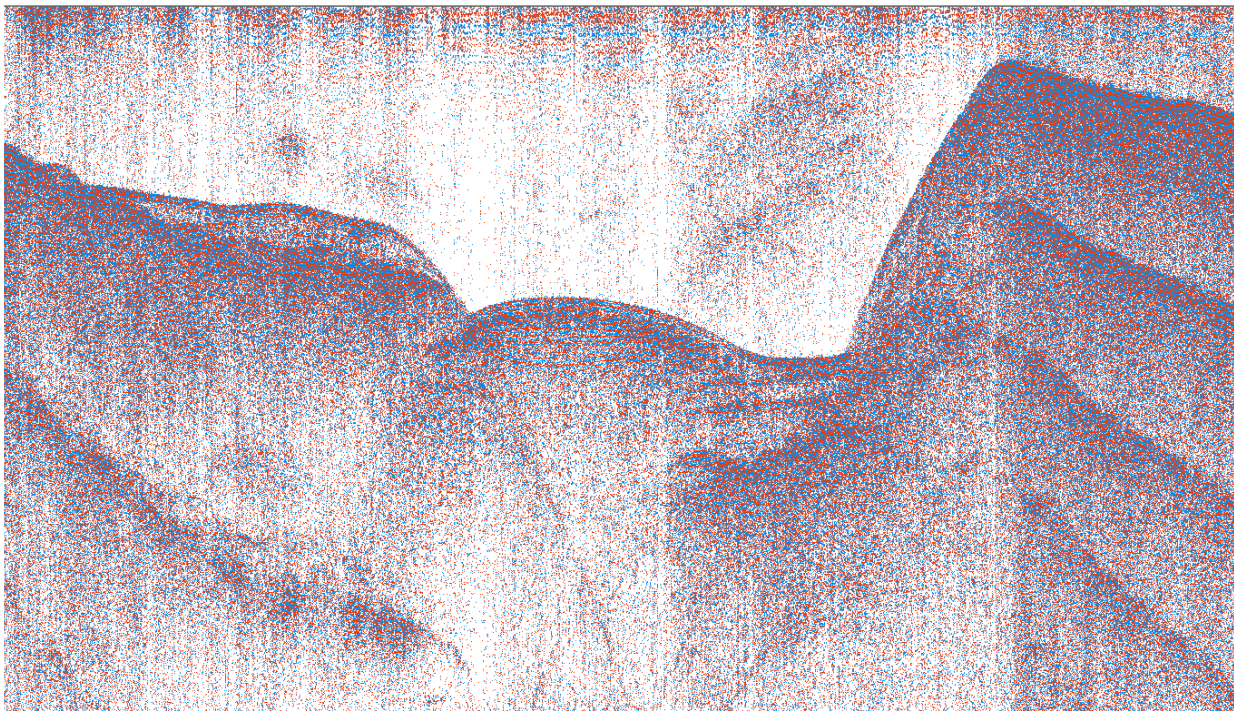


Paleoenvironmental reconstructions from contourites based on core-log-seismic integration in the Baltic Sea

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Abstract

The Baltic Sea carries a rich history of sedimentation that can tell us much about the climate of the region since the last glaciation. Large gatherings of sediments in the Landsort Deep and the Southern Quark can give us insight into this history. Through seismic data collected from the study areas we can gain insight to the internal geometry of these sedimentary units. These can be compared with lithological cores taken from the areas to establish a sequence of events that lead to the environment of today. Doing this may let us establish whether these seismic bodies are contouritic drifts, which has not yet been done, and if this history may have caused the development of shallow gas within the sediment. Here I show that I have found these sedimentary units to be contouritic drifts, and that there are clear evidence in both areas of large amounts of shallow gas. These results further establish the existence of gas, and show how this connects to the sedimentary history through deposition of sediments. They also reveal that the sedimentation in the area, by effect of ocean currents, has created these contouritic drifts, which has only in part been established before. The results can show us a holocene history of sedimentation in the Baltic Sea, and how this is connected to the effects of the last glaciation.

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1. Introduction

The Baltic Seafloor has a very rich history in erosion and sedimentation due to its position in northern Europe, which has been heavily affected by numerous glaciation, and its current landscape can tell us much about how it has looked historically and the processes it has gone through (Hall & van Boeckel, 2020). The deposits that today can give us the largest amount of information are contourites or contouritic drifts (Hernández-Molina et al., 2022).

Contourites are usually of a scale of 10^6 km^2 , however, since the Baltic Sea is of a much smaller scale than the vast global oceans, its processes, and through that, their deposits are also of a smaller scale than normal. Contourites are especially interesting since they are large deposits of sediment that gather over thousands of years by sediment drift caused by ocean currents (Faugères & Stow, 2008). This can then tell us much about how these currents have moved historically and how the climate has varied in this region, which since the last glaciation (~22,000 years) has been sensitive to variations in climate and environment, as well as sea-levels, which has changed due to isostatic rebound in the region. Contourites can however also pose risks, as it is possible for them to accumulate large amounts of shallow gas, such as methane, which can be released very suddenly, and cause disruption in climate and any nearby infrastructure (Hernández-Molina et al., 2022). Developing a good understanding of these deposits is therefore key in reconstructing the Baltic's environmental history, as well as creating tools for assessing potential geohazards to eliminate any risks these may create.

To start to develop this in the Baltic area, this report will investigate contourite drifts in two very key areas of the Baltic Sea (Fig. 1). The first of these areas that has been studied is the Landsort Deep, which is the deepest basin within the entire Baltic Sea, which makes an exceptional setting for sediment research, as thick drifts contain preserved and protected climate settings and shallow gas. The second area is the Southern Quark, situated between Åland and Sweden, which is a narrow marine gateway between the Baltic Sea and the Bothnian Sea, where the currents shape dynamic deposits and evidence of methane gas escaping from the seafloor has already been discovered.

1.1 Aim of Study

Seismic data collected from these areas will be interpreted through seismic facies analysis and be combined with data from sedimentary cores as description and logs, to derive a

seismo-stratigraphic framework that can be characterized. Through comparison between the results extracted from the two study areas, the aim of this study is to characterize significant changes in past environmental conditions. To support the aim of the study, the following questions were formulated:

1. Are the sediment bodies in these areas contourites, and if so, how long ago could they have formed?
2. Is it possible to establish a geometry and internal structures, and find evidence of shallow gas?
3. How do changes in environmental conditions relate to possible gas reserves, and how could this be linked to possible contourites?

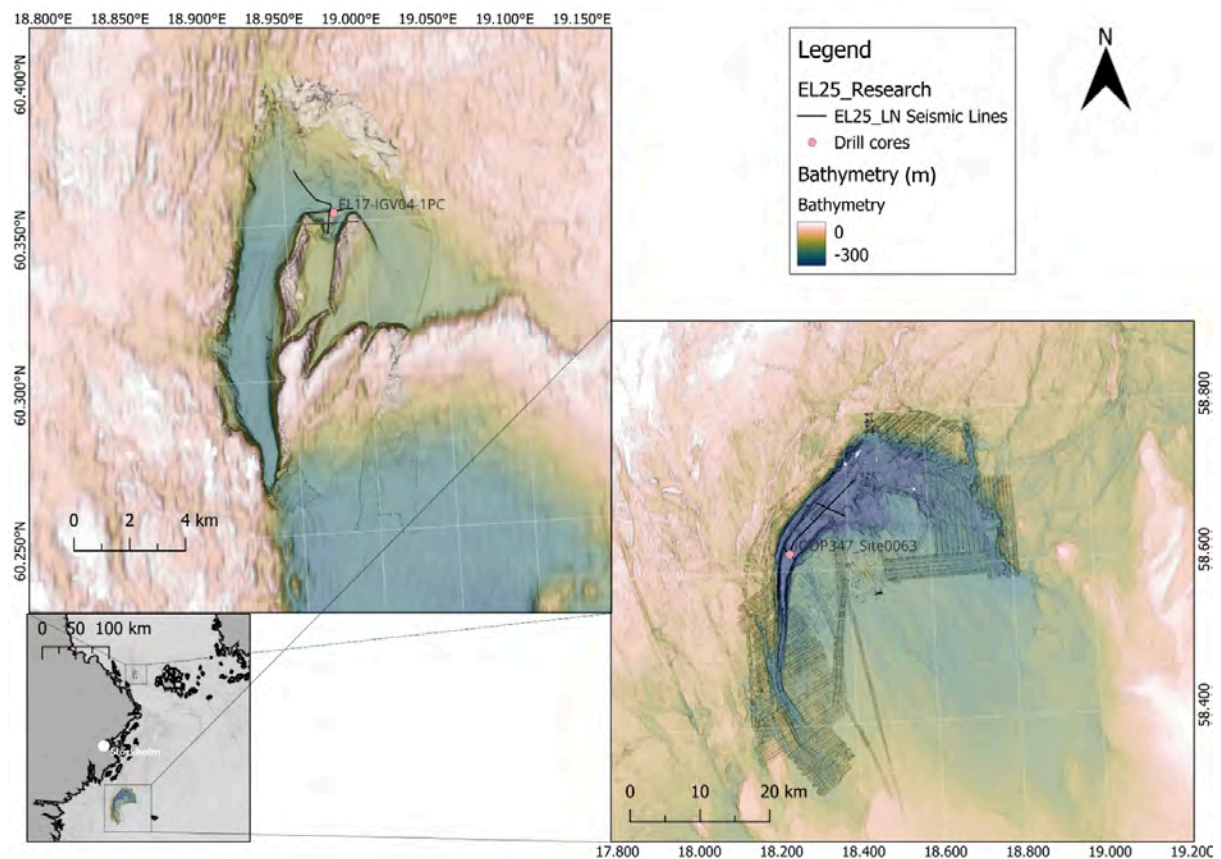


Figure 1: Bathymetric map of the study areas also showing position of cores and seismic lines used. Map projection is set to WGS84 (Ketzer et al., 2025).

