



GEOLOGI FOR SAMFUNNET

SIDEN 1858



**NORGES
GEOLOGISKE
UNDERSØKELSE**
· NGU ·

NGU REPORT
2021.038

Processing and interpretation of water
column data from the
Gardarbankhøgda,
Bjarmelandplattformen,
Sentralbankhøgda and Kong Karls
Land-plattformen, Barents Sea



Report no.: 2021.038		ISSN: 0800-3416 (print) ISSN: 2387-3515 (online)		Grading: Open	
Title: Processing and interpretation of water column data from the Gardarbankhøgda, Bjarmelandplattformen, Sentralbankhøgda and Kong Karls Land-plattformen, Barents Sea					
Authors: Shyam Chand, Terje Thorsnes			Client: Norwegian Petroleum Directorate (NPD)		
County:			Kommune: Trondheim		
Map-sheet name (M=1:250.000)			Map-sheet no. and -name (M=1:50.000)		
Deposit name and grid-reference:			Number of pages: 144 Price (NOK): 250 Map enclosures: 0		
Fieldwork carried out:		Date of report: 01/12/2021		Project no.: 311758	
				Person responsible: Reidulv Bøe <i>Reidulv Bøe</i>	
Summary:					
<p>This study was carried out using multibeam echo sounder data collected during Mareano surveys in 2015, 2017, 2018 and 2021. The data from the surveys have been processed and interpreted to identify natural gas seeps, visible as gas flares, in the water column data. The data is also used for extracting bathymetry and backscatter.</p> <p>The study area lies on Gardarbankhøgda, Bjarmelandplattformen, Sentralbankhøgda and Kong Karls Land-plattformen in the southern Barents Sea. The subsurface geology consists of eroded sediments from Jurassic to middle Triassic age. The shallowest area lies on Gardarbankhøgda, with the seafloor deepening towards Bjarmelandplattformen and Kong Karls Land-plattformen. The subsurface architecture follows a similar trend and therefore subsurface fluid flow is southwards from Kong Karls Land-plattformen and northwards from Bjarmelandplattformen guided by the stratification. The water depth is shallow and ranges from 54 to 370 m with the shallowest part at the north-western part of Gardarbankhøgda.</p> <p>The following results were obtained:</p> <ul style="list-style-type: none"> • Processing and interpretation of water column data covering 5410 km² from the study area in the Southern Barents Sea using Fledermaus Midwater software indicates 725 flares of varying sizes and confidence levels. • Flares are categorized according to the standard methods used in Mareano and other projects. • 105 flares with a magnitude higher than 4 were identified, thus representing ~15% of total flares. 					
Keywords: Water Column		Gas Flare		Acoustic	
Multibeam		Barents Sea		Gardarbankhøgda	
Bjarmelandplattformen		Kong Karls Land-plattformen		Sentralbankhøgda	

Contents

1. Introduction	4
2. Study area	4
3. Methods	7
3.1 Multibeam	7
3.2 Fledermaus Software	7
4. Results	8
4.1 Bathymetry	8
4.2 Backscatter	10
4.3 Sediment Classification	12
4.4 Water Column	14
4.4.1 Meritaito-2017-Kirkegaarden	16
4.4.2 Fosae-2015-BH02	18
4.4.3 Fosae-2015-BH03	43
4.4.4 FGMG-2018-Tr-KKG-BH03	75
4.4.5 FGMG-2018-Kratere	76
4.4.6 FGMG-2018-Kirkegaarden	88
4.4.7 FGMG-2018-Tr_TF01-BH03	105
4.4.8 Meritaito-2021-Hopendjupet	133
4.4.9 Meritaito-2021_SlickEmissionPoints	135
5. Conclusions	142
6. References	143

1. Introduction

Marine methane vents and cold seeps are widespread on continental margins, including the Barents Sea (Skarke et al., 2014; Chand and Thorsnes, 2020). Active seepage on the continental shelf is commonly associated with underlying oil and gas reservoirs, trapped gas under gas hydrates, and dissociation of gas hydrate (Milkov and Sassen, 2003). These seepages can be observed as flares of disturbances in the water column on echosounder data. Detection of gas flares from marine methane vents and cold seeps can be efficiently carried out using multibeam echosounders (Urban et al., 2017).

This study is carried out using multibeam echo sounder data collected during Mareano surveys in 2015, 2017, 2018 and 2021. The surveys included in the study are:

- Meritaito-2017-Kirkegaarden-west-a
- Meritaito-2017-Kirkegaarden-west-b
- Meritaito-2017-Kirkegaarden-west-c
- Meritaito-2017-Kirkegaarden-east-a
- Fosae-2015-BH03
- Fosae-2015-BH02
- FGMG-2018-Tr-KKG-BH03-cell1
- FGMG-2018-Kratere-cells01-08
- FGMG-2018-Kirkegaarden-cells01-12
- FGMG-2018-Tr-TF01-BH03.
- Meritaito-2021-Hopendjupet
- Meritaito-2021-SlickEmissionPoints

The surveys used Kongsberg EM2040 and EM710 systems depending on water depths in the study area. The data from the surveys have been processed and interpreted to identify natural gas seeps, visible as gas flares, in the water column data. The data is also used for extracting bathymetry and backscatter as part of the Mareano mapping programme. Bathymetry and backscatter, sub-bottom profiler data and ground truth data using video and sampling are used to create different types of maps, presented by Mareano.

2. Study area

The study area lies in the Gardarbankhøgda, Bjarmalandplattformen, Sentralbankhøgda and Kong Karls Land-plattformen areas of the southern Barents Sea (Fig. 1a) covering the “Kirkegården and “Kratere” areas. The water depth ranges from 50 to 450 m.

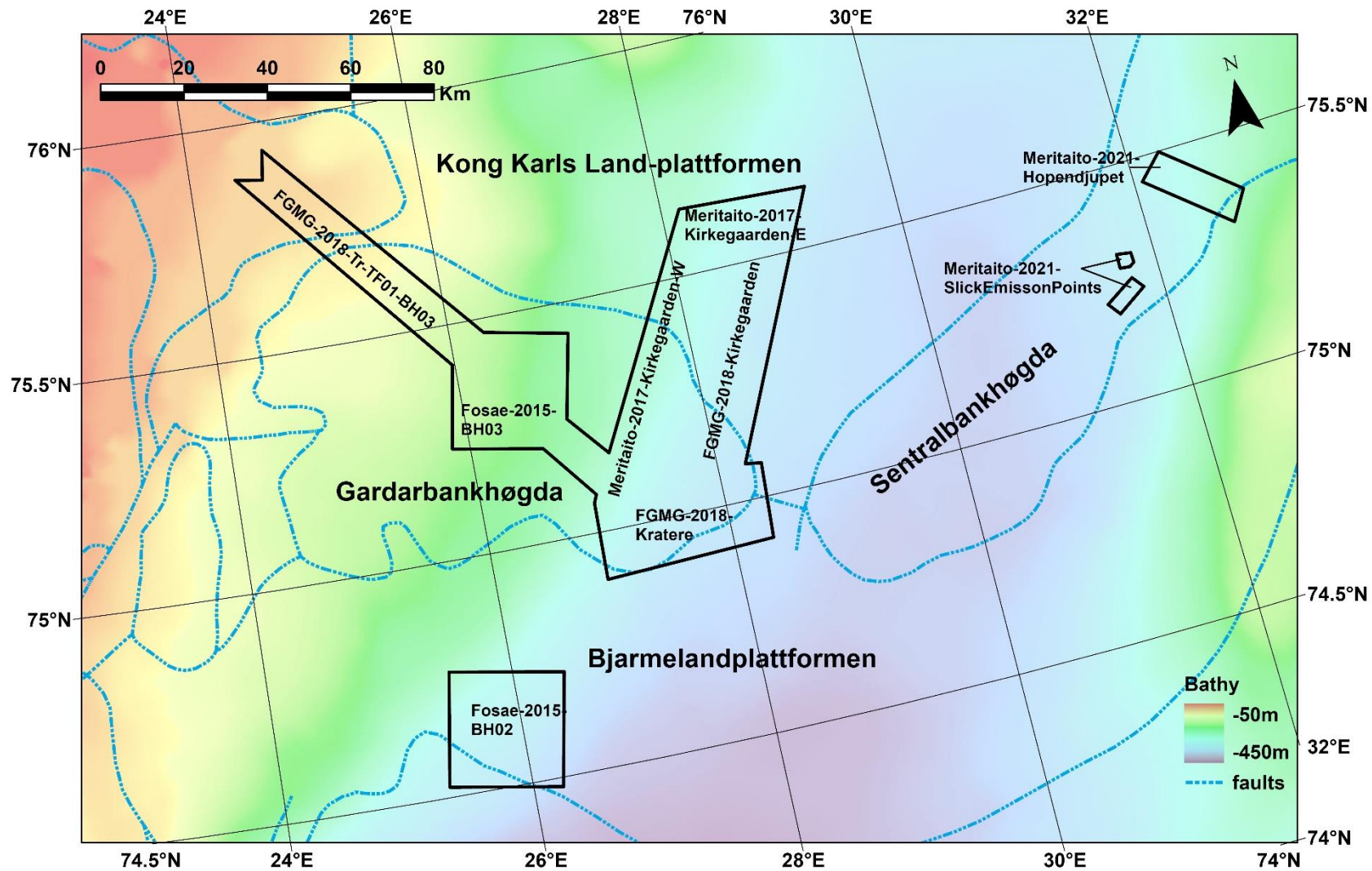


Figure 1a. Regional bathymetry map of the Barents Sea showing the major structural boundaries (blue dotted lines) and the study area (black polygons). The locations of the various surveys are also shown.

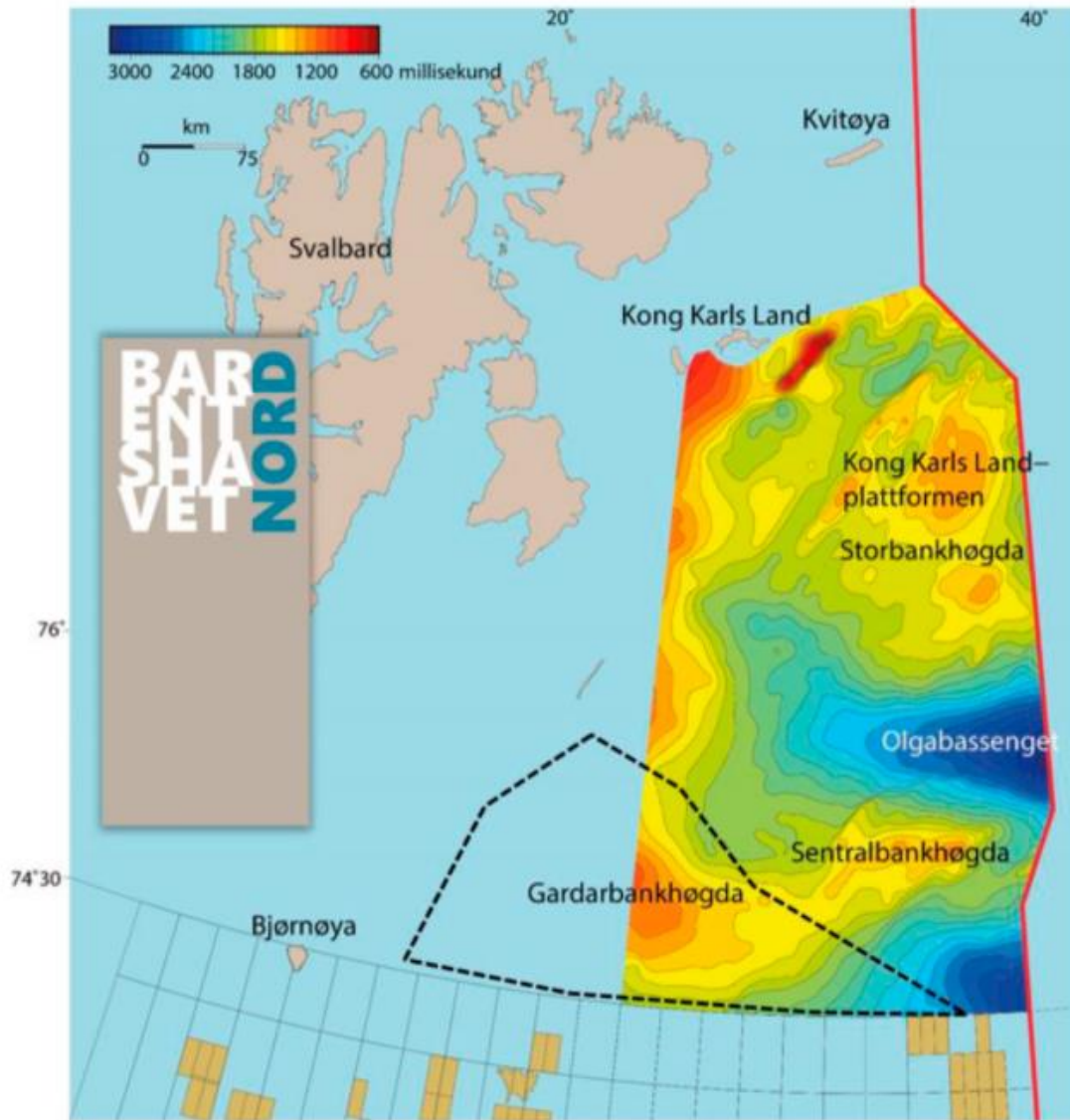


Figure 1b. Subsurface structural map of the study area (NPD, 2018).

3. Methods

3.1 Multibeam

Kongsberg EM2040 and EM710 multibeam systems were used by Meritaito and Fugro respectively to acquire data from the study areas. Both EM2040 and EM710 multibeam echosounders can record water column data. The operating frequencies differ between these systems due to the depth ranges of operation; the EM2040 being a shallow water system operating at 200-400 kHz range, whereas the EM710 uses 70-100 kHz frequency range. The EM2040 system therefore gives up to 5 times higher spatial resolution compared to EM710 at similar water depths. As a rule, features smaller than the size of one fourth the wavelength cannot be resolved (Sheriff, 1980). Hence, only features larger than 0.25 and 1 meter in diameter can be theoretically detected using the EM2040 and EM710 systems respectively at 120 m water depths. Since the water column data recorded by the systems works on the principle of backscattering, these systems can be used for detection of active gas seeps, and also detection of fauna even though they are of smaller sizes compared to spatial resolution limits. The presence of fish schools (air in bladder) can be easily identified and is hence useful to estimate the energy loss in the water column during detailed backscatter processing. More diffuse clouds in the water column are assigned to plankton. Indications of mammals are seen as large, single reflections, often associated with hyperbolic reflections.

3.2 Fledermaus Software

FlederMaus (FM) Midwater package was used to process water column data for detecting and analysing gas anomalies. The data was loaded in FM Midwater along with navigation (*.all) and converted to GWC files. During conversion, it was observed that there was multiple *.gwc files generated for EM2040 data due to multiple transducers representing two sides of the swath. They cannot be combined in FMMW and are therefore interpreted separately. Special care was taken to go through the noisy lines to avoid missing flares. It is concluded that only weak flares might have been missed through this process.

Similar water column anomalies collected in other areas have been ground truthed confirming the feasibility of this method (Chand et al 2012a, 2012b, 2016; Chand and Thorsnes, 2020). During interpretation, the following procedure was used:

1. The depth range was adjusted to maximise the vertical display of the line (FMM).
2. The display was adjusted to 1:1 horizontal display (FMM).
3. The colour range was adjusted to the dynamic range of signals in the water column, optimizing the display of water column features (FMM). Here, we used different ranges based on the system and general loss in the water column through visual inspection. The range is kept constant for the whole survey to avoid any consistency related issues.
4. The data were inspected using the R-stack water column view, and the stacked fan water column view.
5. The locations of gas flares were determined using the GeoPick function in FMM.

The water column data were evaluated in parallel (along-track) and perpendicular (across-track) directions to the track lines for identifying anomalies. The coordinates, time of

acquisition, water depth and height of largest three gas flares above and equal to magnitude 3 were recorded, along with the survey name and line ID. A subjective assessment of the apparent magnitude has been assigned (table 1). A confidence estimate is provided for codes 2-6. The maximum confidence for visual classification is 90%. A confidence of 100% is reserved for gas flares where gas bubbles have been observed by video/photo inspection or measured using gas sniffers, or where authigenic carbonate crusts have been observed. Very uncertain, but still possible gas flares have been assigned 10% confidence.

Table 1. Codes used for assessment of magnitude, and confidence intervals.

Code	Description	Confidence %
2	Weak gas flare	10 – 100
3	Medium strong gas flare	10 – 100
4	Strong gas flare	10 – 100
5	Very strong gas flare	10 – 100
6	Giant gas flare	10 – 100

Generally, the recognition of gas flares is based on two criteria – the bubbles have higher backscatter strength than the ambient noise in the water column data, and the objects with higher backscatter strength form characteristic patterns in the water column. Under ideal conditions, gas plumes may be observed as flare-shaped objects which start at the seabed and become narrower until they disappear at least 50-100 m above the seabed. If currents are sufficiently strong, the flares will be deflected. The identification of gas flares may be complicated due to several factors, such as high ambient (periodic or random) noise, fish schools, high density of plankton, strong and/or irregular currents, and sub-optimal intersection of the multibeam swath with the gas flare (i.e., covering only part of the flare). The MBE data can also be used to derive the seafloor reflection (i.e., backscatter) properties which will indirectly give an indication of sediment type/grain size and/or hardness of the sea bottom. The FM Geocoder package was used to process the MBE data for backscatter.

4. Results

4.1 Bathymetry

The bathymetry of the study area shows a rugged seafloor eroded during last the glaciation, located along the flank of a structural high sloping towards the Bear Island Trough (Fig. 2a). Many iceberg plough marks can be seen criss-crossing the seafloor, especially in the shallowest areas. Large craters occur along the southern part of northern study area, covering the area called “Kratere”. The craters are very large compared to normal pockmarks - up to 1 km across (Fig. 2b).

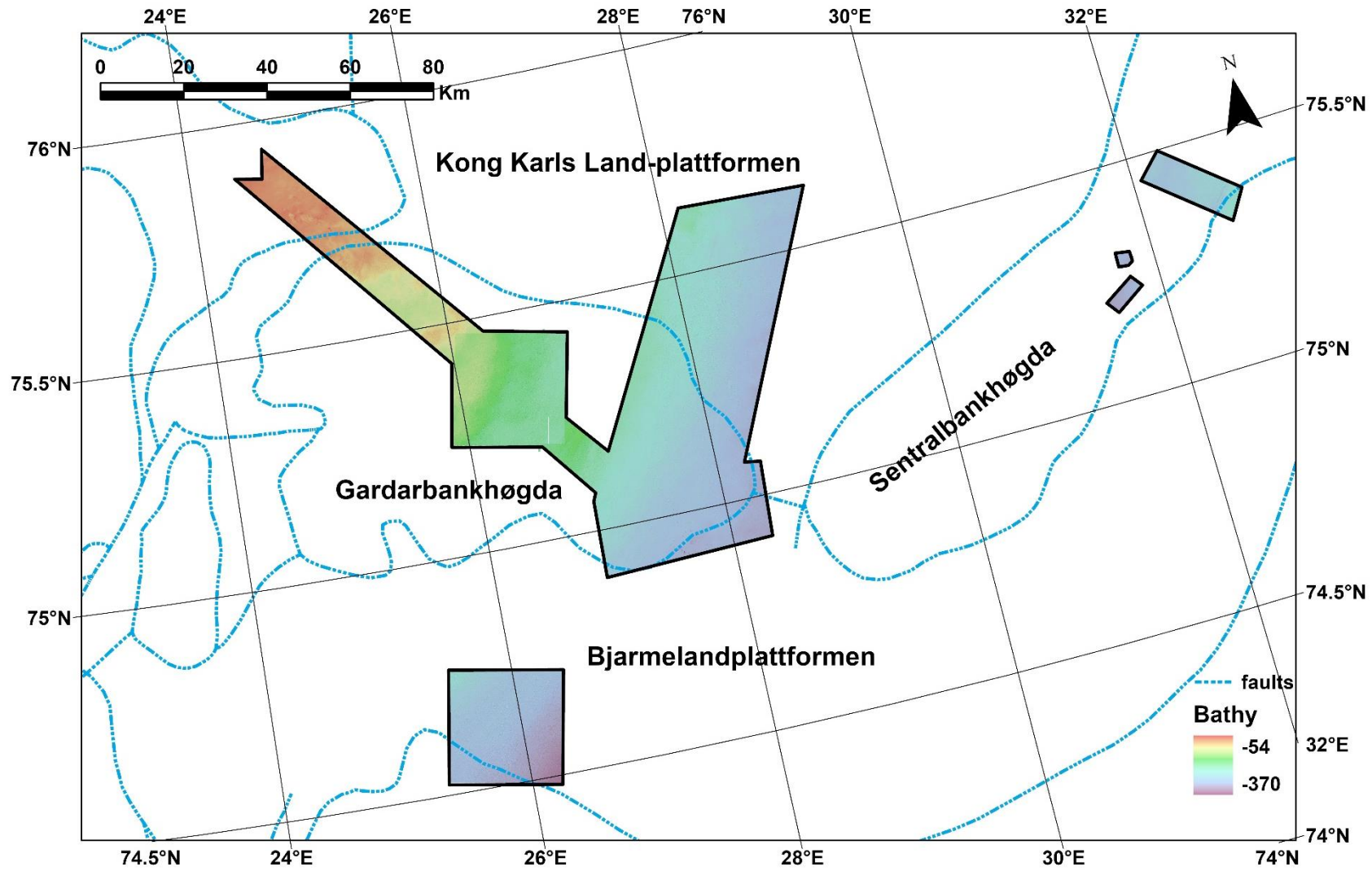


Fig. 2a. Bathymetry of the study area.

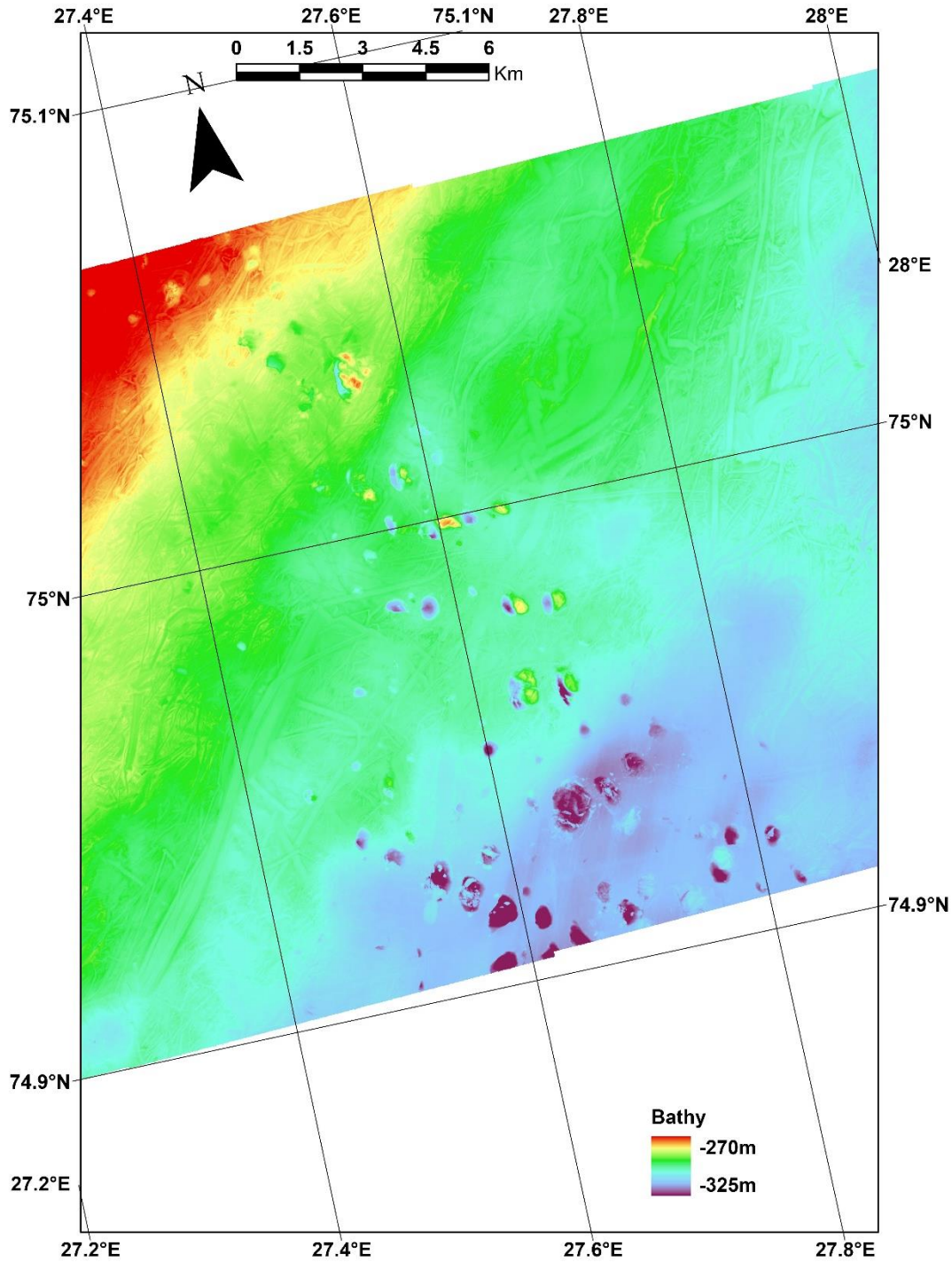


Fig. 2b. Detailed bathymetry of craters in the southern part of the northern study area.

4.2 Backscatter

The backscatter (Fig. 3a) shows low values in the deeper area, likely related to soft sediments deposited during and after deglaciation. Low backscatter values are also observed along the slope area. The craters shown in Fig. 2b are associated with high backscatter (Fig. 3b).

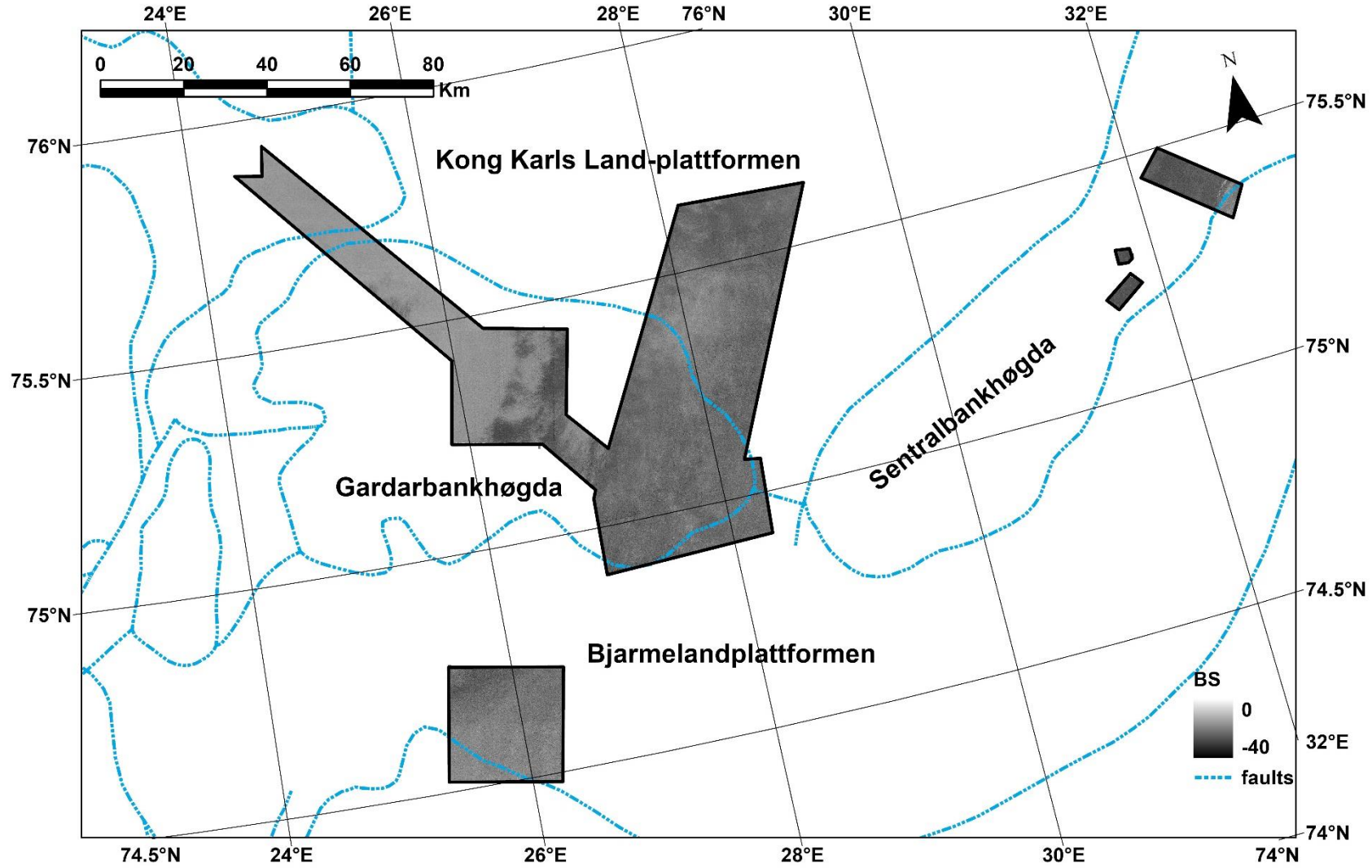


Figure 3a. Map showing low backscatter mainly along the slope and deeper areas.

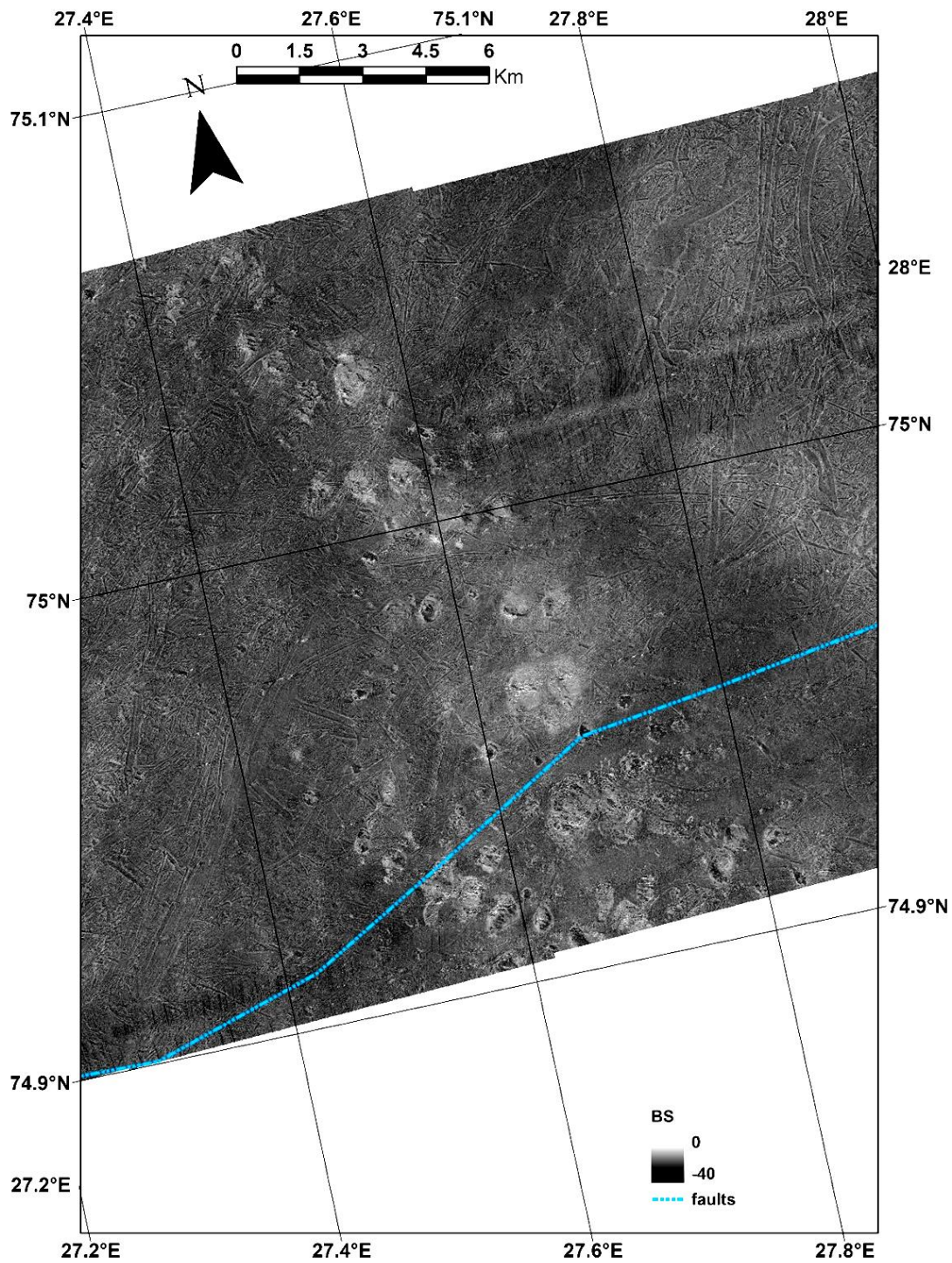


Figure 3b. Backscatter of the crater area it generally higher than in surrounding areas.

4.3 Sediment Classification

The sediments at the seafloor of the study area have been classified using multibeam bathymetry and backscatter together with ground truthing samples from gravity/multicore and video observations. The sediments range from muddy (bluish colours) to gravelly (orange colours) and mixed fine- to coarse grained (mud, sand, gravel, cobbles and boulders) (Fig. 4).

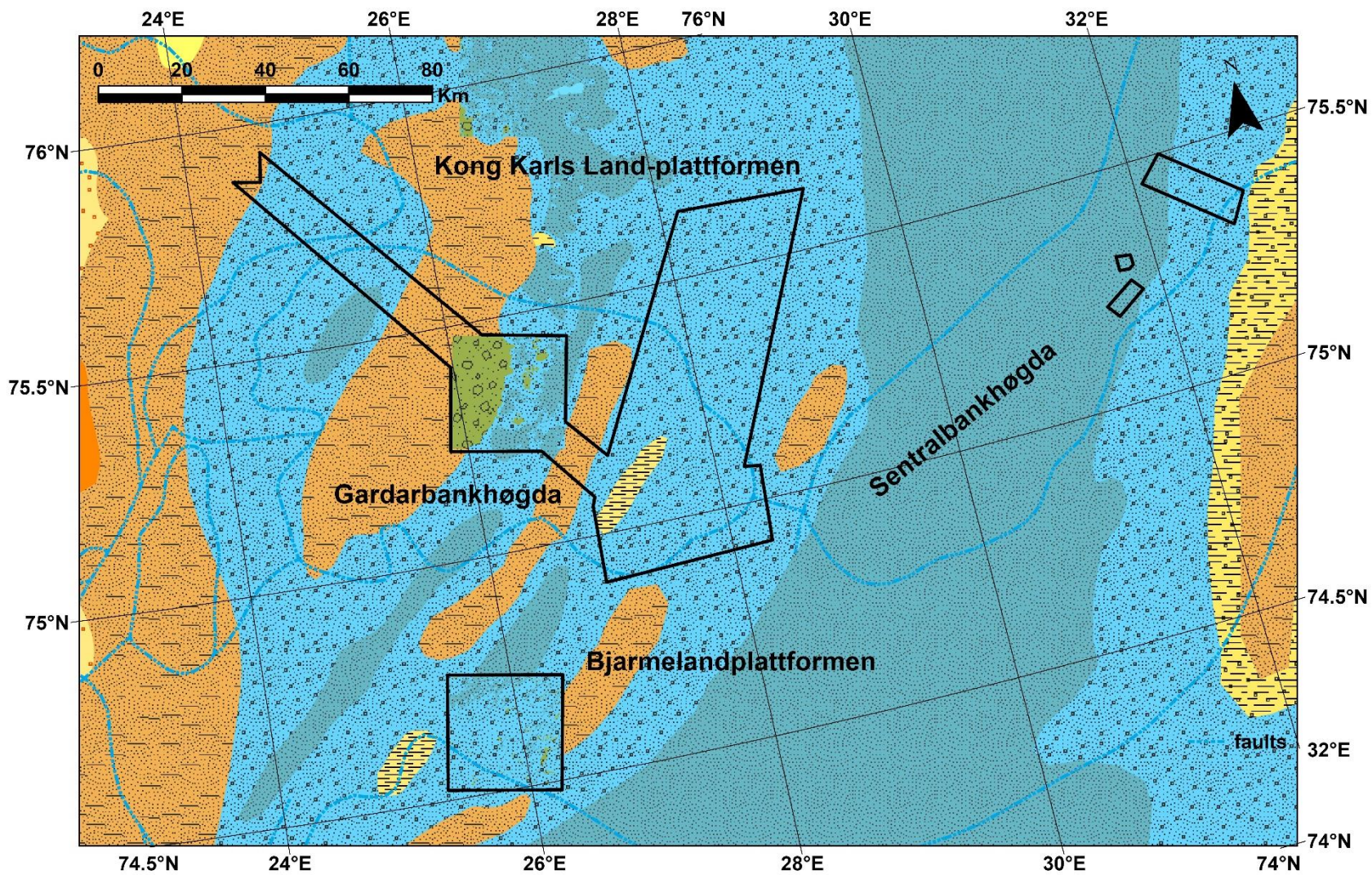


Figure 4. Detailed sediment grain-size map from Mareano based on various datasets (both regional and overview).



4.4 Water Column

Several gas flares have been reported earlier from the southern Barents Sea (Andreassen et al., 2017, Chand et al., 2012b, 2016; Nixon et al., 2019). The flares occur randomly in most areas and are linked to subsurface fluid flow connected to deeper hydrocarbon sources and structural and stratigraphic boundaries (Chand et al., 2012b, 2016; Nixon et al., 2019). The subsurface of the area indicates eroded old sedimentary rocks occurring at the seafloor or pinching out close to the seafloor (NPD, 2018). The present study area is covered by surveys carried out in 2015, 2017, 2018 and 2021 by Meritaito and Fugro. The surveys are named as Meritaito-2017-Kirkegaarden-west-a, Meritaito-2017-Kirkegaarden-west-b, Meritaito-2017-Kirkegaarden-west-c, Meritaito-2017-Kirkegaarden-east-a, Fosae-2015-BH03, Fosae-2015-BH02, FGMG-2018-Tr-KKG-BH03-cell1, FGMG-2018-Kratere-cells01-08, FGMG-2018-Kirkegaarden-cells01-12, FGMG-2018-Tr-TF01-BH03, Meritaito-2021-Hopendjupet and Meritaito-2021-SlickEmissionPoints. The data includes EM2040 and EM710 water column measurements, and the results are divided based on the area names. The combined results from the water column data analysis of all the survey areas are shown in Fig. 5.

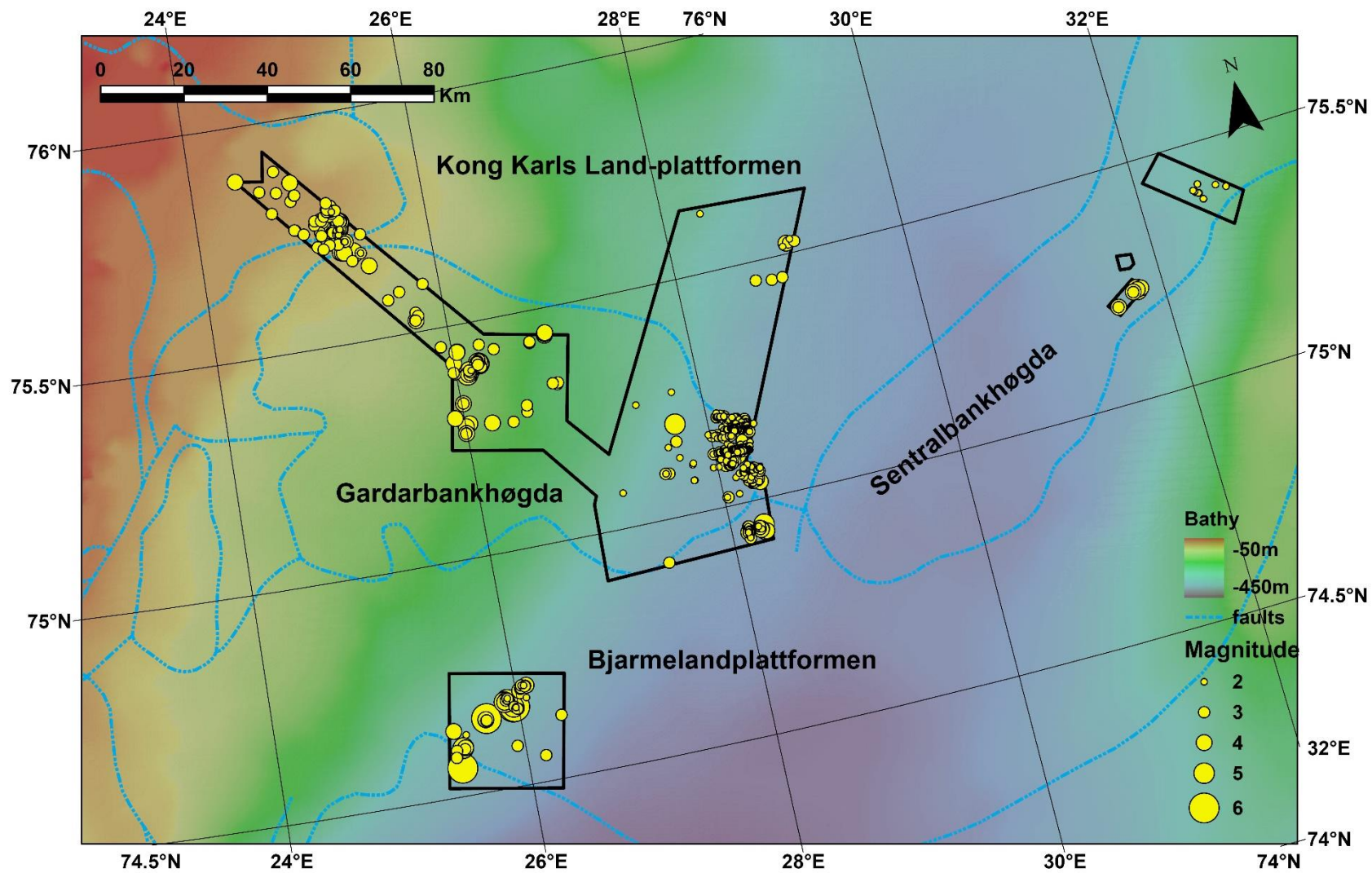


Figure 5. Identified flares and their magnitude, shown on a regional bathymetry map.

4.4.1 Meritaito-2017-Kirkegaarden

The Meritaito-2017-Kirkegaarden survey area is divided into west and east comprising of four blocks names as ‘a’ to ‘c’ from the western survey and ‘a’ from the eastern survey. The survey consists of 268 water column (*.wcd) survey lines. The data was loaded in Fledermaus Midwater along with navigation (*.all) and converted to GWC files. During conversion, it was observed that there were 536 files created due to separate transducers used for different sides of swath, two for each wcd file. Five flares of varying confidence levels were found in the data. The flares found are listed in Table 2. A few lines were noisy but have probably not changed the results. The flares do not have any correlation to changes in bathymetry (Fig. 6).

Table 2. Details of flares identified from Survey Area Meritaito-2017-Kirkegården.

LineId	Latitude	Longitude	Depth	Height	Time	Magnitude	Confidence
0	75.075977	27.185276	-272	80	06/19/2017 22:43:16.3	2	40
0	75.255083	27.441861	-252	48	06/22/2017 3:46:01.6	2	40
3	75.266196	27.757972	-269	43	06/22/2017 5:51:47.9	2	40
33	75.626158	28.328502	-250	40	06/25/2017 22:42:49.0	2	40
33	75.626209	28.328167	-252	45	06/25/2017 22:42:49.0	2	40

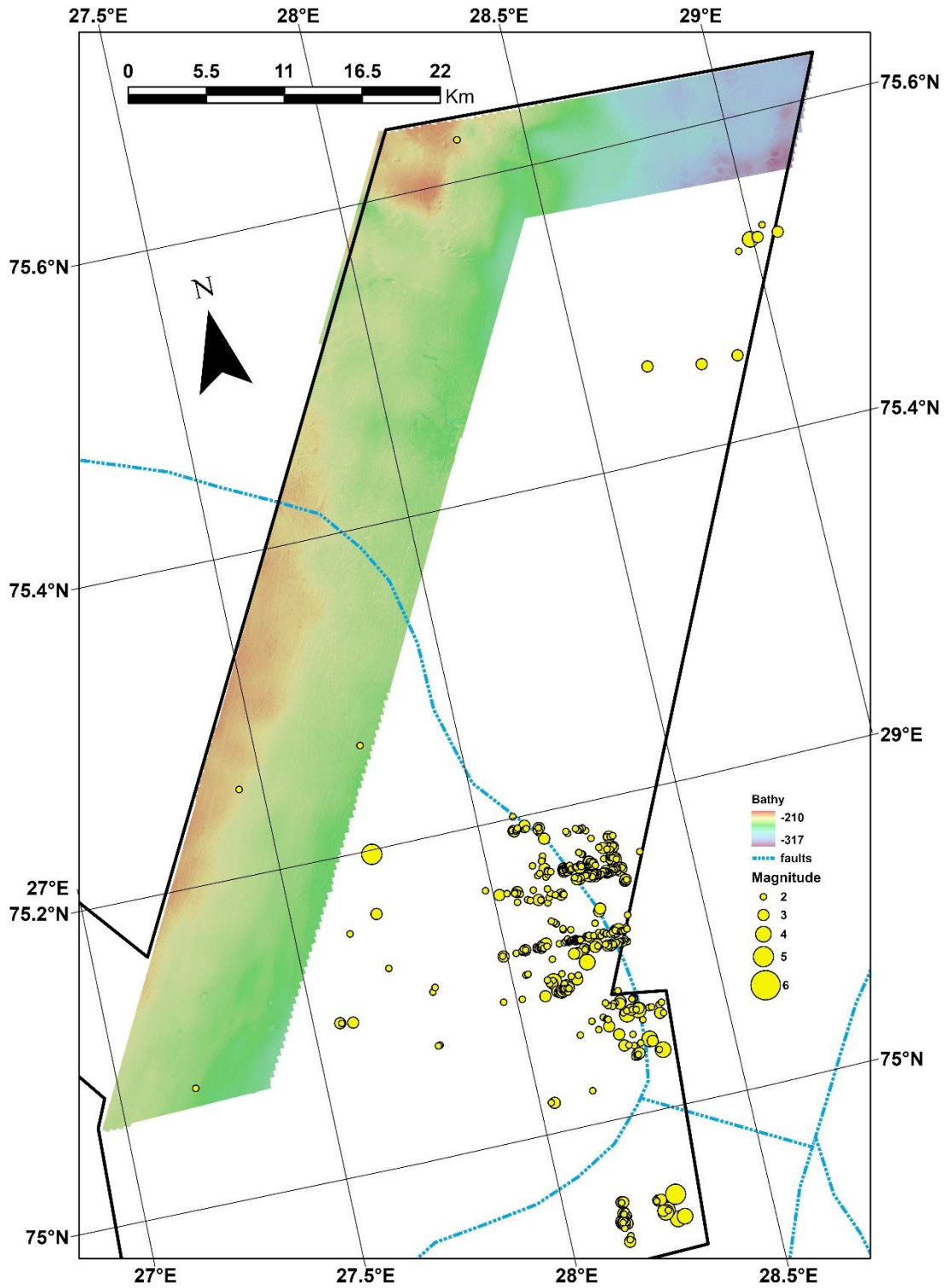


Fig. 6. Bathymetry from the Meritaito-2017-Kirkegaarden survey area showing the location of the flares.

4.4.2 Fosae-2015-BH02

The Fosae-2015-BH02 survey consists of 380 water column (*.wcd) survey lines. The data was loaded in Fledermaus Midwater along with navigation (*.all) and converted to GWC files. 49 flares were found in the data of varying confidence level (Fig. 7). The flares found are listed in Table 3. A few lines were noisy and may have resulted in some weak flares missing. The flares of magnitude 4 and above identified are shown in Figures 8 – 29.

Table 3. Details of flares identified from Survey Area Fosae-2015-BH02.

LineId	Latitude	Longitude	Depth	Height	Time	Magnitude	Confidence
1481	74.556354	26.146813	-359.6	115	06/13/2015 7:05:38.5	3	60
1521	74.5873143	25.9340946	-375.708	100	06/13/2015 7:33:13.5	3	70
1586a	74.630206	25.54068	-305.63	50	06/13/2015 8:03:19.0	2	60
1586b	74.6033199	25.5179195	-302.612	225	06/13/2015 8:17:34.3	4	80
1586c	74.600268	25.512706	-305.02	100	06/13/2015 8:19:15.9	3	60
1589	74.5608342	25.4671064	-313.328	200	06/13/2015 9:31:07.8	6	90
1590a	74.6030487	25.497866	-309.613	180	06/13/2015 9:54:24.0	5	90
1590b	74.6036542	25.4996397	-309.478	160	06/13/2015 9:54:58.1	5	80
1597a	74.58502	25.435207	-307.32	80	06/13/2015 12:38:08.5	3	60
1597b	74.5996317	25.4452521	-308.84	140	06/13/2015 12:45:54.3	3	70
1610	74.6420045	25.4457967	-294.269	110	06/13/2015 18:25:50.9	4	80
1697	74.5850999	25.4346345	-312.458	162	06/15/2015 23:25:15.7	3	60
5996a	74.652637	25.7210287	-301.897	150	10/13/2015 10:10:14.9	3	70
5996b	74.6533262	25.7244996	-299.262	140	10/13/2015 10:10:36.8	3	70
5996c	74.6546162	25.7184142	-303.784	210	10/13/2015 10:11:04.5	4	80
5996d	74.6548372	25.7191428	-303.069	210	10/13/2015 10:11:11.1	4	80
5996e	74.6551998	25.7198623	-303.092	250	10/13/2015 10:11:21.6	4	80
5996f	74.6568198	25.7260397	-305.281	260	10/13/2015 10:12:11.9	6	90
6030a	74.6859042	25.9137118	-305.199	90	10/13/2015 23:56:50.3	2	40
6030b	74.6874869	25.9065711	-304.994	140	10/13/2015 23:57:26.3	4	70

6030c	74.6878659	25.9064664	-306.212	175	10/13/2015 23:57:36.8	3	70
6030d	74.6887632	25.9135072	-306.441	140	10/13/2015 23:58:09.1	5	80
6031a	74.6913011	25.9217735	-304.911	100	10/14/2015 0:55:09.6	2	40
6031b	74.6901281	25.9261803	-303.779	85	10/14/2015 0:55:35.3	3	70
6031b	74.6902421	25.9230343	-304.871	80	10/14/2015 0:55:37.2	3	70
6031c	74.6883071	25.9209227	-304.987	135	10/14/2015 0:56:35.5	5	80
6040a	74.670776	25.957299	-300.52	160	10/14/2015 4:11:55.7	6	80
6040b	74.67101	25.95971	-302.89	150	10/14/2015 4:12:04.2	5	80
6043a	74.6712573	25.9684926	-302.784	200	10/14/2015 5:23:08.3	6	90
6043b	74.670658	25.9686562	-300.605	100	10/14/2015 5:23:24.3	3	70
6046	74.6689355	25.9794151	-301.304	95	10/14/2015 6:31:34.5	2	50
6051a	74.6649171	25.9953941	-301.978	85	10/14/2015 8:05:32.7	3	50
6051b	74.6657162	25.9873538	-301.093	165	10/14/2015 8:05:21.3	3	70
6054a	74.7025905	26.0328991	-301.164	100	10/14/2015 9:15:03.1	4	70
6054b	74.7064588	26.0402137	-300.753	175	10/14/2015 9:17:04.0	3	70
6054c	74.7080275	26.045199	-302.108	125	10/14/2015 9:17:55.3	3	50
6054d	74.713654	26.051059	-303.53	150	10/14/2015 9:20:46.7	2	40
6056	74.7136823	26.051374	-299.855	105	10/14/2015 9:50:38.5	3	70
6060	74.7126259	26.0724467	-304.638	90	10/14/2015 11:35:01.4	2	50
6062a	74.710936	26.0833802	-296.93	75	10/14/2015 12:08:38.8	3	60
6062b	74.7102366	26.0783925	-300.673	115	10/14/2015 12:09:12.9	3	60
6066	74.6858518	26.0760982	-300.949	100	10/14/2015 13:34:07.0	2	50
6067	74.7119801	26.0922584	-302.513	150	10/14/2015 13:46:29.4	4	80
6133	74.6349904	26.3300617	-331.018	120	10/18/2015 4:10:01.6	3	70
6143a	74.6841499	25.8953538	-302.648	335	10/18/2015 9:55:40.7	5	90
6143b	74.6841766	25.8944274	-305.552	330	10/18/2015 9:55:52.8	4	80
6143c	74.68499	25.8943317	-302.993	220	10/18/2015 9:56:09.4	5	90
6150a	74.684152	25.8954576	-303.126	225	10/18/2015 11:19:35.1	5	90
6150b	74.6849409	25.8939144	-304.181	225	10/18/2015 11:19:48.6	5	90

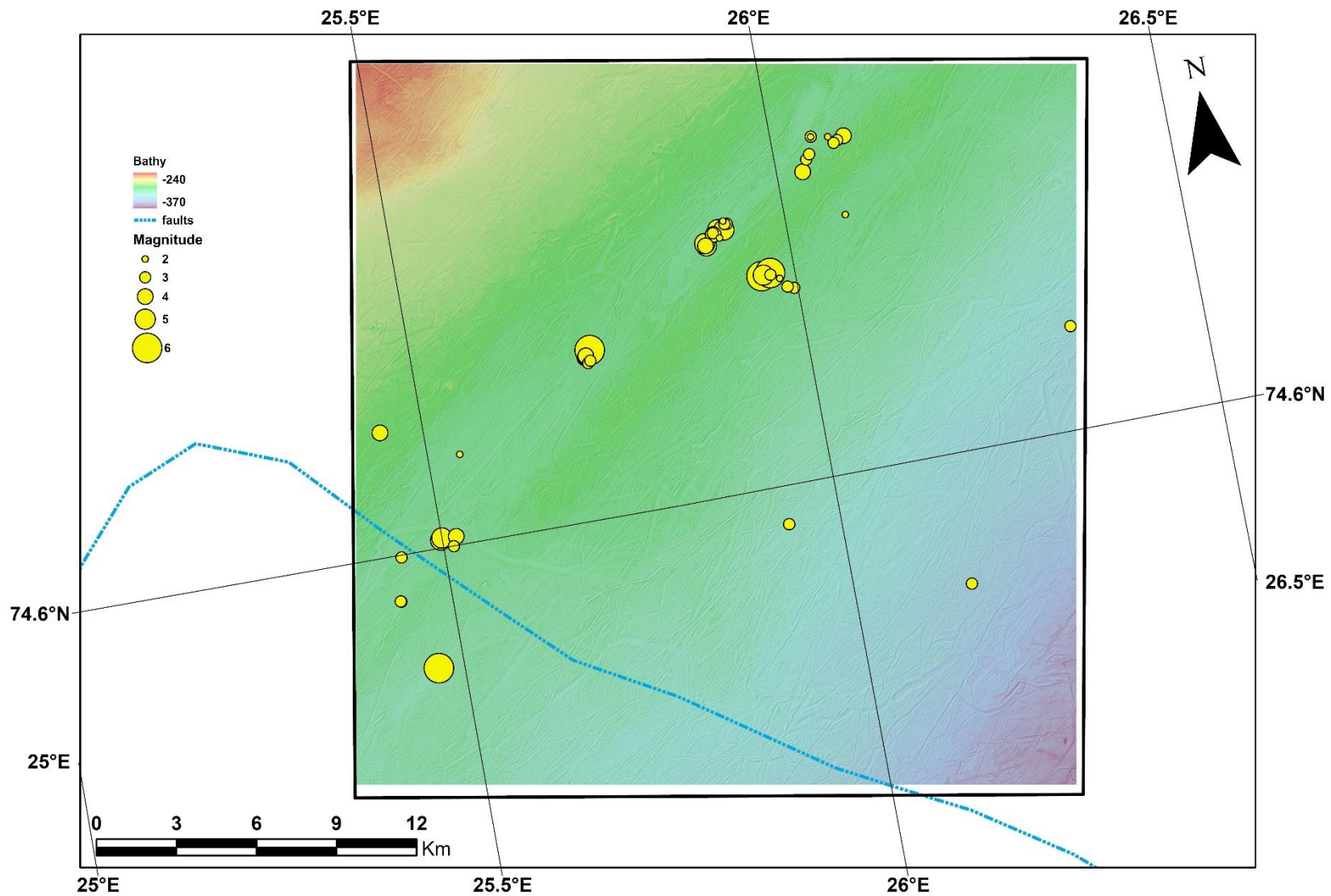


Figure 7. Bathymetry from the Fosae-2015-BH02 survey area showing the location of the flares.

