

Report within the government assignment Geological Storage of Carbon Dioxide in Sweden

Marine Geology – South and West of Skåne

Multibeam and sub-bottom profiling during seismic measurements for Carbon Capture and Storage



Tobias Brattström, Andrea Claesson, Cecilia Edbom Blomstrand,
Max Holmström & Peter Slagbrand

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Authors: Tobias Brattström, Andrea Claesson,
Cecilia Edbom Blomstrand, Max Holmström och Peter Slagbrand
Internal review: Hanna Åkerblom
Head of unit: Maria Khalili
Editor: Johan Sporrang

Cover photo: Stearn deck of R/V Ocean Surveyor passing
under Öresundsbron
Photographer: Max Holmström

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Geological Survey of Sweden

Box 670, 751 28 Uppsala
phone: 018-17 90 00
e-mail: sgu@sgu.se
www.sgu.se

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Abstract

Carbon Capture and Storage (CCS) is an emerging technology with the potential to help mitigate climate change by permanently storing industrially sourced carbon dioxide in deep geological strata. There is therefore a large drive in many European countries to investigate the geological potential for CCS, including in Sweden. Site selection for CCS projects relies heavily on geological data such as marine seismic, borehole and geochemistry to understand the stratigraphy and characteristics of the proposed storage complex. Additionally, knowledge of the near-surface geology is important for the placement of injection infrastructure, as well as for monitoring the storage complex for potential leakage. However, largely due to a lack of a developed petroleum industry, geological data from the marine environment and subsurface in the Swedish territory and exclusive economic zone is limited. As part of a government mandate to investigate the potential for CCS in Sweden this report presents new data of the near surface geology collected during the project along with information about the survey procedures. The presented geological data consist of measurements from three separate survey campaigns with sub-bottom profiler and multibeam echo sounder data collected primarily alongside marine seismic investigations. Multibeam water column data was logged during one of the survey campaigns focusing on known bedrock faults to investigate potential gas leakage. The data indicate some potential gas seep-like anomalies, most with low confidence due to uncertainty in the interpretation and morphology of the observed anomalies. No other gas evacuation structures, such as pockmarks, were observed in the collected data, and sub-bottom profiler investigations have shown no acoustic blanking in conjunction with the observed water column anomalies. This supports the interpretation that the seep-like anomalies either represent very limited gas release or other phenomena.

Sammanfattning

Koldioxidsavskiljning och lagring (CCS, efter engelskans *Carbon Capture and Storage*) är en teknik som har potential att bidra till att mildra klimatförändringarna genom att permanent lagra industriellt framställt koldioxid i djupa geologiska lager. Det finns därför en stor drivkraft i många europeiska länder, inklusive Sverige, att undersöka de geologiska förutsättningarna för CCS. Förutsättningarna för att kunna lagra koldioxid är starkt beroende av geologi och valet av plats är därför starkt beroende av geologiska data såsom marin seismik, borrhål och geokemi för att karaktärisera lagringsplatsens stratigrafi samt egenskaper hos den tilltänkta lagringsenheten. Utöver detta behövs kunskap om de geologiska förhållandena nära havsbotten, bland annat för placering av injektionsinfrastruktur och övervakning av lagringskomplexet. Eftersom Sverige inte har haft en utvecklad petroleumindustri saknas det kunskap om de geologiska förhållandena och därav förutsättningar för CCS inom svenskt territorium och exklusiv ekonomisk zon. I den här rapporten, som är en del av det regeringsuppdrag som tilldelats SGU för att undersöka förutsättningarna för CCS i Sverige, presenterar SGU nya data från havsområdet utanför Skåne. De presenterade dataseten består av mätningar från tre separata undersökningar med sedimentekolod och multistråleekolod, som huvudsakligen har samlats in parallellt med marina seismiska undersökningar. Vattenkolumnsdata från multistråleekolodet loggades under en av undersökningarna med fokus på kända berggrundsförkastningar för att undersöka potentiellt gasläckage. Data indikerar vissa potentiella gasläckage-liknande anomalier, de flesta med låg tillförlitlighet på grund av osäkerhet i tolkningen och morfologin hos de observerade anomalierna. Inga observationer av andra gasevakueringsstrukturer som exempelvis pockmarks har gjorts i de insamlade data, och undersökningar med sedimentekolod har inte visat någon akustisk blankning i samband med de observerade vattenkolumnsanomalierna. Detta stöder tolkningen att de läckage-liknande anomalierna antingen representerar mycket begränsade gasutsläpp eller andra fenomen.

Introduction

The Geological Survey of Sweden has as part of the primary seismic investigation for the government assignment for Carbon Capture and Storage (CCS) gathered near surface marine geological data using sub-bottom profiler and multibeam echosounder in Swedish territorial waters and exclusive economic zone (EEZ) south (Figure 1) and west of Skåne (Figure 2). This report summarises the survey efforts, the challenges faced and gives a short background to the Quaternary geological setting and previous work on gas escape features in the area. The result from the survey is presented as maps of bathymetry and surficial geology, sub-bottom isopachs and potential gas flares along the bedrock faults.

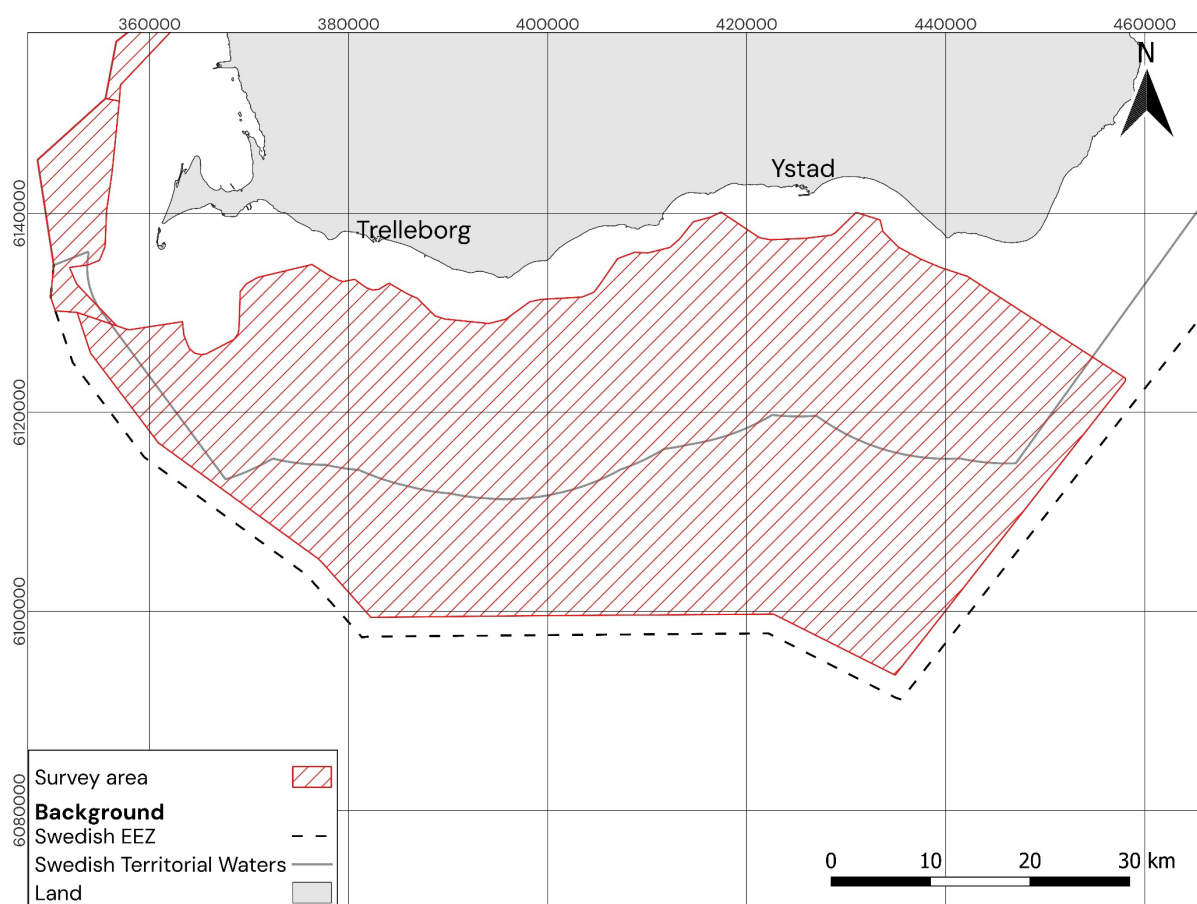


Figure 1. Survey area – South of Skåne.



Figure 2. Survey area – West of Skåne (Öresund).

Survey summary

The project has been active over three years and has had multiple survey campaigns; each survey milestone is shown in Figure 3 illustrating the campaigns during the length of the project. A total of 4 400 line-km has been surveyed in the Skåne survey area (Figure 4). Each of the survey campaigns has had its own focus areas for data collection and the campaigns surveying the areas south and west of Skåne are described in further detail in this chapter.

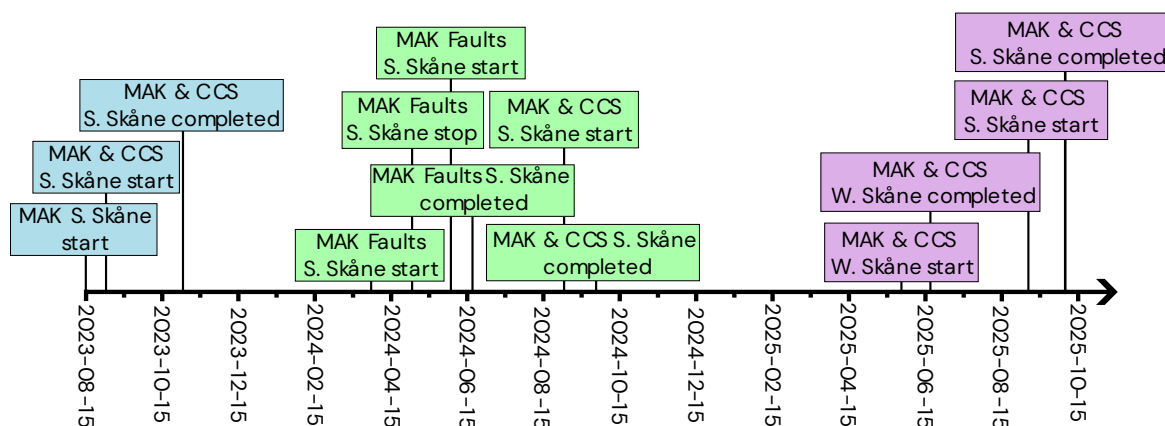


Figure 3. General timeline and survey milestones for the MAK-project (Marin kartering) which was part of the CCS government assignment.

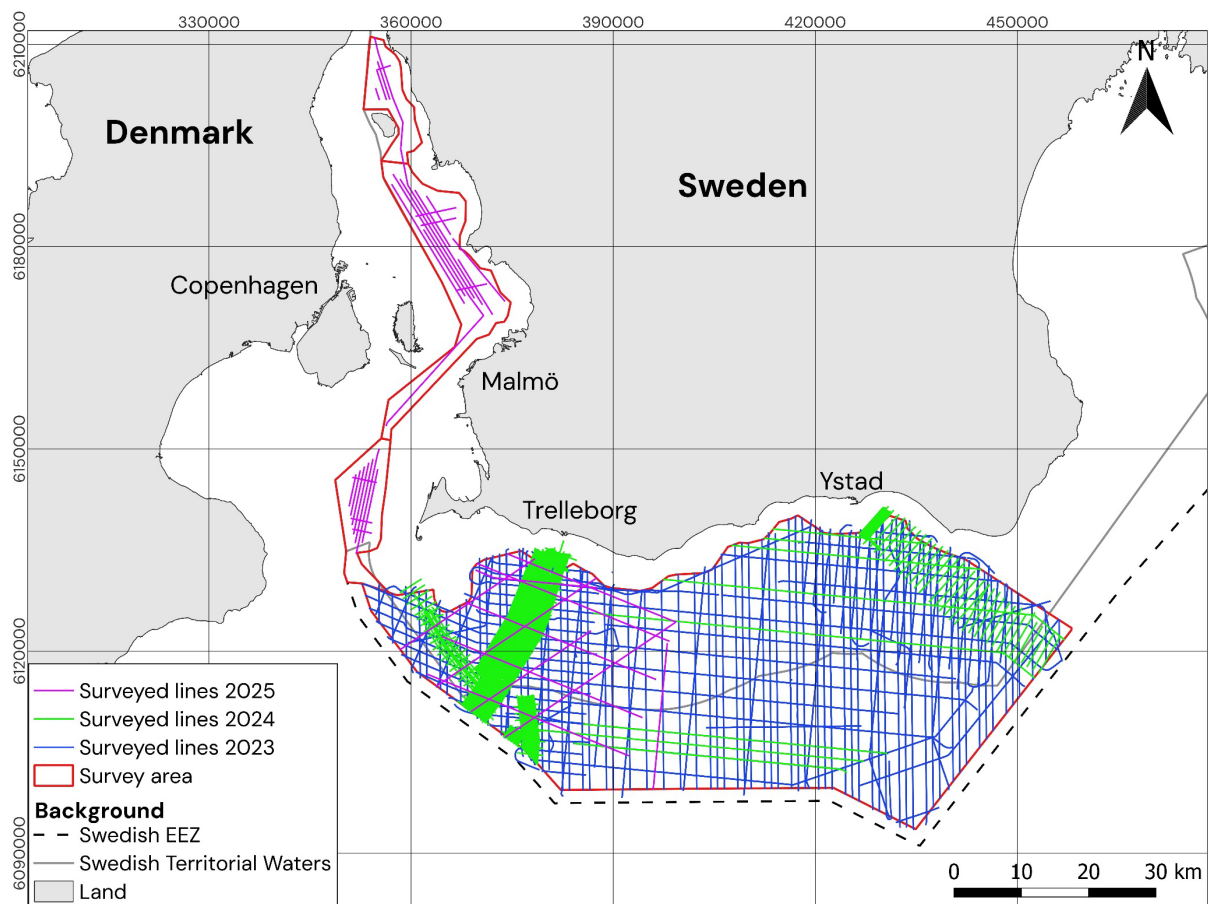


Figure 4. Lines surveyed with multibeam and sub-bottom echosounders in the Skåne area.

In 2023, the marine geological mapping was performed both as part of the seismic data collection needed for CCS but also for assessing geological prerequisites for future wind farms in the areas south of Skåne. Thus, the surveyed lines (Figure 5) consist of evenly spaced lines covering the entire survey area in both N–S and E–W directions, creating a dataset covering the regional geology of the area. Additionally, special focus was put on the western and northeastern parts of the area as these, based on previous studies of the area, were the most promising for windfarm establishment.

The allotted survey time of 77 days 2023 was spent in accordance with Figure 6. The figure is based on a day-by-day account. The weather standby/onboard processing was higher than expected. This was due to the exposed survey location and the survey time being extended to October. Crew changes were held within one day per week and often coincided with weather standby and mobilisations efforts limiting the effect on survey time. The mobilisation and calibration time recorded in the diagram represents mobilisation of the Danish mobile seismic system, which is container based and thus quickly mobilised.

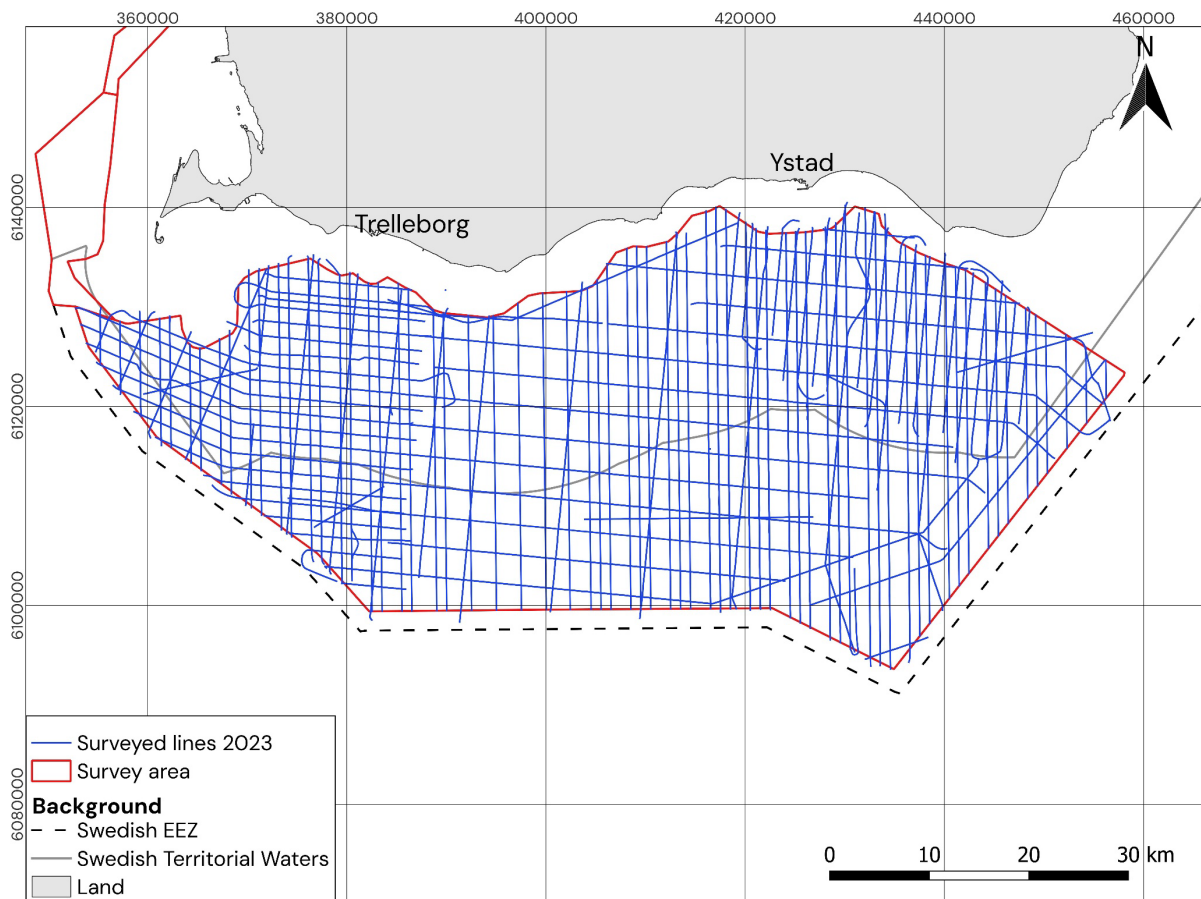


Figure 5. Lines surveyed with multibeam and sub-bottom profiler south of Skåne 2023.

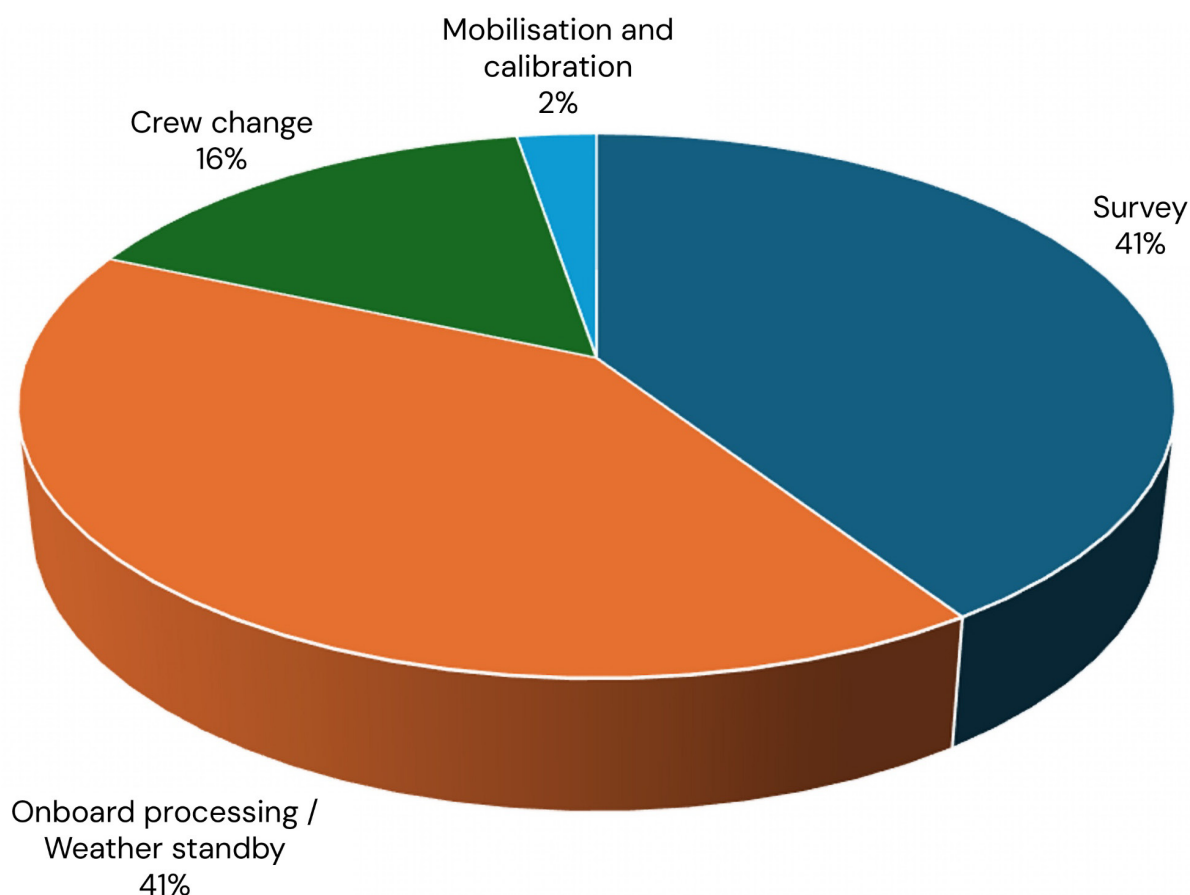


Figure 6. Time (days) spent of allotted survey time during 2023.

In 2024, the aim was to perform seismic surveys, multibeam and sub-bottom profiling in the southeastern area of the Swedish EEZ in the Baltic Sea. However, due to challenges with permits limiting the use of all instruments with an operating frequency under 200 kHz (i.e. seismics and sub-bottom profiler) three additional survey campaigns were planned on short notice. Two of these were performed in the area south of Skåne, the third campaign was performed in the Southeastern part of the Swedish EEZ in the Baltic Sea and is described in a separate report (Marine Geology Southeast Baltic). The aim of the first campaign was to investigate gas escape from previously known bedrock faults by collecting water column data from the multibeam sonar as well as mapping with more continuous coverage to resolve surface features on the seafloor that could indicate gas release. The bedrock fault of main interest based on the bedrock interpretation, and thus most extensively mapped, is the Svedala fault southwest of Trelleborg (Figure 7 - green). The second survey campaign of 2024, was mainly focused on constructing, mobilising and testing SGU's own seismic system. Nevertheless, once the system was functional additional lines with seismics, multibeam and sub-bottom profiler was collected (Figure 7 – light red).

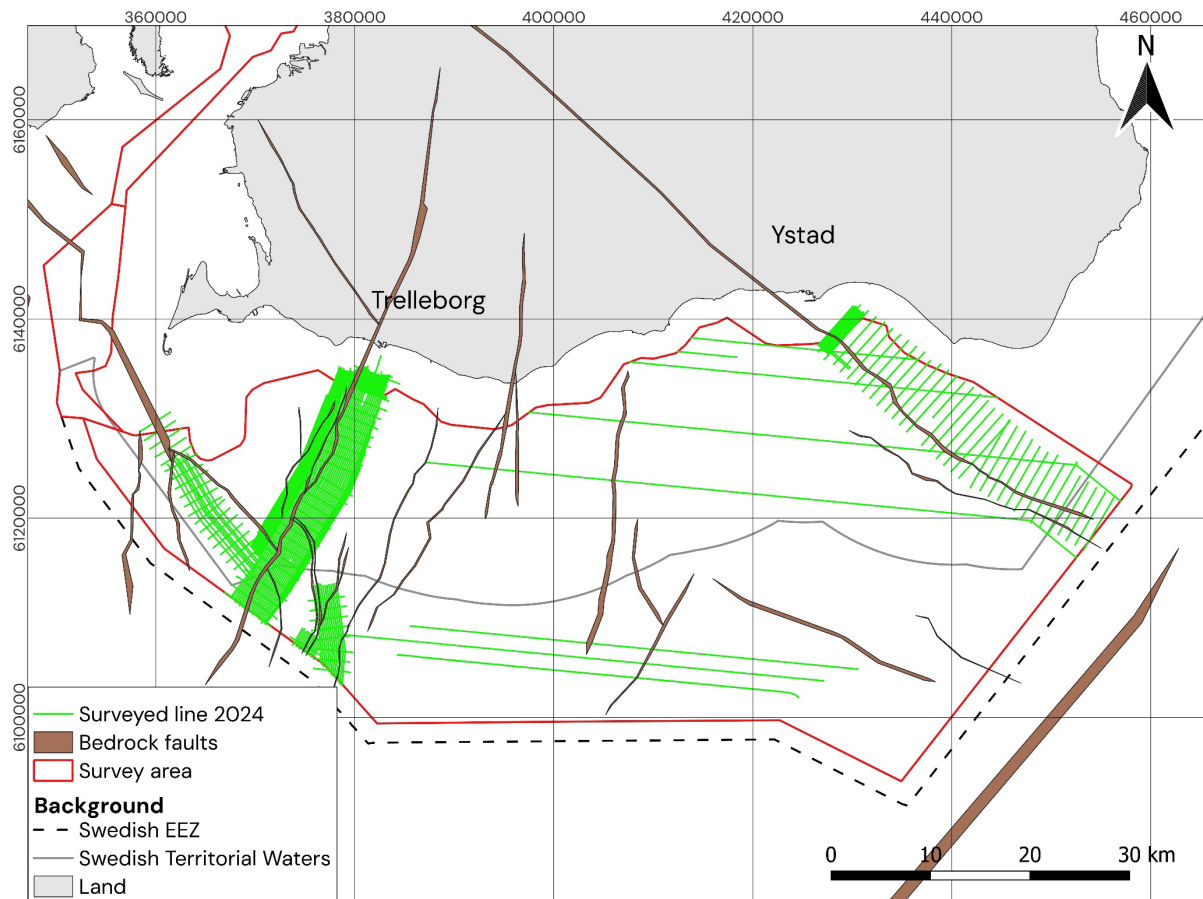


Figure 7. Lines surveyed during 2024. Focus is on mapping gas escapes and surface features close to, or on interpreted bedrock faults.

