TERRAVISION

INTELLIGENT EXPLORATION

AERIAL SPECTROGRAPHIC SURVEY (CST)

Locating Hydrocarbons through the Integrated Processing of Multi-Spectral Zone Data

Introductory Presentation

2014

ABOUT US & CLIENT LIST

- The Terravision Group is an industry leading geophysics surveying and exploration company, that uses innovative Russian space technologies.

- Our expertise is in the remote exploration of the Earth in order to locate and delineate Hydrocarbon Resources.

- The group entered the market over 10 years ago, with a focus on Hydrocarbon Exploration in Russia. Today Africa is our primary focus.

BASHNEFT

GAS-OIL

GAZPROM VNIIGAZ

GAZPROM

company RussNeft

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OVERVEIW

AERIAL SPECTROGRAPHIC SURVEY

- The CST - Terravision Group presents a unique technology and new method for locating and contour mapping hydrocarbons.
- Using a technique involving the Integrated Processing of Multi Zone Data, with varying degrees of generalisation.

FINDING THE HYDROCARBON FOOTPRINT

- It is a scientific fact that where Hydrocarbon Resources are present below ground, over millions of years tiny quantities of hydrocarbon always find their way upwards to the surfac**e)**.
- These traces can be detected by Spectral Analysis in the vegetation and soil texture, as well as by infrared, geochemical and microbiological anomalies.

REDUCES THE COST OF EXPLORATION

- Over 20 successful jobs have been performed for some of Russia's largest oil companies, testament to the fact that the technology is highly capable and can accurately assist in dramatically reducing the costs of hydrocarbon exploration, by enabling the accurate targeting of seismic tests on those areas where the presence of hydrocarbon resources is detected by CST.

TECH OVERVEIW

‘’The process by which a liquid leaks through a porous substance’’ - otherwise known as **SEEPAGE** is a well recognised and basic concept, but the search effectiveness is limited by the quality of scanners and software used for data processing.

AT THE CST – TERRAVISION GROUP WE DEVELOP AND MANUFACTURE

- Opto-electronic tools for remote diagnostics and monitoring of various objects in the optical and infrared parts of the spectrum.
- Unique wide-angle, high-definition airplane-based scanner system & improved data processing software.
- Development of the tools and methods for oil and gas exploration by remote airborne multi-spectral scanning.
- High-sensitivity tools for infrared video recording and mapping
- Optical and electronic instrumentation and data processing software used to identify and monitor technological defects and anomalies in engineering objects such as power transmission lines & railroads.

OVERVEIW

- The underlying physics of the method is based on the established principles of the migration of hydrocarbon fluids and their influences on the existing landscape; and also on the analysis of the thermal field, which related to the sphere of thermodynamics.

- Thermo feel analysis is based on the fact that temperature field gradient changes when crossing boundaries. This technique as a supplement to standard methods of geological and geophysical exploration and will allow oil companies to reduce geological expenditure in this area by 500%.

- The primary objective achieved by the use of this technique is the determination of the extent and distribution on the ground surface of the hydrocarbon deposits.

CST HYDROCARBON SEARCH TECHNIQUE

- Over millions of years tiny quantities of hydrocarbon and associated substances find their way from oil accumulations upwards to the surface.
- Thus affecting the vegetation as well as geochemistry, microbiology and textural characteristics of the soil. Infrared signatures are also analysed.
- The method maps over two dozen types of anomalies which are detectable on the surface due to microseepage.
- The quality of CST's spectrographers allows data acquisition from an airplane which is much faster and cheaper than conventional geochemical and geophysical methods.
- We fly at 5km height, at 500 km/h, and build a picture made of 5x5m pixels. Data takes between 3 and 6 months to analyse.

WHY CST – TERRAVISION

Reducing Exploration Costs and Covering Large Onshore Areas

- The ability to acquire huge volumes of spectral data by overflying vast territories within short time and reveal anomalies by processing the results with specially created software makes it possible to find oil “signatures” in a more accurate, fast and cost-effective way than ever before.

- This method narrows down the areas where expensive seismic tests should be performed and reduces manifold the probability that drilling will return water rather than oil, by eliminating the areas where seismic tests may detect accumulations of liquid which is not oil.

MICROSEEPAGE MODEL

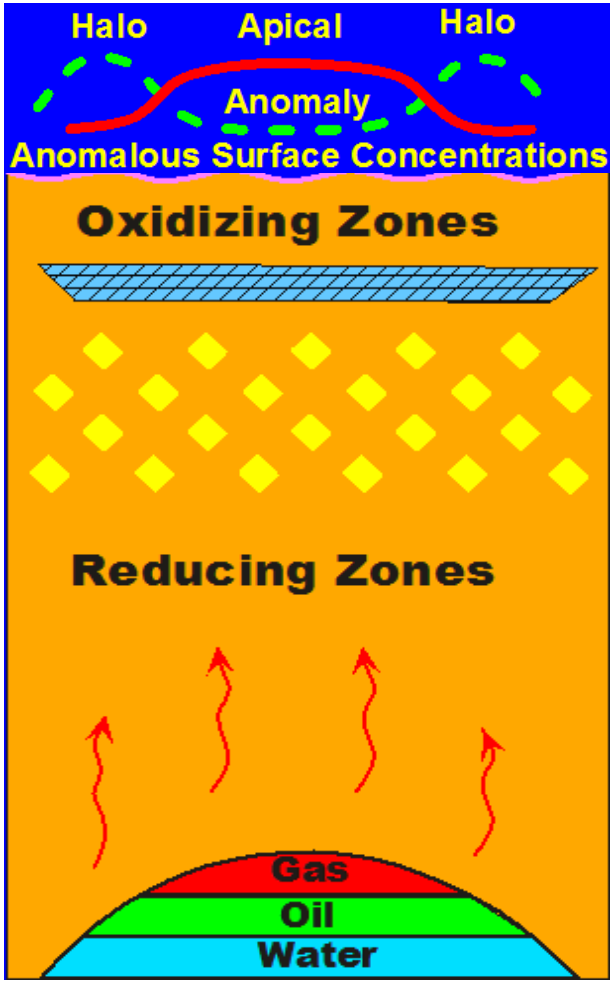
GEOCHEMICAL

Carbonate Precipitation

Pyrite Precipitation, also Sulphur, Pyrrhotite Greigite, Uranium etc

Bacterial Degradation of Hydrocarbons

Light Hydrocarbons Seep Upwards from the Trap creating a Reducing Zone



GEOPHYSICAL

High Resistivity Anomaly

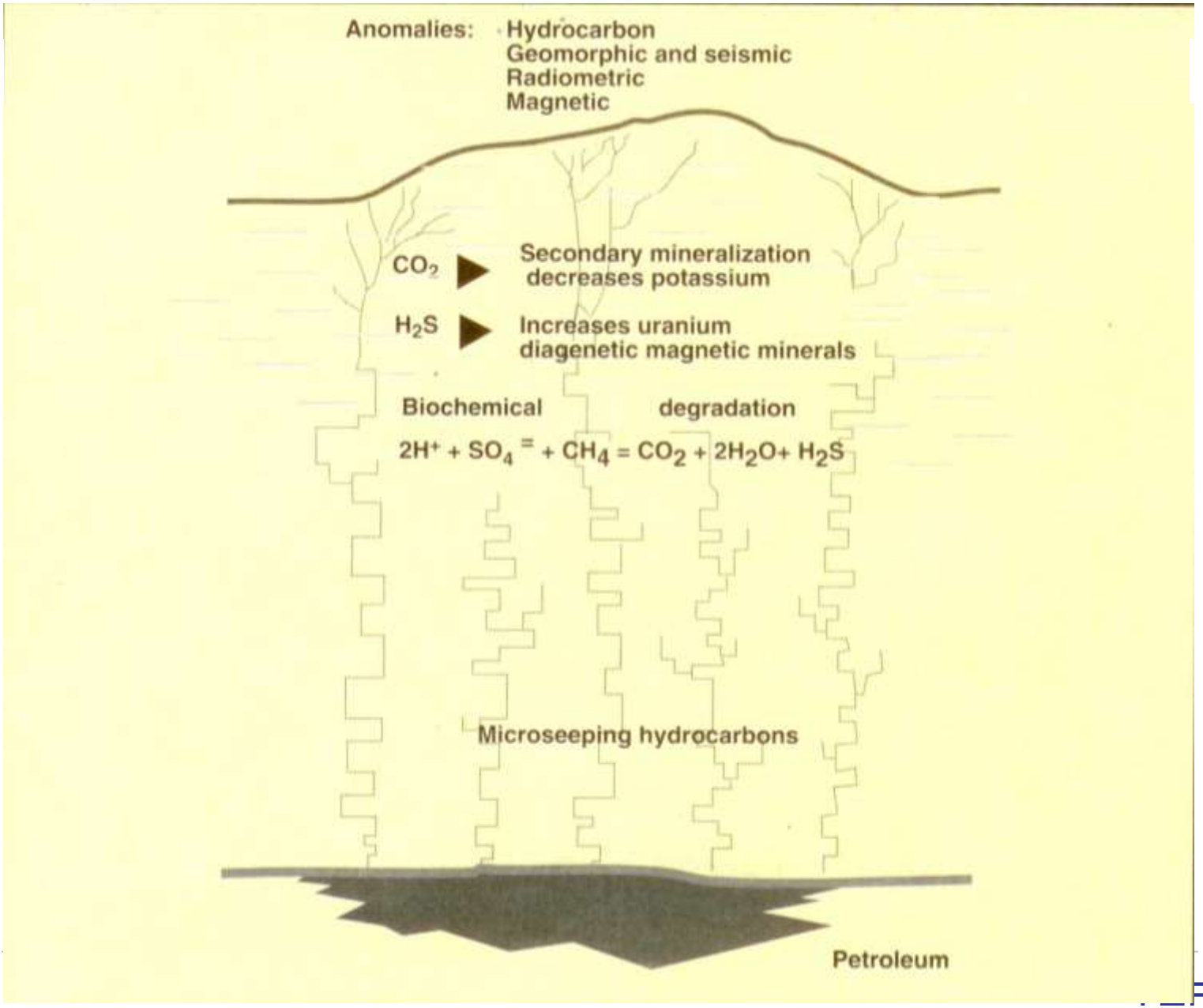
High Polarization Anomaly

Magnetic Anomaly

Low Resistivity Anomaly

Seismic Velocity Anomaly

POSSIBLE MODEL OF HYDROCARBON MICROSEEPAGE RELATED ALTERATION



EXAMPLE: ANOMALIES CAUSED BY THE INFLUENCE OF HS2

- Chemical reduction of hydrocarbons, leads to the removal of hematite and a "whitening" of the colour red, which can be found in CST aerial surveys
- Geochemical bleaching along joints, bedding planes

EXAMPLE OF CO2 RELATED “SEEPAGE” SIGN

Light tonal anomalies reflect the amounts of caliche found at the earth’s surface (Caliche is a sedimentary rock, a hardened deposit of calcium carbonate.)

How did it get there?

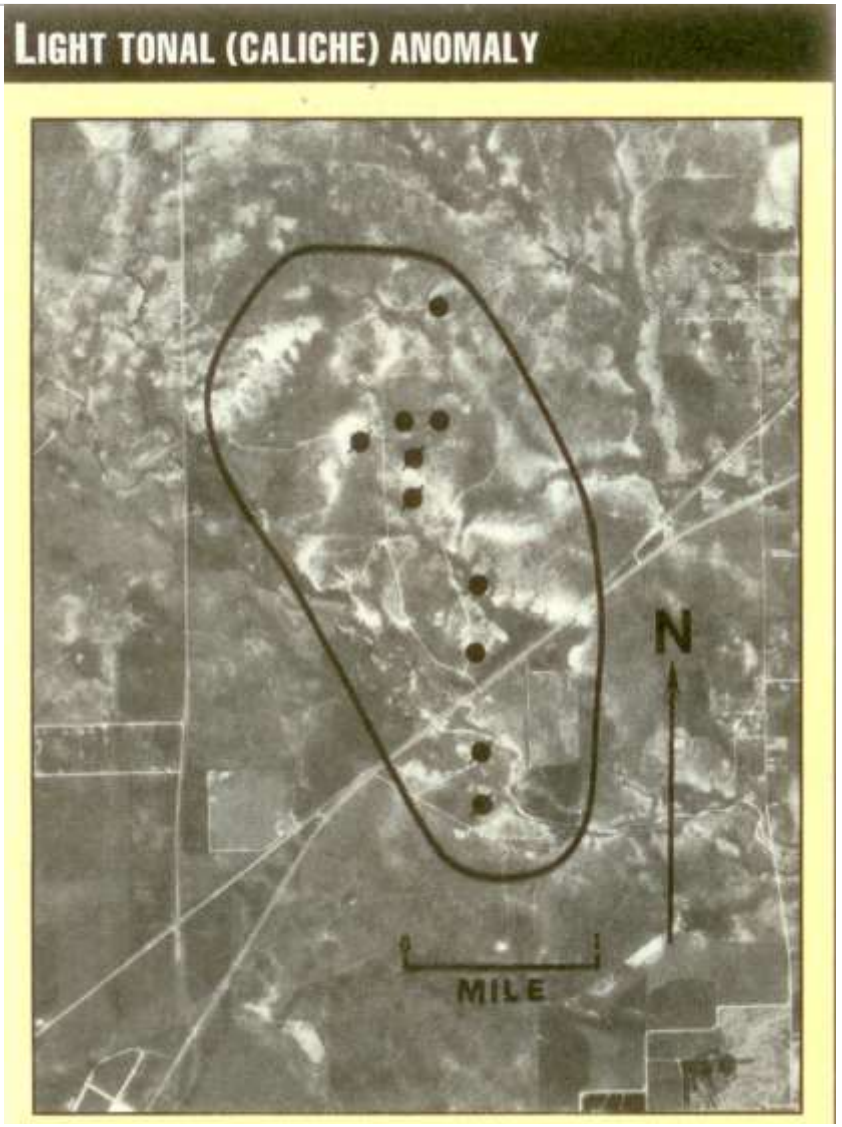
Stage 1: Biochemical decomposition of hydrocarbon takes place above the “source” – for example an oil reservoir.

Stage 2: Co2 formation takes place

Stage 3: The carbonate solidifies or “cements”

Stage 4: Carbonate mineralization is found on the surface, by registering an increase in the content of caliche in the soil. This is represented in tonal anomalies which can be detected by aerial spectrography.

Abnormalities of tone / colour are detected with CST aerial surveys



SEEPAGE – HOW IS IT IDENTIFIED?

- Seepage – where there is a “reservoir” of hydrocarbons, over millions of years, tiny quantities of hydrocarbon always find their way directly upwards to the surface (dissipation angle does not exceed 8%)

- These micro particles leave a “signature” on the surface. CST’s technique simultaneously analyses 26 “Signs” of this signature, to correctly confirm where there is a sub-surface hydrocarbon resource

- Pivotal metrics include:

1. **Vegetation** - Changes in flora
2. **Geochemical -** Chemical changes in the soil
3. **Microbiological** - Changes in bacterial environment
4. **Textural** - Soil texture analysis
5. **Infrared** - Very small differences in temperature are detected where hydrocarbons are present (*)

* Temperature variations can only be detected due to the wide angle and high speed characteristics of CST’s spectrographic equipment. Only simultaneous data acquisition from large areas allows temperature variations to be registered between areas with/without hydrocarbon presence.

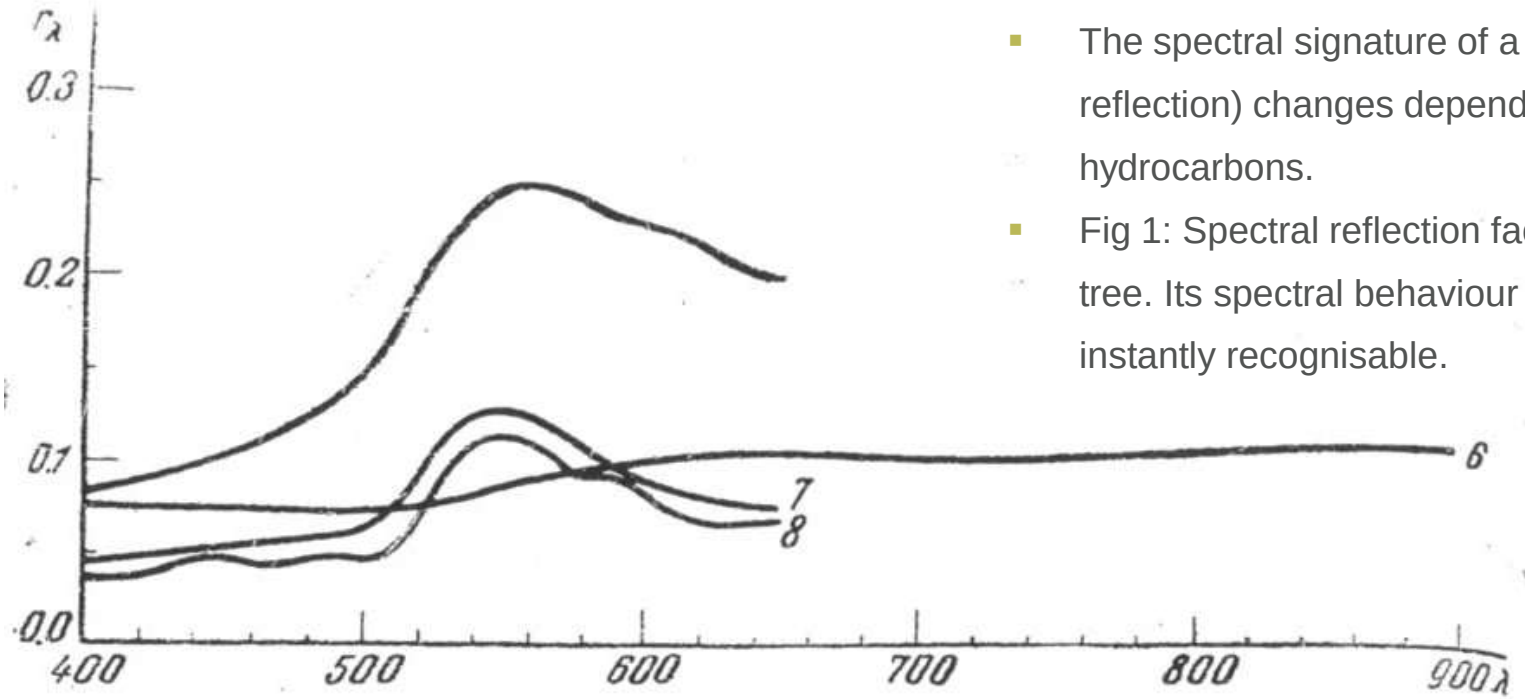
SEEPAGE – HOW IS IT IDENTIFIED?

Further examples of the geo-botanical, mineralogical and temperature anomalies which may reveal the presence of the hydrocarbon micro-seepage, and which CST look for on the spectral images.

- Areas of vegetation with maximum chlorophyll level
- Areas of vegetation with minimum chlorophyll level (vegetation precocity or early fading)
- Areas of vegetation with abnormal biomass level
- Altered geological substrate structure
- Pigmental alterations linked to nitrogen and carotenoid content in vegetation, stunted or more developed vegetation
- Biomass moisture content
- Detection of maximum contrast between soil and vegetation where possible
- Colour change (decolouration or bleaching) of ferruginous soil resulting from hydrocarbon micro-seepage
- Alteration of shales mineralization due to micro-seepage
- Halos due to carbonates formation
- Alteration of background temperatures above hydrocarbons deposits
- Statistically meaningful increase in the number of spots where temperature is lower than average

EXAMPLE 1 - SEEPAGE SIGN IN VEGETATION: BIRCH TREE SPECTRAL BEHAVIOUR

- CST have highly accurate research on thousands of plants which were analysed for their spectral behaviour with and without exposure to hydrocarbons.
- Why do we have this information?
  - The Russian military commissioned the research in the 1950's & 1960's to understand how to look for signs of chemical & biological contamination on the battlefield.