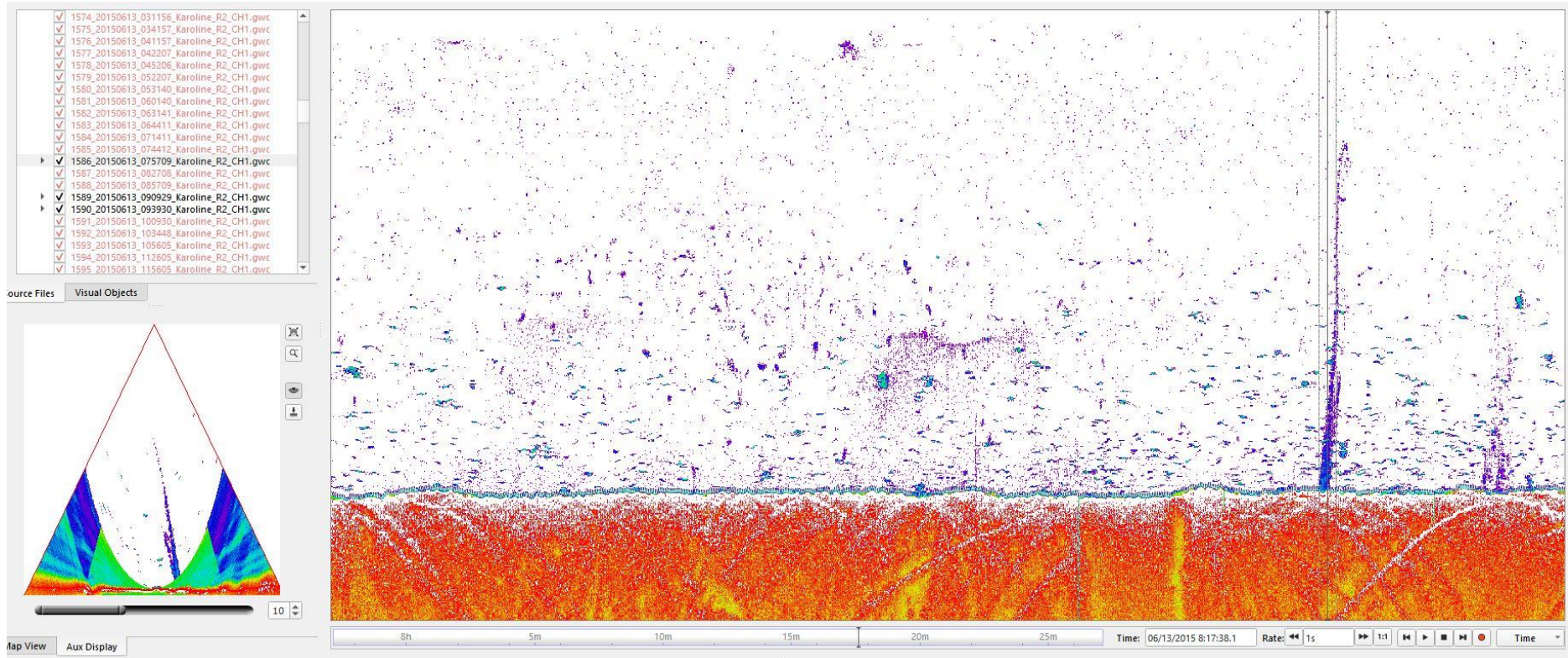


Figure 8. Gas flare b from line 1586 showed on Fan view and stack view. Magnitude 4, Confidence 80%.

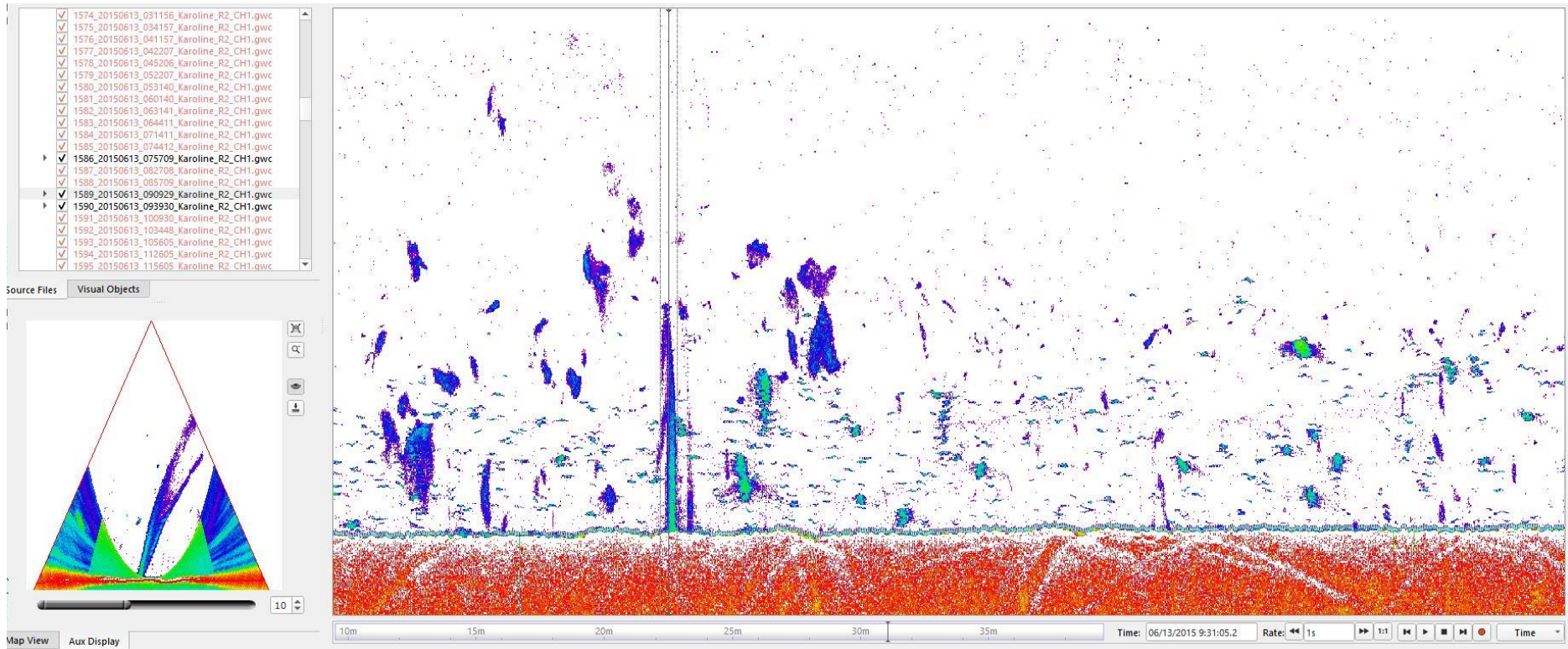


Figure 9. Gas flare from line 1589 showed on Fan view and stack view. Magnitude 6, Confidence 90%.

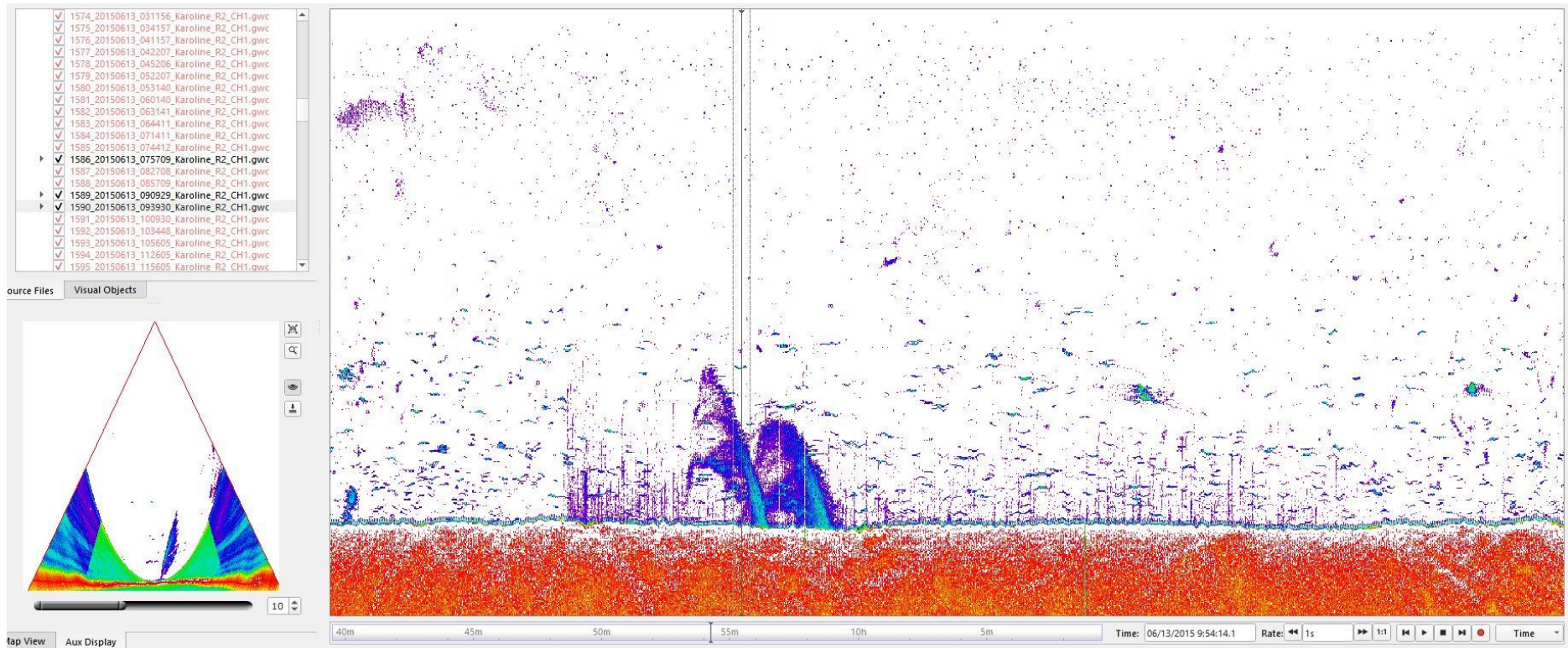


Figure 10. Gas flare a from line 1590 showed on Fan view and stack view. Magnitude 5, Confidence 90%.

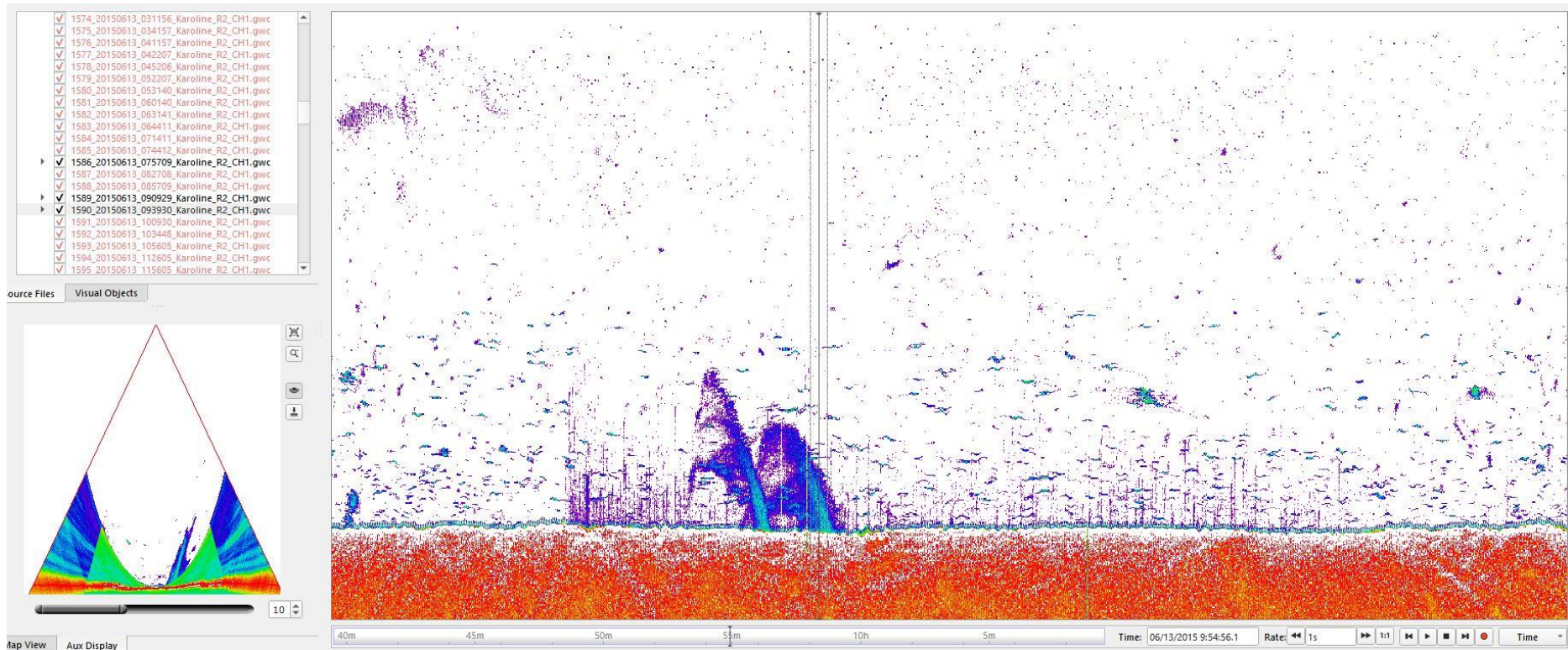


Figure 11. Gas flare b from line 1590 showed on Fan view and stack view. Magnitude 5, Confidence 90%.

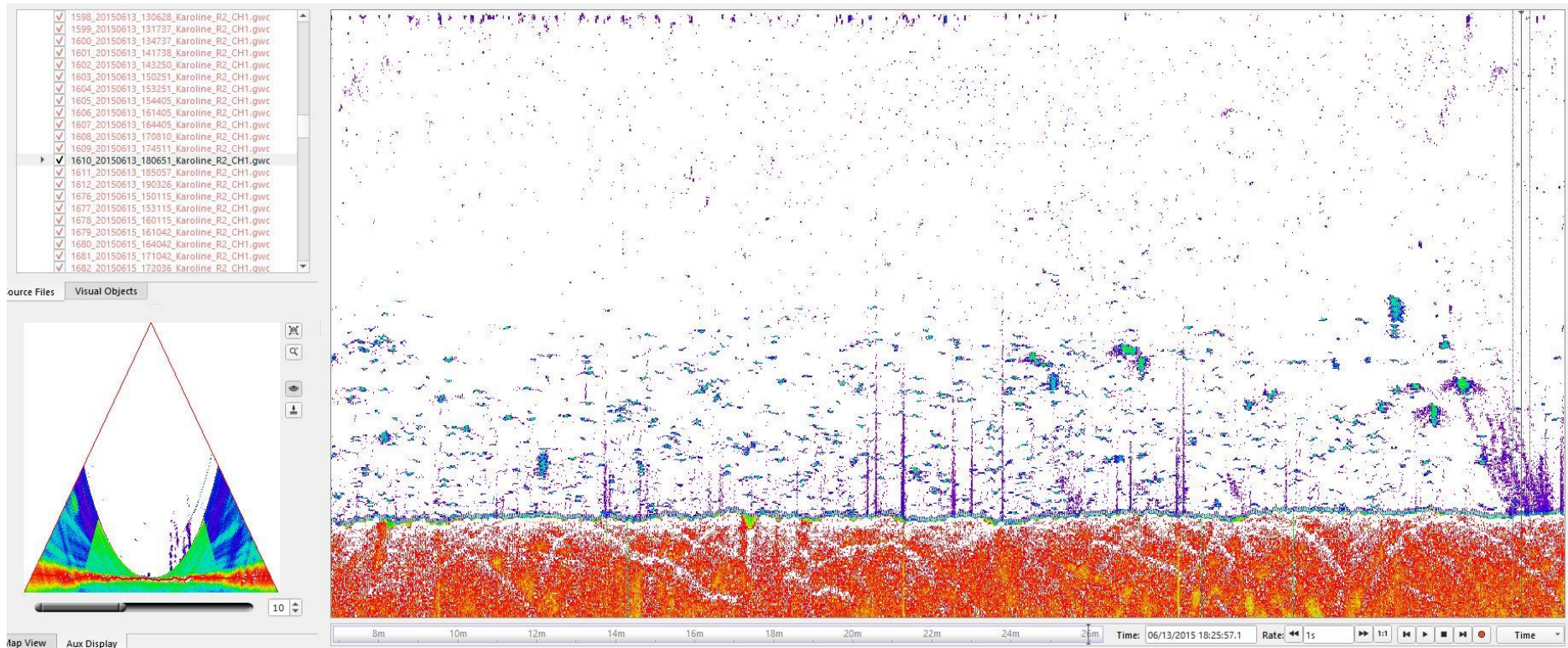


Figure 12. Gas flare from line 1610 showed on Fan view and stack view. Magnitude 4, Confidence 80%.

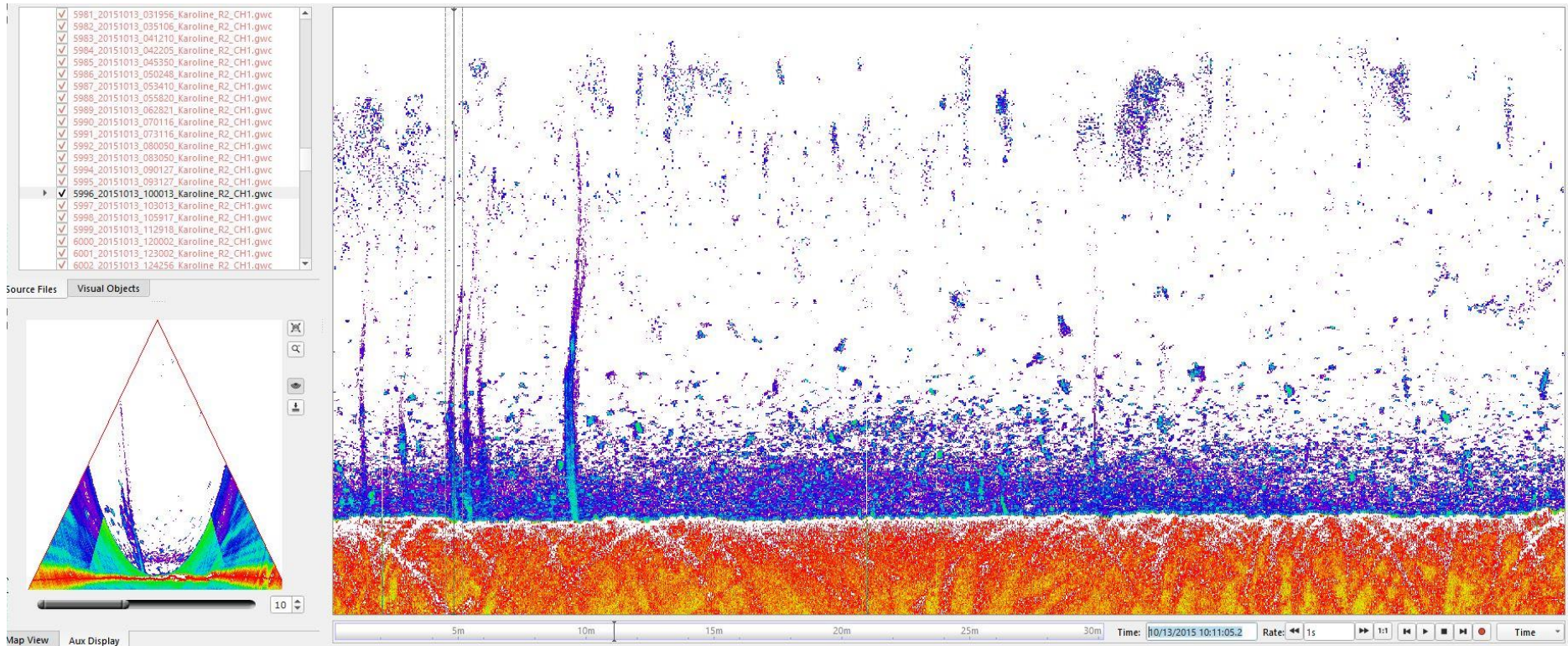


Figure 13. Gas flare c from line 5996 showed on Fan view and stack view. Magnitudes 4, Confidence 80%.

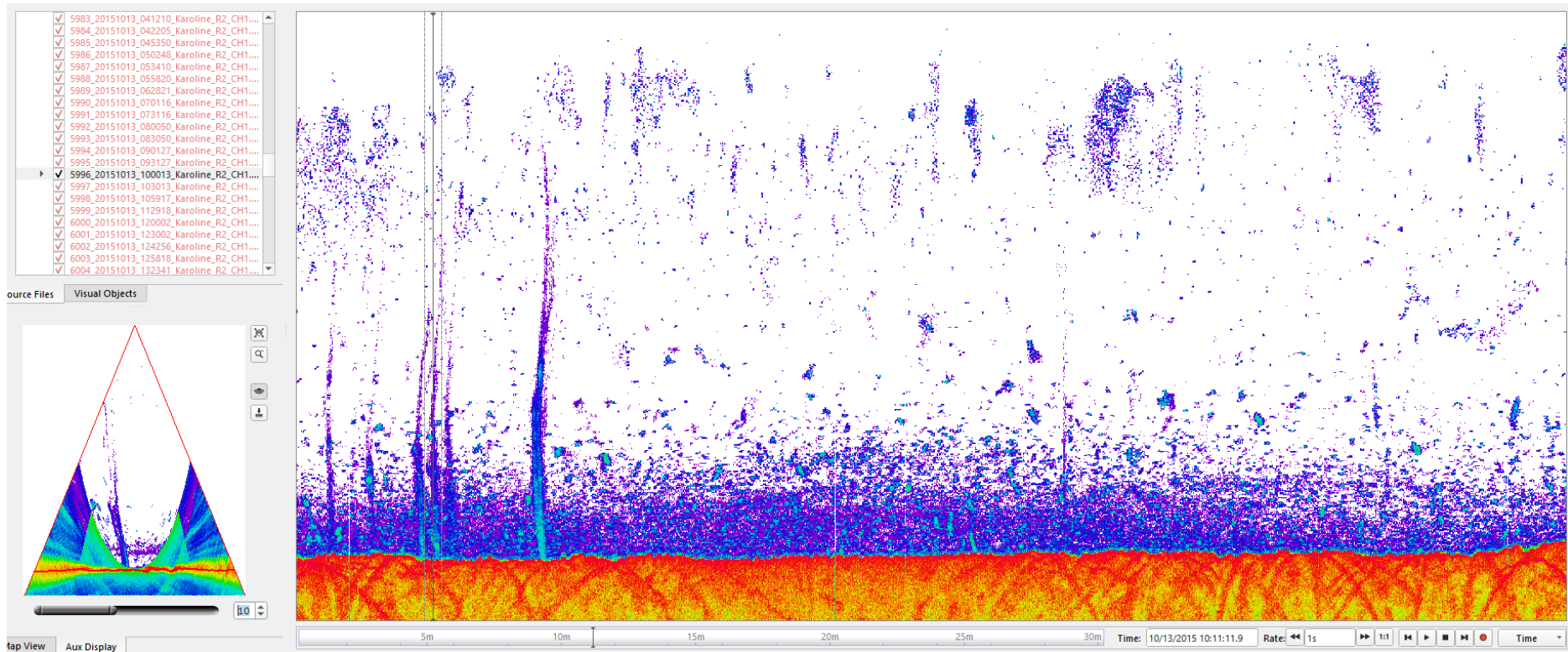


Figure 14. Gas flare d from line 5996 showed on Fan view and stack view. Magnitudes 4, Confidence 80%.

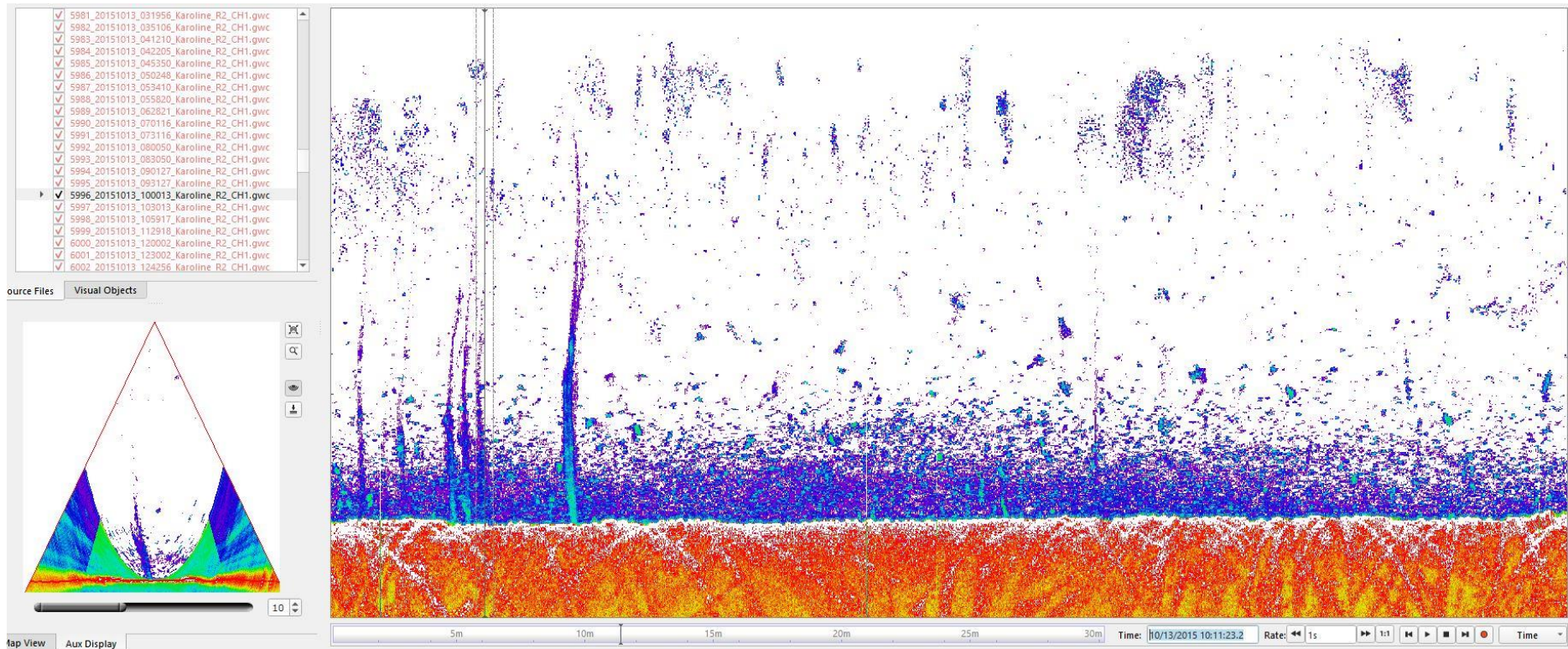


Figure 15. Gas flare e from line 5996 showed on Fan view and stack view. Magnitudes 4, Confidence 80%.

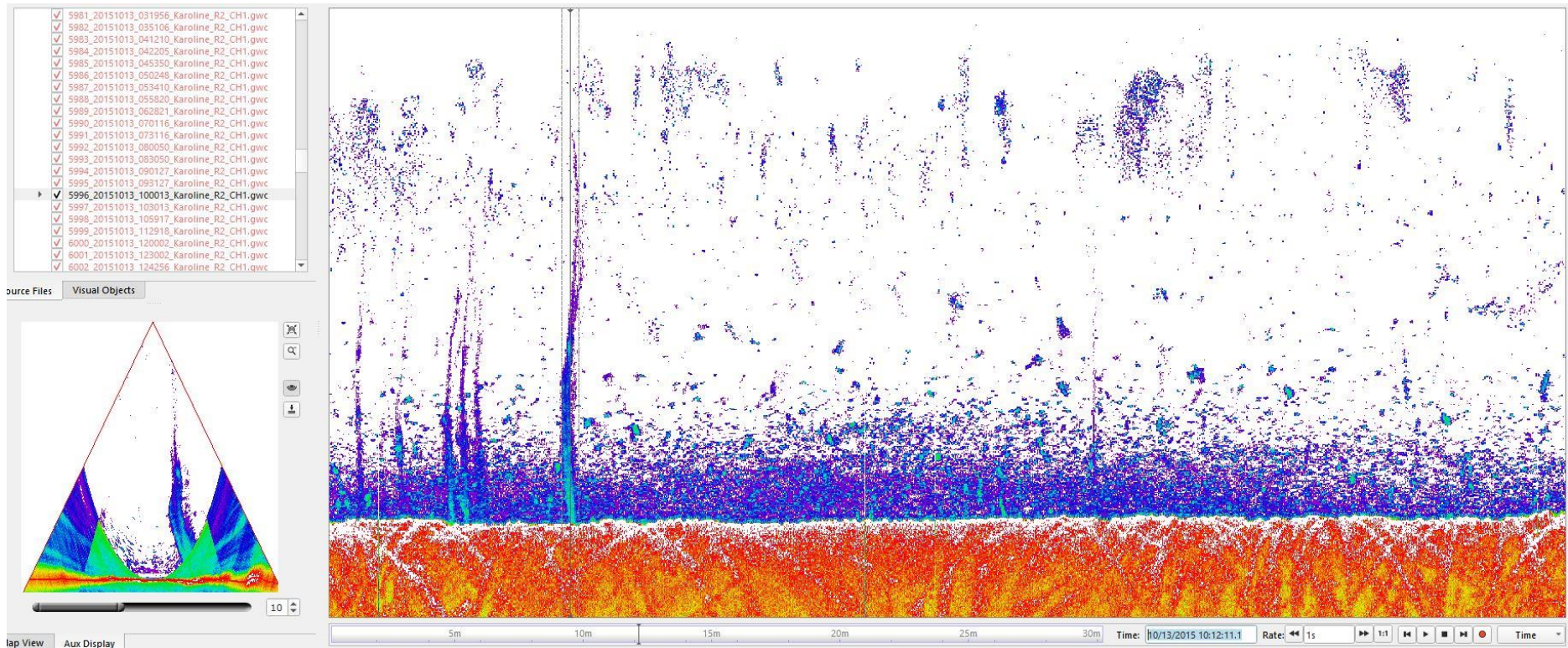


Figure 16. Gas flare from line 5996 showed on Fan view and stack view. Magnitudes 6, Confidence 90%.

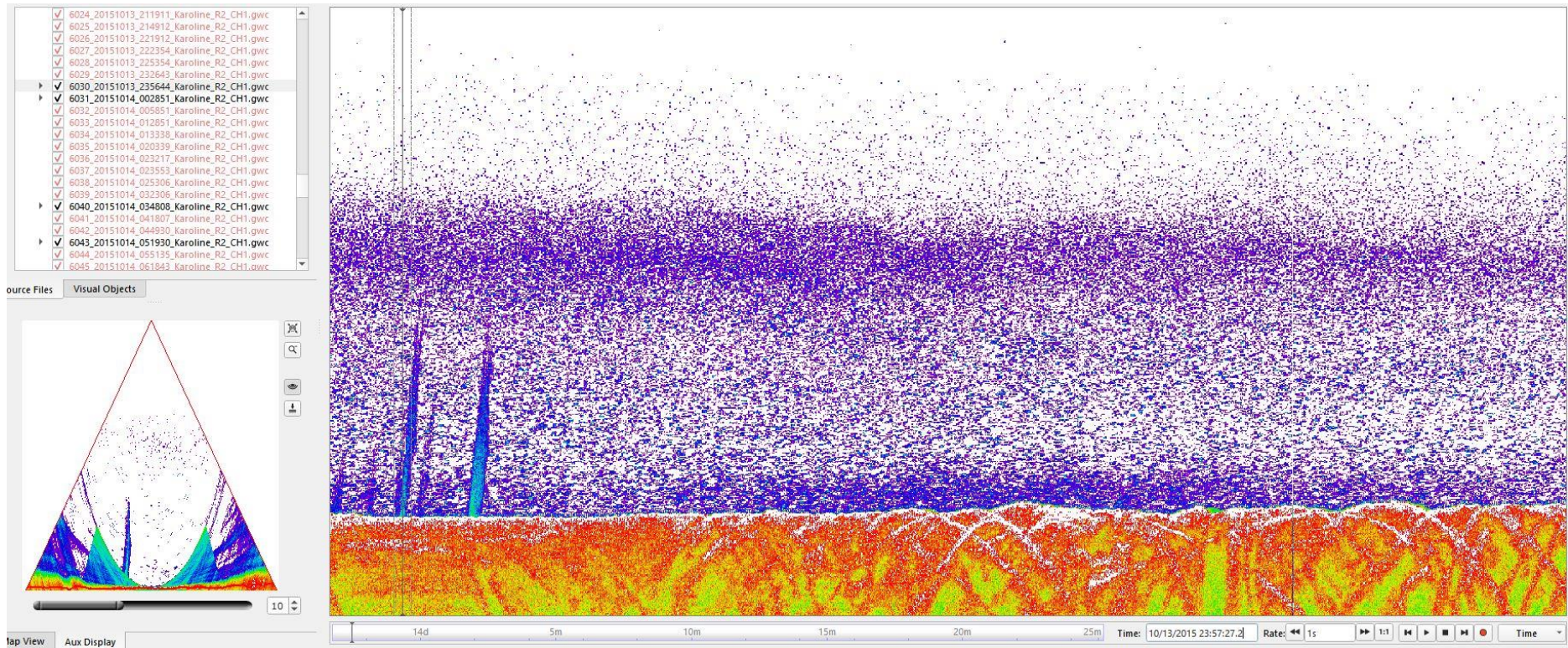


Figure 17. Gas flare b from line 6030 showed on Fan view and stack view. Magnitudes 4, Confidence 70%.

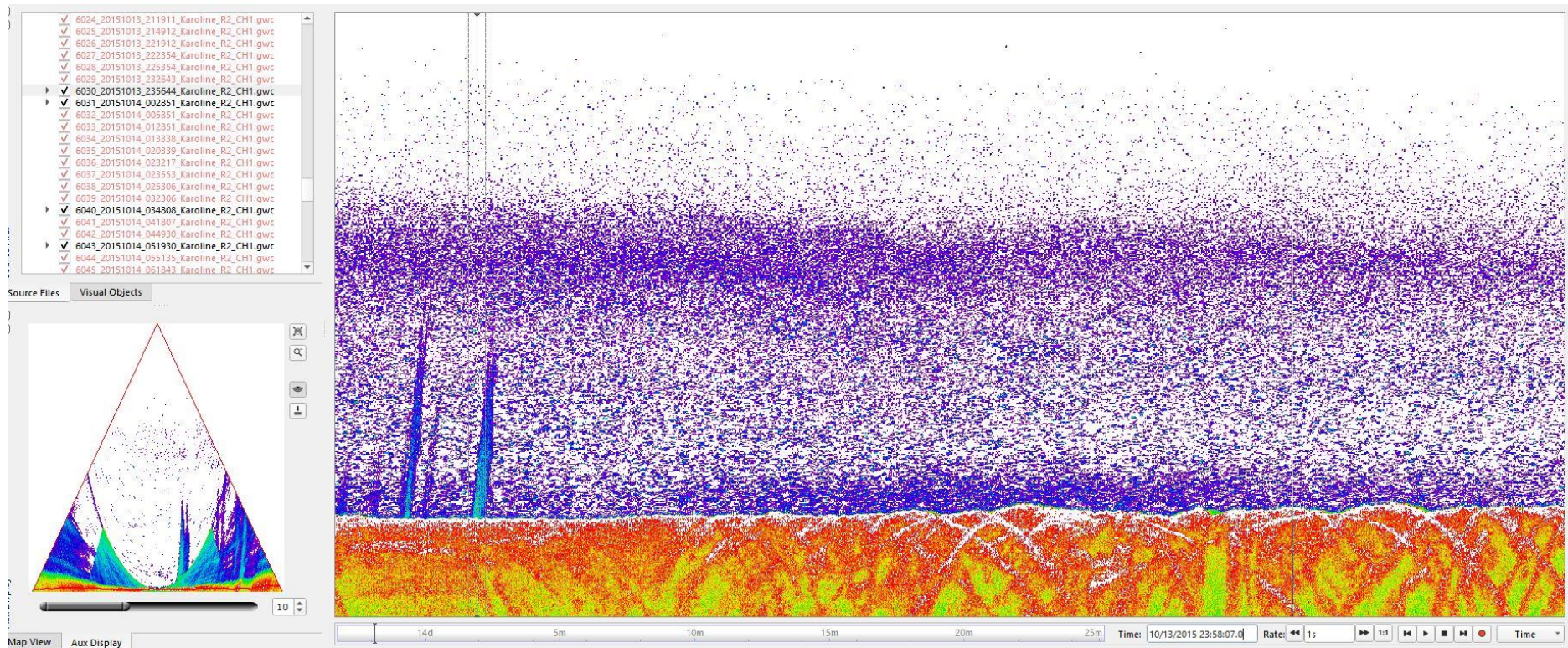


Figure 18. Gas flare d from line 6030 showed on Fan view and stack view. Magnitudes 5, Confidence 80%.

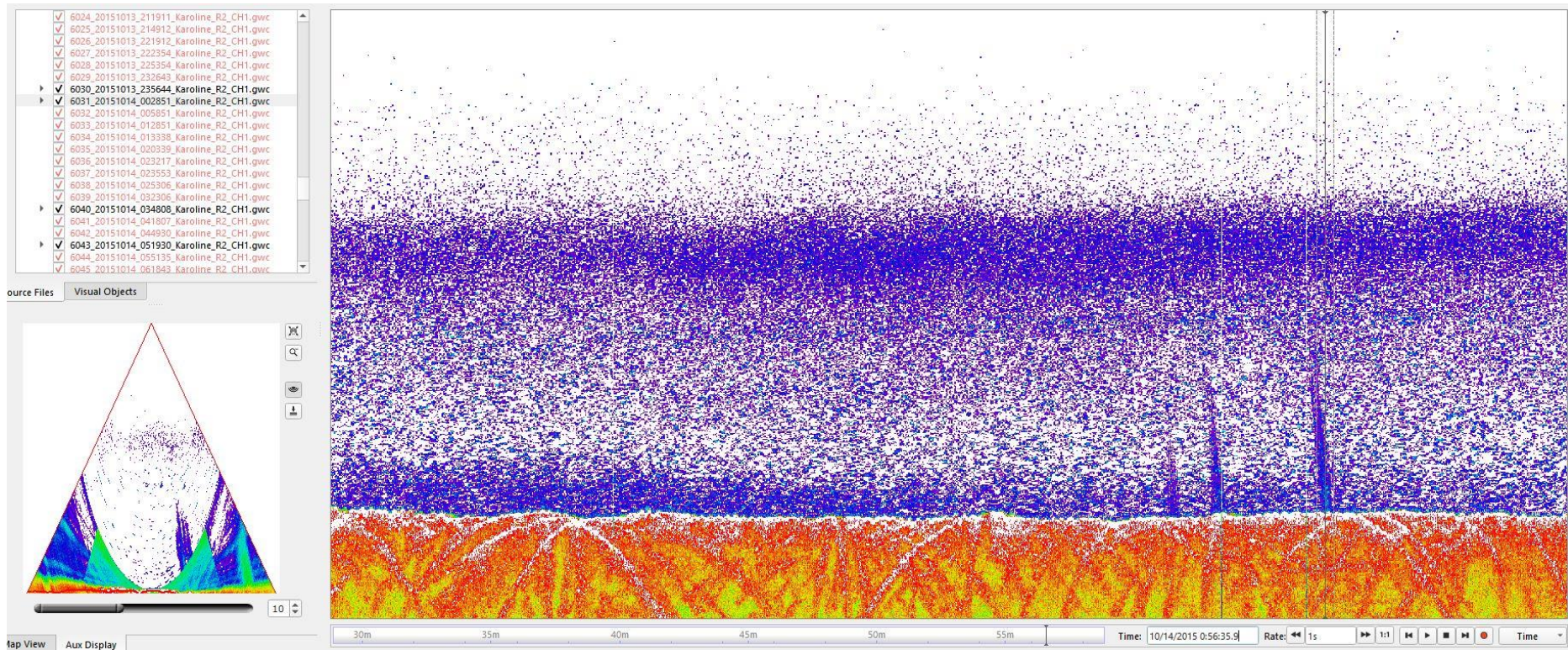


Figure 19. Gas flare c from line 6031 showed on Fan view and stack view. Magnitudes 5, Confidence 80%.

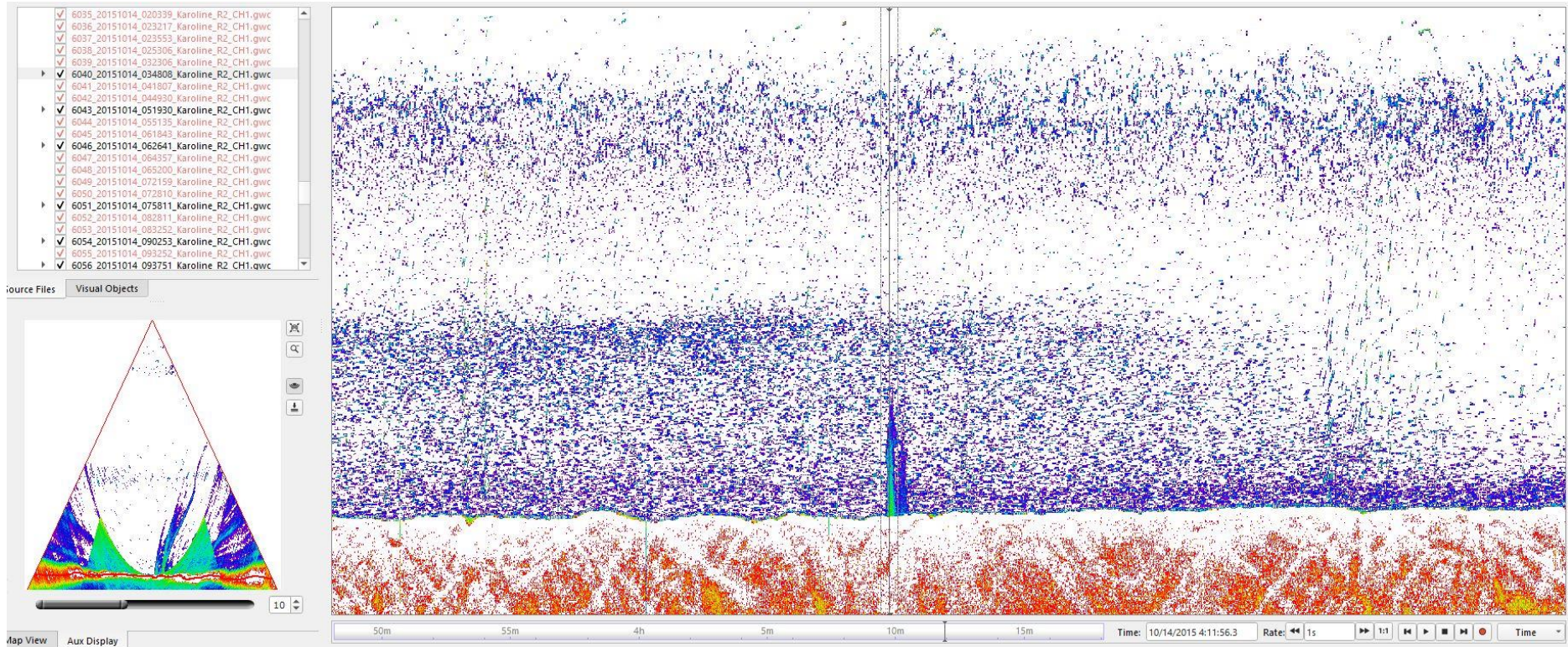


Figure 20. Gas flare a from line 6040 showed on Fan view and stack view. Magnitude 5, Confidence 80%.

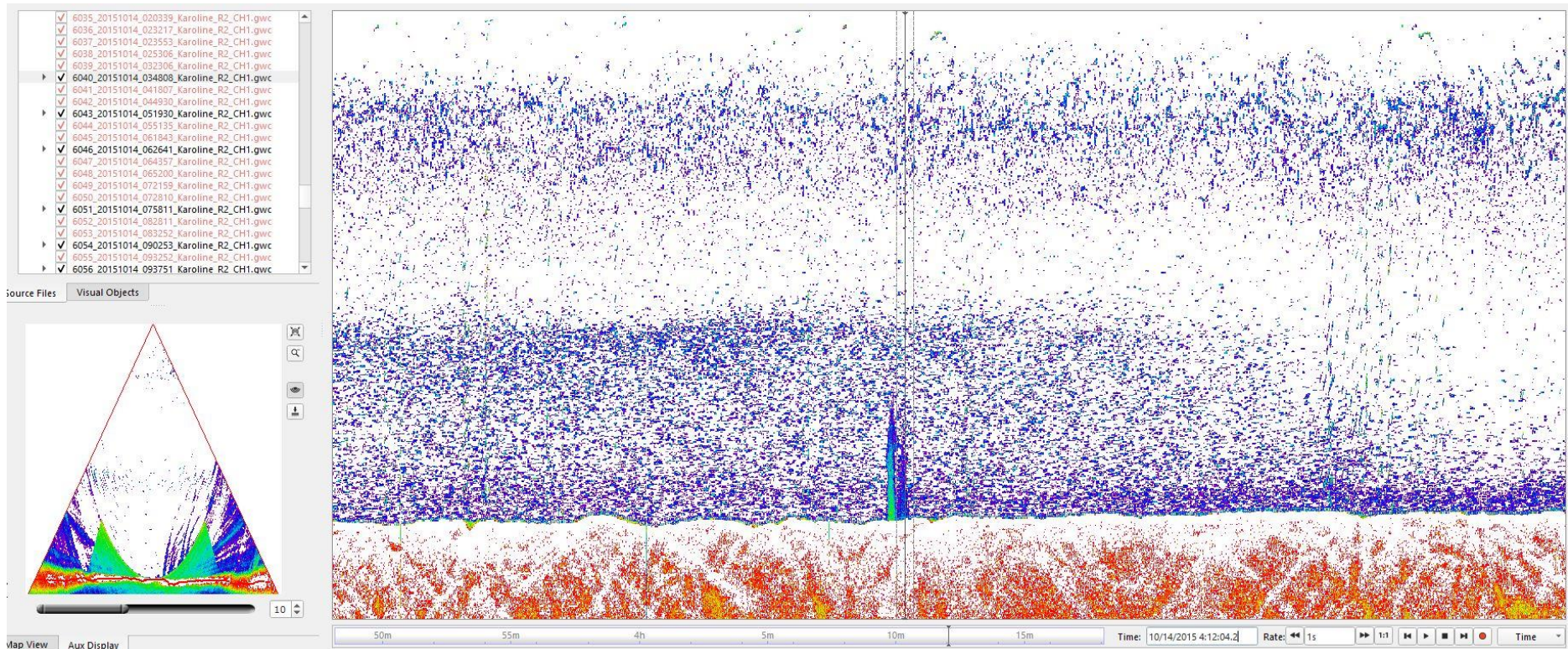


Figure 21. Gas flare b from line 6040 showed on Fan view and stack view. Magnitude 5, Confidence 80%.

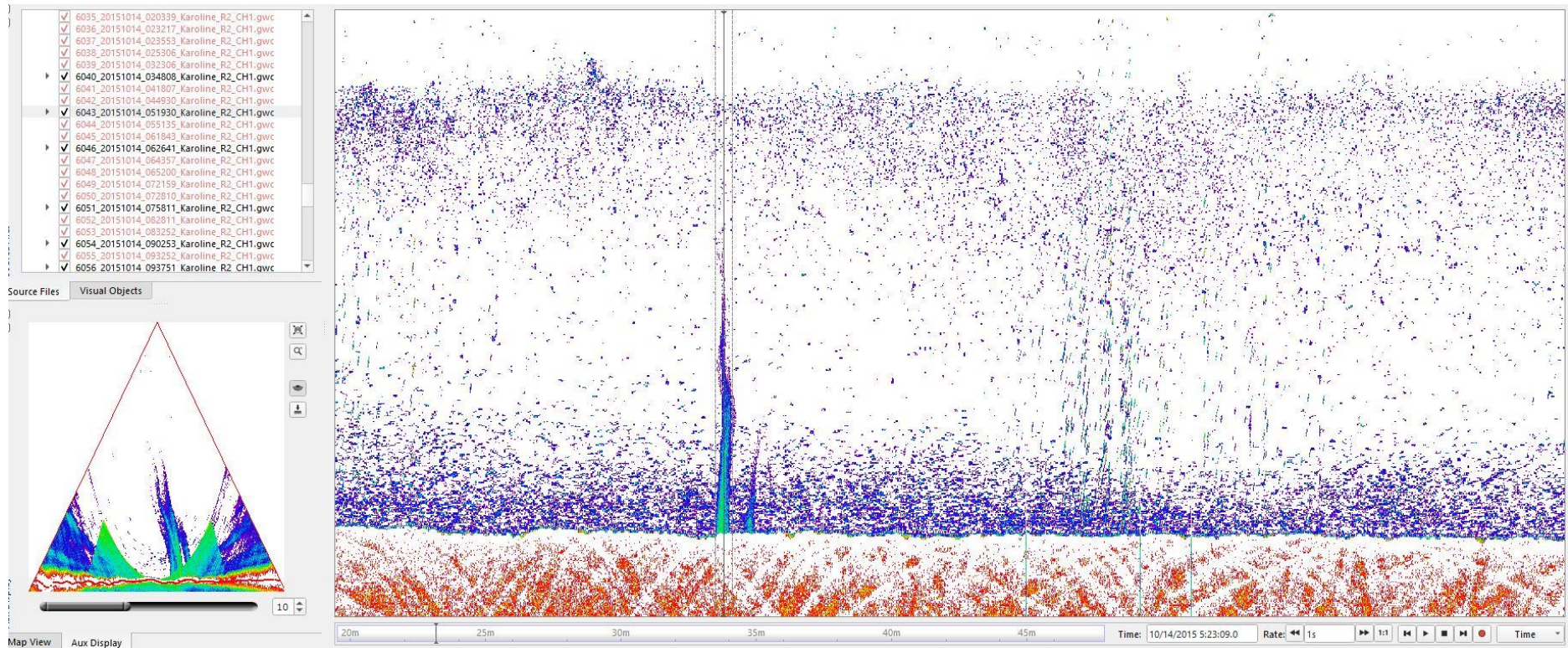


Figure 22. Gas flare a from line 6043 showed on Fan view and stack view. Magnitude 5, Confidence 90%.

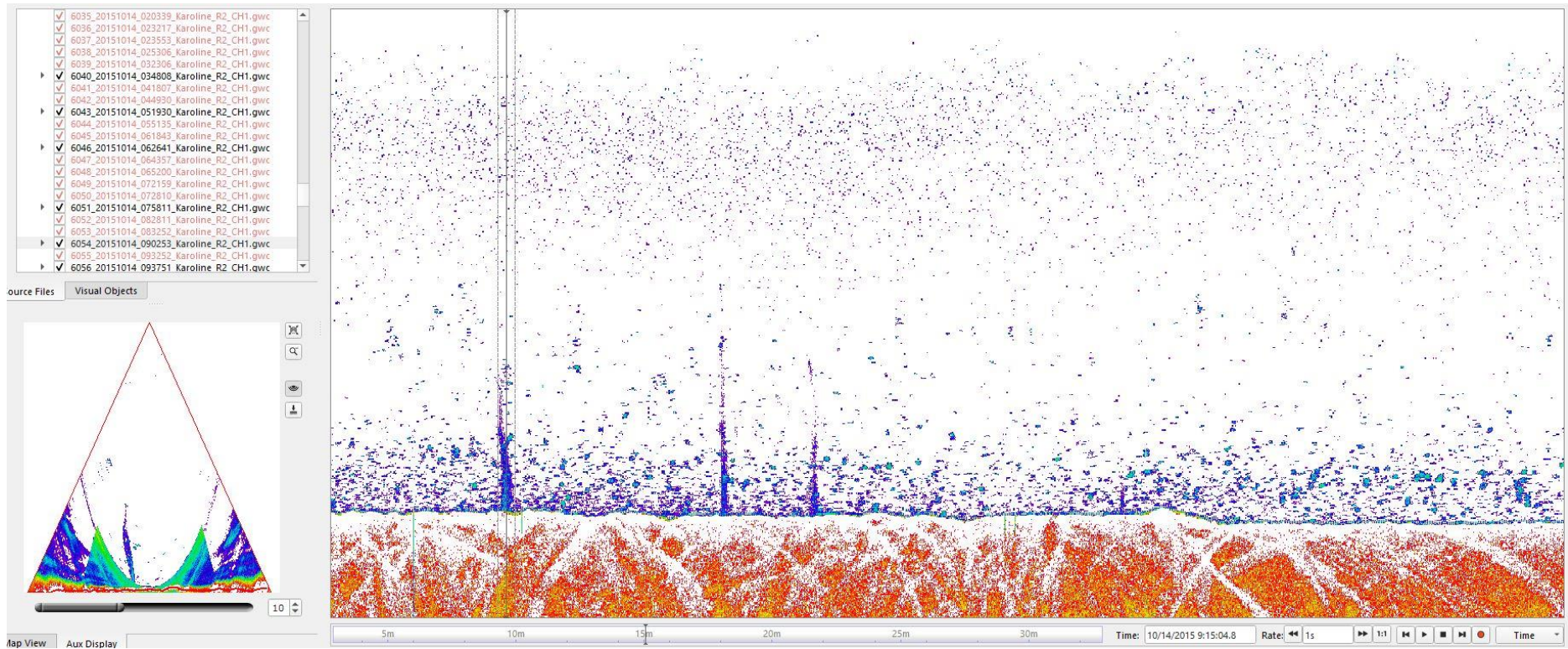


Figure 23. Gas flare a from line 6054 showed on Fan view and stack view. Magnitude 4, Confidence 70%.

