



# THERMAL TECHNOLOGY IN SEARCH OF HYDROCARBON

ТЕПЛОВЫЕ КОСМИЧЕСКИЕ ТЕХНОЛОГИИ В ПОИСКЕ УГЛЕВОДОРОДОВ



# INTRODUCTION



ТЕПЛОВЫЕ КОСМИЧЕСКИЕ ТЕХНОЛОГИИ В ПОИСКЕ УГЛЕВОДОРОДОВ



## What is Thermal Geo-tomography?

- Thermal Geo-tomography is a technology using Data from Spacecraft equipped with Thermal and Radiovisors.
- The Source data is collected from Infrared range of Electro-Magnetic waves detected by the Radiovisors fitted in Spacecraft
- An innovative software has been developed by Aero Space Technologies to analyze thermal Geotomography data and to build 3D images of Thermal variations in vertical geologic settings of a designated area.
- These Thermal intensity images depicted on a 3D Model cube reflect Geologic environment with particular reference to fluid properties of the investigated geologic formations-particularly for oil & gas accumulations



# THEORITICAL BASIS OF TECHNOLOGY OF THERMAL GEO-TOMOGRAPHY



ТЕПЛОВЫЕ КОСМИЧЕСКИЕ ТЕХНОЛОГИИ В ПОИСКЕ УГЛЕВОДОРОДОВ



**Technology of Thermal Geo-tomography is based on two hypothesis:**

- 1. Thermal radiation carries information about its origin.**
- 2. Deep structure of the Earth is translucent in the optical wavelength range.**

The physics that TTG is based on can be expressed with a postulate according to which radiated thermal energy (in the form of endogenous thermal flow), presented with uninterrupted electromagnetic spectrum, is expressed with a physical parameter called ***radiative (brightness) temperature***.





- World's 80% of the petroleum is believed to be produced from deformed reservoirs. Therefore, more emphasis has been given in exploration of thrust fold belt areas in search of structural traps.
- The major challenges in the exploration of these areas are complex geology & limited surface & sub-surface data.
- It is essential to construct a fit to purpose robust geological model which in turn helps in seismic API, identification of prospects and finally reducing the risk of uncertainty.
- A “Thermal Geotomographic Analysis” technique is one of the newly inducted and important tools for implementation of exploration programs in difficult terrains in a cost-effective manner.



- The technology is based on continuous remote sensing of Earth resulting in numerous time-varied thermal satellite and altitude-varied thermal images in the red & infrared range zones.
- Effective radiation flux density at pre-determined depth values is calculated.
- Thermal sensing in geology is based on the detection of thermal anomalies in the solar (external) and endogenous (internal) character of earth.
- The principle parameter of thermal survey is thermal conductivity that characterizes the ability of rock to conduct heat



- In whole, thermal conductivity of the rock depends on properties such as the mineral composition, structure, texture, density, porosity, humidity and temperature.
- Density, porosity and pressure that act on the rock are interconnected.
- The increase of density and pressure which, in turn, means the decrease of porosity, thermal conductivity of the rock increases. With the humidity increase thermal conductivity of the rock increases dramatically.





**So the solution to the heat conduction equation with the account of endogenous thermal current of the Earth, that can be defined by geothermal gradient and vertical speed of convection, lies in the basis of TTG's computer algorithms.**

**A multilayered mathematical thermal model of the geological environment obtained as a result of initial data processing describes a physical process whose essence is in redistribution of the thermal current of the Earth in a three-dimensional space  $X,Y,Z$  that can be registered in the infrared space image of the daylight surface (most appropriate time of the day). This image depicts integral distribution of radiation ability of discrete elements in the geological environment.**



