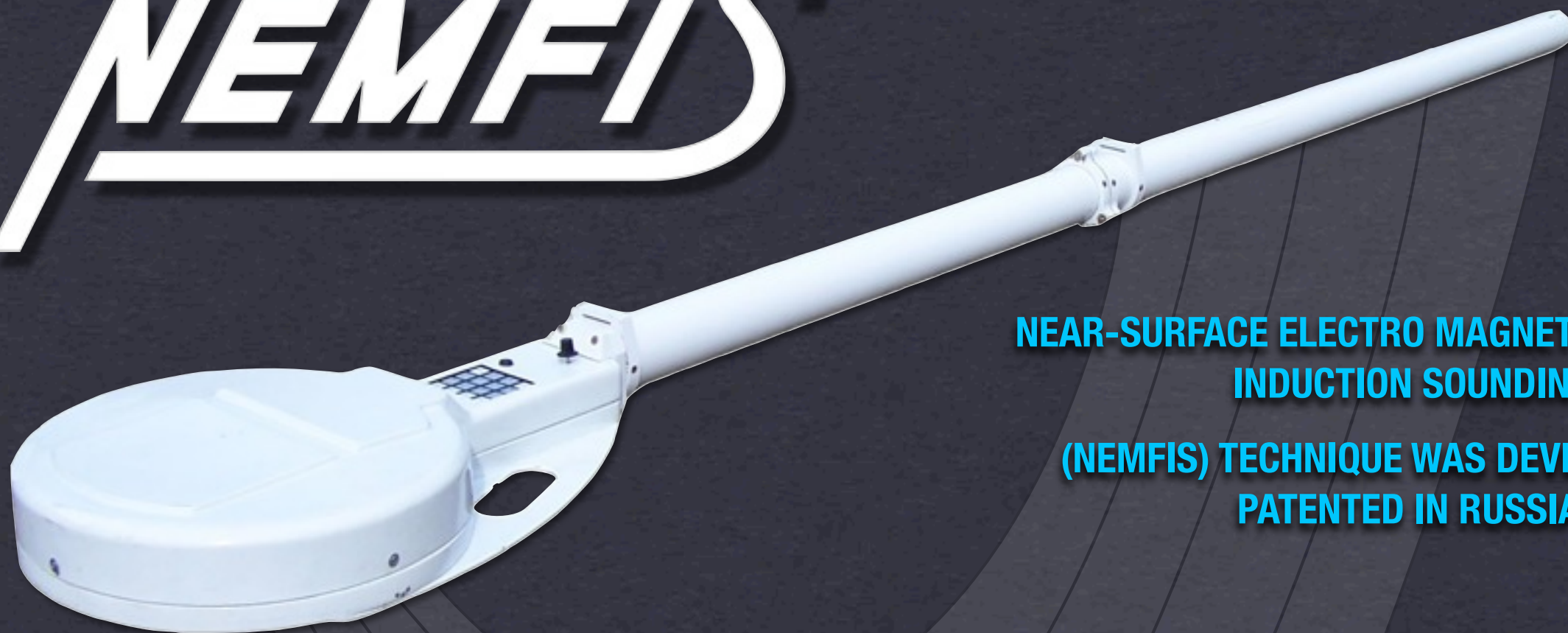


# NEMFIS



**NEAR-SURFACE ELECTRO MAGNETIC FREQUENCY  
INDUCTION SOUNDING**

**(NEMFIS) TECHNIQUE WAS DEVELOPED AND  
PATENTED IN RUSSIA.**

**Non-destructive NEMFIS tool based on NEMFIS can be used to identify precisely archaeological targets. In fact, electromagnetic induction (EMI) method has been used for many years in the exploration for ore bodies (ore bodies contain metal and, therefore, are good electrical conductors), and, more recently, to detect voids but at present NEMFIS tool is widely used for archaeological studies. A few archaeological case stories including Paleolithic, Bronze and Iron ages, antique and medieval targets discovery are presented. The cases include complex geophysical works using GPR, Vertical DC sounding and magnetometry together with Since frequency domain EM device can not resolve the real depth, recently the DC survey multi electrode device was made for joint works with EMS.**



