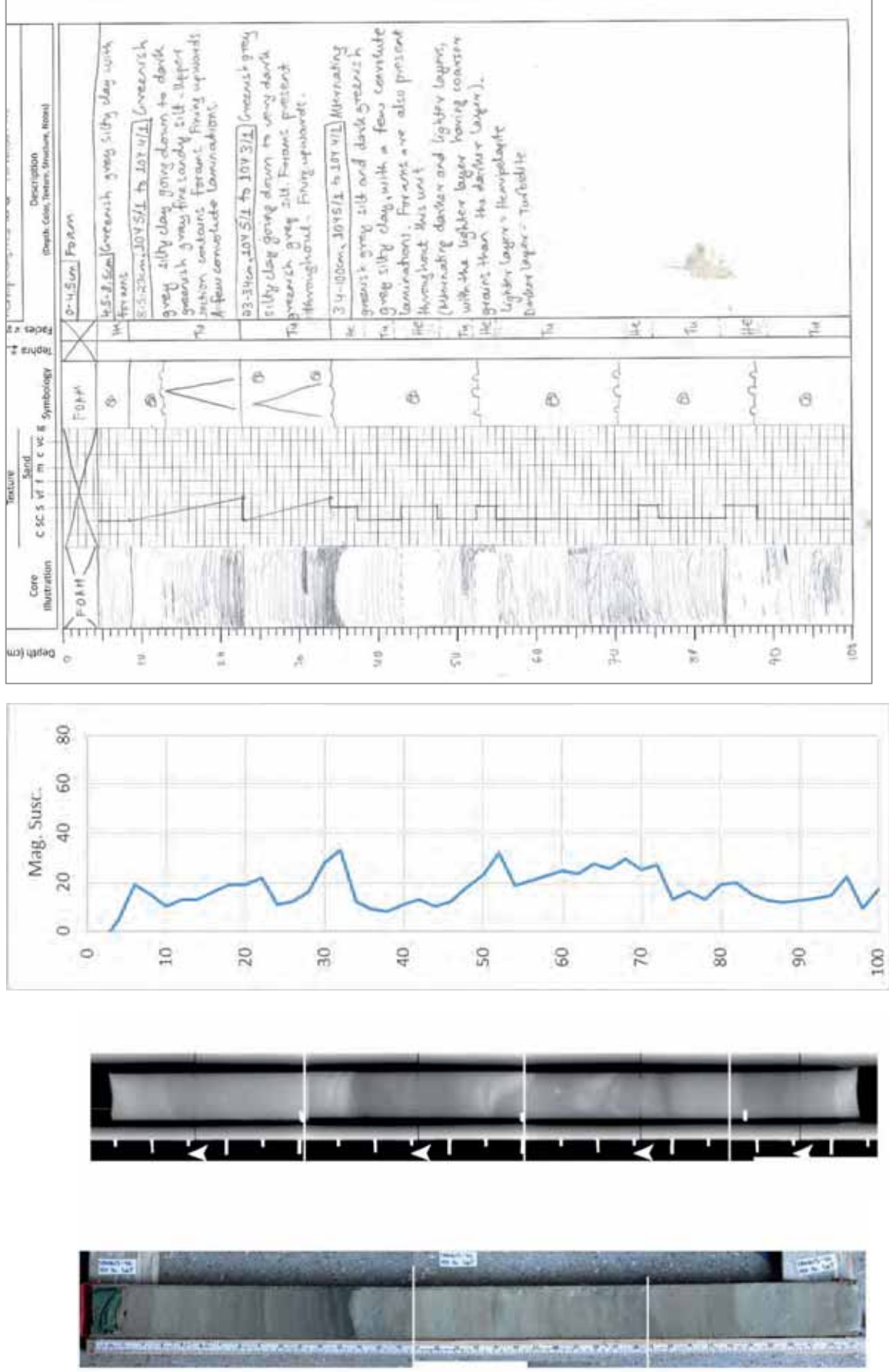
Bathymetry at and around Hik16 core site at the Hikurangi Trough basin floor, outside channel, E of Rock Garden. Light blue lines are 20 m depth contours. Red lines show the 2 km TOPAS survey line over the station, green triangles indicate the actual core site. Multi-label indicate a repeated core and a multicore.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Hik 16

Other ID TAN1613-46

Section 1 of 5

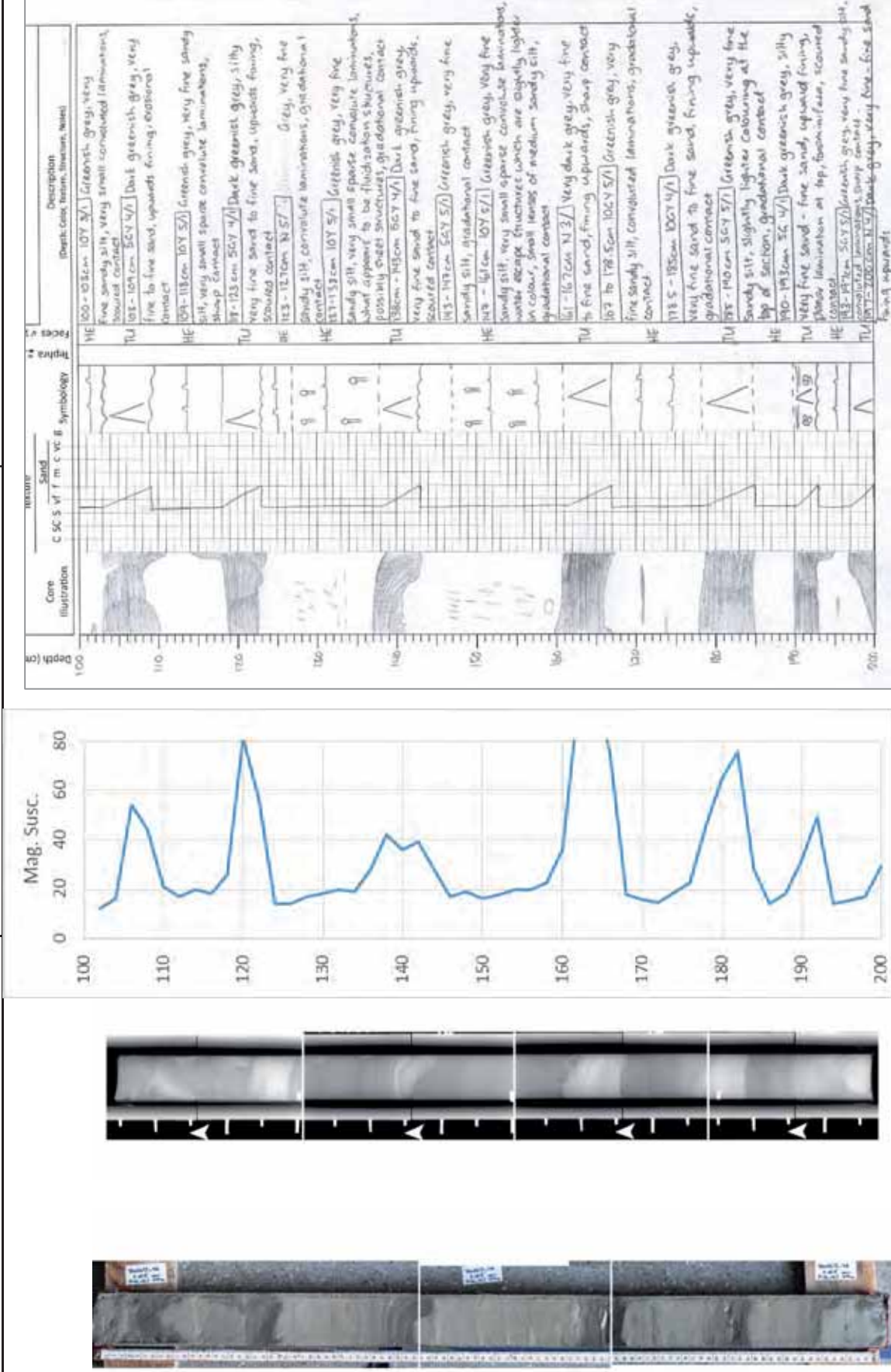


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Hik 16

Other ID TAN1613-46

Section 2 of 5

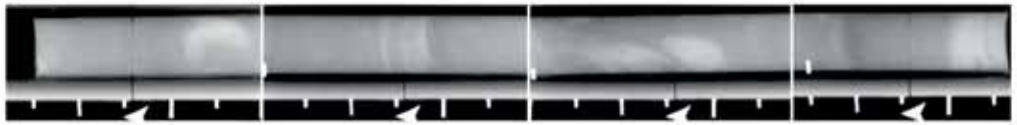
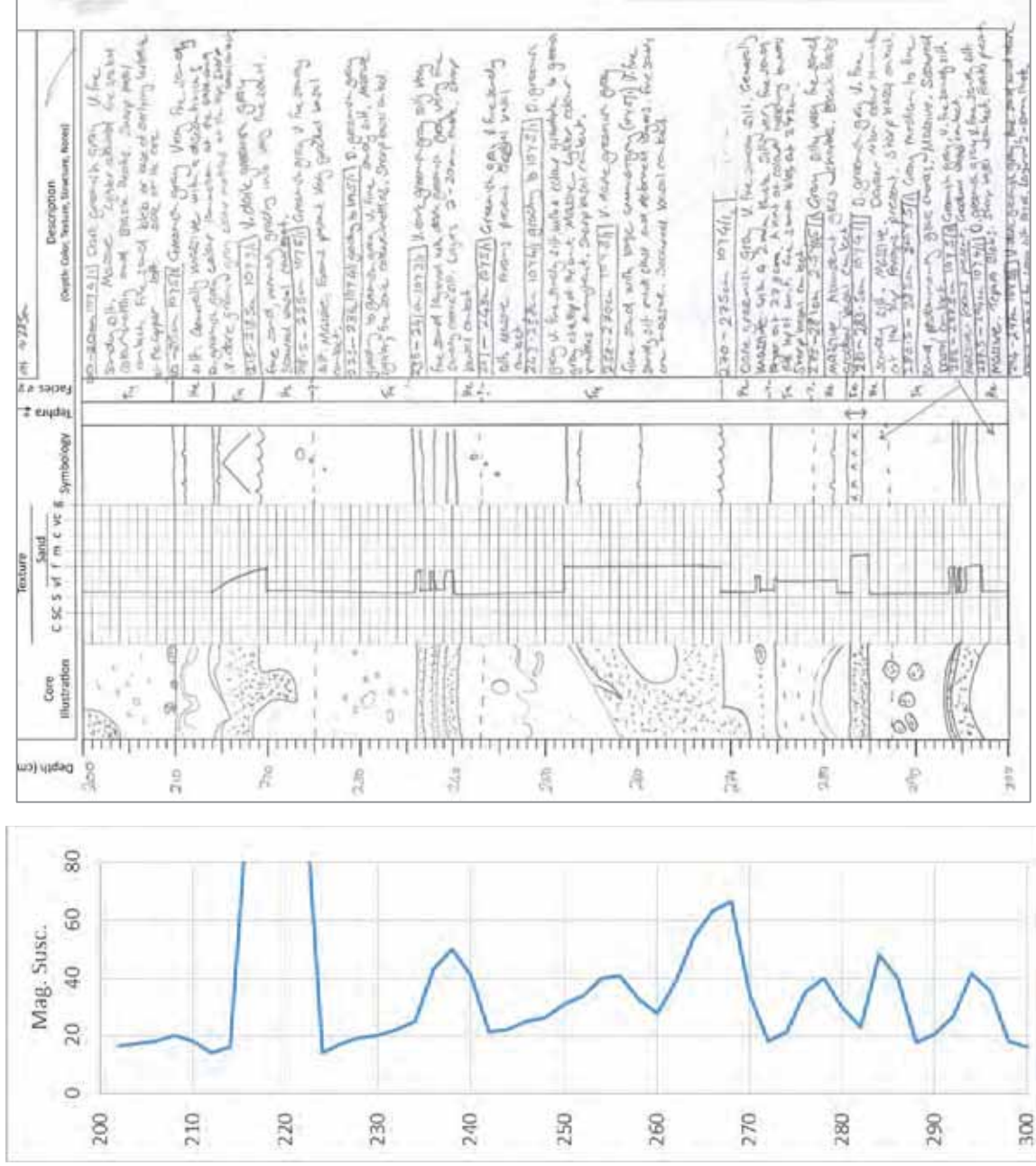


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Hik 16

Other ID TAN1613-46

Section 3 of 5

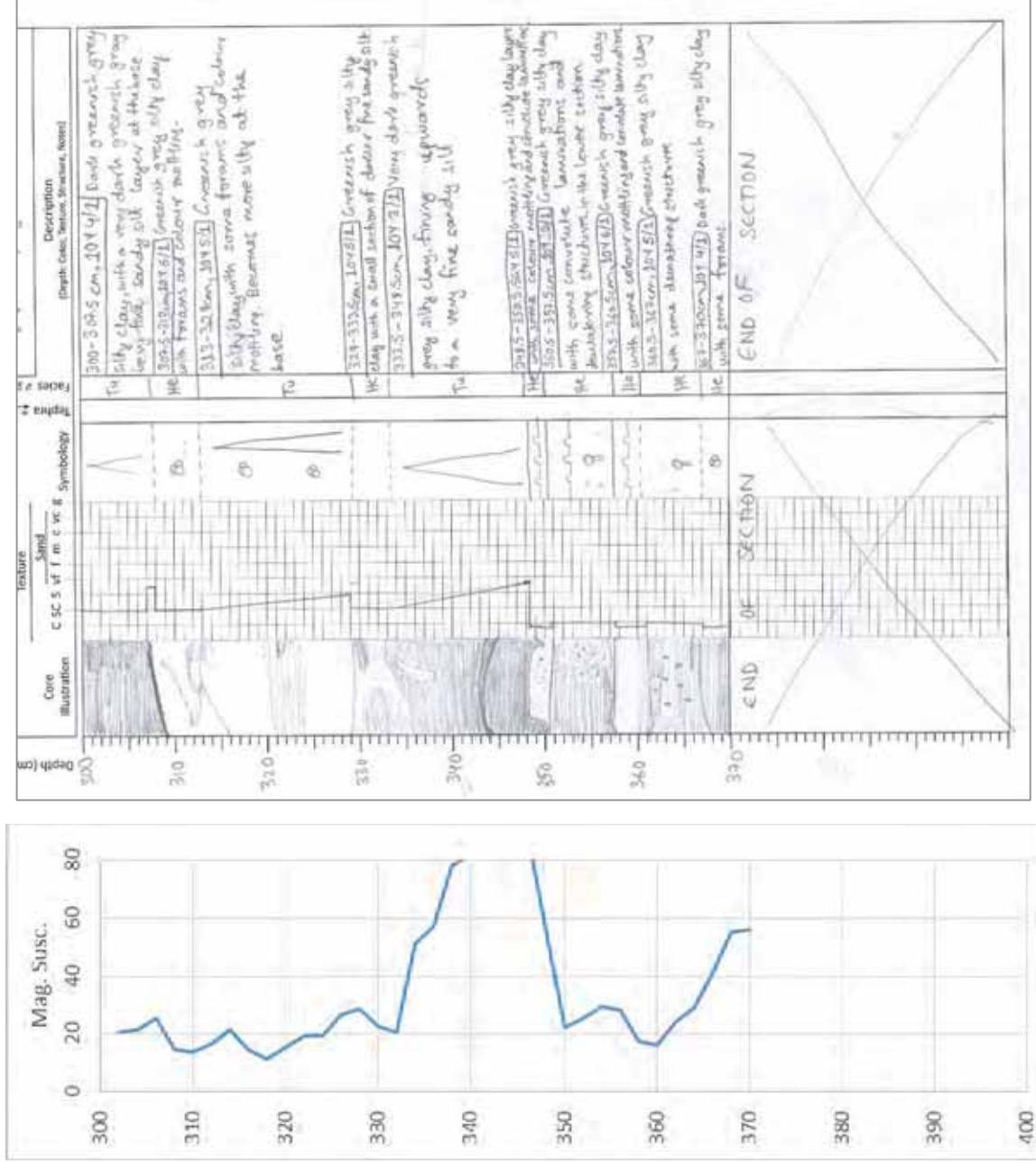


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Hik 16

Other ID TAN1613-46

Section 4 of 5

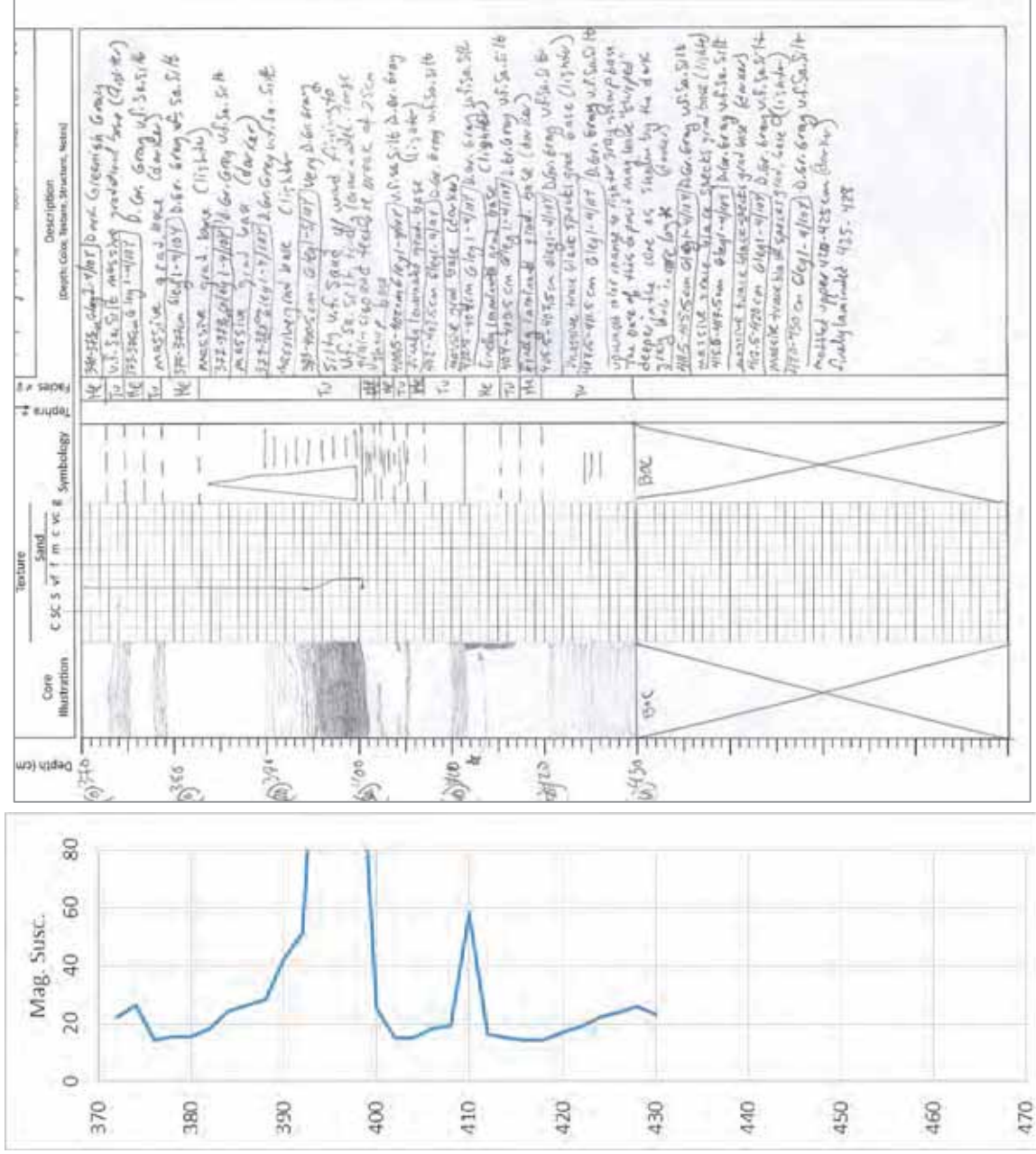


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Hik 16

Other ID TAN1613-46

Section 5 of 5



TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: **Hik 18** Latitude: -40.16283 Date/Time (NZST): 17/11/2016 10:24

Other ID: TAN1613-47 Longitude: 178.93962 Depth (m): **3415**

Sample Description

General Description

Hikurangi Channel E of Rock Garden

Decimetre scale dark turbidites interbedded with cm scale hemipelagites. Unlike slope cores, here a clear colour difference between T and H

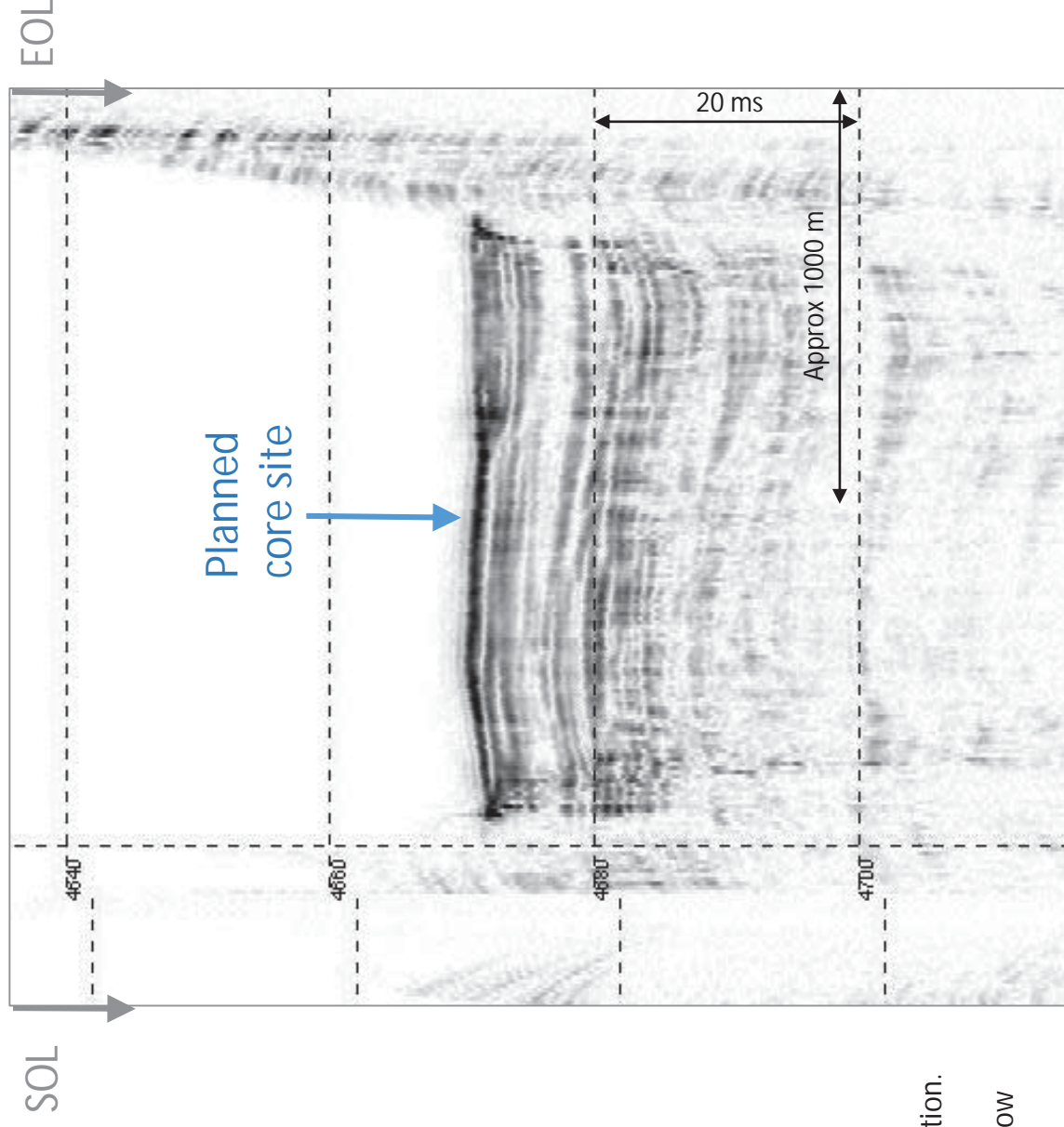
Gear type	Piston core	
Barrel Length (m)	6	Bent barrel
Penetration (m)		Catcher/Cutter bags
Core length (m)	3.13	Samples
Sections	4	Tephra
Fauna		.

Sample processing – core ID:

Section	Top depth (cm)	Btm depth (cm)	Logged	Phys Props	Summary
1	0	100	Y	Y	.
2	100	200	Y	Y	.
3	200	270	Y	Y	.
4	270	313	Y	Y	.
.
.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

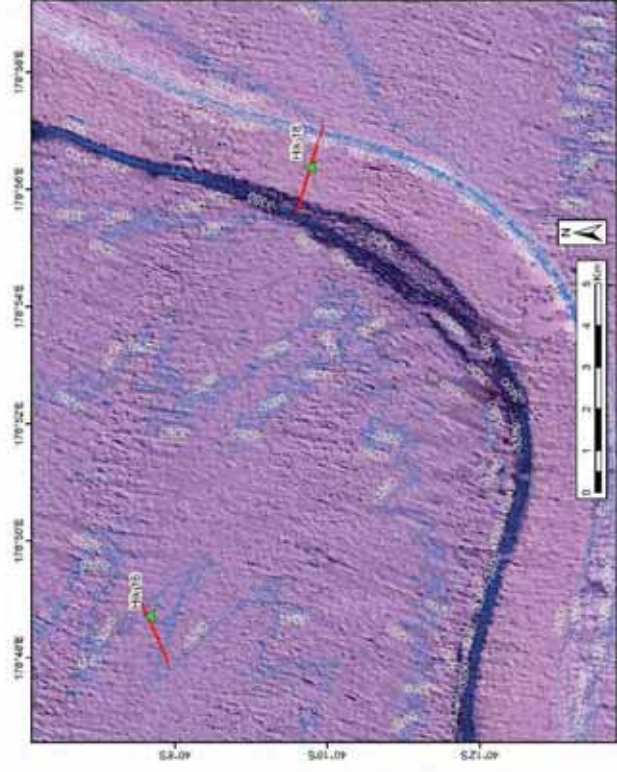
Core ID: Hik 18	Other ID TAN1613-47	Water Depth 3415 m
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2km Topas line over the planned core station.
Grey arrows indicate start and end of the
2km survey line over the station. Blue arrow
marks the planned core site.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Hik 18	Other ID TAN1613-47	Water Depth 3415 m
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No backscatter image!

