SEA BOTTOM (GEOPHYSICAL AND GEOTECHNICAL) SURVEYS IN THE LITHUANIAN MARINE AREA WHERE IT IS REASONABLE TO ORGANISE TENDERS FOR THE DEVELOPMENT AND EXPLOITATION OF THE WIND POWER PLANTS

Part II

GEOPHYSICAL SHALLOW SEISMICS AND HYDROGRAPHIC SURVEY

2022-07-20

CONTRACTING AUTHORITY	Ministry of Energy of the Republic of Lithuania, Gedimino av. 38, Vilnius, e-mail info@enmin.lt, phone: +37070664715
SUPPLIER	Acting on behalf of joint venture agreement between: JSC „Garant Diving“ (Responsible partner) and JSC „Geobaltic“ (Partner)
RESPONSIBLE EXECUTOR	JSC „Geobaltic“, Miglos str. 5-13, Vilnius, e-mail info@geobaltic.lt, phone: +37069954953

Content

I. Methods and equipment

I. 1. Survey task

According to the undersigned agreement (hereafter – Agreement) with Ministry of Energy of the Republic of Lithuania (No. 8-34; dated 2022-04-26), it is obliged to carry out the sea bottom (geophysical and geotechnical) surveys in the Lithuanian marine area where it is reasonable to organize tenders for the development and exploitation of the wind power plants. Current report provides results of the IInd part of the survey, i.e. seabottom hydrographic and shallow geophysical investigations. Survey covers:

(1) Investigation of geological structure of the upper part of the seabottom up to 100 m deep using shallow seismics;
(2) Seabottom morphology and distribution of superficial sediments using hydrographic – geophysical methods.
And, as a result of above mentioned survey it is mandatory to **(3) recommend sites for deep drilling, vibro-coring and CPT testing** (those results to be reported after III^{d} part of the survey as per Agreement conditions).

I.2. Survey vessels

MINTIS

- Type: Catamaran
- Registration (IMO) number: 9713636
- Flag: LT
- Built: 2014
- Length: 39,25 m.
- Breadth: 12 m.
- Draught: 3,6 m.
- Gross tonnage: 499 tons
- Dynamic positioning: DP1
- DGPS: Septentrio RTK DGPS AsteRx-U MARINE Fg

BALTIC EXPLORER

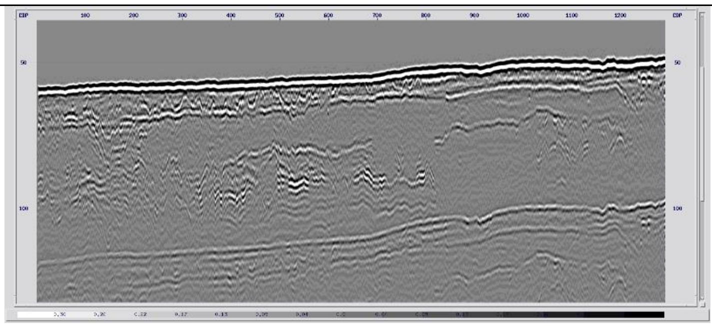
- Type: Vienkorpusinis
- Registration (IMO) number: 8917663
- Flag: LT
- Built: 1991
- Length: 45,6 m.
- Breadth: 11,5 m.
- Draught: 3,1 m.
- Gross tonnage: 498 tons
- Dynamic positioning: DP1
- DGPS: RTK DGPS Spectra Geospatial SP90m

I. 3. Shallow seismic survey

Multichannel seismic survey

Seismic data was collected along predetermined profiles, a seismic pulse is generated by a seismic source (sparker), pulse propagates through the water and the deeper geological medium and is reflected from geological boundaries characterized by a large contrast in physical properties (density and seismic wave propagation speed) between the rocks above and below. The reflected signal travels back and is recorded by seismic streamer via hydrophones.

Equipment	Parameters ant characteristics
Source: Sig mille (SIG, France) high frequency seismic source – sparker (ELC820 system)	Source energy: 500-1000 J; working frequency: 1-1.4 kHz; distance between two source points in the seismic profile: 1.5-2 meters
data registration: Multichannel GeoEel seismic streamer (Geometrics, USA)	50-metre-long streamer with 16 channels, Channel consists of 4 hydrophones; distance between channels – 3.125 meters; Seismic information was recorded for 0.2 seconds from the source excitation, recording every 0.0625 ms, i.e. - 3200 registration points on each seismic track
Positioning: ship's positioning system Septentrio RTK DGPS AsteRx-U MARINE Fg	The coordinates of the source excitation and registration points were assigned by knowing the exact coordinates of the GPS receiver on the ship and adding the known offset from the ship's GPS to the source and each receiver channel.
Data processing: Globe Claritas (Petrosys); Data interpretation: Gverse Geographix (LMKR) software	The processing workflow consisted of: • Data import • Geometry creation and assignment • Amplitude recovery • Band pass filter (100-150-5500-6000 Hz) • Muting of seabed multiple reflections • Normal move-out (NMO) correction • Raw common mid-point (CMP) stacking • Stacking velocity analysis • Preliminary common mid-point (CMP) stacking • F-X deconvolution and band pass filter • Final common mid-point (CMP) stacking • 2D data export (SEG-Y) • Combining 2D data into a 3D data array • 3D data export (SEG-Y) Seismic cross-sections obtained during processing are interpreted in the next step by creating structural, depth and thickness maps for all observed seismic horizons (SH).

	 *Seismic cross section (final CMP stack)*
Data presentation	The processed seismic sections are presented in digital SEG-Y format; Interpreted structural time and depth maps are presented in digital *.XYZ format;

I.4. Hydrographic – geophysical survey of seabottom

Set up of complex hydrographic – geophysical survey.
Hydrographic – geophysical seabottom survey was organized in 3 campaigns:
1st leg survey included deployment and operation of multibeam echosounding equipment (for seabottom morphology and depths), side scan sonar (for identification of targets on the seabottom and analysis of superficial sediments distribution) and multi-channel seismic equipment (for assessment of vertical seabottom structure). All equipment was collecting the data at the same time while vessel was surveying along the pre-defined survey lines.
2nd leg survey was organized in order to collect samples from the seabottom. Those were used for interpretation of the side scan sonar data and while developing the superficial sediments distribution scheme;
3d leg survey covered deployment and operation of seismoacoustic subbottom profiler equipment (for uppermost structure of the seabottom) and magnetometers (analysis of magnetic anomalies). Survey was carried out along the same survey lines as during the 1st leg campaign.

I.4.1. Multibeam echosounding (MBES)

The multibeam echosounder and the motion sensor were mounted on a single frame, which was placed in a special 0.5x0.5 m moon-pool of the Mintis. During operation, the multibeam echo sounder is set to the working position so that the sonar sensors are out of the ship's hull. Using the ship's positioning system and RTK corrections, the exact coordinate of each measurement reflection is obtained, and the distortions obtained due to the ship's movements are compensated through the activation of the stationary gyrocompass and motion sensor. The depth discrepancy due to the different speed of sound propagation in water (caused by changing temperature and salinity) is eliminated by adapting the results of the sound speed profile measurements.

Equipment	**Technical parameters**
Multibeam echosounder Teledyne Reson Seabat 7125 SV2;	Operational frequency: 400 kHz; Number of beams – 512; Depth resolution – 6 mm;

Stationary gyrocompass and motion sensor Ixblue Octans 3000 Rovins;	Heading accuracy: 0.1° secant latitude, resolution: 0.01°, full accuracy setting time: < 5 min; Heave accuracy: 2.5 cm or 2.5% (whichever is greater); Roll/Pitch dynamic accuracy: 0.01°, resolution: 0.001°
Sound velocity probe Reson SVP70 and sound velocity profiler Sea&Sun CTM48M CTD	Resolution: 0,1 m/s; Accuracy: ± 0,15 m/s Range: 1350–1600 m/s
Data acquisition and processing software QPS QINSy V9.5/Qimera V2.4.9	Standard procedures were used to process the depth measurement data: • Positioning correction; • Evaluation of the correction of changes due to sound propagation in water; • Automatic and, if necessary, manual elimination of acoustic noise; • Export to custom size grid.
Data delivery	The processed data is provided in a 1x1 m resolution grid - in an array of depth points in *.TXT format and a bathymetric/depth scheme is provided in *.TIF format.

I.4.2. Side scan sonar (SSS)

When performing a seabottom scanning with a side scan sonar device, in addition to the sonar itself, an underwater positioning system and a hydrographic winch are used to tow the sonar and transfer data to the ship. The integrated system ensures that the position of the device towed overboard by a special cable is precisely fixed by applying the ship's positioning system and the corresponding position correction is obtained from the underwater positioning system (USBL).

Equipment	**Technical parameters**
Side scan sonar L-3 Klein 3000	Dual frequency: low – 132 kHz, high - 445 kHz; Beams: Horizontal: 0.7° @ 132 kHz, 0.21° @ 445 kHz Vertical: 40°
Underwater Positioning System Sonardyne Ranger Mini	Frequency range:19-34 kHz; Position update frequency: 3 Hz; Acoustic beacons: 2 pcs; Position accuracy: 1,3 % of direct distance;
Hydrographic winch for sonar towing and data transfer emma DT3025-EHLWR (emma technologies GmbH)	Power supply: 400V/ 50 Hz; Drum capacity: 500 m of coaxial Ø10,4mm cable, Break strength: 58kN Load: 12 kN

Data processing: object identification was performed with the original Klein SonarPro software; the acoustic image mosaic was created using the specialized hydrographic software Hypack	Standard image processing procedures were performed when processing the side scan data: • signal amplification, • geometric correction of the data was performed; • by adjusting the signal strength - the image is smoothed; • "blind" zone is removed. Deliverables: Overview (low resolution) side scan map (mosaic) - in *.GeoTiff format; Processed side scan sonar data for each profile: in *.xtf format; Lithological scheme of surface deposits (according to SSS interpretation and analysis of bottom samples): lithotype scheme is provided in *.GeoTiff format, lithotype boundaries/polygons in ESRI *.shp format; A scheme with the locations of objects identified on the bottom: scheme in *.GeoTiff format; point positions - ESRI *.shp format; catalog of identified objects - in *.xls table;

I.4.3. Sub bottom profiler survey (SBP)

Sub bottom profiler is seismoacoustic survey method usually used to study sediments immediately beneath the seabed. This method is single-channel, i.e. transmitter and receiver are installed in the same device, and the research method is based on the vertical reflection of the seismic wave from geological boundaries with different physical properties. The device is mounted on a ship on a side pole, and uses the ship's navigation system and motion sensors to record data coordinates.

Equipment	**Technical parameters**
Sub bottom profiler Innomar SES-2000 compact (Innomar, Germany)	Penetration depth: up to 10 m, (in perfect geological conditions up to 15-20 m. Vertical resolution: ~ 0,5 m; Working frequency: -Low: 5-15 kHz; -High: ~ 100 kHz; Pulse length: 66 to 800µs; Pulse rate: more than 30 per second.
Data processing: data acquisition performed with SESWIN software provided by equipment manufacturer. Data interpretation: Gverse Geographix (LMKR) software.	The processing workflow consisted of: • Data import • Positioning correction – elimination of geometry jumps and interpolation of gaps • Combining of data to cross sections • Band pass filter • Stacking of neighboring traces • 2D data export (SEG-Y) Deliverables:

	The processed sub bottom profiler cross sections are presented in digital SEG-Y format;

I. 4.4. Magnetic survey (MAG)

Magnetic survey was performed only in the main hydrographic-geophysical profiles.

Equipment	**Technical parameters**
Geometrics G-882 Cesium magnetometer and transverse gradiometer TVG (2x G-882);	Noise: <0,004 nT/Hz rms Heading error: <2 nT Operating range: 20 000–100 000 nT Max sample rate: 20 Hz
Data processing	The processing workflow consisted of: • Position correction – coordinates cleared of unevenness and jumps; linear interpolation of coordinates by time was used to fill the gaps (magfish_depth.grd); • Geomagnetic corrections were made using data of the observatory closest to the research object (HLP(Hel) Poland http://www.wdc.bgs.ac.uk/obsinfo/hlp.html); i.e. recalculated values of the IGRF13 Earth magnetic model and subtracted from the total measured magnetic field (total_field.grd); • Calculated residual magnetic field (total_field_reduced.grd); • In order to eliminate the influence of deeper geological structures on the magnetic field, a map was made that best reflects objects closer to the sea bottom (total_field_rugedness.grd). Submitted: Magnetometer depth map (*.grd); Measured magnetic field (*.grd); Residual magnetic field (*.grd); Summarized MAG survey data presented in the table *.csv.

I. 4.5. Sampling of seabottom sediments

Equipment	**Technical parameters**
Hydrobios Van veen type grab	Sample area: 1000 cm^2; Weight in air: 25 kg. Penetration: 5-10 cm;

II. Scope of survey

II.1. Survey area

Area in the Baltic Sea were it is foreseen the development of up to 700 MW capacity offshore wind energy park based on the decision of Government of the Republic of Lithuania according to the Resolution No. 697 (dated 2020-06-22) “Regarding the areas of the Territorial Sea and/or parts of the Exclusive Economic Zone of the Republic of Lithuania in the Baltic Sea where it is reasonable to organize tender (tenders) for the development and exploitation of the power plants utilizing the renewable energy sources and determining the installed capacity of these power plants”.

Coordinates of the survey area:

ID	X, LON	Y, LAT
1.	6214874,86	280673,02
2.	6210266,97	281731,59
3.	6205120,56	286214,29
4.	6196802,40	285443,88
5.	6196766,38	283405,67
6.	6197719,01	280435,73
7.	6202274,37	279642,58
8.	6206062,21	271362,10
9.	6207506,01	269872,71

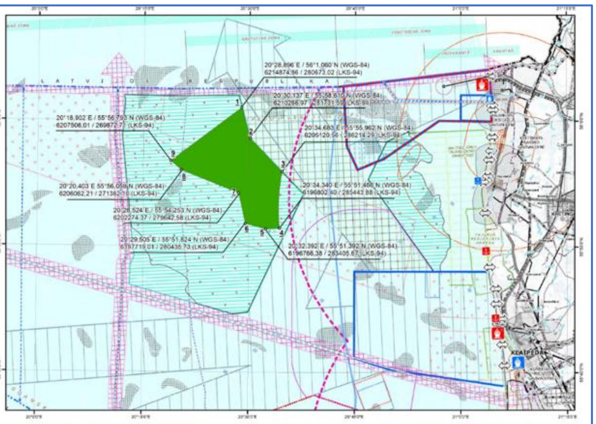


Fig. 2.1 Survey area
Coordinates provided in LKS’94 projection

II.2. Set up and distribution of seismic and hydrographic profiles:

In order to achieve the required 100% coverage by multibeam echosounder and side scan sonar, an optimal set uo of profiles was selected, placing each profile at a distance of 100 m, thus obtaining 176 parallel profiles ensuring the required "full coverage" of the survey area.

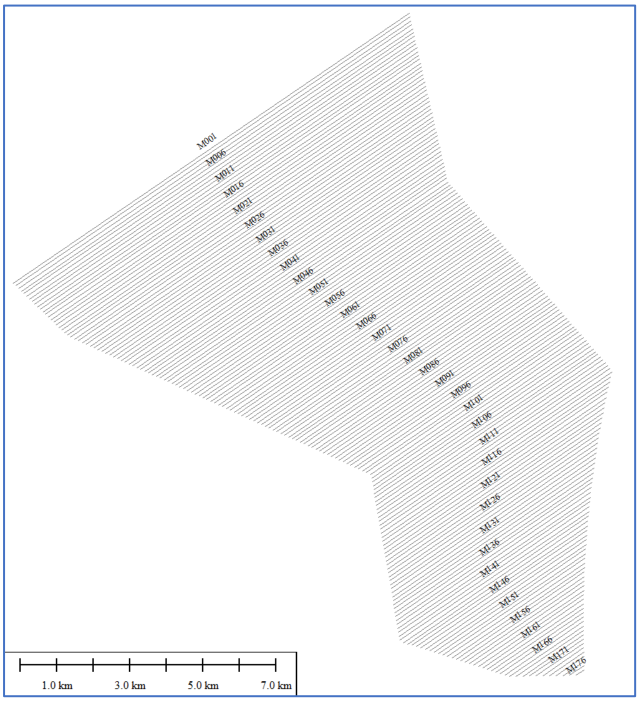


Fig. 2.2 Distribution of survey profiles
Coordinates provided in LKS’94 projection

ID	X1	Y1	X2	Y2
M001	269872,7	6207506	280672,6	6214875
M002	269946,1	6207435	280697,1	6214770
M003	270019,5	6207364	280721,1	6214665
M004	270092,9	6207293	280745,2	6214561
M005	270166,4	6207222	280769,2	6214456
M006	270239,8	6207151	280793,3	6214351
M007	270313,2	6207080	280817,3	6214247
M008	270386,6	6207009	280841,4	6214142
M009	270460	6206938	280865,4	6214037
M010	270533,4	6206867	280889,5	6213933
M011	270606,8	6206796	280913,5	6213828
M012	270680,2	6206725	280937,6	6213723
M013	270753,6	6206654	280961,6	6213618
M014	270827	6206583	280985,7	6213514
M015	270900,5	6206512	281009,8	6213409
M016	270973,9	6206441	281033,8	6213304
M017	271047,3	6206370	281057,9	6213200
M018	271120,7	6206299	281081,9	6213095

