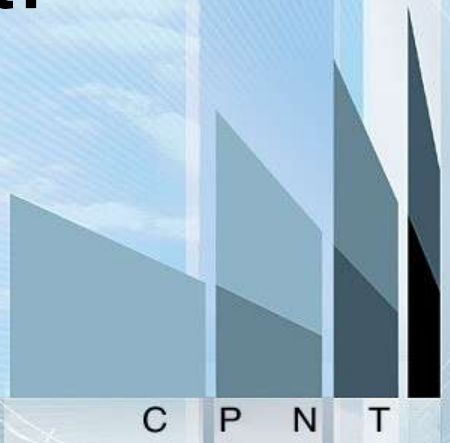
We know…

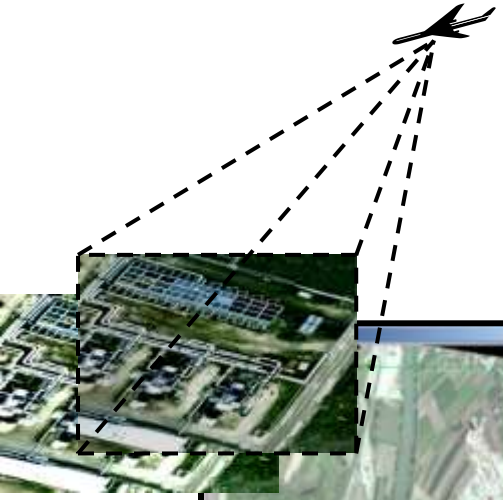
…how to make block selection…

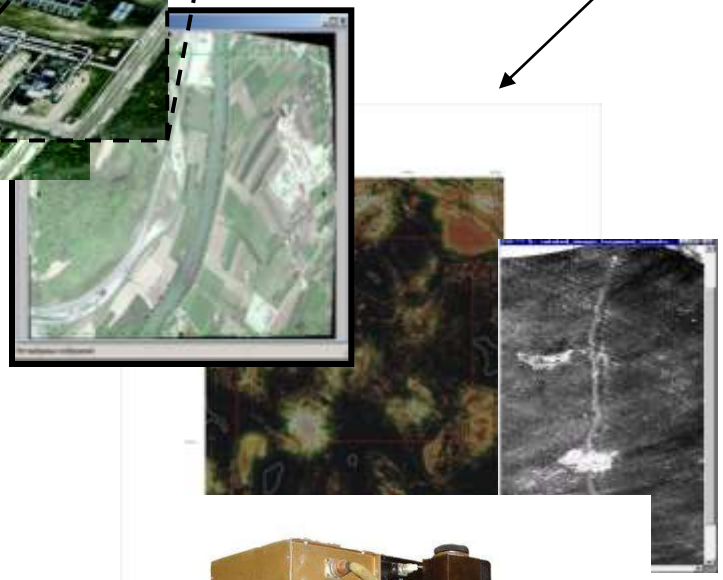
…where deposits occurs…

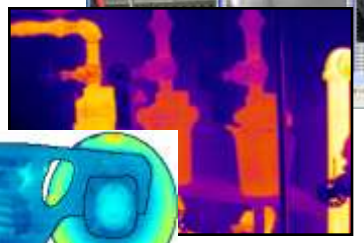
…where to drill wildcat!

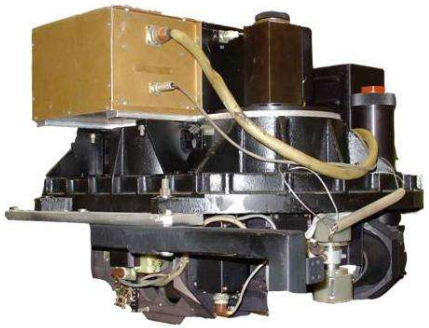


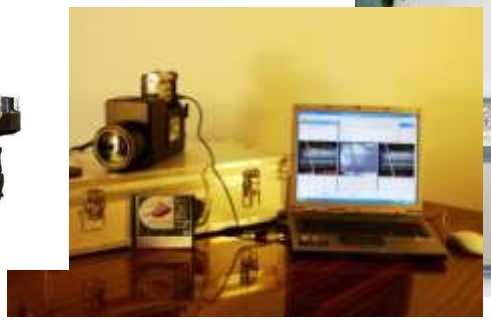
Areas of activity



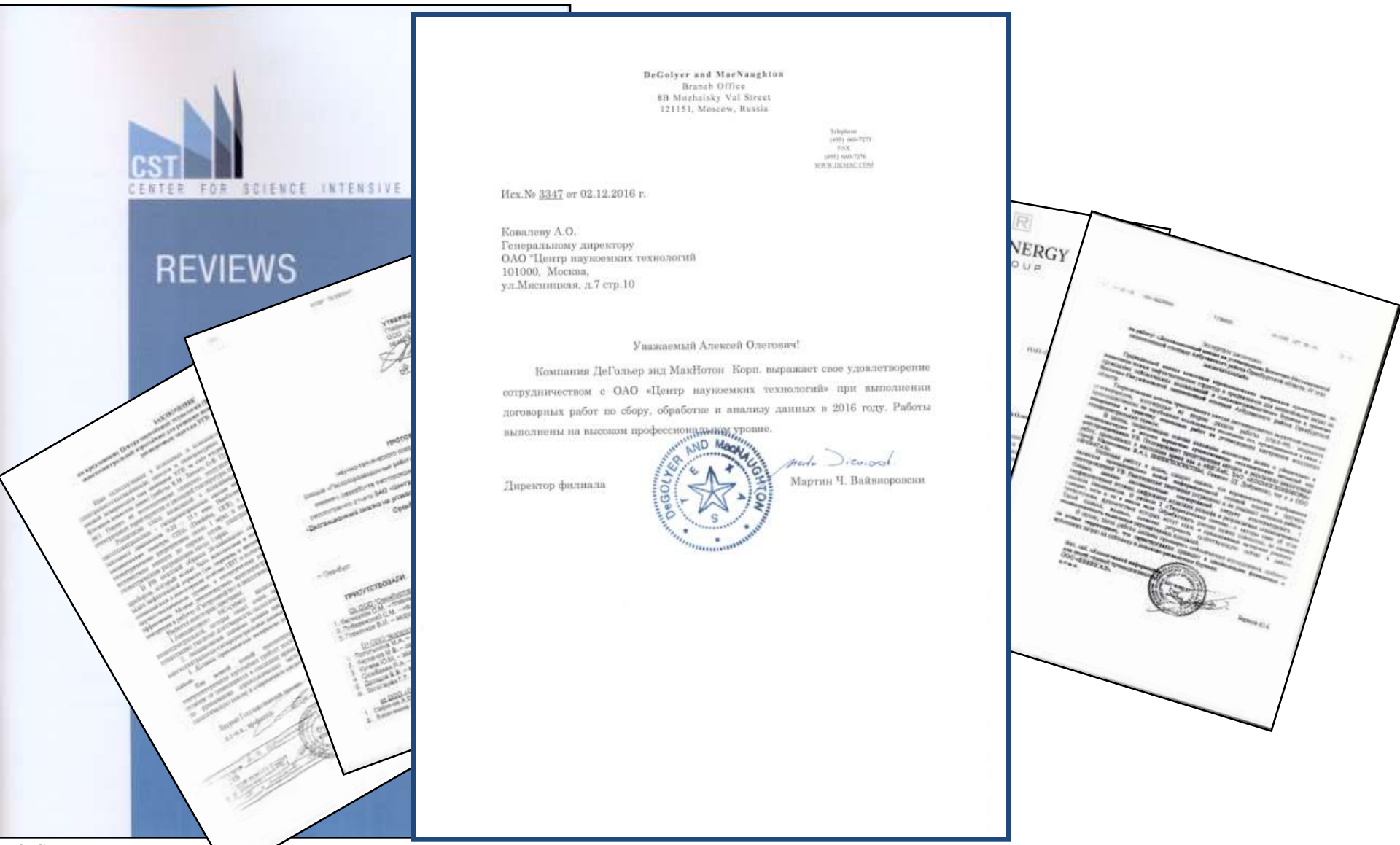








Technology covered by patents pending


CST
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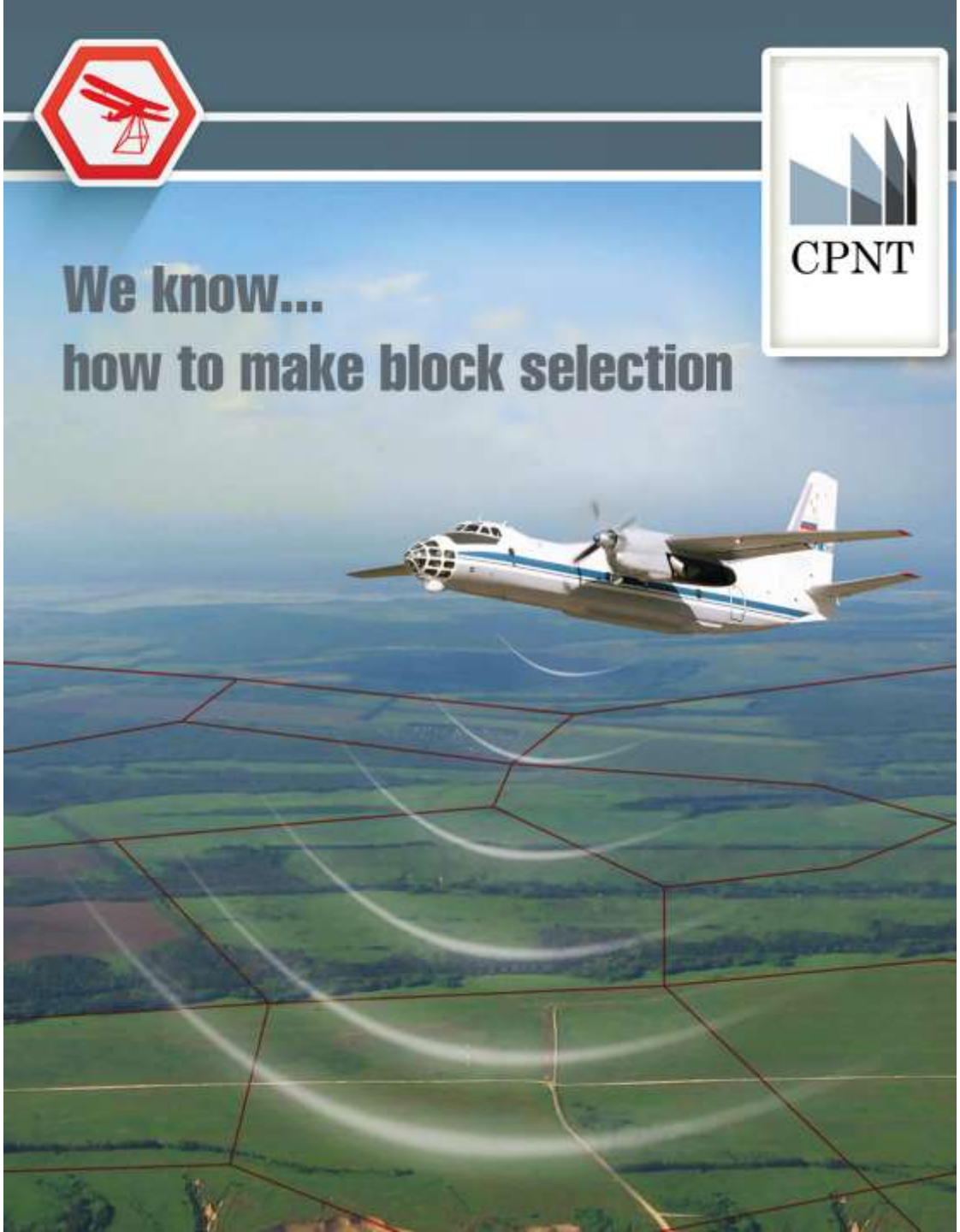
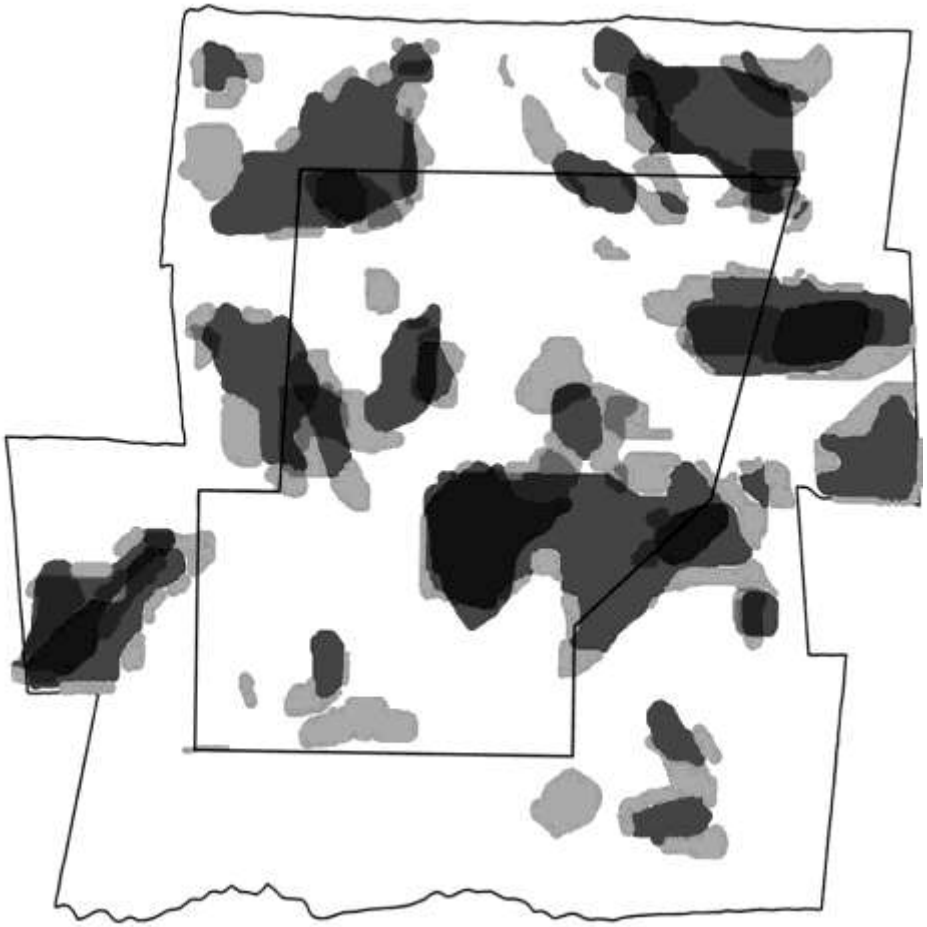
Исх.№ 3347 от 02.12.2016 г.
Ковалеву А.О.
Генеральному директору
ОАО "Центр наукоемких технологий
101000, Москва,
ул.Мясницкая, д.7 стр.10
Уважаемый Алексей Олегович!
Компания ДеГольер энд МакНотон Корп. выражает свое удовлетворение сотрудничеством с ОАО «Центр наукоемких технологий» при выполнении договорных работ по сбору, обработке и анализу данных в 2016 году. Работы выполнены на высоком профессиональном уровне.
Директор филиала
Мартин Ч. Вайвиоровски
DeGOLYER AND MacNAUGHTON
TEXAS