2. Background

The Baltic Sea basin is a basin within the Baltic shield, a large unit of mainly Archean and Proterozoic metamorphosed felsic rocks (Gaál, 1986). These rocks were later covered with sequences of sediments coming from the Caledonides, to create units of sedimentary rocks hundreds of meters thick (Floden, 1977; Hall and van Boeckel, 2020). All of these felsic rocks have over the years been slowly eroded and covered and uncovered by large amounts of sediments coming from the nearby orogens.

On a more recent Quaternary timescale (2.58 Ma), this area has undergone large amounts of erosion due to multiple glaciations during the Quaternary (Andrén et al., 2011). These glaciations (8 over the last 740,000 years (Laurent et al., 2004)) covered the entire Baltic region and during their growth pushed the sediment cover southward, leading to the presence of erratics of Rapakivi granite native to Finland to appear in Germany and Poland (Hall and van Boeckel, 2020). During the glaciations and de-glaciations, the glaciers released large amounts of till and other glacial and post-glacial sediments, that make up the base of our study areas.

In the postglacial Holocene times (last 11,700 years) that followed, the depositional environment has been of a marine nature, with sediment coming from the Swedish inland and the Scandes, from where sediment has flowed out into the Baltic Sea Basin.

2.1 The Landsort Deep

The Landsort Deep is the deepest part of the Baltic Sea Basin, and was first developed by a fault zone that runs through the Baltic (Floden, 1977). As this was later eroded by glaciers and loose material was carried away (Hall and van Boeckel, 2020), this left the Landsort Deep, a 3 km wide and 20 km long depression, which after sedimentation sits at a deepest depth of 459 mbsl. The sedimentation of this area, before, during and after glaciations, has left it with a more than 100 meters thick sediment cover (Andrén et al., 2015), which is the first main focus of the project.

2.2 The Southern Quark

The Southern Quark, due to its position between Åland and Sweden, creates a boundary between the Baltic Sea and the Bothnian Sea marked by the Southern Quark Strait. This is the only part of the Åland Sea that is deep enough for there to be an exchange of saline deep-water moving into the Bothnian Sea (Wagner, 2022), and fresher surface-water originating in northern Sweden and Finland flowing out into the Bothnian Bay and Bothnian Sea moving into the Baltic Sea (Wagner, 2022). This rapid flow of currents causes strong erosion in the area of the strait, carrying large amounts of loose material northward with the denser bottom-water. When this water is released from the strait, it creates a thick, contourite-like landform of sediment in the open area to the east of the strait (Holmlund et al., 2022), at depths between 172-199 m, which is the second main focus of this project.

3. Method

3.1 Multibeam

In the Southern Quark, multibeam data to show the bathymetry was gathered by the RV *Electra* with a Kongsberg EM2040 0.4°*0.7°, 200-400 kHz, multibeam echosounder. The along ship transmit 0.4° transducer array is 727*142 mm and across ship 0.7° receiver is 407*142 mm. This is operated using Kongsbergs's Seafloor Operation System (SIS), version 4.3.2. This data was processed at Stockholm University and provided to this project as a grid.

Multibeam data in the Landsort Deep was collected during cruise 507 with RV *Poseidon*. Data was gathered through a hull-mounted L-3 ELAC Nautik GmbH SB3050 multibeam system, with a central frequency of 50kHz and 1.5° *2° TX/RX apertures. This data was provided to this project as a grid.

3.2 Seismics

For seismics at both areas, an ultra-high resolution seismic sparker system by SIG France was towed behind the ship. The system comprises of a SIG Pulse L5 power supply, an ELP790 antenna and a two-channel seismic streamer with a hydrophone spacing of 6*0.2 m for channel 1 and 8*0.75 m for channel 2. The sparker produces frequencies between 100-3500 Hz, however the main frequency depends on the power settings, and the main power setting used was a power output of 1000 J, resulting in a frequency of about 350 Hz (Ketzer et al., 2025). For this particular project, independent calculations were also made.

$$c = \lambda \times f$$

Where c is the speed of sound, λ is the wavelength and f is the frequency. This formula was rewritten to:

$$\lambda = \frac{c}{f}$$

The vertical resolution could then be calculated by dividing the wavelength by 4.

$$\Delta h \geq \frac{\lambda}{4}$$

3.3 Cores

For core integration in the Landsort Deep, data was collected by the Integrated Ocean Drilling Program (IODP) Expedition 347 (Andrén et al., 2015), where cores were recovered from five holes at site M0063, at a water depth of 437.1 m and an average site recovery of 97.9% (Fig. 2).

For the core integration for the Southern Quark, cores were collected by the Stockholm University coring system on the RV *Electra*. During this cruise the corer was equipped with a 859 mm long core head loaded with 476 kg. PVC liners 6 meters in length and an inner/outer diameter of 110/98.5 mm were used. The trigger weight used consisted of a 1 m long transparent polycarbonate gravity corer with an inner/outer diameter of 88/80 mm. This was provided to the project as data by Holmlund et al., 2022.

These cores were then processed and data such as grain sizes, MSCL data, texture, density and P-wave velocity could be identified and put into logs, provided to the project by Holmlund et al., 2022. Necessary data from these logs (P-wave velocity, bulk density and magnetic susceptibility) could then be extracted from Excel and put into the Kingdom suite to visualise it and to compare them to the seismic data.

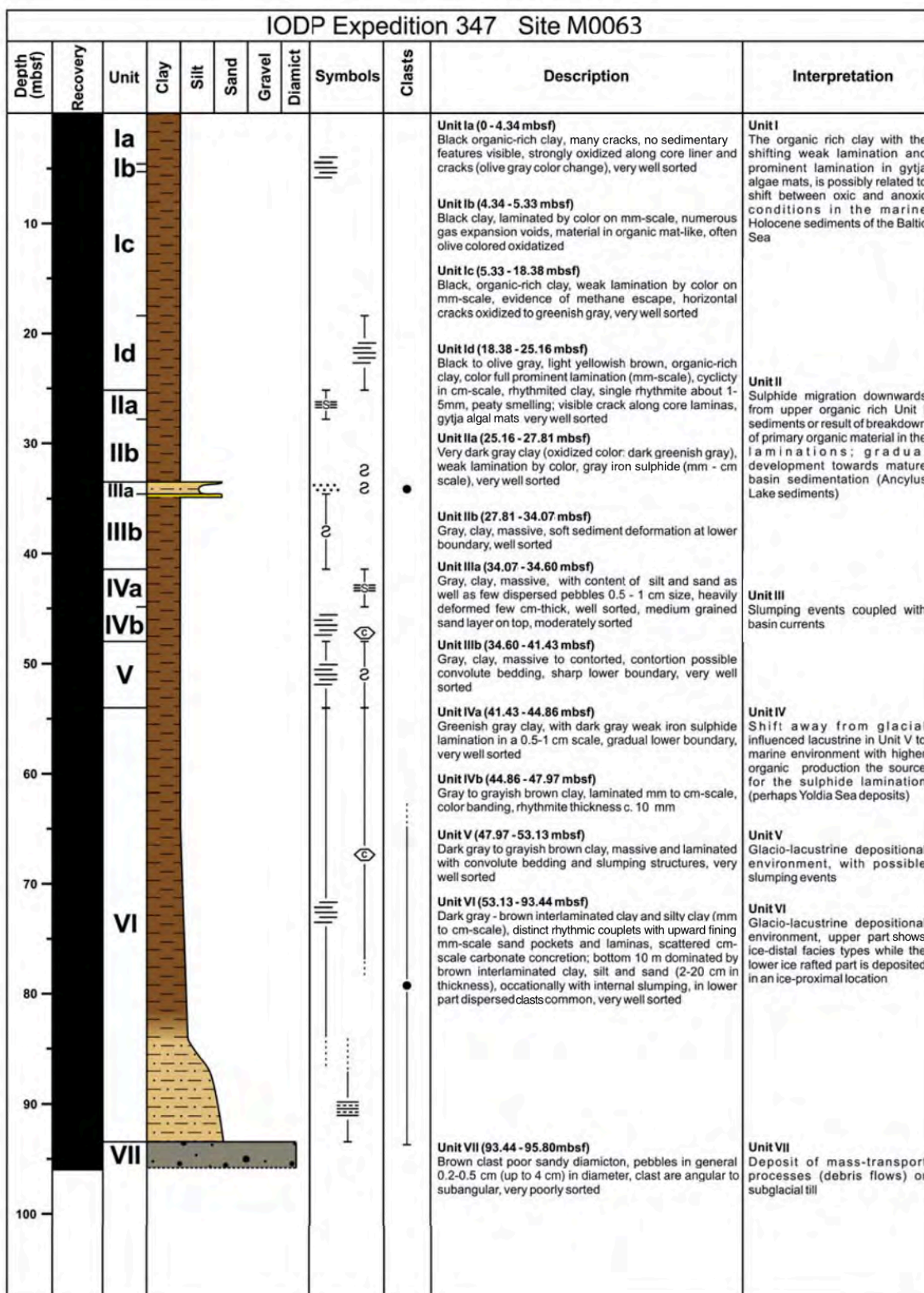


Figure 2: Core data and interpretation of the IODP borehole from expedition 347, site M0063. Image source: Andrén et al., 2015, p. 21.