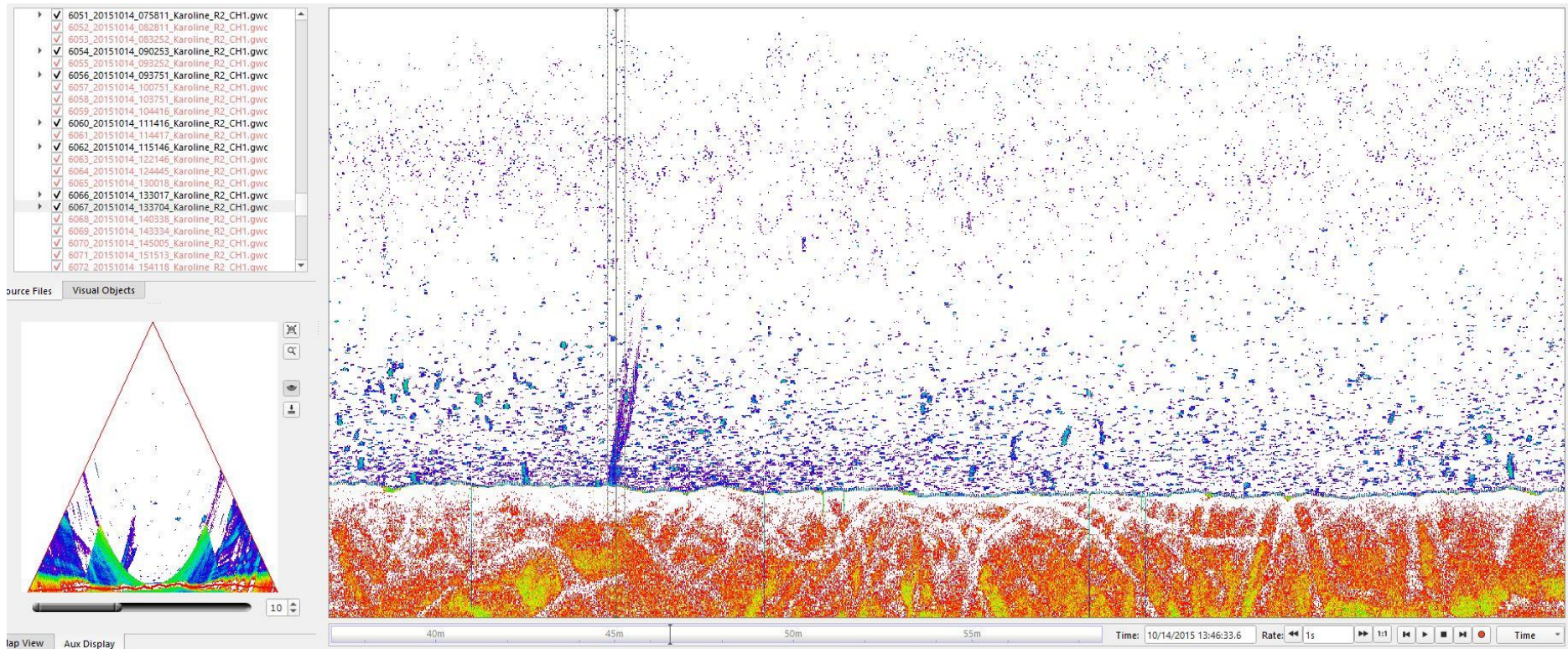


Figure 24. Gas flare from line 6067 showed on Fan view and stack view. Magnitude 4, Confidence 80%.

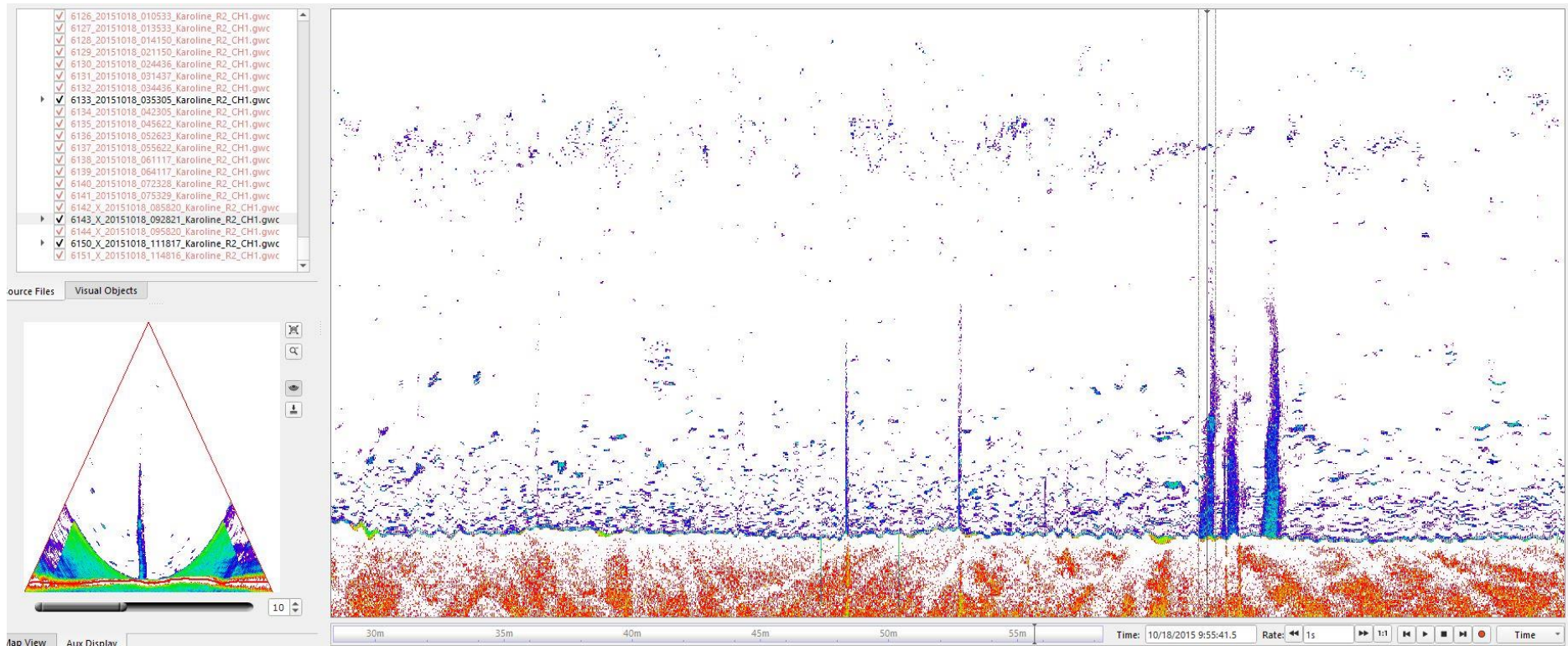


Figure 25. Gas flare a from line 6143 showed on Fan view and stack view. Magnitude 5, Confidence 90%.

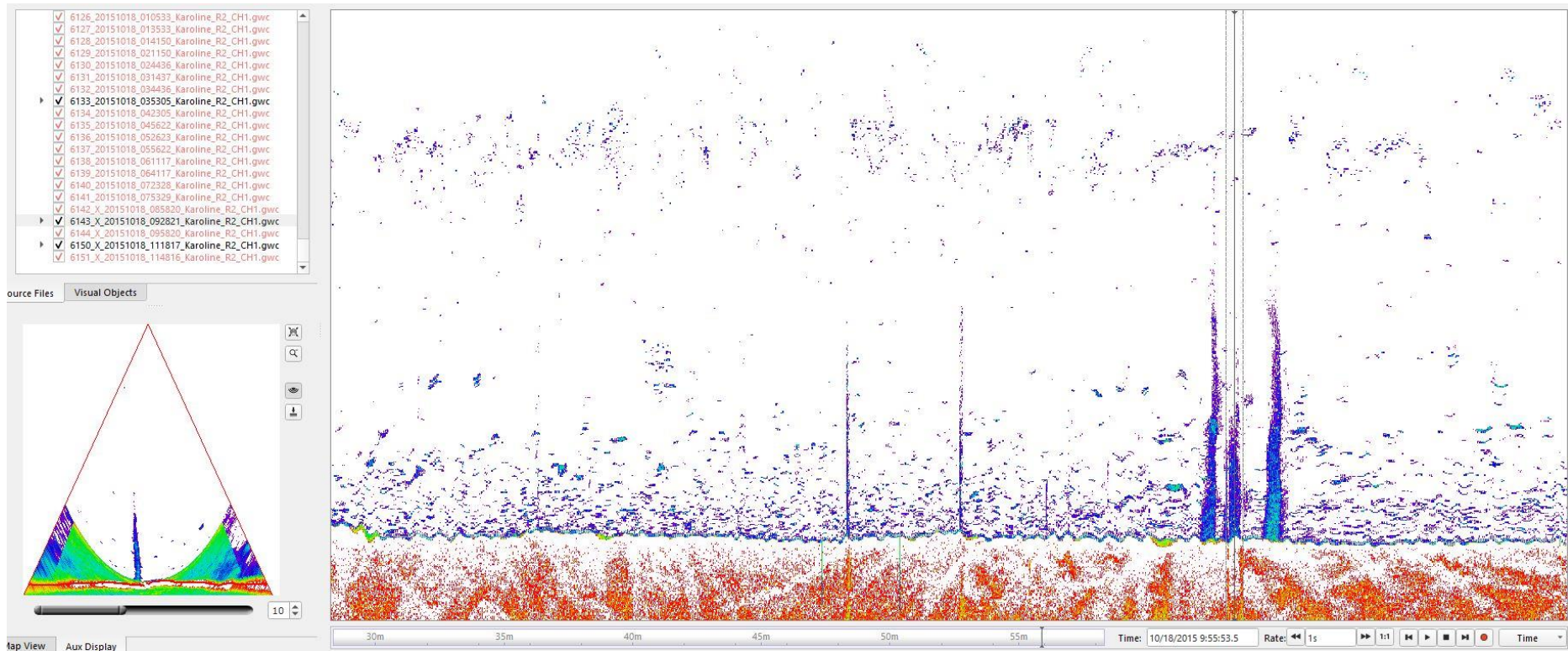


Figure 26. Gas flare b from line 6143 showed on Fan view and stack view. Magnitude 4, Confidence 80%.

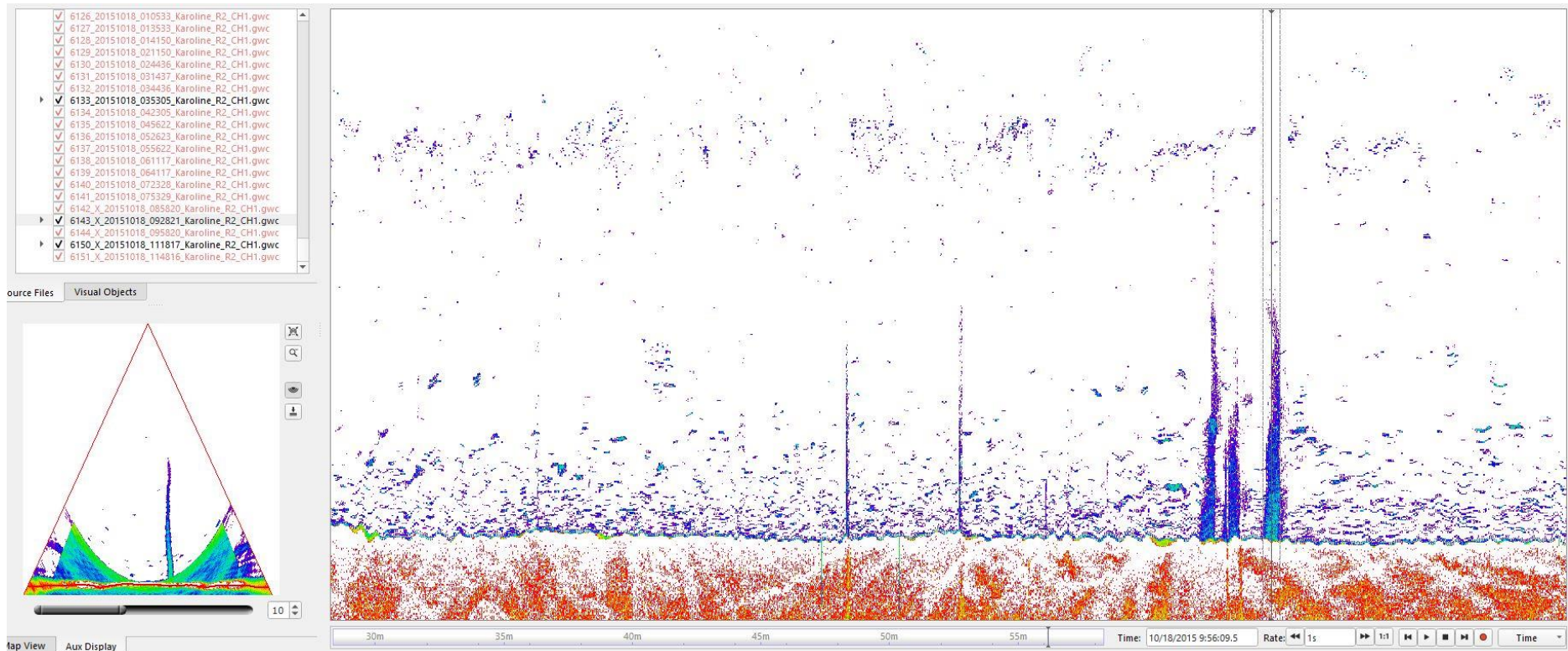


Figure 27. Gas flare c from line 6143 showed on Fan view and stack view. Magnitude 5, Confidence 90%.

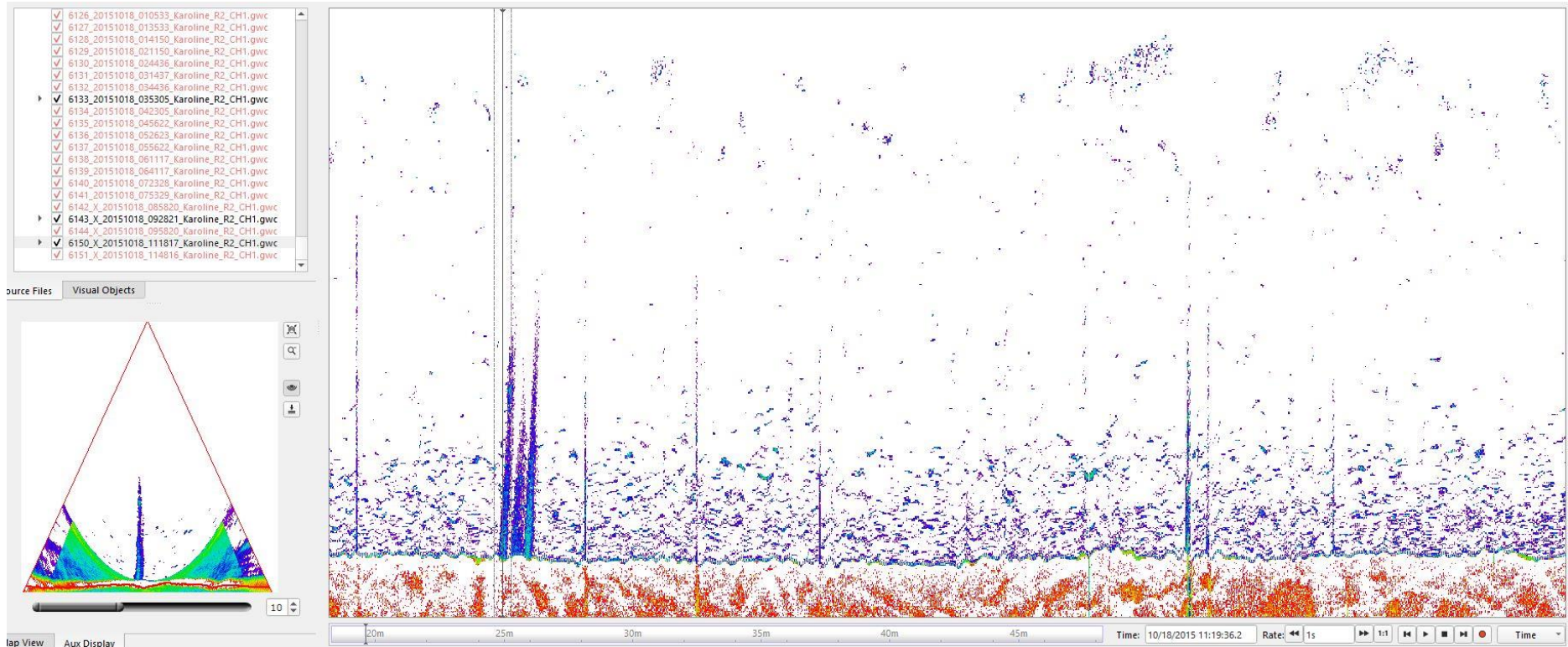


Figure 28. Gas flare a from line 6150 showed on Fan view and stack view. Magnitude 5, Confidence 90%.

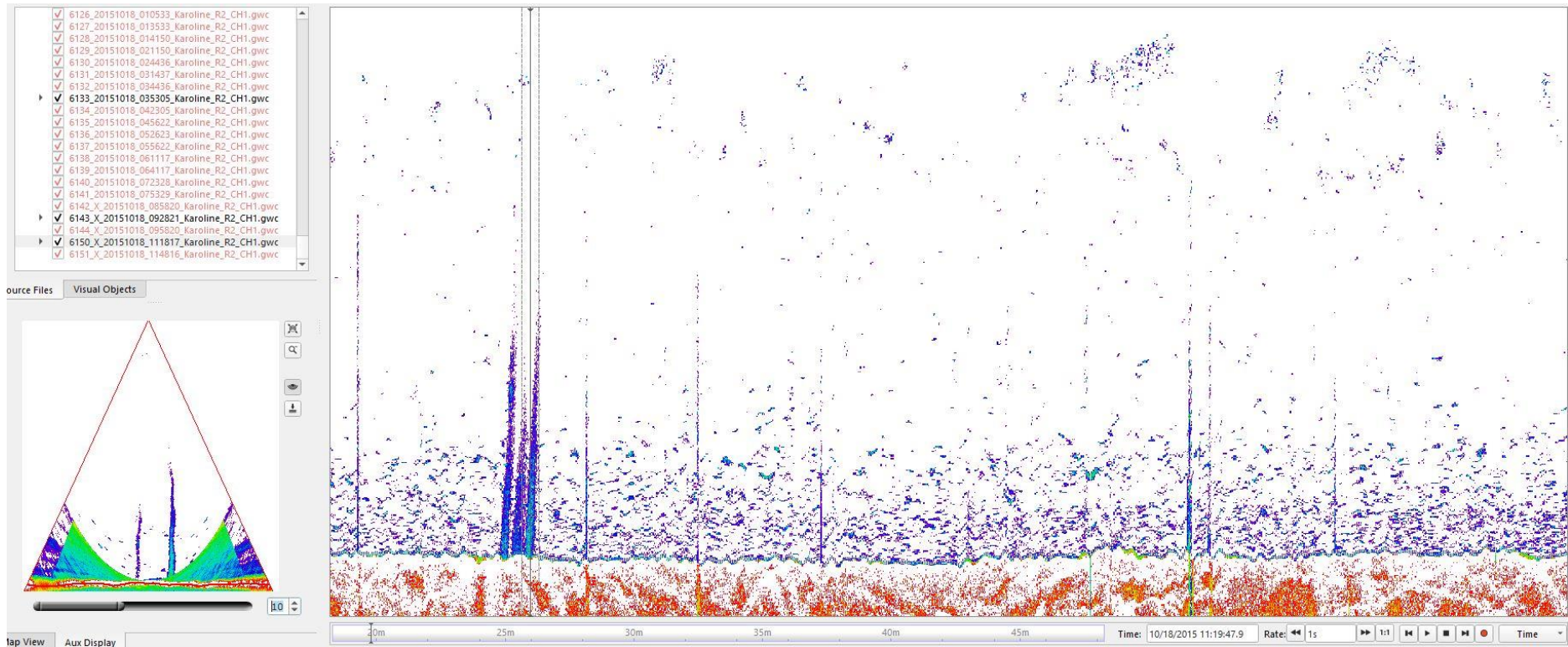


Figure 29. Gas flare b from line 6150 showed on Fan view and stack view. Magnitude 5, Confidence 90%.

4.4.3 Fosae-2015-BH03

The Fosae-2015-BH03 survey consists of 467 water column (*.wcd) survey lines. The data was loaded in Fledermaus Midwater along with navigation (*.all) and converted to GWC files. 57 flares were found in the data of varying confidence level. The flares found are listed in Table 4. Some lines were noisy and may have resulted in some weak flares missing. The locations of the flares are shown on the bathymetry from the study area (Fig. 30). The flares of magnitude 4 and above identified are shown in Figs. 31-58.

Table 4. Details of flares identified from Survey Area Fosae-2015-BH03.

LineId	Latitude	Longitude	Depth	Height	Time	Magnitude	Confidence
406a	75.3336737	26.828035	-216.236	100	05/13/2015 16:16:47.7	3	70
406b	75.3368417	26.8349726	-215.902	70	05/13/2015 16:18:35.3	3	70
423	75.3372082	26.7913316	-217.649	75	05/13/2015 16:29:48.4	3	70
455	75.4420369	26.8019621	-201.301	100	05/13/2015 16:33:51.0	4	80
455	75.445466	26.805366	-197.05	150	05/13/2015 16:35:47.9	4	80
455	75.4458347	26.8070954	-196.819	120	05/13/2015 16:36:02.1	4	80
455	75.4474606	26.8082296	-198.267	135	05/13/2015 16:36:52.1	4	80
564	75.4322347	26.6627785	-193.142	70	05/13/2015 17:14:22.4	3	70
564	75.4339778	26.6651189	-195.568	120	05/13/2015 17:15:19.0	3	80
564	75.434438	26.6649922	-193.72	110	05/13/2015 17:15:32.4	3	70
571	75.2882766	26.5340698	-203.189	115	05/13/2015 17:39:08.0	3	70
572	75.288273	26.534122	-201.65	100	05/13/2015 17:58:40.3	3	60
572	75.301449	26.5405032	-200.98	75	05/13/2015 18:05:43.1	3	70
614	75.2724618	26.4027643	-200.871	55	05/13/2015 19:00:47.4	3	70
695	75.4338725	26.3533252	-159.467	110	05/13/2015 20:31:49.1	3	70
700	75.2785126	26.2255681	-191.711	125	05/13/2015 22:42:39.9	4	80
744	75.4018226	26.2208816	-149.613	90	05/14/2015 19:41:35.9	3	60
750	75.408883	26.2069793	-148.347	125	05/14/2015 22:54:44.7	5	80
750	75.4096406	26.20358	-147.209	110	05/14/2015 22:55:01.4	5	70
750	75.409664	26.206247	-148.002	130	05/14/2015 22:55:05.0	5	80
750	75.4097661	26.2069394	-149.249	110	05/14/2015 22:55:08.6	4	70

750	75.4104707	26.2054748	-146.458	130	05/14/2015 22:55:25.1	5	80
750	75.4121574	26.2123112	-149.098	100	05/14/2015 22:56:17.1	3	70
750	75.4123955	26.213251	-148.028	95	05/14/2015 22:56:24.3	4	80
750	75.4132302	26.2149438	-149.154	90	05/14/2015 22:56:48.6	4	80
750	75.417702	26.2150254	-149.599	100	05/14/2015 22:58:47.5	3	70
751	75.4490492	26.2360192	-156.546	140	05/14/2015 23:12:50.4	3	70
752	75.4150421	26.1993325	-150.884	100	05/14/2015 23:52:32.2	3	80
752	75.4129881	26.1936561	-149.951	110	05/14/2015 23:53:31.7	3	60
752	75.409976	26.196614	-149.54	90	05/14/2015 23:55:49.8	4	80
752	75.4076055	26.1924033	-149.194	115	05/14/2015 23:55:49.8	4	80
770	75.3980425	26.1318386	-148.617	80	05/15/2015 8:45:26.9	3	70
770	75.3977764	26.1305628	-149.888	100	05/15/2015 8:45:35.4	2	70
770	75.3954846	26.1307707	-150.836	130	05/15/2015 8:46:36.0	4	80
773	75.2859067	26.0354969	-164.747	155	05/15/2015 10:29:39.9	4	80
775	75.3890045	26.1113999	-150.74	125	05/15/2015 11:18:34.5	3	60
775	75.3923592	26.1206547	-150.858	85	05/15/2015 11:20:18.2	4	70
775	75.3947113	26.121592	-152.098	95	05/15/2015 11:21:22.5	3	70
775	75.3975348	26.1232822	-149.297	90	05/15/2015 11:22:42.3	4	70
775	75.3986506	26.1158088	-150.526	100	05/15/2015 11:22:42.3	3	50
778	75.4002671	26.1128906	-151.636	100	05/15/2015 12:37:23.4	4	70
778	75.398665	26.112497	-150.92	95	05/15/2015 12:38:05.7	3	70
778	75.3902319	26.1033034	-152.956	100	05/15/2015 12:41:57.7	4	80
784	75.3898849	26.0943529	-150.782	100	05/15/2015 15:40:24.0	5	80
790	75.2812189	26.0032991	-159.37	100	05/15/2015 18:25:29.2	4	80
790	75.2674149	25.9922799	-162.358	90	05/15/2015 18:31:47.8	3	70
790	75.266642	25.9945126	-163.297	150	05/15/2015 18:32:05.9	4	90
790	75.266338	25.98997	-165.67	90	05/15/2015 18:32:18.4	3	60
799	75.331205	26.014233	-147.58	100	05/15/2015 22:13:30.7	3	70
799	75.330905	26.0150941	-146.971	100	05/15/2015 22:13:37.6	4	80

814	75.442862	26.0430862	-146.951	110	05/16/2015 5:21:46.5	4	80
814	75.4417041	26.041011	-147.193	60	05/16/2015 5:22:19.0	4	80
818	75.3026501	25.923343	-165.571	115	05/16/2015 7:30:31.4	4	80
820	75.3957805	25.9927722	-154.747	80	05/16/2015 8:12:55.3	3	60
824	75.3994573	25.9818934	-155.409	120	05/16/2015 9:51:11.9	3	60
839	75.4071792	26.1976025	-145.269	80	05/16/2015 18:33:23.3	3	80
839	75.4074632	26.192135	-146.89	55	05/16/2015 18:33:55.5	4	80

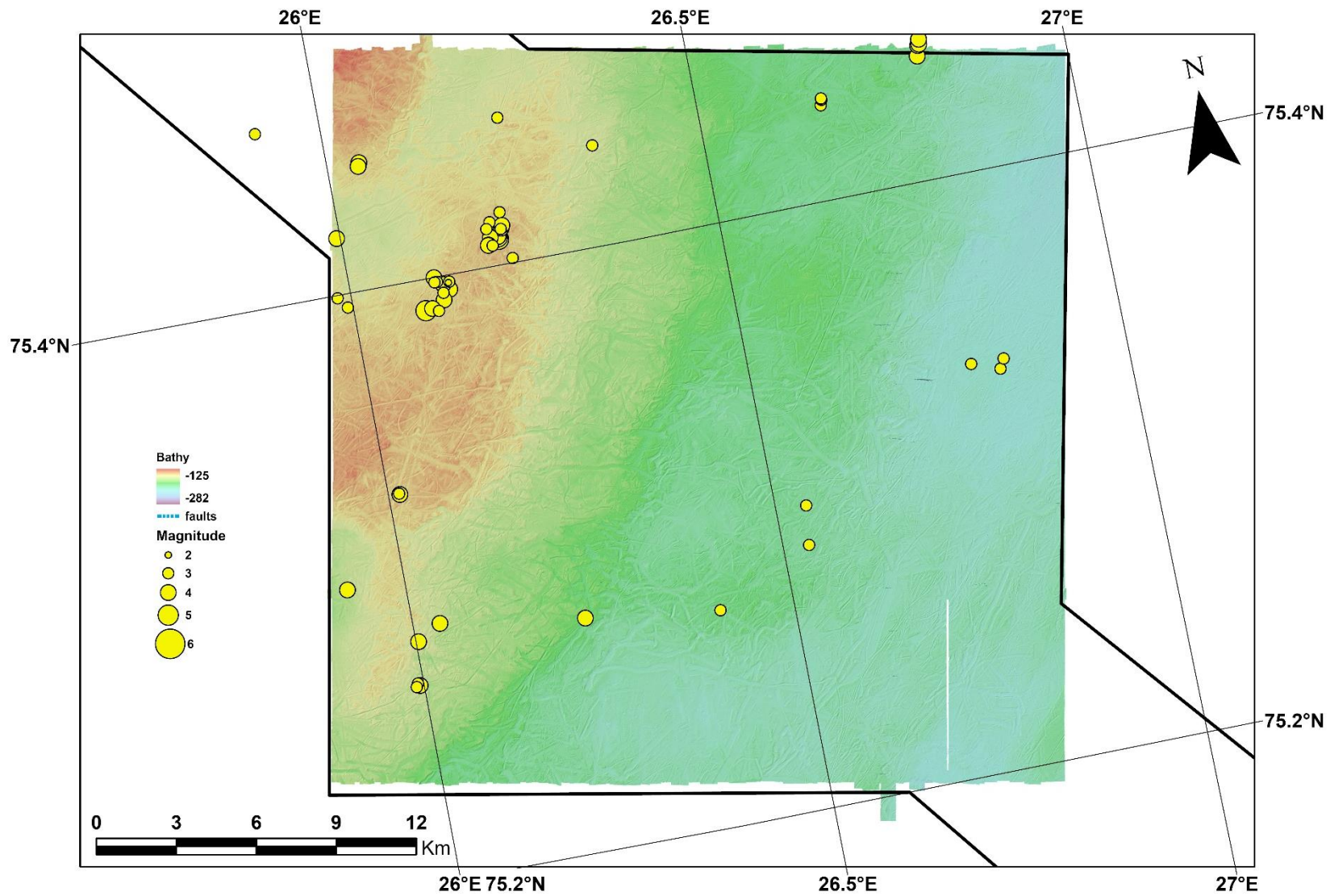


Figure 30. Bathymetry from the Fosae-2015-BH03 survey area showing the location of the flares.

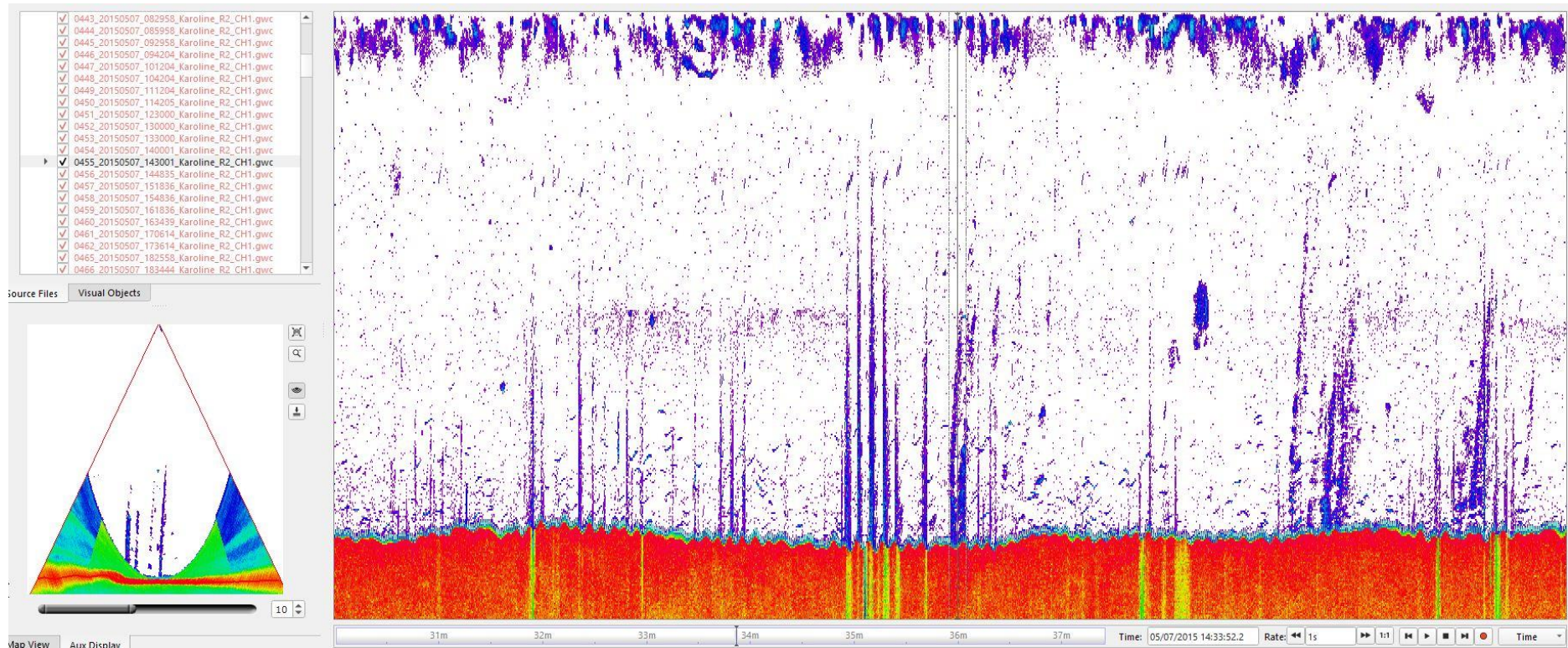


Figure 31. Gas flare a from line 455 showed on Fan view and stack view. Magnitude 4, Confidence 80%.

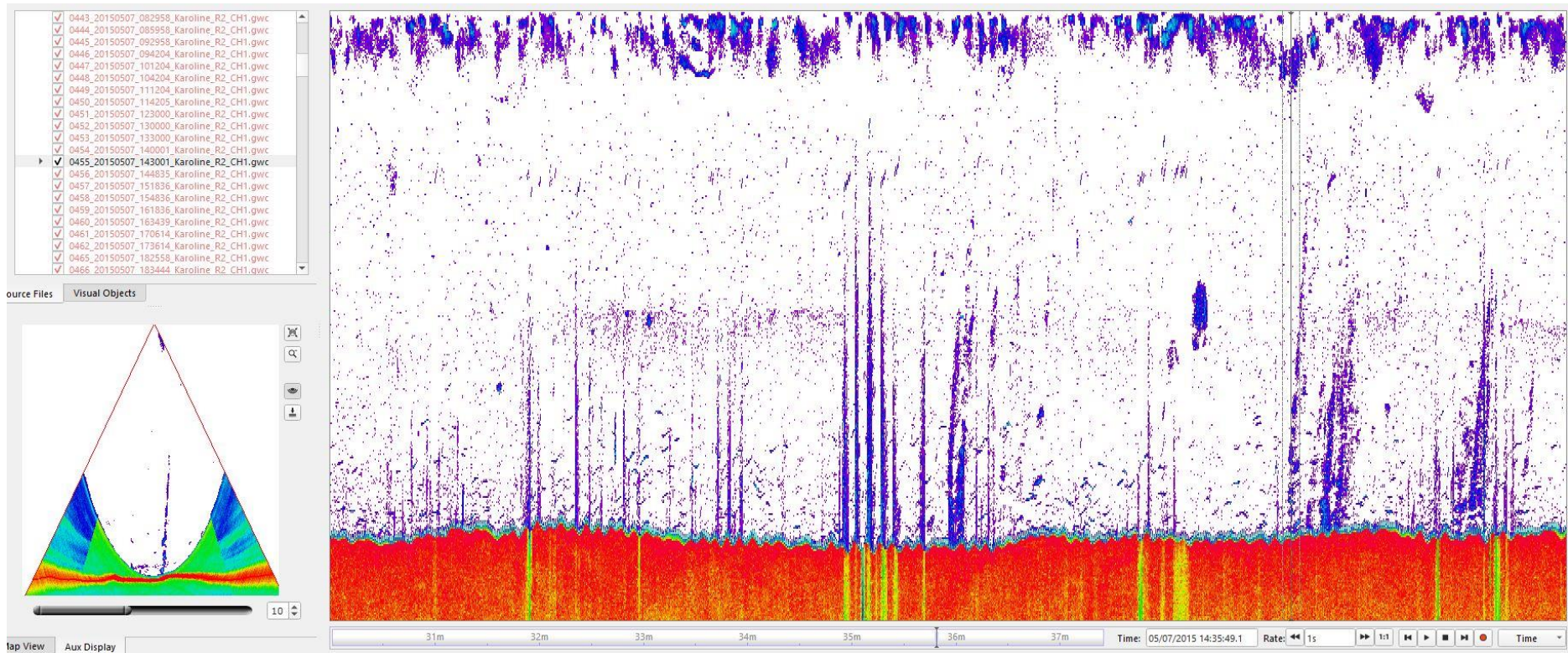


Figure 32. Gas flare b from line 455 showed on Fan view and stack view. Magnitude 4, Confidence 80%.

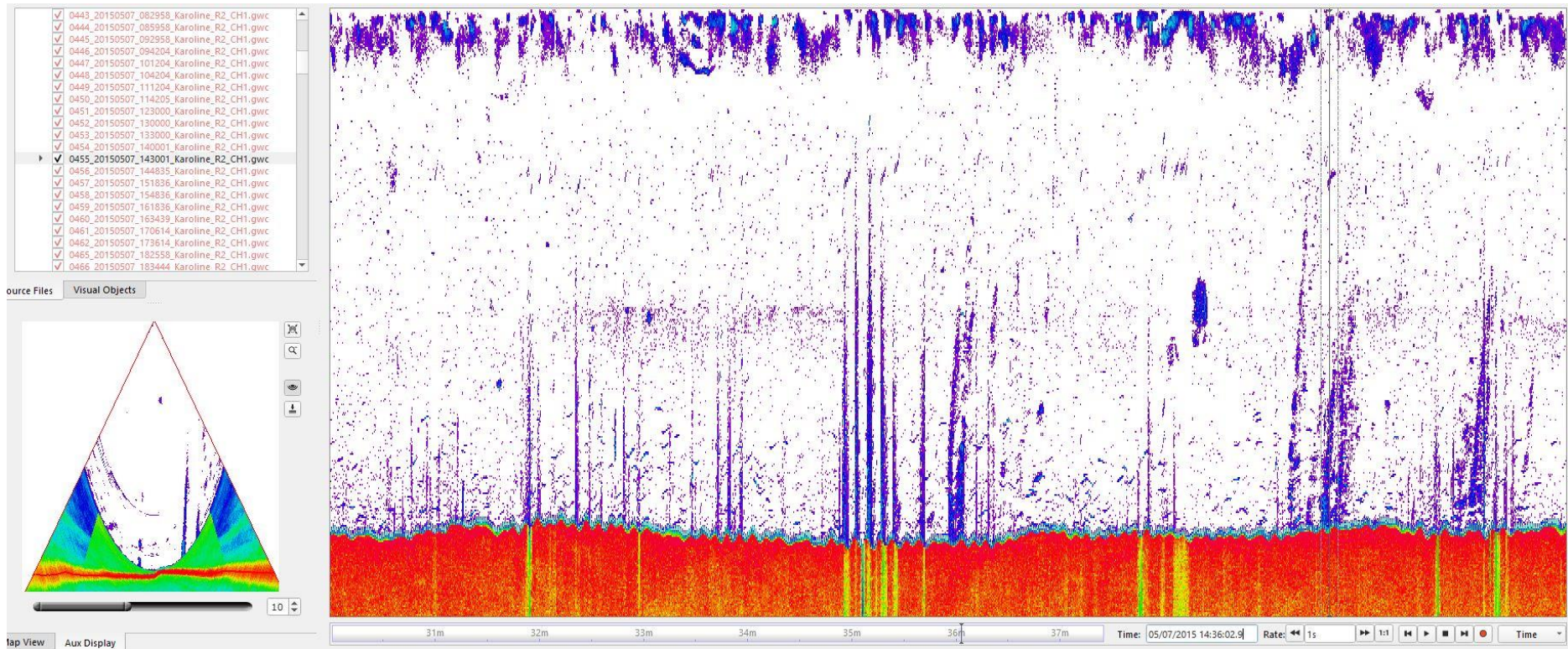


Figure 33. Gas flare c from line 455 showed on Fan view and stack view. Magnitude 4, Confidence 80%.

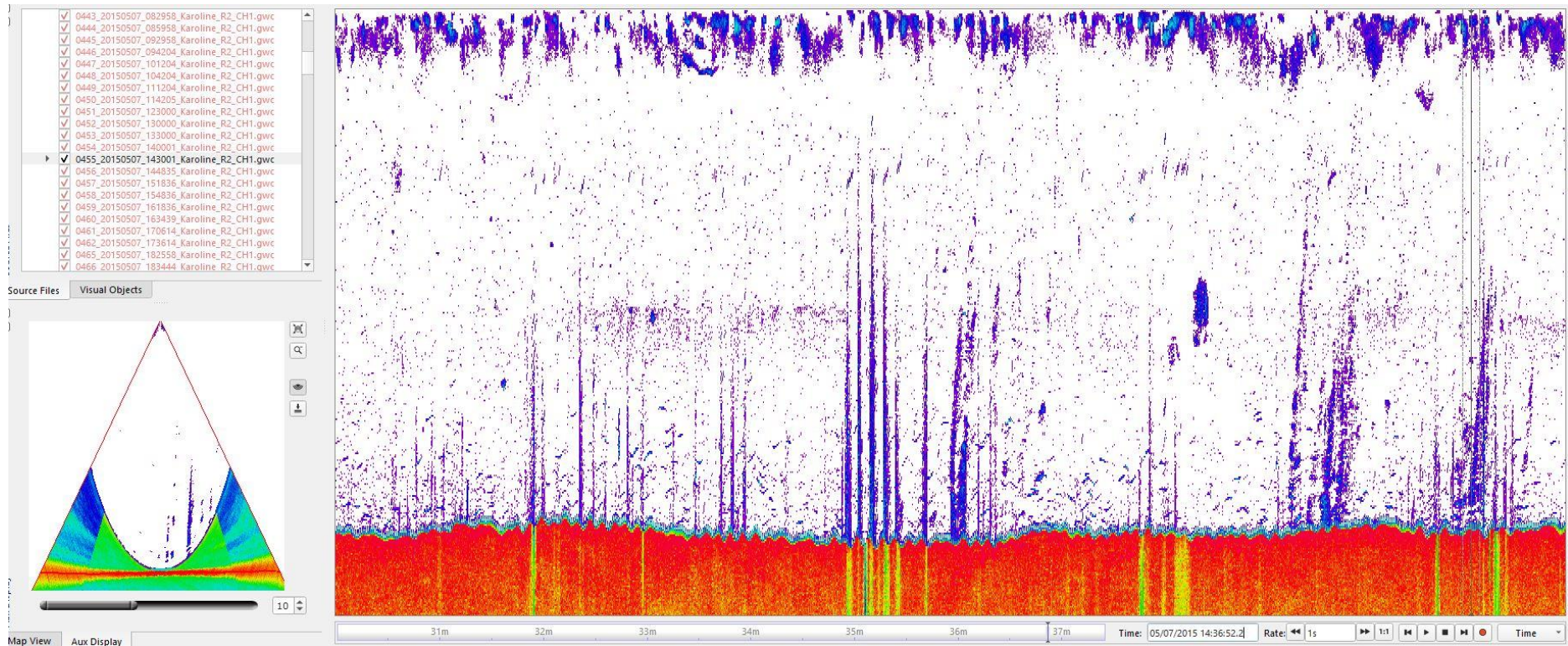


Figure 34. Gas flare d from line 455 showed on Fan view and stack view. Magnitude 4, Confidence 80%.

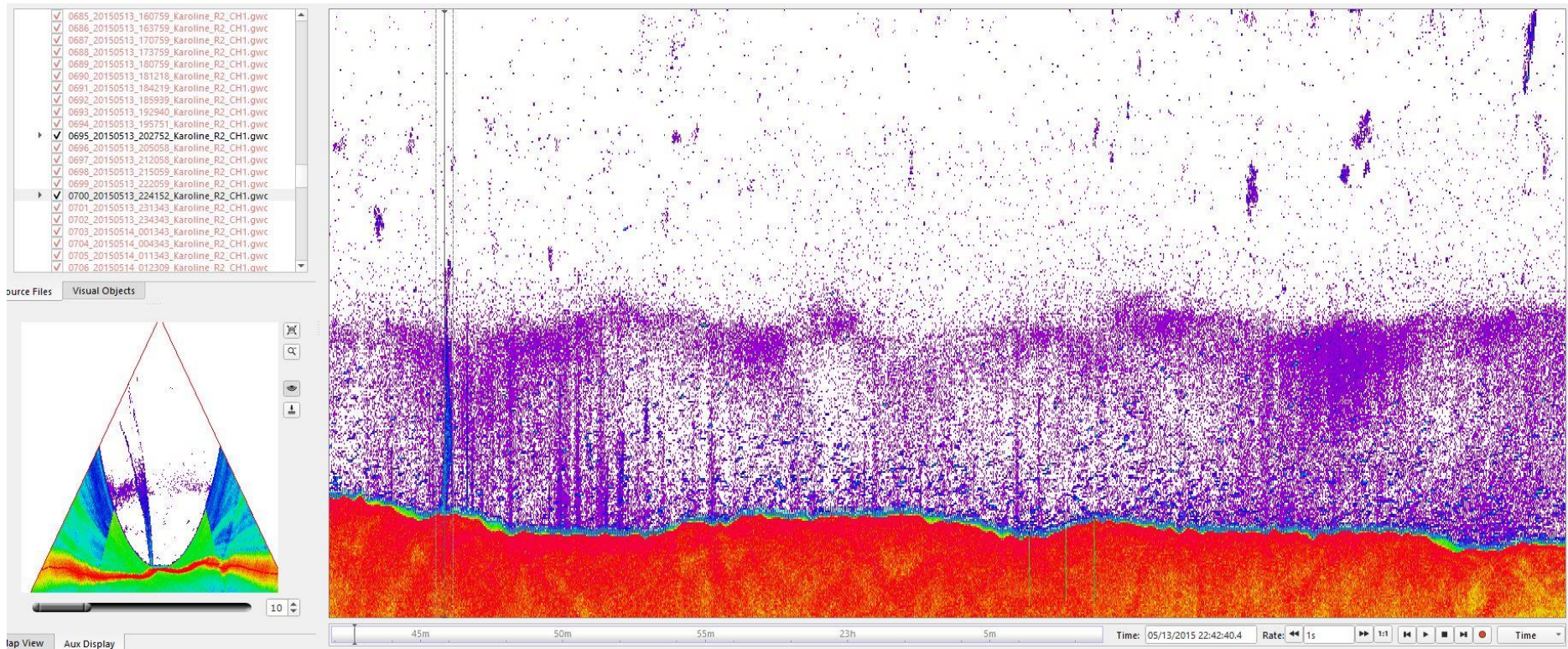


Figure 35. Gas flare from line 700 showed on Fan view and stack view. Magnitude 4, Confidence 80%.

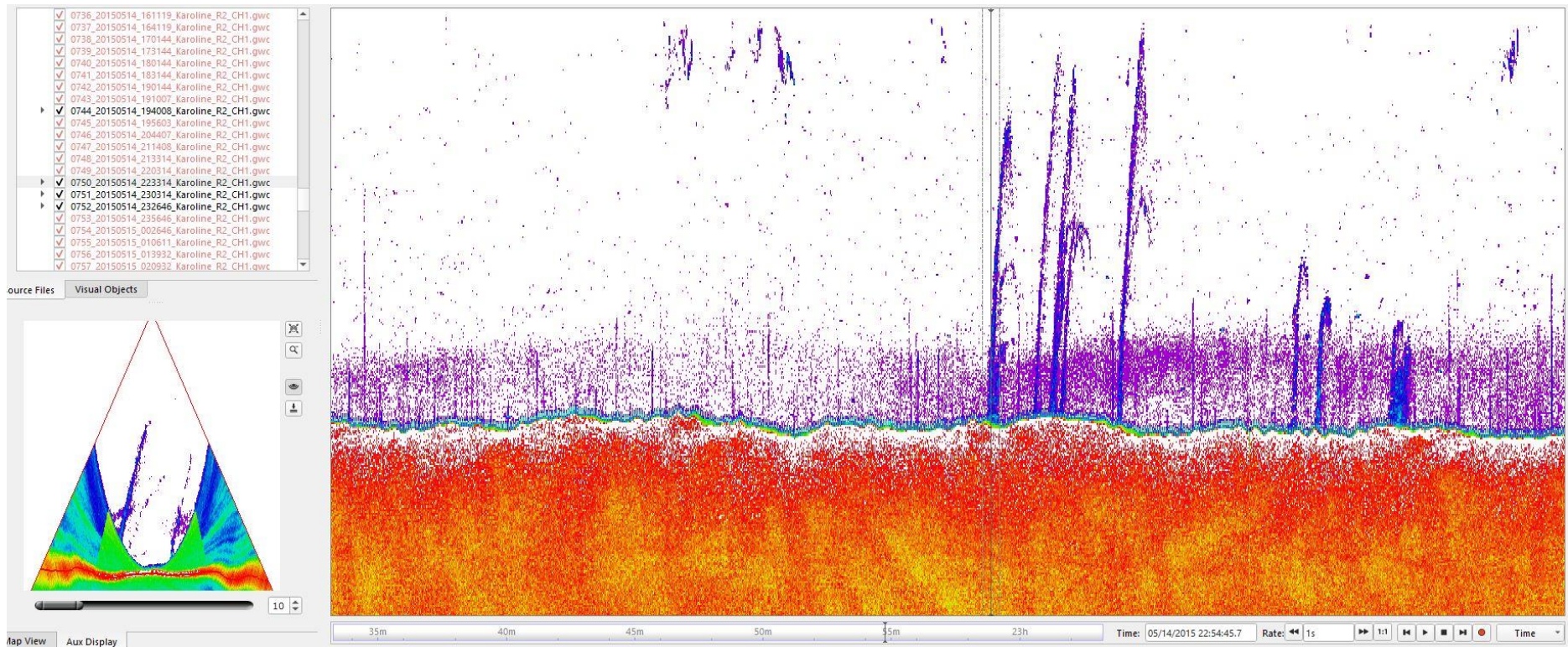


Figure 36. Gas flare a from line 750 showed on Fan view and stack view. Magnitude 5, Confidence 80%.

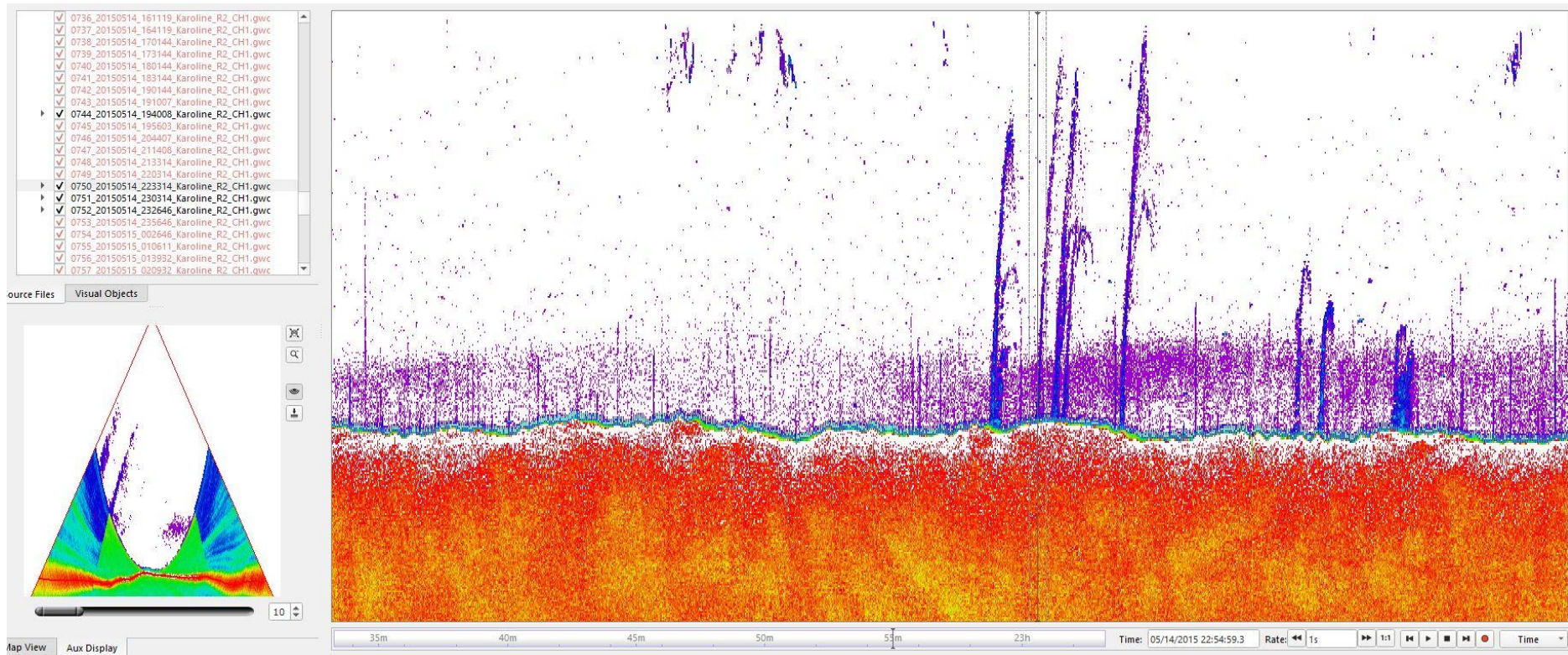


Figure 37. Gas flare b from line 750 showed on Fan view and stack view. Magnitude 5, Confidence 70%.

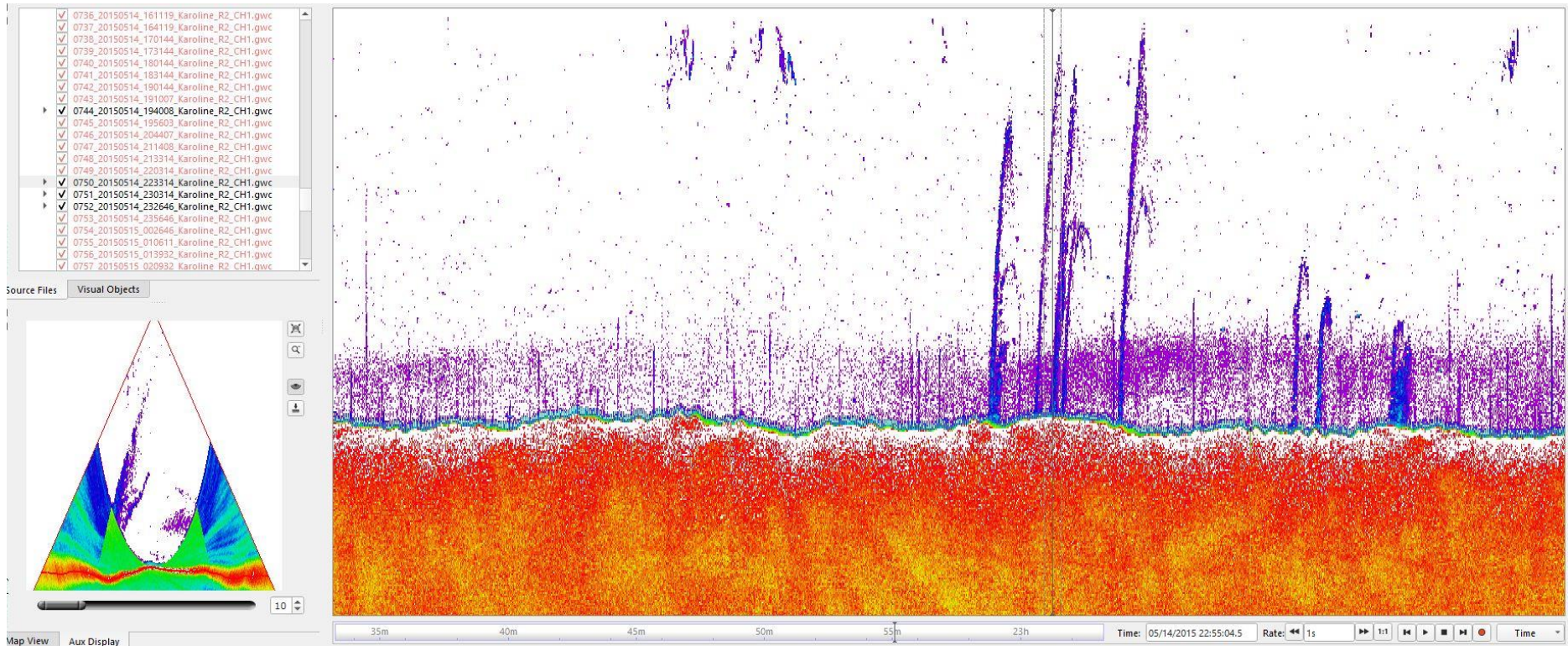


Figure 38. Gas flare c from line 750 showed on Fan view and stack view. Magnitude 5, Confidence 80%.