Textbooks of Gubkin Russian State University of oil and gas comprising CPNT exploration technology

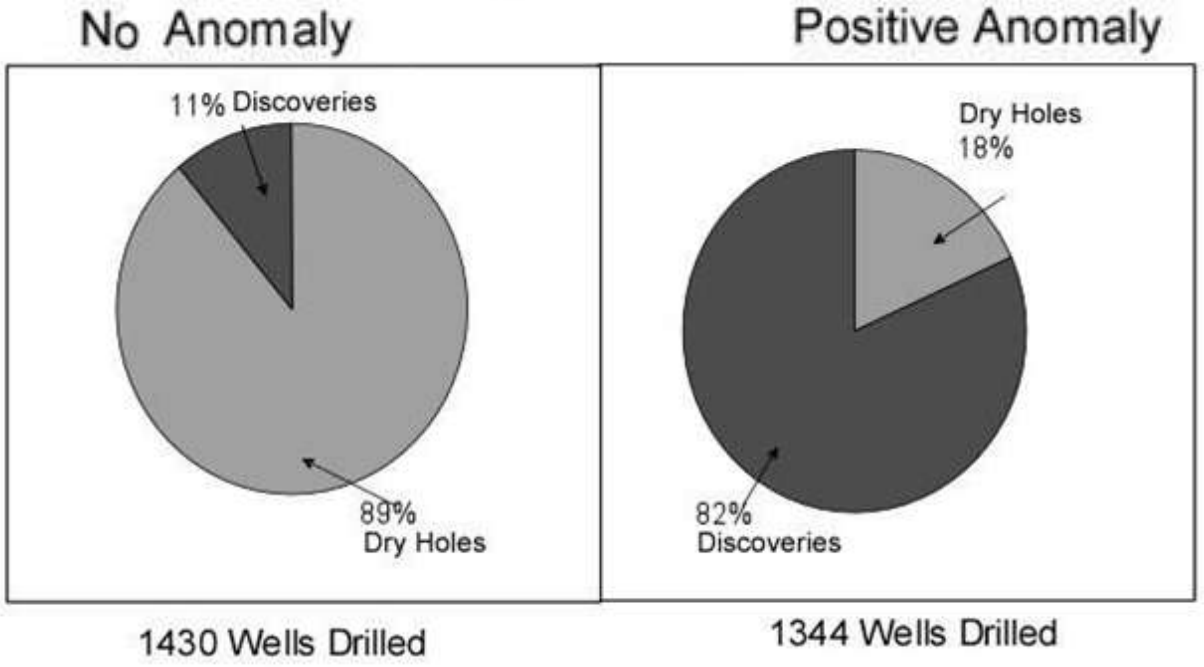


Multy-zone data processing result



Summary

2774 Wells, Various Companies, Various Basins, Various methods

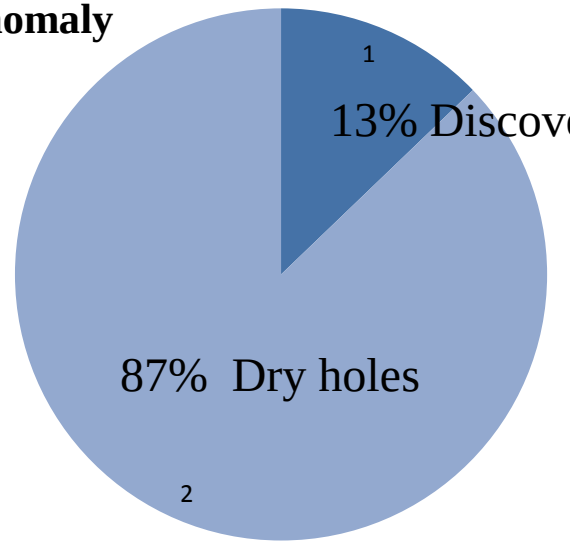


Source:

Schumacher, D., L. Clavareau, and D. C. Hitzman, 2010, Integrating hydrocarbon microseepage data with seismic data doubles exploration success, in Proceedings Indonesian Petroleum Association, Jakarta, IPA10-G-104, 11 pp.

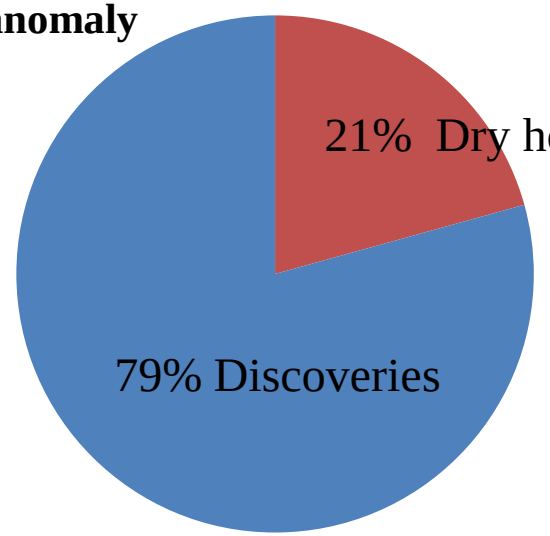
JSC CST remote sensing data and drilling results matching

No anomaly



39 wells drilled

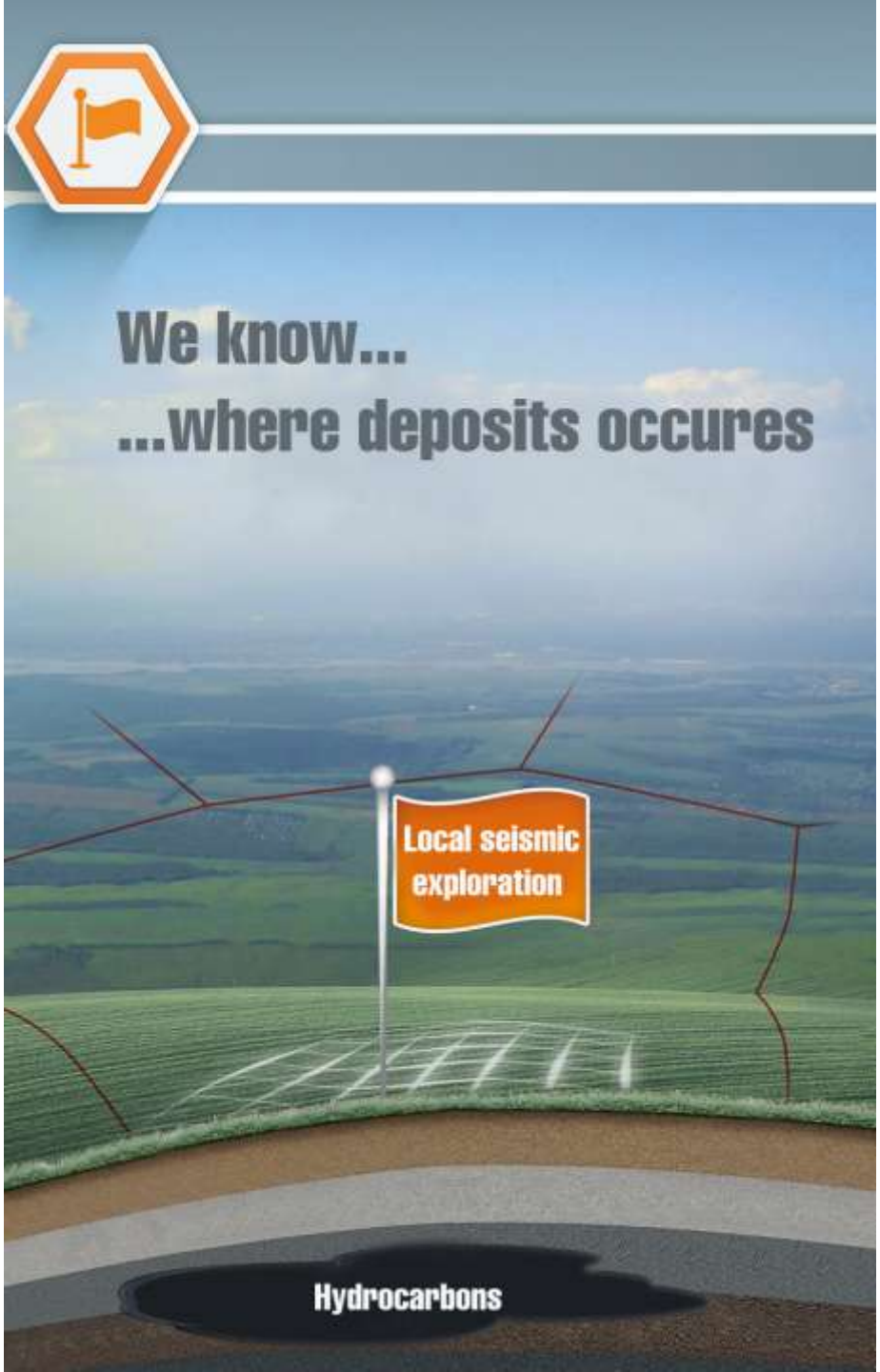
Positive anomaly



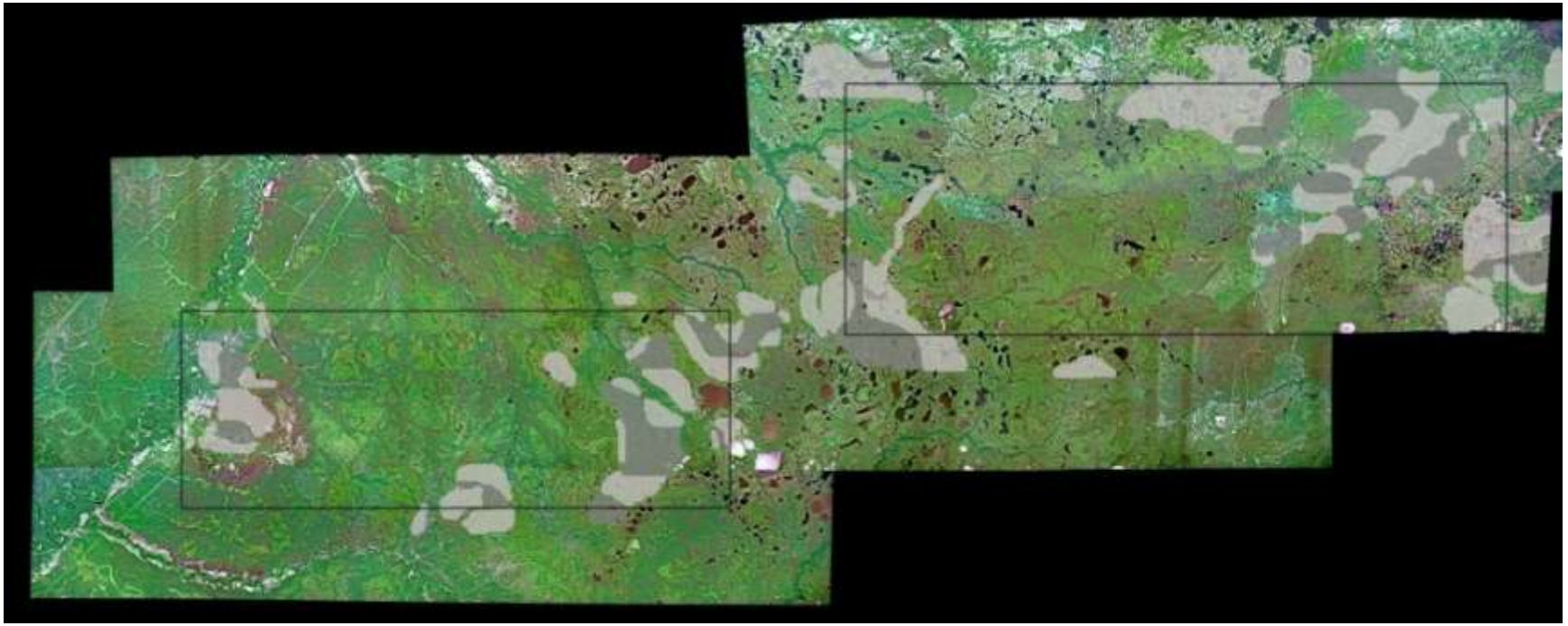
29 wells drilled

Negative anomaly (no anomaly). Discoveries.	Negative anomaly (no anomaly). Dry holes.	Positive anomaly. Discoveries.	Positive anomaly. Dry holes.
5	34	23	6
39		29	
68			

