Petro Seismic

Petro Seismic Agency Limited

# Black Sea Data Catalogue

getech

# Introduction to the Black Sea

**The Black Sea Basin is modern back-arc basin which is located on Eastern Europe, bordered by 6 different countries (Russia, Ukraine, Turkey, Romania, Georgia and Bulgaria) with area of 436,000 km2. The first offshore discovery was Golytsinskoye in 1975, on the Ukrainian Odessa Shelf, and became the first producing gas field in the Black Sea.**

Exploration drilling in the Ukrainian sector of the Black Sea has focused on the shallow water areas, and a number of discoveries have been made, including six gas fields (Golytsinskoye, Schmidta, Arkhangelskoye, Odesskoye, Bezymyannoye and Krymskoye), two gas condensate fields (Shtormovoye, Yuzhno- Golytsinskoye) and one oil field (Subbotina). The Golytsinskoye and Shtormovoye fields are currently under development, and the Arkhangelskoye, Bezymyannoye, Krymskoye and Schmidta discoveries are under appraisal.

This document provides details of the released technical data available for potential investors to license. All released data is available, subject to the signing of a Licensing Agreement with Getech Group Plc.

# Petroleum Geology of the Black Sea

## Regional Tectonic Setting

**Black Sea Basin was formed during late Lower Cretaceous extension phase.**
**Initially the Black Sea Basin was divided into two sub-basins, Western Black Sea Basin and Eastern Black Sea Basin, which were separated by Mid-Black Sea High until Middle Eocene.**

The Western Black Sea Basin was formed by the separation of Western and Central Pontide continental strip from the Moseian Platform and Odessa Shelf caused by the movement between two transform faults. Meanwhile in Eastern part, the rotation of Shatsky Ridge and Mid12 Black Sea High produced the opening of Eastern Black Sea Basin.

The Ukrainian sector of the Black Sea encompasses parts of several major tectonic elements, including the following:

- The Crimean orogenic fold mountain system
- The Eastern and Western Black Sea Deep Basins
- The southern margin of the East European Platform/Scythian Plate and Moesian Platform

The East European Platform is comprised of pre-Riphean basement which dips southwards and is overlain by Paleozoic, Mesozoic and younger sedimentary cover. The basement surface subsides southwards to depths in excess of 5,000 m. Within the sedimentary cover there are generally N–W-trending local structural highs and depressions.

Within the Scythian Plate a number of tectonic elements are defined, including the Kiliysko-Zmeinoye High, Karkinitsky Trough, Gubkin Ridge, Kraevaya Spur, Kalamitskoye High and the Lower Danube Trough. Strike-slip faulting enhances the structuration of this region, part of which lies within the area covered by this recent seismic data set.

Further to the south and west, the Moesian Platform is characterised by a thick and undeformed Paleozoic–Mesozoic section which is covered by a thinner Cenozoic section. The platform extends offshore from Romania and Bulgaria into the westernmost sector of the Black Sea. The Moesian Platform also extends offshore towards the deep Western Black Sea Basin and could well have formed a major source of clastic sediments into the basin during the Late Cretaceous and Cenozoic.

The present Black Sea morphology has been produced by the coalescence of two basins during their post-rift phases. The Maikop Formation is known to be a major oil and gas source rock horizon throughout the Black Sea-Caspian region. Around much of the Black Sea, there is also apparently an upper Eocene oil-prone source, which has been linked to the oil of the Lebada Field.

# Potential Reservoirs

**The main proven reservoirs in the shallow-water sector of the northwest Black Sea Shelf and onshore Crimea are in Lower Cretaceous clastic reservoirs, porous fractured carbonates of Upper Cretaceous–Pliocene age and Paleocene–Eocene sandstones. Cretaceous and Cenozoic shales form regional sealing horizons. Five main reservoir units have been identified:**

- Lower Cretaceous syn-rift and post-rift clastics
- Upper Cretaceous carbonates
- Paleocene–Eocene sandstones, siltstones and carbonates
- Oligocene–lower Miocene sandstones (Maikop Formation)
- Middle Miocene–Pliocene sandstones

The fields of the northwest Black Sea Shelf are generally comprised of multilayer reservoirs within the Maikop Formation and lower Paleocene clastics (the Golytsinskoye, Arkhangelskoye and Schmidt Fields), Paleocene carbonates (the Shtormovoye and Golytsinskoye Fields), Eocene, upper and lower Paleocene (the Odesskoye and Bezymyannoye Fields), Paleocene–lower Miocene (the Maikop Formation) sandstones (the Arkhangelskoye Field), Upper Cretaceous Maastrichtian limestones (the Schmidta Fields) and Albian sandstones (Lebada Est and Vest).

