THERMOVISION TOMOGRAPHY (TVT) - technology of interpretation of infrared data, collected via satellites and processed using Patented Algorithms and Patented Software into 3D, 2.5D and 2D maps of a given area.
Our group presents innovative technology of Thermovision Tomography (TVT) for prospecting of Earth’s mineral resources.

Fields of TVT application:

- Geology
  - Prospecting of solid mineral deposits
  - Prospecting of onshore and offshore oil & gas deposits
- Diagnostics of oil & gas pipelines
- In construction of metro and tunnels
- In construction of high rise buildings
How do we conduct the research?

Comprehensive analysis of spectrozonal aerospace data both onshore and offshore is done using infra-red (IR) and visible imagery, maps of the terrain and bathymetry.

Images are processed into 3D model of thermal field of a given area with the use of patented algorithms and software.
Building a 3D Model of Earth’s Thermal Field
Building a 3D Model of Earth’s Thermal Field

In the next step of processing 3D model of geological environment is calculated and dynamics of geological environment and thermal properties of rock are studied.

As a result, we get profiles of block-and-fault structures of an area, which are capable for selective representation of:

- geodynamical blocks and faults;
- internal thermo-dynamical inhomogeneities of the environment;
- rock compression, extension and decompaction zones, including fluid cross-flow and accumulation areas.
TVT advantages

- Short execution period:
  - 1000-4999 sq.km. – 3-6 months
  - 5000 sq.km. and above – 7 months

- More economical vs. traditional methods

- Zero environmental impact

TVT technology is a progressive geophysical study, with the number of advantages: it allows to save money and time, having high performance and informativeness; it has zero environmental impact.
NO physical presence issues
Physical presence is not required, because TVT uses satellites. It means that there is no need in mobilization of bulky equipment and obtaining permissions for implementation of works;

NO Safety Issues
100% human safety;

NO Weather barriers
TVT is efficiently regardless to weather conditions. Furthermore, scientific team gathered own databank of satellite data. Wide variety of multispectral images taken in different periods of year.
TVT advantages

- TVT has High spatial resolution:
  1:2000 scale, 1 pixel – 60 meters;

- TVT can be used for any geological environment and any rock type for building accurate boundaries of deposits.
Maximal Depth of TVT:

- Up to 100 km.
- TVT allows to build accurate hydrocarbon migration pattern;

TVT enables possibility to build vertical and horizontal profiles of block-and-fault structures at any given depth and in any direction.

TVT advantages
TVT is regardless to relief, terrain and seabed conditions (Inc. complex fault structures);

TVT has no problem identifying oil reserves even due to interference from gas clouds.
Oil & Gas (O&G)
Fields of application of TVT technology in Oil and Gas

According to a task – TVT level of study is chosen:

a) Regional level of study
Quick survey – Searching for areas with proper conditions for hydrocarbon formation

b) Zonal level of study
Zoning on perspective areas – preparation of an area for prospect drilling

c) Local level of study
Searching for Oil deposits – detailisation – target drilling
## Regional level of study

### Comparison table: Seismic method and TVT

<table>
<thead>
<tr>
<th>Seismic method</th>
<th>Thermovision Tomography (TVT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 – limitation of survey scale up to 1:200,000;</td>
<td>1 – high detail scale of 1:50,000 is achieved even during preliminary study of large areas;</td>
</tr>
<tr>
<td>2 – application of complex system of field monitoring together with powerful excitation sources;</td>
<td>2 – doesn’t require mobilization of bulky equipment and obtaining permissions for implementation of works, plus we gathered own databank of satellite images of many regions of the world;</td>
</tr>
<tr>
<td>3 – labor-consuming processing and interpretation of field data;</td>
<td>3 – enables possibility to build maps and profiles of block-and-fault structures at any depth and in any direction;</td>
</tr>
<tr>
<td>4 – 3D environment model cannot be calculated;</td>
<td>4 – calculates 3D models of thermal field and regional thermal flux;</td>
</tr>
<tr>
<td>5 – ambiguity in definition of crustal velocity characteristics;</td>
<td>5 – reliable study of geodynamical block-and-faults at desired depth with identification of zones having high potential of hydrocarbon accumulation;</td>
</tr>
<tr>
<td>6 – only structural factor of the crust is studied;</td>
<td>6 – detection of structural factors and study of thermodynamic irregularities of the crust (rheologic state of material);</td>
</tr>
<tr>
<td>7 – laborious and expensive method taking long time to accomplish.</td>
<td>7 – short execution period (3 to 5 months) and low-cost.</td>
</tr>
</tbody>
</table>
Zonal level of study