Source: JSC CST internal data 2003-2011


We know...
...where deposits occures
Local seismic exploration
Hydrocarbons

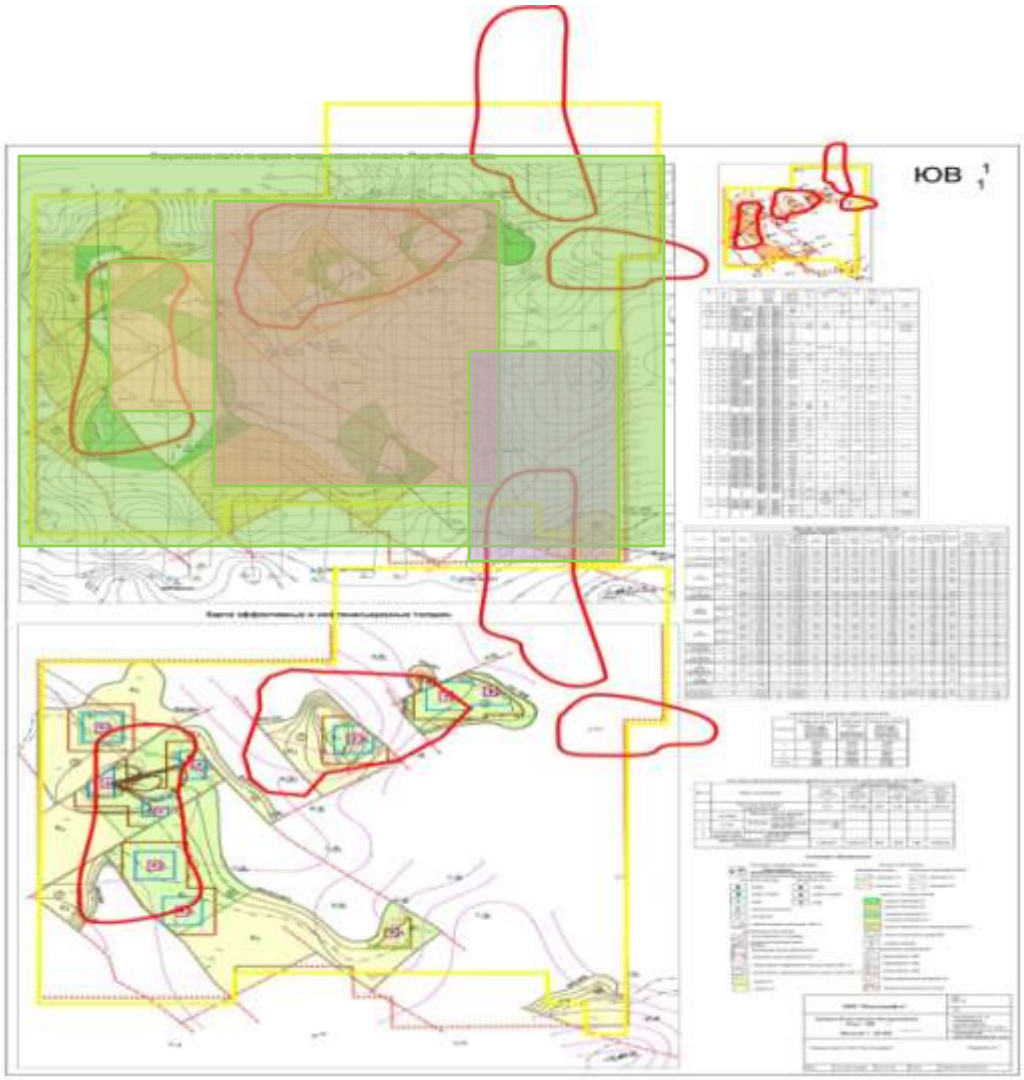
Remote sensing detected hydrocarbon anomalies and scanned stitched digital pseudo-color image overlay example

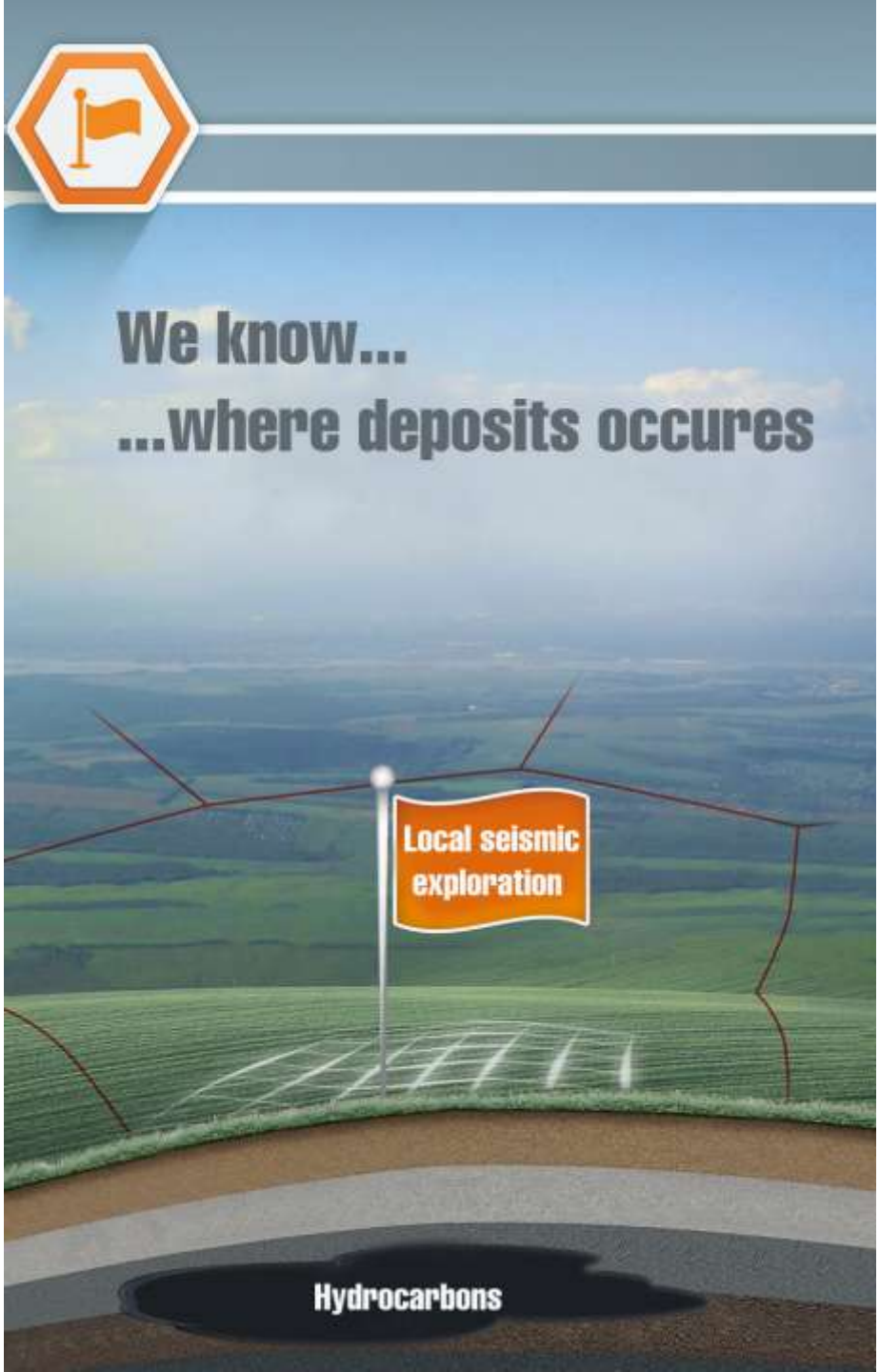


Confirmability and Efficiency

Exploration seismics planning

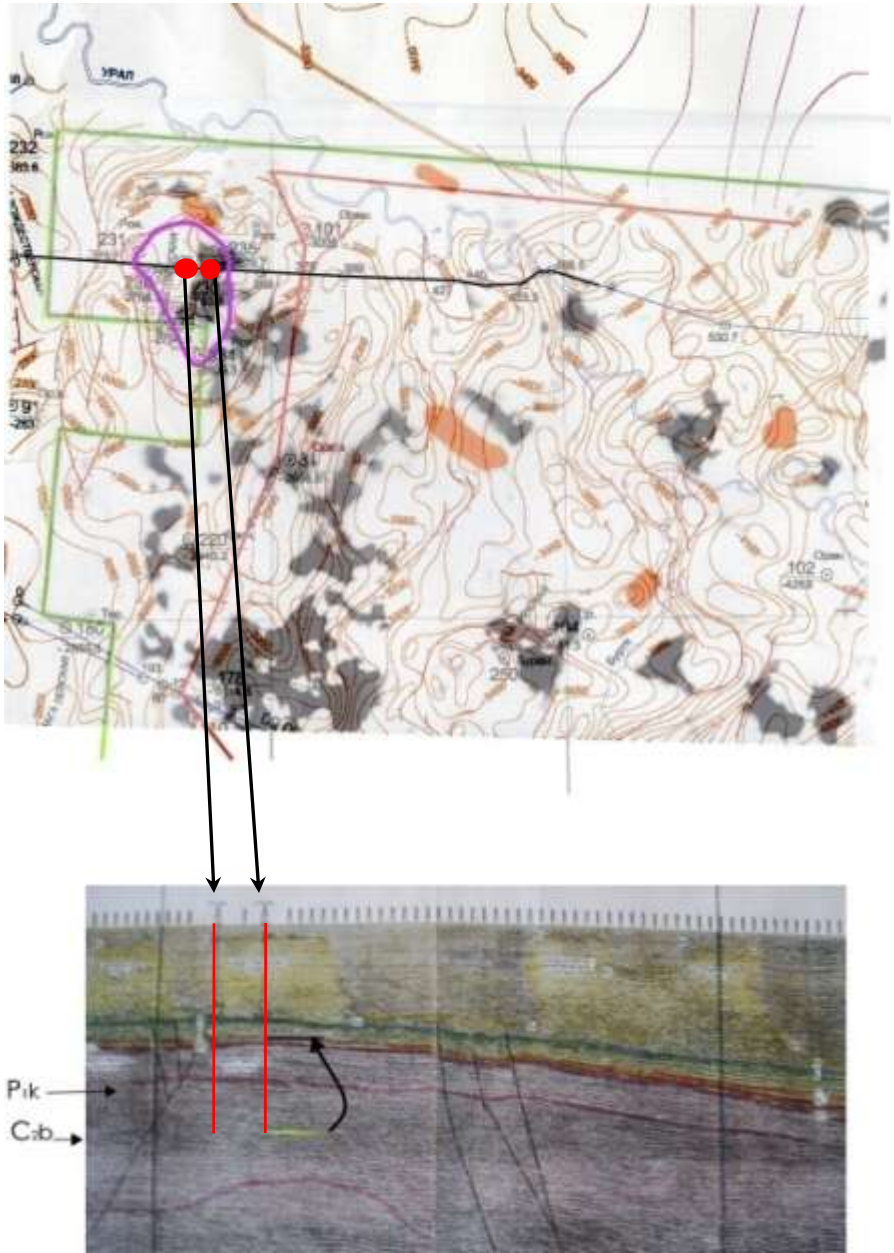
Seismic exploration and remote sensing data overlay example




We know...
...where deposits occures
Local seismic exploration
Hydrocarbons

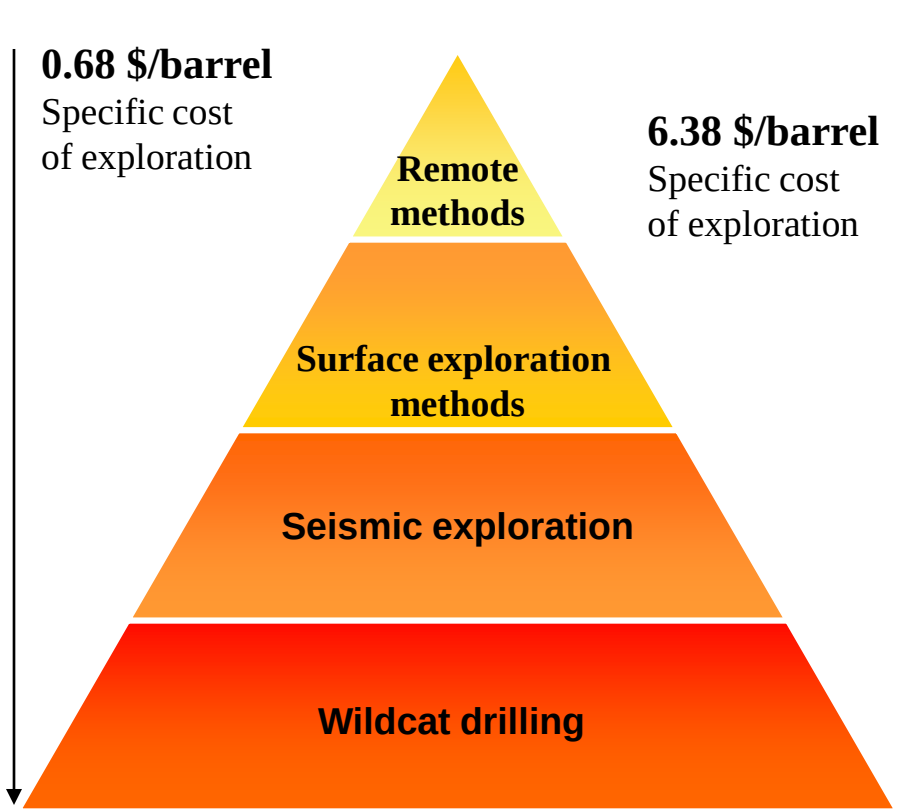
Seismic exploration and remote sensing data overlay example