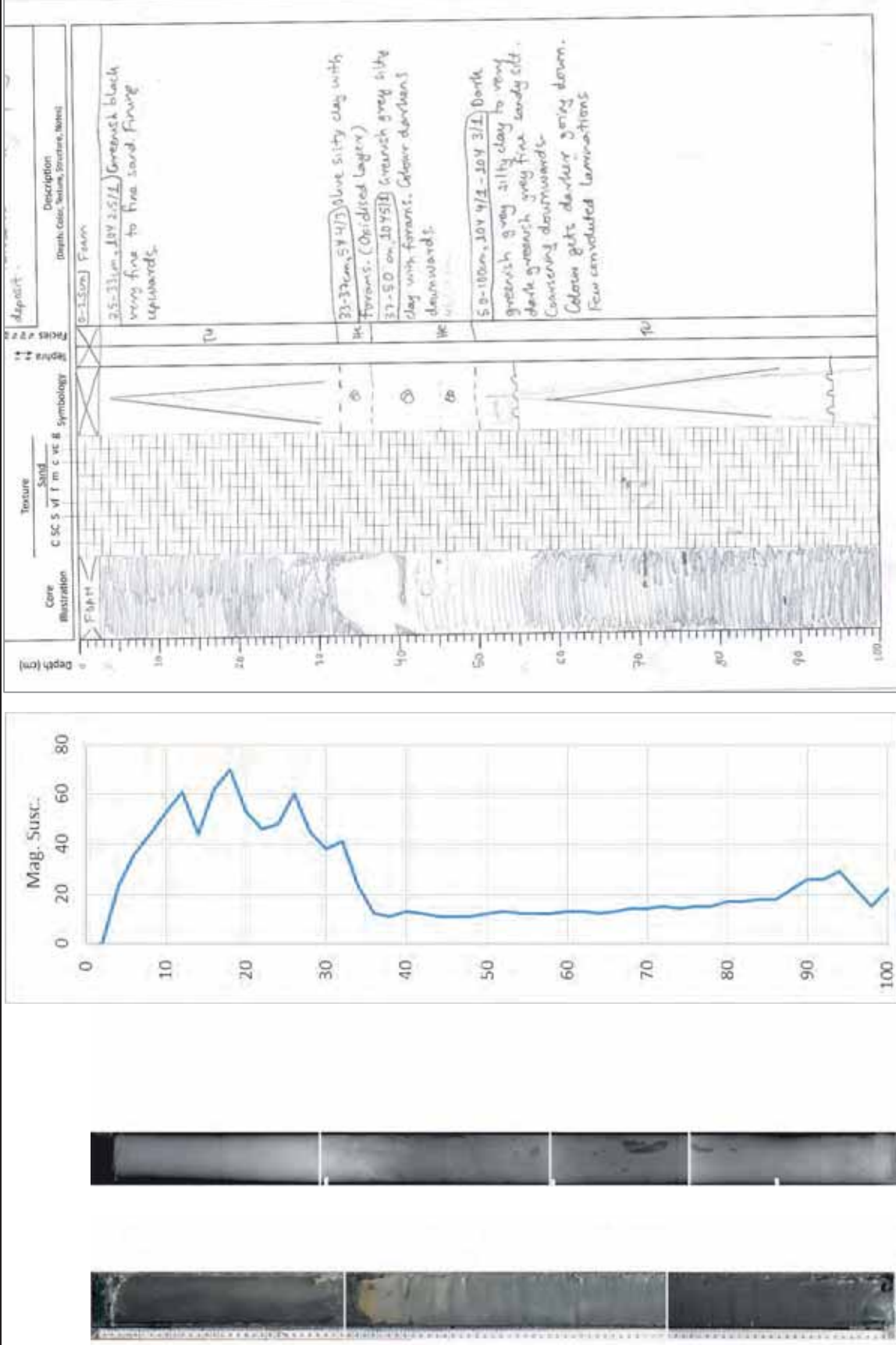
Bathymetry at and around Hik18 core site at the Hikurangi Channel, east of Rock Garden. Light blue lines are 20 m depth contours. Red lines show the 2 km TOPAS survey line over the station, green triangles indicate the actual core site. Multi-label indicate a repeated core and a multicore.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Hik 18

Other ID TAN1316-47

Section 1 of 4

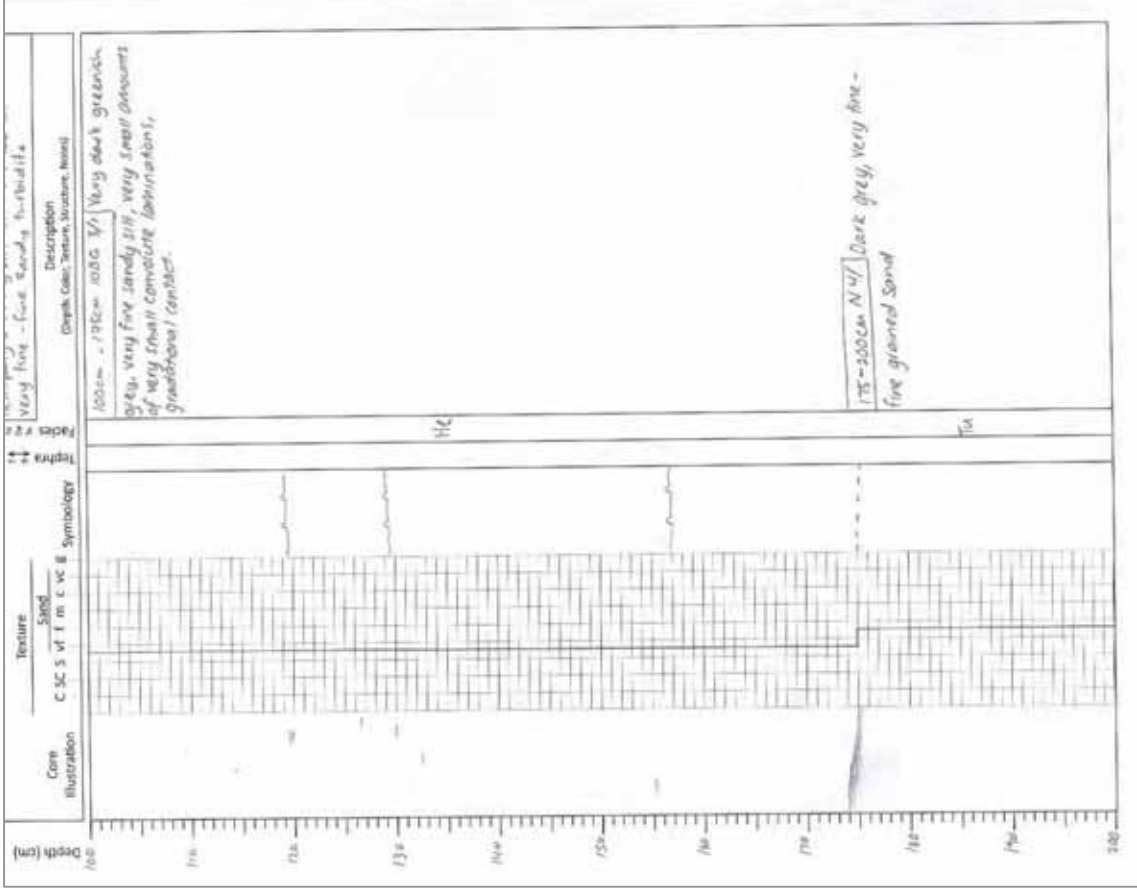
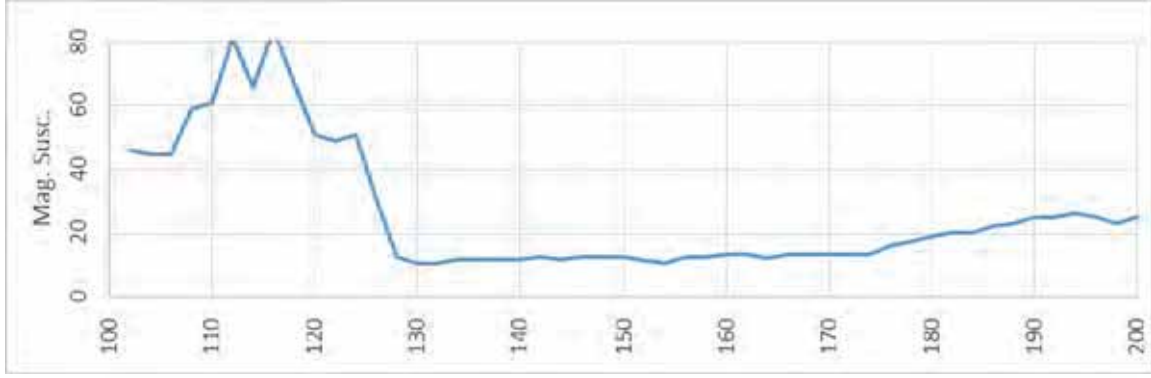


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Hik 18

Other ID TAN1613-47

Section 2 of 4

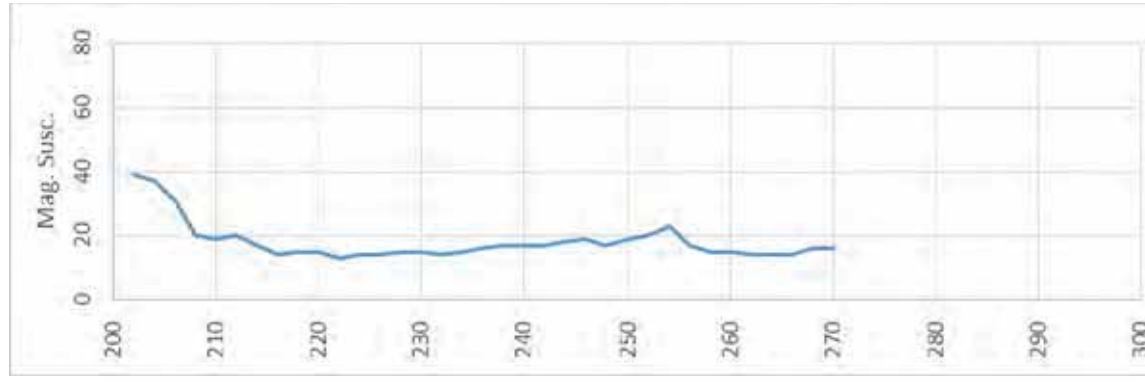
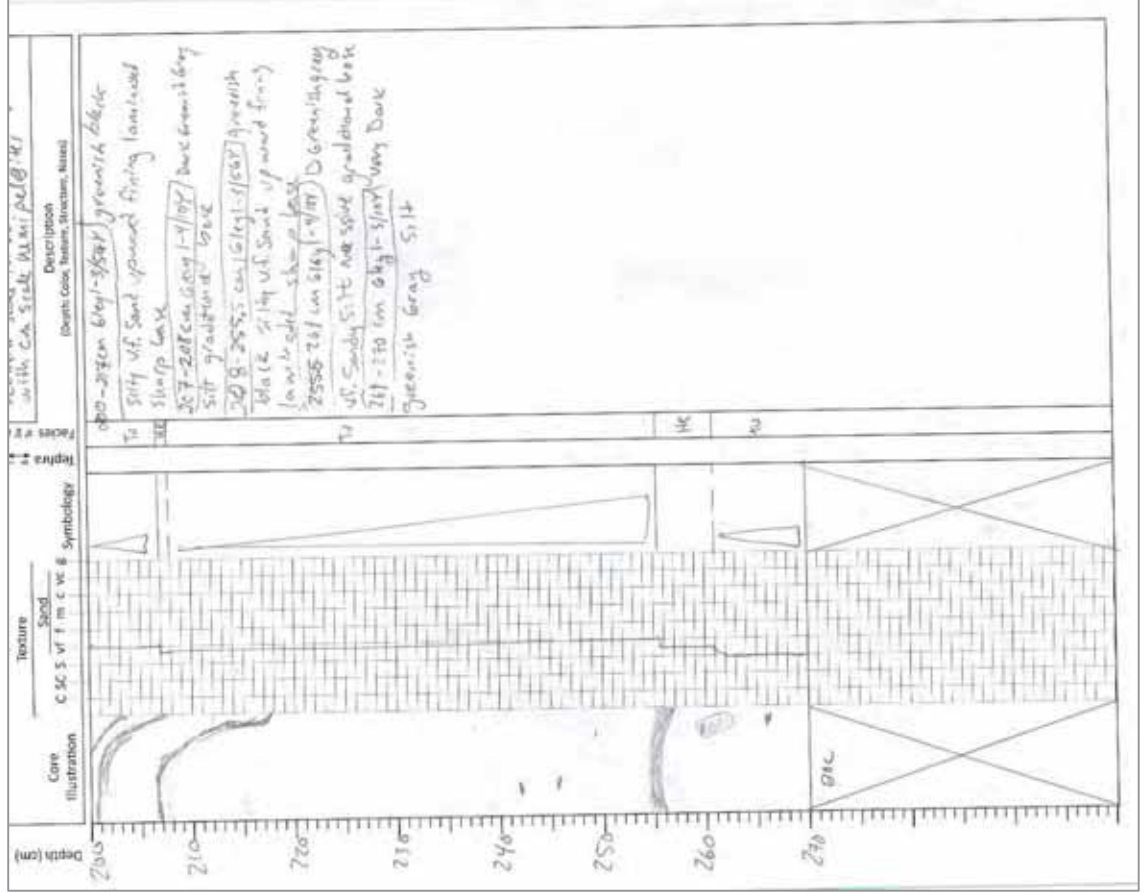


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Hik 18

Other ID TAN1613-47

Section 3 of 4

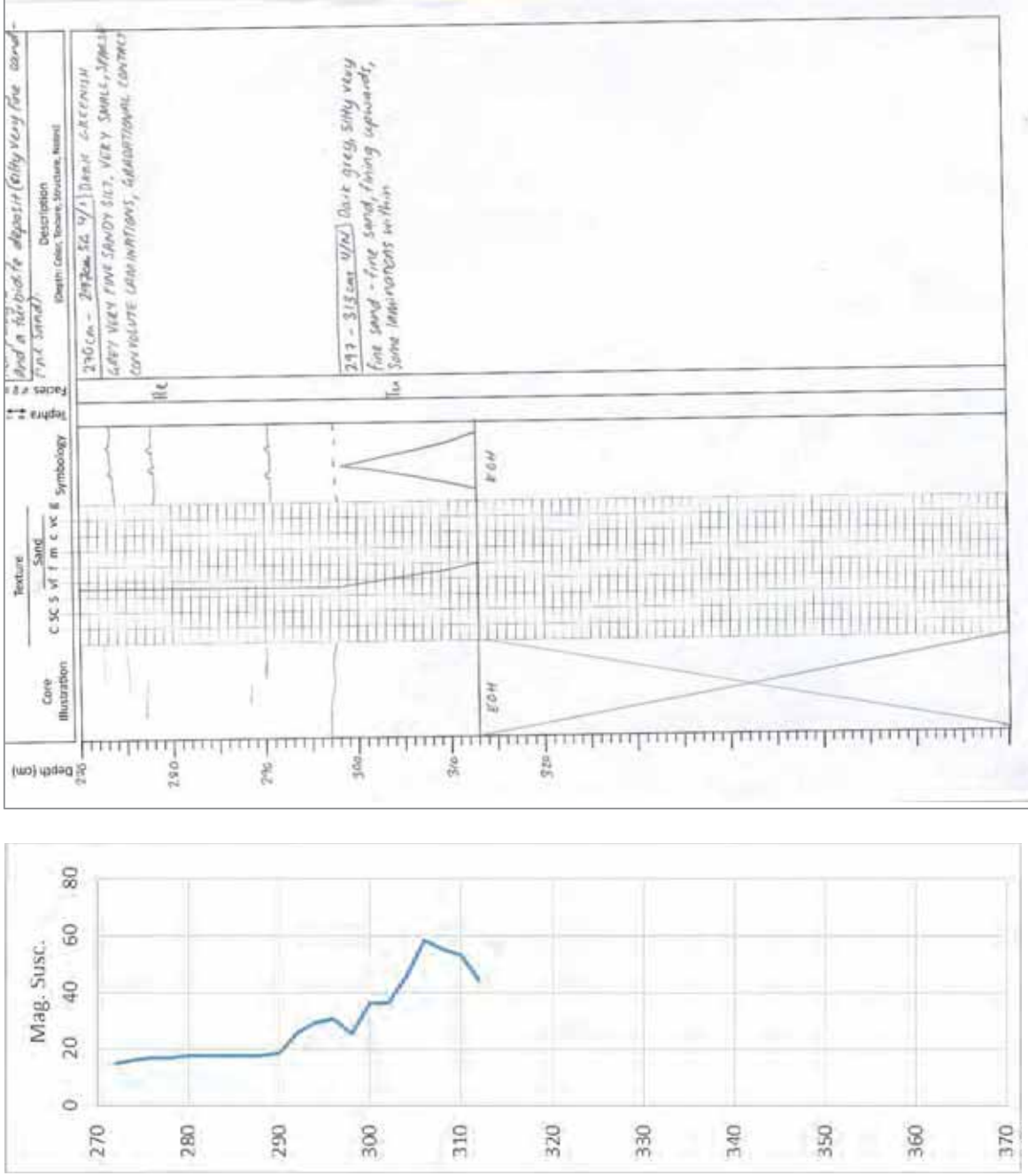


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Hik 18

Other ID TAN1613-47

Section 4 of 4



TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: HB 1	Latitude: -40.52598	Date/Time (NZST): 17/11/2016 18:12
Other ID: TAN1613-48	Longitude: 177.83665	Depth (m): 2267

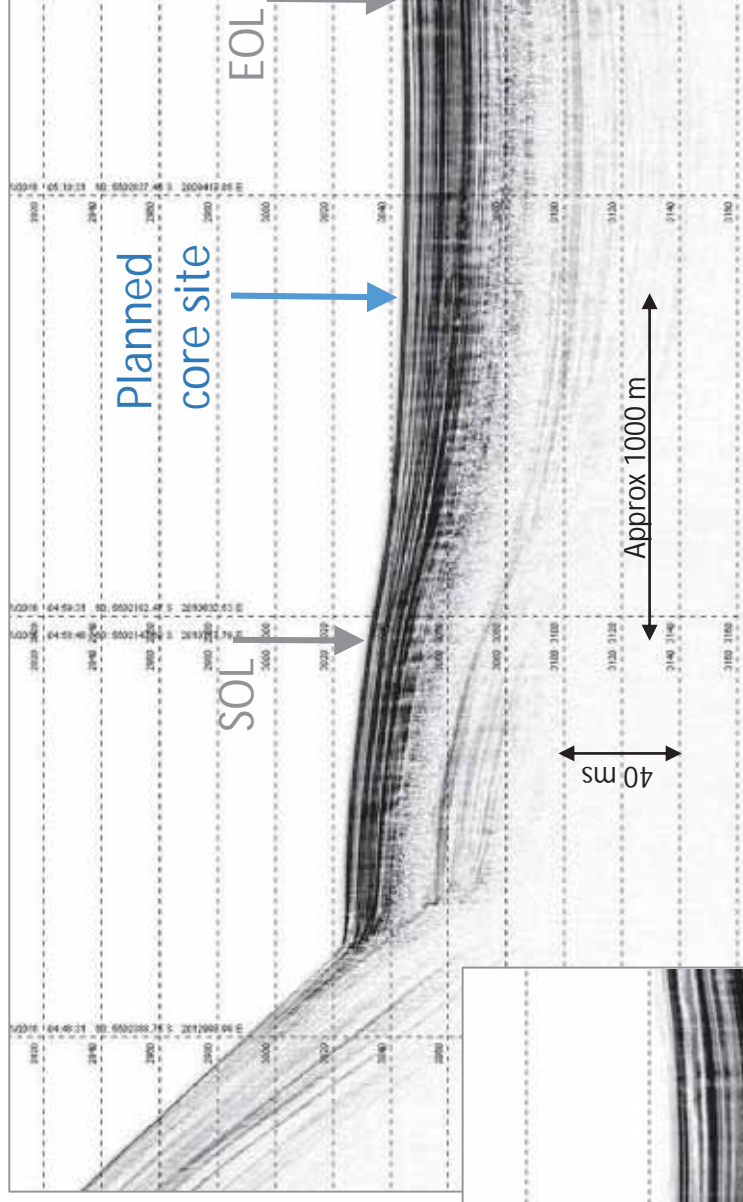
Sample Description	Gear type	Piston core
General Description Un-named basin inside NW Akitio Trough very fine sandy silty hemipelagites interbedded with silty and fine to very fine sandy turbidites reworked tephra turbidite 52.5-62.5 cm	Barrel Length (m)	6 Bent barrel
	Penetration (m)	Catcher/Cutter bags
	Core length (m)	5 Samples
	Sections	5 Tephra
	Fauna	.

Sample processing – core ID:

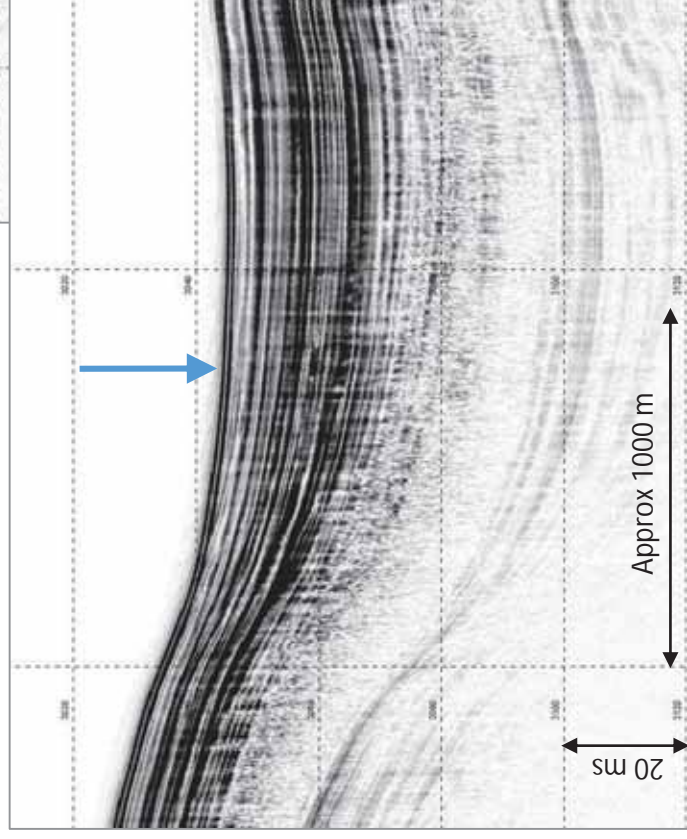
Section	Top depth (cm)	Btm depth (cm)	Logged	Phys Props	Summary
1	0	100	Y	Y	.
2	100	200	Y	Y	.
3	200	300	Y	Y	.
4	300	400	Y	Y	.
5	400	500	Y	Y	.
.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: HB 1	Other ID TAN1613-48	Water Depth 2267 m
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2km Topas line over the planned core station. Grey arrows indicate start and end of the 2km survey line over the station. Blue arrow marks the planned core site.



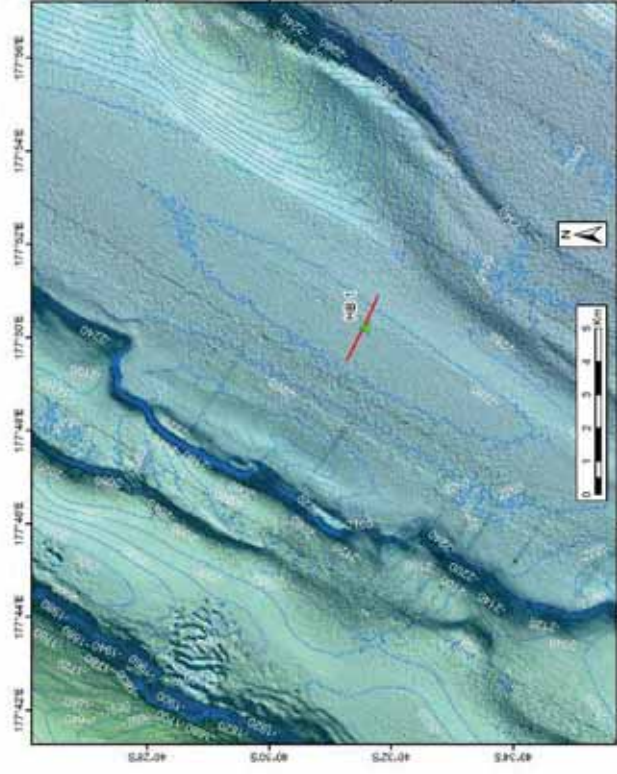
Vertical exaggerated survey line over planned core site.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

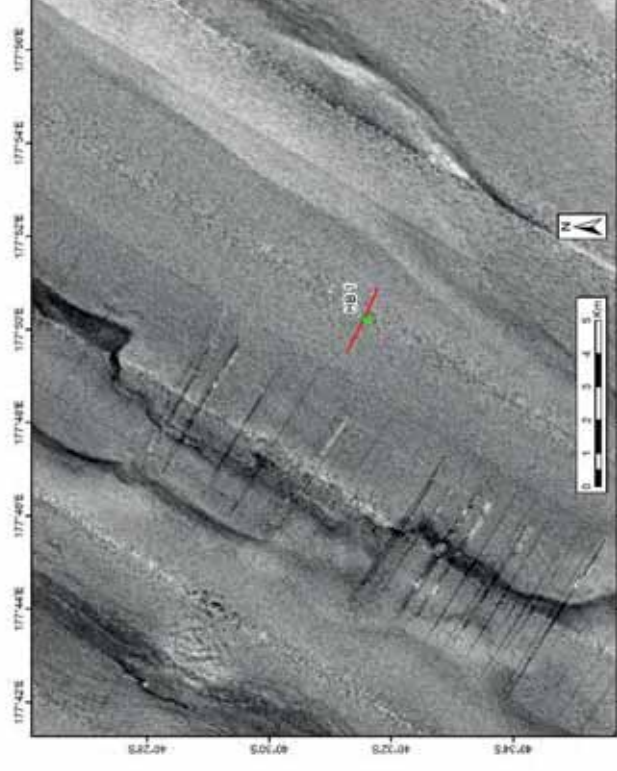
Core ID: HB 1

Other ID TAN1613-48

Water Depth 2267 m



Bathymetry at and around HB1 core site in an un-named basin inside NW Akitio Trough. Light blue lines are 20 m depth contours. Red lines show the 2 km TOPAS survey line over the station, green triangles indicate the actual core site.