- The spectral signature of a plant (its infrared reflection) changes depending on its exposure to hydrocarbons.
- Fig 1: Spectral reflection factor for a type of Birch tree. Its spectral behaviour is unique and instantly recognisable.

EXAMPLE 2 – HALOXYLON BUSH SPECTRAL BEHAVIOUR

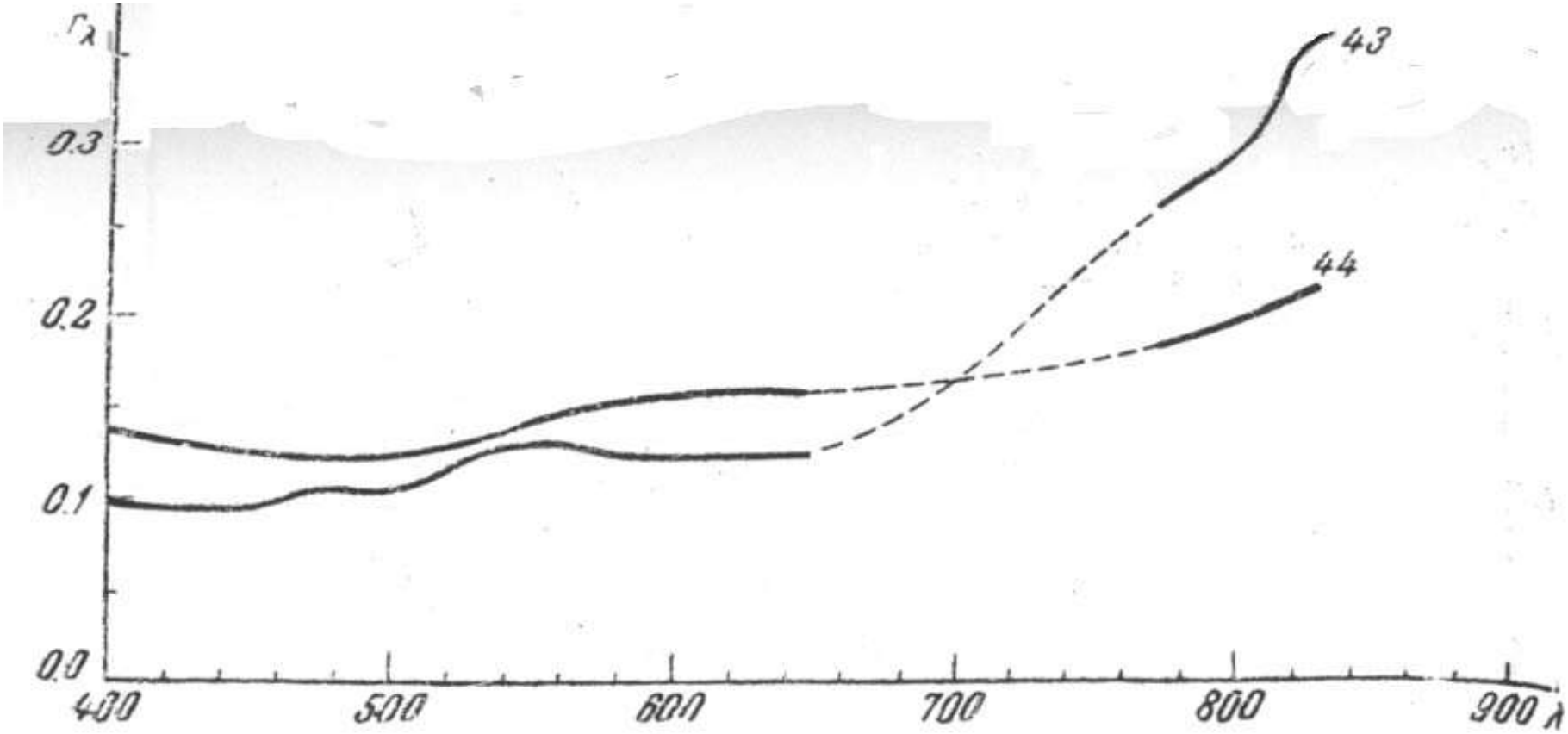
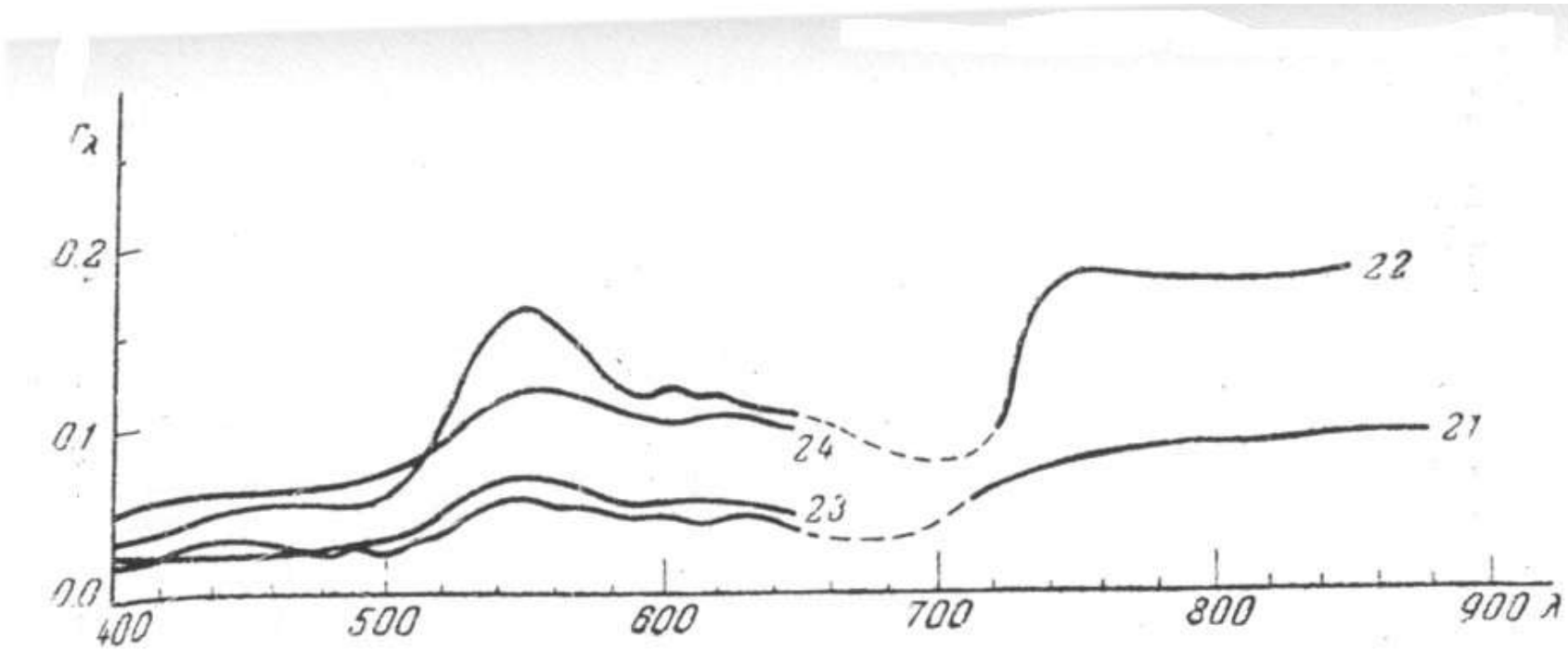


Fig 2: Spectral reflection factor for a type of Haloxylon bush

EXAMPLE 3 – PINE TREE



IX. Ель, спелый древостой

21 — зимний вид; 22 — молодой лист; 23 — полный лист; 24 — поздняя зелень.

Fig 3: Spectral reflection coefficient of pine trees

EXAMPLE 4 – POPLAR TREE

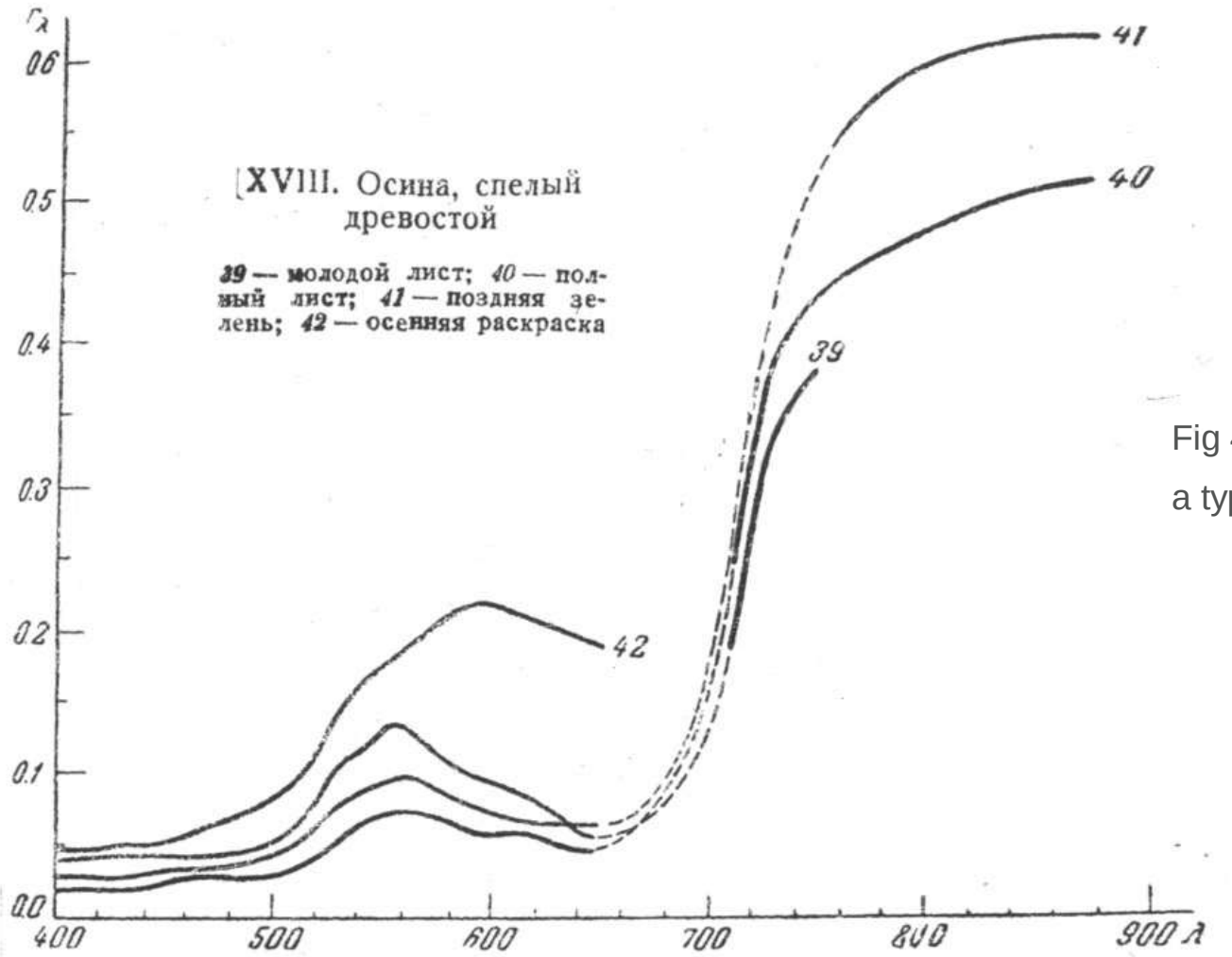
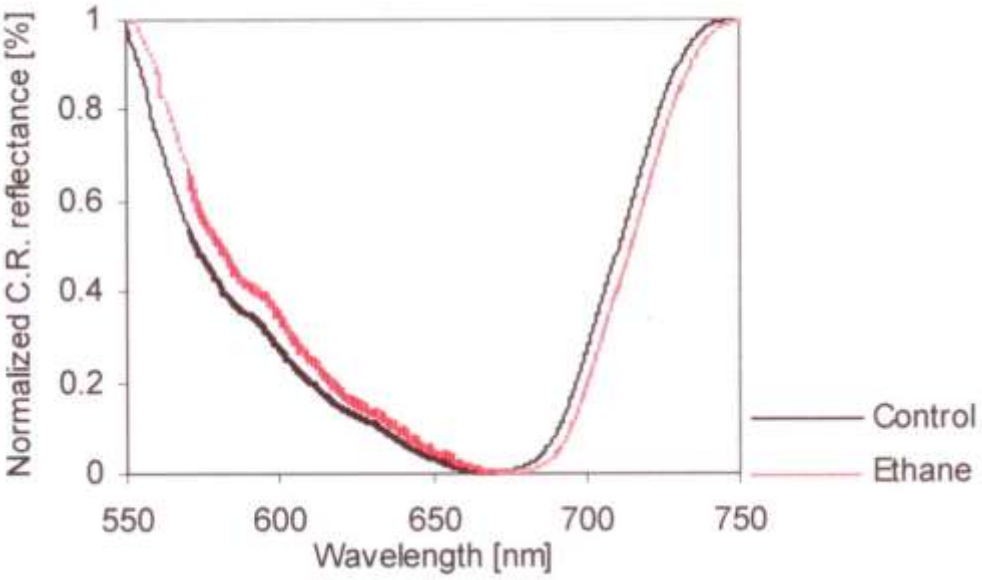
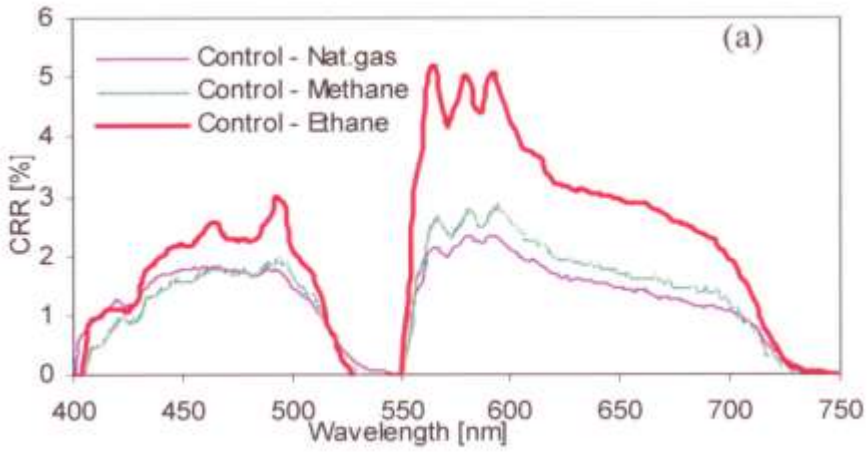


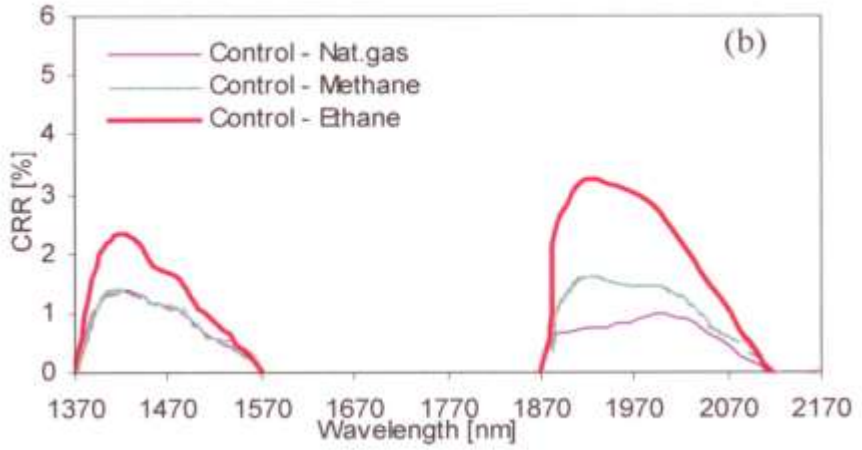
Fig 4: Spectral reflection factor for a type of mature poplar tree.

ETHANE INFLUENCE ON THE REFLECTIVE COEFFICIENT IN VEGETAION

Example of SEEPAGE sign: Fig 5,6,7 focuses on the influence of hydrocarbons in the reflectance coefficient spectrum of vegetation, in the infra-red zone. The indicator can be observed during the aerial survey.







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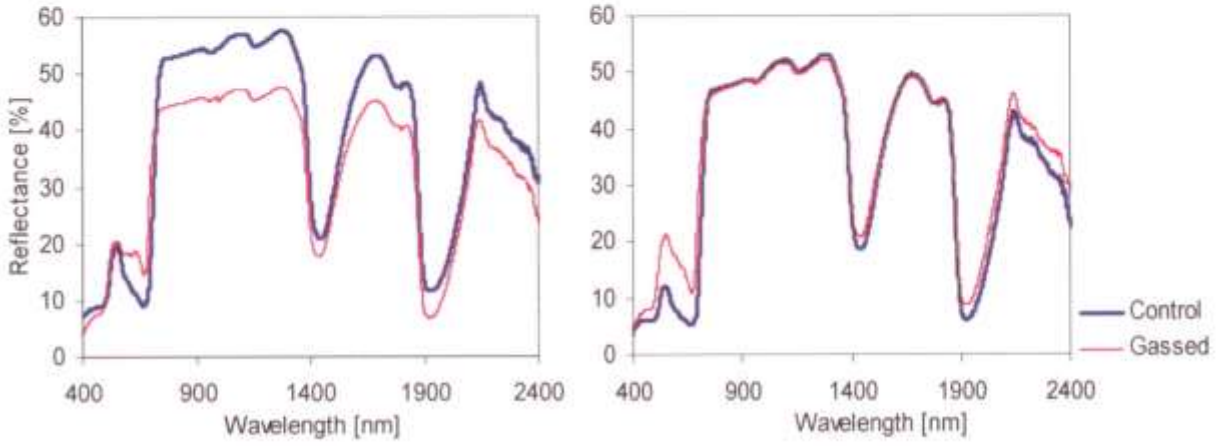
ETHANE INFLUENCE ON THE REFLECTIVE COEFFICIENT IN VEGETAION

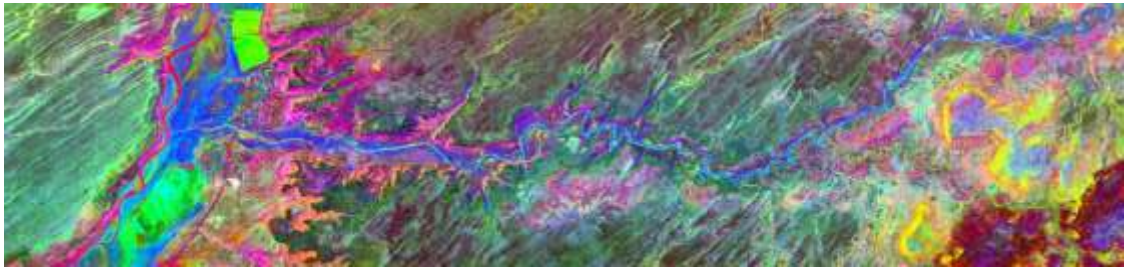
Discolouration of maize leaves (left) and wheat leaves (right)



Reflectance spectrum of maize leaves (left) and wheat leaves (right) from a control plot and a gassed plot

- Example of a “Seepage” sign in vegetation
- Ethane influence on the reflectance coefficient in vegetation (Wheat & Maize)

LOCATING SIGNS OF SEEPAGE



- Unique proprietary spectrographic equipment designed and manufactured by CST is mounted on an airplane, to scan the Earths surface, looking for anomalies related to “seepage”

- The aircraft flies over the Target Area as indicated by the client. AN-30: Flies at about 400 km/h at about 5 km altitude and at each “pass” covers the surface area about 5 km wide. The accuracy is down to about 50 meters.