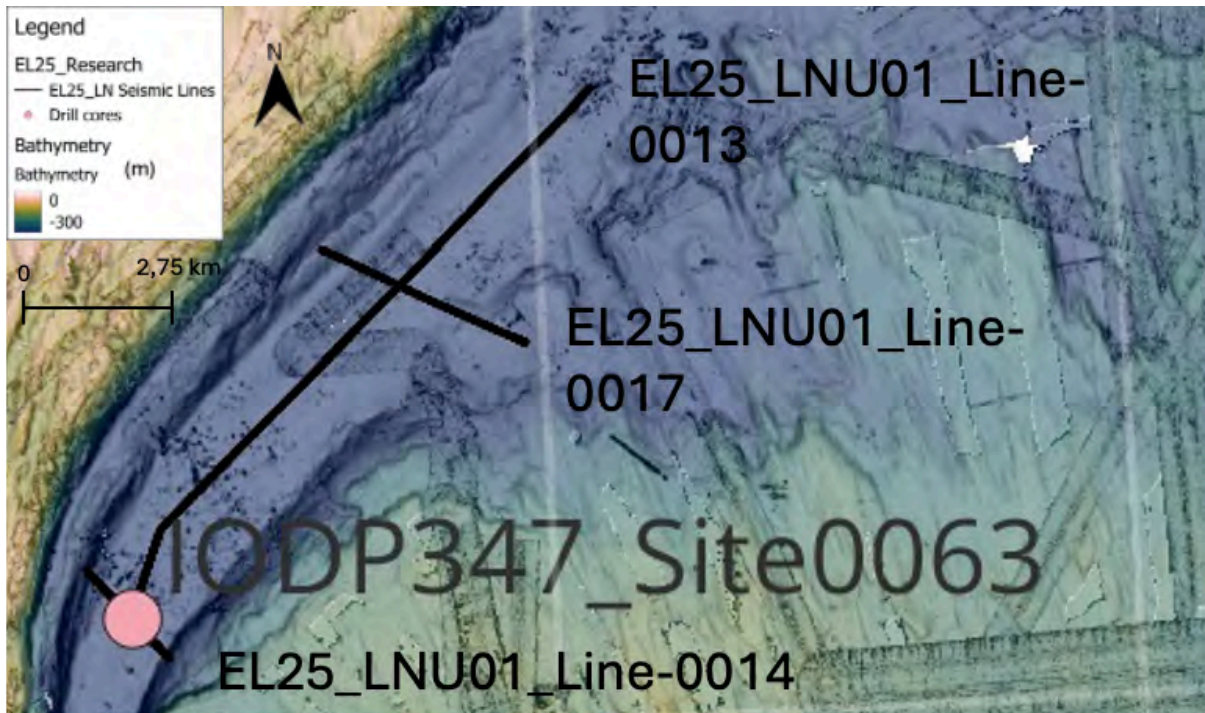


Figure 3: The lines and core from the Landsort Deep. (Andrén et al., 2015 & Ketzer et al., 2025)

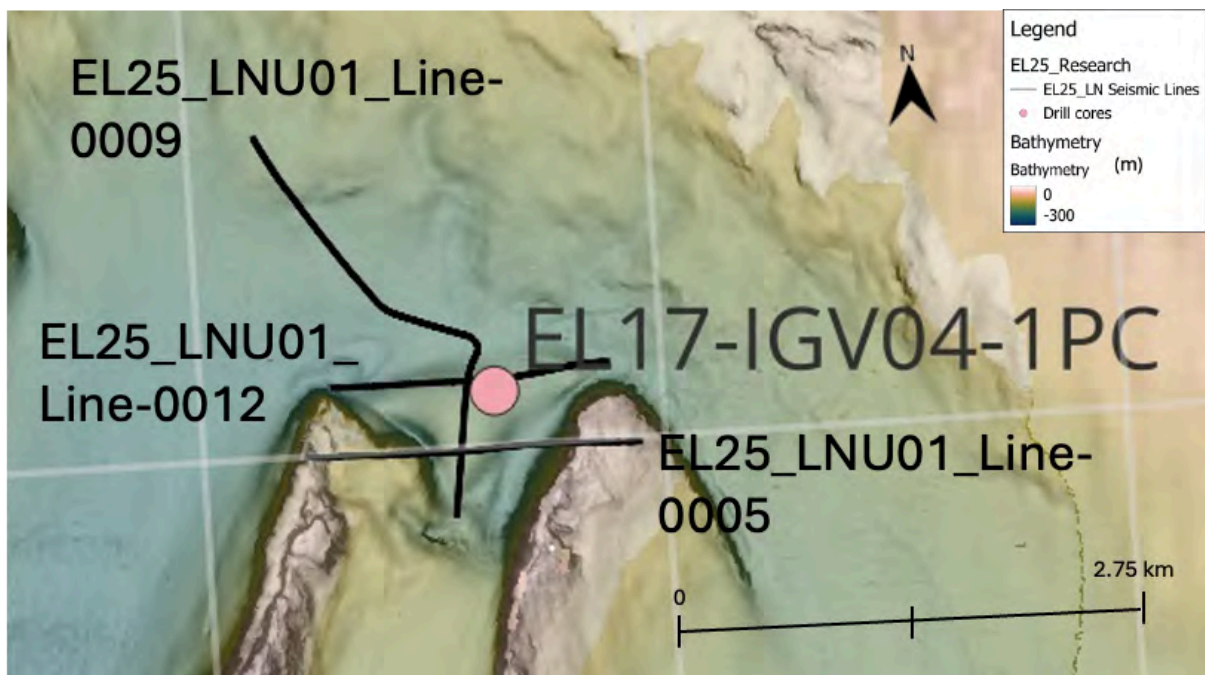


Figure 4: The lines and core from the Southern Quark. (Holmlund et al., 2022 & Ketzer et al., 2025)

3.4 Incorporating data

To prepare the logs for both locations, the seismic data was incorporated in the Kingdom Suite, where the first step was to put out four different horizons that have been described

(Fig. 5), either telling of difference in sedimentary facies, or showing where there is evidence of shallow gas. Horizons for the seafloor and basement were also put out, identified through their strong frequency and no noticeable other units either above or below. The basement units are not described here, as they do not include any relevant information.

Then, the horizons could be converted into grids through flex gridding, with a fit to the data of 0.7 and smoothness of 11. For Landsort Deep, the cell size was set to 50 and the limited distance from the seismic lines to 1000 m. For the Southern Quark, the cell size was set to 10 and the convex hull was set to 100 m. However, for the seafloor and basement here the AOI was limited by distance from data by 500 m. To then calculate the depth below the seafloor, the difference between the seafloor grid and each other layer was calculated in time, to create a new grid. This grid could then be calculated into depth by multiplying it (as difference in time) to the two-way travel time divided by 2.

$$\left(\frac{m/s}{2}\right) \times x$$

(Equation X) The two-way travel time has been taken as an average of the P-wave velocity from the core logs. Two more grids were also created to attempt to give an idea of where the gas pockets might be situated, where the difference between layers in which between, there is a higher amplitude in the seismic data was calculated instead. For this in the Landsort Deep, a polygon was drawn to only include necessary data.