Wildcat location placement

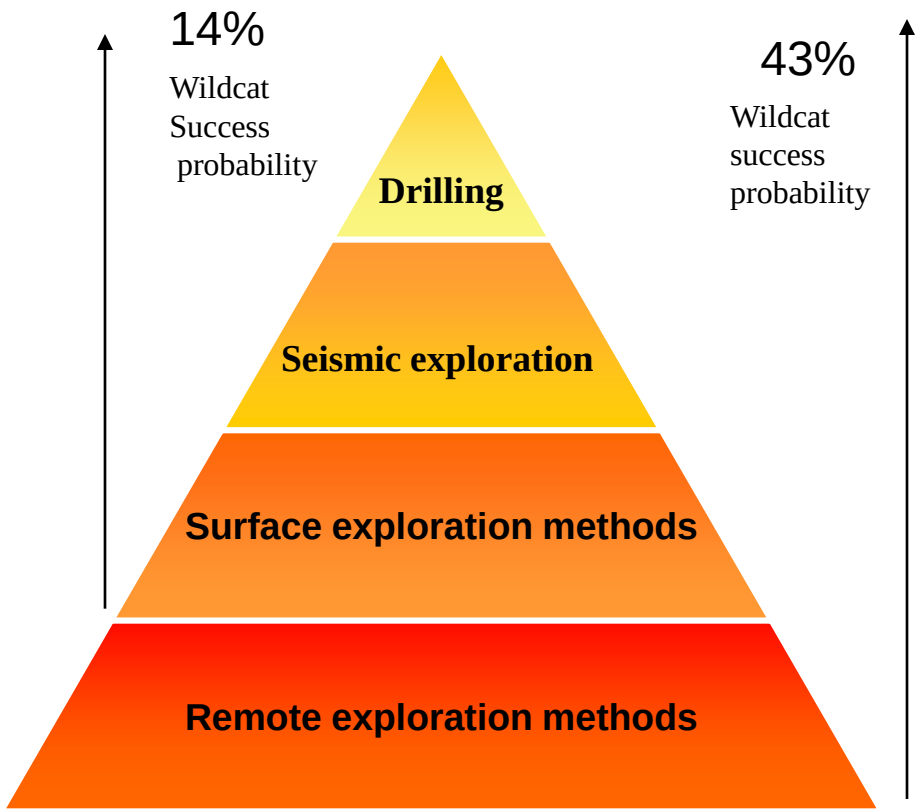


Deposit depth 2830 m

ECONOMY PROSPECTS



Exploration cost



Exploration area

LICENSED BLOCKS

HYDROCARBONS PROSPECTS EVALUATION

WITH USE OF EARTH REMOTE SENSING METHODS

OF POLYZONAL DATA COMPLEX PROCESSING

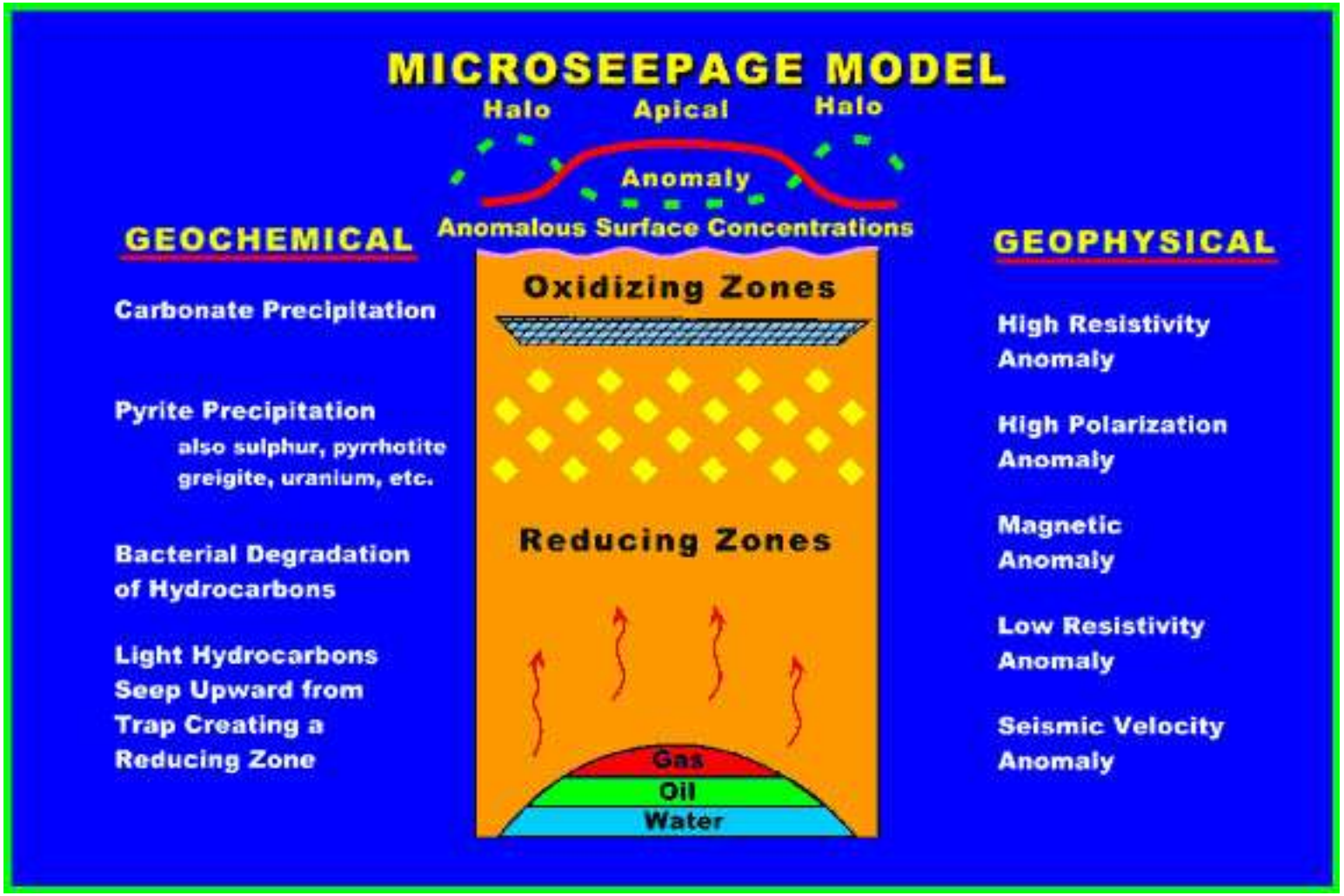
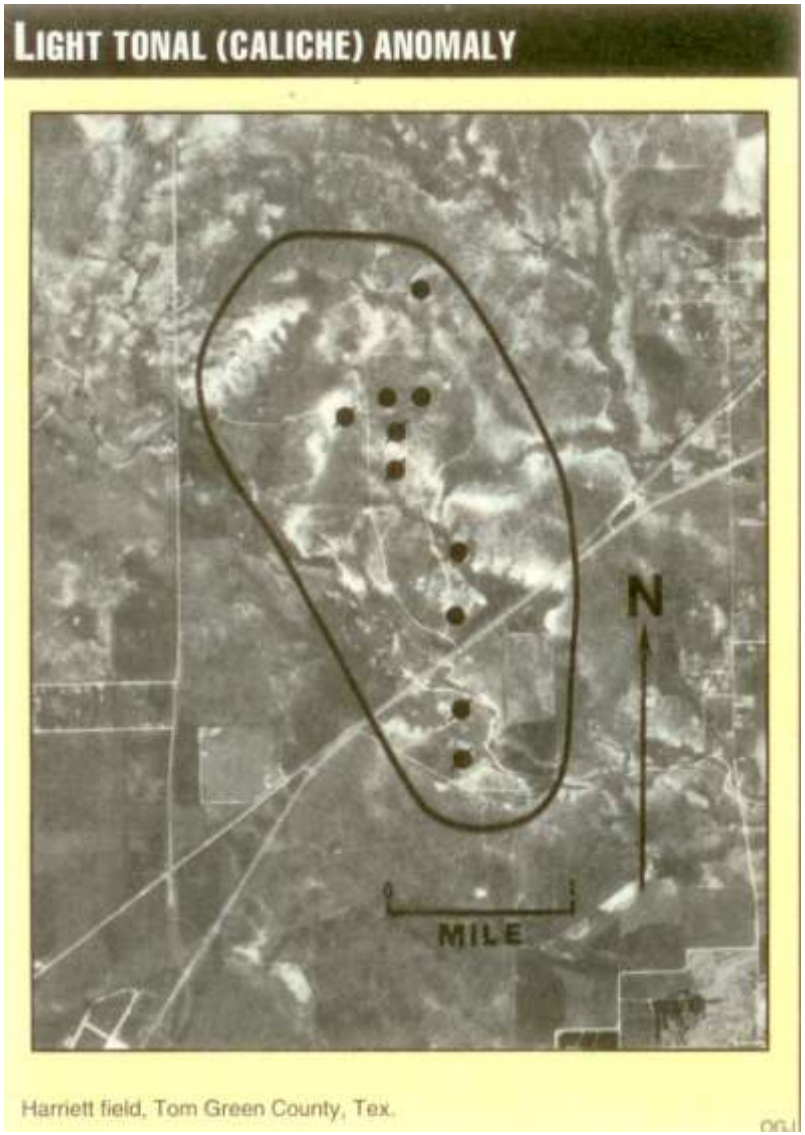


Image source: Schumacher, D., 1996, Hydrocarbon-induced alteration of soils and sediments, *in* D. Schumacher and M. A. Abrams, eds., Hydrocarbon migration and its nearsurface expression: AAPG Memoir 66, p. 71–89, p.83.



CO_2 alteration anomalies example

HC biochemical degradation over petroleum=>
CO_2 formation=>carbonate cements=>
carbonate mineralization of surface=>
excessive caliche in soil =>
tonal/color anomalies=>
can be identified by aerial imagery

Image source: OGJ 1994
Vol.92, No.46, p.97

H_2S alteration anomalies example

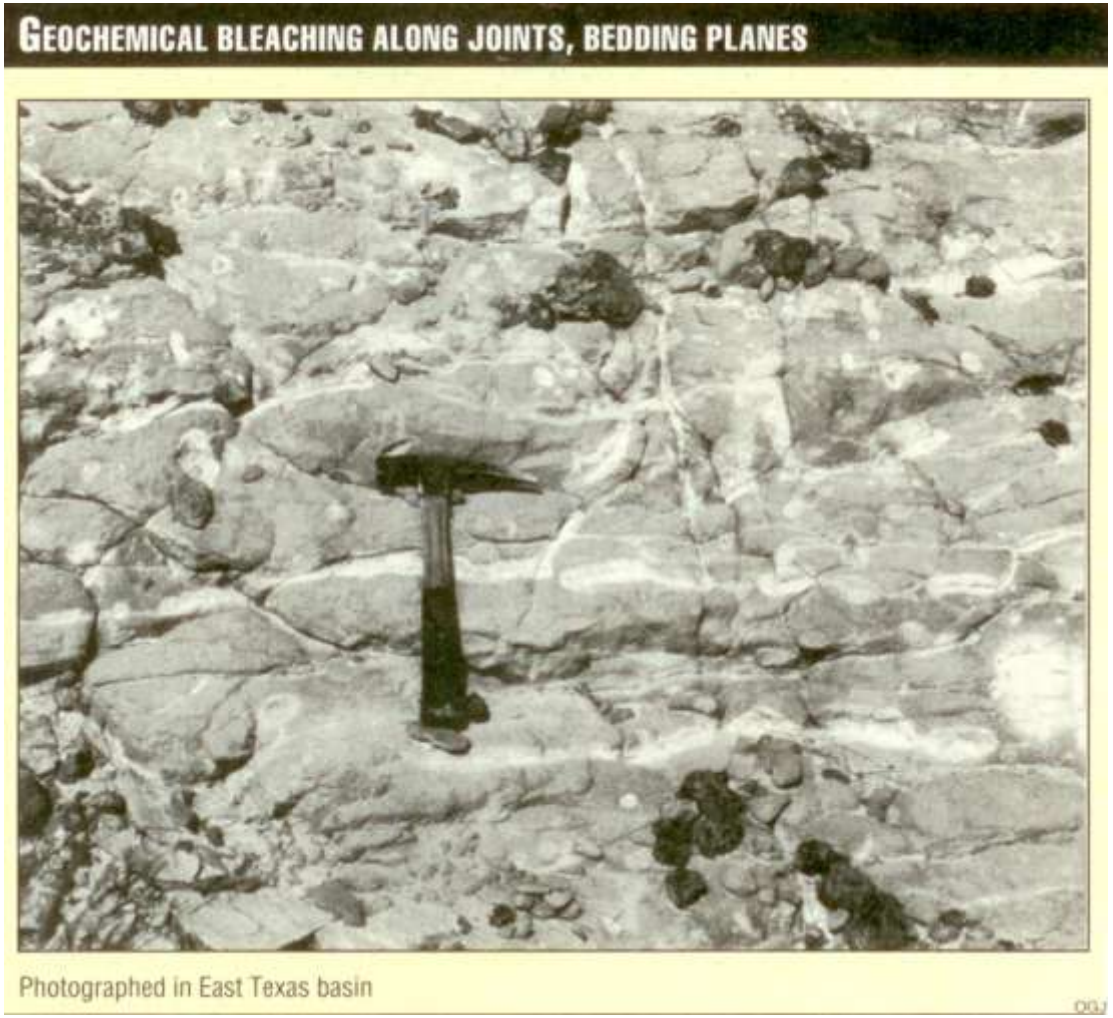
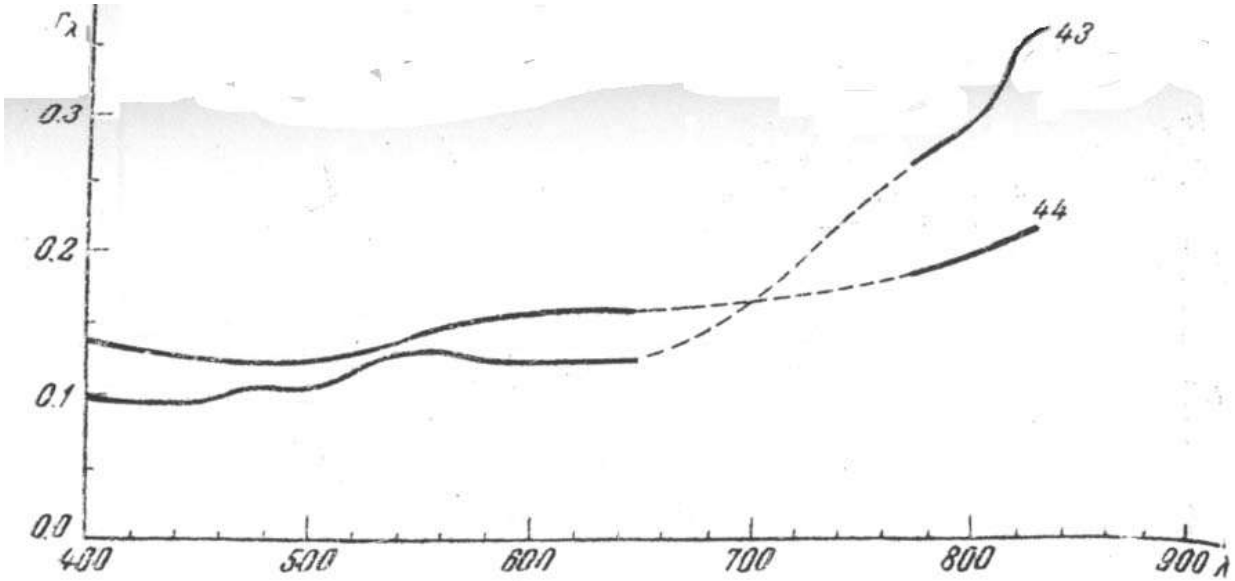


Image source: OGJ 1994 Vol.92, No.46, p.95

Chemical reduction over HC => removal of hematite => bleaching of red color => can be identified by aerial imagery

Spectral reflection coefficient for saxaul (haloxylon)



XIX. Саксаул, спелый древостой

43 — поздняя зелень; 44 — засохший.