LOCATING SIGNS OF SEEPAGE

26 “signs” of the “seepage” signature require 26 spectral channels – each matched to specific coordinates. The proprietary software and equipment is known as “Eagle” and mounted on the aircraft.

Engineering Data

Number of data channels 26
Instant visual angle 5 arcing.
Full scan angle min 70°
Scan speed 18, 36, 72 pages / s
Spectral range 0.43-12.5 μ
Temperature range from -10 ° C to +40 ° C
Power consumption 27 V, 120 W
Cooling of infrared detector - liquid nitrogen

AUGUST 2013: FITTING OUT A TU – 134 AIRCRAFT - FOR CST SURVEY

Optoelectronic equipment being installed in the hatch at the bottom of the TU-134 and made flight ready.

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BENEFITS OF CST OVER THE USE OF SATELLITES

1. Satellites are government owned – security of information

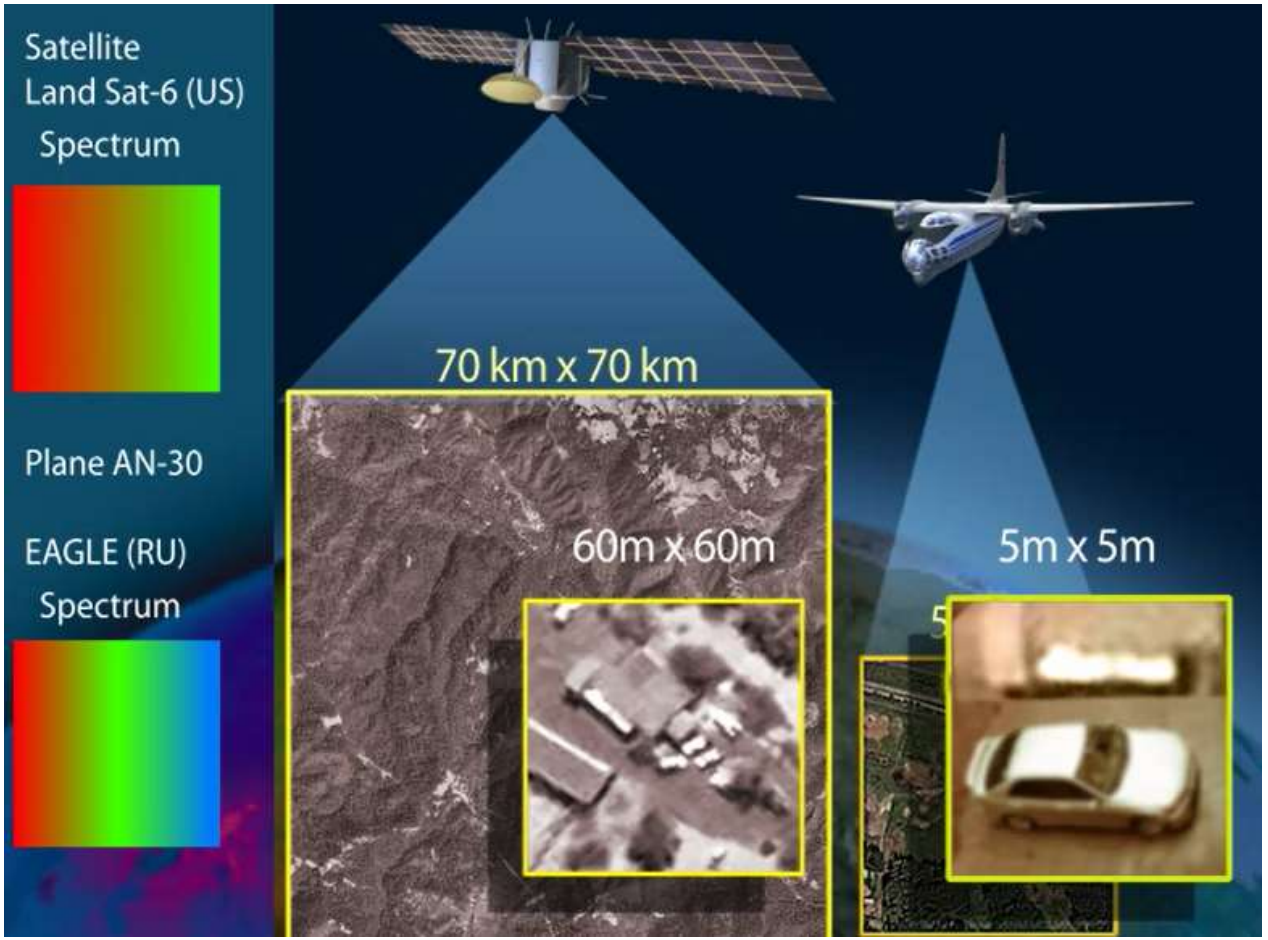
2. Greater reliability of the data as there is less atmospheric distortion

3. Calibration of Thermal images by temperature and brightness

4. High spatial resolution

5. Ease of planning

6. Use of high resolution aerial photography



7. Satellites may have to make two passes at different times and atmospheric conditions to obtain coverage. CST flies over the entire target and obtains 100% coverage in one survey.

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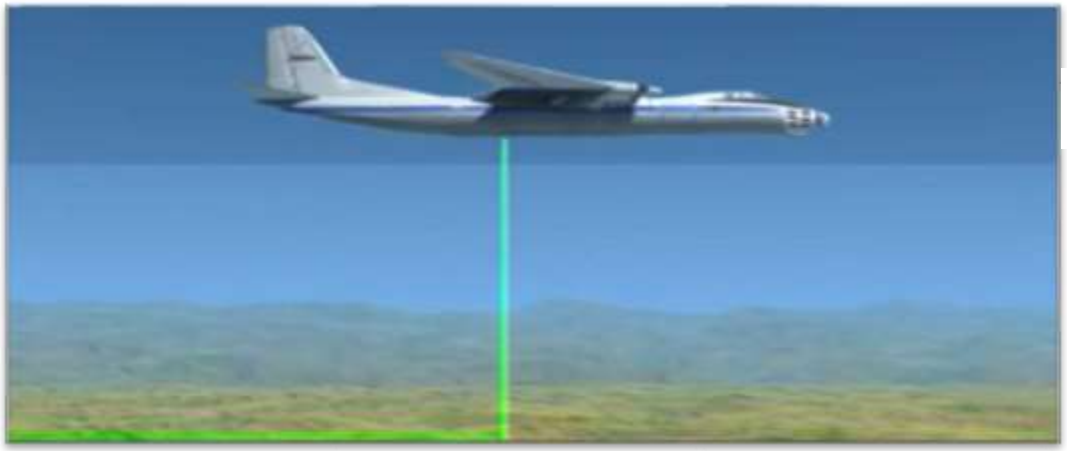
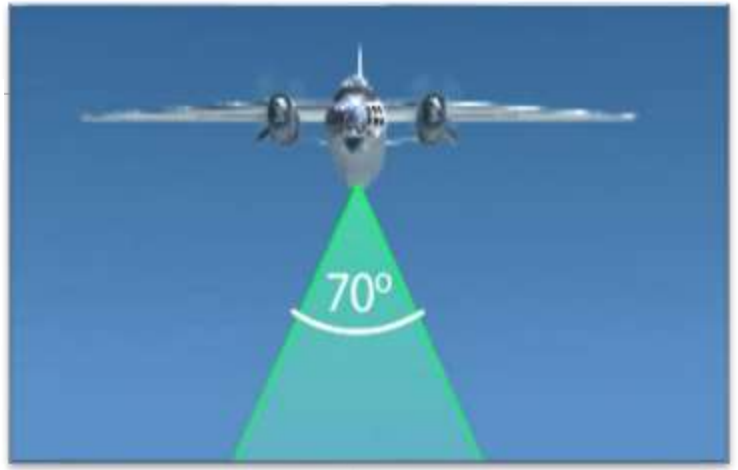
BENEFITS OF CST	IMPLICATIONS	DELIVERABLES
1. Survey scheduling possibility	Imaging routes design	Calibration from a known point close to the target object Excludes clouds on images Enables the selection of the time of day with maximum prospecting efficiency
2. Minimizing the atmospheric influence	Flexibility when choosing the time of day to conduct survey & reduce humidity	Hydrometeor scattering (haze) is minimized, which otherwise absorbs the reflected optical radiation No absorption of radiation in the infrared range
3. Higher Spatial Resolution	Greater coverage in detail	CST Aerial image – 5x5m Satellite image resolution standard - 30x30m or 60x60m
4. Shooting with specialized equipment	Available satellite imaging provides limited data for analysis, when compared to aerial imaging made by CST	Satellites carry no specialized equipment to highlight anomalies, caused by hydrocarbons. Hydrocarbon detection probability is higher with CST
5. Adaptive data processing	Greater proximity to the target	Aerial survey data processing, unlike satellites, has a unique self-training algorithm, enabling rapid calibration to the target area.

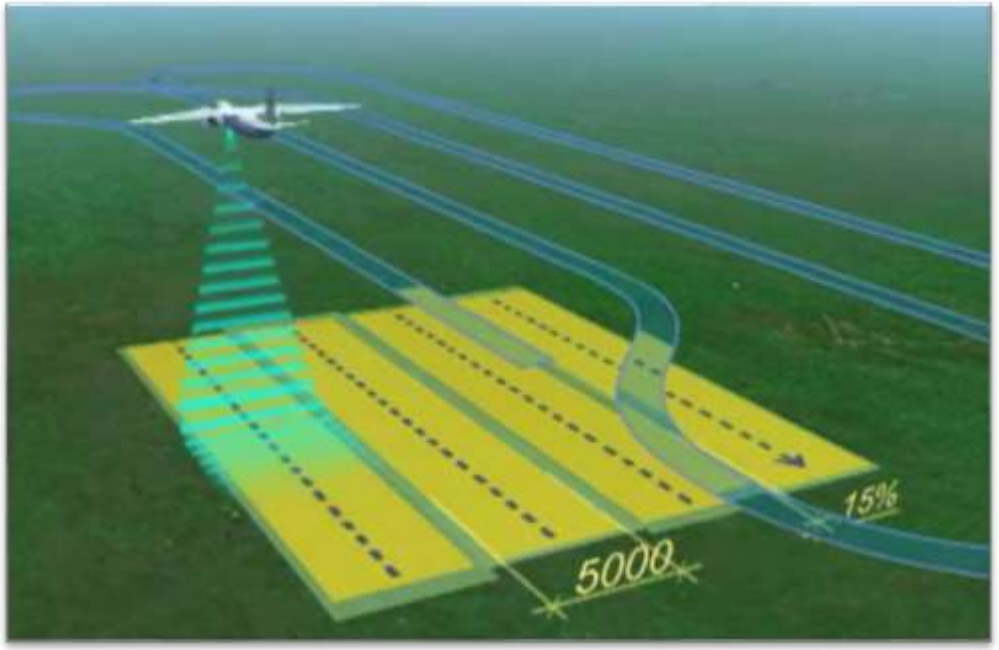
Ground Surface Scan at 5km to 20km per “pass”