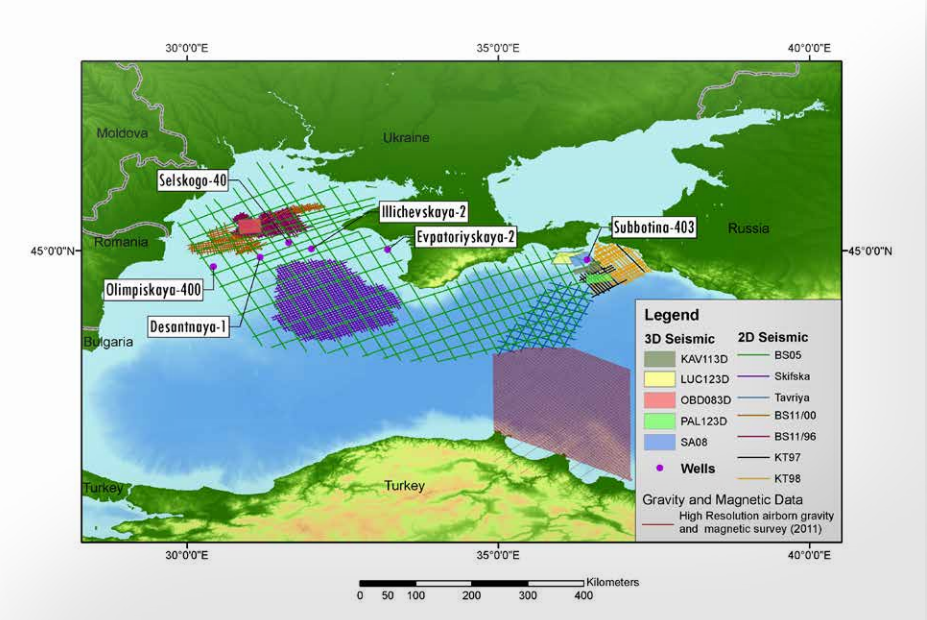


*Figure 1: Map to show seismic, well and gravity & magnetics data available. (KAV113D = Kavkazskaya, LUC123D = Luchinskogo, OBD083D = Odesskaya-Bezimyannaya, PAL123D = Palasa, SA08 = Subbotina-Abiha)*

Deeper reservoirs may exist within the eroded, karstified Jurassic and Triassic carbonate sequences on the Kalamyt High, Krayevaya Spur and in the offshore sector of the Moesian Platform, but these have not yet been adequately explored.

On the basinward flanks of major structural highs (such as the Moesian Platform, Kalamit Ridge and westwards from the Crimean Mountains), deep sea submarine fan systems shed into the deep basin during the Late Cretaceous and Cenozoic drift phase. These geometry types can be interpreted on the seismic profiles of the BSR2005 survey.

As the shallow waters (<100 m) of the Black Sea can be regarded as being at an immature stage of exploration, further discoveries can be expected. The deepwater (>100 m) sector of the Ukrainian Black Sea is undrilled; it is this frontier region that holds the greatest potential for substantial oil and gas finds.

# Well Data

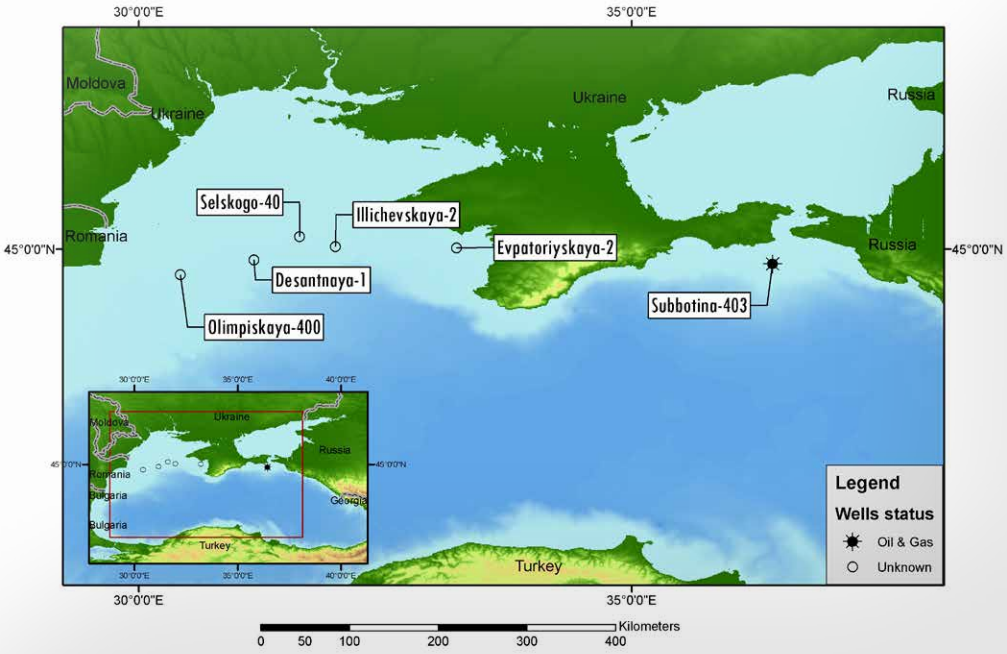


*Figure 2: Map to show well data available*

**The well database includes original and composite well logs and final well reports.**

The following data are available for licensing:

| Well name | Year(s) Drilled | CPI Log (image files) | Merged Log Data (LAS) | Original Logged Data (LAS) | Well Stratigraphy |
|---|---|---|---|---|---|
| Illichevskaya-2 | 1981 | ✓ | ✓ | ✓ | ✓ |
| Subbotina-403 | 2004-2005 | ✓ | ✓ | ✓ | ✓ |
| Desantnaya-1 | 1987 | ✓ | ✓ | ✓ | ✓ |
| Evpatoriyskaya-2 | 1994-1995 | ✓ | ✓ | ✓ | ✓ |
| Olimpiskaya-400 | 2001 | ✓ | ✓ | ✓ | ✓ |
| Selskogo-40 | 1987-1980 | ✓ | ✓ | ✓ | ✓ |

**For each well, a CPI plot is available (in Corel Draw and Acrobat formats). Key log data have been merged and spliced into a single LAS file, for each well and the following curves are included:**

