



GEOINVEST s.r.l.

Geologia-Geofisica



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Geoinvest s.r.l. is a privately owned geophysical and geotechnical engineering company with a reputation for providing timely and reliable services. Geoinvest serves individuals and industry, public and private companies, governments, international development agencies and academic institutions.

Established in 1980 to enhance and develop geophysical technology for the geotechnical engineering sector, the company has steadily expanded to offer services in a wide range of geophysical exploration activities.



With a staff of experienced professionals (from geophysicists and geologists to geotechnical engineers) and a large inventory of state-of-the-art in-house software, Geoinvest is uniquely positioned to serve most of exploration needs, whatever they involves:



Geoelectrical Surveys

- *High resolution Resistivity Imaging*
- *IP tomography*

Electromagnetic Surveys

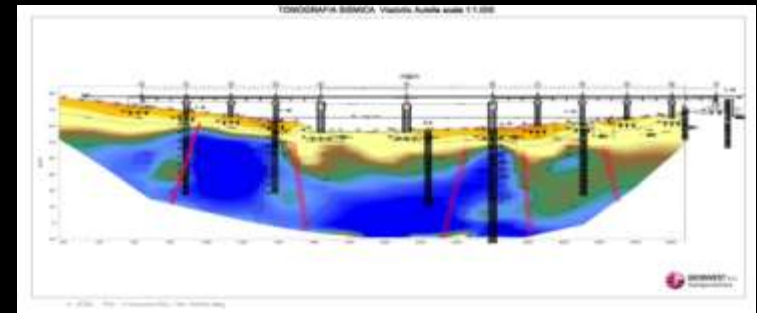
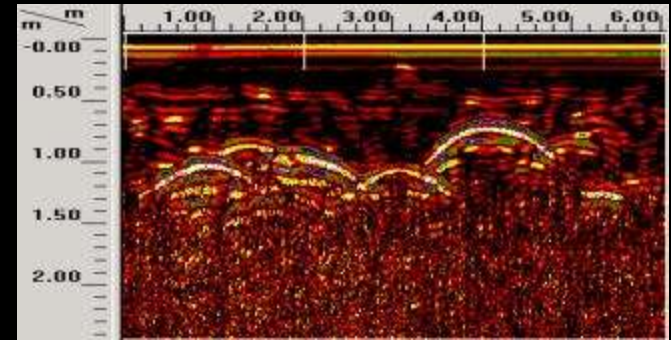
- *Ground Penetrating Radar*
- *Frequency and time domain EM*
- *High resolution MT and AMT*

Gravity and Magnetic Surveys

- *Total field*
- *Gradiometry*

Seismic and Microseismic

- *V_p and V_s refraction and tomography*
- *High resolution Reflection*
- *Borehole seismic*



Geoinvest services are applied in the following fields:

Archaeology

- *Preliminary investigations in regional planning*
- *Location of buried archaeological remains*

Engineering Geology and Geotechnical

- *Tunneling*
- *Highways Railways Pipelines Slope stability Foundations*
- *Cavity detection*

Hydro geological Studies

- *Aquifer geometry , water well positioning*

Environmental Geology and contaminated site

- *Site characterization*
- *Leachate plumes, contaminant migration*
- *Landfill study, Leak detection on liner geomembrane*
- *Vibrations monitoring*

Mining Geophysics

- *Hydrocarbon and mineral exploration*
- *Geothermal exploration*



SUBSURFACE GEOPHYSICAL INVESTIGATION FOR GEOENGINEERING GROUNDWATER AND ENVIRONMENTAL STUDIES

04/10/2010



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GEOPHYSICAL METHODS

The geophysical methodologies use physical properties of the materials to characterize their presence and distribution in the subsurface

Measuring from the surface in a non-invasive way geophysics is able to supply informations about the subsurface structure

The main geophysical parameters are:

- ◆ **electrical resistivity/conductivity**
- ◆ **elasticity, density**
- ◆ **magnetic susceptibility**
- ◆ **radioactivity**



GEOPHYSICAL METHODS

To explore the subsurface you always need a source of “energy” who defines the method:

PASSIVE METHODS (Natural source)

- ✓ Natural electric currents (telluric)
- ✓ Electrical Spontaneous Potential
- ✓ Gravity
- ✓ Magnetism
- ✓ Seismic waves

ACTIVE METHODS (Artificial source)

- ✓ Electromagnetic waves
- ✓ Electrical resistivity
- ✓ Seismic waves



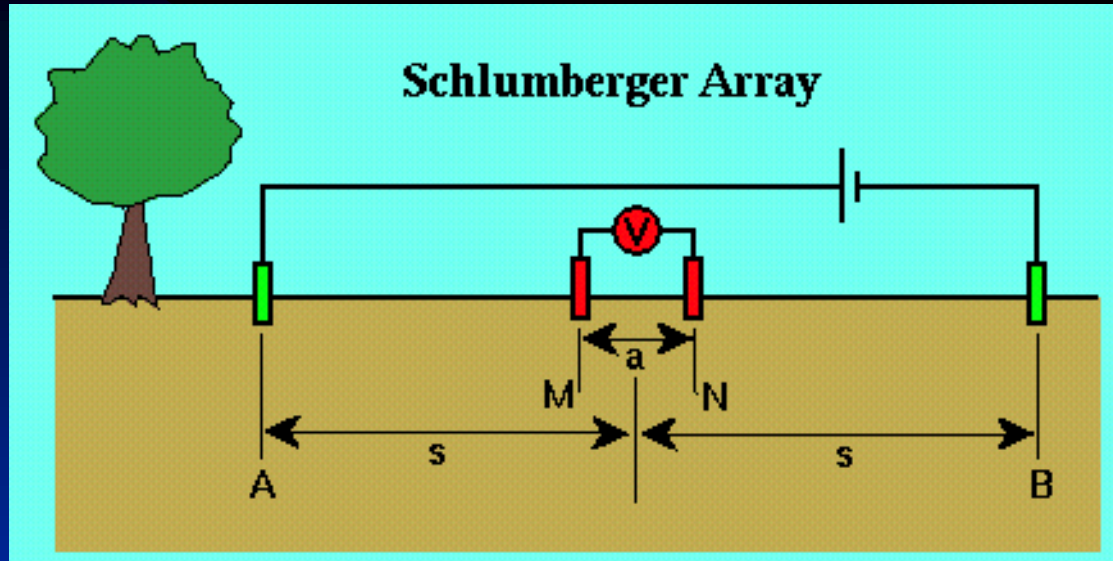
ELECTRICAL RESISTIVITY METHODS

These method are used for hydrogeological and ground contamination surveys, site investigation (geological and mineral prospecting) and archaeological surveying

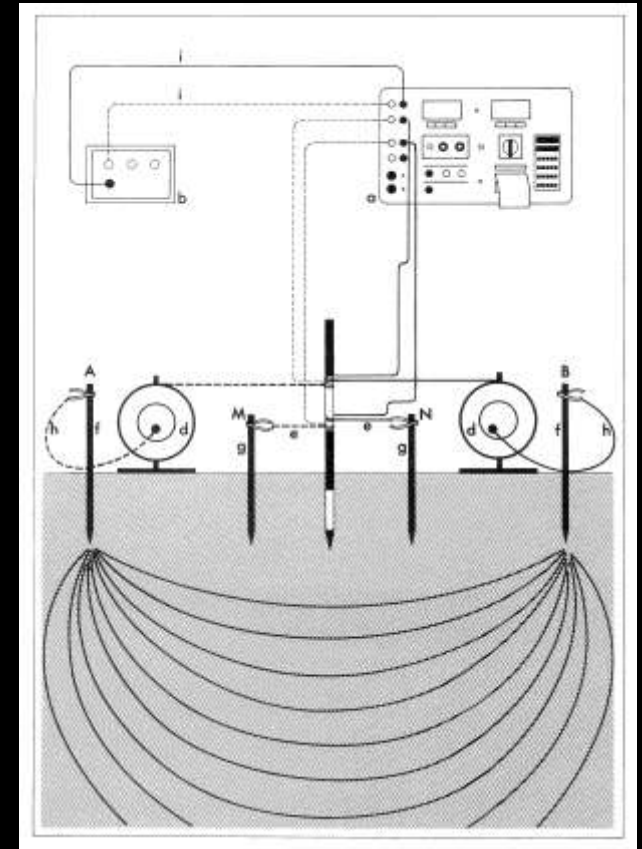
- ◆ **VERTICAL ELECTRIC SOUNDINGS**
- ◆ **RESISTIVITY PROFILING**
- ◆ **ELECTRICAL IMAGING**



VERTICAL ELECTRIC SOUNDING - VES



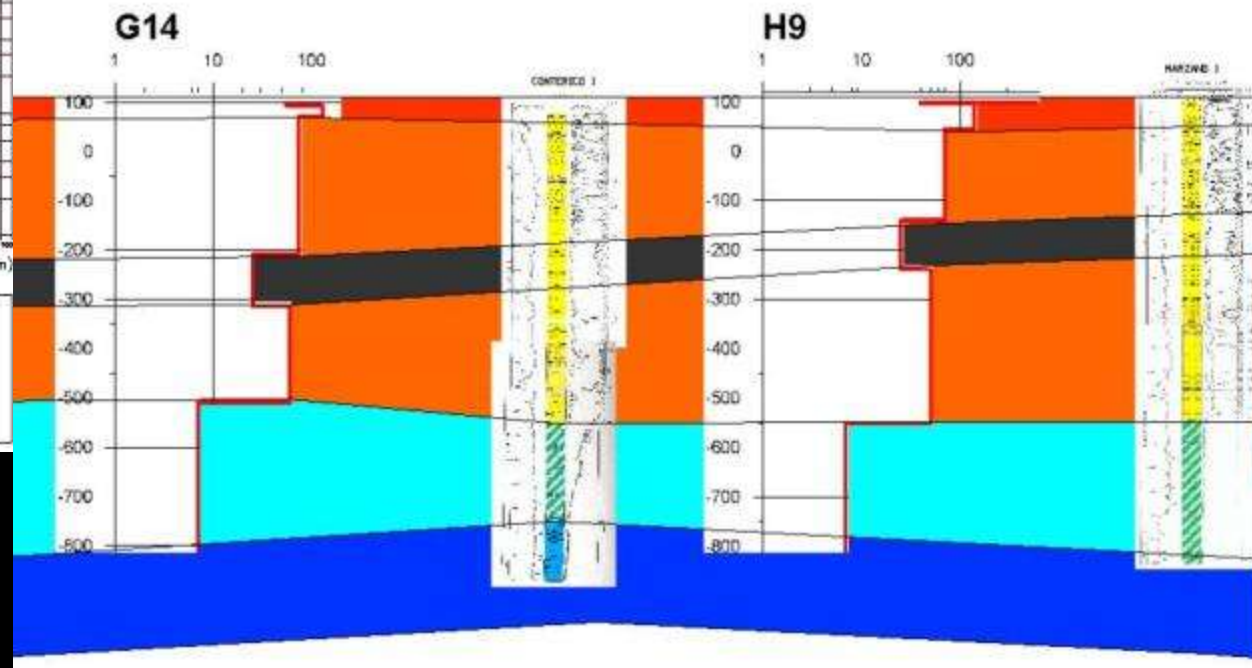
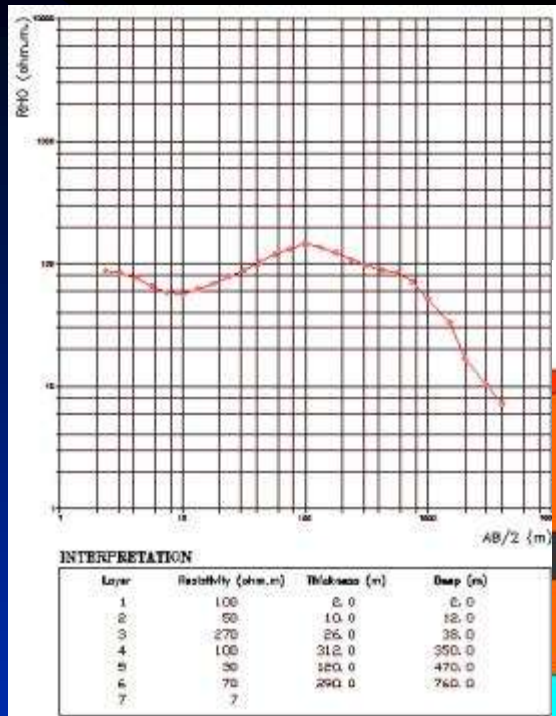
- **Four electrodes**
- **Measure resistivity at increasing depth**



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VERTICAL ELECTRIC SOUNDING - VES

VES FIELD CURVE

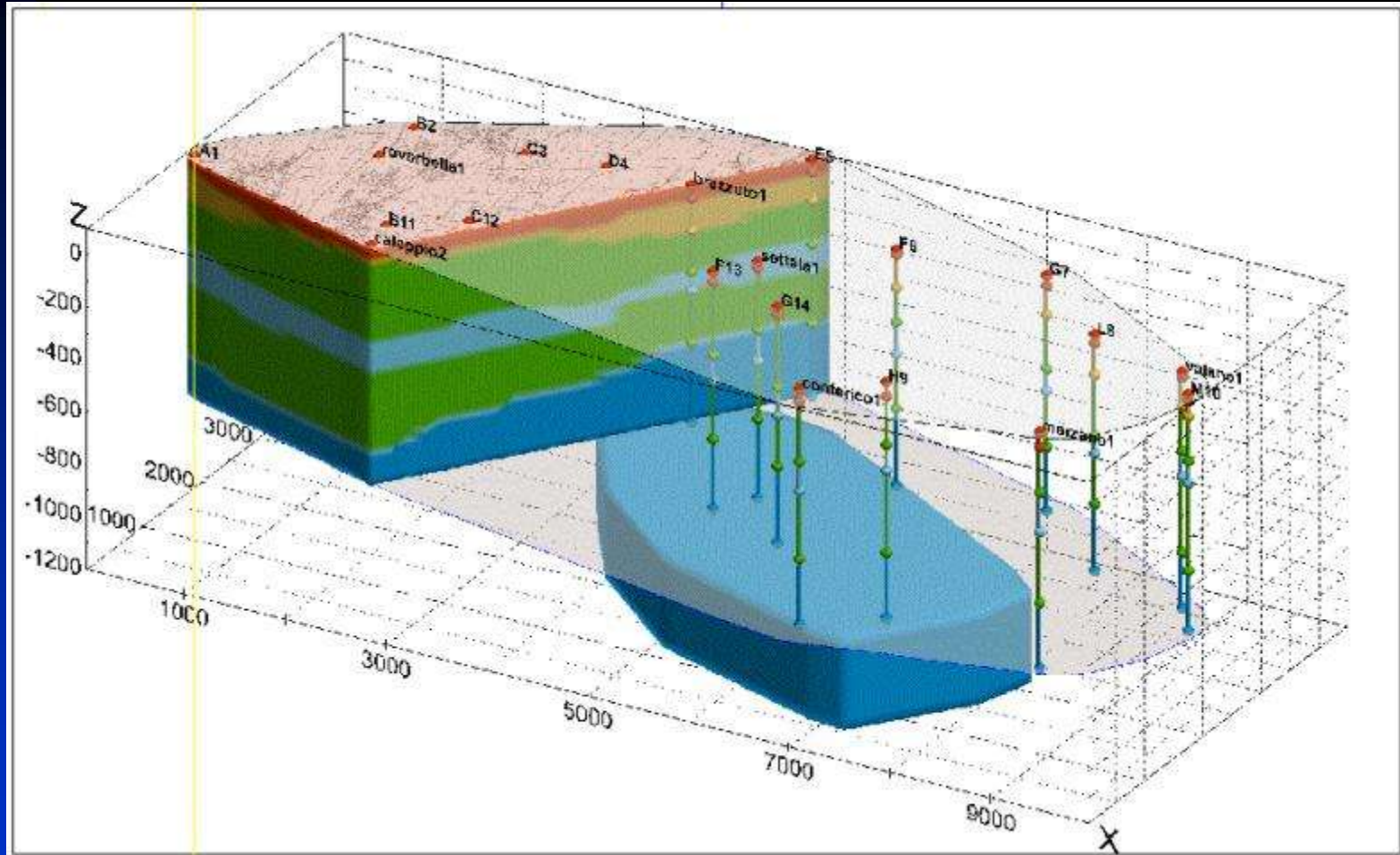


RESISTIVITY CROSS SECTION



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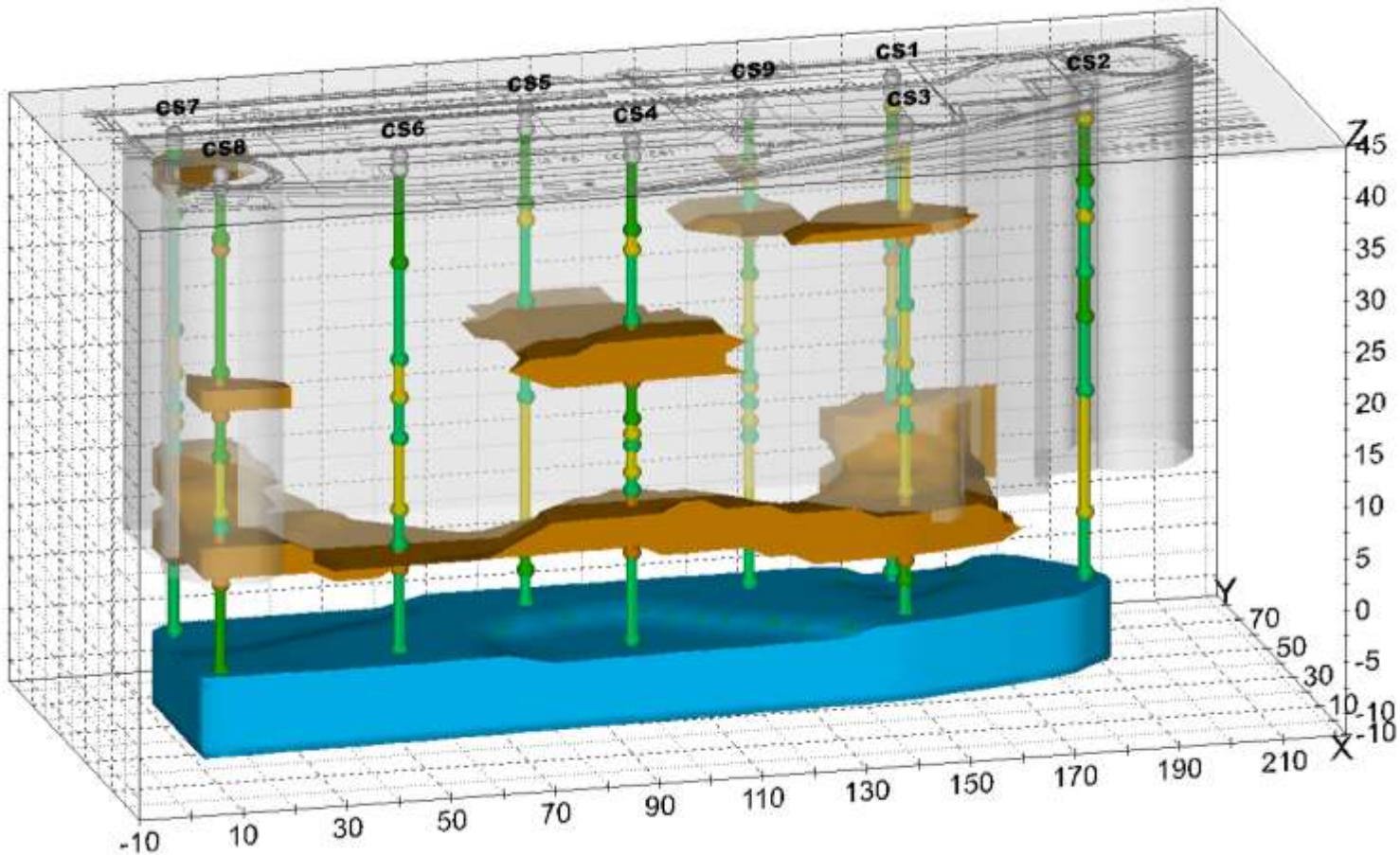
VERTICAL ELECTRIC SOUNDING - VES



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HYDROGEOLOGICAL 3D MODEL

VERTICAL ELECTRIC SOUNDING - VES



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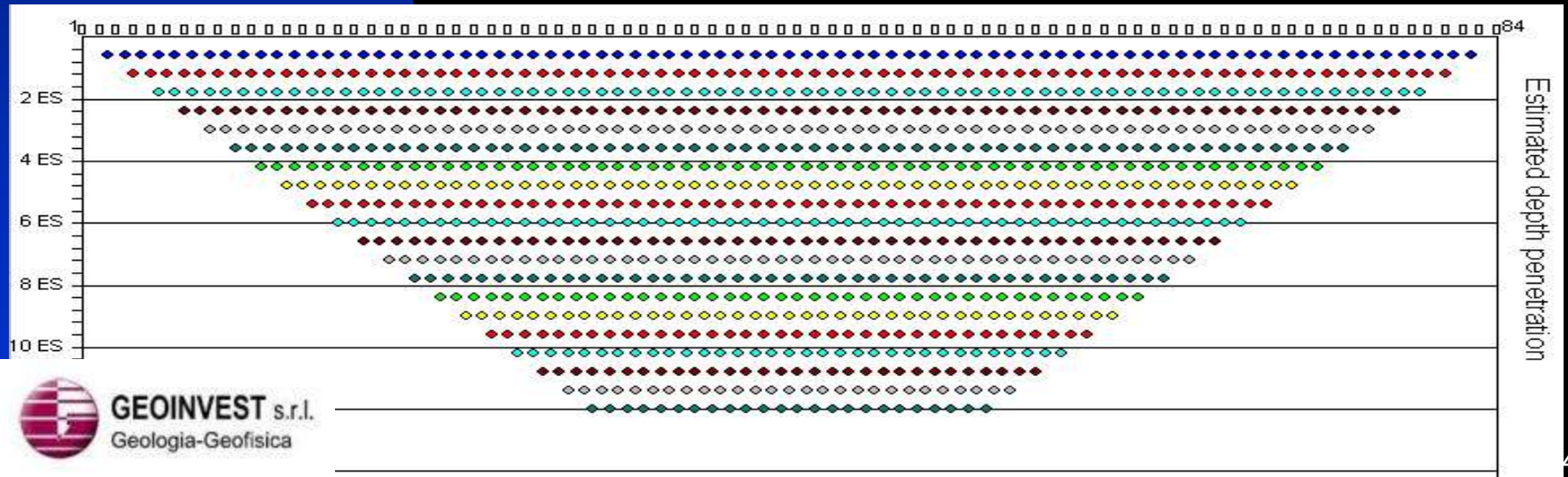
HYDROGEOLOGICAL 3D MODEL

RESISTIVITY IMAGING

A CONTINUOUS 2D RESISTIVITY CROSS SECTION

Field
array

Measurement scheme



DC Resistivity imaging

• Data acquisition

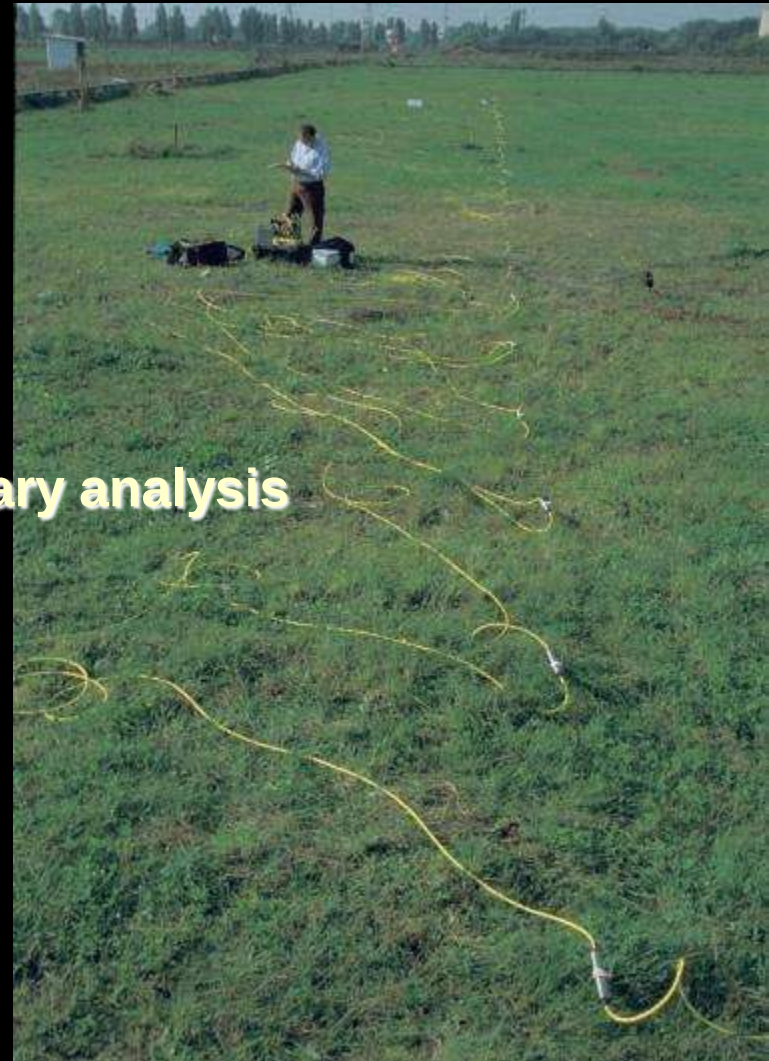
- ✦ AGI Super Sting R1 IP
- ✦ Swift Smart electrodes and cables
- ✦ Automatic resistivity & IP imaging