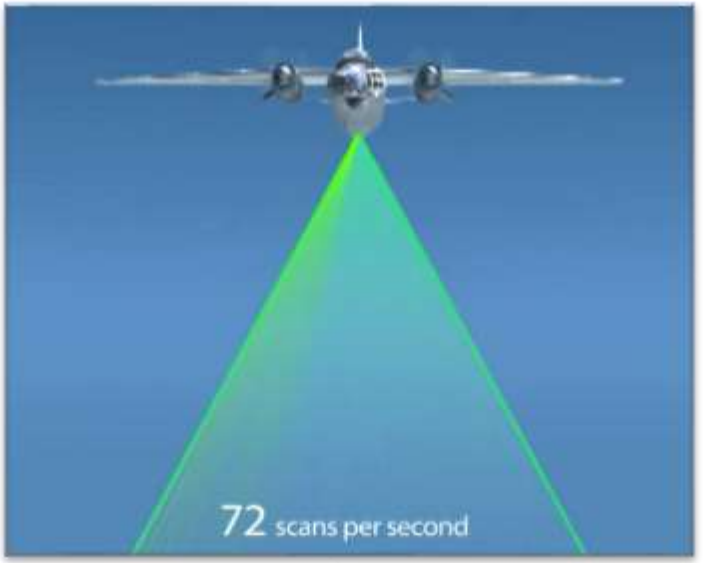


Ground Surface Scanning at 70 Degrees



Scans of parallel strips with a zone view overlap of 15%

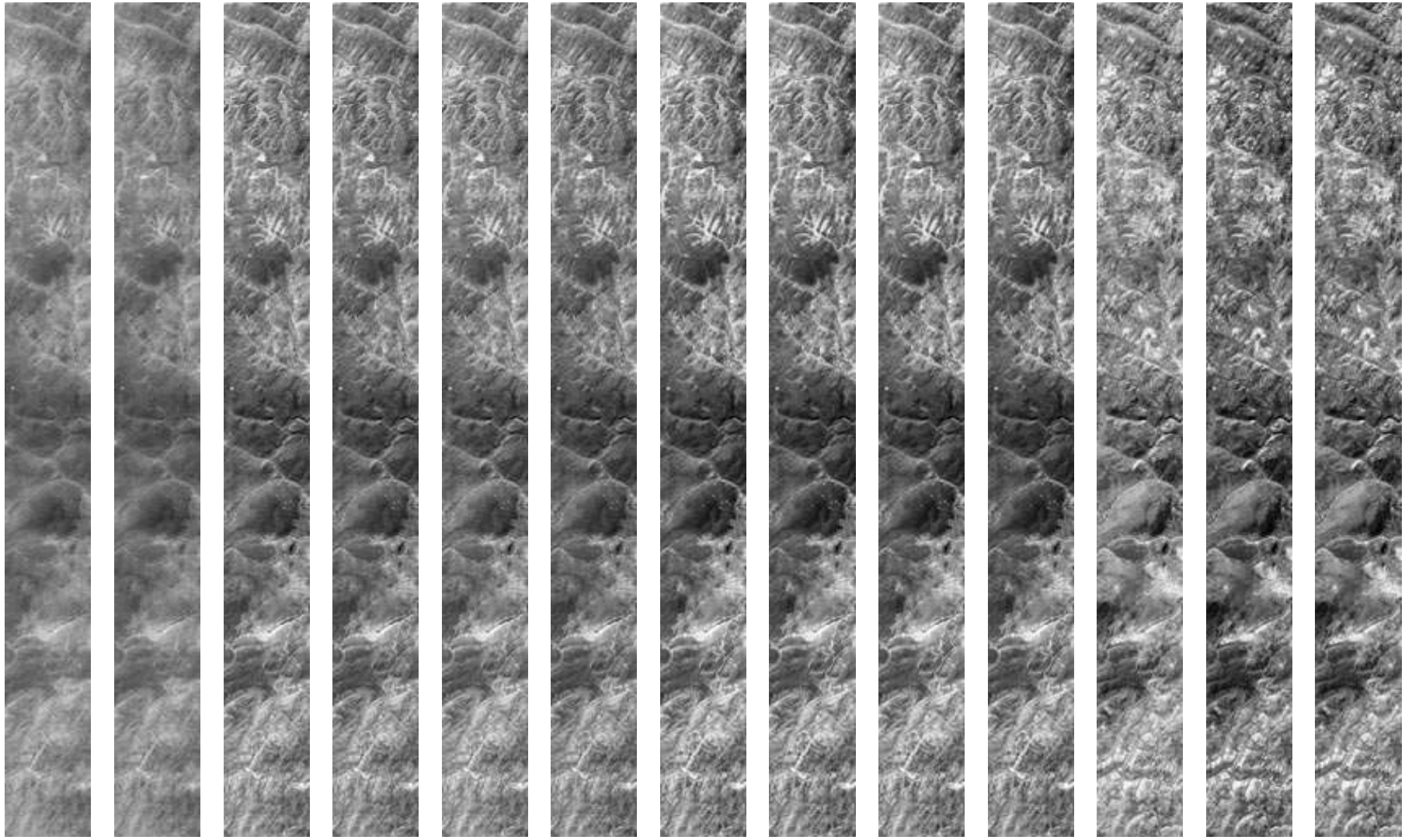




Ground Surface Scanning Rate at 18 – 72 Scans per second

PROCESSING DATA: SPECTRAL CHANNELS 1-13 ROUTE 1

26 SPECTRAL ANOMALIES CAN BE SEEN FROM THE AIR SURVEY



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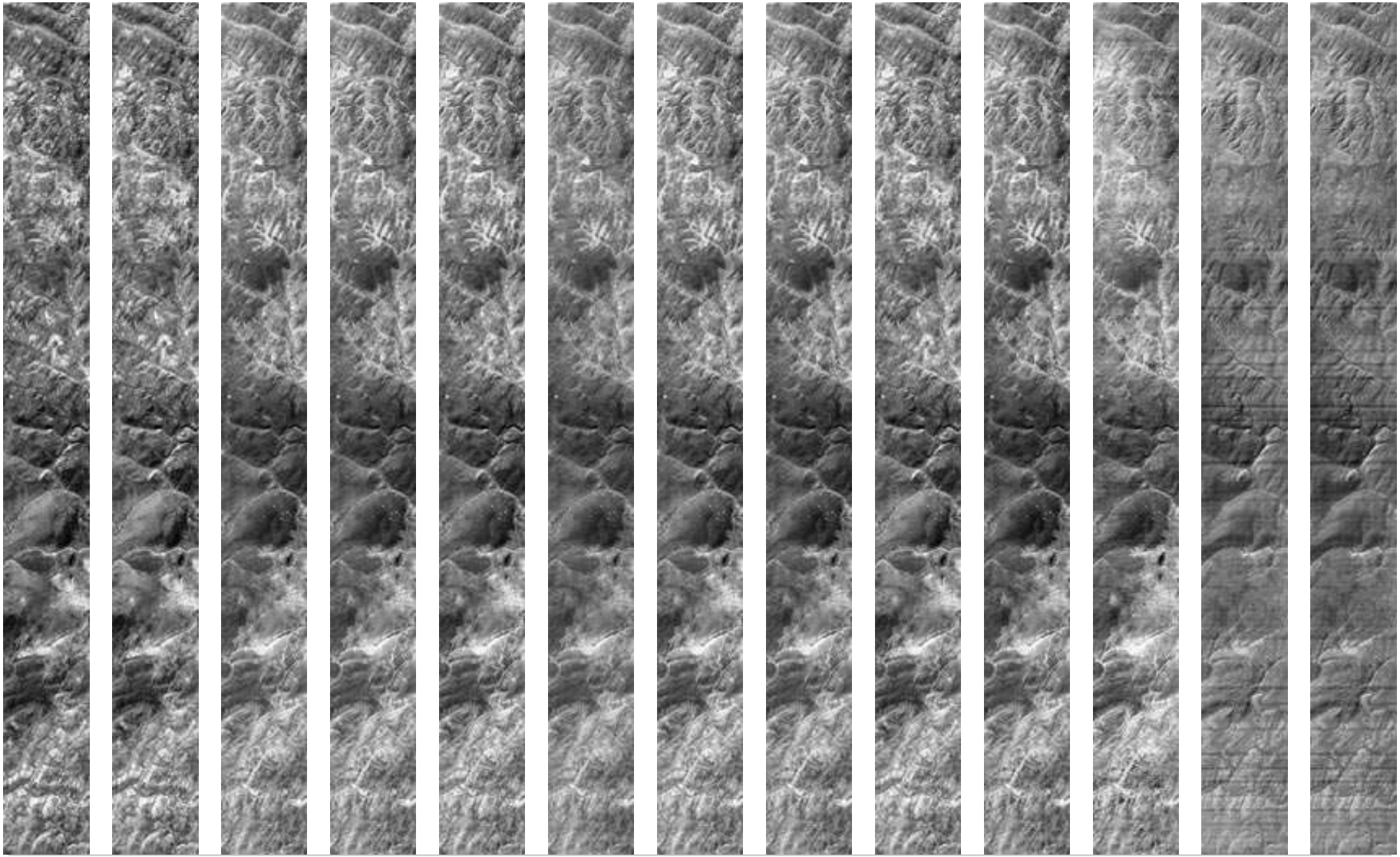
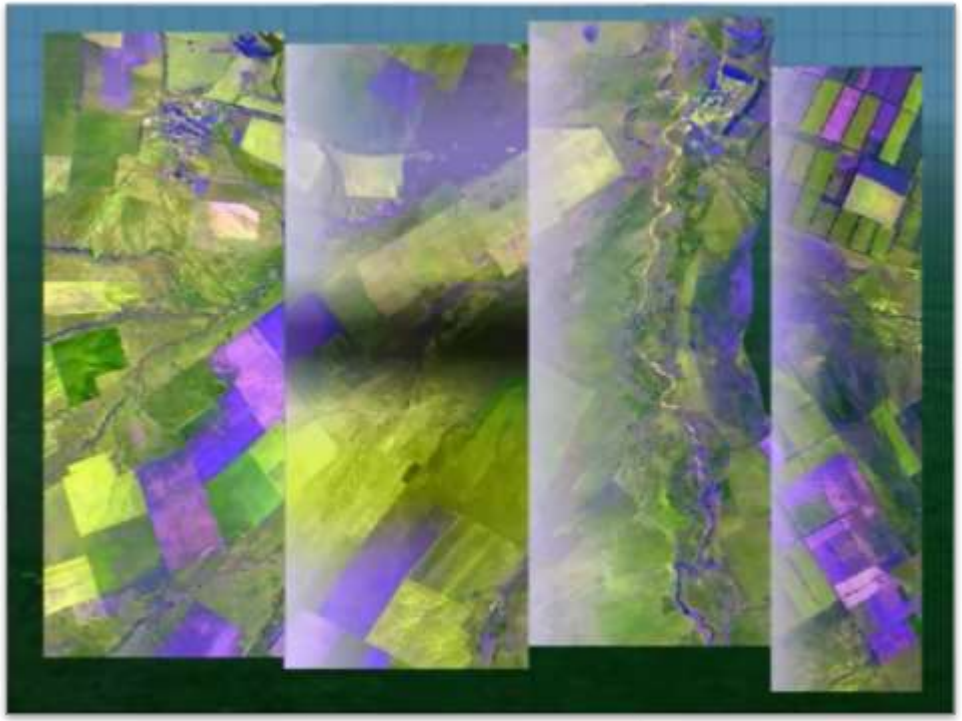
PROCESSING DATA: SPECTRAL CHANNELS 14-26 ROUTE 1



DATA GENERATION

Preliminary Data is collected, analysed and linked using mosaic cartographical techniques, accurate to 5m at scales of 1:25,000 and 1:50,000

PRIMARY

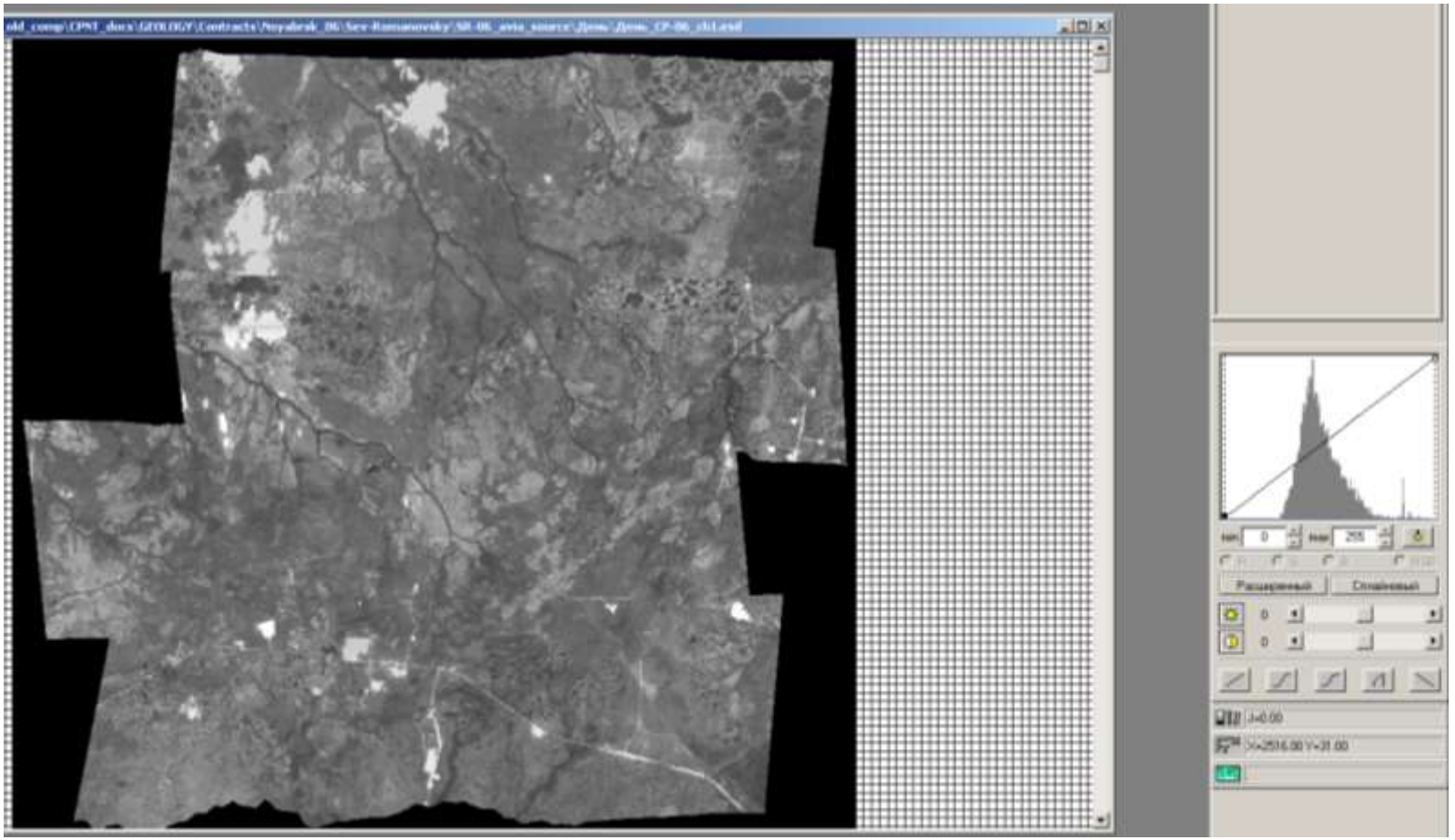


PROCESSED

Processing to reach precise combination of images includes:

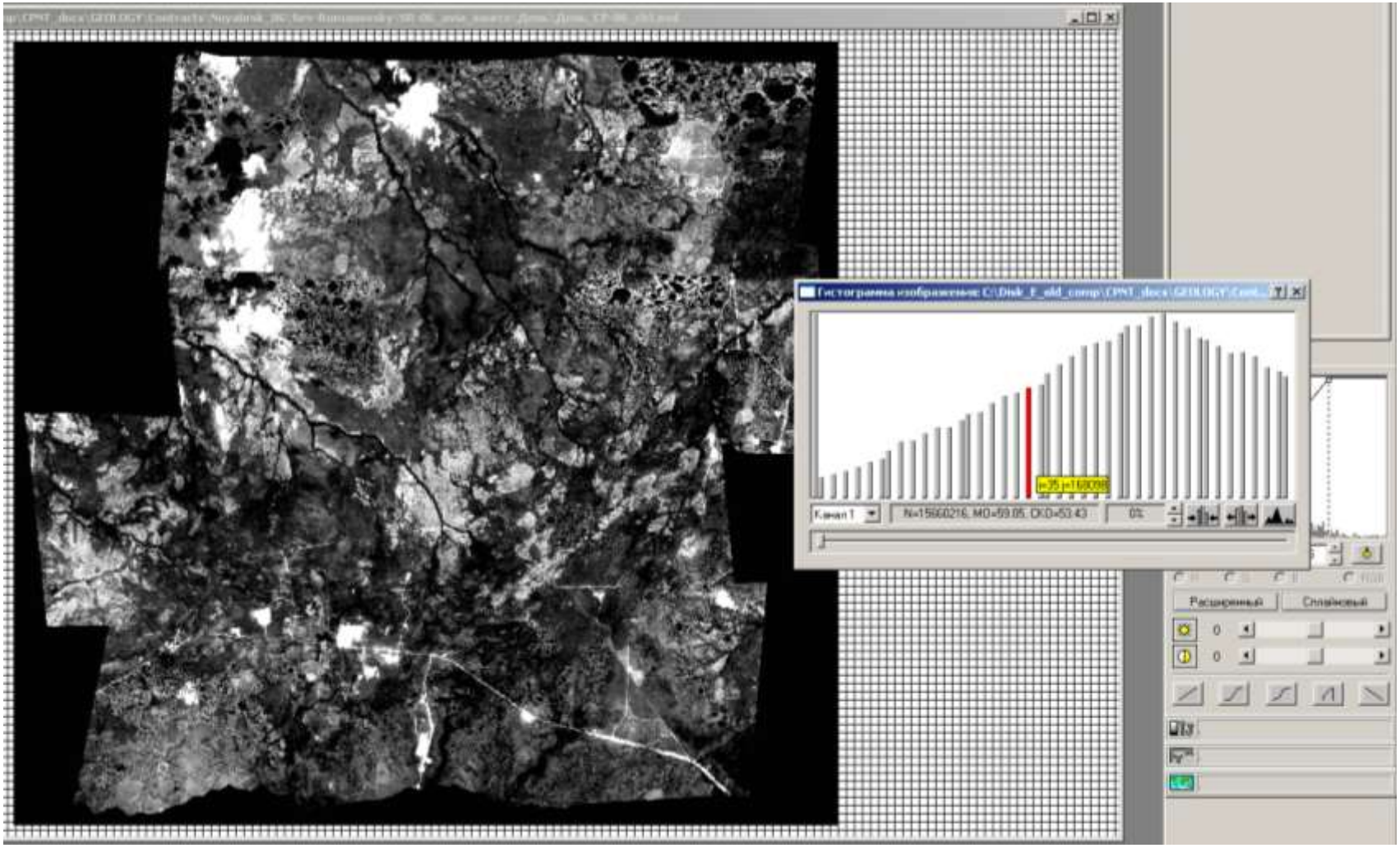
1. Impulse Noise Filtering
2. Radiometric distortion correction
3. Brightness Correction
4. Geometric Correction

PROCESSING OF THE SPECTRAL DATA



The following “Screen-shots” will demonstrate the Processing Sequence

HISTOGRAM ANALYSIS & TRANSFORMATION



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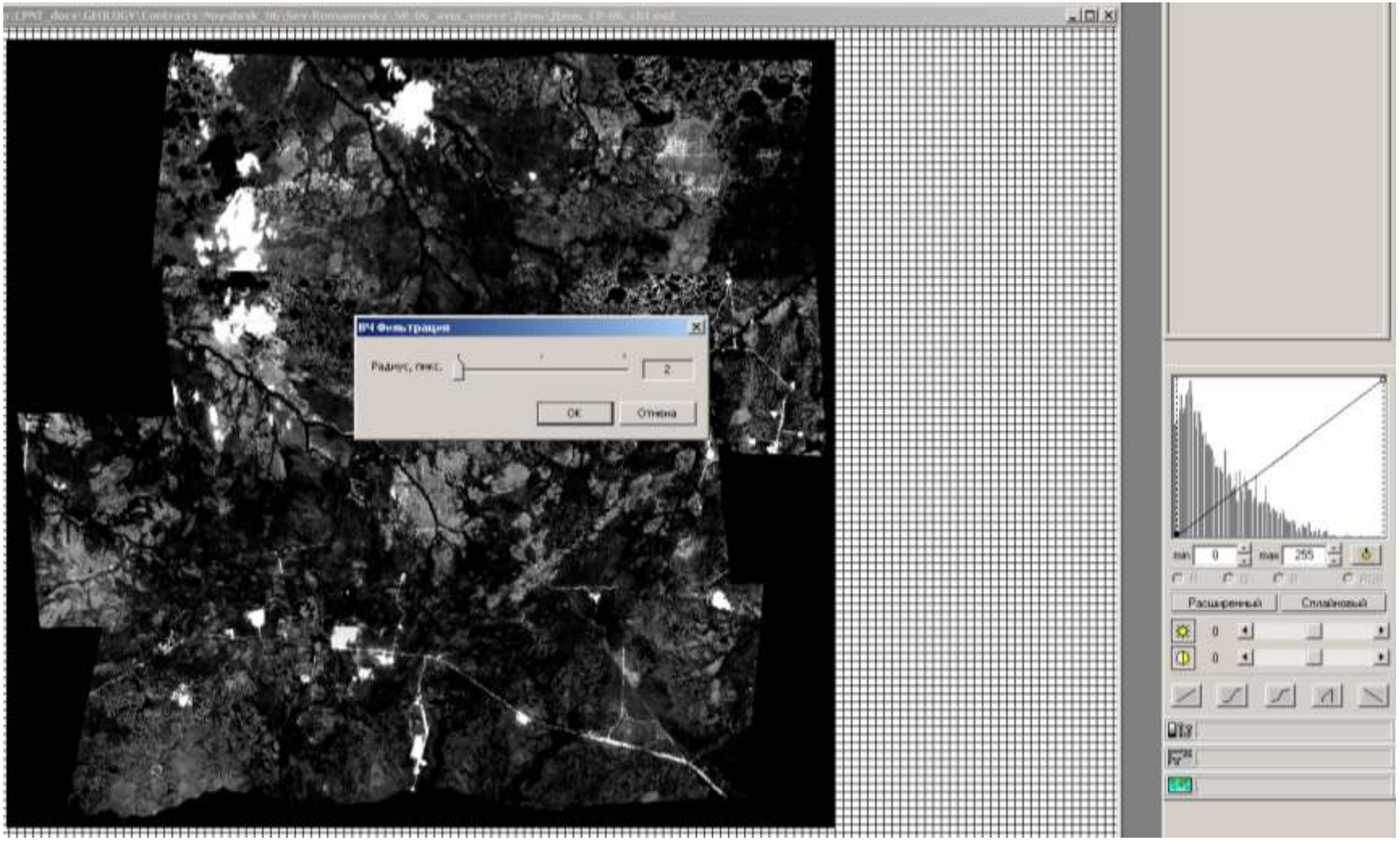
RECALIBRATING BRIGHTNESS



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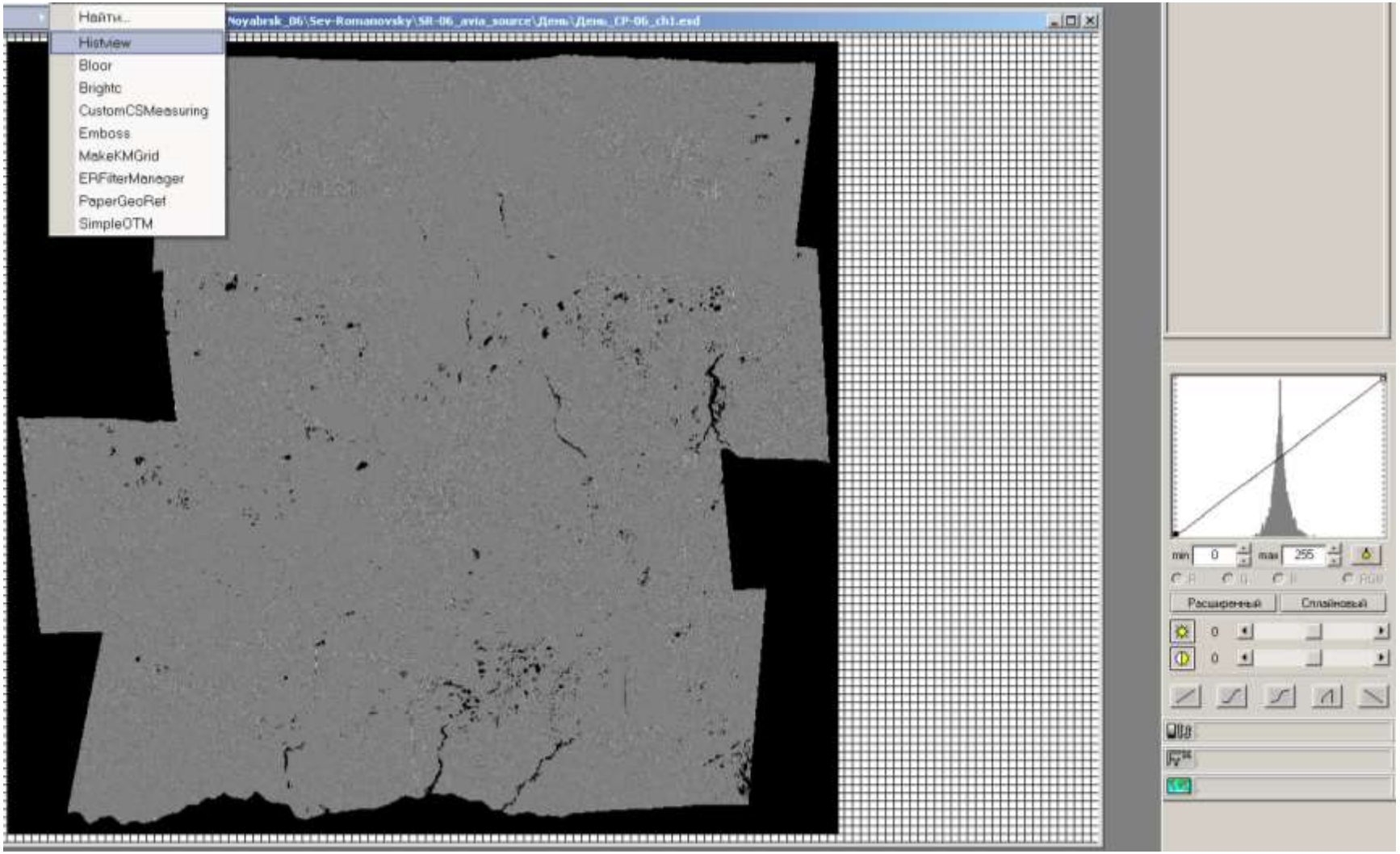
TRANSFORMING HISTOGRAM