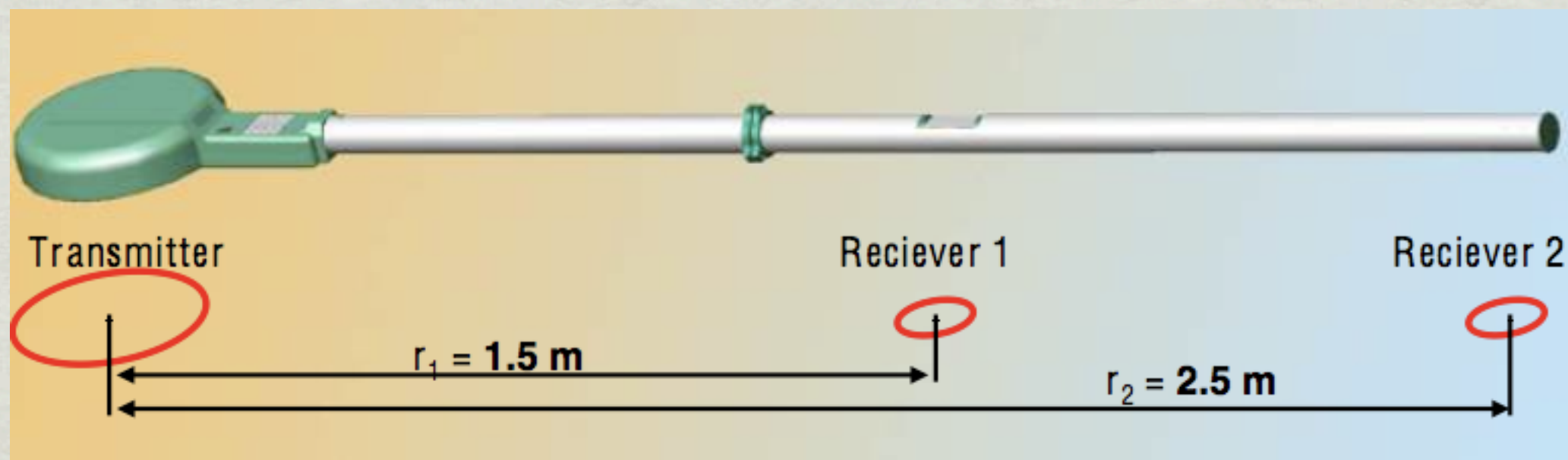
NEMFIS is the three-coil sounding device that includes the transmitter and two receivers. Alternating magnetic field with controllable phase is generating consequently on several frequencies within the range from 2.5 to 250 kHz. Receivers cancel primary field in the air, by obeying the following relation:

$$\frac{M_1}{r_1^3} = \frac{M_2}{r_2^3}$$

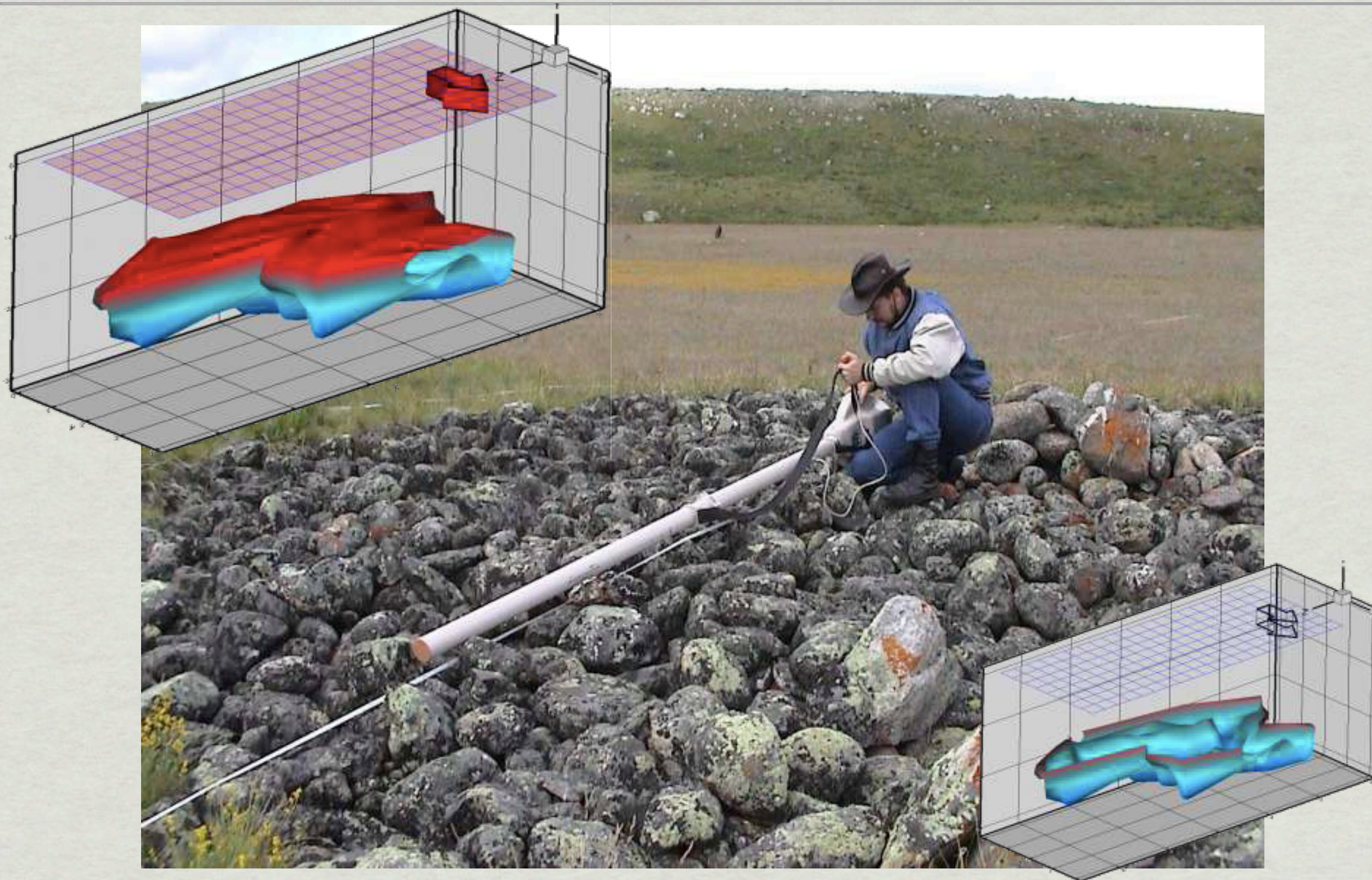
M1 and M2 are the momentums of the receivers. The transmitter-field cancellation is necessary to reduce contribution of primary field to measured signal. Cancellation reduces the primary field up to less 400 times.