• Data processing

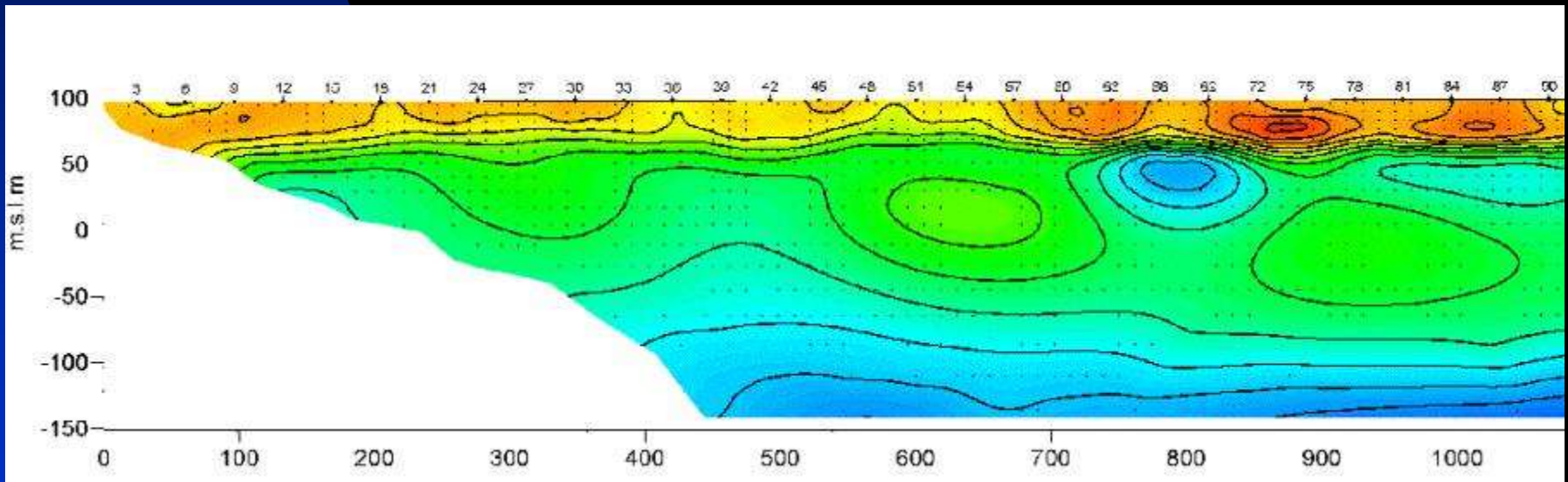
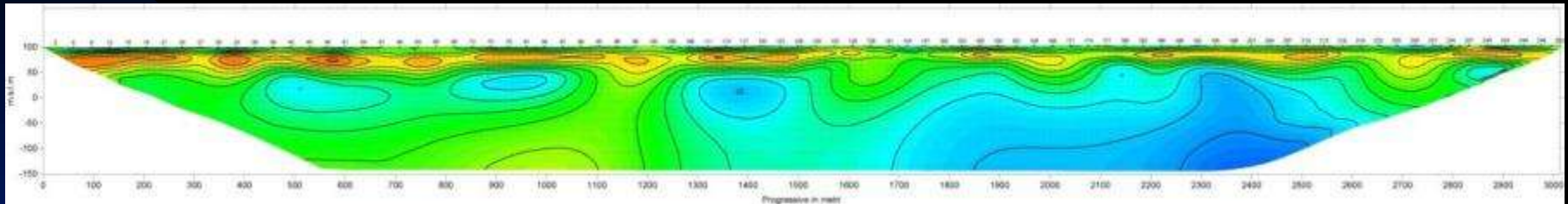
- ✦ Complete in-field QC
- ✦ Crooked line correction & preliminary analysis

• Data interpretation

- ✦ 2D, 3D inversion
- ✦ 3D topographic modeling
- ✦ Cooperative interpretation



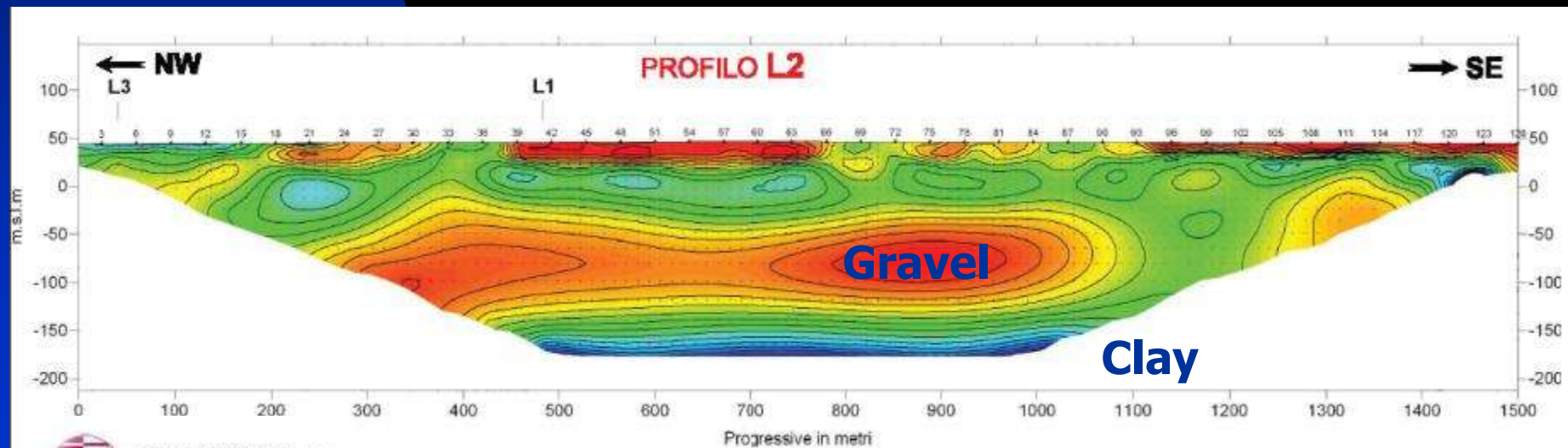
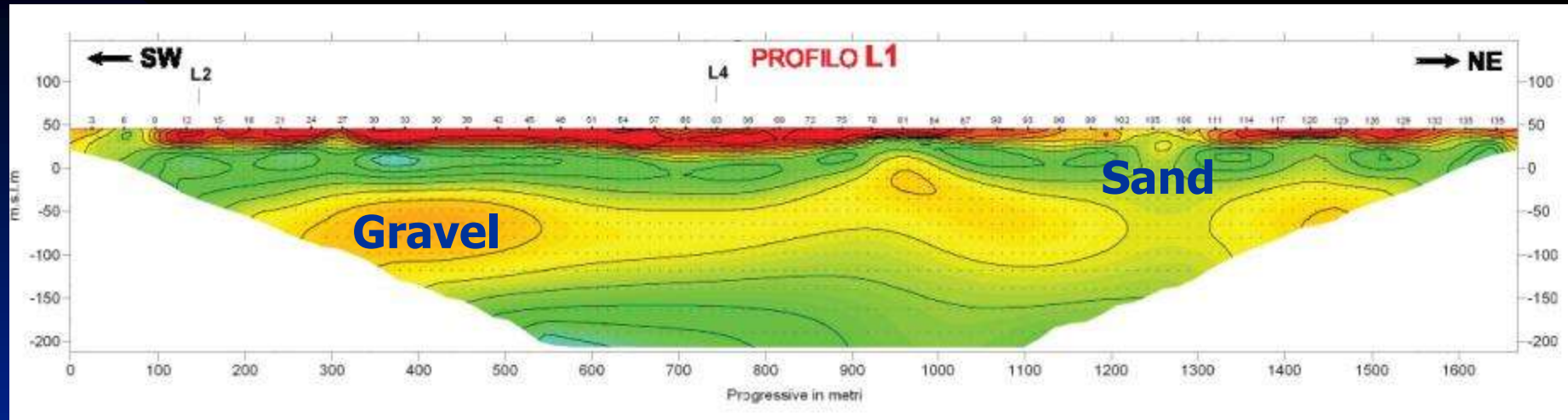
Hydrogeological survey



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Evaluation of the subsurface layering

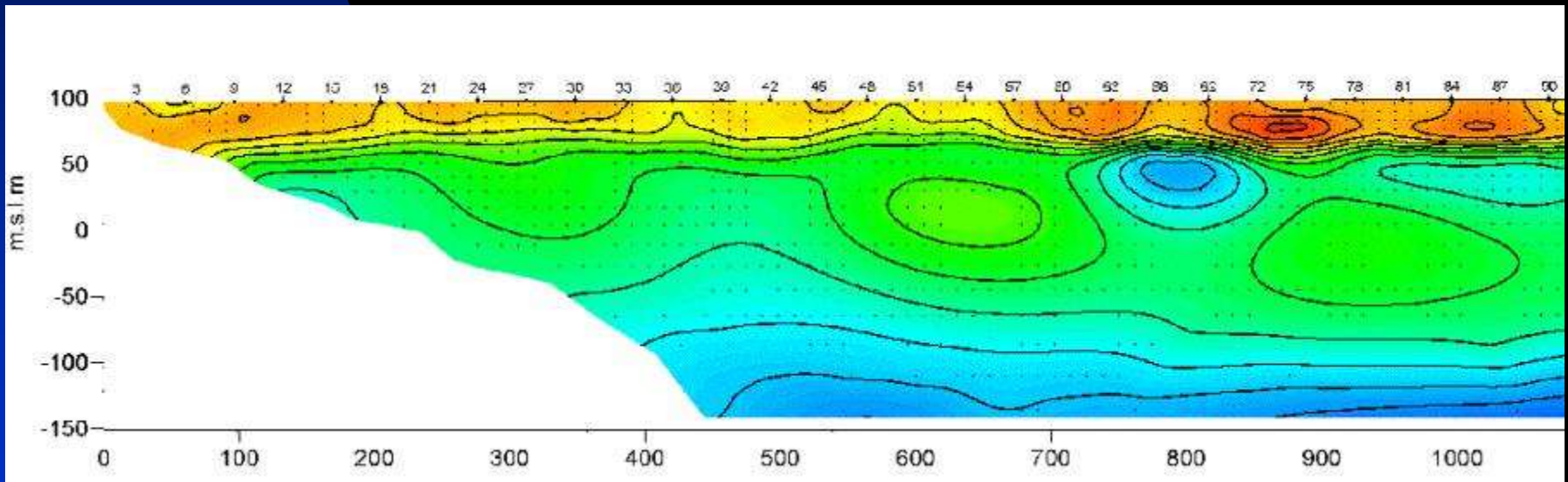
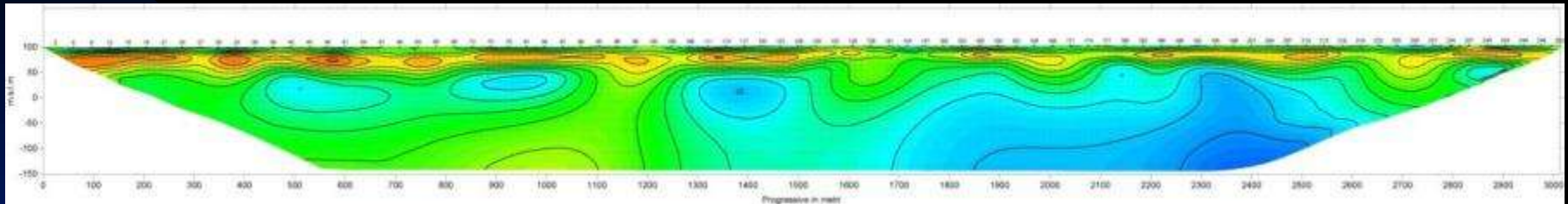
Hydrogeological survey



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Evaluation of the subsurface layering

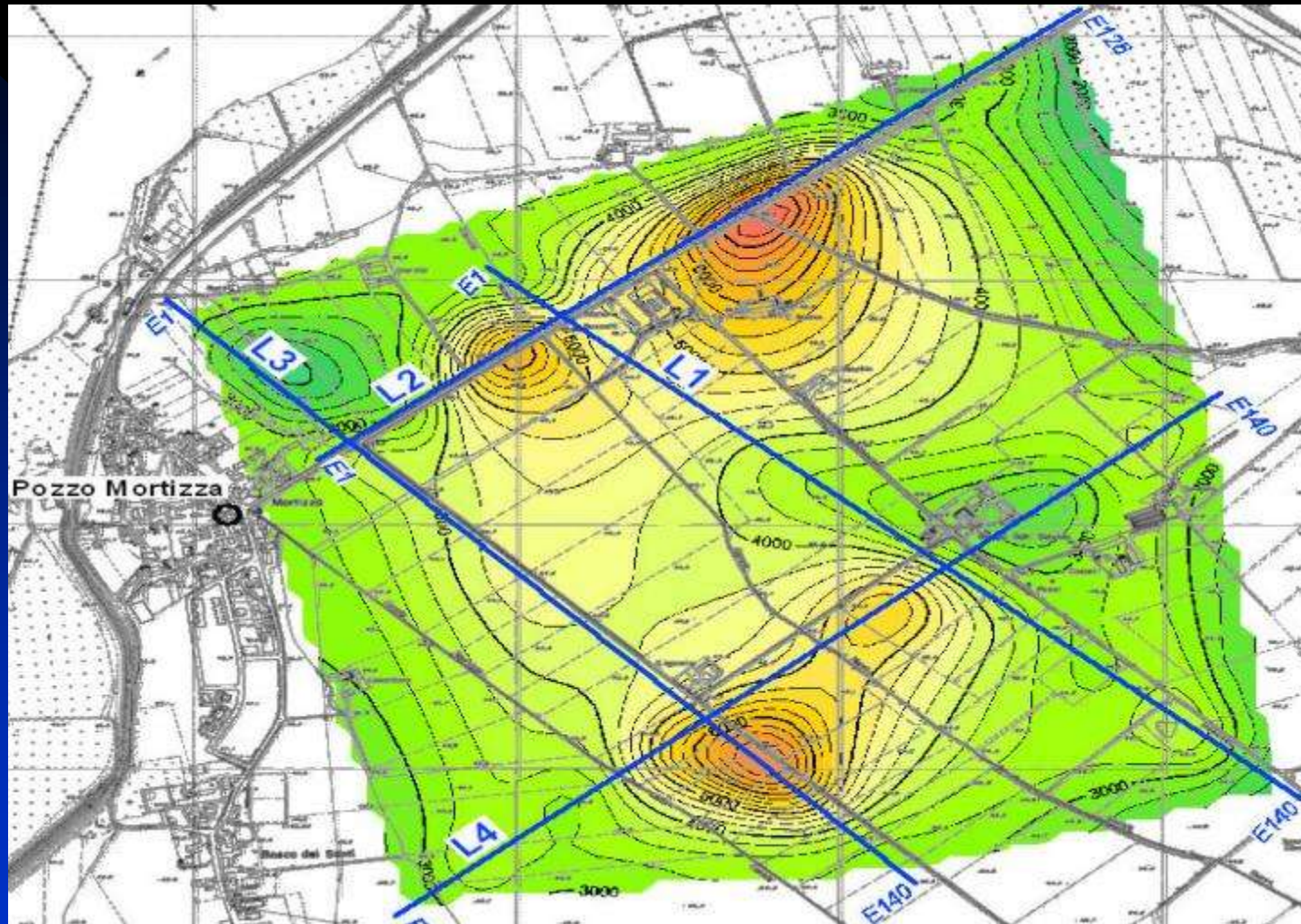
Hydrogeological survey



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Evaluation of the subsurface layering

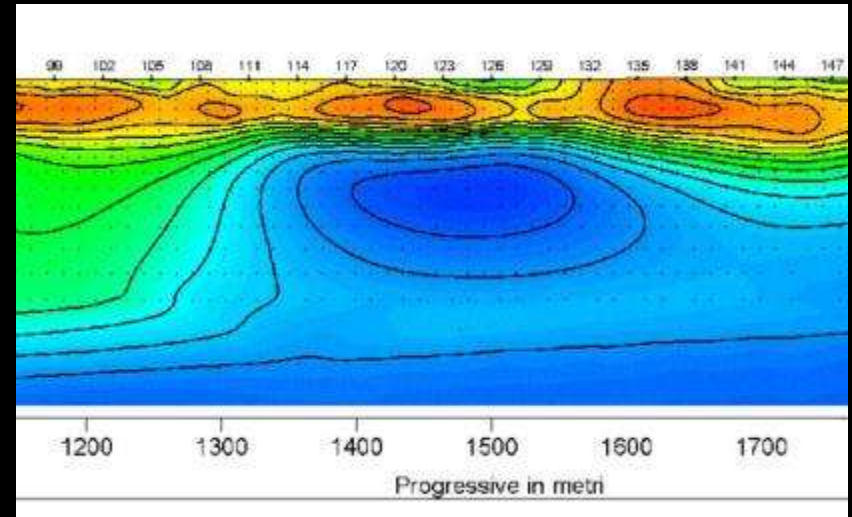
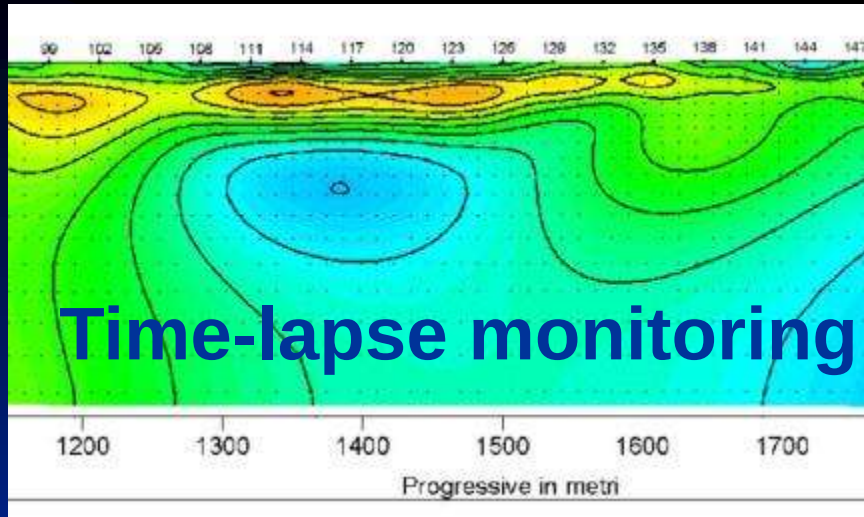
Hydrogeological survey



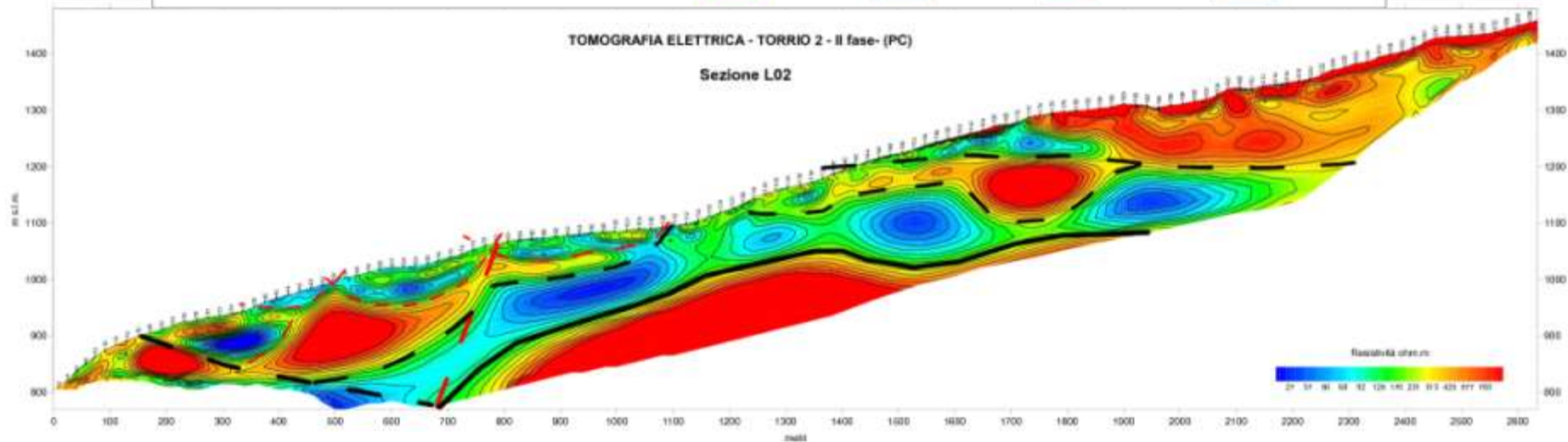
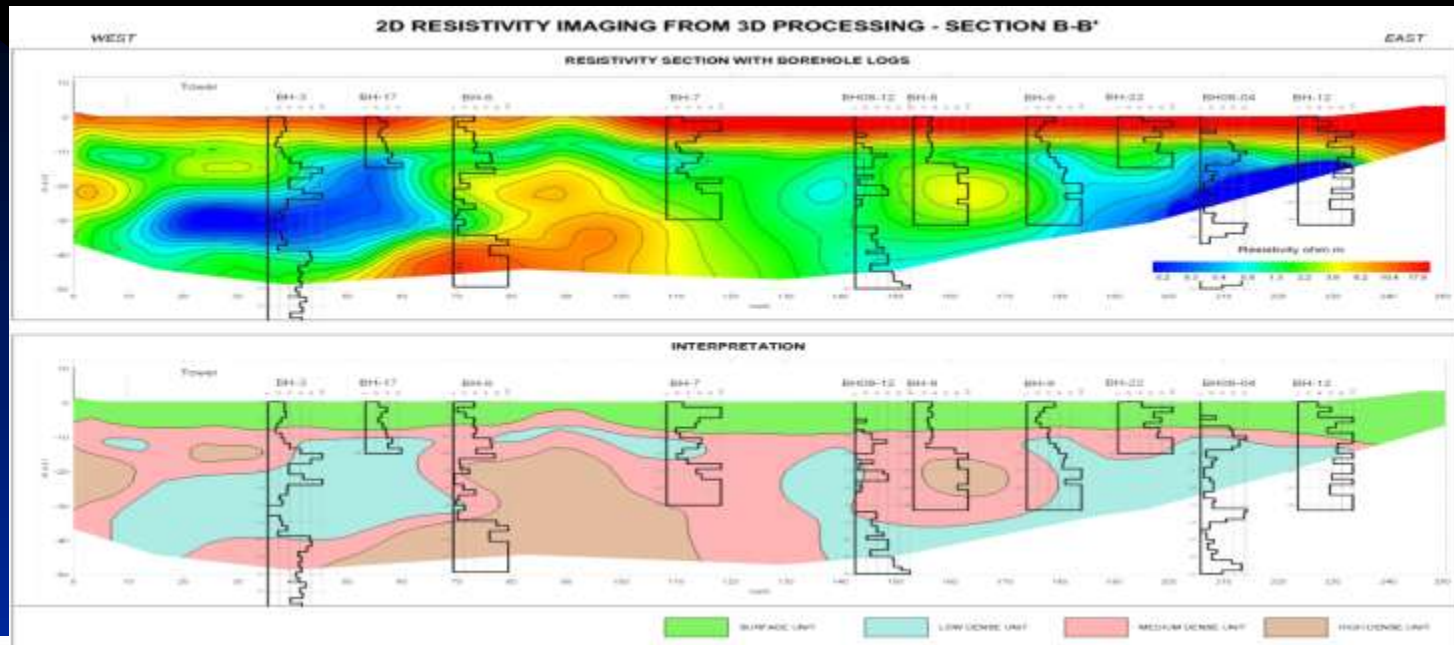
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Water well planning