Mature saxaul

43-mature leafs; 44-dryed

Image source:
Krinov E.L. Spectral reflectance of natural formations, Academy of Scienses of USSR, Moscow, 1947

Spectral reflection coefficient for mature aspen wood

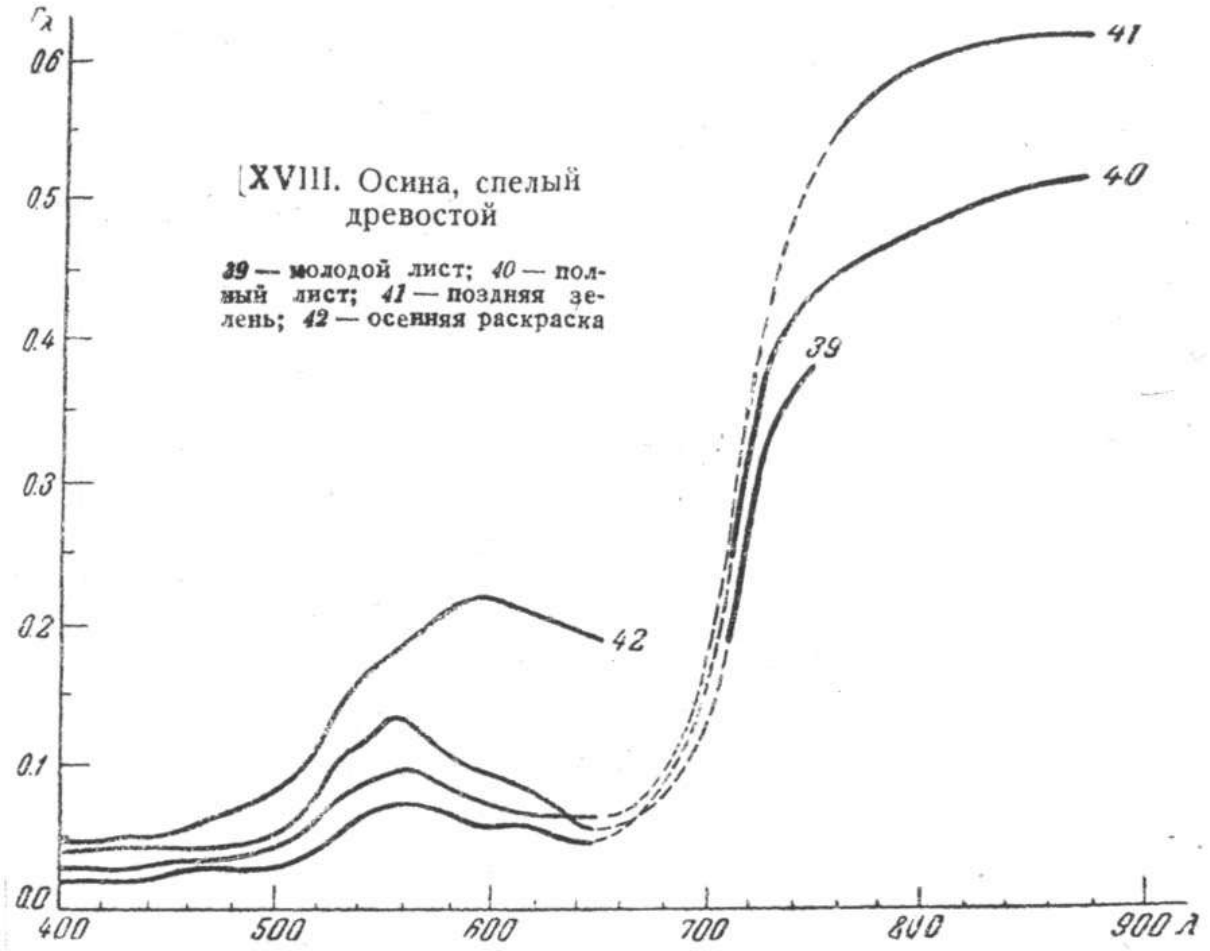
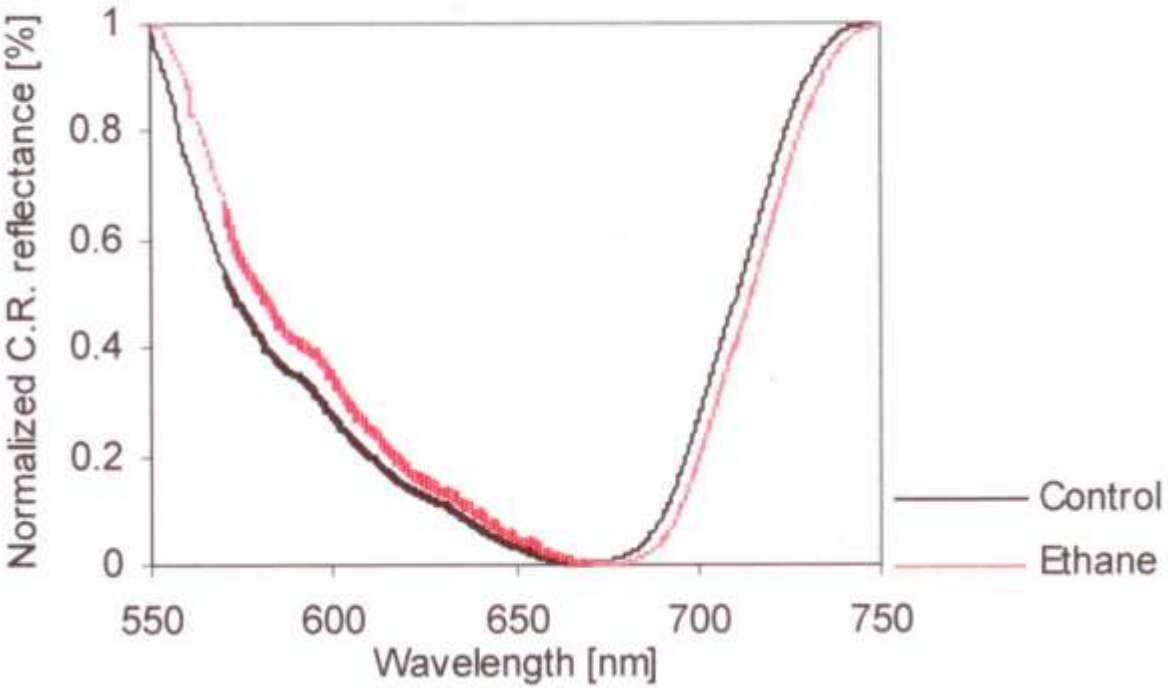


Image source:
Krinov E.L. Spectral reflectance of natural formations, Academy of Scienses of USSR, Moscow, 1947

Mature aspen wood

39-young leafs; 40-full leafs; 41-mature leafs; 42-autemn coloration

Ethane influence on vegetation reflectance (example – maize)

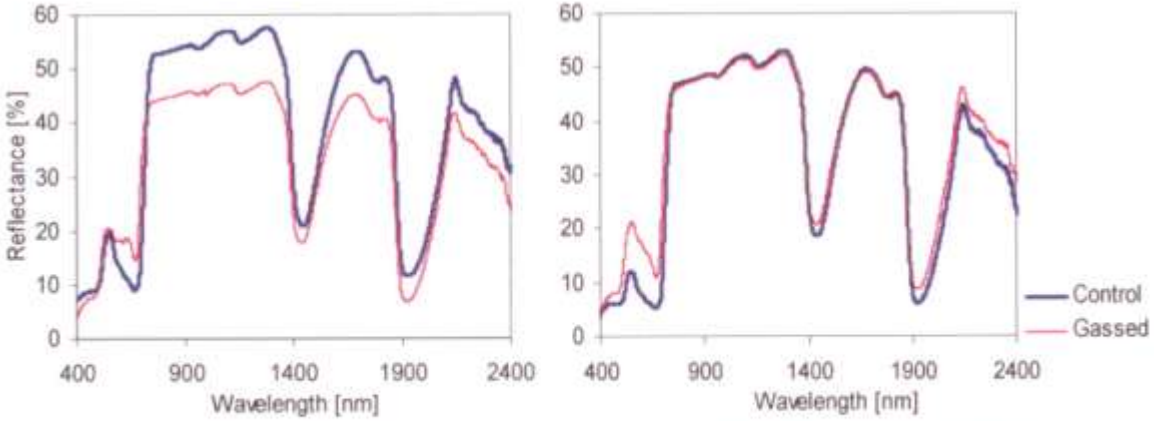


Source:
Nooman M.F. Hyperspectral reflectance of vegetation affected by underground hydrocarbon gas seepage, ISBN: 978-90-8504-671-4, International Institute for Geo-information Science and Earth Observation, Enschede, the Netherlands,2007, p35
ITC Dissertation number :145

Reflectance shift towards red over spectrum => can be identified by aerial imagery

HC influence
on vegetation reflectance

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

Source:
Nooman M.F. Hyperspectral reflectance of vegetation affected by underground hydrocarbon gas seepage, ISBN: 978-90-8504-671-4, International Institute for Geo-information Science and Earth Observation, Enschede, the Netherlands,2007, p.86.
ITC Dissertation number :145

Different parts of spectrum – different influence => way for complex data interpretation

Scanner survey and plane imaging

Received data processing assessment

«Eagle» multyspectral airborne scanner

System destination is scanning of earth from aircraft and obtaining of images in several selectable spectral bands.

Technical parameters of «Eagle» scanner:

- **Information channels 26;**
- **Instant viewing angle 5';**
- **Scanning angle 70^0;**
- **Scanning frequencies 18, 36, 72 lines/sec;**
- **Spectral range 0.43-12.5 μm;**
- **Operation mode interactive;**
- **Operation temperature range -10^0C, $+40^0$C;**
- **Power supply 27V, 120 W;**
- **Cooling agent liquid nitrogen.**