### MAIN PARAMETERS:

- Frequency range: 2.5-250 kHz
- 14 freqs operating time: 2 sec
- Weight: 7.0 kg
- Length: 2.75 m
- Storage capacity: 8000 stations
- Battery operation time: 12 hours



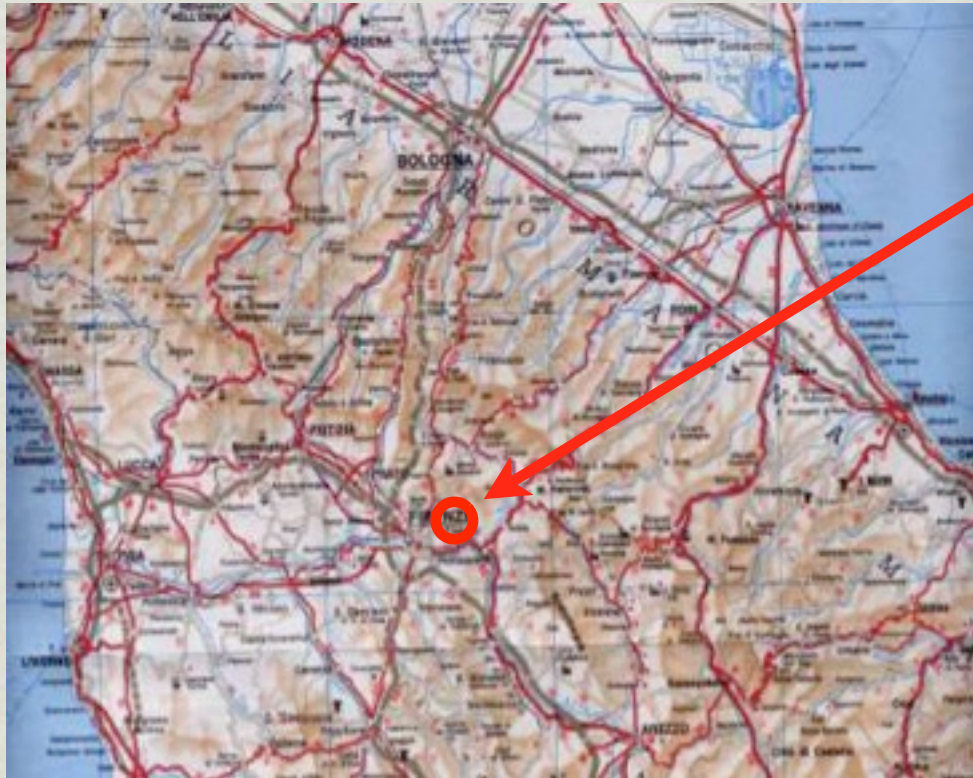




EM sounding was performed by NEMFIS over the mound. The set of cross-sections and 3D view (with and without the upper surface) of the anomaly of high resistivity (frozen burial camera) can be seen at the figures.