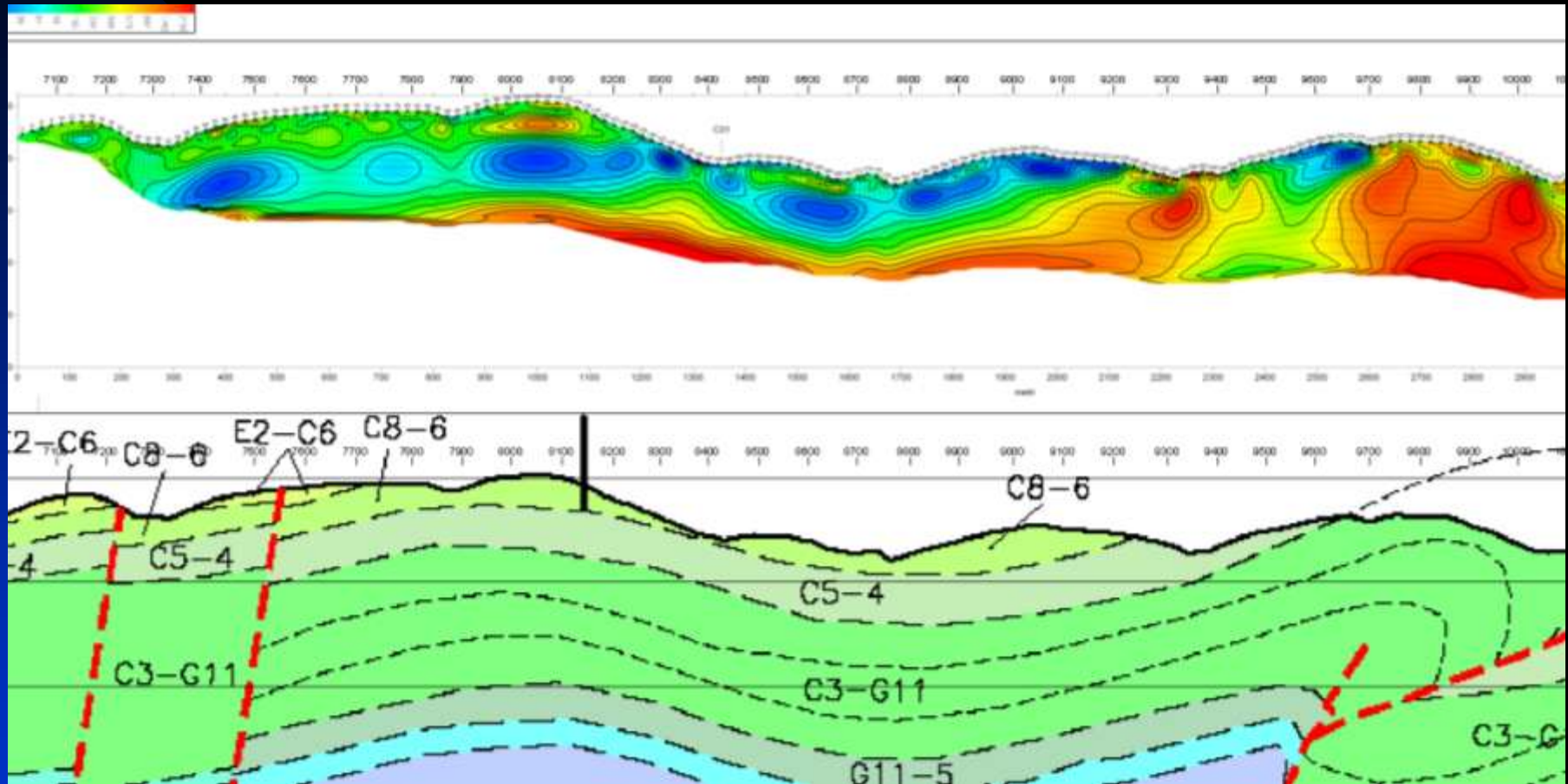
Watertable contamination survey



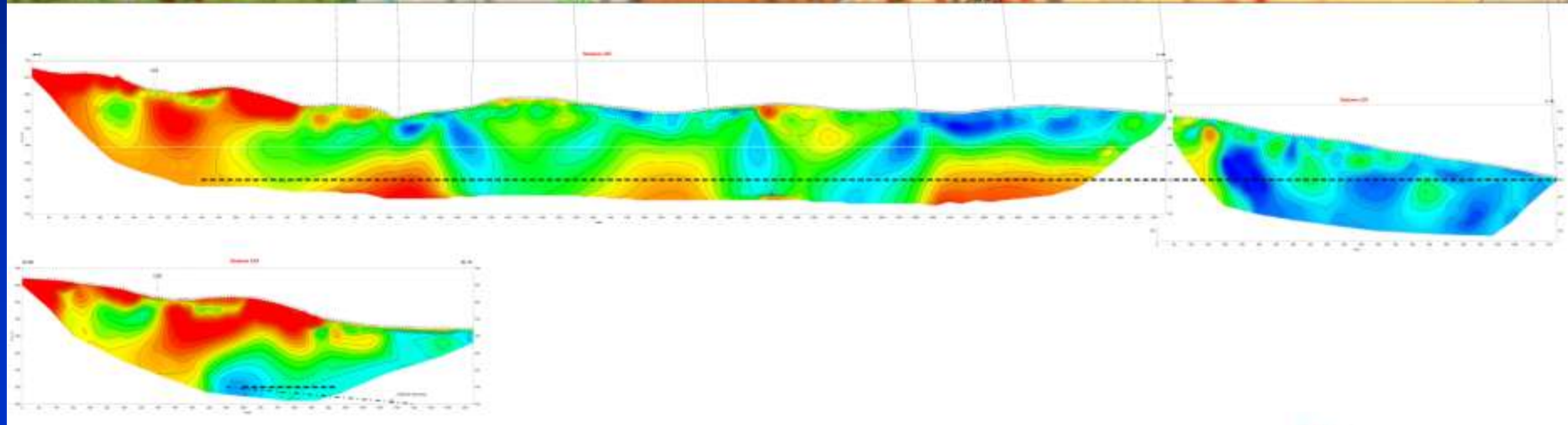
Geoengineering studies



ELECTRIC TOMOGRAPHY TO BUILT THE GEOLOGICAL SECTION FOR A TUNNEL FEASIBILITY STUDY

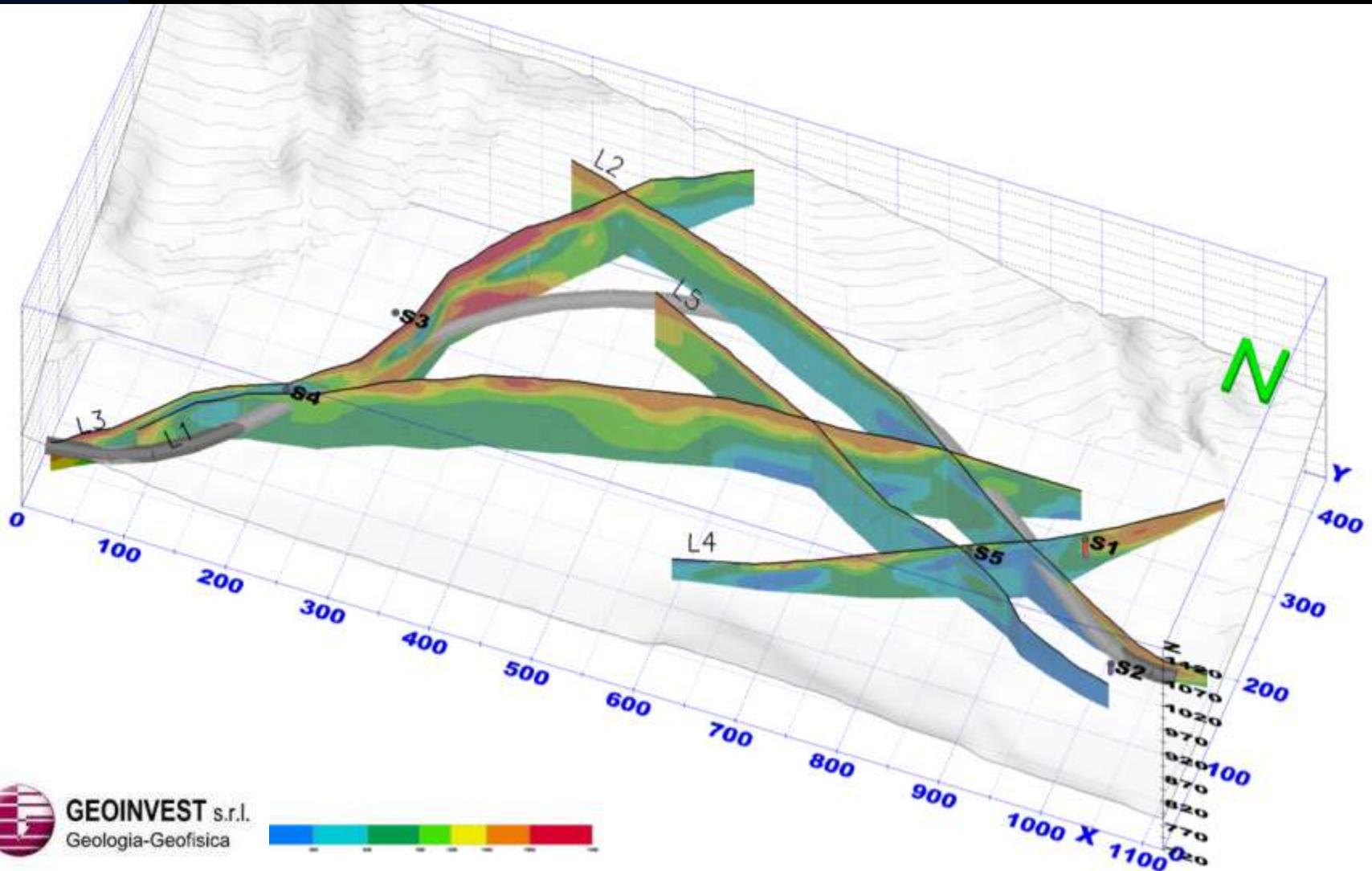


GEOLOGICAL SECTIONS



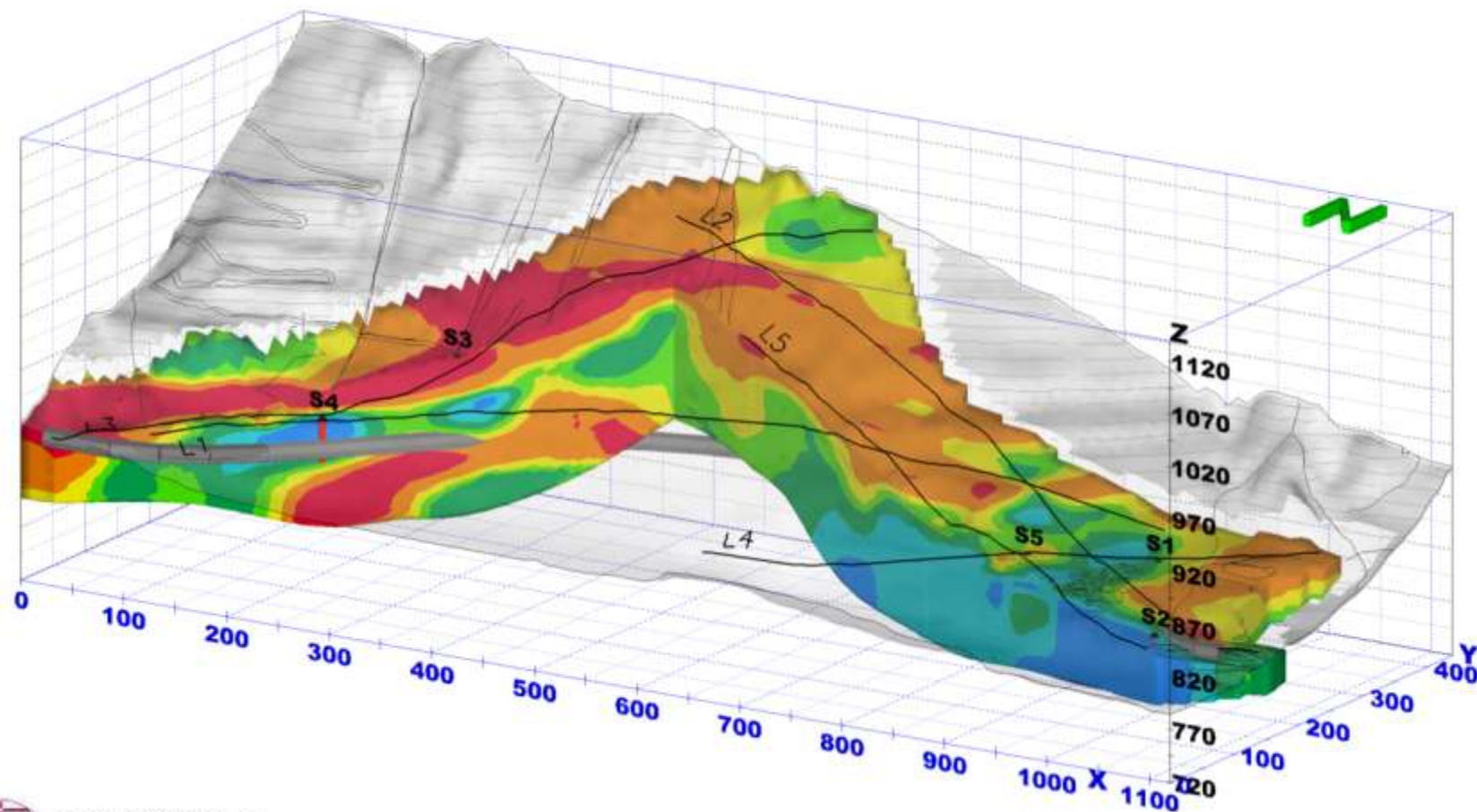
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ELECTRIC TOMOGRAPHY 2D SECTIONS ON A TUNNEL PROJECT



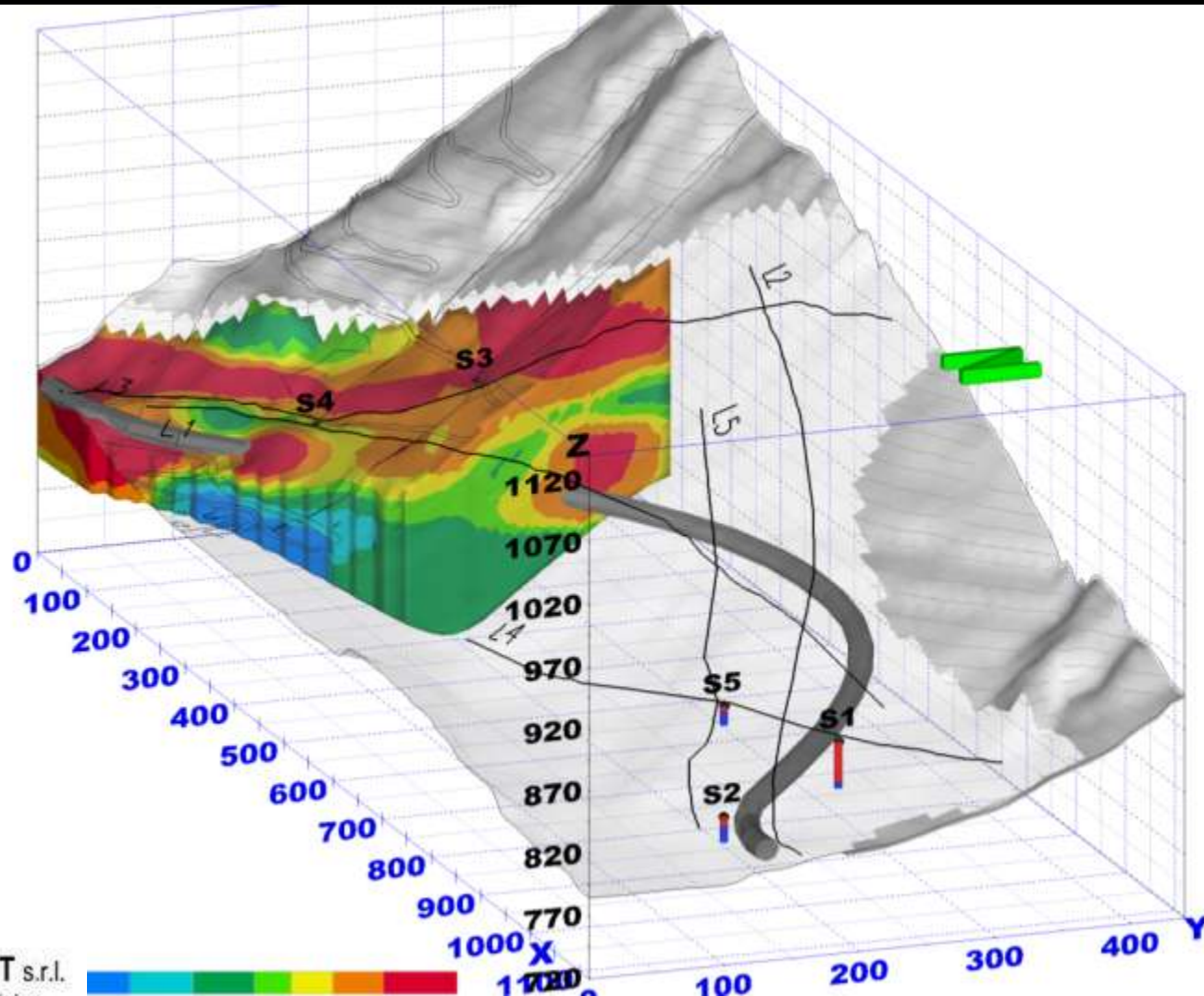
ELECTRIC TOMOGRAPHY DATA PROCESSING

3D VIEW



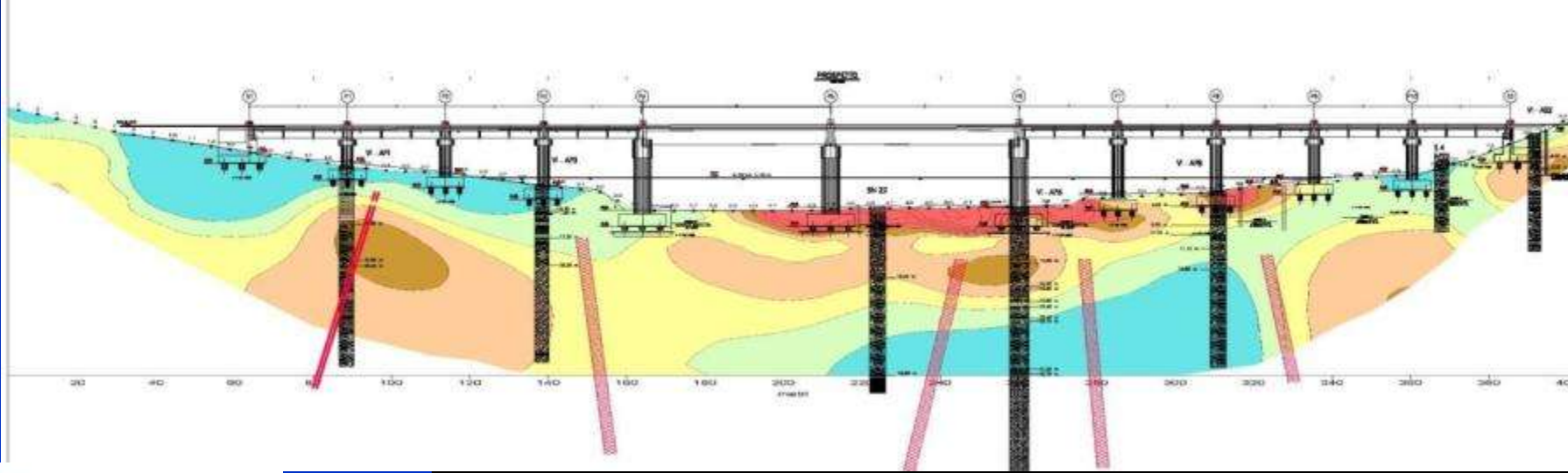
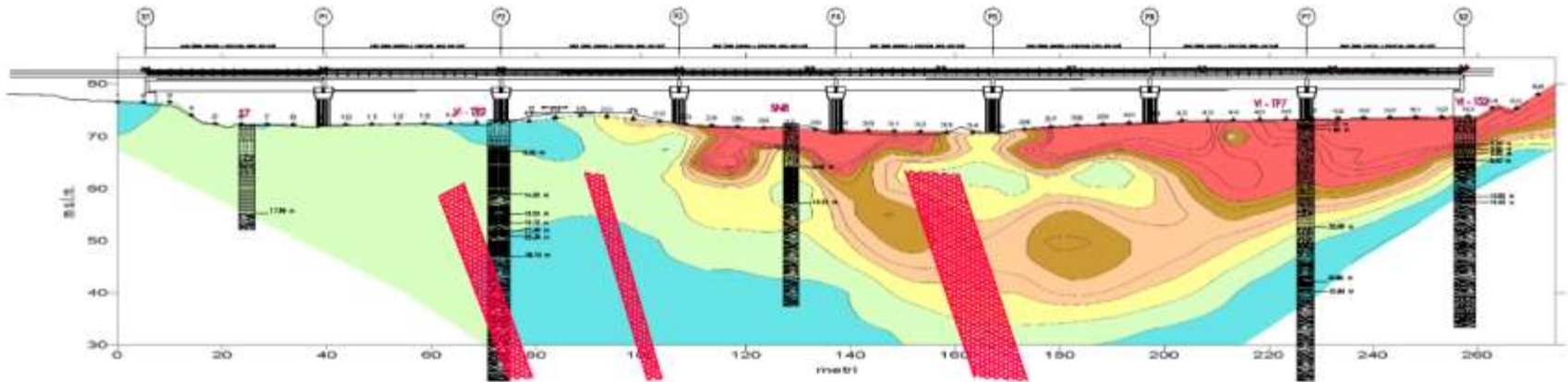
ELECTRIC TOMOGRAPHY DATA PROCESSING

3D VIEW



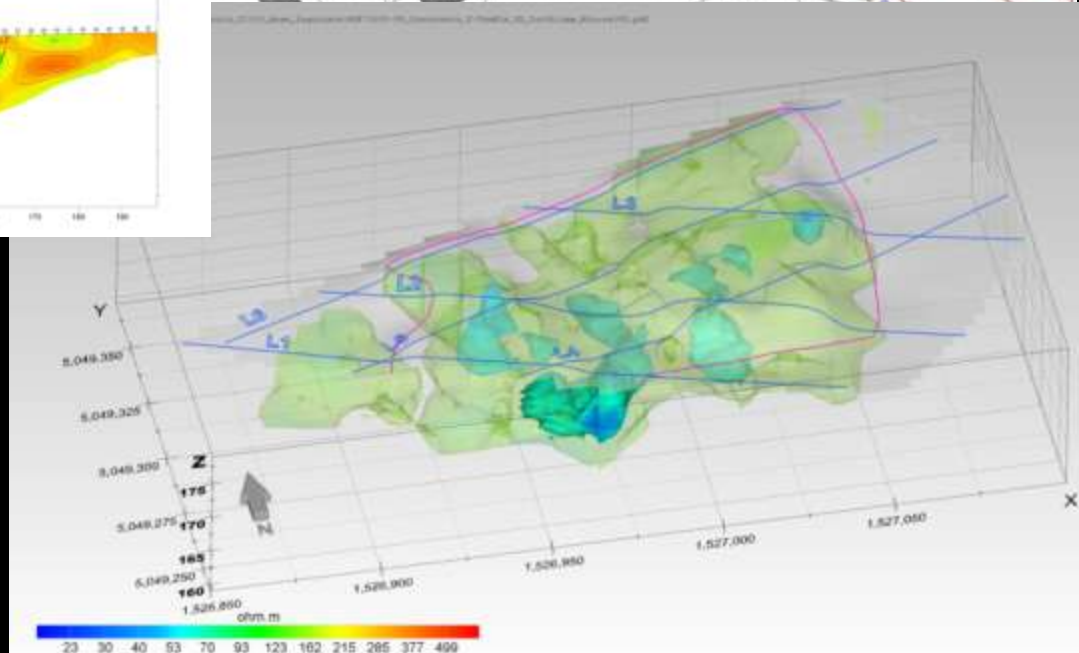
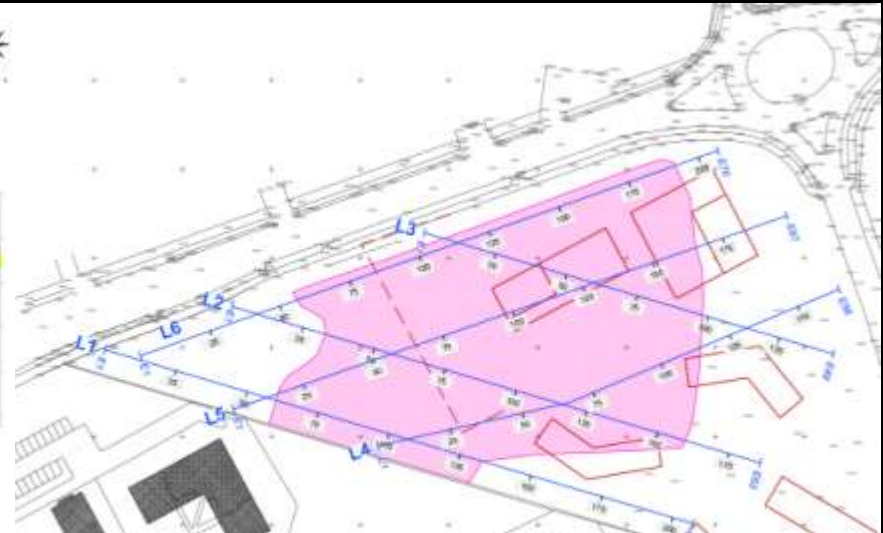
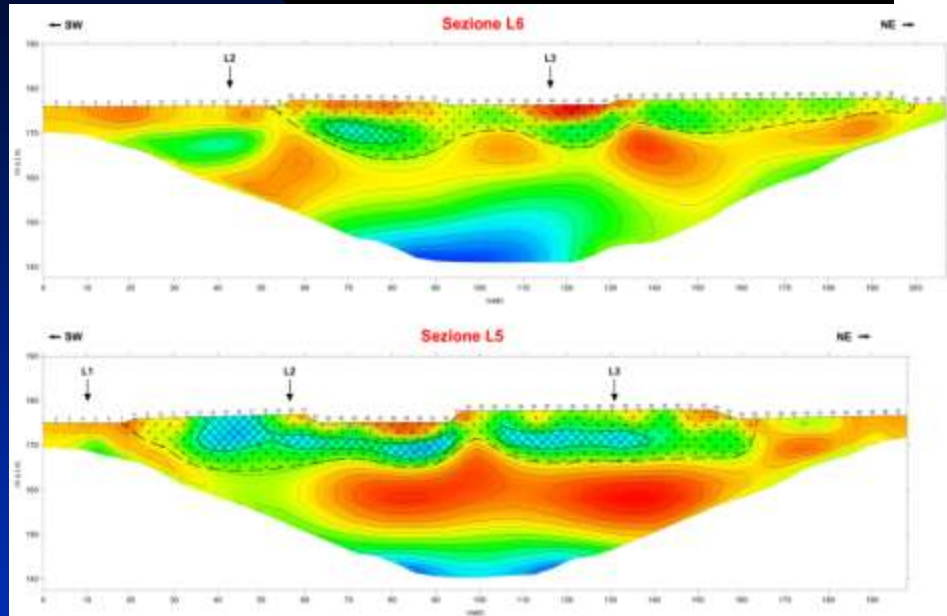
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ELECTRIC TOMOGRAPHY ON BRIDGE PROJECTS