M019	271194,1	6206228	281106	6212990
M020	271267,5	6206157	281130	6212886
M021	271340,9	6206086	281154,1	6212781
M022	271436,3	6206030	281178,1	6212676
M023	271542,5	6205981	281202,2	6212571
M024	271648,8	6205932	281226,2	6212467
M025	271755	6205884	281250,3	6212362
M026	271861,3	6205835	281274,3	6212257
M027	271967,5	6205786	281298,4	6212153
M028	272073,8	6205738	281322,4	6212048
M029	272180	6205689	281346,5	6211943
M030	272286,3	6205641	281370,5	6211839
M031	272392,5	6205592	281394,6	6211734
M032	272498,8	6205543	281418,6	6211629
M033	272605	6205495	281442,7	6211525
M034	272711,3	6205446	281466,7	6211420
M035	272817,5	6205397	281490,8	6211315
M036	272923,8	6205349	281514,8	6211210
M037	273030	6205300	281538,9	6211106
M038	273136,3	6205252	281563	6211001
M039	273242,5	6205203	281587	6210896
M040	273348,7	6205154	281611,1	6210792
M041	273455	6205106	281635,1	6210687
M042	273561,2	6205057	281659,2	6210582
M043	273667,5	6205009	281683,2	6210478
M044	273773,7	6204960	281707,3	6210373
M045	273880	6204911	281731,3	6210268
M046	273986,2	6204863	281796,9	6210192
M047	274092,5	6204814	281863	6210116
M048	274198,7	6204765	281929,1	6210040
M049	274305	6204717	281995,1	6209964
M050	274411,2	6204668	282061,2	6209888
M051	274517,5	6204620	282127,3	6209812
M052	274623,7	6204571	282193,4	6209736
M053	274730	6204522	282259,4	6209660
M054	274836,2	6204474	282325,5	6209584
M055	274942,5	6204425	282391,6	6209508
M056	275048,7	6204377	282457,6	6209432
M057	275155	6204328	282523,7	6209355
M058	275261,2	6204279	282589,8	6209279
M059	275367,4	6204231	282655,9	6209203
M060	275473,7	6204182	282721,9	6209127
M061	275580	6204133	282788	6209051
M062	275686,2	6204085	282854,1	6208975
M063	275792,4	6204036	282920,2	6208899
M064	275898,7	6203988	282986,2	6208823
M065	276004,9	6203939	283052,3	6208747
M066	276111,2	6203890	283118,4	6208671
M067	276217,4	6203842	283184,4	6208595
M068	276323,7	6203793	283250,5	6208519
M069	276429,9	6203744	283317,1	6208443
M070	276536,2	6203696	283383,6	6208368
M071	276642,4	6203647	283450,1	6208292
M072	276748,7	6203599	283516,7	6208216
M073	276854,9	6203550	283583,2	6208141
M074	276961,2	6203501	283649,7	6208065
M075	277067,4	6203453	283716,2	6207989
M076	277173,7	6203404	283782,7	6207913
M077	277279,9	6203356	283849,3	6207838

M078	277386,2	6203307	283915,8	6207762
M079	277492,4	6203258	283982,3	6207686
M080	277598,6	6203210	284048,8	6207611
M081	277705	6203161	284115,5	6207535
M082	277811,3	6203112	284182	6207459
M083	277917,5	6203064	284248,5	6207383
M084	278023,8	6203015	284314,9	6207307
M085	278130	6202967	284380,9	6207231
M086	278236,3	6202918	284447	6207155
M087	278342,5	6202869	284513	6207079
M088	278448,8	6202821	284579	6207003
M089	278555	6202772	284645,1	6206927
M090	278661,3	6202723	284711,1	6206851
M091	278767,5	6202675	284777,2	6206775
M092	278873,8	6202626	284843,3	6206699
M093	278980	6202578	284909,3	6206623
M094	279086,3	6202529	284975,4	6206547
M095	279192,5	6202480	285041,4	6206471
M096	279298,7	6202432	285107,4	6206395
M097	279405	6202383	285173,5	6206319
M098	279511,2	6202334	285239,5	6206243
M099	279617,5	6202286	285305,6	6206167
M100	279657	6202192	285371,6	6206091
M101	279675,8	6202083	285437,7	6206015
M102	279694,7	6201975	285503,8	6205939
M103	279713,5	6201867	285569,8	6205863
M104	279732,4	6201759	285635,9	6205787
M105	279751,2	6201650	285701,9	6205710
M106	279770,1	6201542	285767,9	6205634
M107	279788,9	6201434	285834	6205558
M108	279807,8	6201326	285900	6205482
M109	279826,6	6201217	285966,1	6205406
M110	279845,5	6201109	286032,1	6205330
M111	279864,3	6201001	286098,2	6205254
M112	279883,2	6200893	286164,3	6205178
M113	279902	6200784	286208	6205087
M114	279920,8	6200676	286180,4	6204947
M115	279939,7	6200568	286148,4	6204804
M116	279958,5	6200460	286117,2	6204662
M117	279977,4	6200351	286086,8	6204520
M118	279996,2	6200243	286057,3	6204379
M119	280015,1	6200135	286028,6	6204238
M120	280033,9	6200027	286000,7	6204098
M121	280052,8	6199918	285973,6	6203958
M122	280071,6	6199810	285947,3	6203819
M123	280090,5	6199702	285921,8	6203681
M124	280109,3	6199594	285897	6203543
M125	280128,2	6199485	285873	6203405
M126	280147	6199377	285849,7	6203268
M127	280165,9	6199269	285827,1	6203132
M128	280184,7	6199161	285805,2	6202995
M129	280203,6	6199052	285784	6202860
M130	280222,4	6198944	285763,5	6202725
M131	280241,3	6198836	285743,8	6202590
M132	280260,1	6198728	285724,8	6202456
M133	280279	6198619	285706,4	6202322
M134	280297,8	6198511	285688,7	6202189
M135	280316,6	6198403	285671,6	6202057
M136	280335,5	6198295	285655,2	6201924

M137	280354,3	6198186	285639,4	6201792
M138	280373,2	6198078	285624,2	6201661
M139	280392	6197970	285609,7	6201530
M140	280410,9	6197862	285595,8	6201399
M141	280429,7	6197753	285582,6	6201269
M142	280518,1	6197693	285569,9	6201139
M143	280638,8	6197654	285557,9	6201010
M144	280759,6	6197615	285546,4	6200881
M145	280880,3	6197576	285535,4	6200753
M146	281001	6197538	285525,2	6200624
M147	281121,8	6197499	285515,5	6200497
M148	281242,5	6197460	285506,4	6200369
M149	281363,3	6197422	285497,8	6200242
M150	281484	6197383	285489,7	6200116
M151	281604,8	6197344	285482,2	6199990
M152	281725,5	6197305	285475,4	6199864
M153	281846,2	6197267	285469	6199738
M154	281967	6197228	285463,2	6199613
M155	282087,7	6197189	285457,9	6199489
M156	282208,5	6197150	285453,1	6199364
M157	282329,2	6197112	285448,8	6199240

M158	282449,9	6197073	285445,2	6199117
M159	282570,7	6197034	285442	6198993
M160	282691,4	6196995	285439,3	6198870
M161	282812	6196957	285437	6198748
M162	282932,7	6196918	285435,3	6198626
M163	283053,5	6196879	285434,2	6198504
M164	283174,2	6196841	285433,5	6198382
M165	283295	6196802	285433,3	6198261
M166	283420,8	6196767	285433,5	6198140
M167	283603,1	6196770	285434,3	6198019
M168	283785,3	6196773	285435,6	6197899
M169	283967,5	6196776	285437,3	6197779
M170	284149,7	6196780	285439,4	6197659
M171	284332	6196783	285442	6197540
M172	284514,2	6196786	285445,2	6197421
M173	284696,4	6196789	285448,8	6197303
M174	284878,6	6196792	285452,8	6197184
M175	285060,8	6196796	285456,3	6197065
M176	285243,1	6196799	285453,4	6196942

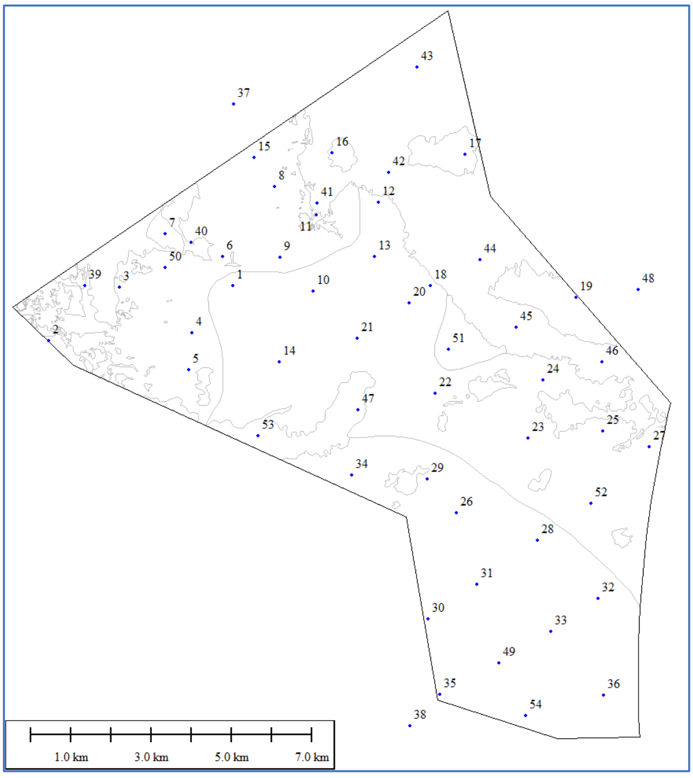
II.3. Seabottom sediments sampling sites

54 stations (51 within the study area or 1 sample/2.7 km^2 area and 3 additional outside the study area) were selected for sediment sampling. The selection of locations and number of samples depends on the results of side survey sonar survey, during which different types of seabottom sediment fields are revealed. This allowed to evenly represent the sediments of different lithotypes and create a distribution map of surface sediments.

Nr	X	Y
1	275345,72	6208011,77
2	270774,70	6206651,86
3	272540,18	6207977,38
4	274332,62	6206844,55
5	274250,95	6205926,32
6	275090,04	6208754,21
7	273666,27	6209304,62
8	276380,85	6210479,55
9	276516,45	6208720,22
10	277338,54	6207874,90
11	277414,72	6209787,96
12	278964,67	6210102,11
13	281121,69	6211297,41
13	278875,44	6208739,03
14	276497,13	6206118,91
15	275874,76	6211202,56
16	277823,77	6211317,09
18	280263,54	6208012,73
19	283872,22	6207720,15
20	279737,14	6207585,65
21	278434,38	6206718,02
22	280383,65	6205343,61
23	282687,35	6204216,73
24	283057,47	6205672,59
25	284547,90	6204402,04
26	280910,72	6202358,96
27	285689,55	6204005,89

Nr	X	Y
28	282915,41	6201690,70
29	280183,36	6203202,68
30	280207,84	6199732,97
31	281417,50	6200586,34
32	284422,50	6200227,44
33	283247,26	6199406,94
34	278313,10	6203309,10
35	280504,19	6197847,32
36	284555,88	6197824,96
37	275368,62	6212541,65
38	279754,12	6197067,38
39	271681,30	6208024,98
40	274304,97	6209096,70
41	277444,02	6210066,84
42	279222,73	6210845,09
43	279930,38	6213463,45
44	281502,20	6208674,55
45	282398,33	6206979,20
46	284521,65	6206116,57
47	278459,79	6204931,38
48	285423,11	6207920,41
49	281963,39	6198638,79
50	273668,19	6208475,12
51	280706,18	6206433,65
52	284243,14	6202607,17
53	275970,38	6204283,15
54	282629,95	6197320,74

Fig. 2.3 Sites of seabottom sediments sampling
Coordinates provided in LKS'94 projection



III. Results

III. 1. Determination of seismic horizons

Seismic horizon picking

After the initial processing of the seismic data, 3 distinct seismic horizons - SH (Figure 3.1) were identified in the seismic data, which are observed in the almost entire research area. The first is the bottom of the sea (Bottom). The second layer (SH1), whose thickness varies from 0 (in the N-NW part) to 12 m (in the S part), and on average reaches about 5-10 m, is clearly visible in almost all seismic sections, the geological origin and lithological characteristics will be clear only after shallow vibro-coring and static cone penetration tests (CPT) are completed. The third (SH2) seismic horizon has been successfully correlated in all seismic sections. The results of two deep boreholes and CPT studies will be used to determine its genesis. Time maps of seismic horizons SH1 and SH2 were created during processing.

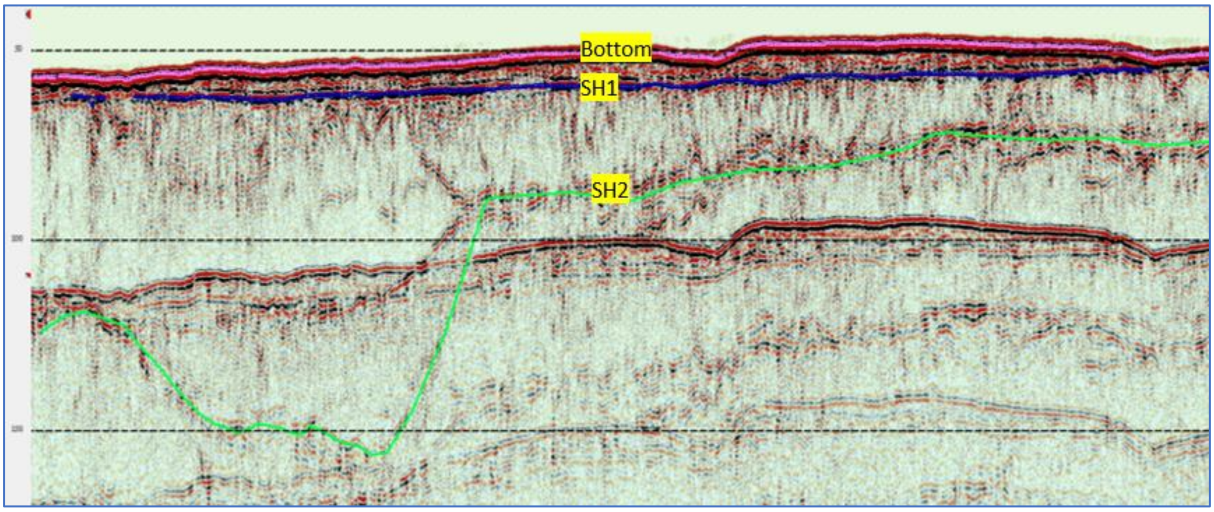


Fig. 3.1 Example of a seismic section with 3 seismic horizons: seabed (purple line), SH1 (blue line) and SH2 (green line)

Structural depth maps

2 interval velocities were applied to create depth maps of seismic horizons: in the water up to the surface of the seabed, the average velocity of seismic waves in seawater - 1480 m/s was used, and below the surface of the seabed, the average velocity of seismic waves of 1700 m/s sediments was used (inherent of Quaternary sediments). Thus, applying seismic waves velocity correction, time scale values were recalculated into depth values and seismic horizons SH1 and SH2 depth maps were created.
As mentioned above, the seismic horizon SH1 rises to the surface of the seabed at the NE edge of the research area (Figure 3.2). Comparing its distribution limit with the lithological map based on side scan sonar and lithological analysis of bottom samples, we observe that it corresponds to the distribution limit of glacial till formations. Based on this, it is likely that the SH1 reflecting horizon corresponds to the boundary between the sandy deposits that are common over most of the area and the glacial till formations below.

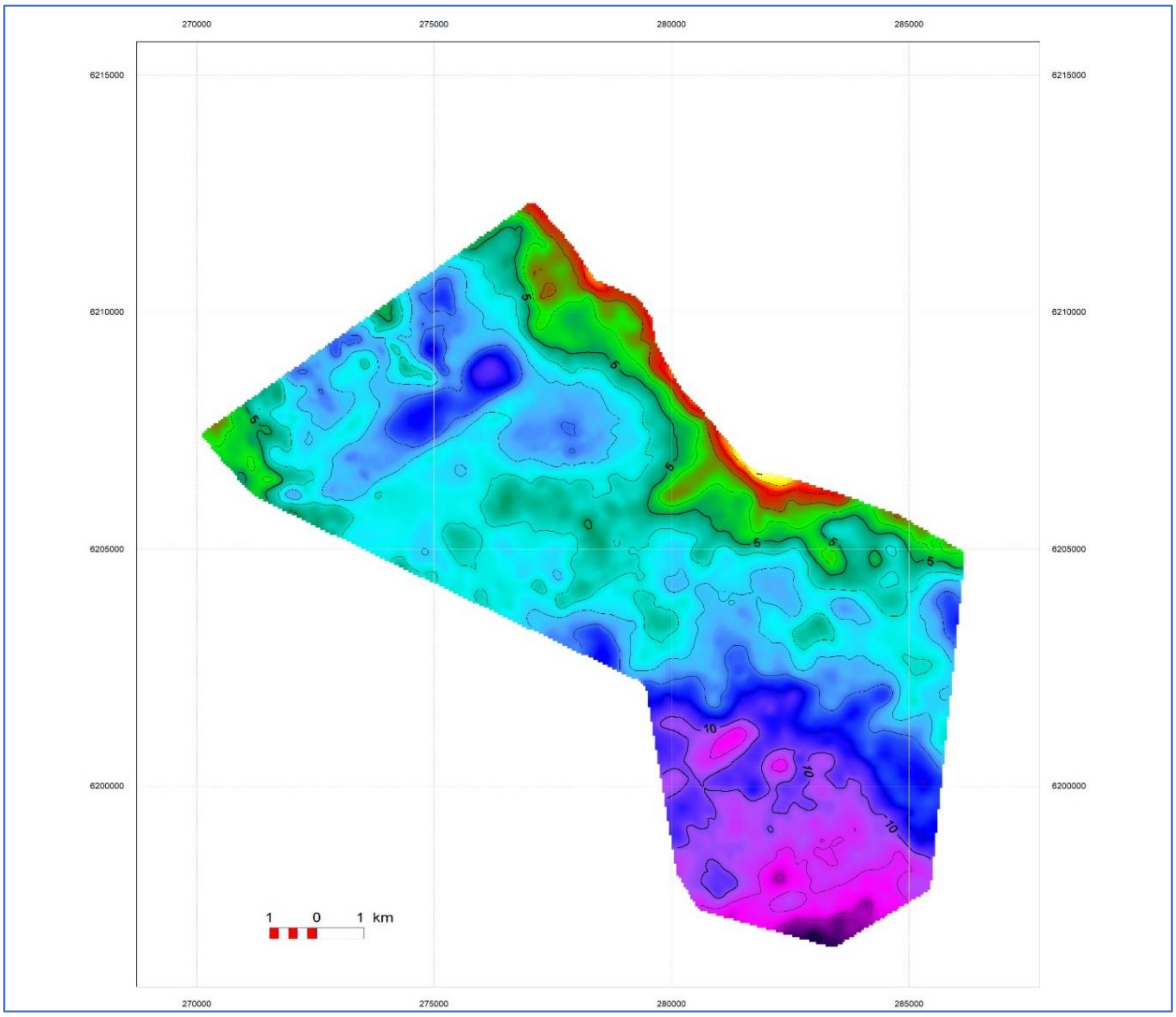


Fig. 3.2 Depth map of seismic horizon SH1 below the seabed.