Comparison table: Seismic method and TVT

<table>
<thead>
<tr>
<th>Geophysical methods</th>
<th>Block area, Sq.km.</th>
<th>Survey scale</th>
<th>Time frame, months</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gravity study</td>
<td>1000</td>
<td>250 x 250 m</td>
<td>24</td>
</tr>
<tr>
<td>Electrical study (MTS)</td>
<td>1000</td>
<td>2 x 1 km, detailing</td>
<td>20</td>
</tr>
<tr>
<td>Seismic study (2d onshore)</td>
<td>1000</td>
<td>1:100,000 / 1:50,000</td>
<td>36</td>
</tr>
<tr>
<td>TVT</td>
<td>1000</td>
<td>1:100,000 / 1:25,000</td>
<td>3</td>
</tr>
</tbody>
</table>

1 – survey scale up to 1:50,000;
2 – seasonal limitations;
3 – limitations in regions difficult to access, such as thick forests, swamp and-lake terrain, mountain systems;
4 – construction of 2D models of the environment (maps and profiles) constrained by assigned profile direction survey with 2 km offset.

1 – survey scale up to 1:10,000;
2 – wide variety of multispectral images taken in different periods of the year;
3 – study in any terrain conditions (taiga, jungle, offshore, mountains, etc.), environmental friendly, highly productive and abundant resulting data;
4 – study of 3D models (ring structures and complex oil traps);
5 – overlaying and integration of TVT with any other geophysical method to build confidence;
6 – 5 times less exploration and prospecting works, at the same time 8-10 times cheaper;
7 – allows early assessment of an area for oil-and-gas prospects for investors.
### Local level of study

#### Comparison table: Seismic method and TVT

<table>
<thead>
<tr>
<th>Seismic method</th>
<th>Thermovision Tomography (TVT)</th>
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</thead>
<tbody>
<tr>
<td>1 – expensive 3D survey of good structures;</td>
<td>1 – 3D models of good structures about 10 times cheaper comparing to seismic method;</td>
</tr>
<tr>
<td>2 – absence of confident fluid saturation interface criteria (water-oil);</td>
<td>2 – detailed characteristics of fluid systems during formation of deposits;</td>
</tr>
<tr>
<td>3 – limitation in application for biogenesis structures (e.g. bindstone, etc.), salt domes, fractures, show-string deposits, etc.</td>
<td>3 – effective interpretation of bio-genesis structures (e.g. bindstone, etc.), salt domes, fractures, show-string deposits, etc.;</td>
</tr>
<tr>
<td></td>
<td>4 – building of 1 : 2,500 scale maps owing to high spatial resolution of an image;</td>
</tr>
<tr>
<td></td>
<td>5 – localization of fractured environment zones, compression, dilatation and decompaction of the rock, including detection of fluid flow and accumulation zones;</td>
</tr>
<tr>
<td></td>
<td>6 – acquiring of geochemical information based on maps of spectral indicators of environment-landscape systems;</td>
</tr>
<tr>
<td></td>
<td>7 – local assessment of oil content and optimization of prospect well allocation.</td>
</tr>
</tbody>
</table>
Final Result:  
Target drilling

We provide client with information about exact spots for drilling, its coordinates and its depth.
## Some of the Examples – Oil & Gas

<table>
<thead>
<tr>
<th>Example no\location</th>
<th>Task\Problem</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Russia</td>
<td>TVT exploration</td>
<td>Target drilling</td>
</tr>
<tr>
<td>2) Equatorial Guinea</td>
<td>Overlaying TVT data over seismic data</td>
<td>Excluding water areas</td>
</tr>
<tr>
<td>3) Tatarstan, Russia</td>
<td>Deposit exploration assessment</td>
<td>Reducing searching area on 30%, more accurate boundaries of oil deposits</td>
</tr>
<tr>
<td>4) Spain, Cadiz Bay, offshore</td>
<td>Dry well</td>
<td>TVT survey discovered dense rock instead of collector</td>
</tr>
<tr>
<td>5) Equatorial Guinea</td>
<td>Assessment of pilot well location</td>
<td>Recommendations on relocation of the well to improve its production</td>
</tr>
<tr>
<td>6) Equatorial Guinea, offshore</td>
<td>Seismic data mistake, TVT survey</td>
<td>New oil deposit found</td>
</tr>
</tbody>
</table>
Fields of application of TVT technology in Oil and Gas

1. Greenfield

**TVT** can be used in complete greenfield, where no surveys were made.

The only information required: **GPS Coordinates** of licensed block.

Scientific team is collecting and processing satellites’ data **24/7** using patented algorithms and software.

With the use of vast databank our team is able to start any project immediately.
Fields of application of TVT technology in Oil and Gas

1. Greenfield

Example 1
TVT exploration, local level of study, Volga-Ural Province, Russia.