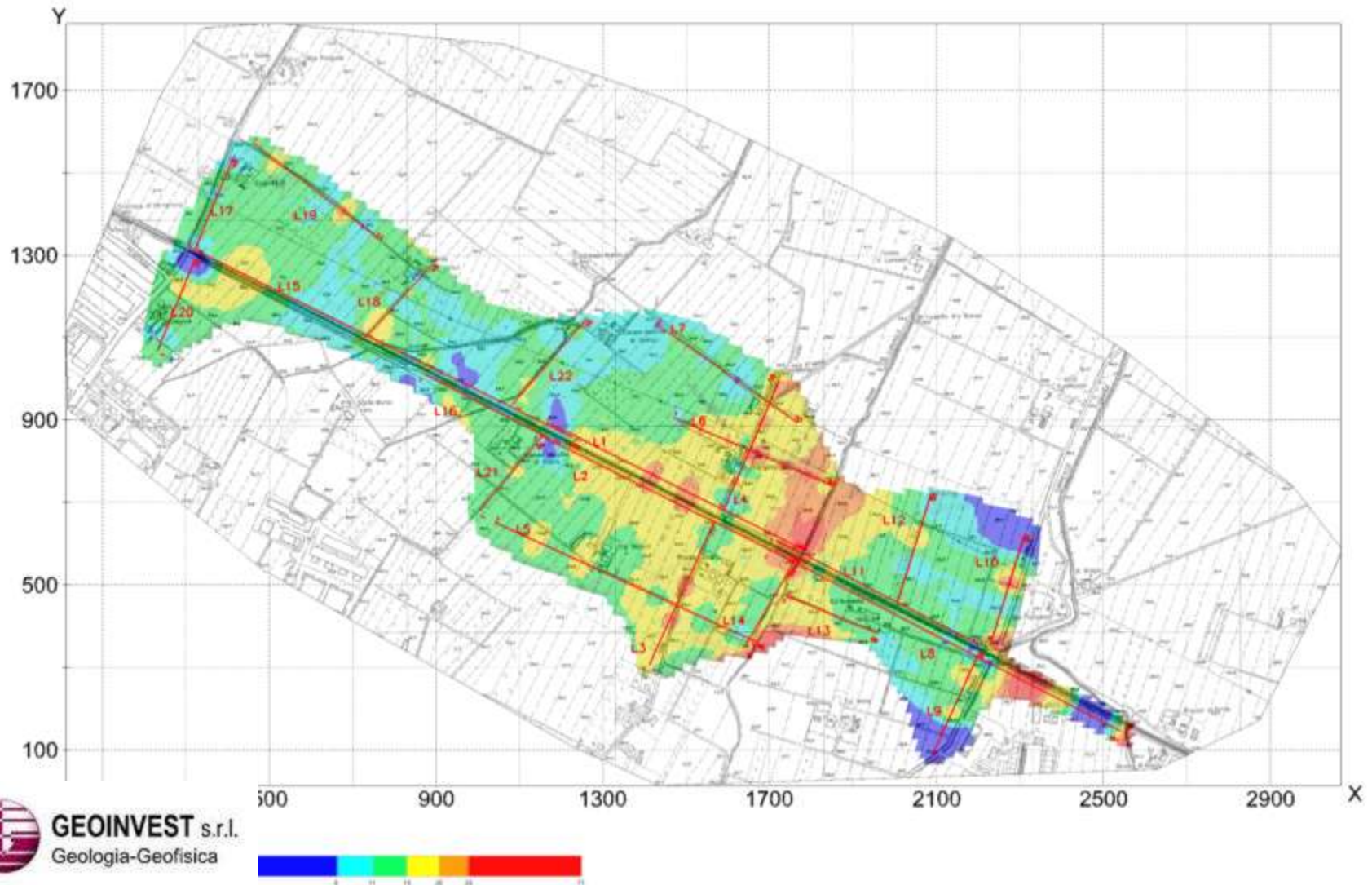


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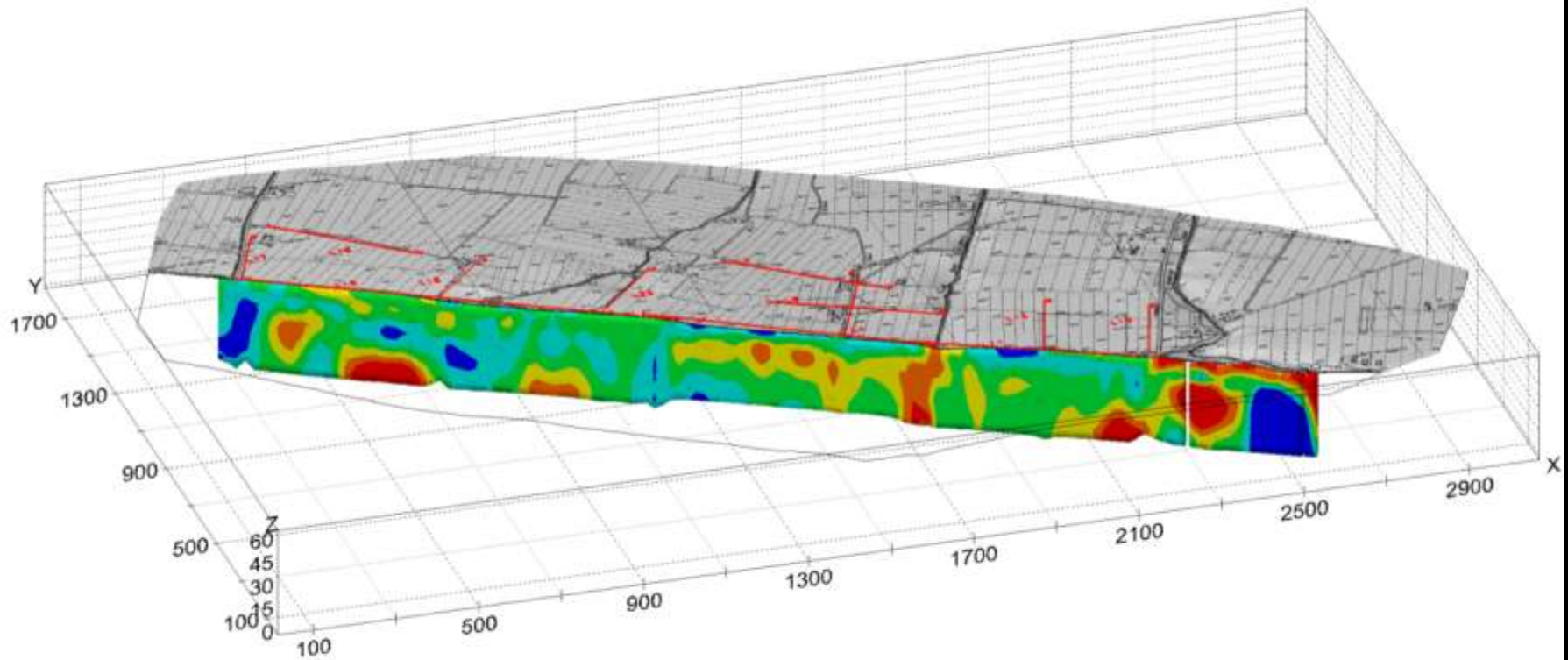
ELECTRICAL TOMOGRAPHY SURVEY ON A INDUSTRIAL SITE ENVIRONMENTAL ASSESMENT



ELECTRICAL TOMOGRAPHY SURVEY FOR ENVIRONMENTAL SITE ASSESMENT



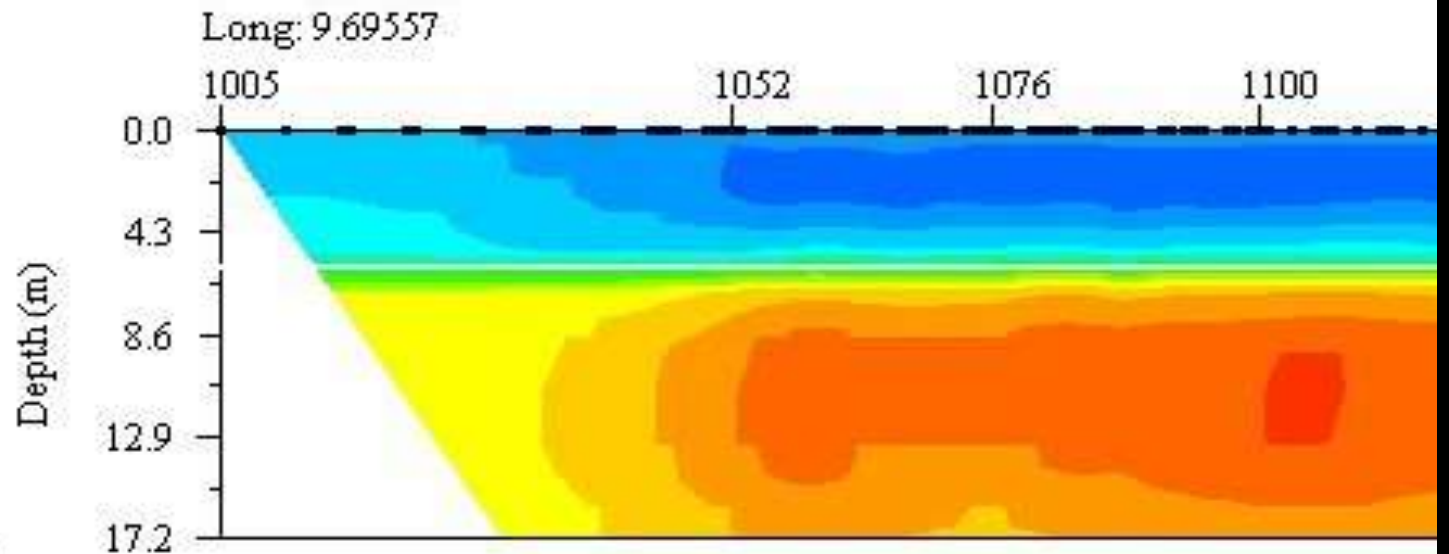
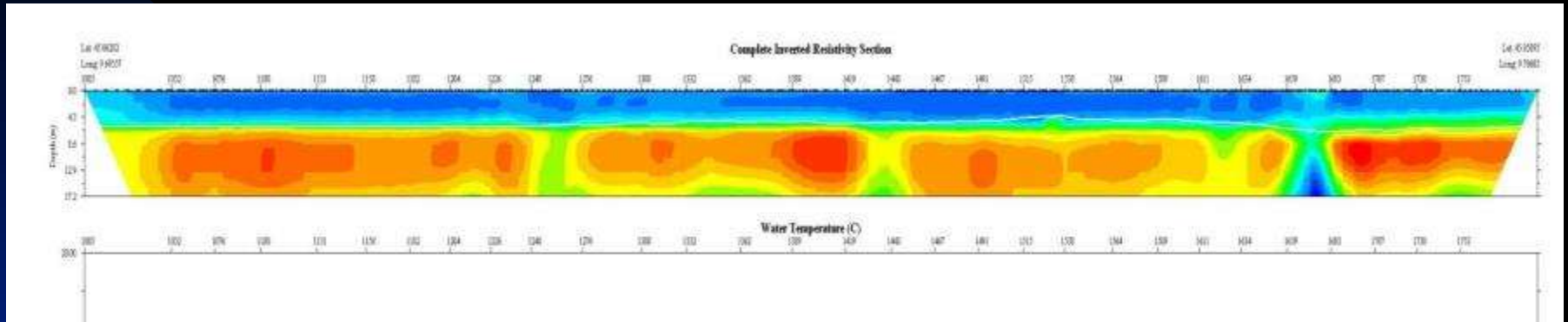
GEOPHYSICAL SITE ASSESMENT – 3D VISUALIZATION





**River bottom
resistivity section**

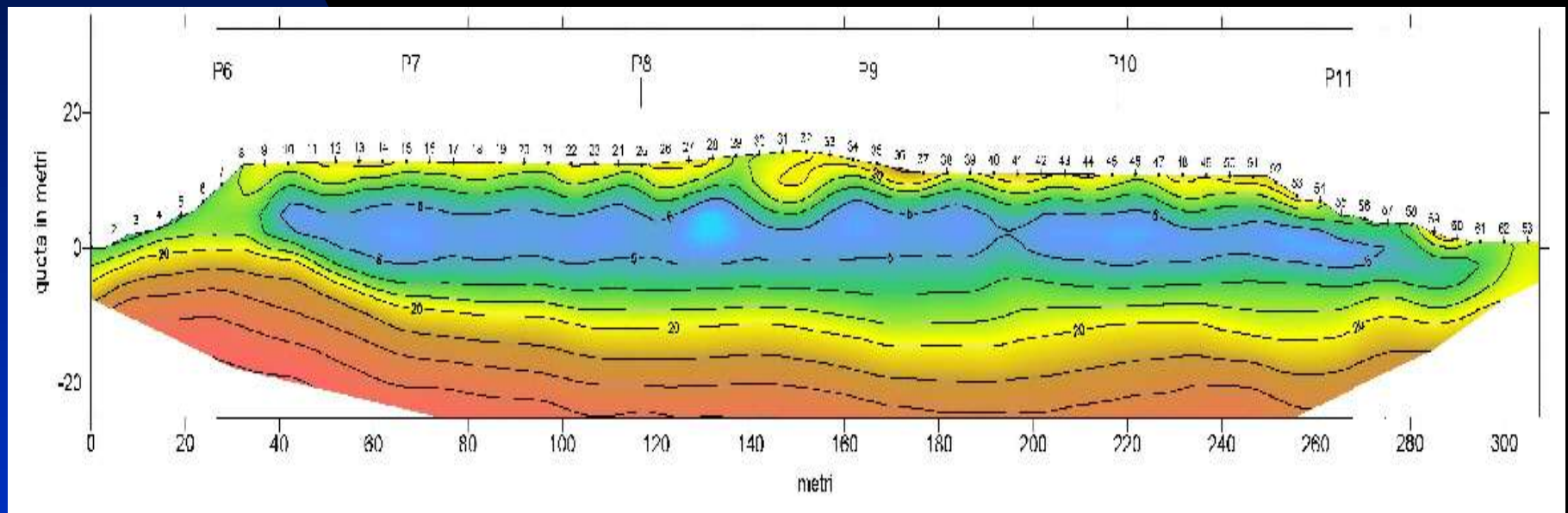
River bottom resistivity section



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WASTE LANDFILL ELECTRICAL IMAGING

THE VISUALIZATION OF A WASTE LANDFILL BODY CAN BE PERFORMED USING ELECTRIC IMAGING



GEOMEMBRANE LINERS CHECK

THE EARLY DETECTION OF A LEAKAGE IN A GEOMEMBRANE LINER CAN AVOID POLLUTION FROM A WASTE DISPOSAL OR WATER LOOSE IN AN ARTIFICIAL LAKE

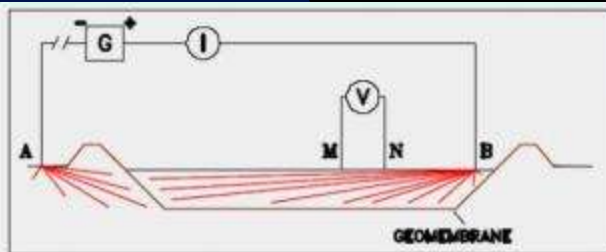


Figura 1 Distribuzione del campo elettrico in condizioni di buon isolamento.
A-B Elettrodi di corrente M-N Elettrodi di potenziale

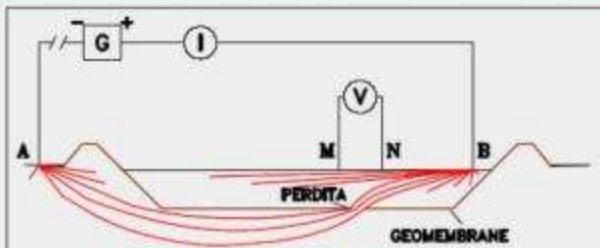
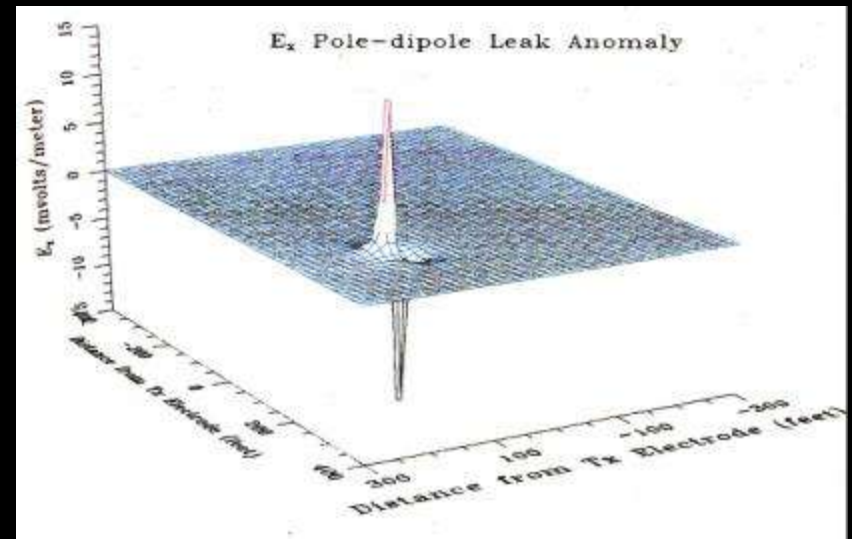
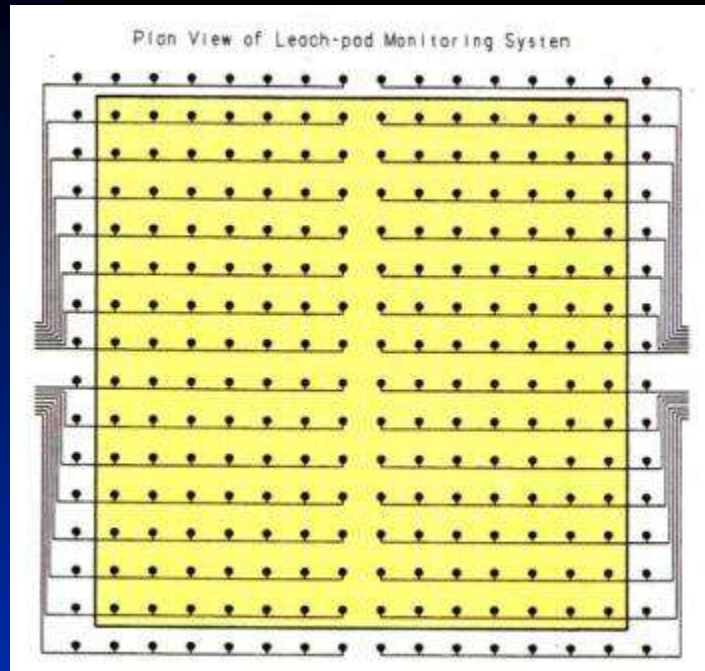


Figura 2 Distribuzione del campo elettrico in presenza di una perdita
A-B Elettrodi di corrente M-N Elettrodi di potenziale



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GEOMEMBRANE LEAKAGE DETECTION



THE LEAKAGE IN THE LINER CAN BE DETECTED PERFORMING AN ELECTRIC SURVEY JUST BEFORE THE FILLING PHASE OF THE BASIN



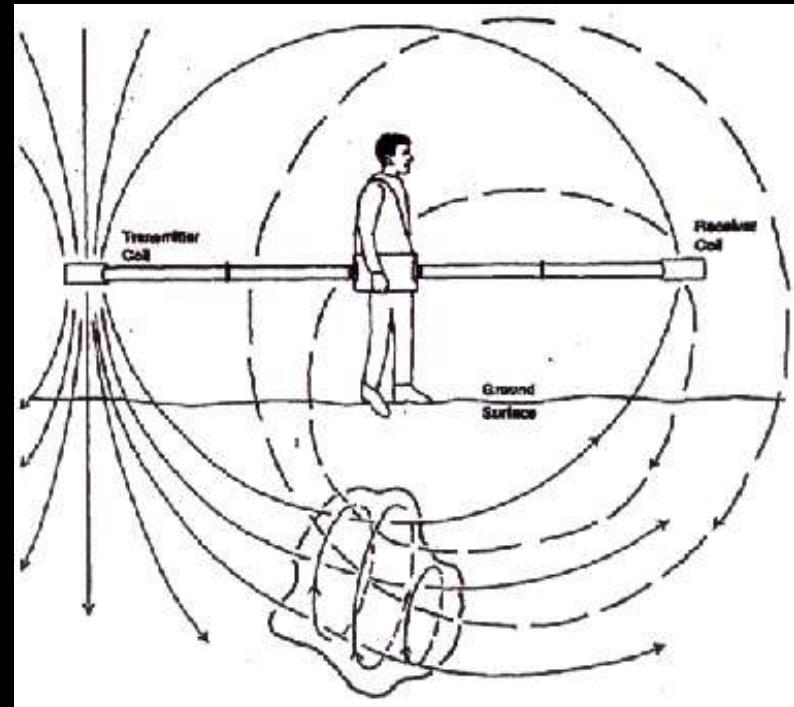
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ELECTROMAGNETIC CONDUCTIVITY SURVEY

Frequency domain EM

THE ELECTRICAL CHARACTERIZATION OF THE GROUND CAN BE PERFORMED USING EM METHODS

THE CONDUCTIVITY (the reciprocal of resistivity) IS MEASURED WITHOUT ELECTRODES BUT THROUGH EM INDUCTION



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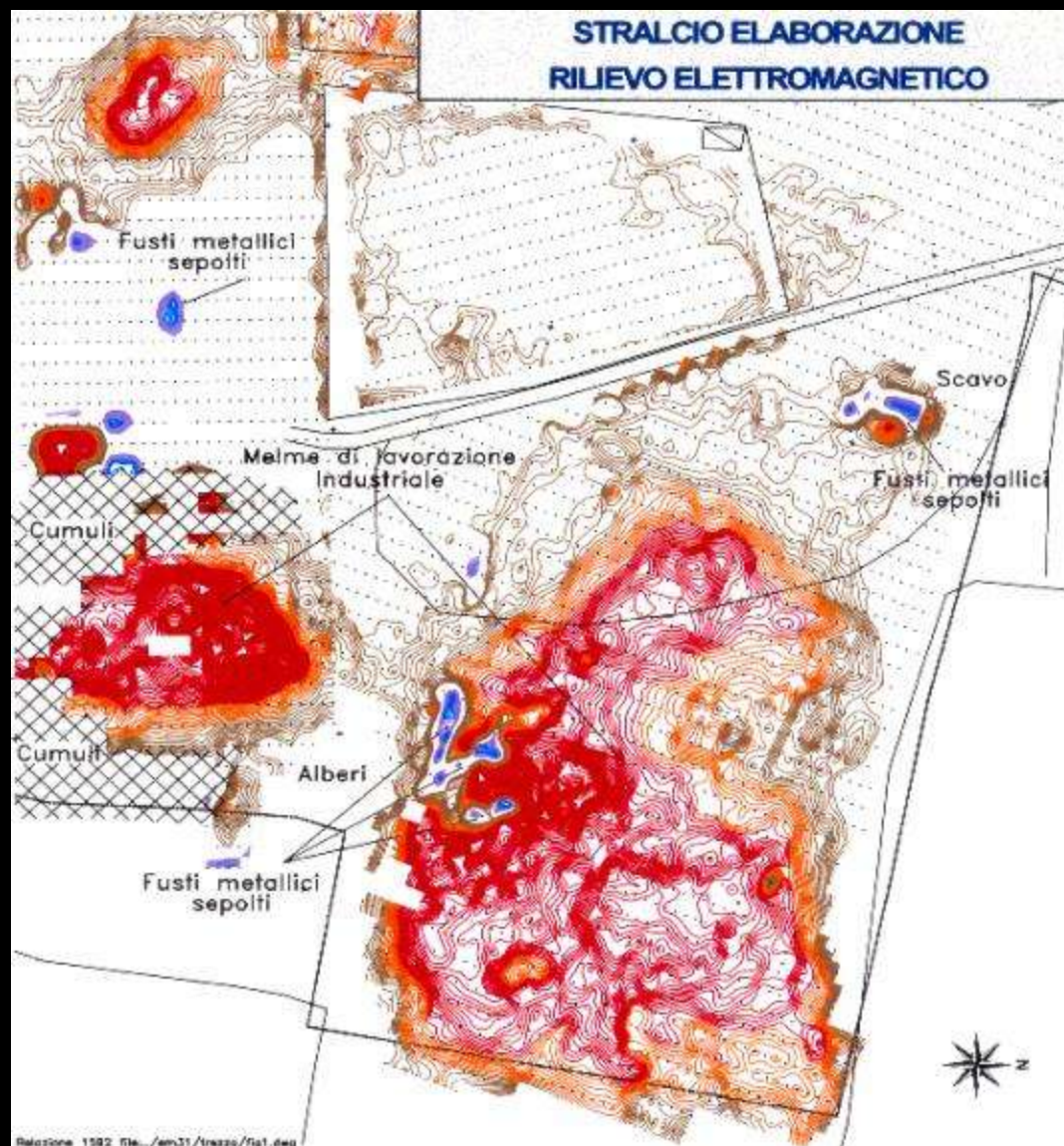
ELECTROMAGNETIC CONDUCTIVITY SURVEY