The SH2 horizon is observed over the entire study area (Fig. 3.3) and it is likely that it reflects either the geological boundary of the Quaternary bed or the lithological boundary in the Quaternary strata, characterized by a high contrast of physical properties. Unlike SH1, it is not unambiguously interpreted due to the extremely variable structure of the Quaternary sediments, where the reflectors often overlap each other, so it is likely that the structural map does not reflect the same lithological boundary in the entire area. Nevertheless, produced depth map is useful because it shows Quaternary paleo incisions, where an obvious increase in the thickness of the Quaternary sediments is observed. Generally, Quaternary paleo incisions have different sedimentary fill and, at the same time, different geomechanical properties than the rest of the Quaternary column, so their mapping is an important element in the subsequent planning and design of foundations of wind energy installation. The depth of the SH2 horizon bellow the seabed varies within 20-40 m in most of the area, but reaches up to 90 m in paleo incisions.

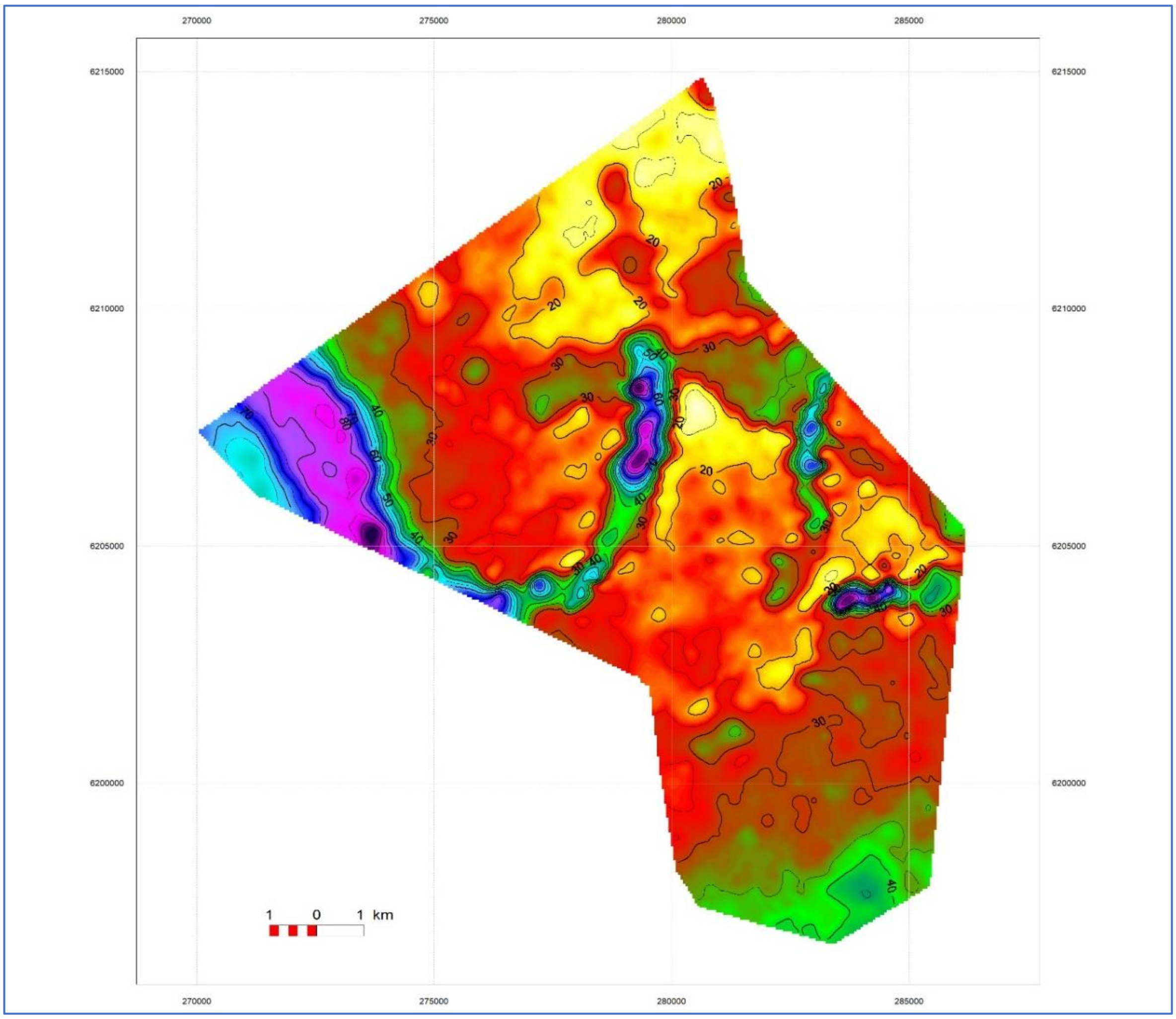


Fig. 3.3 Depth map of seismic horizon SH2 below the seabed.

Delivery of digital data (see Annex No. 4 "Digital data")

For the convenience of data interpretation, processed seismic data is presented in 2D and 3D arrays (SEG-Y IBM Float 4 byte):
The localization information of 2D file tracks is given in the following bytes:
CDP No.: byte 1
X coordinate: byte 181
Y coordinate: byte 185
The localization information of the 3D array tracks is provided in the following bytes:
CDP Inlaine no.: byte 189
CDP Crossline no.: byte 193
X coordinate: byte 181
Y coordinate: byte 185

Deliverables:
• 176 seismic cross sections in digital SEG-Y format;
• 3D data array in digital SEG-Y format;
• Compiled time maps of seismic horizons Bottom, SH1 and SH2 in *.XYZ format;
• Bottom, SH1 and SH2 seismic horizons depth maps (bellow the seabed) in *.XYZ and *.JPG format.

III. 2. Morphology and depth of the seabed

Multibeam echo sounder survey of the bottom of the area was organized along 176 profiles, ensuring 100% coverage. This resulted in a very accurate depth chart (Fig. 3.4), where we can observe the regular division of the area into a shallower (28-36 m) northeastern and deeper (36-46 m) south-western zone. Morphologically, the northern part is the western part of the Klaipėda-Ventspils plateau, the southwestern part is a slope that deepens evenly in the south direction. The predominant depths are between 38 - 43 m (about 40% of all values), the next most common depth zone (basically the entire slope) - between 34-38 m (about 30%) is the relatively flattest central part of the district, depths from 31 to 34 m are recorded in elevation and account for about 20% of all depth values.

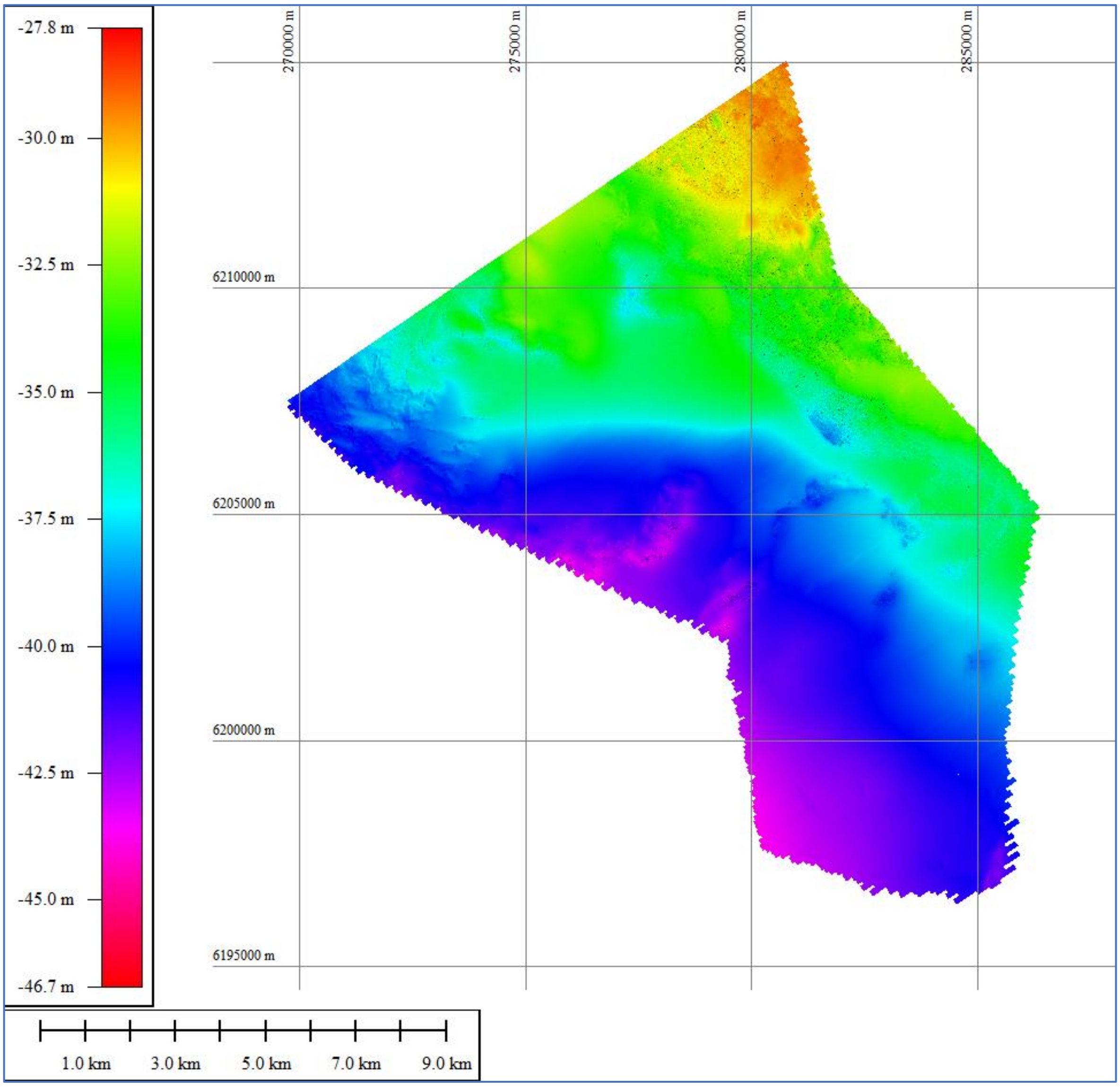


Fig. 3.4 Depth chart of the seabed

Delivery of digital data (see Annex No. 4 "Digital data")

Deliverables:

- Postprocessed depth values at 1x1 m resolution grid in *.XYZ format;
- Map of seabed depth in *.GeoTiff format

III. 3. Results of side scan sonar

As a result of acoustic soundings of the seabottom the side scan sonar mosaic was compiled (Fig. 3.5), we observe the reflections from the geological structures and lithological bodies as well as identified the objects on the seabed.

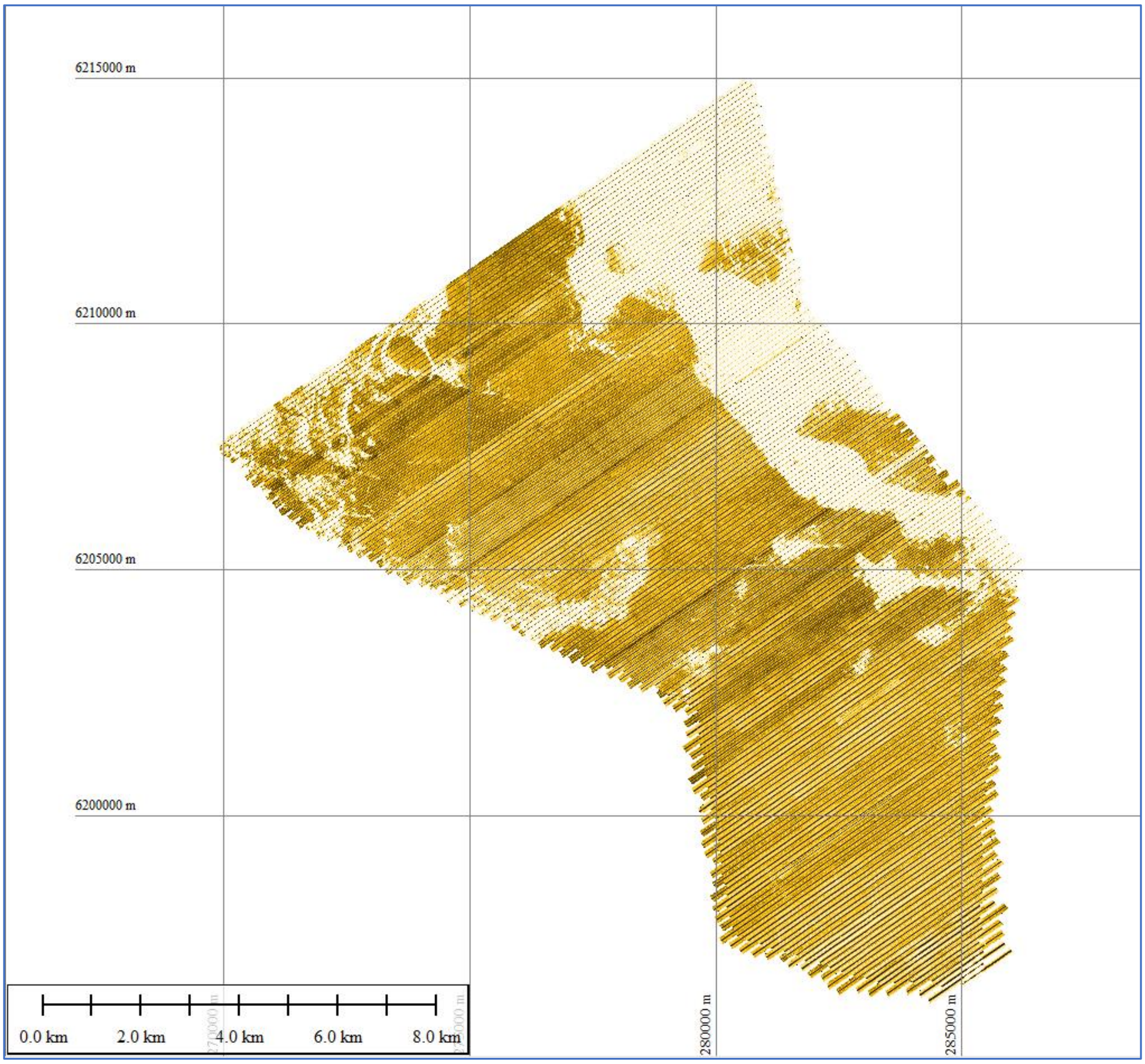


Fig. 3.5 Side scan sonar mosaic

Hard (strong reflection, light tones) and soft (weak reflection, dark tones) bottoms are easily identify according to the physical peculiarities of the reflection of acoustic signal. Sand and gravel ripples, boulder fields are well visible, easy to recognize morphological features of the seabottom and anthropogenic objects.

The main result of the interpretation of the side scan sonar mosaic – preliminary boundaries of different sediments on the seabottom (Fig. 3.6). Those are the basis for selecting the sites for sediment sampling (see chapter III.4 “Type and distribution of seabottom sediments”).

After a detailed review of each sonar line record, characteristic anthropogenic, natural and undetermined objects on the seabed were identified (see Chapter III. 7 "Anthropogenic and other objects on the seabed"), which may influence the selection of the position of wind power plants and cable routes, as well as geological - engineering works to ensure safety of operations.

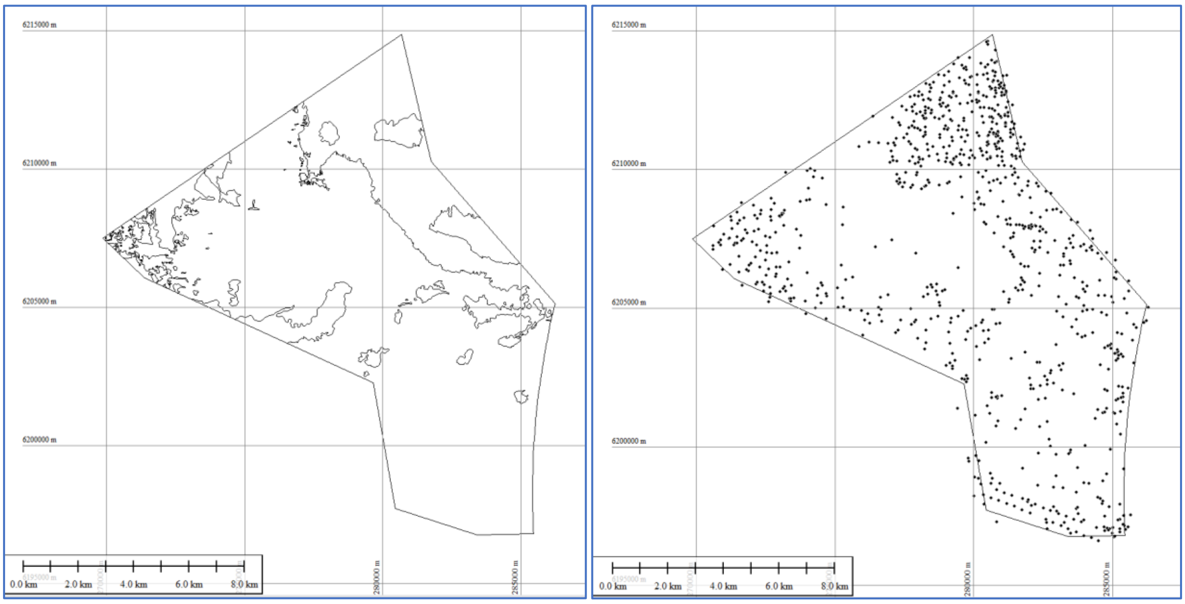


Fig. 3.6 Preliminary lithological boundaries (on the left) and objects on the seabed (on the right)

Delivery of digital data (see Annex No. 4 "Digital data")

Deliverables:

- Postprocessed data of side scan sonar – 176 profiles in *.xtf format;
- SSS mosaic in *.GeoTiff format;
- Positions of objects on the seabed in ESRI *.shp format.