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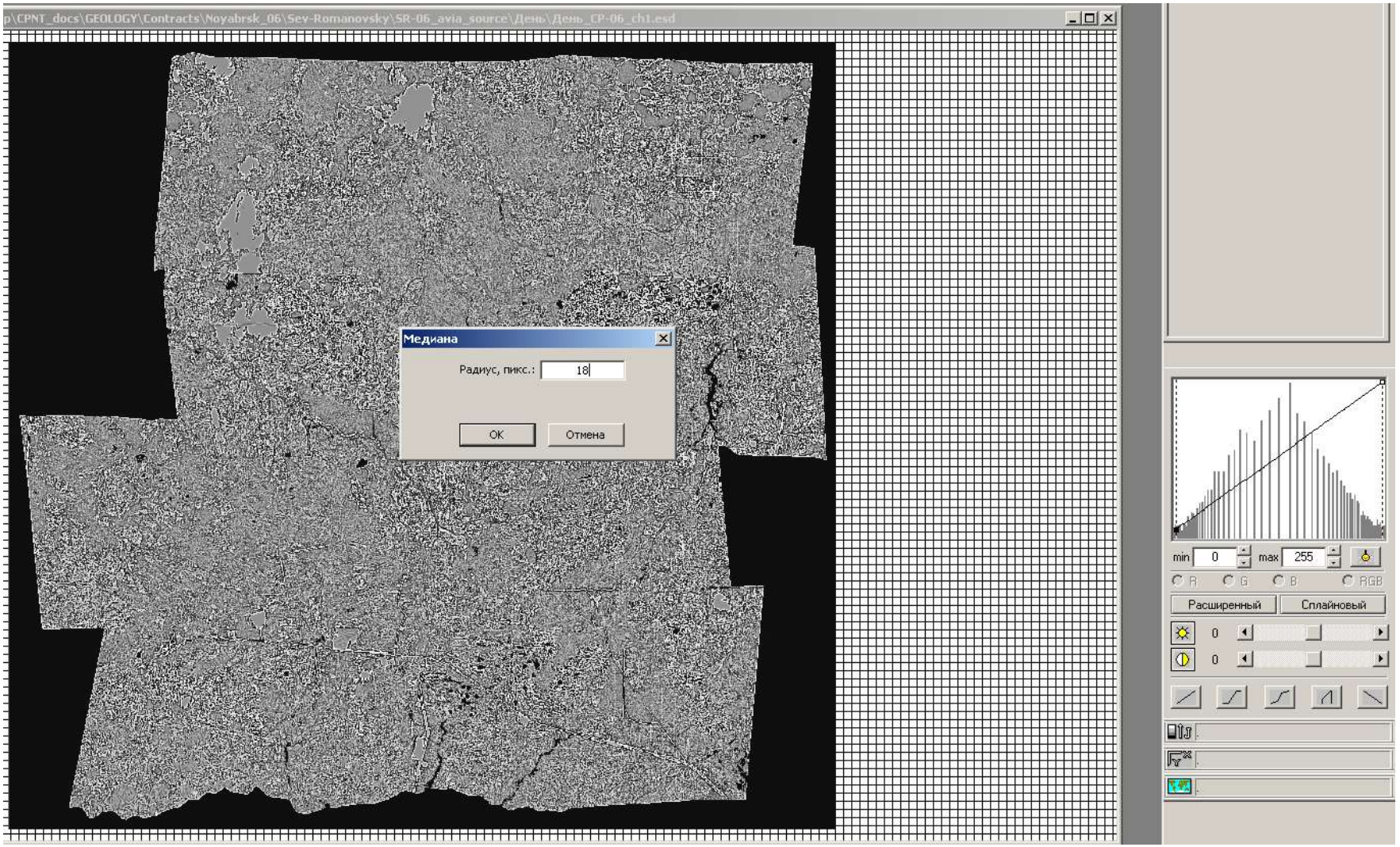
DIGITAL FILTERING, WITH CORRECTION PARAMETERS INSERTED AND PREPERATION OF THE FIRST CHANNEL FOR INTERGRATION



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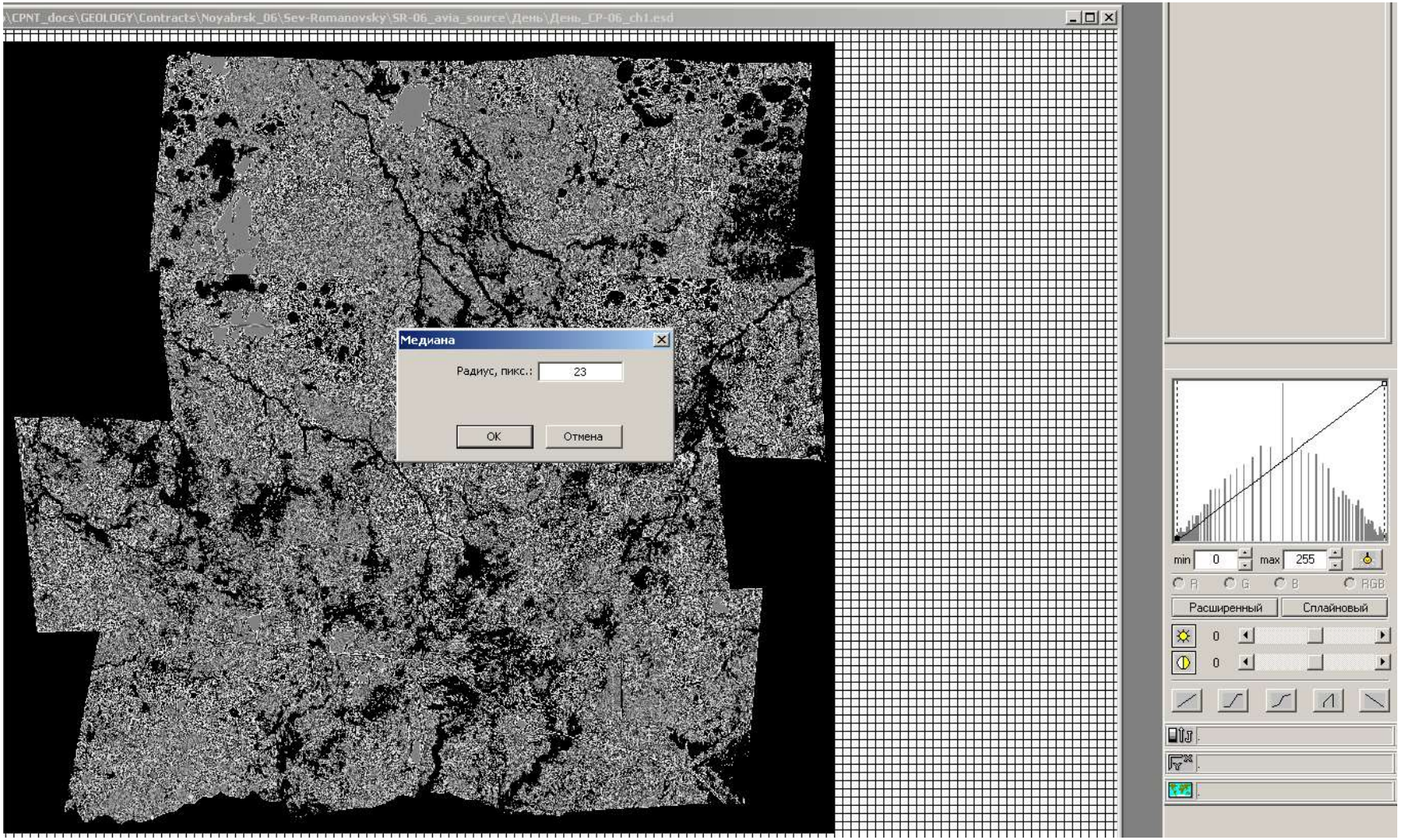
DIGITAL FILTERING, WITH CORRECTION PARAMETERS INSERTED AND PREPERATION OF THE SECOND CHANNEL FOR INTERGRATION



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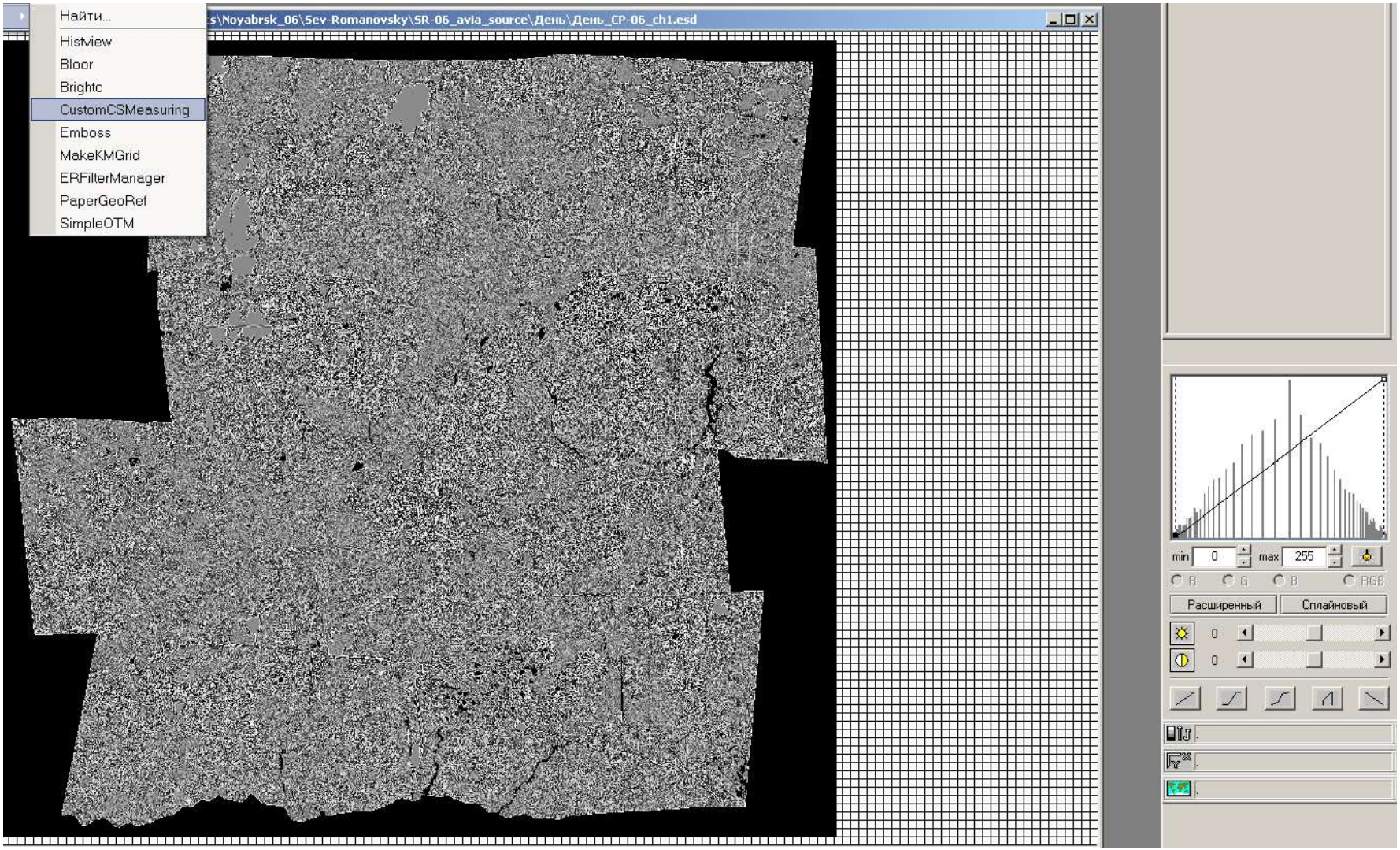
INTERGRATION OF THE CHANNELS



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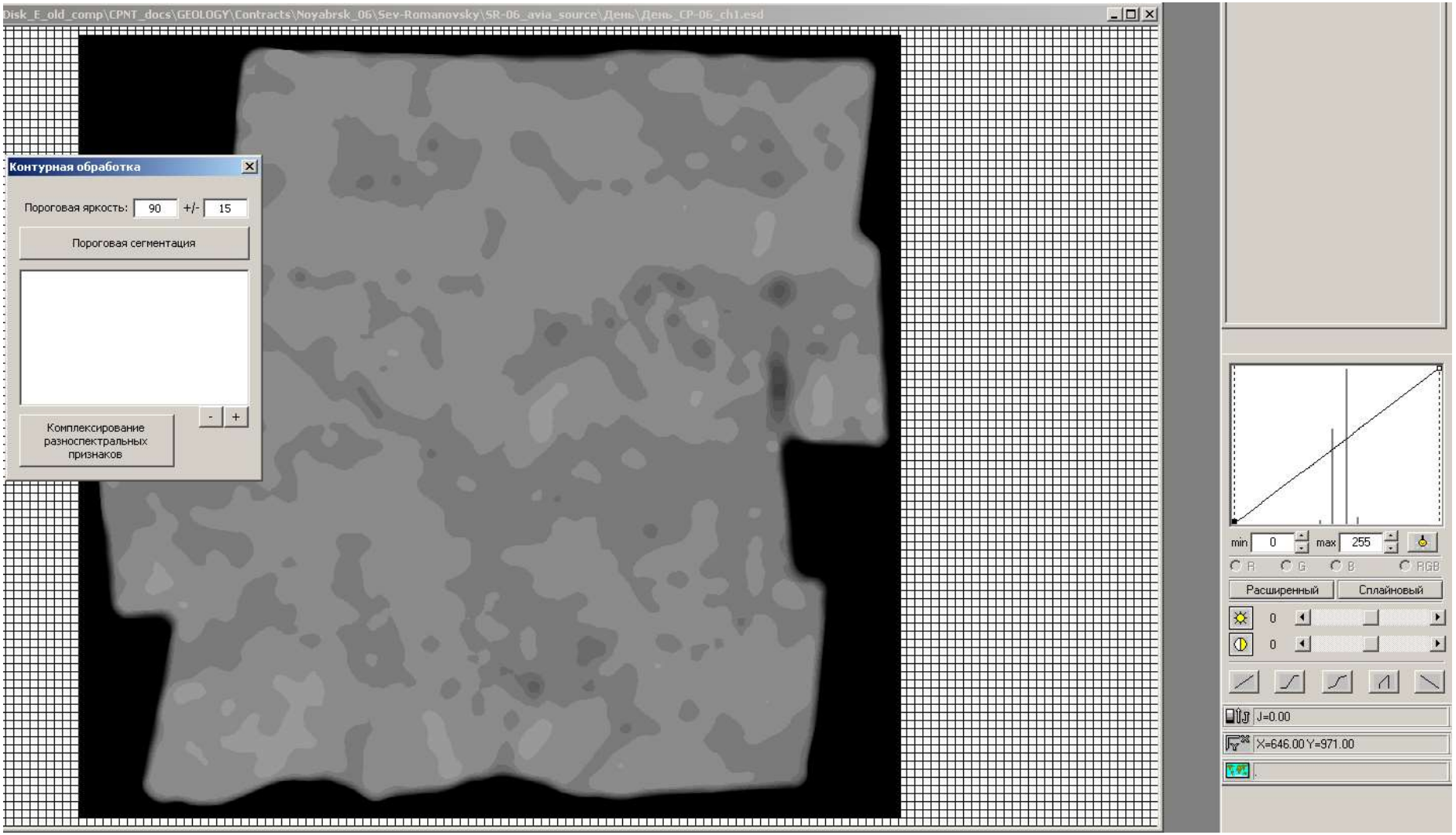
SELECTION OF PARAMETERS AND BOUNDARIES BETWEEN SEGMENTS



