

GEO TECHNOLOGIES

2014



WE

Today **WE** are the GeoTechnologies group of companies

- GeoTechnologies, Russia
- GeoTechnologies, North America



We operate worldwide and our main business lines are:

- developing of airborne geophysical instruments
- delivering of airborne geophysical turn-key technologies, personnel training and technical support
- providing of airborne geophysical surveys

Our technologies are complete and balanced. We achieve not only high precision and sensitivity of our instruments, but also high reliability and productivity of airborne geophysical systems even in the most difficult geographical and climate conditions.

Professionalism of our employees, long term experience in technologies development, wide range of own geophysical equipment and software, capability to generate and apply scientific knowledge are our recipe for success.



We'll be happy to answer all the questions, just contact us.

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USA

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PDAC, Trade Show:

booth # 444

We've got many scientific and business partners -
Institute of Control Sciences of RAS, VSEGEI, Alrosa, Geoken
and many others.

JOIN US!

OUR TECHNOLOGIES

are

FAST AND PRECISE:

ensure perfect data quality combining excellent precision with high speed and resolution.



RELIABLE AND EASY-TO-USE:

even the survey of small areas is economically viable - all instruments are easy to transport and mount, compact and effective

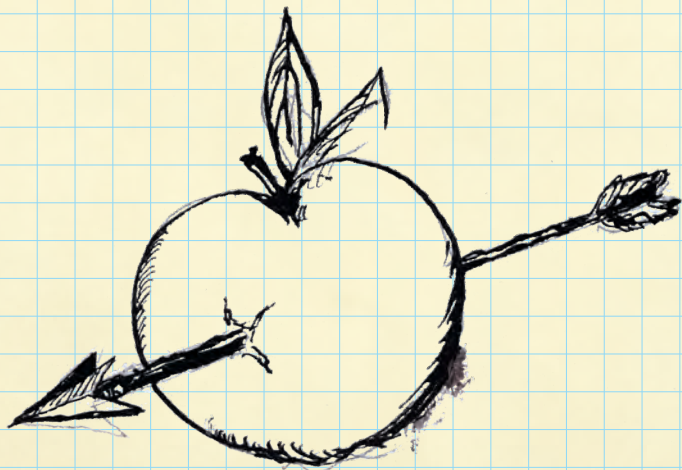
SAFE:

our systems are easy to fly with, they provide comfortable working conditions for a pilot and deliver accident-free operations.

CUSTOMER-FRIENDLY:

high automation of airborne geophysical equipment and processing software provides fast delivery (within few days after) of survey data ideal for geological and geophysical interpretation.

ALWAYS HIT THE TARGET



THANKS TO

our scientific research, ongoing development of geophysical instruments, methods of signal processing and software. Continuous evolution of our capabilities ensures high data quality, effectiveness of geological and geophysical interpretation, accuracy of mapping and efficient exploration.

OUR CAPABILITIES

All these systems are developed and produced by our specialists

AIRBORNE ELECTROMAGNETIC SYSTEMS

Developed in 2005 EM4H is a four-frequency AEM system. There are two EM-4H modifications: fixed-wing (AN-2 and AN-3) and helicopter-borne (MI-8). High position of transmitting dipole and large footprint make EM-4H the system of choice for regional mapping.



Developed in 2010 EQUATOR is a fully towed helicopter-borne time-domain electromagnetic system. Full-time signal measurement allows transformation of collected data to frequency-domain representation. The system is light and compact, it combines perfect aerodynamics along with high sensitivity and provides excellent data quality and high penetration depth.



AIRBORNE MAGNETIC & DATA ACQUISITION SYSTEMS

We developed high-precision aeromagnetic system GT-MAG and magnetic variation station GT-MVS.

GT-MAG has an integrated system for monitoring of measurement conditions that allows connection of additional sensors (thermometer, barometer and so on).

GT-MVS base station works autonomously and use wireless data transfer.



INFRARED SCANNER

Autonomous line scanner of long-wave infrared range (8-14 μm) was developed for airborne topographic thermal surveying. Combining high energy (0.05 K) and angular (0.7 mrad) resolution ensures perfect quality of infrared images.



NAVDAT

NavDat provides data control and high accuracy navigation for airborne geophysical surveys employing any geophysical equipment.

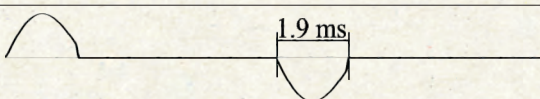
AIRBORNE ELECTROMAGNETICS

EQUATOR

Helicopter-borne
Time-Domain Electromagnetic
and
High-Precision Magnetic
System



SPECIFICATION

Electromagnetic measurements	
Principle of operation	Time-Domain & Frequency-Domain
Base frequency	77 Hz
Dipole moment (NIA)	100 000 Am ²
Pulse shape	
Output data in time domain	14 off-time channels from 5 μs to 4.5 ms, X,Y,Z components
Output data in frequency domain	on 14 frequencies from 77 Hz to 12 kHz, X,Y,Z components
Total weight	250 kg
Transmitter loop diameter	7.5 m
Tow cable length	70 m
Receiver placement	In the towed bird, 40 m from transmitter loop
Power requirements	100 A from 27 V network
Survey speed	0-200 km/hr

Magnetic measurements	
Sensor	SCINTREX CS-3
Sensitivity	0.6 pT/√Hz
Sample rate	1000 Hz
Output rate of 'distilled' data	25 Hz
Synchronization	by GPS
Sensor placement	In the towed bird



EM-4H

Frequency-Domain
Airborne Electromagnetic System

SPECIFICATION

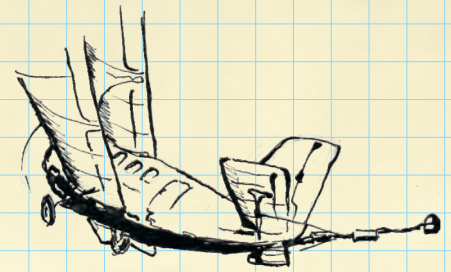
Electromagnetic measurements

Principle of operation	Frequency-Domain
Frequencies	130, 520, 2080, 8320 Hz
Dipole moments	20000, 10000, 6000, 3000 Am ²
Waveform	Sum of four harmonic signals
Output data	Inphase and quadrature X, Y, Z components for four frequencies
Total weight	200 kg
Transmitter loop area	42 m ² for An-2, An-3 fixed-wing aircrafts, 60 m ² for Mi-8 helicopter
Tow cable length	70 m
Receiver placement	In the towed bird, 70 m from transmitter loop
Power requirements	30 A from 27 V

Magnetic measurements

Sensor	SCINTREX CS-3
Sensitivity	0.6 pT/ $\sqrt{\text{Hz}}$
Sample rate	100 Hz
Output data rate	100 Hz
Synchronization	by GPS
Sensor placement	In the towed bird

MAGNETOMETERS



FOR AIRBORNE SURVEY

Airborne magnetometer and data acquisition system GT-MAG-2 for high-precision survey with one or two sensors suits both stinger-mounted and towed (in a bird) configurations.

For stinger-mounted configuration magnetic compensation software ReinMag is used for data processing.



GT-MAG-2 magnetometer and computer of NavDat system

'WALKING' and BASE STATION



We produce two GT-MVS modifications:

- walking magnetometer
- base station

Sensor: cesium or potassium vapour.

For all operations including system control, data overview and download a smartphone is employed.



ARE YOU LOOKING FOR AN AIRBORNE OR GROUND MAGNETOMETER?

Always a broad selection,
enough for everyone
Come in, you will not regret!



This table will help you to make your choice.