The allotted survey time of 79 days for the Skåne surveys 2024 was spent in accordance with Figure 8. The figure is based on a day-by-day account. The time spent on mobilisation is due to the focus on using SGU's own system, including constructing supports for and modifying the purchased streamer drum. Time spent on weather standby/onboard processing is as expected for the vessel working in this exposed area during the months April and September. Crew changes were held within 1 day per week and often coincided with weather standby and mobilisations efforts limiting the effect on survey time. The transit time represents the time spent on transit to and from the survey area from the vessels home port of Stockholm. This also included a short system test in Kanholmsfjärden in route to the survey area.

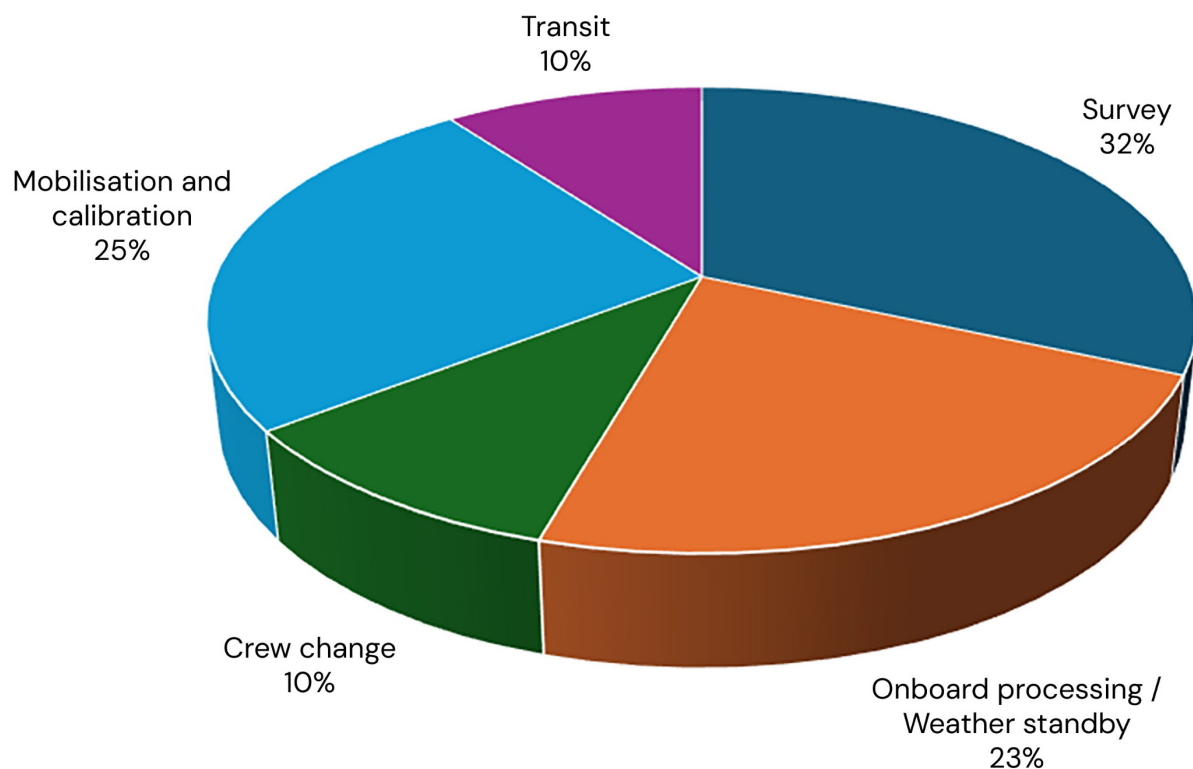


Figure 8. Time (days) spent of allotted survey time in Skåne during 2024.

In 2025, the primary plan was to survey the southeast part of the Swedish Baltic Sea exclusive economic zone, but as the permit got further delayed, several alternative plans were prepared as well. The further survey work was completed in two separate campaigns. The first campaign surveyed, using seismics, multibeam and sub-bottom profiler, was the Öresund region west of Skåne (Figure 9). The primary focus was seismic dataset but the additional sub-bottom profiler and multibeam datasets are, once analysed, of interest both for increasing the knowledge of the near-surface geology and as background data for infrastructure establishment in the region. The second 2025 campaign focused on collecting additional seismic data in the survey area south of Skåne. In this campaign, focus was put on adding additional data in the western part of the survey area since this had been identified as an area of interest through analysis of the seismic dataset collected during previous survey campaigns (Figure 10).

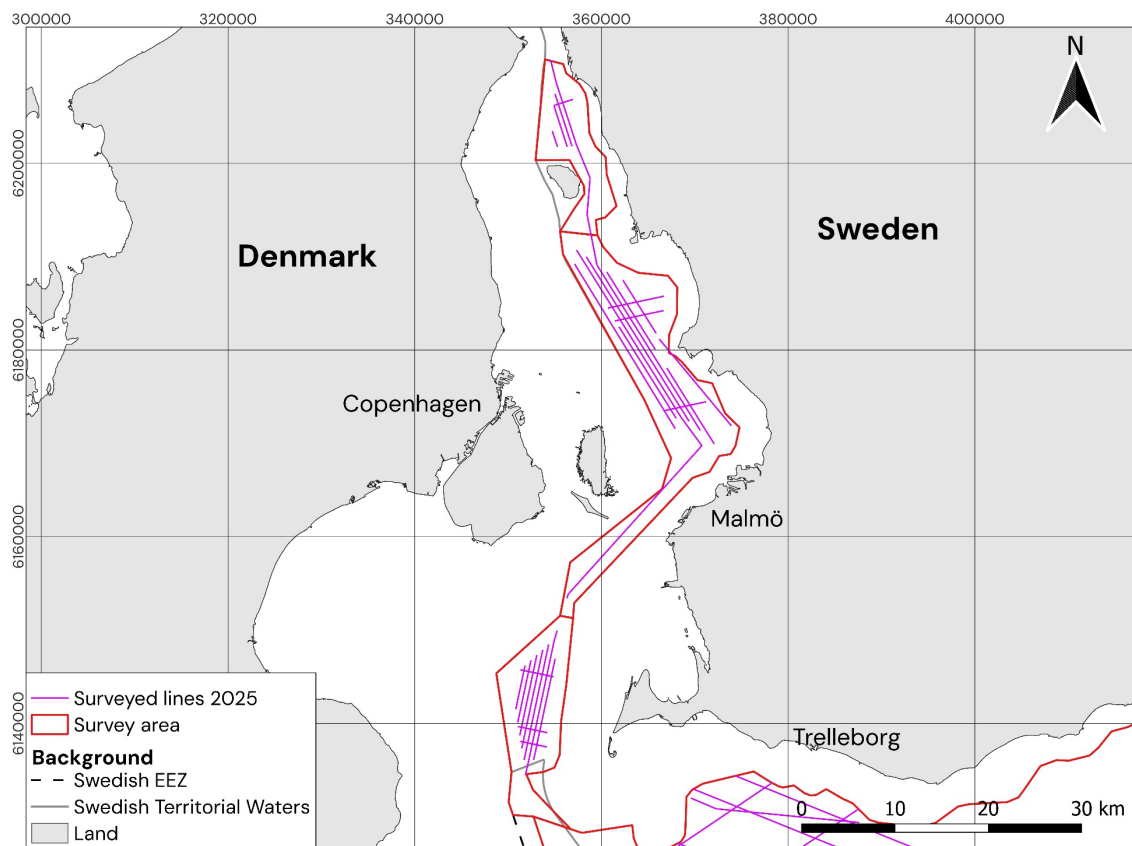


Figure 9. Lines surveyed with multibeam and sub-bottom echosounders in the area west of Skåne.

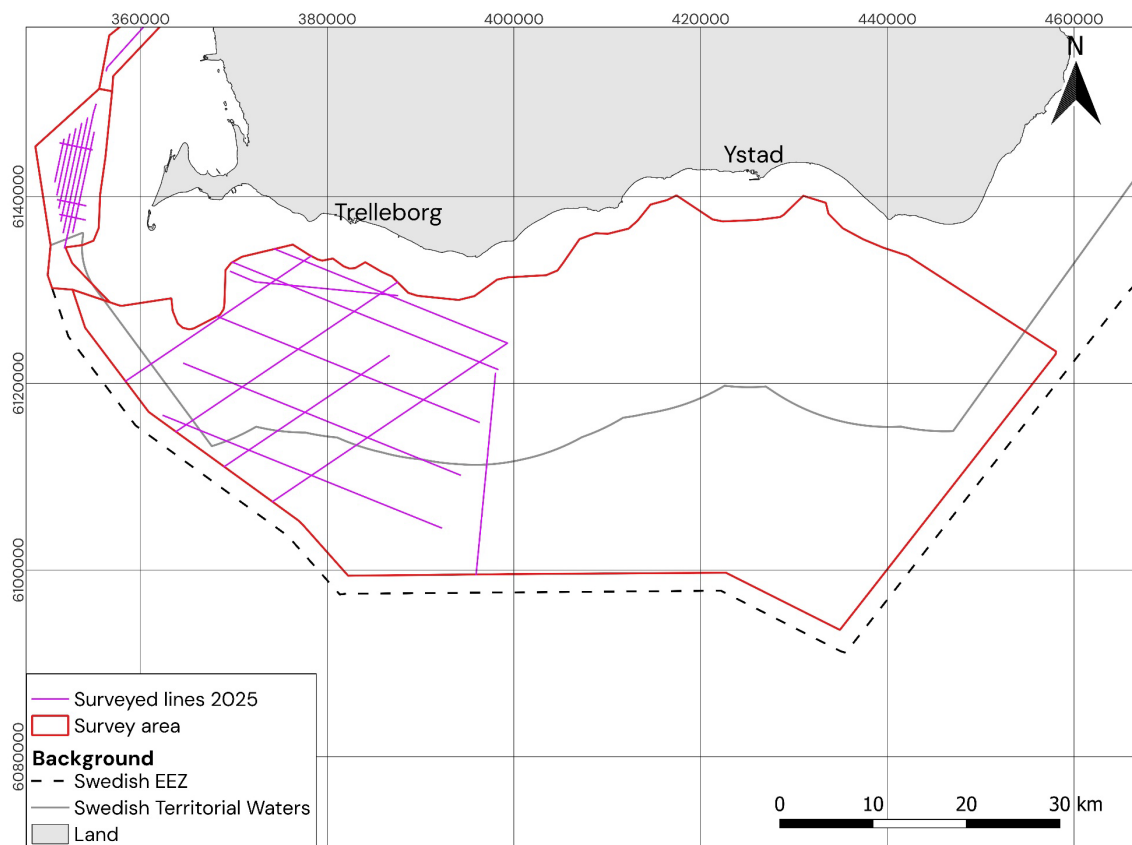


Figure 10. Lines surveyed with Seismics, MBES and SBP south of Skåne 2025.

The allotted survey time of 45 days 2025 was spent in accordance with Figure 8. The figure is based on a day-by-day account. Time spent on weather standby/onboard processing is relatively high for the vessel during the June survey, which this year unfortunately was a windy month in the survey area. The mobilisation time is again looking high at the summary for the year. This is partly due to the survey being split into two campaigns, thus requiring double mobilisations, but also due to a more complex system with deeper penetration than used in 2024. This required additional equipment borrowed from the Geological Survey of Greenland and Denmark (GEUS) in June and rented in September and this also increased the time needed for mobilisation due to the increase in complexity when interfacing different seismic systems with each other. The transit time represents the time spent on transit to and from the survey area from the vessels home port of Stockholm or from previous projects. This yielded a shorter transit to the project in June as the previous project was in Oskarshamn. During the September campaign the transit was impaired by a storm requiring the vessel to seek shelter in the port of Kalmar for two days before being able to continue to the project location. Crew changes were held within one day per week and often coincided with weather standby and mobilisation efforts limiting the effect on survey time.

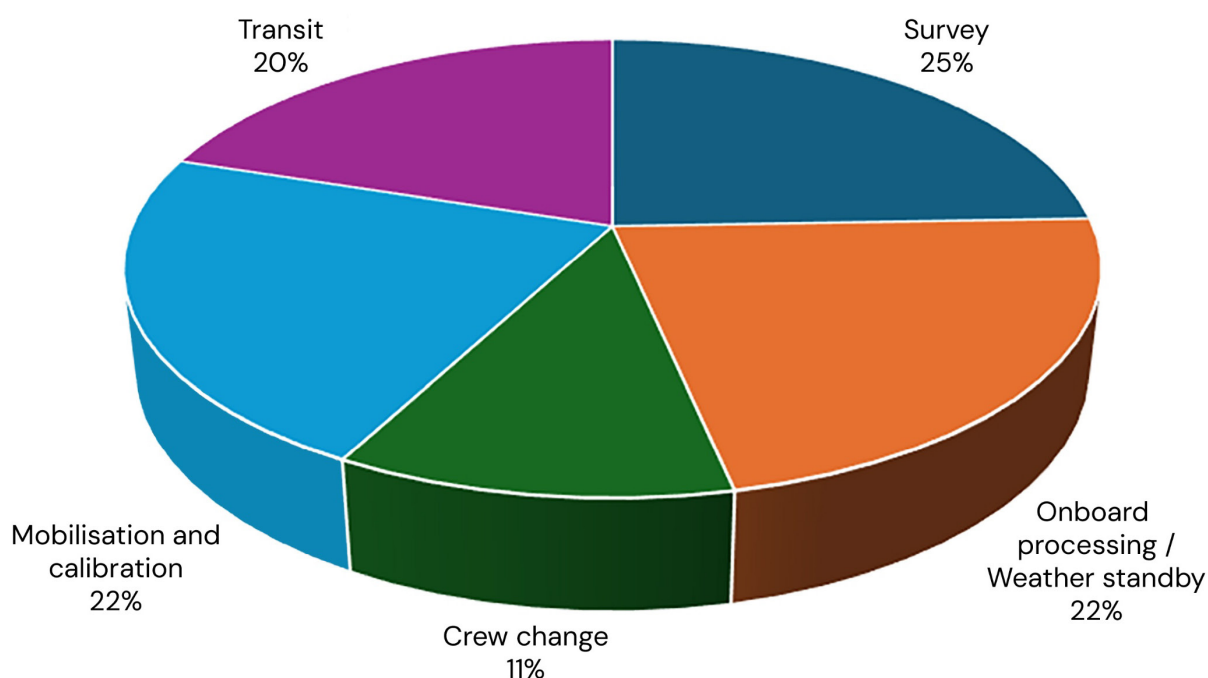


Figure 11. Time (days) spent of allotted survey time in 2025.

Challenges faced

A number of the project's risks have been resolved; their consequences and the actions taken within the project are presented in Table 1.

Table 1. Challenges faced during the course of the project.

Challenge	Consequence	Actioned
Permits for geophysical survey in the southeast part of Swedish Baltic EEZ were denied 2024	No survey using equipment under 200 kHz in the planned area	• Quick re-planned survey scope around bedrock faults using MBES (frequency over 200 kHz) with Water column data in the area an additional survey in the area South of Skåne • Further discussions with governing agency (Länsstyrelsen Gotland) resulting in a full MKB being filed
Permits for geophysical survey in the southeast part of Swedish Baltic EEZ were delayed until midway through September 2025	No survey using equipment under 200 kHz in the planned area	• Fallback plans in place of extended survey in Öresund and further denser surveys south of Skåne
Red (classified) IT-infrastructure not available for workers in Gothenburg until midway through 2024	Backlog of data-processing and interpretation mainly affecting sub-bottom and surficial geology interpretation	• Red IT capability in Gothenburg has been increased • Interpretation scope adjusted to fit timeline
Amount of vessel time spent on mobilisation and demobilisation of seismic equipment	A total of 16% of the vessel time allotted to the project was spent of mobilisation and demobilisation causing less actual survey time than planned for	• The extra time spent has increased SGU's capability to operate its newly acquired seismic system. • Efficiency measures were taken resulting in the time spent decreasing for each mobilisation required
High degree of vessel traffic during the survey west of Skåne (Öresund)	Increased time spent on line turns	• Length of seismic streamer shortened to allow for sharper turns and easier adaption to traffic. • Line plan adjusted to decrease number of lines crossing the shipping lanes while still collecting a relevant amount of data
Weather impacting survey time	A total of 29% of the vessel time allotted to the project was spent in port waiting on weather and processing the collected dataset	• Adjustment and prioritisation of line plan to fit in with time allowed by weather at the location

Geological Background

Site selection for CCS projects relies heavily on seismic characterisation of the proposed storage complex and surrounding geological units. To do this, detailed seismic surveys are performed to establish the geological boundary conditions and make sure that the complex has the desired attributes for successful long term carbon dioxide storage. However, in addition to the knowledge of the deeper geology, it is equally important to also map the surface geology. Geological knowledge of the surface is important for positioning infrastructure needed for injection (platforms, pipelines and wells) but also for the purpose of monitoring the storage complex for leakage and other potential changes over time. It is therefore crucial to establish a baseline before injection and then continue with monitoring surveys of the complex for its effective lifetime, somewhere between 25 and 50 years (Long & Akhurst 2012).

The leakage of geological fluids (gas or liquids) from a proposed geological storage complex poses a significant risk for successful storage of carbon dioxide in the bedrock. It is therefore important to investigate the proposed storage area for signs of gas seepage at an early stage. The highest risk occurs along already existing weaknesses in the underlying geology such as faults, since they might not be as tight as the surrounding cap rock. In addition, near surface features such as infilled sub-glacial channels and/or buried iceberg ploughmarks could also act as pathways for leakage if they are present (Long & Akhurst 2012).

When the leaking gas reaches the surface it can form crater-like depressions called pockmarks by disturbing the surface sediments as the gas protrudes from the seafloor. In this case it is important to determine the source of the gas, which could originate in-situ through biological processes, something that is common in post-glacial sediment with higher amounts of organic matter. Along geological faults the pockmarks can form a string or area that generally follows the fault on the seafloor, which indicates that the gas could have originated from a fossil source (Hovland et.al. 2002).

The area south of Skåne on the Swedish mainland forms part of the Arkona Basin of the Baltic Sea. The area of the Arkona basin that falls within the Swedish territory and EEZ has previously been surveyed by, among others, Lund University, Stockholm University, the Baltic Sea Research Institute in Warnemünde, the energy company Vattenfall AB and the Geological Survey of Sweden.

Surface sediments are underlain by Paleogene and Cretaceous sedimentary bedrock. The sequence of sedimentary bedrock is approximately 1 000 m. The upper part of the sedimentary rock is incised by a complex system of buried channels of Quaternary age. The Quaternary sediments of the area are mainly of Weichselian age, with the infill of the above-mentioned channels being remnants of earlier glacial episodes. The thickness of the sedimentary cover varies from 0 m (bedrock outcropping) to around 40 m.

The overall stratigraphic sequence of the Quaternary sediments from the bottom up is till, glacial clay, postglacial clay and postglacial stone, gravel and sand. The general sequence of surficial sediments is shown from shore outwards in Figure 12.

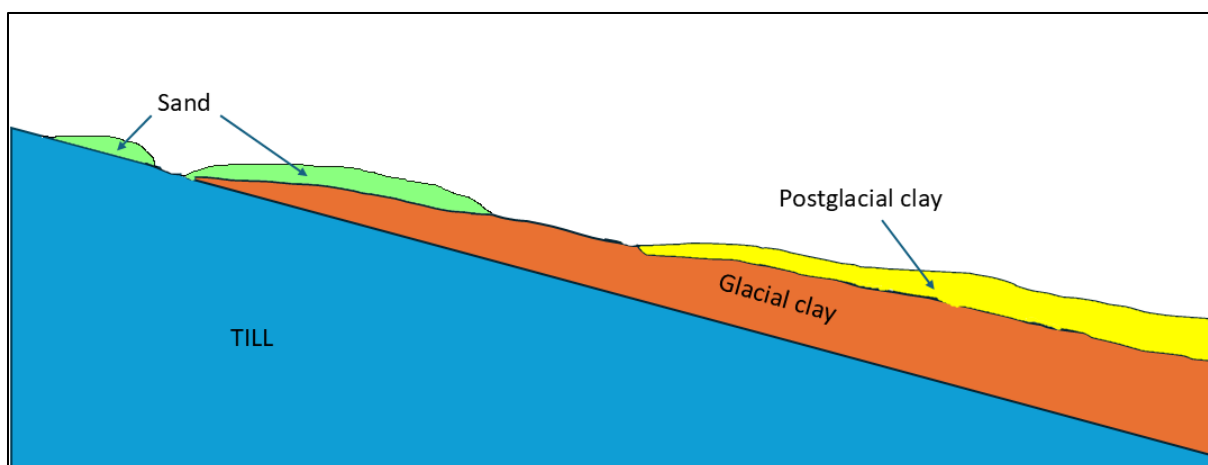


Figure 12. General sequence of surficial sediments.

The till which overlays the sedimentary bedrock consists of two tills that have been mapped in the area. Firstly, a younger till, which is rich in clay and deposited from the ice sheet moving in from the northwest. Secondly an older till was deposited from an ice movement from the east and is richer in gravel and boulders. This unit often forms the acoustic basement for sub-bottom profiler measurements. Glacial clay deposited close to the icefront and overlaying the tills. The extent of the glacial clay is greater than what can be seen from the surface as it is generally overlain by later deposits. Its thickness varies but is generally just a few meters. Postglacial clay occurs in areas where the water depth is greater. Its thickness is generally less than 5m. Finally, postglacial stone, gravel and sand occur both as a thin residual layer on glacial clay and as a thicker layer (1–5 m).

Generally, evidence that would indicate large-scale gas release, such as flares or pockmarks, has not been reported in the Arkona basin. However, sedimentary surficial gas has been reported by several studies (Mathys et al. 2005, Mogollón et al. 2012). The sedimentary gas shows up as acoustic blanking in sub-bottom profiler and shallow seismic systems and is more widespread towards the geographic centre of the basin where it forms a clear gaseous horizon (Thießen et al. 2006). There have been no reports of active gas seeps in the Swedish part of the Arkona basin, the closest indication of an active gas seep has been reported from the eastern part of the adjacent Bornholm basin (Jaśniewicz et al. 2018) in similar soft clays as those that make up the centre of the Arkona Basin, suggesting that gas seepage in the general area is not a common feature.

Scientific Aim

The scientific aim for this report has been to:

- (1) Investigate the presence of gas escape features on the seafloor and investigate whether or not active gas seepage occurs along known fault lines in the area south of Skåne by studying water column data from the multibeam echosounder.
- (2) Map the sediments extent and thickness which can form a base for a risk assessment for subsea construction.

Method

Sub-bottom Profiler

A sub-bottom profiler (or sediment echo sounder) is a high-resolution acoustic instrument used to survey the upper layers of sediment beneath the seafloor. Depending on the pulse type and energy level of the signal, different rates of resolution and penetration can be achieved. Typically, unconsolidated sediments will be penetrated but the signal will not be able to go through denser sediments like till or thick layers of sand. The signal will not pass through bedrock.

There is a trade-off between penetration and resolution. High frequency signals will give better resolution, but poorer penetration and low frequency signals will give better penetration but poorer resolution.

There were two different pulse types to choose from: a Ricker pulse or a Chirp pulse.

The Ricker pulse is a short, broadband, symmetric pulse with a well-defined central frequency. It has good temporal resolution, which allows for precise identification of thin sediment layers and sharp boundaries. Because the pulse is compact and free from long tails, it reduces the risk of overlapping reflections, making interpretation easier. The Ricker pulse provides less energy over time compared to the Chirp pulse. This limits penetration depth.

The Chirp pulse sweeps through a range of frequencies over a longer duration. This design allows for pulse compression processing, which improves the signal-to-noise ratio and enhances penetration depth while still maintaining good vertical resolution. The main drawback is that Chirp signals are more susceptible to artifacts if the sediment boundaries are extremely sharp and the longer pulse duration can increase the risk of overlapping echoes in very shallow or highly reflective environments, thus blurring the image.

The Ricker pulse is better for high-resolution imaging of fine sediment structures at shorter depths, and the chirp pulse is better when deeper penetration is called for Figure 13.