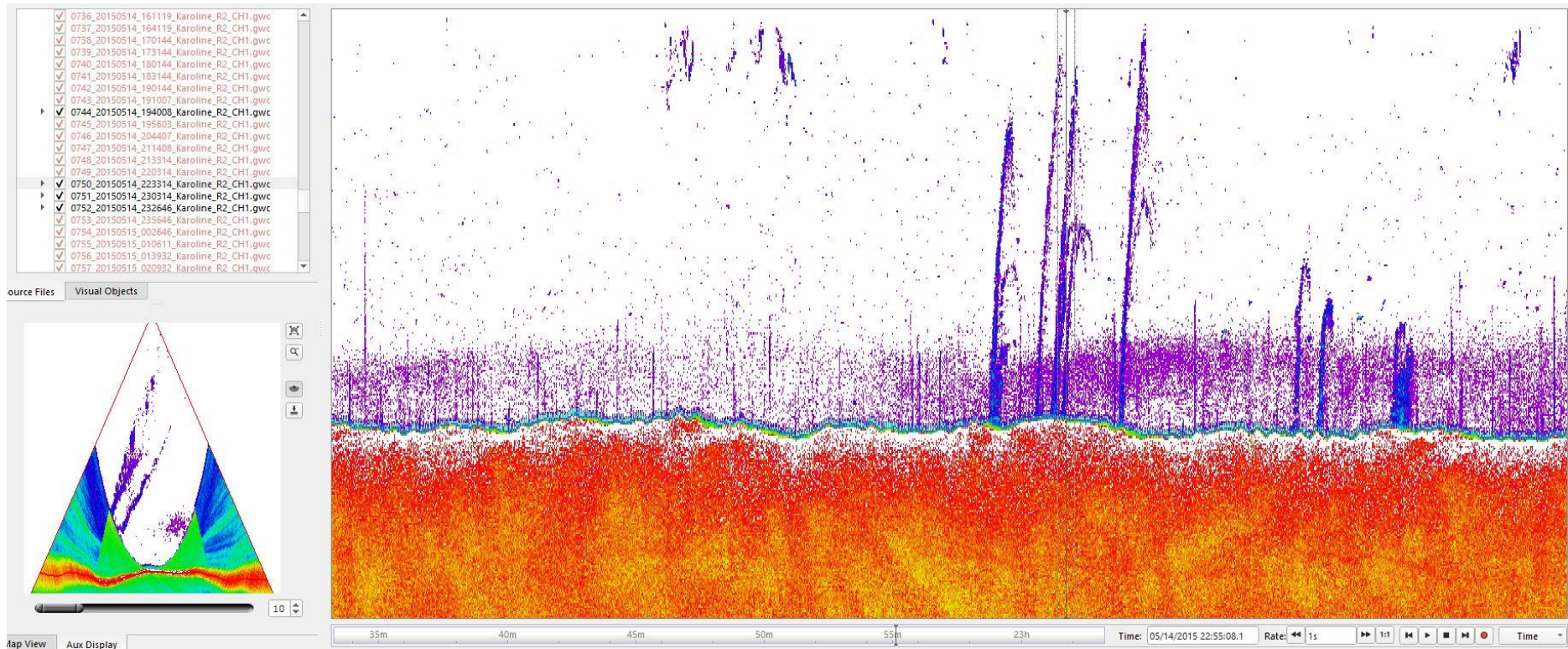


Figure 39. Gas flare d from line 750 showed on Fan view and stack view. Magnitude 4, Confidence 70%.

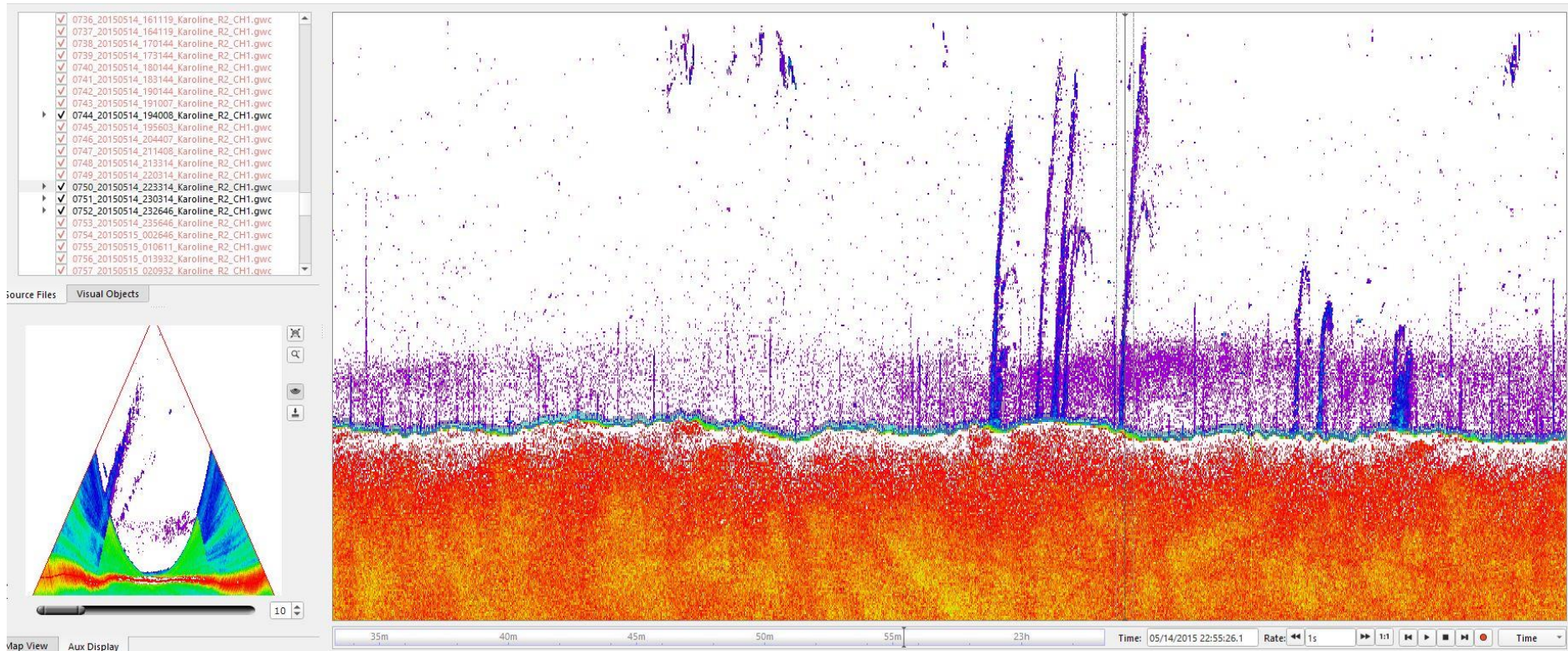


Figure 40. Gas flare e from line 750 showed on Fan view and stack view. Magnitude 5, Confidence 80%.

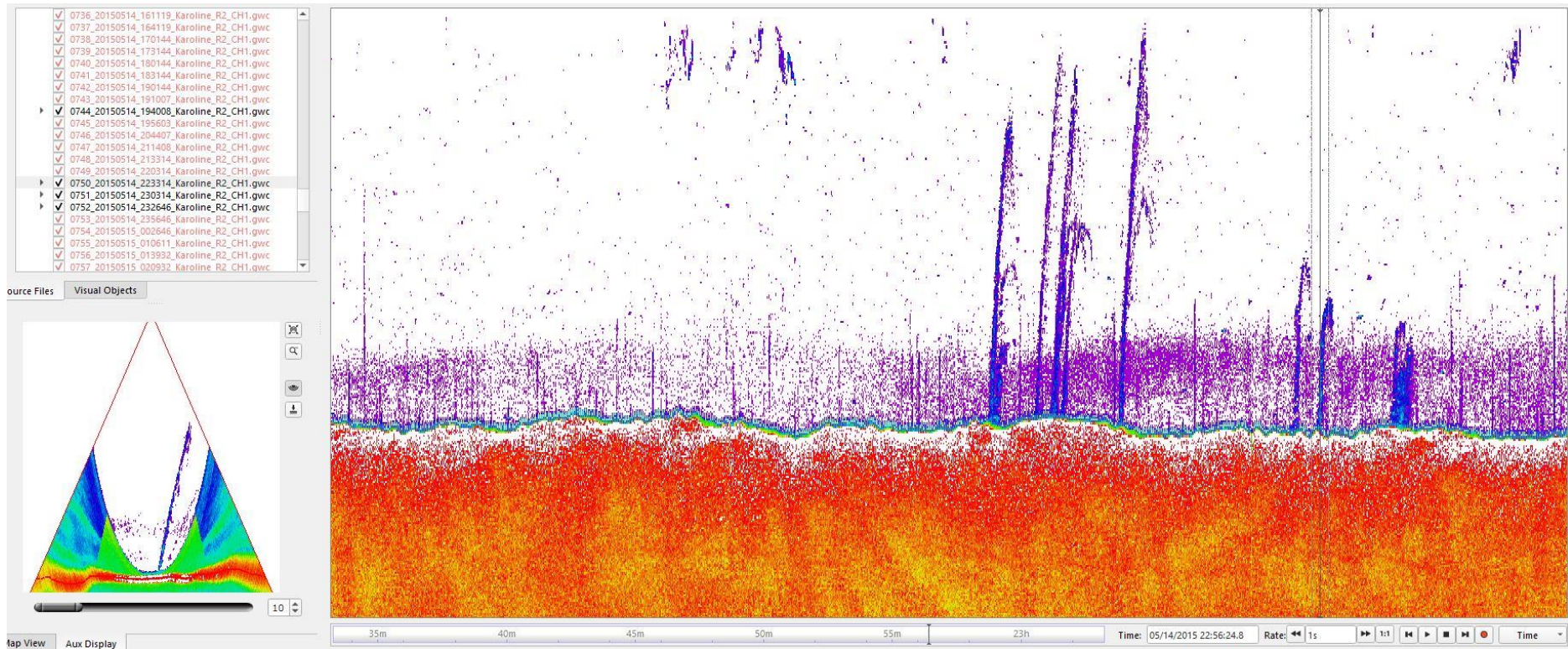


Figure 41. Gas flare g from line 750 showed on Fan view and stack view. Magnitude 4, Confidence 80%.

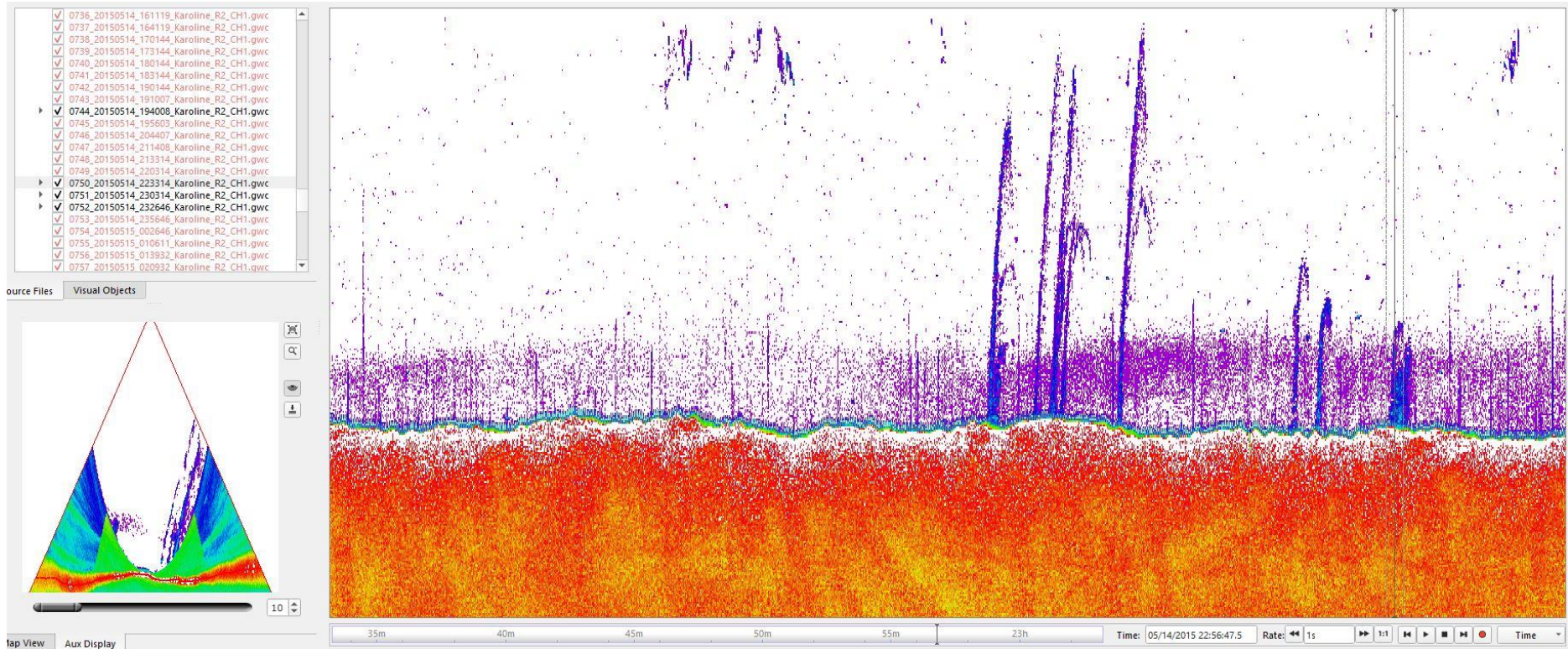


Figure 42. Gas flare h from line 750 showed on Fan view and stack view. Magnitude 4, Confidence 80%.

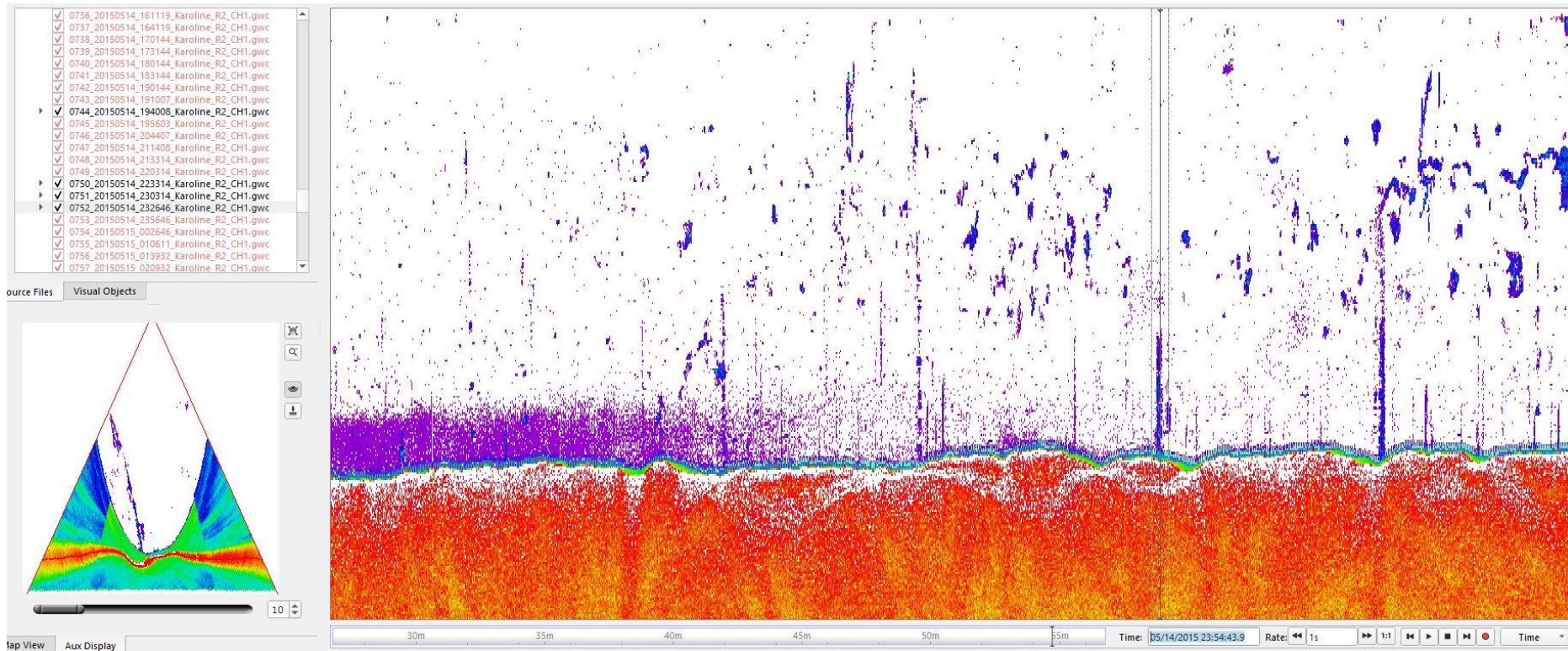


Figure 43. Gas flare c from line 752 showed on Fan view and stack view. Magnitude 4, Confidence 80%.

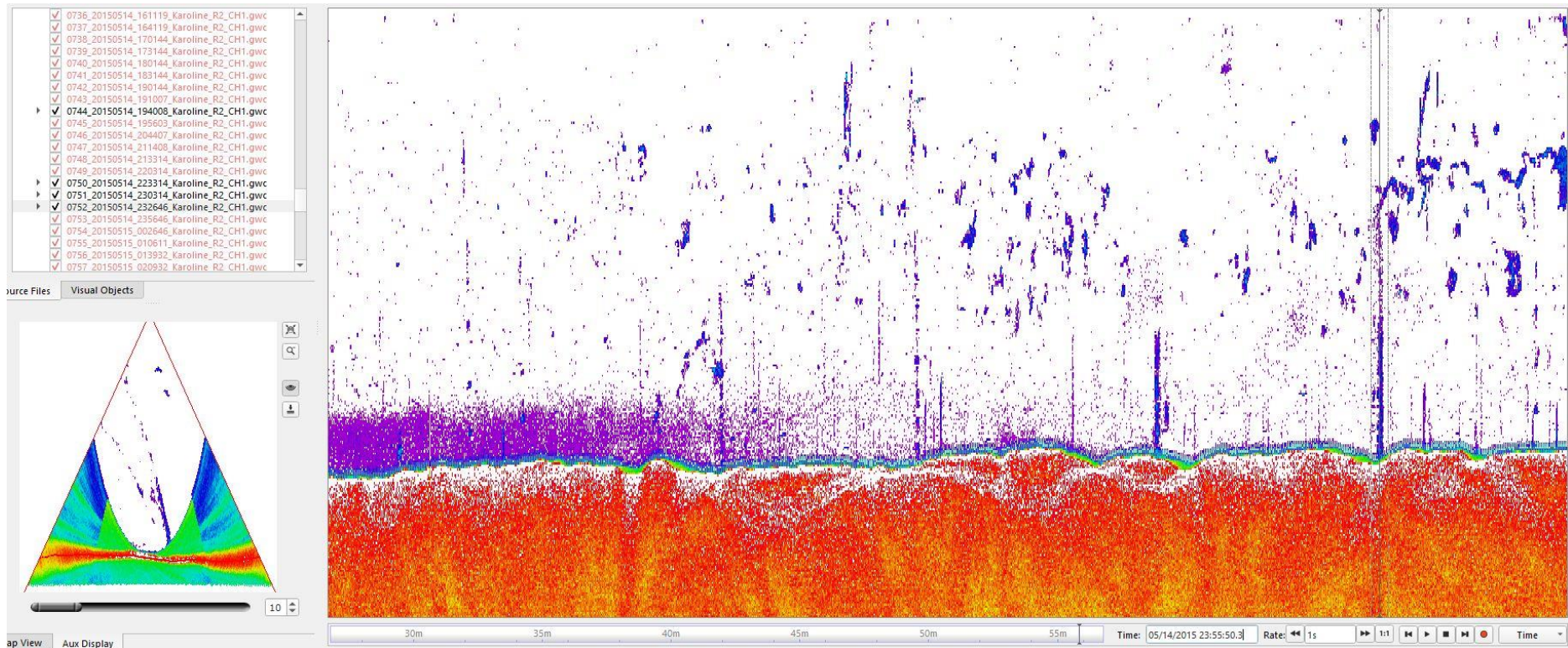


Figure 44. Gas flare d from line 752 showed on Fan view and stack view. Magnitude 4, Confidence 80%.

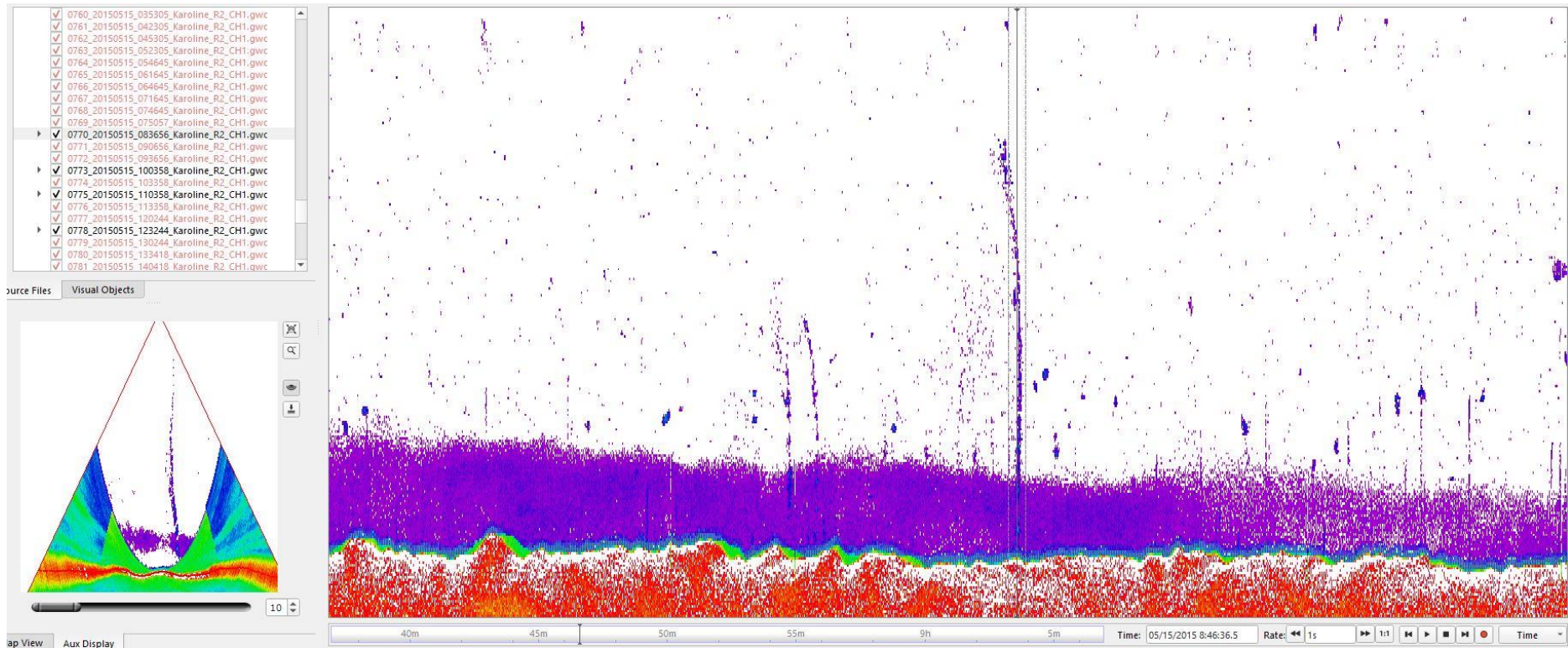


Figure 45. Gas flare c from line 770 showed on Fan view and stack view. Magnitude 4, Confidence 80%.

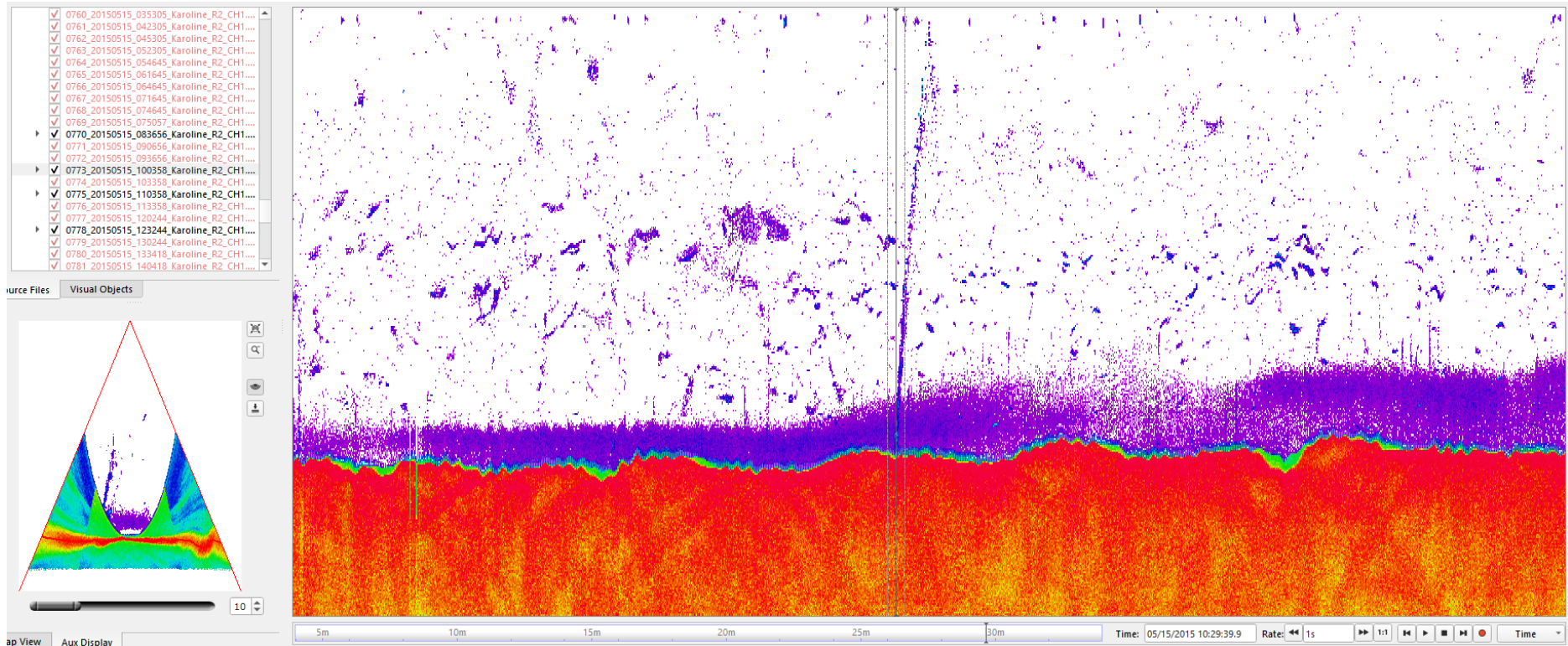


Figure 46. Gas flare from line 773 showed on Fan view and stack view. Magnitude 4, Confidence 80%.

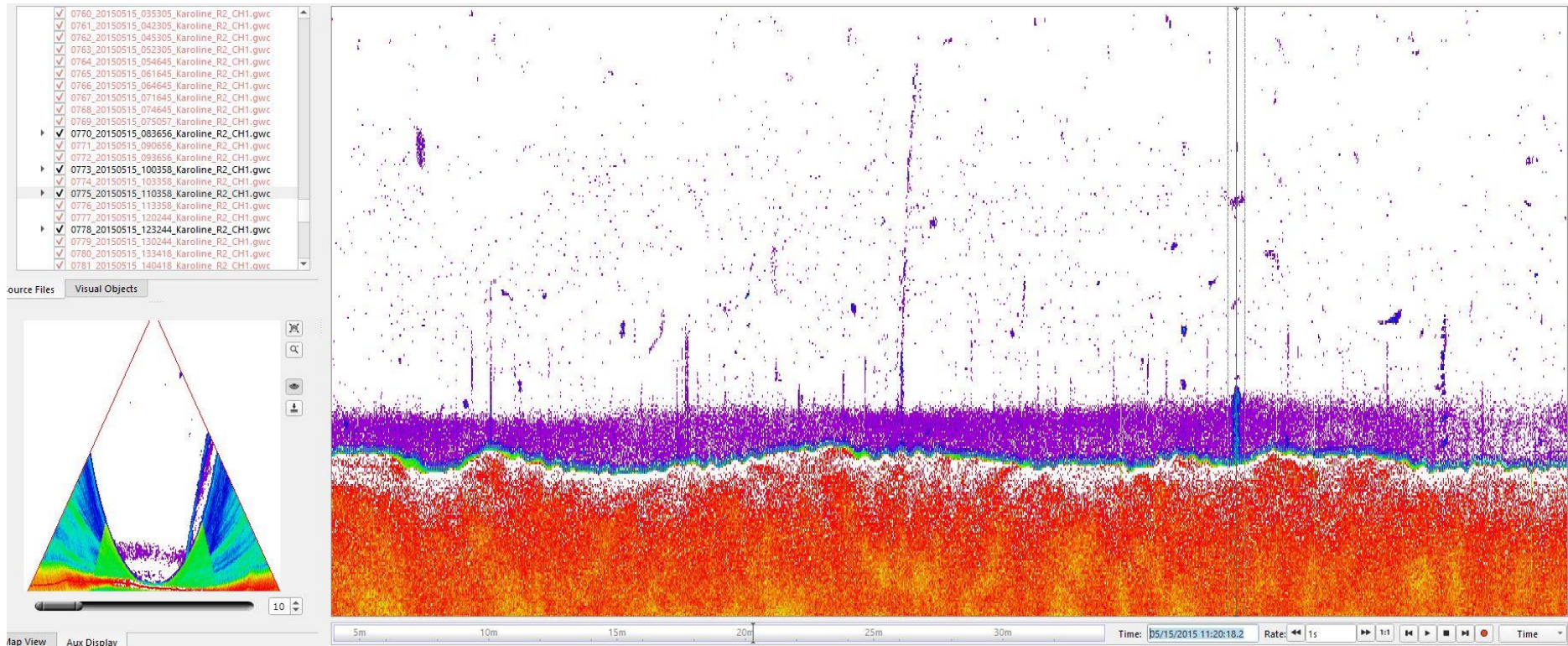


Figure 47. Gas flare b from line 775 showed on Fan view and stack view. Magnitude 4, Confidence 70%.

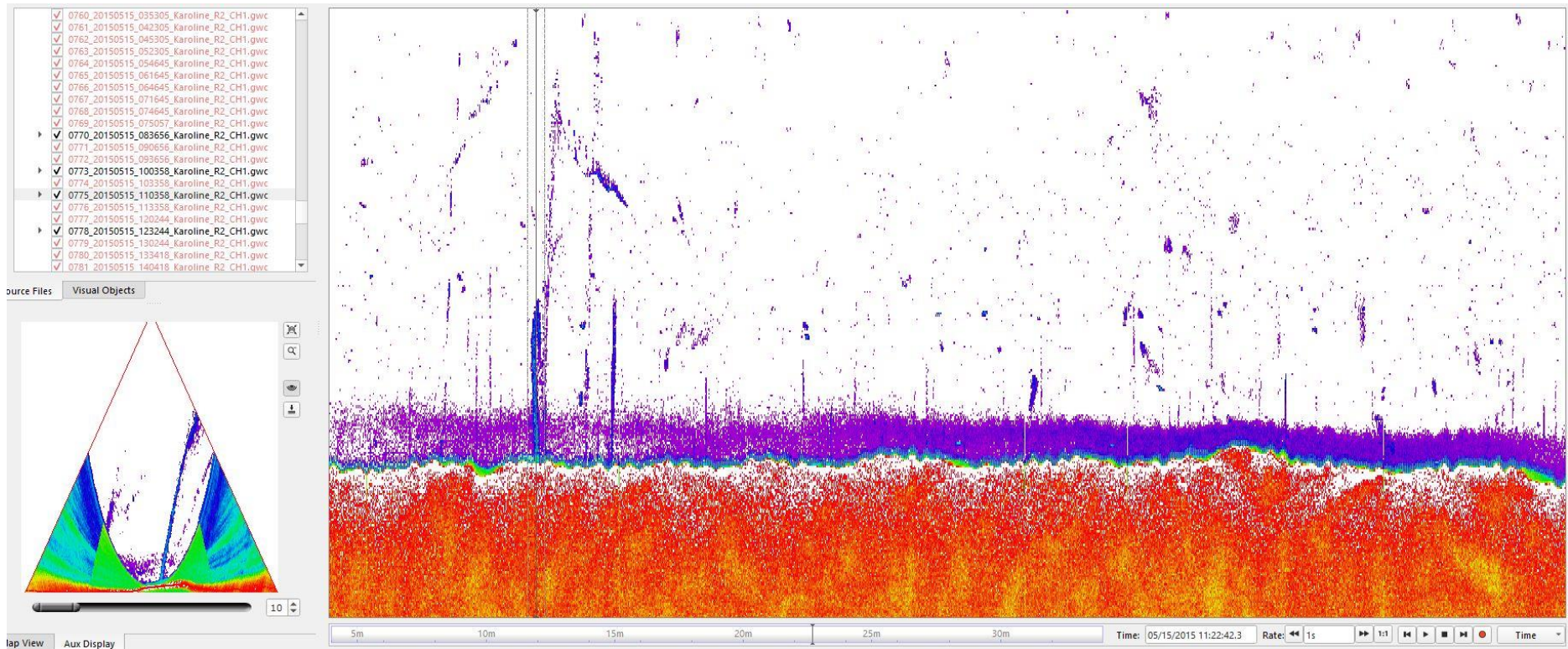


Figure 48. Gas flare d from line 775 showed on Fan view and stack view. Magnitude 4, Confidence 70%.

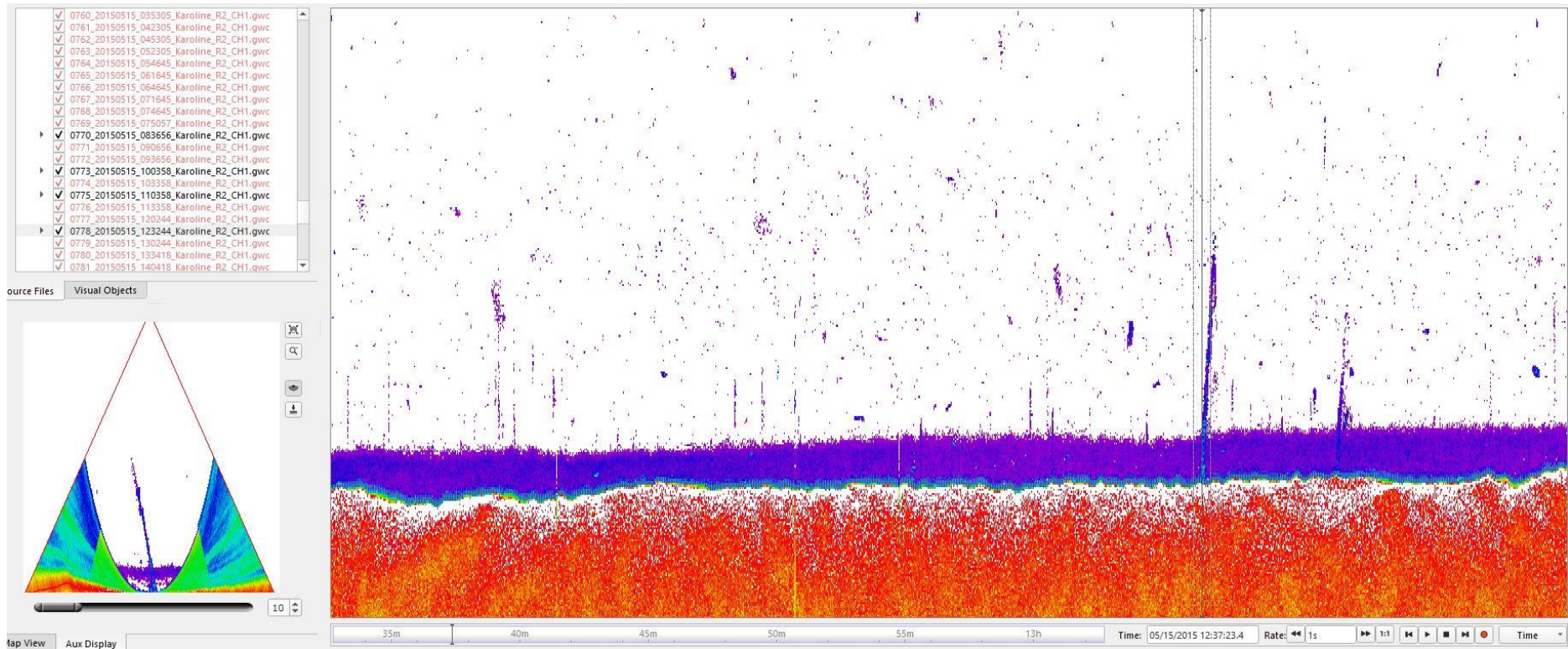


Figure 49. Gas flare a from line 778 showed on Fan view and stack view. Magnitude 4, Confidence 70%.

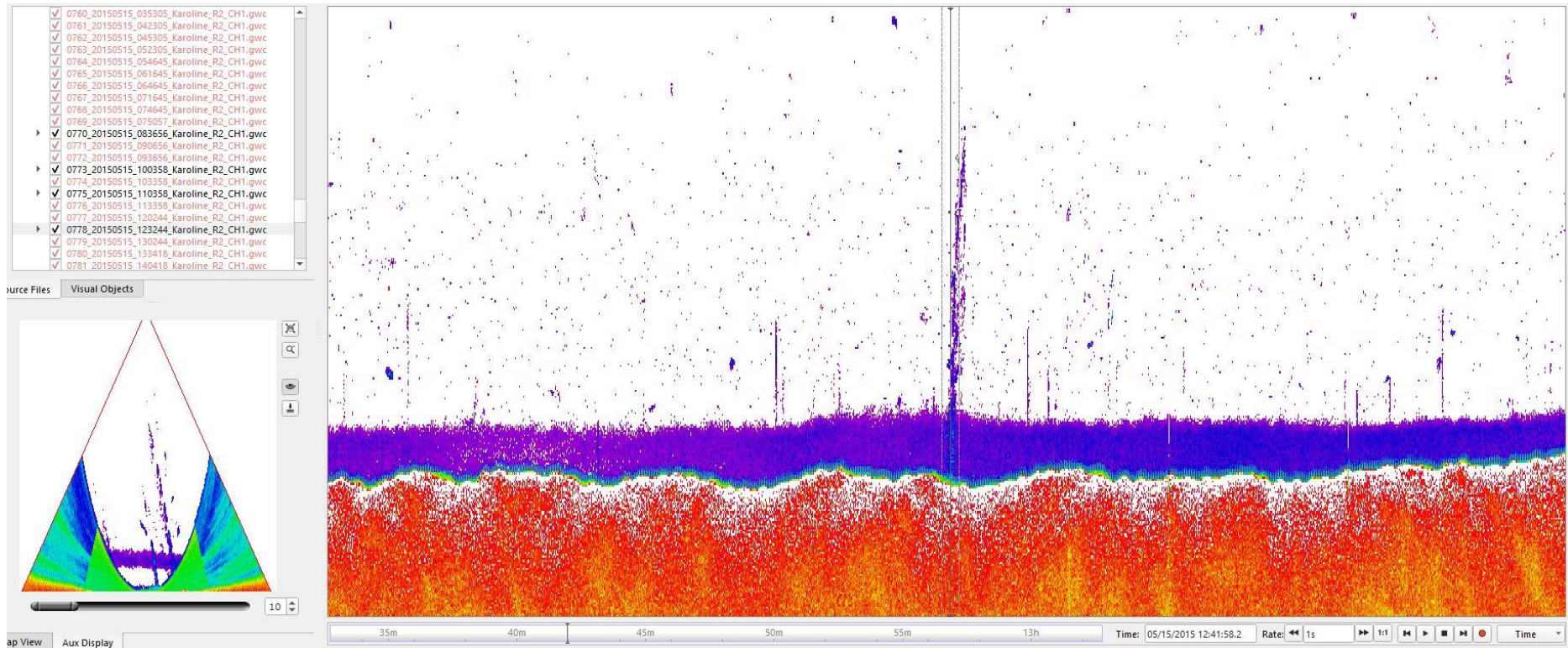


Figure 50. Gas flare c from line 778 showed on Fan view and stack view. Magnitude 4, Confidence 80%.

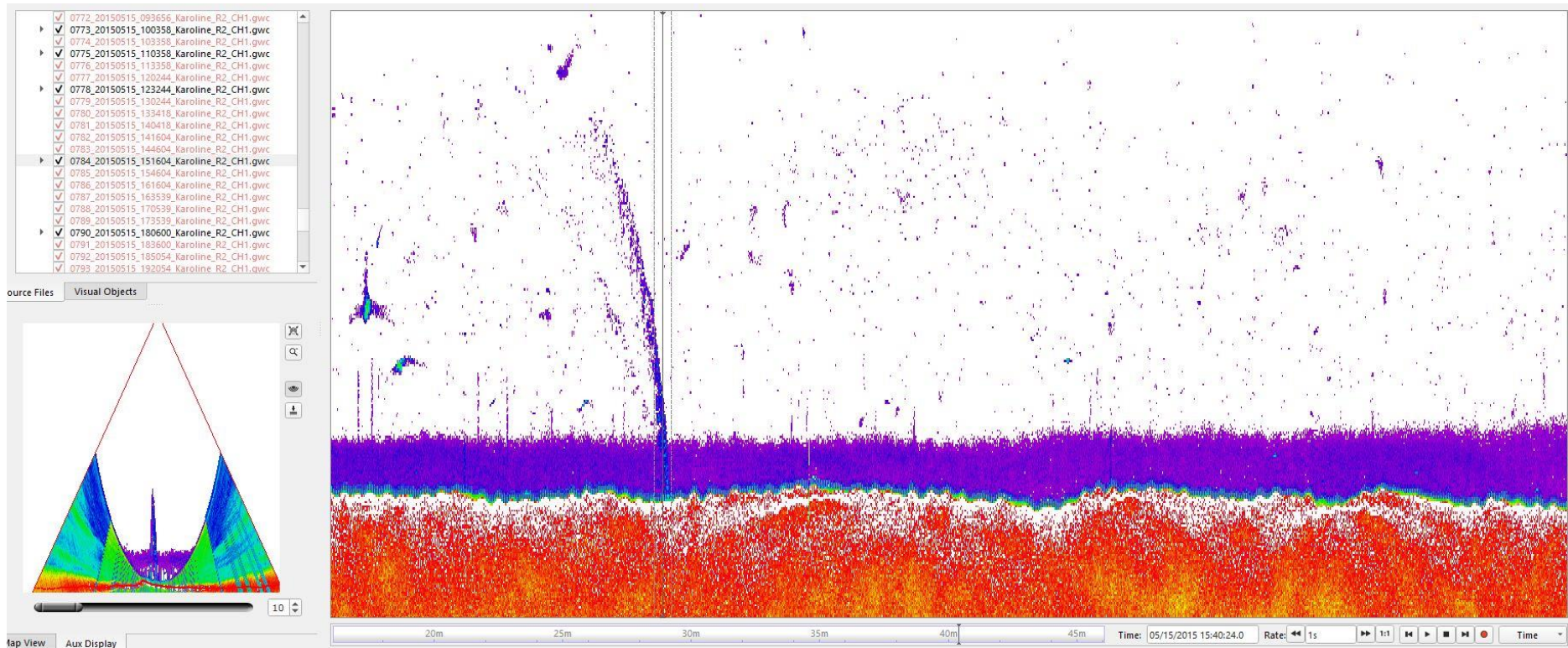


Figure 51. Gas flare from line 784 showed on Fan view and stack view. Magnitude 5, Confidence 80%.

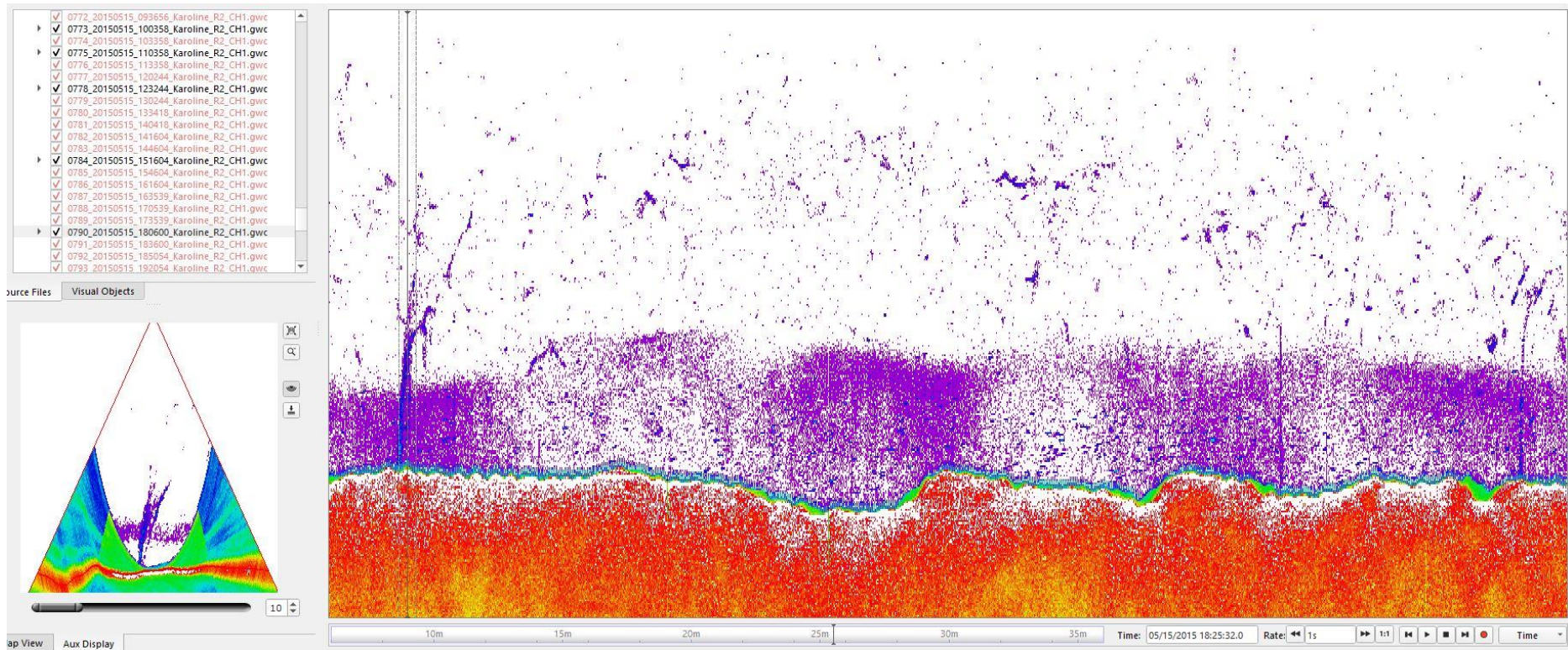


Figure 52. Gas flare a from line 790 showed on Fan view and stack view. Magnitude 4, Confidence 80%.

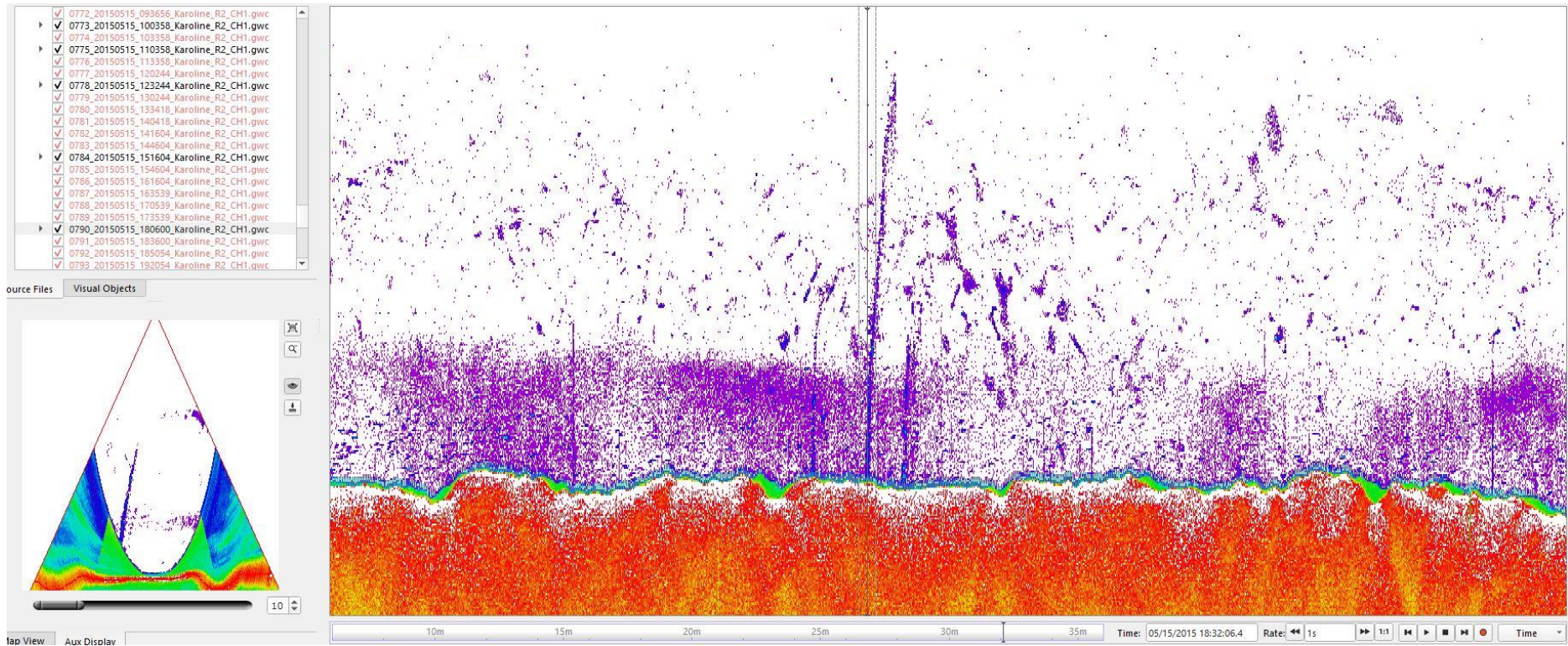


Figure 53. Gas flare *c* from line 790 showed on Fan view and stack view. Magnitude 4, Confidence 90%.

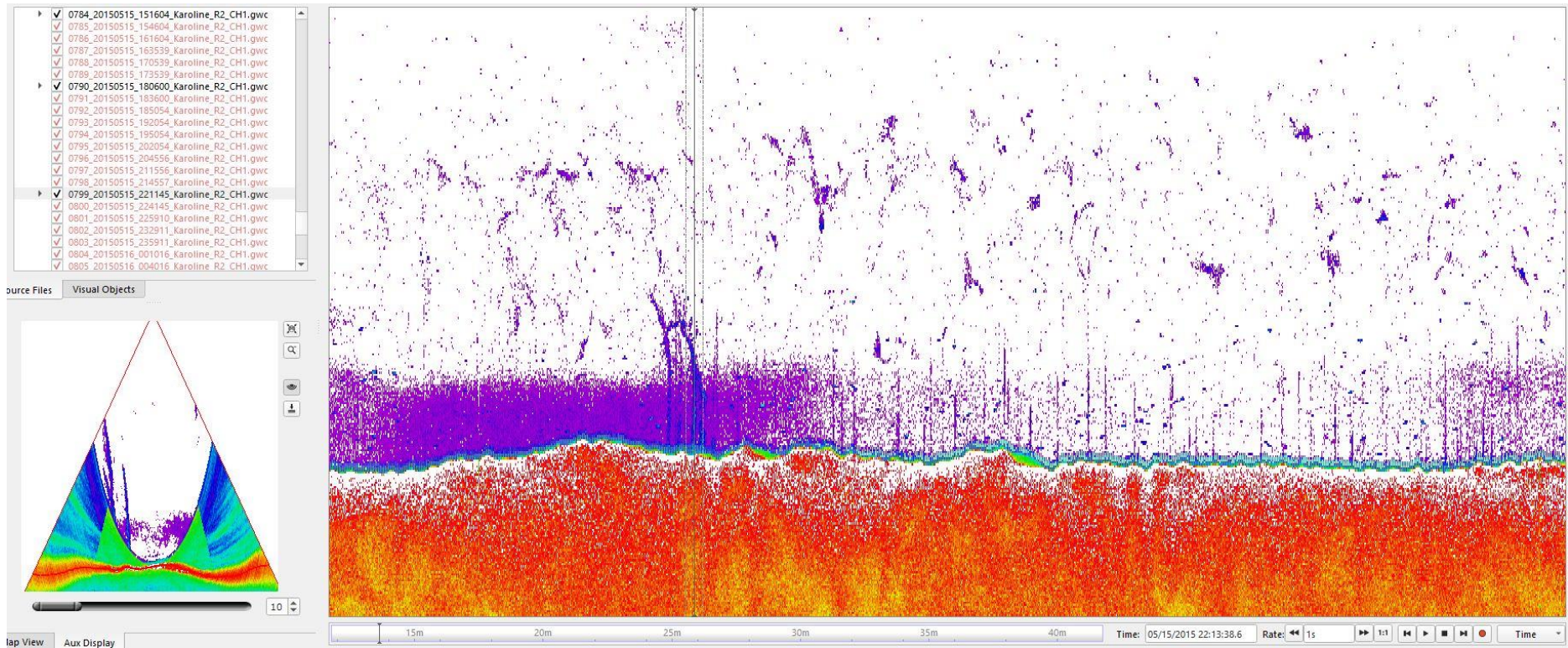


Figure 54. Gas flare b from line 799 showed on Fan view and stack view. Magnitude 4, Confidence 80%.

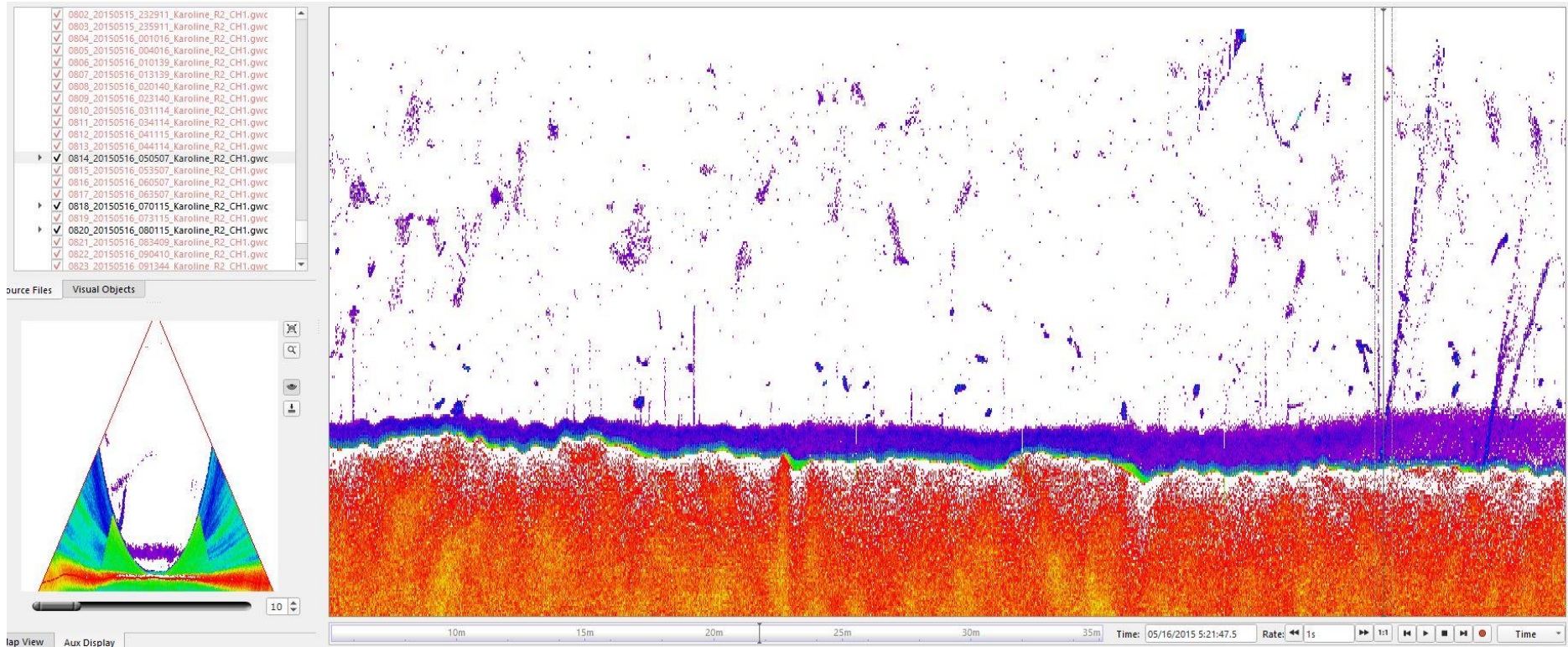


Figure 55. Gas flare a from line 814 showed on Fan view and stack view. Magnitude 4, Confidence 80%.