A CONDUCTIVITY SURVEY CAN EASILY DEFINE THE PRESENCE OF HIDDEN MATERIALS IN THE SUBSURFACE

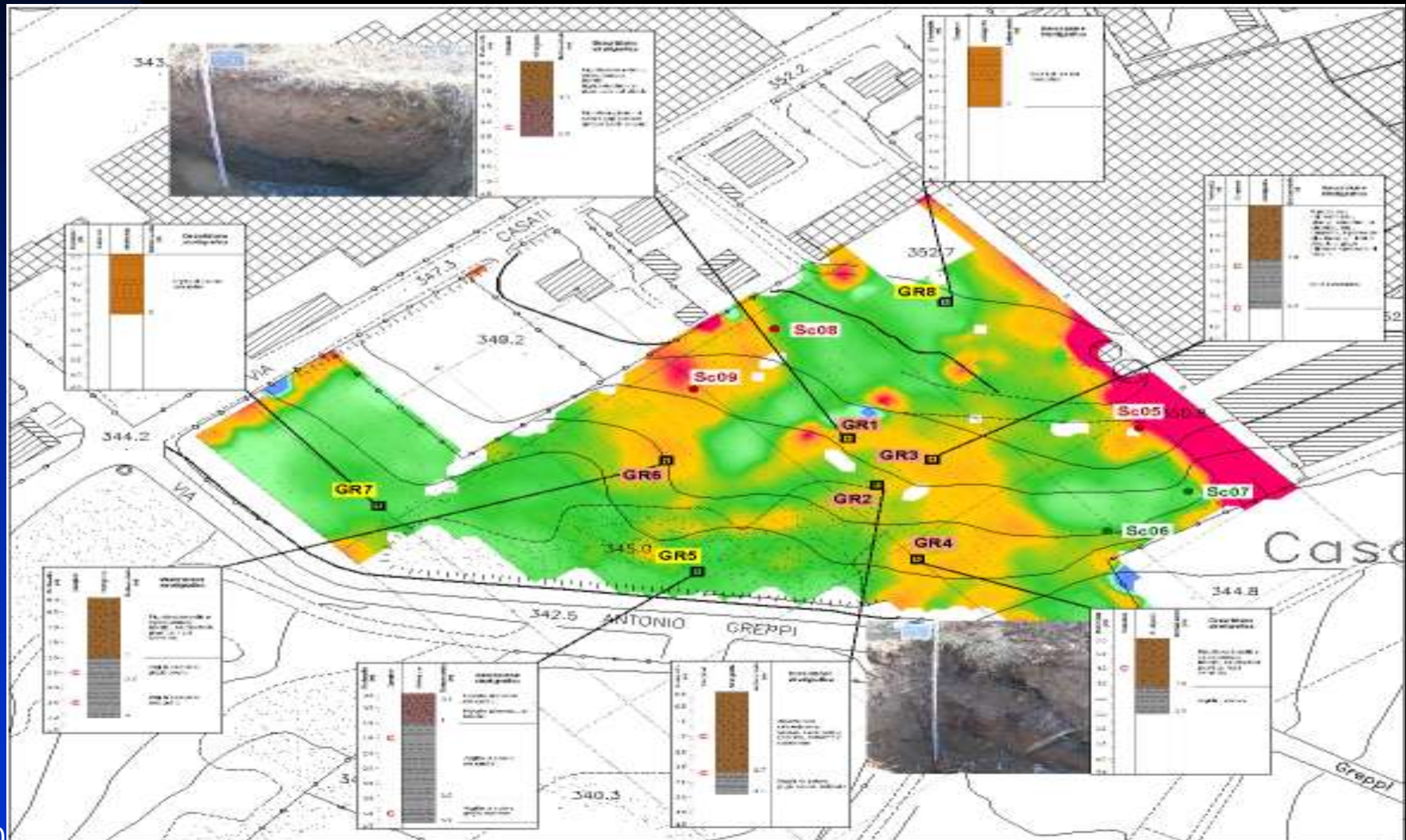
THE METHOD HAS WIDE VARIETY OF APPLICATIONS IN HYDROGEOLOGICAL, ENVIRONMENTAL AND ARCHAEOLOGICAL SURVEYS



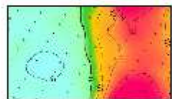
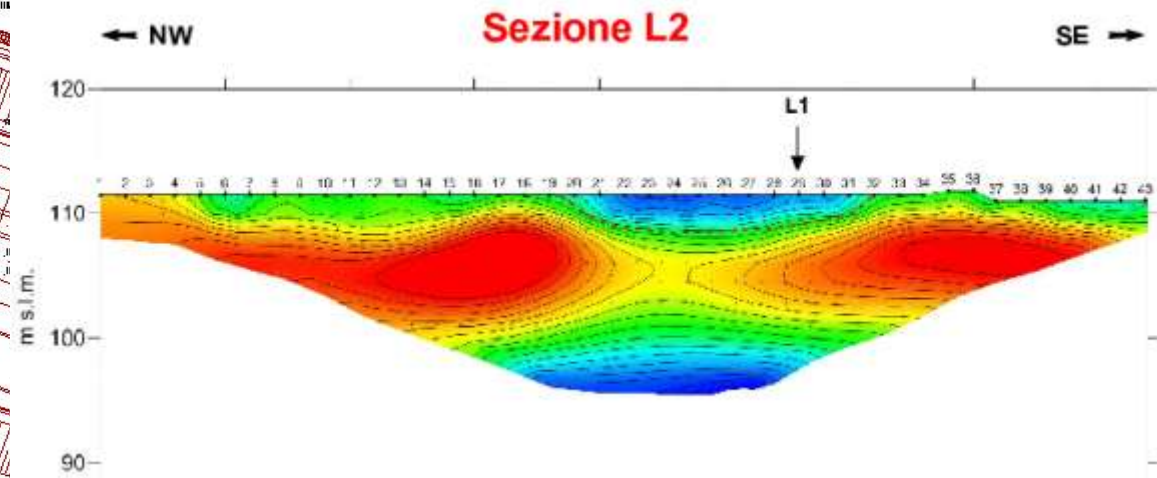
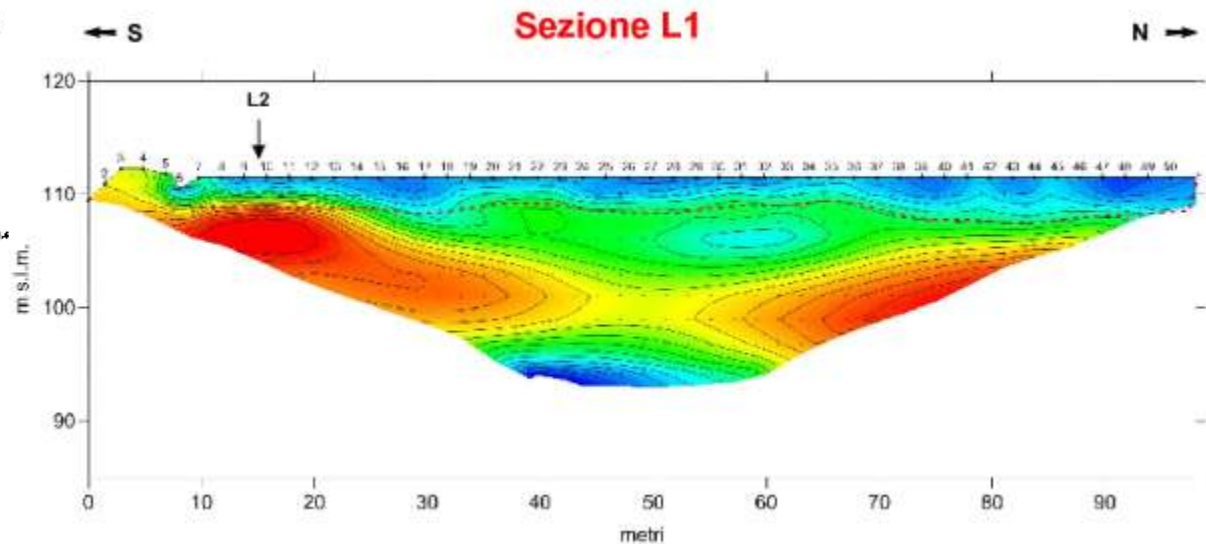
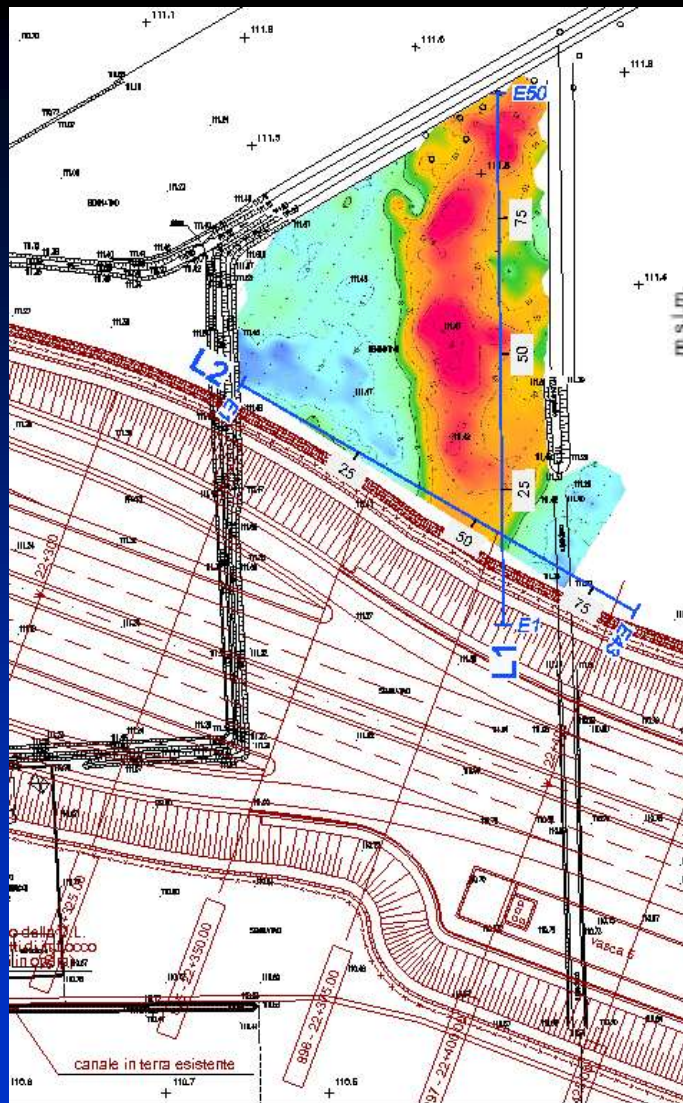
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ELECTROMAGNETIC SURVEY FOR INDUSTRIAL ENVIRONMENTAL SITE ASSESSMENT



ELECTROMAGNETIC AND ELECTRICAL TOMOGRAPHY FOR ENVIRONMENTAL SITE ASSESMENT

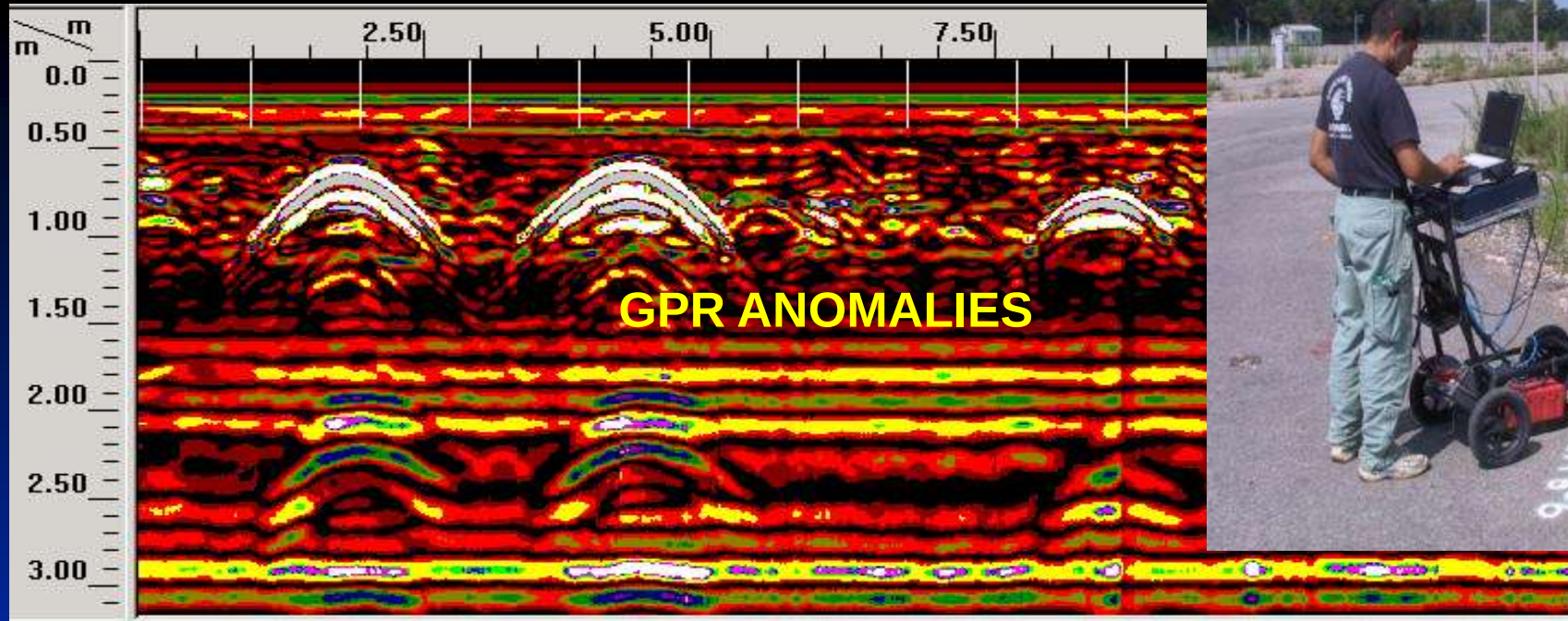


Area indagata
con il rilievo
elettromagnetico



Traccia sezioni
elettriche
tomografiche

Ground Penetrating Radar (GPR)



GROUND PENETRATING RADAR USES EM WAVE TO INVESTIGATE THE SUBSURFACE

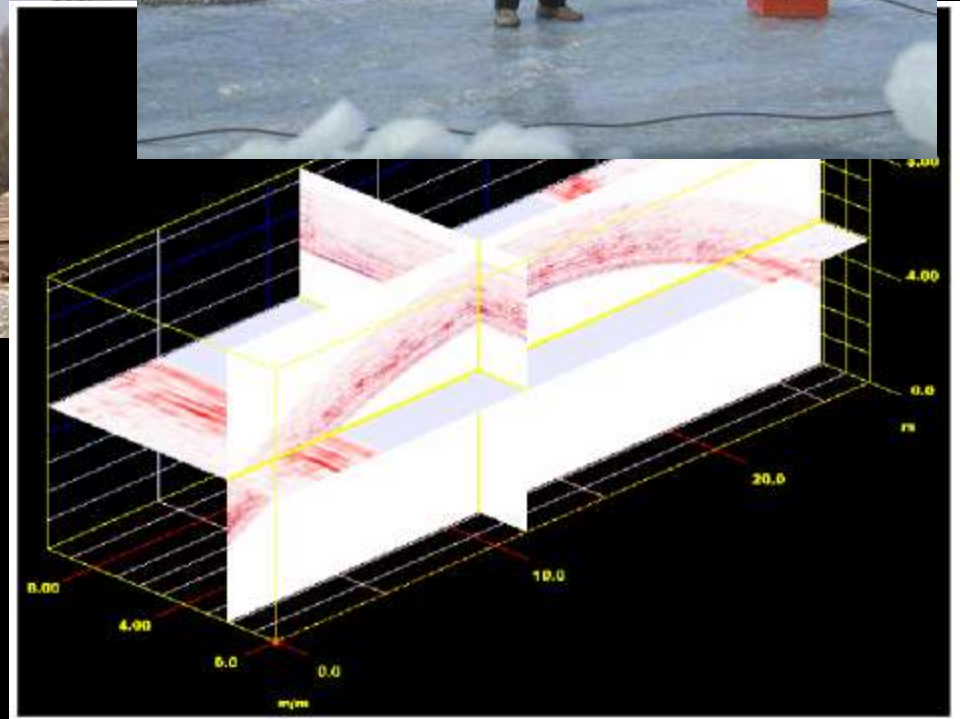
PHYSICAL DISCONTINUITIES DUE TO CHANGE IN THE ELECTRICAL PROPERTIES CAN REFLECT THE RADAR SIGNAL AND BE DETECTED FROM THE SURFACE

THE METHOD HAS A WIDE VARIETY OF APPLICATION FROM SITE CHARACTERIZATION TO ARCHAEOLOGICAL SURVEY



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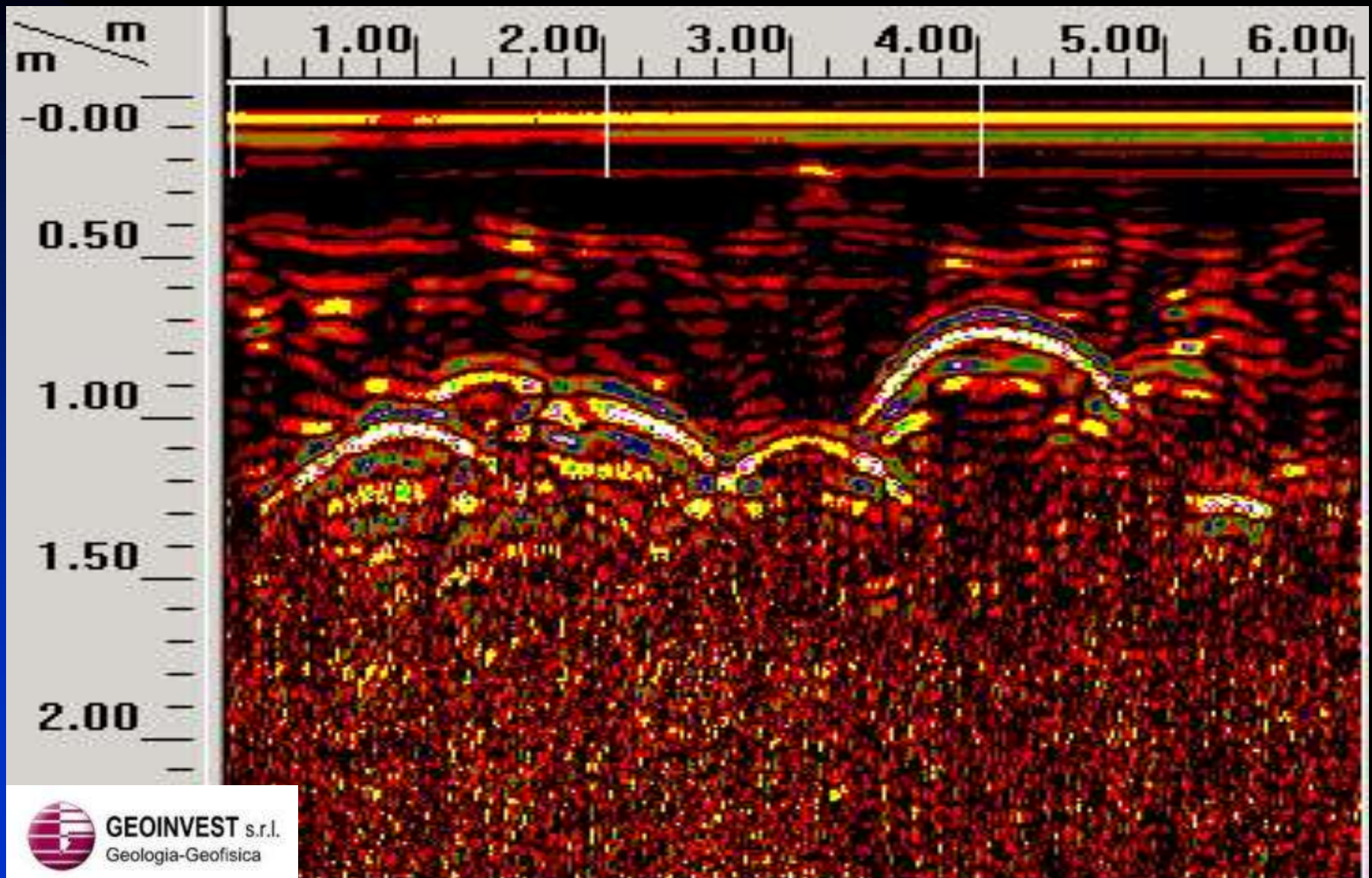
Ground Probing Radar (GPR)



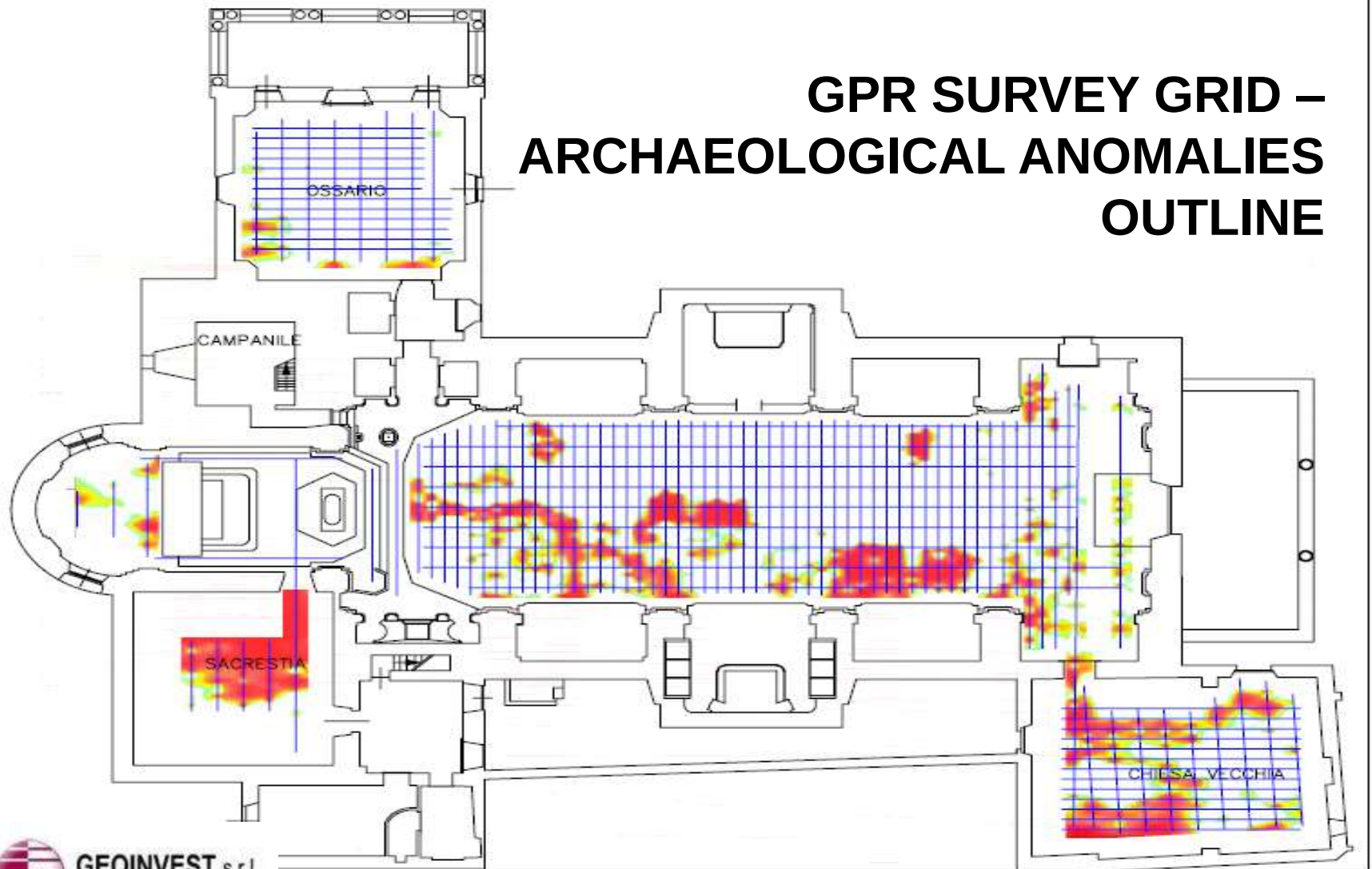
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**3D DATA
PROCESSING**

GPR ANOMALIES FROM ARCHAEOLOGICAL REMAINS



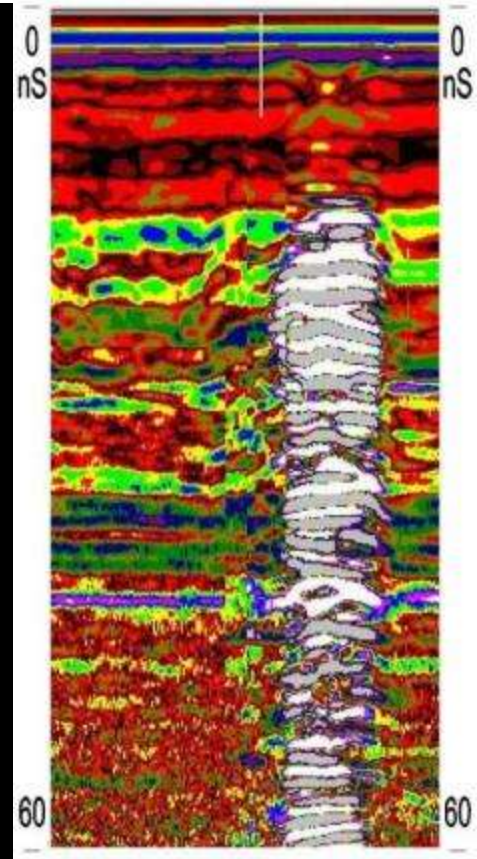
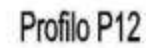
GPR SURVEY GRID – ARCHAEOLOGICAL ANOMALIES OUTLINE