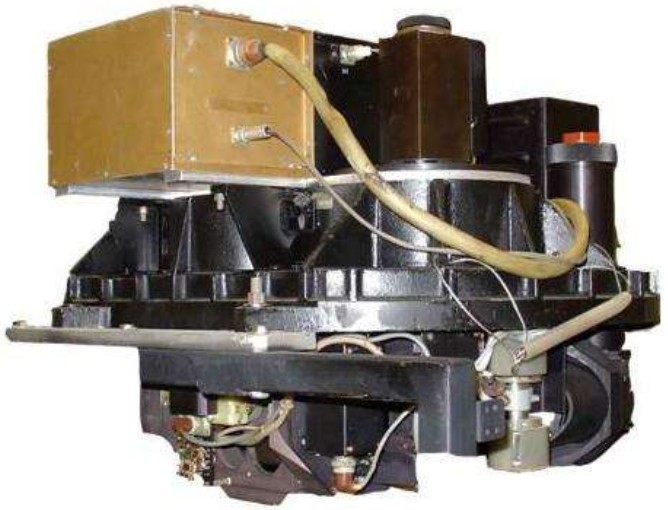
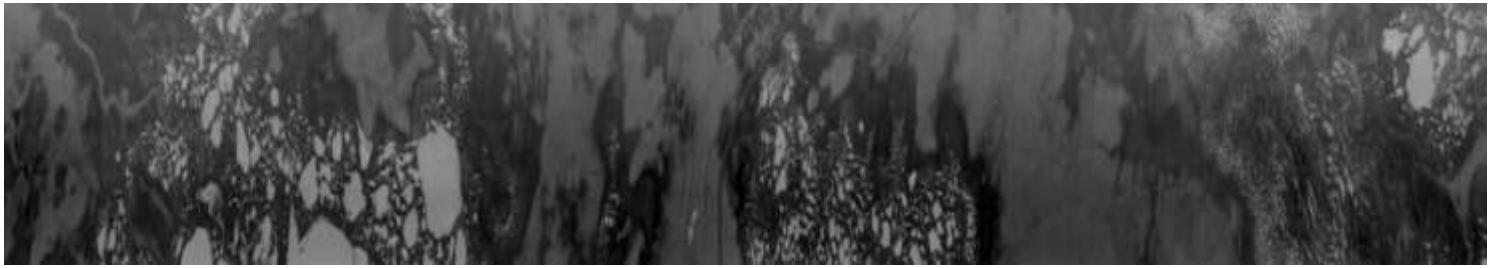
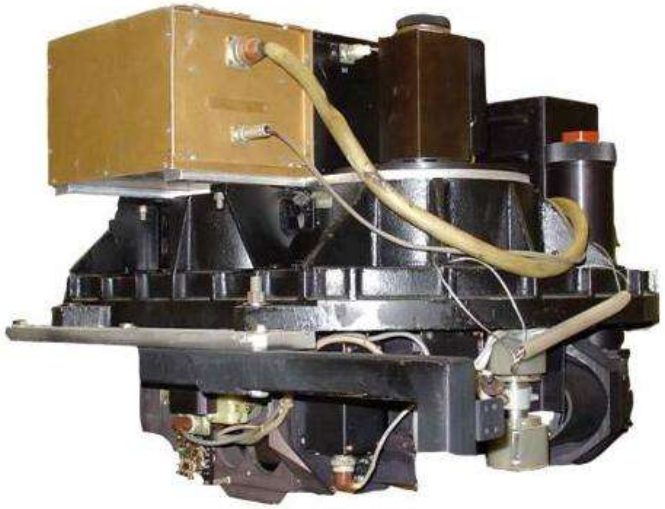
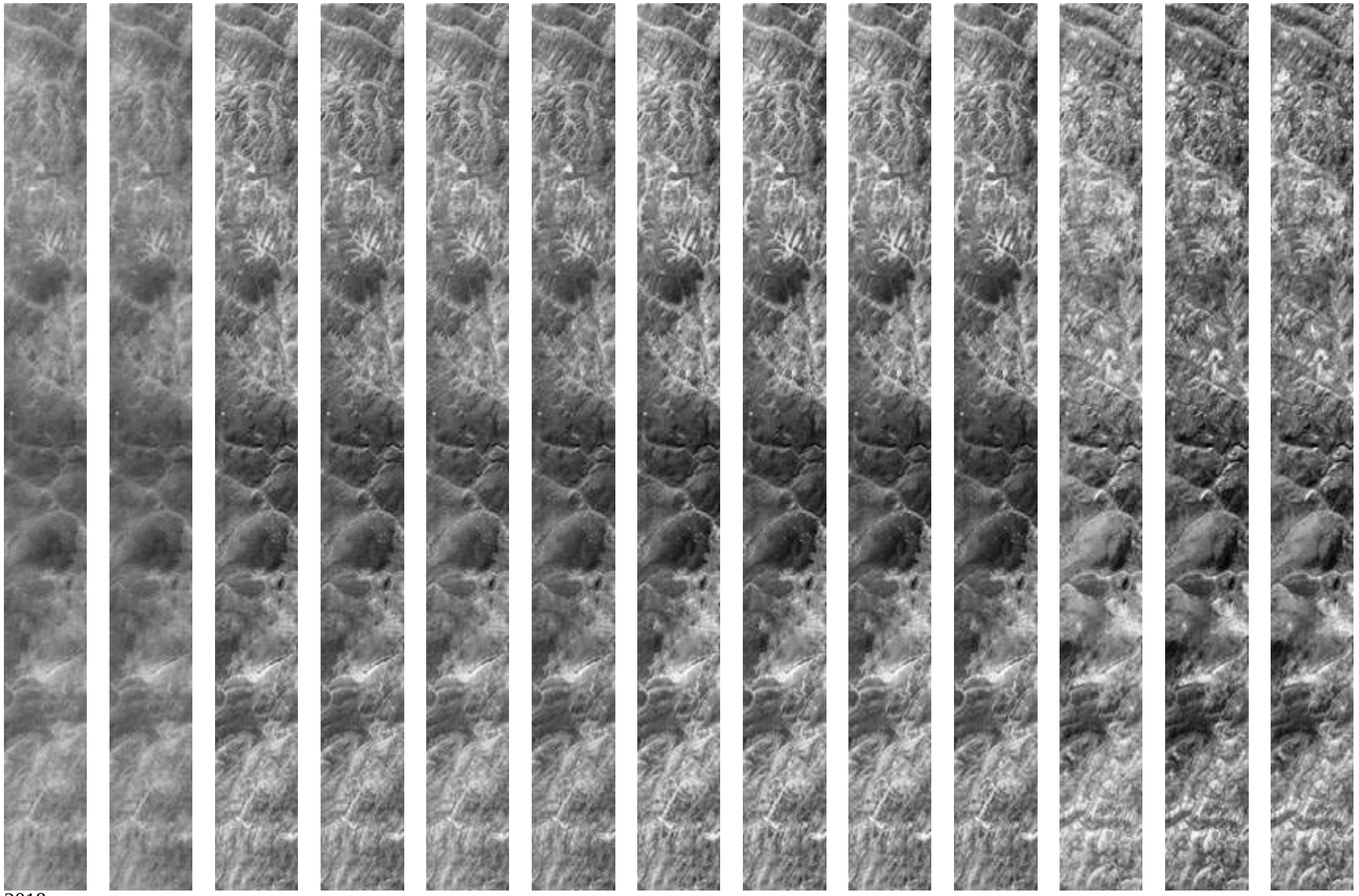


Image example (rotated 90^0)