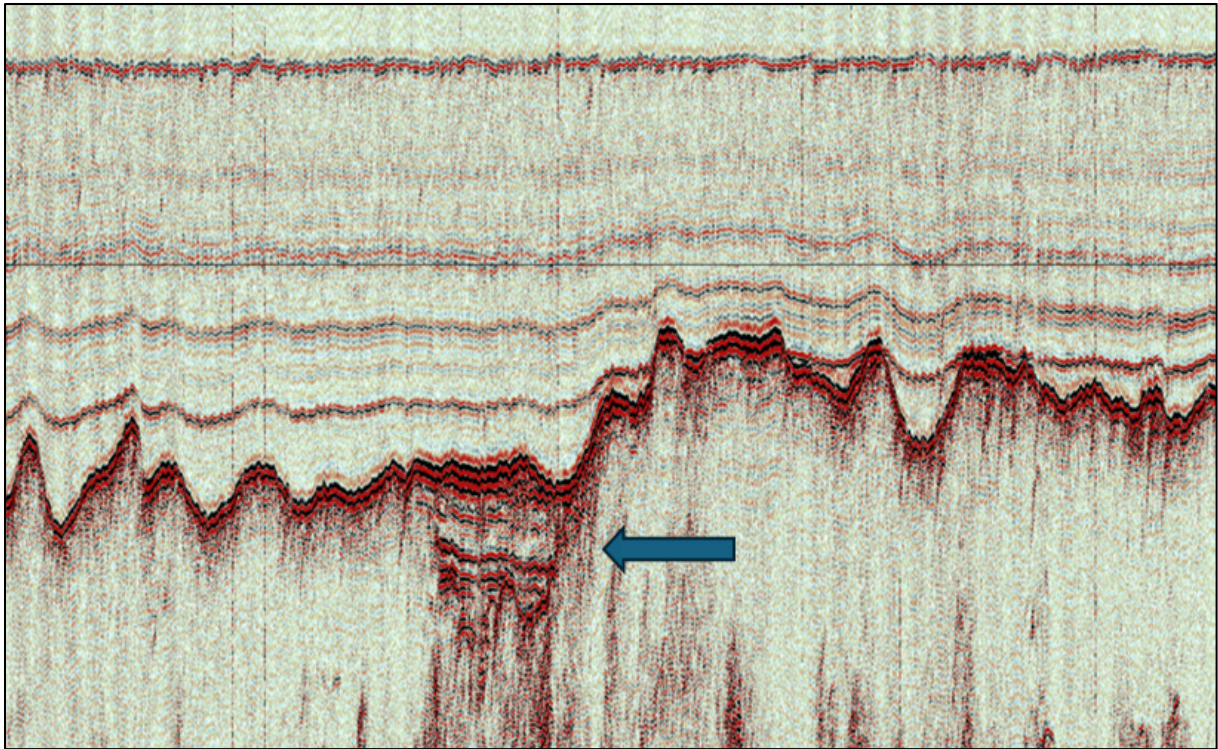


Figure 13. Example showing the resolution achieved by using a Ricker pulse. Most notable at the buried channel to the left of the arrow.

Sub-bottom profiler data was collected using a hull mounted Topas PS120 on board *The Geological Survey of Sweden's* research vessel (R/V) *Ocean Surveyor*. This sub-bottom profiler is parametric with a highly directional beam and has minimal side lobes, resulting in a clearer image of the sediment layers. A Ricker pulse at a frequency of 5 kHz was utilized. The data was logged using Kongsberg's Topas MMI software. The software was set to create two files per log on. One is a .raw file with no filters applied and the other is a .segy file with the filters applied online to visualize the data for quality control during collection. As this online filter relied on an automatic bottom tracking function, which has issues with the transition between soft clay and till a raw (no filters applied) .segy file was created based on the logged .raw file.

The sub-bottom .segy files were loaded into the IHS Kingdom software and filtered using a Butterworth bandpass with a low cut frequency of 4 500 Hz (slope 72 dB/Oct) and a high cut frequency of 31 000 Hz (slope 12 dB/Oct). The files were then bottom tracked and height referenced to the MBES depths using an imported XYZ grid file.

SBP Interpretation

The SBP data for the area south of Skåne was interpreted in the IHS Kingdom software. Interpretation started with five intersecting reference lines aimed at covering as much of the area's geology as possible (Figure 14). These were interpreted referencing previous profiles in the area and ground trothed at multiple geotechnical sampling locations from SGU's database on previous samples. Once the interpretation of the reference lines was agreed upon by the project team, it was extended to an additional 20 lines arranged in a grid pattern at approximately 8 km intervals, in order to cover as much of the area as the available interpretation time allowed.

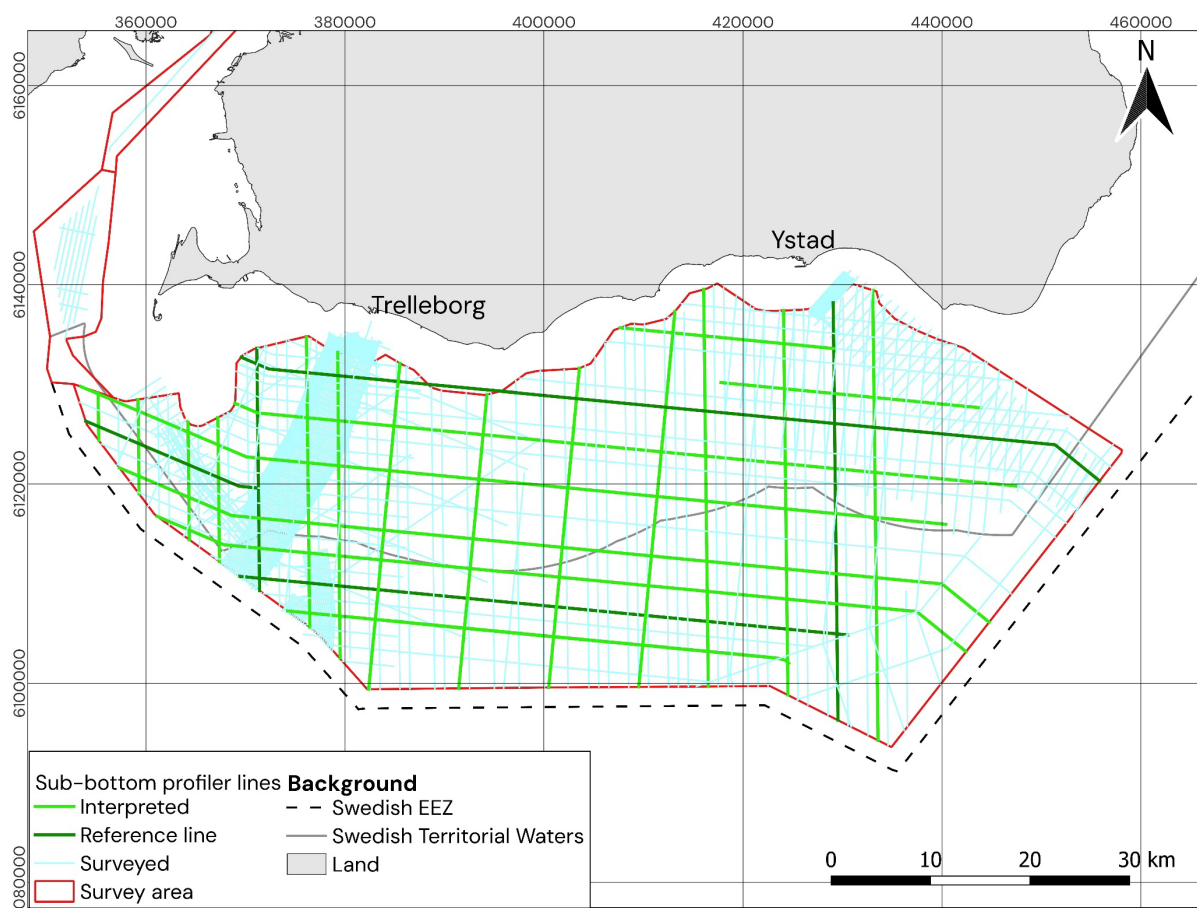


Figure 14. Sub-bottom profiler interpretation reference lines.

Isopach (sediment thickness) maps were created in the Kingdom software in two steps. Firstly, through converting the difference in time between the seabed horizon and interpreted base of unit horizons from time to depth using a static sediment velocity of 1500 m/s, thus creating depth BSB (Beneath SeaBed) horizons. Then, the thickness of each unit was then calculated as the difference between the base of unit BSB horizon and the overlying unit BSB horizon(s).

Multibeam

High-resolution bathymetry and backscatter were collected using a hull mounted Kongsberg EM2040 dual-head multibeam echo sounder (MBES) on board *The Geological Survey of Sweden's* research vessel *R/V Ocean Surveyor*. The MBES was operating at a fixed frequency of 300 kHz with a short continuous wave (CW) pulse. Data were logged using the Kongsberg Seafloor Information System (SIS 4) software in the ALL-file format. Sound velocity was measured continuously at the transducer using a Valeport mini SVS (sound velocity sensor) and sound velocity through the water column was measured by taking discrete profiles using a Moving Vessel Profiler (MVP) system equipped with an AML sound velocity probe. Sound velocity profiles were taken at regular intervals in the survey area with the aim of not using profiles older than 6 hours, but generally the sampling frequency was much higher (roughly at least 1 profile per hour).

To maximize backscatter coverage during the survey, which was a priority, the outer opening angles on port and starboard were set to 75° at the expense of outer beam bathymetry data quality. The inner opening angles were set to 10° to provide a suitable overlap between the swaths of the two sonar heads.

In addition, water column data was logged in SIS 4 on a subset of survey lines that followed previously interpreted fault lines (SGU Unpublished) to investigate the potential leakage of gas through geological weaknesses within the CCS project survey area. Water column data was logged directly into the Kongsberg ALL files meaning water column backscatter information as well as position and motion data were combined into a single file. It is important to note that with the large outer opening angles (75°) that were used during data collection a large portion of the water column data falls outside the minimum slant range and therefore is susceptible to seafloor interference which could impact the ability to detect gas seeps. Additionally, the coverage of the beam fan increases with distance from the survey vessel, meaning that when survey lines are run with small overlaps a significant portion of the water column between those lines are not mapped. Gas flares that occur in this zone are therefore unlikely to be detected.

MBES Data Processing

The bathymetry data was processed in QPS Qimera (2.6.2). Raw depths were height referenced using the SWEN17_RH2000 geoid placing the data on a common height scale that refers to the zero in the Swedish National Height System 2000 (RH2000) (Lilje et al. 2007). Sound velocity profiles were applied to the data using the real time scheduling option and if needed an SVP crossfade of 60 seconds was used to smooth out transitions between profiles. GPS position and height data was evaluated using the time-series editor and if large spikes or jumps were detected in the height it was removed, and data was interpolated between the start and end point of the height position error. Data cleaning was done using primarily the medium spline filter to remove large errors and any remaining errors were edited out manually.

Seafloor backscatter was processed in the QPS Fledermaus Geocoder Toolbox (FMGT, ver. 7.11.0). Backscatter data was made into a mosaic using automatic processing after which the histogram was manually adjusted to display the differences in backscatter intensity in as clear a way as possible.

Water column backscatter from the MBES system was processed using the QPS Fledermaus Midwater (FMMidwater, v.7.11.0.2112) software. Here the raw sonar files were first converted to the Generic Water Column (GWC) file format. Because the EM2040 multibeam on Ocean Surveyor consists of two sonar heads, two separate GWC files were created, one for each head.

Gas Seep Detection

The water column data was inspected largely following the method presented in Thornes et al. (2023) which utilises FMMidwater to identify and interpret the presence of active gas seeps in the water column backscatter data. Each GWC file was inspected in the R-stack (range stack) which displays the file along track on the horizontal axis, collapsing each beam in the swath down and displays the maximum signal level for all the discrete range increments in the display. The view is optimised to display as many water column features as possible and is therefore not geometrically corrected, so some features can appear distorted. The R-stack view was used to identify interesting anomalies in the water column and was then inspected further in beam-fan view which provides a ping by ping across track perspective.

Anomalies interpreted as potential gas seeps were then provided with scores to illustrate the acoustic strength of the anomaly (score 1–5, see Table 2) as well as confidence in the interpretation of the anomaly in percentage. Like in Thornes et al. (2023) only gas seeps with observed bubble streams could score a certainty of 100% and since ROV or camera inspection was not part of this project the highest possible score in this study was 90%.

Table 2. Scores used for detected gas flares to indicate their acoustic strength, scores follow Thornes et al. (2017).

Score	Description
1	Weak gas flare
2	Medium-strong gas flare
3	Strong gas flare
4	Very strong gas flare
5	Giant gas flare

Potential gas flare anomalies were then catalogued using the Geopicking tool in FMMidwater by taking the position on the seafloor where the potential gas seep started (if this was not visible, an estimation was made) recording the seafloor depth and position. In addition, the shallowest depth in the water column that the anomaly was detected was also recorded.

Results

The presented bathymetry, backscatter and interpreted seabed and sub-bottom geology have been limited to 300 x 300 m resolution to comply with the granted dissemination permit (SGU Dn: 316-566/2025 & 316-567/2025) from the Swedish Maritime Administration (Sjöfartsverket) for Swedish territorial waters in the survey areas south and west of Skåne. This limits the detail that can be discerned from the presented datasets; rather, they provide a general overview of the surficial geology of the area of interest for CCS development.

Bathymetry and Surface Geology

The survey area south of Skåne generally has a south-eastward sloping bathymetry with depths ranging from roughly 10 to 45 m. Deepest and shallowest recorded values within the southern Skåne survey area (Figure 15) are 47.7 m and 13.5 m respectively, both located in the eastern part of the survey area. In the western Skåne survey area (Figure 16) the deepest point is 48.6 m and the shallowest 8.1 m. Here, the deepest point is in the northern part of the Lomma basin, between the Swedish cities of Landskrona and Helsingborg, and the shallowest just outside of the city of Malmö.

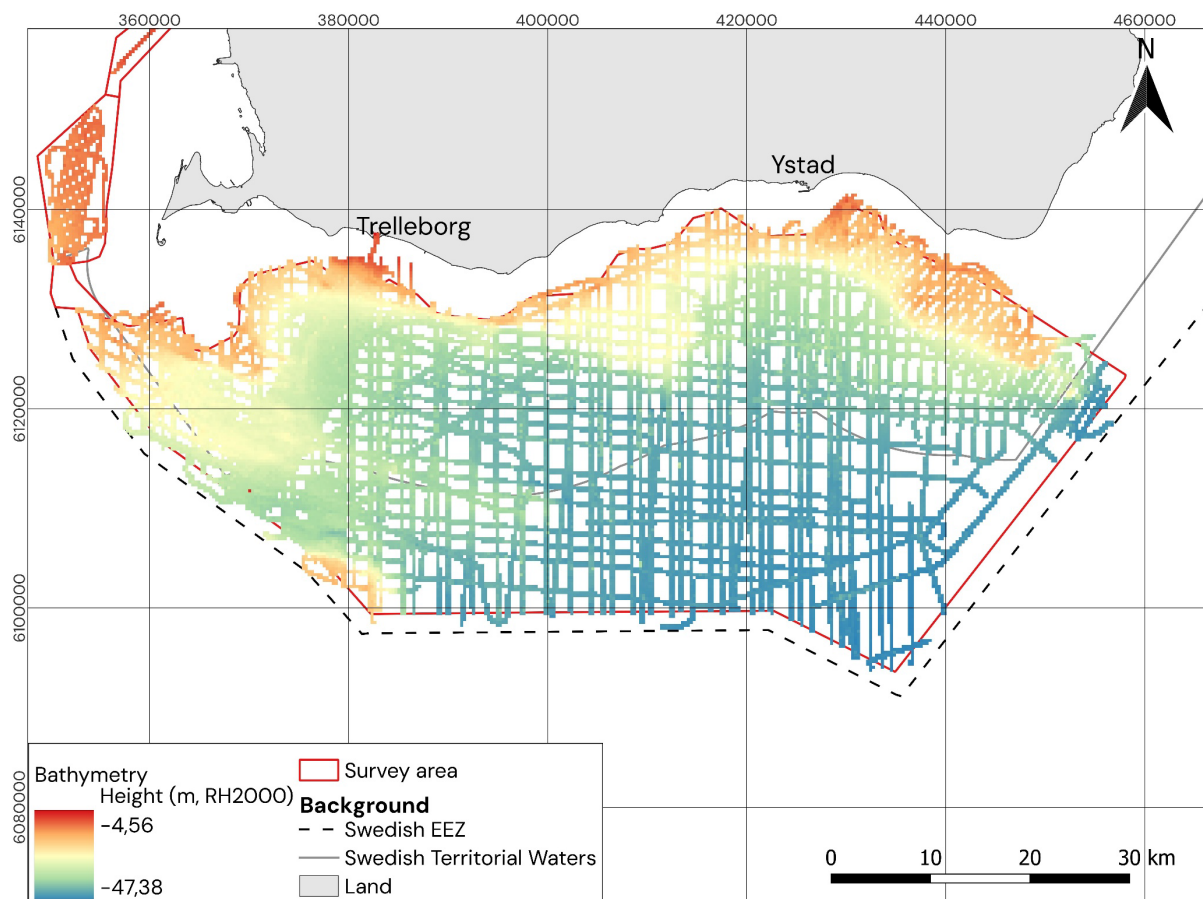


Figure 15. Seafloor bathymetry of the Southern Skåne survey area gridded at 300 m resolution. The data presented represents the average value in each 300 x 300 m grid cell and the bathymetry is presented as heights in RH2000.

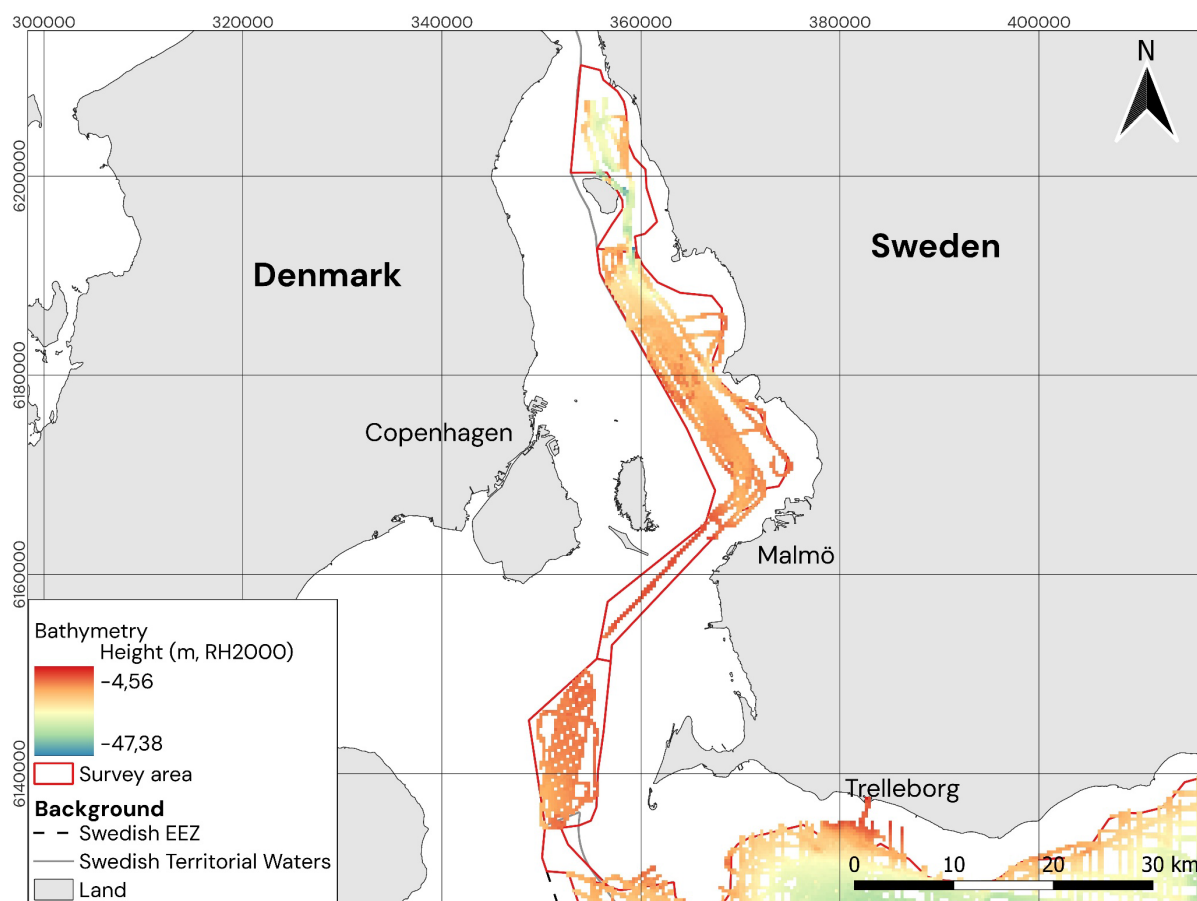


Figure 16. Seafloor bathymetry of the Western Skåne survey area gridded at 300 m resolution. The data presented represents the average value in each 300 x 300 m gridcell and the bathymetry is presented as heights in RH2000.

Seafloor backscatter is presented in Figure 17 for South Skåne and Figure 18 for West Skåne survey areas. Backscatter intensity in the Southern Skåne survey area generally mirrors the overall bathymetry, suggesting a relationship between local geology and depth. Seafloor intensity is lowest in the southeastern parts towards the middle of the basin and generally shows stronger intensities towards land. In the Western Skåne survey area, the backscatter values are lowest in the Lomma basin and higher in the northern and southern parts of the survey area.

The combined bathymetry and seafloor backscatter intensity was used in conjunction with publicly available marine geological data (SGU's map viewer Marine Geology 1:100 000) to create a new substrate interpretation. The new map is general in its nature but is permitted for publishing via the two dissemination permits mentioned above, therefore, it adds important new knowledge about seafloor substrates in this area of the Swedish territory that is available to the public.

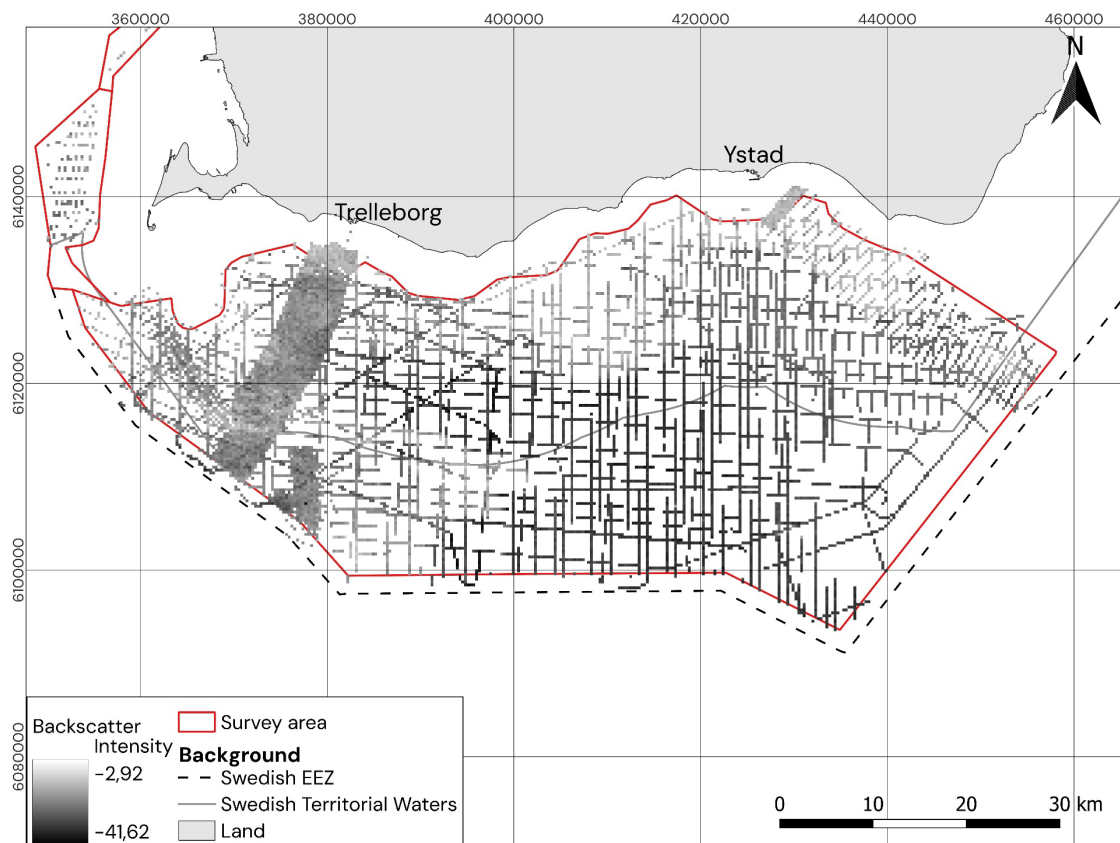


Figure 17. Seafloor backscatter intensity from the Southern Skåne survey area in 300 m resolution.



Figure 18. Seafloor backscatter intensity from the Western Skåne survey area in 300 m resolution.

The interpreted surface geology generally consists of a mixture of fine sands, sand and coarser material such as gravel with some more limited areas consisting of larger stones. Moving further from land into the basin, the surface geology gradually changes from sandier sediments to softer clays, as reflected by the lower seafloor backscatter intensities (Figure 19). The backscatter values also indicate that there is more coarse sandy material in the eastern and western parts of the survey area with finer material between.