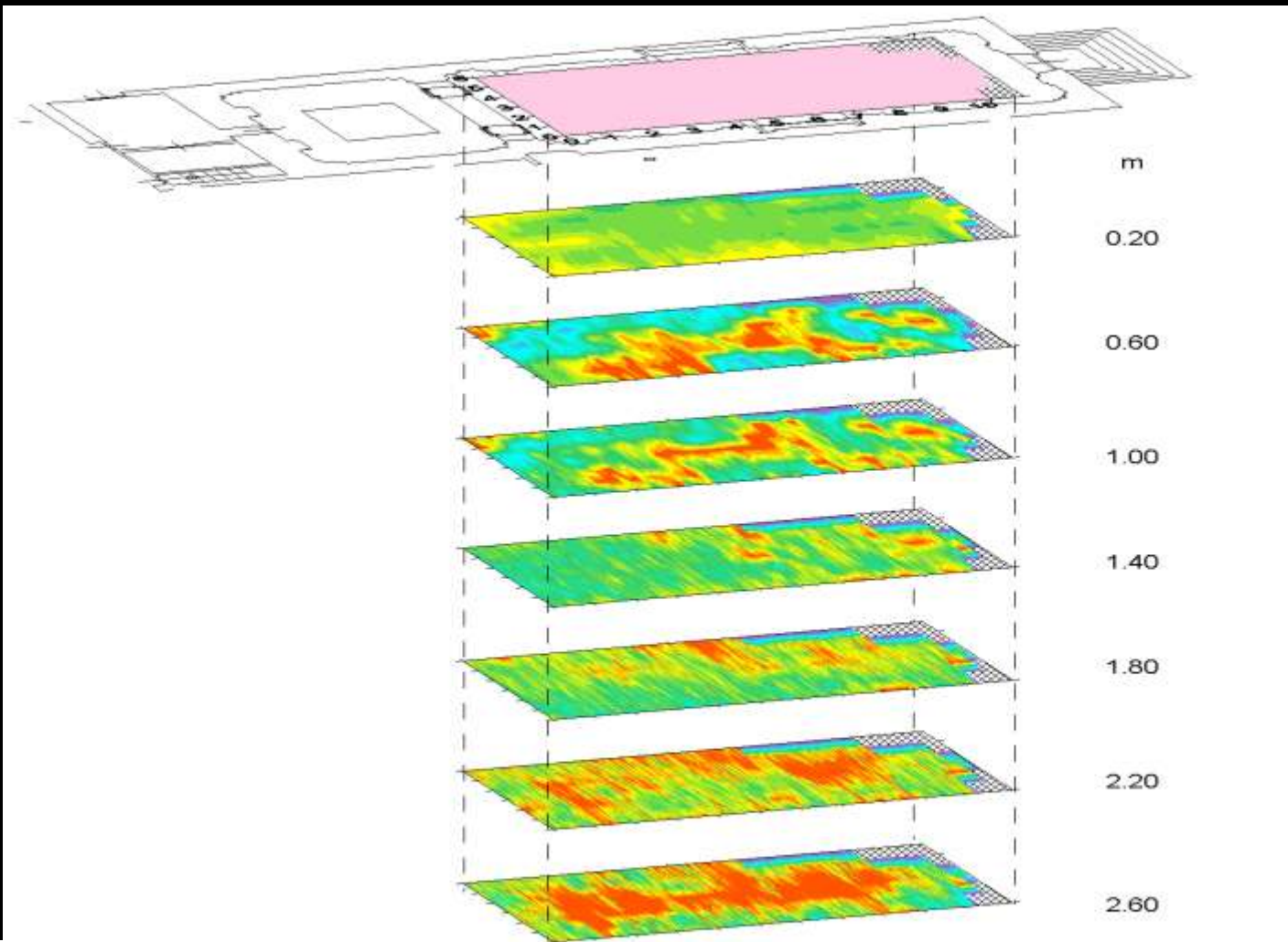
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LEGENDA

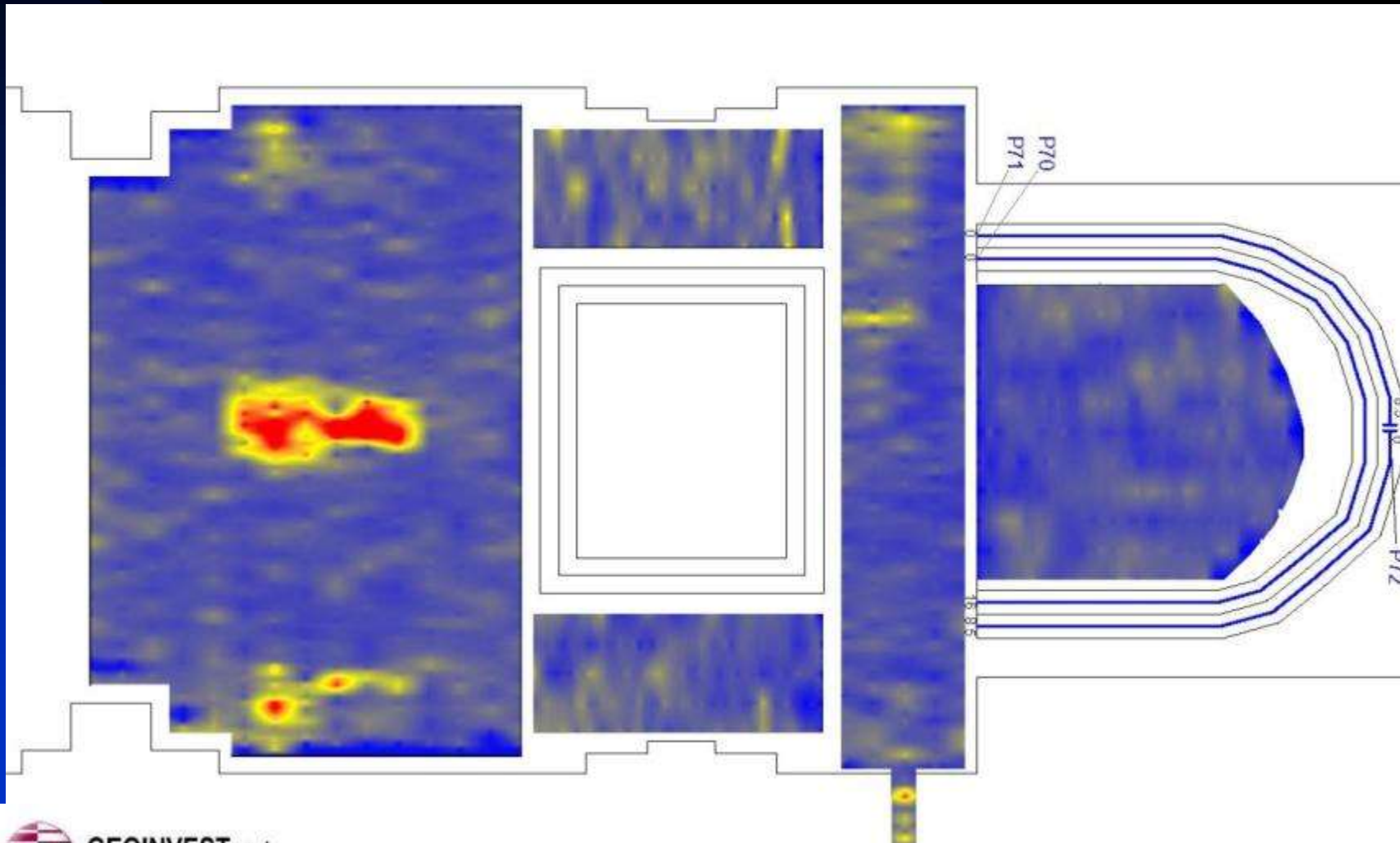
Study materials



GPR ANOMALIES “TIME SLICE “3D VIEW



GPR ANOMALY SHOWING THE PRESENCE OF A BURIED TOMB BELOW A CHURCH FLOOR



SEISMIC METHODS

Rock density affect the seismic propagation velocity

The study of the propagation of the seismic waves in the ground is useful for determining interfaces between the different physical units

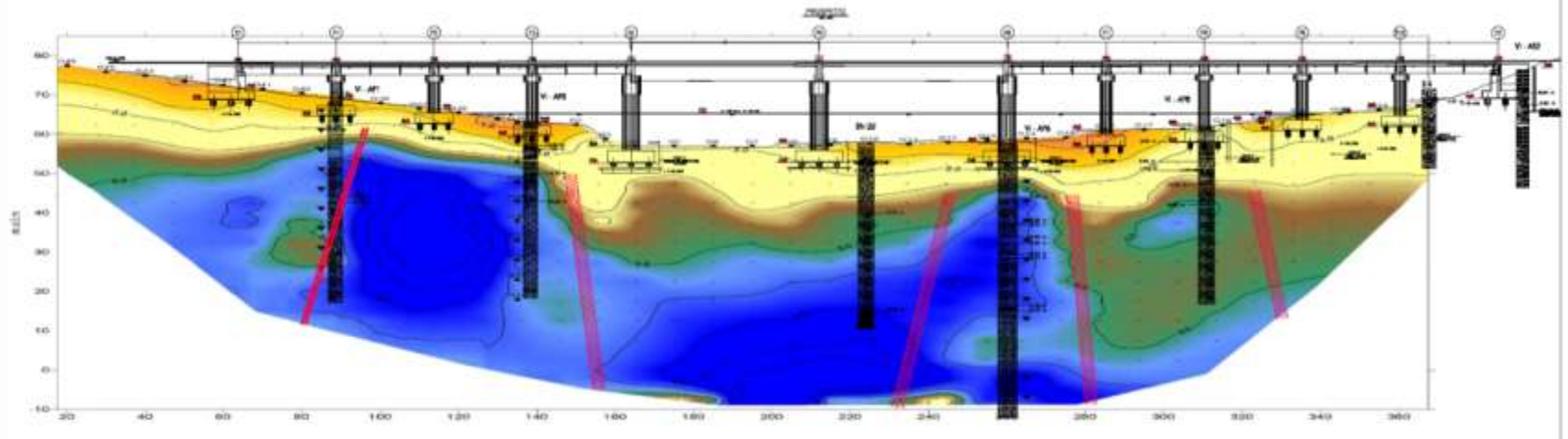
The most common seismic methods are:

- ◆ **REFRACTION SEISMIC - REFLECTION SEISMIC
TOMOGRAPHY**

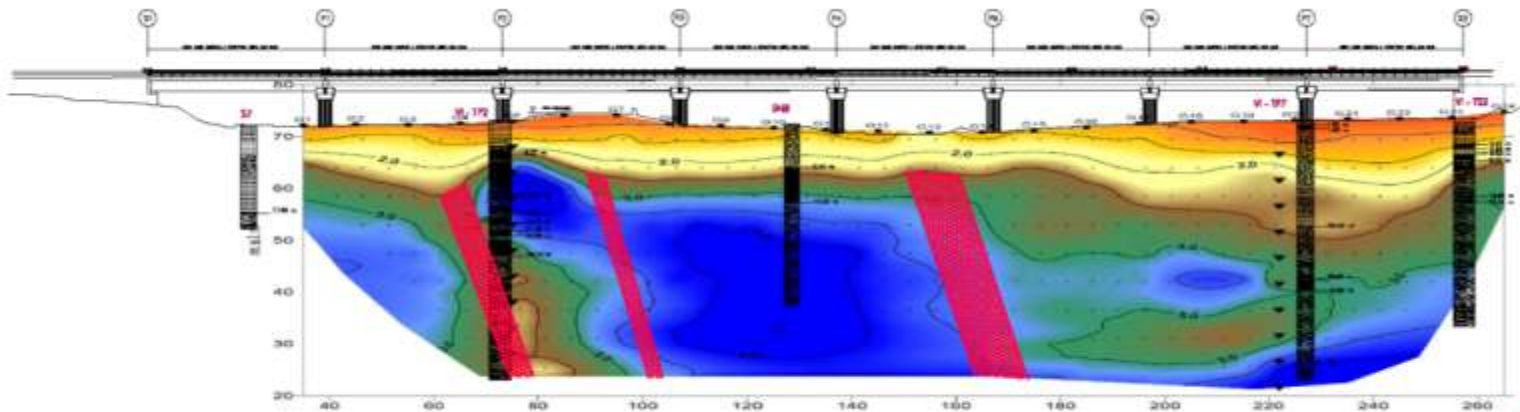


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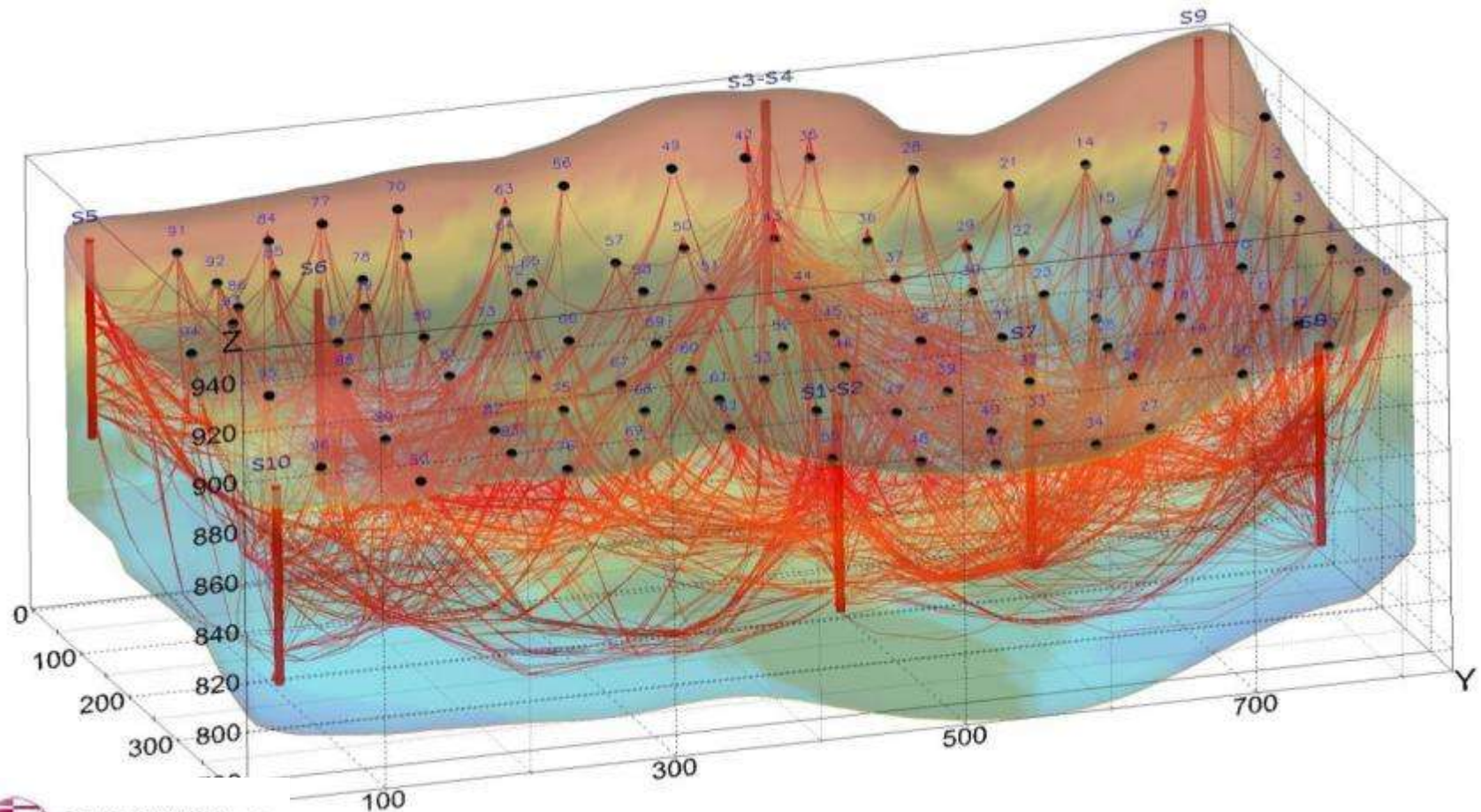
2D SEISMIC TOMOGRAPHY ON BRIDGE PROJECTS



SEISMIC PROPERTIES OF THE MATERIALS CAN BE USED TO BUILD UP A GEOLOGIC MODEL WITHIN GEOENGINEERING PROJECTS

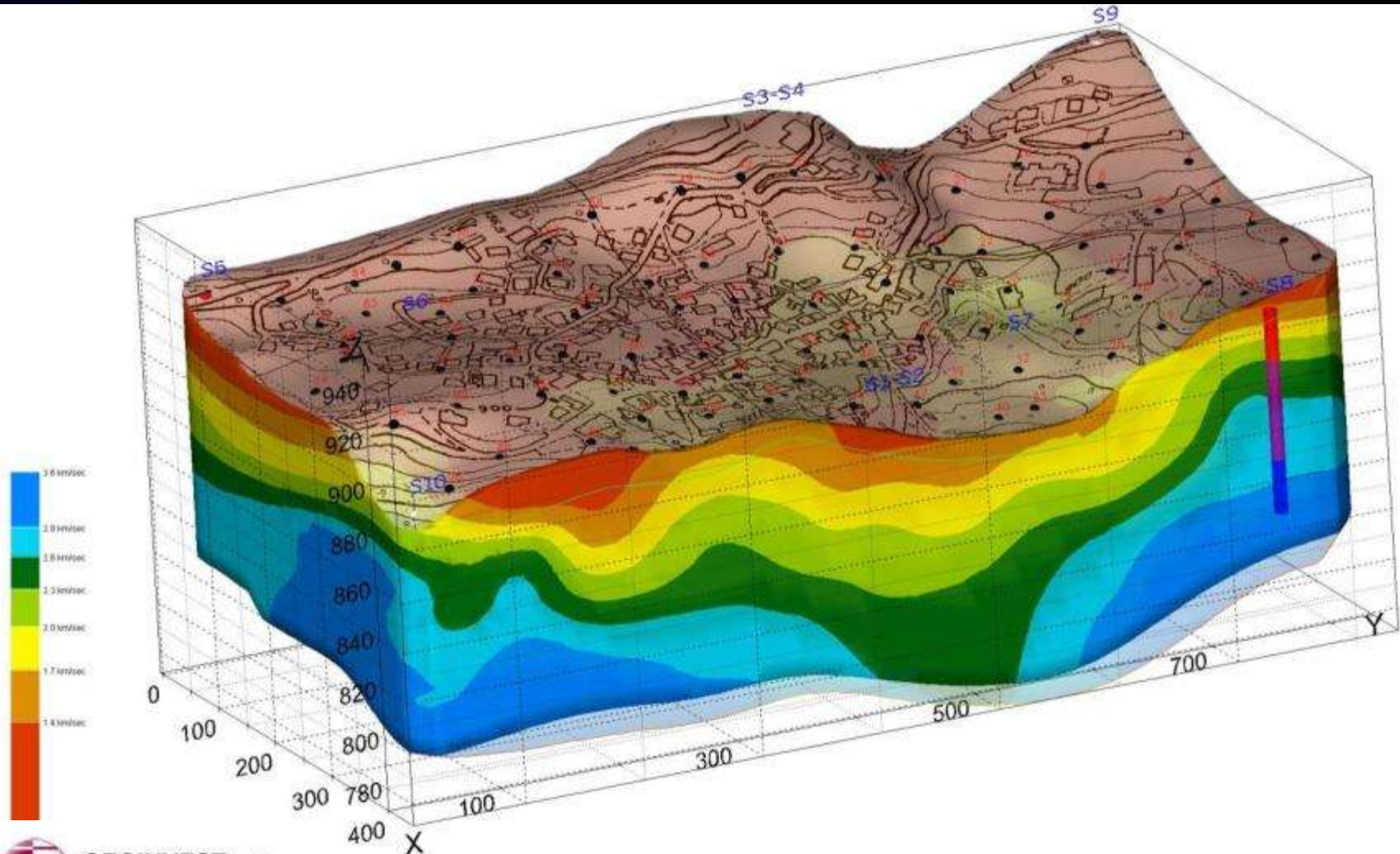


SUBSURFACE 3D SEISMIC SURVEY SENSORS LAYOUT AND RAY PATHS



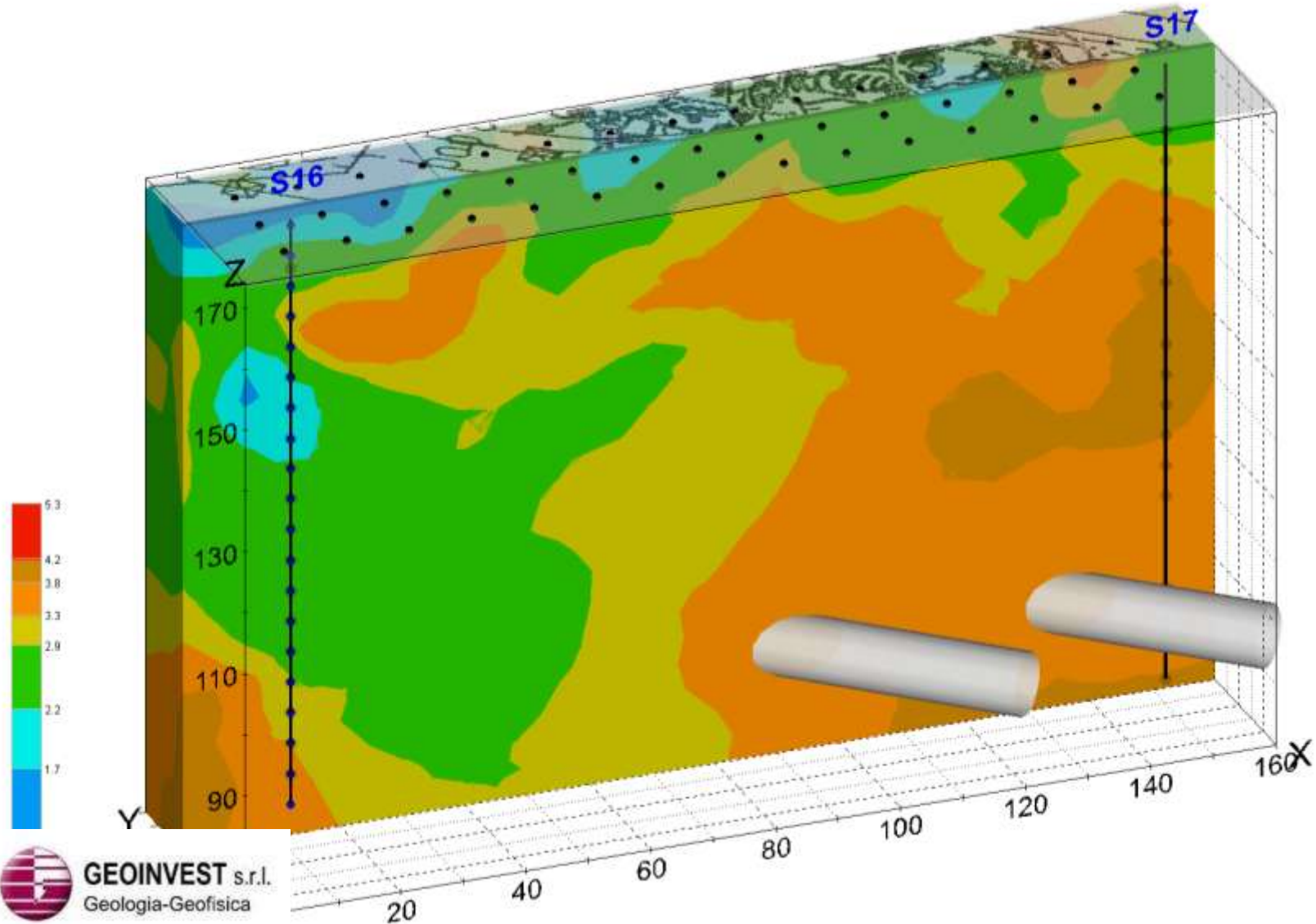
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SUBSURFACE 3D SEISMIC SURVEY VELOCITY MODEL