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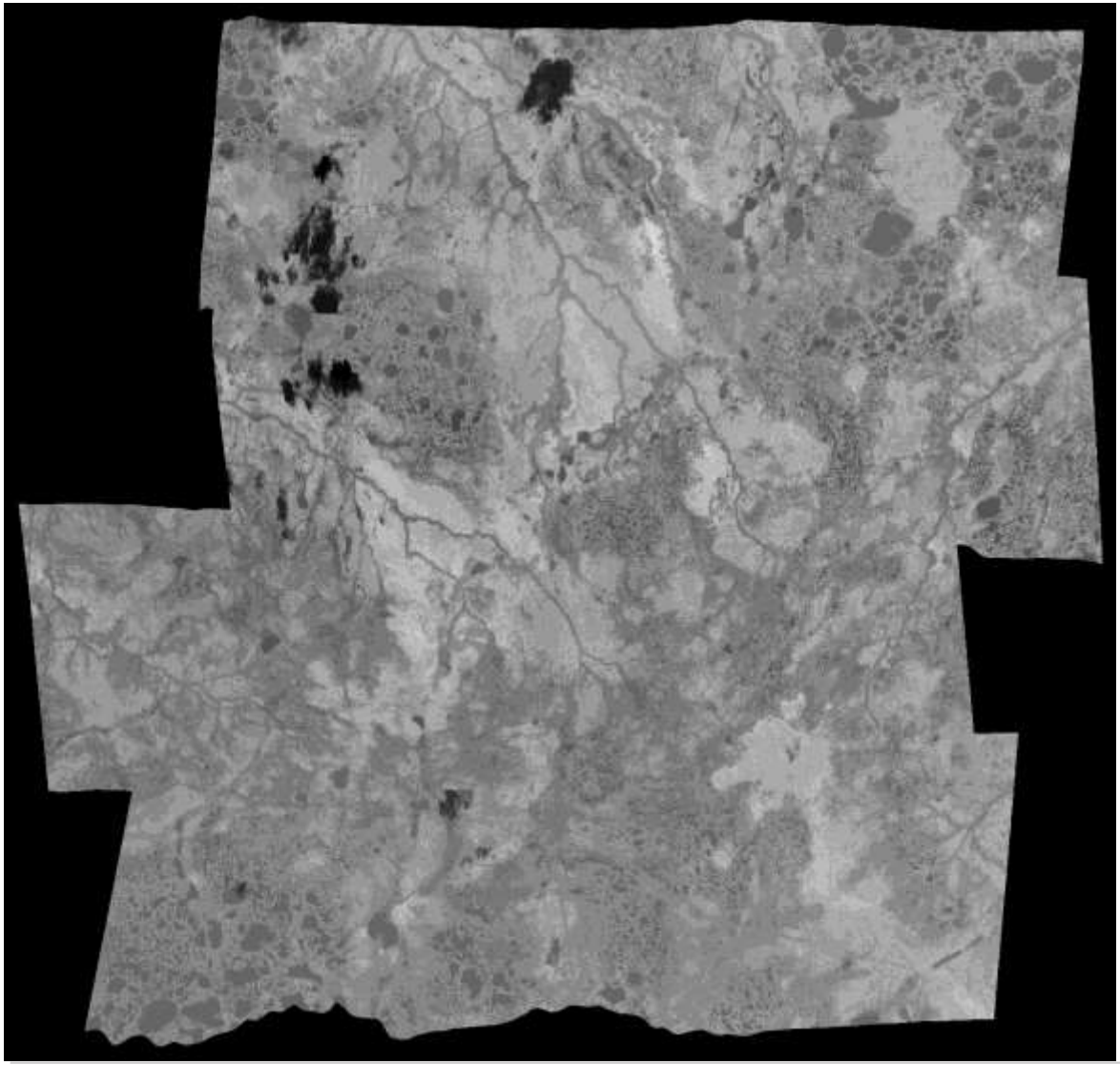
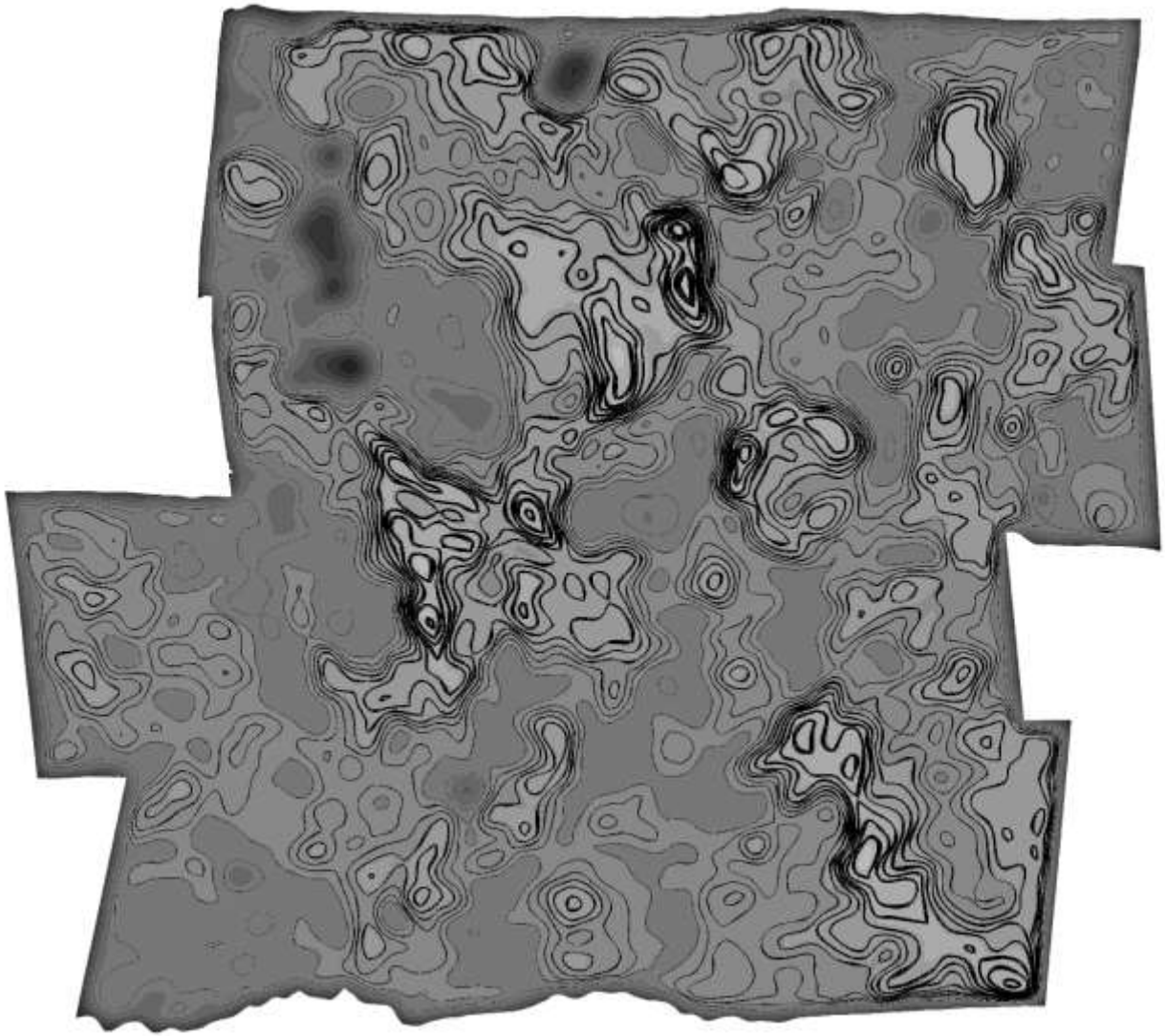
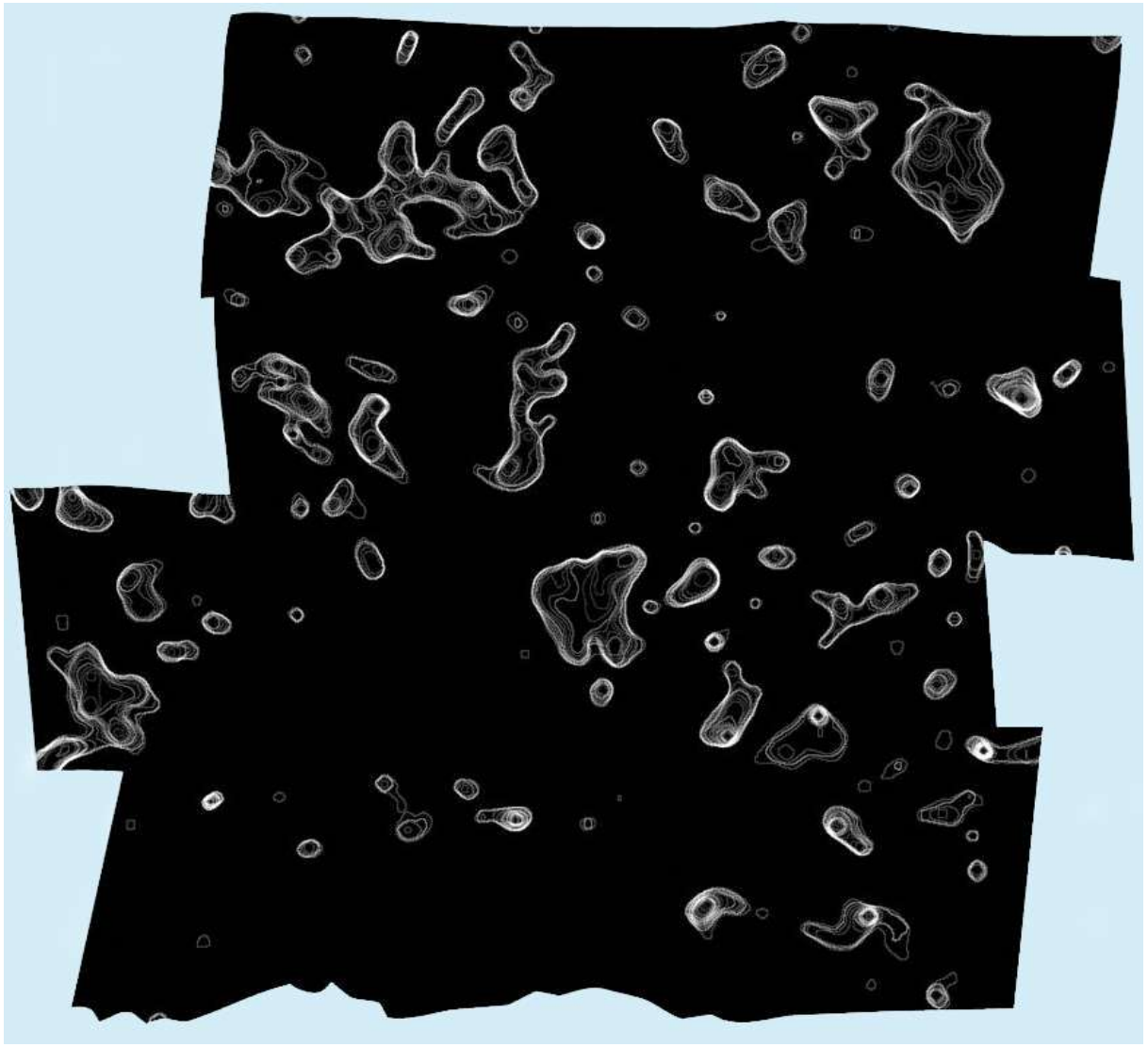
INFRARED IMAGE



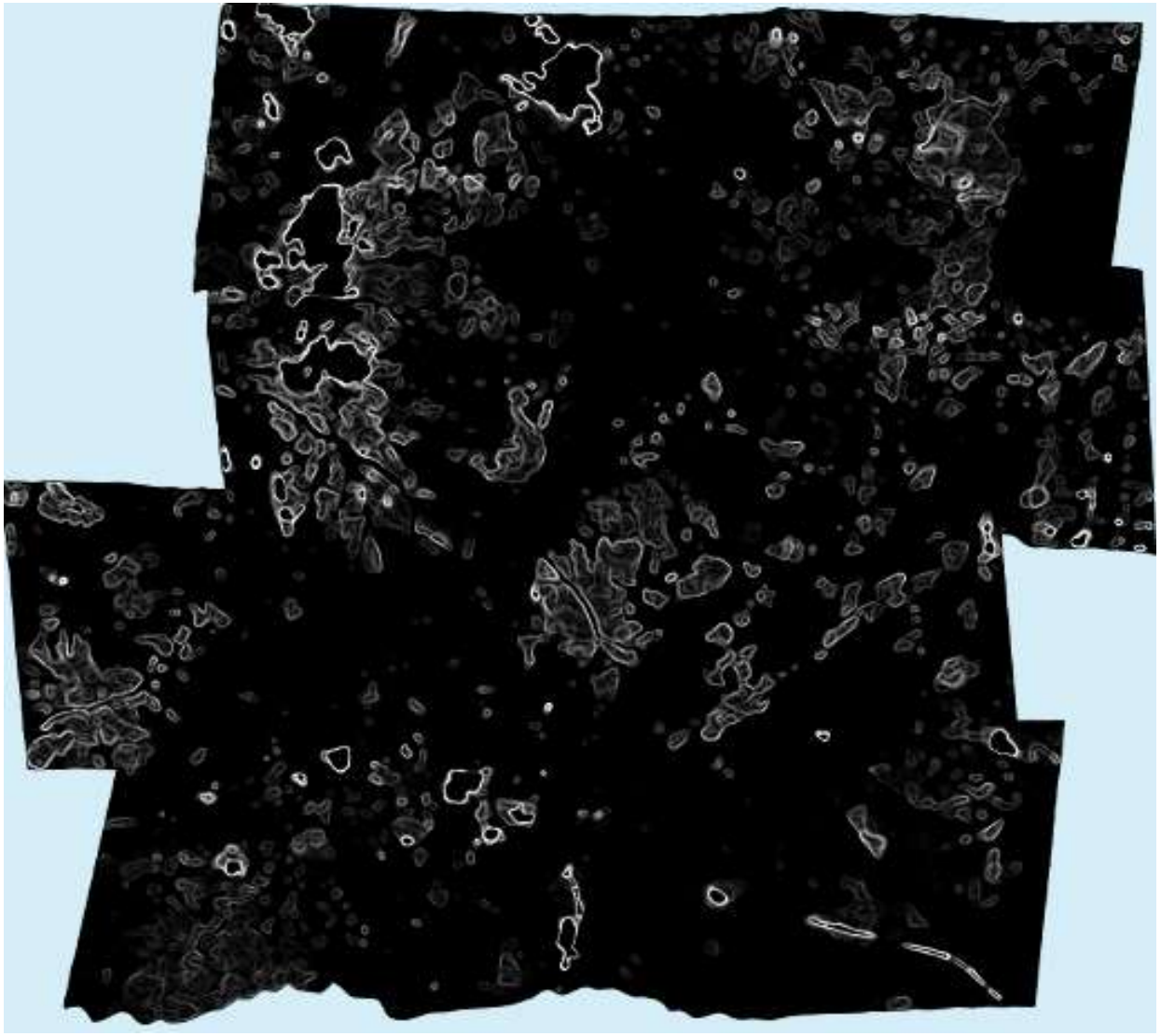
DISTRIBUTION OF TEMPERATURE RANGES



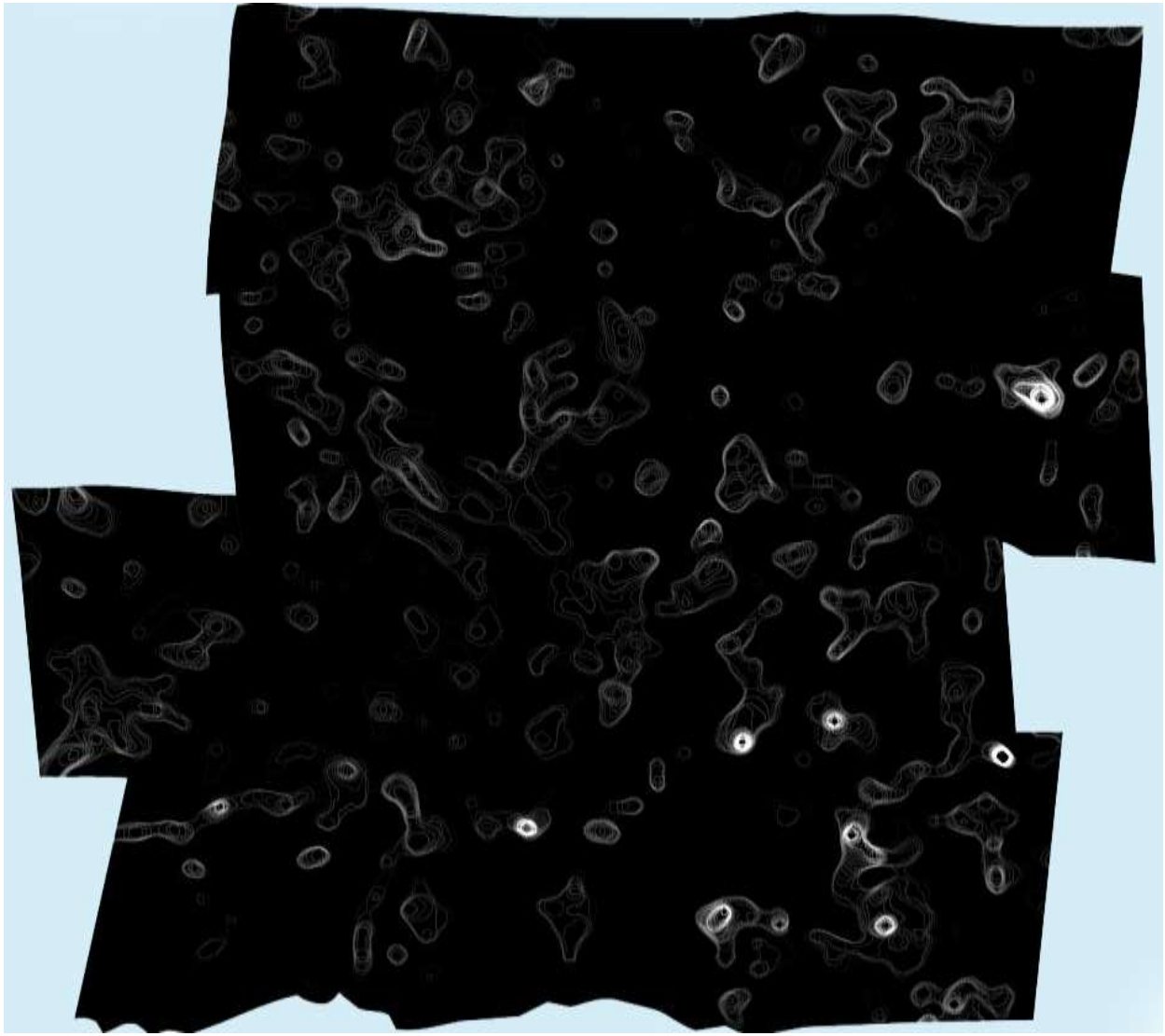
DISTRIBUTION OF ANOMALIES PRESENT IN SOILS



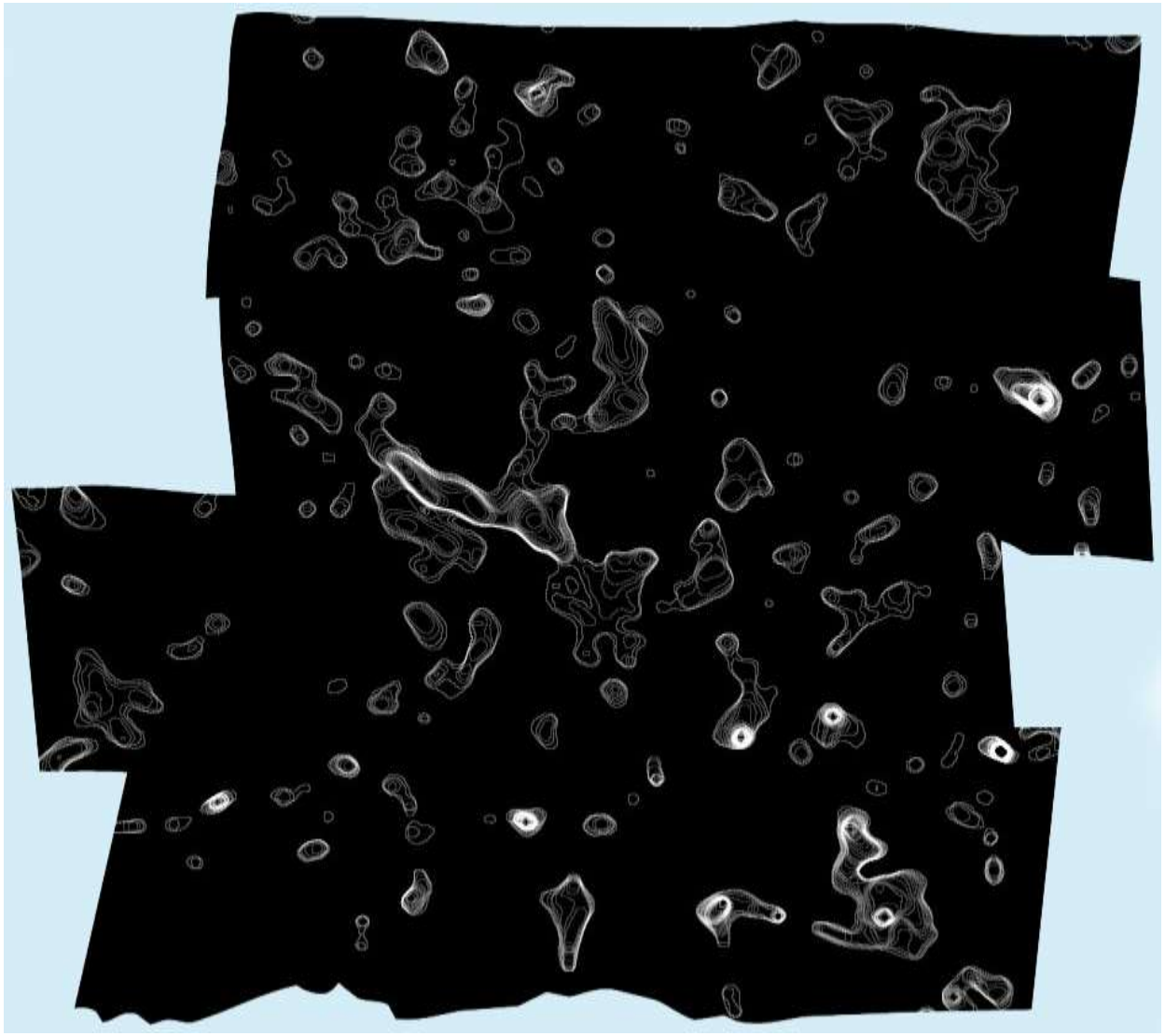
DISTRIBUTION OF ANOMALIES PRESENT IN VEGETATION