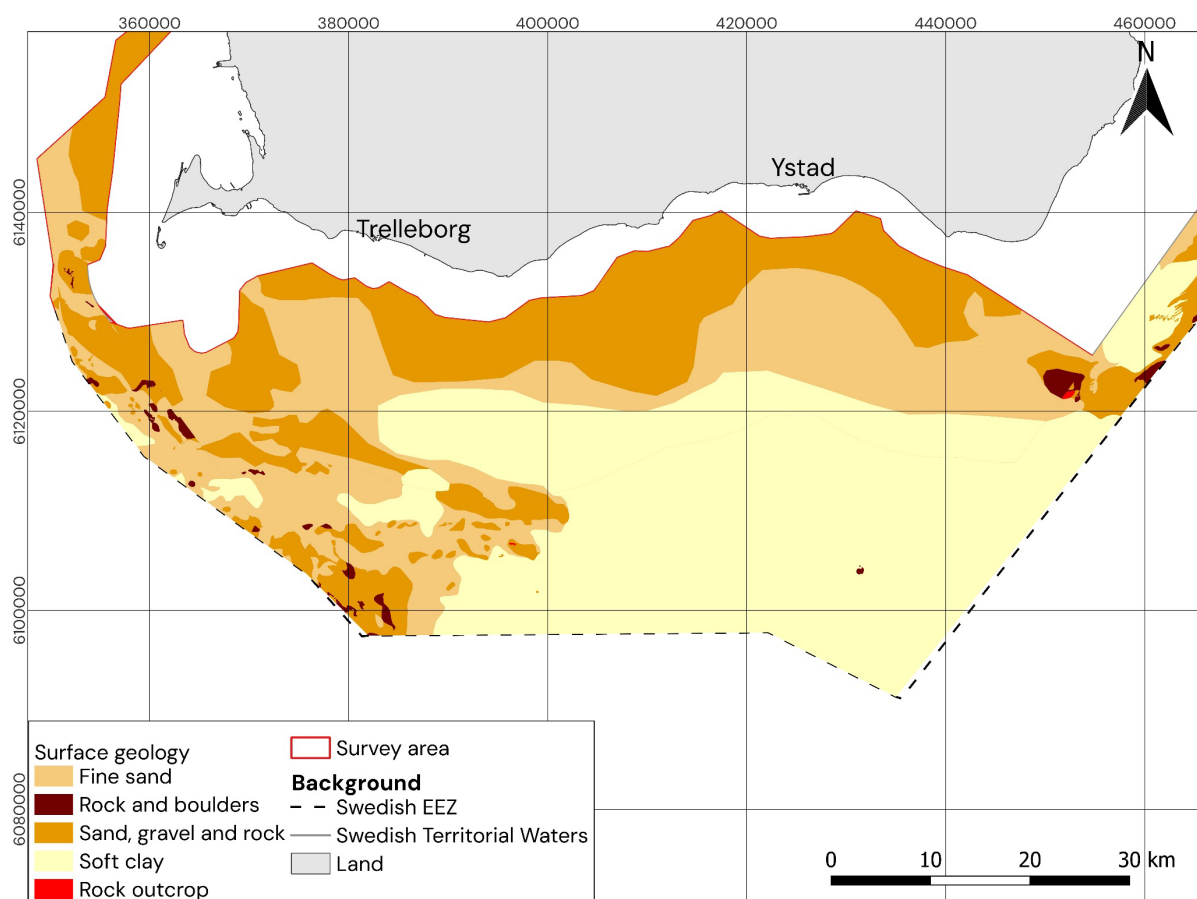


Figure 19. Interpreted surface substrate in the Southern Skåne survey area. Within Swedish territorial waters the resolution is limited to 300 m, since the interpretation is based on the resolution of the backscatter intensity and bathymetry grids. In the Swedish EEZ the map is made using marine geological map (1:100 000) from SGU.

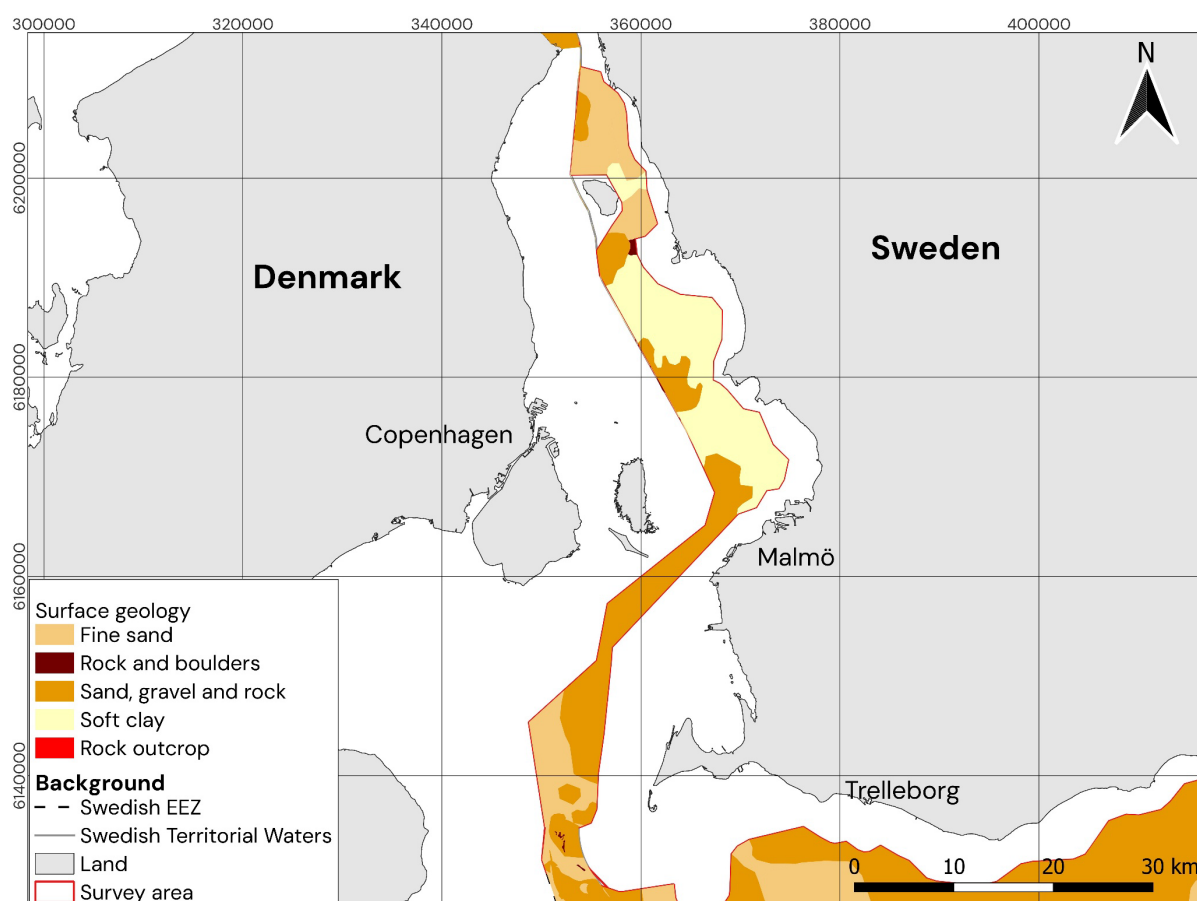


Figure 20. Interpreted surface substrate in the Western Skåne survey area. Within Swedish territorial waters the resolution is limited to 300 m, since the interpretation is based on the resolution of the backscatter intensity and bathymetry grids. In the Swedish EEZ the map is made using marine geological map (1:100 000) from SGU.

Sub-bottom Geology

Data Quality

The sub-bottom data from the Topas 120 system onboard R/V Ocean Surveyor is of generally high quality and deemed fit for the purpose of the survey (Figure 21). Within the dataset, there are however two known sources of noise. The first is caused by the seismic equipment which produces noise bursts at regular intervals, visible in the data as short wavelength disturbances (Figure 22, yellow arrow). The second source of noise is thought to be related to the vessel engine RPM, visible as an increased amplitude at a long wavelength interval (Figure 22, green arrow).

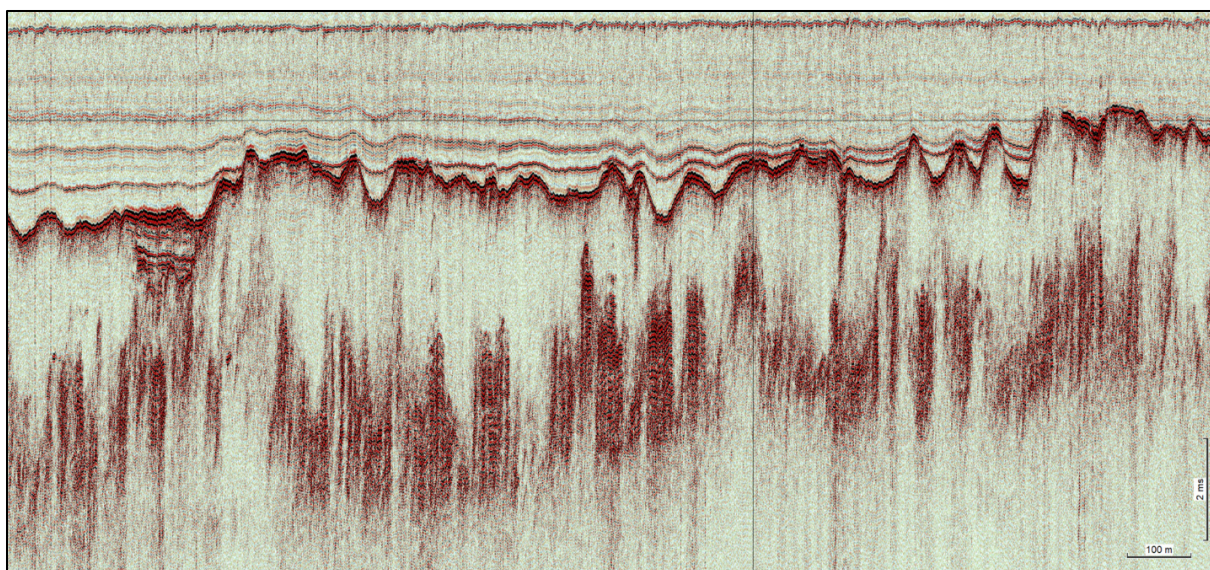


Figure 21. Example of sub-bottom data from the hull mounted Topas 120 system (R/V Ocean Surveyor).

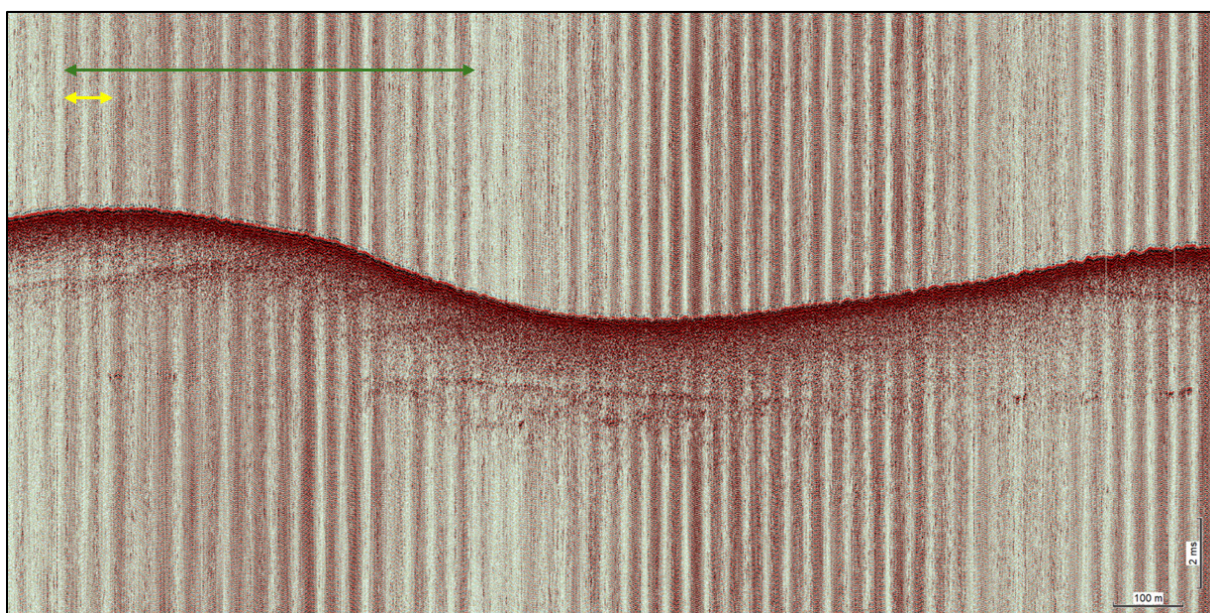


Figure 22. Example of sub-bottom data from the hull mounted Topas 120 system (R/V Ocean Surveyor). Yellow arrow indicating a short wavelength noise source caused by the seismic equipment. Green arrow indicating a longer wavelength noise related to the engines RPM.

Sub-bottom Profiles

The collected data produced high-resolution sub-bottom profiles in which thin, discrete sedimentary layers can be distinguished. At no location was the acoustic signal able to penetrate bedrock or pass through glacial boulder dense till. Thick layers of sand or gas-charged sediments also limited signal penetration. The narrow beam width of the profiler resulted in a small seafloor footprint, thereby enhancing the lateral resolution of seabed returns.

Interpretation of Sub-bottom Profiler Data

In sub-bottom profiler records, acoustic reflectors appear at interfaces where there is a contrast in acoustic impedance, typically associated with changes in sediment composition, grain size, porosity, or water content. Such reflectors are interpreted as boundaries between sedimentary units. Within individual units, internal reflectors may appear, reflecting depositional variations or erosional surfaces.

To infer the sediment type of a given unit, the acoustic texture is examined. Key criteria include: the presence and geometry of internal reflectors (e.g., parallel, chaotic, or cross-cutting patterns), the occurrence of hyperbolic diffractions, and the relative amplitude and continuity of bounding reflectors.

When adjacent sediment units have similar sound velocities and densities, no distinct reflector forms at their boundary; in such cases, differentiation relies on the analysis of the acoustic texture.

In this survey, postglacial clay, glacial clay, sand, and till could generally be reliably distinguished. It was more difficult to distinguish between the two different tills and between till and sedimentary bedrock (Figure 21).

Sediment Isopaches and Extent

The sediments extents and isopachs, computed from the interpreted sub-bottom echosounder lines, presented in Figure 14. These lines were selected to cover as much of the area's varying geology as possible at the time allotted for the interpretation. The isopached sedimentary units are summarized in Table 3.

The postglacial SAND unit (Figure 23) is generally a thin surficial unit extending in the shallower water parts (Figure 15) of the mapped area, along the Skåne coast, towards Öresund straits and down towards Kriegers flak. The unit thickness is on average 0.39 m with a standard deviation of 0.53. Maximum thickness reaches up to 5.72 m locally. The local maxima are limited to the southwest region around Kriegers flak and the northeastern region north of Svartgrund. The presence of the postglacial SAND unit indicates areas of high energy, reflecting the currents in and out of the Öresund straight and wave motion closer to shore. It's absence in the southeastern quadrant of the survey area is indicative of a calmer depositional environment.

Table 3. Isopached sedimentary units.

Sedimentary Unit	Horizon reference	Depositional environment
Postglacial SAND	H05 – Base of Postglacial SAND	Postglacial High energy
Postglacial CLAY	H10 – Base of Postglacial CLAY	Postglacial Low energy
Glacial CLAY	H20 – Base of glacial CLAY	Close to icefront, Low energy
Clayey TILL	H30 – Base of Clayey TILL	At or very close to icefront, low energy
Bouldery TILL	H35 – Base of Bouldery TILL	At icefront, high energy

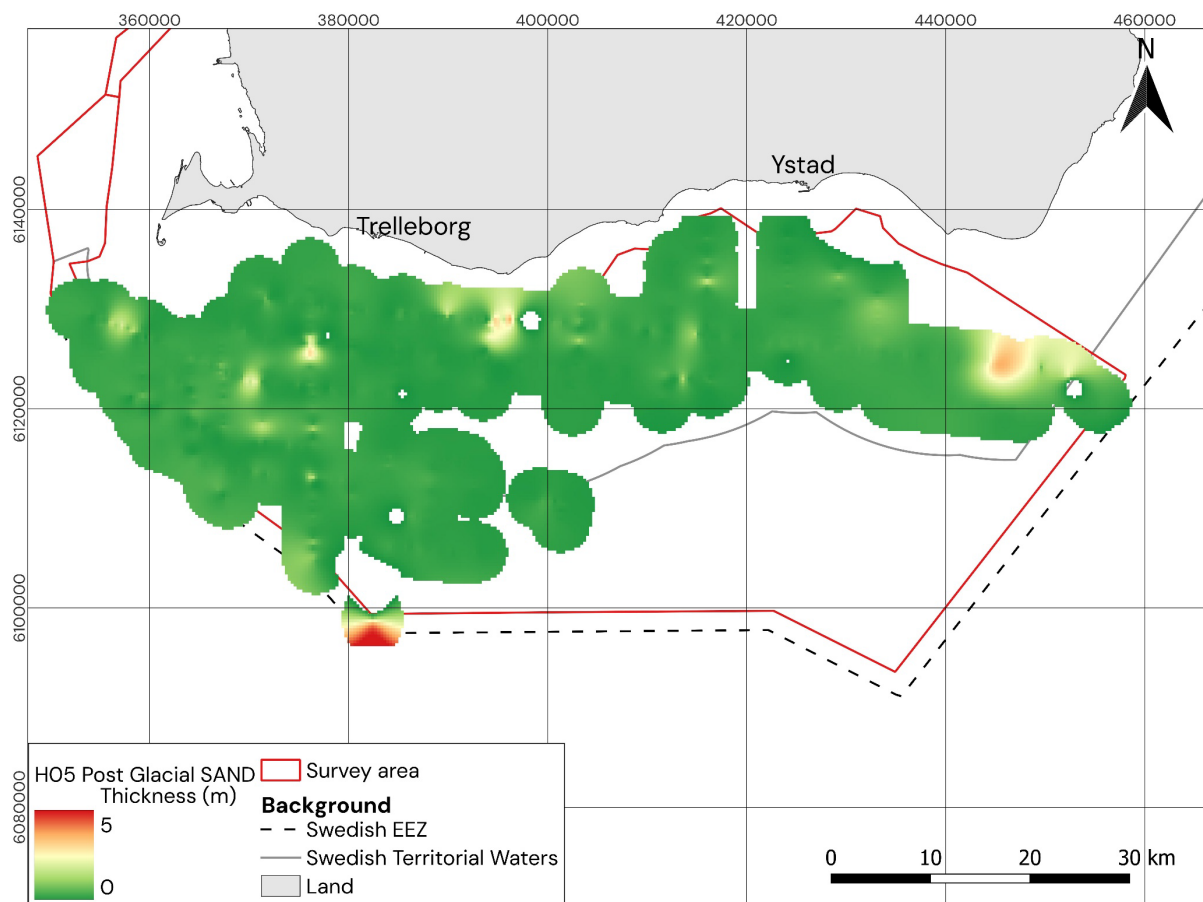


Figure 23. Isopach surface of Unit H05 Post Glacial SAND.

The postglacial CLAY unit (Figure 24) is a surficial unit extending in the deep water parts (Figure 15) of the survey area. The extent is thus in the southeastern quadrant of mapped area. The unit thickness is on average 0.77 m with a standard deviation of 0.53. Maximum thickness reaches up to 3.06 m locally, mainly increasing to the southeast. Its presence in the southeastern quadrant of the survey area indicates a calm depositional environment.

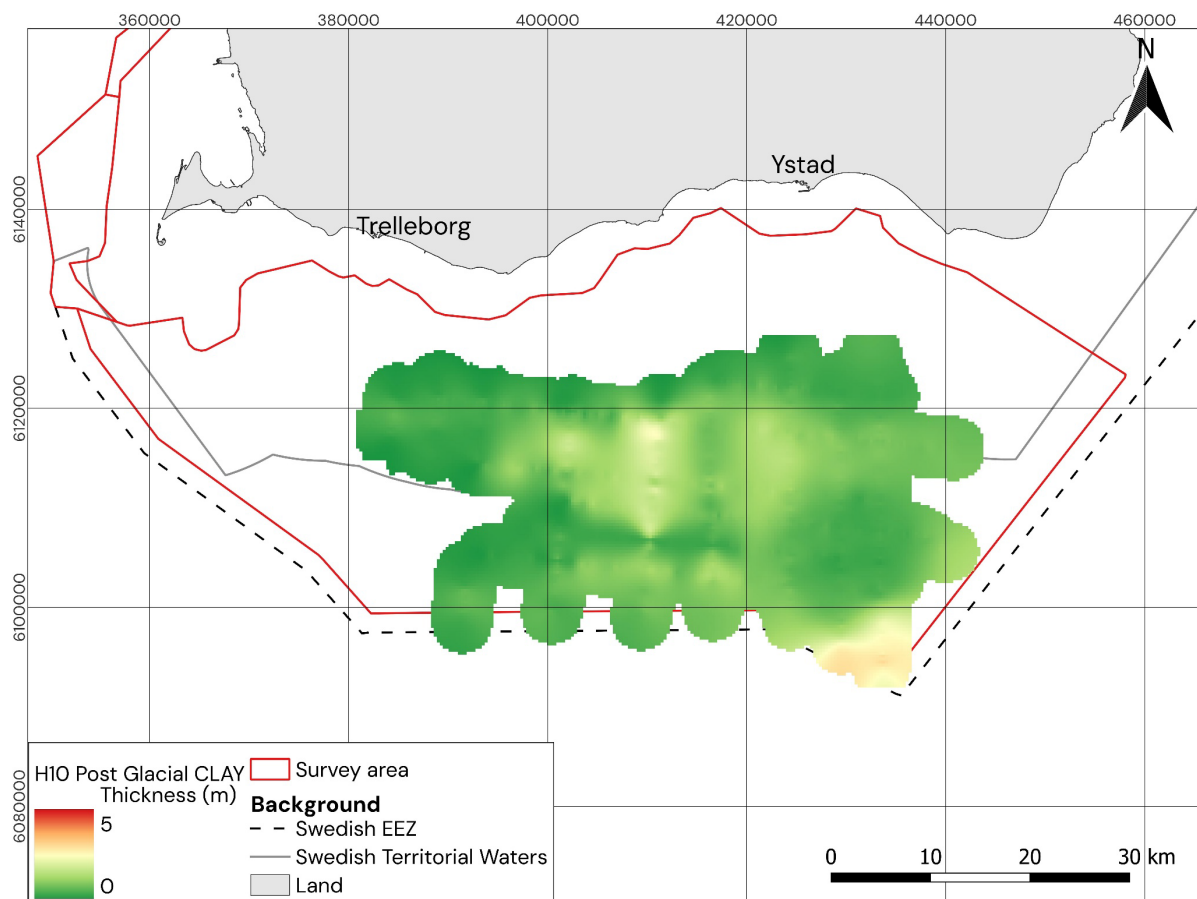


Figure 24. Isopach surface of Unit H10 Post Glacial CLAY.

The glacial CLAY unit (Figure 25) lies between the surficial unit (postglacial SAND or postglacial CLAY) and the Clayey TILL unit in the strata. The unit is mapped with varying thickness throughout almost the entire survey area. The unit thickness is on average 1.82 m with a standard deviation of 1.56. The maximum thickness reaches up to 10.60 m locally around the centre and southeastern part of the surveyed area. Its presence and greater thickness in regions of the area indicate that these regions likely had a greater water depth, thus a calmer environment, during deposition.

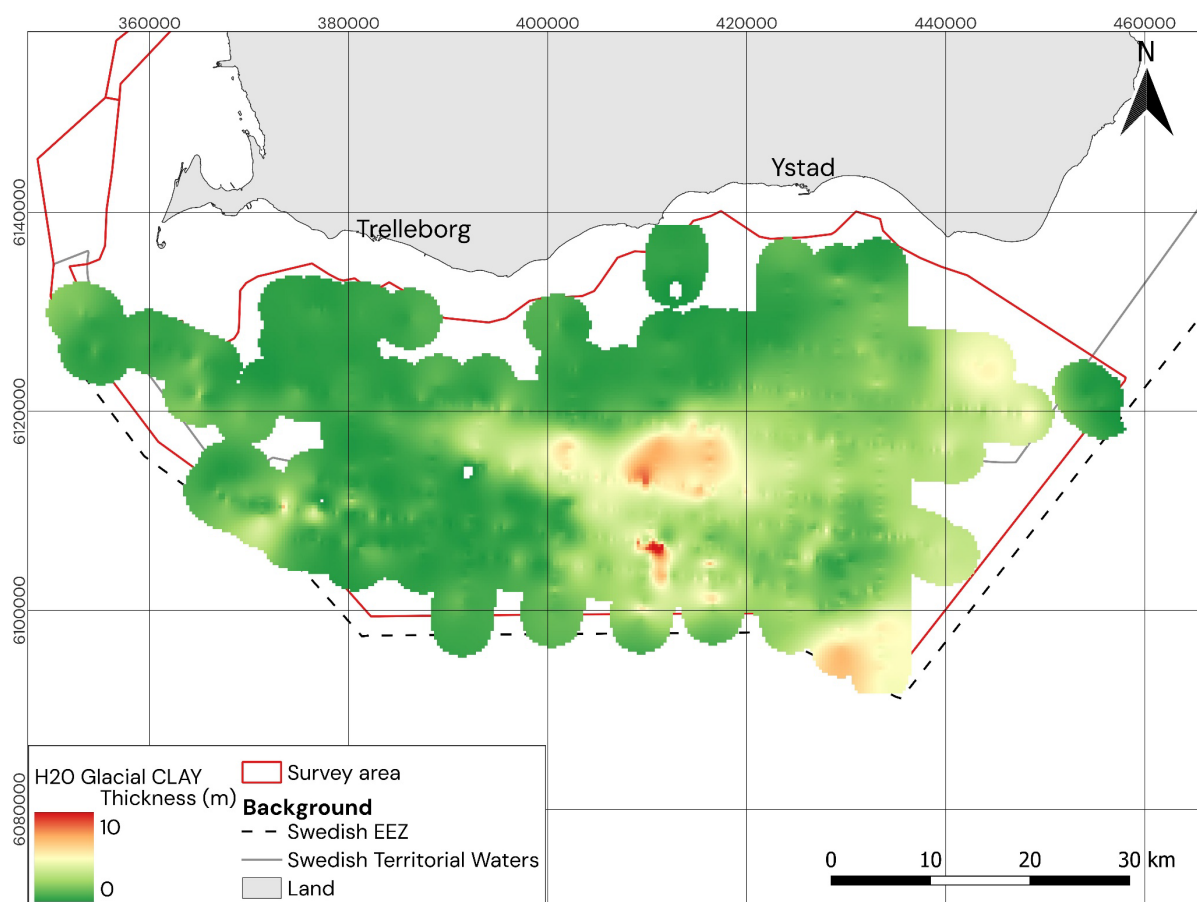


Figure 25. Isopach surface of Unit H20 Glacial CLAY.