# The Demidoff's villa

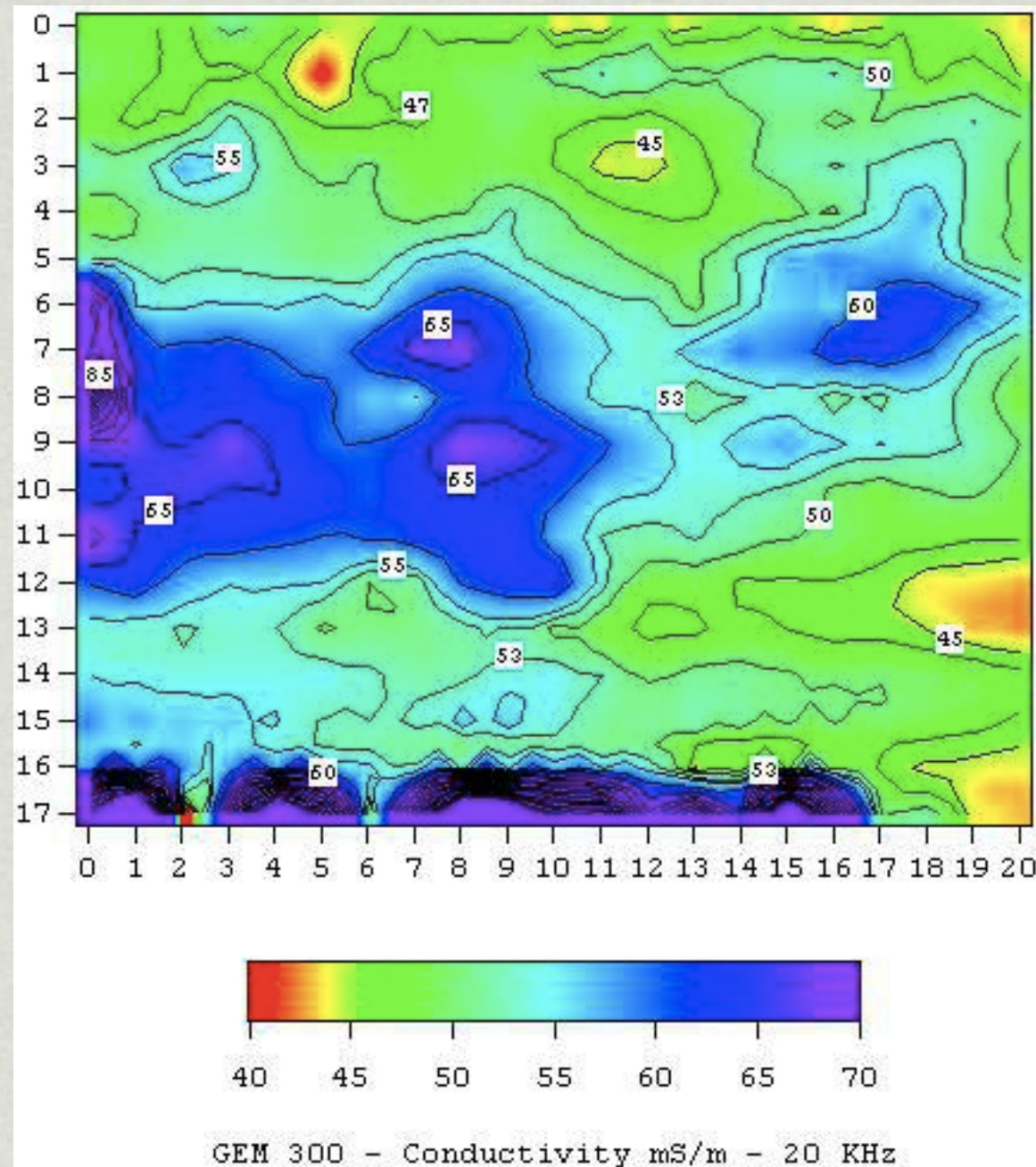


The medieval ages villa was destroyed in XIX century AC. The purpose of work – to find the subsurface remains of the building below loamy filling. Survey was effected using GEM-300, 2D DC resistivity tomography, GPR and NEMFIS.