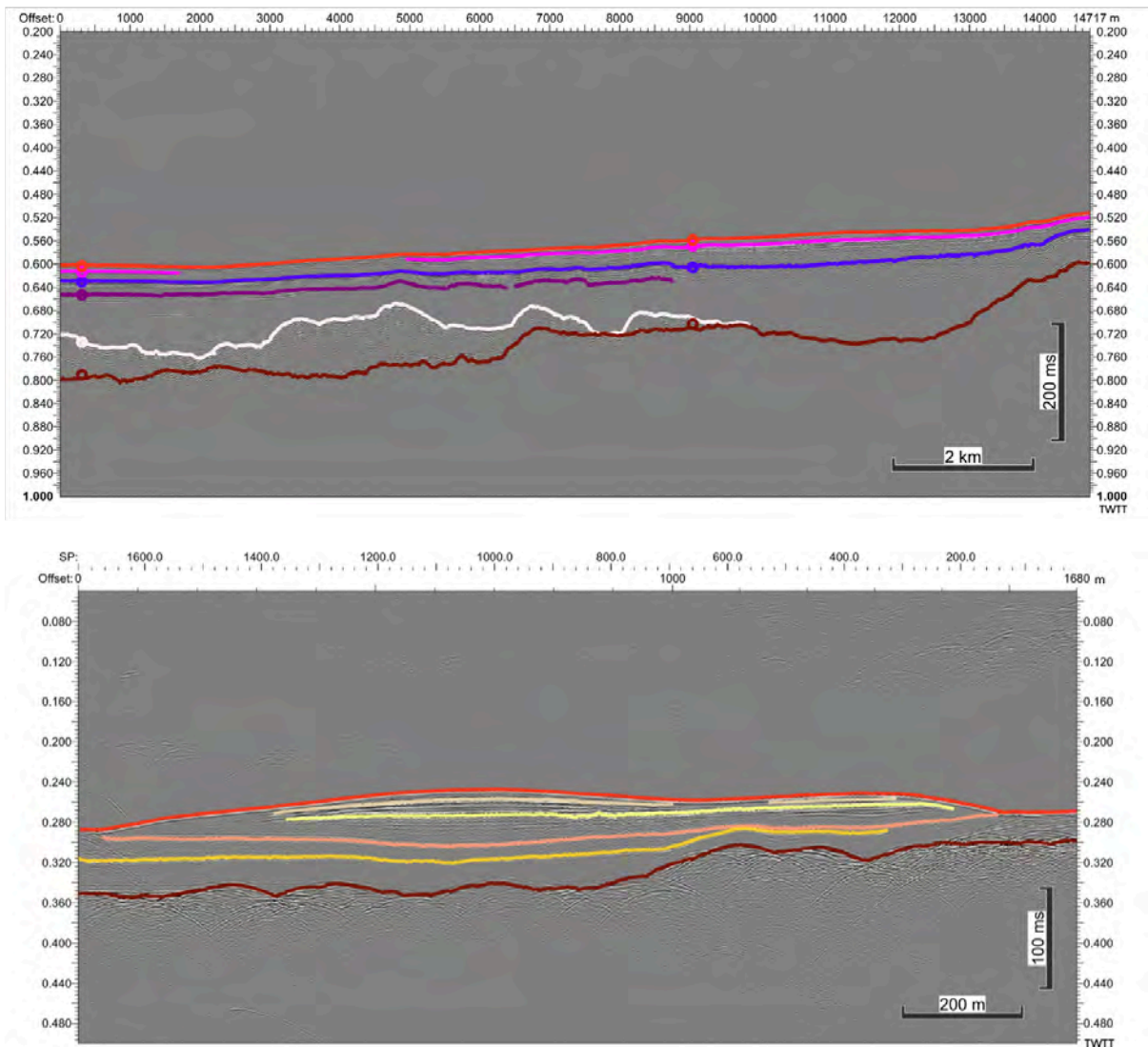


Figure 5: Lines EL25_LNU01_Line-0013 and EL25_LNU01_Line0012 from the Landsort Deep and The Southern Quark respectively. The x-axis shows the distance along the profile and the y-axis shows the two way travel time in seconds. The horizons picked show the boundaries of the seismic units.

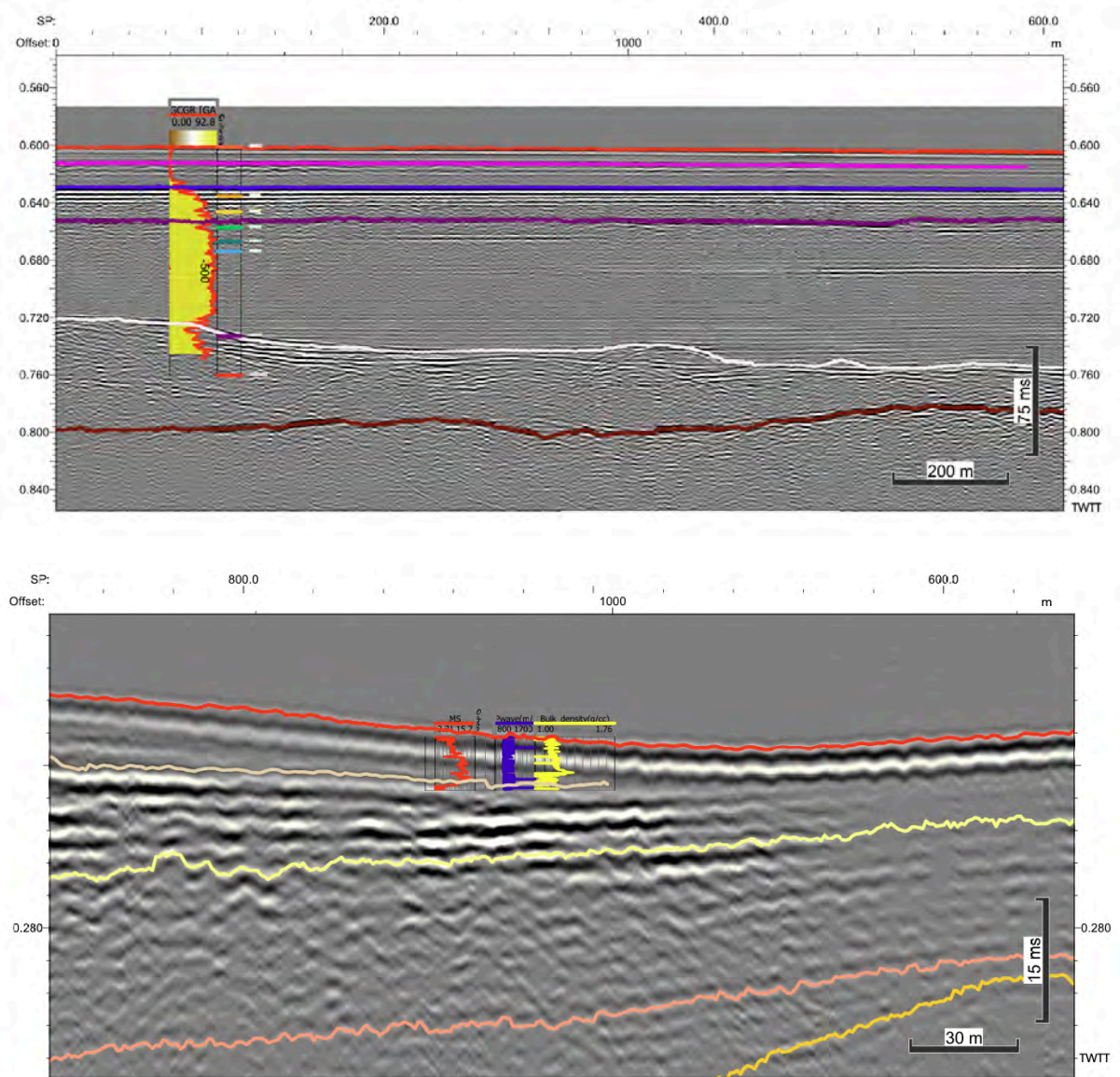


Figure 6: Cores with significant data from the Landsort Deep (upper) (units numbered in figure 2) and the Southern Quark (lower) (Andrén et al., 2015 & Holmlund et al., 2022).

4. Result

4.1 Sedimentary units

In the Landsort Deep, the bottom seismic unit shows a very chaotic structure, with many diffraction hyperbolas (Fig. 7), and lines up with the bottom unit of the lithologic core from the IODP site 347, which shows a sandy diamicton with angular clasts up to 4 cm in size and is poorly sorted (Andrén et al., 2015). This layer appears to be at depths between 140-60 mbsf according to the calculations made (Fig. 8). The third unit (counting the basement as the first) has a more laminated structure (Fig. 7), with a top section of fairly high amplitude and showing some toplap into the unit above. This unit appears at depths of between 125-40 mbsf (Fig. 8), with much variation based on the layers below. The fourth unit is varied in depth, in parts being more chaotic and in parts more laminated (Fig. 7). This unit is of a higher amplitude, however, it blends with the third layer where the boundary is not identifiable, due to overlying layers having very high amplitudes. This layer sits between 60-20 mbsf, with a very uniform thickness (Fig. 8). Unit five contains the highest amplitudes in the Landsort Deep, with a well laminated top section, and a more chaotic lower section, sitting in the shadow of the higher amplitudes above (Fig. 7). This unit is between 40-5 mbsf, however it only covers the parts with noticeably higher amplitudes as these horizons were made to show where the gas pocket might be. The final unit in the Landsort Deep is the top sediments at the seafloor. This is a very well laminated unit, connected to the lithological core (Andrén et al., 2015), which also shows a well laminated unit of dark, organic-rich clays. This unit, at its deepest, goes to about 10 mbsf (Fig 8).

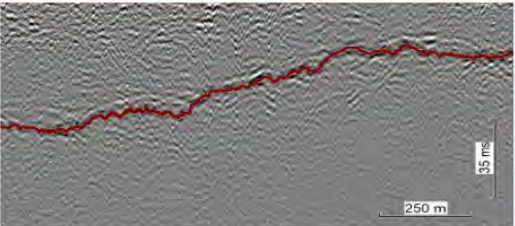
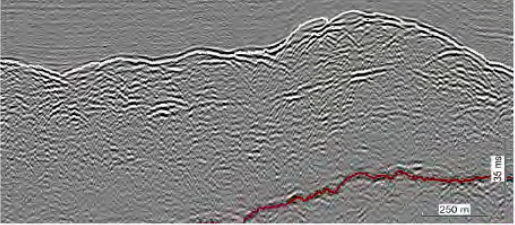
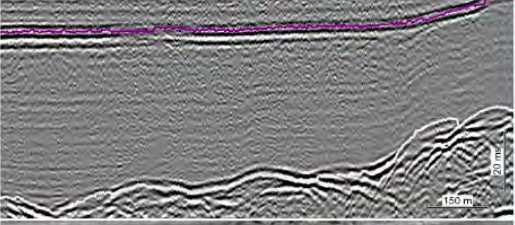
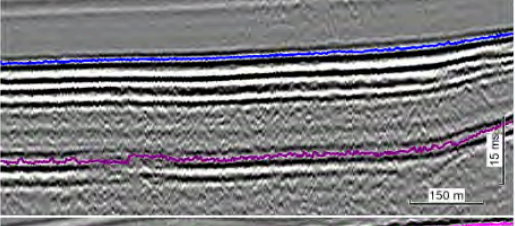
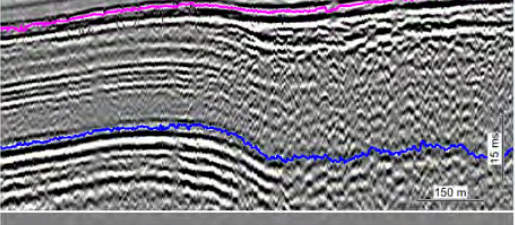
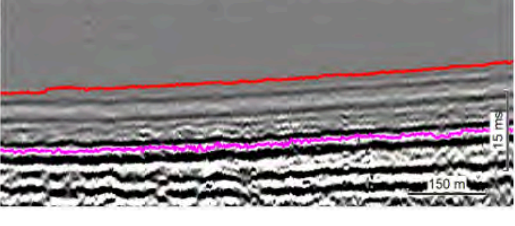
Seismic image	Seismic unit	Description	Interpretation
	I	Chaotic, some diffraction hyperbolas, corrugated surface	Basement, possibly hard rock
	II	Chaotic, diffraction hyperbolas	Pre-marine glacial sediments, subglacial till
	III	Laminated, periods of higher amplitude, some toplap	Potential lacustrine sediments, with glacial influence, boundary between glacial and marine sedimentation
	IV	Well laminated top section, chaotic bottom, high amplitude	Fine-grained sediments, includes gas
	V	Laminated in parts, chaotic in parts, high amplitude	Finer marine sediments, likely holds large amounts of gas
	VI	Laminated, lower amplitudes	Placement of seafloor, likely fine-grained mud, younger marine sediments

Figure 7: The main units derived from the seismic lines in the Landsort Deep, described and interpreted, in part based on how they relate to the IODP drill core (Andrén et al., 2015).