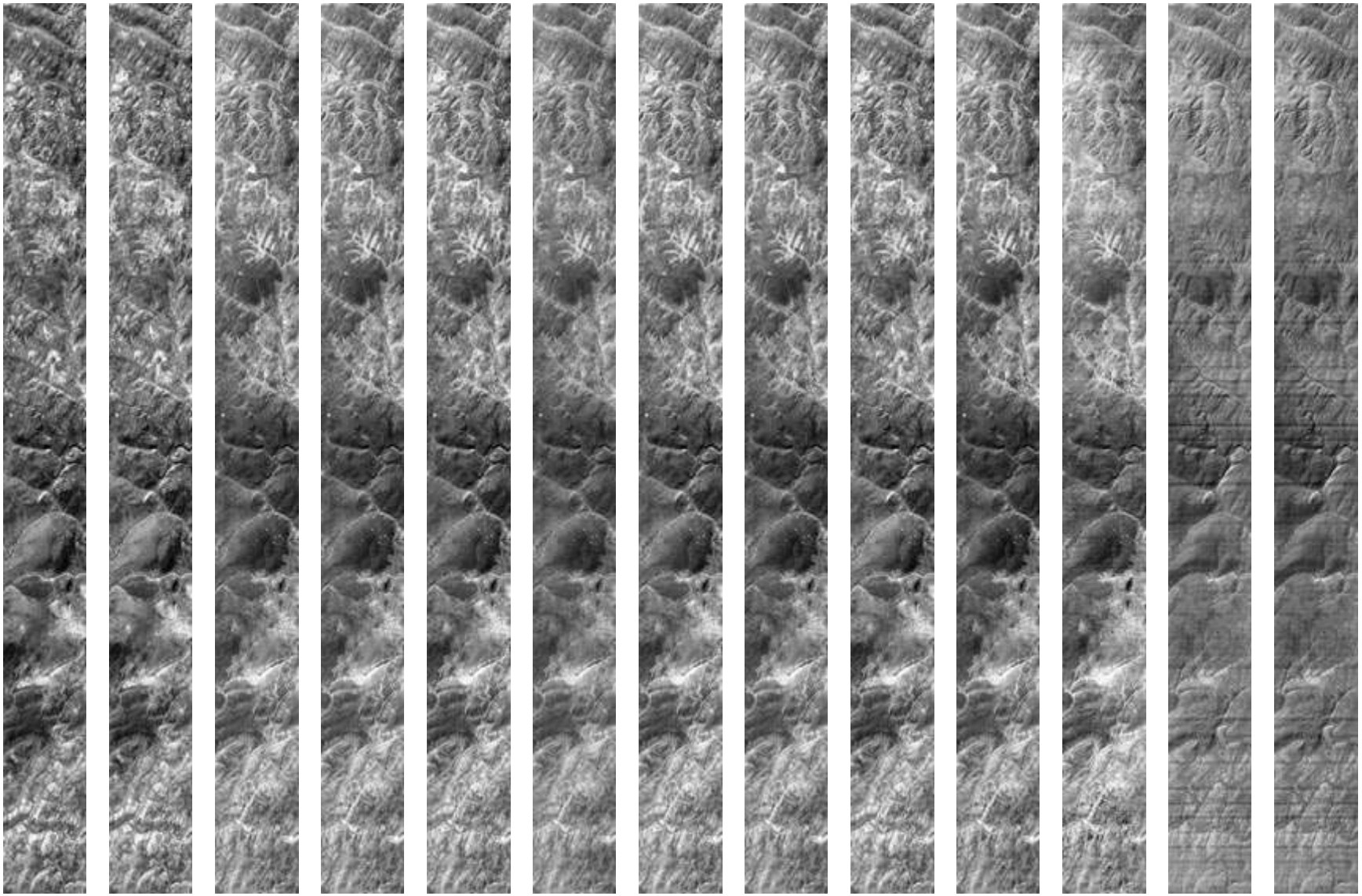




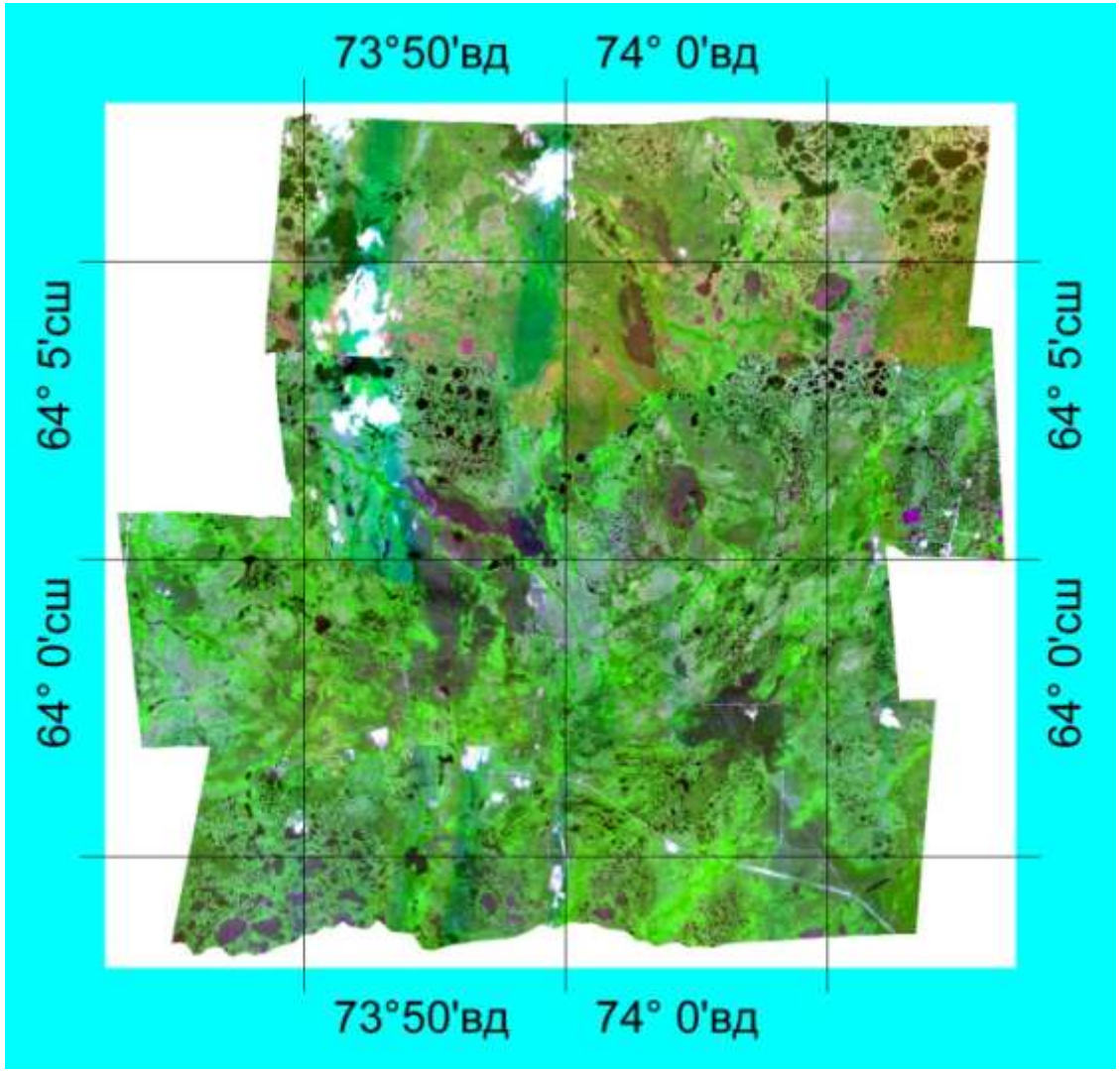
Spectral channels 1-13, route 1



Spectral channels 14-26, route 1

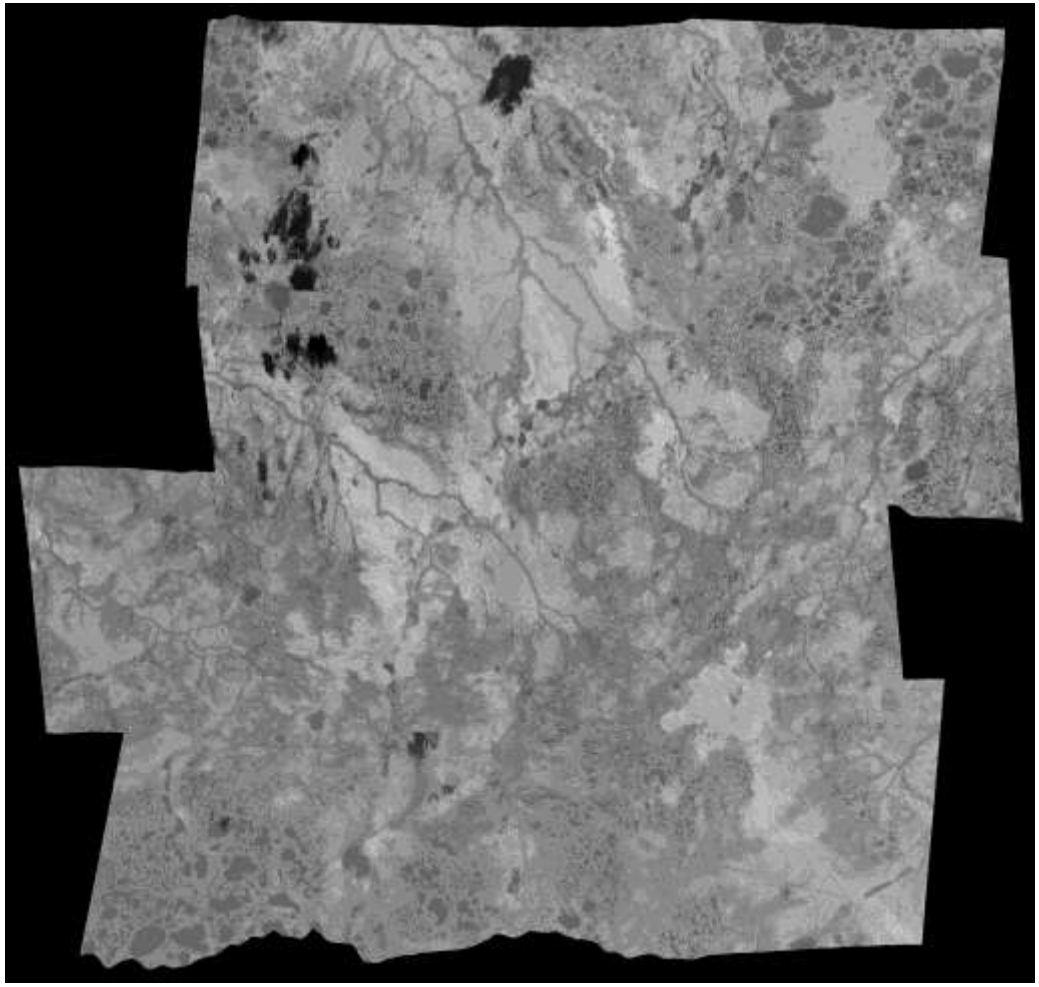


Digital pseudo-color image linked to geographical coordinates

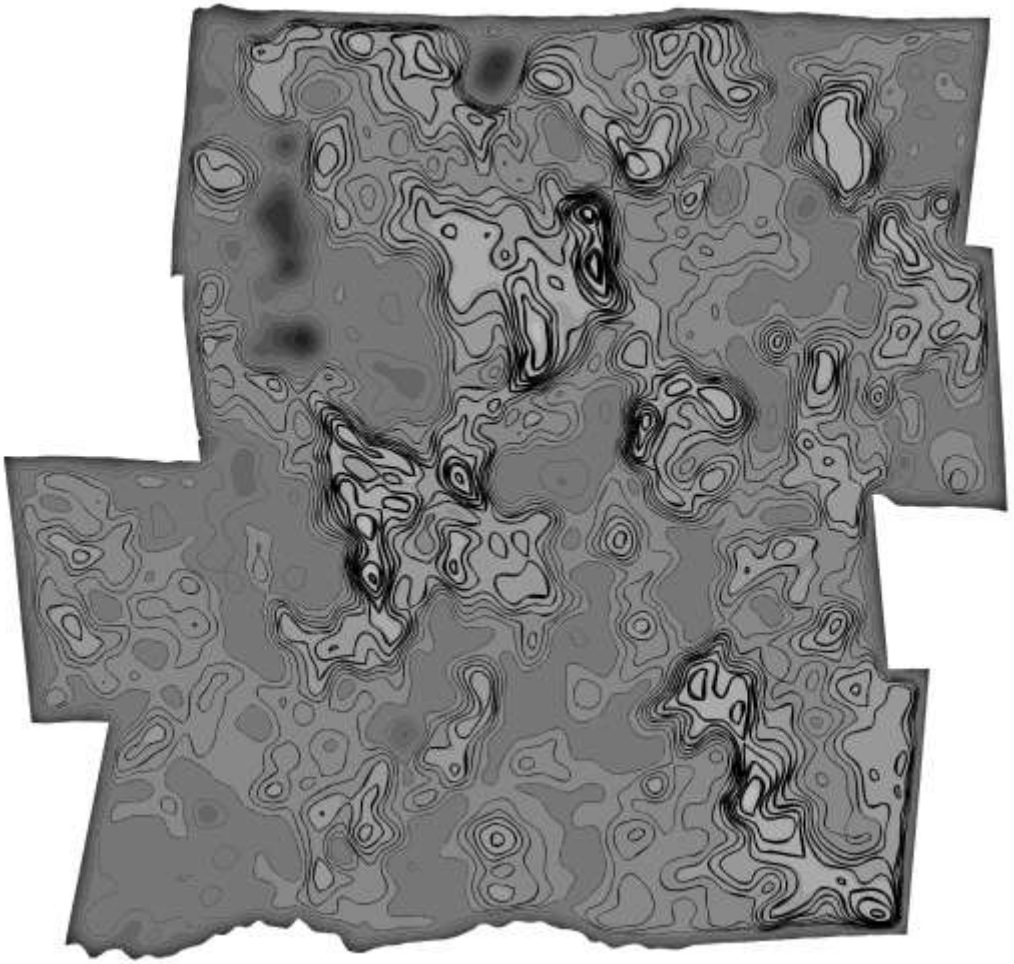


Scanner survey and plane imaging

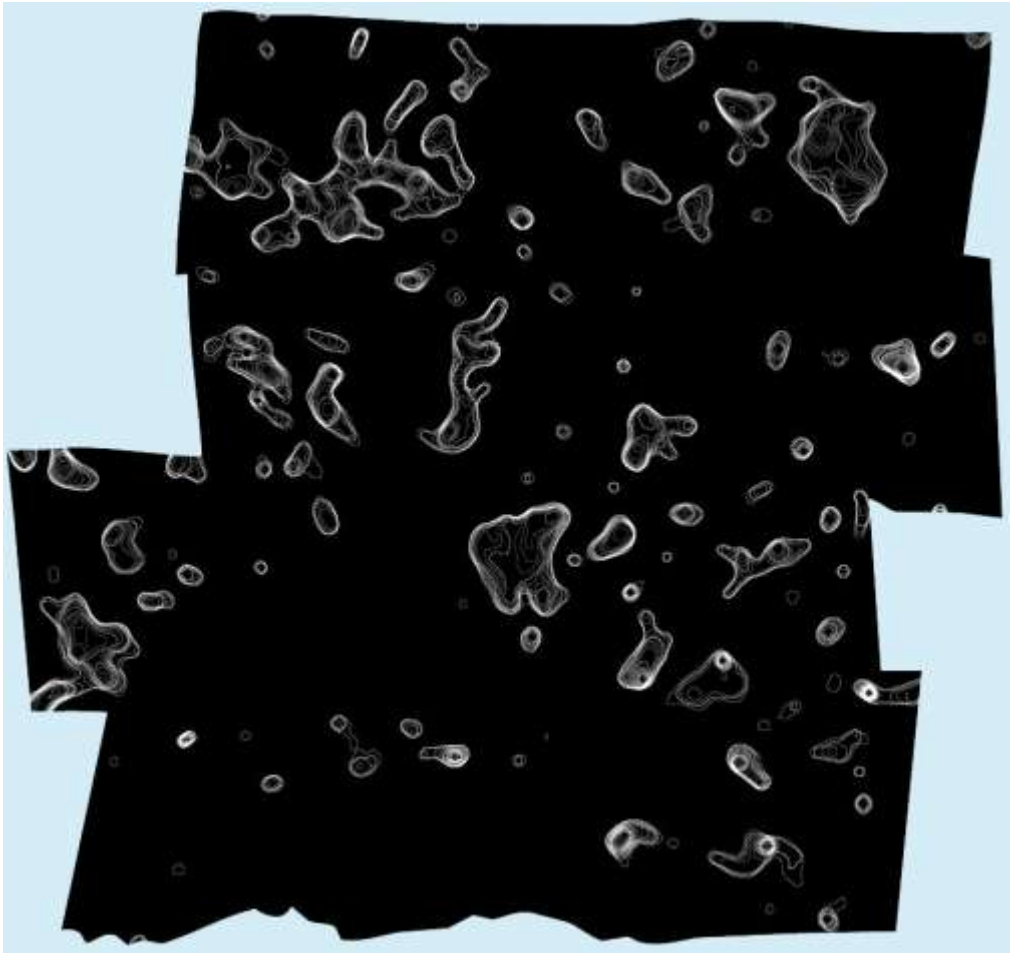
Received data processing assessment



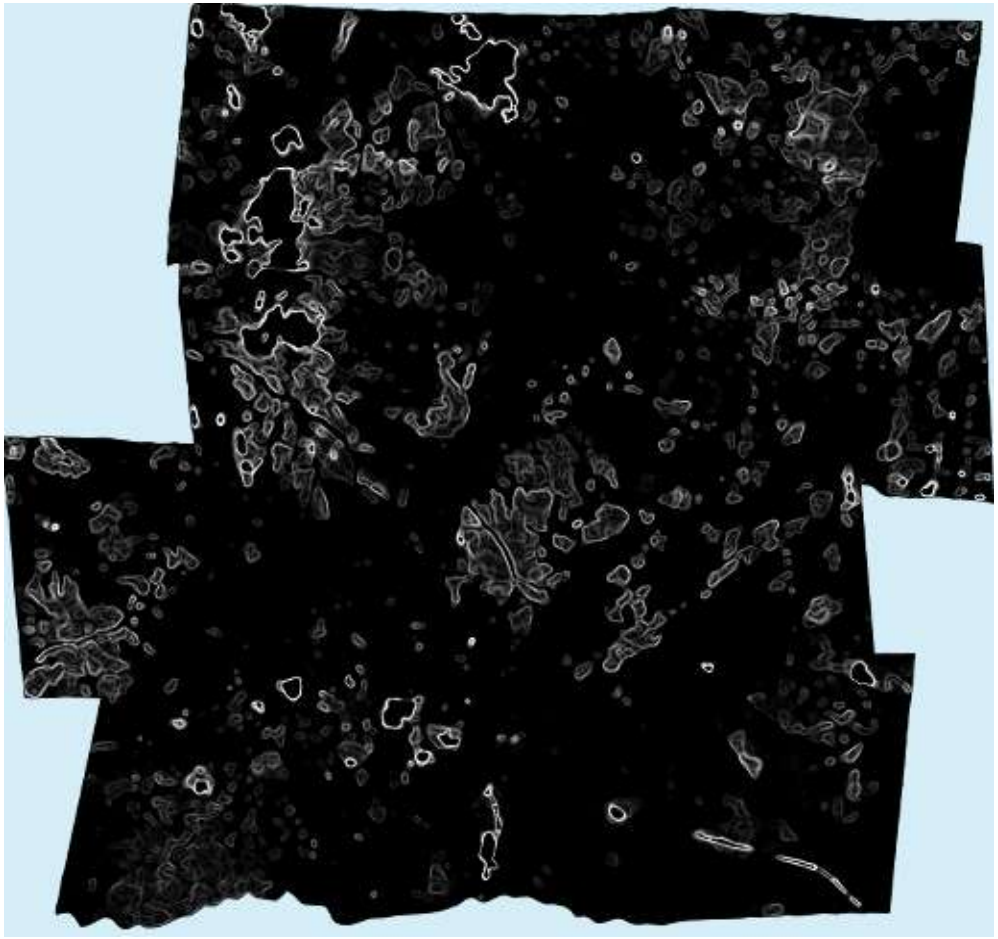
DISTRIBUTION OF THERMAL FIELDS



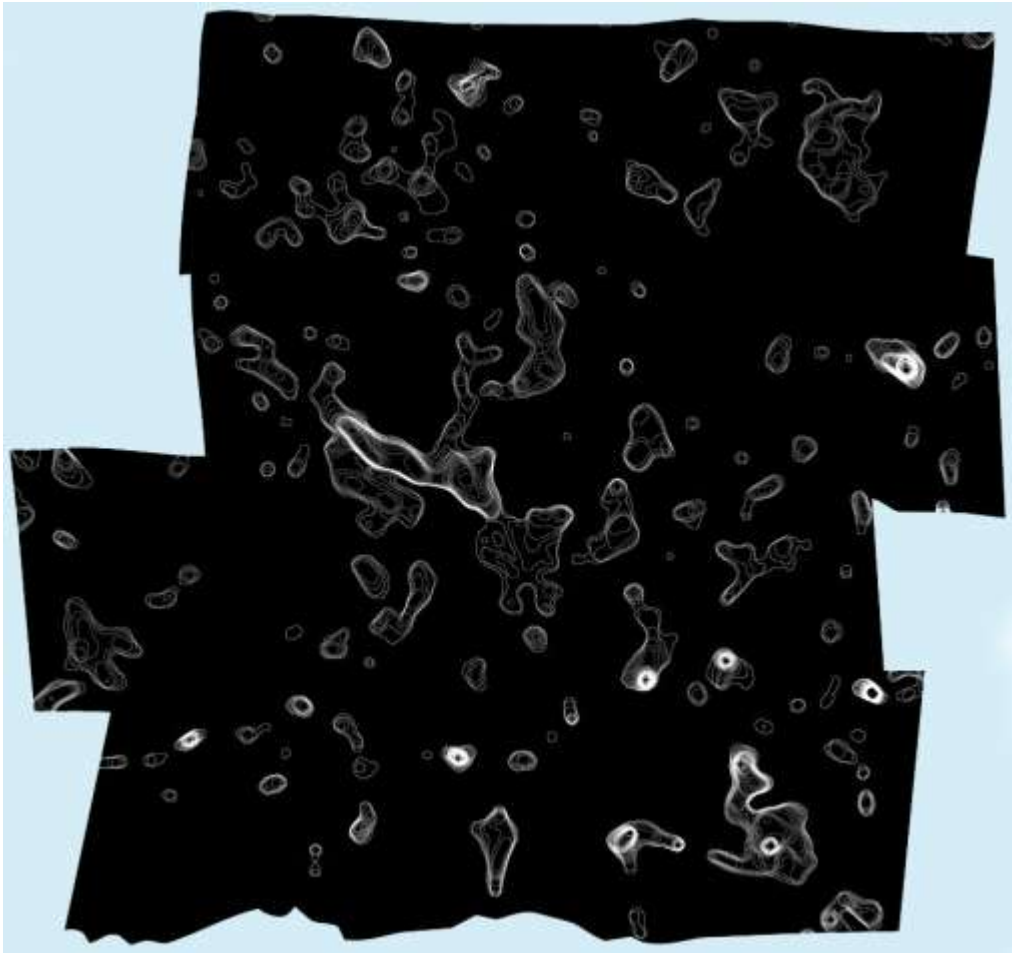
SOIL ANOMALIES



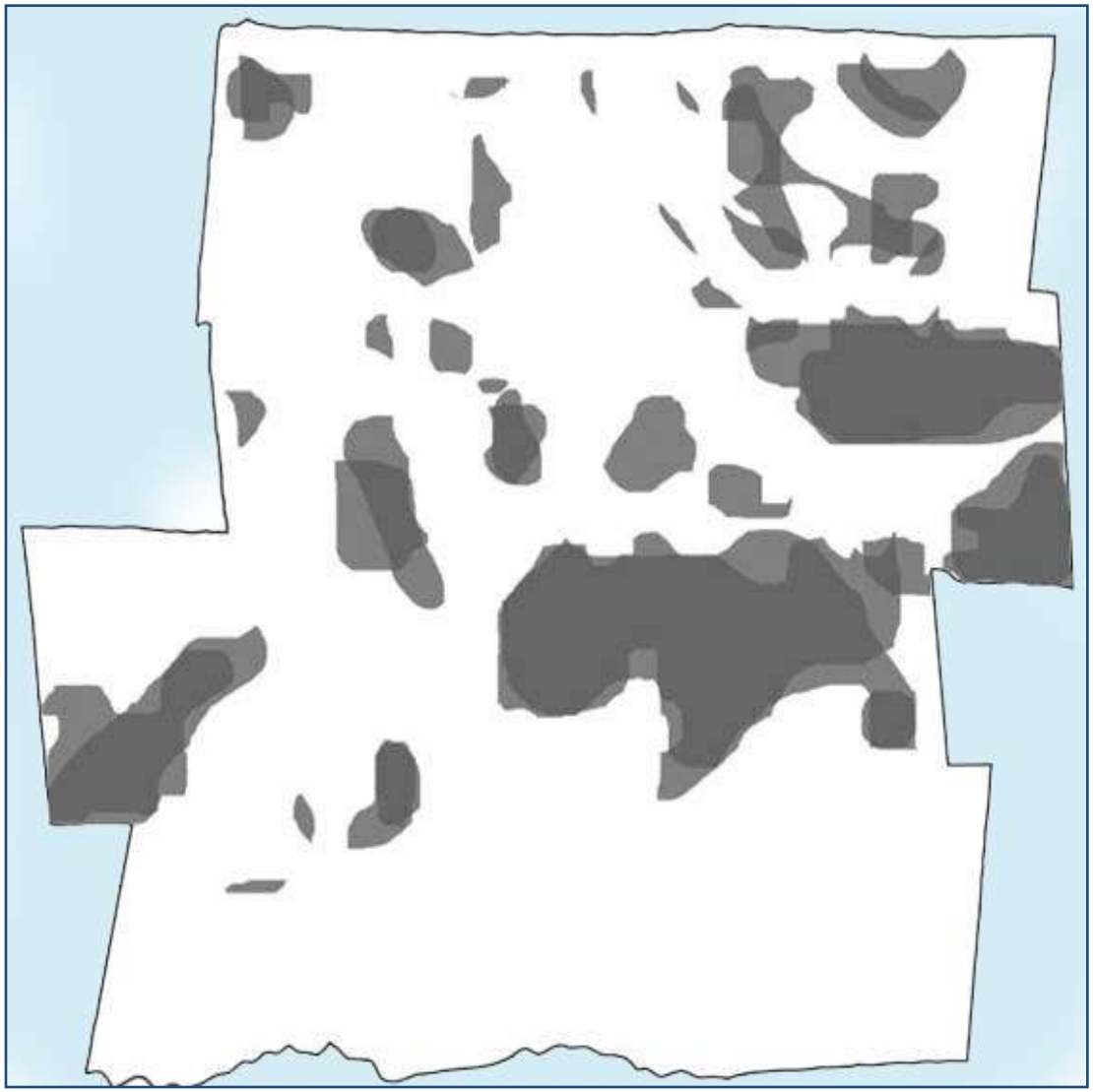
VEGETATION ANOMALIES



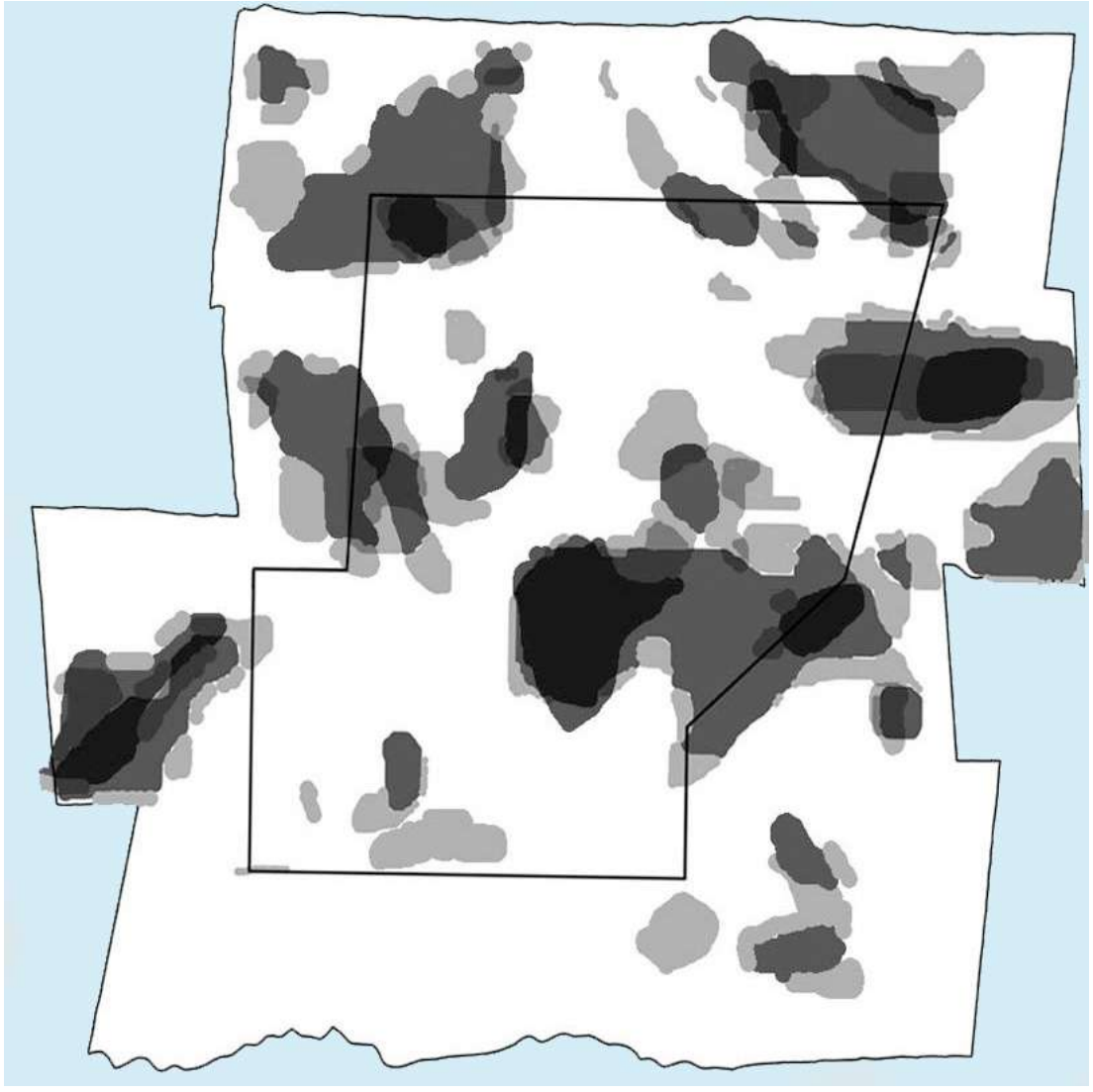
BACTERIA INDUCED ANOMALIES



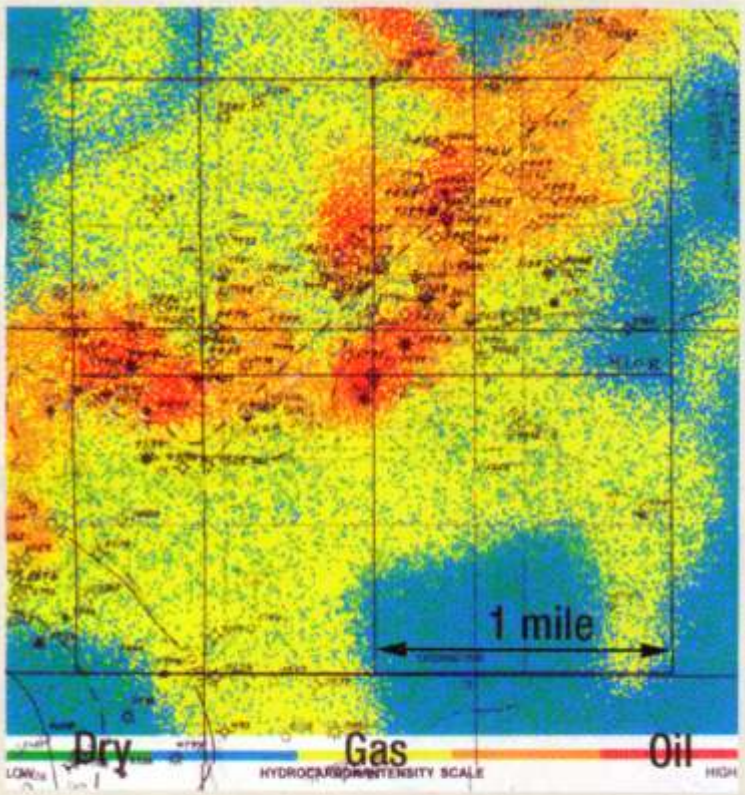
SUMMING-UP OF PROSPECTING FEATURES

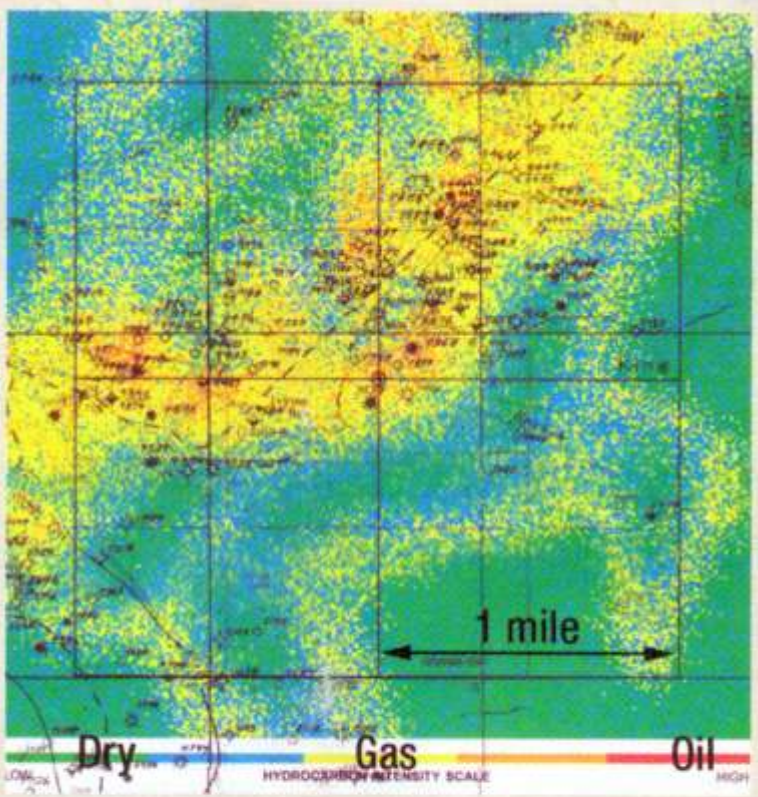