## GEM300 – 20 KHz – detail survey



## NEMFIS – 20 KHz – detail survey – RAW DATA

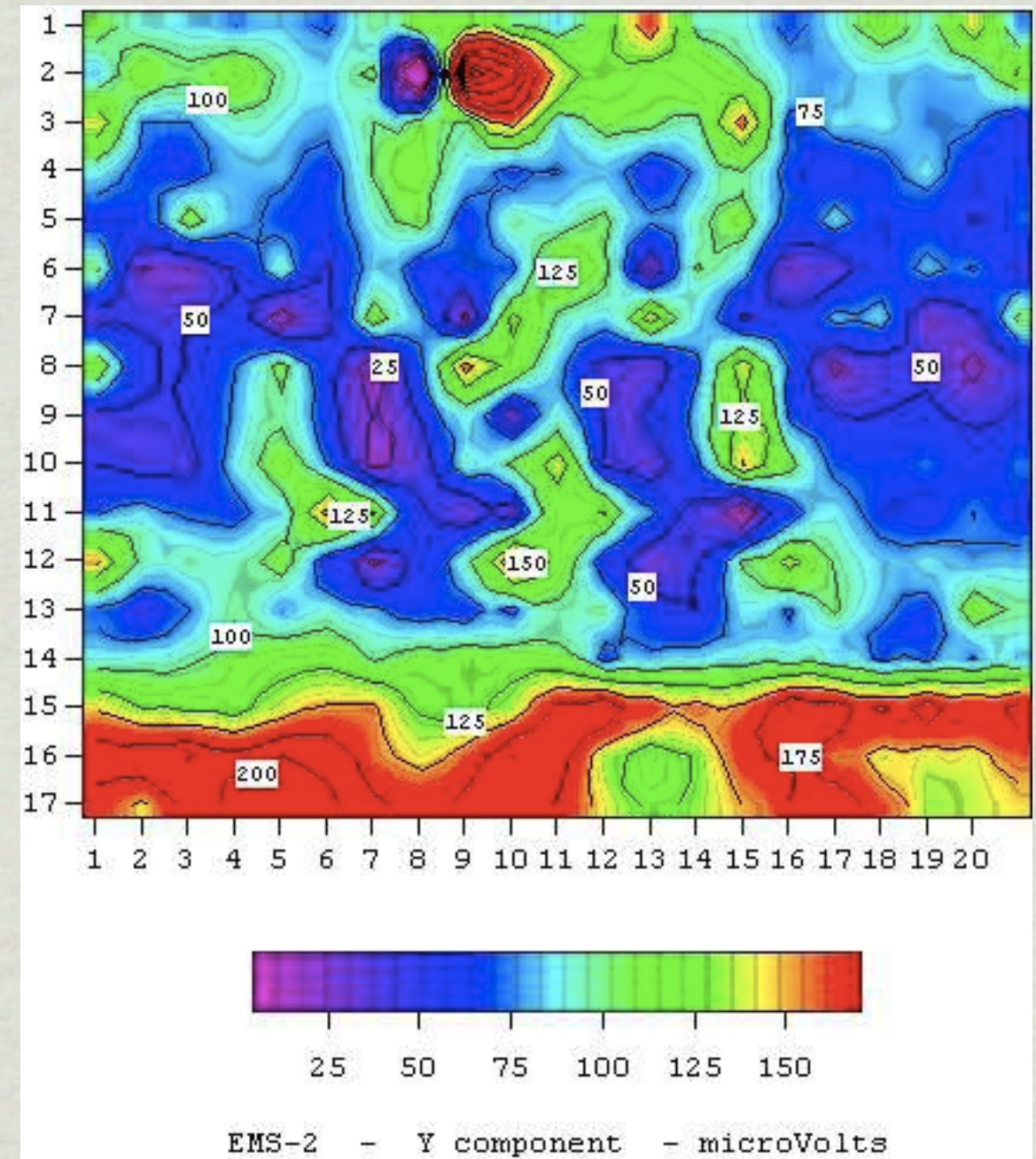


Figure shows the maps based on GEM-300 (on the left) and NEMFIS (on the right) data at the same frequency. Subsurface structure more informative on NEMFIS data map.



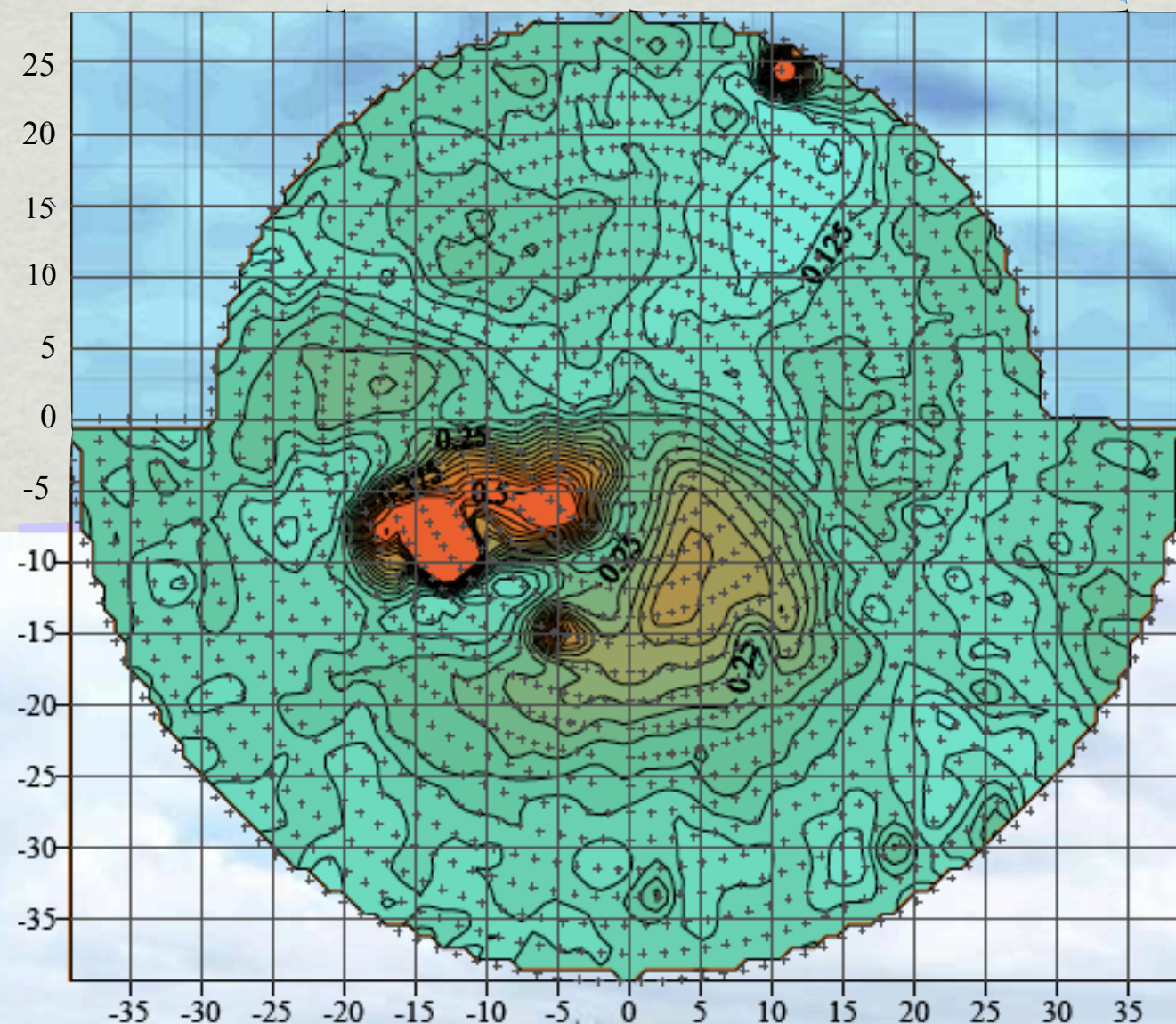


One of the anomalies was immediately excavated by power shovel. The wall was discovered. The wall was built using stones and dried bricks.