Input data – Map of Licensed block

Result – TVT Horizontal section of local thermal field, 1020 m depth
# Fields of application of TVT technology in Oil and Gas

## 1. Greenfield

![Result - Map of Perspective areas](image)

### Results of TVT-analysis

<table>
<thead>
<tr>
<th>Structure</th>
<th>2d seismic survey results</th>
<th>TVT Perspective-analysis</th>
<th>Results of drilling</th>
<th>TVT method accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surulovskaya</td>
<td>Perspective</td>
<td>Non-perspective</td>
<td>Terrigenous oil collector, depth: 1002-1004 м, 1008-1010 м</td>
<td></td>
</tr>
<tr>
<td>Maryevskaya</td>
<td>Not done</td>
<td>high</td>
<td>Terrigenous oil collector, depth: 820 м</td>
<td>100%</td>
</tr>
<tr>
<td>Voronskaya</td>
<td>Not done</td>
<td>high</td>
<td>In Process of drilling</td>
<td></td>
</tr>
<tr>
<td>South-Baranovskaya</td>
<td>Not done</td>
<td>high</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Surulovskaya**
- Perspective zone
- Collector: 100%

**Maryevskaya**
- Not done
- High level of terrigenous oil collector, depth: 820 м

**Voronskaya**
- Not done
- High level of terrigenous oil collector

**South-Baranovskaya**
- Not done
- High level of terrigenous oil collector
Fields of application of TVT technology in Oil and Gas

2. Brownfield

TVT technology can be used in Brownfield. We can provide client with additional information on block that will:

- Significantly Increase accuracy
- Focus only on perspective zones
- Exclude water areas
Fields of application of TVT technology in Oil and Gas

2. Brownfield

Example 2
Integration of the results of seismic study with TVT, Equatorial Guinea.

Integration (overlaying) of models additionally provides information on fluid saturation of the environment within seismic structures.

Water areas are excluded.
More accurate boundaries of oil deposit.
Fields of application of TVT technology in Oil and Gas

2. Brownfield

Example 3
Assessment of the block. Integration of the results of seismic study with TVT, Romashkinskoe Oilfield, Yuzhno-Ulyanovskaya structure, Russia. Local level of study.

3 billions tonnes of oil already produced. It is ongoing, 1 more billion tonnes is expected.

Map of faults with indication of seismic structures at -1000 m depth

Yuzhno-Ulyanovskaya structure

Area Map
Fields of application of TVT technology in Oil and Gas

2. Brownfield

Overlaying of TVT contour allows to decrease searching area on 30%. Results of drilling correlate with TVT contour.

TVT increases accuracy of the Survey. **Less wildcat drilling** is needed, which means saving time and funds on this stage.
Dry well?

TVT technology can answer the question.

Using TVT survey we can find reasons of problems and give recommendations on solving problems and improving oil and gas production where possible.

TVT reduces uncertainty of information.
Fields of application of TVT technology in Oil and Gas

3. Assessment of existing wells

Example 4
Overlaying of the results of seismic study onto TVT-image, Spain, Cadiz Bay.

Well 6Y-1bis was drilled in the cover of seismic structure. Zero oil production.
Integration with TVT technology clearly demonstrates the reason of zero oil production – absence of reservoir. Red color shows dense rock on the profile.

Fields of application of TVT technology in Oil and Gas

3. Assessment of existing wells
• Low / declining oil production?

TVT technology can answer the question.

Using TVT survey we can find reasons of problems and give recommendations on solving problems and improving oil and gas production where possible.

TVT reduces uncertainty of information.
Fields of application of TVT technology in Oil and Gas

3. Assessment of existing wells

Example 5
Assessment of pilot well location, Equatorial Guinea.

TVT horizontal model of block-and-fault structures of Rio Muni basin, Eq. Guinea, 1,750 m deep.

Existing low-production oil well “F-5”. TVT reveals the reason of its low production:
The well is located on the edge of the oil trap. Relocation of the well 1.5 km left would significantly improve its production.
Fields of application of TVT technology in Oil and Gas

4. Missed opportunities

Example 6
Local assessment of offshore prospect structure, Equatorial Guinea.

A. Fragment of local thermal field map, TVT
B. Map of block-and-fault structure, TVT, 1750 depth
C. Map of homogeneity, TVT 1750 depth

This structural map as per Seismic data provided by client

Consecutive development and analysis of maps A, B, C and corresponding profiles allow to identify and assess oil content.