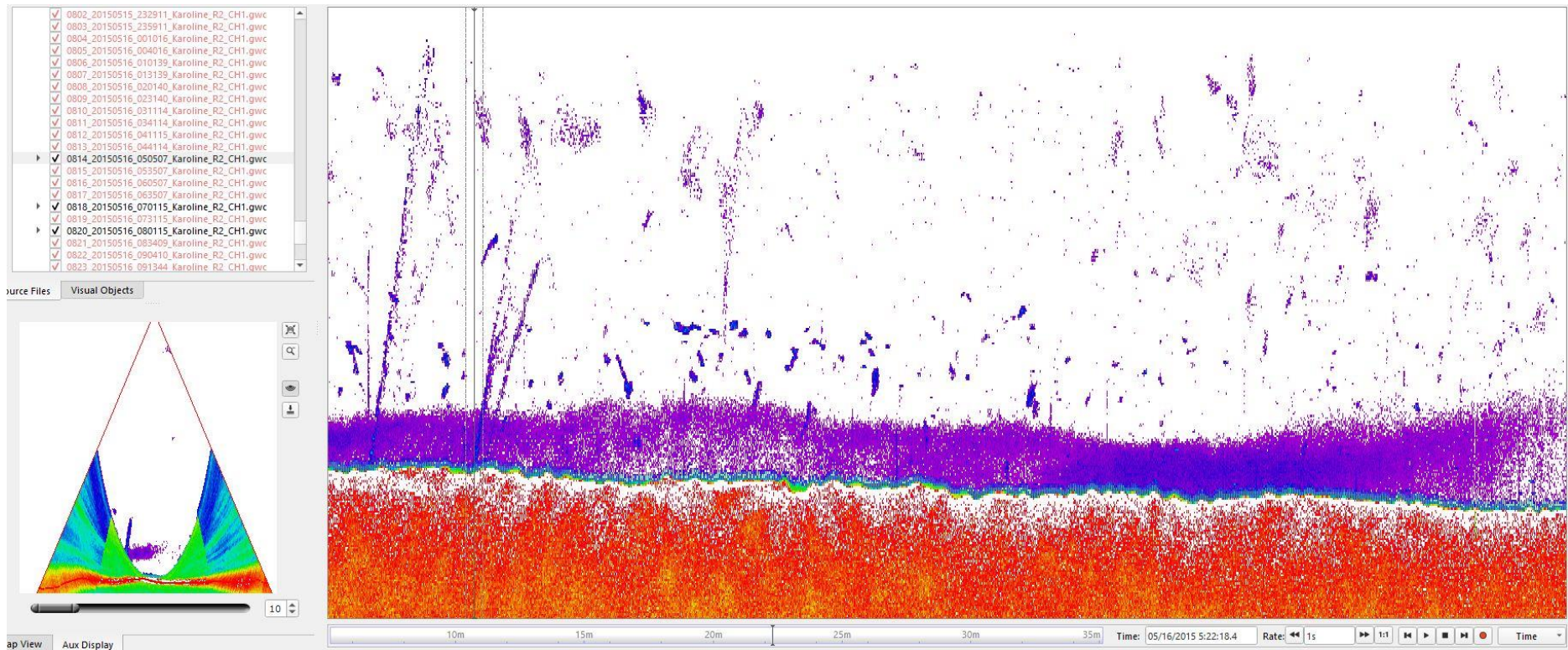


Figure 56. Gas flare b from line 814 showed on Fan view and stack view. Magnitude 4, Confidence 80%.

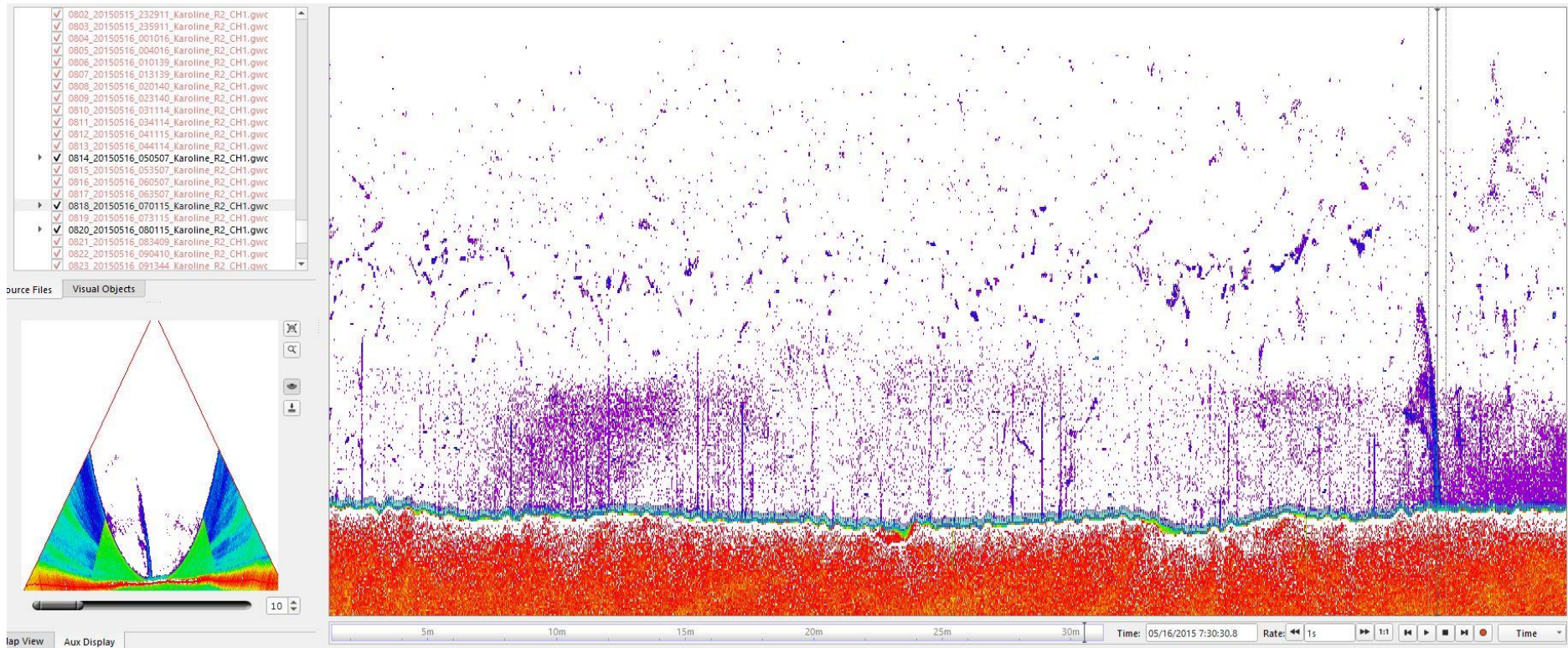


Figure 57. Gas flare from line 818 showed on Fan view and stack view. Magnitude 4, Confidence 80%.

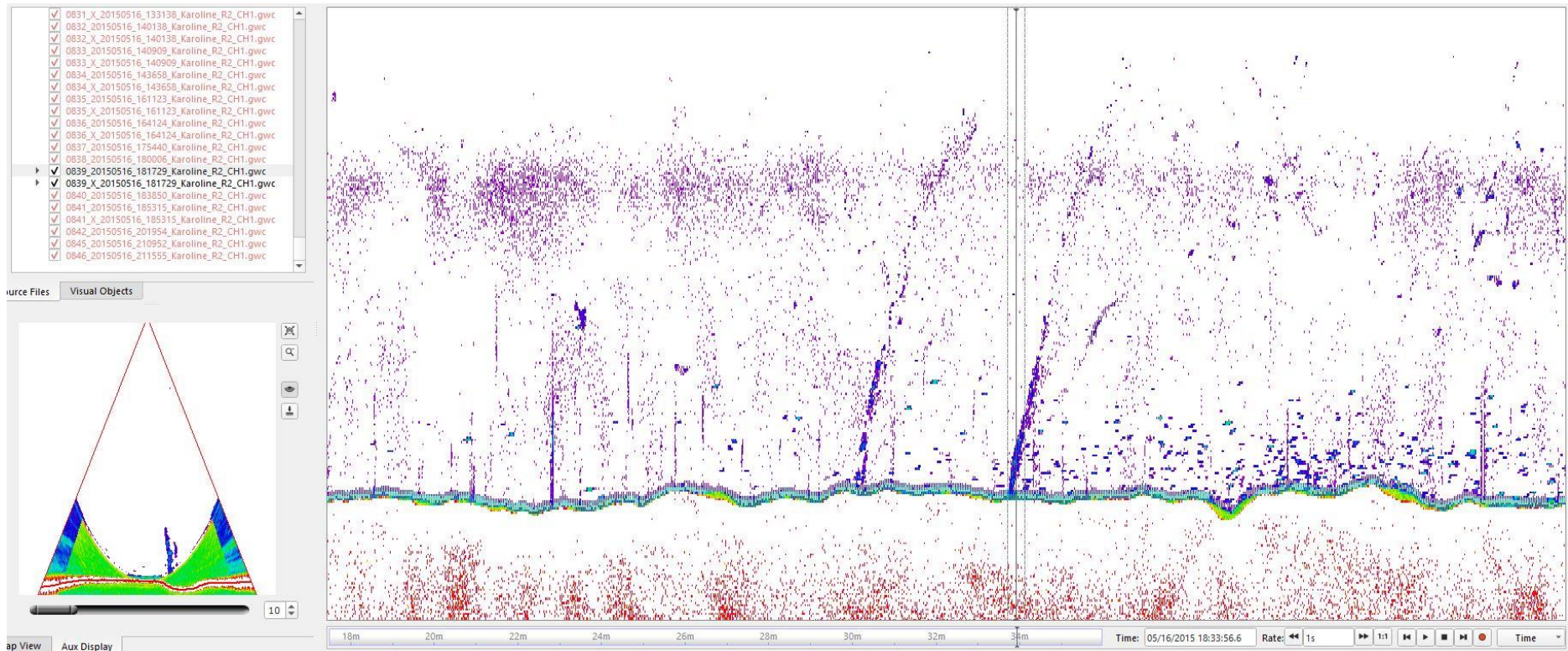


Figure 58. Gas flare b from line 839 showed on Fan view and stack view. Magnitude 4, Confidence 80%.

4.4.4 FGMG-2018-Tr-KKG-BH03

The FOSAE-2018-Tr-KKG-BH03 survey consists of 104 water column (.wcd) survey lines. The data was loaded in Fledermaus Midwater along with navigation (.all) and converted to GWC files. No flares were identified from this survey area. The bathymetry of the study area is shown in Figure 59.

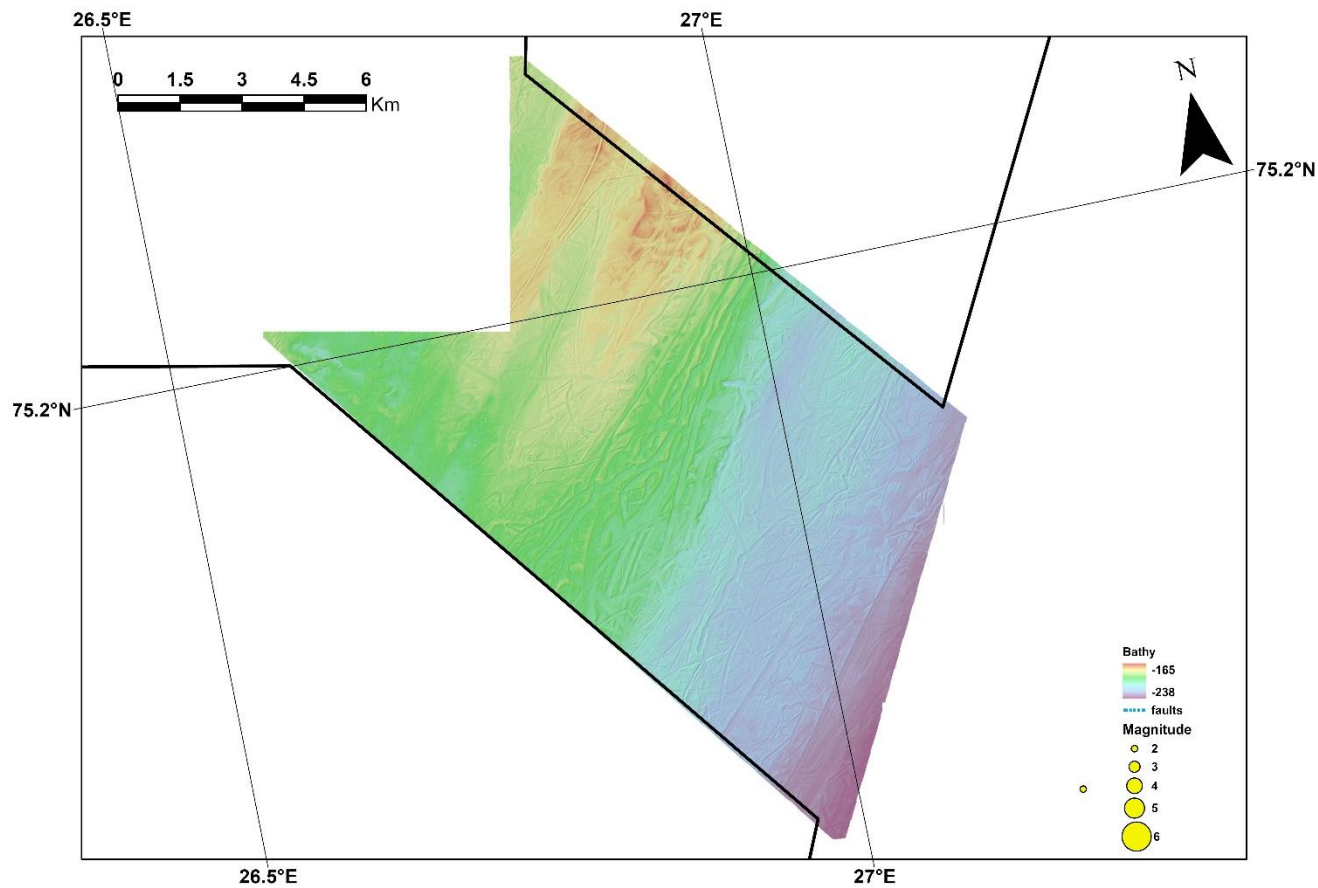


Figure 59. Bathymetry from the transit line FGMG-2018-Tr-KKG-BH03 survey areas.

4.4.5 FGMG-2018-KRT

The FGMG-2018-KRT survey consists of 338 water column (.wcd) survey lines. The data was loaded in Fledermaus Midwater along with navigation (.all) and converted to GWC files. All the lines were converted with this method giving 338 gwc files. The flares found are listed in Table 5. 103 gas flares of varying confidence and amplitude levels were identified from this survey. The flares are shown on bathymetry map from the study area (Fig. 60). The screen dumps of flares with magnitude 4 and above are shown on fan and stack views in Figs. 61- 69.

Table 5. Details of flares identified from Survey Area FGMG-2018-KRT.

LineId	Latitude	Longitude	Depth	Height	Time	Magnitude	Confidence
8184	74.9094622	27.4414241	-327.078	200	06/15/2019 19:18:54.1	3	70
8225a	74.9487874	28.1405522	-339.436	100	06/19/2019 0:32:31.2	3	70
8225b	74.9484944	28.1448689	-336.329	70	06/19/2019 0:32:38.7	3	70
8225c	74.9483504	28.1408271	-336.279	85	06/19/2019 0:32:45.4	2	70
8225d	74.942752	28.1427902	-337.637	85	06/19/2019 0:35:50.7	2	70
8225e	74.9424469	28.1460677	-339.366	120	06/19/2019 0:35:59.0	2	60
8225f	74.9419877	28.1406254	-338.75	110	06/19/2019 0:36:17.4	3	70
8225g	74.941769	28.141194	-337	200	06/19/2019 0:36:26.6	3	70
8225h	74.9415652	28.1390746	-338.424	200	06/19/2019 0:36:32.5	3	70
8225i	74.9414431	28.1377734	-338.893	90	06/19/2019 0:36:37.5	2	60
8225j	74.9408628	28.1403399	-337.431	110	06/19/2019 0:36:55.1	2	60
8225k	74.93957	28.1439274	-338.92	120	06/19/2019 0:37:36.1	3	60
8225l	74.939261	28.140809	-340	180	06/19/2019 0:37:46.9	3	60
8225m	74.9384767	28.1395163	-340.479	180	06/19/2019 0:38:14.7	3	60
8225n	74.938106	28.1406013	-338.344	160	06/19/2019 0:38:26.5	3	70
8225o	74.9366925	28.1381136	-341.927	150	06/19/2019 0:39:14.5	3	70
8225p	74.9363393	28.1352497	-340.922	180	06/19/2019 0:39:27.2	4	60
8225q	74.9361274	28.1358786	-344.538	175	06/19/2019 0:39:34.0	3	70
8225r	74.936019	28.1332321	-342.634	150	06/19/2019 0:39:39.1	3	70

8225s	74.9357074	28.1430691	-345.622	95	06/19/2019 0:39:45.0	2	70
8225t	74.9352434	28.1380597	-342.931	150	06/19/2019 0:40:02.8	3	70
8225u	74.9351075	28.1348578	-340.885	150	06/19/2019 0:40:08.7	3	70
8225v	74.9346944	28.1435463	-342.761	200	06/19/2019 0:40:18.9	3	70
8225w	74.934442	28.140120	-345	160	06/19/2019 0:40:29.9	3	70
8225x	74.9342719	28.136137	-341.412	160	06/19/2019 0:40:36.7	3	70
8225y	74.9322002	28.1344907	-345.958	165	06/19/2019 0:41:45.4	2	70
8225z	74.9268311	28.1452113	-339.927	120	06/19/2019 0:44:38.0	2	70
8225aa	74.9244449	28.1416454	-340.955	45	06/19/2019 0:45:58.4	2	60
8225ab	74.9234705	28.1402221	-342.434	165	06/19/2019 0:46:30.6	3	70
8225ac	74.9231528	28.139916	-342.831	100	06/19/2019 0:46:41.6	3	70
8332	74.9285318	28.1229097	-343.977	90	06/21/2019 1:34:26.3	2	40
8333a	74.9305576	28.2658893	-341.057	320	06/21/2019 1:56:04.0	4	80
8333b	74.9313463	28.2835181	-340.56	300	06/21/2019 1:58:46.8	4	80
8334a	74.9372233	28.247192	-343.391	120	06/21/2019 2:25:13.1	2	60
8334b	74.9376773	28.2451066	-343.363	235	06/21/2019 2:25:31.7	4	80
8334c	74.9364409	28.2403651	-342.115	120	06/21/2019 2:26:11.0	4	80
8334d	74.9385486	28.2369844	-339.928	150	06/21/2019 2:26:43.7	3	70
8334e	74.9375489	28.2350814	-342.273	140	06/21/2019 2:26:58.9	3	70
8334f	74.9366758	28.1381922	-342.283	100	06/21/2019 2:41:11.5	2	60
8334g	74.9361143	28.1355708	-342.415	130	06/21/2019 2:41:37.7	3	80
8334h	74.9359763	28.1335646	-339.479	120	06/21/2019 2:41:58.5	2	70
8338a	74.9453689	28.2233835	-336.745	80	06/21/2019 4:05:35.5	2	60
8338b	74.9443672	28.2247454	-338.178	100	06/21/2019 4:05:44.3	2	60
8338c	74.9447284	28.2288194	-339.995	110	06/21/2019 4:06:20.2	3	70
8338d	74.9447506	28.2357477	-338.136	120	06/21/2019 4:07:18.9	3	80
8338e	74.946165	28.2730919	-342.739	300	06/21/2019 4:12:44.6	5	80
8364a	75.0197917	28.0271931	-331.324	80	06/21/2019 15:47:21.0	2	60
8364b	75.0191969	28.0350589	-330.523	70	06/21/2019 15:48:27.8	3	60

8364c	75.0214406	28.1319536	-330.683	110	06/21/2019 16:02:27.2	2	70
8374a	75.0364459	28.2511305	-337.219	45	06/21/2019 21:08:25.0	2	60
8374b	75.0366245	28.2566673	-337.131	45	06/21/2019 21:09:12.5	2	60
8374c	75.0375343	28.2579343	-337.805	100	06/21/2019 21:09:24.6	3	70
8374d	75.0374624	28.2587934	-336.012	70	06/21/2019 21:09:31.7	2	70
8374e	75.0374029	28.2605201	-338.785	80	06/21/2019 21:09:47.0	2	70
8374f	75.0381603	28.2640629	-339.115	160	06/21/2019 21:10:18.7	3	80
8374g	75.0376437	28.3131421	-338.435	85	06/21/2019 21:17:19.5	2	70
8374h	75.0369259	28.3217515	-340.961	140	06/21/2019 21:18:31.8	4	80
8375a	75.0437783	28.3018909	-339.368	80	06/21/2019 21:36:30.6	3	70
8375b	75.045476	28.296022	-334.824	130	06/21/2019 21:37:21.5	3	70
8375c	75.0441493	28.2723622	-336.783	45	06/21/2019 21:40:40.6	2	60
8375d	75.0435259	28.2553999	-335.867	50	06/21/2019 21:43:05.4	2	60
8375e	75.044534	28.2431342	-332.688	105	06/21/2019 21:44:49.3	2	70
8375f	75.0449385	28.232063	-332.517	70	06/21/2019 21:46:23.3	3	70
8379a	75.0525412	28.2257822	-332.057	100	06/21/2019 23:24:54.4	3	60
8379b	75.050614	28.258115	-334.99	70	06/21/2019 23:29:32.1	2	60
8380a	75.0595238	28.3432896	-335.524	50	06/21/2019 23:51:04.1	2	60
8380b	75.0599579	28.3349889	-332.309	110	06/21/2019 23:52:14.0	3	70
8380c	75.0582836	28.290051	-332.599	60	06/21/2019 23:58:37.2	2	60
8380d	75.0588207	28.2060883	-333.997	120	06/22/2019 0:10:36.3	3	70
8380e	75.0582175	28.1792911	-333.907	75	06/22/2019 0:14:26.1	2	60
8381	75.0574496	28.1324058	-329.192	90	06/22/2019 0:21:11.1	2	60
8382	75.0643425	28.1674265	-333.884	100	06/22/2019 1:33:24.8	2	60
8383a	75.0652791	28.1967471	-331.007	60	06/22/2019 1:37:38.8	2	60
8383b	75.0637274	28.2038309	-333.101	55	06/22/2019 1:38:40.6	2	60
8383c	75.0635803	28.2053329	-332.072	80	06/22/2019 1:38:54.7	2	60
8383d	75.0632351	28.2073442	-332.725	110	06/22/2019 1:39:12.0	2	60
8383e	75.0651873	28.2476111	-334.153	110	06/22/2019 1:45:03.6	2	70

8383f	75.065064	28.252519	-336	110	06/22/2019 1:45:47.32	2	60
8383g	75.0637582	28.2554606	-331.624	220	06/22/2019 1:46:12.7	4	80
8383h	75.0660772	28.2568016	-334.103	125	06/22/2019 1:46:24.9	2	70
8383i	75.0660772	28.2675938	-334.148	150	06/22/2019 1:47:59.1	3	70
8383j	75.0659253	28.2701969	-336.235	80	06/22/2019 1:48:21.4	2	60
8383k	75.0653703	28.2797607	-336.495	100	06/22/2019 1:49:45.5	2	50
8383l	75.0649405	28.2842059	-333.01	100	06/22/2019 1:50:25.0	3	80
8383m	75.0659625	28.2858877	-336.877	135	06/22/2019 1:50:39.2	3	70
8383n	75.064843	28.3109749	-336.777	80	06/22/2019 1:54:19.5	2	60
8383o	75.065536	28.313760	-337	110	06/22/2019 1:54:44.9	2	60
8383p	75.0648711	28.3176885	-332.765	100	06/22/2019 1:55:17.4	2	40
8383q	75.0652849	28.3373408	-337.45	110	06/22/2019 1:58:08.7	2	70
8383r	75.0663693	28.344069	-334.726	85	06/22/2019 1:59:07.4	2	70
8384a	75.0726851	28.2820312	-334.811	75	06/22/2019 2:16:49.8	2	60
8384b	75.0725233	28.2801103	-335.109	85	06/22/2019 2:17:06.0	2	60
8384c	75.07292	28.276903	-334.741	90	06/22/2019 2:17:34.4	2	60
8384d	75.072824	28.2759301	-334.781	80	06/22/2019 2:17:42.5	2	60
8384e	75.072532	28.2749867	-336.225	85	06/22/2019 2:17:50.7	2	60
8384f	75.0724504	28.2472757	-333.378	140	06/22/2019 2:21:53.0	3	70
8384g	75.0729283	28.246129	-332.403	210	06/22/2019 2:22:03.1	3	70
8384g	75.071418	28.2434653	-332.213	130	06/22/2019 2:22:28.4	3	80
8384h	75.0723254	28.2335701	-330.76	80	06/22/2019 2:23:54.4	2	70
8384i	75.0721192	28.2284953	-331.097	105	06/22/2019 2:24:40.0	2	70
8384j	75.0706275	28.2252783	-333.268	100	06/22/2019 2:25:10.3	2	70
8384k	75.071557	28.214677	-330	110	06/22/2019 2:26:42.6	2	70
8384l	75.0717806	28.2144804	-333.606	85	06/22/2019 2:26:43.6	2	70

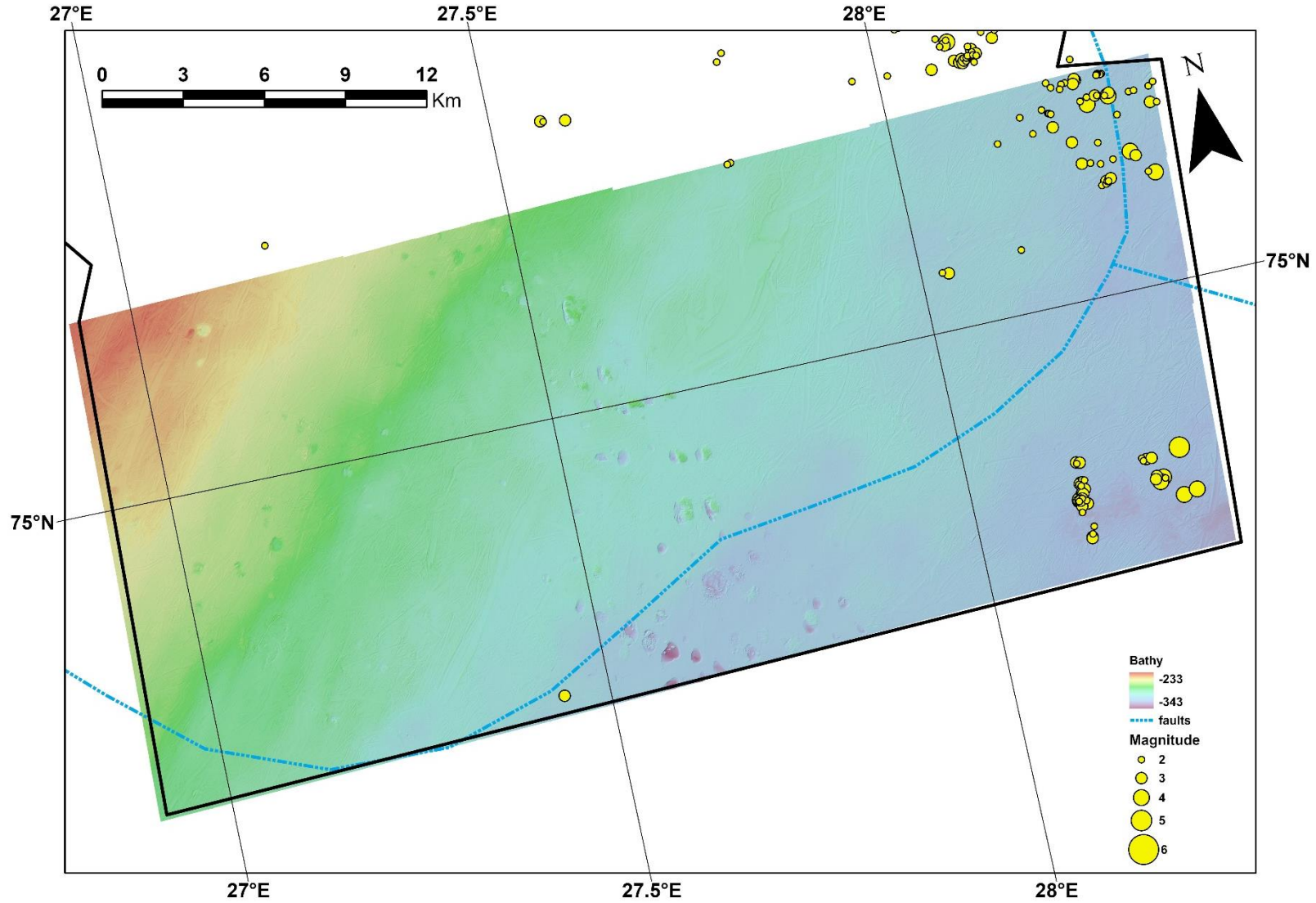


Figure 60. Bathymetry and backscatter from the FGMG-2018-KRT (Kratere) survey area showing the location of the flares.

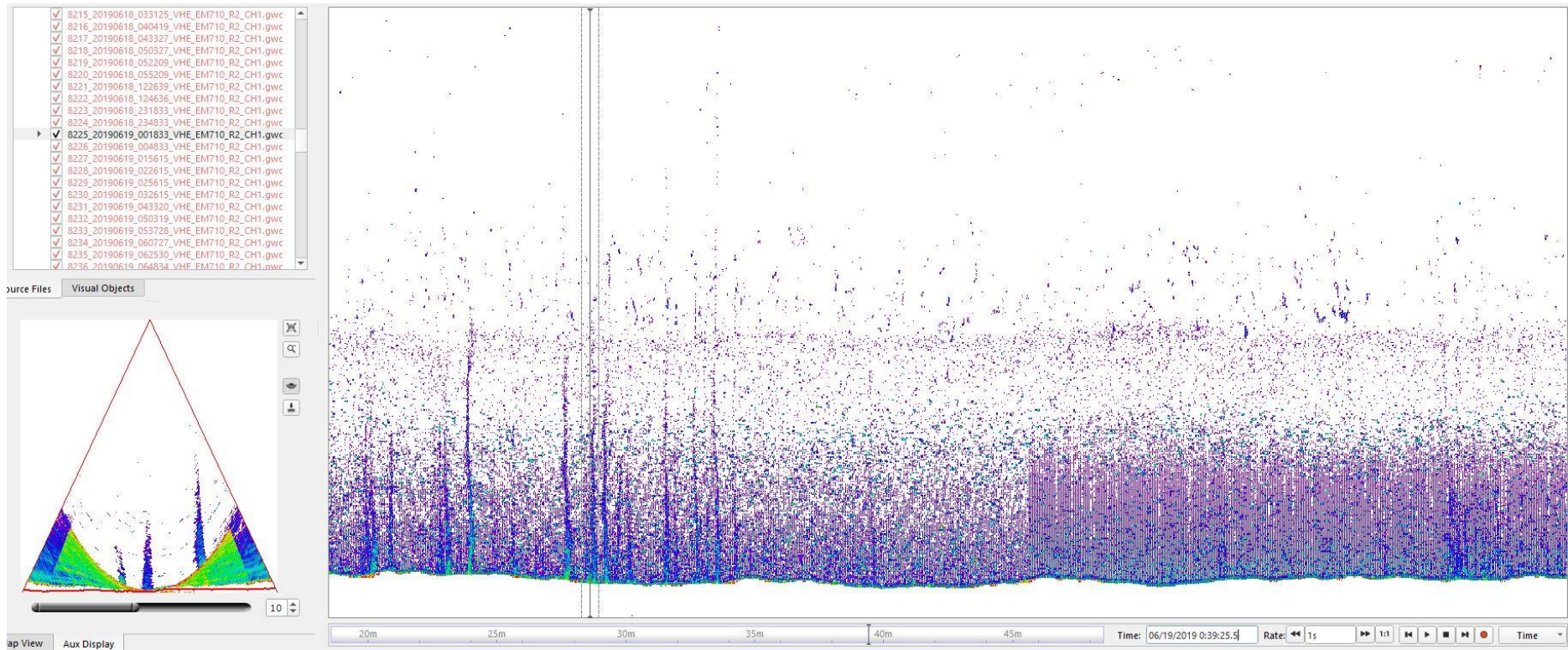


Figure 61. Gas flare p from line 8225 showed on Fan view and stack view. Magnitude 4, Confidence 60%.

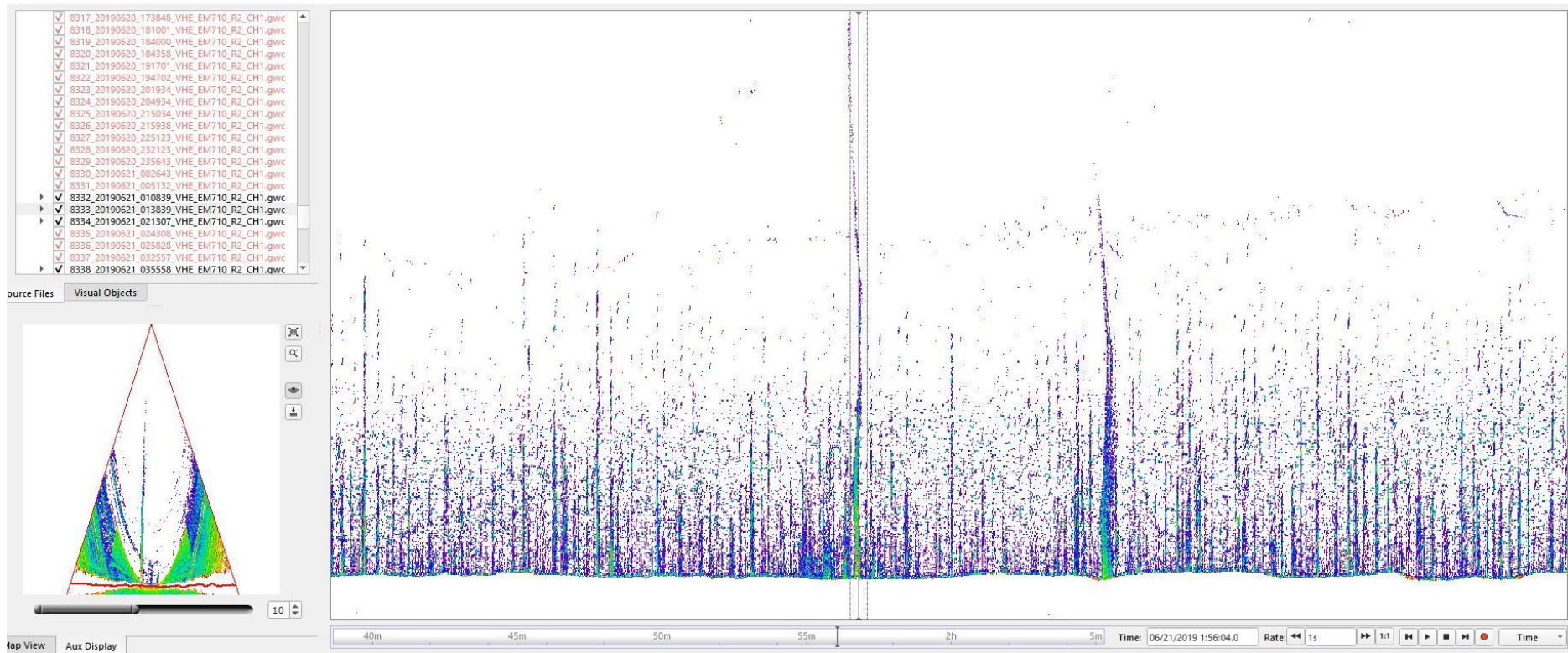


Figure 62. Gas flare a from line 8333 showed on Fan view and stack view. Magnitude 4, Confidence 80%.

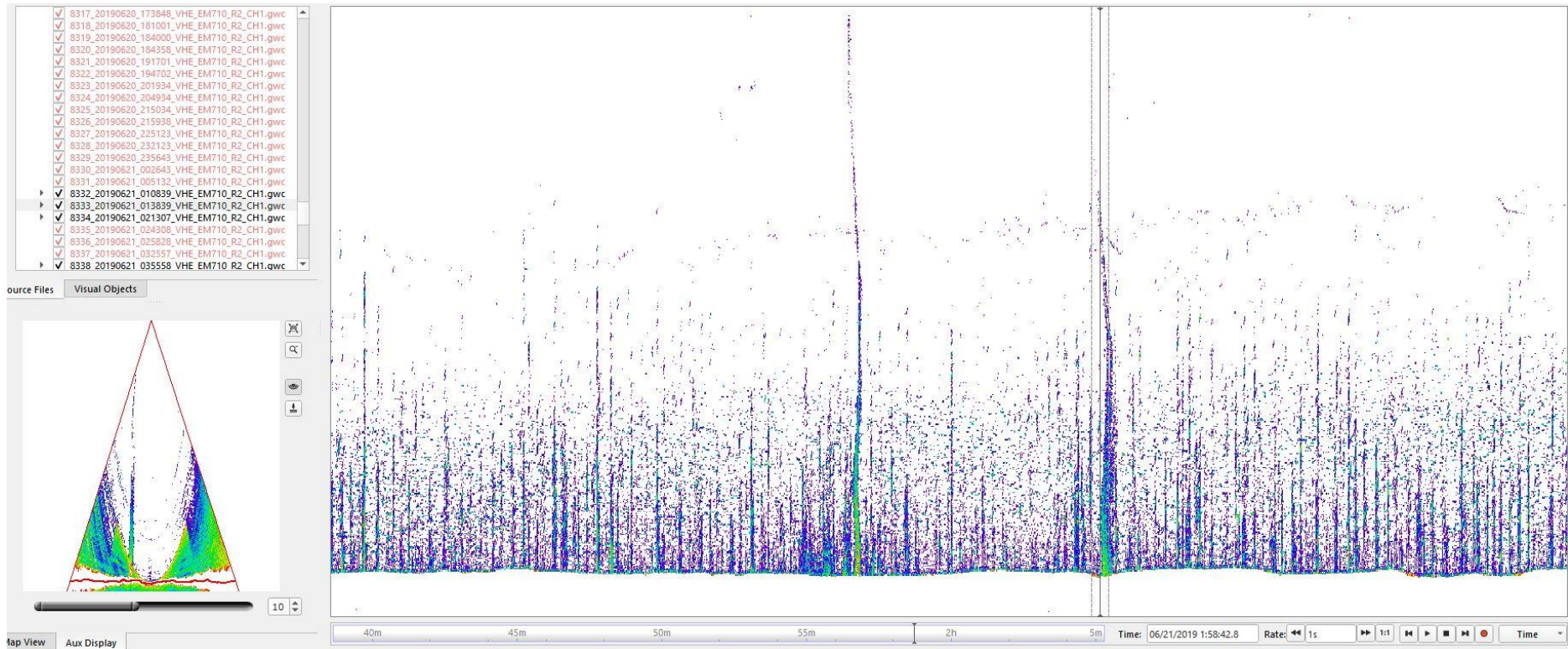


Figure 63. Gas flare b from line 8333 showed on Fan view and stack view. Magnitude 4, Confidence 80%.

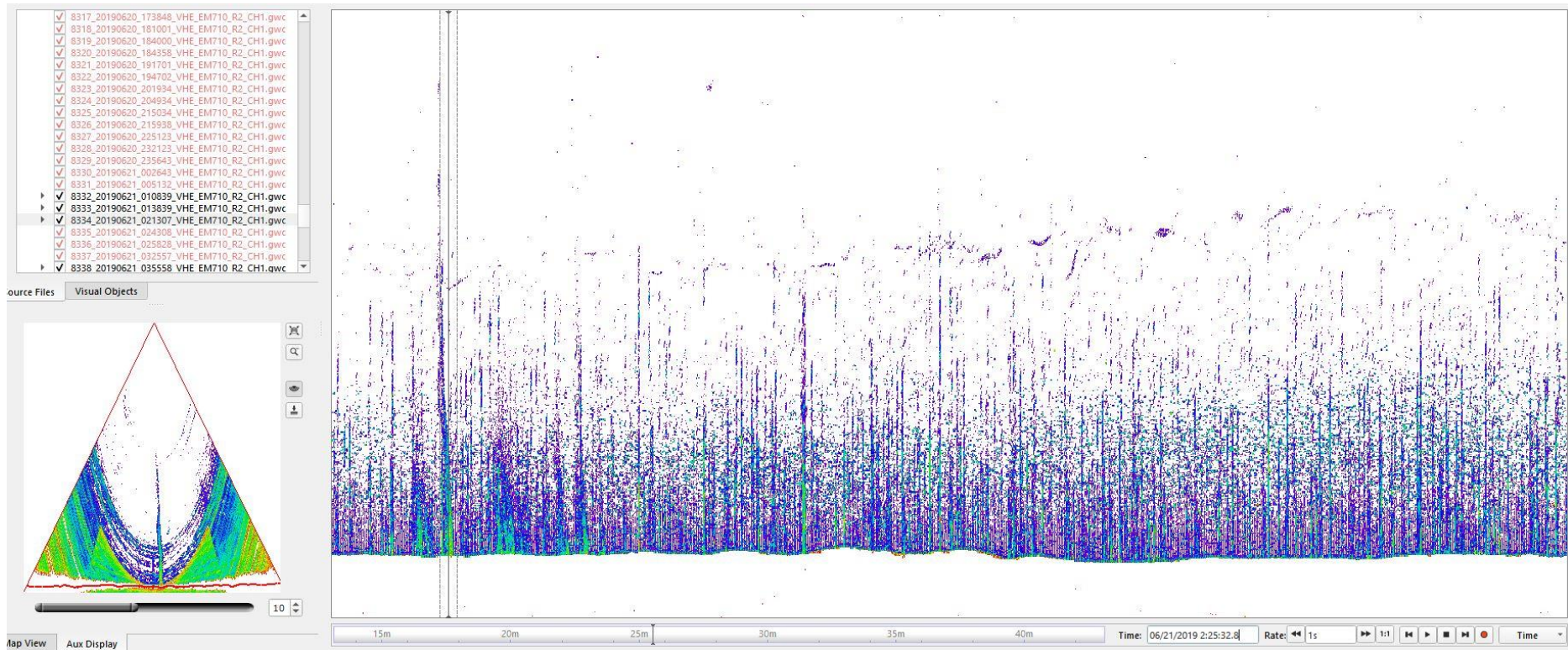


Figure 64. Gas flare b from line 8334 showed on Fan view and stack view. Magnitude 4, Confidence 80%.

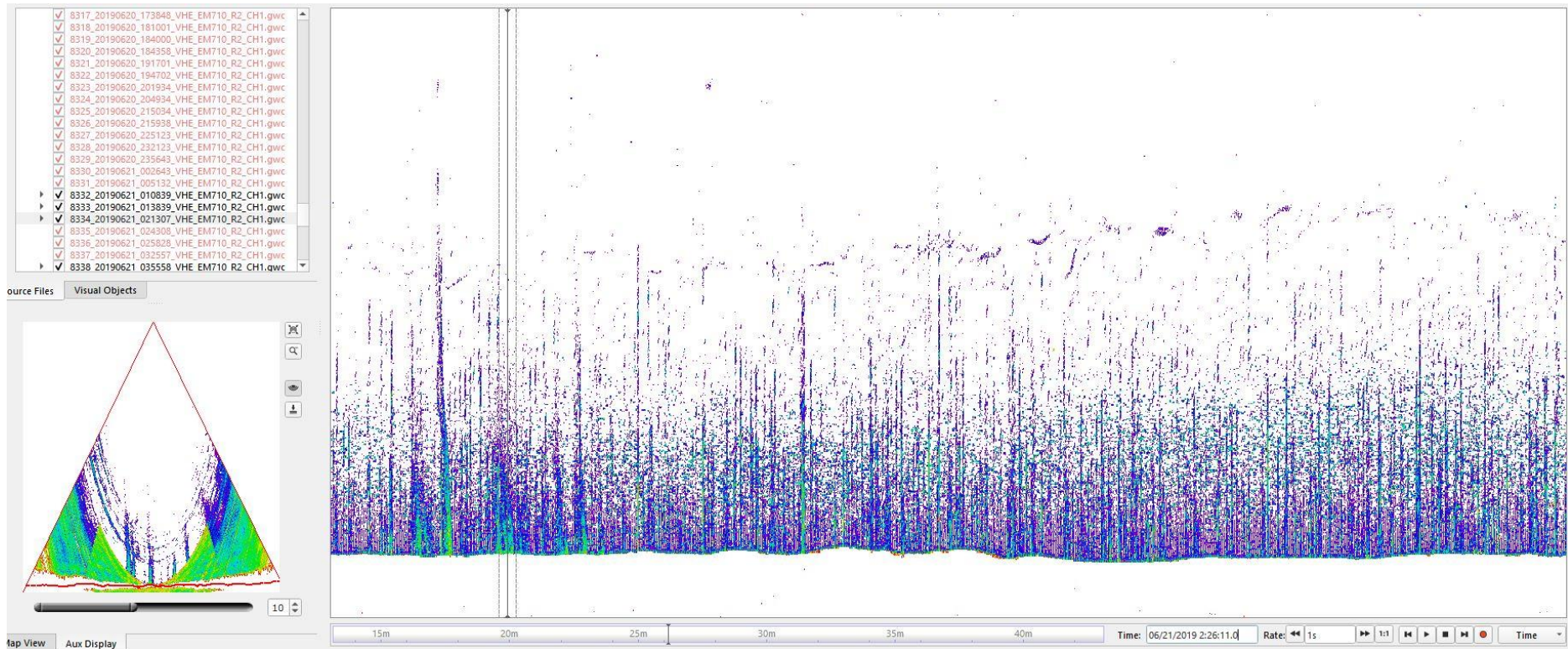


Figure 65. Gas flare c from line 8334 showed on Fan view and stack view. Magnitude 4, Confidence 80%.

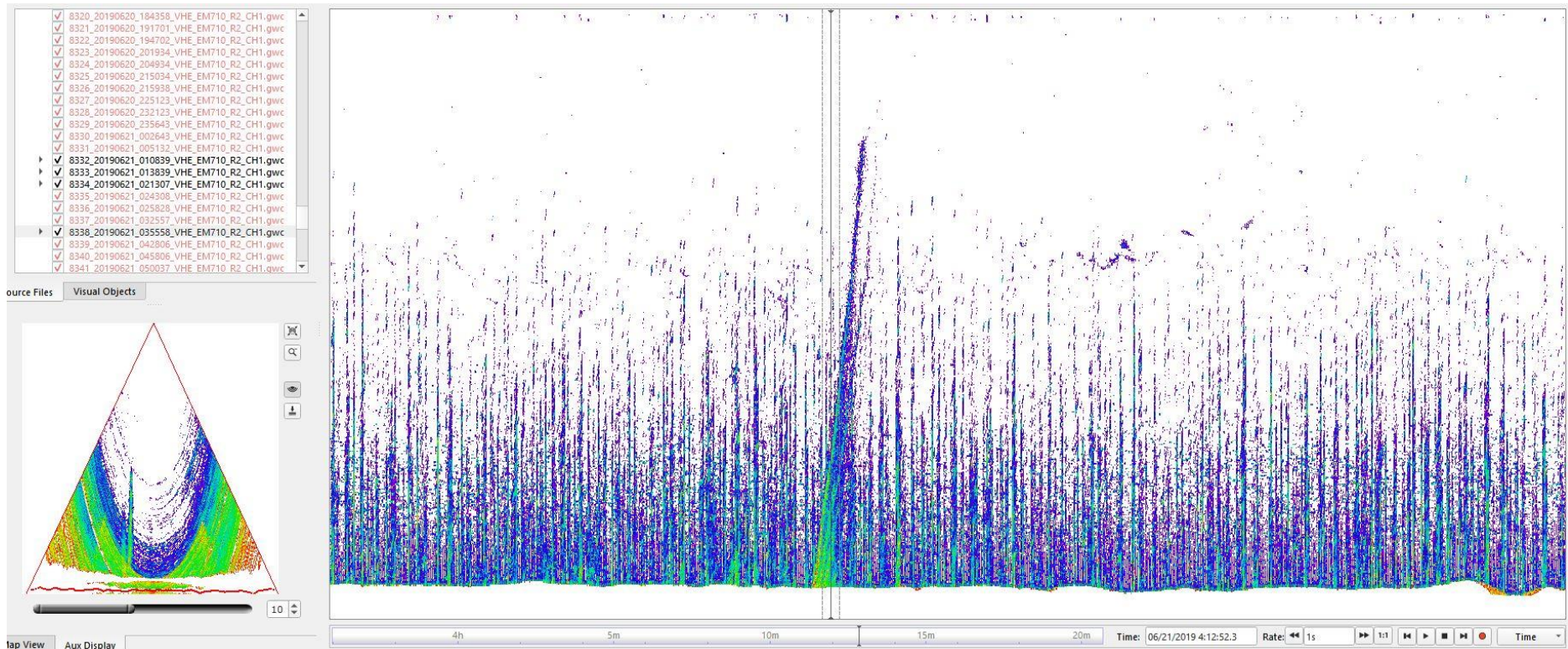


Figure 66. Gas flare e from line 8338 showed on Fan view and stack view. Magnitude 5, Confidence 80%.

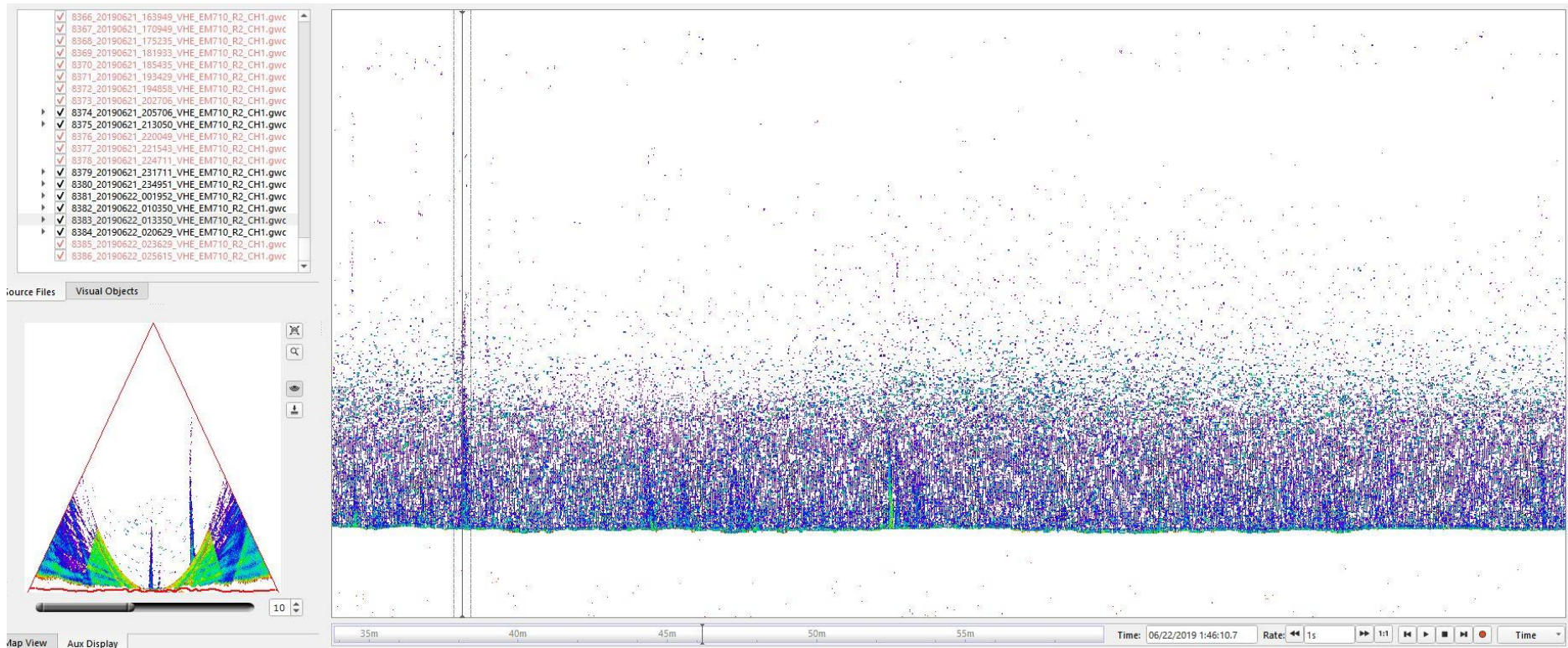


Figure 67. Gas flare g from line 8383 showed on Fan view and stack view. Magnitude 4, Confidence 80%.

4.4.6 FGMG-2018-Kirkegaarden

The FGMG-2018-Kirkegaarden survey consists of 563 water column (.wcd) survey lines. The data was loaded in Fledermaus Midwater along with navigation (.all) and converted to GWC files. 361 flares of varying magnitude and confidence were picked for location from this survey area (Table 6). Most of the flares are visible on stack sections shown for picked flares. The picked flares are shown on bathymetry map (Fig. 68) and those with magnitude 4 and above are shown individually on fan and stack views in Figs. 69-71.

Table 6. Details of flares identified from Survey Area FGMG-2018-Kirkegaarden.