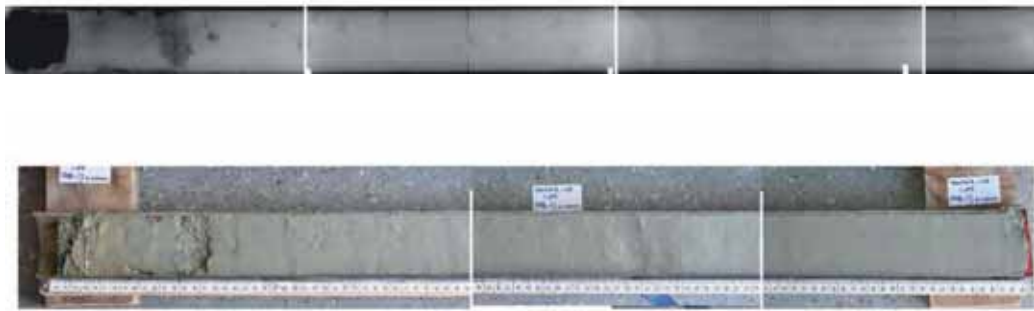
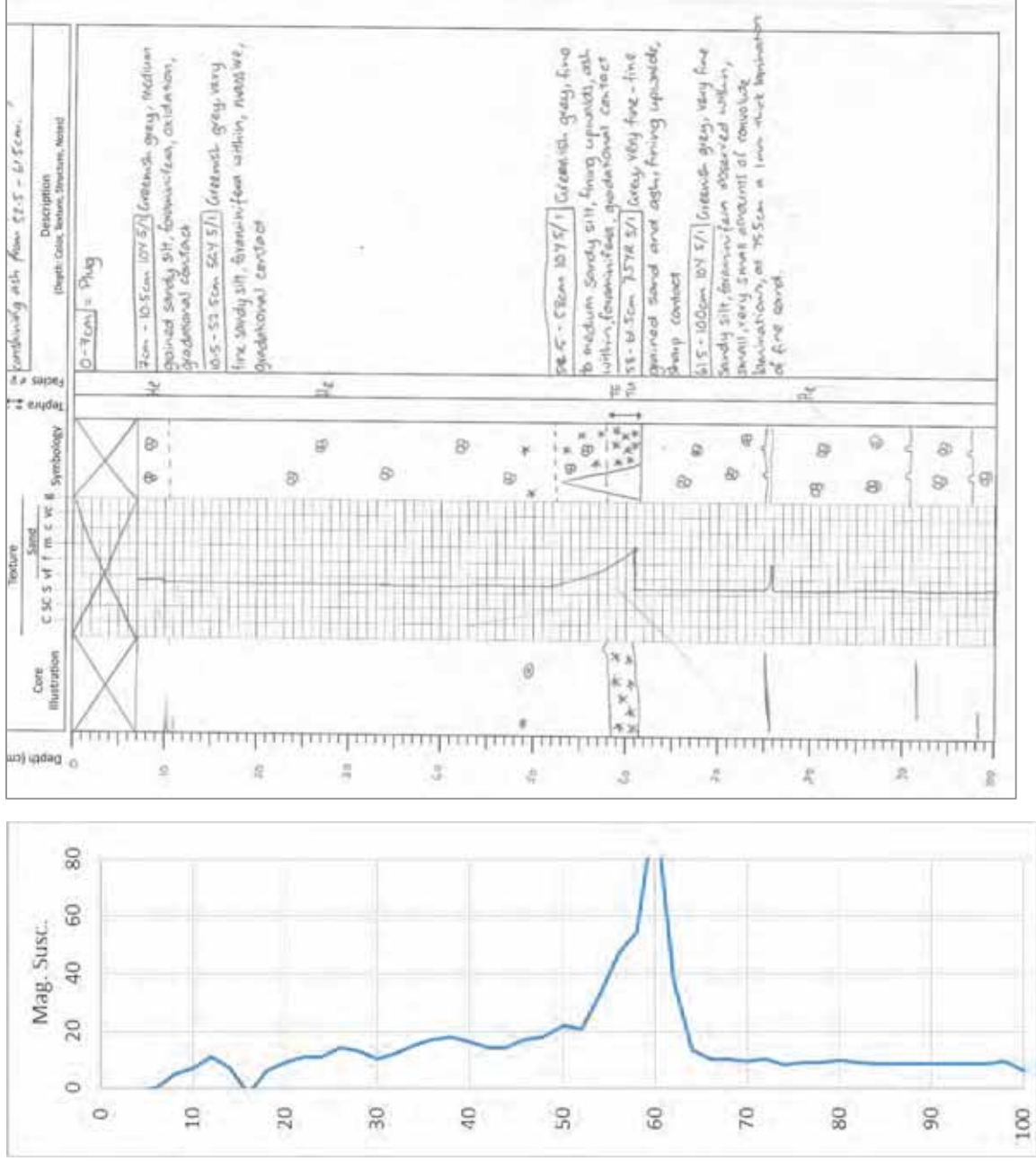
Backscatter at and around HB1 core site in an un-named basin inside NW Akitio Trough. Red lines show the 2 km TOPAS survey line over the station, green triangles indicate the actual core site.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: HB 1

Other ID TAN1613-48

Section 1 of 5

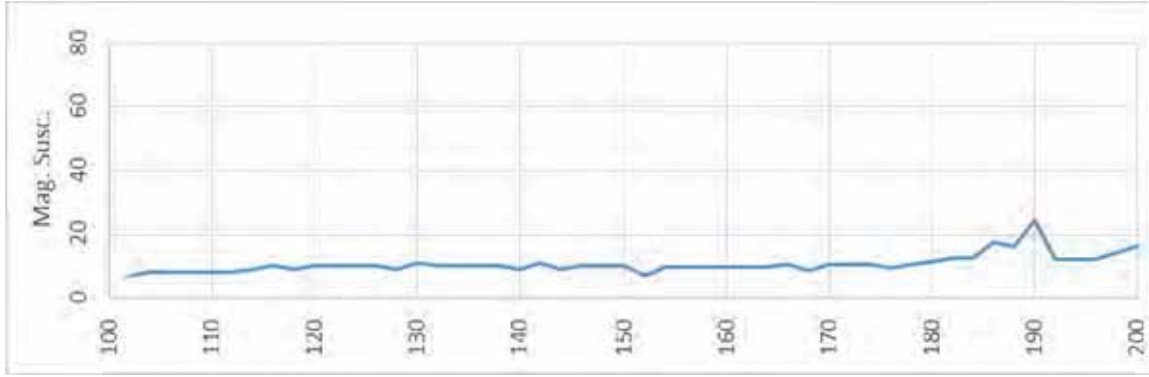
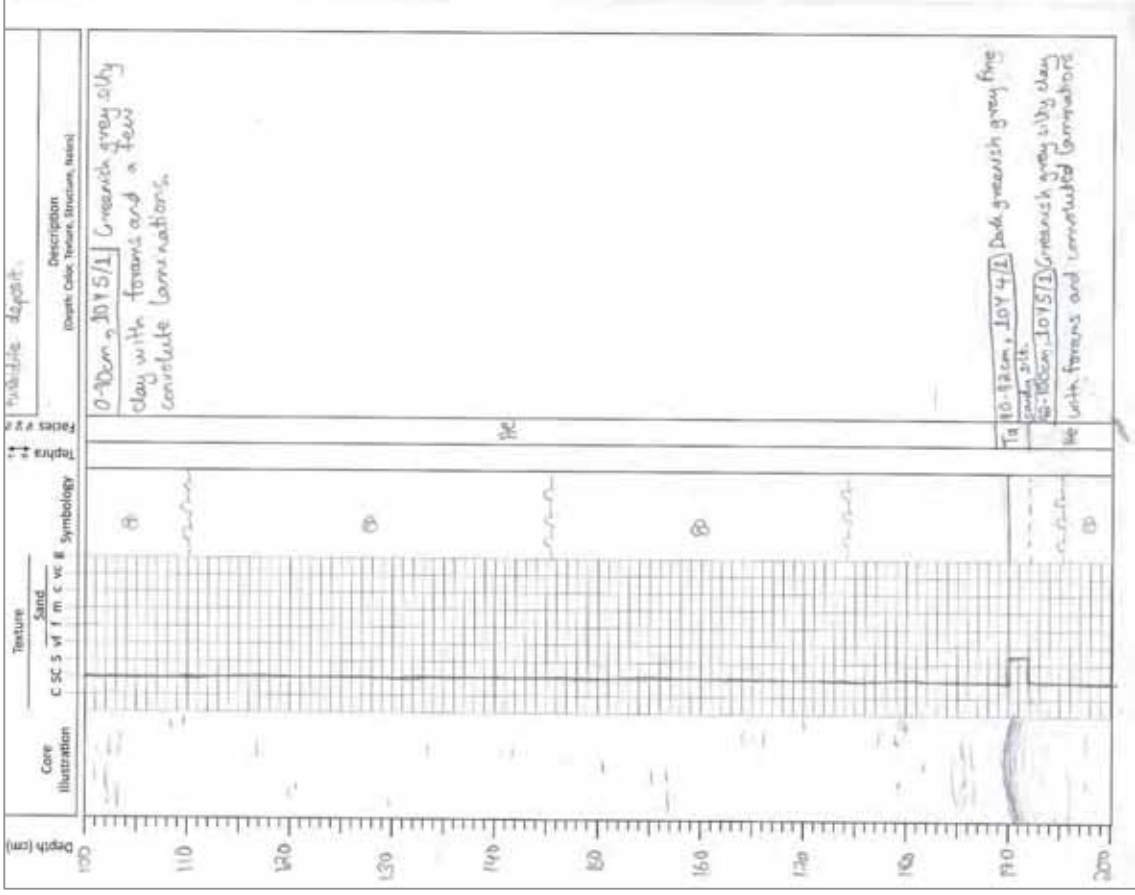


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: HB 1

Other ID TAN1613-48

Section 2 of 5

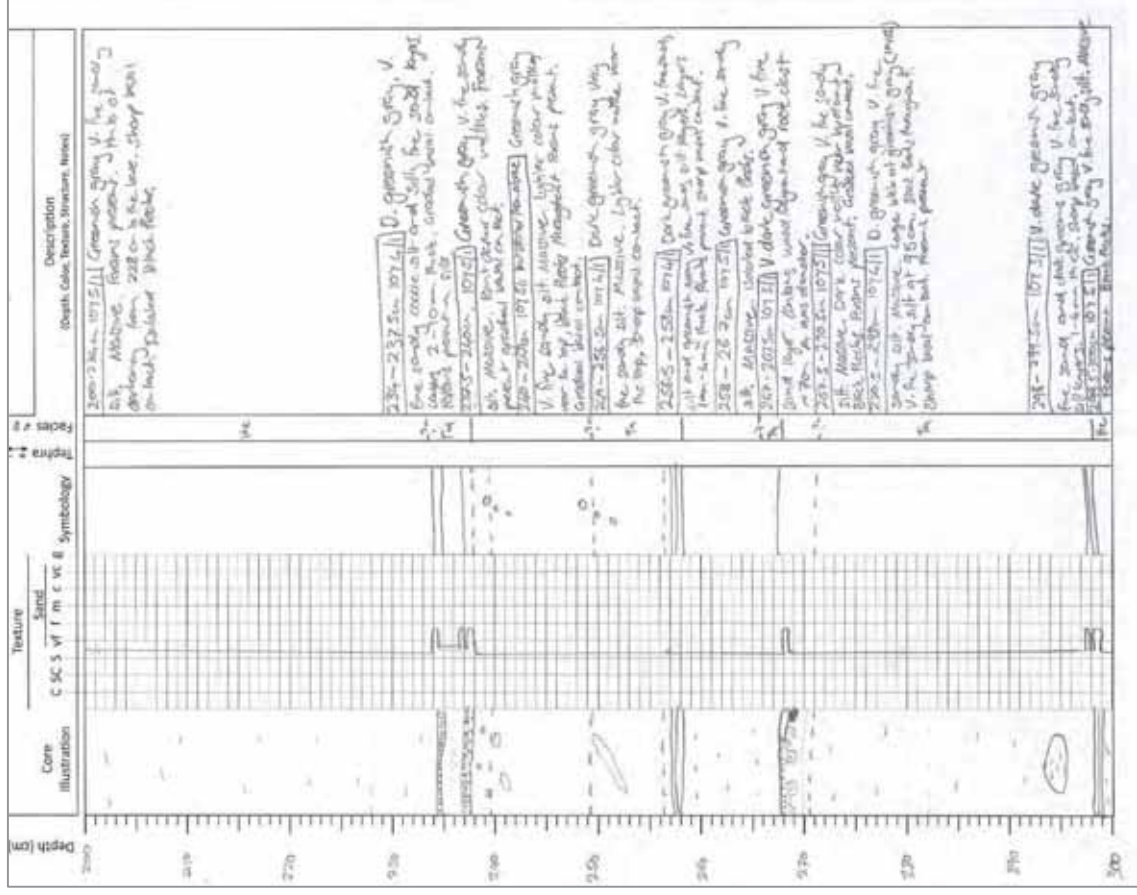
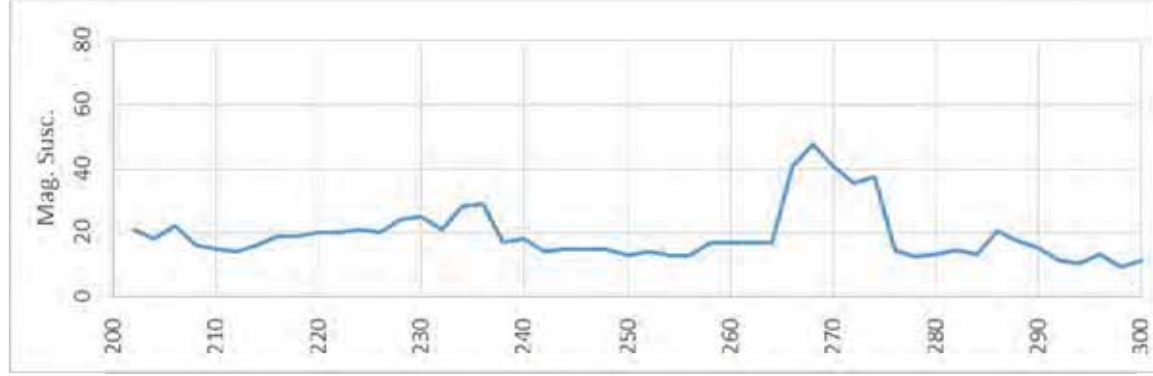


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: HB 1

Other ID TAN1613-48

Section 3 of 5

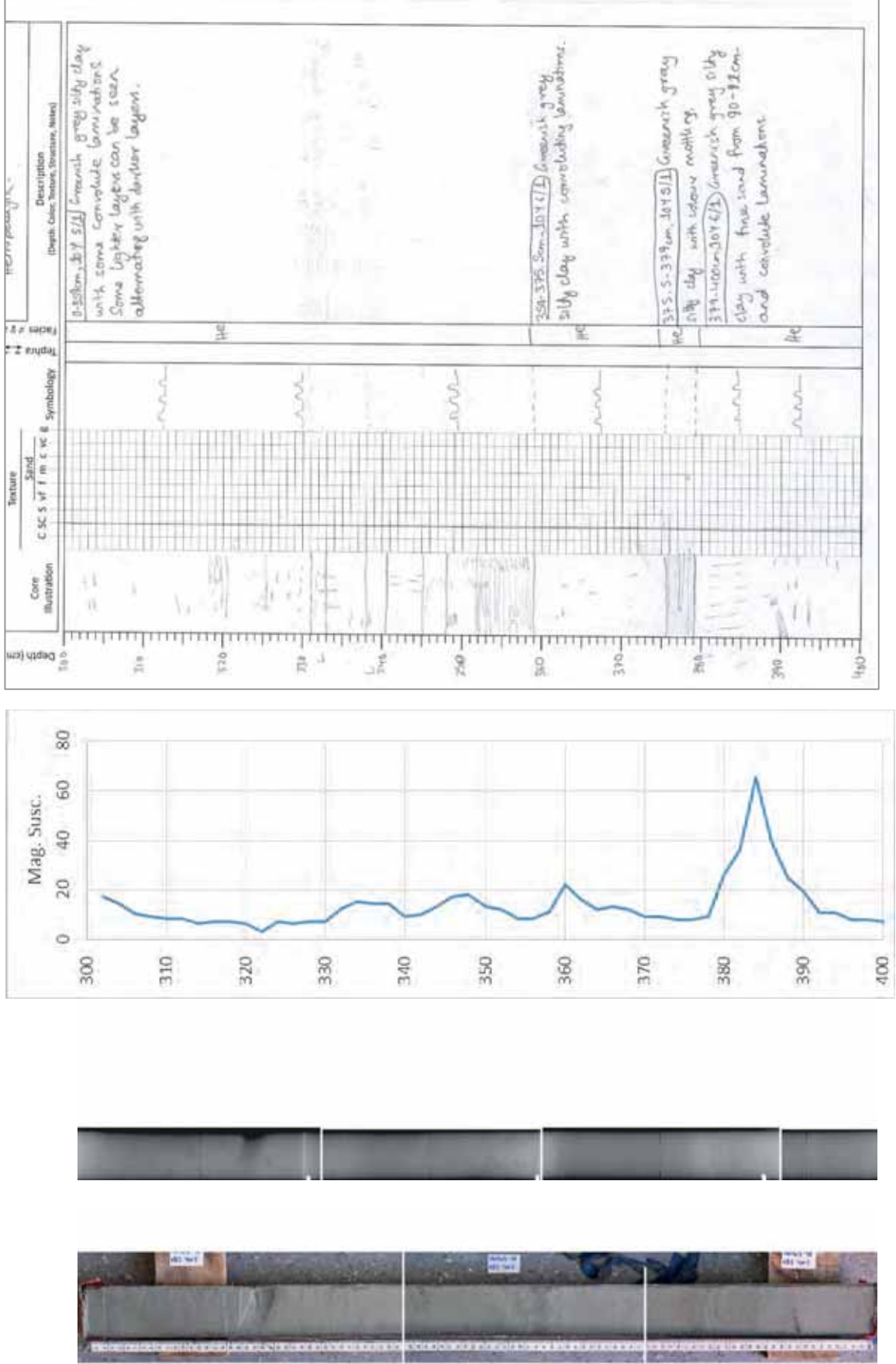


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: HB 1

Other ID TAN1613-48

Section 4 of 5

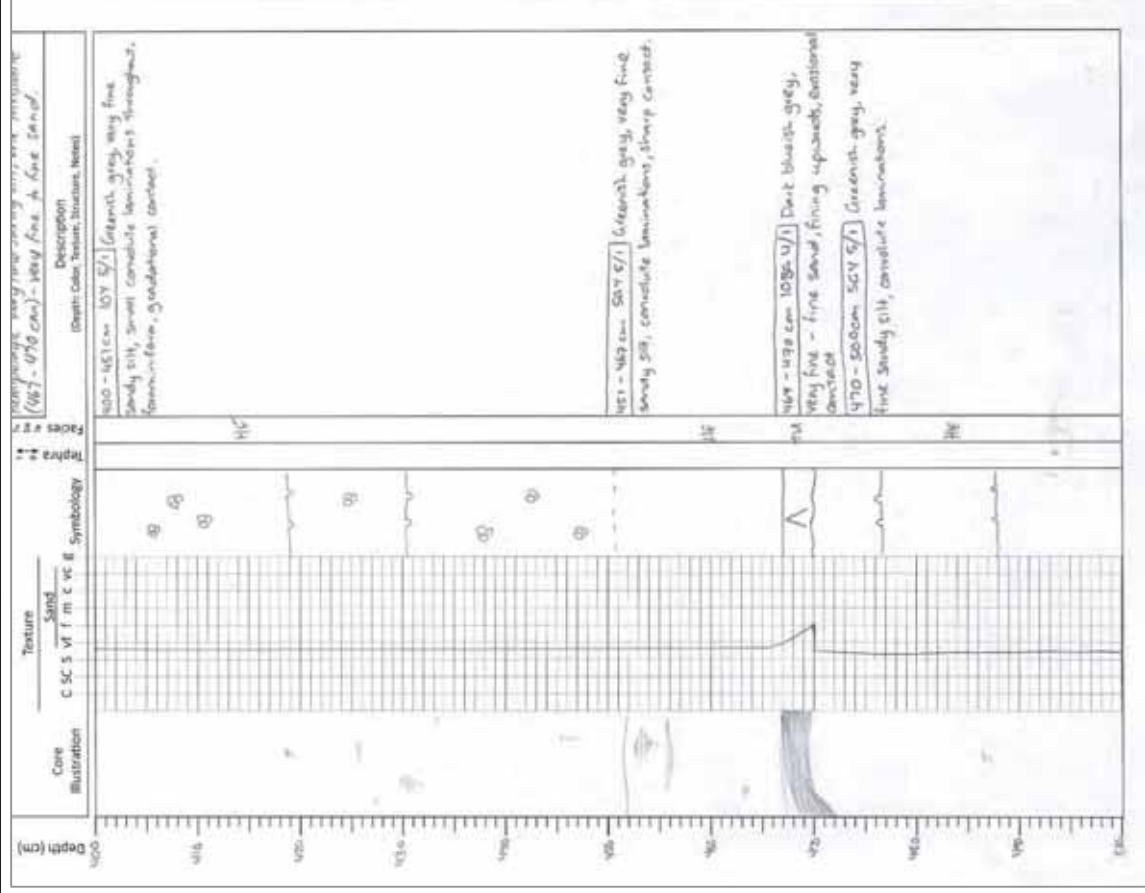
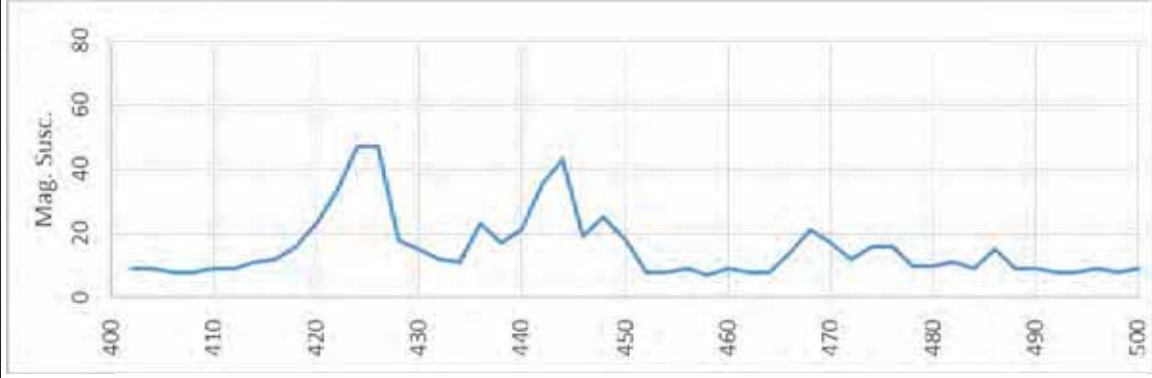
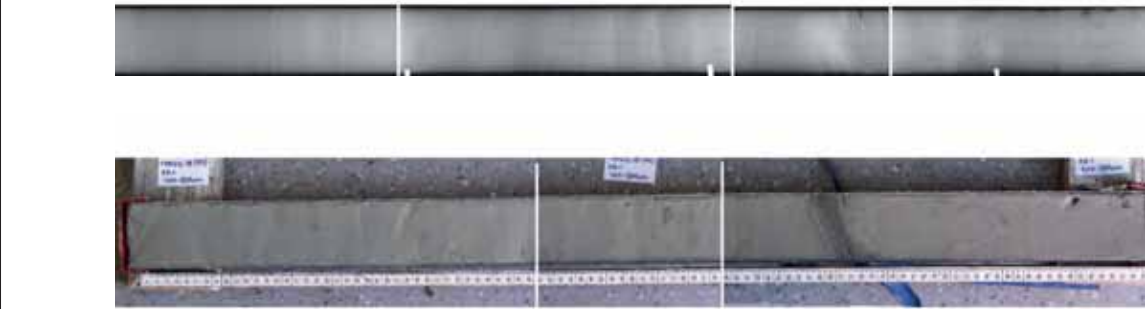


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: HB 1

Other ID TAN1613-48

Section 5 of 5



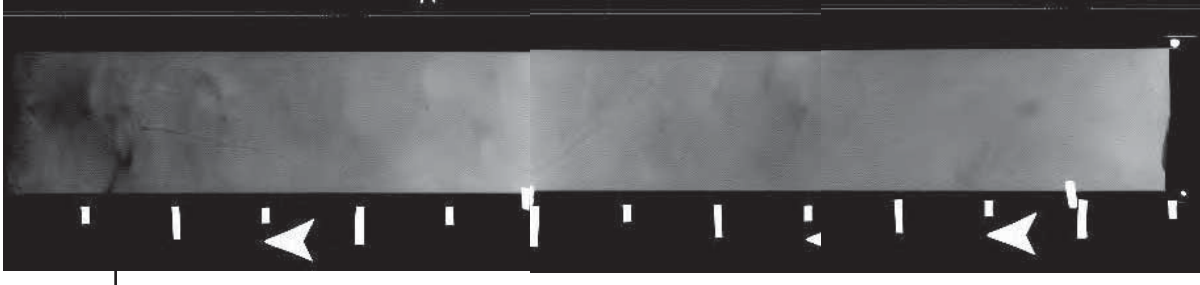
TAN1613 – Paleoseismicity of the Southern Hikurangi Margin - Multicore data sheet

Core ID: **HB 4**
Other ID: **TAN1613-49**

Latitude: **-40.24415**
Longitude: **177.55075**

Date/Time (NZST): **17/11/2016 22:32**
Depth (m): **1907**

Length (cm) **65 cm**



Sample Description

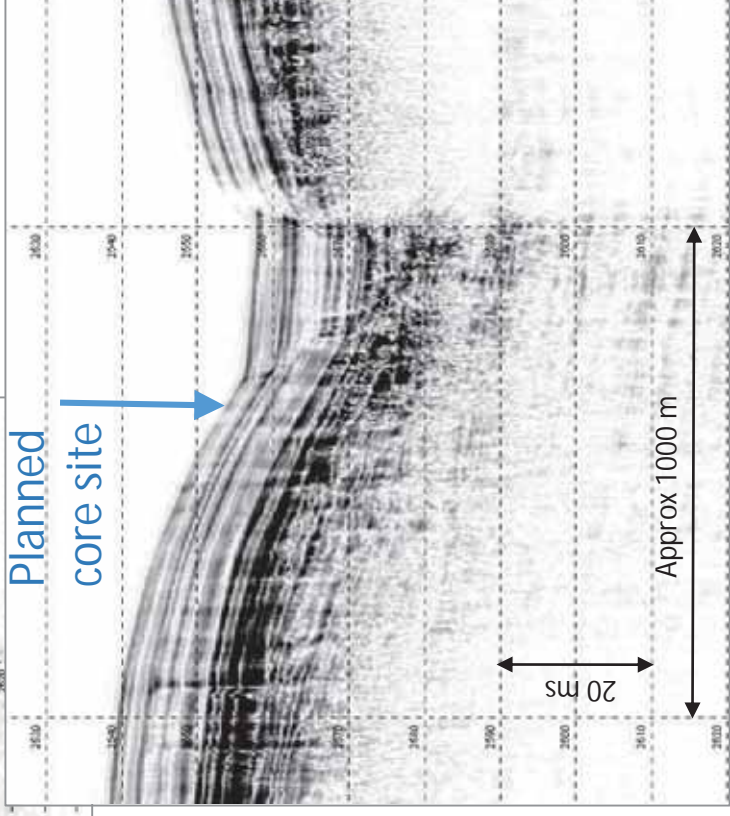
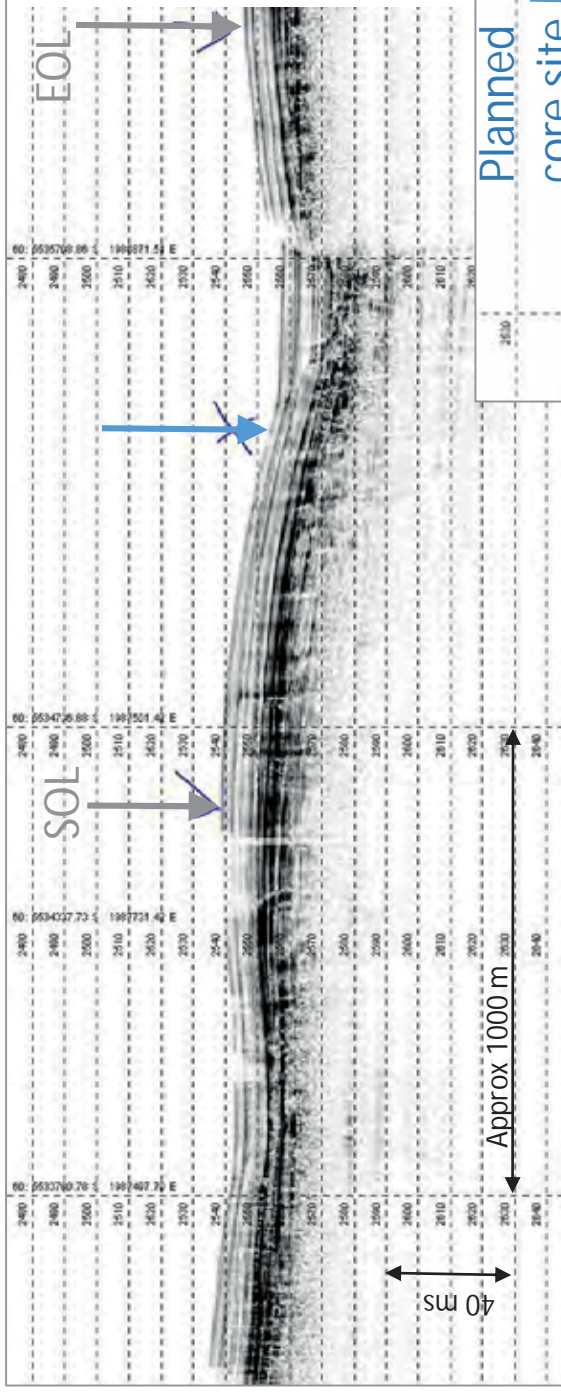
General Description

Inner Paoanui Basin

Brown oxidised layer (7cm) overlying hemipelagite interbedded with dm scale turbidite

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: HB 4	Other ID TAN1613-49	Water Depth 1907 m
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Topas line including short transit to the station. Grey arrows indicate start and end of the 2km survey line over the station, the blue arrow marks the planned core site.