DISTRIBUTION OF TEXTURAL ANOMALIES

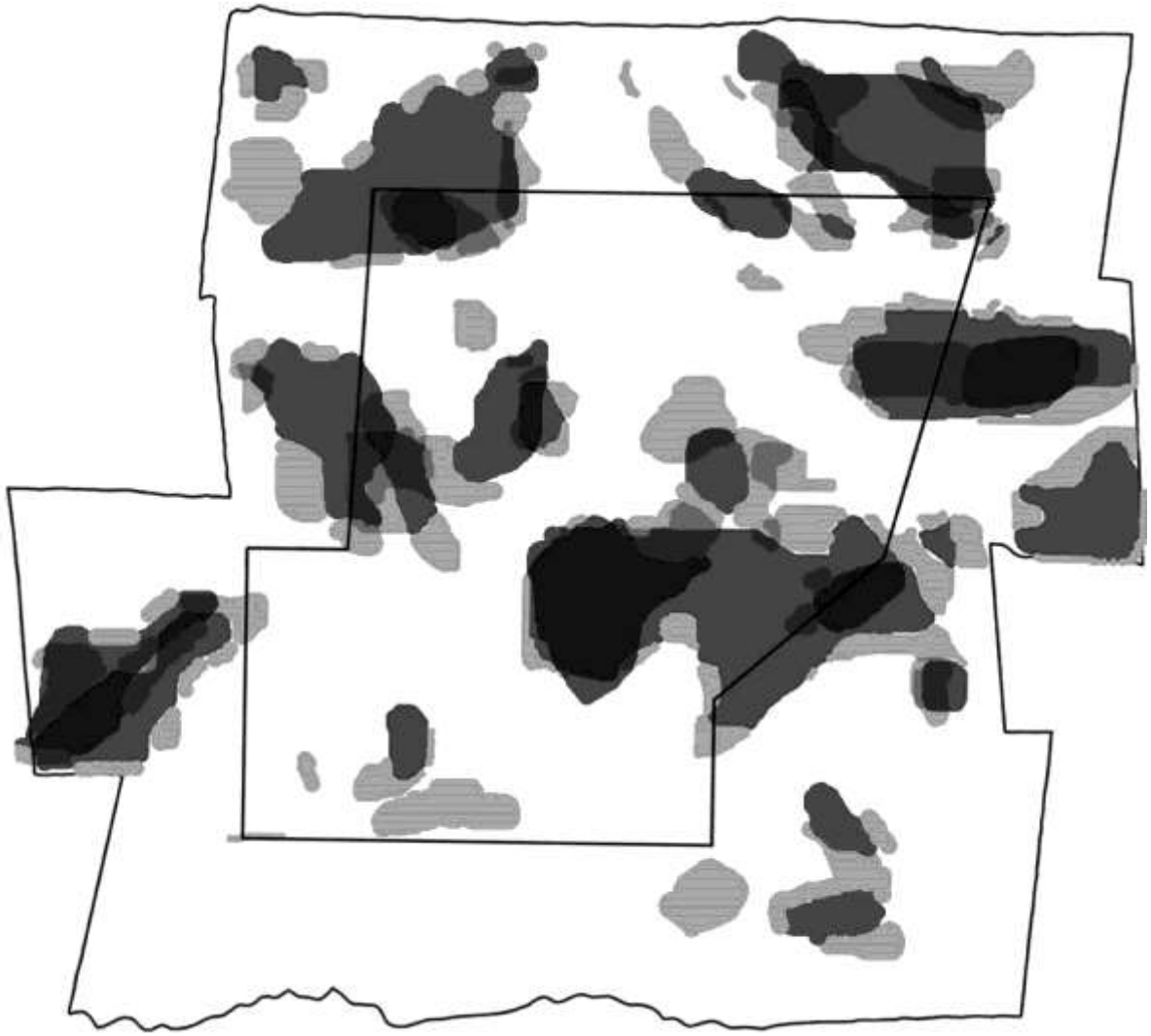


DISTRIBUTION OF BACTERIAL ANOMALIES

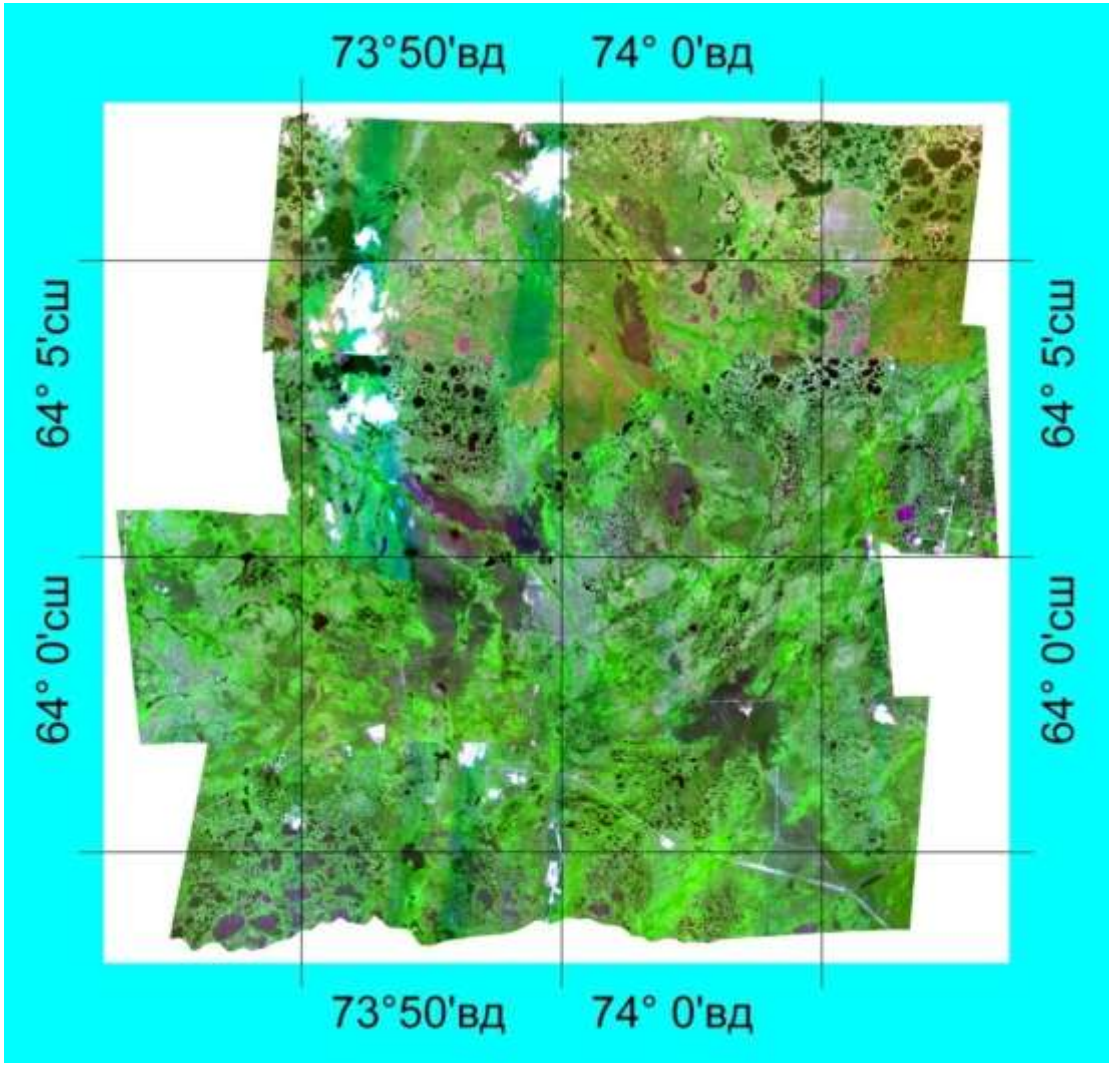


SUMMARY OF THE INDICATIVE RESULTS OF THE PROSPECTIVE AREA

GROUPING TOGETHER OF RESULTS

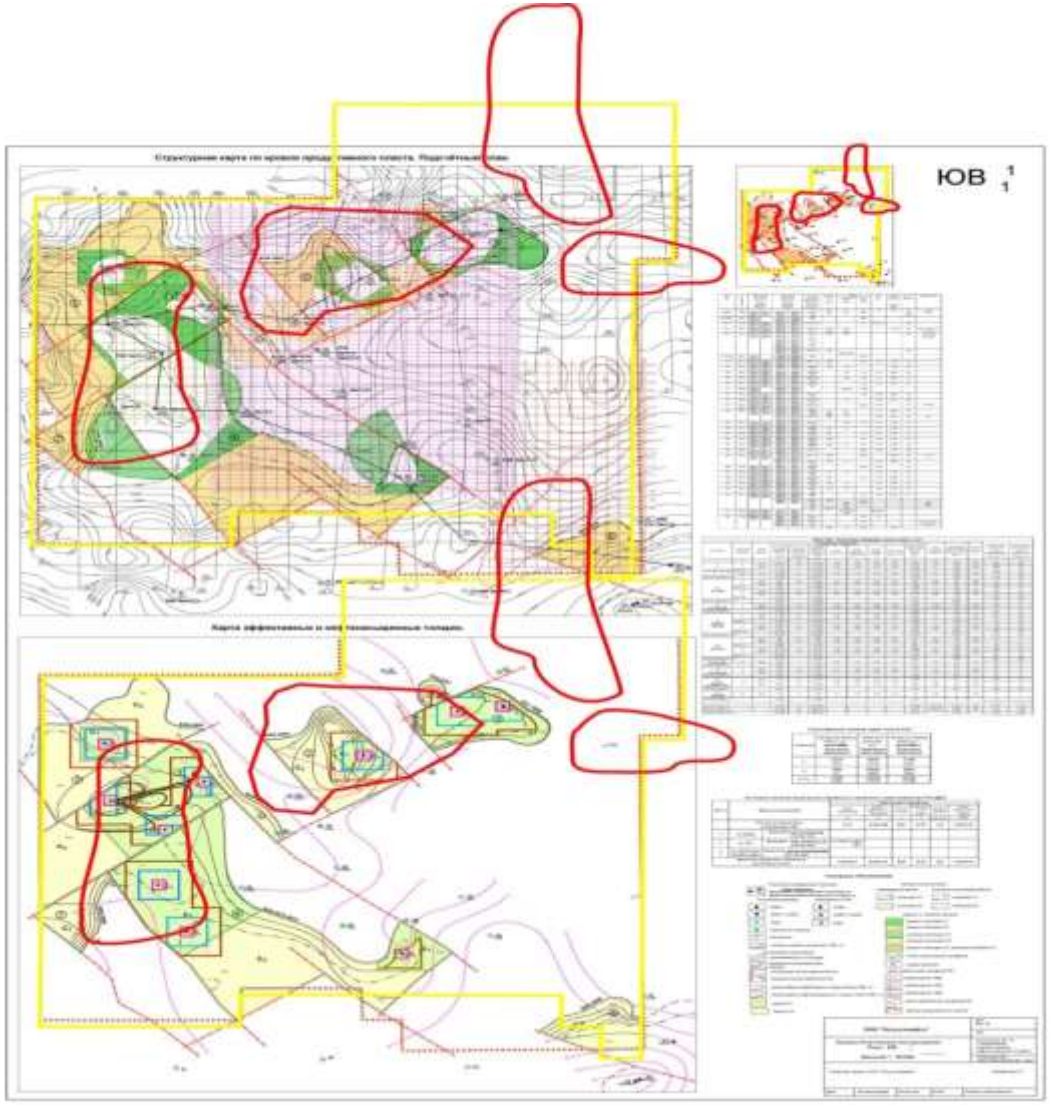


GROUPING TOGETHER OF RESULTS



Preliminary Data is linked to coordinates using mosaic cartographical techniques, accurate to 5m at scales of 1:25,000 and 1:50,000

GROUPING TOGETHER OF RESULTS



All Results Grouped and

Cartographically Overlaid

TERRAVISION

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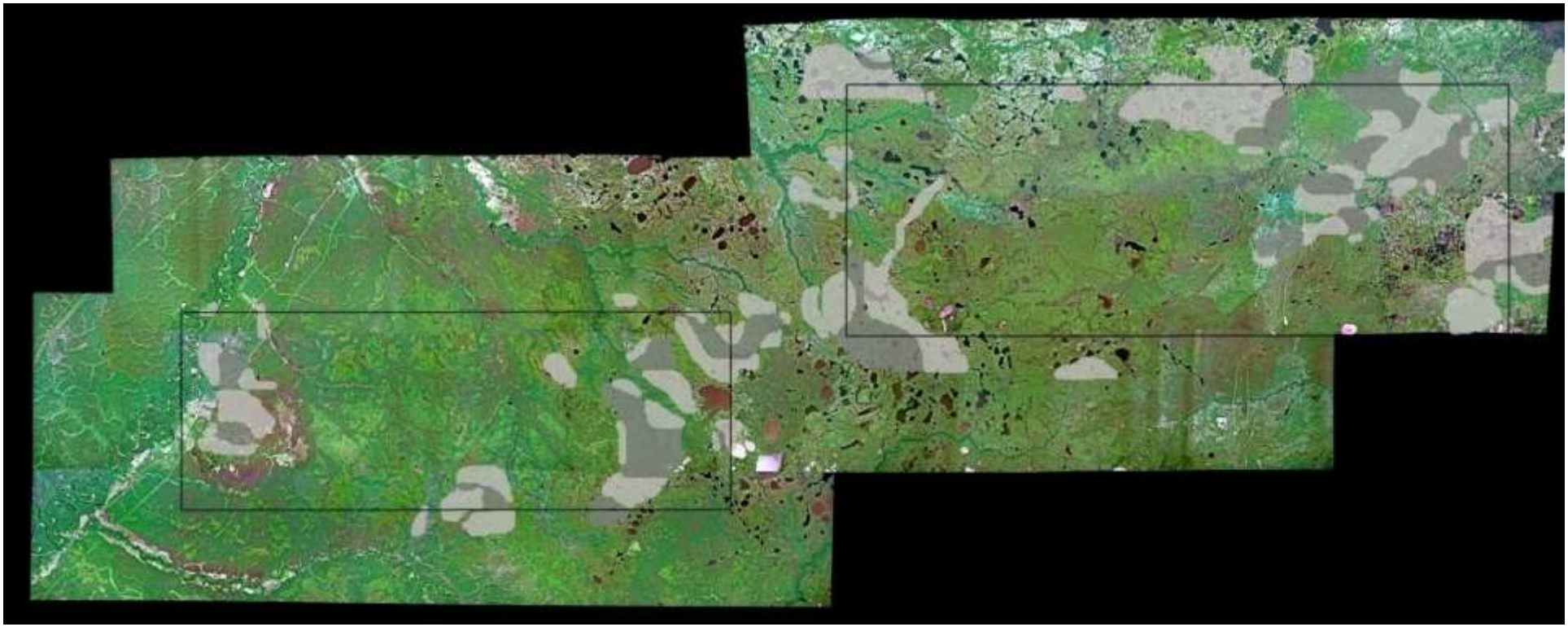
GROUPING TOGETHER OF RESULTS

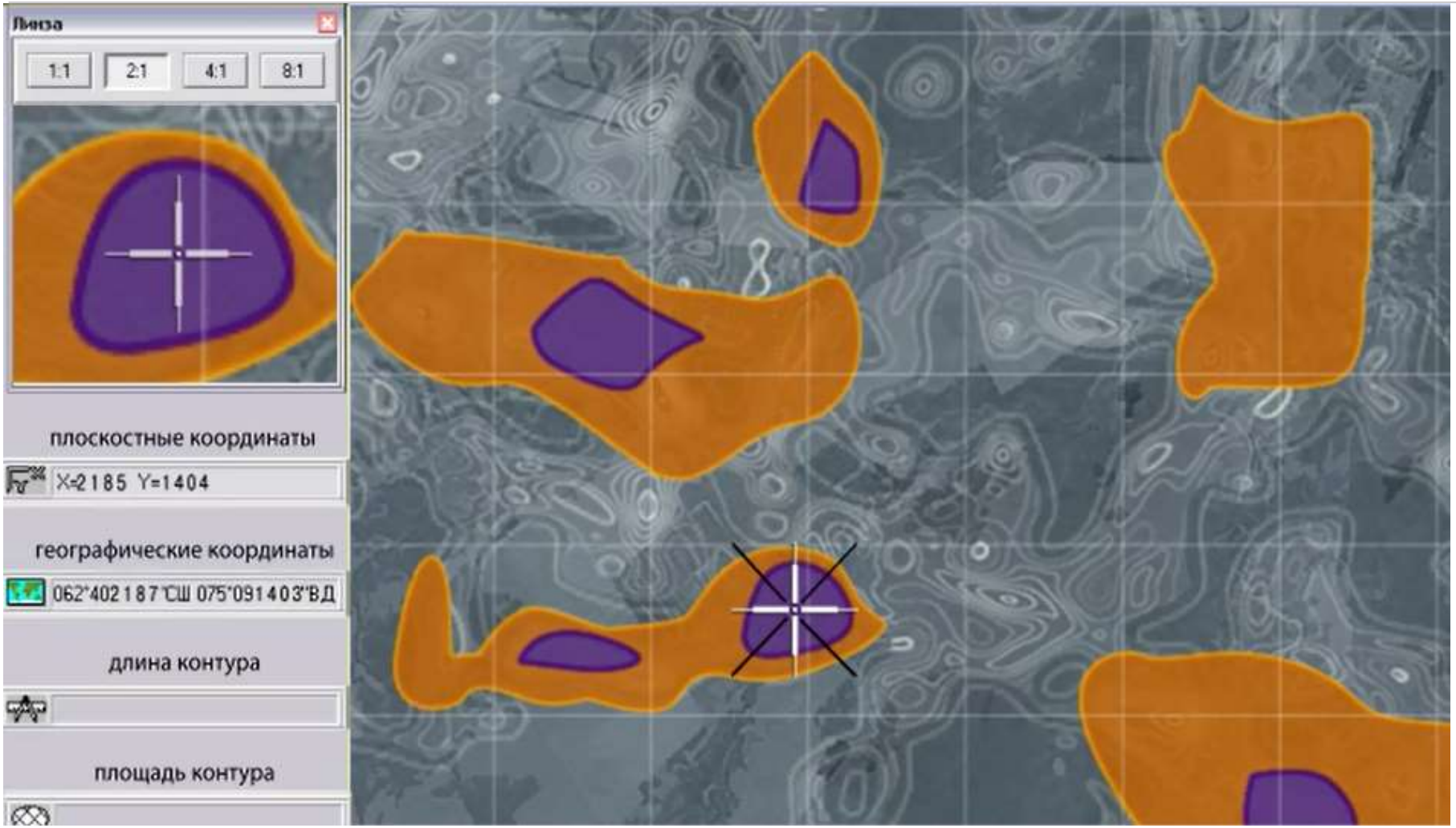


All Results Grouped and Cartographically Overlaid

FINAL PRODUCT

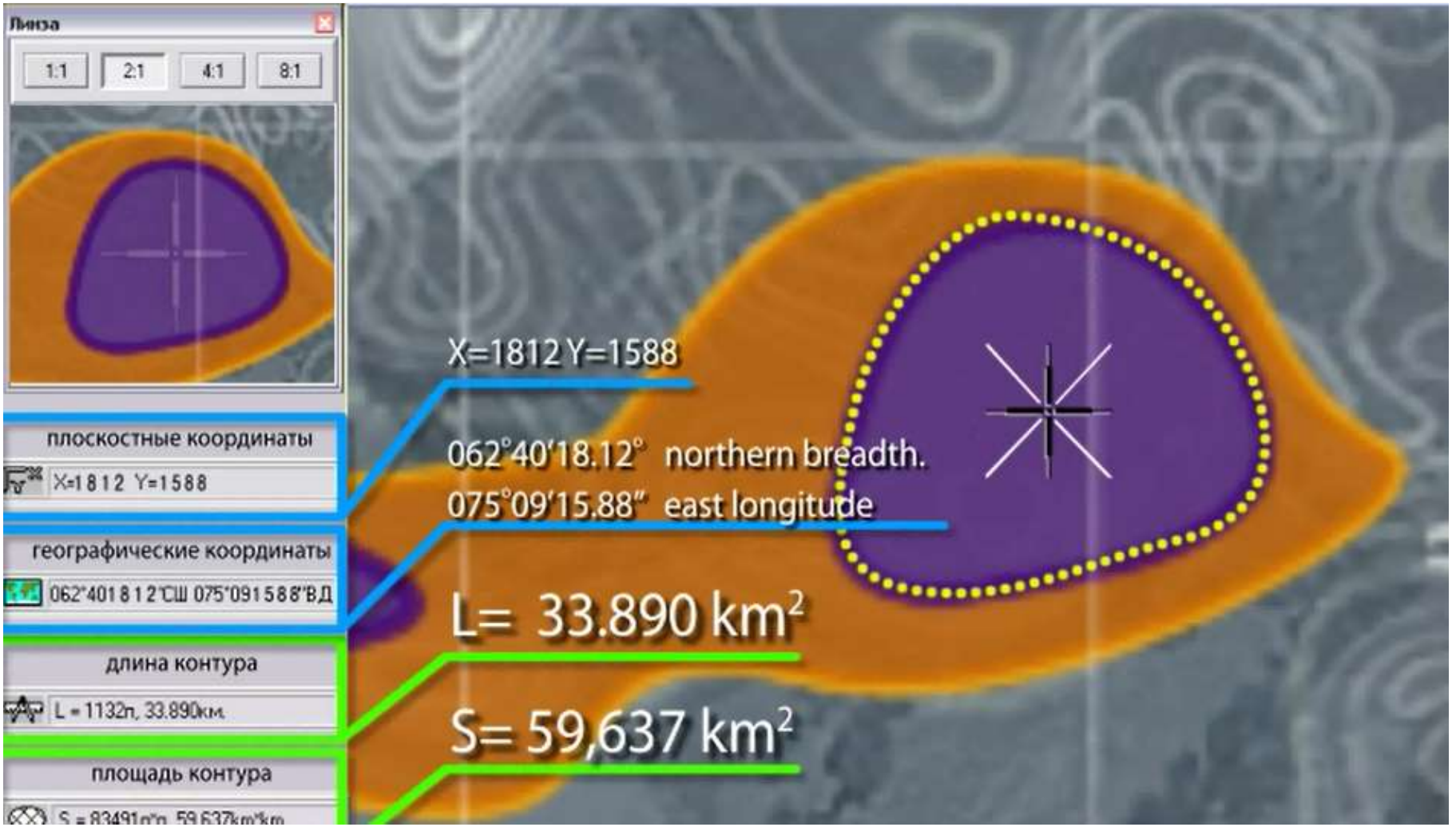
All types of “anomaly criteria” are measured, and areas of “adequate” and “high” probability of hydrocarbon reserves are identified (85% of the reserves proven to be within these zones of probability.)