1. Acoustic logging
2. Lateral logging sensing
3. Gamma ray
4. Lateral logging
5. Measuring caliper
6. Induction logging
7. Spontaneous potential
8. Microlateral log survey
9. Temperature logging
10. Acoustic travel time
11. Impulse neutron-neutron logging

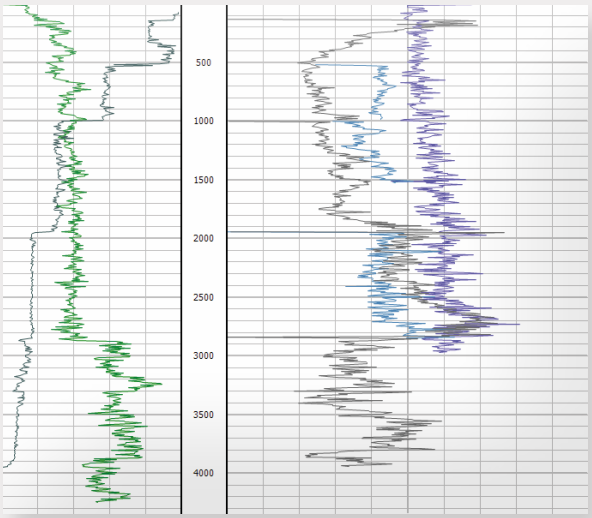


*Figure 3: Example of digital logs available*

# 2D Seismic Data

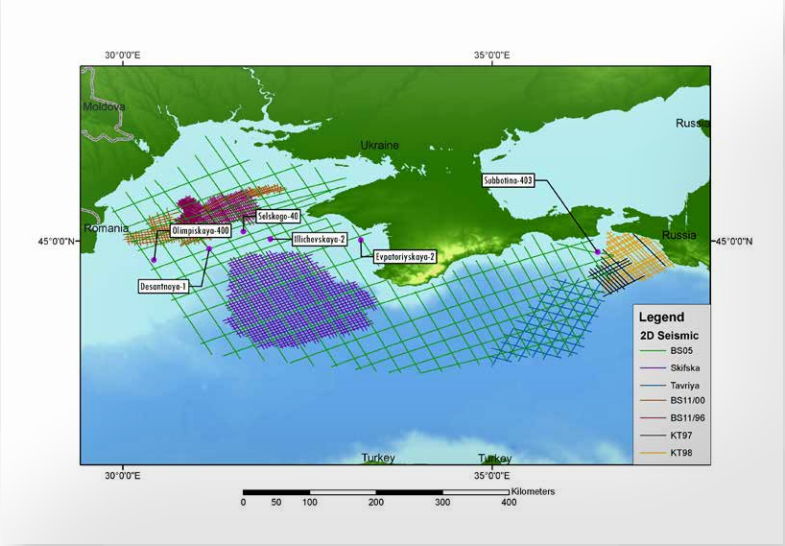


*Figure 4: Map to show 2D seismic data available*

## BSR2005 (BS05)

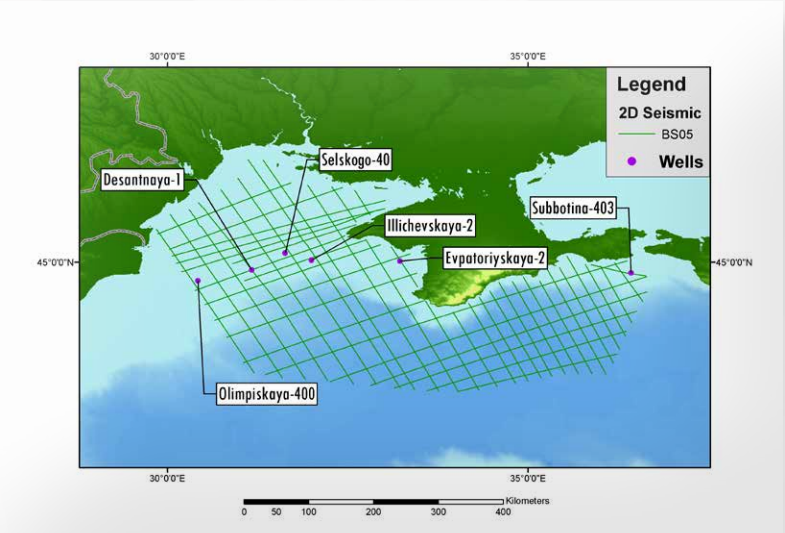


*Figure 5: Map to show location of BS05 2D seismic data*

**The BSR2005 survey was acquired in 2005. The seismic acquisition was performed by the vessel Professor Polshkov by deploying a 6,000 m streamer.** The total seismic data set consists of 47 lines, totaling 9,875 km of high-quality seismic data.

### Processing Sequence–BSR2005

1. Demultiplexing
2. Further trace edit
3. F-K filtering
4. Adjacent trace SUM
5. Geometry application
6. Static correction
7. Resample to 4 ms
8. Spherical divergence correction
9. Predictive deconvolution
10. Band-pass filtering
11. First-pass velocity analysis
12. WB-multiple suppression
13. Second-pass velocity analysis
14. Radon multiple attenuation
15. DMO and prestack time migration
16. DMO
17. Stolt pre-stack time migration
18. Final velocity analysis
19. NMO
20. Muting
21. Stack
22. Stolt demigration
23. Static correction
24. Residual amplitude correction
25. Random noise attenuation
26. Deconvolution
27. Band-pass filter
28. Final time post-stack Kirchhoff migration
29. Display

Deliverables:

- Stacked and stacked migrated data in a SEGY format
- Esso V2 stacking velocity data
- Navigation data in a UKOOA format
- Shot point location map (hard copy)