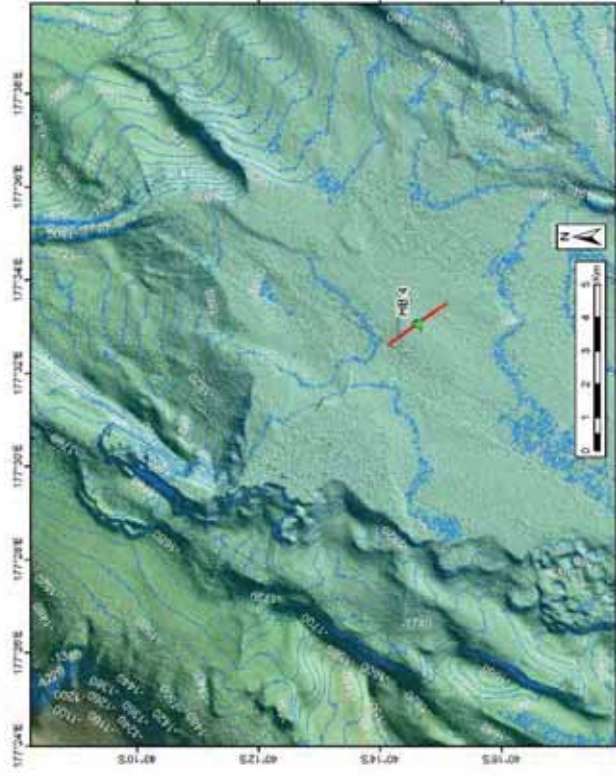
Zoom into 2km survey lines over planned core site.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: HB 4

Other ID TAN1613-49

Water Depth 1907 m



Bathymetry at and around HB4 core site at the inner Paoanui Basin. Light blue lines are 20 m depth contours. Red lines show the 2 km TOPAS survey line over the station, green triangles indicate the actual core site.



Backscatter at and around HB4 core site at the inner Paoanui Basin. Red lines show the 2 km TOPAS survey line over the station, green triangles indicate the actual core site.

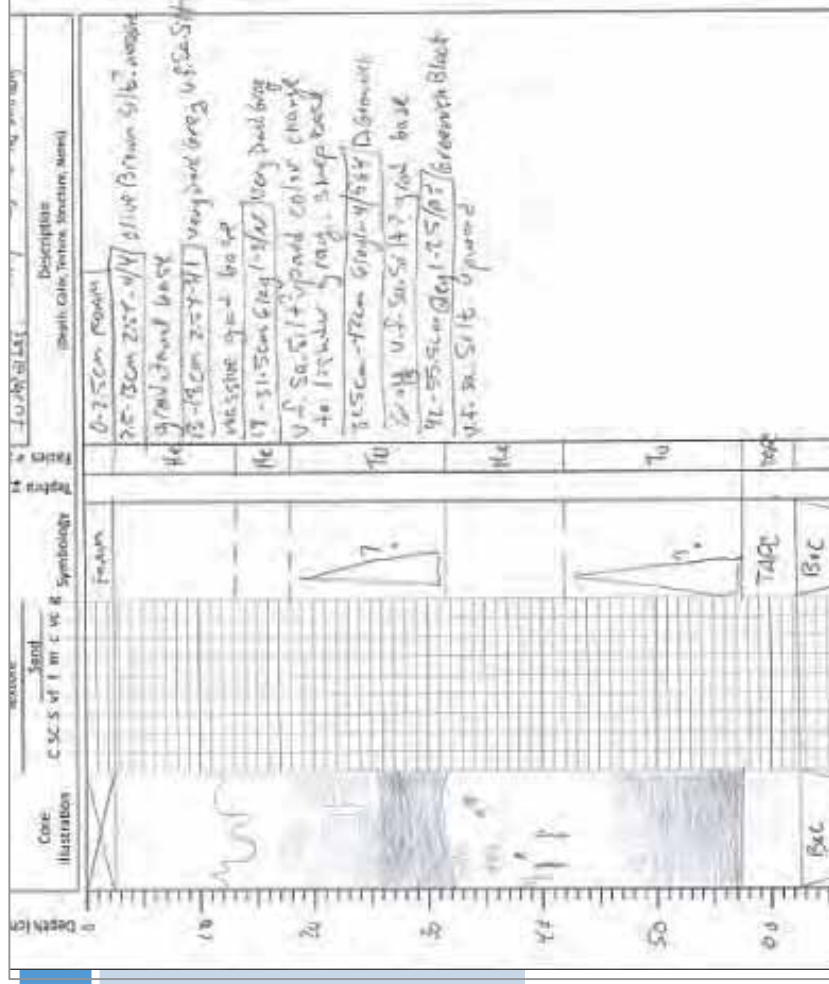
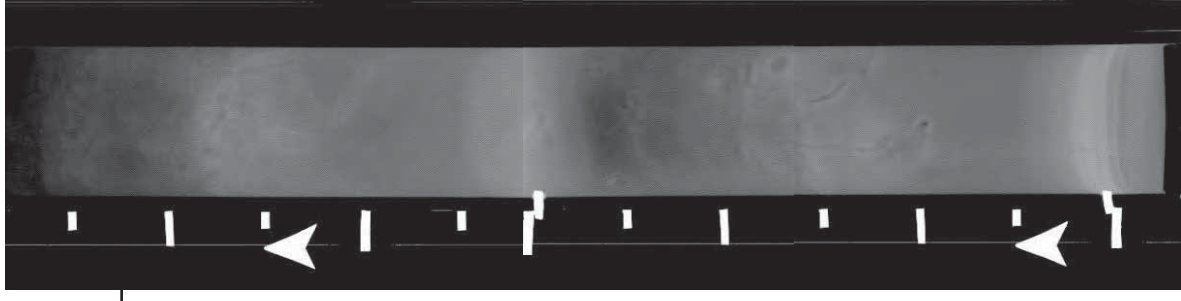
TAN1613 – Paleoseismicity of the Southern Hikurangi Margin - Multicore data sheet

Core ID: **Hik 9**
 Other ID: **TAN1613-50**

Latitude: **-41.68672**
 Longitude: **176.98278**

Date/Time (NZST): **18/11/2016 20:47**
 Depth (m): **2864**

Length (cm): **62.5 cm**



Sample Description

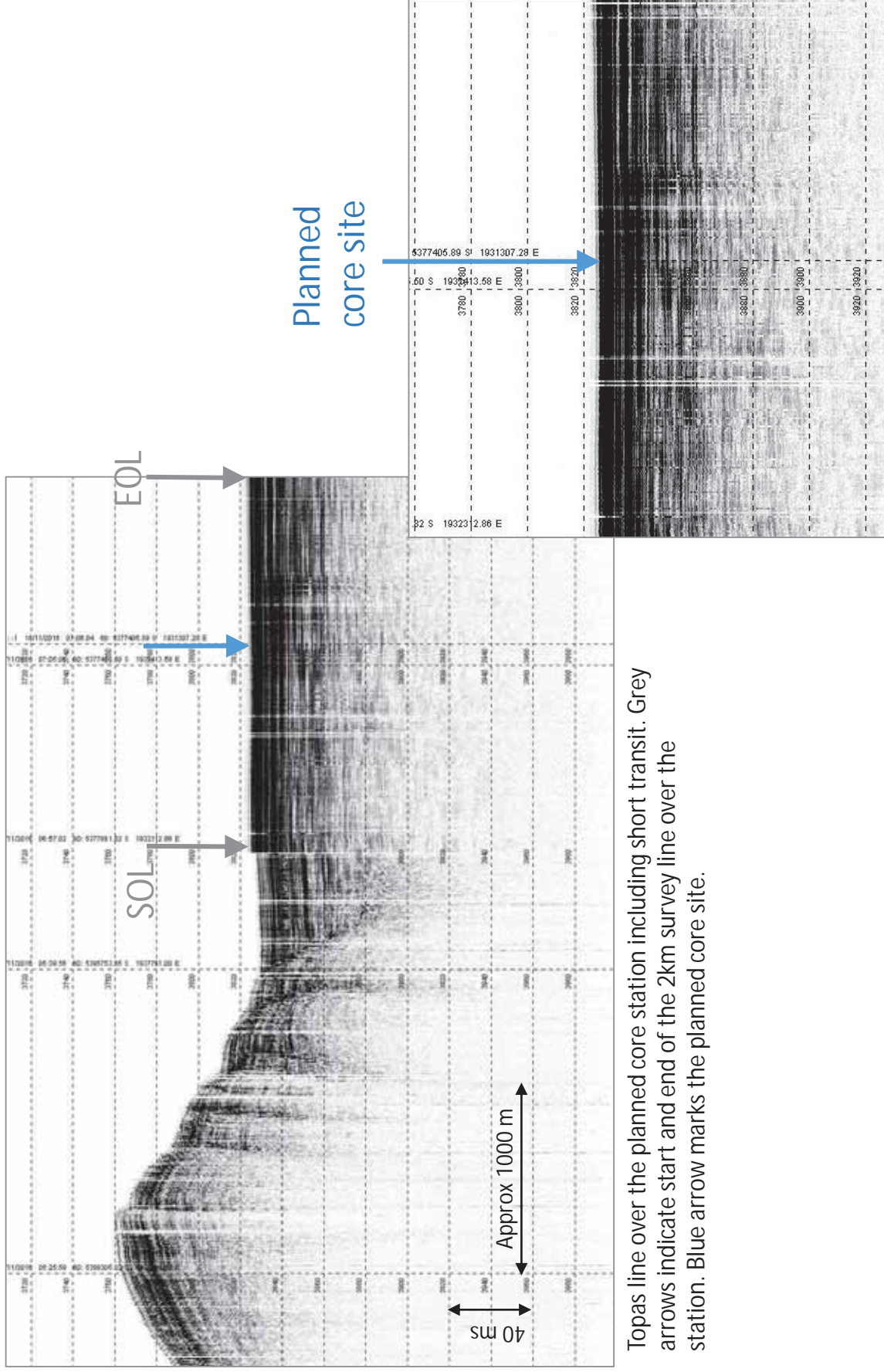
General Description

Hikurangi basin floor east of southern Aorangi Ridge

Oxydized surface layer overlying interbedded hemipelagites and muddy turbidites

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Hik 9	Other ID TAN1613-50 & 51	Water Depth 2864 m & 2848 m
----------------	--------------------------	-----------------------------

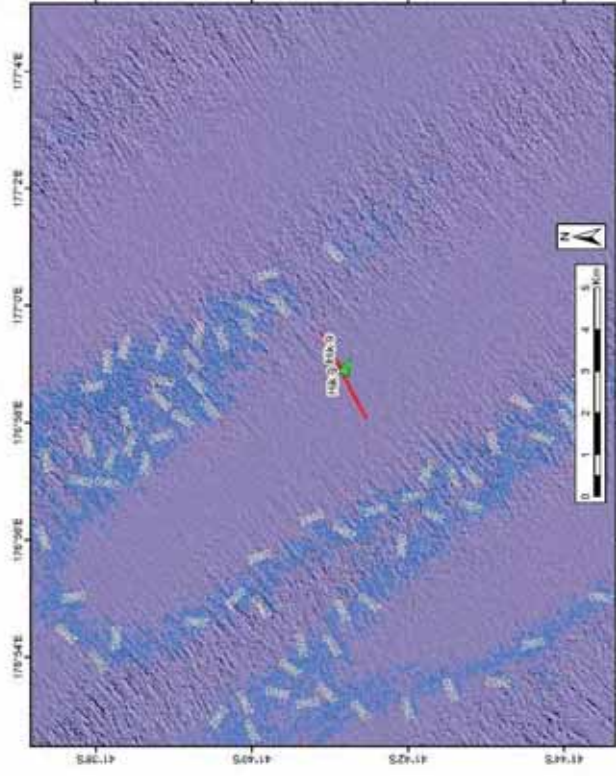


Topas line over the planned core station including short transit. Grey arrows indicate start and end of the 2km survey line over the station. Blue arrow marks the planned core site.

Slightly zoomed in survey line over planned core site.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Hik 9	Other ID TAN1613-50 & 51	Water Depth 2848 m & 2848 m
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Bathymetry at and around Hik9 core site at Hikurangi basin floor, east of southern Aorangi Ridge. Light blue lines are 20 m depth contours. Red lines show the 2 km TOPAS survey line over the station, green triangles indicate the actual core site. Multi-label indicate core repeat and/or multicore.



Backscatter at and around Hik9 core site at Hikurangi basin floor, east of southern Aorangi Ridge. Red lines show the 2 km TOPAS survey line over the station, green triangles indicate the actual core site. Multi-label indicate core repeat and/or multicore.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: **Hik 9** Latitude: -41.68612 Date/Time (NZST): 18/11/2016 23:33

Other ID: TAN1613-51 Longitude: 176.98147 Depth (m): **2848**

Sample Description

General Description

Hikurangi basin floor east of southern Aorangangi Ridge

Interbedded turbidites and hemipelagites

Gear type	Piston core	
Barrel Length (m)	6	Bent barrel
Penetration (m)		Catcher/Cutter bags
Core length (m)	4.37	Samples
Sections	5	Tephra
Fauna		

Sample processing – core ID:

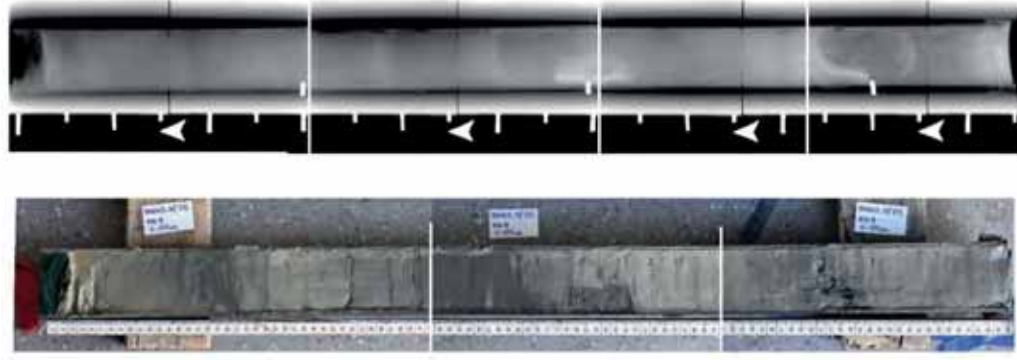
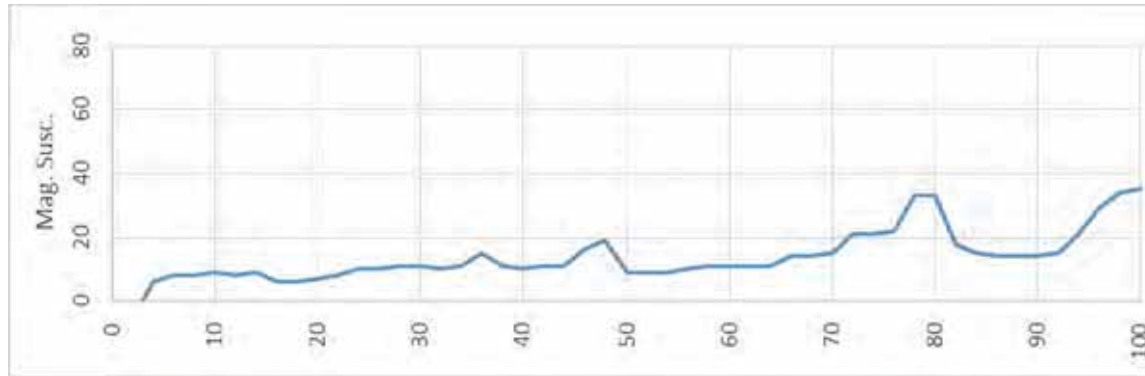
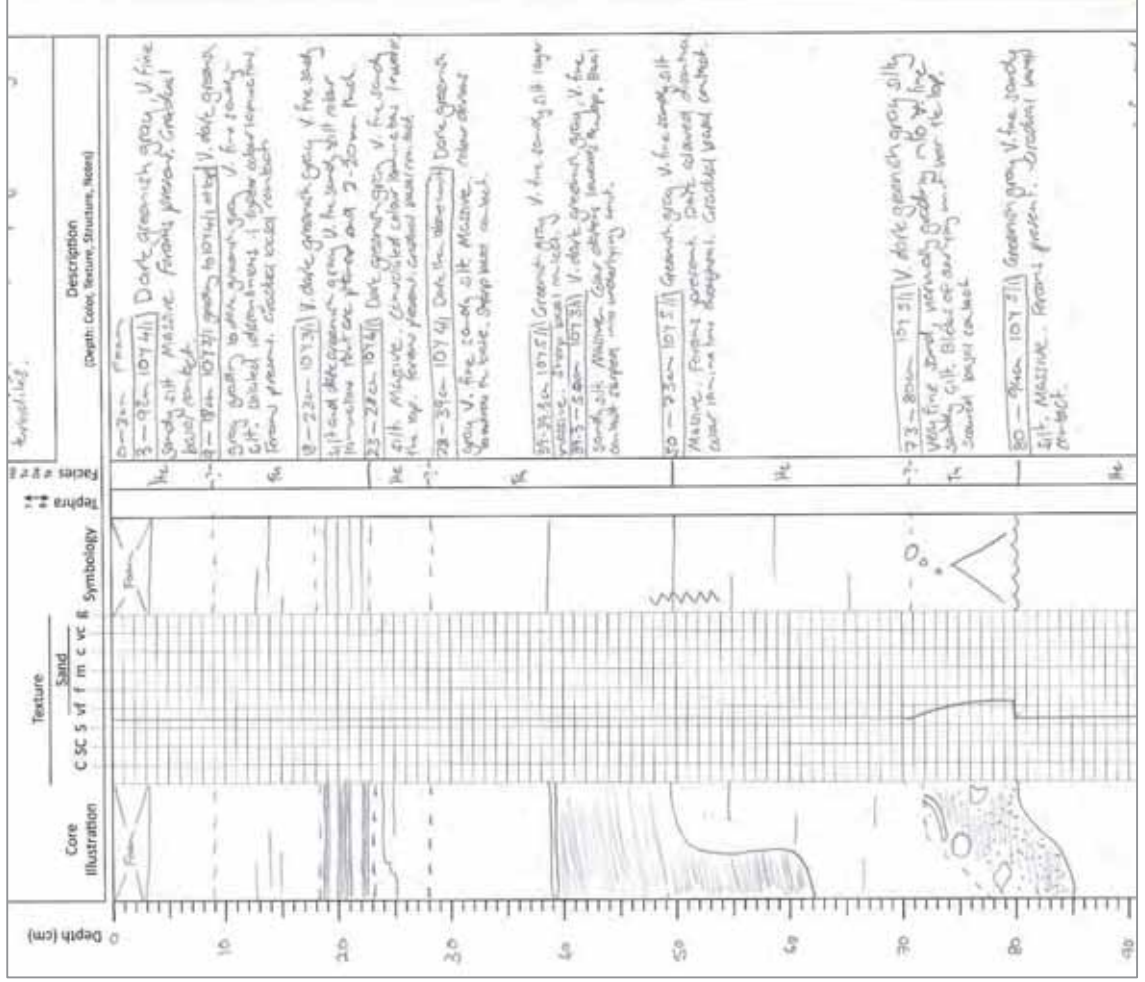
Section	Top depth (cm)	Btm depth (cm)	Logged	Phys Props	Summary
1	0	100	Y	Y	.
2	100	200	Y	Y	.
3	200	300	Y	Y	.
4	300	390	Y	Y	.
5	390	437	Y	Y	.
.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Hik 9

Other ID TAN1613-51

Section 1 of 5

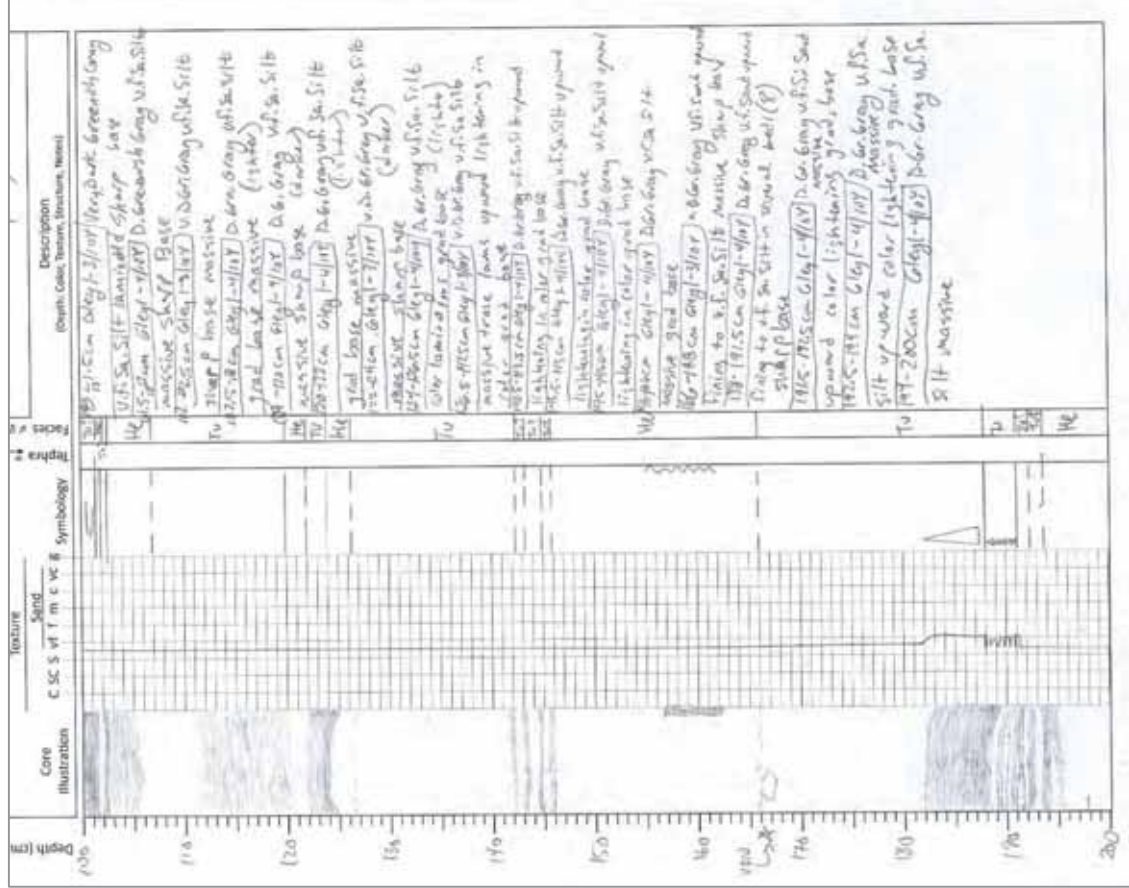
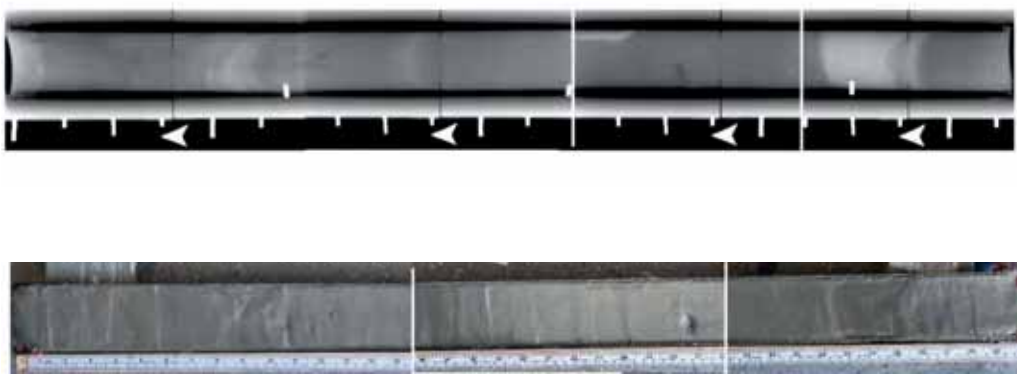
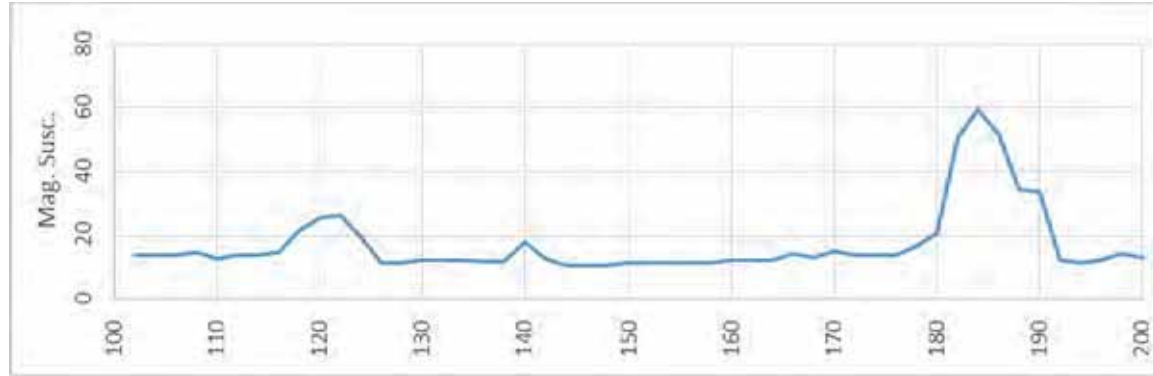