	GT-MVS-SB (Base Station)	GT-MVS (Walk)	GT-MAG-2 (Airborne)
Precise sensor type	High-sensitivity Self-oscillating split-beam (Cs, K, ...)		
Sensor number	1	1	2
Sensitivity	0.0002 nT/√Hz		
Resolution	0.001 nT		
Sample rate	1 Hz	up to 1 000 Hz	up to 1 000 Hz
Fluxgate chanel	-	-	3
Fluxgate sample rate	-	-	same as for precise channel
Data storage	USB-flash	USB-flash	-
Data output interface	Wi-Fi, USB	Wi-Fi, USB	USB
Internal GPS	GlobalSat OEM GPS Receiver ET-332, 1 Hz	GlobalSat OEM GPS Receiver ET-332, 1 Hz	up to two GPS-receivers (1 - 100 Hz)
External GPS	Any with serial output	Any with serial output	-
Radar altimeter	-	-	TRA 3000/3500
Standard software	NavDat (ground module)	NavDat (ground module)	NavDat, Reinmag
Power supply	10-26 V / 15W (45W max)	10-26 V / 15W (45W max)	22-31V / 15W (60W max)
Console dimensions	170x215x35 mm	170x215x35 mm	325x290x70 mm

AIRBORNE INFRARED IMAGING

Successfully used for engineering and hydrogeological studies, for diagnostics of various industrial structures, underground heat supply network, oil and gas pipelines.

INFRARED SCANNER SCAN-T

Linear scanning technique allows to obtain thermal image with maximum energy resolution and to georeference it with topographical accuracy. Wide view angle combined with high geometrical resolution provide high efficiency of survey.



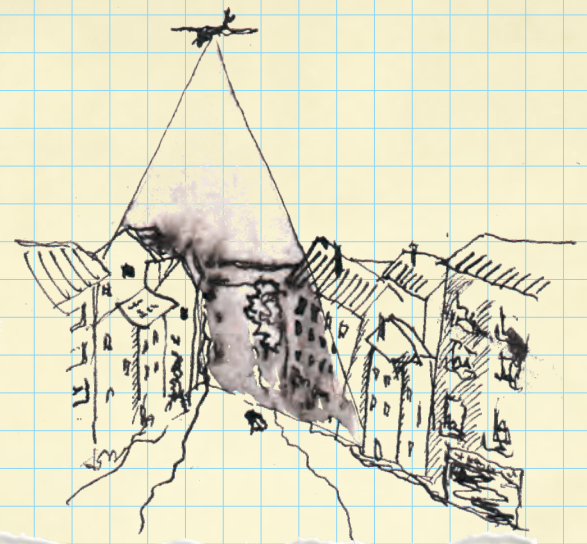
SPECIFICATION

Operating principle	scanner: image is captured line by line
Angle of view	120°
Scanning frequency	230 lines per second
Ray width	2.4'
Number of points in a line	3500
Wavelength range	8-14 μm (LWIR)
Sensitivity	0.03°C for background temperature 20°C
Software	NavDat
Navigation system	integrated navigation system based on - GPS/GLONASS(Javad/Topcon/Novatel); - strapped-down attitude system; - radar altimeter TRA 3000/3500.
Accuracy of navigation system	- attitude angles — 1° - position — 3-5 m
Sensitivity of attitude system	less than 1'
Noise of positioning	less than 10 cm
Dimensions	50x30x30 cm
Weight	30 kg
Installation	outside fuselage (Mi-2, BK-117, Cessna-172) or inside fuselage in a hatch (Mi-8, Ka-26, An-2)
Output image	Raster layer in ArcGis format

FEATURES

Geometrical accuracy of infrared image and its georeferencing are provided by an integrated navigation system.

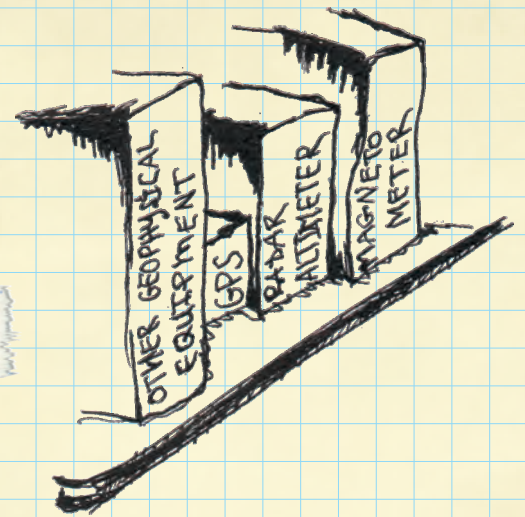
Here you can see the result of an image correction:
on the left: the image before correction
on the right: automatically corrected image



DATA CONTROL AND NAVIGATION

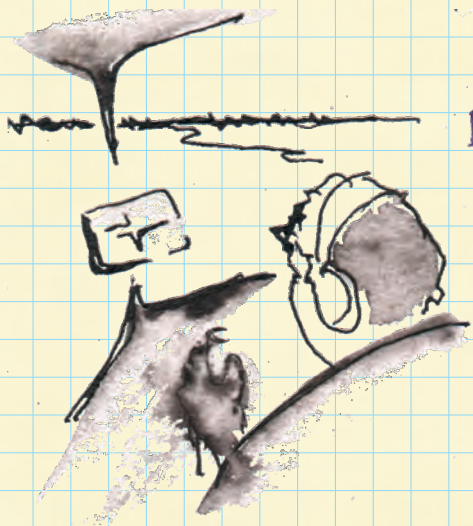
NAVDAT SYSTEM

Allows for integration of all geophysical instruments almost as simple as putting all necessary books on a shelf.



NAVDAT controls collected data

It receives and records data from all elements of geophysical system, verifies their quality and integrity. Protection from operator's mistakes is guaranteed!



NAVDAT ensures high-accuracy navigation

Following navigation instructions from the indicators of NavDat system a pilot can fly along routes with 2-meter accuracy and turn from one route to another within 1-2 minutes.

NAVDAT monitors survey process

All measured signals and navigation parameters are visualized on the screen of the on-board computer.

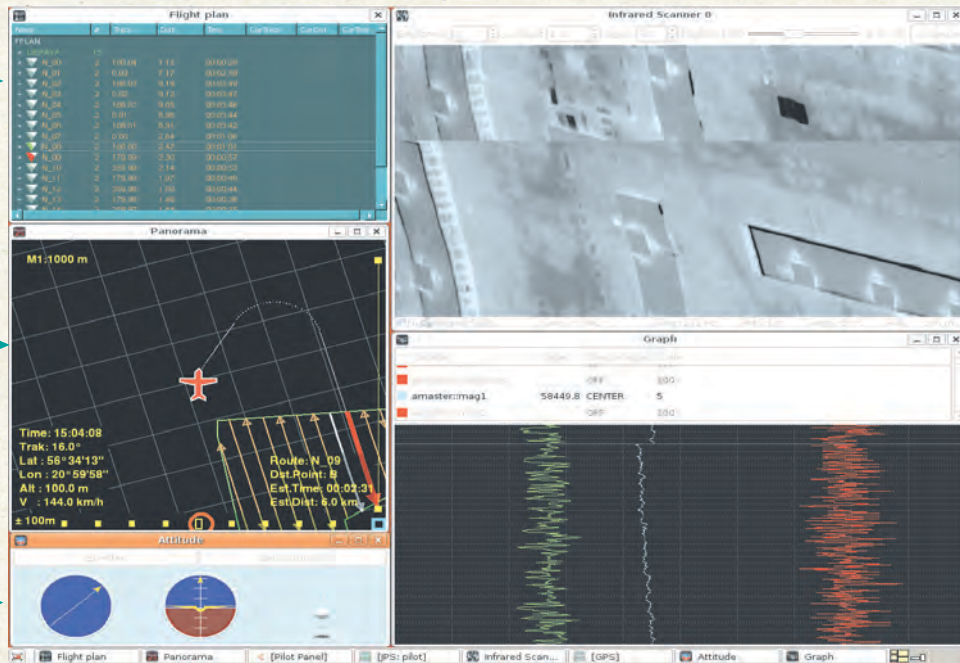
For survey without operator in case of equipment failure a pilot obtains warning signal immediately.