## Skifska Area

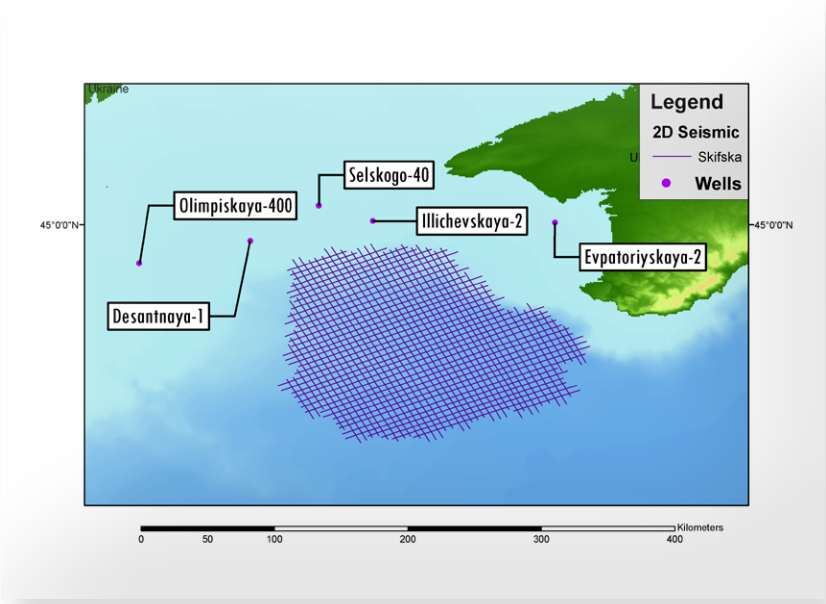


*Figure 6: Map to show Skifska 2D seismic data*

**The Skifska survey was acquired and processed in 2010, prior to the 2012 licensing round, with RPS Energy providing seismic acquisition and processing QC support.** In total, over 8,800 line kms was acquired, including 2D seismic, gravity and magnetic data; the data provide excellent coverage over the Skifska area and extend into the Forosa area. This survey complements the existing BSR-2005 survey which was acquired by Polar Trade & Research Associates Ltd. in 2005.

Deliverables:

- Seismic acquisition report
- Seismic acquisition supervisor's (QC) report
- Seismic processing report
- Seismic processing supervisor's (QC) report
- PSTM CDP gathers
- Processed data-PSTM stacks (near, mid, far and full)
- Seismic velocities
- Navigation data
- Gravity and magnetics data and report

## Tavriya Area

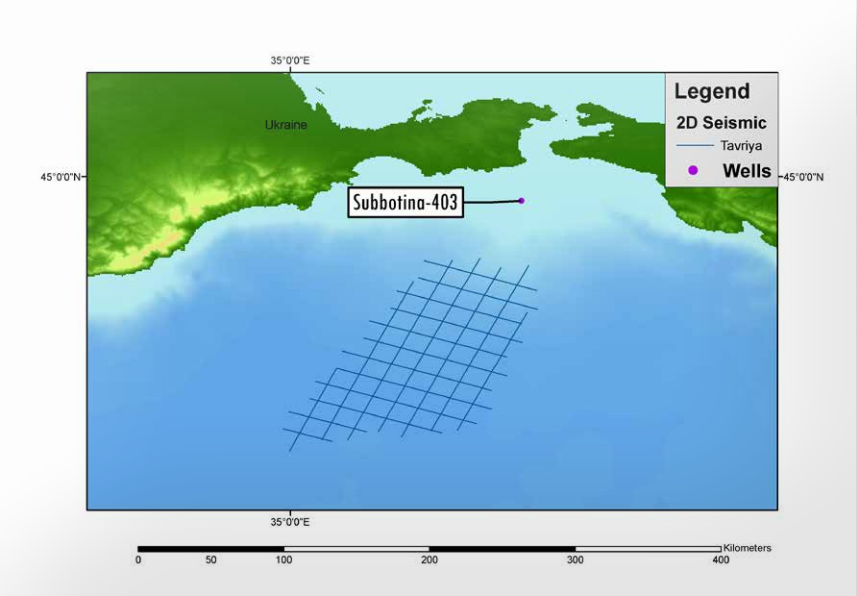


*Figure 7: Map to show Tavriya 2D seismic data*

**Under an agreement between Polar Trade & Research Associates Ltd., and the Ministry of Environmental Protection of Ukraine, Polar Trade acquired a 2D survey in the Tavriya Block in 2010. Gravity and magnetic data were also acquired, and the survey acquisition and processing were QC'd by RPS Energy.**