## Burial mound, Khakassia. NEMFIS survey map.



The round burial hill was studied using circling measurement net. The cross of resistive soil centered on the top of the hill can be seen. It means that initially the hill has pyramidal shape.

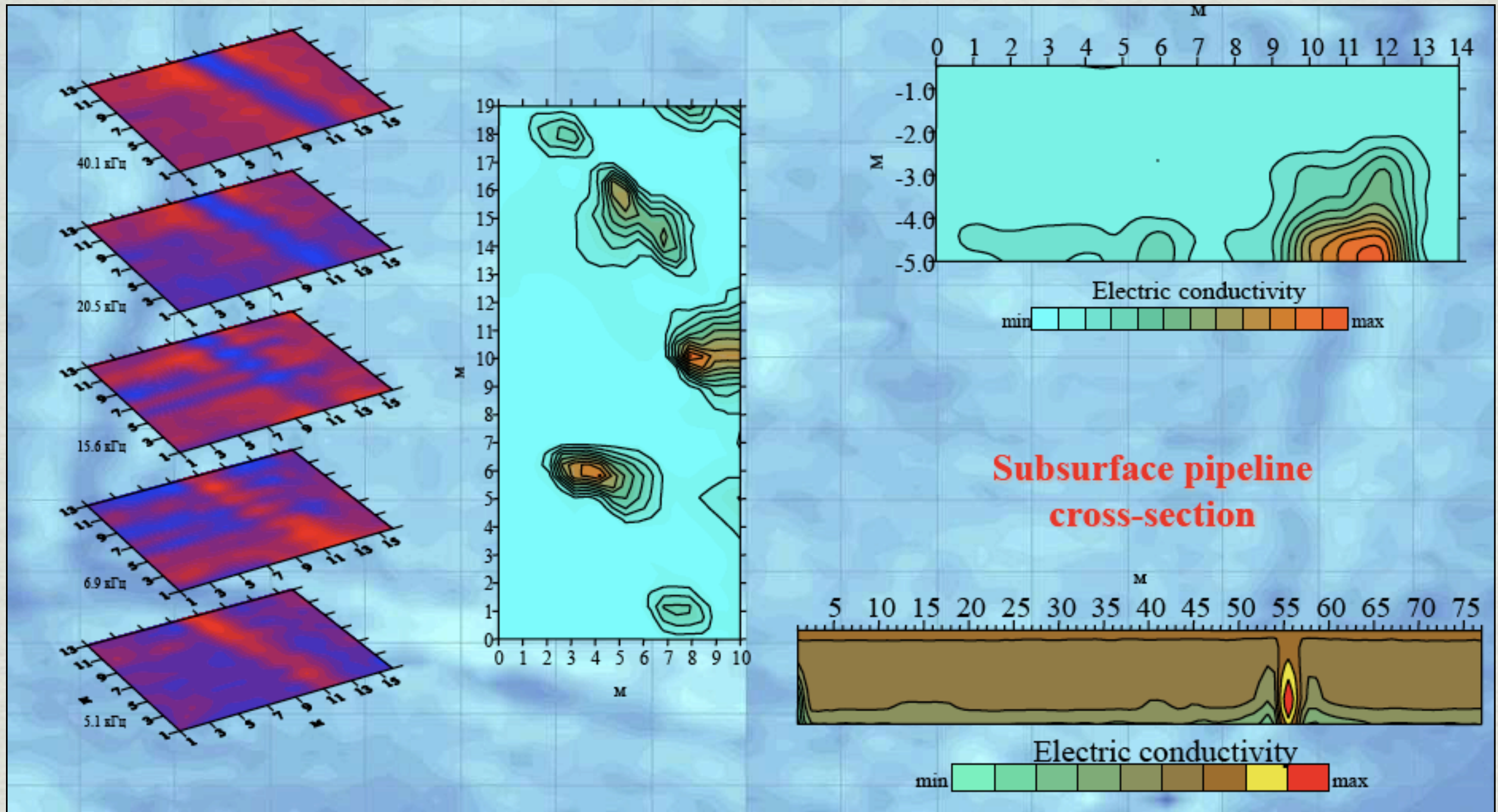