III. 4. Type and distribution of seabottom sediments

Based on the side scan sonar results, 51 surface sediment samples were collected in the study area (see Chapter II. 3). All samples were examined in the geomechanical research laboratory of Klaipėda University, the grain size distribution of the sediments was determined (see Annex No. 2 "Protocols of grain size analysis") and the lithotype was assigned according to the valid LST EN ISO 14688:2018 standard. Based on the results of grain size analysis and seismo-acoustic surveys, the primary (interpreted side scan sonar mosaic) lithological boundaries were specified and a distribution scheme of surface deposits of the district was drawn up (Fig. 3.7).

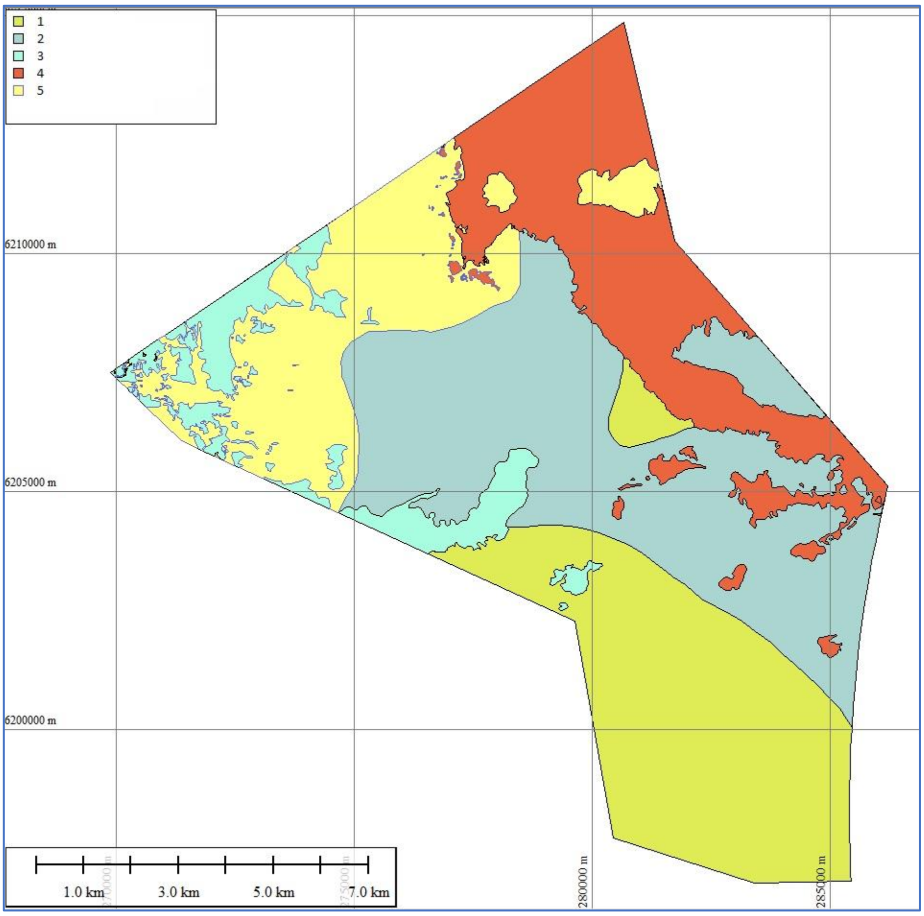


Fig. 3.7 Lithological scheme of seabottom sediments (1-silty sand; 2-low silt, clayey sand; 3-clay, clayey sand; 4-boulders, gravel, gravelly sand; 5-evenly sorted sand)

Unsorted mixed deposits of sand, gravel and boulders of glacial origin (washed moraine) are common in the northeastern part, deposited directly on the moraine base (glacial sandy loam and loam). In the rest of the territory, modern deposits of marine sand, silty and clayey sand formed in the relief depressions and on the slope of the Klaipėda-Ventspils plateau are deposited.

Delivery of digital data (see Annex No. 4 "Digital data").

Deliverables:

- Locations of lithological sampling: in ESRI *.shp format;
- Results of grain size analysis: analysis protocols in *.xls format;
- Revised geological boundaries of the seabed sediments: in ESRI *.shp format.
- Lithological scheme: in *.GeoTiff format;

III. 5. Sub bottom profiler survey results

Seismoacoustic profiling is intended for structural investigations of the upper (up to ~15 m) geological part of the bottom. Due to the high frequency, these studies reflect the internal structure of the sediments quite well and can serve as additional geophysical information in the analysis of the distribution of shallow sediments (to fine down lithological boundaries), as well as provide information on objects buried under the sediments, allow to distinguish boundaries between smaller but distinct layers. In addition, it serves as the main geophysical information for the selection of shallow vibro-coring sites.
Due to the relatively low penetration and complex internal structure of the Quaternary sediments, tracing of seismic horizons and time/depth mapping was carried out in conjunction with seismic data analysis (see Chapter III.1).
In the cross sections presented below, we can see SH1 horizon (determined during the seismic data interpretation) is also visible in the sub bottom survey data. Sh1 horizon is not consistent: in the northern part of the area SH1 is observed partially and with cracks (profiles No. M003 and M037, Figs. 3.8 and 3.9), then from the middle part of the area to the south, where the depth of the boundary of SH1 from the seabed exceeds 6-7 meters, horizon practically disappears or is observed only episodically (profile No. M127, Figure 3.10). The SH2 horizon was not traced in sub bottom survey.

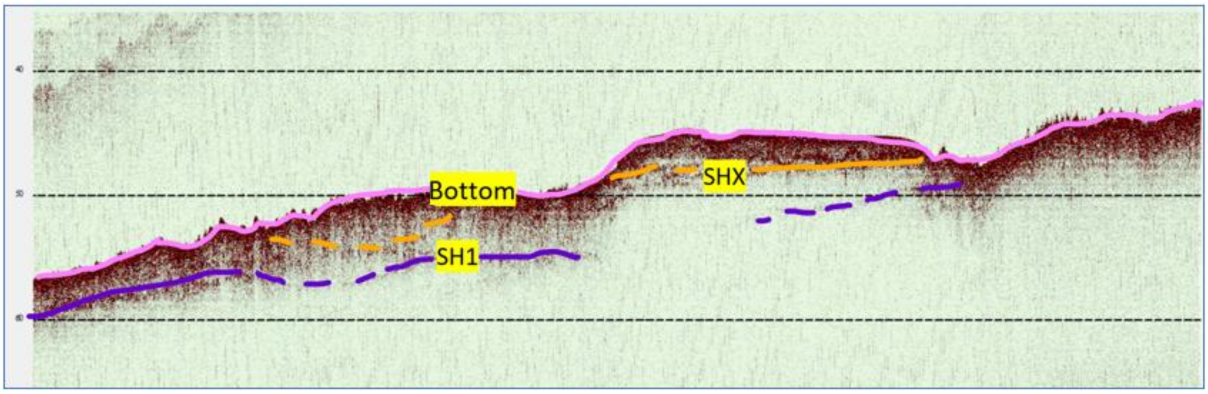


Fig. 3.8 Sub bottom cross section No. M003 (fragment)

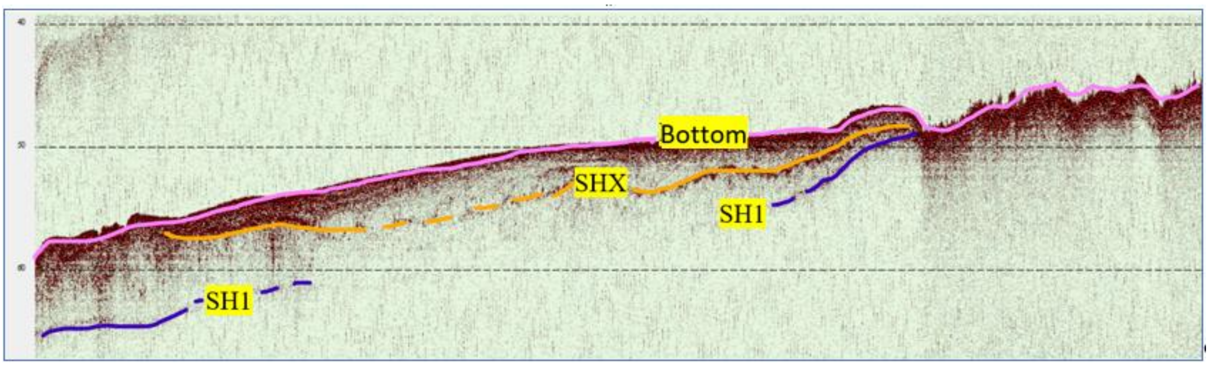


Fig. 3.9 Sub bottom cross section No. M037 (fragment)

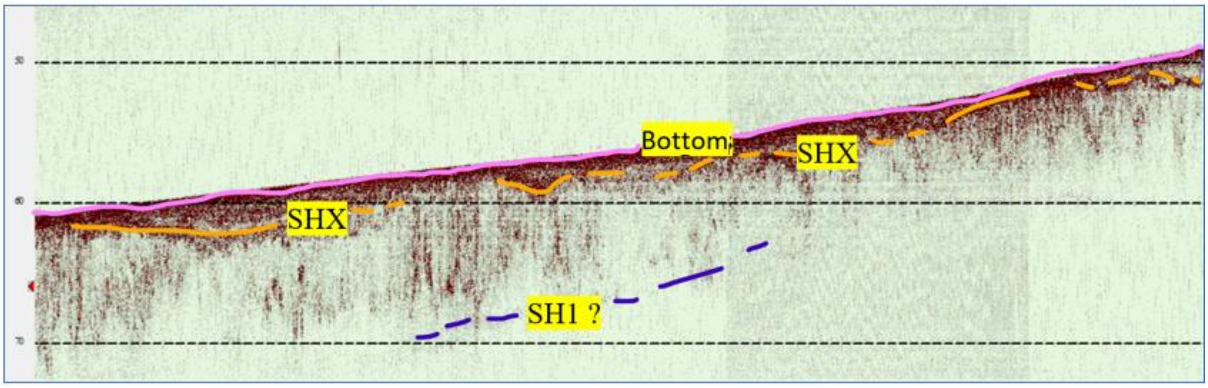


Fig. 3.10 Sub bottom cross section No. M127

Combination of sub bottom profiler data and seismic data were used, in order to create seismic horizons time and depth maps (Figs. 3.1, 3.2 and 3.3), as well as, to create a lithological map of the bottom sediments and to fine down the distribution of different lithological layers (Fig. 3.5). In addition, after drilling the shallow boreholes, these cross sections will be used to refine the boundary of SH1 in those intervals where it is well observed in the northern part of the area, as well as to refine the upper geological structure of the seabed (the results will be presented with the III^{d} survey report), possibly distinguishing more lithological layers or local lenses, of whose boundaries are observed in seismoacoustic sections (SHX horizons).

Presentation of digital data (see Annex No. 4 "Digital data")

Coordinates for exported data SEG-Y files is provided in the following bytes:
CDP no: byte 21
X coordinate: byte 73
Y coordinate byte 77

Delivered:
• 176 sub bottom cross sections in digital SEG-Y format;
• Interpreted structural time and depth maps of seismic horizons in XYZ format are presented in Part III.1 ("Determination of seismic horizons ").

III. 6. Magnetic anomalies

Survey studies of magnetic anomalies were carried out in the main 176 profiles (see section II.2) – i.e. every 100 m. Such a resolution does not allow us to expect a complete study of the area, but it provides valuable information about the general characteristics of the magnetic field and allows to record larger magnetic anomalies, which must be taken into account before starting detailed geological studies for foundations and electric cable laying lines. The total magnetic field (Fig. 3.11) varies from 51,400 to 52,600 nT and reflects the total geomagnetic field in the study area. After performing geomagnetic corrections, the residual magnetic field reflecting the geological conditions characteristic of the area was obtained. An increased concentration of ferromagnetic particles is observed in the northeastern part of the studied area, where glacial moraine deposits rich in clay minerals and boulders come to the surface.

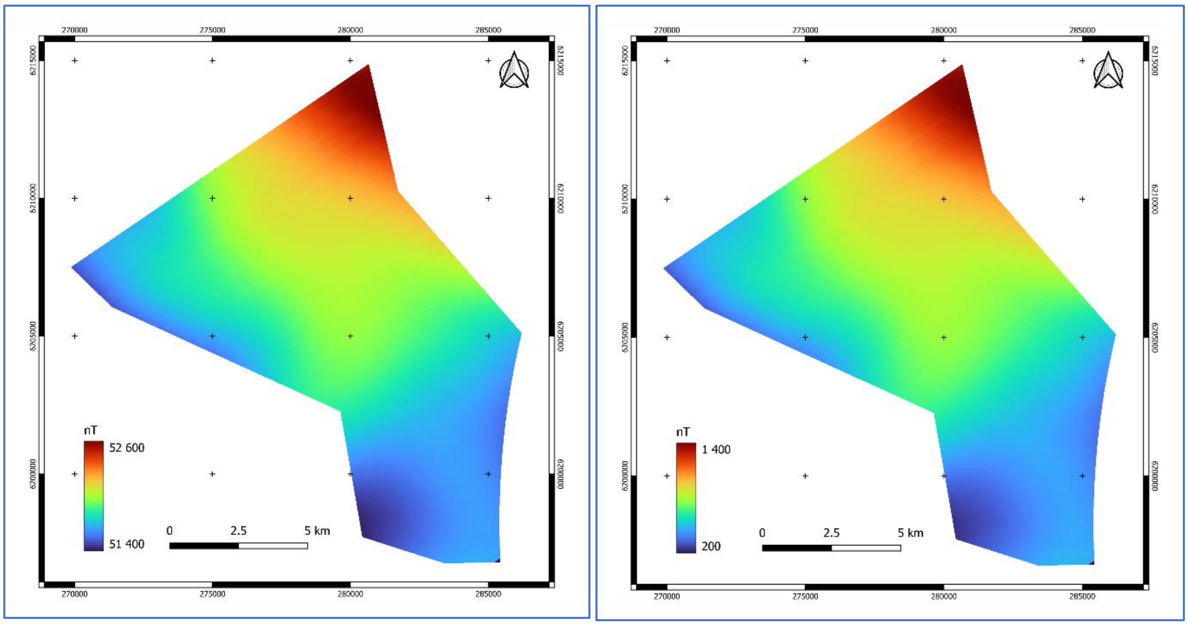


Fig. 3.11 pav. Total (left) and residual (right) magnetic field

In order to identify areas where additional caution is necessary in planning engineering works, the general magnetic field was compared with the magnetic values determined in a specific profile, i.e. a magnetic field gradient or magnetic anomalies reflecting possible anthropogenic metallic objects on the seabed (on the surface or in shallow sediments) have been determined (Fig. 3.12).

In addition to several larger (>50 nT) point anomalies spread over the entire area, a strong linear anomaly is very clearly observed in the western part, undoubtedly connected to a cable or pipeline at the bottom, the origin and position of which is recommended to be clarified during additional research (before the construction of the wind farm).

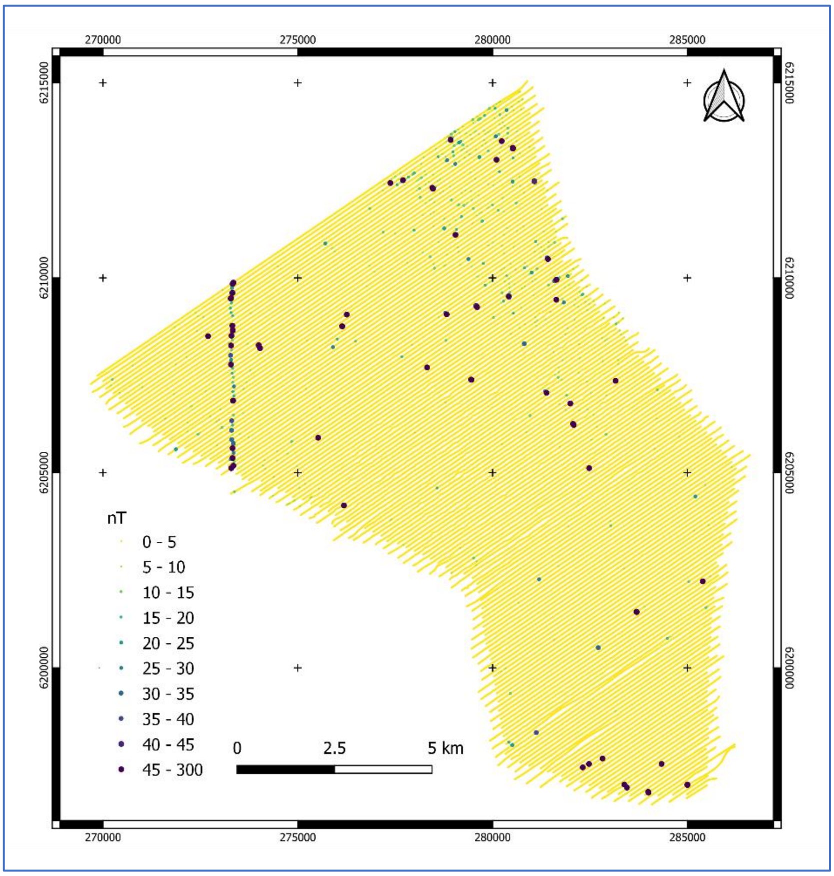


Fig. 3.12 Magnetic field gradient (anomalies)

Presentation of digital data (see Annex No. 4 "Digital data")

The processed magnetometry (MAG) data is presented in a summary table indicating:
• signal coordinate (LKS'94 system);
• total magnetic field (nT),
• magnetic field gradient (nT) and
• magnetometer depth and distance from the seabed (m).