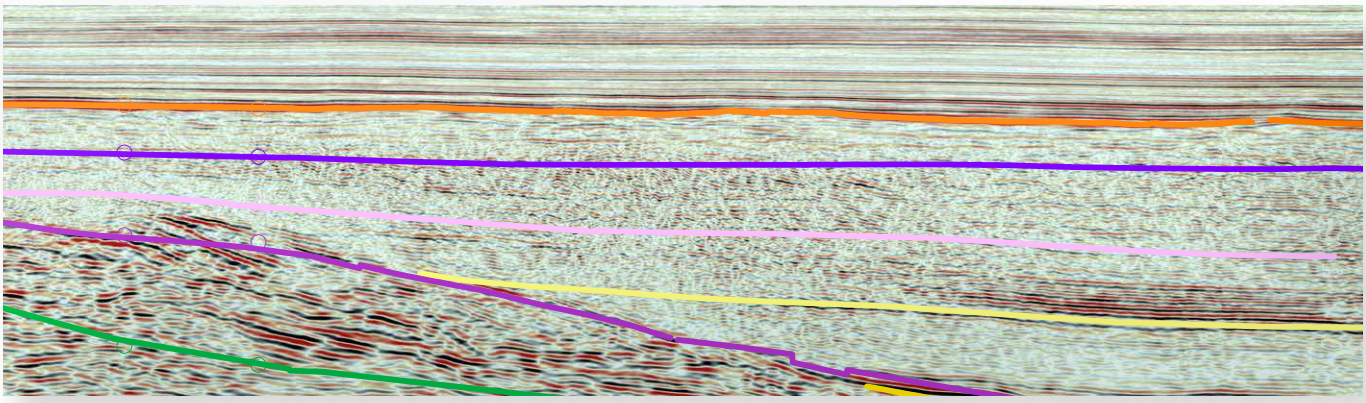

*Figure 8: Tayvria 2D seismic line*

## BS 11/00 & BS 11/96

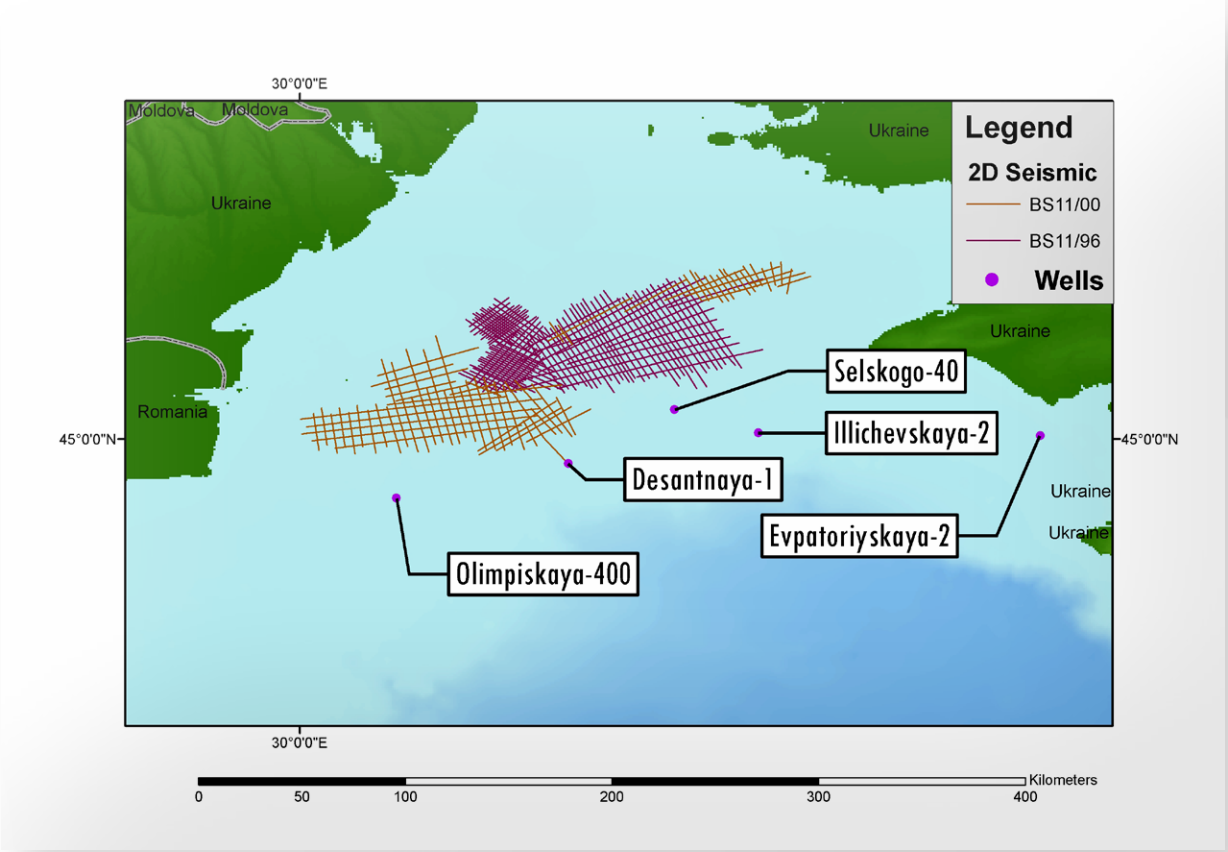


*Figure 9: Map to show BS 11/00 and BS/96 2D seismic data available*

**SMNG acquired two 2D seismic surveys in the Black Sea (Ukraine), BS 11/96 survey in 1996 and BS11/00 survey 2000, under an agreement with Ukrainian Chernomorneftegaz. Seismic data acquisition was performed by SMNG's Professor RjabinkinandIskatel-3 vessels.**

The BS11/96 survey targeted three areas (Karkinitskaya, Bezymyannaya and Odessksya) and totaled some 3,183 line kms. Processing was undertaken by SMNG.