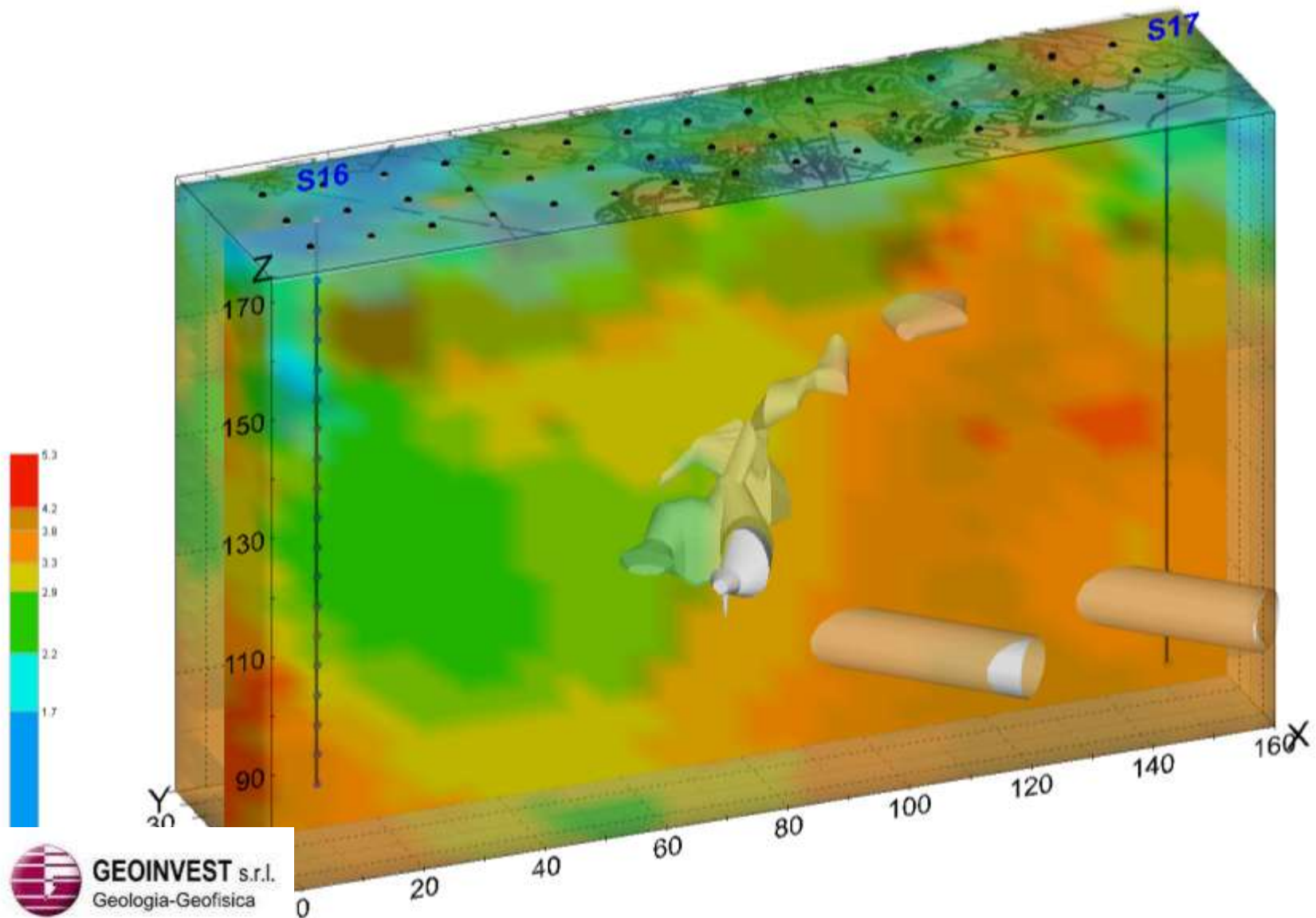


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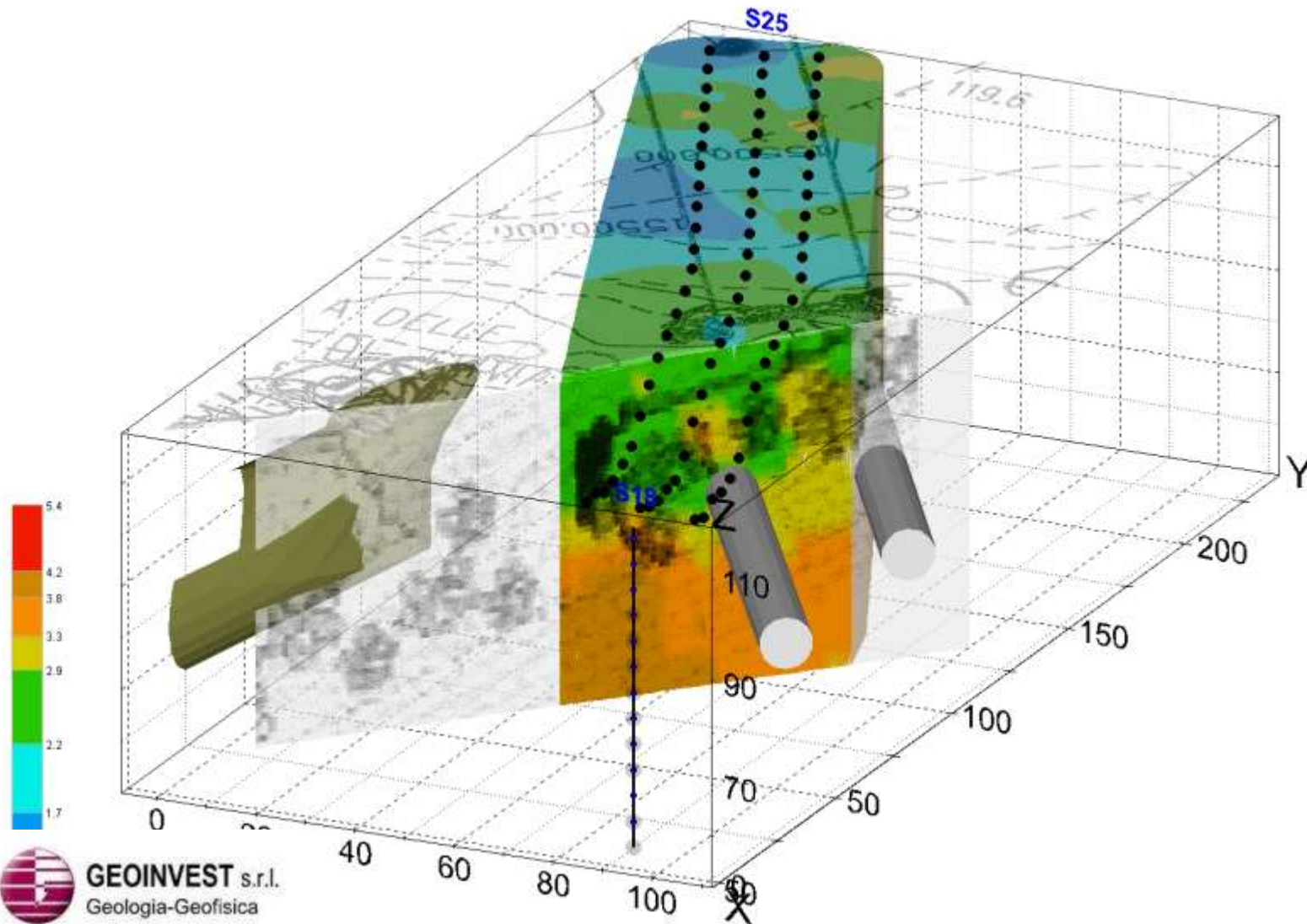
TUNNELLING PROJECT - SEISMIC TOMOGRAPHY



TUNNELLING PROJECT - SEISMIC TOMOGRAPHY

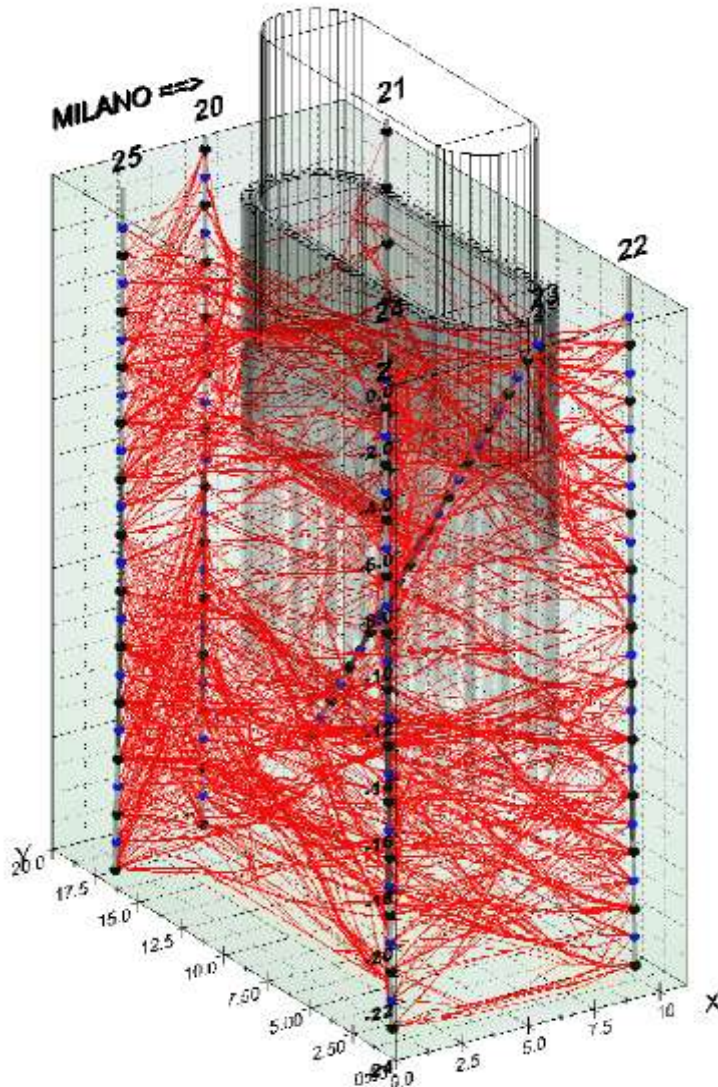


TUNNELLING PROJECT - SEISMIC TOMOGRAPHY

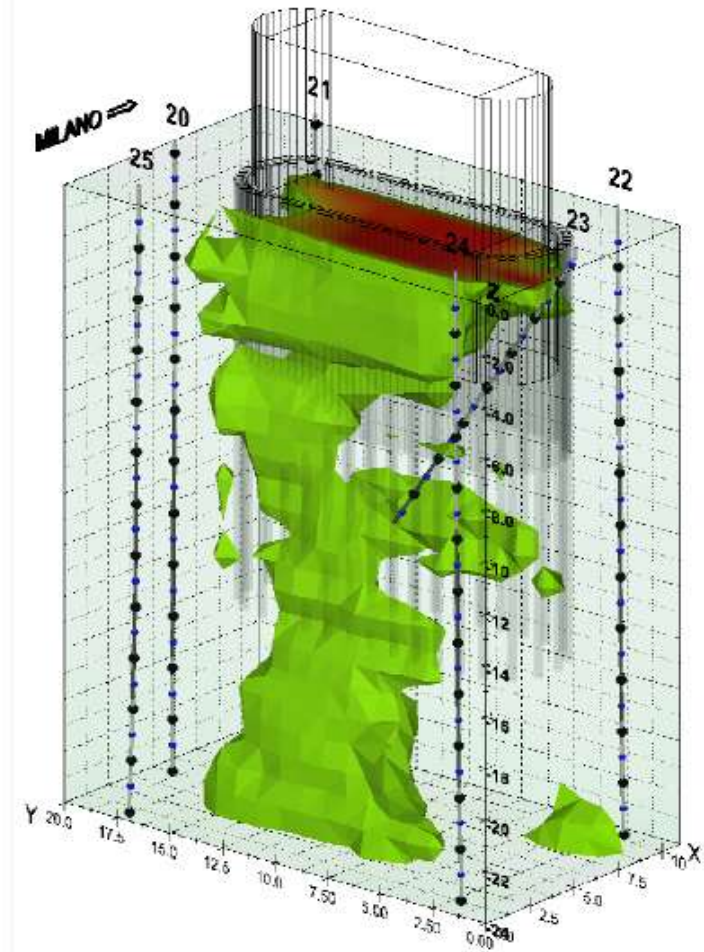


3D SEISMIC SURVEY ON A BRIDGE PILE

RILIEVO SISMICO 3D - Percorso dei raggi



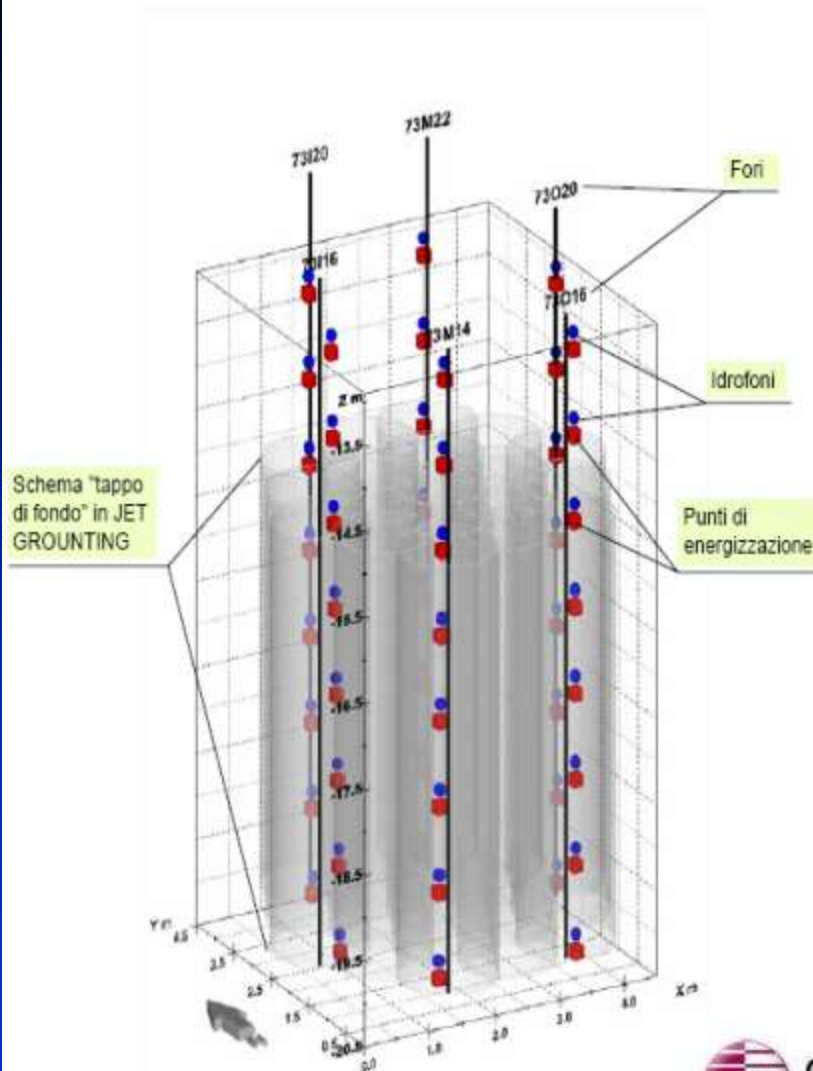
RILIEVO SISMICO 3D - Isovolume $V > 2000$ m/sec, vista lato Vigevano



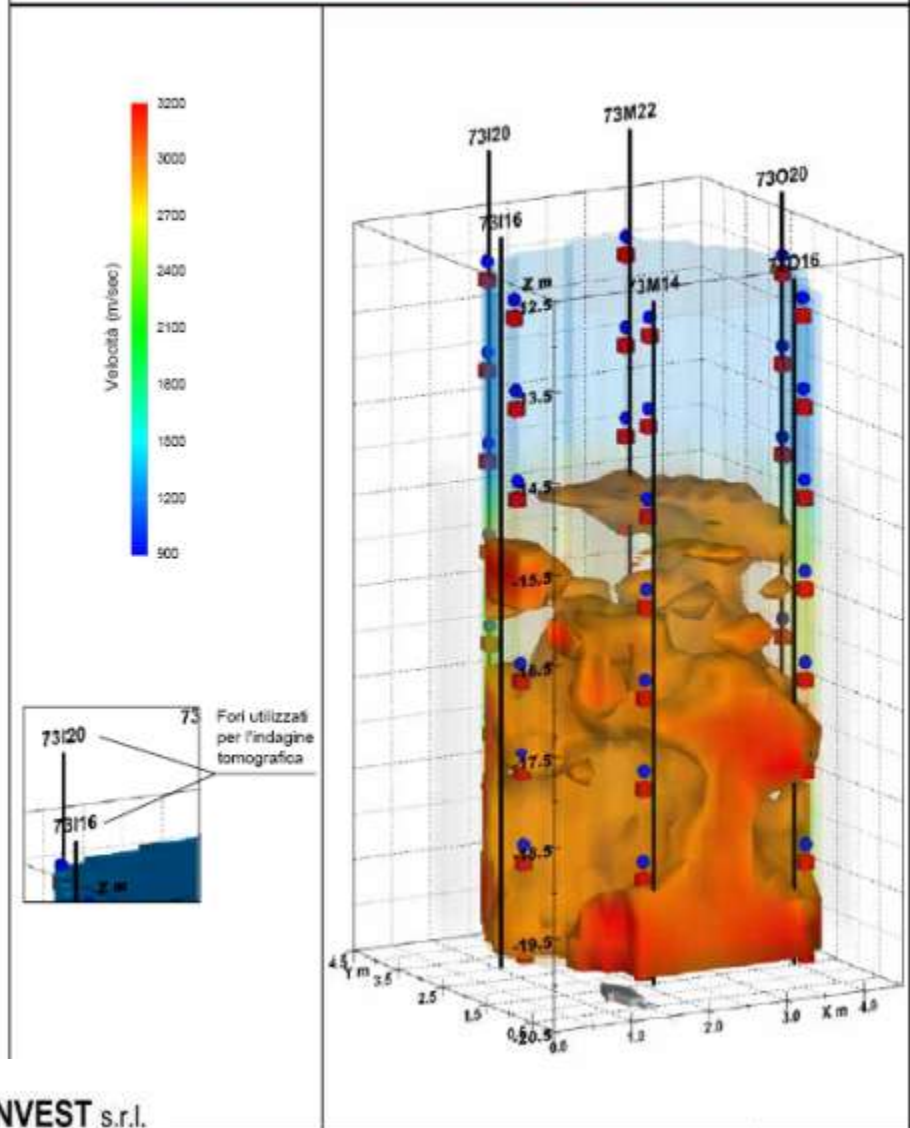
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3D SEISMIC SURVEY ON A BRIDGE PILE

RILIEVO SISMICO 3D - Schema volumetrico di acquisizione

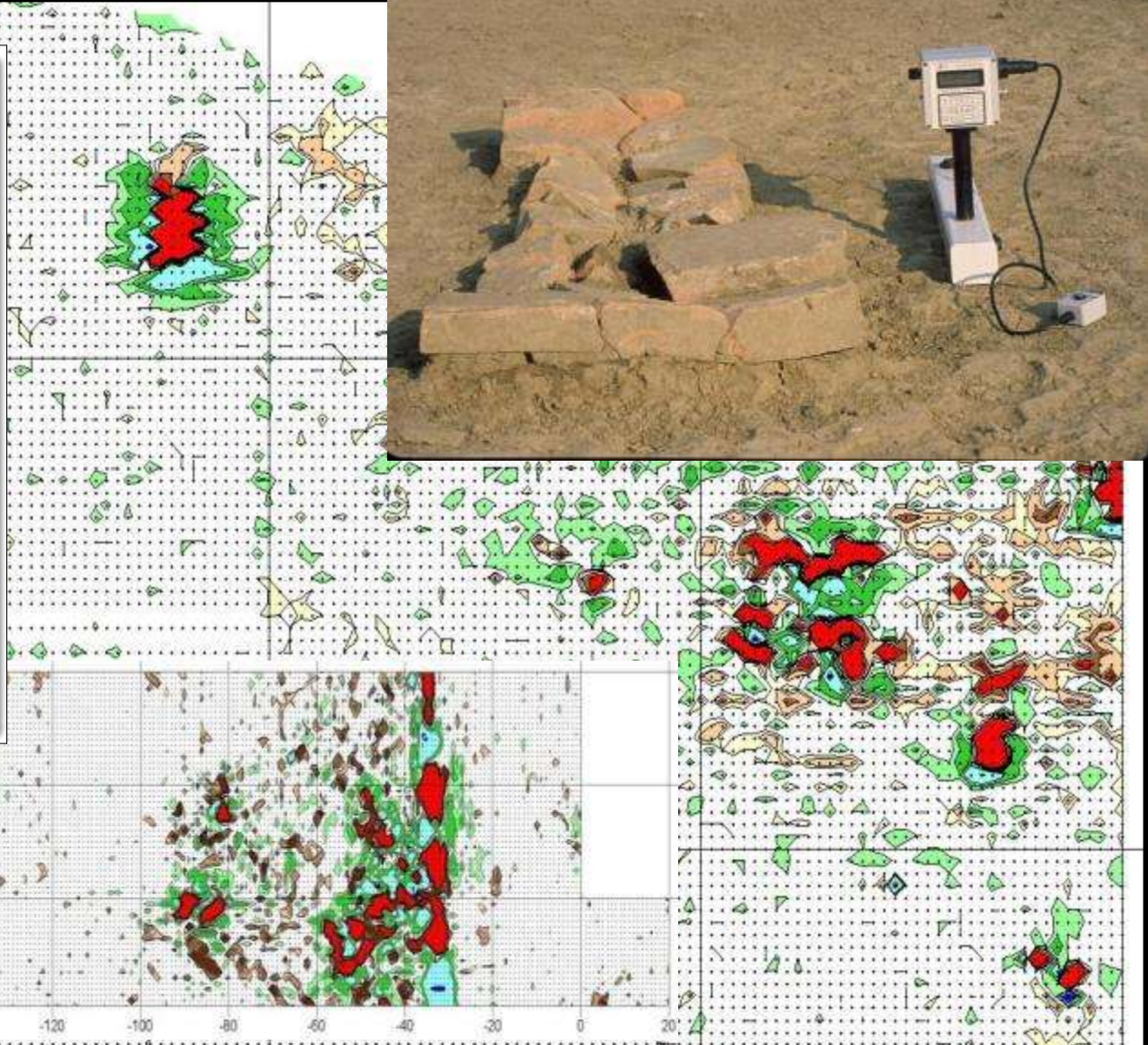


RILIEVO SISMICO 3D - Isovolume $V_p > 2700$ m/sec



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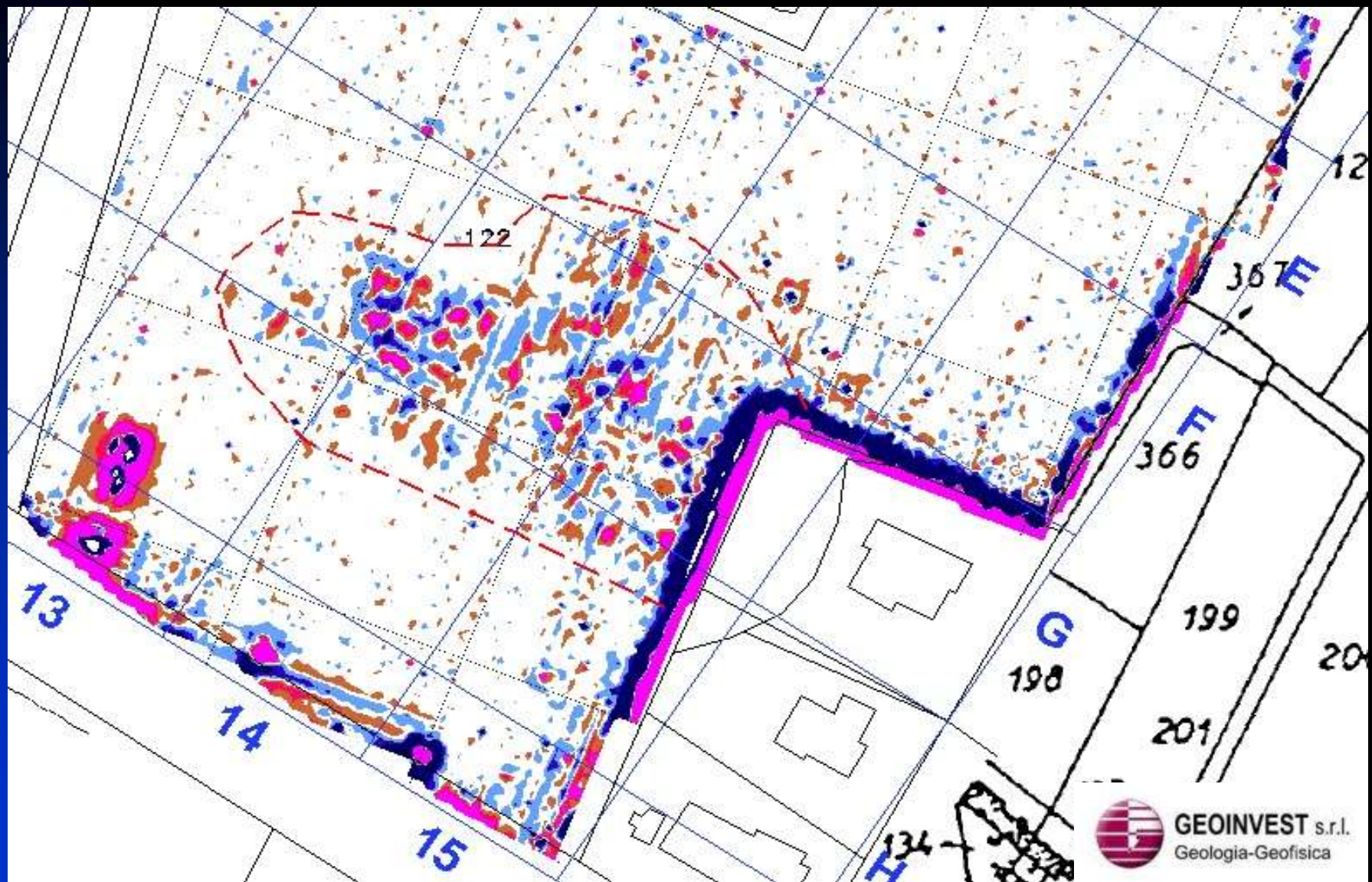
MAGNETIC SURVEY - ARCHAEOLOGICAL CHARACTERIZATION