The clayey TILL unit (Figure 26) is stratigraphically located between the surficial units (postglacial SAND or postglacial CLAY), the mid strata unit of glacial CLAY and the basement unit of the bouldery TILL. The unit has been mapped with varying thickness throughout almost the entire survey area. The unit thickness is on average 7.27 m with a standard deviation of 6.43. The maximum thickness reaches up to 28.64 m locally around the middle to southeastern region of the mapped area.

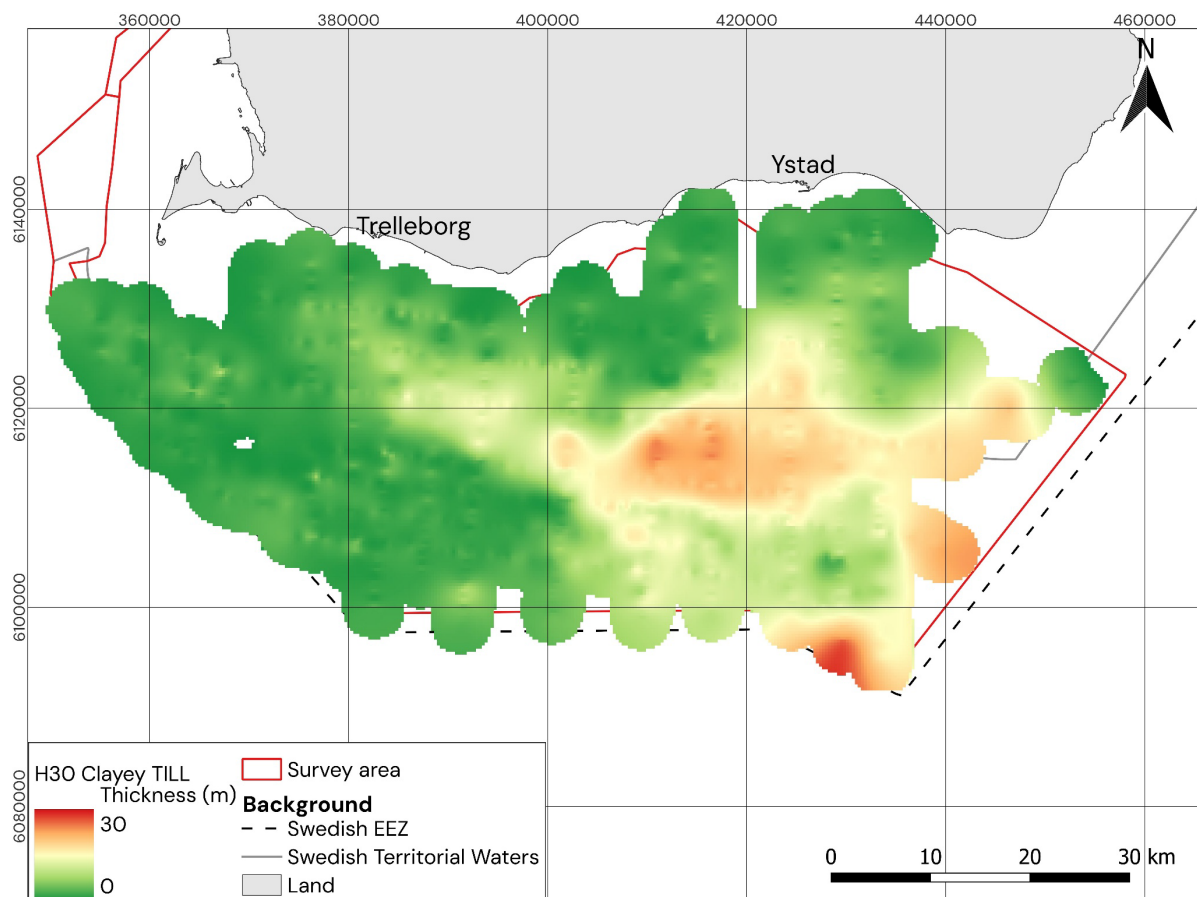


Figure 26. Isopach surface of Unit H30 Clayey TILL.

The bouldery TILL unit (Figure 27) is mapped below the clayey TILL unit in the strata. The unit can only be mapped where the penetration is sufficient to distinguish the boundary between it and the underlying boundary TILL which in many cases is deeper than the penetration achieved. Thus, the unit is mainly mapped in the southern section of the survey area. The unit thickness is on average 6.70 m with a standard deviation of 4.58. The maximum thickness reaches up to 19.35 m locally in the south to southeastern region of the mapped area.

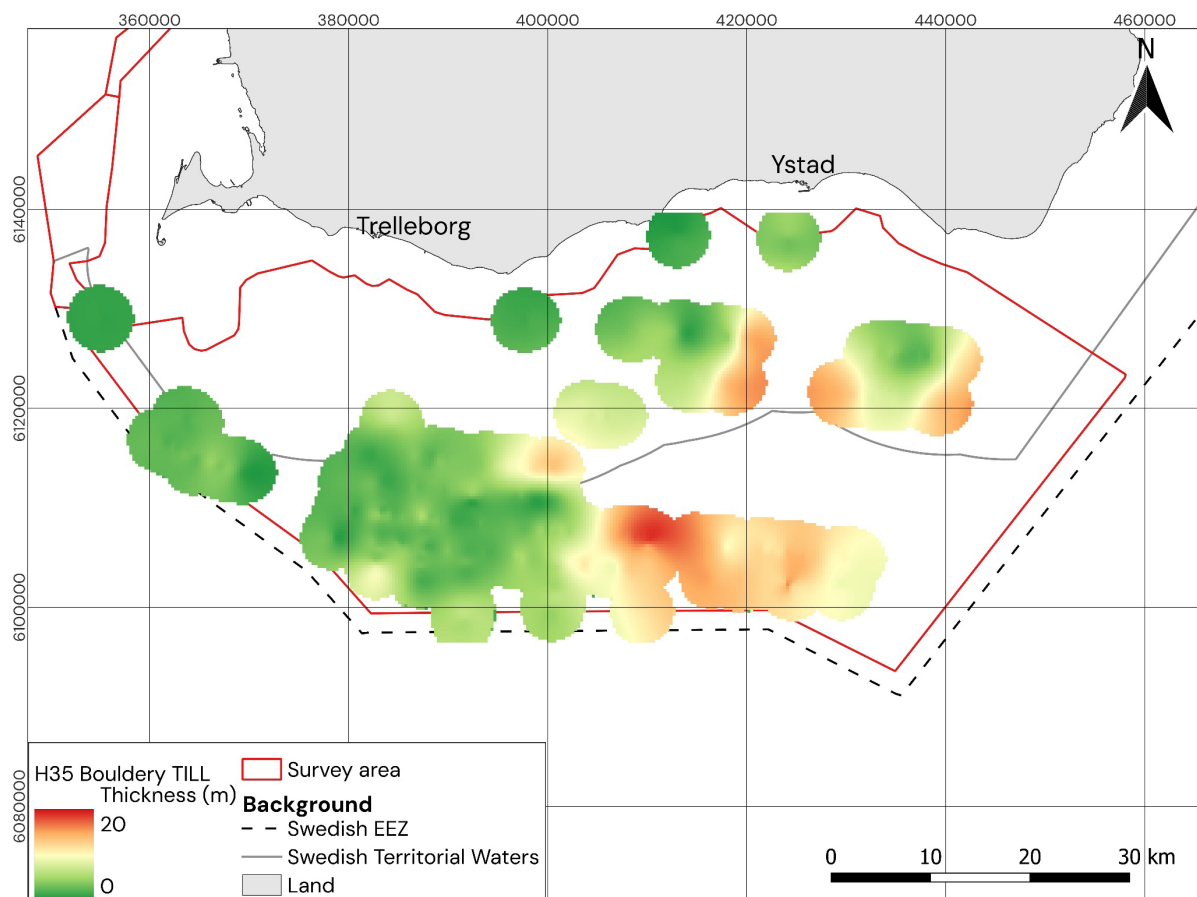


Figure 27. Isopach surface of Unit H35 Bouldery TILL.

Water Column Data

A total of 1 858 km of survey lines with water column data was logged (Figure 7, green).

Artifacts and Non-seep Anomalies

To discern correct interpretation of the water column data it is important to also be aware of anomalies that most likely do not represent gas leakage from the seafloor. Because of the large impedance contrast between the surrounding water and the leaking gas the gas should show up with much stronger backscatter values. The gas seeps also have a characteristic shape, protruding from the seafloor, rising through the water column and dissipating gradually- therefore thinning- as they move upward (Thorsnes et al. 2023). Figure 28 presents some of the more common anomalies that have been detected in the collected water column data. Of these, the semi-regular noise is the most common and after that potential fish schools.

In fan view (Figure 28A), the detected fish schools are manifested as rounded shapes. Within the along-track R-stack view, they may occasionally present a seep-like morphology, appearing to protrude from the seafloor; however, this is most likely an artefact of the R-stack processing, resulting from the large outer opening angles (75°) which induce data smearing. The semi regular noise that is observed in panel C of Figure 28 would not be as easily misinterpreted as a natural gas seep but could instead obscure data and therefore make detection of small or very faint seeps (magnitude 1–2) more difficult. The observed noise could be artefacts related to interference with the sub-bottom profiler (SBP) that was used simultaneously with the MBES, external sources or onboard electronic interference. Another observed systematic anomaly is what appears in the R-stack (panel A and C, Figure 28) as a something akin to a seafloor multiple and may again be related to interference with the SBP. Investigating these anomalies further is, however, beyond the scope of this study but may need to be considered by SGU in further water column data collection campaigns.

Close to the seafloor reflection, a number of strong anomalies are visible in the water column dataset (not shown here). These likely correspond with rocks and have therefore not been interpreted as gas seep structures. The rocks can also be observed in the full resolution bathymetry dataset supporting this interpretation.

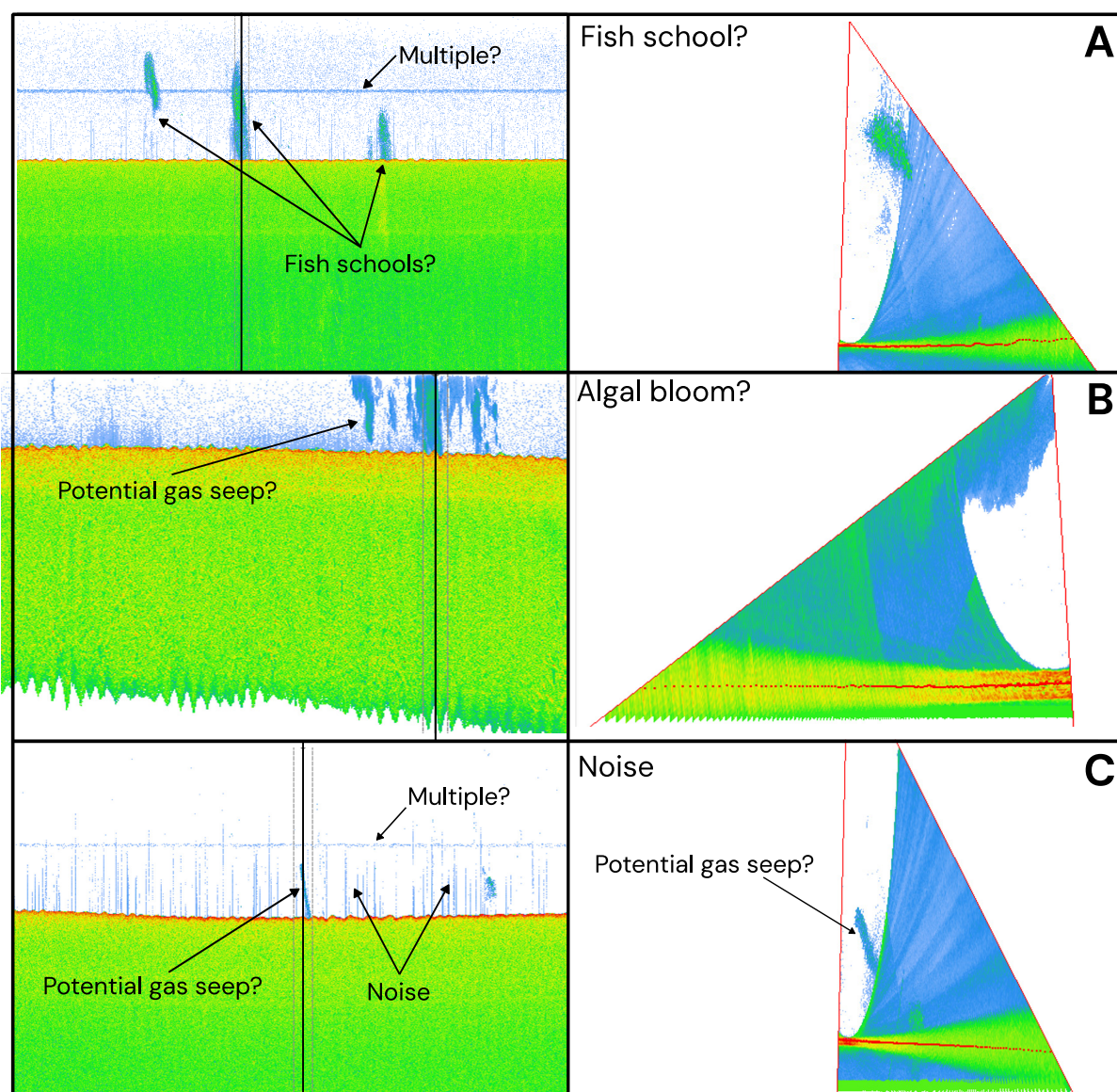


Figure 28. Examples of anomalies interpreted as non-seep like anomalies in the collected water column data. In the figure the left display panel shows along track with the black vertical line illustrating the position of the across track view, the thinner grey line represents the 10-ping window that was used to smooth out the fan view. The right panel shows the across track view. Interpretations of the anomalies are **(A)** fish schools, **(B)** algal blooms and **(C)** semi regular noise. Additionally, in panel A and C a straight along track artifact is observed, possibly representing some seafloor multiple interaction.

Potential Seep-like Anomalies

A total of 58 potential gas seeps were initially observed in the survey area, all with low confidence (between 5–20%). After a visual quality check, several of these were discarded, for example as potential school of fish, algal blooms or other non-seep like anomalies (Figure 28). Of the original 58 anomalies identified, 23 remain as potential gas seep-like anomalies (Table 4). Figure 29 through Figure 48 show every remaining potential gas seeps-like anomalies as seen in FMMidwater. The strength (magnitude) of the anomalies varies from 1–4 in acoustic strength.

Table 4. Details of the identified potential gas seeps in the Southern Skåne survey area.

LineID	GasSeepID	N (SWEREF99)	E (SWEREF99)	Depth	Height	Date and Time	Magnitude (1-5)	Confidence (%)
0006_20240418_192140	GS_001	55.18207103	12.89302561	n/a	-19	04/18/2024 19:22:00.7	2	10
0013_20240419_074039	GS_002	55.27426890	12.80128491	n/a	-5	04/19/2024 7:54:27.2	2	5
0025_20240419_11180	GS_003	55.21741137	12.85850576	n/a	-9	04/19/2024 11:22:45.4	3	5
0001_20240422_071910	GS_007	55.30829618	13.11694909	n/a	-17	04/22/2024 07:22:01.5	4	20
0002_20240422_073041	GS_008	55.29277629	13.10690791	n/a	-23	04/22/2024 07:31:45.8	2	5
0006_20240422_081622	GS_009	55.21108540	13.04206106	n/a	-23	04/22/2024 08:25:18.7	3	10
0022_20240422_134753	GS_011	55.26386703	13.11196714	n/a	-25	04/22/2024 13:48:11.9	3	5
0028_20240422_145412	GS_014	55.28282131	13.11741056	n/a	-20	04/22/2024 14:57:37.1	4	5
0029_20240422_150545	GS_015	55.26741155	13.10735647	n/a	-25	04/22/2024 15:07:13.1	4	5
0021_20240423_154835	GS_017	55.27123430	13.09576799	n/a	-15	04/23/2024 15:57:07.5	1	5
0016_20240424_151727	GS_018	55.21559141	13.03907645	n/a	-13	04/24/2024 15:19:53.4	2	5
0021_20240424_161458	GS_019	55.31304575	13.11263964	n/a	-13	04/24/2024 16:22:09.0	1	5
0005_20240427_101048	GS_023	55.24647252	13.04466661	n/a	-20	04/27/2024 10:11:52.0	2	5
0007_20240427_103350	GS_024	55.21458660	13.01433097	n/a	-2	04/27/2024 10:38:14.0	1	5
0007_20240418_144218	GS_032	55.09285423	13.06720913	n/a	-30	04/18/2024 14:47:44.1	2	5
0016_20240421_043538	GS_036	55.12939239	13.09403224	n/a	-10	04/21/2024 4:37:54.6	2	5
0023_20240421_060817	GS_037	55.09250772	13.05804178	n/a	-17	04/21/2024 6:13:16.3	4	20
0000_20240422_095423	GS_039	55.10998558	13.03492320	n/a	-15	04/22/2024 10:03:49.9	4	10
0000_20240422_095423	GS_040	55.10979405	13.03598484	n/a	-12	04/22/2024 10:03:54.2	4	10
0014_20240614_040230	GS_045	55.14982645	12.94930631	n/a	-21	06/14/2024 4:13:52.5	3	10
0005_20240417	n/a	55.28328074	13.08063182	n/a	n/a	04/17/2024 14:55:25.9	n/a	n/a
0025_20240418	n/a	55.28989240	13.11380705	n/a	n/a	04/18/2024 05:16:14.2	n/a	n/a
0001_20240422_071910	n/a	55.29823395	13.11035912	n/a	-19	04/22/2024 7:28:20.5	4	20

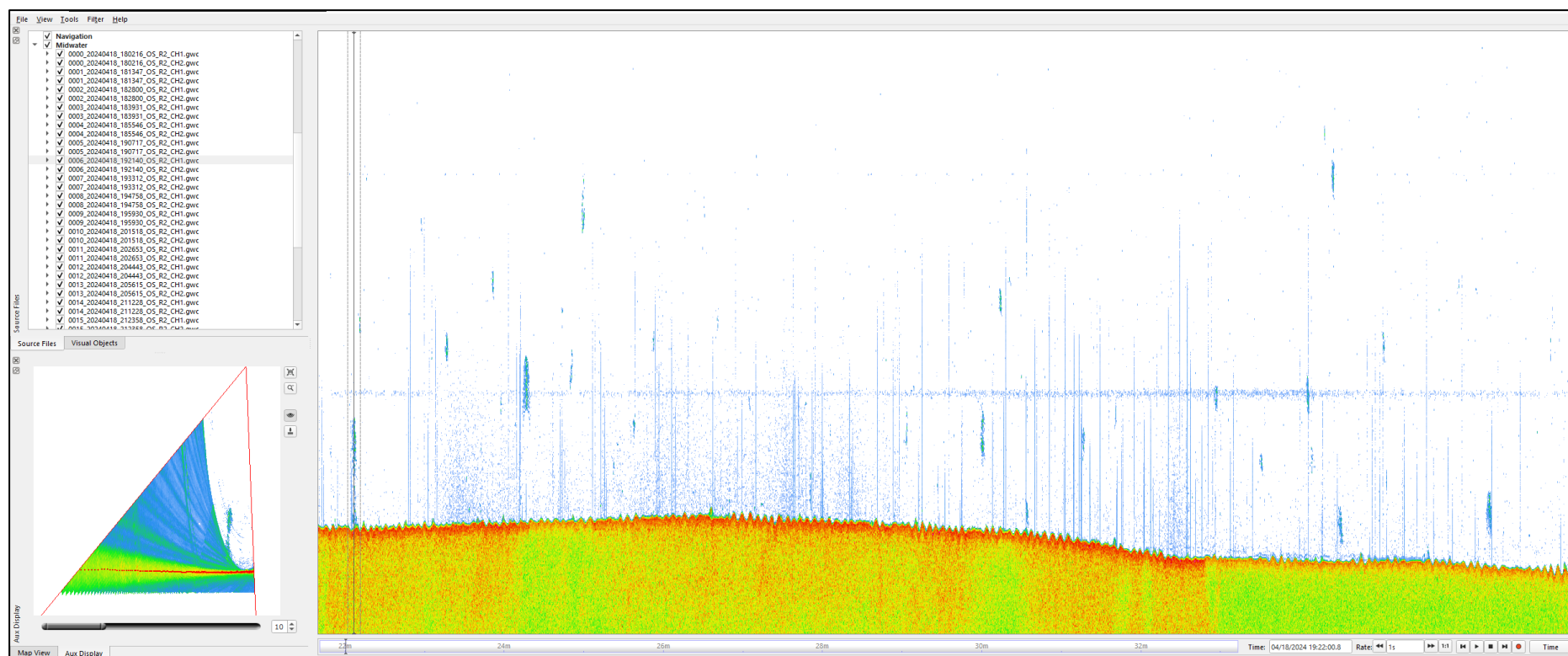


Figure 29. Possible gas seep (ID GS_001). The image shows data from line 0006_20240418_192140 as seen in R-stack view and fan view in FMMidwater, with an assessed magnitude of 2, and 10% confidence.

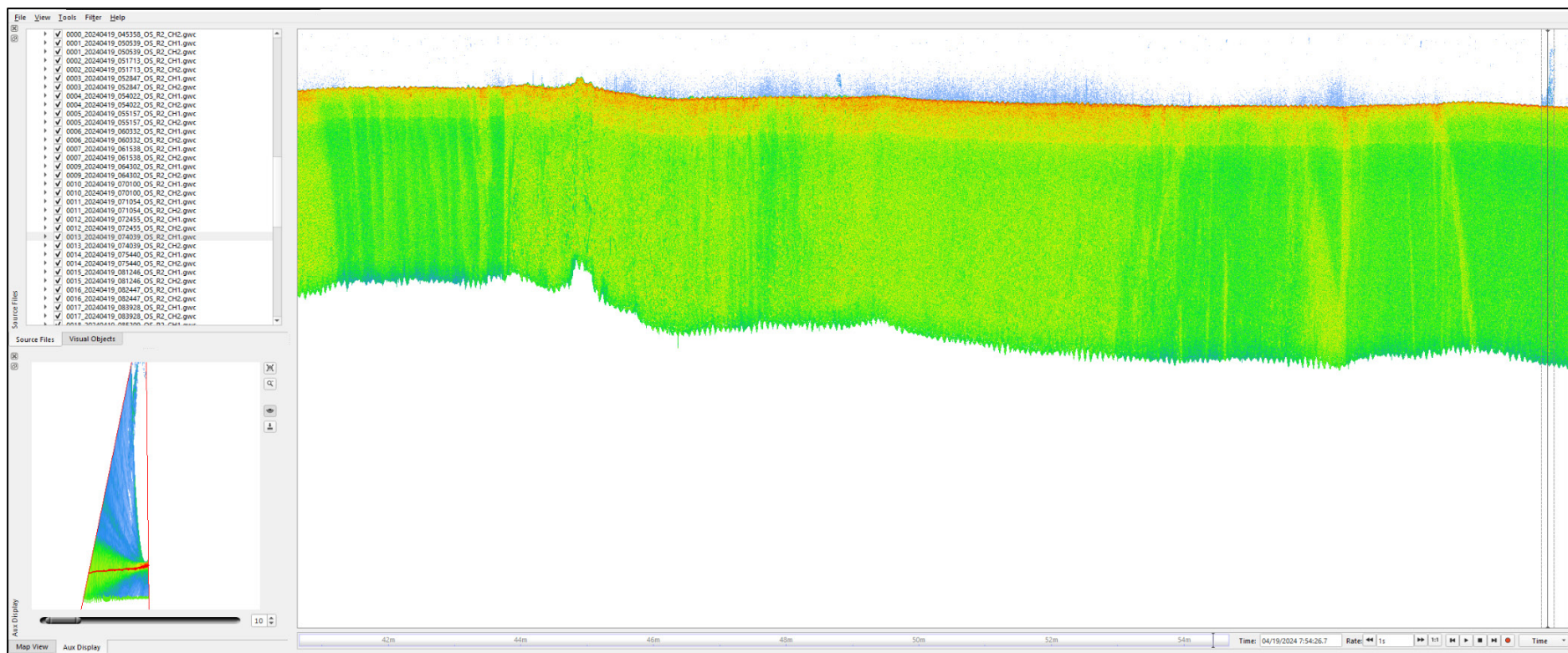


Figure 30. Possible gas seep (ID GS_002). The image shows data from line 0013_20240419_074039 as seen in R-stack view and fan view in FMMidwater, with an assessed magnitude of 2, and 5% confidence.