# The Field Work Samples

**Subsurface pipeline mapping**

**Buried metal bars mapping**

**Buried graphite bars cross-section**





## Subsurface pipeline nearby Busseto town



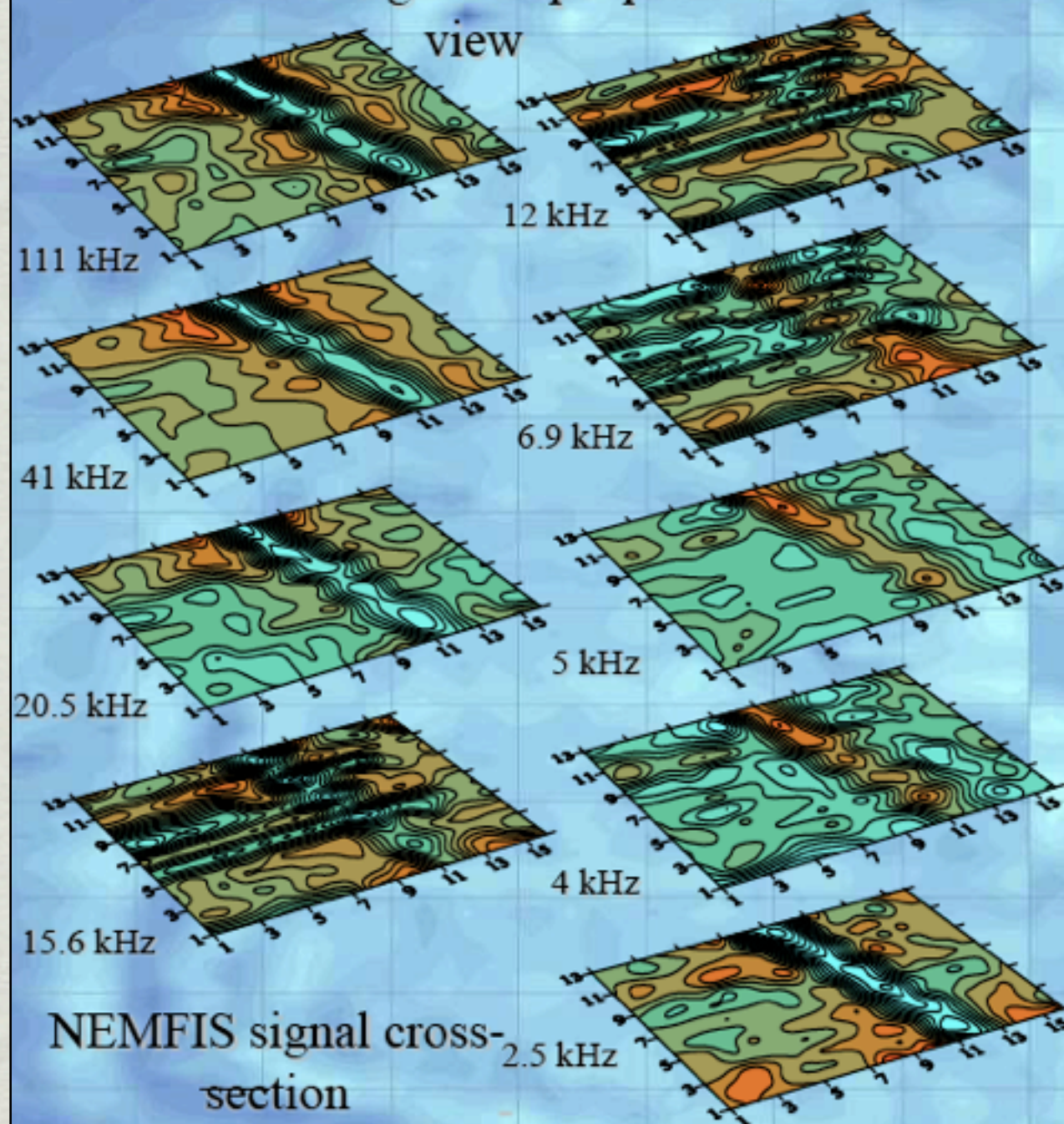
An old metal pipeline is located under the tillage. The work done using four instruments: IRIS Syscal, GEM-300, EM-31 and NEMFIS.