The example of NavDat screen for an airborne infrared survey

Navigation map and flight plan file

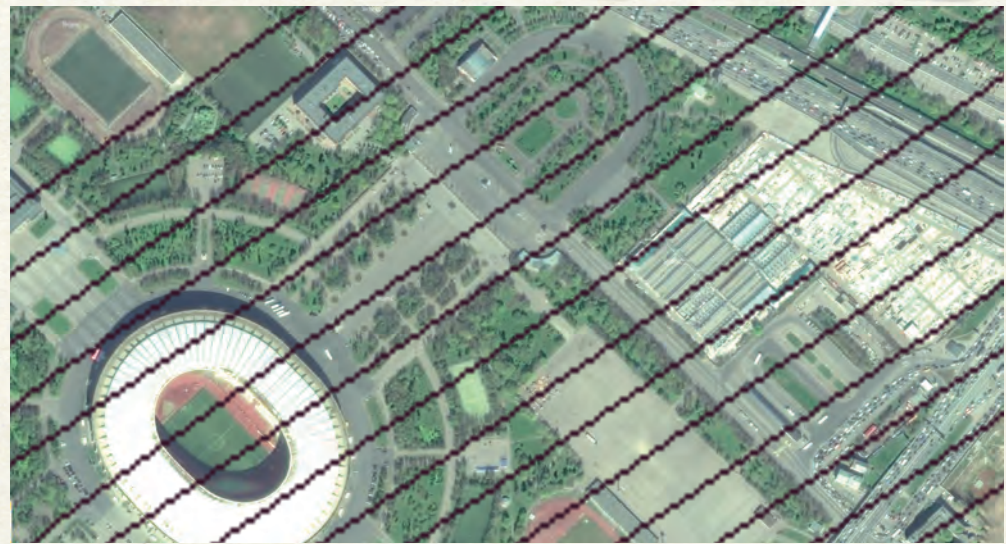
Infrared image in real time



Parameters of gyro system

List of measured signals and their charts

The fragment of flight paths. The route distance is 50 meters.



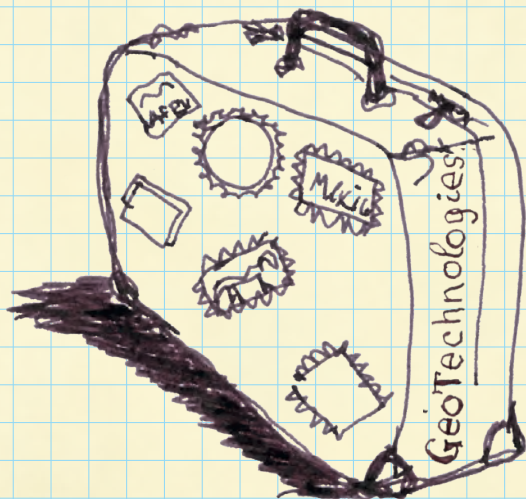
AROUND THE WORLD

Our technologies are operated worldwide

Here is only part of our geography.

By now our instruments are used by many geophysical companies in Russia and abroad. We look after our customers and listen attentively to their suggestions and comments. Working with our support customers can always rely on the experience of our professionals.

Performing a survey our geophysicists always achieve the best possible results. Constant support of the developing group – of engineers and programmers – allow them to use highly effective geophysical data processing methods and interpretation software.



SCAN-T, Mexico, 2011



EM-4H, Transbaikal, 2007



GT-MAG, Kazakhstan, 2011



EQUATOR, Arkhangelsk, 2010



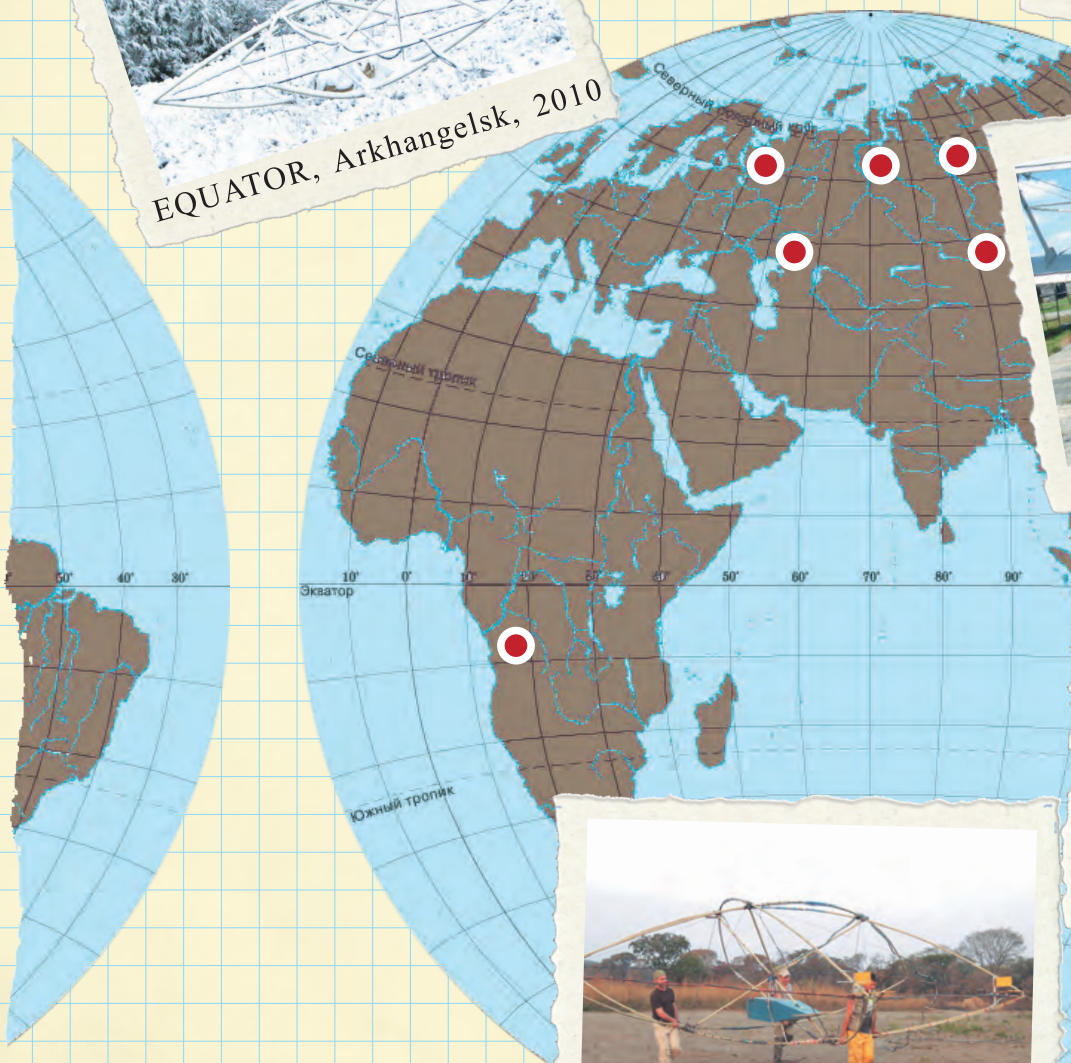
EM-4H, Yakutia, 2012



EQUATOR, the Sayan Mountains, 2010



EQUATOR, Angola, 2013



AIRBORNE EM SYSTEM EQUATOR



Electromagnetic time-domain systems are irreplaceable for exploration of large conductive objects.

Frequency-domain systems are very useful for geological mapping or when conductivity contrast between the object and the host rock is not so high.

But what if both are necessary?

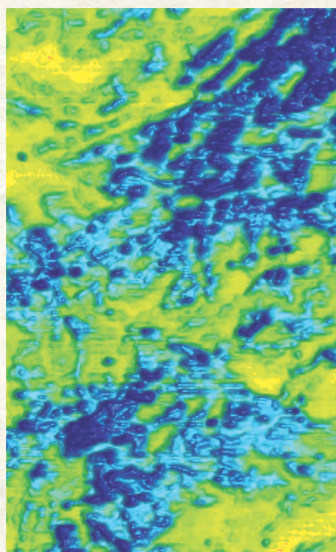
USE EQUATOR!