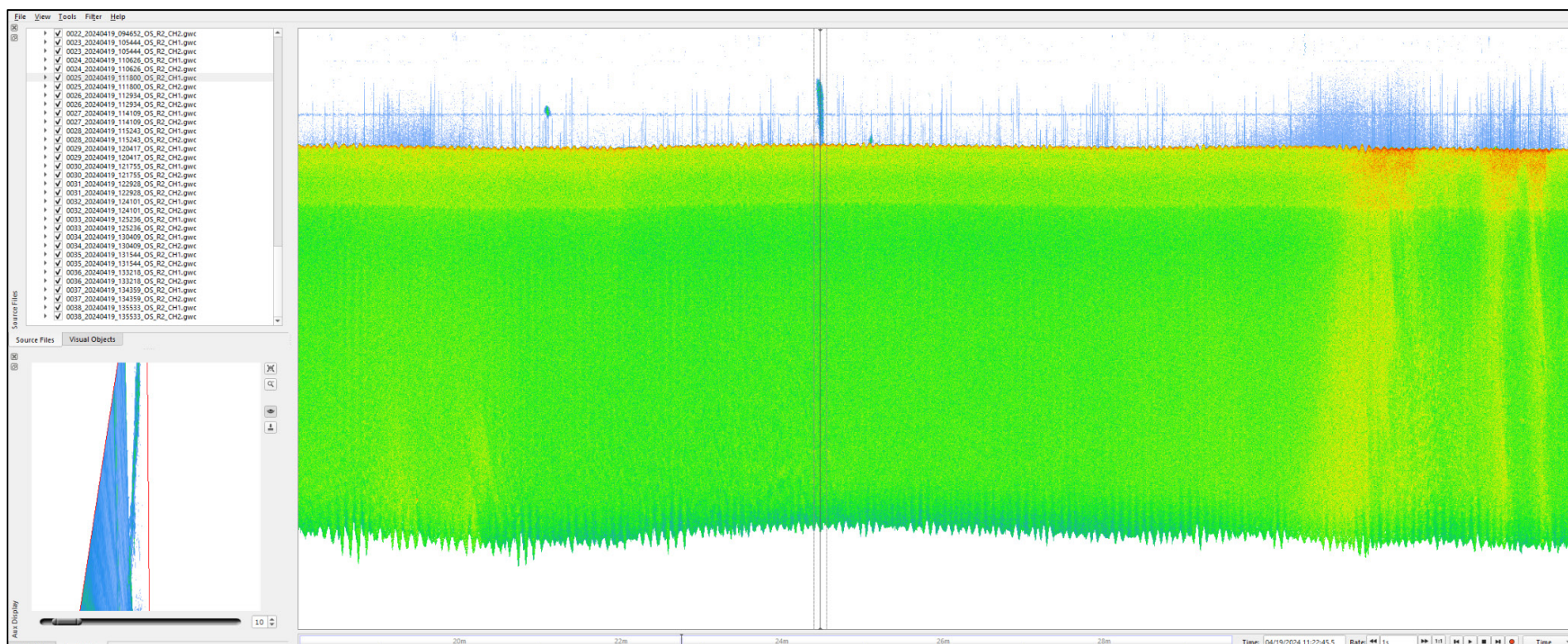


Figure 31. Possible gas seep (ID GS_003). The image shows data from line 0025_20240419_11180 as seen in R-stack view and fan view in FMMidwater, with an assessed magnitude of 3, and 5% confidence.

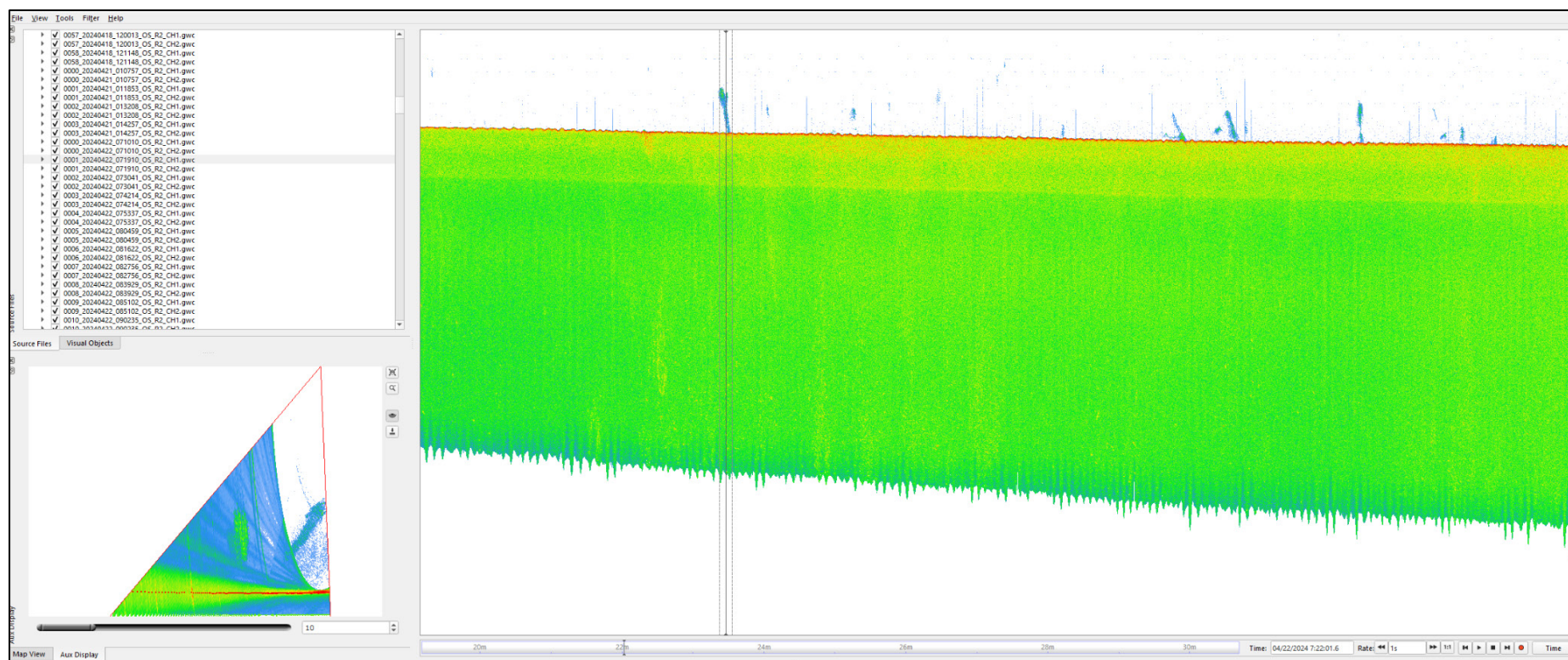


Figure 32. Possible gas seep (ID GS_007). The image shows data from line 0001_20240422_071910 as seen in R-stack view and fan view in FMMidwater, with an assessed magnitude of 4, and 20% confidence.

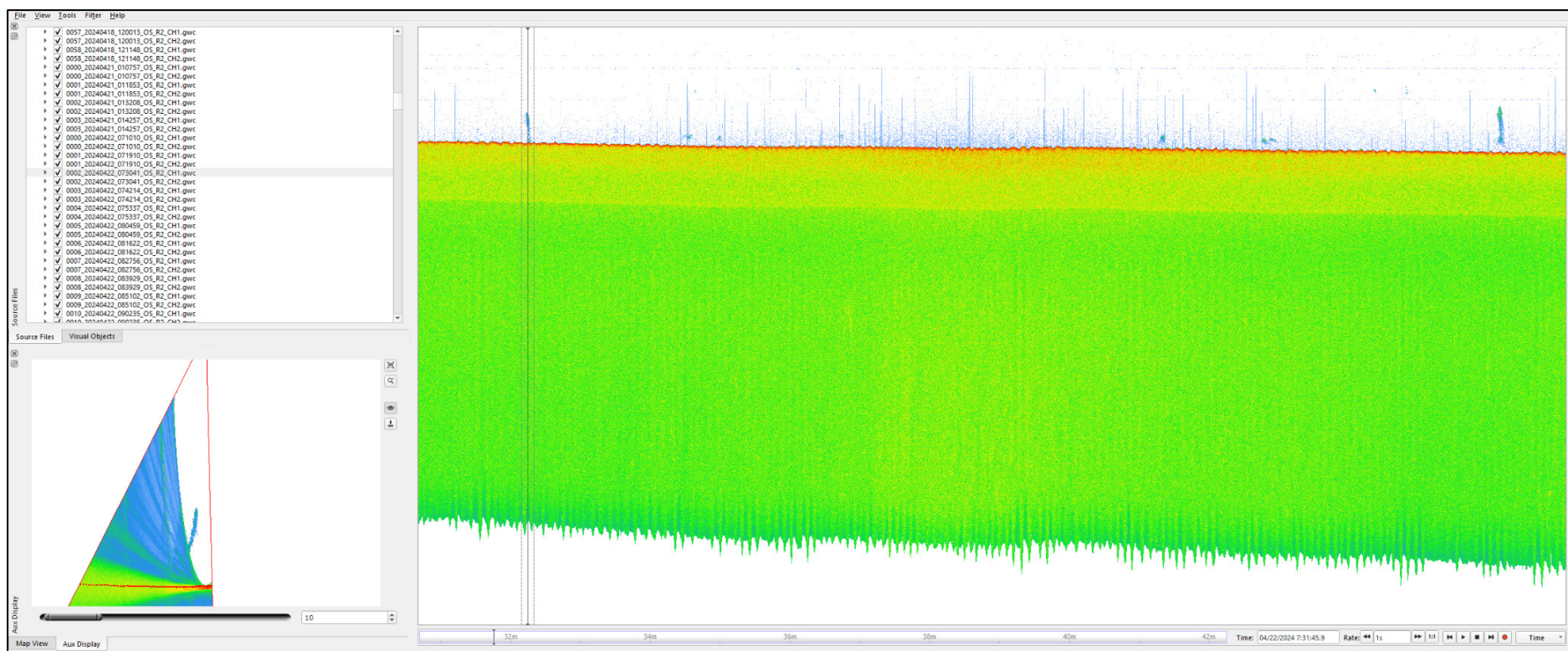


Figure 33. Possible gas seep (ID GS_008). The image shows data from line 0002_20240422_073041 as seen in R-stack view and fan view in FMMidwater, with an assessed magnitude of 2, and 5% confidence.

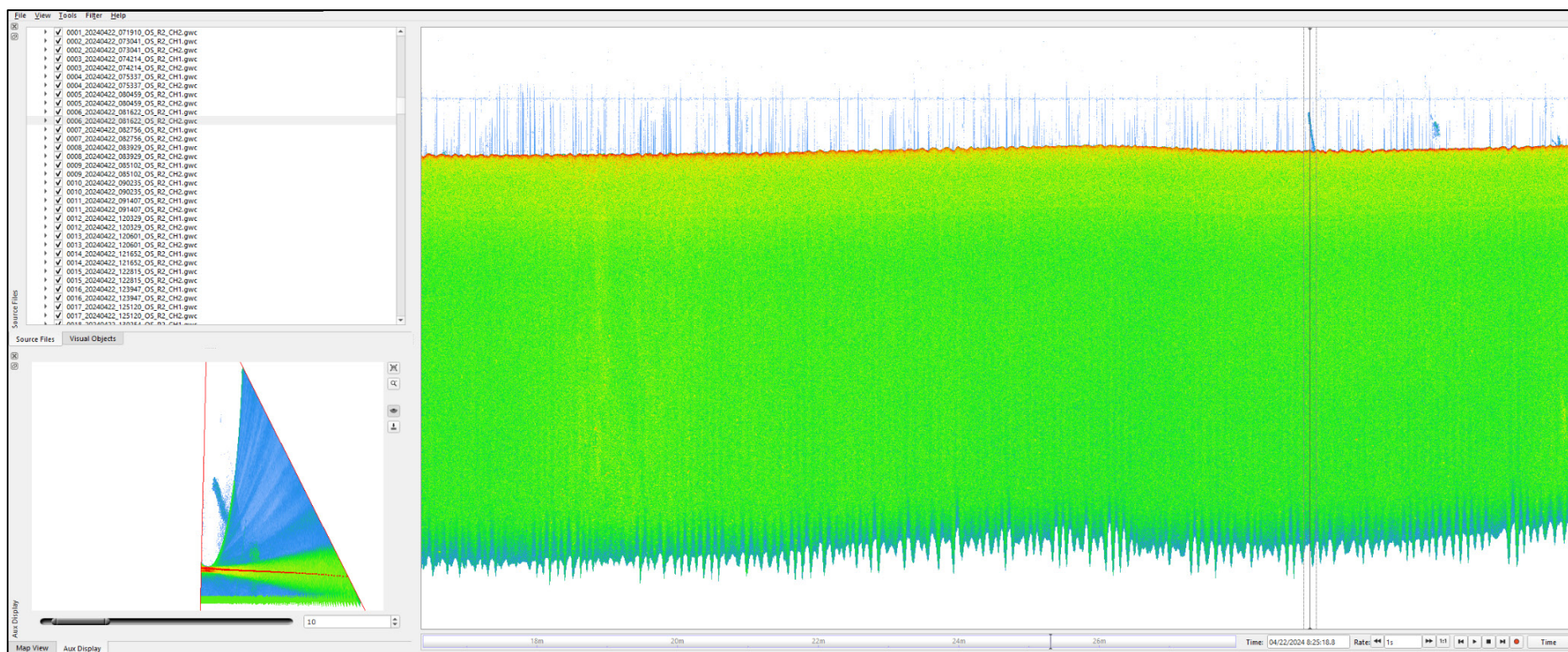


Figure 34. Possible gas seep (ID GS_009). The image shows data from line 0006_20240422_081622 as seen in R-stack view and fan view in FMMidwater, with an assessed magnitude of 3, and 10% confidence.

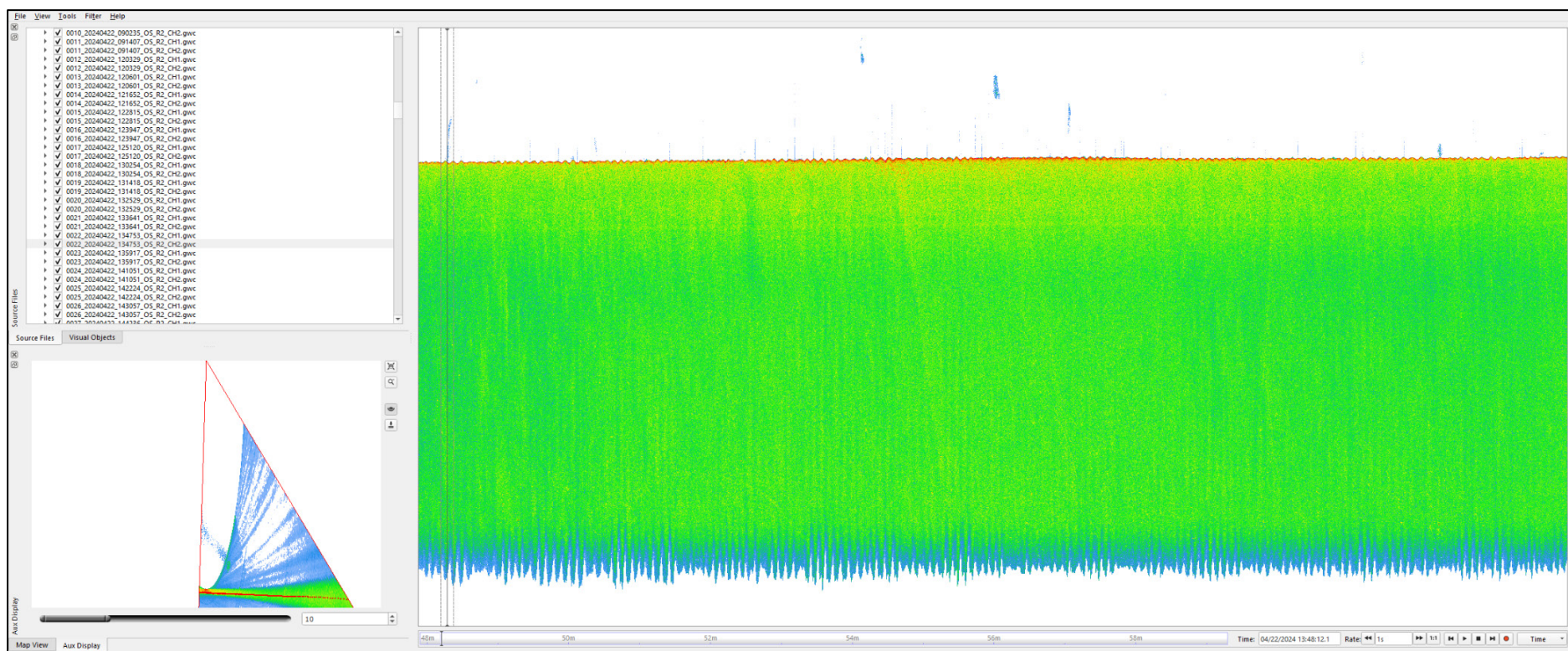


Figure 35. Possible gas seep (ID GS_011). The image shows data from line 0022_20240422_134753 as seen in R-stack view and fan view in FMMidwater, with an assessed magnitude of 3, and 5% confidence.

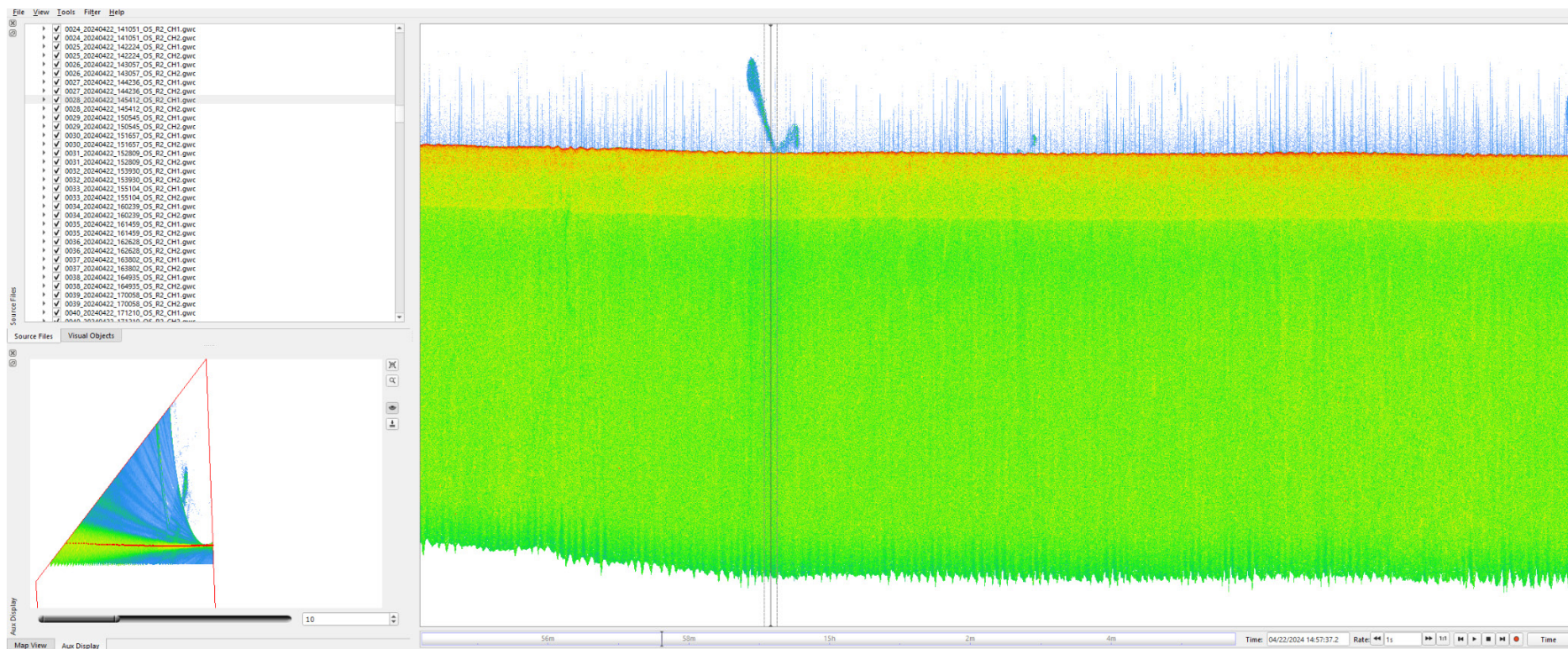


Figure 36. Possible gas seep (ID GS_014). The image shows data from line 0028_20240422_145412 as seen in R-stack view and fan view in FMMidwater, with an assessed magnitude of 4, and 5% confidence.

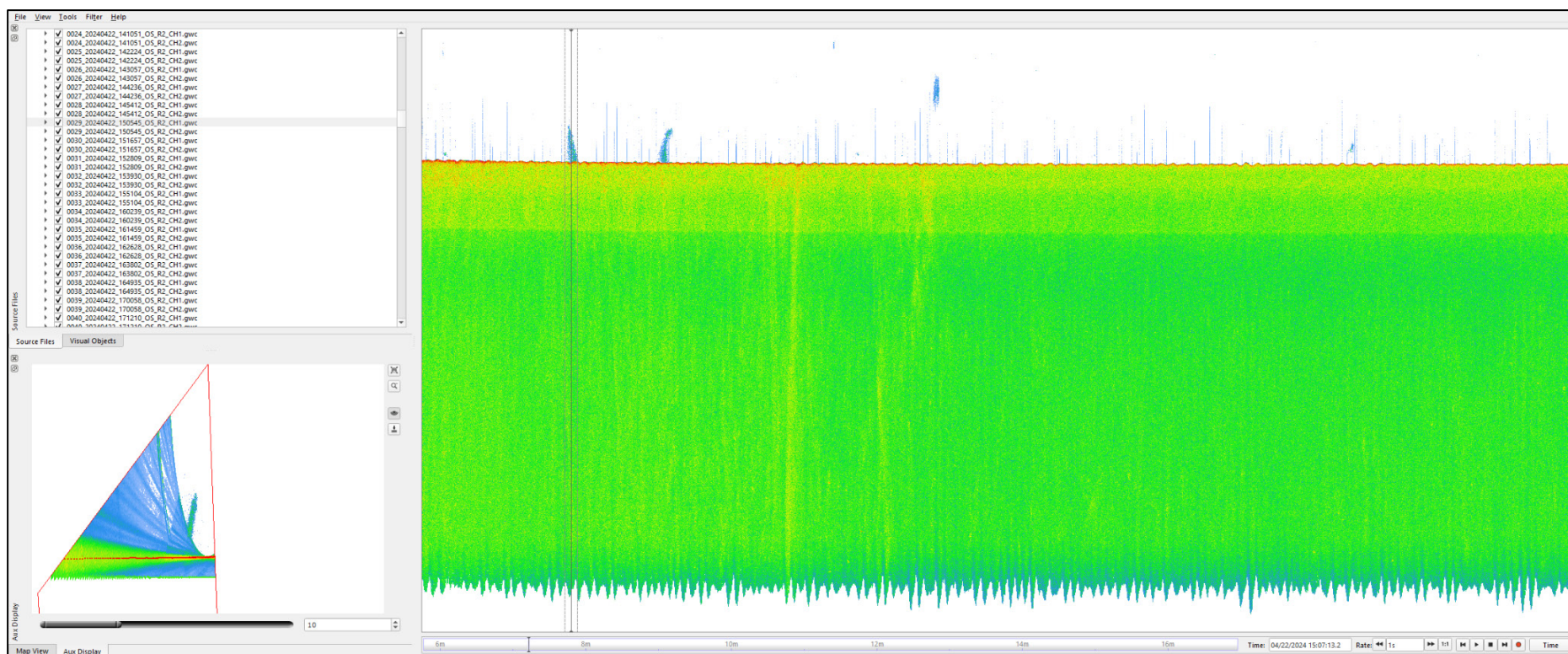


Figure 37. Possible gas seep (ID GS_015). The image shows data from line 0029_20240422_150545 as seen in R-stack view and fan view in FMMidwater, with an assessed magnitude of 4, and 5% confidence.