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Hik 9

Other ID TAN1613-51

Section 2 of 5

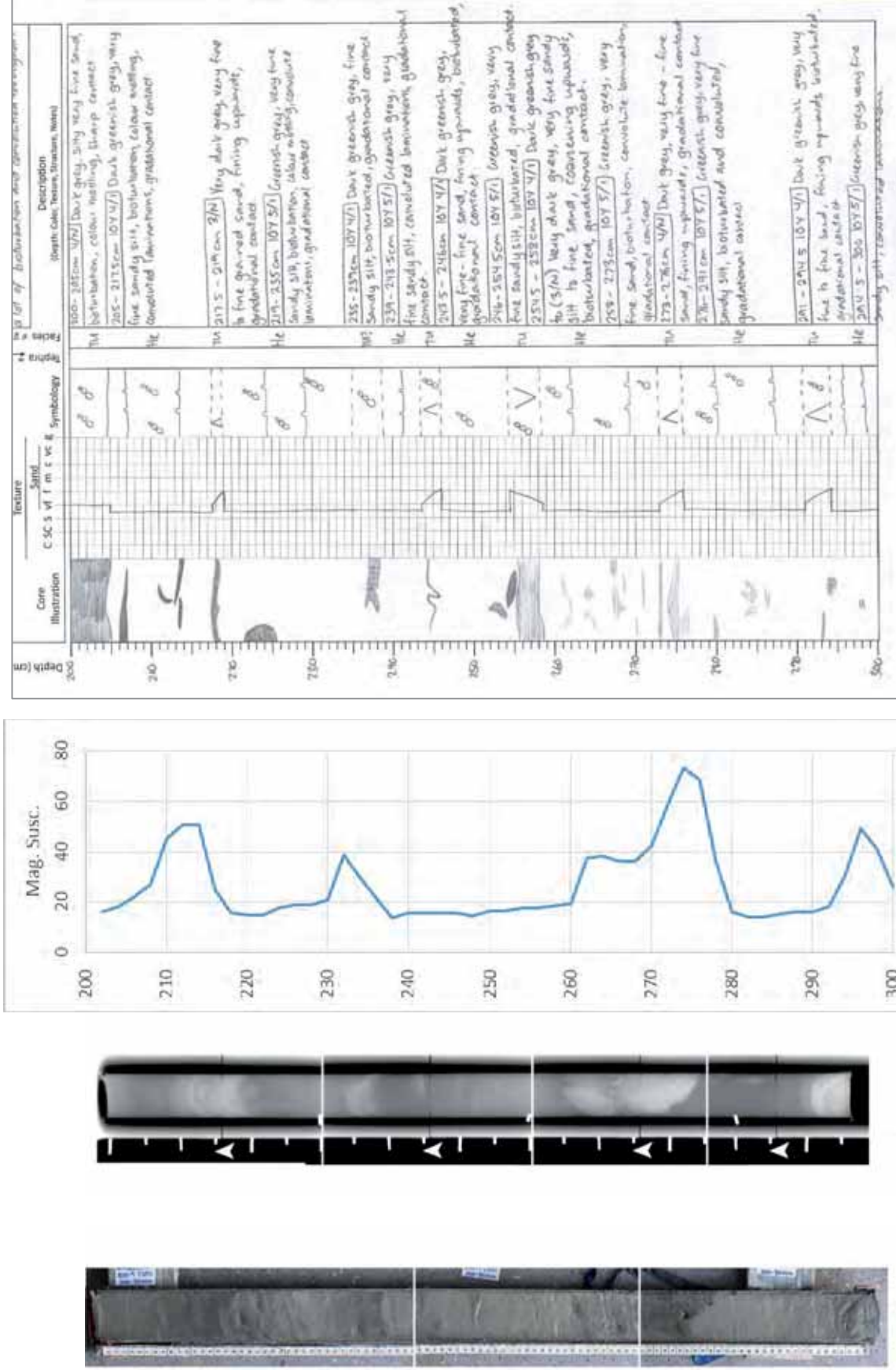


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Hik 9

Other ID TAN1613-51

Section 3 of 5

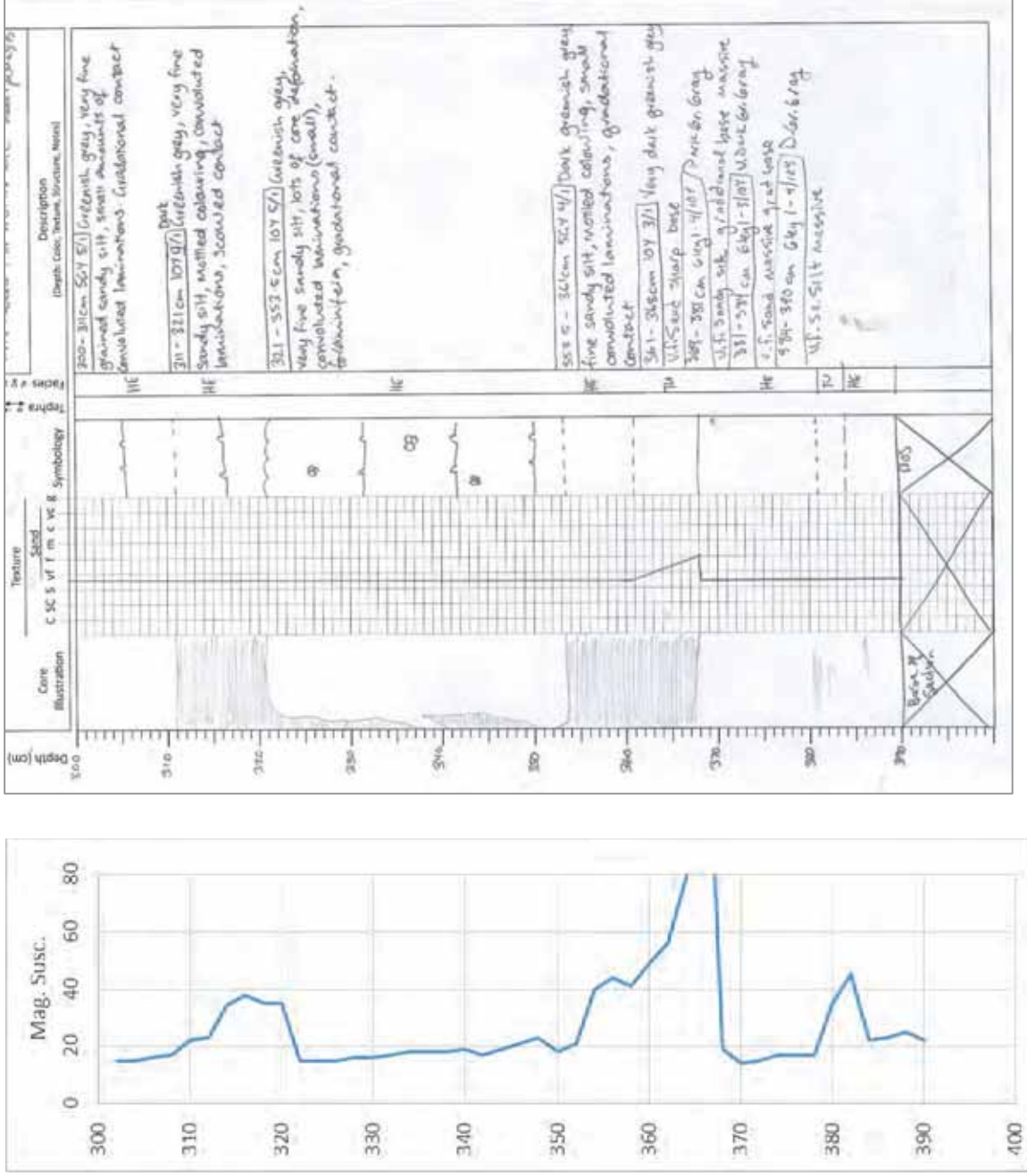


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Hik 9

Other ID TAN1613-51

Section 4 of 5

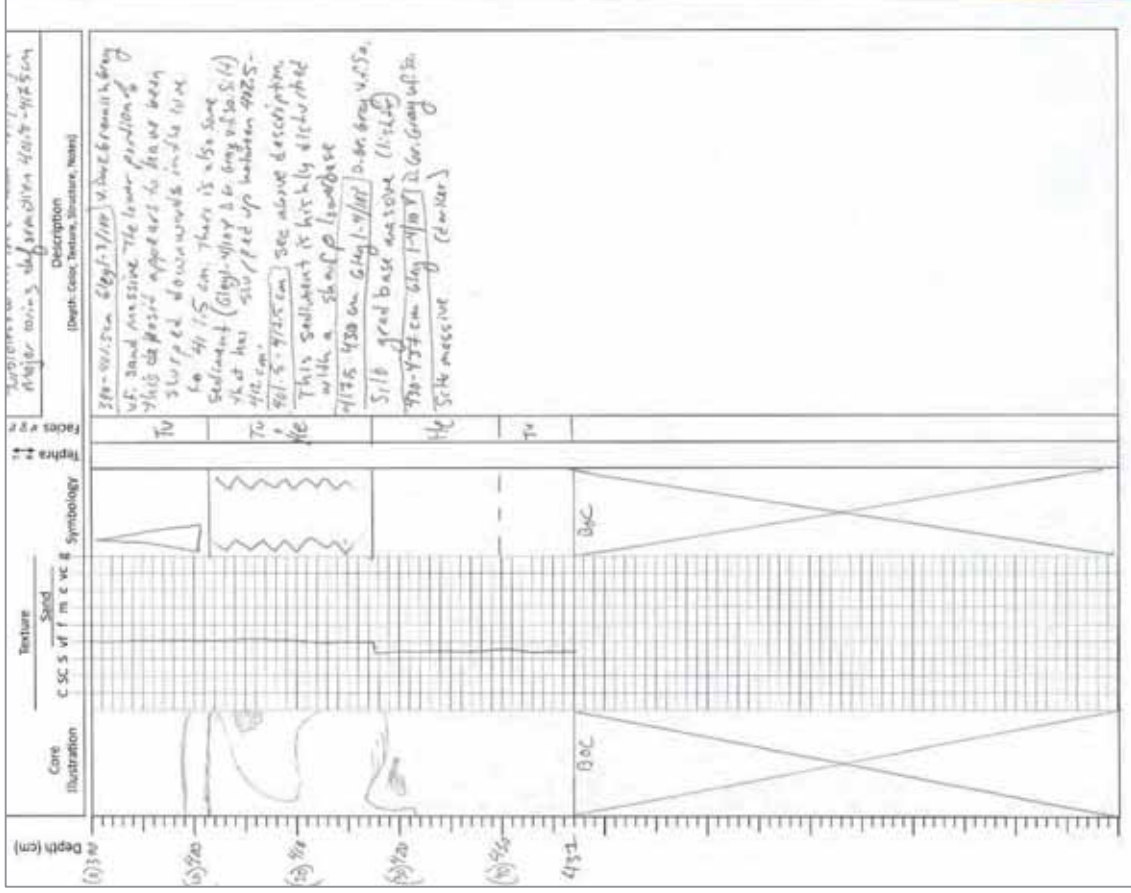
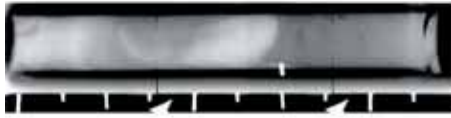
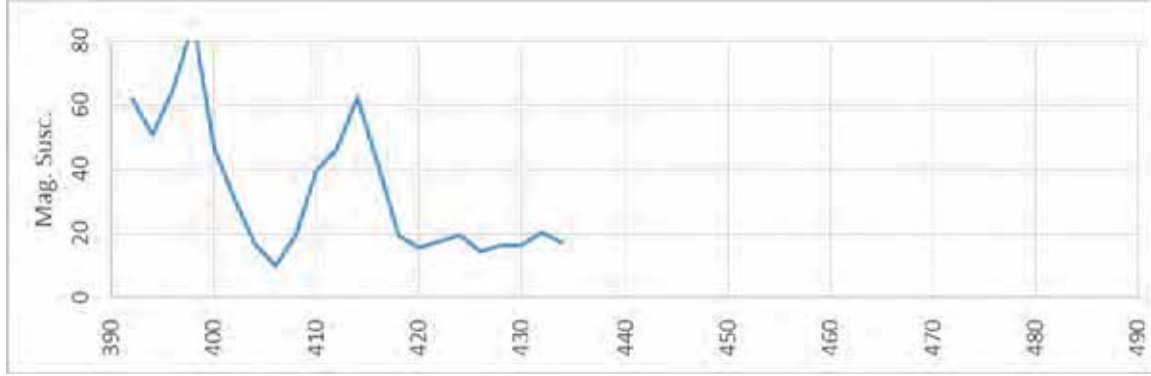


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Hik 9

Other ID TAN1613-51

Section 4 of 5



TAN1613 – Paleoseismicity of the Southern Hikurangi Margin - Multicore data sheet

Core ID: **Hik 20** Latitude: -42.09625 Date/Time (NZST): 19/11/2016 04:49

Other ID: **TAN1613-52** Longitude: 176.80105 Depth (m): **2969**

Length (cm) 64



Sample Description

General Description

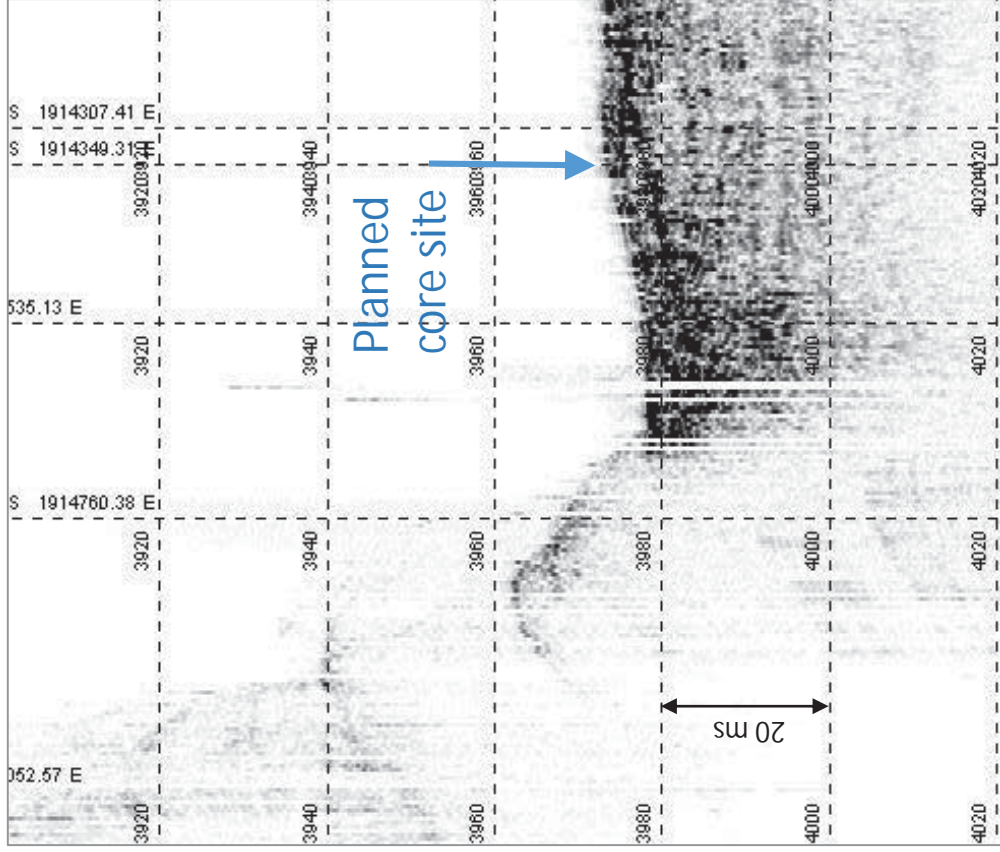
Hikurangi Channel , first major meander loop E of Cook Strait
(site TAN1507-19)

Black very fine to muddy sand upward fining to dark greenish
gray silty very fine to fine sand gradational base

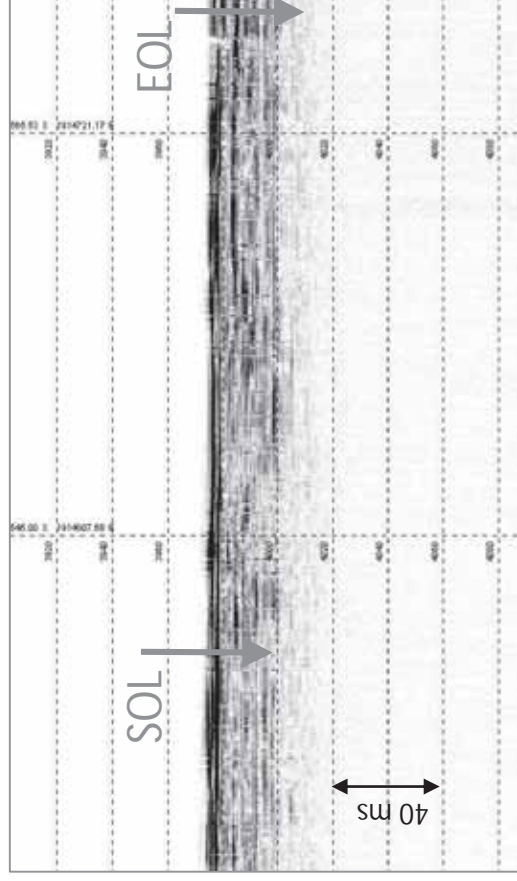
Dark grey silty fine sand massive

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Hik 20	Other ID TAN1613-52	Water Depth 2969 m
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Topas line over the planned core station. The blue arrow marks the planned core site.



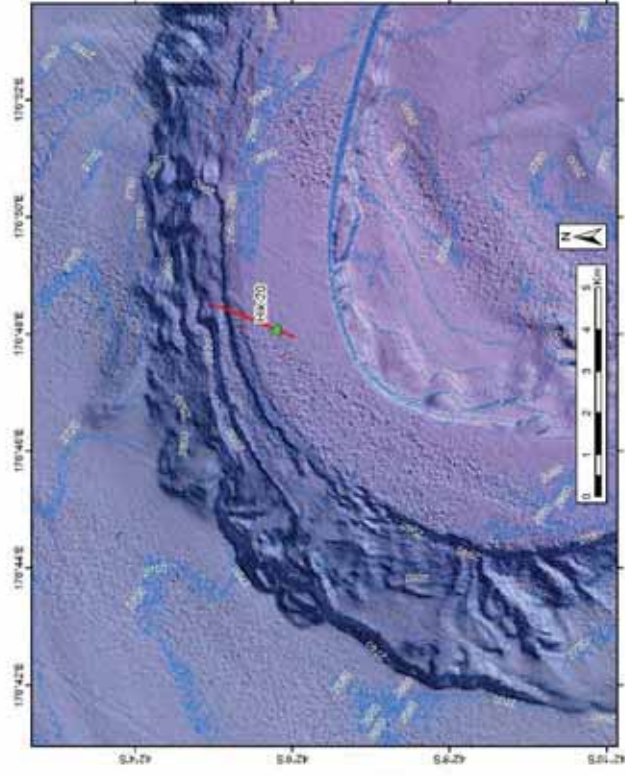
Idle survey while coring at site.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

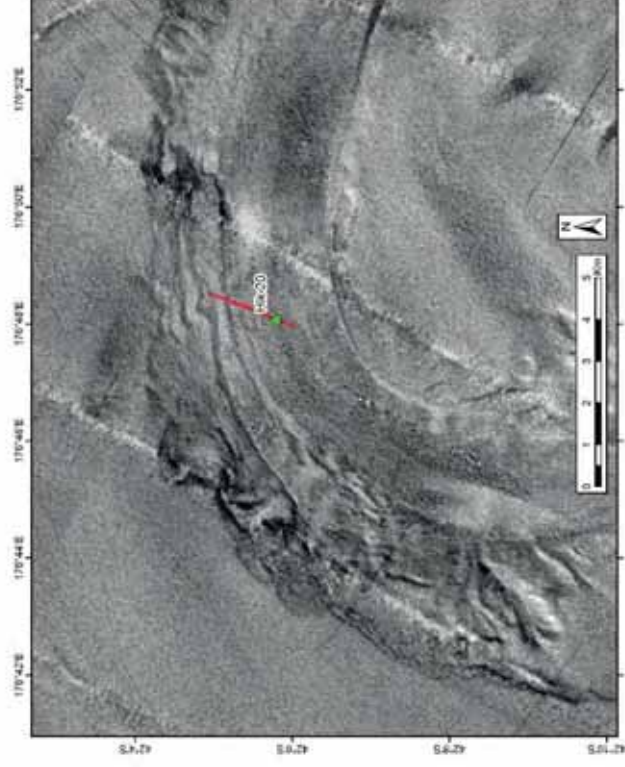
Core ID: Hik 20

Other ID TAN1613-52

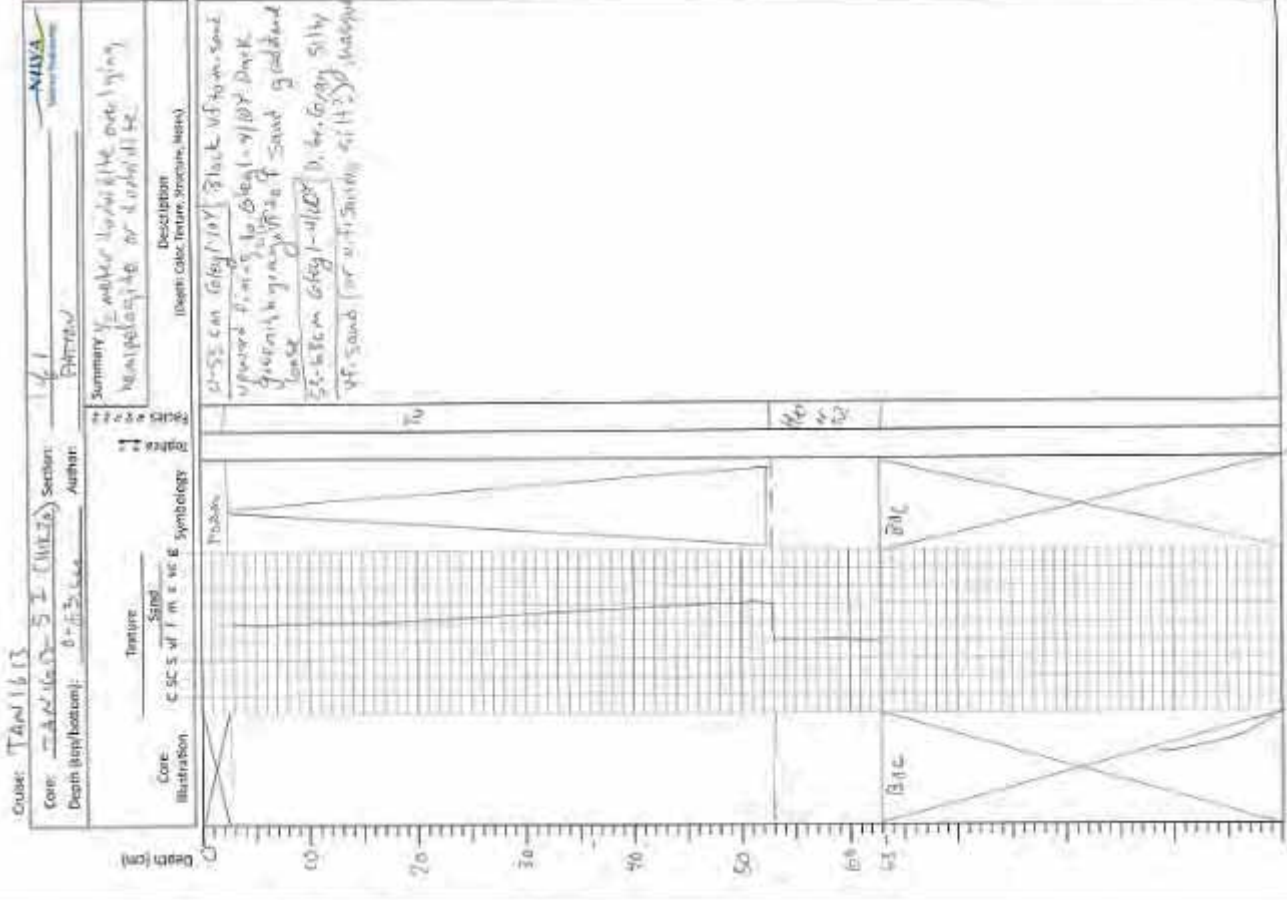
Water Depth 2969 m



Bathymetry at and around Hik20 core site in the Hikurangi Channel, first major meander loop E of Cook Strait (site TAN1507-19). Light blue lines are 20 m depth contours. Red line shows the 2 km TOPAS survey line over the station, green triangles indicate the actual core site.



Backscatter at and around Hik20 core site in the Hikurangi Channel, first major meander loop E of Cook Strait (site TAN1507-19). Red lines show the 2 km TOPAS survey line over the station, green triangles indicate the actual core site.



TAN1613 – Paleoseismicity of the Southern Hikurangi Margin - Multicore data sheet

Core ID: **Hik 21**
Other ID: **TAN1613-53**

Latitude: **-41.99917**
Longitude: **176.50097**

Date/Time (NZST): **19/11/2016 08:17**
Depth (m): **2733**

Length (cm)

Sample Description

General Description

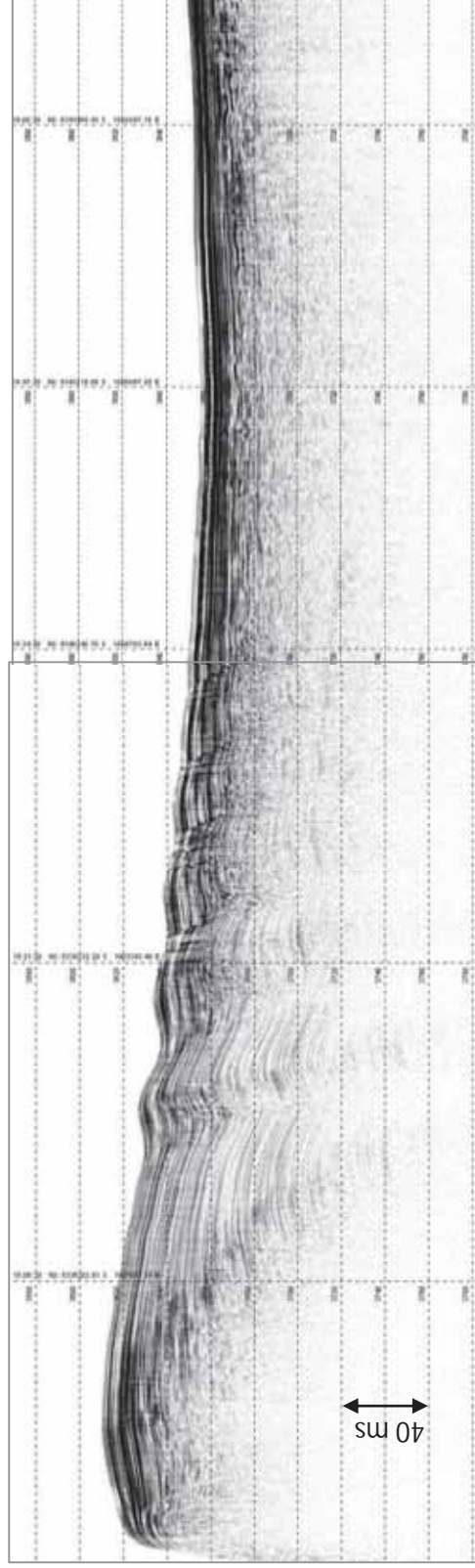
Hikurangi basin floor east of Cook Strait (site TAN1507-12)

Core taken from multicore but not yet described

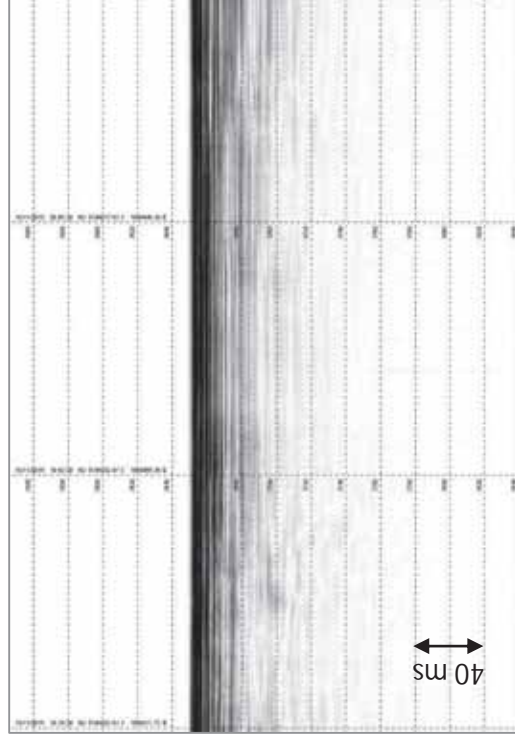


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Hik 21	Other ID TAN1613-53	Water Depth 2733 m
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Transit towards Hik21 core station.
NB: There is no Topas line going over core location!