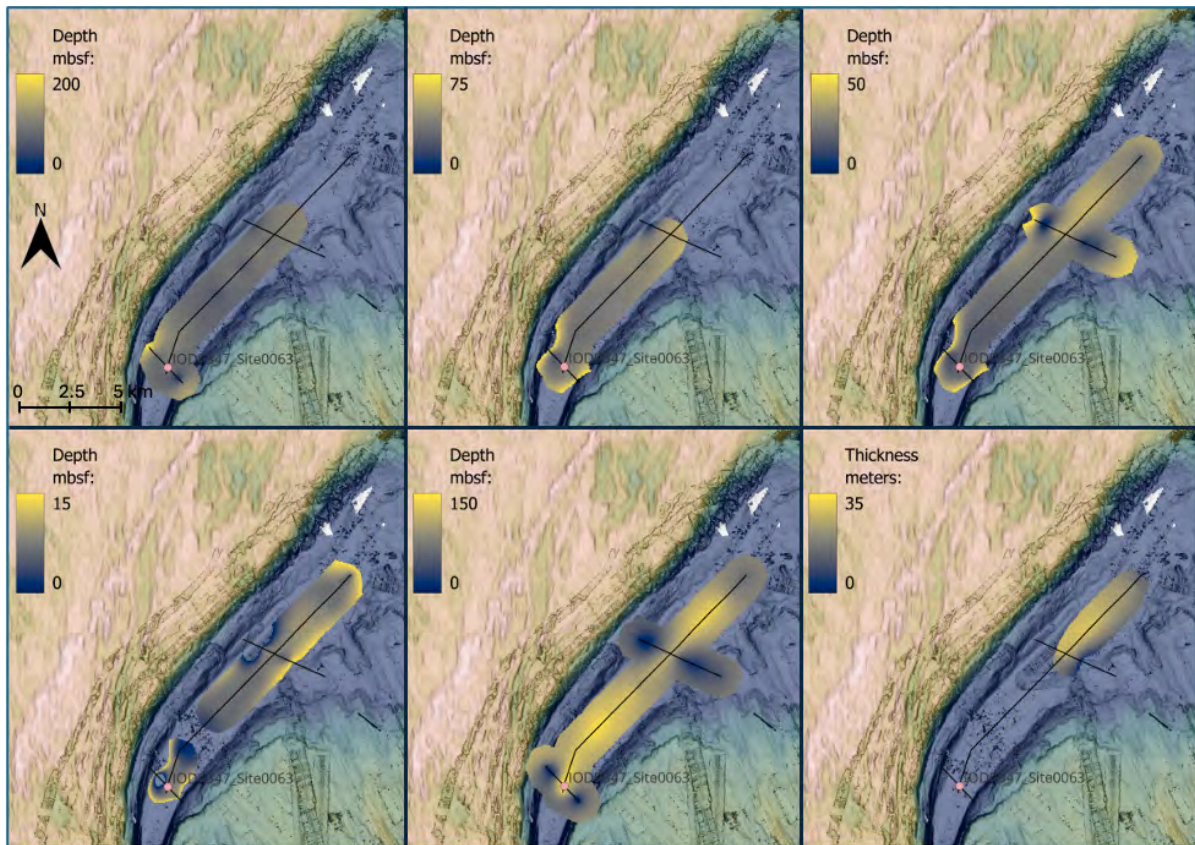


Figure 8: Depth charts of the different seismic units in the Landsort Deep.

In the Southern Quark, the first seismic unit is, as in the Landsort Deep, what has been interpreted as the basement (Fig. 5 & 9). The second unit is somewhat laminated, with pretty low amplitudes. It has a quite varied depth, but is always relative to the basement (Fig. 9). The unit is at depths between 75-10 mbsf, and this varies very much based on the sediment cover, which is a lot less to the northern part of the seismic line (Fig. 10). The third unit is quite limited in the extent in which it is visible, as much of it falls underneath units with much higher amplitudes that overshadow much of it. It is quite chaotic and has low amplitudes, and reaches depths of 45 mbsf and, as the units above are limited to the drift landform, at its edges it reaches the seafloor (Fig. 10). Unit four is laminated with medium amplitudes. It is at depths between 40-5 mbsf (Fig. 10). The fifth unit is well laminated with very high amplitudes. The top of this unit gets cut by the lithological core, and where the horizon is cut, there is a noticeable change in the core data (Fig. 6, Holmlund et al., 2022). This unit lies at depths between 30-2 mbsf, and at the coring point lies at a depth of about 4.5 mbsf. The final unit is laminated and has high amplitudes, and only reaches depths of 10 mbsf, as this is the top layer with youngest sediments.

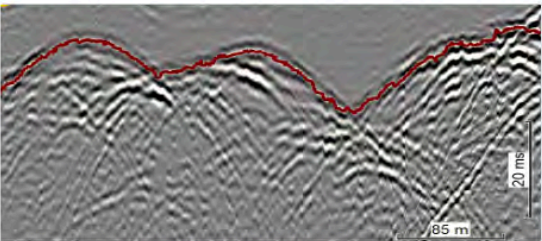
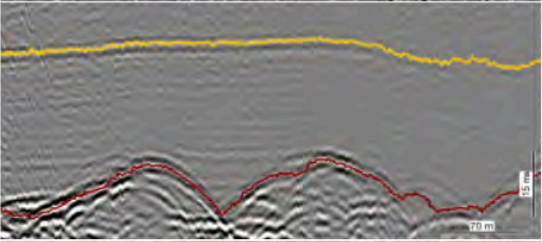
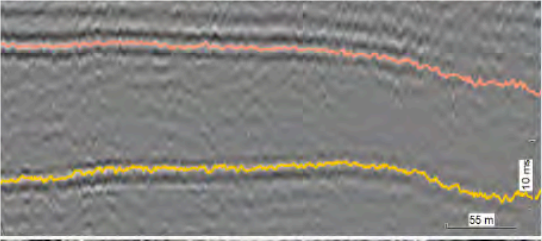
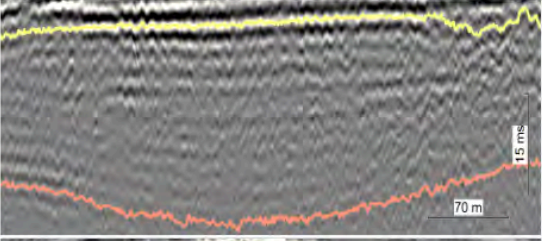
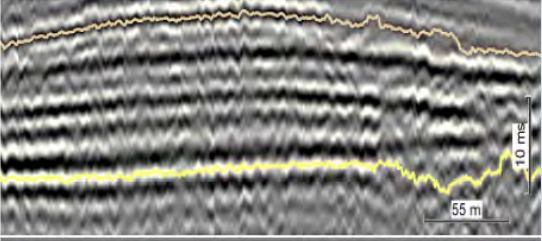
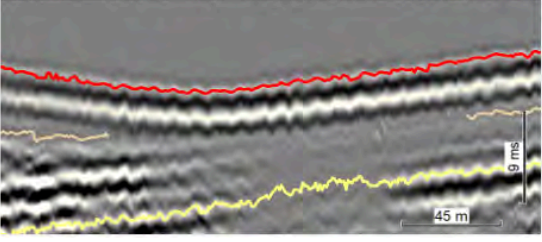
Seismic Image	Seismic Unit	Description	Interpretation
	I	Chaotic, diffraction hyperbolas, corrugated surface	Basement, possibly hard rock
	II	Somewhat laminated, slightly chaotic, corrugated surface	Potential glacial derived, could also be contouritic, slightly larger grained
	III	Chaotic, laminated in parts, low amplitude	Semi-fine grained sediments, deposited by contouritic drift
	IV	Laminated, but chaotic, with corrugated layers	Finer grained sediments, potentially holds gas
	V	Well laminated, high amplitudes	Likely high gas amount within fine-grained sediment
	VI	Partially laminated, high amplitudes, above section has no seismic indication	Placement of seafloor, top layer includes coarser sediments

Figure 9: The main units derived from the seismic lines in the Southern Quark, described and interpreted.