Like a Joker, EQUATOR will be the system that suits your needs best.

At your desire high-precision airborne electromagnetic system EQUATOR will be time-domain or multi-frequency system or even both simultaneously.

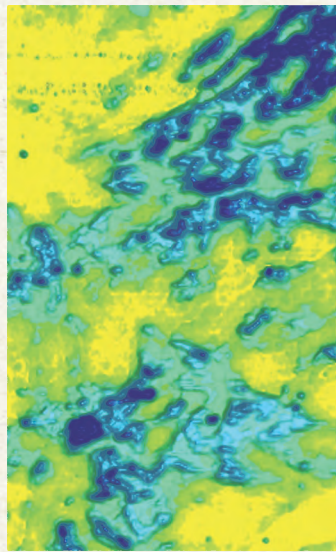
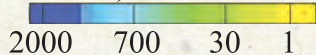
Here EQUATOR is a traditional Time-Domain system

Looking at these maps sounding effect is easily seen: at later times the influence of the shallow sub-surface 'disappears' and deep conductive object 'appears' more clearly.



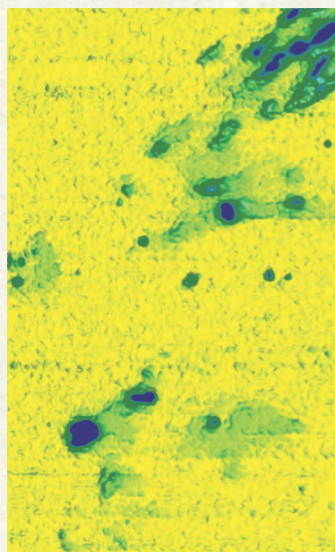
$t = 10 \mu\text{s}$

dBz/dt, nT/s

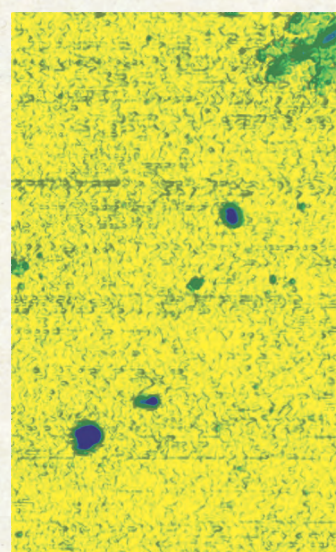


$t = 50 \mu\text{s}$

5km 0 5km



$t = 400 \mu\text{s}$

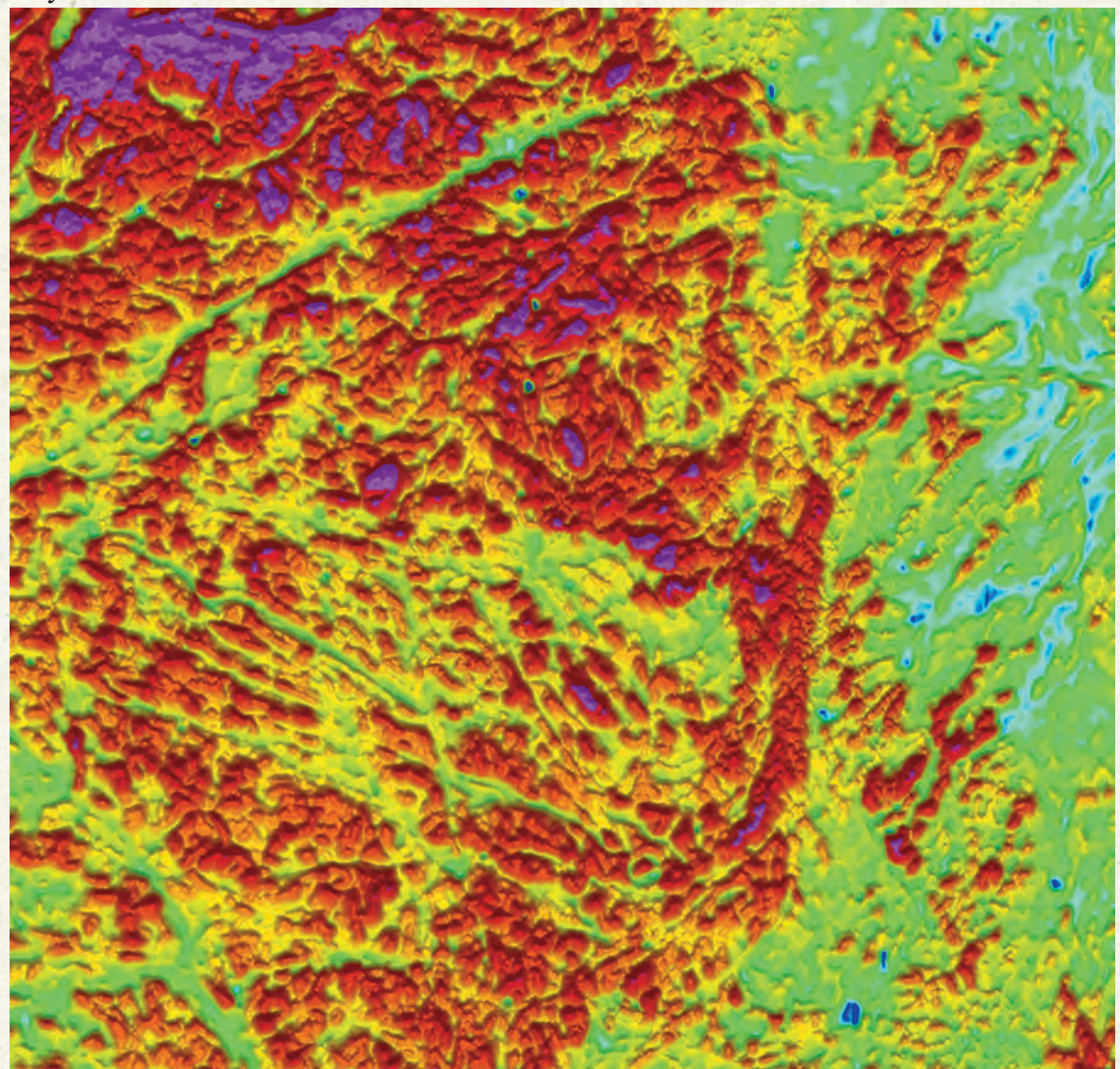


$t = 1000 \mu\text{s}$

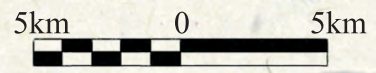


Here EQUATOR is a traditional frequency-domain system

Faults structure is clearly seen on the frequency map. You can also see local conductive areas. They are associated with reddish crusts and terrigenous material in accumulation zones of paleovalleys and stream ways.



Apparent conductivity map, $f = 3\ 163\ \text{Hz}$



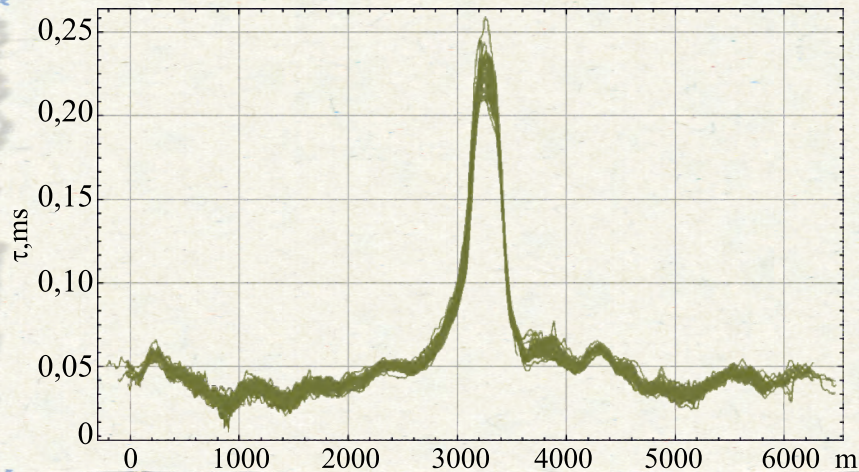
This map and maps on the left page are the results of the same survey. EQUATOR gives you the unique opportunity to see geological results of your survey in different ways.