Processing Sequence-BS11/96 Survey

1. Input seg-D data: 7,100 ms/2 ms, 120 chan`s
2. Resample 4 ms
3. Bulk statics: to sea level
4. Editing traces: noise traces edit
5. True amplitude recovery: spherical divergence correction
6. Band-pass filter: 4-8-60-70 Hz
7. Velocity analysis: step 2 km
8. Automatic gain control: operator length 600 ms
9. Top muting
10. F-K filter: fan, -1,440–-2,740 m/s, 1,440–2,740m/s, 5–50 Hz
11. Adapt deconvolution: operator length 160 ms; predict. dist. 32 ms; rate of adapt 0.2
12. Top muting
13. Radon velocity filter

14. Automatic gain control: remove AGC
15. Velocity analysis for DMO: step 2 km
16. Common offset F -K DMO 17. Velocity analysis for stack: step 2 km
18. NMO, top and bottom muting (for multiple attenuation)
19. CDP/ensemble stack: min./max. exclude
20. Automatic gain control: operator length 600 ms
21. Predictive deconvolution: operator length 240 ms; predict. dist. 32 ms; white noise 1.0
22. F-X decon.: horizon; window length 11; number of filter samples 7
23. Kirchhoff time migration: max. dip of 45 deg, 0,95 veloc. RMS (smooth), max. freq. of 70 Hz
24. Automatic gain control: remove AGC
25. Time-varient scaling gain: 0.6, T 0–1,300 ms; 2.1, T 1,900–3,500 ms; 1.6, T 4,000–7,000 ms
26. Time-varient band-pass filter: 4-10-50-60 Hz, T 0–800 ms; 4-10-40-50 Hz, T 1,200–2,000 ms; 4-10-30-40 Hz, T 2,500–3,500 ms; 4-10-25-35 Hz, T 4,000–7,000 ms
27. Trace equalisation: time gate 400–7,000 ms
28. Seg-Y output

**The BS11/00 survey targeted two areas (Gubkinskaya and Golytsinskoye) and totaled some 2,010 line kms. The processing was undertaken by MNG and the Gubkinskaya area data was re-processed in 2002.**

Processing Sequence-BS11/00 Survey

1. Input seg-D data: 7,100 ms/2 ms, 120 chan`s
2. Resample 4 ms
3. Bulk statics: to sea level
4. Editing traces: noise traces edit
5. True amplitude recovery: spherical divergence correction
6. Band-pass filter: 4-8-60-70 Hz
7. Velocity analysis: step 2 km
8. Automatic gain control: operator length 600 ms
9. Top muting
10. F-K filter: fan, -1,440–-2,740 m/s, 1,440–2,740m/s, 5–50 Hz
11. Adapt deconvolution: operator length 160 ms; predict. dist. 32 ms; rate of adapt 0.2
12. Top muting
13. Radon velocity filter
14. Automatic gain control: remove AGC
15. Velocity analysis for DMO: step 2 km
16. Common offset F -K DMO
17. Velocity analysis for stack: step 2 km
18. NMO, top and bottom muting (for multiple attenuation)
19. CDP/ensemble stack: min./max. exclude
20. Automatic gain control: operator length 600 ms
21. Predictive deconvolution: operator length 240 ms; predict. dist. 32 ms; white noise 1.0
22. F-X decon.: horizon; window length 11; number of filter samples 7
23. Kirchhoff time migration: max. dip of 45 deg, 0,95 veloc. RMS (smooth), max. freq. of 70 Hz
24. Band-pass filter: 7-13-50-70 Hz, T 0–1,200 ms; 5-10-40-50 Hz, T 1,500–3,000 ms; 4-8-25-35 Hz, T 3,500–6,000 ms
25. Time-variant scaling – time gates
26. Time-variant scaling – user gain values 1.0 T 0–3,300; 0.4 T 4,000–6,600 ms
27. Header static: + 10 ms – down
28. Seg-Y output

## KT97 & KT98

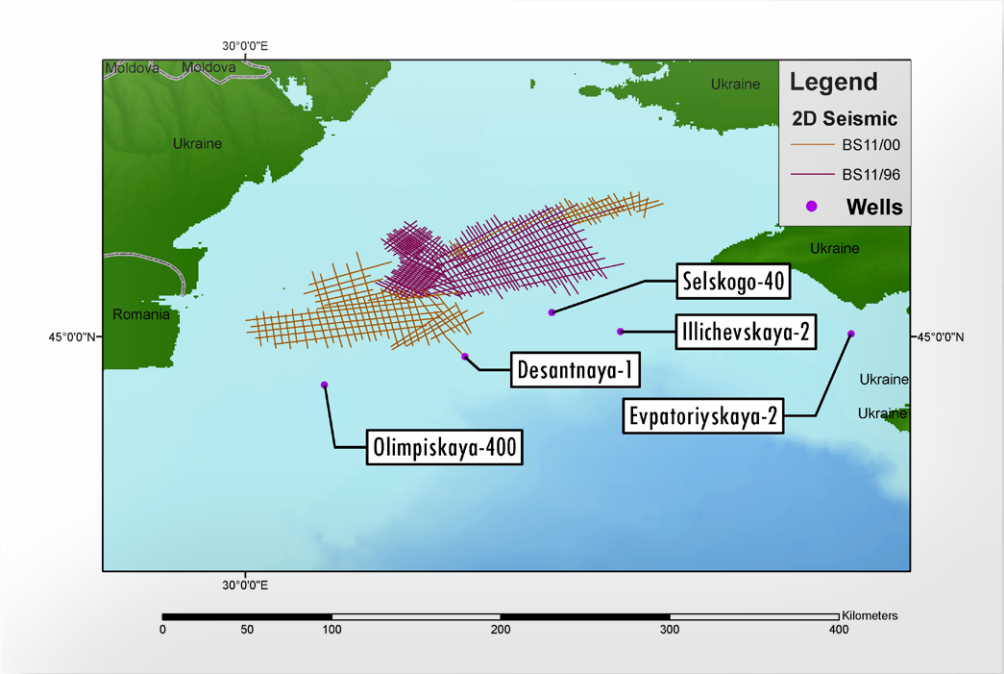


*Figure 10: Map to show KT97 and KT98 2D seismic data available*

The KT97 and KT98 2D seismic surveys were shot to the south-east of the Kerch Strait in 1997 and 1998 respectively. For the KT97 survey, 150 line km are available and 1630 line km for the KT98 survey.