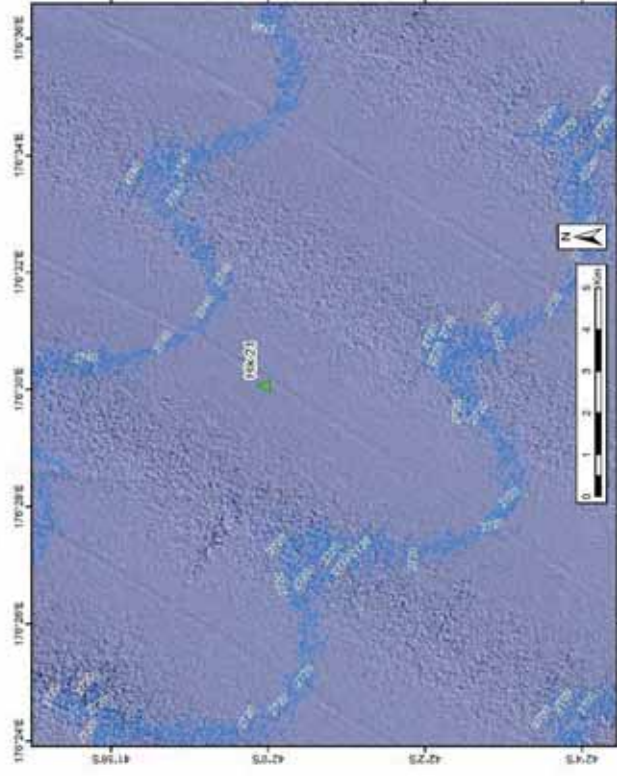
Idle survey while coring site.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

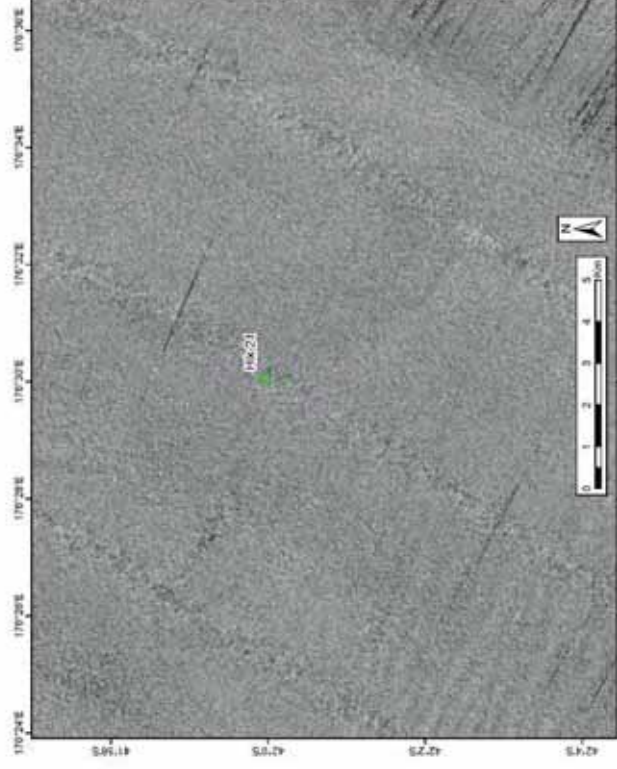
Core ID: Hik 21

Other ID TAN1613-53

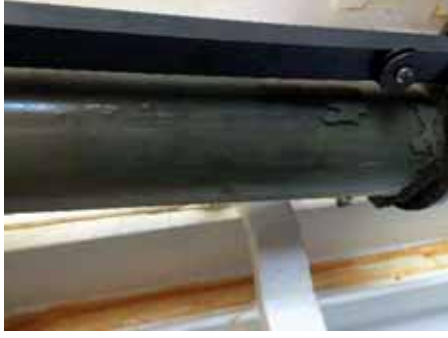
Water Depth 2733 m



Bathymetry at and around Hik21 core site at the Hikurangi basin floor, east of Cook Strait (site TAN1507-12). Light blue lines are 20 m depth contours. Note there was no Topas survey done over this core station. The green triangles indicate the actual core site.



Backscatter at and around Hik21 core site at the Hikurangi basin floor, east of Cook Strait (site TAN1507-12). Light blue lines are 20 m depth contours. Note there was no Topas survey done over this core station. The green triangles indicate the actual core site.



TAN1613 – Paleoseismicity of the Southern Hikurangi Margin - Multicore data sheet

Core ID: **Hik 7**
Other ID: TAN1613-54

Latitude: -42.23588
Longitude: 175.70825

Date/Time (NZST): 19/11/2016 14:41
Depth (m): 2750

Length (cm)

Sample Description

General Description

Hikurangi Channel 40 km E of Cook Strait canyon mouth



TAN1613 – Paleoseismicity of the Southern Hikurangi Margin - Multicore data sheet

Core ID: **Hik 7 (repeat)**

Latitude: -42.23600

Date/Time (NZST): 19/11/2016 16:47

Other ID: TAN1613-55

Longitude: 175.70893

Depth (m): 2749

Length (cm)

Sample Description

General Description

Hikurangi Channel 40 km E of Cook Strait canyon mouth

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: **Hik 7** Latitude: -42.23588 Date/Time (NZST): 19/11/2016 19:08

Other ID: TAN1613-56 Longitude: 175.70847 Depth (m): 2741

Sample Description

General Description

Hikurangi Channel 40 km E of Cook Strait canyon mouth

sandy hemipelgate sequences with interbedded silty turbidites, organic layers for 55.5 to 59 severe core deformation from 70-136.5 cm

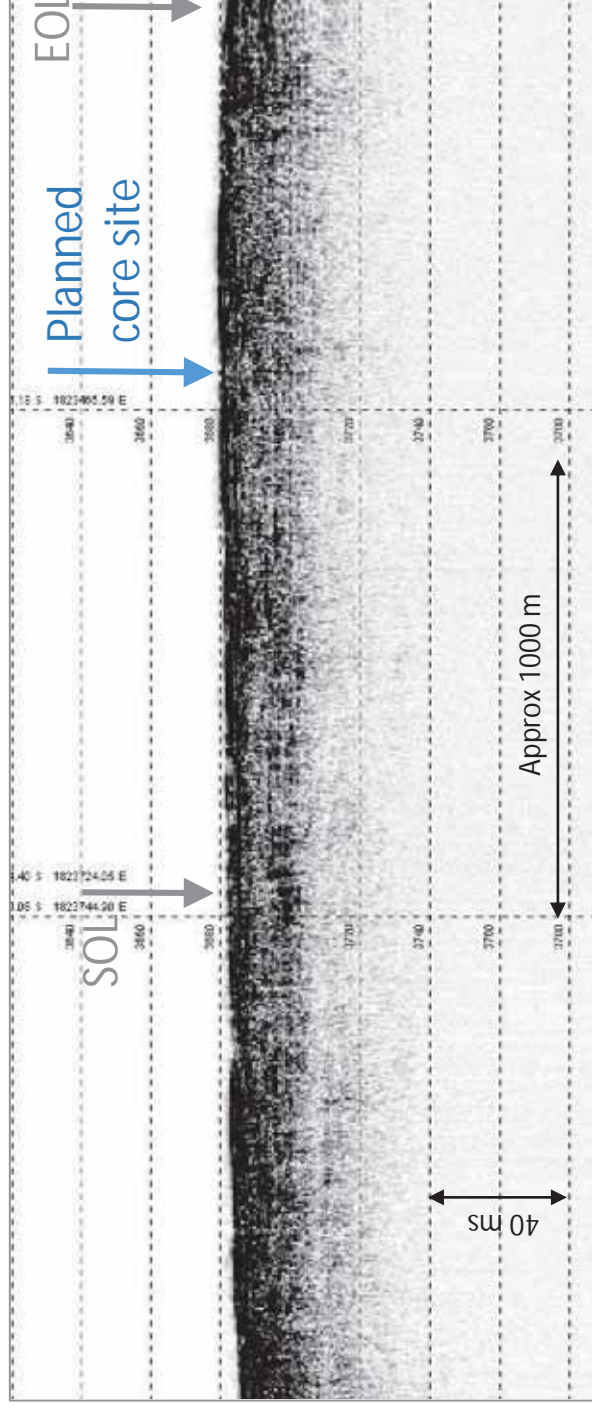
Gear type	Piston core	
Barrel Length (m)	6	Bent barrel
Penetration (m)		Catcher/Cutter bags
Core length (m)	1.36	Samples
Sections	2	Tephra
Fauna		

Sample processing – core ID:

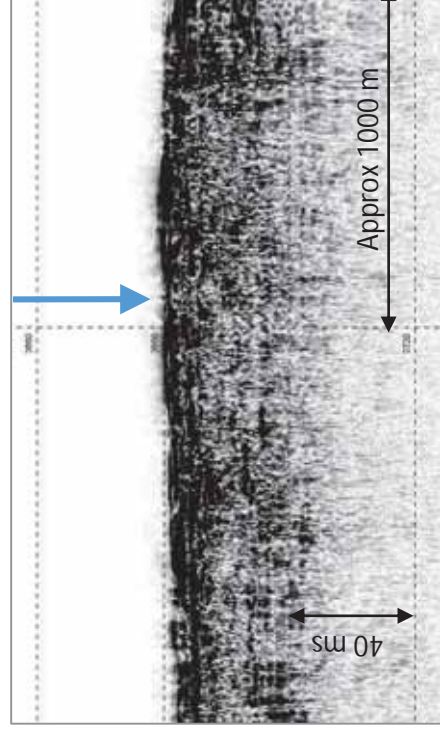
Section	Top depth (cm)	Btm depth (cm)	Logged	Phys Props	Summary
1	0	70	Y	Y	.
2	70	136.5	Y	Y	.
.
.
.
.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Hik 7	Other ID TAN1613-54, 55 & 56	Water Depth 2750 m
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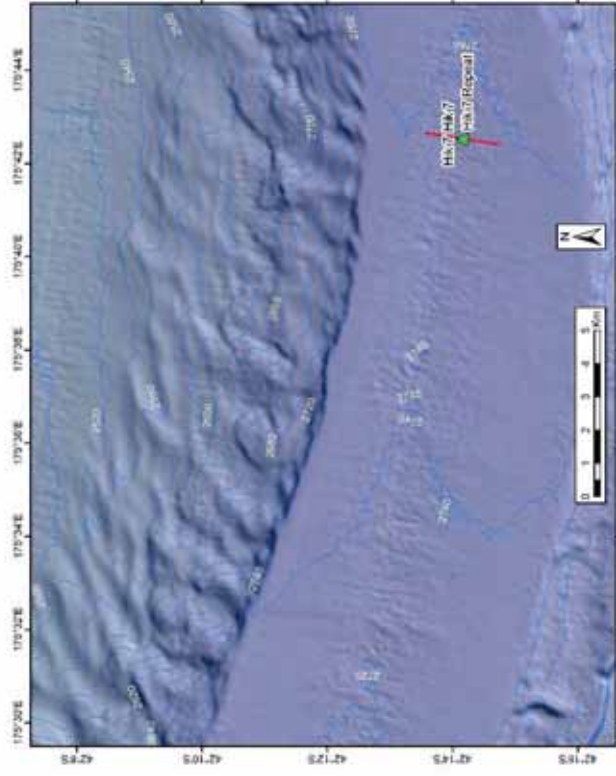
Topas line, including short transit, over the planned core station. Grey arrows indicate start and end of the 2km survey line over the station. Blue arrow marks the planned core site.



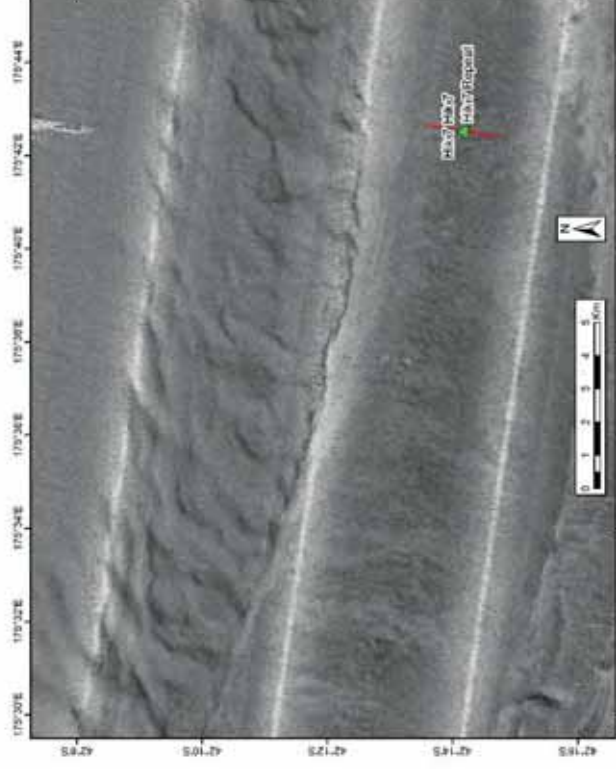
Vertical exaggerated survey line over planned core site.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Hik 7	Other ID TAN1613-54, 55 & 56	Water Depth 2750 m
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Bathymetry at and around Hik7 in the Hikurangi Channel 40 km East of Cook Strait canyon mouth. Light blue lines are 20 m depth contours. Red lines show the 2 km TOPAS survey line over the station, green triangles indicate the actual core site. Multi-labelling indicated repeated cores and/or multicore.



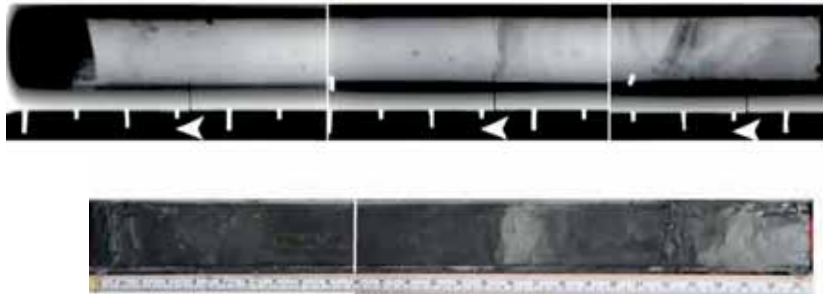
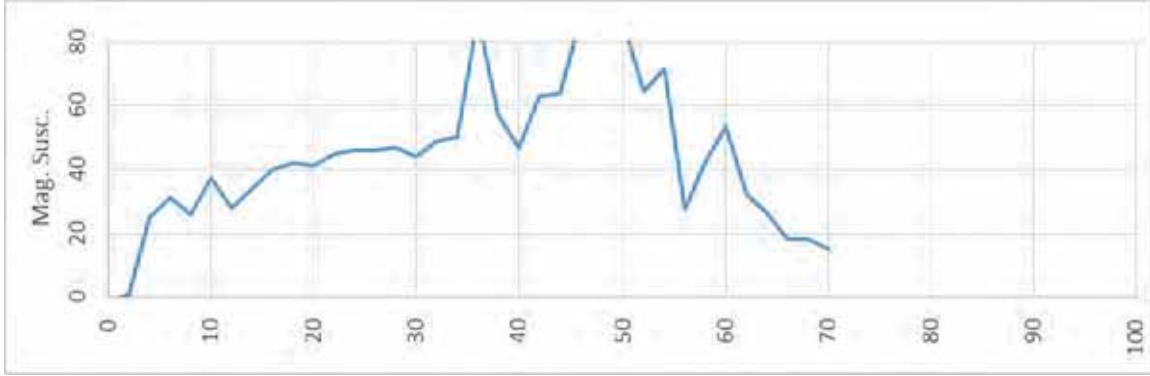
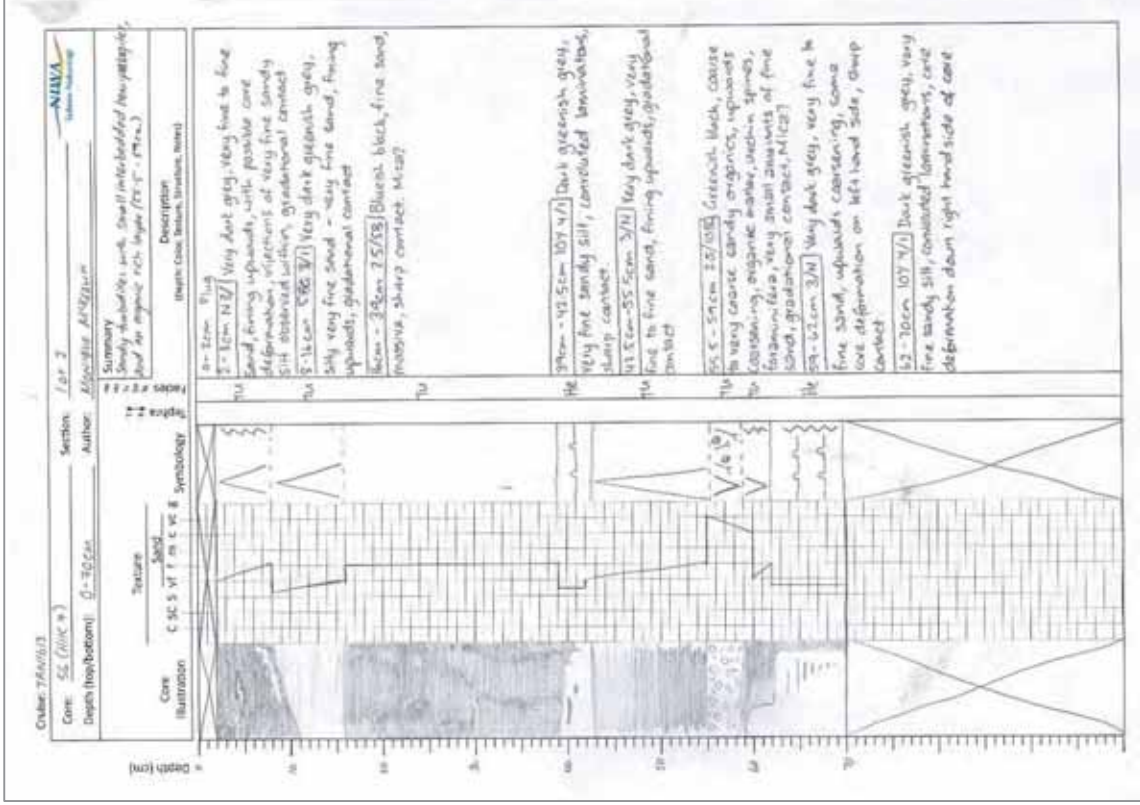
Backscatter at and around Hik7 in the Hikurangi Channel 40 km East of Cook Strait canyon mouth. Red lines show the 2 km TOPAS survey line over the station, green triangles indicate the actual core site. Multi-labelling indicated repeated cores and/or multicore.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Hik 7

Other ID TAN1613-56

Section 1 of 2

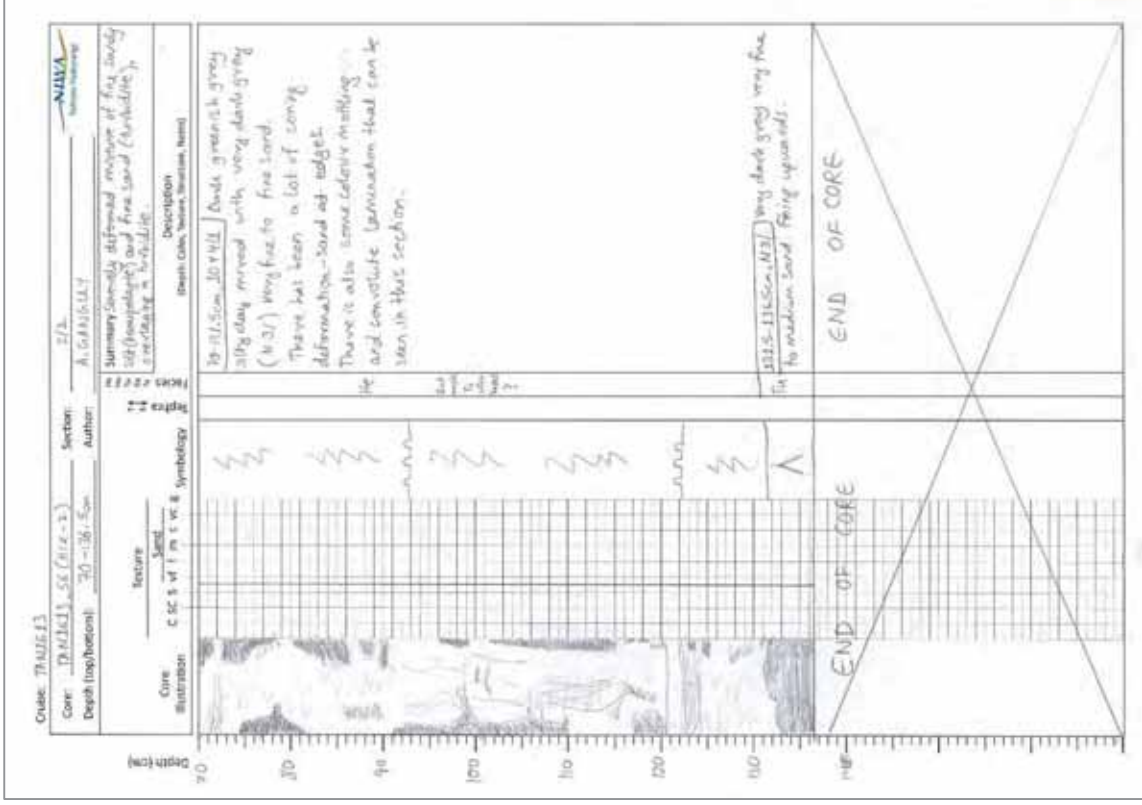
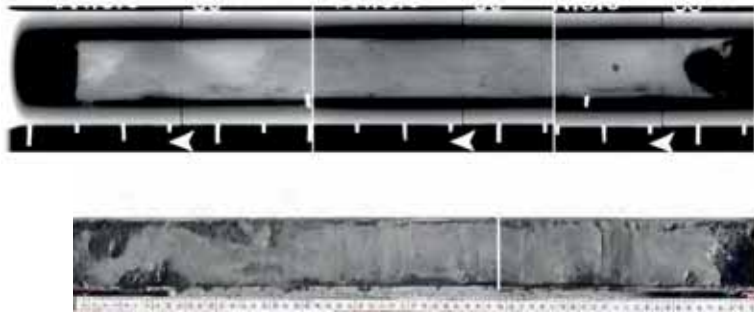
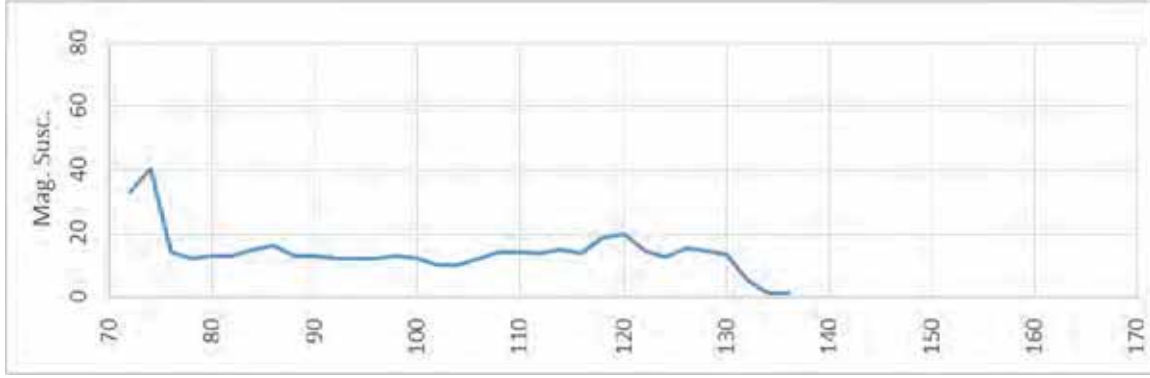


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Hik 7

Other ID TAN1613-56

Section 2 of 2



TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Hik 4	Latitude: -42.23283	Date/Time (NZST): 20/11/2016 01:16
Other ID: TAN1613-57	Longitude: 174.96500	Depth (m): 2439

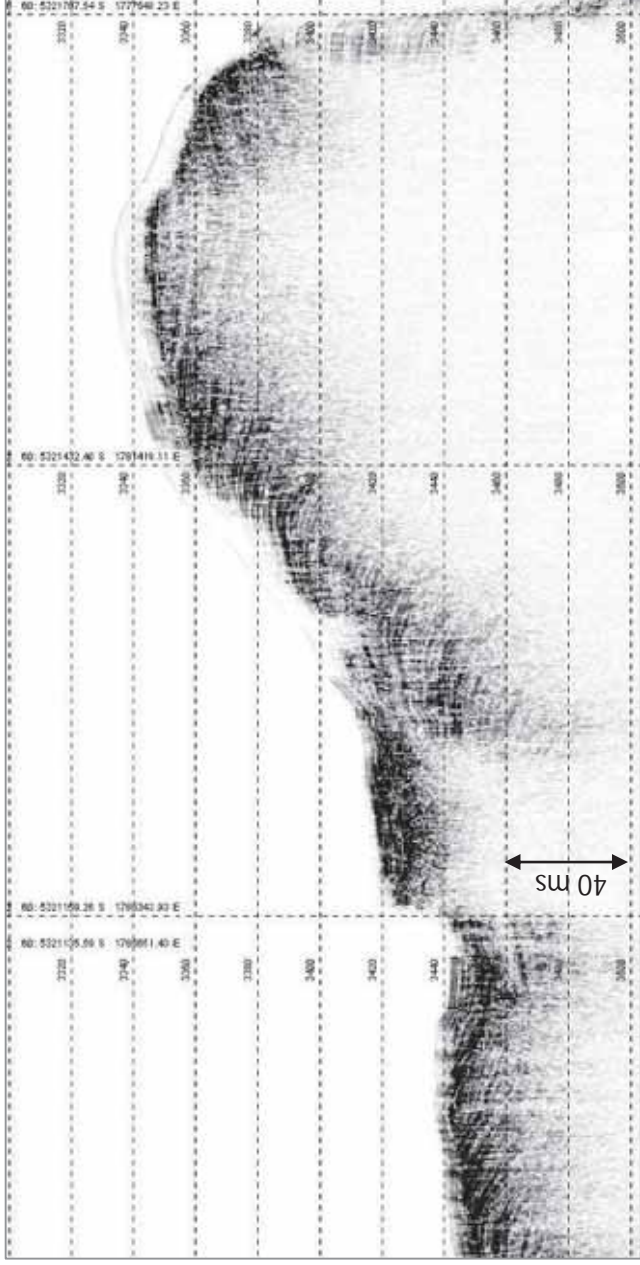
Sample Description	Gear type	Piston core
General Description Mud waves on the flank of the Hikurangi Channel wall (site CR2055 S964) Highly bioturbated hemipelagites interbedded with silty and sandy turbidites that are up to 20 cm thick	Barrel Length (m)	6 Bent barrel
	Penetration (m)	Catcher/Cutter bags
	Core length (m)	4.55 Samples
	Sections	5 Tephra
	Fauna	