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TOO GOOD TO BE TRUE ?

We tested, specially for you. It's up to you to decide!

EQUATOR system, stability



Here are time constant (τ) charts calculated for 80 control flights along the same route.

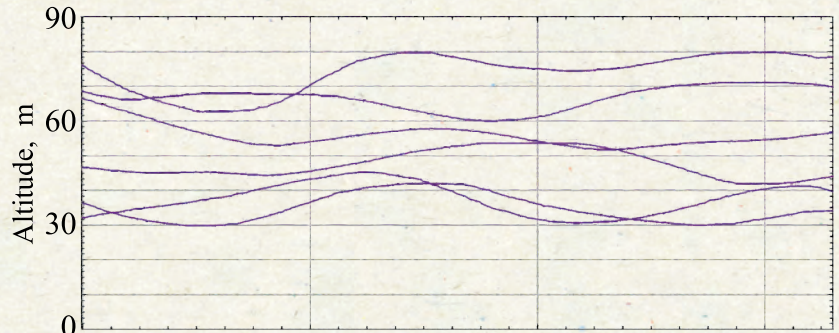
One flight for each survey day.

As it should be
all charts are the same!

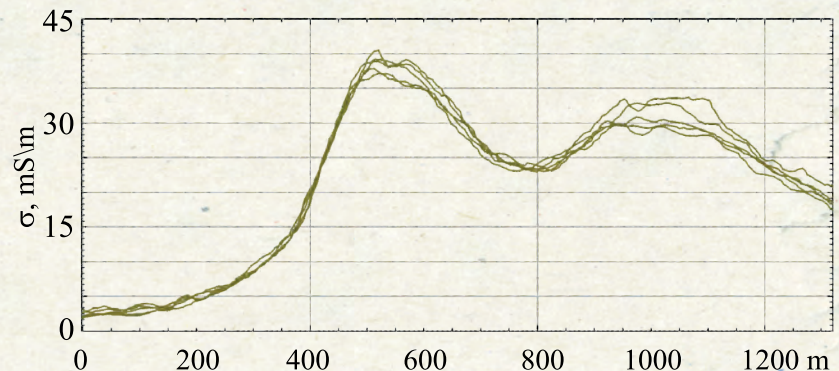
EQUATOR system, invariance

Let's look from another point of view. But no matter how you look at it, conductivity should remains the same from any altitude (if something can be seen, of course).

Here are EQUATOR altitude values for six flight along the same route.



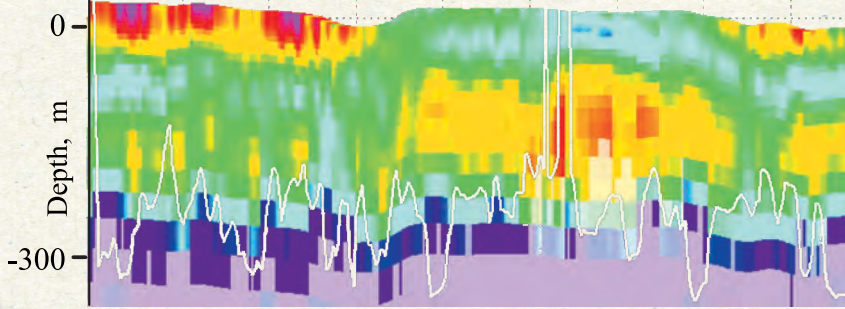
Here are values of apparent conductivity for these six routes.



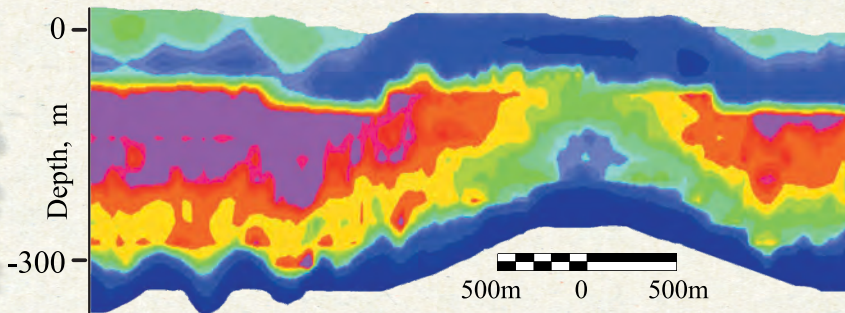
Things change. But
quality of measurements
should remains high

EQUATOR system, penetration depth

How to test the vision? Just try to see!

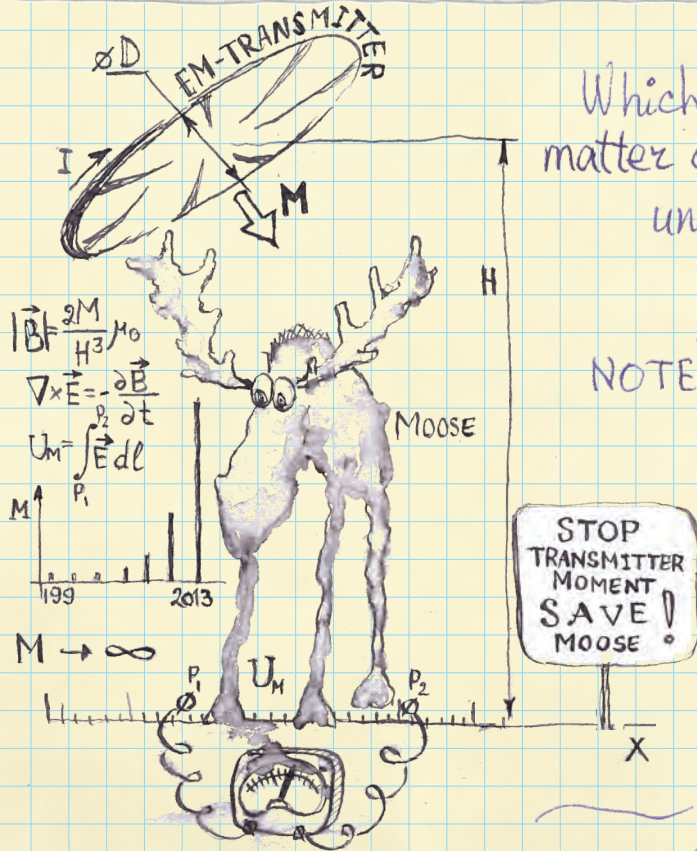


This is 2-D inversion, constructed by Aarhus Geophysics. Under upper quite conductive layers strong conductor at depth of more than 100 metres is clearly seen. For this section traditional time-domain representation of data was used.



And this is an ordinary CDI. To make it we used frequency-domain data representation. It looks similar, doesn't it?

Yes, but... also here is a low-contrast conductive object between upper and lower conductive layers. This is a known kimberlite body.



Which of these sections is better. This is a matter of discussion. But conductive object under conductive cover is **FOUND!**

NOTE! EQUATOR transmitter moment is quite small - 100 000 NIA. To achieve high detectability and penetration depth we focused on the improvement of receiver sensitivity and signal processing.