LineId	Latitude	Longitude	Depth	Height	Time	Magnitude	Confidence
8387a	75.0872872	28.1192601	-329.267	80	06/22/2019 3:50:05.1	2	60
8387b	75.0874878	28.1187963	-328.339	80	06/22/2019 3:50:11.6	2	60
8387c	75.0881207	28.1201525	-328.199	45	06/22/2019 3:50:33.4	2	60
8387d	75.0891098	28.1258017	-328.771	100	06/22/2019 3:51:06.6	2	70
8387e	75.0901214	28.1256909	-328.803	100	06/22/2019 3:51:40.6	3	70
8387f	75.0911886	28.1222252	-330.618	70	06/22/2019 3:52:13.0	2	60
8387g	75.0976818	28.1217315	-331.182	70	06/22/2019 3:55:49.1	2	60
8387h	75.1167289	28.1314222	-331.058	85	06/22/2019 4:06:22.6	2	70
8388a	75.1294292	28.1353201	-327.808	100	06/22/2019 4:13:21.8	2	60
8388b	75.1306523	28.1307919	-327.043	80	06/22/2019 4:14:01.6	2	60
8388c	75.1315995	28.1244918	-326.973	135	06/22/2019 4:14:29.8	2	70
8388d	75.1434497	28.1260585	-323.106	150	06/22/2019 4:21:01.2	2	60
8388e	75.1465565	28.1325331	-323.276	150	06/22/2019 4:22:46.6	2	60
8388f	75.1490337	28.1375982	-325.322	100	06/22/2019 4:24:09.5	2	70
8388g	75.1521242	28.1328676	-323.811	65	06/22/2019 4:25:50.8	2	70
8388h	75.1596509	28.1354489	-326.228	85	06/22/2019 4:29:59.1	2	70
8388i	75.1633935	28.1420122	-326.458	110	06/22/2019 4:32:04.3	2	60
8388j	75.1649005	28.1366572	-324.867	75	06/22/2019 4:32:52.2	3	70
8388k	75.1706144	28.1364204	-323.881	90	06/22/2019 4:36:09.5	2	60
8389	75.173066	28.139048	-319.73	90	06/22/2019 4:37:57.2	2	60
8390a	75.1880585	28.1415186	-315.501	110	06/22/2019 4:55:17.6	2	60

8390b	75.1889961	28.1399738	-317.898	90	06/22/2019 4:55:49.5	2	60
8390c	75.1894231	28.1384109	-317.007	80	06/22/2019 4:56:02.7	2	60
8390c	75.18926	28.1452486	-316.622	100	06/22/2019 4:56:00.4	2	70
8390d	75.1908438	28.1452596	-317.553	100	06/22/2019 4:56:52.6	3	70
8390e	75.1914238	28.1456912	-318.108	95	06/22/2019 4:57:11.4	2	60
8395a	75.0705429	27.7923469	-317.952	90	06/22/2019 8:18:55.8	2	70
8395b	75.0702613	27.7879652	-318.399	80	06/22/2019 8:19:32.6	2	60
8409a	75.0960105	27.5963111	-300.584	110	06/22/2019 14:30:21.8	3	60
8409b	75.0970611	27.5682902	-298.081	50	06/22/2019 14:34:33.1	2	60
8409c	75.0973865	27.5647239	-300.128	195	06/22/2019 14:35:05.9	3	70
8413a	75.1041919	27.8030478	-305.98	70	06/22/2019 16:16:21.5	2	60
8413b	75.1067569	27.8107849	-308.218	90	06/22/2019 16:17:34.3	2	60
8422	75.124704	27.709722	-303.95	40	06/22/2019 19:43:32.6	2	60
8436	75.151148	27.634437	-286.18	65	06/23/2019 1:23:27.7	2	70
8437	75.1599765	27.7087419	-292.27	200	06/23/2019 2:19:52.3	3	70
8439	75.159523	27.982867	-315.7	90	06/23/2019 3:10:12.0	2	70
8455	75.1974585	27.7289282	-283.033	210	06/23/2019 9:58:08.5	5	40
8482	75.201436	28.088638	-318.79	120	06/23/2019 20:53:25.5	2	40
8484a	75.1928486	28.0796079	-316.023	135	06/23/2019 21:22:23.2	2	70
8484b	75.1924343	28.0824174	-315.637	175	06/23/2019 21:22:48.9	3	70
8484c	75.1921675	28.0837835	-316.547	185	06/23/2019 21:23:00.2	3	70
8484d	75.1923172	28.0844094	-314.76	165	06/23/2019 21:23:05.4	3	70
8484e	75.1921464	28.0881839	-317.425	135	06/23/2019 21:23:38.2	2	70
8484f	75.1928132	28.0904833	-318.334	110	06/23/2019 21:23:57.7	2	70
8484g	75.1935702	28.0935916	-317.111	135	06/23/2019 21:24:24.5	2	70
8484h	75.1917884	28.1096765	-316.153	95	06/23/2019 21:26:42.0	2	60
8484i	75.1934635	28.1107828	-315.529	200	06/23/2019 21:26:50.3	3	70
8484j	75.1941694	28.1118886	-318.381	135	06/23/2019 21:27:01.8	3	60
8484k	75.1921552	28.1144644	-318.514	85	06/23/2019 21:27:22.6	2	70

8484l	75.1909504	28.1444253	-318.544	130	06/23/2019 21:31:40.3	2	70
8487a	75.1827378	28.2563286	-326.005	110	06/23/2019 22:56:17.9	2	60
8487b	75.1847073	28.2496248	-327.235	80	06/23/2019 22:57:21.6	2	60
8487c	75.1837094	28.2434116	-326.405	50	06/23/2019 22:58:15.6	2	60
8487d	75.1845977	28.2433506	-327.465	45	06/23/2019 22:58:16.6	2	60
8487e	75.183994	28.237818	-326.575	80	06/23/2019 22:59:05.3	2	70
8487f	75.1853041	28.2328733	-323.775	85	06/23/2019 22:59:49.7	2	70
8488a	75.1835534	28.2115507	-323.779	75	06/23/2019 23:02:56.3	2	60
8488b	75.1849452	28.2082113	-322.813	65	06/23/2019 23:03:26.7	2	70
8488c	75.1835768	28.1519323	-316.341	90	06/23/2019 23:11:40.7	3	70
8491	75.177248	28.264807	-330.91	60	06/24/2019 0:37:06.6	2	60
8492a	75.175942	28.3027629	-329.425	70	06/24/2019 0:42:45.2	2	60
8492b	75.1756971	28.3086813	-333.475	90	06/24/2019 0:43:39.3	3	70
8492c	75.1754455	28.3119164	-329.975	75	06/24/2019 0:44:07.4	2	60
8492d	75.1757561	28.3188115	-331.255	60	06/24/2019 0:45:08.9	2	70
8493a	75.169318	28.3150089	-331.589	40	06/24/2019 1:22:19.5	2	60
8493b	75.1689116	28.3129182	-334.223	75	06/24/2019 1:22:36.8	3	70
8493c	75.1678469	28.3048928	-331.419	90	06/24/2019 1:23:42.7	2	60
8493d	75.1681337	28.3024461	-330.524	110	06/24/2019 1:24:04.3	3	70
8493e	75.1683711	28.2974063	-331.699	80	06/24/2019 1:24:46.5	2	60
8493f	75.1695344	28.2880512	-333.67	70	06/24/2019 1:26:06.2	3	70
8493g	75.170453	28.2784374	-331.227	95	06/24/2019 1:27:27.0	2	60
8493h	75.1685295	28.2362412	-328.815	55	06/24/2019 1:33:19.8	2	50
8493i	75.1687794	28.2351627	-328.755	75	06/24/2019 1:33:29.5	2	60
8493j	75.168815	28.2330677	-328.832	60	06/24/2019 1:33:47.7	2	60
8493k	75.1701178	28.227843	-329.325	95	06/24/2019 1:34:31.6	2	60
8494a	75.1701225	28.133639	-321.548	55	06/24/2019 1:48:09.8	2	60
8494b	75.1683246	28.1095097	-320.297	70	06/24/2019 1:51:43.8	2	60
8497a	75.1616014	28.1169731	-321.916	70	06/24/2019 2:57:20.0	2	70

8497b	75.1627083	28.1228472	-324.145	85	06/24/2019 2:58:10.3	2	70
8497c	75.1610278	28.1415236	-325.269	65	06/24/2019 3:00:52.2	2	70
8497d	75.1628472	28.1425335	-325.963	75	06/24/2019 3:00:59.6	2	60
8497e	75.1621747	28.1503205	-327.197	90	06/24/2019 3:02:07.1	2	70
8498a	75.1622978	28.1772844	-326.232	60	06/24/2019 3:05:58.4	2	70
8498b	75.1617184	28.1794181	-327.799	60	06/24/2019 3:06:17.5	2	60
8498b	75.1612976	28.1800497	-326.668	60	06/24/2019 3:06:22.8	2	60
8498c	75.1616314	28.1812321	-326.202	100	06/24/2019 3:06:33.4	3	70
8498c	75.1604572	28.1816097	-327.034	100	06/24/2019 3:06:37.6	3	70
8498d	75.1624295	28.1831321	-326.628	85	06/24/2019 3:06:49.2	3	70
8498d	75.1612989	28.1829703	-327.164	100	06/24/2019 3:06:49.2	3	70
8498e	75.1623321	28.1856245	-325.756	85	06/24/2019 3:07:11.5	2	60
8498f	75.1626916	28.1858547	-326.232	80	06/24/2019 3:07:13.6	2	60
8498f	75.1614526	28.1858897	-327.839	90	06/24/2019 3:07:13.6	2	60
8498f	75.1630179	28.1869143	-327.449	85	06/24/2019 3:07:22.1	2	60
8498f	75.1624882	28.1868891	-326.914	90	06/24/2019 3:07:22.1	2	60
8498g	75.1615725	28.1874357	-327.989	65	06/24/2019 3:07:27.4	2	60
8498g	75.1609432	28.1911652	-326.663	80	06/24/2019 3:07:59.1	3	70
8498g	75.1623259	28.1911676	-325.591	85	06/24/2019 3:07:59.1	2	60
8498h	75.1625236	28.1951175	-324.504	110	06/24/2019 3:08:33.0	2	70
8498h	75.1605929	28.1951521	-328.695	100	06/24/2019 3:08:34.1	2	70
8498h	75.161796	28.1952035	-328.159	50	06/24/2019 3:08:34.1	2	60
8498i	75.161617	28.1982261	-325.031	65	06/24/2019 3:09:00.7	2	60
8498i	75.1634745	28.1985618	-324.565	180	06/24/2019 3:09:01.8	2	60
8498j	75.1611144	28.2015702	-329.101	100	06/24/2019 3:09:29.4	2	60
8498k	75.1616882	28.2115287	-329.037	35	06/24/2019 3:10:55.6	2	60
8498l	75.161643	28.2143655	-328.523	100	06/24/2019 3:11:20.1	2	70
8498m	75.1606789	28.2212353	-328.681	95	06/24/2019 3:12:21.0	3	70
8498n	75.1626506	28.2233196	-331.164	100	06/24/2019 3:12:37.0	2	60

8498o	75.162228	28.2251443	-329.477	80	06/24/2019 3:12:53.0	2	60
8498p	75.1612634	28.2265608	-328.209	65	06/24/2019 3:13:05.8	2	70
8498q	75.161871	28.235449	-332	60	06/24/2019 3:14:23	2	70
8498r	75.161872	28.236688	-331	80	06/24/2019 3:14:33.8	2	70
8498s	75.1612854	28.2429863	-330.142	110	06/24/2019 3:15:28.6	2	70
8498t	75.161519	28.2441482	-330.428	95	06/24/2019 3:15:38.3	3	70
8498t	75.1621026	28.244399	-330.668	150	06/24/2019 3:15:40.4	3	70
8498u	75.1622482	28.2453061	-332.006	115	06/24/2019 3:15:48.0	3	70
8498v	75.1624703	28.24649	-331.76	110	06/24/2019 3:15:57.7	3	70
8498v	75.1630803	28.246589	-329.617	120	06/24/2019 3:15:57.7	3	70
8498v	75.1612861	28.2462979	-330.688	55	06/24/2019 3:15:57.7	2	60
8498w	75.1629849	28.2476483	-332.621	100	06/24/2019 3:16:07.3	3	70
8498w	75.1624734	28.2475851	-330.478	70	06/24/2019 3:16:07.3	2	60
8498x	75.1610792	28.2498731	-331.124	140	06/24/2019 3:16:27.8	3	70
8498x	75.1630632	28.2500359	-330.558	80	06/24/2019 3:16:28.9	2	60
8498y	75.1615027	28.2510899	-332.076	120	06/24/2019 3:16:38.6	3	70
8498z	75.1613362	28.2523995	-330.688	100	06/24/2019 3:16:50.4	2	60
8498aa	75.1612762	28.2541752	-331.92	140	06/24/2019 3:17:05.4	3	70
8498ab	75.162015	28.2556864	-329.902	75	06/24/2019 3:17:18.4	2	60
8498ac	75.1600124	28.260851	-329.547	120	06/24/2019 3:18:05.6	2	60
8498ad	75.1627852	28.2844112	-330.468	55	06/24/2019 3:21:28.6	2	50
8498ae	75.1621029	28.2974677	-331.65	60	06/24/2019 3:23:23.9	2	60
8498ae	75.1625698	28.2974827	-332.721	60	06/24/2019 3:23:23.9	2	60
8498ae	75.1606685	28.29786	-329.077	80	06/24/2019 3:23:28.3	2	60
8498af	75.1627631	28.3007174	-330.718	70	06/24/2019 3:23:51.0	2	60
8498ag	75.1628053	28.3042622	-330.738	105	06/24/2019 3:24:22.3	3	70
8498ag	75.1622041	28.3041779	-330.202	80	06/24/2019 3:24:22.3	2	70
8498ah	75.1621491	28.3060347	-330.538	70	06/24/2019 3:24:38.5	2	60
8498ai	75.1605693	28.3121054	-331.054	150	06/24/2019 3:25:34.6	3	70

8498ai	75.1616367	28.3130071	-331.86	135	06/24/2019 3:25:41.1	3	70
8498aj	75.1604224	28.3132335	-329.952	145	06/24/2019 3:25:45.5	3	70
8498ak	75.1607497	28.3146596	-331.154	90	06/24/2019 3:25:56.3	2	60
8499	75.162194	28.374916	-337.86	80	06/24/2019 3:34:40.0	2	60
8500a	75.153433	28.3263563	-333.702	65	06/24/2019 3:53:01.5	2	70
8500b	75.1547326	28.3237841	-332.848	75	06/24/2019 3:53:24.2	2	60
8500c	75.1547713	28.3216269	-334.018	100	06/24/2019 3:53:42.7	3	60
8500d	75.1534498	28.3158979	-332.889	105	06/24/2019 3:54:31.5	3	70
8500e	75.1553877	28.3138068	-332.749	110	06/24/2019 3:54:49.8	3	70
8500f	75.1548274	28.3118297	-331.176	90	06/24/2019 3:55:08.2	2	70
8500g	75.1545918	28.3095062	-330.751	170	06/24/2019 3:55:27.8	3	70
8500h	75.1548413	28.3082269	-329.158	100	06/24/2019 3:55:39.7	2	70
8500i	75.1545565	28.3033248	-333.868	90	06/24/2019 3:56:26.2	2	70
8500j	75.1547682	28.2977512	-330.861	80	06/24/2019 3:57:28.0	2	70
8500k	75.1544239	28.29644	-332.959	100	06/24/2019 3:57:45.2	3	70
8500k	75.1551062	28.2964871	-330.821	90	06/24/2019 3:57:45.2	3	70
8500l	75.1543462	28.2954687	-330.611	150	06/24/2019 3:57:58.2	3	70
8500l	75.1552239	28.2960332	-329.048	125	06/24/2019 3:57:51.7	3	70
8500m	75.1543937	28.2948322	-331.376	135	06/24/2019 3:58:06.9	3	70
8500n	75.1534888	28.2923139	-331.881	80	06/24/2019 3:58:42.5	2	70
8500o	75.1538211	28.2892249	-331.076	50	06/24/2019 3:59:33.2	2	60
8500p	75.1533083	28.2872539	-332.999	100	06/24/2019 4:00:08.8	2	70
8500q	75.1546205	28.2859796	-330.317	50	06/24/2019 4:00:39.0	2	70
8500r	75.1537313	28.2845046	-333.858	85	06/24/2019 4:01:04.9	3	70
8500s	75.1544875	28.2833373	-332.605	80	06/24/2019 4:01:36.1	3	70
8500t	75.1549541	28.2832925	-332.145	60	06/24/2019 4:01:40.5	2	70
8500t	75.1550442	28.2830792	-332.04	70	06/24/2019 4:01:45.8	3	70
8500t	75.1545947	28.283084	-331.79	70	06/24/2019 4:01:42.6	2	60
8500u	75.1546888	28.2820396	-332.275	75	06/24/2019 4:02:08.5	2	70

8500v	75.1547485	28.280522	-331.166	60	06/24/2019 4:02:45.1	2	60
8500w	75.154023	28.2767891	-332.255	45	06/24/2019 4:04:14.4	2	60
8500x	75.1552285	28.2757084	-330.107	75	06/24/2019 4:04:44.5	2	70
8500y	75.1533642	28.2713107	-331.362	45	06/24/2019 4:06:38.7	2	60
8500z	75.1534521	28.2702965	-331.73	40	06/24/2019 4:07:05.6	2	50
8500aa	75.1538056	28.2695483	-333.323	45	06/24/2019 4:07:29.3	2	70
8500ab	75.1548013	28.2631075	-332.435	70	06/24/2019 4:09:44.1	2	70
8500ac	75.1539976	28.2613682	-331.246	70	06/24/2019 4:10:07.8	2	70
8500ad	75.1539264	28.2602759	-330.951	110	06/24/2019 4:10:21.8	3	70
8500ae	75.1531941	28.2585224	-331.216	45	06/24/2019 4:10:42.2	2	40
8501a	75.1552724	28.2551327	-329.887	100	06/24/2019 4:11:21.1	2	70
8501a	75.153739	28.2547833	-331.453	50	06/24/2019 4:11:22.1	2	50
8501b	75.1532654	28.2540136	-330.007	90	06/24/2019 4:11:29.7	3	70
8501c	75.1538232	28.2533171	-330.778	50	06/24/2019 4:11:37.2	2	40
8501d	75.1544119	28.2508795	-330.483	55	06/24/2019 4:12:00.9	2	60
8501e	75.153336	28.2473304	-330.097	105	06/24/2019 4:12:32.1	2	60
8501f	75.1546067	28.245191	-328.947	115	06/24/2019 4:12:52.6	3	70
8501g	75.1536891	28.2440795	-329.522	120	06/24/2019 4:13:02.2	3	70
8501h	75.154409	28.2382575	-329.502	120	06/24/2019 4:13:52.7	3	70
8501i	75.1549323	28.2355058	-331.128	75	06/24/2019 4:14:16.2	2	70
8501j	75.1549547	28.2322476	-330.443	80	06/24/2019 4:14:44.0	2	70
8501k	75.1544002	28.2201128	-331.553	70	06/24/2019 4:16:24.5	2	60
8501l	75.1537278	28.2149618	-329.804	90	06/24/2019 4:17:08.3	3	70
8501m	75.154162	28.2131435	-328.877	85	06/24/2019 4:17:25.4	2	70
8501n	75.1540347	28.2088166	-329.282	95	06/24/2019 4:18:03.8	3	70
8501o	75.1553165	28.2044729	-326.502	100	06/24/2019 4:18:44.2	2	60
8501p	75.1533341	28.0982992	-320.521	90	06/24/2019 4:34:27.6	2	70
8501q	75.1527575	28.0647506	-313.024	180	06/24/2019 4:39:22.0	2	70
8501r	75.1542691	28.0587191	-313.629	140	06/24/2019 4:40:15.4	3	70

8501r	75.1536513	28.0584722	-316.62	75	06/24/2019 4:40:16.4	2	60
8502a	75.1547063	28.0531662	-318.16	85	06/24/2019 4:41:04.7	2	70
8502b	75.1538147	28.0519443	-316.262	90	06/24/2019 4:41:15.0	2	70
8502c	75.1547666	28.0333342	-317.767	90	06/24/2019 4:43:57.7	2	60
8502d	75.1550164	28.0141908	-316.49	90	06/24/2019 4:46:44.9	3	70
8503a	75.1480654	28.0537731	-314.971	75	06/24/2019 5:29:25.9	2	70
8503b	75.14822	28.0794105	-317.877	150	06/24/2019 5:33:07.1	2	70
8503c	75.1473214	28.0855111	-317.389	85	06/24/2019 5:33:59.7	2	70
8503d	75.1465793	28.1054728	-319.042	120	06/24/2019 5:36:54.7	3	70
8503e	75.1461262	28.1106307	-319.262	100	06/24/2019 5:37:39.4	2	70
8504a	75.1473071	28.149019	-325.544	90	06/24/2019 5:43:08.1	2	70
8504b	75.1466609	28.1627593	-326.59	90	06/24/2019 5:45:08.1	3	70
8504c	75.1467045	28.1661163	-329.922	55	06/24/2019 5:45:36.7	2	70
8504d	75.146357	28.169239	-327.84	100	06/24/2019 5:46:03.4	2	70
8505a	75.1463413	28.3232051	-335.597	50	06/24/2019 6:08:21.5	2	60
8505b	75.1462846	28.3234528	-337.345	80	06/24/2019 6:08:23.6	3	70
8505c	75.1468903	28.3253218	-335.951	110	06/24/2019 6:08:39.8	3	70
8505d	75.1467911	28.3277035	-337.658	75	06/24/2019 6:09:00.4	2	70
8511a	75.1310921	28.2447232	-335.957	120	06/24/2019 8:44:26.4	3	70
8511b	75.1326429	28.2486996	-336.175	145	06/24/2019 8:45:05.2	3	70
8512a	75.1248238	28.3108743	-337.166	80	06/24/2019 9:07:28.1	2	70
8512b	75.1243552	28.2283862	-337.115	35	06/24/2019 9:19:07.4	2	60
8512c	75.1237561	28.1666821	-333.828	95	06/24/2019 9:28:02.9	2	70
8512d	75.1246468	28.1482655	-332.346	70	06/24/2019 9:30:43.9	2	60
8512e	75.1254177	28.1481043	-332.106	50	06/24/2019 9:30:46.0	2	70
8515a	75.1167004	27.9894152	-321.006	100	06/24/2019 10:41:19.0	2	70
8515b	75.1165381	27.9913147	-320.13	70	06/24/2019 10:41:35.5	3	70
8515c	75.1166517	28.0234847	-320.946	70	06/24/2019 10:46:24.7	2	70
8515d	75.1166481	28.0380921	-320.846	100	06/24/2019 10:48:35.2	2	70

8515d	75.1173695	28.0380725	-324.439	45	06/24/2019 10:48:35.2	2	70
8515e	75.1183044	28.0425248	-322.416	90	06/24/2019 10:49:16.0	2	70
8515f	75.1173445	28.0465465	-325.426	85	06/24/2019 10:49:50.6	3	70
8515g	75.1167862	28.047769	-325.031	75	06/24/2019 10:50:01.2	2	70
8515g	75.1173991	28.047709	-324.519	45	06/24/2019 10:50:01.2	2	70
8516a	75.1164628	28.074007	-325.409	110	06/24/2019 10:53:58.1	2	70
8516b	75.1178307	28.074397	-324.932	115	06/24/2019 10:54:01.3	2	70
8516b	75.1163233	28.0748159	-326.157	115	06/24/2019 10:54:05.5	2	70
8516c	75.1167712	28.0753071	-326.604	135	06/24/2019 10:54:09.8	2	70
8516d	75.1162373	28.0785609	-325.202	125	06/24/2019 10:54:38.2	2	70
8516e	75.1162375	28.0836541	-325.102	55	06/24/2019 10:55:23.7	2	60
8516f	75.1162747	28.0843188	-325.543	45	06/24/2019 10:55:30.1	2	60
8516f	75.1165841	28.0847652	-327.025	50	06/24/2019 10:55:34.4	2	60
8516g	75.1166903	28.085684	-329.428	70	06/24/2019 10:55:42.9	2	70
8516h	75.1171682	28.0856887	-328.427	60	06/24/2019 10:55:42.9	2	60
8516i	75.1166536	28.086288	-327.164	70	06/24/2019 10:55:48.2	3	70
8516j	75.1178514	28.0889608	-329.628	100	06/24/2019 10:56:12.6	2	70
8516k	75.1176786	28.090344	-328.991	70	06/24/2019 10:56:24.3	3	70
8516l	75.1162033	28.0922971	-327.155	65	06/24/2019 10:56:41.3	2	70
8516m	75.116982	28.09525	-327	70	06/24/2019 10:57:09	2	70
8516n	75.1186232	28.099777	-328.306	220	06/24/2019 10:57:49.5	3	80
8516o	75.1168101	28.1007293	-330.9	70	06/24/2019 10:57:57.0	2	70
8516p	75.116553	28.1439019	-330.339	65	06/24/2019 11:04:21.8	2	70
8516q	75.1172757	28.1486507	-330.56	40	06/24/2019 11:05:03.5	2	60
8516r	75.1183844	28.1542179	-329.738	100	06/24/2019 11:05:53.8	2	60
8516r	75.1161946	28.1549069	-330.061	80	06/24/2019 11:05:59.2	2	60
8516s	75.1164815	28.1572074	-329.347	85	06/24/2019 11:06:19.6	2	70
8516t	75.1166052	28.1592454	-329.308	40	06/24/2019 11:06:37.8	2	60
8516u	75.1170304	28.1609301	-331.461	55	06/24/2019 11:06:52.8	2	70

8516v	75.1172509	28.1640042	-332.552	55	06/24/2019 11:07:20.7	2	60
8516w	75.1166921	28.1668948	-329.778	45	06/24/2019 11:07:46.3	2	60
8516x	75.1174142	28.168789	-330.339	40	06/24/2019 11:08:03.5	2	60
8516y	75.1161879	28.1706607	-330.72	65	06/24/2019 11:08:20.6	2	70
8516z	75.1164799	28.1715605	-330.119	65	06/24/2019 11:08:28.2	2	60
8516aa	75.1156194	28.1720126	-330.163	90	06/24/2019 11:08:32.5	2	70
8516aa	75.1156679	28.1734326	-330.279	65	06/24/2019 11:08:44.3	2	70
8516aa	75.1165855	28.1738837	-331.751	75	06/24/2019 11:08:48.6	2	70
8516aa	75.1176314	28.1738865	-331.751	75	06/24/2019 11:08:48.6	2	70
8516ab	75.1164662	28.1748349	-331.33	55	06/24/2019 11:08:57.2	2	60
8516ab	75.117503	28.1748828	-332.832	65	06/24/2019 11:08:57.2	2	70
8516ab	75.1167637	28.1748486	-328.827	65	06/24/2019 11:08:57.2	2	70
8516ac	75.1162972	28.1767782	-330.73	70	06/24/2019 11:09:14.4	2	70
8516ad	75.1164021	28.178491	-331.801	85	06/24/2019 11:09:29.4	2	70
8516ae	75.1161051	28.1797052	-330.249	80	06/24/2019 11:09:40.2	2	70
8516af	75.1157709	28.182413	-331.932	60	06/24/2019 11:10:04.9	2	60
8516ag	75.1165325	28.1841501	-332.762	65	06/24/2019 11:10:19.9	2	70
8516ag	75.1161808	28.1841456	-332.262	40	06/24/2019 11:10:19.9	2	60
8516ah	75.1163219	28.2000859	-333.474	80	06/24/2019 11:12:43.2	2	70
8516ah	75.1175931	28.2001595	-333.975	60	06/24/2019 11:12:43.2	2	70
8516ai	75.1172819	28.2040832	-332.042	40	06/24/2019 11:13:18.7	2	60
8516ai	75.1156859	28.2040443	-332.542	75	06/24/2019 11:13:18.7	2	70
8516aj	75.1176916	28.2071389	-334.585	65	06/24/2019 11:13:45.7	2	70
8516ak	75.115502	28.2148256	-330.58	110	06/24/2019 11:14:55.7	3	70
8516al	75.1169828	28.2187433	-332.883	30	06/24/2019 11:15:29.2	2	50
8516am	75.1159409	28.2320678	-332.522	30	06/24/2019 11:17:28.7	2	50
8516am	75.1180425	28.2318979	-330.339	65	06/24/2019 11:17:26.5	2	60
8516an	75.1159088	28.2361999	-333.298	70	06/24/2019 11:18:05.3	2	70
8516ao	75.117592	28.2435626	-334.625	85	06/24/2019 11:19:09.9	2	50

8516ap	75.1161586	28.2483385	-334.435	75	06/24/2019 11:19:54.1	2	40
8516aq	75.1164047	28.2499615	-334.165	45	06/24/2019 11:20:08.1	2	60
8517a	75.1156048	28.2575398	-333.274	70	06/24/2019 11:21:17.1	2	50
8517b	75.1161838	28.2650002	-333.054	65	06/24/2019 11:22:22.9	2	70
8517c	75.1160289	28.2697782	-334.295	70	06/24/2019 11:23:06.0	3	70
8517d	75.1170525	28.2731568	-334.207	80	06/24/2019 11:23:36.2	3	70
8517d	75.1171256	28.2729055	-334.473	75	06/24/2019 11:23:34.0	2	70
8517e	75.1164305	28.2744423	-333.274	75	06/24/2019 11:23:48.0	3	70
8517f	75.1173896	28.281419	-335.132	75	06/24/2019 11:24:49.5	3	70
8517g	75.1157064	28.2847383	-334.361	45	06/24/2019 11:25:19.6	2	60
8517h	75.116129	28.2864684	-336.616	45	06/24/2019 11:25:35.8	2	60
8517i	75.1156076	28.2897139	-336.956	40	06/24/2019 11:26:05.0	2	40
8517j	75.1159441	28.2947881	-337.627	45	06/24/2019 11:26:50.2	2	60
8517k	75.1174229	28.3002689	-335.055	45	06/24/2019 11:27:38.8	2	60
8517l	75.1163603	28.3018294	-334.165	80	06/24/2019 11:27:54.0	2	60
8518a	75.1088684	28.2953552	-337.35	75	06/24/2019 11:46:40.7	2	70
8518a	75.1085344	28.2953427	-337.35	65	06/24/2019 11:46:40.7	2	60
8518b	75.1098815	28.2913433	-337.092	80	06/24/2019 11:47:16.3	2	70
8518b	75.1103869	28.2913651	-336.057	65	06/24/2019 11:47:16.3	2	60
8518c	75.1094262	28.2888875	-336.862	45	06/24/2019 11:47:37.9	2	60
8518d	75.1082467	28.285714	-334.174	55	06/24/2019 11:48:04.9	2	70
8518e	75.109685	28.2828138	-333.697	95	06/24/2019 11:48:31.8	2	70
8518f	75.1095726	28.279079	-332.167	70	06/24/2019 11:49:04.1	2	70
8518g	75.1095263	28.2773684	-331.727	45	06/24/2019 11:49:19.2	2	70
8518h	75.1080884	28.2736207	-330.772	60	06/24/2019 11:49:50.4	2	60
8518i	75.1093818	28.2689283	-334.354	55	06/24/2019 11:50:33.6	2	60
8518j	75.1087149	28.2607227	-335.599	50	06/24/2019 11:51:45.7	2	60
8518k	75.1087347	28.2554415	-333.429	75	06/24/2019 11:52:32.1	3	70
8518l	75.1086097	28.2532869	-334.982	90	06/24/2019 11:52:50.4	3	70

8518m	75.1094403	28.2494615	-335.399	45	06/24/2019 11:53:24.9	2	60
8518n	75.1083519	28.2479323	-333.389	45	06/24/2019 11:53:36.7	2	40
8518o	75.1088919	28.2463219	-333.776	85	06/24/2019 11:53:51.8	3	70
8518p	75.1099343	28.2416563	-334.742	60	06/24/2019 11:54:33.8	2	60
8518q	75.109894	28.2225009	-334.035	65	06/24/2019 11:57:21.7	2	70
8518r	75.1108872	28.2212761	-330.652	130	06/24/2019 11:57:33.6	3	60
8518s	75.1097729	28.2159393	-332.832	75	06/24/2019 11:58:19.9	3	70
8518t	75.1103288	28.1926419	-333.857	45	06/24/2019 12:01:45.5	2	60
8518u	75.1094822	28.1902084	-330.512	45	06/24/2019 12:02:05.9	2	60
8518v	75.1099226	28.1883346	-332.204	85	06/24/2019 12:02:23.1	3	80
8518w	75.1084334	28.1692575	-331.349	70	06/24/2019 12:05:09.8	3	60
8518x	75.1084629	28.1616407	-331.429	100	06/24/2019 12:06:17.3	3	70
8518y	75.1080776	28.1065614	-330.532	90	06/24/2019 12:14:16.5	2	60
8522a	75.1019427	28.0349207	-327.977	55	06/24/2019 13:33:25.4	2	60
8522b	75.1021916	28.0404838	-327.248	80	06/24/2019 13:35:05.5	2	60
8523	75.1014473	28.1884657	-350.384	150	06/24/2019 14:03:42.6	4	80
8525a	75.0946372	28.1603583	-351.277	80	06/24/2019 14:40:55.3	2	70
8525b	75.092252	28.1552758	-328.809	175	06/24/2019 14:41:41.4	3	70
8525c	75.0948901	28.1427139	-331.997	80	06/24/2019 14:43:29.8	2	70
8525d	75.094136	28.0975382	-347.973	80	06/24/2019 14:50:04.9	4	80
8525e	75.0947787	28.0964092	-331.279	60	06/24/2019 14:50:14.6	2	70
8525f	75.0932581	28.0935276	-330.543	100	06/24/2019 14:50:41.3	3	70
8525g	75.0931185	28.087248	-330.239	100	06/24/2019 14:51:35.7	2	70
8525h	75.0959278	28.0836533	-329.104	90	06/24/2019 14:52:05.5	2	70
8530a	75.0882398	27.9672885	-319.588	50	06/24/2019 16:13:23.8	2	50
8530b	75.0874985	28.0130923	-327.127	75	06/24/2019 16:20:14.9	2	60
8530c	75.0862636	28.0704373	-328.695	75	06/24/2019 16:28:37.5	3	60
8530d	75.0875867	28.1012024	-330.887	60	06/24/2019 16:33:05.1	3	60
8530e	75.086634	28.1071087	-329.155	100	06/24/2019 16:33:57.3	3	60

8530f	75.0875843	28.11086	-332.162	70	06/24/2019 16:34:29.2	3	60
8530g	75.0861757	28.1112002	-330.214	90	06/24/2019 16:34:33.5	3	60
8530h	75.086914	28.1138583	-329.418	90	06/24/2019 16:34:55.8	3	70
8530h	75.0876907	28.113777	-331.459	120	06/24/2019 16:34:54.7	2	60
8530i	75.0865562	28.1162656	-330.144	90	06/24/2019 16:35:17.1	2	60
8530j	75.0876103	28.1175442	-329.288	70	06/24/2019 16:35:27.8	2	60
8530k	75.0882018	28.1195555	-329.448	120	06/24/2019 16:35:44.8	2	70
8530k	75.0856589	28.1261098	-328.885	90	06/24/2019 16:36:43.3	2	60
8530k	75.088067	28.1264939	-330.584	85	06/24/2019 16:36:45.4	2	70
8530l	75.0883642	28.1305377	-332.009	90	06/24/2019 16:37:20.6	3	70
8530l	75.0876672	28.1306266	-331.227	90	06/24/2019 16:37:21.7	2	70
8532	75.0795441	28.2466309	-352.022	45	06/24/2019 17:02:02.5	2	50
8537	75.0736672	28.2096944	-352.777	95	06/24/2019 19:20:26.0	2	60
8869	75.453162	28.80088	-323.44	65	06/24/2019 20:16:43.5	3	70
8869	75.4532718	28.8934487	-343.812	100	06/24/2019 20:29:51.2	3	80
8871	75.4595294	28.6668056	-327.899	75	06/24/2019 20:23:41.0	3	80
8892	75.516985	28.957478	-32280		06/24/2019 21:15:11.0	2	70
8896a	75.5226762	28.9929962	-339.991	90	06/24/2019 22:02:06.8	4	80
8896b	75.5230797	29.0122924	-337.928	77	06/24/2019 22:05:09.6	3	80
8897	75.5233208	29.0648698	-342.505	45	06/24/2019 22:13:29.1	3	70
8898	75.5298074	29.0304088	-339.01	50	06/24/2019 22:31:00.0	2	60

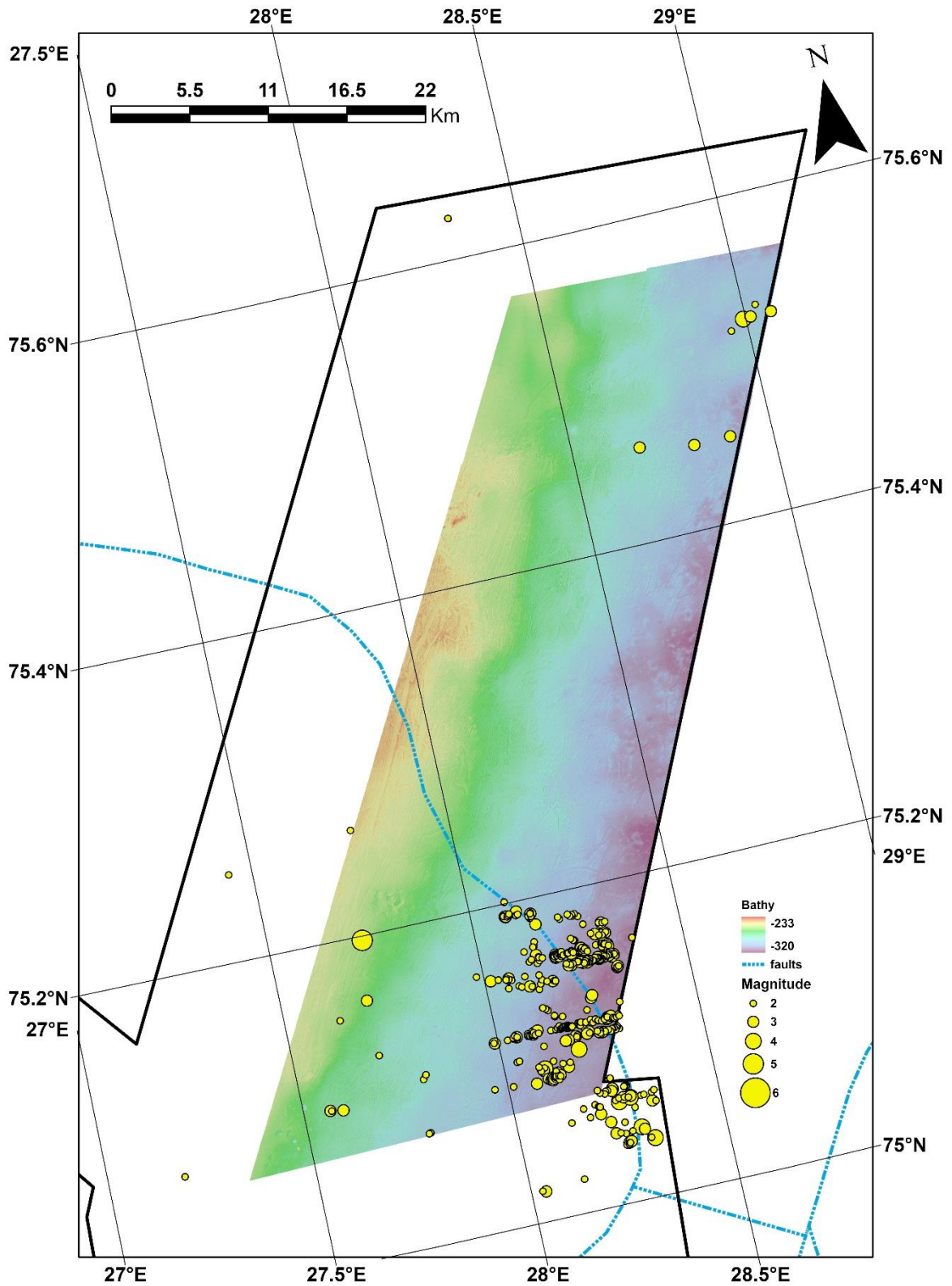


Figure 68. Bathymetry from the FGMG-2018-KKG (Kirkegaarden) survey area showing the location of the flares.

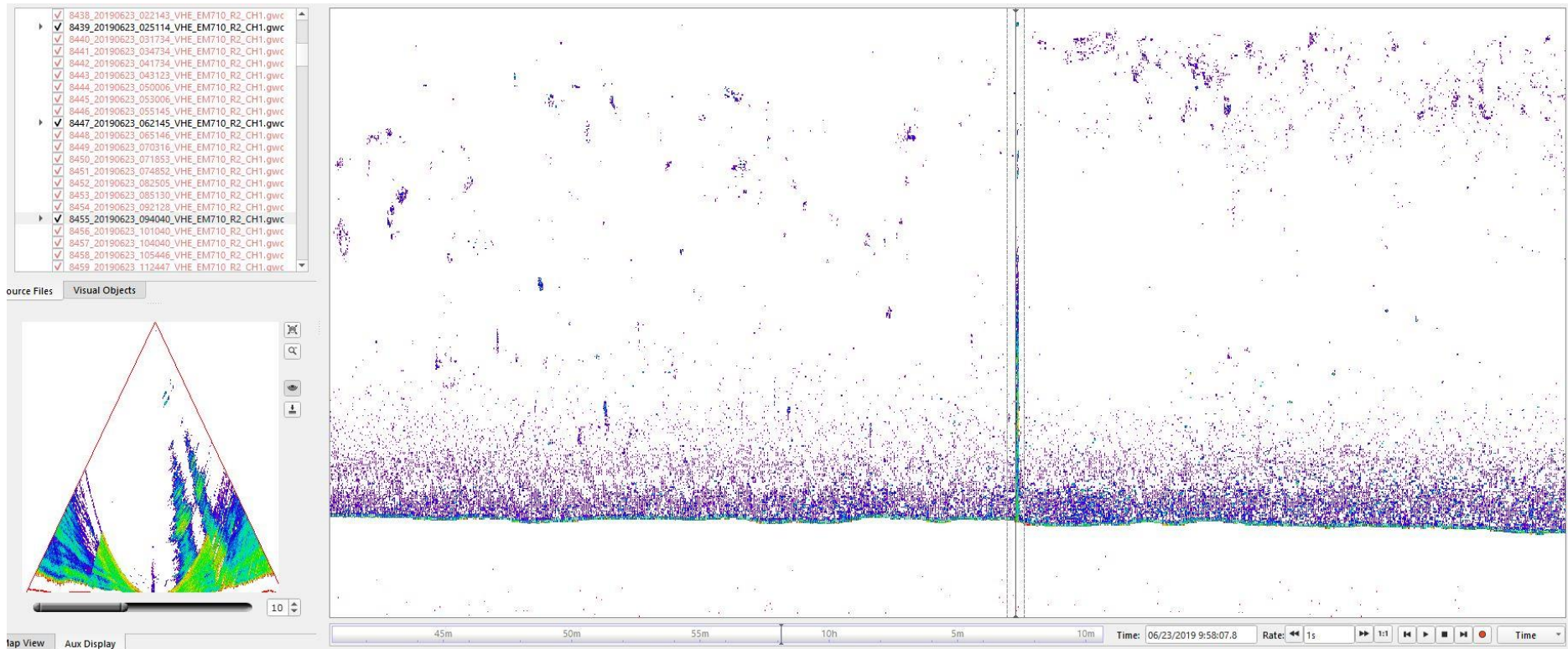


Figure 69. Gas flare from line 8455 showed on Fan view and stack view. Magnitude 5, Confidence 40%.

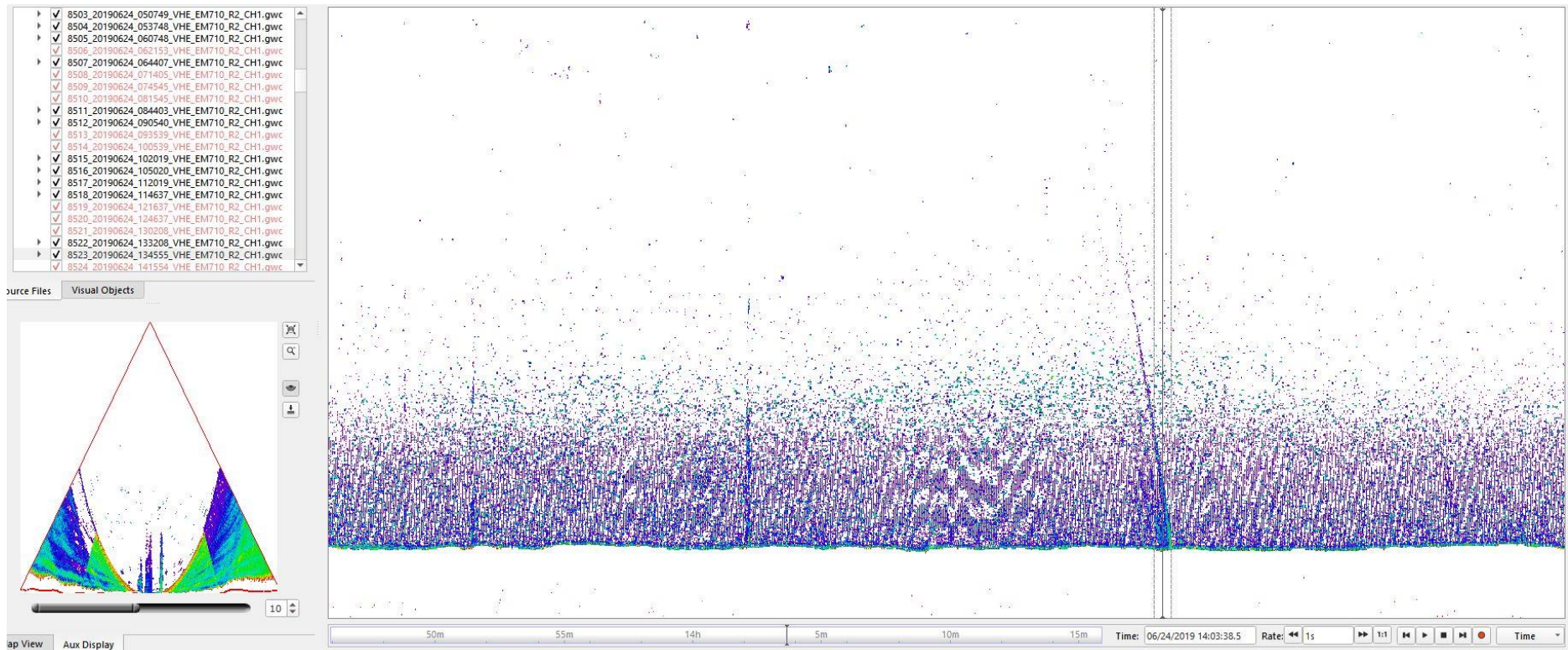


Figure 70. Gas flare from line 8523 showed on Fan view and stack view. Magnitude 4, Confidence 80%.

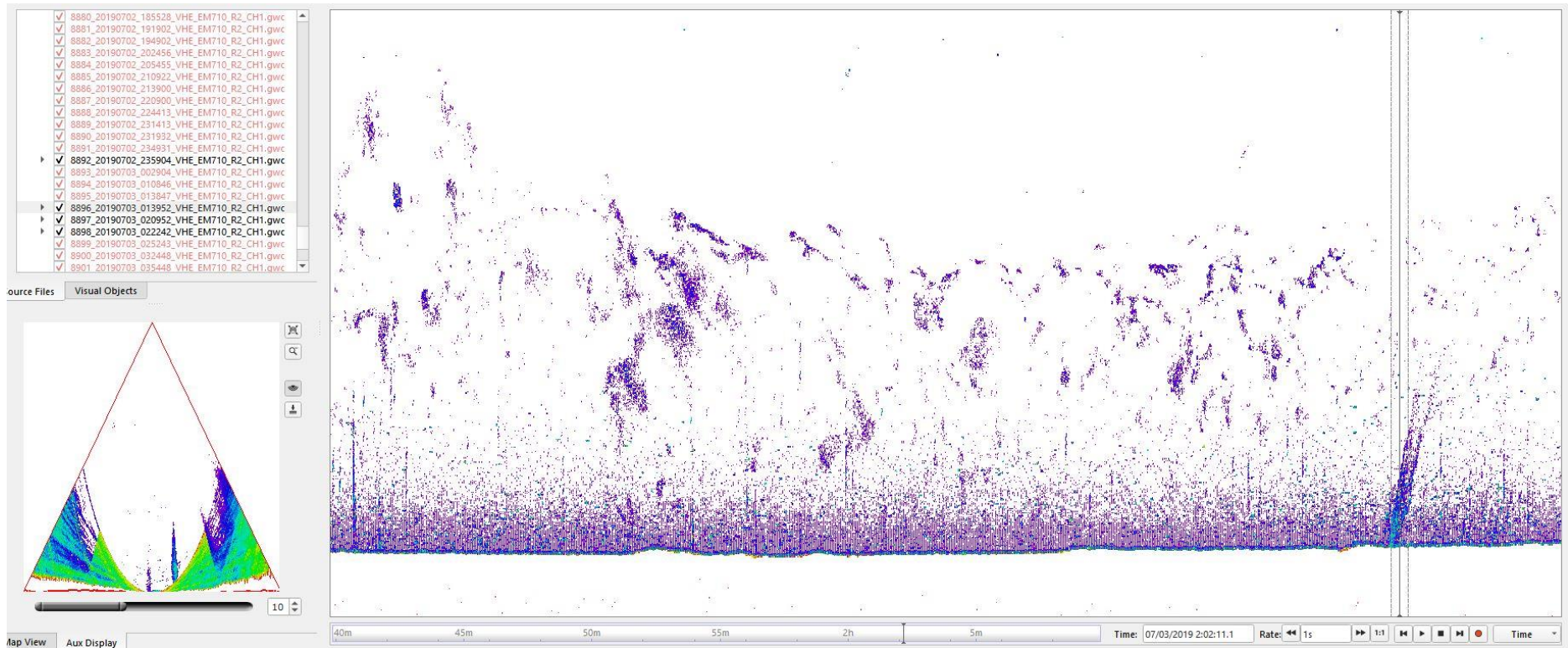


Figure 71. Gas flare a from line 8896 showed on Fan view and stack view. Magnitude 4, Confidence 80%.

4.4.7 FGMG-2018-Tr TF01-BH03

The FGMG-2018-Tr_TF01-BH03 survey consists of 631 water column (.wcd) survey lines. The data was loaded in Fledermaus Midwater along with navigation (.all) and converted to GWC files. 134 flares of varying magnitude and confidence were picked for location from this survey (Table 7). Most of the flares are visible on stack sections shown for picked flares. The picked flares shown on bathymetry map (Fig. 72) and those with magnitude 4 and above shown individually on fan and stack views in Figs. 73-94.

Table 7. Details of flares identified from Survey Area FGMG-2018-Tr_TF01-BH03.