# 3D Seismic Data

**Getech is pleased to announce the availability for licensing of the Palasa, Odesskaya-Bezimyannaya, Subbotina-Abiha, Kavkazskaya and Luchinskogo 3D surveys. Field data is available for all surveys, but processed data is only available for the Palasa survey.**

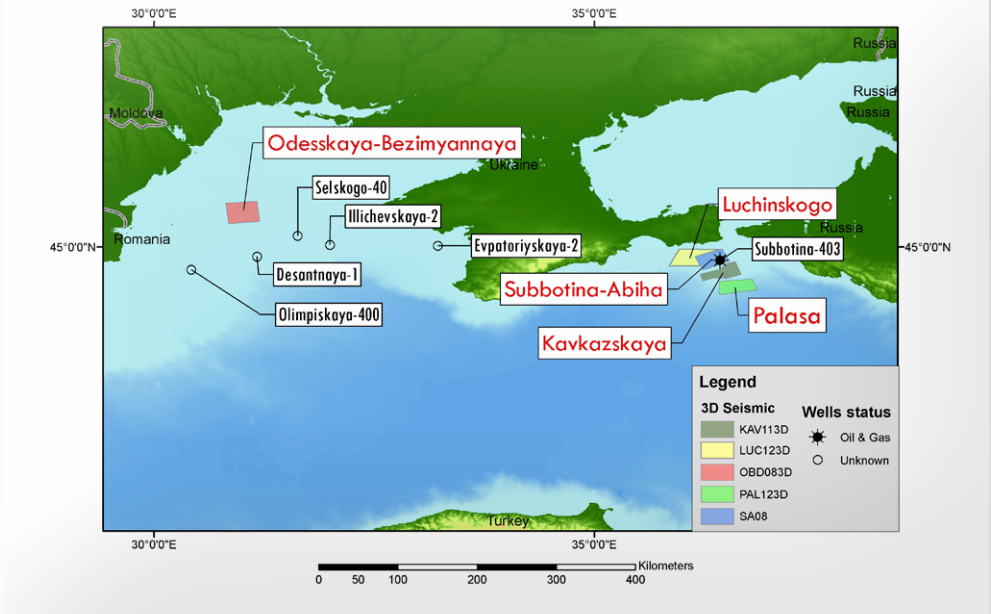


*Figure 11: Map to show 3D seismic data available. (KAV113D = Kavkazskaya, LUC123D = Luchinskogo, OBD083D = Odesskaya-Bezimyannaya, PAL123D = Palasa, SA08 = Subbotina-Abiha)*

## Palasa Survey

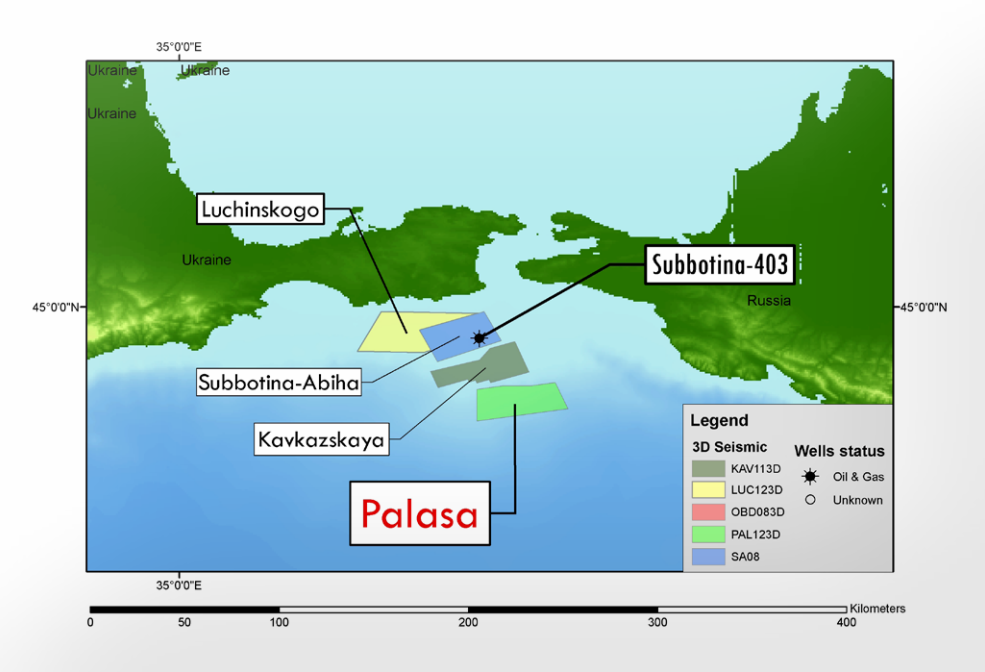


*Figure 12: Map to show Palasa 3D seismic data. (KAV113D = Kavkazskaya, LUC123D = Luchinskogo, OBD083D = Odesskaya-Bezimyannaya, PAL123D = Palasa, SA08 = Subbotina-Abiha)*

**The Palasa Survey, PAL12 3D, was acquired from Dec 2012 to Jan 2013 and covers 500 sq km of the Kerch Shelf, between Ukraine and Russia.**

The data add to the already substantial library of 2D seismic data available for the area.