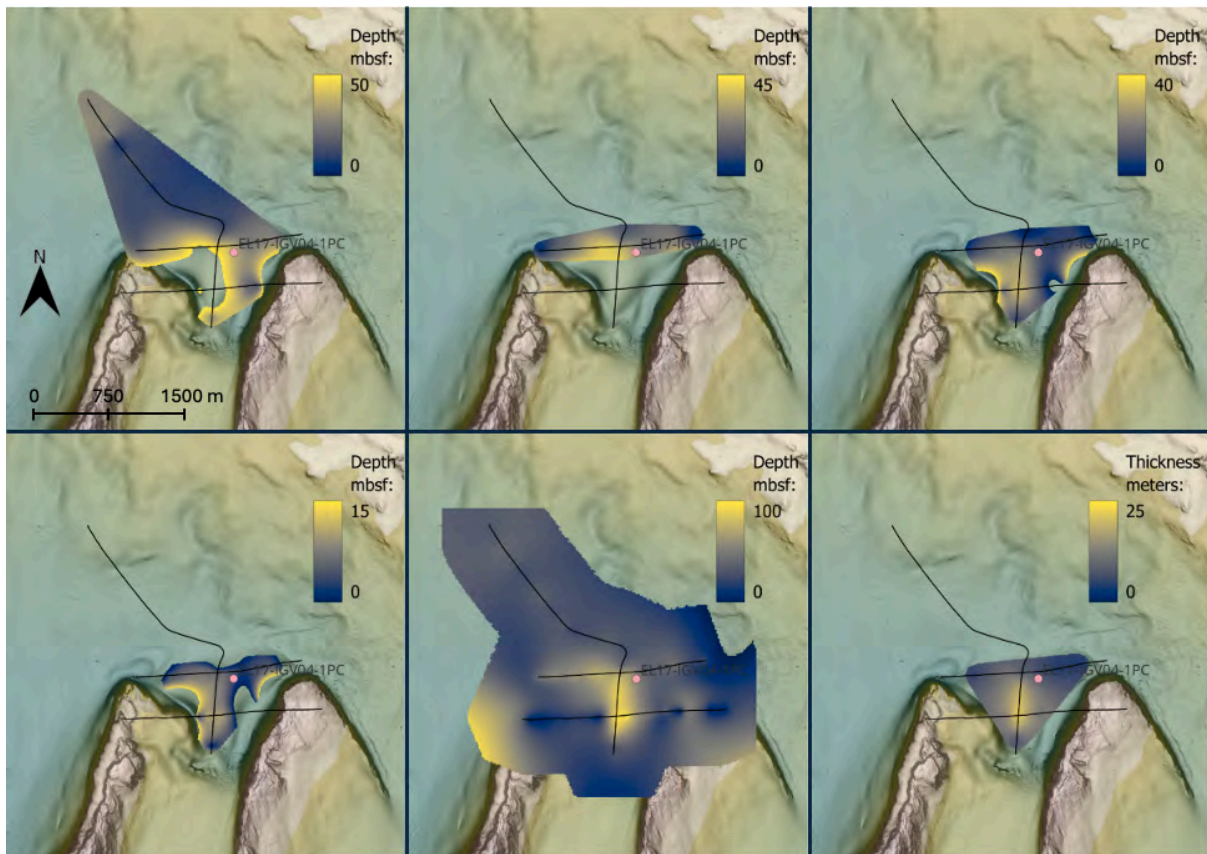


Figure 10: Depth chart of the different seismic units in the Southern Quark.

4.2 Sedimentary structures

Along the seismic line EL25_LNU01_Line-0017 (Fig. 3), horizon 3 gets cut off by the seafloor horizon, but then appears further along this line (Fig. 11). I interpret this structure as erosional truncation since it is cut off by a post-depositional surface. Within the third unit in the Landsort Deep, there is much visible onlap towards the first horizon.

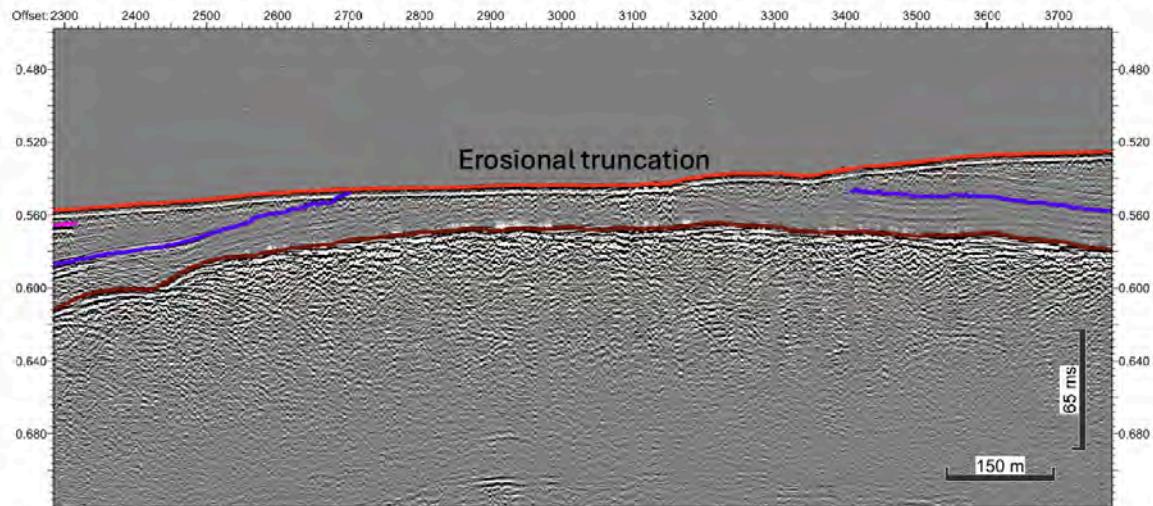


Figure 11: Erosional truncation showing evidence of erosion, potentially as a landslide, in line EL25_LNU01_Line-0017.

4.3 Shallow gas

As there is evidence of shallow gas escape in the Southern Quark through visible gas bubbles in the sedimentary cores from previous studies (Holmlund et al., 2022), horizons were established to encapsulate the extent of these gas pockets, identifiable through the higher amplitudes in the seismic data. In the Southern Quark, these are marked as horizons 2-4, and the grid calculated to show the thickness of the pocket is between horizons 3 and 4 (Fig. 10), as horizon 2 is not visible enough where it lies beneath the others (Fig. 10). This unit has a maximum thickness of about 22 m, and thins out towards the limits of the drift (Fig. 10). In the Landsort Deep, the evidence for shallow gas is not as clearly defined to a specific area, but still very apparent through high amplitude anomalies (Fig. 7). Here, a polygon was drawn out to try and show the major extent of the area with highest amplitudes in the seismic data. This unit was measured between the horizons 3 and 4 and has a maximum thickness of 35 m (Fig. 8).

5. Discussion

5.1 Historical sedimentation and erosional patterns in the Landsort Deep

The first unit of sediments (seismic unit II) in the Landsort Deep contains larger sediment sizes with sandier sediment and grains of sizes up to 4 cm (Andrén et al., 2015). The seismic data of this unit is very chaotic and shows diffraction hyperbolas (Fig. 7), which indicates an unstructured sedimentation and potentially very large clasts. This evidence, along with the history of the region (Hall and van Boeckel, 2020), can tell us that this unit very likely is of a glacial or sub-glacial origin, as the sediment has a close likeness to till. The unit above this is a lot more well stratified than the last and shows onlap into the previous unit (Fig. 12). This may indicate that the sedimentation of this unit has occurred much more periodically. The only boundary of units from the IODP lithologic core that here aligns with the seismic data is the boundary to the till-like unit below (Andrén et al., 2015, Fig. 2). There are multiple units from the core that would fit inside the seismic unit (Fig. 6), and the boundary of the seismic unit would lie close in relation to the unit of the core where there is a change in material from glaciolacustrine to a more organic-rich marine environment (Andrén et al., 2015). Between these two lithological core units, two more are identified as glaciolacustrine sediment, making it likely that these sediments were deposited before the Baltic was opened up to the Atlantic. This gives us a likely timeline of these sediments to between 16 and 11.7 ka, during the Baltic Ice Lake (Andrén et al., 2011). In the drill core units above this, there is now marine sediment and evidence of slumping events connected to basin currents (Fig. 2), showing that the Baltic Sea Basin has opened up to the Atlantic during the Yoldia Sea period (11.7 - 10.7 ka, Andrén et al., 2011). These sediments include sulphide laminations and production of organic material (Andrén et al., 2015). At this depth, the seismic unit (unit IV) shows quite high amplitudes, which is an indicator that these sediments contain shallow gas, which could well relate to the presence of sulphides and organic material (Fig. 2 & 7). Above this, the next core unit describes more mature basin sediments with breakdown of organic material. This likely coincides with the Ancylus Lake at 10.7 - 9.8 ka (Andrén et al., 2011). This lithological unit is in relation to the fourth and fifth seismic unit (Fig. 6), which contains high amplitudes, making it likely that there are large amounts of gas at these depths, which could be connected to the breakdown of organic material creating methane. In the final unit of the IODP borehole, the sediment is very rich in organic material and also shows evidence of gas escaping through cracks and bubbles. The seismic data show that there is likely still

gas at deeper depths of this unit as well. However, the upper parts show less evidence of this (Fig. 7), and these being organic-rich clays, they are potentially too young to have been able to develop much gas, and, this being a shallow unit, if gas have been developed, it has probably already escaped.

Along line EL25_LNU01_Line-0017 (Fig. 4), where there is evidence of erosional truncation, there would likely have been a peak in gathered sediment that at some point more recently got cut off (Fig. 11). Further along this line, there is evidence of a landslide, which would be where the cut off sediment ended up (Fig. 13). This is a more recent event and holds no apparent connection to the shallow gas, so the reason for this landslide remains unclear.