EQUATOR OR GROUND EM

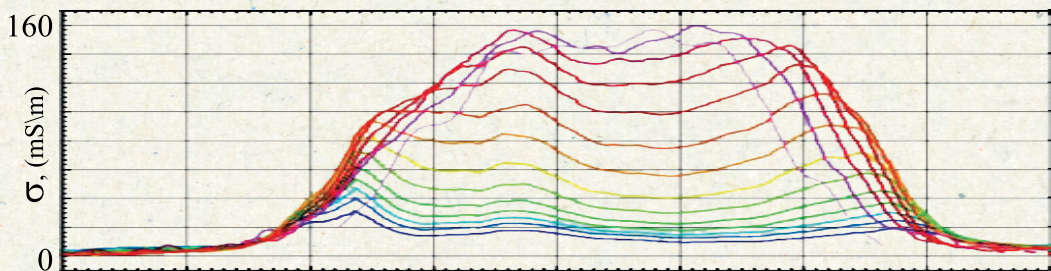
EQUATOR flies very fast. But what about its detectability if compared to ground electromagnetics? We had a chance to test



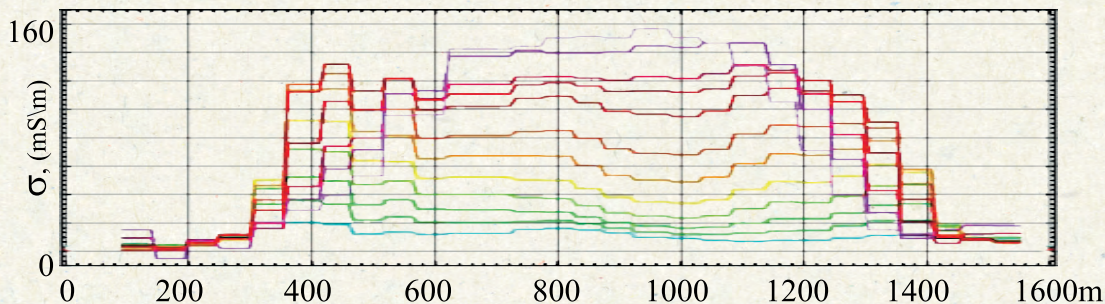
EQUATOR or TSIKL-5 (Time-Domain method)

Let's compare EQUATOR data with data of ground EM system Tsikl-5. Both set of data were collected at the same well-known geological profile. The charts below represents calculated values of apparent conductivity.

EQUATOR data

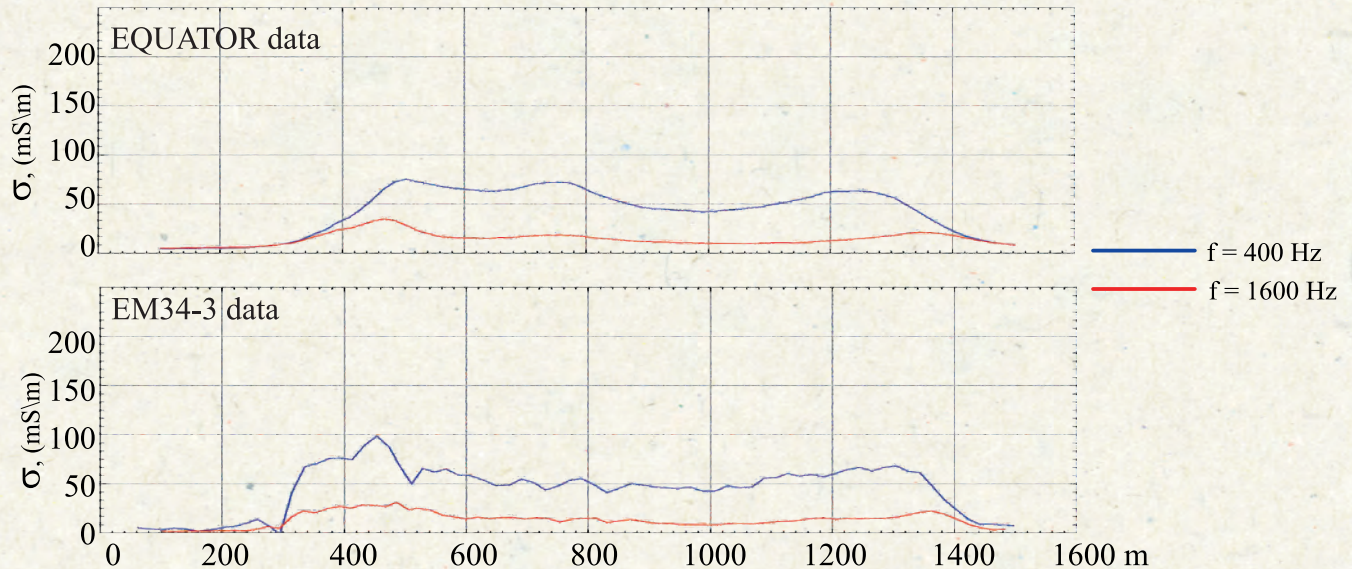


TSIKL-5 data



EQUATOR OF FREQUENCY-DOMAIN SYSTEM EM34 (Geonics) The same profile

And here there is the comparison between EQUATOR results and results of a ground survey with an electromagnetic system EM34-3 (Geonics). These charts represent values of apparent conductivity.

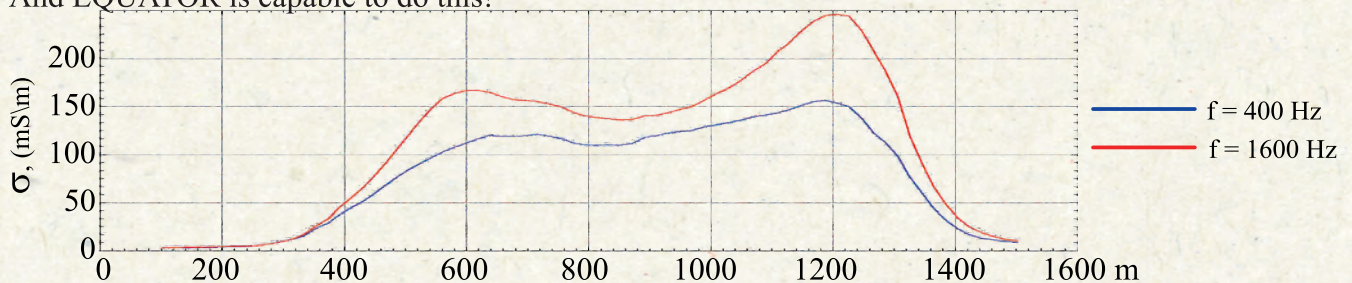


We performed calculation in the same way as they were performed for EM34-3. And we've got the same results.

Note! They are **WRONG!**

But do not jump to conclusions! **HERE ARE THE CORRECT ONES!** To obtain correct values not only quadrature component but in-phase component should be used.

And EQUATOR is capable to do this!



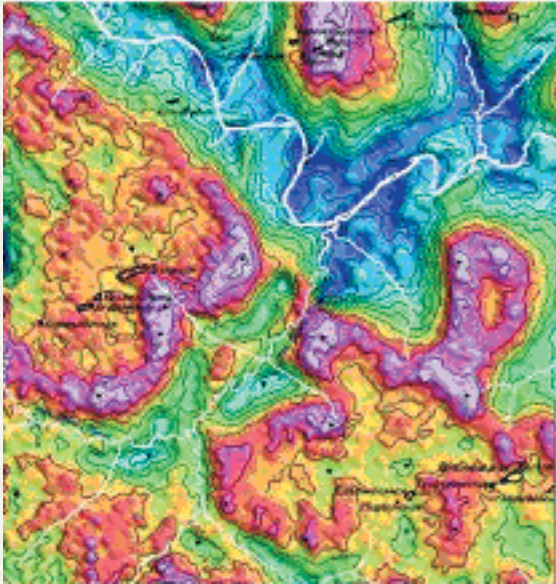
This data was obtained at the same profile and the corresponds very well to a-priori geological information.

Put your doubts aside, use EQUATOR!