Deliverables for the PAL12 3D include:

- Final Stack Data
- CMP Gathers
- Velocity volumes
- AVO volumes
- SEG-D field data
- Pre-stack migrated gathers
- Acquisition and Processing reports

SEG-D field data and acquisition reports are also available for the Odesskaya -Bezimyannaya (OBD08 3D), Subbotina-Abiha (SA08 3D), Kavkazskaya (KAV11 3D) and Luchinskogo (LUC12 3D) 3D surveys.

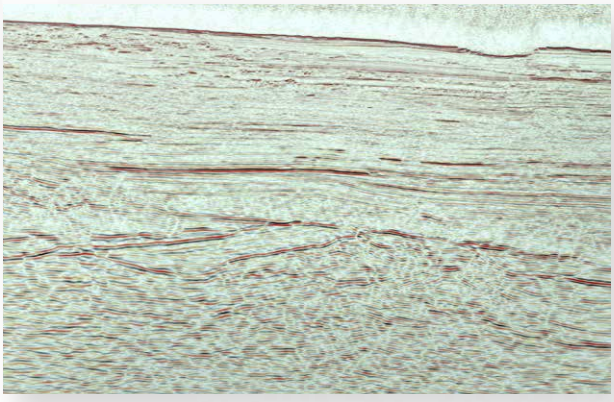

*Figure 13: Palasa 3D survey Crossline*

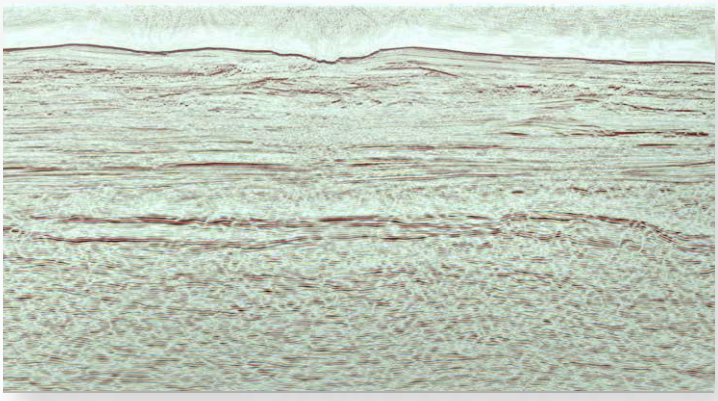

*Figure 14: Palasa 3D survey Inline*

# Gravity and Magnetic Data

**Since 1988, Getech's regional gravity and magnetic maps of Africa have been used by almost all the major oil companies to help resolve uncertainties in seismic interpretation and develop deeper insights into sub-surface exploration environments.**

Getech's Multi-Sat is the most accurate, reliable and coherent gravity data available for all of the world's oceans and provides comparable resolution to regional 2D shipborne solutions.

Getech gravity & magnetic data available for Black Sea region include:

| Data Type | Onshore | Offshore | High Resolution |
|---|---|---|---|
| Gravity data | Surrounding the Black Sea, Getech has many thousand gravity stations throughout Turkey, Bulgaria, Romania, Ukraine, Russia and Georgia contributing to grids of Bouguer anomaly and isostatic residual anomaly | Offshore, Getech's award-winning Multi-Sat gravity provides 2 km grids of free air, Bouguer and isostatic residual anomaly with consistent coverage over the entire Sea | In addition to the regional grids, Getech can provide access to a high-resolution G&M survey available off the Turkish coast (Figure 15). This is a 2011 survey flown 150m above the sea with 42,478 line km at 1 km spacing in 45/225 orientation and 4 km tie lines in 135/315 orientation. Available as profile data plus 200 m grids of TMI and RTP magnetic anomaly, Bouguer and isostatic residual magnetic anomaly and a suite of derivative grids |
| Magnetic data | Thanks to many years building relationships with national bodies and private data owners, Getech has magnetic data in Turkey, Bulgaria, Russia and Georgia contributing to grids of TMI and RTP anomaly | Our regional magnetic compilation is available to give the very long-wavelength component of the magnetic field in the Black Sea | |

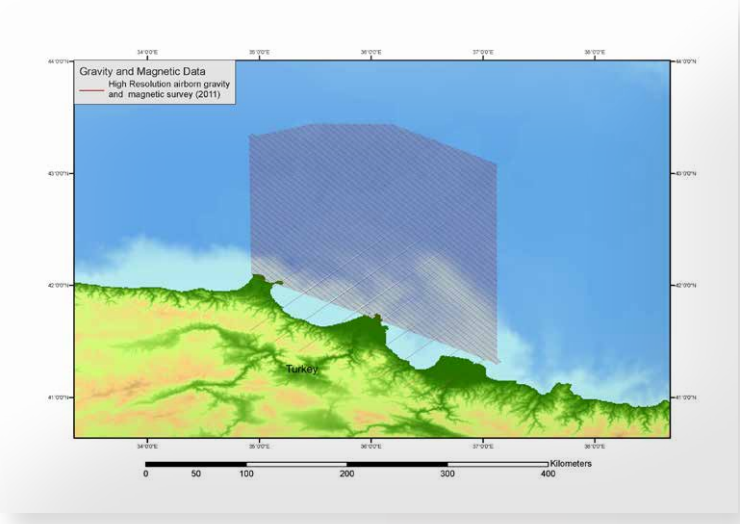


*Figure 15: High resolution airborne gravity and magnetic survey off the Turkish coast.*



**Contact us for more information and pricing:**

**e: kvdutton@aol.com** or **info@getech.com**