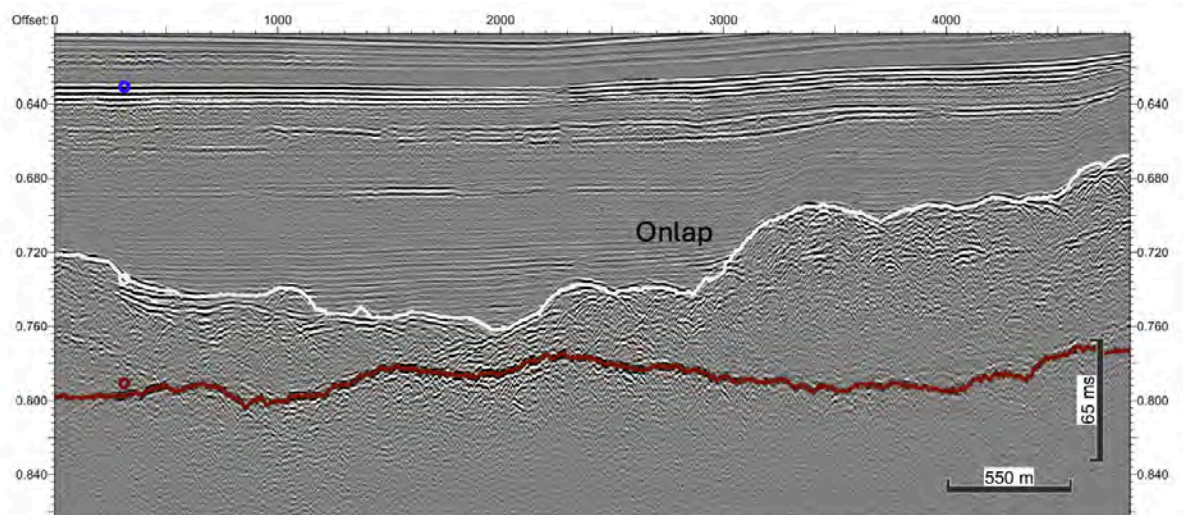


Figure 12: Onlap in unit III in line EL25_LNU01_Line-0013.

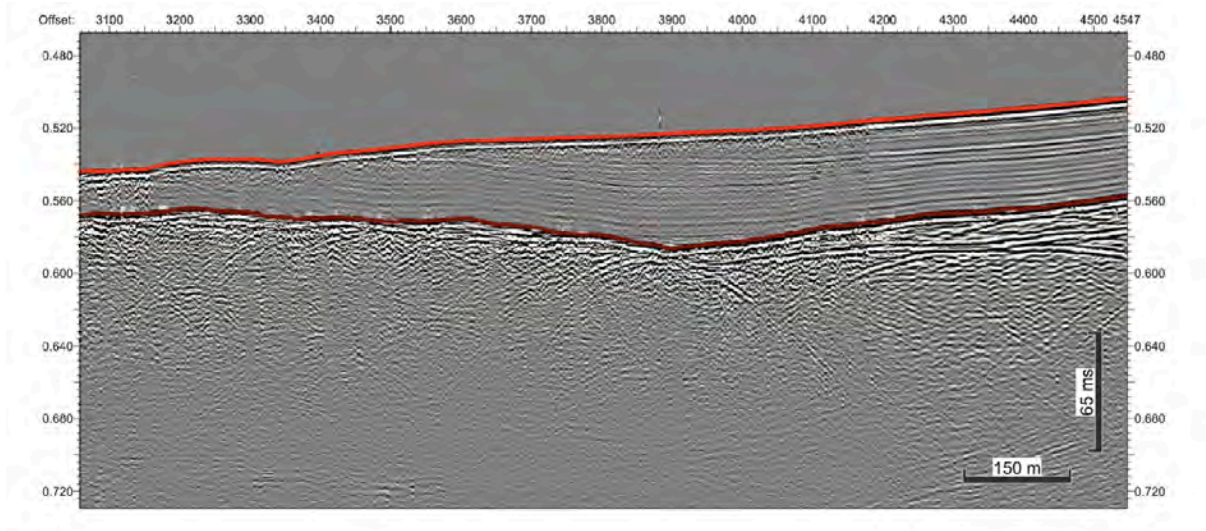


Figure 13: Gathering of slumped sediments along line EL25_LNU01_Line-0017, evidence of a landslide.

5.2 Historical sedimentation and erosional patterns in the Southern Quark

In the Southern Quark the connection between core and seismic data is more difficult to draw, as the cores only go to a maximum depth of 6 m, and therefore only penetrates the top most layer of the second to last unit (Fig. 6). This also makes it so that I cannot interpret any ages for these sediments, and, as sedimentation rates differ, I cannot compare it to the Landsort Deep by age, but the depositional processes visible in the seismic facies can give a comparison of the areas. The first seismic unit here looks to be the sediment that was collected before the contouritic drift deposit started to accumulate, as this unit continues on further north, beyond the deposit (Fig. 10). It is difficult to ascertain what the sediments of this unit are, although it is very chaotic, and shows diffraction hyperbolas, similarly to the second unit of the Landsort Deep, which could indicate a glacial origin, containing a mix of grain sizes, as in till (Fig. 9). In the units above this, up until the sixth, there is also difficulty to ascertain the sediment types, but the seismic data could show us that they are quite fine and somewhat fining upward. These units could all be assumed to have accumulated by contouritic drift, as they only appear in the drift deposit, and not further along the lines (Fig. 10). It is quite likely that all of these units hold shallow gas, but there is clear evidence of this in units IV and V, as they are very high in amplitude in the seismic data (Fig. 9). This high amplitude blocks out data from the units below, so it becomes very difficult to interpret unit III. In the core there is pronounced evidence of gas escape, through cracks and bubbles in the sediment (Holmlund et al., 2022, pp.48-49). The upper-most unit is made up of slightly coarser sediment, containing much organic material, typical for Holocene Baltic sediments

(Holmlund et al., 2022). There are noticeable changes in the bulk density and the magnetic susceptibility in this core, at depths of about 3 m, and the bulk density drops below this, which would indicate that there is a change in the saturation, making this part of the core fissile. At the point where the core crosses the boundary between units V and VI, there is a substantial drop in the magnetic susceptibility and anomalies in the P-wave velocity, which could indicate that this marks the position of the major gas pocket.

5.3 Comparing depositional pattern and relative timing between the Landsort Deep and the Southern Quark

Although the age of sediments is not available from the Southern Quark, and therefore not comparable to the Landsort Deep, one can draw connections between these areas through their depositional pattern, and from that give a relative timing of events. In both of the areas the bottom seismic unit has been interpreted as a glacial or sub-glacial sediment, likely placing these as being from after the last glacial maximum, but before the onset of the Baltic Ice Lake (between 22 and 16 ka) (Andrén et al., 2011). The next unit in the Landsort Deep is interpreted as glaciofluvial from the Baltic Ice Lake (Fig 2), however, during this time the Southern Quark was still ice covered (Andrén et al., 2011), so those sediments are not present here. The same is the case with the sediments from the Yoldia Sea. The Southern Quark was uncovered properly first at around 10.7 ka, during the Ancylus Lake (Andrén et al., 2011), which coincides with the presence of organic material in the Landsort Deep sediments (Andrén et al., 2015). This could be good timing for the first of the drift units to have been accumulated, and as the Baltic then opens up to the Atlantic, the raised presence of ocean currents would simply benefit the accumulation of sediments in this drift unit.

5.4 Answering the questions and further research

Based on the data gathered for this study and the conclusions I have been able to draw from this and the existing literature (Moros et al., 2020), I would argue that there is evidence for considering both of the study areas as contouritic drifts, the Landsort Deep having been this since 11.7 ka, and the Southern Quark since about 10.7 ka, but this is not possible to ascertain more than as a guess based on the Landsort Deep. By studying the seismic data, one can study the internal structure to ascertain a geometry showing fluctuations in amplitude and

diffraction where there are changes in material. Through studying this, there is very clear evidence of the existence of shallow gas in both of the study areas, based on the high amplitude anomalies. The existence of gas would be caused by the breakdown of organic material in the sediments, which is common in the Baltic Sea (Holmlund et al., 2022), and this can relate to previous environments based on in which units the gas appears in, as the older units do not have as much organic material (Andrén et al., 2015), and have lower amplitudes in the seismic data (Fig. 7 & 9), and these being deposited before the Baltic Sea Basin was open to the Atlantic, causing less circulation (Andrén et al., 2011).

For further research within this subject, more substantial coring to deeper depths would make it possible to get better connections between cores and seismic data in the Southern Quark. Having access to physical cores would also assist in a more thorough description of the sediments, as well as being able to date them, to give a higher certainty of their origin.

6. Conclusion

In this study I have compared different physical datasets from two major sediment bodies in the Baltic Sea Basin. The main aims of studying these bodies has been to establish whether these bodies could be considered as contourite drifts and to extract information about the presence of shallow gas in these areas and how this may relate to the sedimentary history of the region. The datasets studied have been seismic, to distinguish an internal geometry to help identify where gas might exist through high amplitudes and how different units in the sediment are structured, and sediment cores, to study the types of sediment and what other data they may include to give ideas about the age and depositional environment of the sediments. Based on these data, I have come to the conclusion that the bodies in these areas may be considered contouritic drifts based on the history of their deposition, and that there may be large units of shallow gas within these drifts. Connecting this with the stratigraphy of the sediment, I have been able to draw the connection between the type of environment the sediment was deposited in, based on where the sediment originated and whether the Baltic Sea Basin was connected to the Atlantic and if they hold gas based on the seismic amplitudes and the presence of organic material in the sediments. From the results that I have discussed, I can draw the conclusion that the presence of gas clearly correlates to the Holocene age sediments that do include much organic material, so I can by extension see that the presence of organic material correlates to the presence of shallow gas. Through all of the information gathered and investigated, I can finally conclude that the contourite drifts in the Landsort Deep and the Southern Quark are well suited as archives for the historical environments of the Baltic Sea, and to comprehend this history and to understand how the drifts may affect today's environment, further investigation should be conducted.