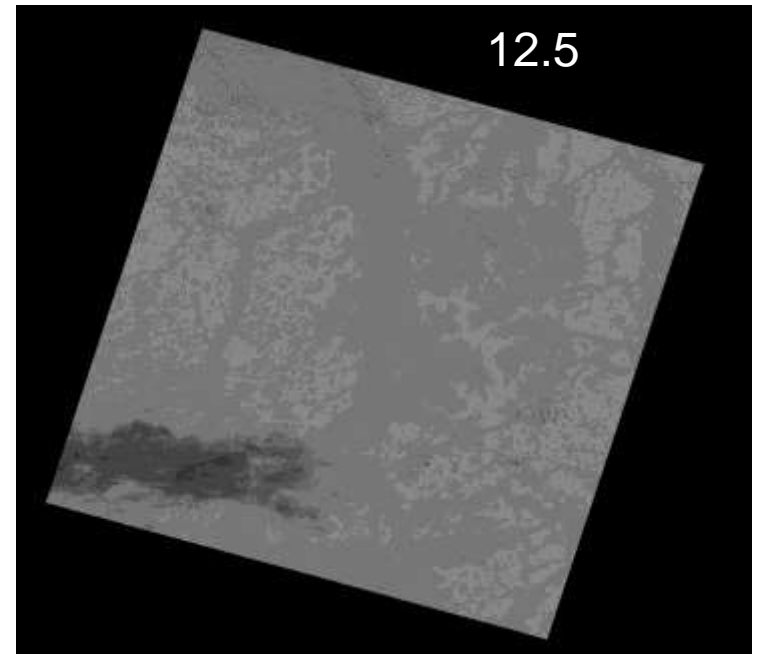
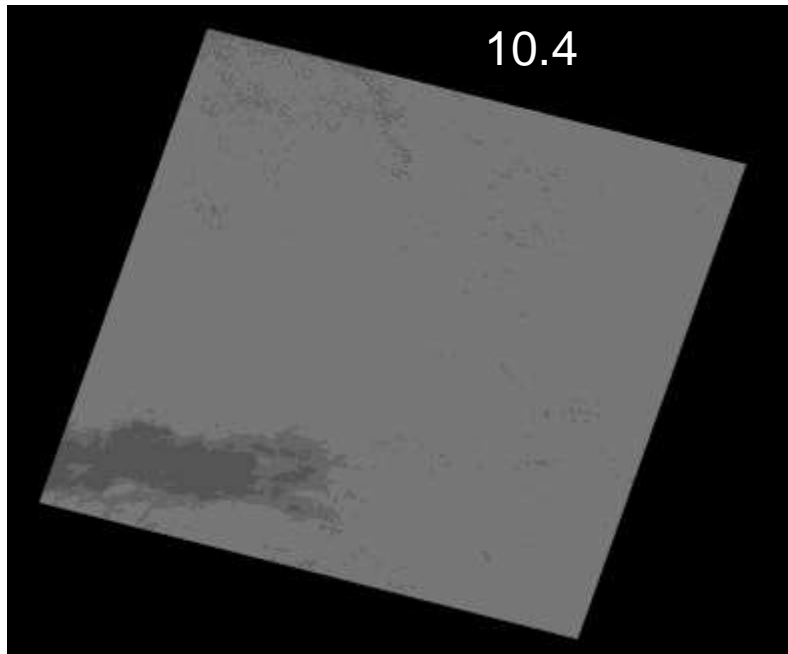
# PHYSICAL DATA BASE



ТЕПЛОВЫЕ КОСМИЧЕСКИЕ ТЕХНОЛОГИИ В ПОИСКЕ УГЛЕВОДОРОДОВ



**In Technology of Thermal Geo-tomography : we use images obtained from Earth satellites or from other aircraft in the visible range (1,2,3), near (4) and far (5,7) spectrum and in thermal infrared range (10.4-12.5  $\mu\text{m}$ )**





# TECHNICAL PROCEDURE



ТЕПЛОВЫЕ КОСМИЧЕСКИЕ ТЕХНОЛОГИИ В ПОИСКЕ УГЛЕВОДОРОДОВ



- Acquiring Satellite Image of Target Area
- Processing of Satellite Data.
- Generating all require data from processed Satellite Image for Interpretation.
- Interpretation of Satellite Data.
- Delineating hydrocarbon bearing zones
- Generating thermal images of location.
- Providing our recommendation and suggestion for drilling well with coordinates.





## Capabilities of Software

The Software developed allows the Geo-thermal 3D model cube to perform and analyze thermodynamic anomalies caused by the presence of hydrocarbons:

Vertically segment geologic formations based on a number of parameters and then ultimately slice them horizontally at pre-determined depth Zones

- Fluid contents
- Compactness of rocks
- Oil / Gas deposits
- Depth of occurrence
- Thickness coefficients
- Tectonically disturbed zones
- Possible migration path ways

The Geo-Thermogenic software is a mathematically derived algorithmic model with great resolution.



- Acquiring and processing of Satellite Image of Target Area







## Generation of Data layer by layer