Sample processing – core ID:

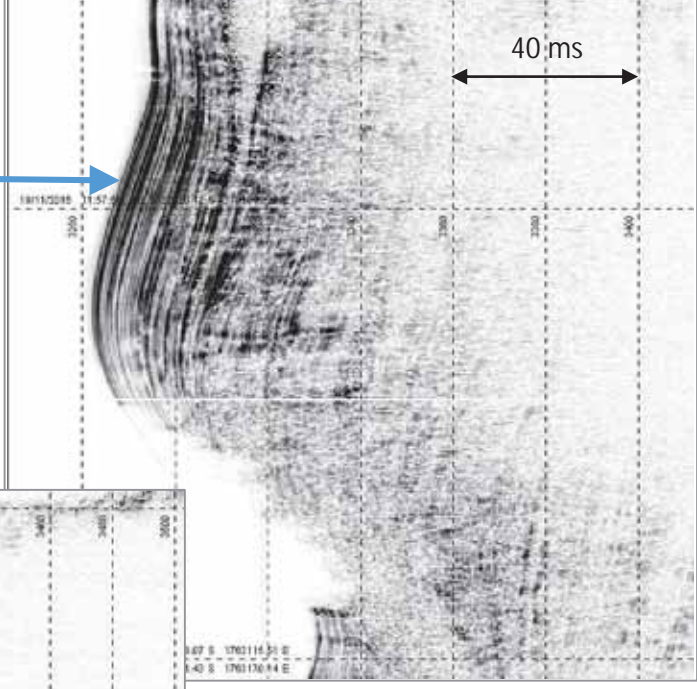
Section	Top depth (cm)	Btm depth (cm)	Logged	Phys Props	Summary
1	0	100	Y	Y	.
2	100	200	Y	Y	.
3	200	300	Y	Y	.
4	300	400	Y	Y	.
5	400	455	Y	Y	.
.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Hik 4	Other ID TAN1613-57	Water Depth 2439 m
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Planned core site

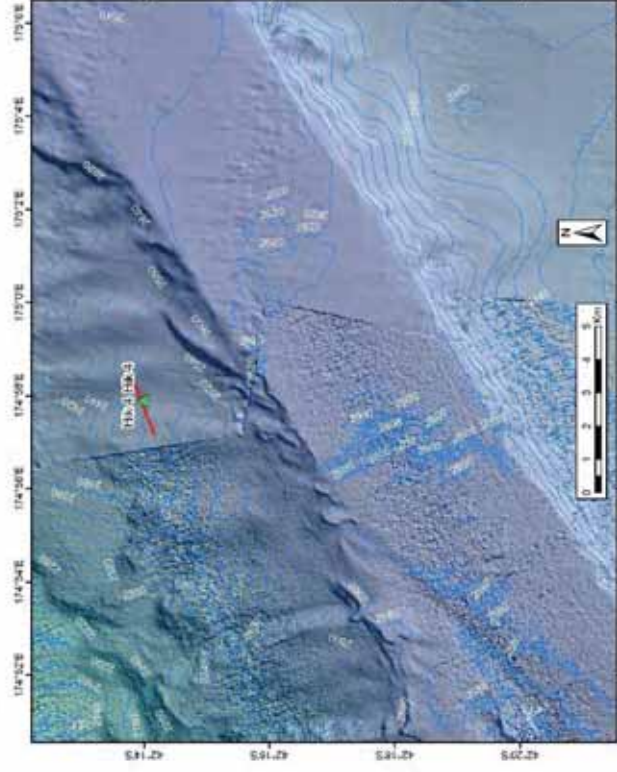


Topas survey on transit towards Hik4 core site.

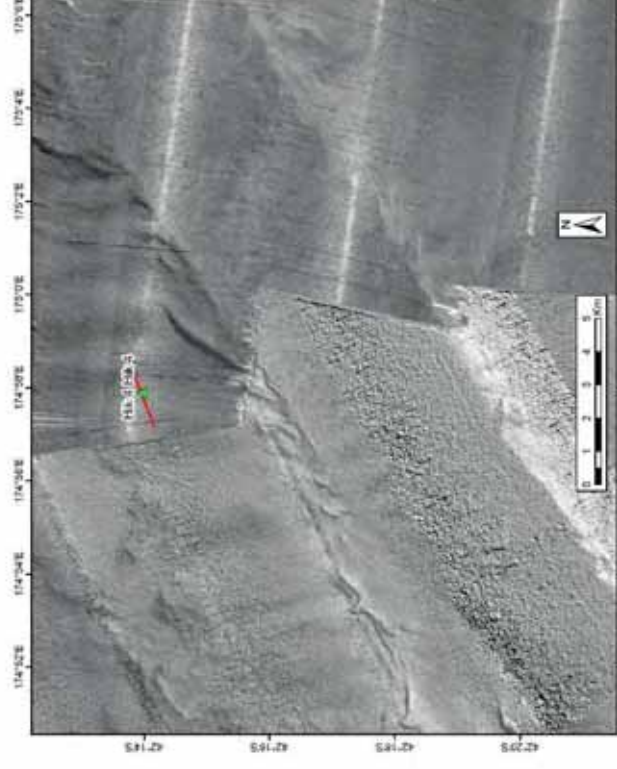
Vertical exaggerated survey line over planned core site. The blue arrow marks the planned core site.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Hik 4	Other ID TAN1613-57	Water Depth 2439 m
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Bathymetry at and around Hik4 in the mud waves on the flank of the Hikurangi Channel wall (site CR2055 S964). Light blue lines are 20 m depth contours. Red lines show the 2 km TOPAS survey line over the station, green triangles indicate the actual core site. Multi-labelling indicates a repeated core and/or multicore.



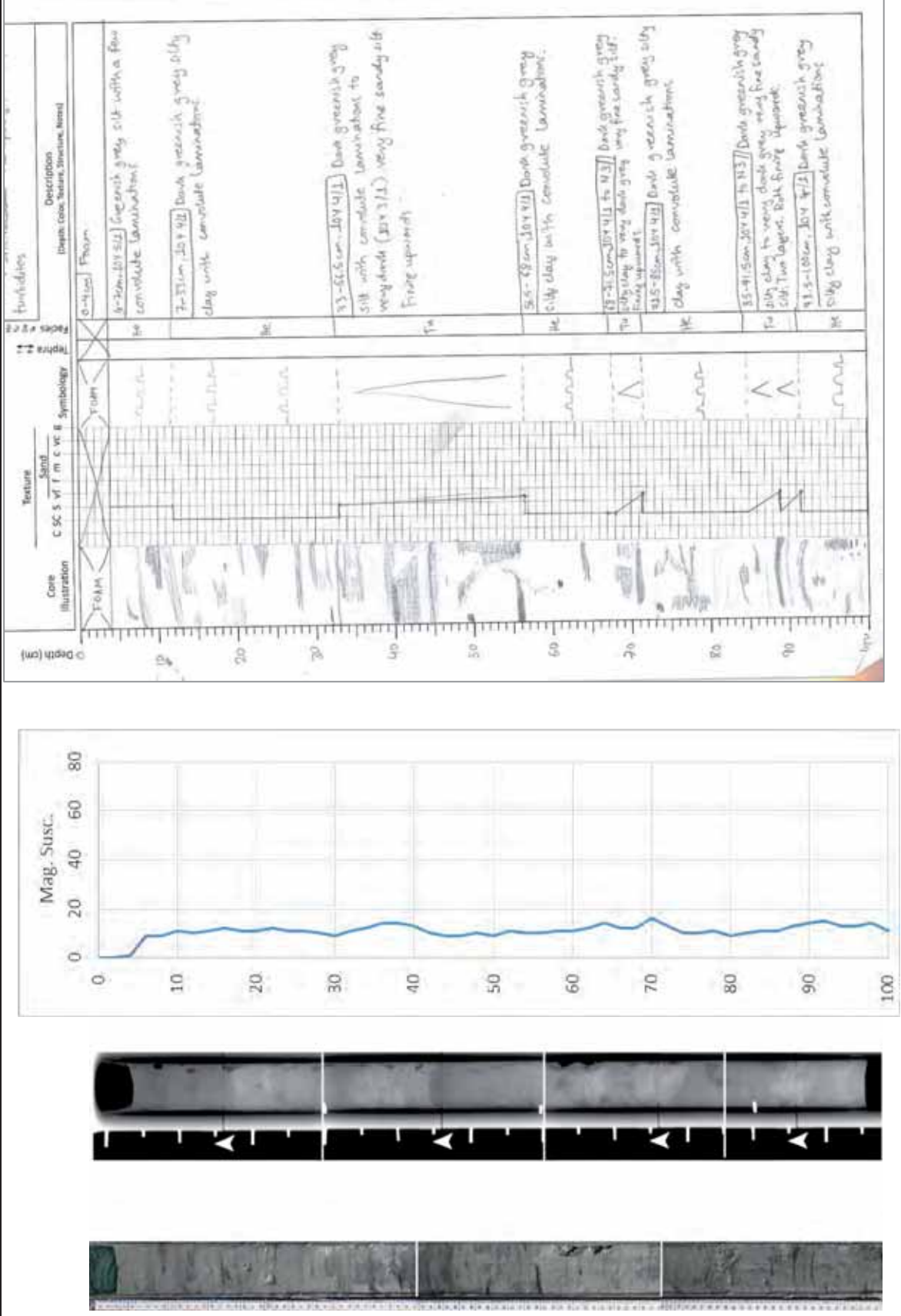
Backscatter at and around Hik4 in the mud waves on the flank of the Hikurangi Channel wall (site CR2055 S964). Red lines show the 2 km TOPAS survey line over the station, green triangles indicate the actual core site. Multi-labelling indicates a repeated core and/or multicore.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Hik 4

Other ID TAN1613-57

Section 1 of 5

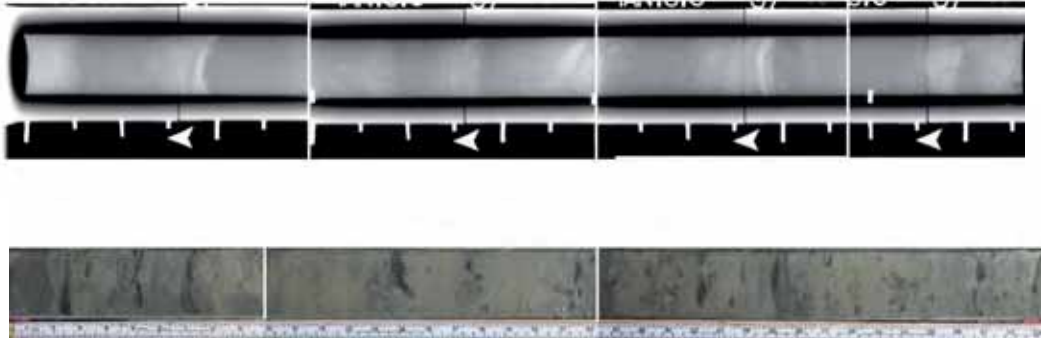
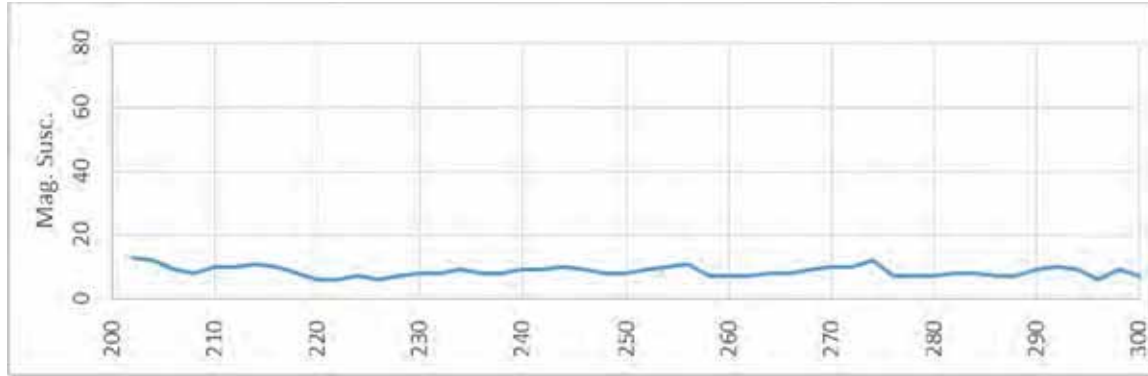
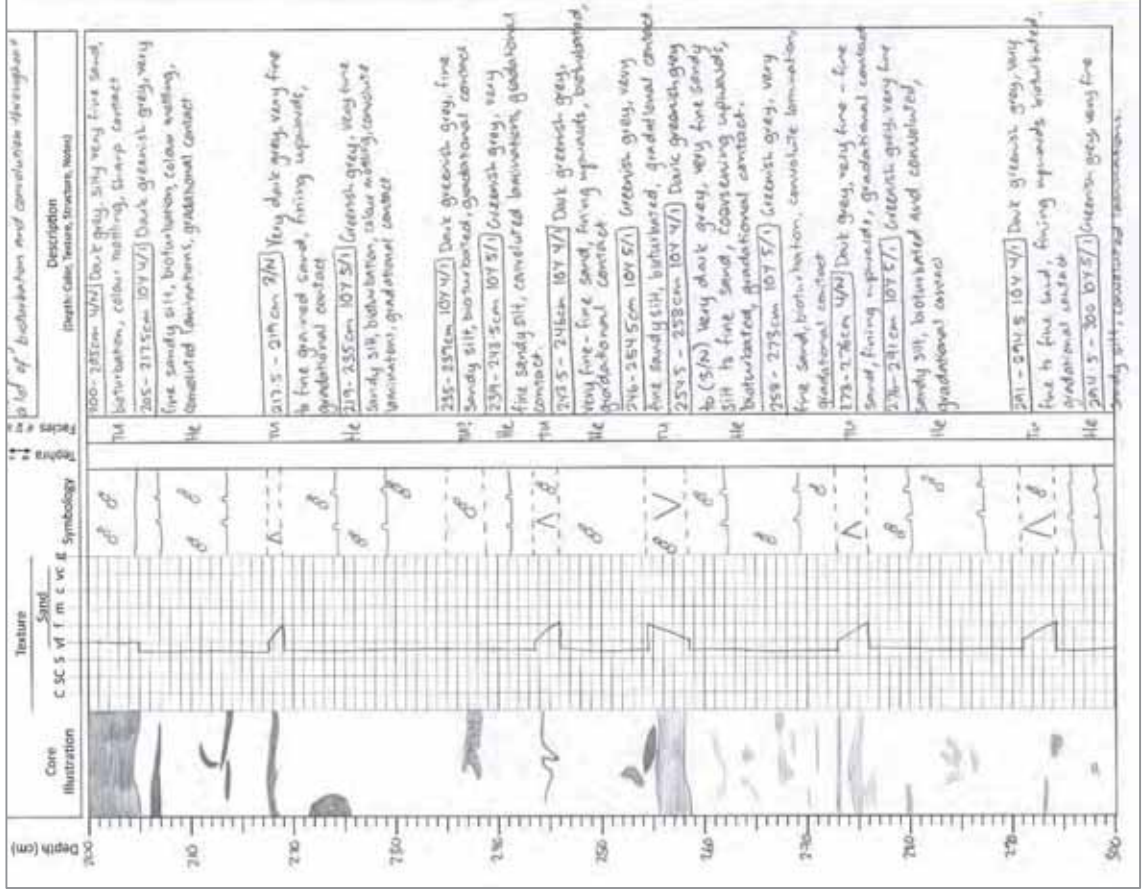


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Hik 4

Other ID TAN1613-57

Section 3 of 5

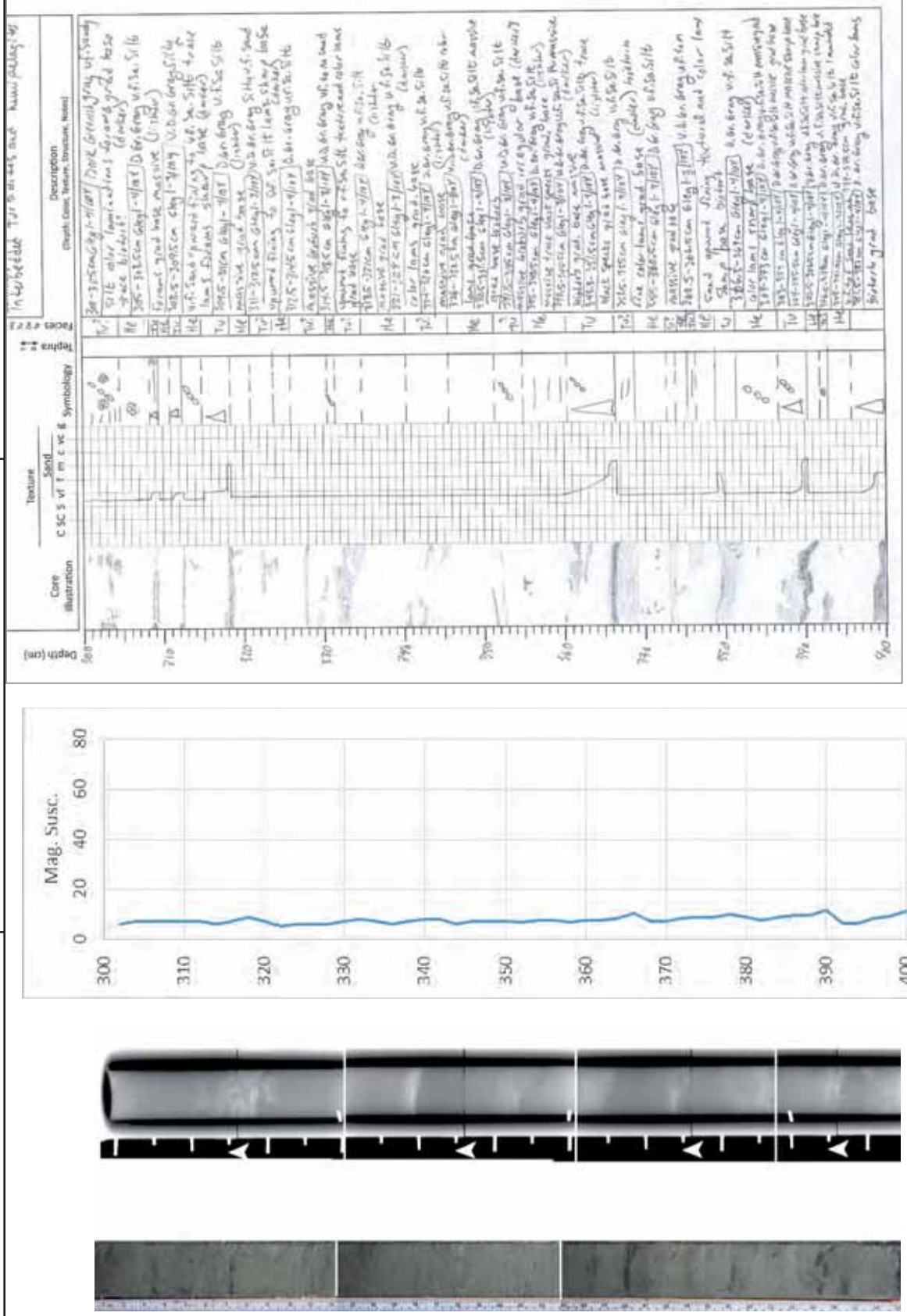


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Hik 4

Other ID TAN1613-57

Section 4 of 5

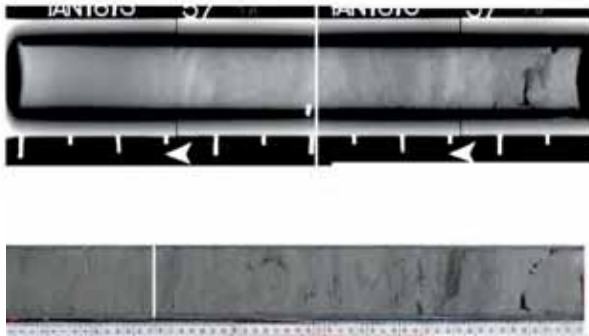
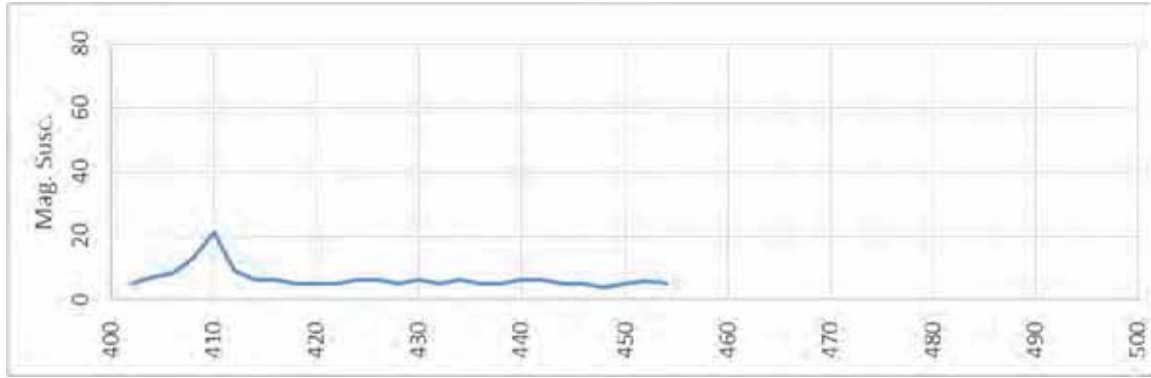
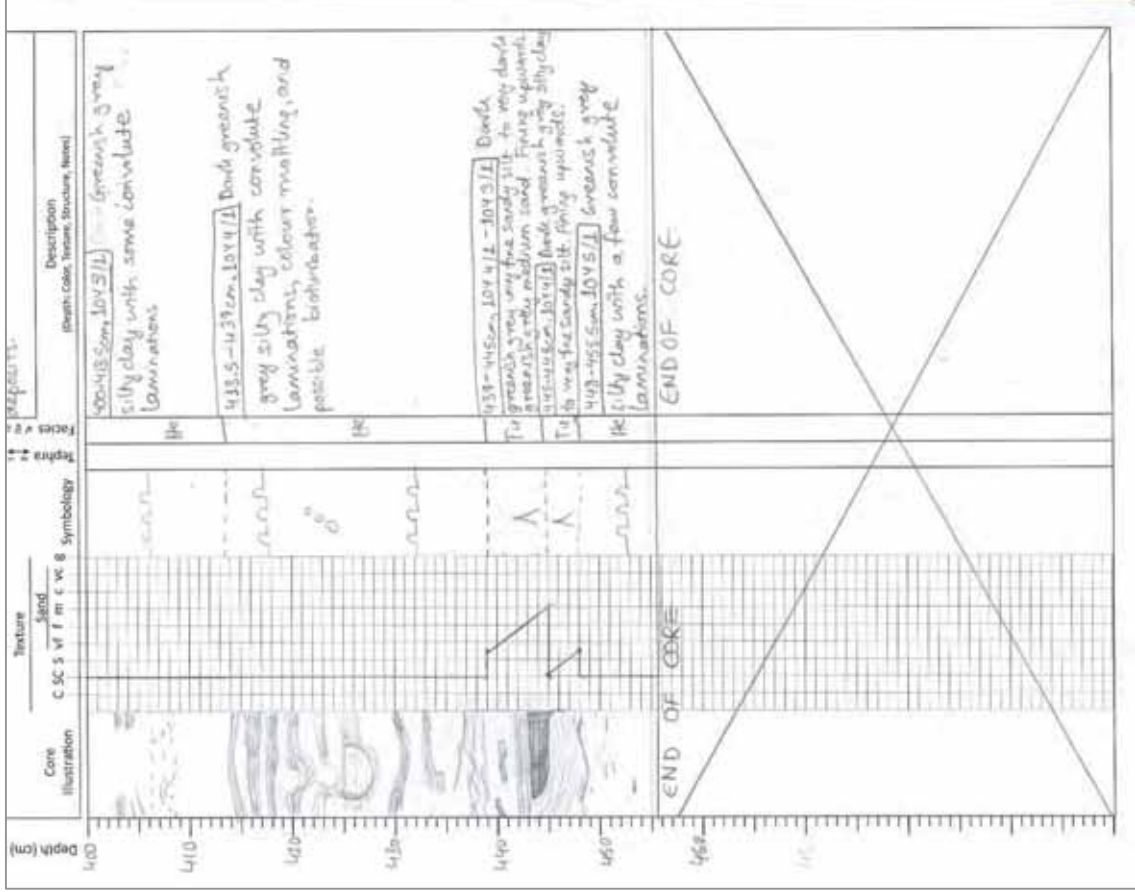


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Hik 4

Other ID TAN1613-57

Section 5 of 5



TAN1613 – Paleoseismicity of the Southern Hikurangi Margin - Multicore data sheet

Core ID: Hik 4	Latitude: -42.23283	Date/Time (NZST): 20/11/2016 01:16
Other ID: TAN1613-58	Longitude: 174.96480	Depth (m): 2446

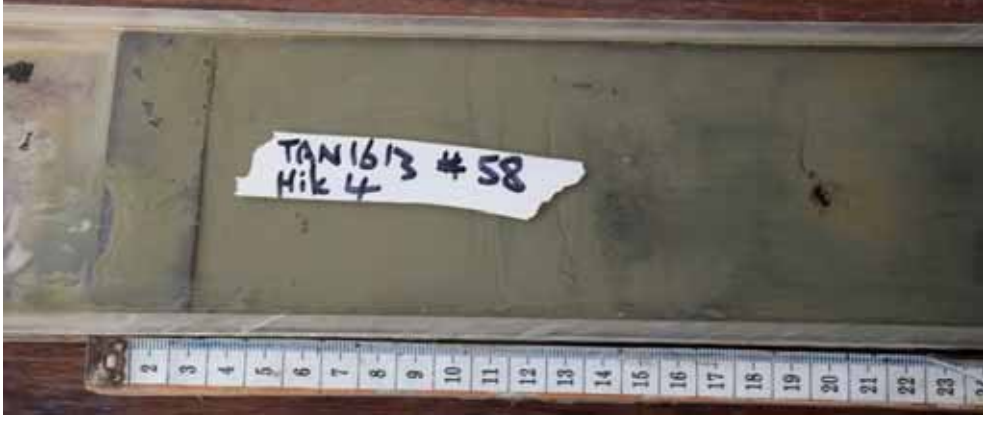
Length (cm)	62
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Sample Description

General Description

Mud waves on the flank of the Hikurangi Channel wall (site CR2055 S964)

12cm of Brownish mud over 4cm grey silt, above an oxidation blob around a worm tube hole (possible pre-EQ seafloor horizon/. Below this a graded turbidite to 62 cm basal sands and silts.