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Appendix

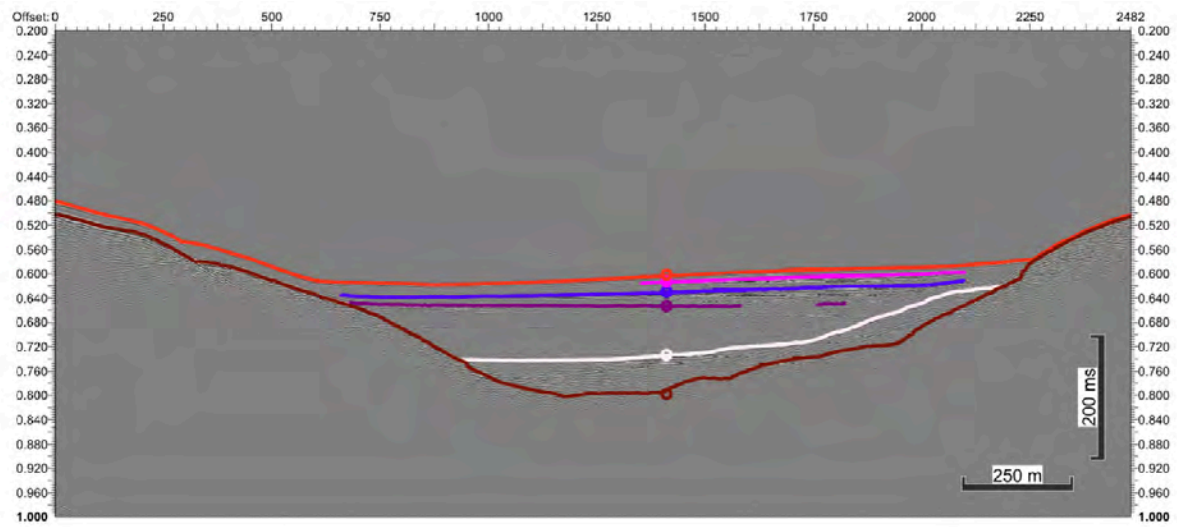


Figure A: Line: EL25_LNU01_Line0014 from the Landsort Deep. The x-axis is the distance along profile. Y-axis is the two-way travel time.

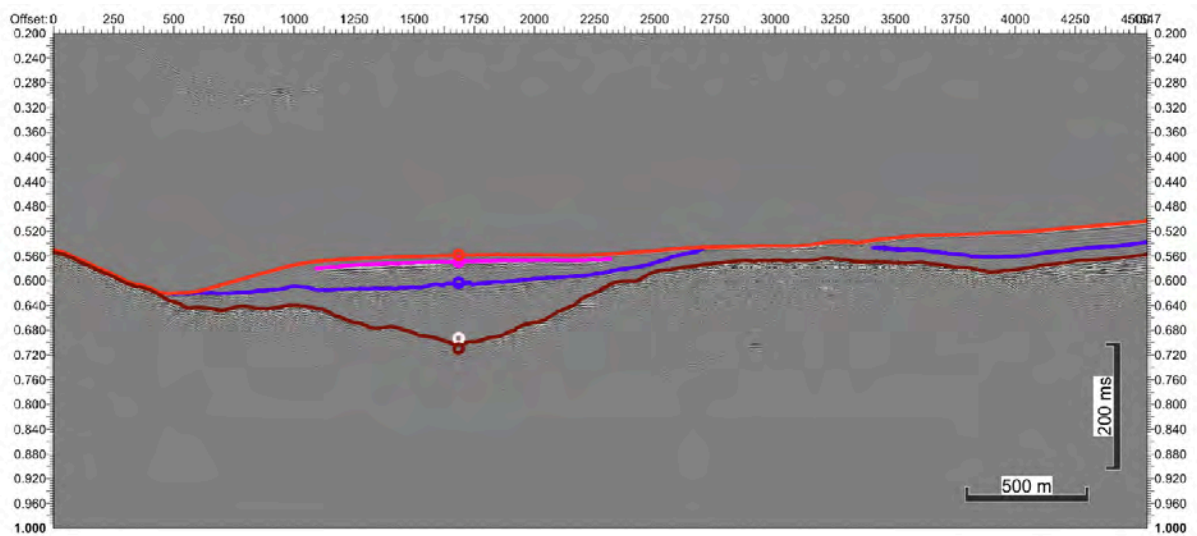


Figure B: Line: EL25_LNU01_Line0017 from the Landsort Deep. X-axis is the distance along profile. Y-axis is the two-way travel time.

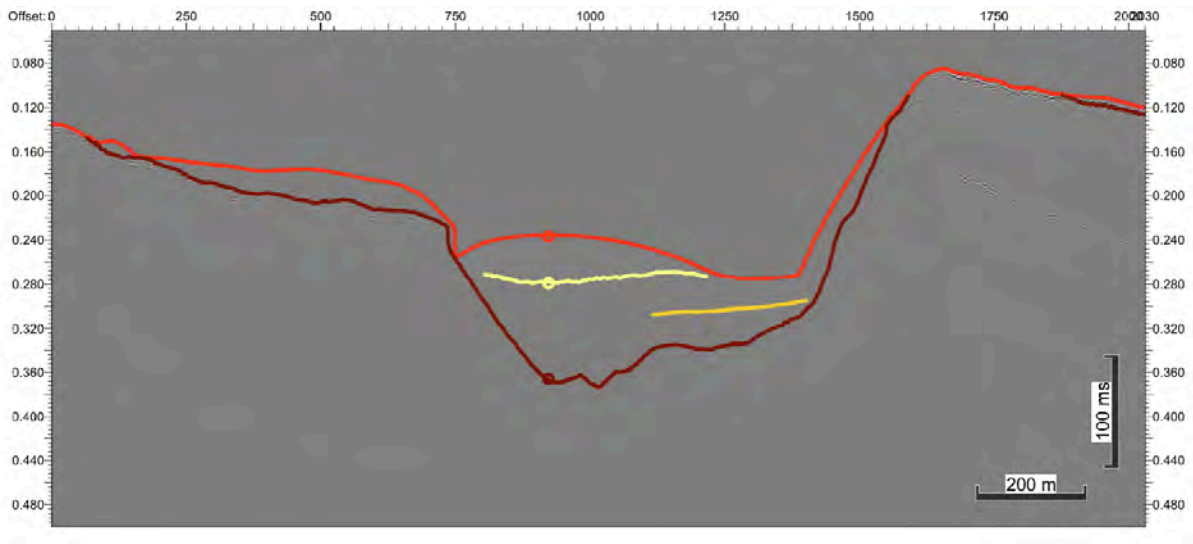


Figure C: Line: EL25_LNU01_Line0005 from the Southern Quark. X-axis is the distance along profile. Y-axis is the two-way travel time.

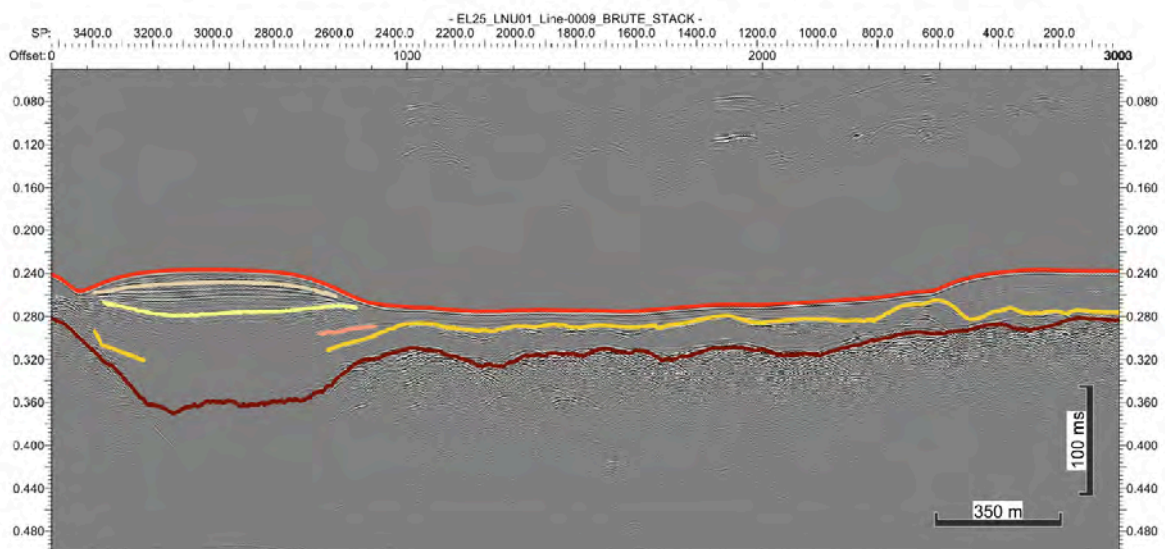


Figure D: Line: EL25_LNU01_Line0009 from the Southern Quark. X-axis is the distance along profile. Y-axis is the two-way travel time.