LineId	Latitude	Longitude	Depth	Height	Time	Magnitude	Confidence
9051	75.5916539	25.6467991	-143.267	80	07/07/2019 04:59:32.9	2	70
9071	75.5781825	25.5413425	-149.823	85	07/07/2019 13:31:40.8	2	70
9102	75.5416526	25.7548699	-162.176	85	07/08/2019 01:52:15.1	2	60
9110	75.5339732	25.7719327	-156.626	110	07/08/2019 04:03:12.4	2	60
9121a	75.5257659	25.7394547	-159.672	115	07/08/2019 08:14:32.6	2	70
9121b	75.5251565	25.7426539	-160.095	90	07/08/2019 08:15:01.7	2	70
9121c	75.5247007	25.7452202	-156.898	75	07/08/2019 08:15:24.7	2	70
9174	75.4587457	25.9135256	-140.539	30	07/09/2019 08:59:31.0	3	70
9187	75.4192691	25.9952672	-164.57	90	07/09/2019 13:44:16.6	4	80
9194a	75.743845	25.239963	-109.283	70	07/10/2019 04:35:39.8	3	70
9194b	75.743928	25.238165	-109.283	70	07/10/2019 04:35:54.6	3	70
9194c	75.743928	25.238165	-109.283	40	07/10/2019 04:36:02.7	2	60
9194d	75.744061	25.234932	-109.283	50	07/10/2019 04:36:21.1	3	80
9194e	75.7441279	25.2337558	-109.283	100	07/10/2019 04:36:30.4	4	80
9194f	75.7440095	25.2304767	-108.992	90	07/10/2019 04:36:56.7	4	80
9194g	75.744543	25.223939	-107	40	07/10/2019 04:37:52.4	3	70
9194h	75.745128	25.210086	-110	85	07/10/2019 04:39:44.5	3	70
9194i	75.745241	25.207788	-107	66	07/10/2019 04:40:06.0	2	60
9194j	75.745325	25.205761	-109	42	07/10/2019 04:40:22.7	2	60
9194k	75.745334	25.205316	-109	60	07/10/2019 04:40:26.8	2	60
9194l	75.7454627	25.1919354	-107.25	80	07/10/2019 04:42:14.1	5	80

9196	75.7603618	24.8505262	-99.51	60	07/10/2019 05:30:40.0	2	70
9196	75.7608234	24.8433904	-99.773	70	07/10/2019 05:31:42.0	3	80
9197a	75.741663	25.231811	-106	80	07/10/2019 07:58:47.4	4	80
9197b	75.74171	25.230777	-107	80	07/10/2019 07:58:55.9	4	80
9197c	75.741757	25.229598	-106.528	80	07/10/2019 07:59:05.2	3	70
9197d	75.741823	25.228064	-106	60	07/10/2019 07:59:16.5	2	60
9197e	75.741889	25.226437	-106.844	70	07/10/2019 07:59:31.7	2	70
9197f	75.741938	25.225407	-106	80	07/10/2019 07:59:40.4	3	70
9197g	75.741993	25.224243	-106	80	07/10/2019 07:59:50.2	3	70
9197h	75.742015	25.223747	-107	85	07/10/2019 07:59:54.8	2	70
9197i	75.7420866	25.2186289	-106.528	80	07/10/2019 07:00:33.4	2	70
9198a	75.7432081	25.1971817	-104.898	90	07/10/2019 08:03:38.9	2	70
9198b	75.7438182	25.1795446	-108.231	80	07/10/2019 08:06:09.0	2	70
9198c	75.7445047	25.1641019	-105.882	70	07/10/2019 08:08:21.8	2	70
9201	75.7466315	25.0603868	-107.725	60	07/10/2019 09:38:19.5	2	70
9201	75.7422885	25.1658688	-109.235	75	07/10/2019 09:53:17.0	2	60
9201	75.7422176	25.1676441	-108.819	70	07/10/2019 09:53:32.5	2	60
9203	75.745499	25.1708764	-109.628	80	07/10/2019 09:01:05.8	3	80
9203	75.7454761	25.1688167	-110.033	80	07/10/2019 09:01:24.5	2	70
9203	75.7458274	25.1597119	-105.537	80	07/10/2019 09:02:48.2	4	80
9204a	75.742179	25.164618	-103	70	07/10/2019 10:19:24.4	2	70
9204b	75.74214	25.165564	-103	75	07/10/2019 10:19:31.8	3	70
9204c	75.742107	25.166309	-104	55	07/10/2019 10:19:38.1	2	70
9204d	75.742052	25.167546	-105	85	07/10/2019 10:19:48.7	3	70
9204e	75.741869	25.172006	-104	70	07/10/2019 10:20:26.4	2	70
9204f	75.739936	25.21689	-100	60	07/10/2019 10:27:02.3	3	70
9204g	75.739918	25.217329	-100	50	07/10/2019 10:27:06.2	3	70
9204h	75.739857	25.218838	-101	60	07/10/2019 10:27:19.2	3	70
9204i	75.739775	25.220708	-100	55	07/10/2019 10:27:36.4	3	70

9206	75.7289101	25.4010833	-111.46	70	07/10/2019 11:08:50.2	2	50
9207	75.7373643	25.2161455	-103.641	70	07/10/2019 11:36:54.0	3	80
9210	75.7488845	24.9177071	-99.64	76	07/10/2019 12:44:29.3	2	70
9211a	75.735435	25.209876	-100	75	07/10/2019 13:27:08.9	4	80
9211b	75.735271	25.213678	-100	70	07/10/2019 13:27:41.5	2	70
9211c	75.735245	25.214259	-98	90	07/10/2019 13:27:46.5	4	80
9211d	75.735204	25.215382	-99	50	07/10/2019 13:27:56.6	2	60
9211e	75.735185	25.215884	-98	87	07/10/2019 13:28:01.6	3	70
9211f	75.735142	25.216915	-100	70	07/10/2019 13:28:09.5	2	70
9215a	75.7321352	25.2319006	-95.437	75	07/10/2019 14:40:26.2	2	70
9215b	75.7393516	25.0690252	-105.051	80	07/10/2019 14:02:42.8	3	80
9233a	75.718945	25.253471	-104	65	07/10/2019 22:33:06.3	2	60
9233b	75.718737	25.258374	-104	65	07/10/2019 22:33:50.7	2	60
9233c	75.718701	25.259168	-103	95	07/10/2019 22:33:58.1	3	80
9233d	75.718661	25.260176	-103	55	07/10/2019 22:34:07.5	2	70
9233e	75.718618	25.261222	-104	80	07/10/2019 22:34:16.6	3	80
9233f	75.718562	25.262508	-104	90	07/10/2019 22:34:28.3	3	70
9233g	75.7184194	25.2641007	-109.015	70	07/10/2019 22:34:42.5	3	80
9243	75.7146915	25.1978039	-109.217	65	07/11/2019 02:03:54.0	3	80
9244	75.7165091	25.1249226	-109.235	70	07/11/2019 03:13:58.1	2	30
9252	75.7168734	25.0185917	-105.722	80	07/11/2019 06:33:10.4	2	40
9259	75.70953	25.0673156	-106.957	90	07/11/2019 09:30:53.0	2	50
9265	75.6978974	25.2331198	-109.571	75	07/11/2019 11:15:29.9	4	80
9265	75.6977327	25.230452	-111.068	70	07/11/2019 11:15:49.6	4	80
9268	75.6970466	25.2052446	-112.758	72	07/11/2019 13:22:17.5	4	80
9269a	75.6952785	25.2232191	-115.108	75	07/11/2019 13:26:05.8	2	80
9269b	75.6950653	25.2383682	-110.057	55	07/11/2019 13:28:20.5	3	80
9269c	75.6921398	25.3107698	-115.01	95	07/11/2019 13:38:09.8	5	80
9269d	75.688698	25.379022	-109	80	07/11/2019 13:47:45.5	2	60

9269e	75.688631	25.380544	-109	80	07/11/2019 13:47:58.5	3	70
9294	75.6751696	25.2964657	-116.513	110	07/12/2019 00:25:19.5	2	50
9308	75.6584325	25.4324509	-108.043	83	07/12/2019 05:17:31.5	3	80
9369	75.599901	25.8587868	-136.481	110	07/13/2019 6:08:18.0	2	70
9381a	75.746646	25.228616	-110	80	07/13/2019 13:32:59.2	2	60
9381b	75.746627	25.229054	-109	84	07/13/2019 13:33:03.0	2	70
9381c	75.74573	25.249961	-109	84	07/13/2019 13:33:05.	3	70
9381d	75.7466	25.229769	-109	65	07/13/2019 13:33:09.2	2	60
9381e	75.746408	25.234119	-109	70	07/13/2019 13:33:11.9	2	70
9381f	75.746468	25.232468	-107	62	07/13/2019 13:33:33.0	3	70
9381g	75.7460284	25.2329135	-110.676	70	07/13/2019 13:33:36.8	4	80
9381h	75.746392	25.234503	-107	75	07/13/2019 13:33:50.9	2	60
9381i	75.746338	25.235722	-108	85	07/13/2019 13:34:01.	3	70
9381j	75.7465445	25.2364822	-112.562	95	07/13/2019 13:34:07.3	4	80
9389	75.7547101	25.1905137	-106.134	75	07/13/2019 17:26:28.8	4	80
9394a	75.7643309	25.0230686	-102.505	60	07/13/2019 19:09:18.4	2	70
9394b	75.7601436	25.1280847	-105.509	65	07/13/2019 19:23:53.0	4	80
9402a	75.7605441	25.2295622	-105.928	83	07/13/2019 22:42:39.2	4	80
9402b	75.7595877	25.2318651	-106.396	67	07/13/2019 22:43:08.3	3	80
9402c	75.760211	25.2361395	-105.33	80	07/13/2019 22:43:35.7	5	80
9402d	75.760076	25.23725	-102	95	07/13/2019 22:43:46.1	3	70
9413	75.7618072	25.2521025	-106.215	55	07/18/2019 20:12:14.1	2	70
9413	75.7616017	25.2528165	-106.297	80	07/18/2019 20:12:22.7	4	80
9413	75.7622187	25.2541766	-106.205	50	07/18/2019 20:12:33.2	2	70
9416	75.7644107	25.2403336	-106.357	85	07/18/2019 20:47:51.0	4	80
9416	75.7643026	25.2370861	-105.132	75	07/18/2019 20:48:29.8	4	80
9416	75.7652411	25.2362349	-105.915	55	07/18/2019 20:48:43.1	3	70
9418	75.7710541	25.0862311	-96.74	85	07/18/2019 21:21:28.3	4	80
9419	75.7731574	25.0312207	-101.019	50	07/18/2019 21:33:28.1	2	70

9440	75.7710447	25.0862818	-97.464	75	07/19/2019 3:32:50.3	3	80
9441	75.7644522	25.2403868	-106.447	75	07/19/2019 3:57:37.6	3	80
9441	75.7641937	25.2375335	-105.236	80	07/19/2019 3:57:11.0	4	80
9459	75.7797849	25.1157931	-93.641	65	07/19/2019 11:10:54.3	3	70
9468	75.7827255	25.1855365	-105.331	50	07/19/2019 15:14:24.3	3	70
9468	75.7826491	25.1665669	-100.994	75	07/19/2019 15:17:23.9	4	80
9471	75.8036978	24.6732275	-97.979	57	07/19/2019 16:31:39.6	2	70
9476a	75.786803	25.190175	-90	65	07/19/2019 18:20:48.5	2	60
9476b	75.7874928	25.1820015	-95.756	70	07/19/2019 18:22:02.5	4	80
9476c	75.7875567	25.1742637	-98.402	65	07/19/2019 18:23:10.3	2	70
9476d	75.7884883	25.1469942	-94.379	60	07/19/2019 18:27:15.1	3	80
9483	75.7891356	25.195494	-100.577	65	07/19/2019 21:09:28.0	3	80
9483	75.7882948	25.2181387	-98.042	60	07/19/2019 21:12:48.7	2	60
9483	75.7879246	25.2203672	-96.016	60	07/19/2019 21:13:09.6	2	70
9484	75.7927084	25.1650348	-90.719	65	07/19/2019 21:26:52.0	4	80
9484	75.7925659	25.1532337	-90.869	55	07/19/2019 21:28:32.7	3	80
9491	75.7964897	25.1725352	-91.393	70	07/20/2019 0:46:29.5	2	80
9518	75.8071606	25.1534454	-96.735	60	07/20/2019 11:39:54.1	2	70
9531	75.8233178	24.8524211	-103.11	65	07/20/2019 17:35:57.8	2	80
9558	75.8352045	24.8886248	-105.52	65	07/21/2019 3:57:56.2	2	70
9558	75.8352601	24.8929558	-106.661	75	07/21/2019 3:58:33.3	2	80
9565	75.8460782	24.7388186	-103.611	85	07/21/2019 6:50:05.9	2	70
9570	75.853943	24.5932738	-98.779	75	07/21/2019 8:57:45.1	3	80
9609	75.8631648	24.8727384	-112.797	104	07/21/2019 23:50:09.9	2	50
9614	75.8841166	24.3989383	-99.66	80	07/22/2019 1:36:06.2	3	80
9638	75.892811	24.742936	-104.79	70	07/22/2019 10:55:37.4	3	70

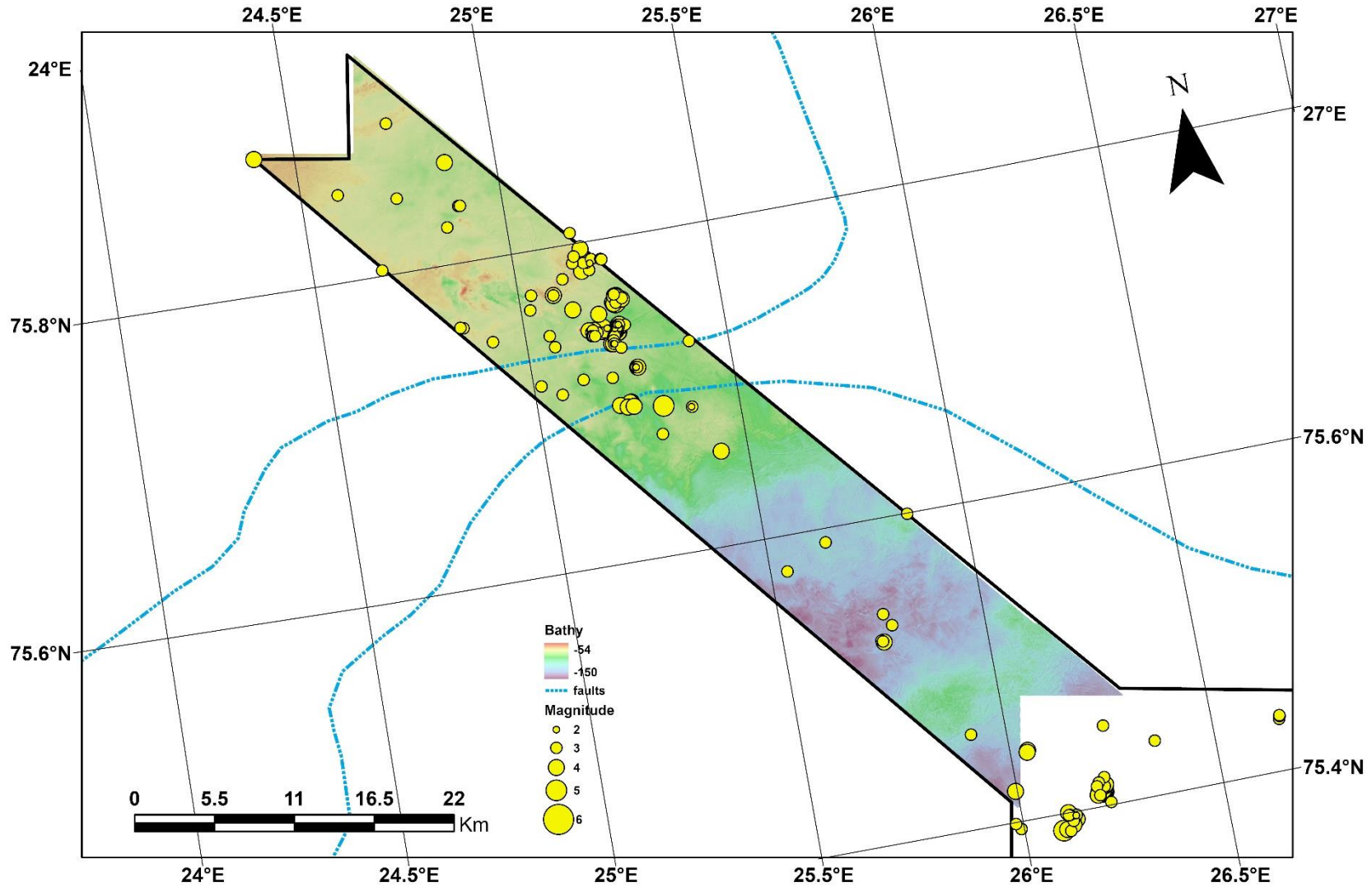


Figure 72. Flare locations from additional area fgmg-2018-Tr_TF01-BH03 shown on bathymetry map from the area.

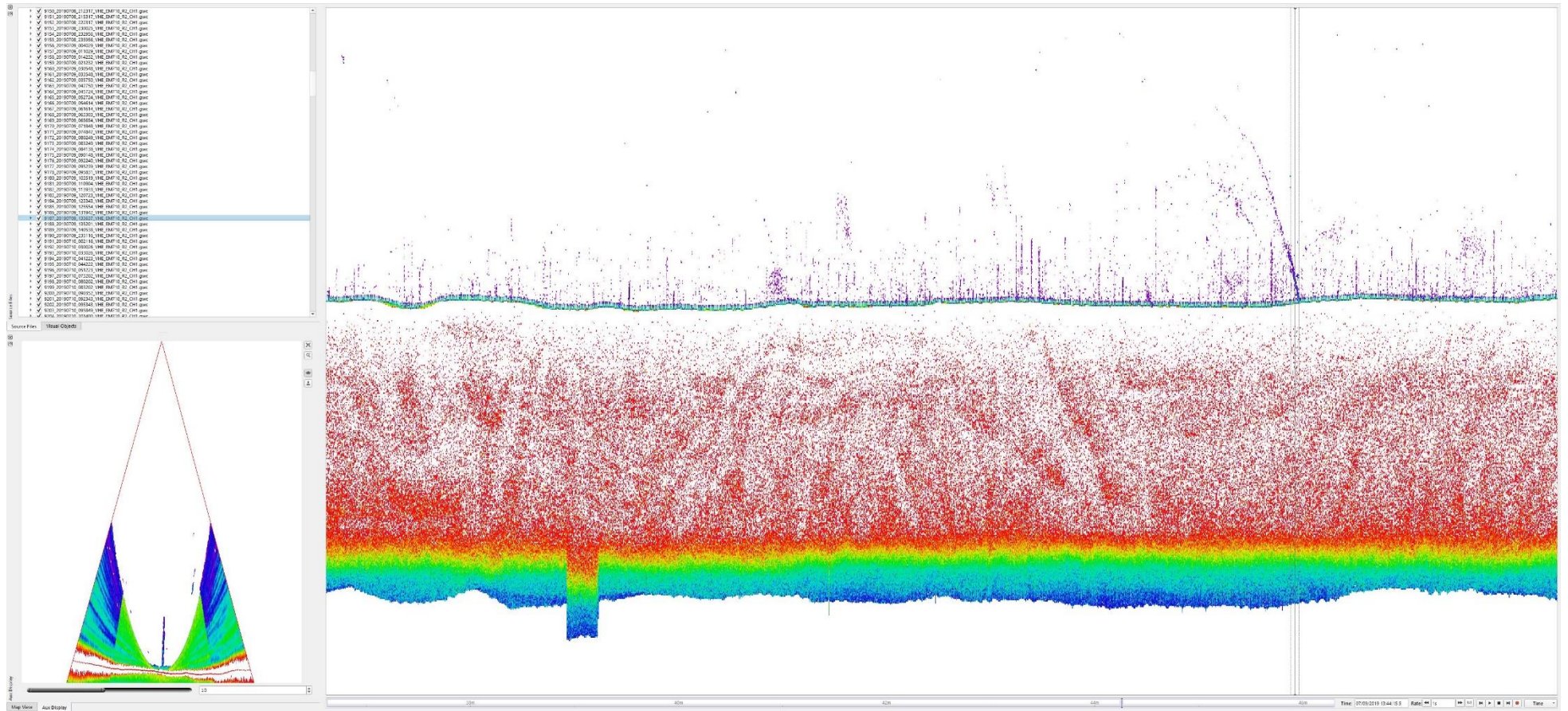


Figure 73. Gas flare from line 9187 showed on Fan view and stack view. Magnitude 4, Confidence 80%.

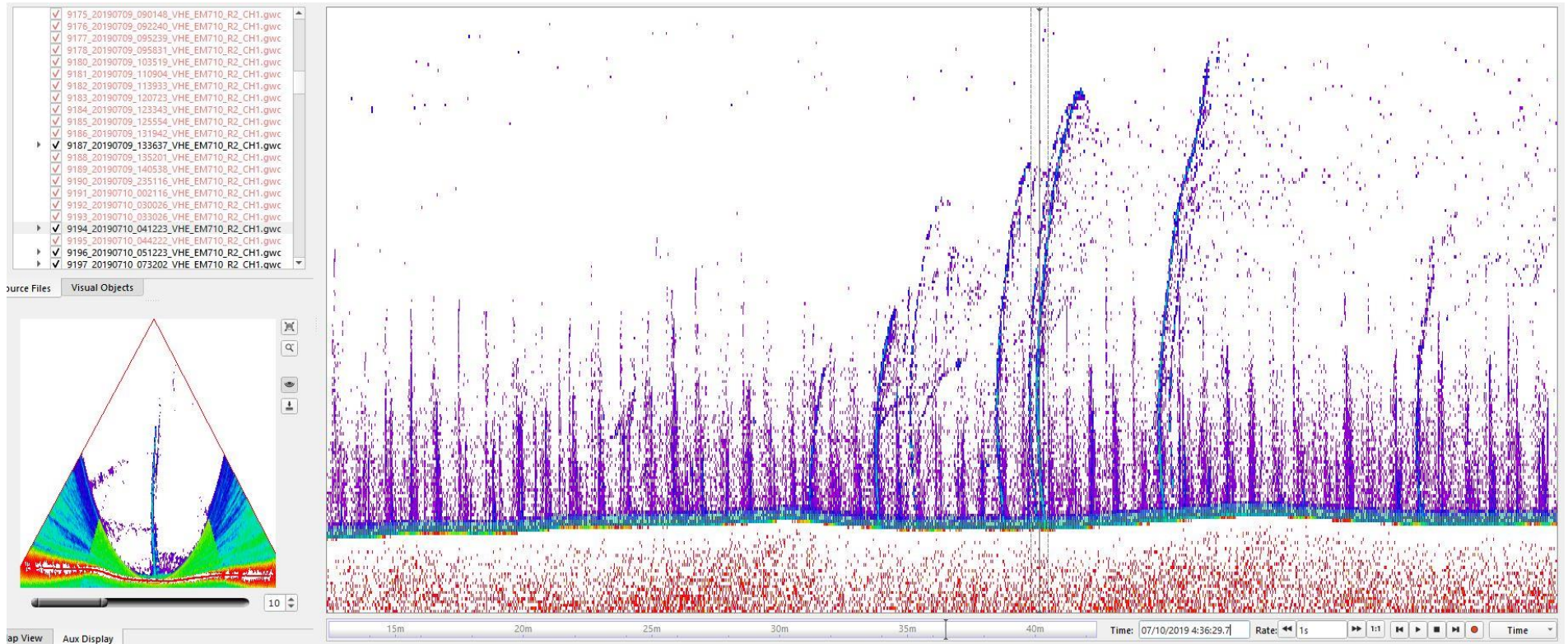


Figure 74. Gas flare e from line 9194 showed on Fan view and stack view. Magnitude 4, Confidence 80%.

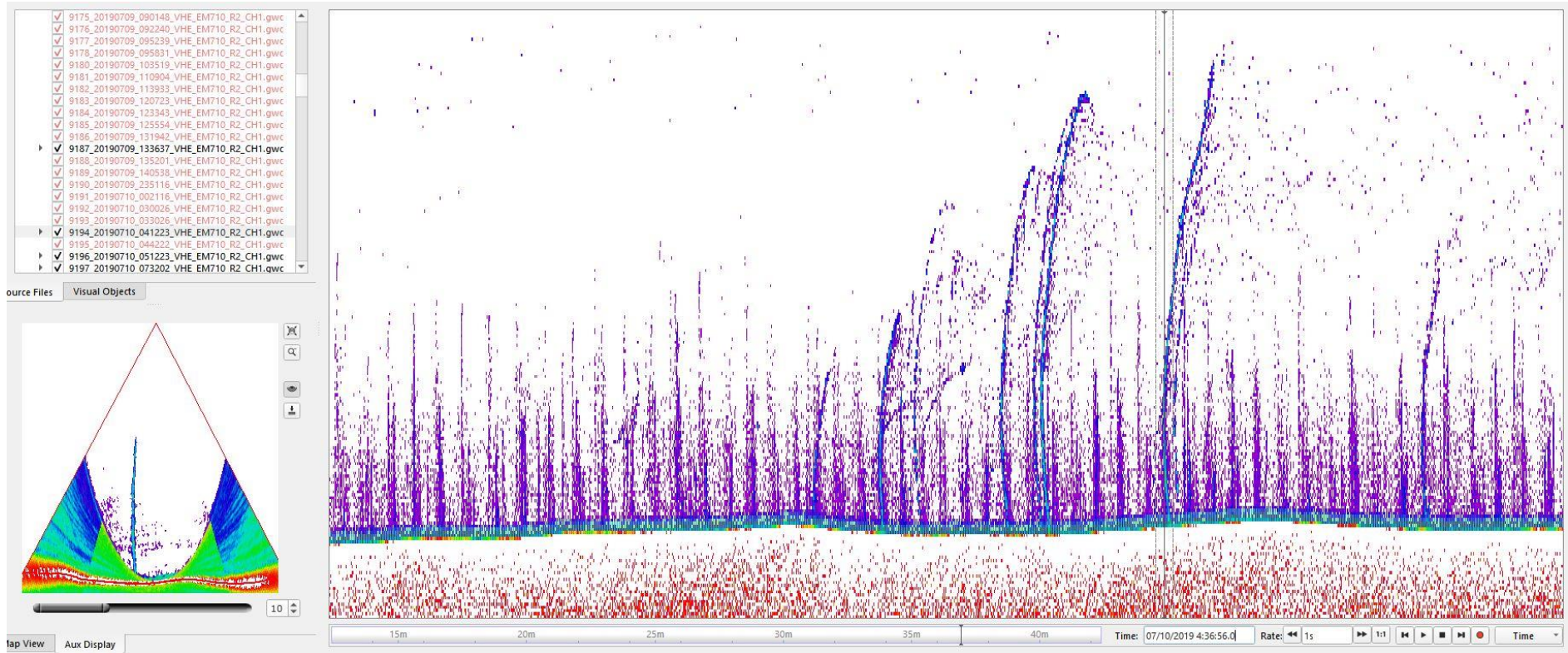


Figure 75. Gas flare from line 9194 showed on Fan view and stack view. Magnitude 4, Confidence 80%.

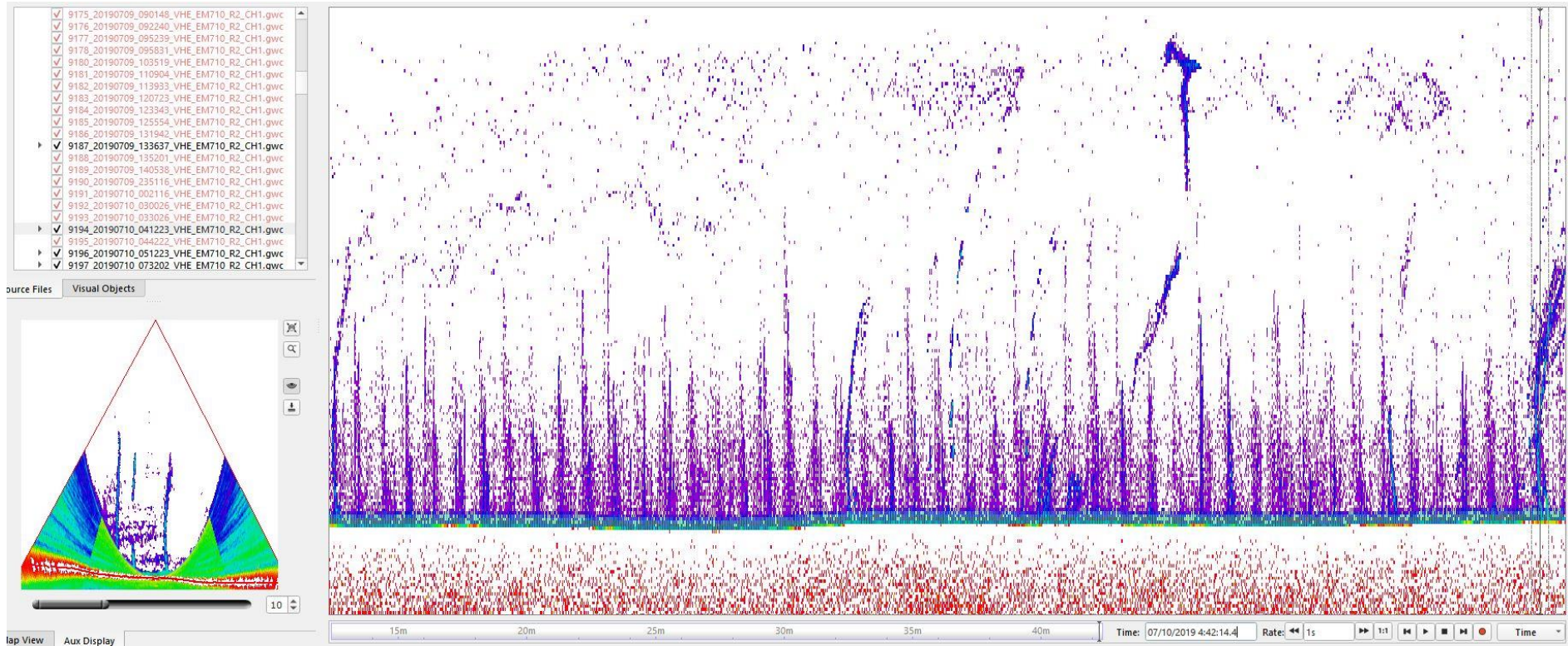


Figure 76. Gas flare 1 from line 9194 showed on Fan view and stack view. Magnitude 5, Confidence 80%.

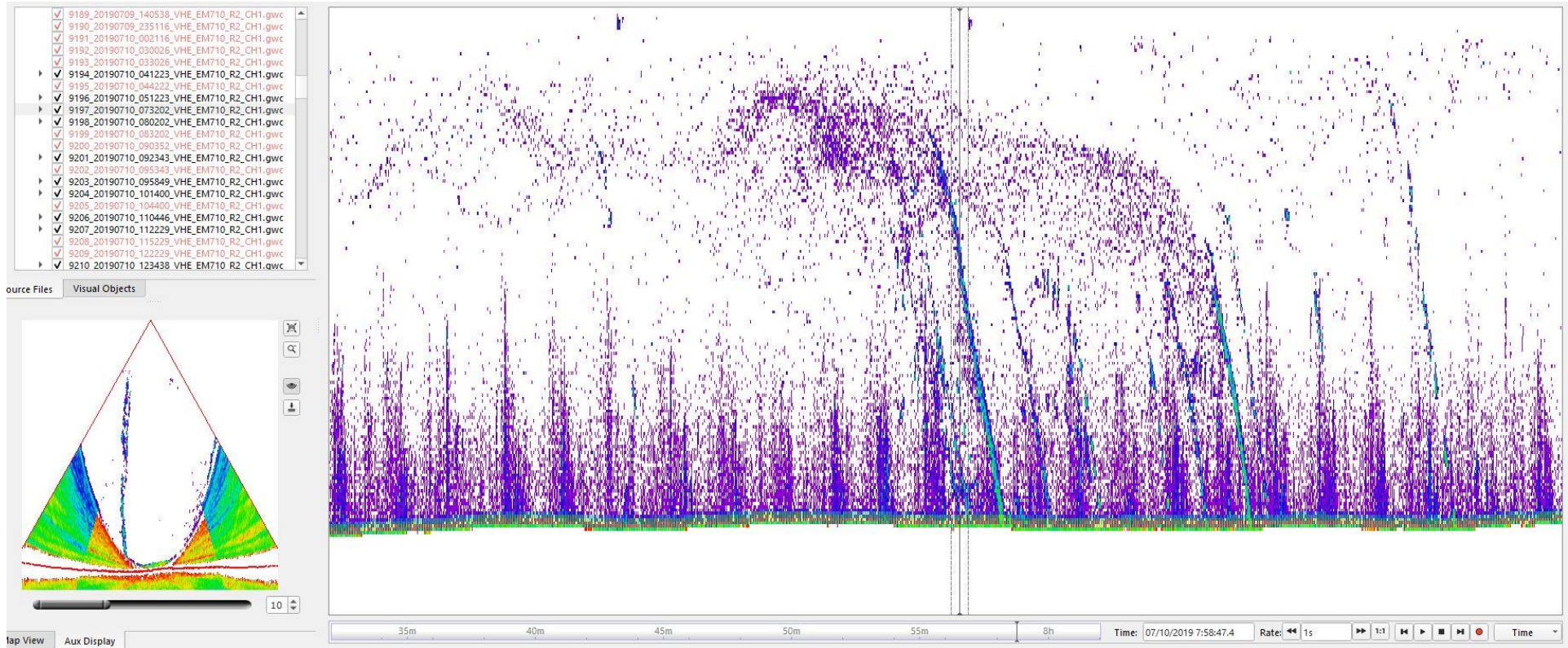


Figure 77. Gas flare a from line 9197 showed on Fan view and stack view. Magnitude 4, Confidence 80%.

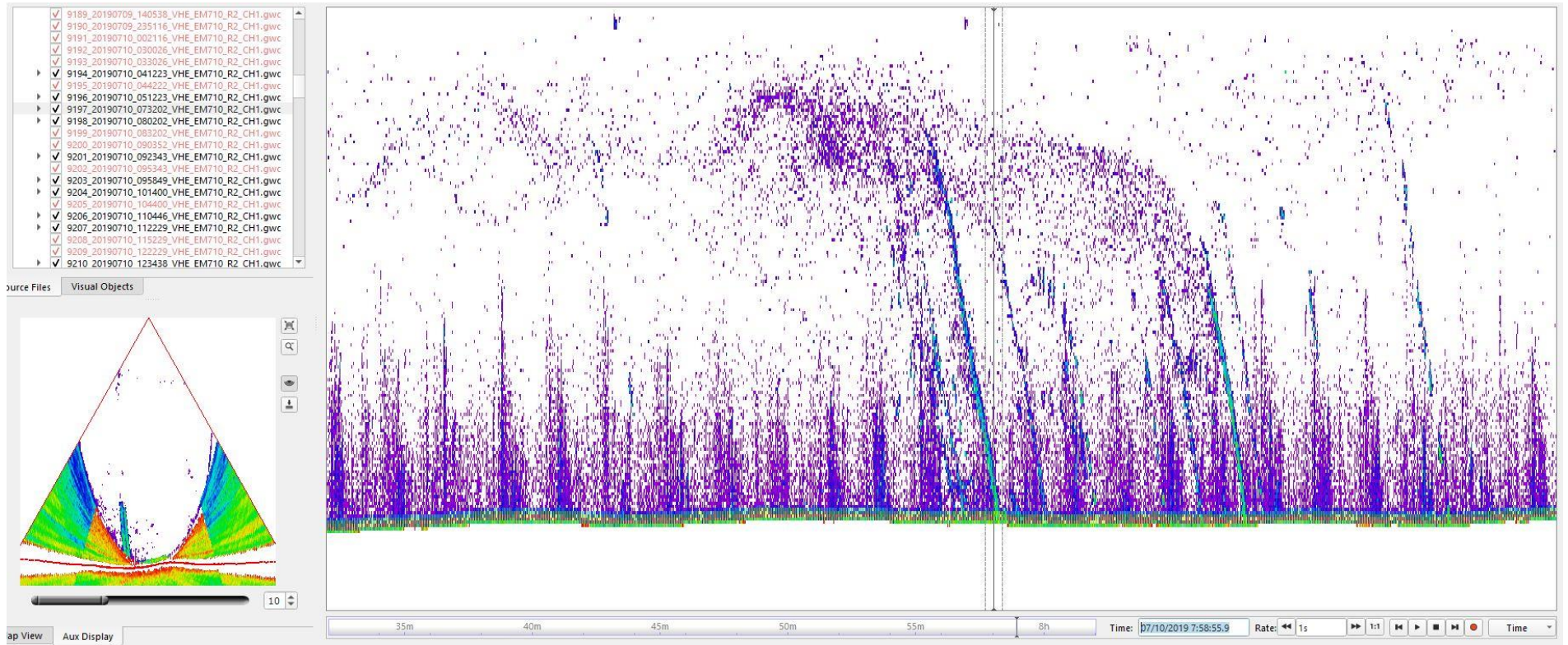


Figure 78. Gas flare b from line 9197 showed on Fan view and stack view. Magnitude 4, Confidence 80%.

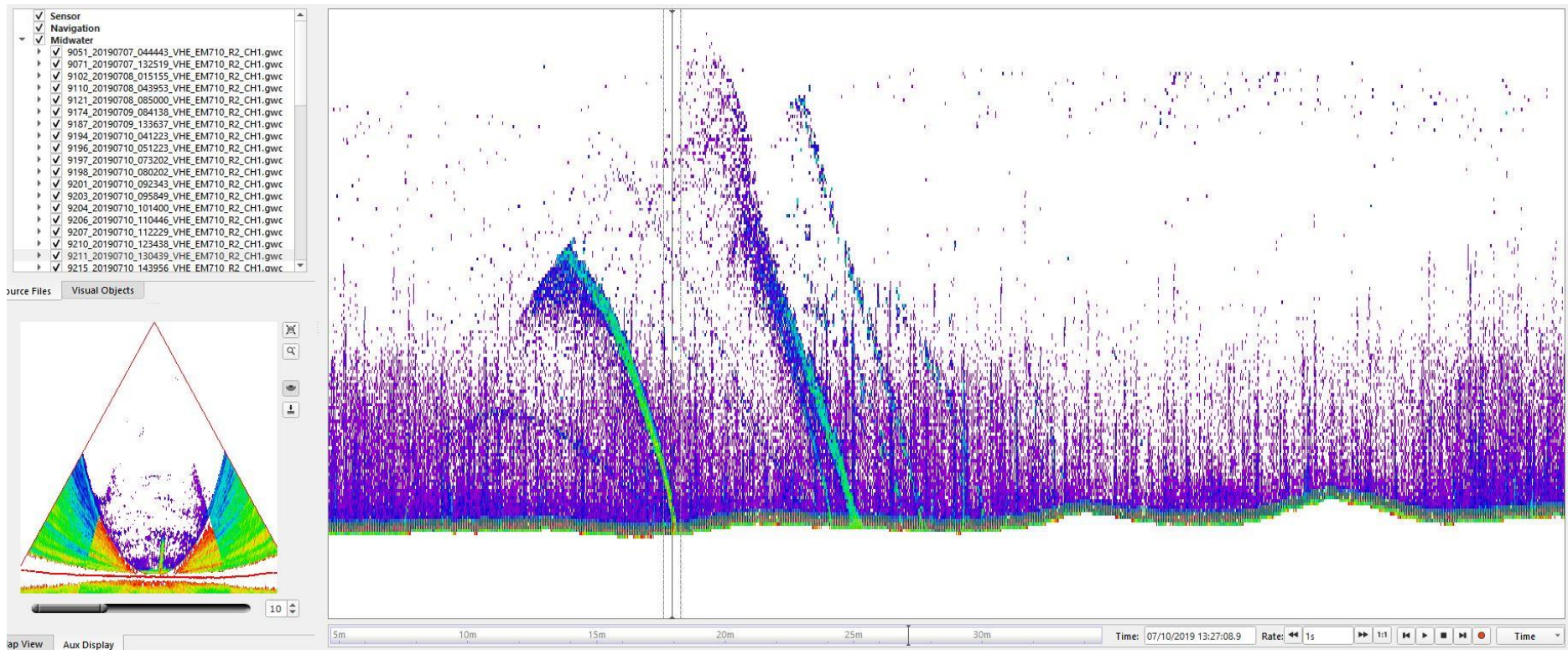


Figure 79. Gas flare a from line 9211 showed on Fan view and stack view. Magnitude 5, Confidence 80%.

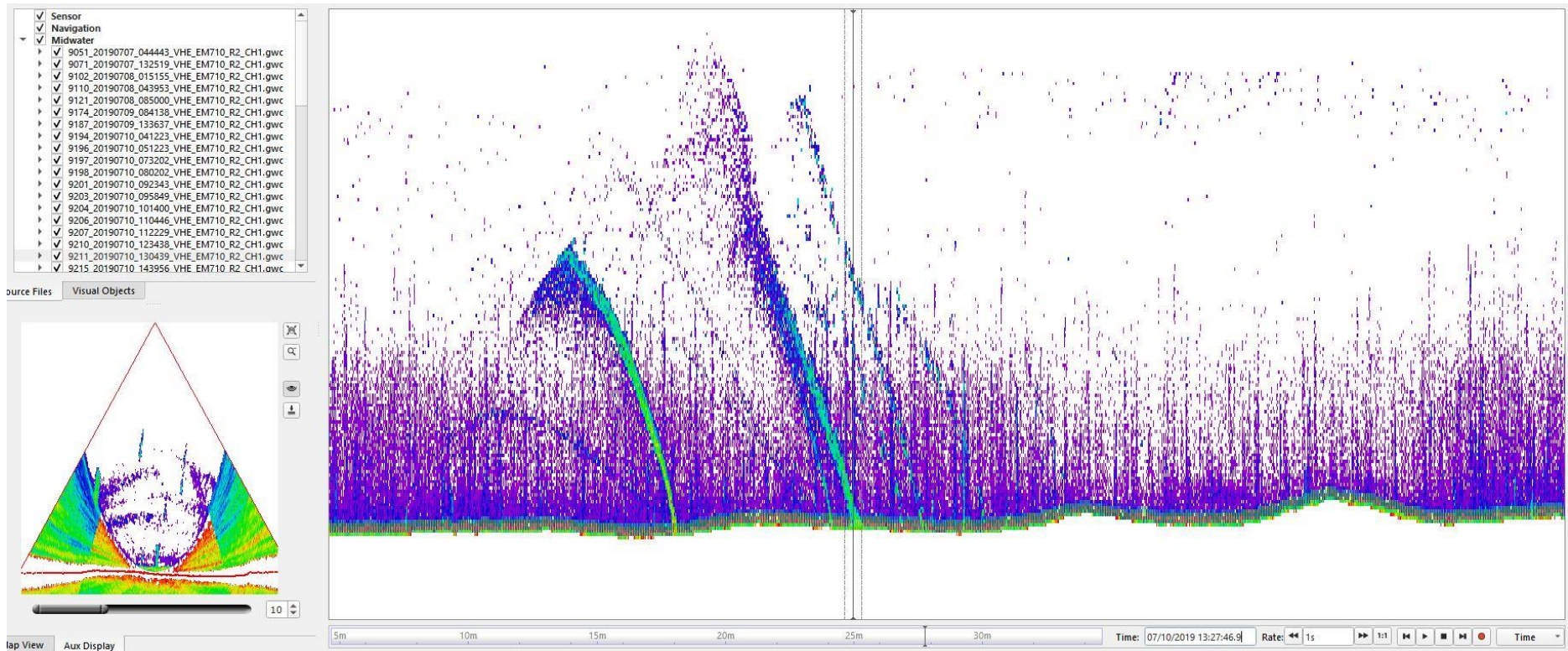


Figure 80. Gas flare c from line 9211 showed on Fan view and stack view. Magnitude 5, Confidence 80%.

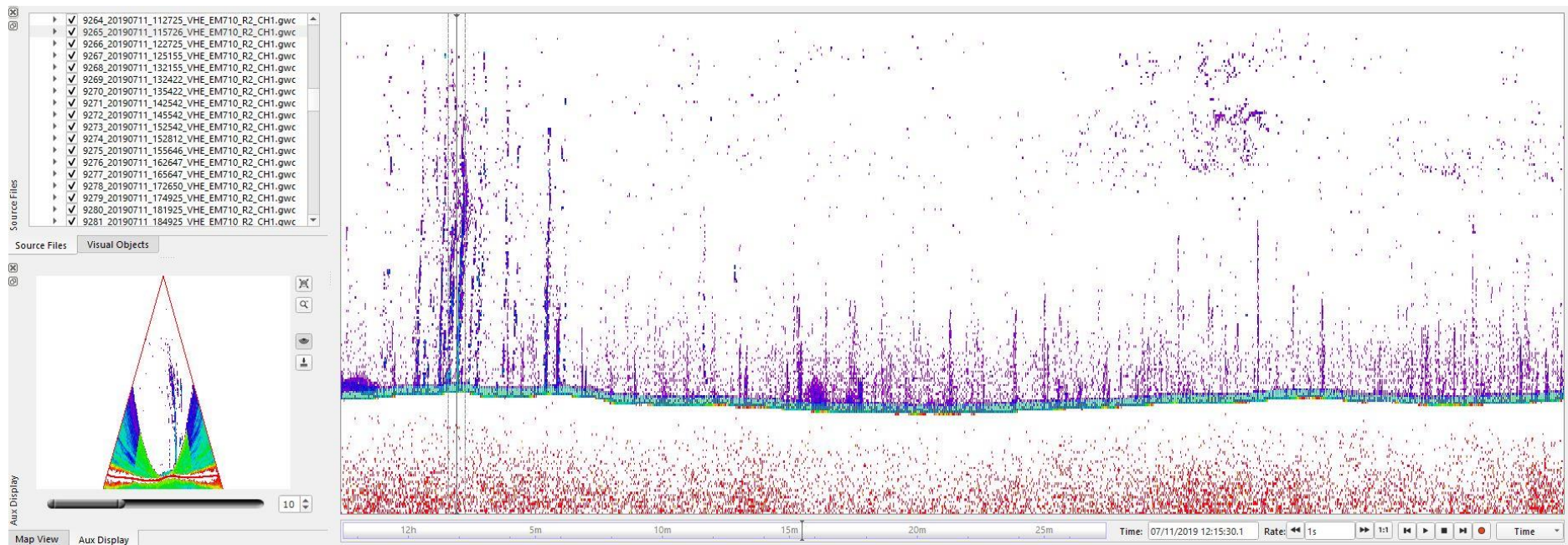


Figure 81. Gas flare from line 9265 showed on Fan view and stack view. Magnitude 4, Confidence 80%.

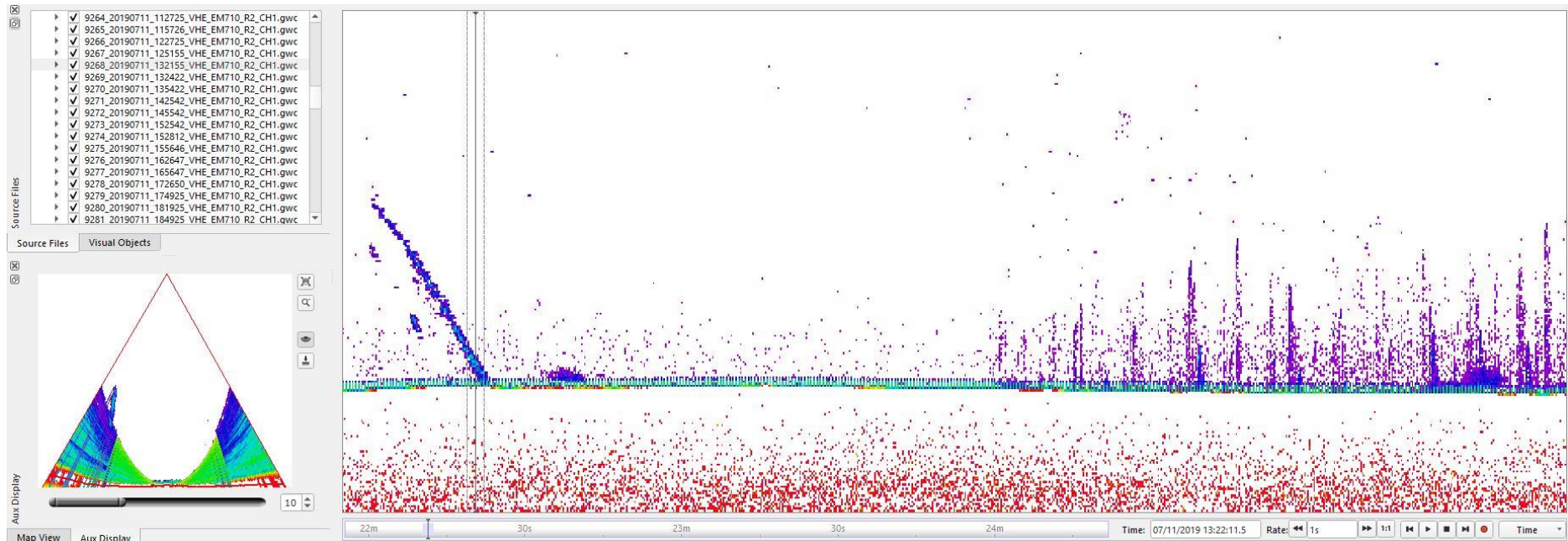


Figure 82. Gas flare from line 9268 showed on Fan view and stack view. Magnitude 4, Confidence 80%.

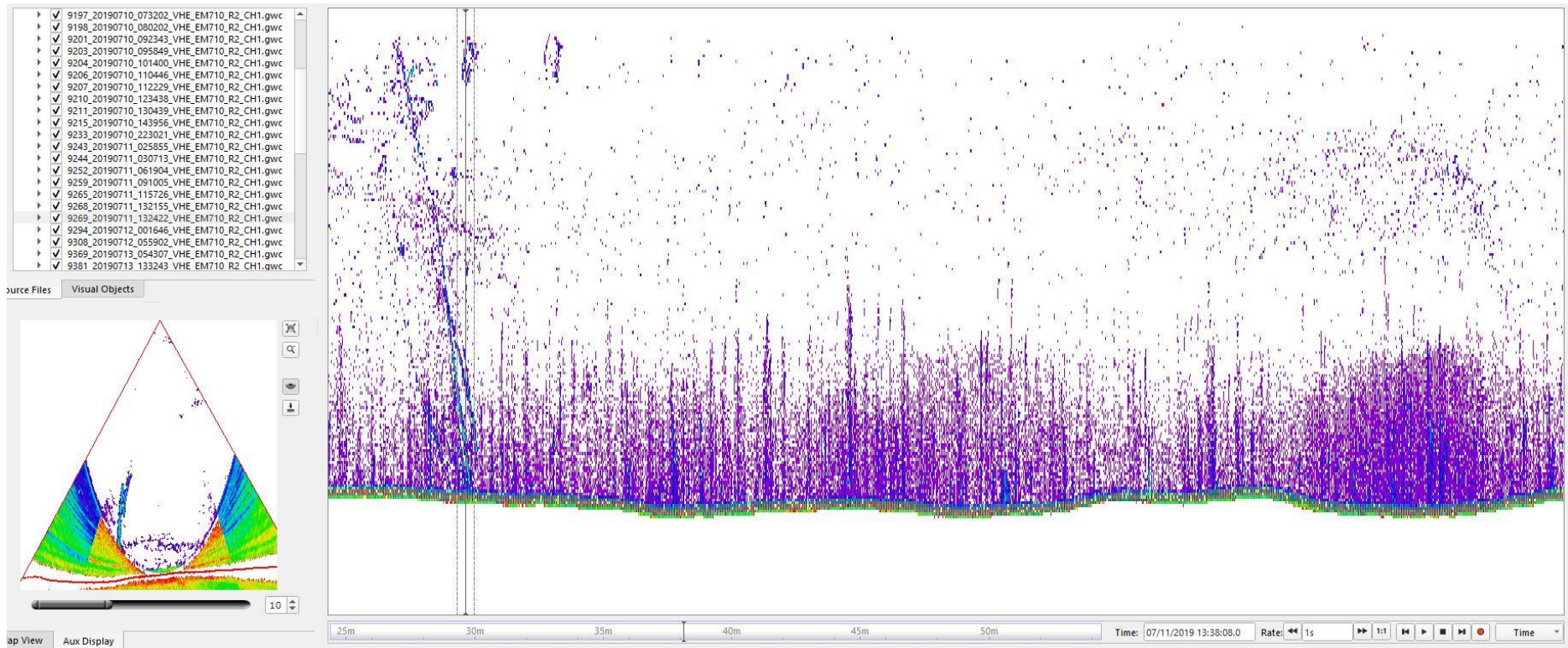


Figure 83. Gas flare c from line 9269 showed on Fan view and stack view. Magnitude 5, Confidence 80%.

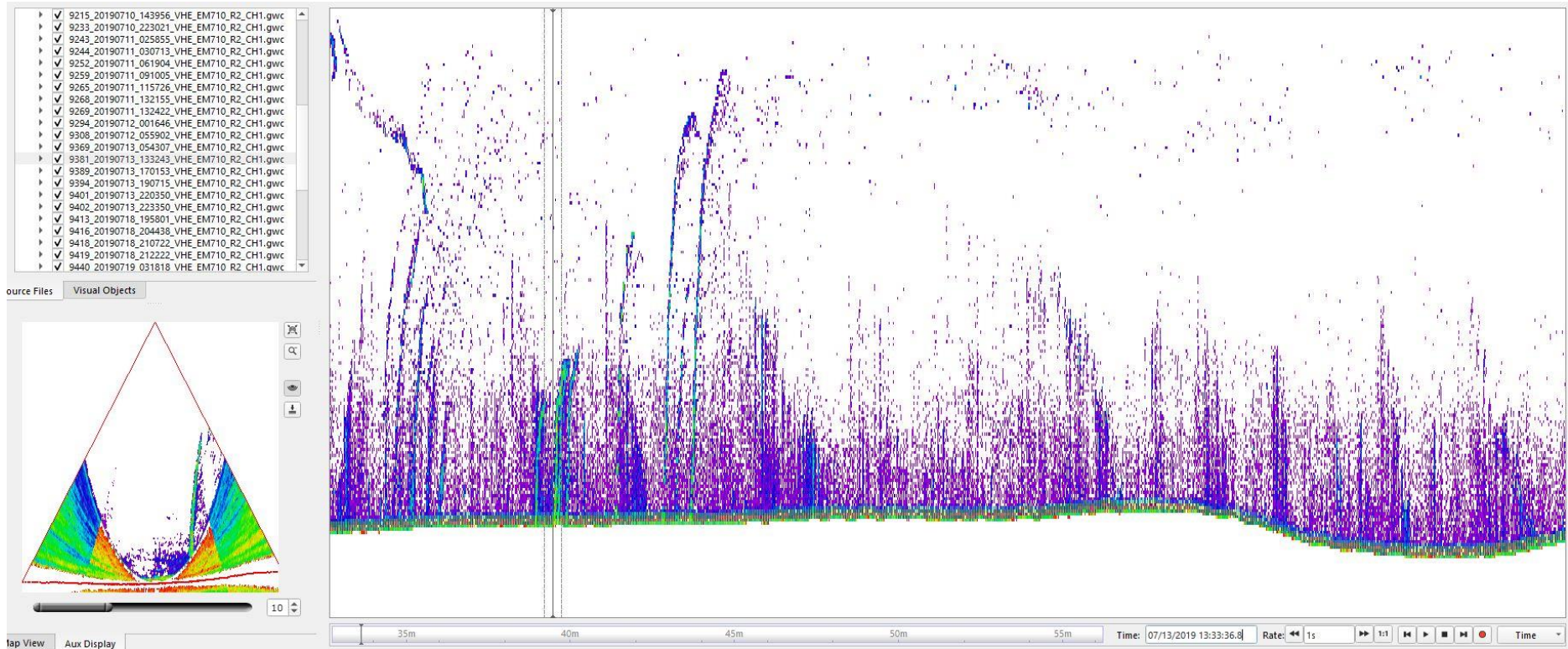


Figure 84. Gas flare g from line 9381 showed on Fan view and stack view. Magnitude 4, Confidence 80%.

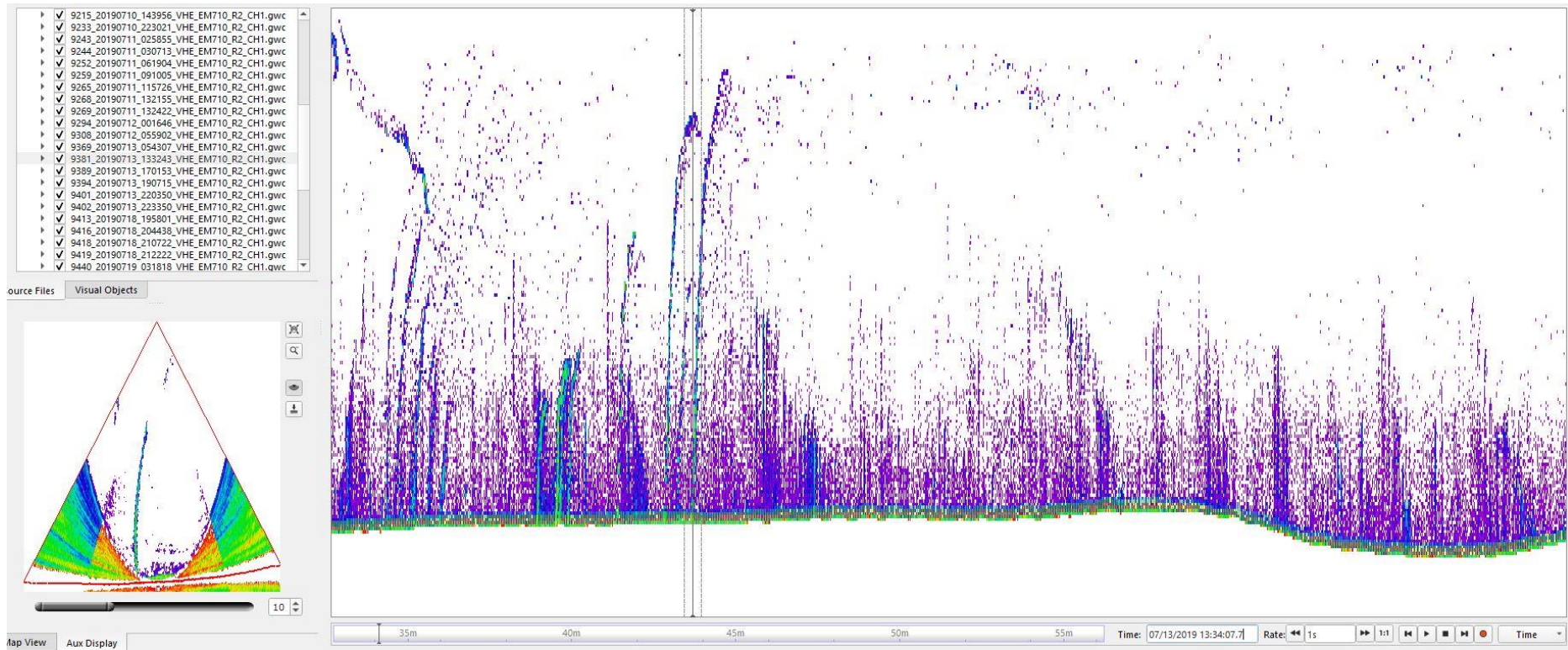


Figure 85. Gas flare j from line 9381 showed on Fan view and stack view. Magnitude 4, Confidence 80%.

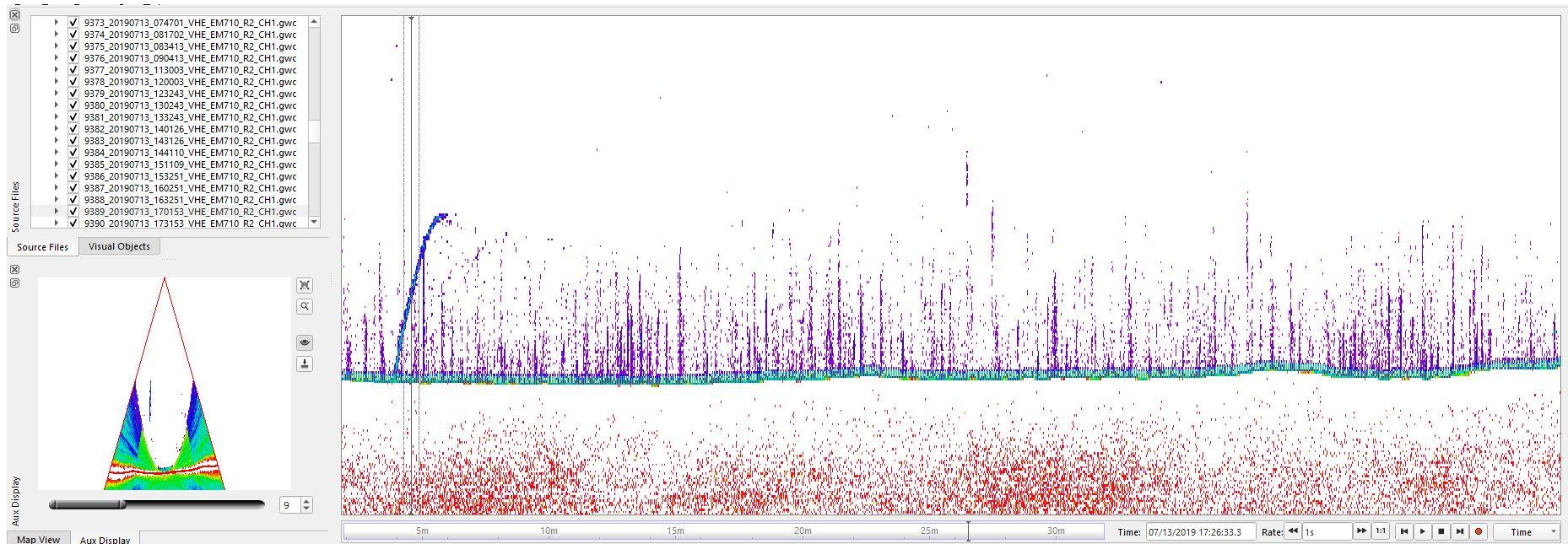


Figure 86. Gas flare from line 9389 showed on Fan view and stack view. Magnitude 4, Confidence 80%.