TAN1613 – Paleoseismicity of the Southern Hikurangi Margin - Multicore data sheet

Core ID: **Hik 2**
Other ID: **TAN1613-59**

Latitude: -42.46913
Longitude: 174.49060

Date/Time (NZST): 20/11/2016 08:16
Depth (m): **2386**

Length (cm)

Sample Description

General Description

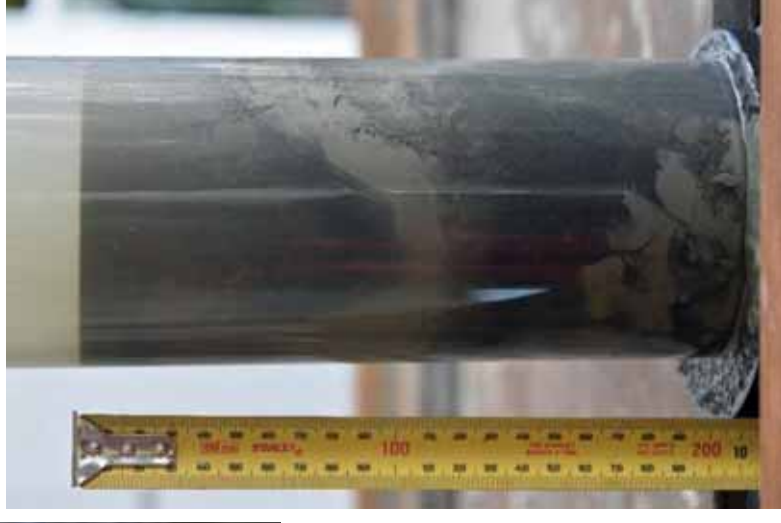
South Hikurangi Channel floor

Fresh echinoderm within the base of turbidites

Unconsolidated silty fine sand turbidites overlain by fluid mud.

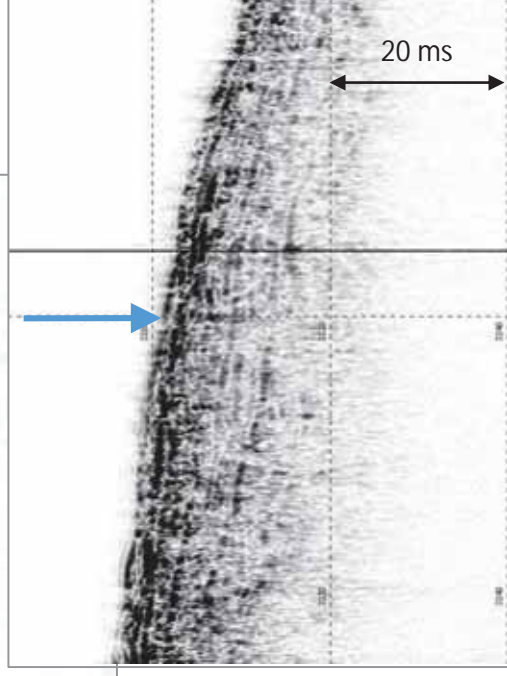
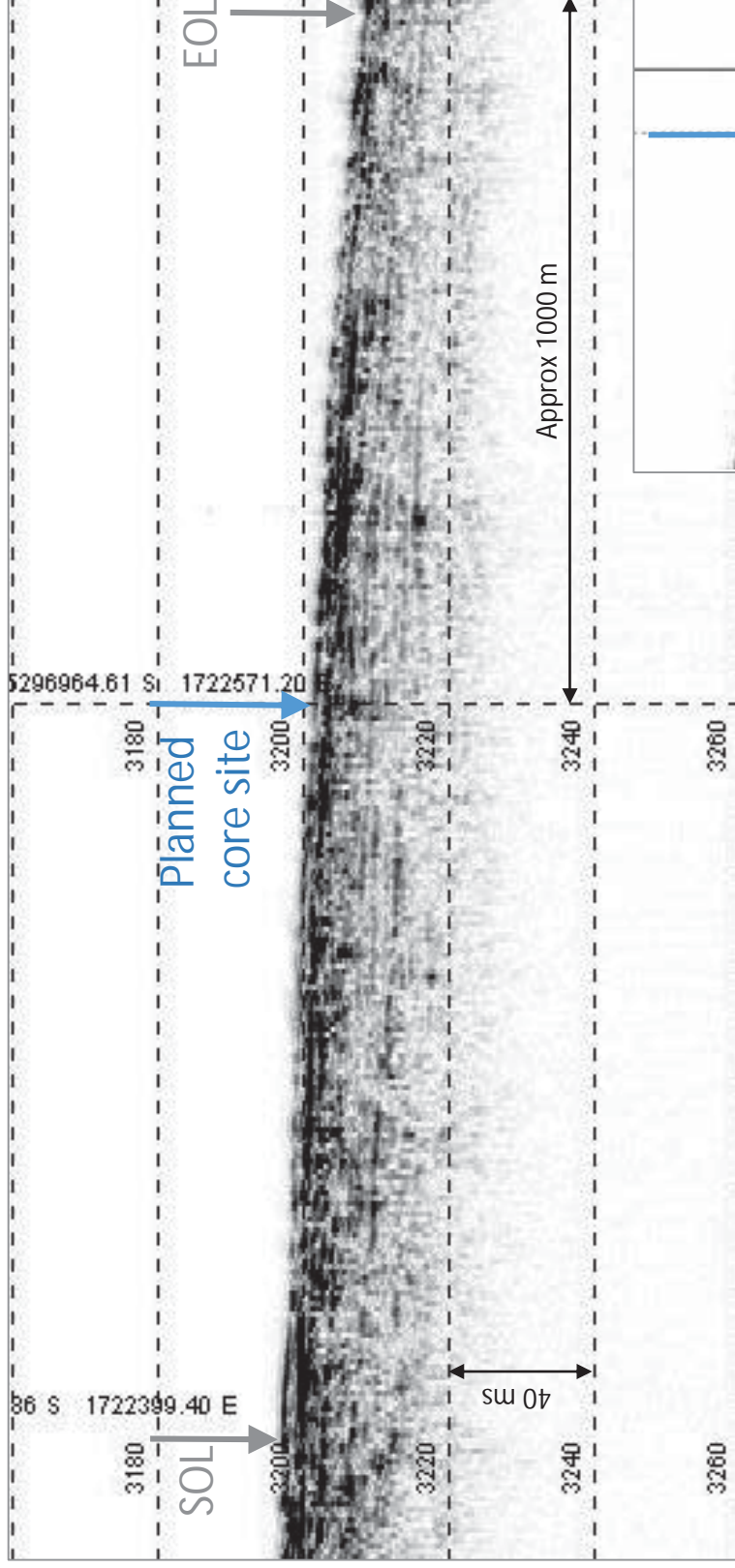


~1cm



TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Hik 2	Other ID TAN1613-59 & 60	Water Depth 2386 m
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2km Topas line over the planned core station. Grey arrows indicate start and end of the 2km survey line over the station. Blue arrow marks the planned core site.

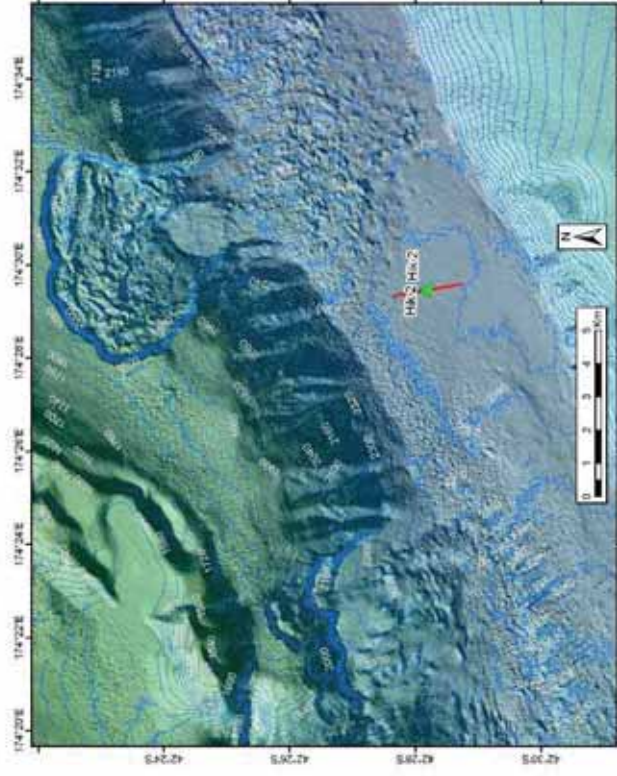
Vertical exaggerated survey line over planned core site.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Hik 2

Other ID TAN1613-59 & 60

Water Depth 2386 m



Bathymetry at and around Hik2 core site at the South Hikurangi Channel floor. Light blue lines are 20 m depth contours. Red lines show the 2 km TOPAS survey line over the station, green triangles indicate the actual core site. Multi-labelling indicates core repeat and/or multicore.



Backscatter at and around Hik2 core site at the South Hikurangi Channel floor. Red lines show the 2 km TOPAS survey line over the station, green triangles indicate the actual core site. Multi-labelling indicates core repeat and/or multicore.

Multicore

Hik 2

TAN1613-59



Fresh echinoderm within the base of turbidites

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: **Hik 2**
Other ID: **TAN1613-60**

Latitude: -42.46963
Longitude: 174.49132

Date/Time (NZST): 20/11/2016 11:15
Depth (m): **2376**

Sample Description

General Description

Turbidite depocentre half way along the Marlborough section of the Hikurangi Channel

Gear type		Piston core	
Barrel Length (m)		Bent barrel	
Penetration (m)		Catcher/Cutter bags	
Core length (m)	1.07	Samples	2
Sections	2	Tephra	
Fauna	y		

Sample processing – core ID:

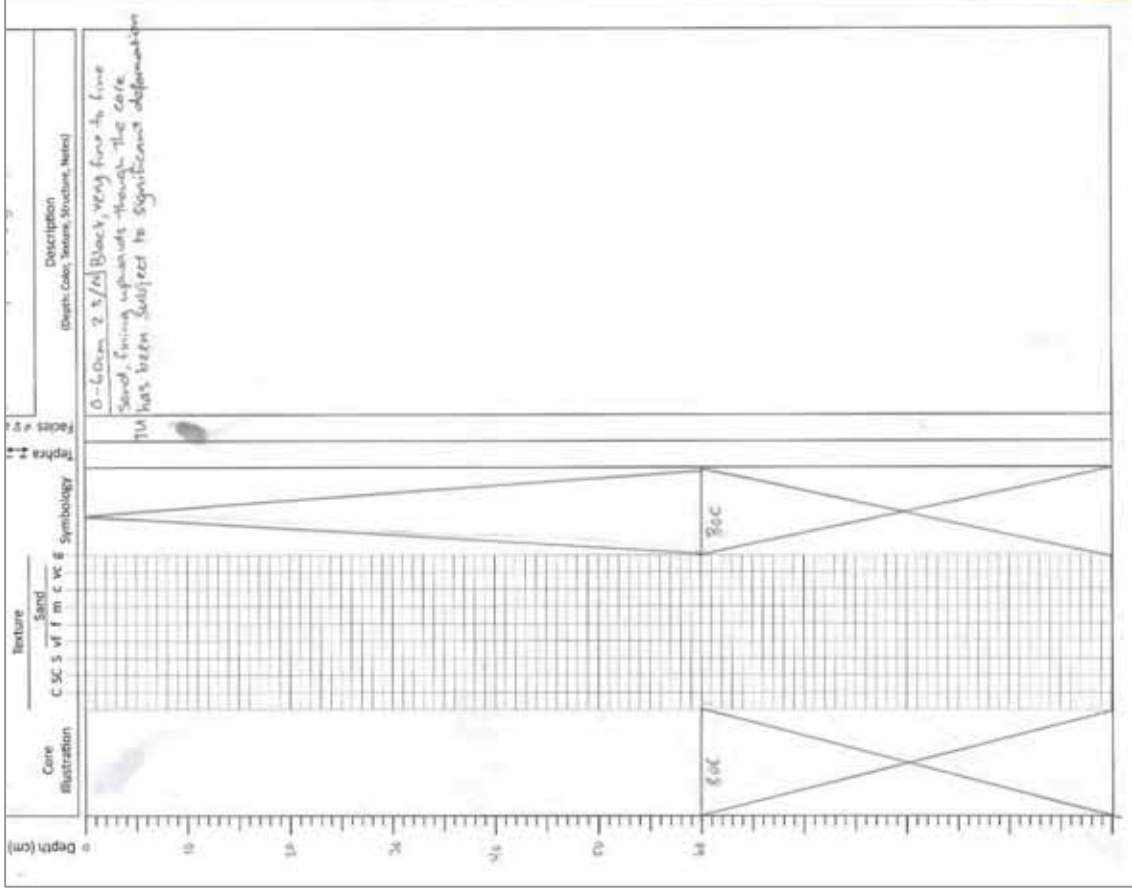
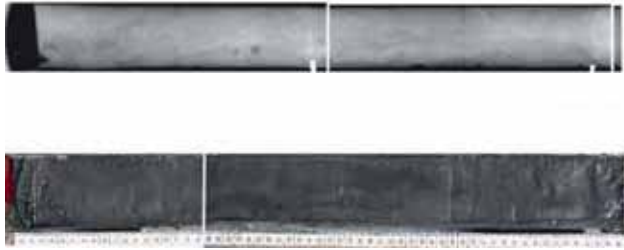
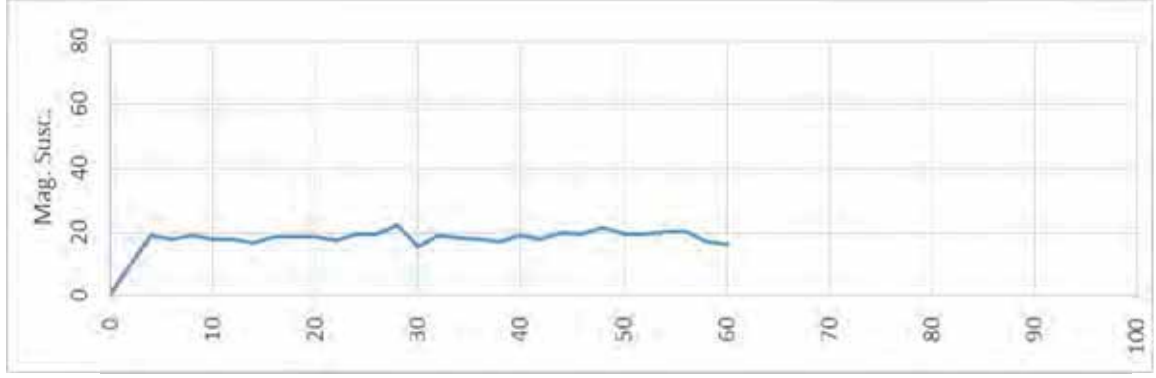
Section	Top depth (cm)	Btm depth (cm)	Logged	Phys Props	Summary
1	0	60	Y	Y	.
2	60	107	Y	Y	.
.	.	.	Y	Y	.
.	.	.	Y	Y	.
.	.	.	Y	Y	.
.	.	.	Y	Y	.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Hik 2

Other ID TAN1613-60

Section 1 of 2

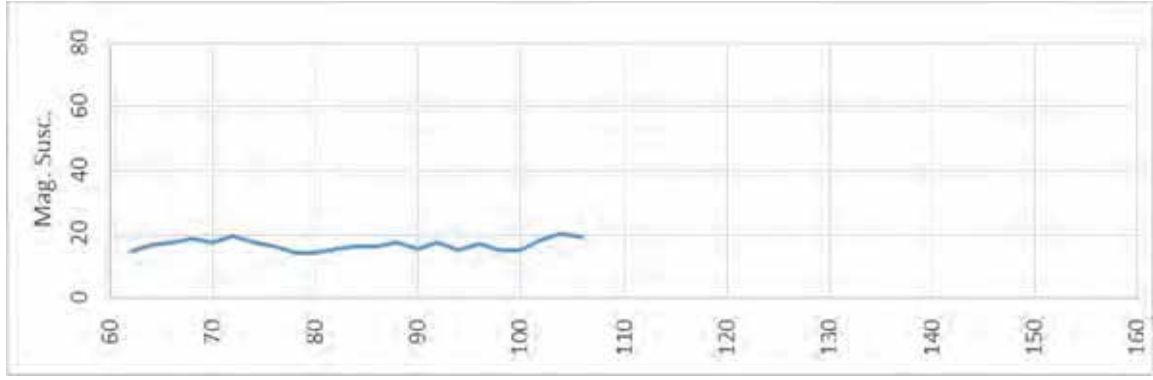
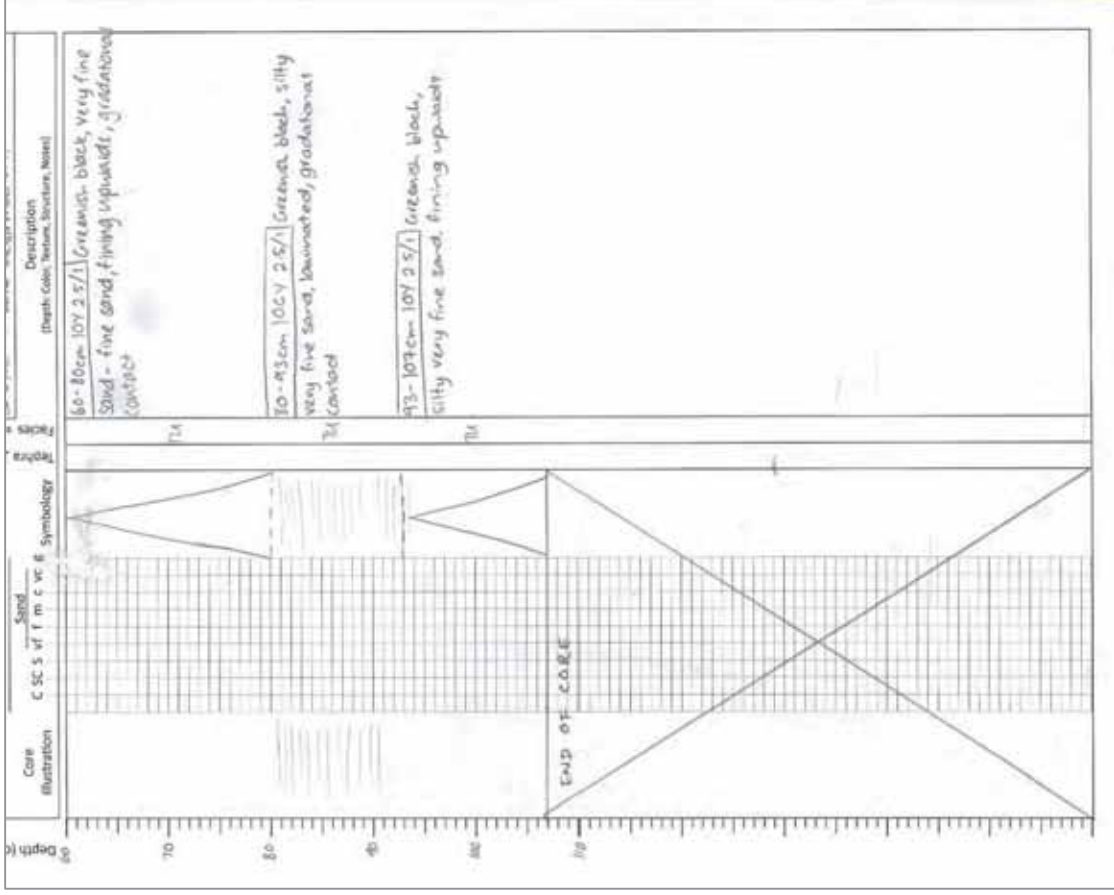


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: Hik 2

Other ID TAN1613-60

Section 2 of 2



TAN1613 – Paleoseismicity of the Southern Hikurangi Margin - Multicore data sheet

Core ID: **Marl 2**
Other ID: TAN1613-61

Latitude: -42.09943
Longitude: 174.48862

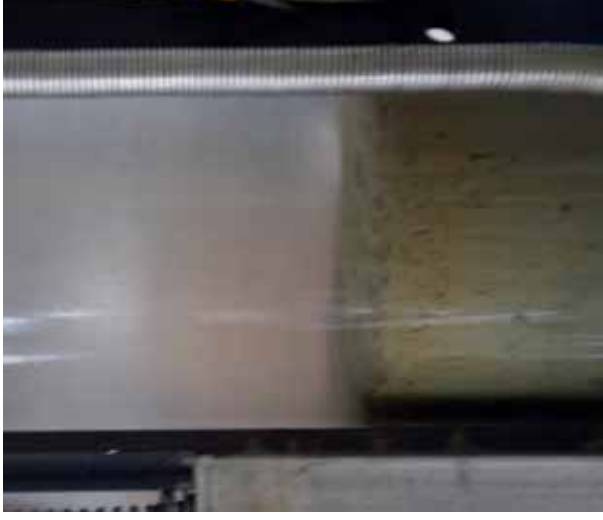
Date/Time (NZST): 20/11/2016 15:43
Depth (m): 1150

Length (cm)

Sample Description

General Description

Kekerengu Bank upper slope basin



Oxydised zone at top of core

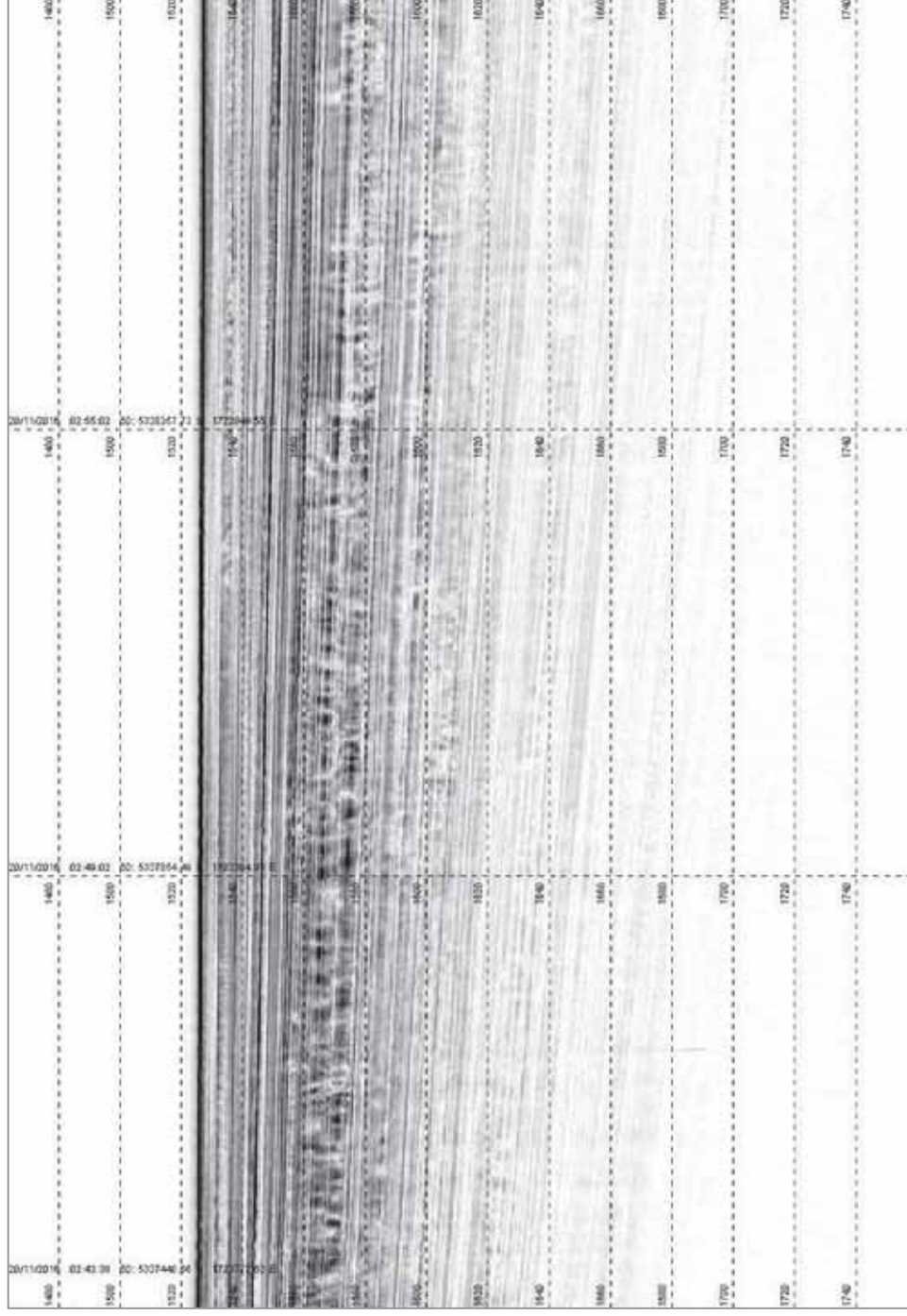


TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: **Mar12**

Other ID **TAN1613-61**

Water Depth **1150 m**



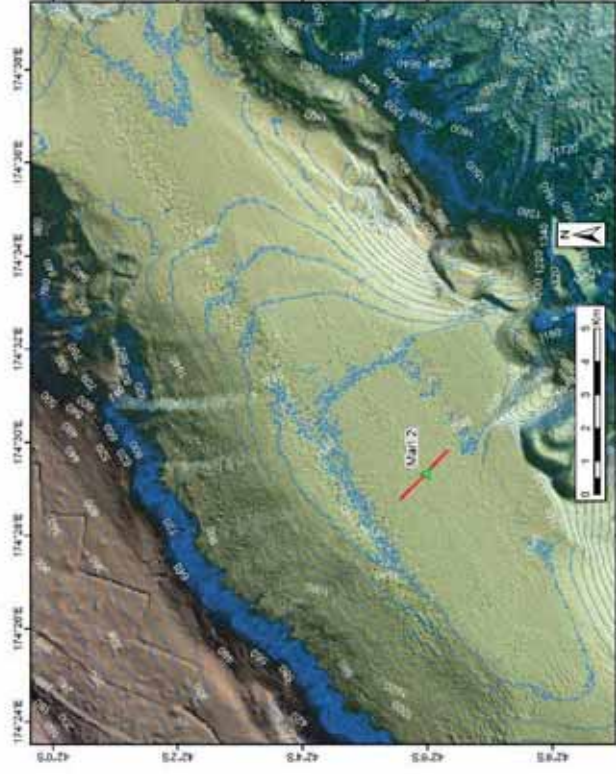
Topas line, including transit, over the planned core station.

TAN1613 – Paleoseismicity of the Southern Hikurangi Margin

Core ID: **Mar12**

Other ID **TAN1613-61**

Water Depth **1150 m**



Bathymetry at and around Marlborough2 core site at the Keherengu Bank upper slope basin. Light blue lines are 20 m depth contours. Red lines show the 2 km TOPAS survey line over the station, green triangles indicate the actual core site.



Backscatter at and around Marlborough2 core site at the Keherengu Bank upper slope basin. Red lines show the 2 km TOPAS survey line over the station, green triangles indicate the actual core site.