COMPLEX ANALYSIS OF THE DATA



Anomalies stability





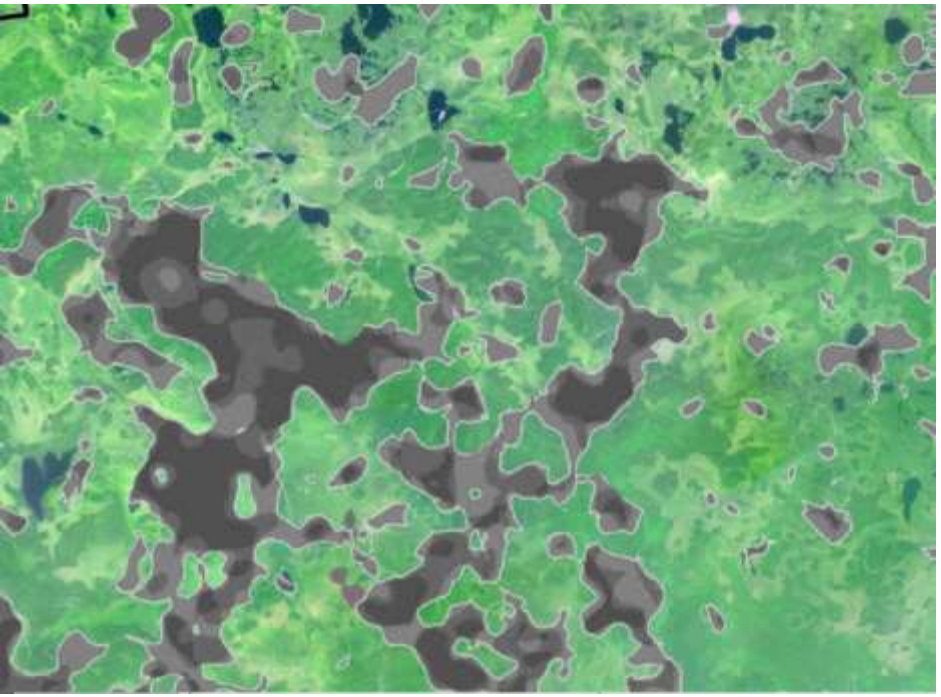
Digital spectral satellite map (left), interpretation around the Millers Chapel Area in Overton County, Tennessee, as it appeared in 1977. The wells shown were drilled after 1977. Right, the same area in 2003 after over 25 years of production. Note the dramatic color change, and that very few successful wells were drilled outside the "good" areas predicted in the 1977 map. *Courtesy Mammoth Geophysical.*

Source: Fischer P.A.«Unconventional exploration technologies: take another look» World Oil, September 2006

Anomalies stability

Licensed block survey in Khanty-Mansiysk autonomous region .
Aerial scanning interval 5 years.

Anomalies in 2005



Anomalies in 2013