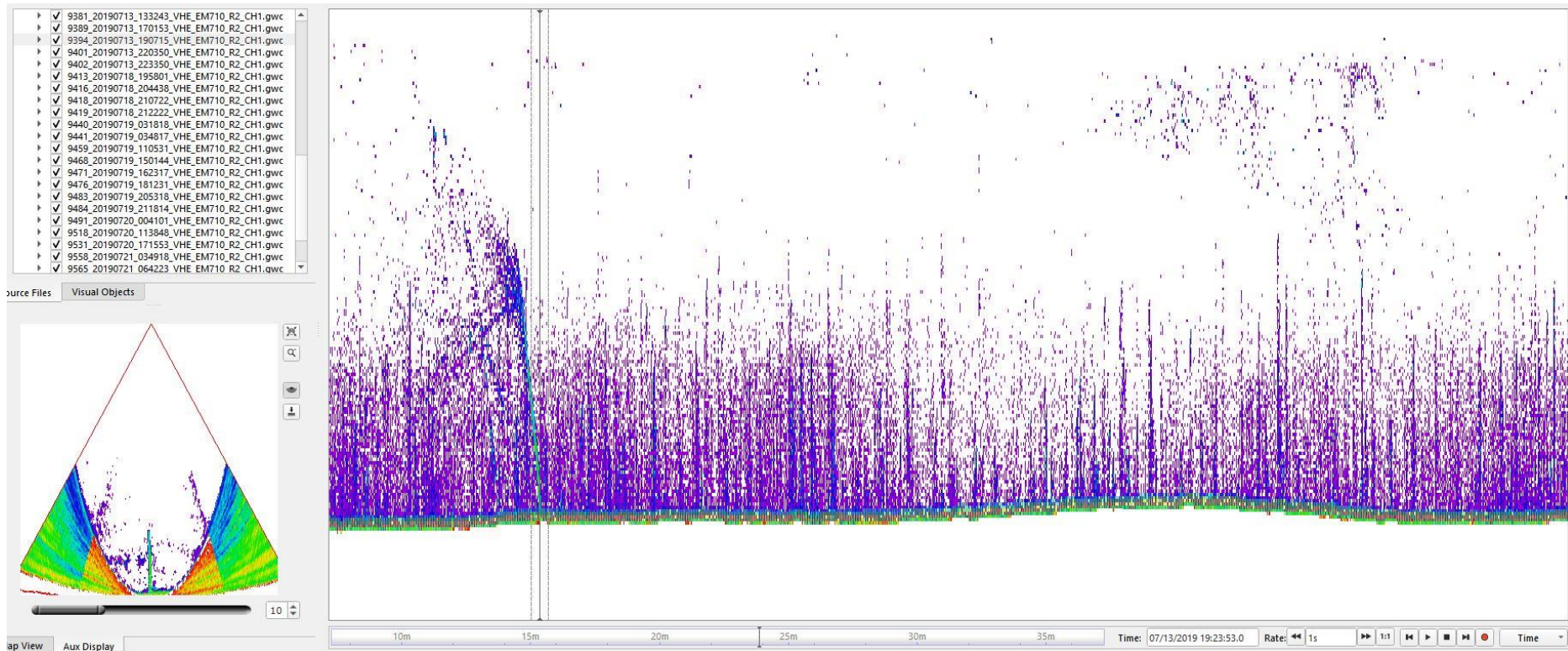


Figure 87. Gas flare b from line 9394 showed on Fan view and stack view. Magnitude 4, Confidence 80%.

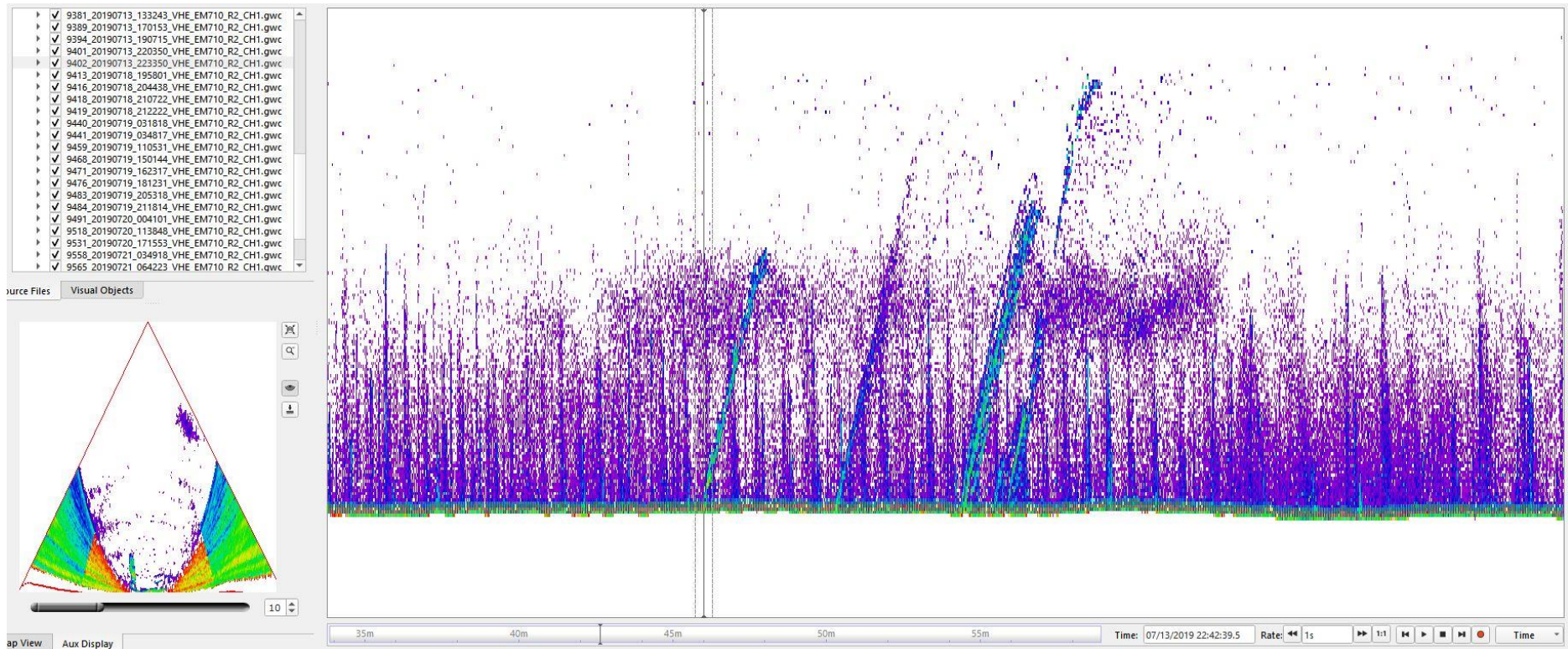


Figure 88. Gas flare a from line 9402 showed on Fan view and stack view. Magnitude 4, Confidence 80%.

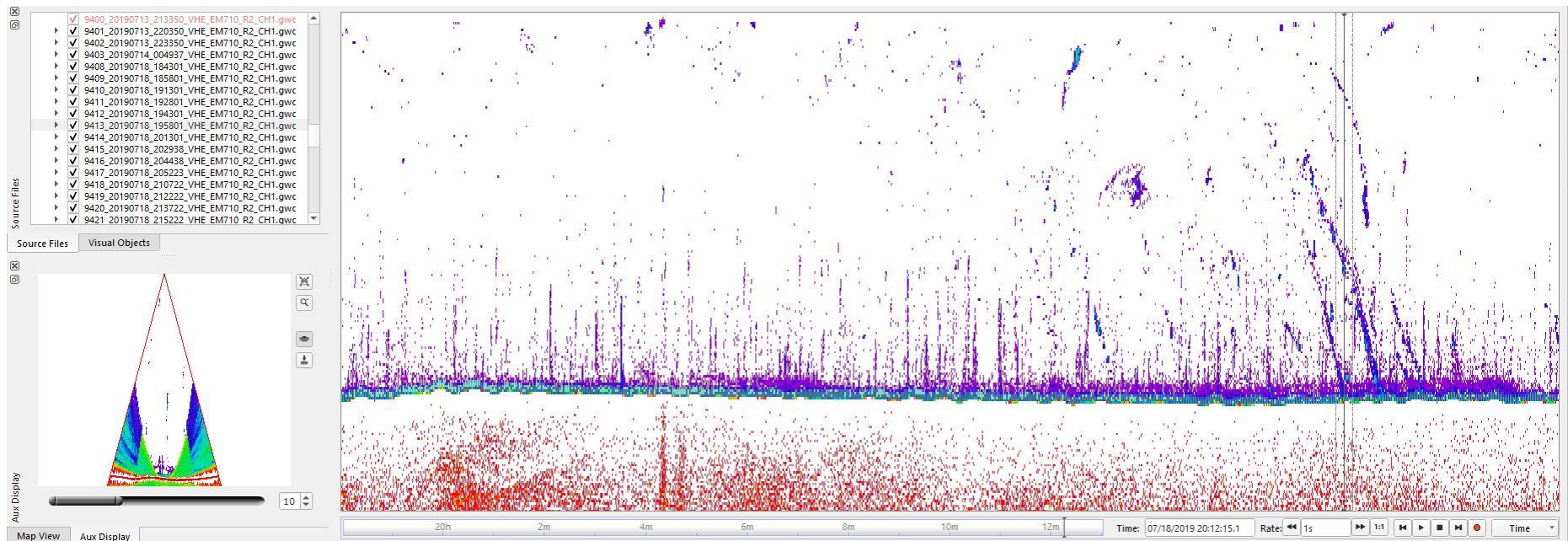


Figure 89. Gas flare from line 9413 showed on Fan view and stack view. Magnitude 4, Confidence 80%.

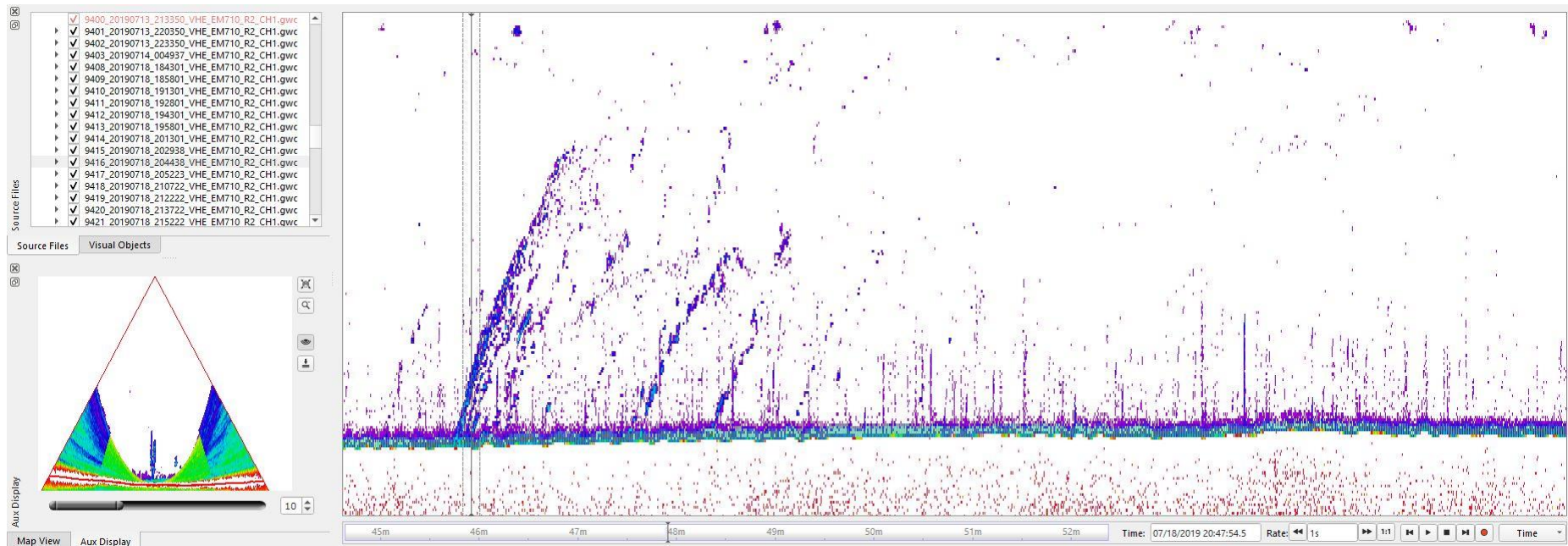


Figure 90. Gas flare from line 9416 showed on Fan view and stack view. Magnitude 4, Confidence 80%.

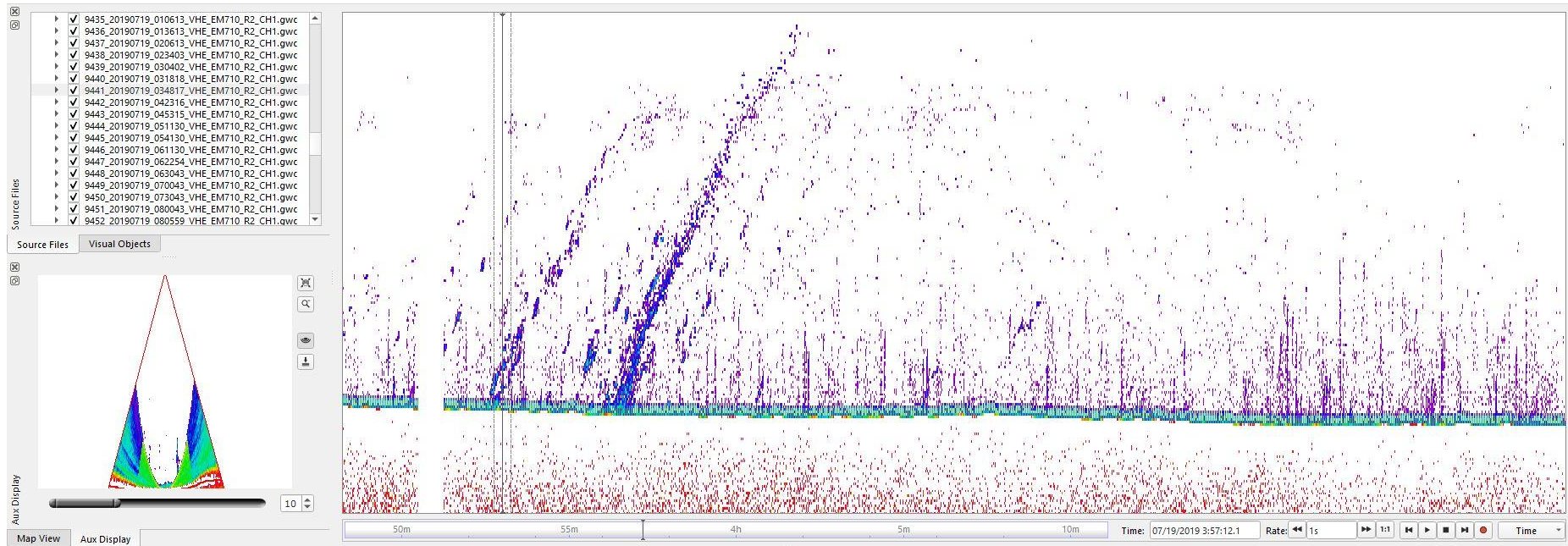


Figure 91. Gas flare from line 9441 showed on Fan view and stack view. Magnitude 4, Confidence 80%.

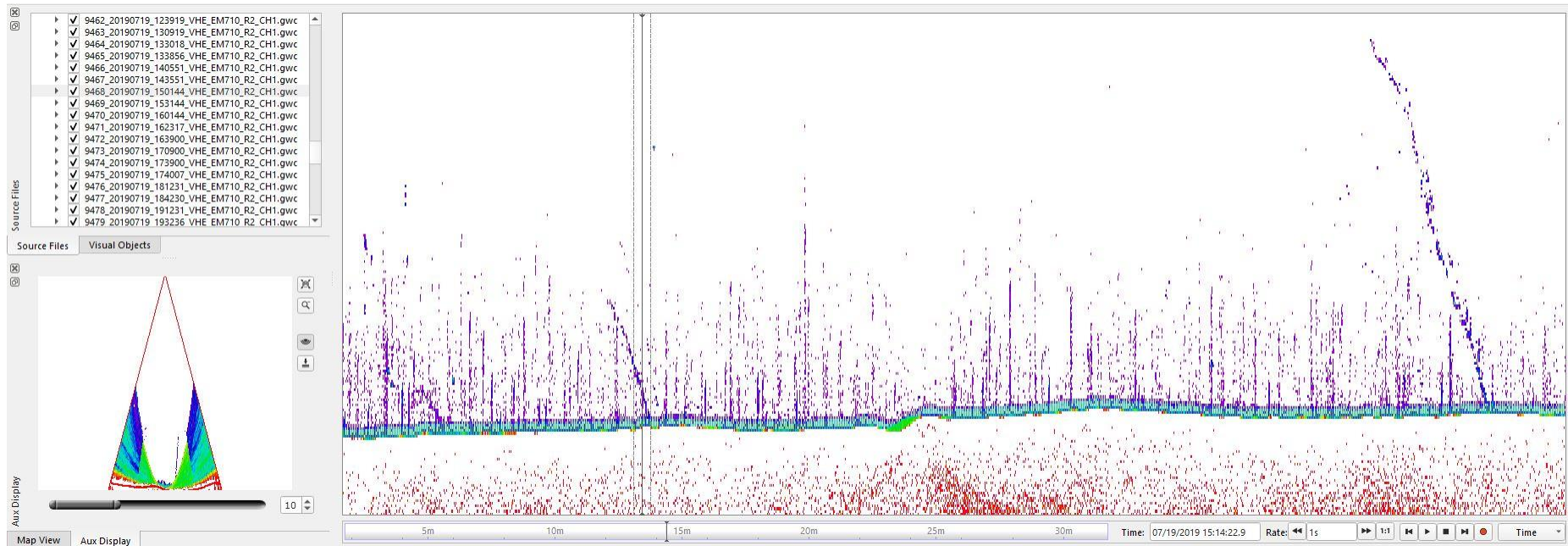


Figure 92. Gas flare from line 9468 showed on Fan view and stack view. Magnitude 4, Confidence 80%.

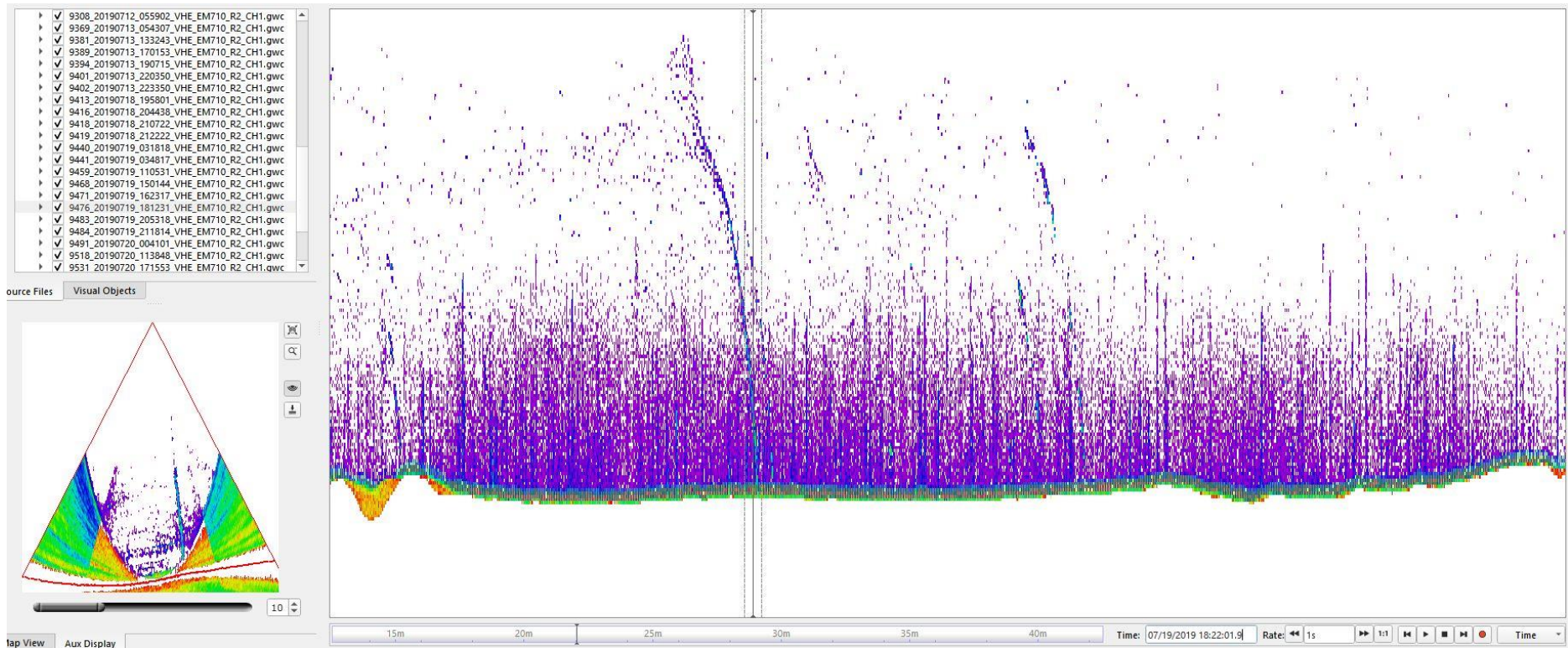


Figure 93. Gas flare b from line 9476 showed on Fan view and stack view. Magnitude 4, Confidence 80%.

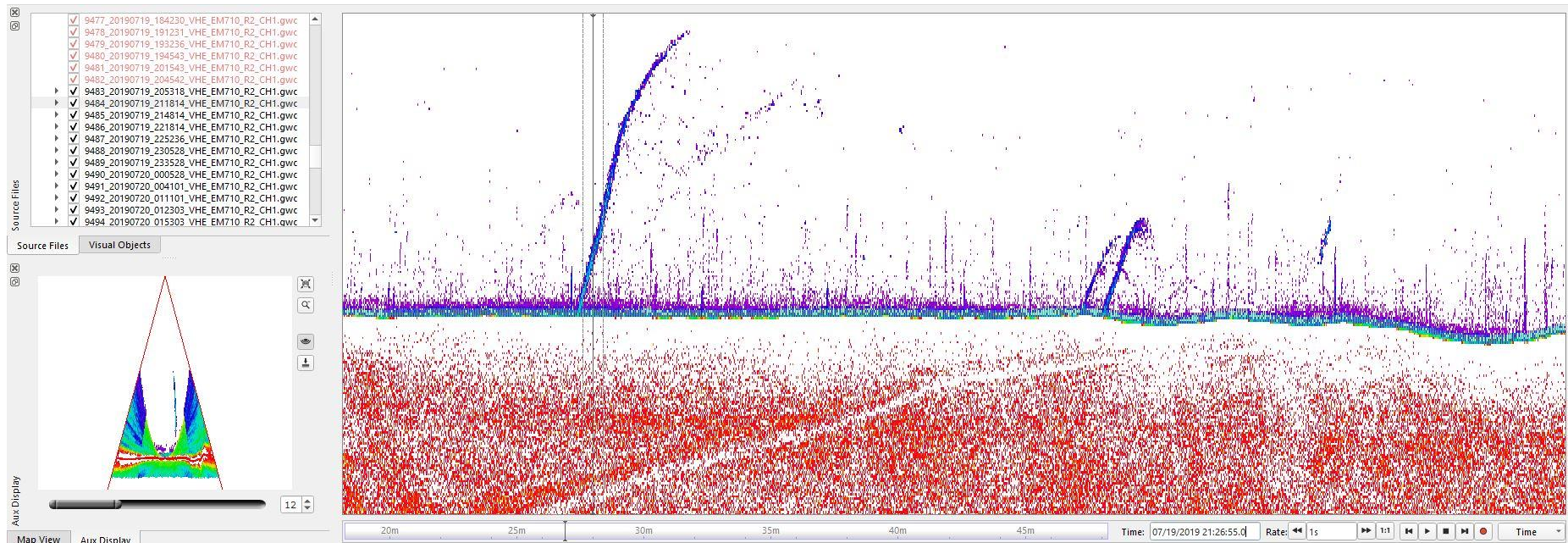


Figure 94. Gas flare from line 9484 showed on Fan view and stack view. Magnitude 4, Confidence 80%.

4.4.8 Meritaito-2021-Hopendjupet

The Meritaito-2021-Hopendjupet survey consists of 106 water column (.wcd) survey lines, recorded with EM2040. The data was loaded in Fledermaus Midwater along with navigation (.all) and converted to GWC files. 11 flares of varying magnitude and confidence were picked for location from this survey (Table 8). Most of the flares are visible on stack sections shown for picked flares. The picked flares are shown on bathymetry map (Fig. 95). Since there are no flares with sizes larger than or equal to 4 no fan and stack views are shown.

Table 8. Details of flares identified from Survey Area Meritaito-2021-Hopendjupet.

LineId	Latitude	Longitude	Depth	Height	Time	Magnitude	Confidence
11	75.389832	32.745792	-273	225	07/26/2021 6:48:57.2	2	60
18	75.39995	32.664457	-263	200	07/26/2021 9:59:19.0	2	40
45	75.396896	32.48304	-277	180	07/26/2021 23:38:22.408	2	30
45	75.392707	32.511345	-269	250	07/26/2021 23:35:06.787	2	50
45	75.393383	32.504217	-272	180	07/26/2021 23:35:50.198	2	50
45	75.399405	32.480541	-280	200	07/26/2021 23:39:14.2	2	60
45	75.401823	32.467336	-282	230	07/26/2021 23:40:53.3	2	40
50	75.377967	32.53202	-272	170	07/27/2021 2:31:28.112	2	60
51	75.378331	32.52983	-270	230	07/27/2021 2:31:43.204	2	60
71	75.394859°	32.350252°	-286	125	07/28/2021 5:23:47.5	3	60
91	75.412424	32.518158	-271	150	07/29/2021 5:48:04.6	2	30

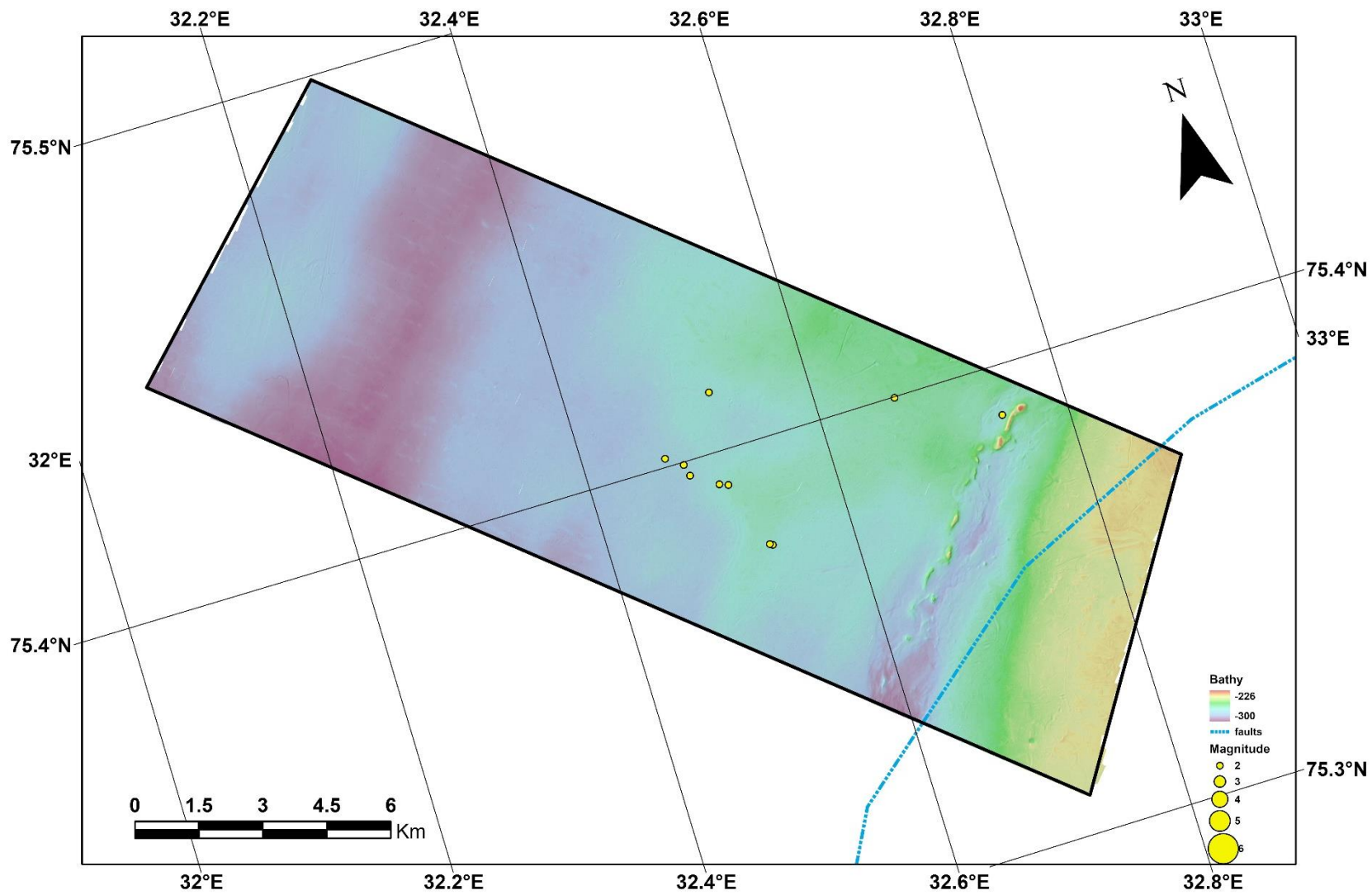


Figure 95. Flare locations from additional area Meritaito-2021-Hopendjupet shown on bathymetry map from the area.

4.4.9 Meritaito-2021 SlickEmissionPoints

The Meritaito-2021_SlickEmissionPoints survey consists of 49 water column (.wcd) survey lines recorded with EM2040. The data was loaded in Fledermaus Midwater along with navigation (.all) and converted to GWC files. 7 flares of varying magnitude and confidence were picked for location from this survey (Table 7). Most of the flares are visible on stack sections shown for picked flares. The picked flares shown on bathymetry map (Fig. 96) and those with magnitude 4 and above shown individually on fan and stack views in Figs. 97-101.

Table 9. Details of flares identified from Survey Area Meritaito-2021_SlickEmissionPoints.

LineId	Latitude	Longitude	Depth	Height	Time	Magnitude	Confidence
24	75.233705	31.808685	-320.00	270.00	07/28/2021 16:40:12.5	4	90
27	75.232457	31.776425	-324.00	280.00	07/28/2021 17:55:19.8	5	90
29	75.229759	31.737386	-324.55	100.00	07/28/2021 18:47:07.6	3	80
29	75.232457	31.776425	-323.88	170.00	07/28/2021 18:47:31.6	4	80
31	75.229780	31.738201	-324.41	205.00	07/28/2021 19:23:06.5	4	90
33	75.207046	31.584799	-338.61	220.00	07/28/2021 19:54:41.8	4	90
34	75.207271	31.583517	-337.45	135.00	07/28/2021 20:48:48.7	3	80

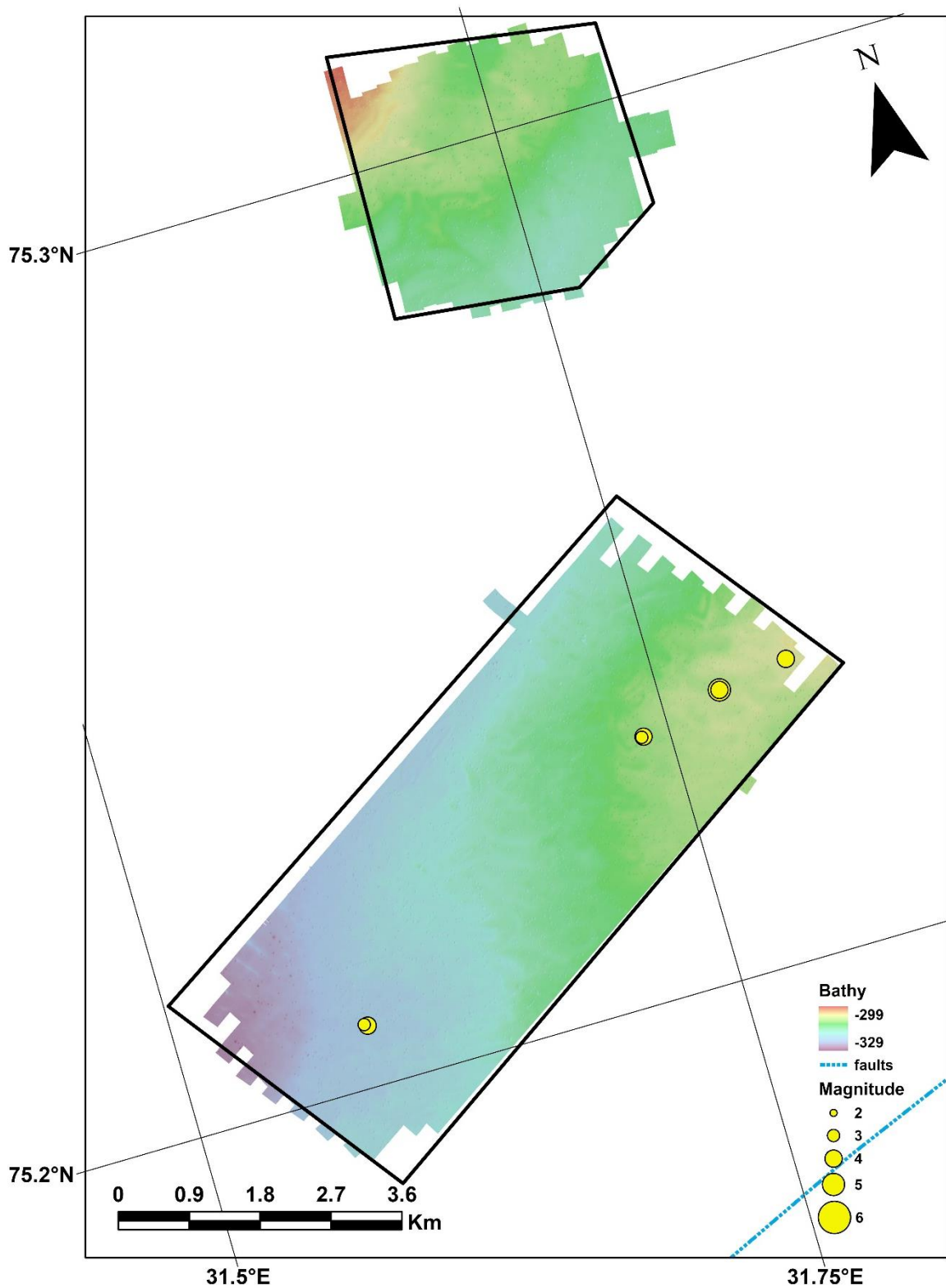


Figure 96. Flare locations from additional area Meritaito-2021_SlickEmissionPoints shown on bathymetry map from the area.

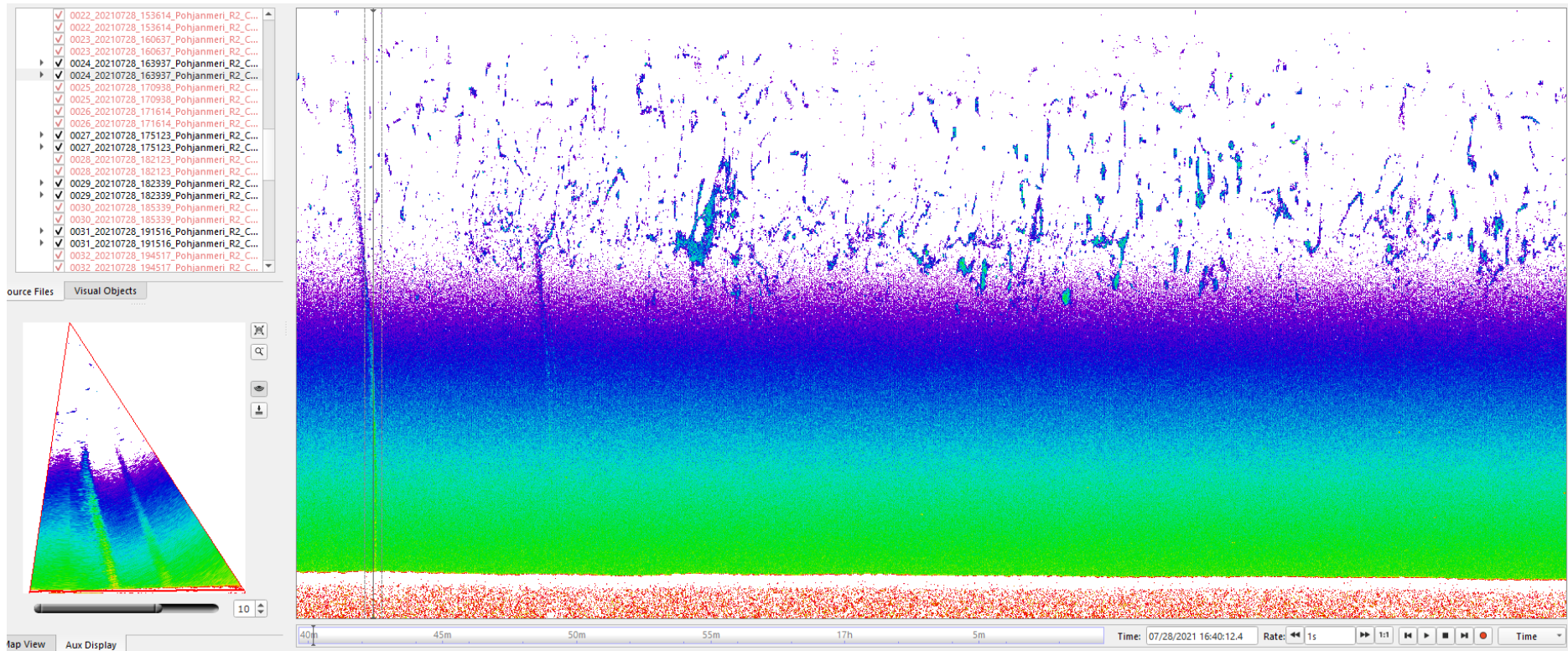


Figure 97. Gas flare from line 24 showed on Fan view and stack view. Magnitude 4, Confidence 90%.

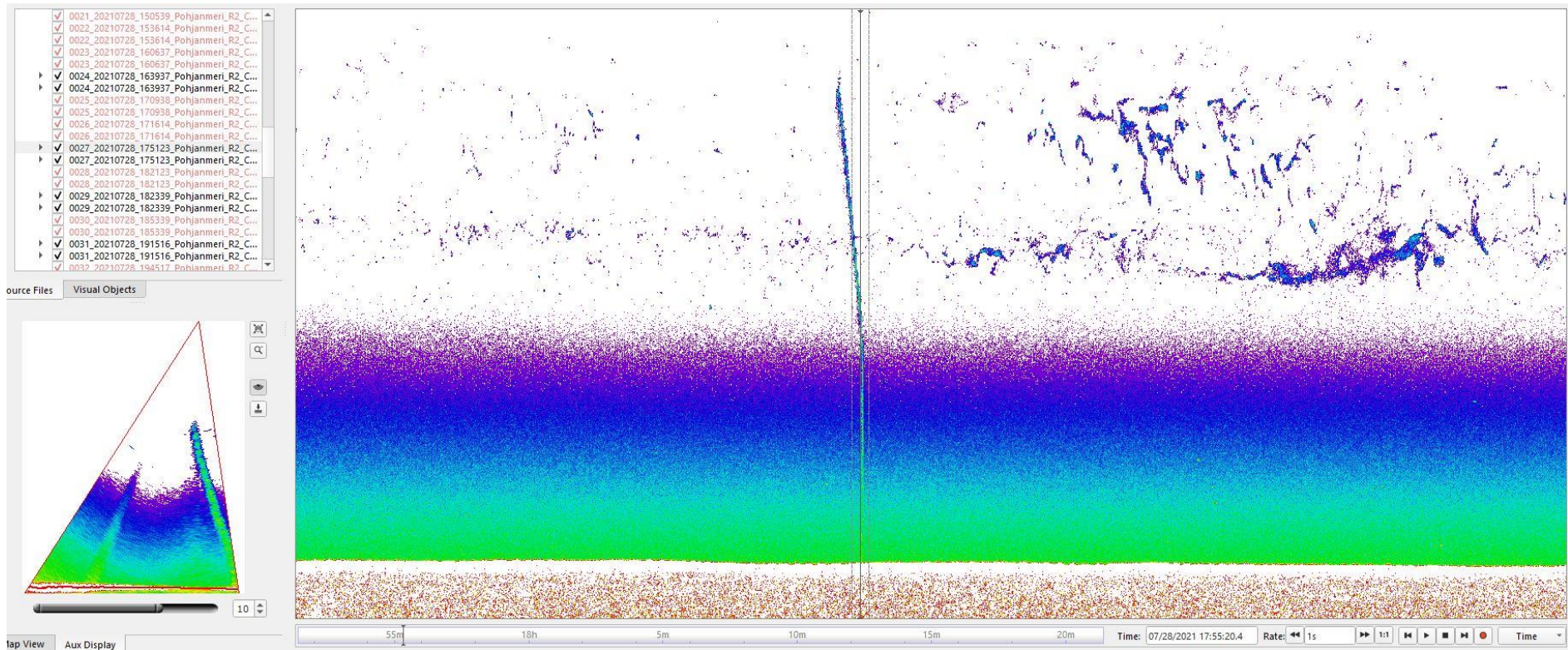


Figure 98. Gas flare from line 27 showed on Fan view and stack view. Magnitude 5, Confidence 90%.

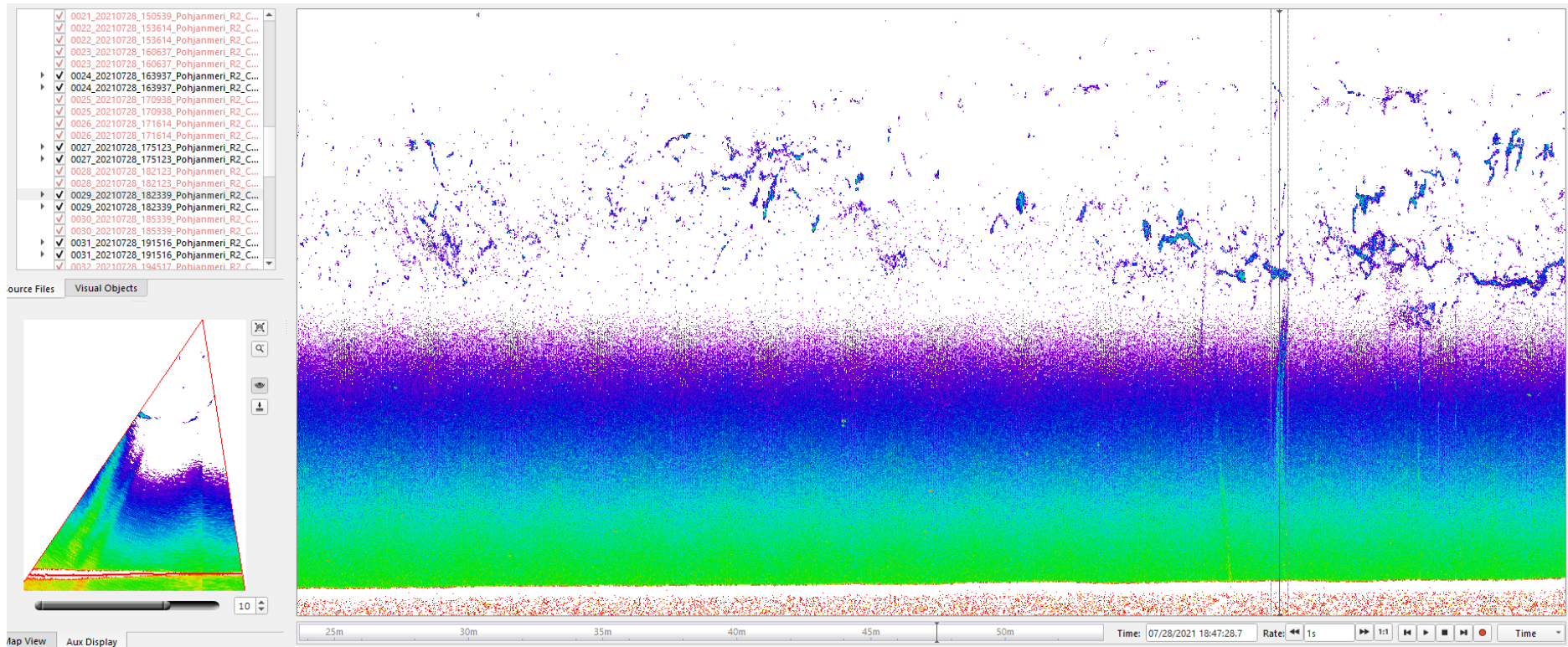


Figure 99. Gas flare from line 29 showed on Fan view and stack view. Magnitude 4, Confidence 80%.

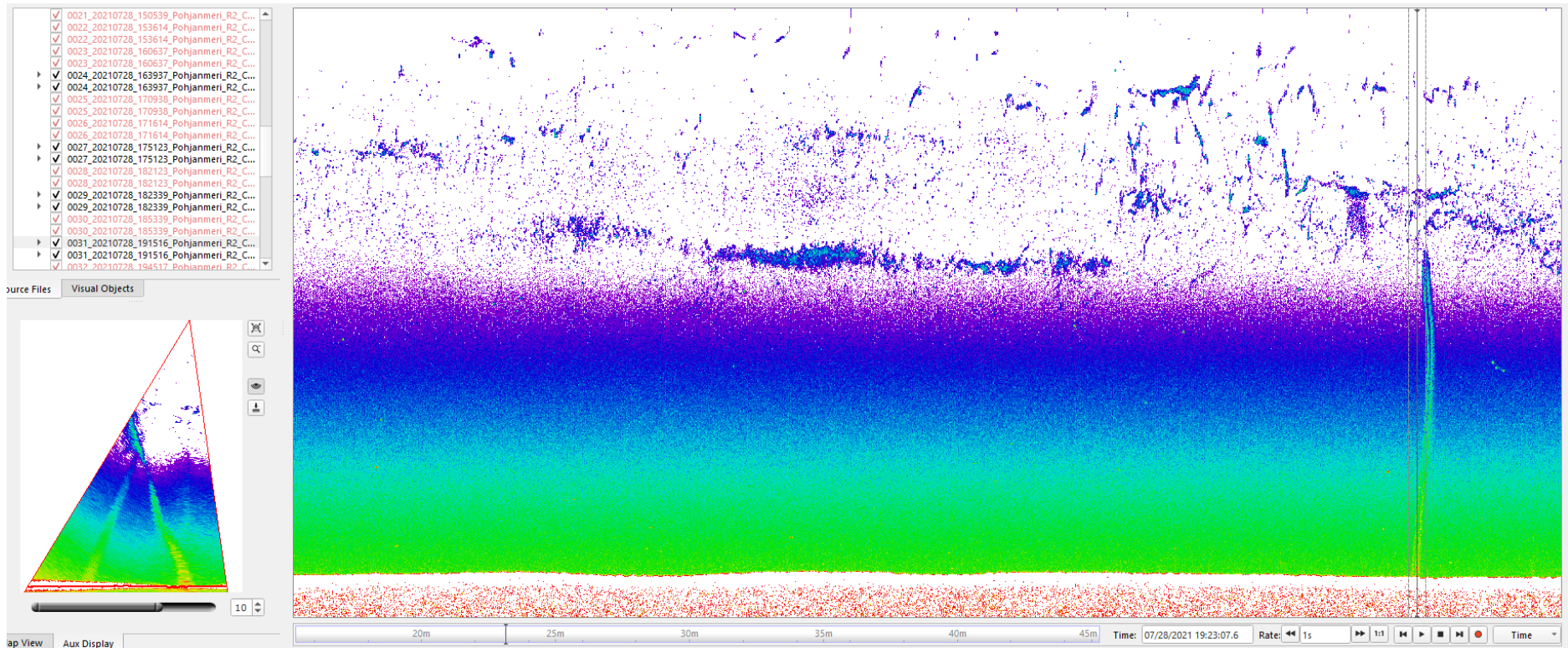


Figure 100. Gas flare from line 31 showed on Fan view and stack view. Magnitude 4, Confidence 90%.

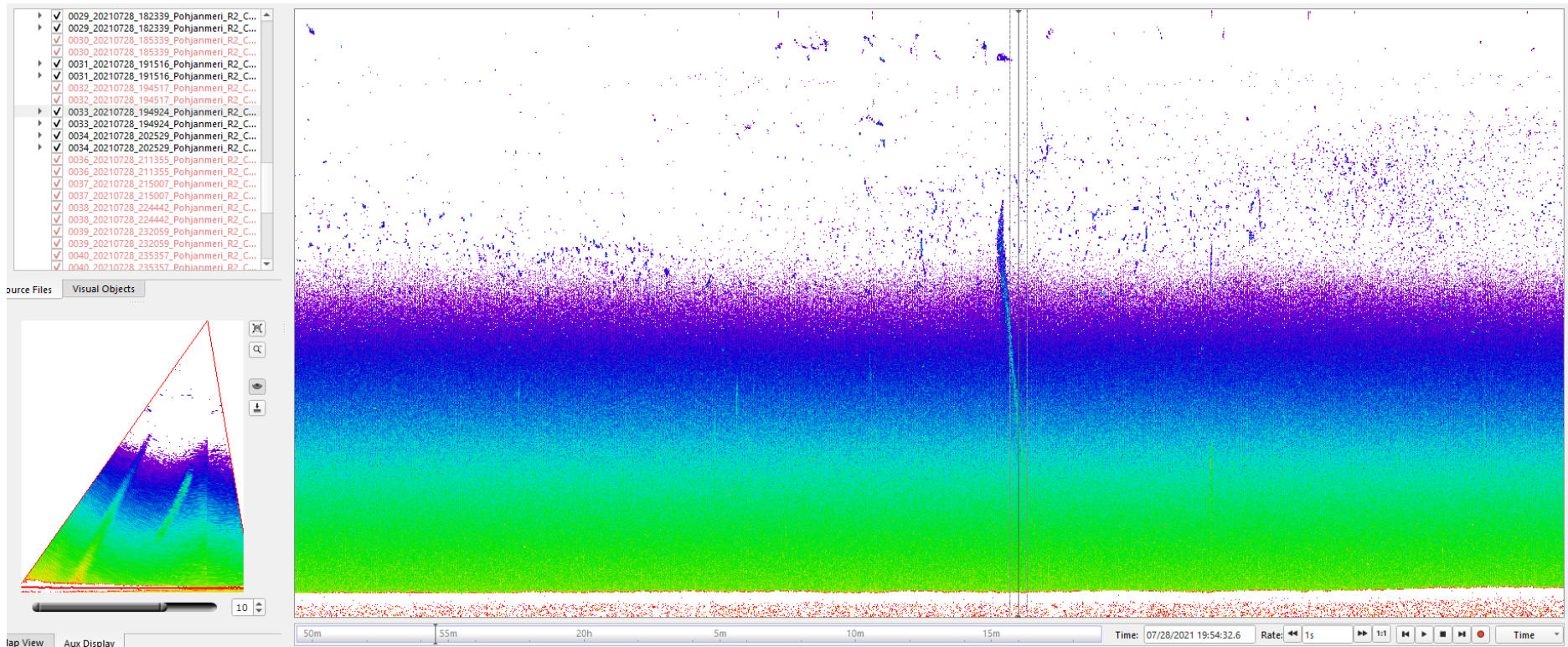


Figure 101. Gas flare from line 33 showed on Fan view and stack view. Magnitude 4, Confidence 90%.

5. Conclusions

Flares are observed with high confidence in the survey locations and are distributed all over the study area. A relation to the subsurface structural features can be observed based on the regional tectonic map of the region. A total of 725 certain and uncertain gas flares have been found in the water column data, of which 105 are magnitude 4 and above.

6. References

- Andreassen, K., Hubbard, A., Winsborrow, M., Patton, H., Vadakkepuliambatta, S., Plaza-Faverola, A., Gudlaugsson, E., Serov, P., Deryabin, A., Mattingsdal, R., Mienert, J., Buenz, S. 2017. Massive blow-out craters formed by hydrate-controlled methane expulsion from the Arctic seafloor. *Science*, 356, 948-953.
- Chand, S., Cremiere, A., Lepland, A., Thorsnes, T., Brunstad, H., Stoddart, D. 2016: Long-term fluid expulsion revealed by carbonate crusts and pockmarks connected to subsurface gas anomalies and palaeo-channels in the central North Sea. *Geo Marine Letters*, doi.10.1007/s00367-016-0487-x.
- Chand, S., Thorsnes, T., Rise, L., Bøe, R. 2012a: Pockmarks, gas flares, tectonic features and processes leading to their formation, southwestern Barents Sea. NGU Report 2012.017.
- Chand, S., Thorsnes, T. 2020: Processing and interpretation of water column data from the Polarrev High, Barents Sea. NGU Report 2020.025.
- Chand, S., Thorsnes, T., Brunstad, H., Stoddart, D., Bøe, R., Lågstad, P., Svolsbru, T. 2012b: Huge gas flares, pockmarks and gas accumulation along the Loppa High, SW Barents Sea indicate multiple episodes of formation and fault controlled focused fluid flow. *Earth and Planetary Science Letters*, 331-332, 305-314.
- Milkov, A.V., Sassen, R. 2003: Two-dimensional modeling of gas hydrate decomposition in the northwestern Gulf of Mexico: significance to global change assessment. *Global and planetary Change* 36, 31-46.
- Nixon, F. C., Chand, S., Thorsnes, T., Bjarnadottir, L.R. 2019: A modified gas hydrate-geomorphological model for a new discovery of enigmatic craters and seabed mounds in the Central Barents Sea, Norway. *Geo Marine Letters*, doi.org/10.1007/s00367-019-00567-1.
- NPD 2018: <https://www.npd.no/en/facts/news/general-news/2018/Successful-seismic-acquisition-on-Gardarbank-High/>
- Sheriff, R. 1980: Nomogram for Fresnel zone calculation. *Geophysics* 45, 968-972.
- Skarke, A., Ruppel, C., Kodis, M., Brothers, D., Lobecker, E. 2014: Widespread methane leakage from the sea floor on the northern US Atlantic margin: *Nature Geoscience*. doi.10.1038/NGEO2232
- Urban, P., Koser, K., Greinert, J. 2017: Processing of multibeam water column image data for automated bubble/seep detection and repeated mapping. *Limnology Oceanography: Methods* 15, 1-21. Doi.10.1002/lom3.10138.



NORGES
GEOLOGISKE
UNDERSØKELSE
· NGU ·

Norges geologiske undersøkelse
Postboks 6315, Sluppen
7491 Trondheim, Norge

Besøksadresse
Leiv Eirikssons vei 39
7040 Trondheim

Telefon 73 90 40 00
E-post ngu@ngu.no
Nettside www.ngu.no