FINAL PRODUCT



Final Product: Provided on a GIS system “digitiser” to permit the measurements of any coordinates in Geodesic and Rectangular Co-ordinate Systems

GROUPING TOGETHER OF RESULTS



Digitiser allows for the measurement of the identified Hydrocarbon Resource

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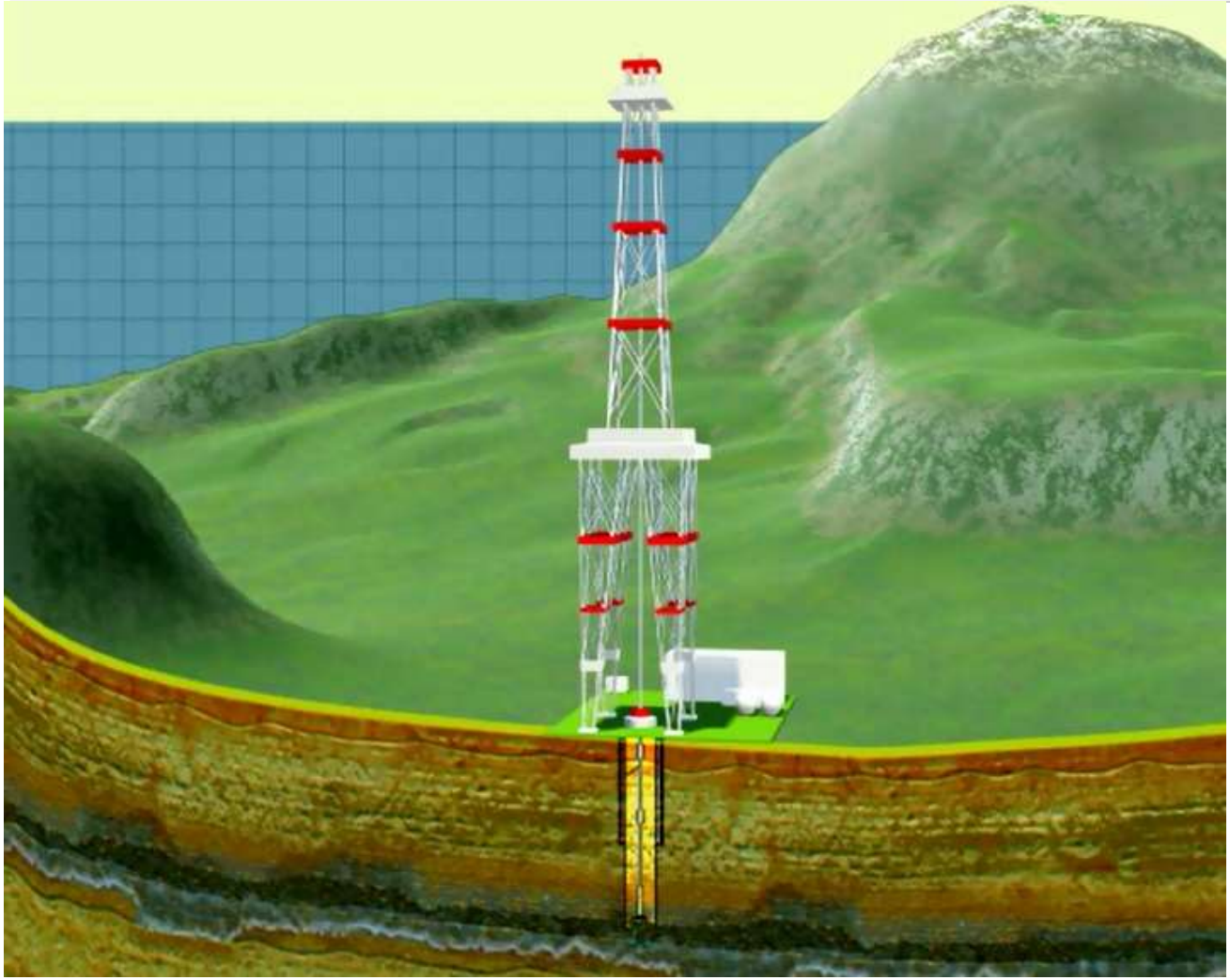
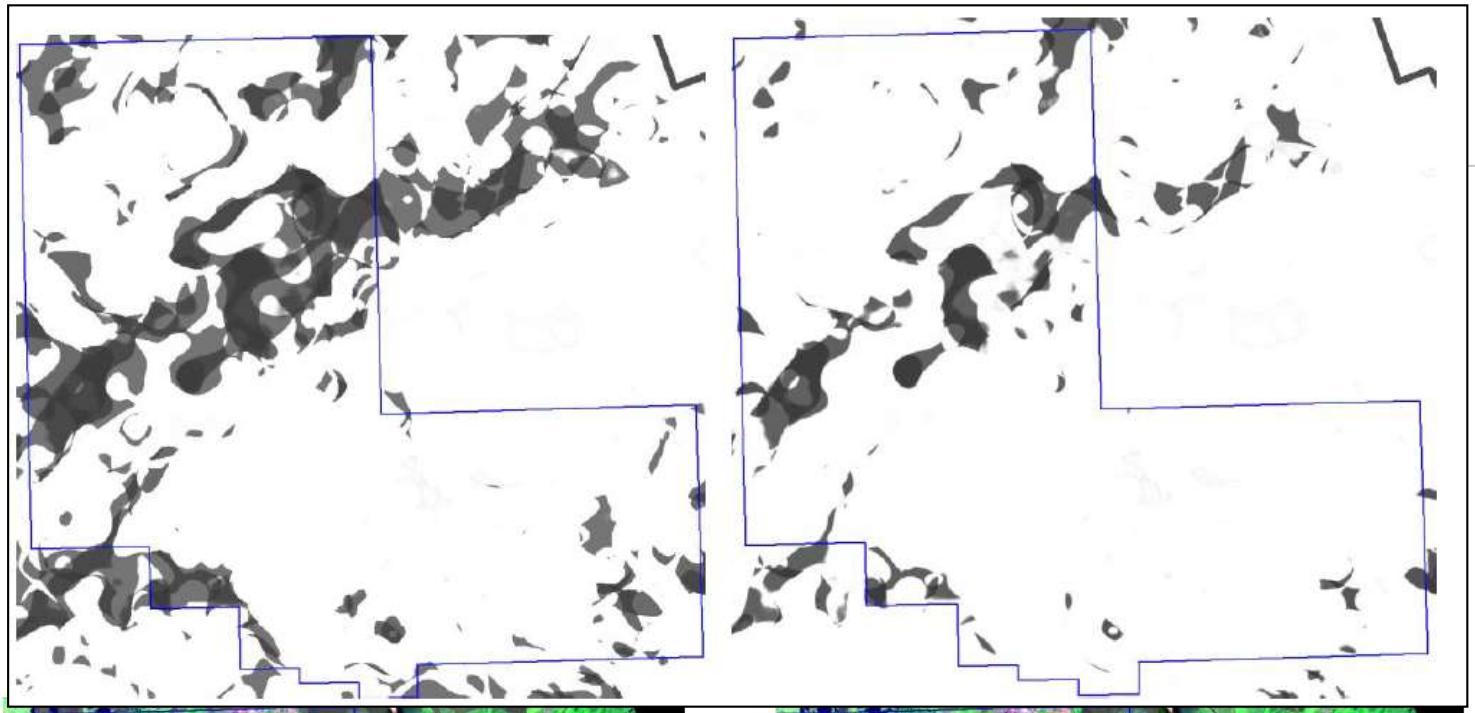
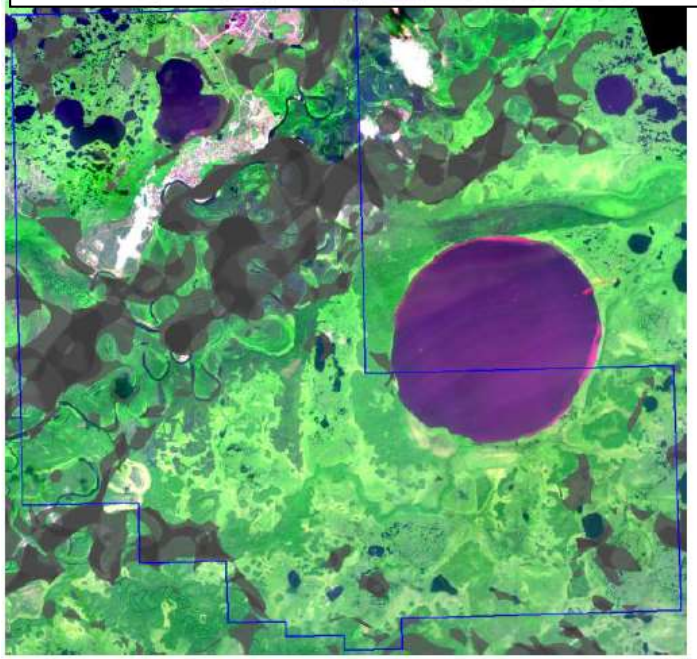
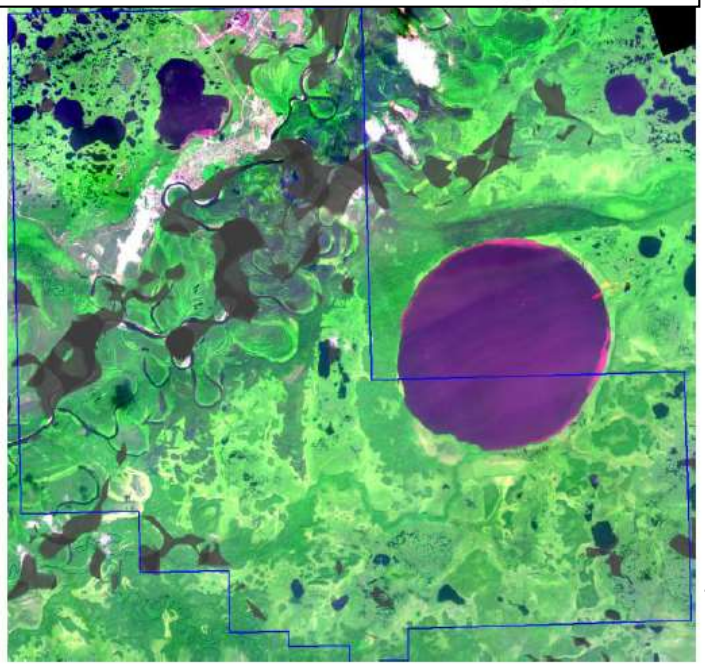
NEXT PHASE OF EXPLORATION



Exploratory Seismics & Drilling is then directed to the exact coordinates of the identified resource for confirmation of the reserve







CST Recent Case Study

The areas where all the anomalies coincide are in the box on the right. Box on the left shows where all but one of the anomalies coincide. Both areas are where hydrocarbons are very likely to be present. Seismic survey is still necessary to establish the location of the accumulations in the areas of hydrocarbon presence. Doing seismic and drilling outside the black areas shown on the map would be useless. Money and time are saved by avoiding unnecessary seismic surveys and drilling

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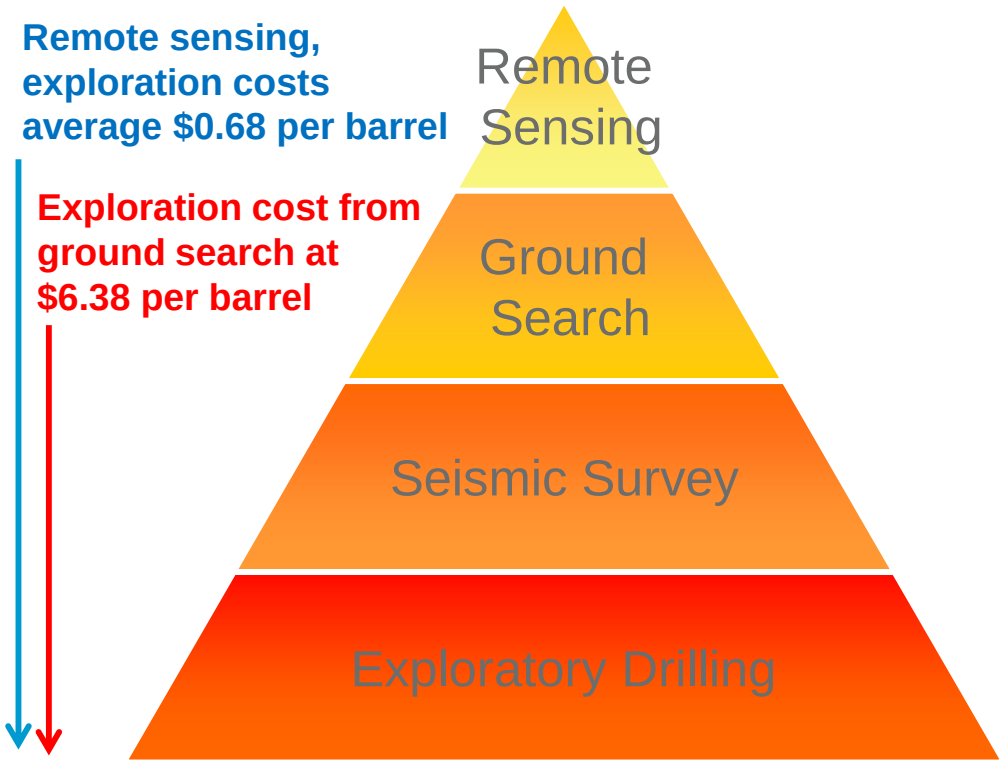
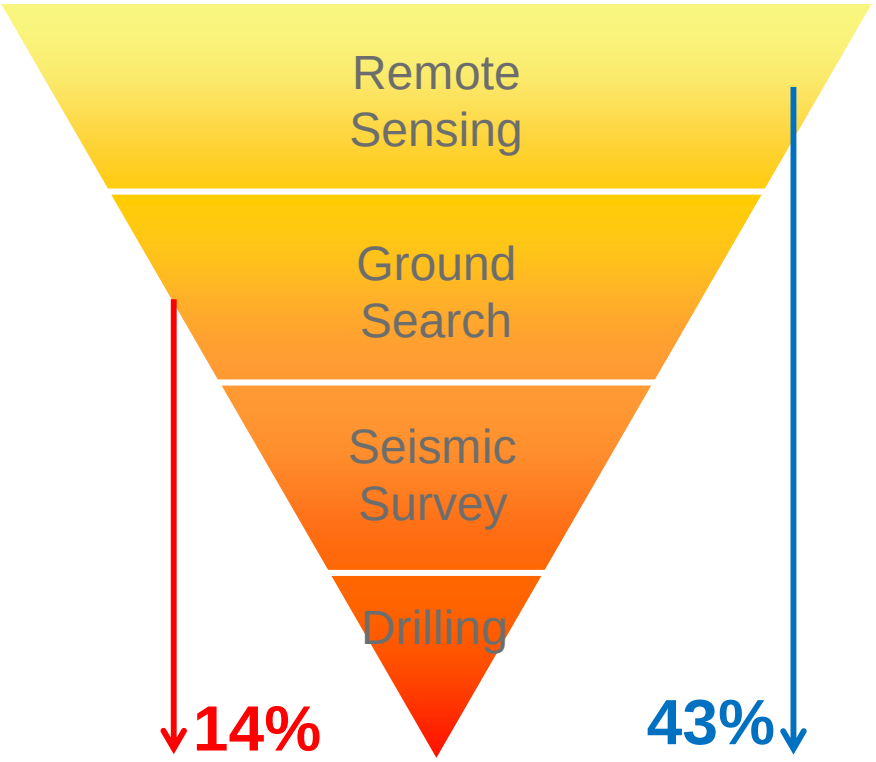
THE ECONOMICS OF CST EXPLORATION

Average Cost of Exploration per barrel of P1 Oil



Using remote sensing cuts exploration costs

Average % of Boreholes showing economically viable oil resource



Remote sensing increases "strike rate"

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CERTIFICATION

РОССИЙСКАЯ ФЕДЕРАЦИЯ

СВИДЕТЕЛЬСТВО

о государственной регистрации программы для ЭВМ

№ 2011615556

Программа Digitizer - OIL

Правообладатель(ли): *Ковалев Алексей Олегович (RU)*

Автор(ы): *Ковалев Алексей Олегович (RU)*

Заявка № 2011613758
Дата поступления 24 мая 2011 г.
Зарегистрировано в Реестре программ для ЭВМ
15 июля 2011 г.

Руководитель Федеральной службы по интеллектуальной собственности, патентам и товарным знакам

Б.П. Симонов

CST Certificate confirms the registration of the original software for the processing of the remote spectrographic sensing data. Issued by the Russian Government

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PLEASE SEE OUR VIDEO AT

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