Deliverables:
• 176 processed profiles of magnetometry data in *.csv format;
• Magnetometer depth map in *.grd format;
• Total measured magnetic field in *.grd format;
• Residual magnetic field in *.grd format;

III. 7. Anthropogenic and other objects on the seabed

After reviewing all 179 side scan profiles, 858 objects were selected (Fig. 3.13), which are recommended to pay attention to before starting drilling or foundation installation work. Preliminary classification of objects - based exclusively on visual assessment. Since both anthropogenic and larger natural objects can influence the planning of foundation installation sites and cable laying trenches, the catalog of objects includes a pin compendium of objects indicating the coordinate of the center of the object and preliminary length and width. Identified:

- 496 natural objects (classified as "NO") are mostly single larger (over 2 m diameter) boulders, more expressive landforms, geological objects (blocks, moraine outcrops, trenches, etc. bodies resembling natural objects);
- 276 possibly natural objects "N?O", which due to characteristic acoustic properties and/or the geometry of the object itself (sharper or regular angles, longer than the acoustic shadow of surrounding natural objects, etc.) raise doubts about their natural and/or anthropogenic origin;
- 58 possibly anthropogenic objects ("M?M"), which are less similar to the above-mentioned "possibly natural" objects;
- 4 extremely similar to artificial - objects of anthropogenic origin, tentatively classified as anthropogenic ("MM");
- And 24 characteristic linear objects (LIN), which are mostly not of natural origin, but can also be the result of certain specific natural structures

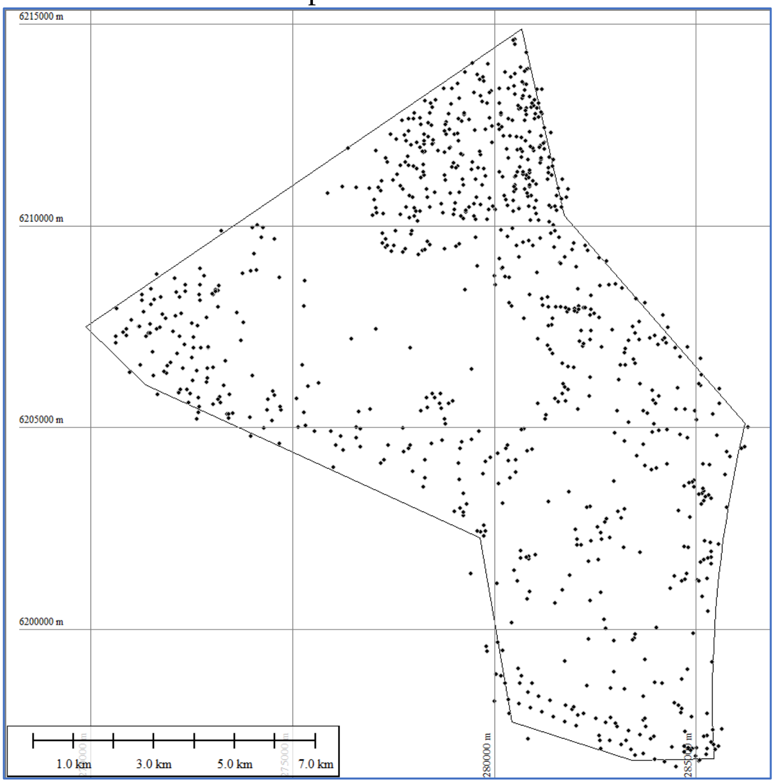


Fig. 3.13 Objects on the seabed

Presentation of digital data (see Annex No. 4 "Digital data")

Deliverables:

- 858 targets obtained from side scan sonar profiles: in *.GeoTiff format;
- Position of the targets: in ESRI *.shp format;
- Catalogue of the targets: in *.xls format;

III. 8. Recommended locations for boreholes and cone penetration test (CPT)

The locations of the wells were selected considering several main criteria:

• boreholes must be distributed evenly as possible over the research area and represent all identified lithotypes - wells are placed in the area in such a way that at least a few fall into the area of each isolated lithological variety;

• during the research, most diverse geological section must be drilled and probed with CPT;

• results of drilling and CPT must allow the interpretation of seismic horizons observed during seismic surveys and the refinement of structural depth maps.

Deep boreholes G1 and G2 were planned to drill a different geological section based on seismic data. SH2 seismic horizon map and seismic section no. 20, shows that borehole G1 should be drilled in the Quaternary paleo incision, reaching a depth of more than 80 m from the seabed, while borehole G2 falls into the Quaternary sedimentary zone with a lower thickness (seismic section No. 110), which is common in most of the research area. The recommended position of deep (G1 and G2) boreholes up to 100 meters and shallow (Z1-Z20) boreholes up to 5 meters and CPT locations in LKS-94 coordinate projection is given in the table:

ID	Depth, m	X	Y
G1	100	273094,9	6207391,7
G2	100	282672,6	6203028,7
Z1	5	271799,5	6206491,2
Z2	5	274474,7	6208316,2
Z3	5	277000,3	6210073,0
Z4	5	280103,0	6212183,7
Z5	5	274307,8	6205184,1
Z6	5	276829,8	6206944,5
Z7	5	279324,3	6208625,6
Z8	5	281360,2	6210018,5
Z9	5	278365,8	6204916,4
Z10	5	280942,7	6206672,4
Z11	5	282867,0	6208031,3
Z12	5	280113,1	6203123,8
Z13	5	281902,8	6204309,7
Z14	5	283765,3	6205590,2
Z15	5	280383,2	6200277,1
Z16	5	282523,4	6201700,4
Z17	5	284547,7	6203140,7
Z18	5	281937,8	6198298,4
Z19	5	284102,5	6199775,6
Z20	5	284513,3	6197511,1

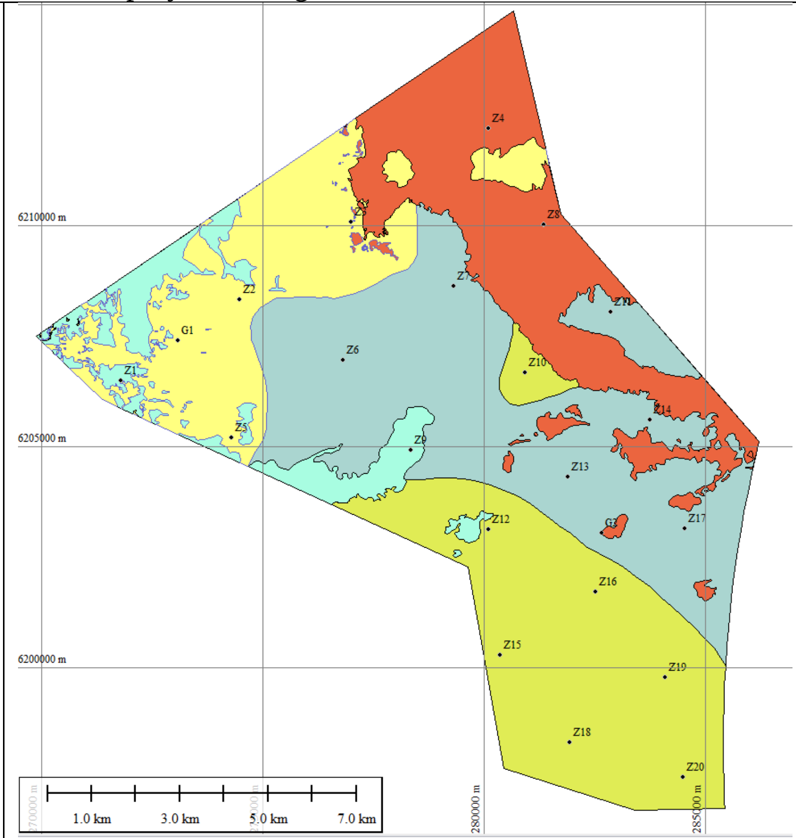


Fig. 3.14 Locations of recommended sites for deep boreholes (G1, G2), shallow boreholes (z1 – z20) and CPT stations.
Coordinates provided in LKS'94 projection

The positions of recommended boreholes and CPT stations in relation to seismic and sub bottom profiler cross sections are presented in the Annex No. 3 " Positions of boreholes and CPT on seismic cross sections ". Allowed position error – within 5m radius.

Presentation of digital data (see Annex No. 4 "Digital data")

Deliverables:

• Coordinates of recommended sites for deep (G1 and G2) and shallow (Z1-Z20) boreholes and CPT stations in *.xls table and ESRI *.shp format;

IV. Annexes

No.1 „ List of figures "

No.2 „ Protocols of grain size analysis "

No 3 „ Positions of boreholes and CPT on seismic cross sections "

No. 4 „Digital data "

1. Annex „List of figures“:

2. Annex „Protocols of grain size analysis“

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Viešoji įstaiga, Herkaus Manto g. 84, 92294 Klaipėda, tel.: (8 46) 398 846, faks.: (8 46) 398 999, el. p. info@apc.ku.lt
Duomenys kaupiami ir saugomi Juridinių asmenų registre, kodas 211951150

Gruntų laboratorinių tyrimų protokolas Nr. TP-043-2022

Data	2022-04-28
Užsakovas:	UAB "Geobaltic", Savanorių pr. 11A-76, LT-03116 Vilnius
Projektas:	Jūrinis VE projektas
Objektas:	Gruntas
Gruntų pridavimo data:	2022-03-09
Grunto bandinių kiekis:	50
Tyrimai atlikti pagal:	
	* LST EN ISO 14688-1:2018 Geotechniniai tyrinėjimai ir bandymai. Gruntų identifikavimas ir klasifikavimas. 1 dalis. Identifikavimas ir aprašymas (ISO 14688-1:2017)
	* LST EN ISO 14688-2:2018 Geotechniniai tyrinėjimai ir bandymai. Gruntų identifikavimas ir klasifikavimas. 2 dalis. Klasifikavimo principai (ISO 14688-2:2017)
	* LST EN ISO 17892-1:2015 Geotechniniai tyrinėjimai ir bandymai. Laboratoriniai grunto bandymai. 1 dalis. Vandens kiekio nustatymas (ISO 17892-1:2014)
	* LST EN ISO 17892-2:2015 Geotechniniai tyrinėjimai ir bandymai. Laboratoriniai grunto bandymai. 2 dalis. Tūrinio tankio nustatymas (ISO 17892-2:2014)
	* LST EN ISO 17892-3:2016 Geotechniniai tyrinėjimai ir bandymai. Laboratoriniai grunto bandymai. 3 dalis. Dalelių tankio nustatymas (ISO 17892-3:2015)
	* LST EN ISO 17892-4:2017 Geotechniniai tyrinėjimai ir bandymai. Laboratoriniai grunto bandymai. 4 dalis. Granuliometrinės sudėties nustatymas (ISO 17892-4:2016)
	* LST EN ISO 17892-12:2018 Geotechniniai tyrinėjimai ir bandymai. Laboratoriniai grunto bandymai. 12 dalis. Takumo ir plastiškumo ribų nustatymas (ISO 17892-12:2018)
Protokolo priedai:	1. Laboratorinių tyrimų rezultatai - 2 lapai
	2. Granuliometrinės sudėties kreivės - 11 lapų
Parengė:	Pajūrio aplinkos ir biochemijos laboratorijos vadovas Mindaugas Žilius

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Duomenys kaupiami ir saugomi Juridinių asmenų registre, kodas 211951150

Laboratorinių tyrimų rezultatai

Data 2022-04-28

Protokolo nr.	TP-043-2022
Užsakovas:	UAB "Geobaltic", Savanorių pr. 11A-76, LT-03116 Vilnius
Projektas:	Jūrinis VE projektas
Papildoma informacija:	

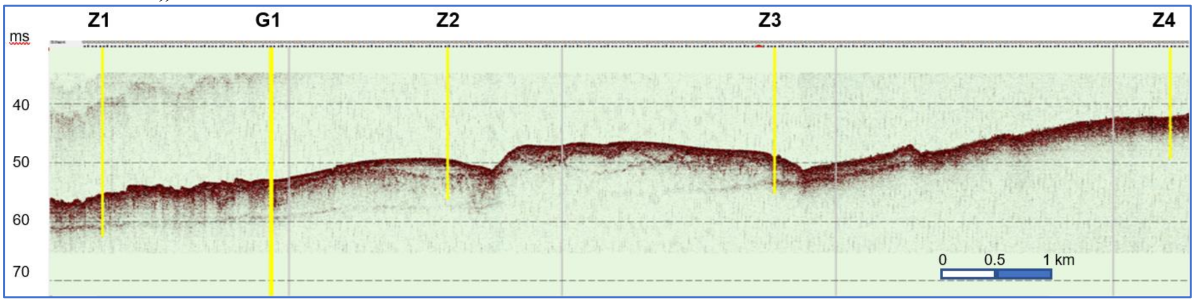
Laboratorinę analizę atliko:	j.m.d. Mindaugas Kazbaris	parašas:
Pajūrio aplinkos ir biochemijos laboratorijos vad	dr. Mindaugas Žilius	parašas:

			Skaitiklyje-likęs gruntas,vardiklyje-išsijotas per sietą gruntas , % — Sietų akučių dydžiai, mm											Drėgnis, %	Smulkiosios frakcijos plastiškumas, %		Organinės medž.kiekis, %	Žymuo	Grunto pavadinimas
Eil.Nr.	Gręžinio Nr.	Pavyzdžio Nr.	31,5	20	6,3	4	2	1	0,63	0,2	0,125	0,063	Dukio/molio %	w	w_L/w_P	I_P/I_L			LST EN ISO 14688-2:2018
1	1	1	0,00	0,00	0,00	0,00	0,00	0,00	0,00	30,10	38,19	26,14	4,78	25,62				SaFU	tolygiai išrūšiuotas mažai dulkingas-molingas smėlis
			100,00	100,00	100,00	100,00	100,00	100,00	100,00	69,90	31,72	5,58	0,80						
2	2	1	0,00	0,00	0,00	0,00	0,00	0,00	0,00	76,68	17,38	3,23	2,29	22,09				SaU	tolygiai išrūšiuotas smėlis
			100,00	100,00	100,00	100,00	100,00	100,00	100,00	23,32	5,94	2,71	0,41						
3	3	1	0,00	0,00	0,00	0,00	0,00	0,00	0,00	60,20	28,74	7,55	2,95	23,49				SaU	tolygiai išrūšiuotas smėlis
			100,00	100,00	100,00	100,00	100,00	100,00	100,00	39,80	11,06	3,51	0,56						
4	4	1	0,00	0,00	0,00	0,00	0,00	0,00	0,00	39,96	35,91	19,53	3,96	26,15			0,79	SaU	tolygiai išrūšiuotas smėlis
			100,00	100,00	100,00	100,00	100,00	100,00	100,00	60,04	24,13	4,60	0,65						
5	5	1	0,00	0,00	0,00	0,00	0,00	0,00	0,00	40,70	34,76	19,68	4,17	25,48				SaU	tolygiai išrūšiuotas smėlis
			100,00	100,00	100,00	100,00	100,00	100,00	100,00	59,30	24,54	4,86	0,70						
6	6	1	0,00	0,00	0,00	0,00	0,00	0,00	0,00	57,04	29,38	11,83	1,36	21,50				SaU	tolygiai išrūšiuotas smėlis
			100,00	100,00	100,00	100,00	100,00	100,00	100,00	42,96	13,58	1,75	0,39						
7	7	1	0,00	0,00	0,00	0,00	0,00	0,00	0,00	81,18	15,35	2,23	1,00	21,67				SaU	tolygiai išrūšiuotas smėlis
			100,00	100,00	100,00	100,00	100,00	100,00	100,00	18,82	3,47	1,24	0,24						
8	8	1	0,00	0,00	0,00	0,00	0,00	0,00	0,00	46,46	34,28	16,12	2,63	23,90				SaU	tolygiai išrūšiuotas smėlis
			100,00	100,00	100,00	100,00	100,00	100,00	100,00	53,54	19,27	3,14	0,52						
9	9	1	0,00	0,00	0,00	0,00	0,00	0,00	0,00	57,31	31,14	9,64	1,52	22,89				SaU	tolygiai išrūšiuotas smėlis
			100,00	100,00	100,00	100,00	100,00	100,00	100,00	42,69	11,54	1,91	0,38						
10	10	1	0,00	0,00	0,00	0,00	0,00	0,00	0,00	15,47	38,07	37,36	8,17	20,18			0,85	SaFU	tolygiai išrūšiuotas mažai dulkingas-molingas smėlis
			100,00	100,00	100,00	100,00	100,00	100,00	100,00	84,53	46,47	9,11	0,93						
11	11	1	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,84	16,76	51,95	29,01	30,82	24,22	0,00	1,64	siSa	dulkingas smėlis
			100,00	100,00	100,00	100,00	100,00	100,00	100,00	99,16	82,40	30,44	1,44						
12	11	2	0,00	0,00	0,00	0,00	0,00	0,00	0,00	52,01	29,48	12,26	5,51	24,10			0,88	SaFP	blogai išrūšiuotas mažai dulkingas-molingas smėlis
			100,00	100,00	100,00	100,00	100,00	100,00	100,00	47,99	18,51	6,25	0,74						
13	12	1	0,00	0,00	0,00	0,00	0,00	0,00	0,00	29,54	38,36	26,84	4,58	24,30			0,84	SaFU	tolygiai išrūšiuotas mažai dulkingas-molingas smėlis
			100,00	100,00	100,00	100,00	100,00	100,00	100,00	70,46	32,09	5,25	0,67						
14	13	1	0,00	0,00	0,00	0,00	0,00	0,00	0,00	16,23	38,94	36,51	7,43	25,65			1,06	SaFU	tolygiai išrūšiuotas mažai dulkingas-molingas smėlis
			100,00	100,00	100,00	100,00	100,00	100,00	100,00	83,77	44,84	8,32	0,89						
15	14	1	0,00	0,00	0,00	0,00	0,00	0,00	0,00	5,31	30,52	49,51	13,47	29,16			0,42	SaFP	blogai išrūšiuotas mažai dulkingas-molingas smėlis
			100,00	100,00	100,00	100,00	100,00	100,00	100,00	94,69	64,17	14,66	1,19						
16	15	1	0,00	0,00	0,00	0,00	0,00	0,00	0,00	71,04	21,88	5,24	1,50	22,30				SaU	tolygiai išrūšiuotas smėlis
			100,00	100,00	100,00	100,00	100,00	100,00	100,00	28,96	7,08	1,84	0,34						
17	16	1	0,00	0,00	0,00	0,00	0,05	11,49	42,36	44,59	0,63	0,33	0,47	19,50				SaU	tolygiai išrūšiuotas smėlis
			100,00	100,00	100,00	100,00	99,95	88,47	46,11	1,52	0,89	0,56	0,08						