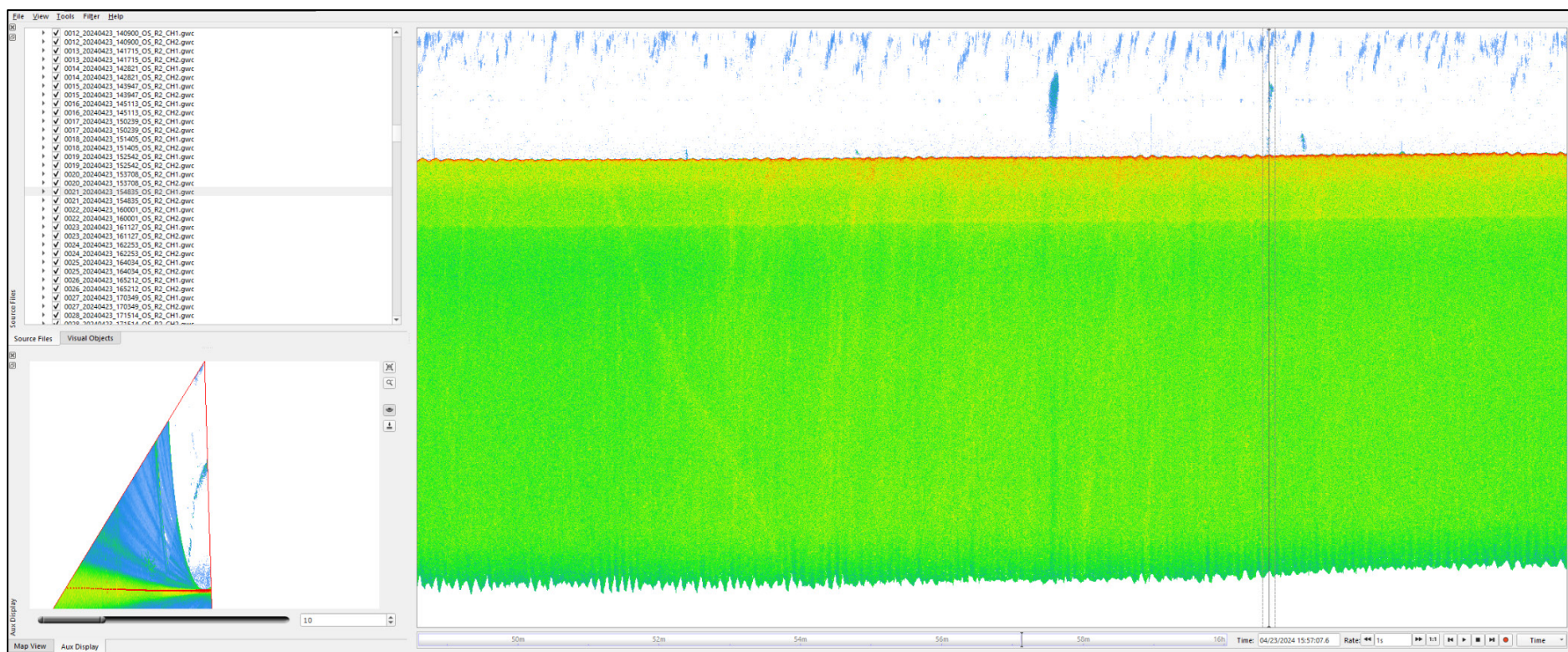


Figure 38. Possible gas seep (ID GS_017). The image shows data from line 0021_20240423_154835 as seen in R-stack view and fan view in FMMidwater, with an assessed magnitude of 1, and 5% confidence.

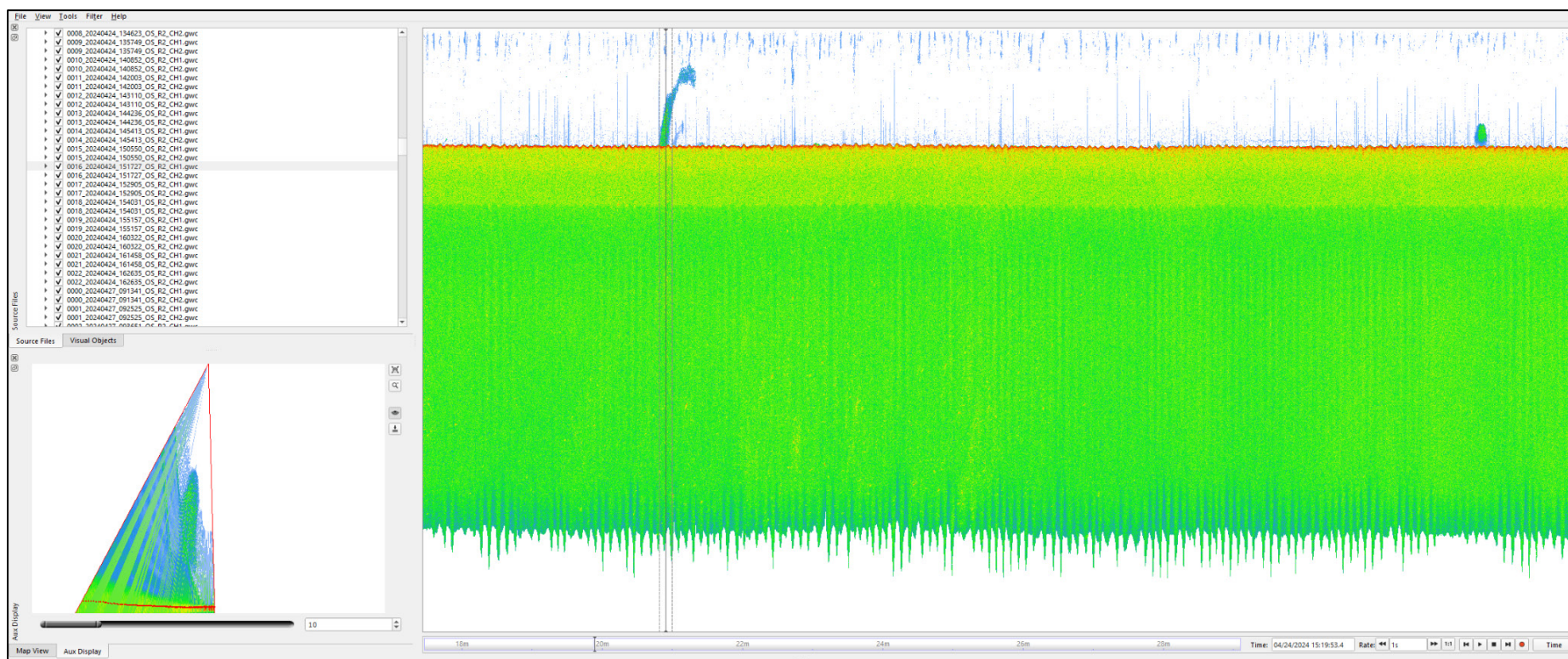


Figure 39. Possible gas seep (ID GS_O18). The image shows data from line 0016_20240424_151727 as seen in R-stack view and fan view in FMMidwater, with an assessed magnitude of 2, and 5% confidence.

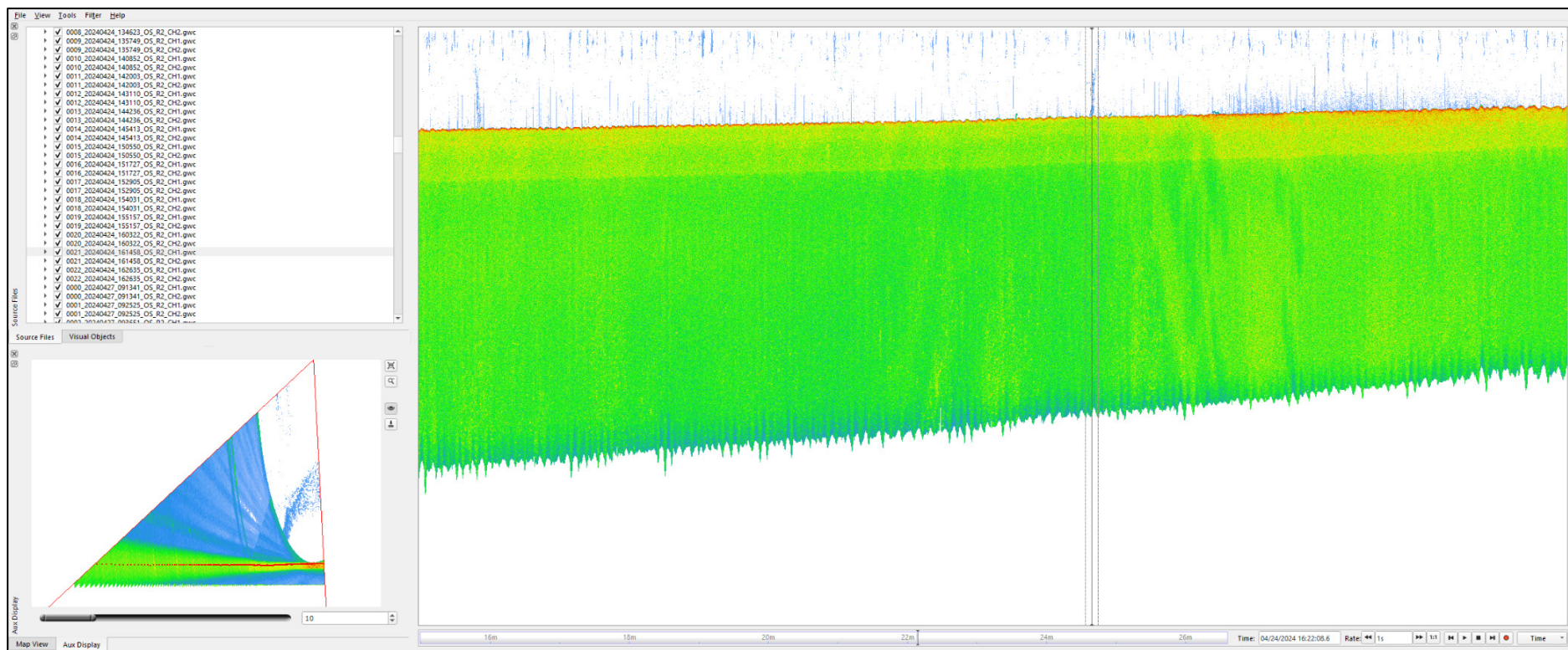


Figure 40. Possible gas seep (ID GS_019). The image shows data from line 0021_20240424_161458 as seen in R-stack view and fan view in FMMidwater, with an assessed magnitude of 1, and 5% confidence.

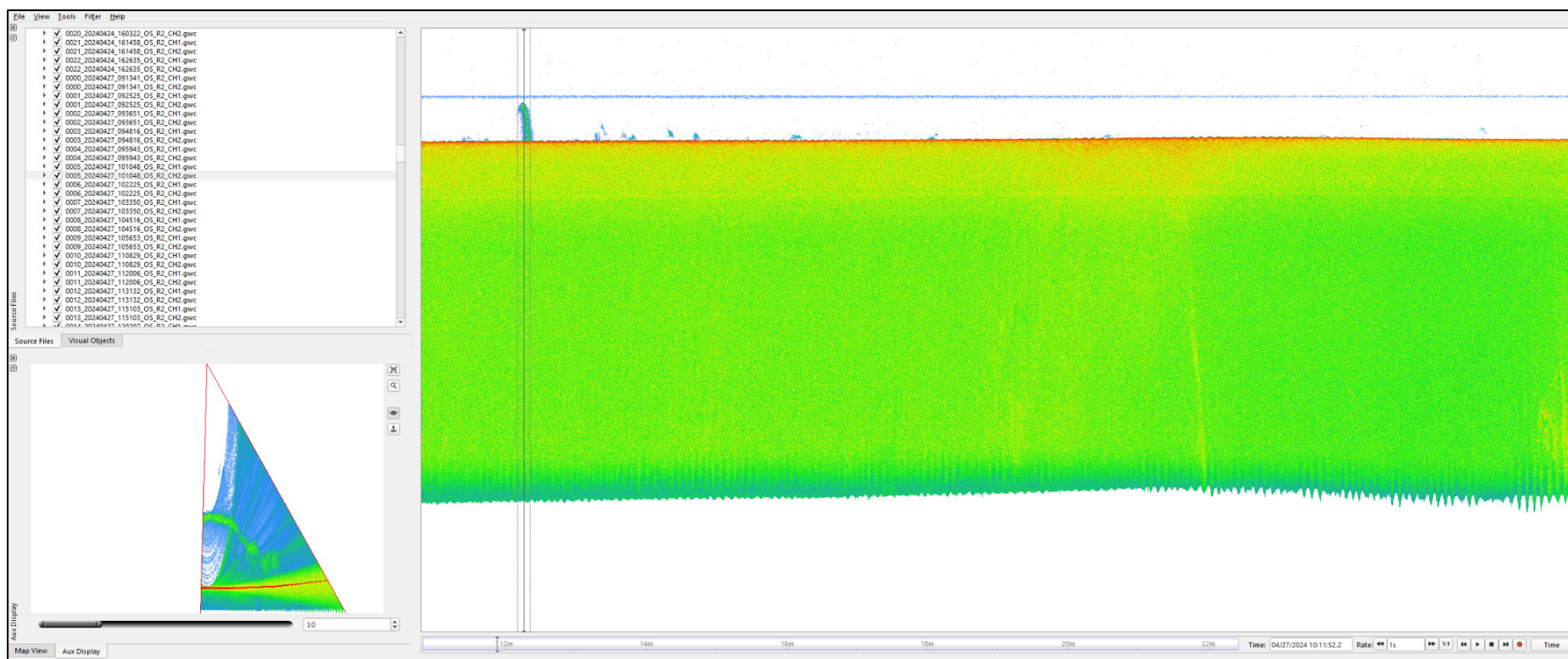


Figure 41. Possible gas seep (ID GS_O23). The image shows data from line 0005_20240427_101048 as seen in R-stack view and fan view in FMMidwater, with an assessed magnitude of 2, and 5% confidence.

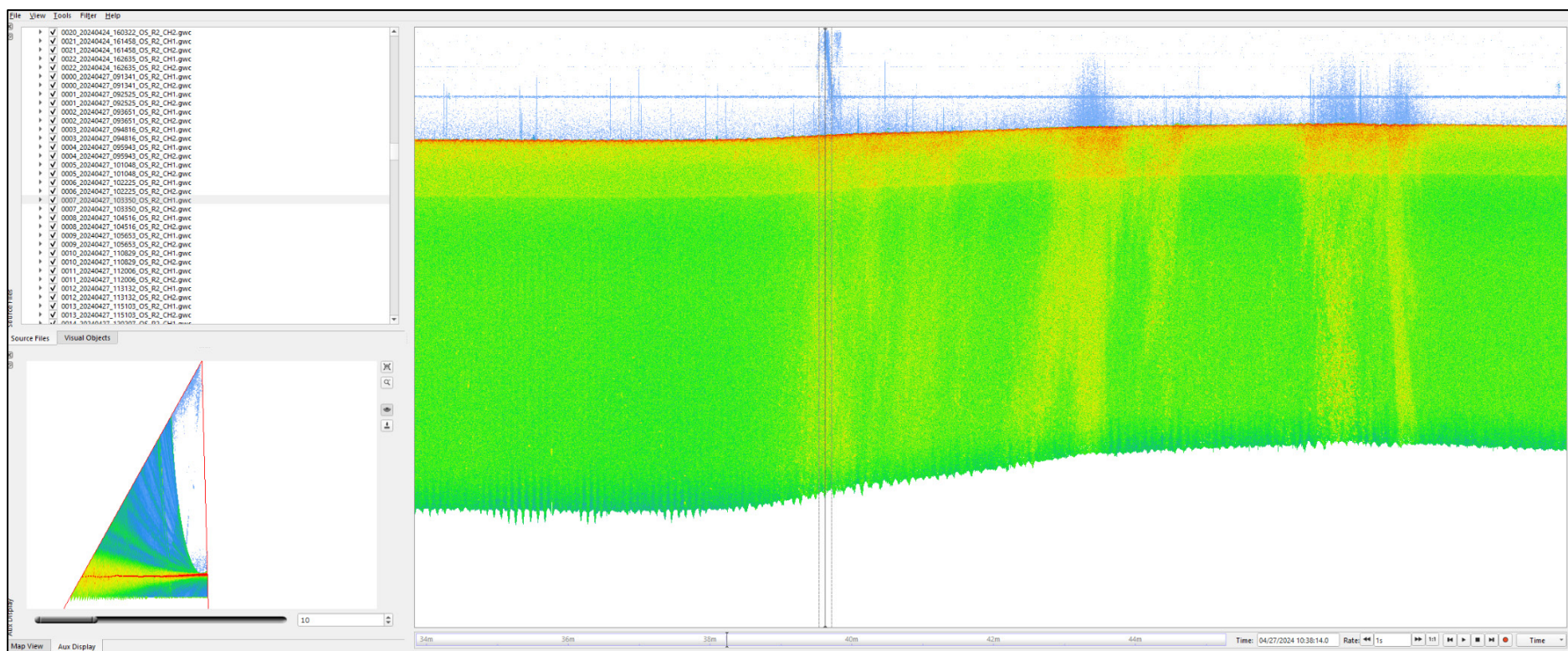


Figure 42. Possible gas seep (ID GS_024). The image shows data from line 0007_20240427_103350 as seen in R-stack view and fan view in FMMidwater, with an assessed magnitude of 1, and 5% confidence.

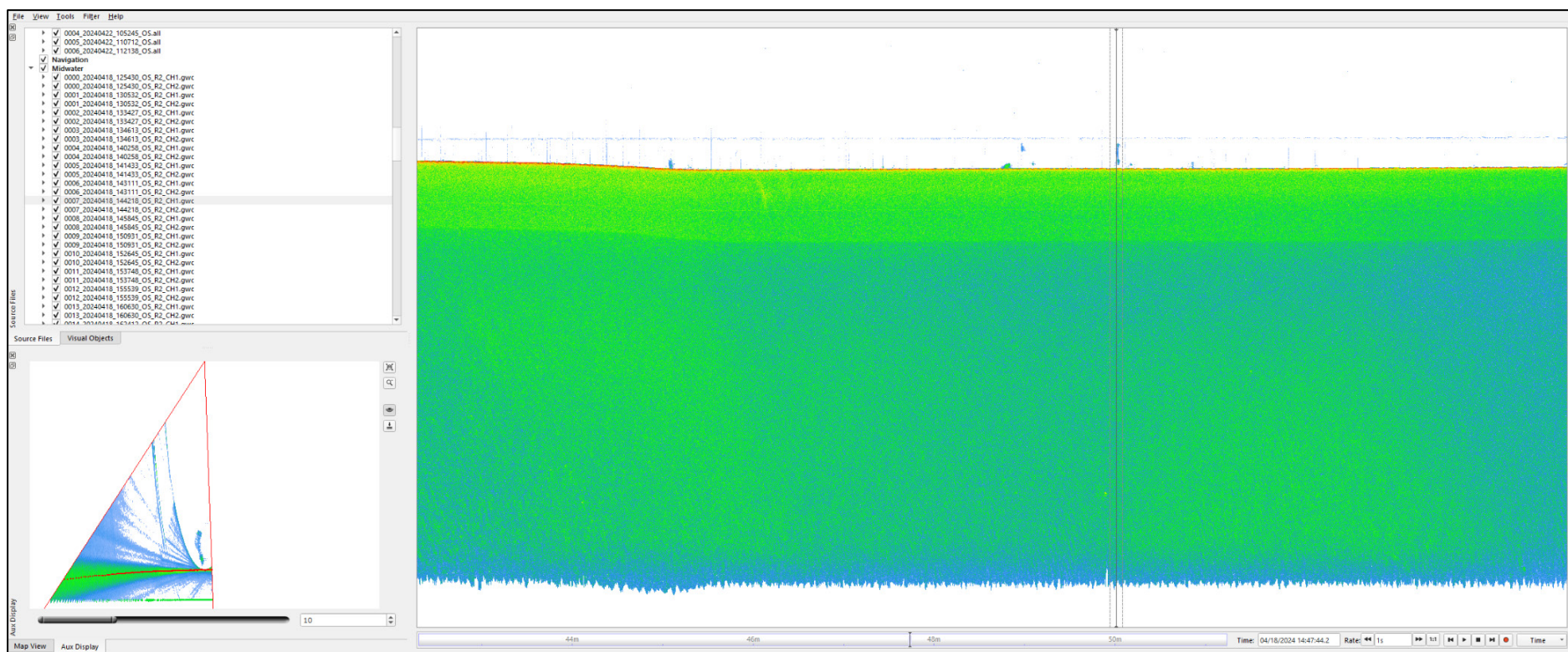


Figure 43. Possible gas seep (ID GS_032). The image shows data from line 0007_20240418_144218 as seen in R-stack view and fan view in FMMidwater, with an assessed magnitude of 2, and 5% confidence.

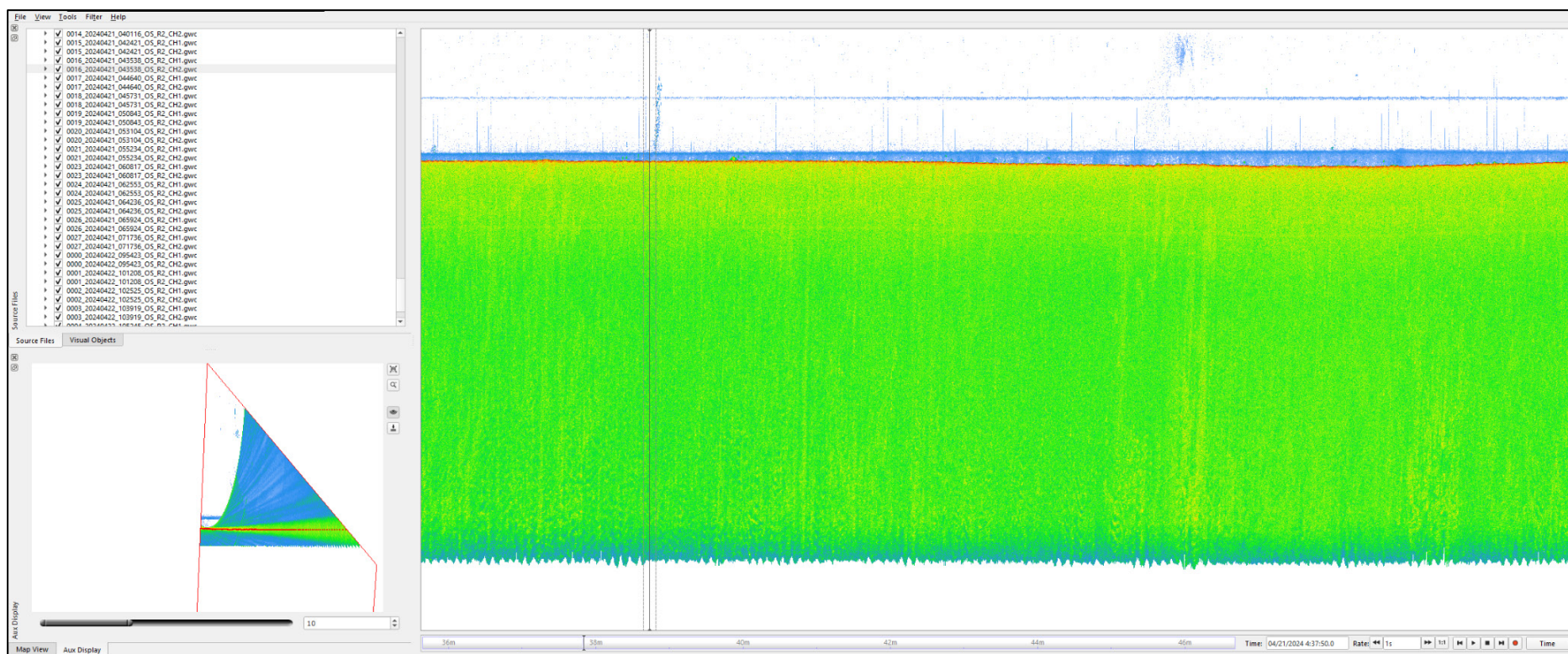


Figure 44. Possible gas seep (ID GS_O36). The image shows data from line 0016_20240421_043538 as seen in R-stack view and fan view in FMMidwater, with an assessed magnitude of 2, and 5% confidence.