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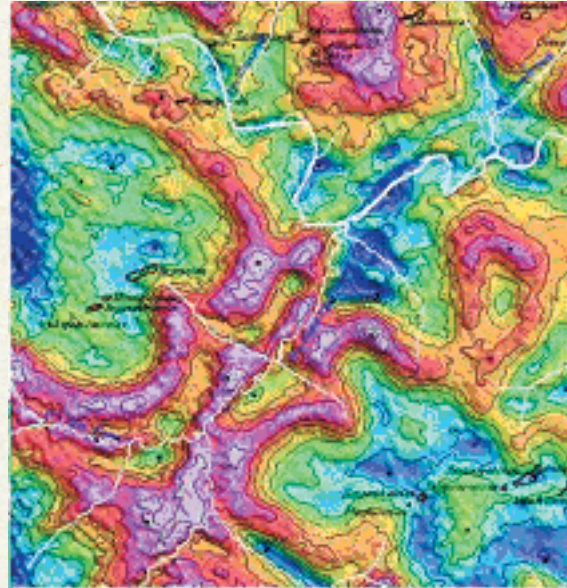
A GOOD MAP IS ALWAYS USEFUL

Technical capabilities of EM-4H system make it the system of choice for mapping in various geological conditions. Apparent conductivity maps allow geologists to delineate boundaries between structures of different age and lithology.

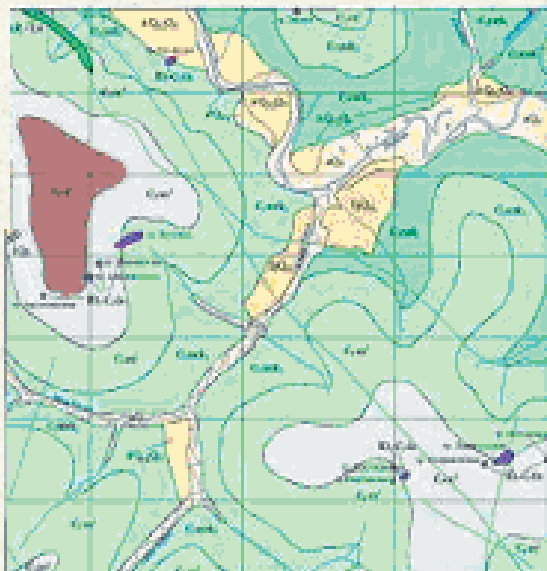


f = 520 Hz

ρ , Ohm · m



f = 2080 Hz



There are EM4H apparent resistivity maps for 520 Hz and 2080 Hz frequencies.

And this is detailed geologic map of the area.

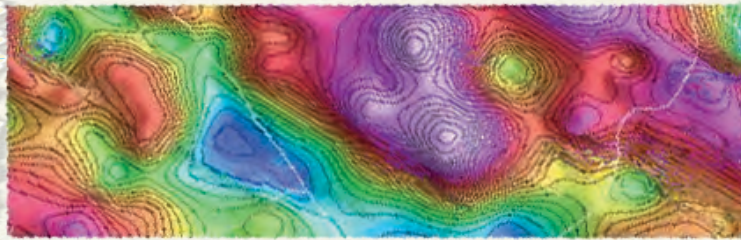
NOTE! Even structures with subtle resistivity difference are clearly distinguished.

500 0 500M

DIFFERENT METHODS, SAME MAPS

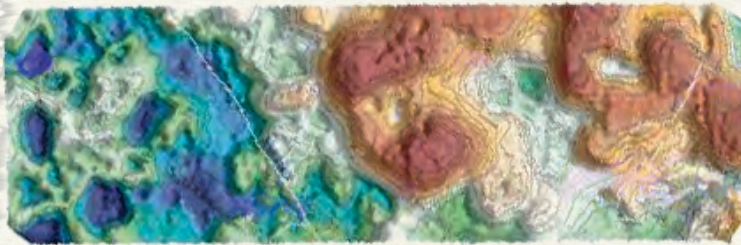
Let's compare EM-4H apparent resistivity map and maps based on other geophysical methods.

On this page you can see three maps obtained by different methods. The survey region is paved by trap rocks. The purpose of the investigation is to measure trap thickness.



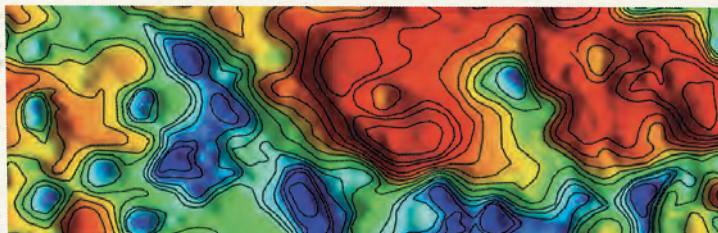
For this map drilling data was used.
The work took two years.

Trap isopach map, exploration drilling data



This one is the result of ground
gravimetric survey.
The survey took six months.

Gravity field map, ground survey data.
50 m distance between data points

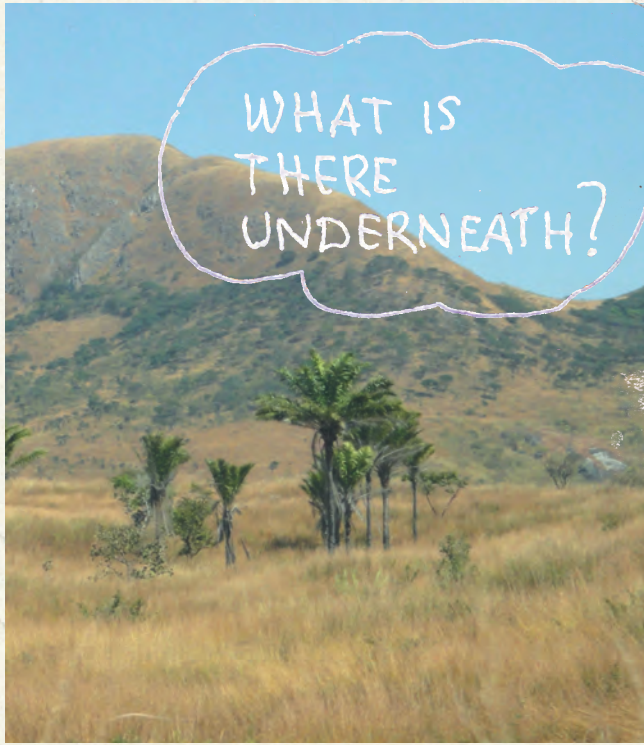


And here is the result of airborne
electromagnetic survey with EM4H.
The survey took one day.

EM-4H apparent resistivity map (2080 Hz).
100 m distance between routes.

500 0 500 m

It can be easily seen that both gravity and electromagnetic maps correlate with trap thickness and level of details of electromagnetic map is comparable to that of gravity map.



WHAT IS THERE UNDERNEATH?

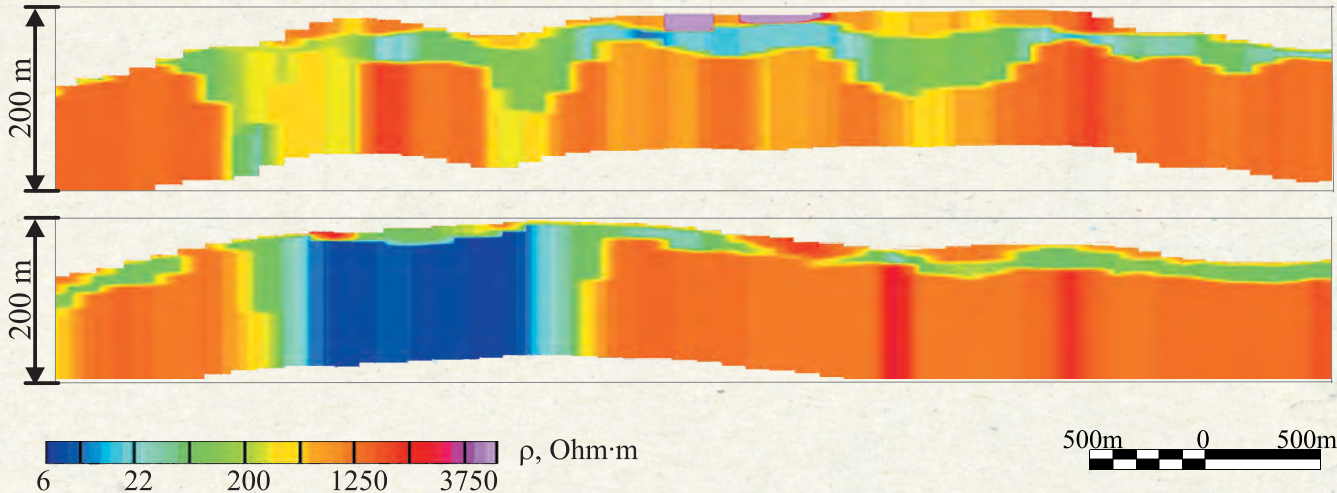


NOTHING SPECIAL, JUST SIGNALS

Even the best system registers only signals. But can we find out **WHAT** is under us?