Seismic Data Map demonstrates perfect correlation with TVT models, although oil content is missed.
Fields of application of TVT technology in Oil and Gas

4. Missed opportunities

2.5D map, TVT, 1750 depth

Scientific team built 2.5 d maps to see the geometry of this deposit, and estimated oil reserves, using additional information such as porosity and fluid saturation.

2.5D map of homogeneity, TVT, 1750 depth

90 mmbbl of oil-in-place.
Estimation of newly identified prospect’s reserve using Thermovision Tomography. TVT helps to detect such “missed opportunities” zones.
Solid Mineral Resources (SMR)
## Some of the Examples – Solid Mineral Resources

<table>
<thead>
<tr>
<th>Example no\location</th>
<th>Task\Problem</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) North-west and south-west of Nigeria</td>
<td>Survey for gold</td>
<td>Places with high perspective of new occurrences</td>
</tr>
<tr>
<td>2) Jos Plateau</td>
<td>Survey for polymetals</td>
<td>Hidden intrusive formations found</td>
</tr>
<tr>
<td>3) Jos Plateau, Riruway Ring Structure</td>
<td>Riruway ring structure detailing</td>
<td>Polymetal outcrops found</td>
</tr>
</tbody>
</table>
Solid Mineral Resources

Example 1
TVT Survey for Gold, Nigeria.

Main placer and ledge gold deposits of the region are located within “shale belt” in the north-west and south-west of Nigeria. We placed deep vertical TVT Profiles (sections of the lithosphere down to 100 km) through known gold deposits; indicated as Profile 2 and Profile 4.
marks indicate locations of known occurrences of gold. As seen in the pictures, the locations of known occurrences perfectly match with outcrops of homogeneous lithosphere structures (yellow-green tree-like zones).

Similar structures indicate high perspective of discovery of new occurrences of polymetals (gold).

marks indicate High perspective of discovery of new occurrences of polymetals (gold).

TVT finds new gold occurrences.
Green-yellow colors indicate outcrops of intrusive formations (ring structures) on the surface which correspond to main occurrences of ore deposits of the region (gold, iron, copper, lead, diamonds).
Solid Mineral Resources

Deposits of polymetals are formed within zones of sulfide mineralization on the boundary of intrusion and sedimentary rock. TVT technology allows to locate such zones.

Profile 4 - Vertical profile down to 6 km shows areas of hidden intrusive formations. TVT helps to find hidden occurrences of gold.
Example 3
Detailing of Riruway Ring Structure, Nigeria

Profile 6 was laid through Riruway ring structure to understand environment geometry.

TVT technology helps to understand the genesis and the geometry of hidden intrusive formations. Magnetic field intensity graph and structure homogeneity graph are used as additional signs. Thereby with the use of TVT we can locate polymetals outcrops.
TVT technology can be used in following fields of application:

- Geology:
  - In construction of metro and tunnels
  - In construction of high rise buildings

**Summary**

Prospecting of onshore and offshore oil-and-gas deposits:
1) Greenfield
2) Brownfield
3) Assessment of existing wells
4) Missed opportunities

Prospecting of solid mineral deposits:
1) Greenfield
2) Brownfield
3) Assessment of existing mines
4) Missed opportunities
Summary

Service codes:

- O&G Express – Oil & Gas Express analysis
- SMR Express – Solid Mineral Resources Express analysis
- O&G FS – Oil & Gas Full Scale analysis
- SMR FS – Solid Mineral Resources Full Scale analysis
- O&G PL – Oil & Gas Pipelines inspection
- METRO – Metro, tunnels inspection
- TOWER – Construction of high rise buildings
Summary

TVT-Process:

1. GPS Coordinates - provided by client;
2. IR-images, data;
3. 3D model of thermal field;
4. Different types of horizontal and vertical profiles;
5. Interpretation;
6. Presentation of final results and recommendations.
Final results

8-Hour seminar
“Reading and interpretation of TVT materials”

After final report presentation our team additionally holds 8-hour seminar “Reading and interpretation of graphic TVT materials” for clients’ specialists. So specialists will be able to read our material properly.
The final result of our service is prognostic maps of mineral deposits, including:

- 3D model of oil & gas deposits;
- Comprehensive hydrocarbon migration pattern / report;
- Approximate estimated reserves of the block;
- Exact GPS coordinates for recommended drilling point;
- Vertical and horizontal profiles (sections) of geological environment at a given depth;
- Maps of spectral indicators of environment landscape systems.
The final result of our service is prognostic maps of mineral deposits, including:

- 3D model of deposits;
- Geothermal sections and maps of blocks;
- Forecast maps of prospects of search for ore structures, excluding not prospective zones, highlighting prospective zones with its analysis and explanation of signs;
- Recommendations for optimization of exploration of ore zones.
Thank You.