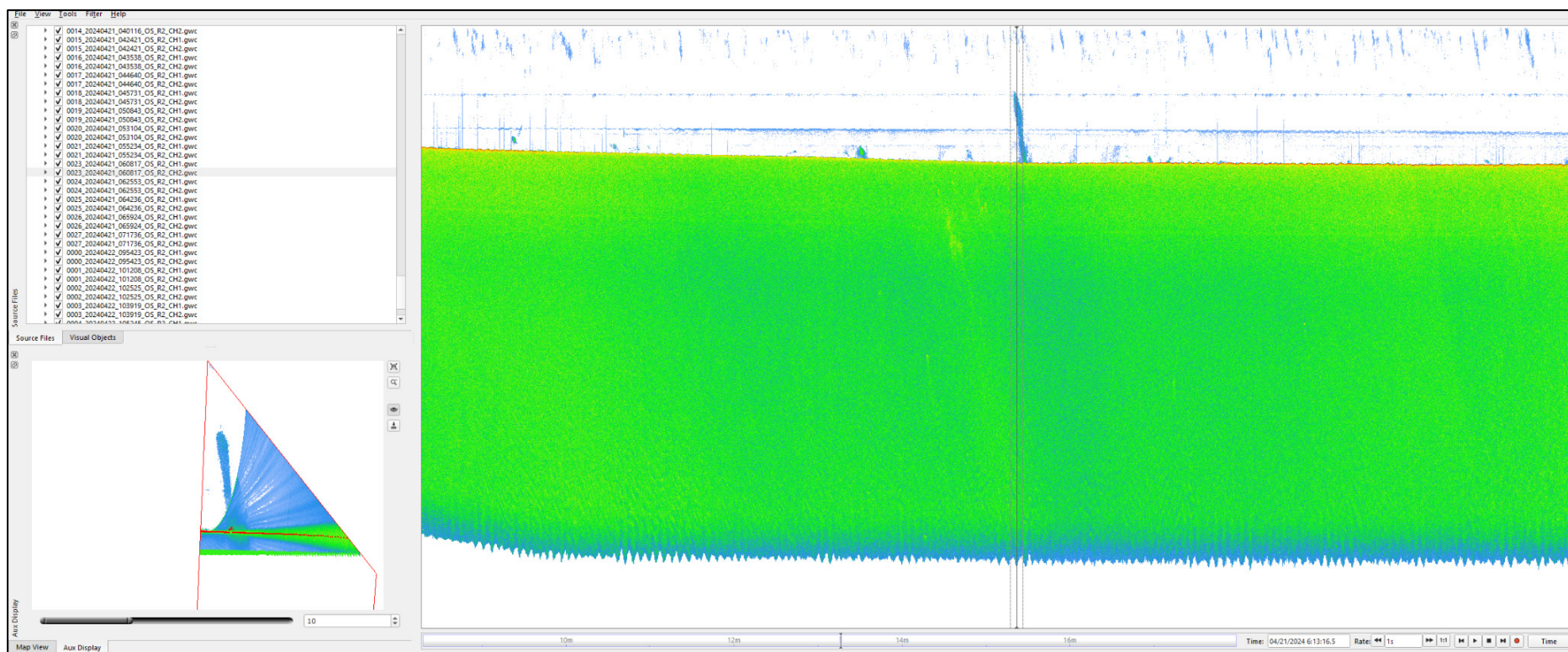


Figure 45. Possible gas seep (ID GS_037). The image shows data from line 0023_20240421_060817 as seen in R-stack view and fan view in FMMidwater, with an assessed magnitude of 4, and 20% confidence.

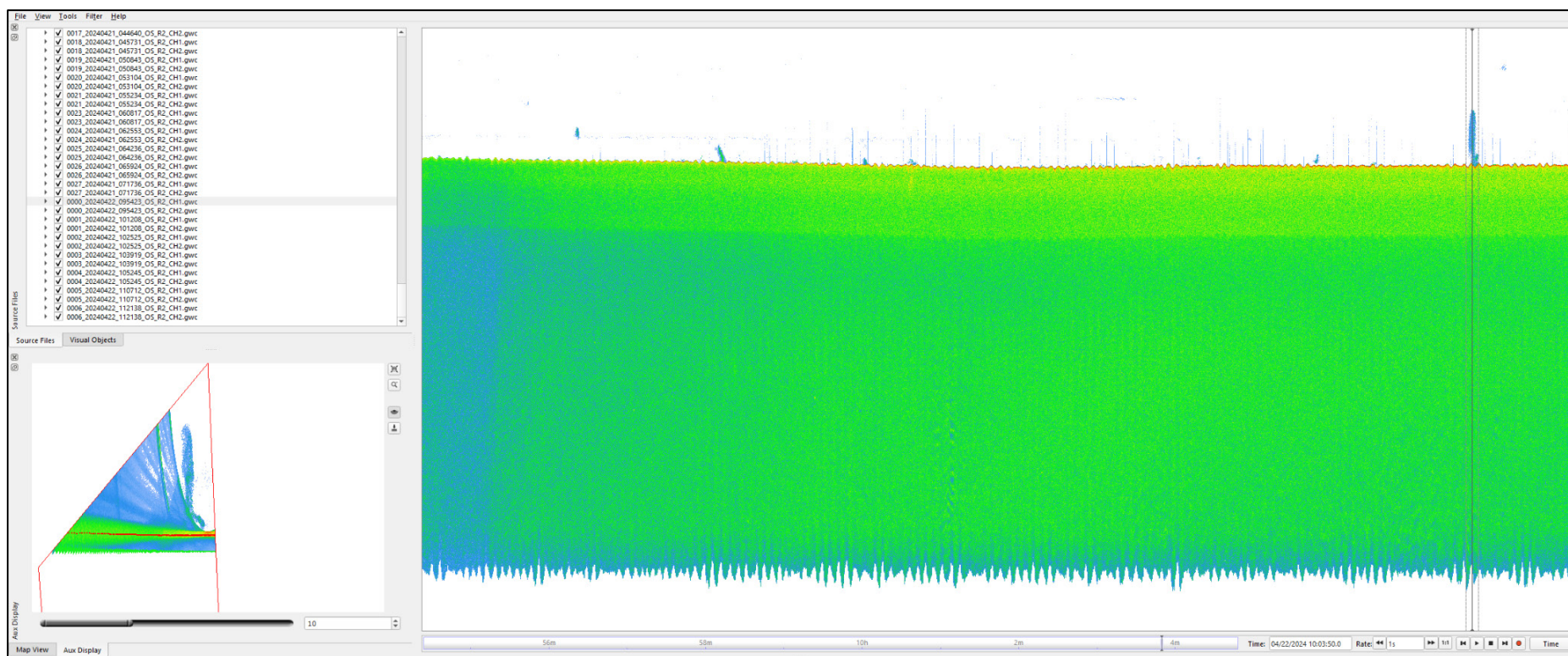


Figure 46. Possible gas seep (ID GS_039). The image shows data from line 0000_20240422_095423 as seen in R-stack view and fan view in FMMidwater, with an assessed magnitude of 4, and 10% confidence.

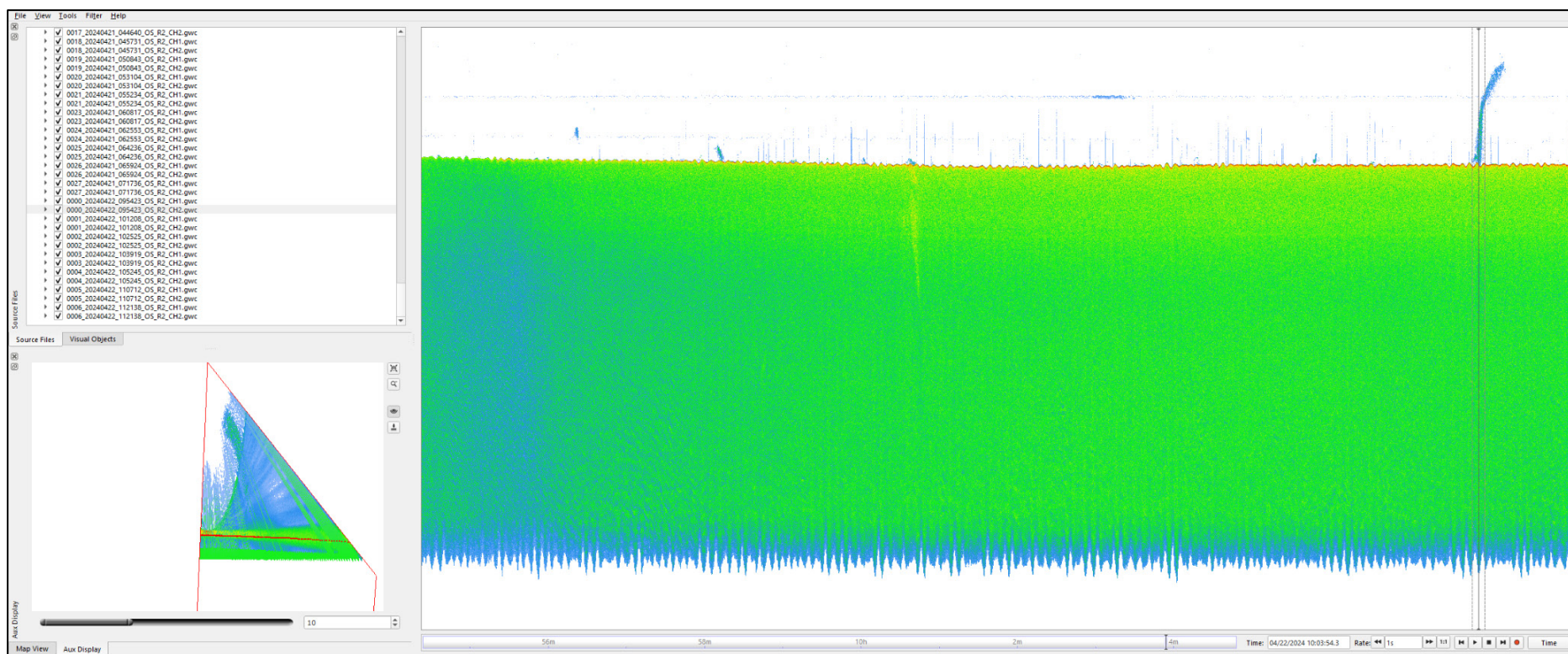


Figure 47. Possible gas seep (ID GS_O40). The image shows data from line O000_20240422_095423 as seen in R-stack view and fan view in FMMidwater, with an assessed magnitude of 4, and 10% confidence.

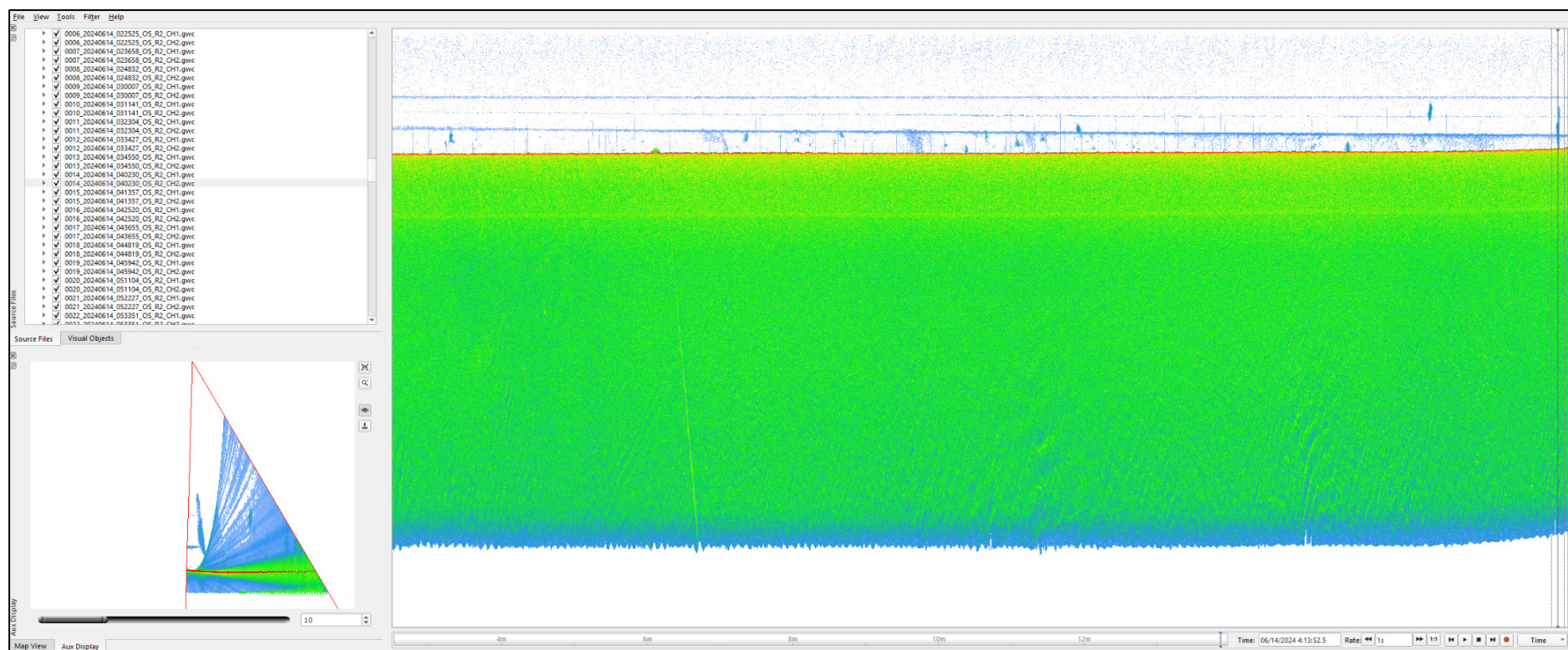


Figure 48. Possible gas seep (ID GS_045). The image shows data from line 0014_20240614_040230 as seen in R-stack view and fan view in FMMidwater, with an assessed magnitude of 3, and 10% confidence.

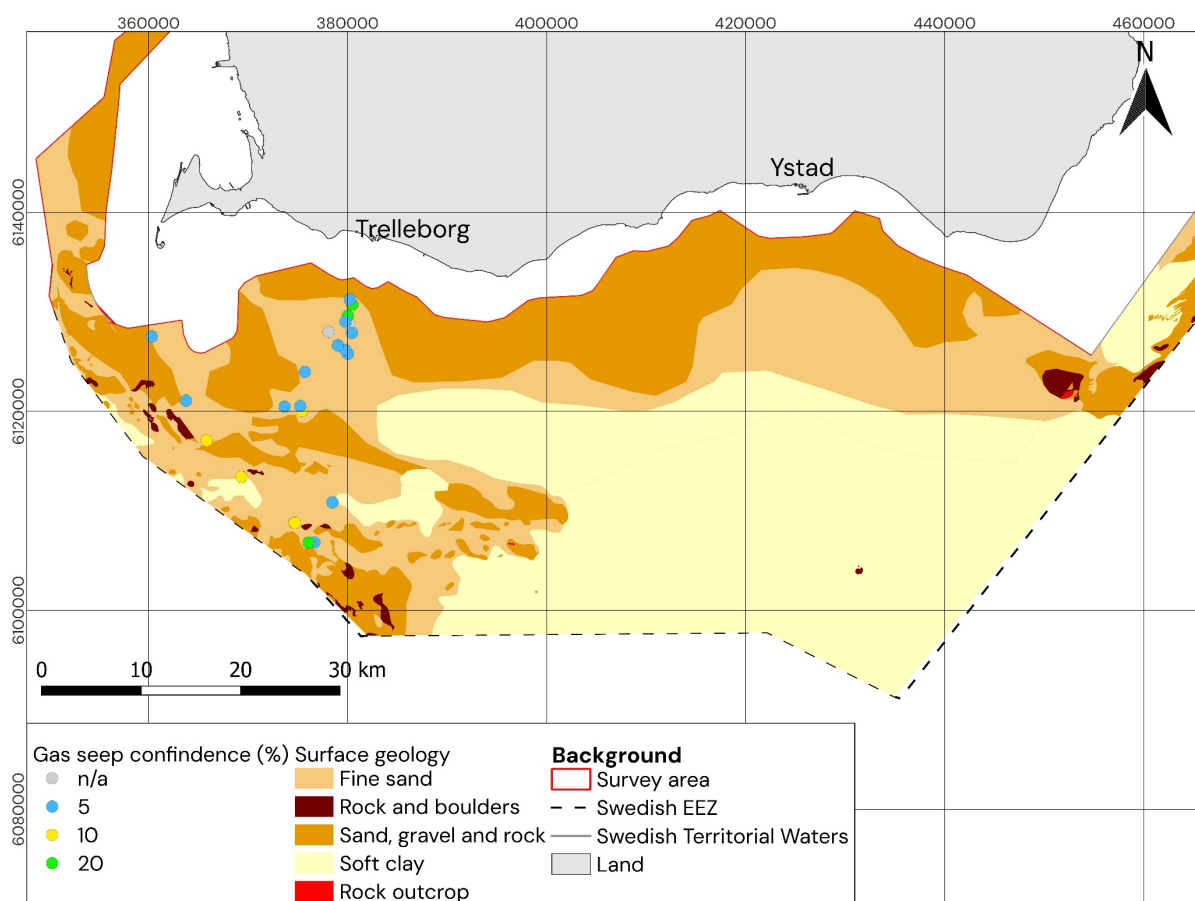


Figure 49. Positions and certainty of gas seep-like anomalies in the Southern Skåne survey area. Different colours represent varying confidence levels. Surface geology from this report in Swedish territorial waters and from the marine geological map (1:100 000) produced by SGU in the EEZ.

All the observed potential seep-like anomalies in the Southern Skåne survey area (Figure 49) occur in the western part of the surveyed area. This is also area where the survey coverage with logged MBES water column data is most complete. Of the 23 anomalies the confidence score does not exceed 20% because even though they display seep-like qualities large uncertainties remain in their classification.

Relationship Between Seep-like Anomalies and Bedrock Faults

When presented together with information about previously known and recently reviewed interpretations of bedrock faults (Figure 50) the gas seep-like anomalies generally follow the largest of the mapped fault lines, the Svedala fault. This would at first glance indicate potential leakage of gas along the fault line. However, it is difficult to state if the discovery of potential gas seep-like anomalies with this orientation is an artifact of the surveying method as water column data was only logged along the suspected fault lines.

During the 2024 mapping campaign, in which water column data was collected south of Skåne, another objective was detection of geological structures relating to current and past gas seepage from deeper geological layers in the area. These were primarily structures that would indicate the presence of pockmarks such as round, crater like depressions in the seafloor accompanied with changes in seafloor backscatter due to the mixing of surface sediments by the escaping gas.

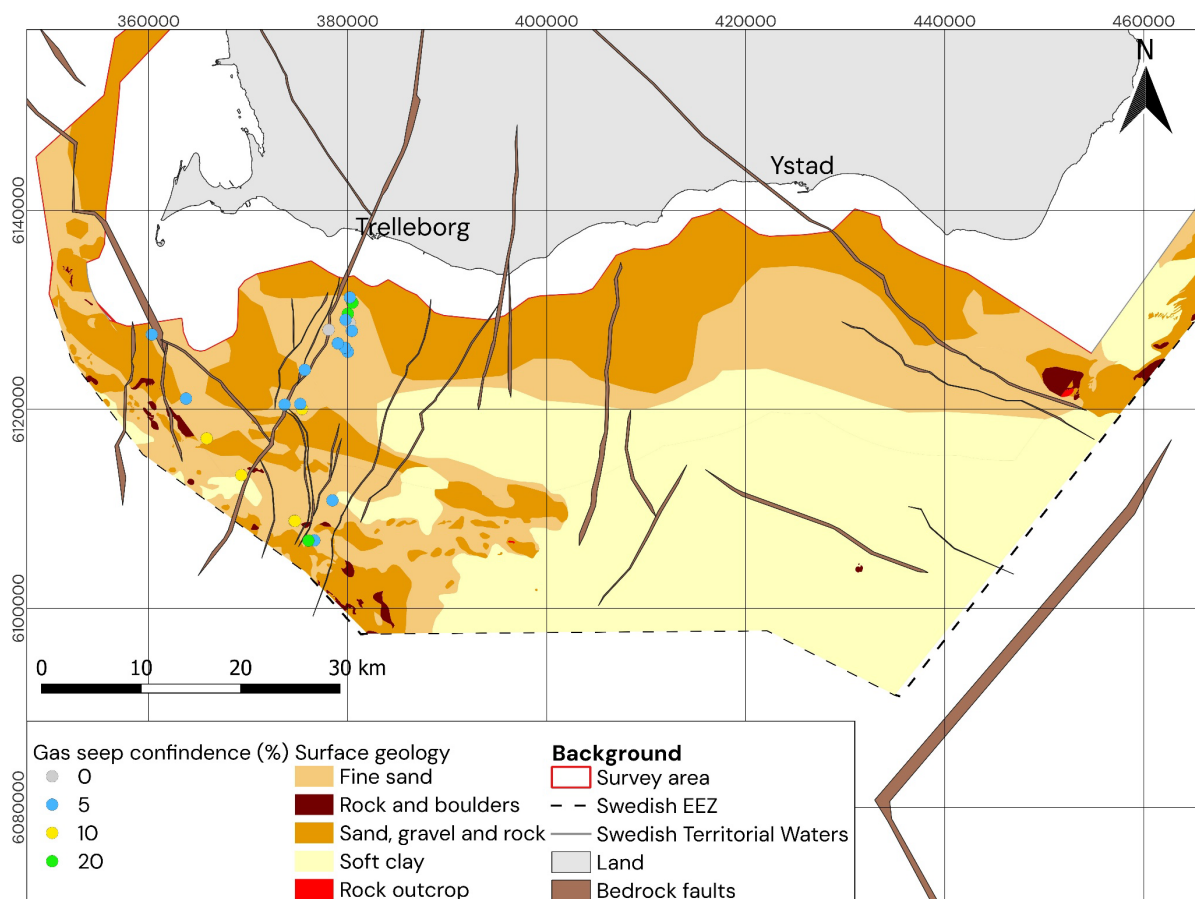


Figure 50. Positions and certainty of gas seep-like anomalies in the Southern Skåne survey area. Different colours represent varying confidence levels. Bedrock fault areas visible in brown. Surface geology from this report in Swedish territorial waters and from the marine geological map (1:100 000) produced by SGU in the EEZ.

Observations from the high resolution multibeam bathymetry and backscatter data (not presented in this report due to dissemination restrictions) have not indicated the presence of pockmarks along the investigated fault. In addition, no observation of such structures has been made in the SBP data, which also have not shown evidence of acoustic blanking that could indicate gas in the surface sediments. The only observed acoustic blanking in the SBP dataset has been seen in the thick postglacial soft CLAY of the southeastern part of the survey area. It is therefore interpreted as biogenic. This suggests that there has not been gas release of sufficient extent to form pockmarks from the investigated fault lines in recent time. However, during the CCS government mandate it was not possible to achieve complete coverage of each fault zone due to time constraints (e.g. Figure 7).

Most of the anomalies occur in the seafloor substrate fine sand rather than in the coarser material and cluster closer to land rather than further out. This would be opposite of previous observations of gas in the surface sediments of the Arkona Basin which has been reported primarily from the geographical centre of the basin and in post glacial clays (Mathys et al. 2005, Thießen et al. 2006, Mogollón et al. 2012).

However, survey coverage with water column logging is lacking in the central part of the basin in this study. Therefore, it is currently not possible to determine whether additional anomalies occur in the more central areas of the basin.

Confidence in the interpretation of the gas seep-like anomalies did not exceed 20% so even though their morphology does not exclude a seep interpretation, it is still possible that they could have originated from some other phenomena in the water column. Fish schools are probably the most likely because of their varied morphology and relative ease of detection in water column data.

Conclusions

As part of the government mandate for CCS in Sweden, the Geological Survey of Sweden has collected data about the near surface geology in two areas in the seas outside Skåne on the Swedish mainland. Several survey campaigns were conducted, during which near surface data was collected alongside seismic profiles. During one campaign to the Arkona Basin (south of Skåne) multibeam water column data were logged alongside multibeam bathymetry and backscatter data, as well as sub-bottom profiler data along faultlines with more complete survey coverage. From these new data it is possible to draw the following conclusions:

- There are indications of gas seep-like anomalies along the investigated fault lines, especially along the Svedala fault. However, the origin of these anomalies is still uncertain, and it is not possible to rule out that they could represent other phenomena. The anomalies generally follow the interpreted fault line which would support gas evacuation, but the relationship could also be down to survey method, the Svedala fault is by far the best covered fault in the dataset.
- No other indication of gas evacuation structures has been observed in the bathymetry, backscatter and sub-bottom profiler datasets. Suggesting that any potential gas release is limited in nature.
- New dataset of bathymetry, backscatter, surficial geology interpretation and sub-bottom isopachs can now be shared in the territorial waters. This has not been possible before, so these data adds new information, albeit at a lower resolution.
- Five isopaches of the sediment in the survey area have been created.
- The resulting mapped geology generally supports the previous geological model of the area.
- The dataset presented here can act as a base survey for further planning as the CCS industry in Sweden develops.

References

- Hovland, M., Gardner, J. V. & Judd, A. G., 2002: The significance of pockmarks to understanding fluid flow processes and geohazards. *Geofluids* 2, 127–136.
- Jaśniewicz, D., Klusek, Z., Brodecka-Goluch, A. & Bolalek, J., 2018: Acoustic investigations of shallow gas in the southern Baltic Sea (Polish Exclusive Economic Zone): a review. *Geo-Marine Letters* 39, 1–17.
- Lilje, M., Eriksson, P-O., Olsson, P-A., Svensson, R. & Ågren, J., 2007: RH 2000 och riksavvägningen (in Swedish), *LMV-rapport 2007*, 14, pp. 1–55.
- Long, D., and M. Akhurst, 2012: The Role of Site Surveys in Carbon Capture and Storage., Paper presented at the Offshore Site Investigation and Geotechnics: Integrated Technologies – Present and Future, London, UK, September 2012
- Mathys, M., Thießen, O., Theilen, F. & Schmidt, M., 2005: Seismic characterisation of gas-rich near surface sediments in the arkona basin, baltic sea. *Marine Geophysical Research*, 26 (2-4), 207–224.
- Mogollón, J. M., Dale, A. W., Fossing, H. & Regnier, P., 2012: Timescales for the development of methanogenesis and free gas layers in recently-deposited sediments of Arkona Basin (Baltic Sea). *Biogeosciences* 9, 1915–1933.
- Thießen, O., Schmidt, M., Theilen, F., Schmitt, M. & Klein, G., 2006: Methane formation and distribution of acoustic turbidity in organic-rich surface sediments in the Arkona basin, Baltic Sea. *Continental Shelf Research*, 26, 2469–2483.
- Thorsnes, T., Chand, S., Bellec, V., Nixon, F.C., Brunstad, H., Lepland, A. & Aarrestad, S.M., 2023: Gas seeps in Norwegian waters – distribution and mechanisms. *Norwegian Journal of Geology* 103, 202309.