HERE IT IS!

Below there is an example of sections that are automatically constructed by our interpretation software of EQUATOR data.

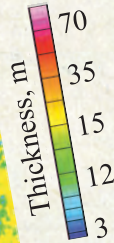
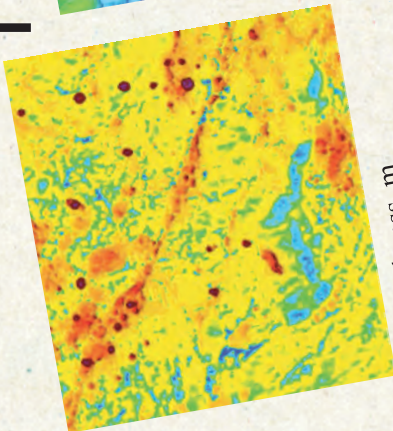
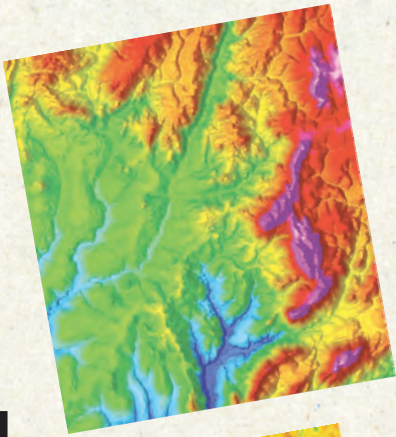


We checked - the sections are in perfect correlation with drilling results and known geology. Two upper layers correspond to the sediments.

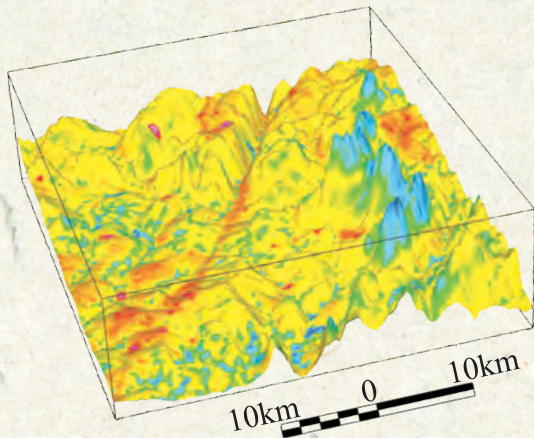
WHERE TO DIG?

You should agree, it is very important to know!

Let's construct 3D model combining relief map with map of sediments thickness



At this model 3D relief is colored in accordance with sediments thickness. Zones of sediments transportation and deposition are easily seen.



The obtained information helps to locate potential placer deposits and to define their type.



AIRBORNE INFRARED IMAGING

If there is a hot object underground the surface will be slightly warmer and vice versa if there is a cold object. It is almost unnoticeable, but our thermal scanner will find anything if only there is only a 0.05K temperature difference.

HOT OBJECTS



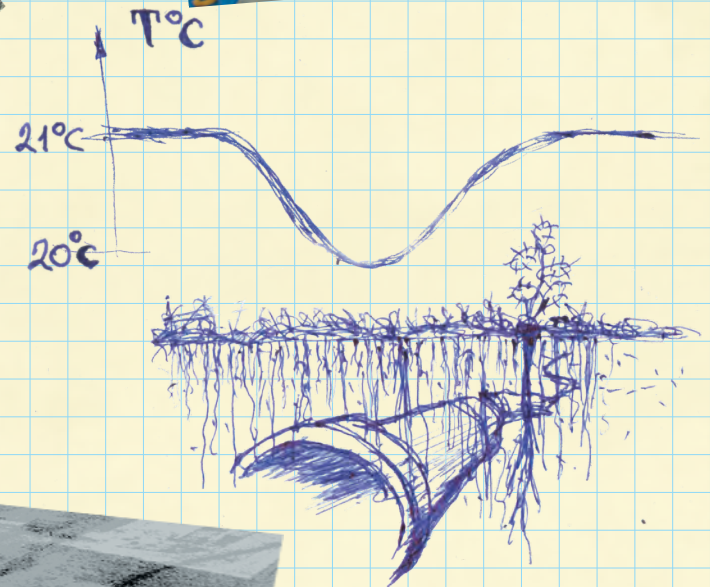
This hot spot marks damage to an underground heat supply network. There was nothing outside but inside it turns out to be this.

This is a thermal image:
white means hot and
black means cold.

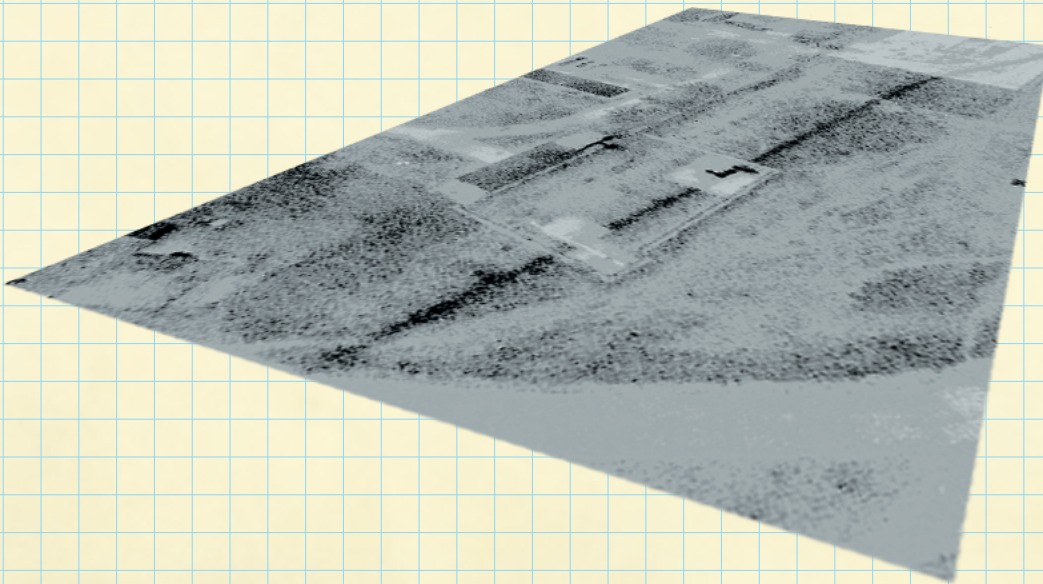


COLD OBJECTS

While conducting an infrared survey in Mexican outback (January 2011) we found a long cold underground object among swamps, cactus and wild animals.



It turned out to be an ammonia pipeline. Its temperature was just 5°C colder than that of the ground surface.



CONVENIENT FOR EVERYONE



Pilots are satisfied because flying with our systems is easy.



Operators like that our instruments are reliable and user-friendly.



Even transportation is not a problem - any standard transport can be used.



Geophysicists are delighted with the quality of data; processing takes little time and the customers always get what they need.

AND THIS IS NOT A DREAM!

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TO BE CONTINUED

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