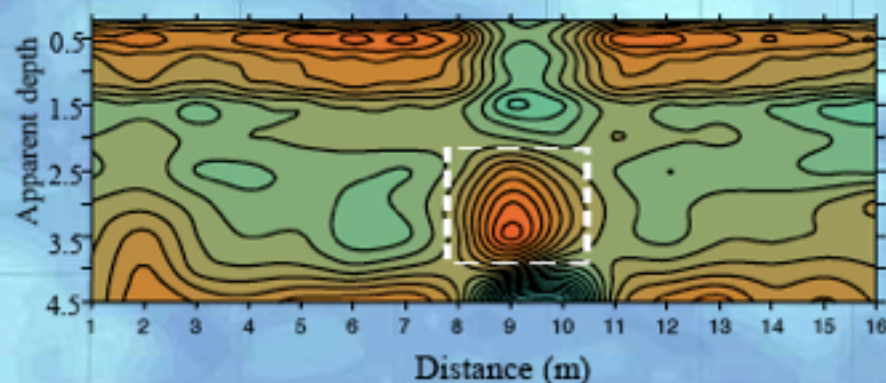


## NEMFIS signal maps quazi 3D

view



NEMFIS signal cross-section

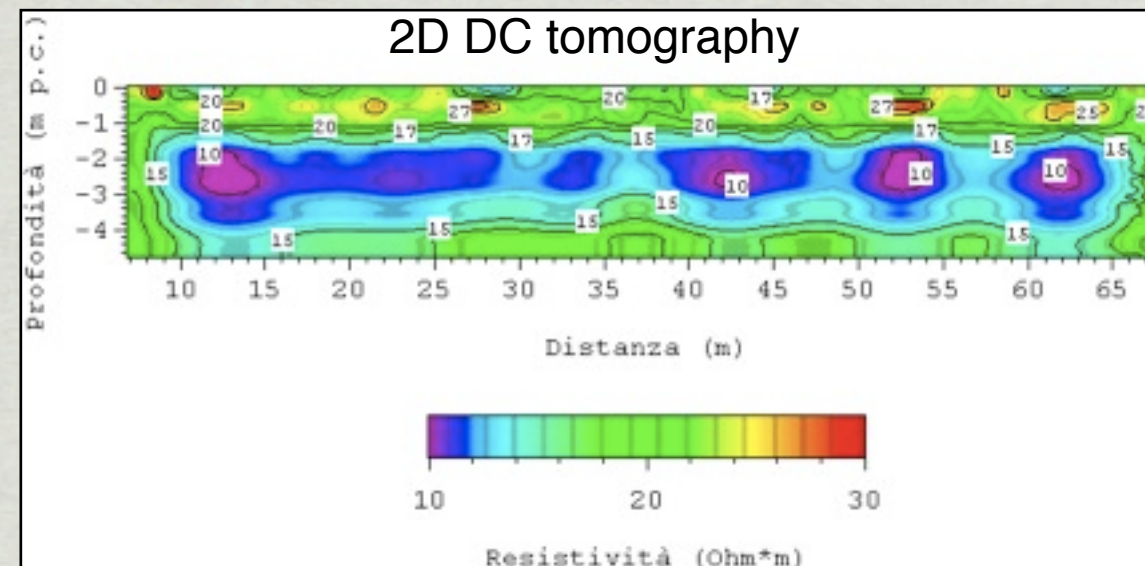


[WWW.NEMFIS.RU](http://WWW.NEMFIS.RU)

## The results of comparative work above pipeline

Only NEMFIS data show immediately two theft's pipes on freqs from 6,9 to 15 kHz.

### 2D DC tomography

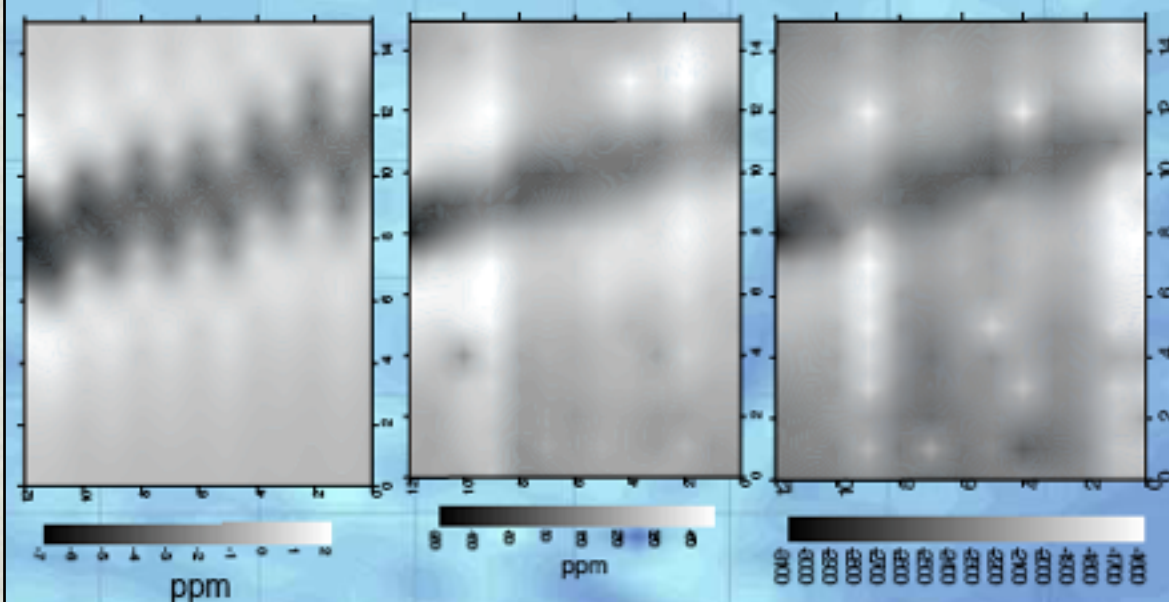


EM-31 signal

GEM-300 signal

20 kHz

2.5 kHz



NEMFIS



## Visualization of measurement data



NEMFIS can build 2D, kvazi-3D and 3D visualization, so the operator can understand the possible depth of the target. On the PDA you can see the result of scanning of area 12x12m with 4 different pipes underground (from left to right: metal pipe 250mm for water on the depth 3,5m; metal pipe 150mm for water on depth 2,5m; plastic gas pipe 100mm on depth 2m and the cable 50mm on depth 0,7m). Also there is the pictures with 3D visualization of some value of conductivity.