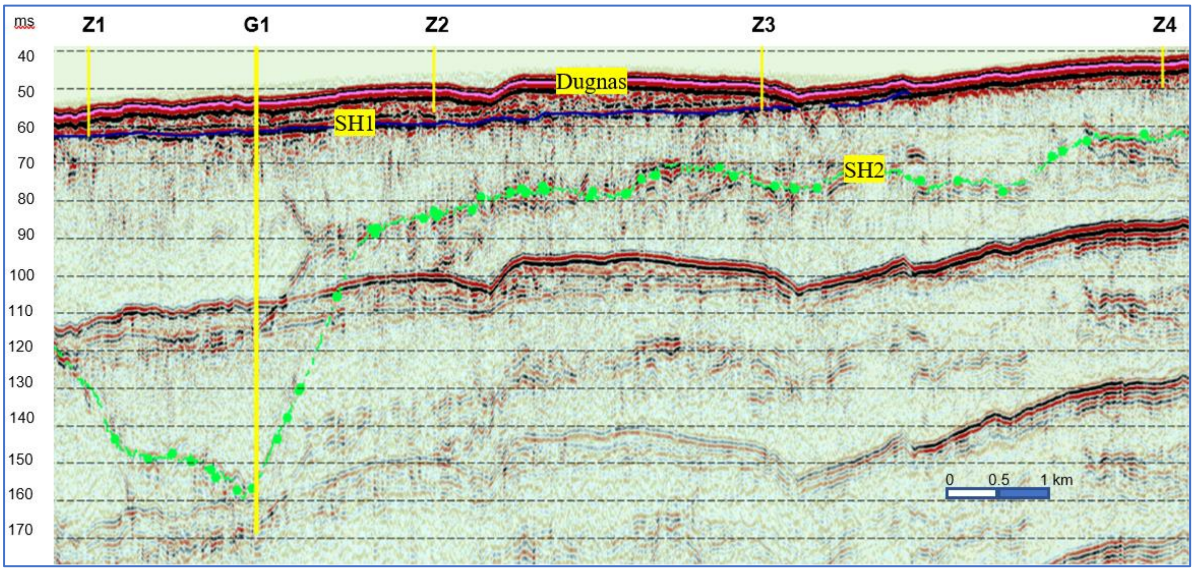
18	17	1	0,00	0,00	0,00	0,00	0,00	0,00	0,00	56,58	30,83	10,79	1,45	22,09				SaU	tolygiai išrūšiuotas smėlis
			100,00	100,00	100,00	100,00	100,00	100,00	100,00	43,42	12,59	1,80	0,35						
19	18	1	0,00	0,00	0,00	0,00	0,00	0,00	0,00	9,56	37,02	42,99	9,42	27,10			1,14	SaFU	tolygiai išrūšiuotas mažai dulkingas-molingas smėlis
			100,00	100,00	100,00	100,00	100,00	100,00	100,00	90,44	53,42	10,42	1,01						
20	19	1	0,00	0,00	0,00	0,00	0,00	0,00	0,00	17,52	38,66	33,84	8,98	20,88			1,33	SaFU	tolygiai išrūšiuotas mažai dulkingas-molingas smėlis
			100,00	100,00	100,00	100,00	100,00	100,00	100,00	82,48	43,82	9,98	1,00						
21	20	1	0,00	0,00	0,00	0,00	0,00	0,00	0,00	12,01	38,04	40,50	8,51	27,43			1,25	SaFU	tolygiai išrūšiuotas mažai dulkingas-molingas smėlis
			100,00	100,00	100,00	100,00	100,00	100,00	100,00	87,99	49,96	9,46	0,94						
22	21	1	0,00	0,00	0,00	0,00	0,00	0,00	0,00	24,34	38,14	29,36	7,28	25,75			0,84	SaFU	tolygiai išrūšiuotas mažai dulkingas-molingas smėlis
			100,00	100,00	100,00	100,00	100,00	100,00	100,00	75,66	37,52	8,16	0,88						
23	22	1	0,00	0,00	0,00	0,00	0,00	0,00	0,00	9,64	34,33	42,68	12,30	28,71			1,36	SaFP	blogai išrūšiuotas mažai dulkingas-molingas smėlis
			100,00	100,00	100,00	100,00	100,00	100,00	100,00	90,36	56,03	13,35	1,05						
24	23	1	0,00	0,00	0,00	0,00	0,00	0,00	0,00	5,54	31,21	48,62	13,49	27,93			1,28	SaFP	blogai išrūšiuotas mažai dulkingas-molingas smėlis
			100,00	100,00	100,00	100,00	100,00	100,00	100,00	94,46	63,25	14,63	1,14						
25	24	1	0,00	0,00	0,00	0,00	0,00	0,00	0,00	7,96	34,07	44,93	11,95	28,31			1,11	SaFP	blogai išrūšiuotas mažai dulkingas-molingas smėlis
			100,00	100,00	100,00	100,00	100,00	100,00	100,00	92,04	57,97	13,04	1,09						
26	25	1	0,00	0,00	0,00	0,00	0,00	0,00	0,00	11,49	35,99	40,04	11,45	27,83			0,79	SaFP	blogai išrūšiuotas mažai dulkingas-molingas smėlis
			100,00	100,00	100,00	100,00	100,00	100,00	100,00	88,51	52,51	12,47	1,02						
27	26	1	0,00	0,00	0,00	0,00	0,00	0,00	0,00	1,75	18,28	44,49	33,88	38,85	21,21	0,00	1,23	siSa	dulkingas smėlis
			100,00	100,00	100,00	100,00	100,00	100,00	100,00	98,25	79,97	35,48	1,60						
28	27	1	0,00	0,00	0,00	0,00	0,00	0,00	0,00	7,54	33,29	44,72	13,29	23,61			0,56	SaFP	blogai išrūšiuotas mažai dulkingas-molingas smėlis
			100,00	100,00	100,00	100,00	100,00	100,00	100,00	92,46	59,18	14,46	1,17						
29	28	1	0,00	0,00	0,00	0,00	0,00	0,00	0,00	3,13	24,88	49,10	21,55	24,08	20,92	0,00	0,90	siSa	dulkingas smėlis
			100,00	100,00	100,00	100,00	100,00	100,00	100,00	96,87	71,99	22,89	1,34						
30	29	1	0,00	0,00	0,00	0,00	0,00	0,00	0,00	4,68	27,49	45,74	20,77	29,93	19,78	0,00	1,12	siSa	dulkingas smėlis
			100,00	100,00	100,00	100,00	100,00	100,00	100,00	95,32	67,83	22,09	1,32						
31	31	1	0,00	0,00	0,00	0,00	0,00	0,00	0,00	2,28	22,64	50,65	23,15	30,12	21,50	0,00	0,90	siSa	dulkingas smėlis
			100,00	100,00	100,00	100,00	100,00	100,00	100,00	97,72	75,07	24,42	1,27						
32	32	1	0,00	0,00	0,00	0,00	0,00	0,00	0,00	2,61	24,53	50,50	21,06	29,26	19,81	0,00	0,75	siSa	dulkingas smėlis
			100,00	100,00	100,00	100,00	100,00	100,00	100,00	97,39	72,86	22,36	1,30						
33	33	1	0,00	0,00	0,00	0,00	0,00	0,00	0,00	1,85	20,96	50,71	25,14	29,90	22,15	0,00	0,42	siSa	dulkingas smėlis
			100,00	100,00	100,00	100,00	100,00	100,00	100,00	98,15	77,19	26,47	1,34						
34	34	1	0,00	0,00	0,00	0,00	0,00	0,00	0,00	9,06	30,55	41,01	18,17	28,20	20,20	0,00	0,78	siSa	dulkingas smėlis
			100,00	100,00	100,00	100,00	100,00	100,00	100,00	90,94	60,39	19,38	1,22						
35	35	1	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,53	13,67	49,88	34,41	26,22	23,27	0,00	0,89	siSa	dulkingas smėlis
			100,00	100,00	100,00	100,00	100,00	100,00	100,00	99,47	85,80	35,92	1,52						
36	36	1	0,00	0,00	0,00	0,00	0,00	0,00	0,00	2,32	22,42	50,01	23,98	29,93	20,78	0,00	1,11	siSa	dulkingas smėlis
			100,00	100,00	100,00	100,00	100,00	100,00	100,00	97,68	75,25	25,24	1,26						
37	39	1	0,00	0,00	0,00	0,00	0,00	0,00	0,00	57,21	30,44	8,65	3,15	23,99				SaU	tolygiai išrūšiuotas smėlis
			100,00	100,00	100,00	100,00	100,00	100,00	100,00	42,79	12,36	3,70	0,56						
38	40	1	0,00	0,00	24,99	0,03	0,52	6,46	38,12	28,47	0,66	0,36	0,33	12,72				grSaP	blogai išrūšiuotas žvyringas smėlis
			100,00	100,00	75,01	74,98	74,45	68,00	29,87	1,40	0,74	0,38	0,06						
39	41	1	0,00	0,00	4,53	2,56	33,95	54,82	2,90	1,20	0,01	0,01	0,03	17,54				grSaU	tolygiai išrūšiuotas žvyringas smėlis
			100,00	100,00	95,47	92,92	58,96	4,14	1,24	0,04	0,04	0,03	0,00						
40	42	1	0,00	88,98	11,02	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,38				GrU	tolygiai išrūšiuotas žvyras
			100,00	11,02	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00						
41	43	1	0,00	0,00	2,61	3,51	26,10	54,48	10,47	2,77	0,00	0,00	0,05	11,24				grSaU	tolygiai išrūšiuotas žvyringas smėlis
			100,00	100,00	97,39	93,89	67,79	13,31	2,83	0,06	0,06	0,06	0,01						
42	44	1	0,00	0,00	23,28	11,22	22,83	30,62	8,63	3,27	0,03	0,03	0,08	6,64				saGrP	blogai išrūšiuotas smėlingas žvyras
			100,00	100,00	76,72	65,50	42,67	12,05	3,43	0,15	0,13	0,09	0,01						
43	45	1	0,00	0,00	0,93	2,38	19,72	52,71	21,73	2,48	0,00	0,00	0,04	15,21				grSaU	tolygiai išrūšiuotas žvyringas smėlis
			100,00	100,00	99,07	96,68	76,96	24,25	2,52	0,04	0,04	0,04	0,01						
44	46	1	0,00	0,00	50,36	7,08	7,22	8,28	7,98	12,10	2,38	2,04	2,36	7,71				saGr	smėlingas žvyras
			100,00	100,00	49,64	42,56	35,33	27,06	19,08	6,97	4,60	2,55	0,19						
45	47	1	0,00	0,00	0,66	0,45	0,30	1,87	3,40	1,73	3,45	4,00	62,99	23,94	28,74	13,59		CIL	mažo plastiškumo molis
			100,00	100,00	99,34	98,89	98,60	96,72	93,32	91,59	88,14	84,14	21,14		15,15	0,65			
46	49	1	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,83	16,09	51,02	30,49	31,04	23,02	0,00	0,78	siSa	dulkingas smėlis
			100,00	100,00	100,00	100,00	100,00	100,00	100,00	99,17	83,08	32,06	1,57						
47	50	1	0,00	0,00	0,00	0,00	0,00	0,00	0,00	75,66	19,06	3,61	1,34	21,05				SaU	tolygiai išrūšiuotas smėlis
			100,00	100,00	100,00	100,00	100,00	100,00	100,00	24,34	5,28	1,67	0,34						
48	51	1	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,96	17,52	52,44	27,76	30,70	21,18	0,00	0,97	siSa	dulkingas smėlis
			100,00	100,00	100,00	100,00	100,00	100,00	100,00	99,04	81,52	29,08	1,31						
49	52	1	0,00	0,00	0,00	0,00	0,00	0,00	0,00	4,91	30,08	50,51	13,39	29,53			0,76	SaFP	blogai išrūšiuotas mažai dulkingas-molingas smėlis
			100,00	100,00	100,00	100,00	100,00	100,00	100,00	95,09	65,01	14,50	1,10						
50	53	1	0,00	0,00	0,00	0,00	0,00	0,00	0,00	75,79	13,35	4,86	5,39	19,71			0,57	SaFP	blogai išrūšiuotas mažai dulkingas-molingas smėlis
			100,00	100,00	100,00	100,00	100,00	100,00	100,00	24,21	10,86	6,00	0,62						

3. Annex "Positions of boreholes and CPT on seismic cross sections"

Cross section „Z1-Z4“:

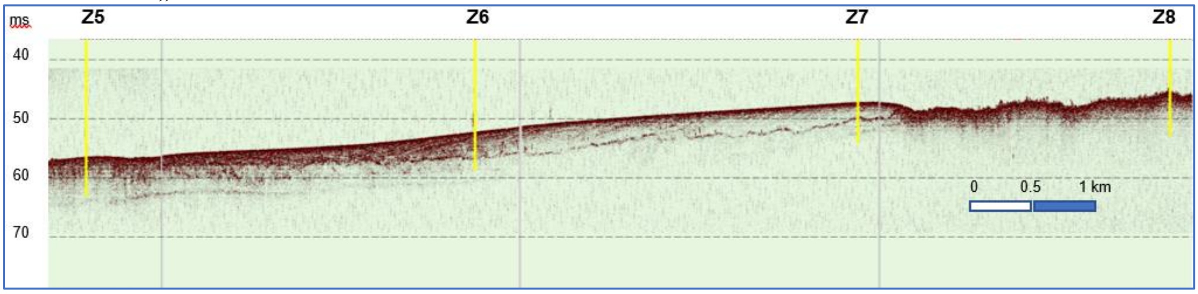


Sub bottom profiler cross section No. M020

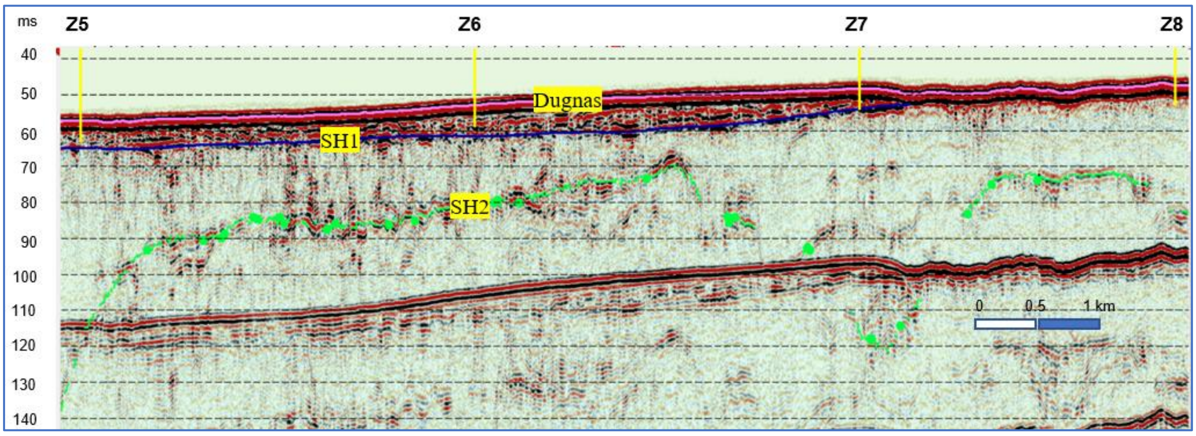


Seismic cross section No. 20

Cross section „Z5-Z8“:

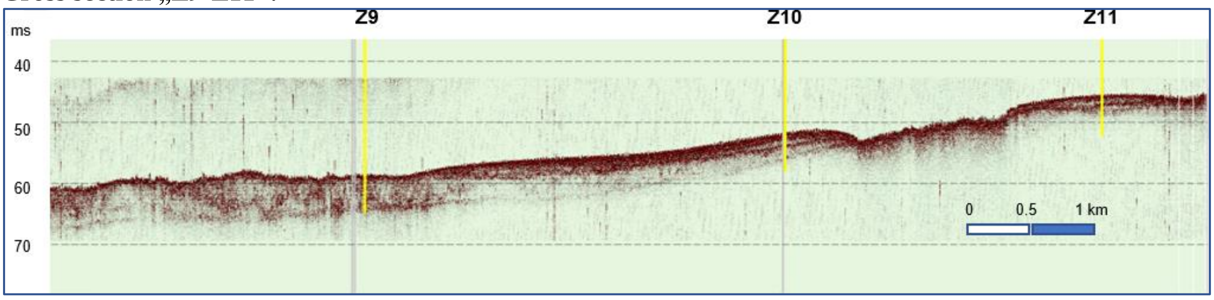


Sub bottom profiler cross section No. M045

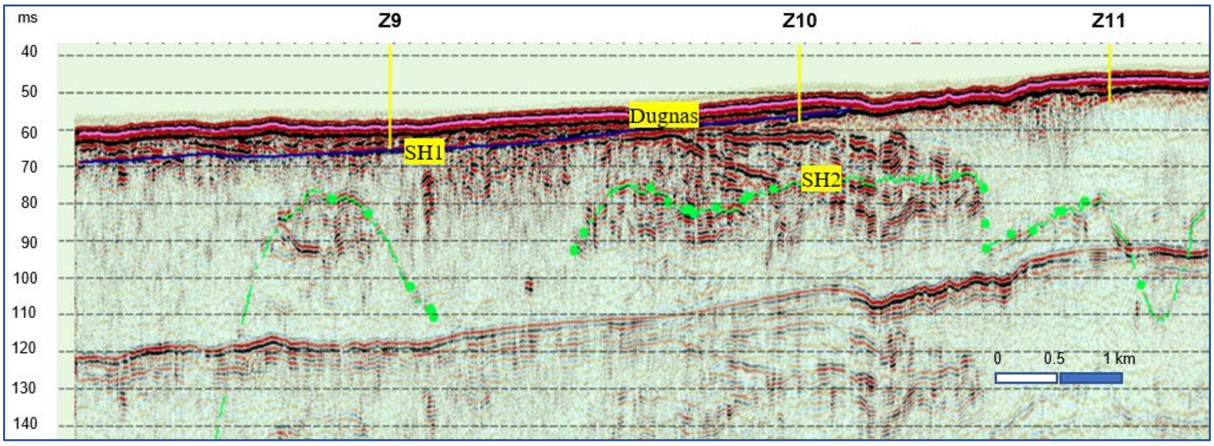


Seismic cross section No. 45

Cross section „Z9-Z11“:

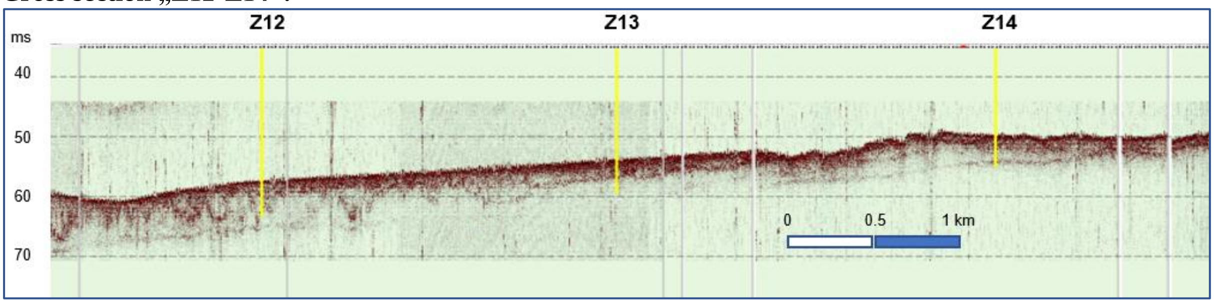


Sub bottom profiler cross section No. M070

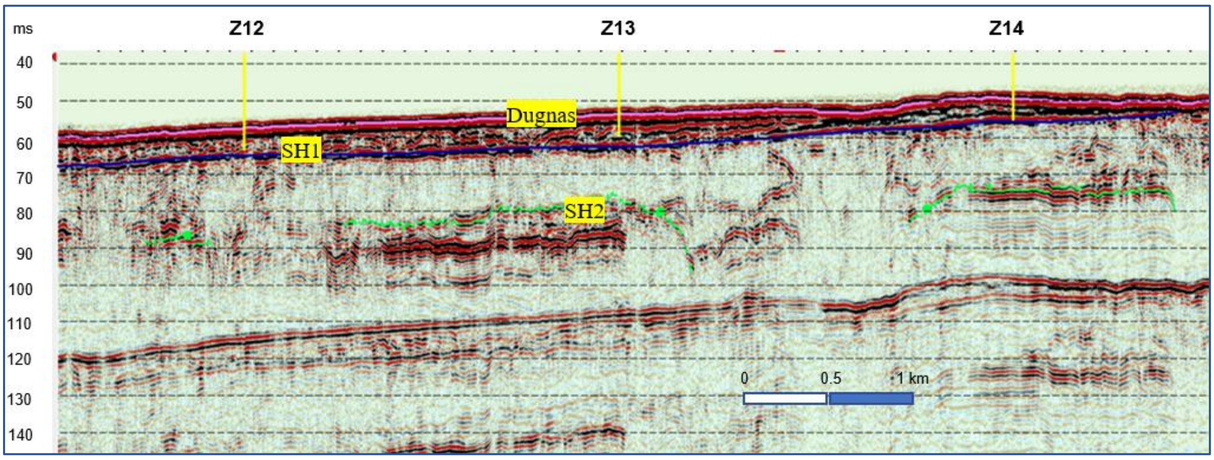


Seismic cross section No. 70

Cross section „Z12-Z14“:

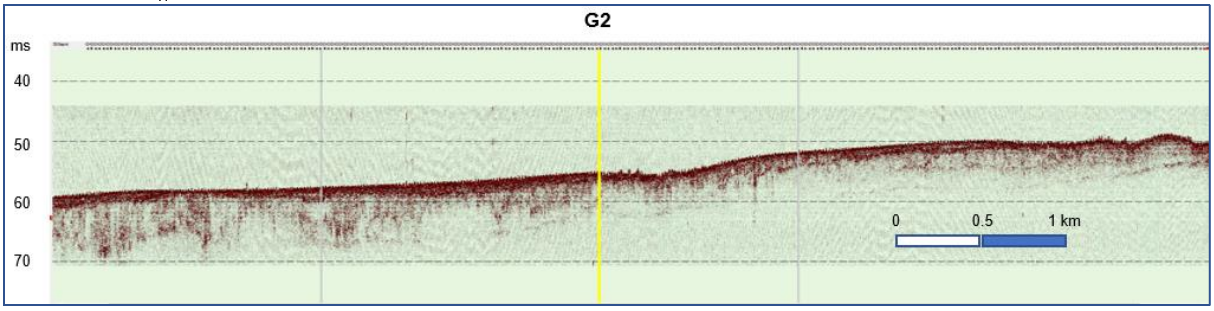


Sub bottom profiler cross section No. M095

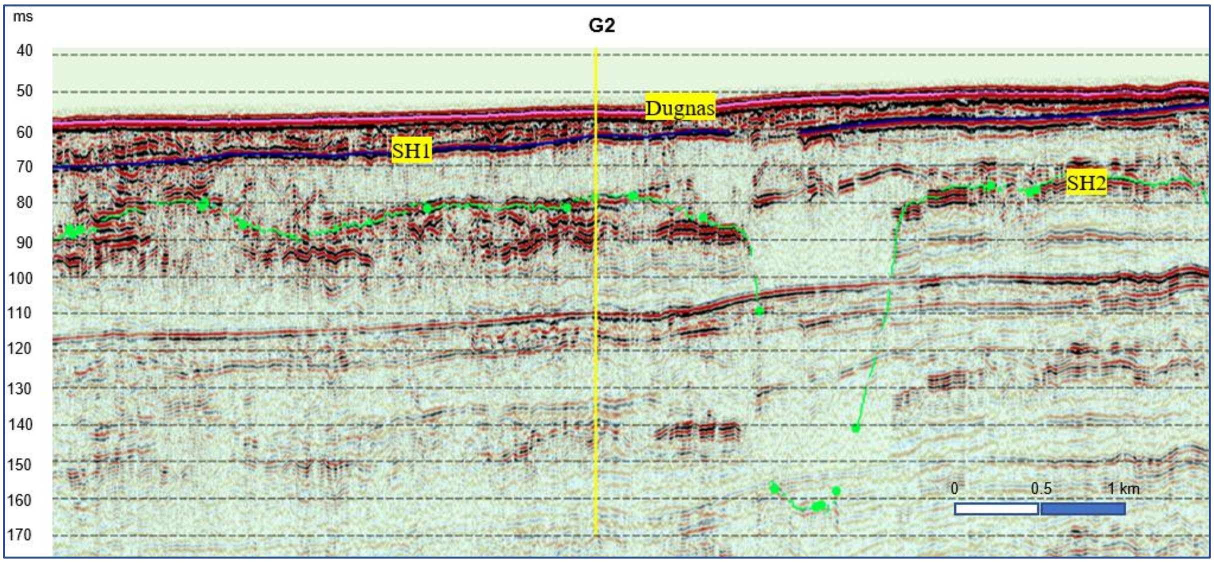


Seismic cross section No. 95

Cross section „G2“:

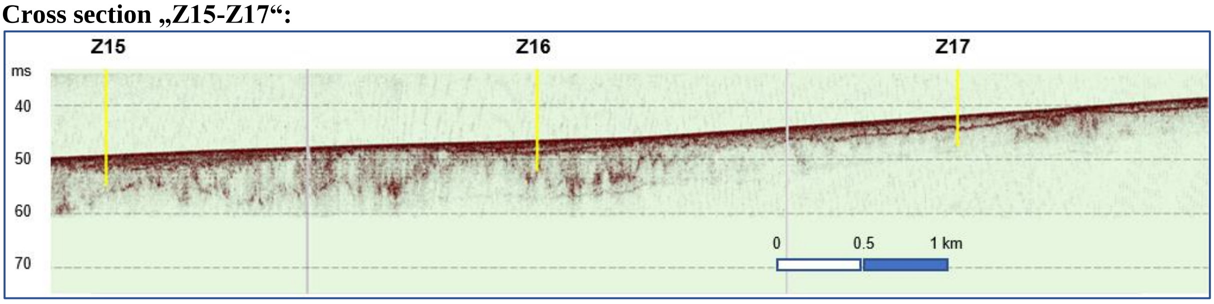


Sub bottom profiler cross section No. M110

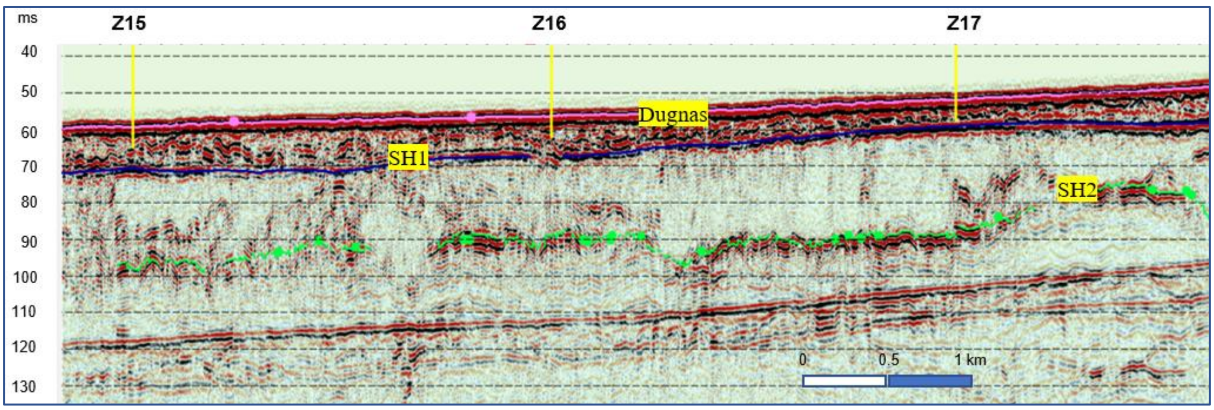


Seismic cross section No. 110

Cross section „Z15-Z17“:

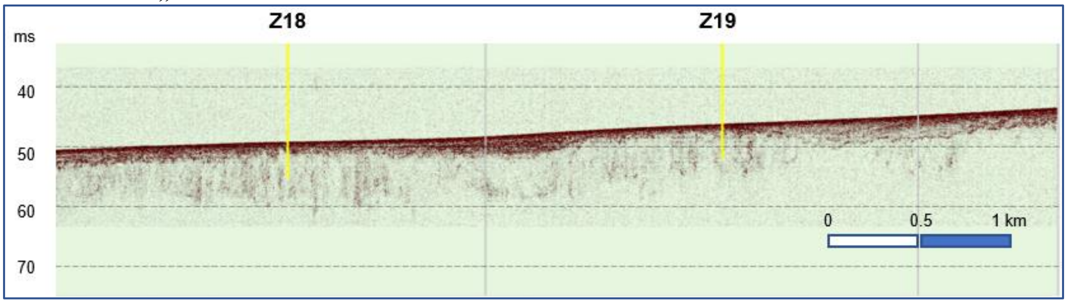


Sub bottom profiler cross section No. M120

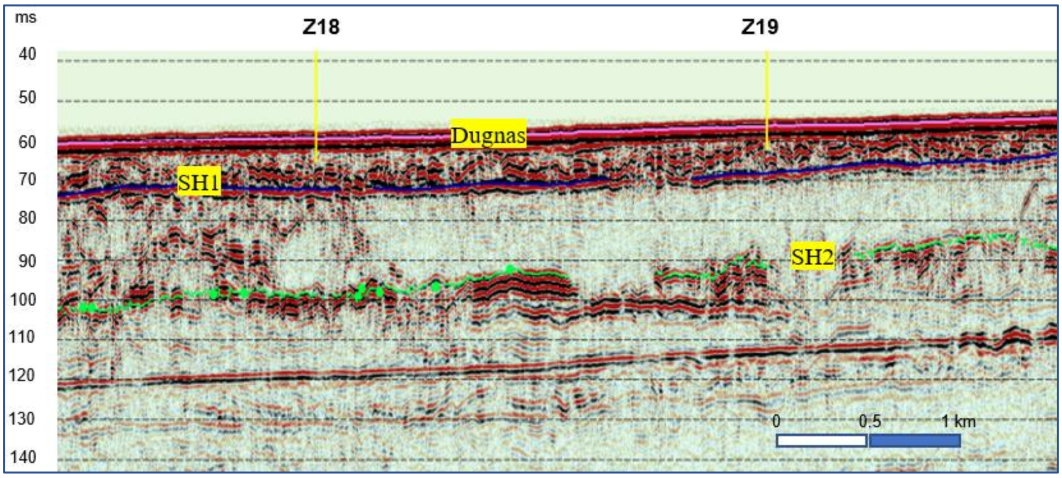


Seismic cross section No. 120

Cross section „Z18-Z19“:

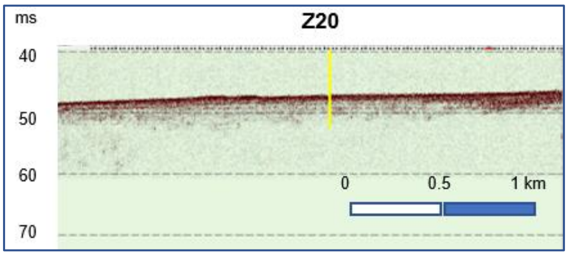


Sub bottom profiler cross section No. M145

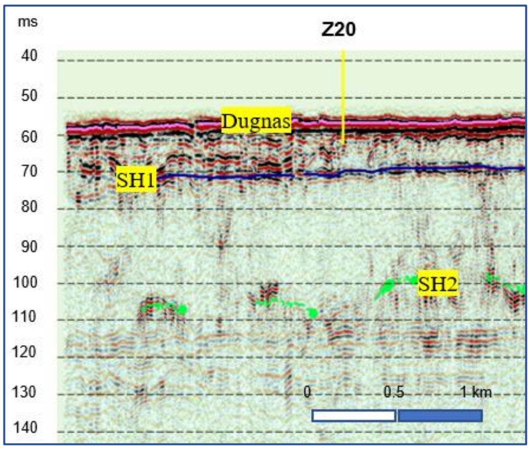


Seismic cross section No. 145

Cross section „Z20“:



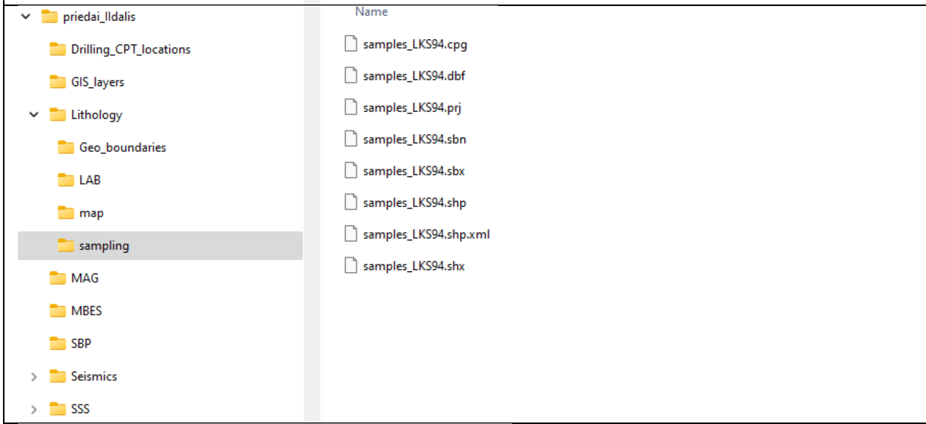
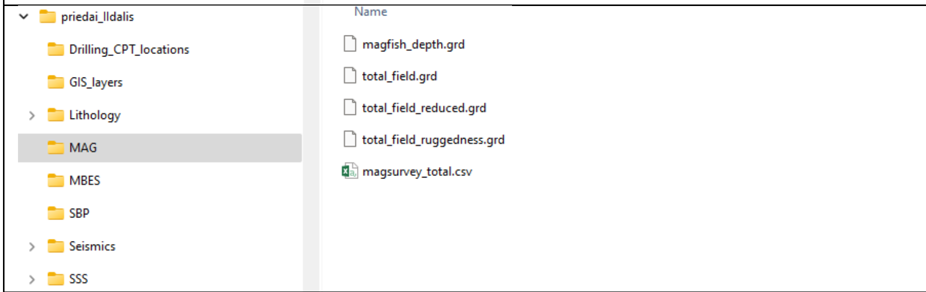
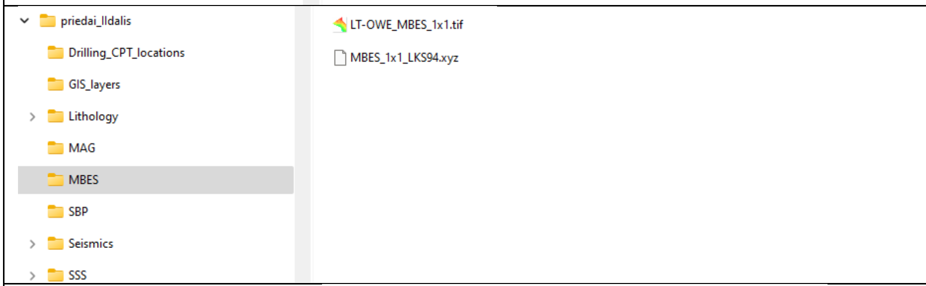
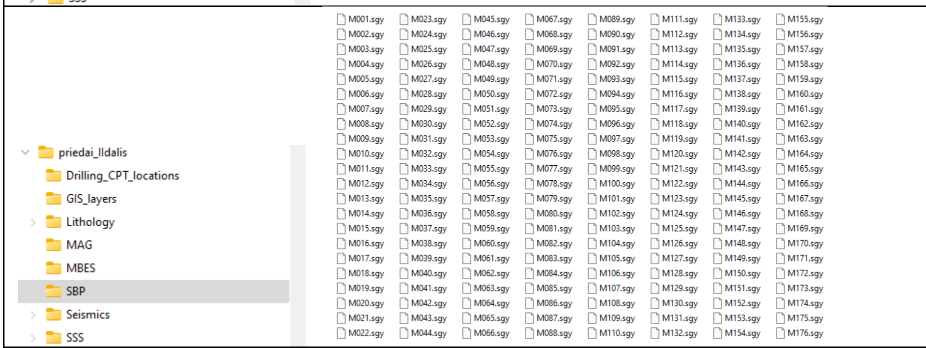
Sub bottom profiler cross section No. M167

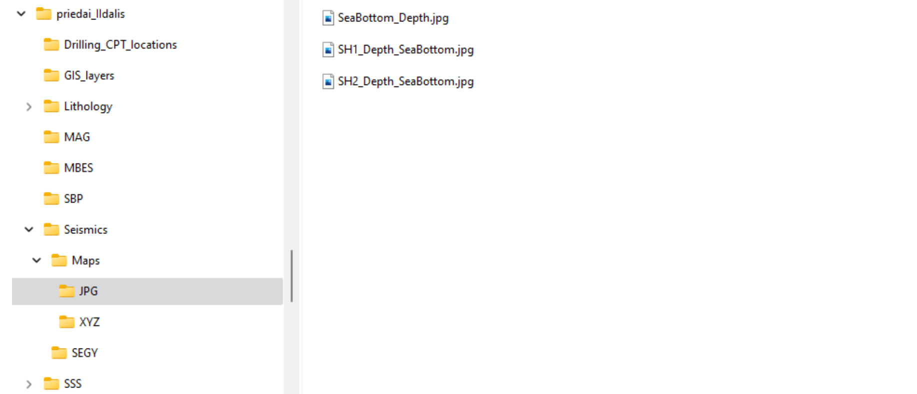


Seismic cross section No. 167

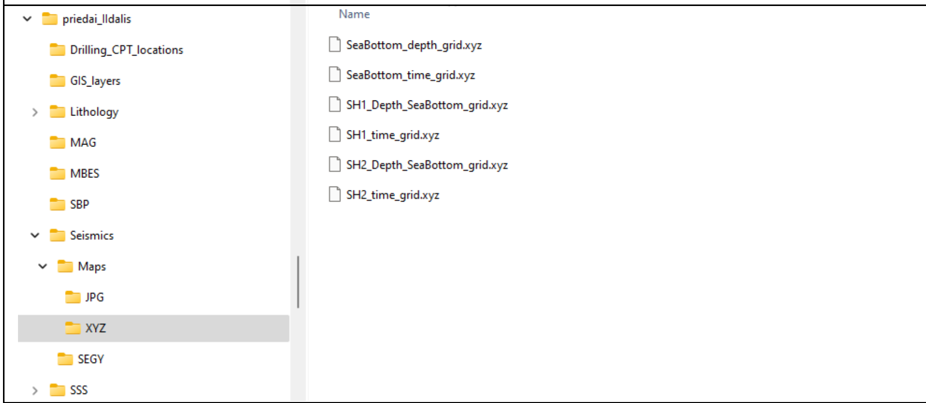
4. Annex „Digital data“

Folder	Files	Description
priedai_IIdalis Drilling_CPT_locations GIS_layers Lithology MAG MBES SBP Seismics SSS	Name IGG_coordinates.xlsx Location_IGG_LKS94.cpg Location_IGG_LKS94.dbf Location_IGG_LKS94.prj Location_IGG_LKS94.sbn Location_IGG_LKS94.sbx Location_IGG_LKS94.shp Location_IGG_LKS94.shx	Recommended coordinates of deep (G1 and G2) and shallow (Z1-Z20) boreholes and CPT stations in *.xls table and ESRI *.shp format
priedai_IIdalis Drilling_CPT_locations GIS_layers Lithology MAG MBES SBP Seismics SSS	Name OWE_area_LKS94.cpg OWE_area_LKS94.dbf OWE_area_LKS94.prj OWE_area_LKS94.sbn OWE_area_LKS94.sbx OWE_area_LKS94.shp OWE_area_LKS94.shp.xml OWE_area_LKS94.shx profiles_LKS94.dbf profiles_LKS94.sbn profiles_LKS94.sbx profiles_LKS94.shp profiles_LKS94.shx	Survey area and hydrographic and seismic survey lines in ESRI *.shp format
priedai_IIdalis Drilling_CPT_locations GIS_layers Lithology Geo_boundaries LAB map sampling MAG MBES SBP Seismics SSS	Name geo_boundaries_LKS94.cpg geo_boundaries_LKS94.dbf geo_boundaries_LKS94.prj geo_boundaries_LKS94.sbn geo_boundaries_LKS94.sbx geo_boundaries_LKS94.shp geo_boundaries_LKS94.shp.xml geo_boundaries_LKS94.shx	Lithological boundaries of seabed sediments in ESRI *.shp format.
priedai_IIdalis Drilling_CPT_locations GIS_layers Lithology Geo_boundaries LAB map sampling MAG MBES SBP Seismics SSS	Name TP-043-2022_700MW.xls	Results of grain size analysis: lab protocol in *.xls format;

<table>
<tr><td>
</td><td>Lithological scheme in *.GeoTiff format;</td></tr>
<tr><td>
</td><td>Sites of lithological sampling in ESRI *.shp format;</td></tr>
<tr><td>
</td><td>Mag data of 176 postprocessed profiles in *.csv format;
Mag depth chart in *.grd format;
Total magnetic field in *.grd format;
Residual magnetic field in *.grd format;</td></tr>
<tr><td>
</td><td>Postprocessed depth values at 1x1 m resolution grid in *.XYZ format;
Map of seabed depth in *.GeoTiff format</td></tr>
<tr><td>
</td><td>176 sub bottom cross sections in digital SEG-Y format</td></tr>
</table>

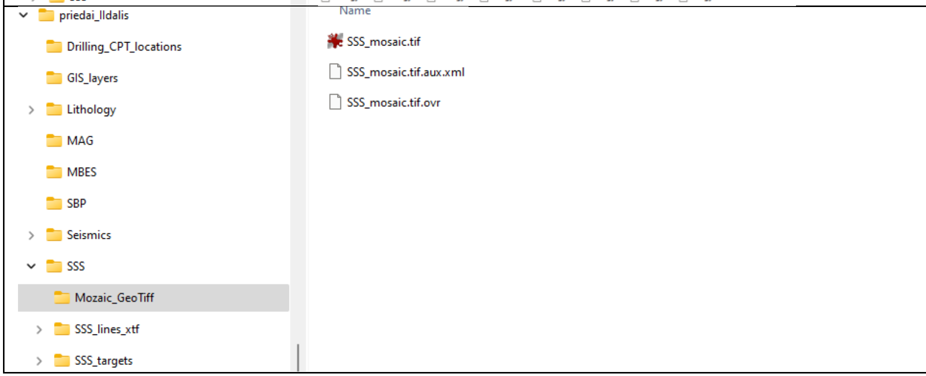


Bottom, SH1 and SH2 seismic horizons depth maps (bellow the seabed) in *.JPG format

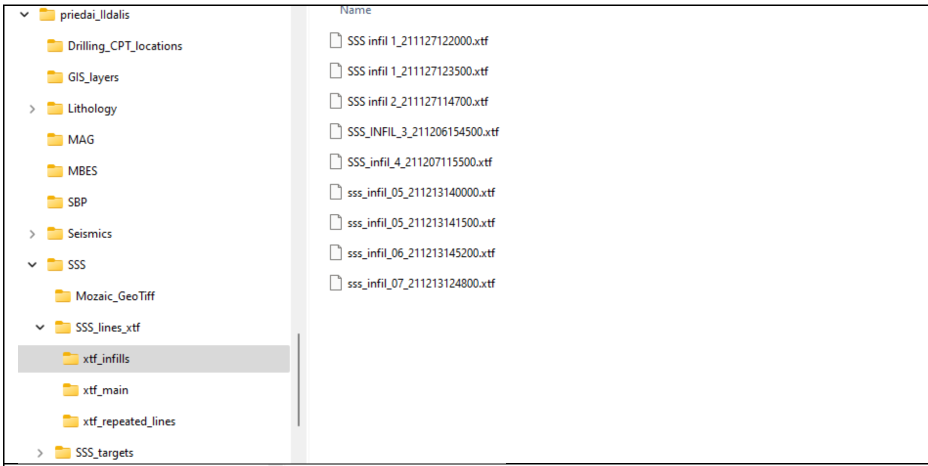


Bottom, SH1 and SH2 seismic horizons depth maps (bellow the seabed) in *.XYZ format

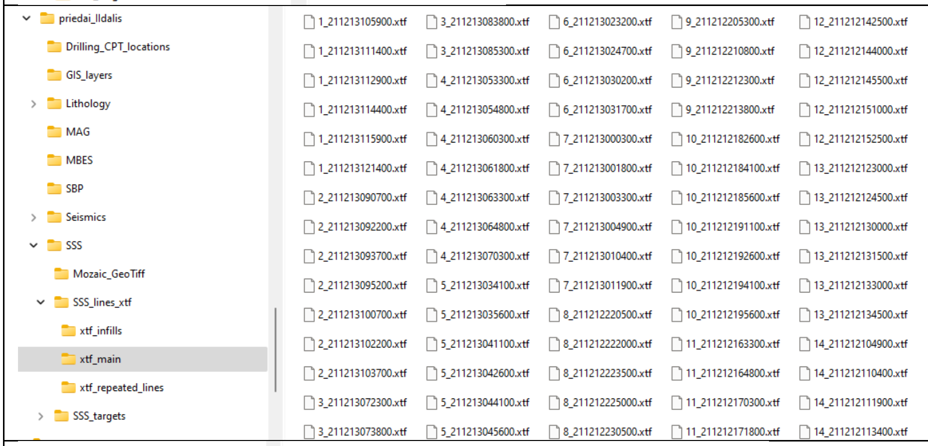
176 seismic cross sections in digital SEG-Y format and 3D data array in digital SEG-Y format



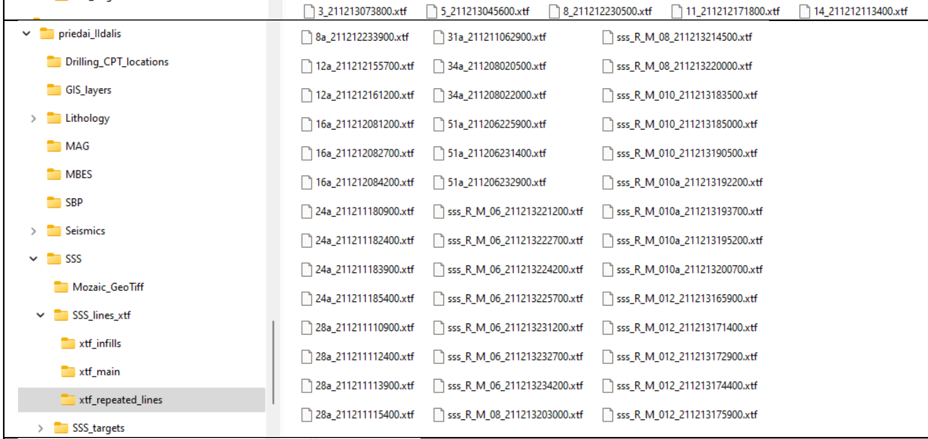
SSS mosaic in *.GeoTiff format



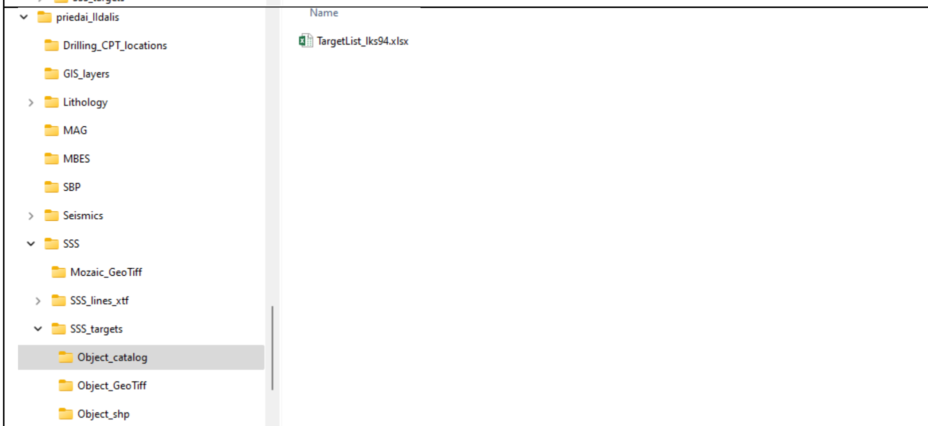
Postprocessed data of side scan sonar infills in *.xtf format



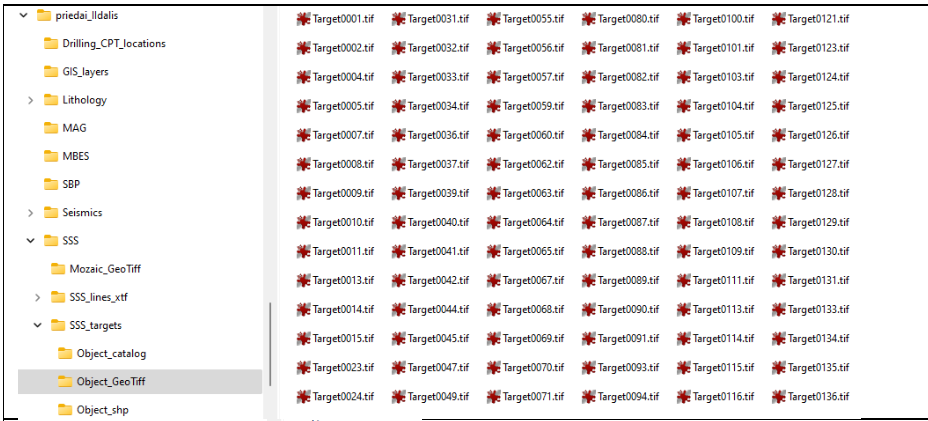
Postprocessed data of side scan sonar – 176 profiles in *.xtf format



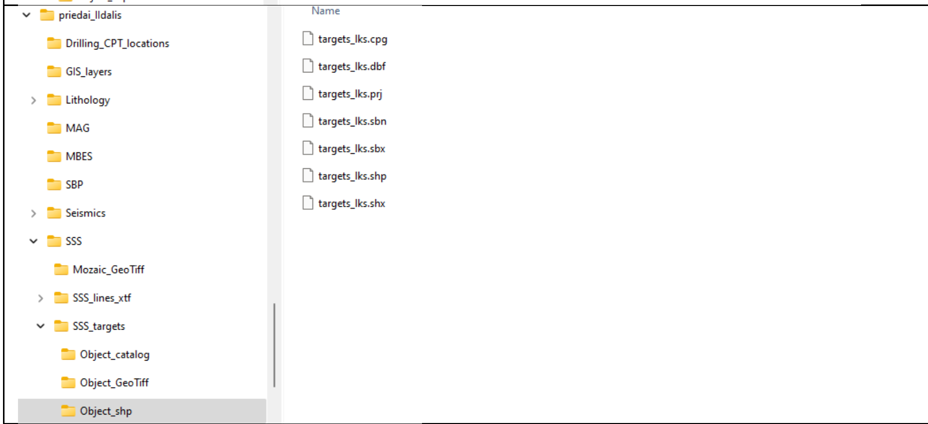
Postprocessed data of repeated side scan sonar profiles in *.xtf format



Catalogue of the targets: in *.xls format



858 targets obtained from side scan sonar profiles in *.GeoTiff format;



Position of the targets in ESRI *.shp format