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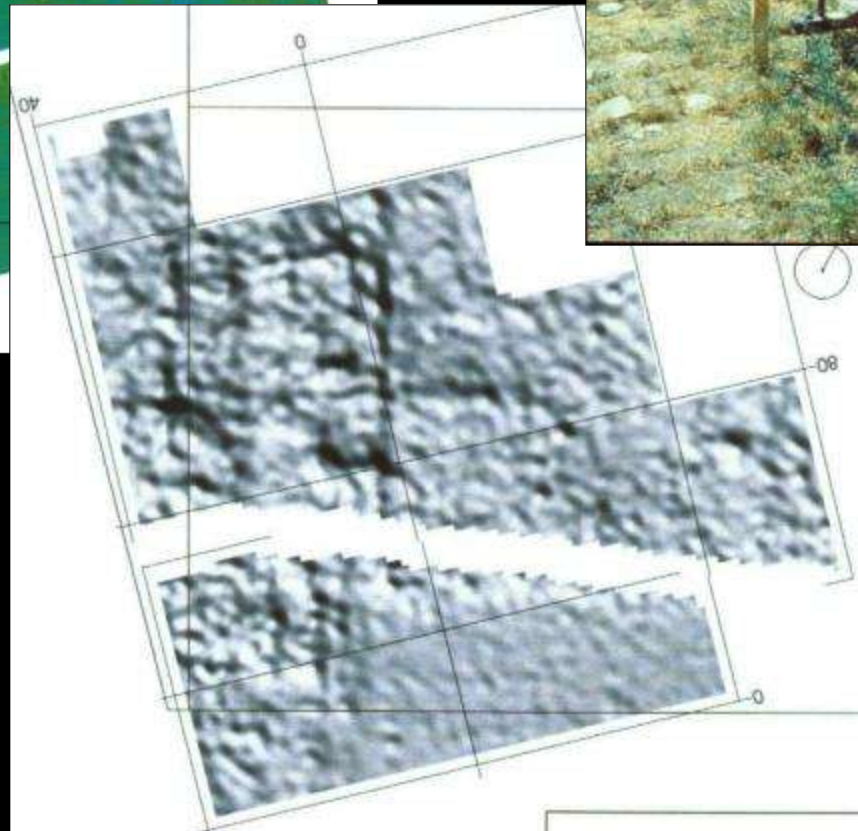
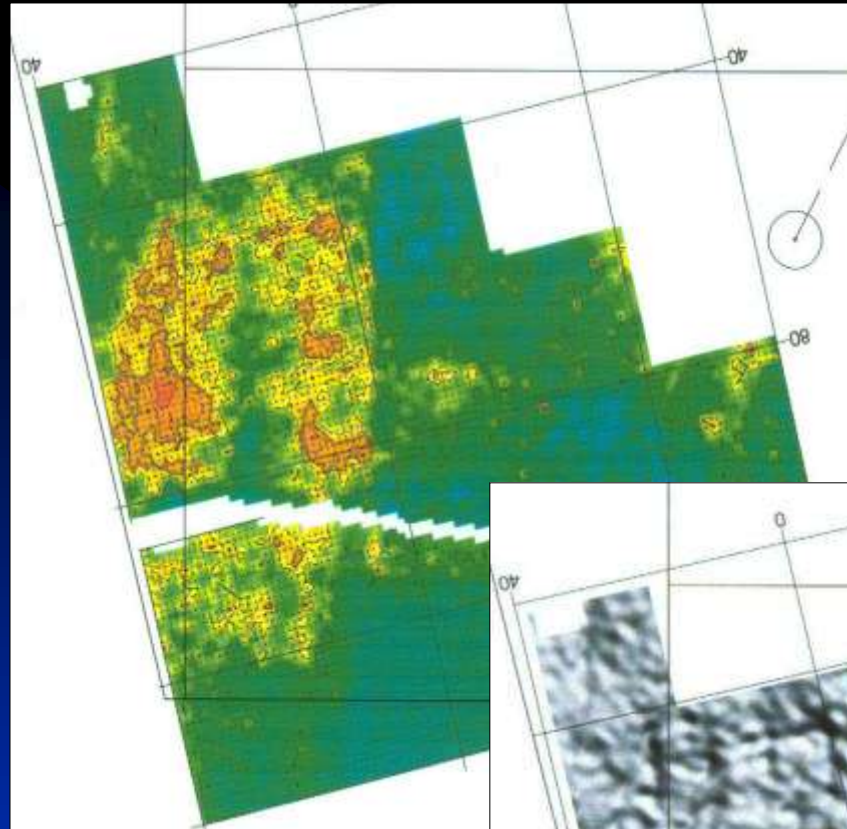


MAGNETIC SURVEY PROCESSING



MAGNETIC SURVEY – DATA INTERPRETATION OUTLINE OF THE POSSIBLE ARCHAEOLOGICAL STRUCTURES



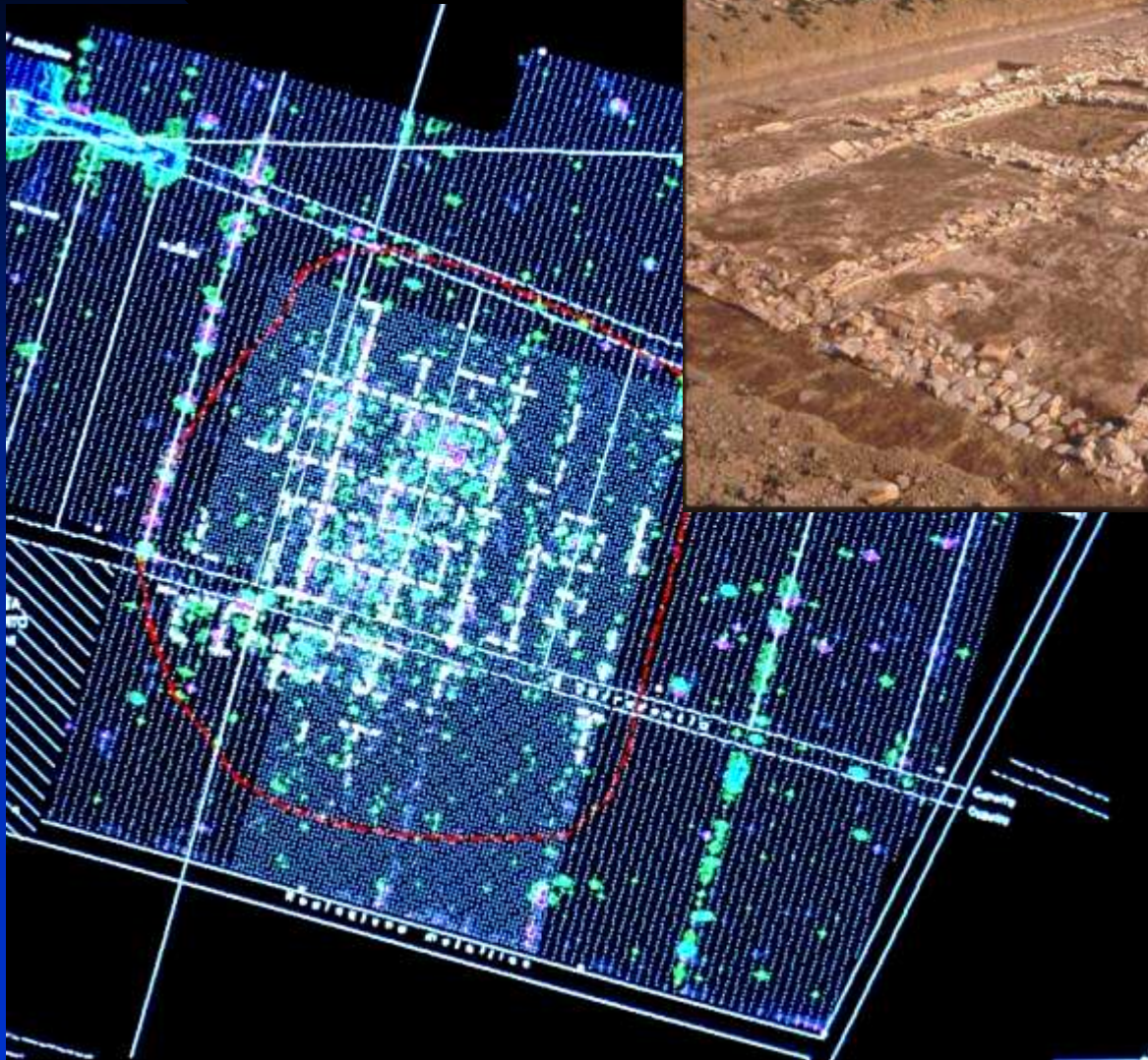


GEOELECTRICAL SURVEY for ARCHAEOLOGY



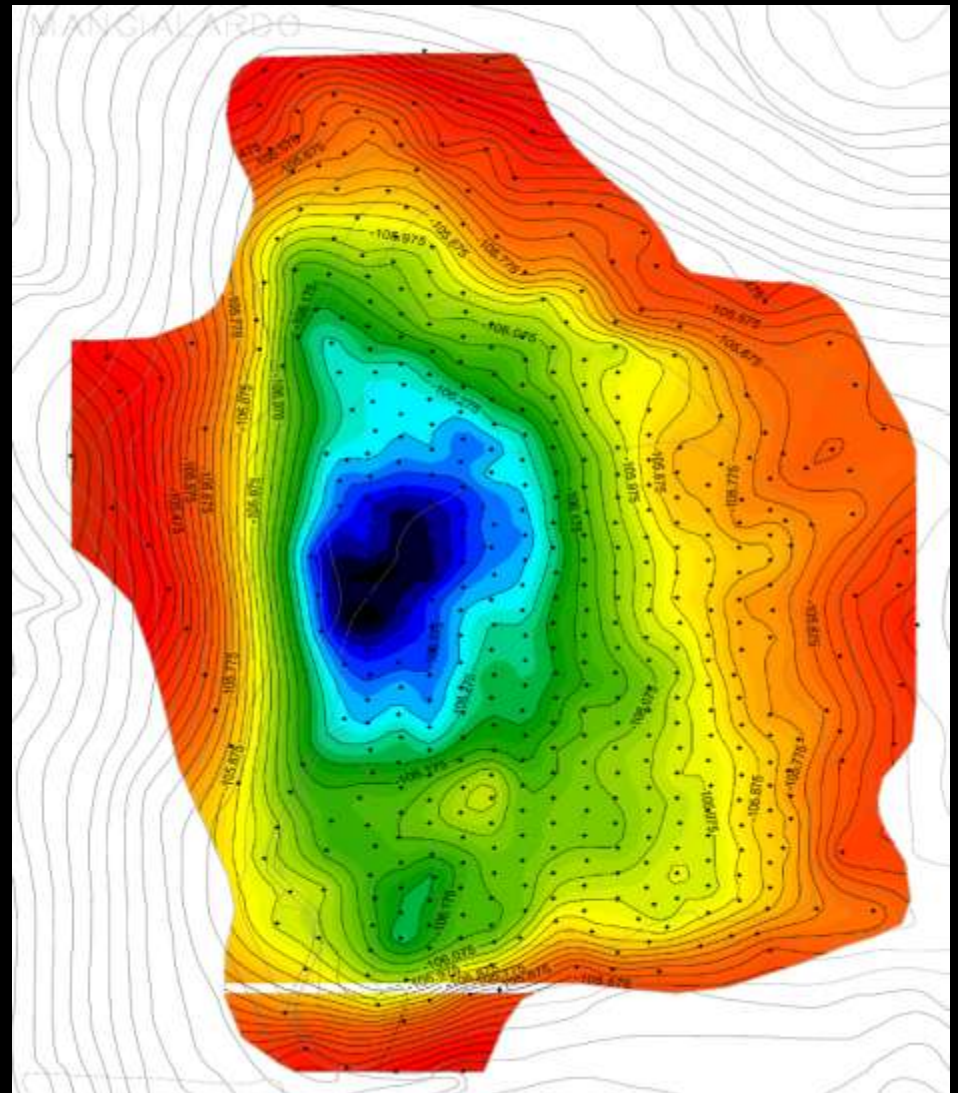
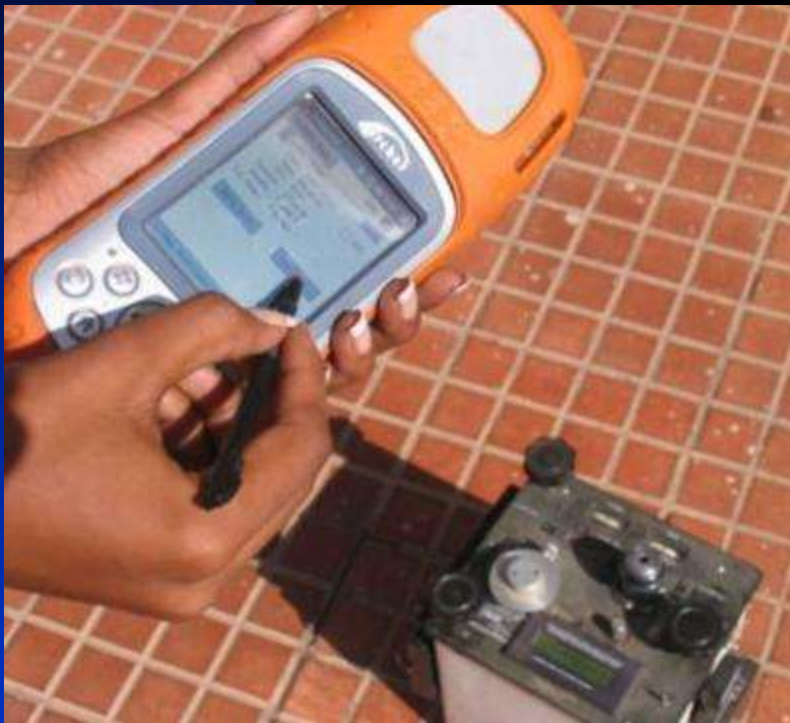
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SITE EXCAVATIONS



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High Resolution Gravity

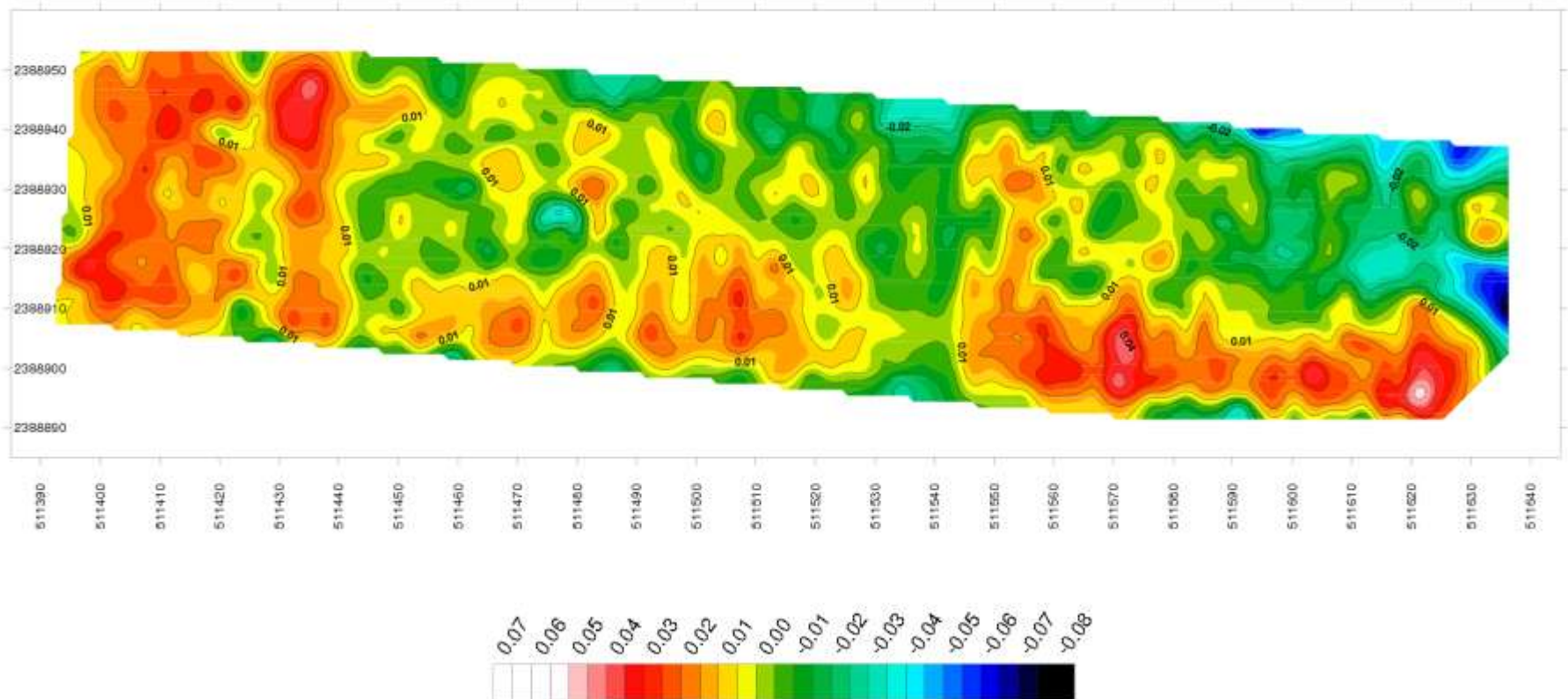


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High Resolution Gravity

Low Pass Filtered Residual Gravity Al Corniche Towers Site, Jeddah KSA

UTM Zone 37N WGS84
Bouguer density 2.00 gm/cc



High Resolution MT

• Data acquisition

- ✦ MT, AMT, CSMT, Continuous tensor profiling surveys
- ✦ 24-bit networked system
- ✦ GPS-clock synchronized remote reference
- ✦ Frequency range: 24 KHz to 0.001 Hz

• Data processing

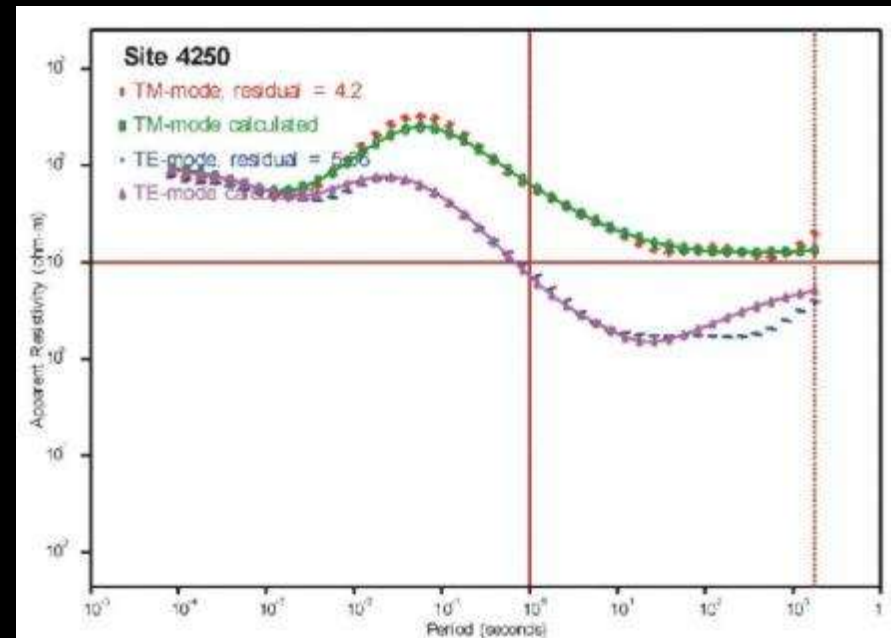
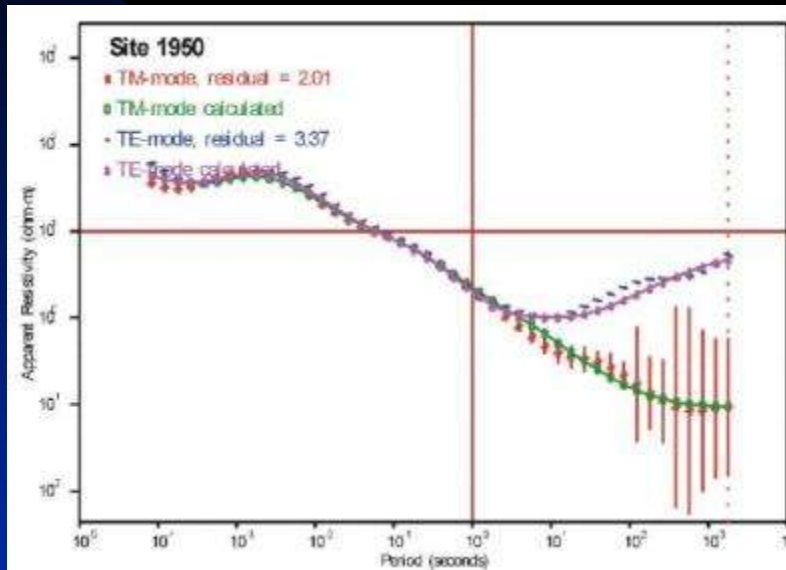
- ✦ Remote reference & robust in-field processing
- ✦ Complete in-field QC, data analysis & preliminary interpretation

• Data interpretation

- ✦ Decomposition & analysis
- ✦ 1D, 2D inversion
- ✦ 3D modeling
- ✦ Cooperative interpretation



EM METHOD FOR HYDROCARBON INVESTIGATION

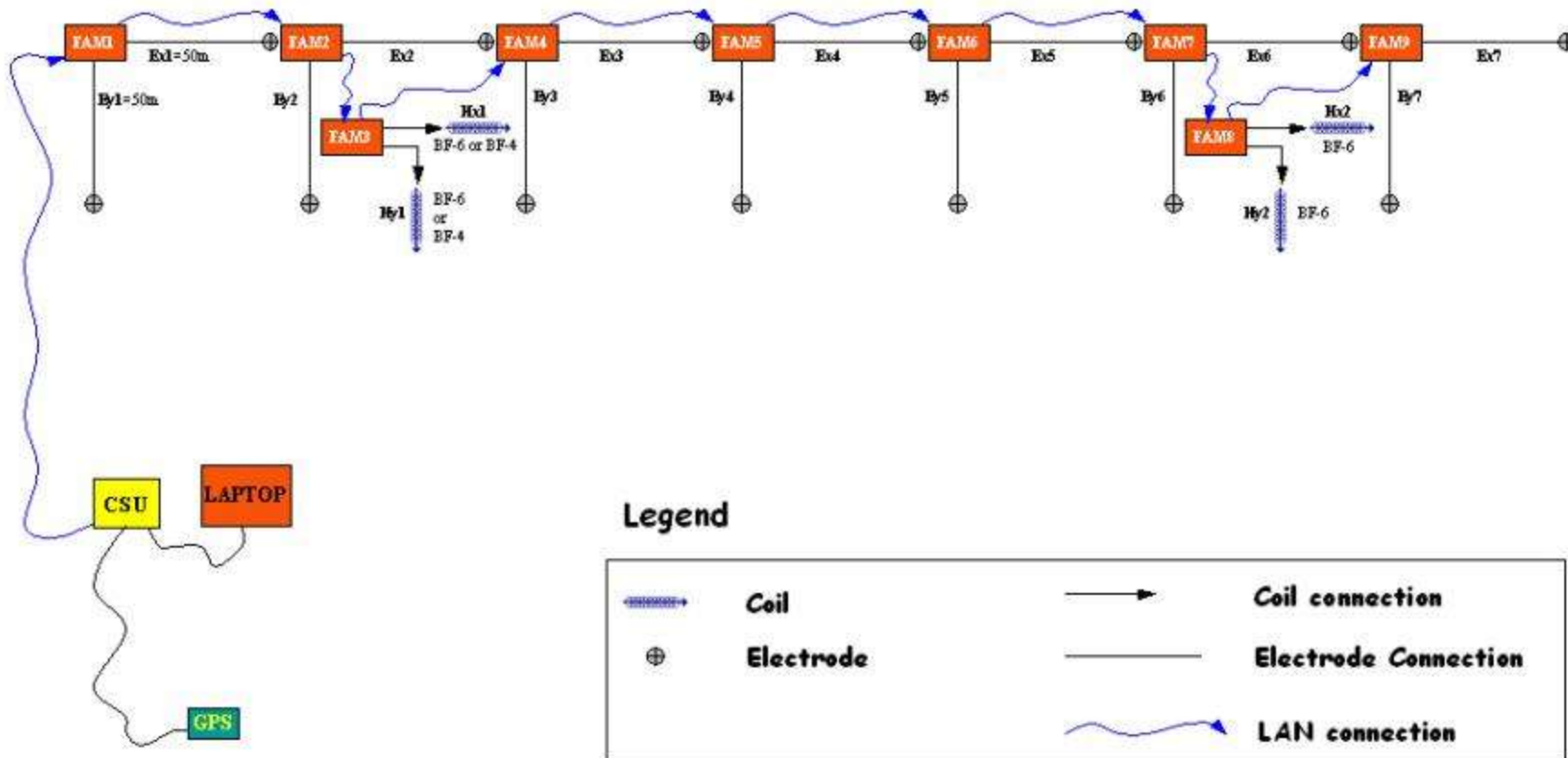


RESISTIVITY vs FREQUENCY



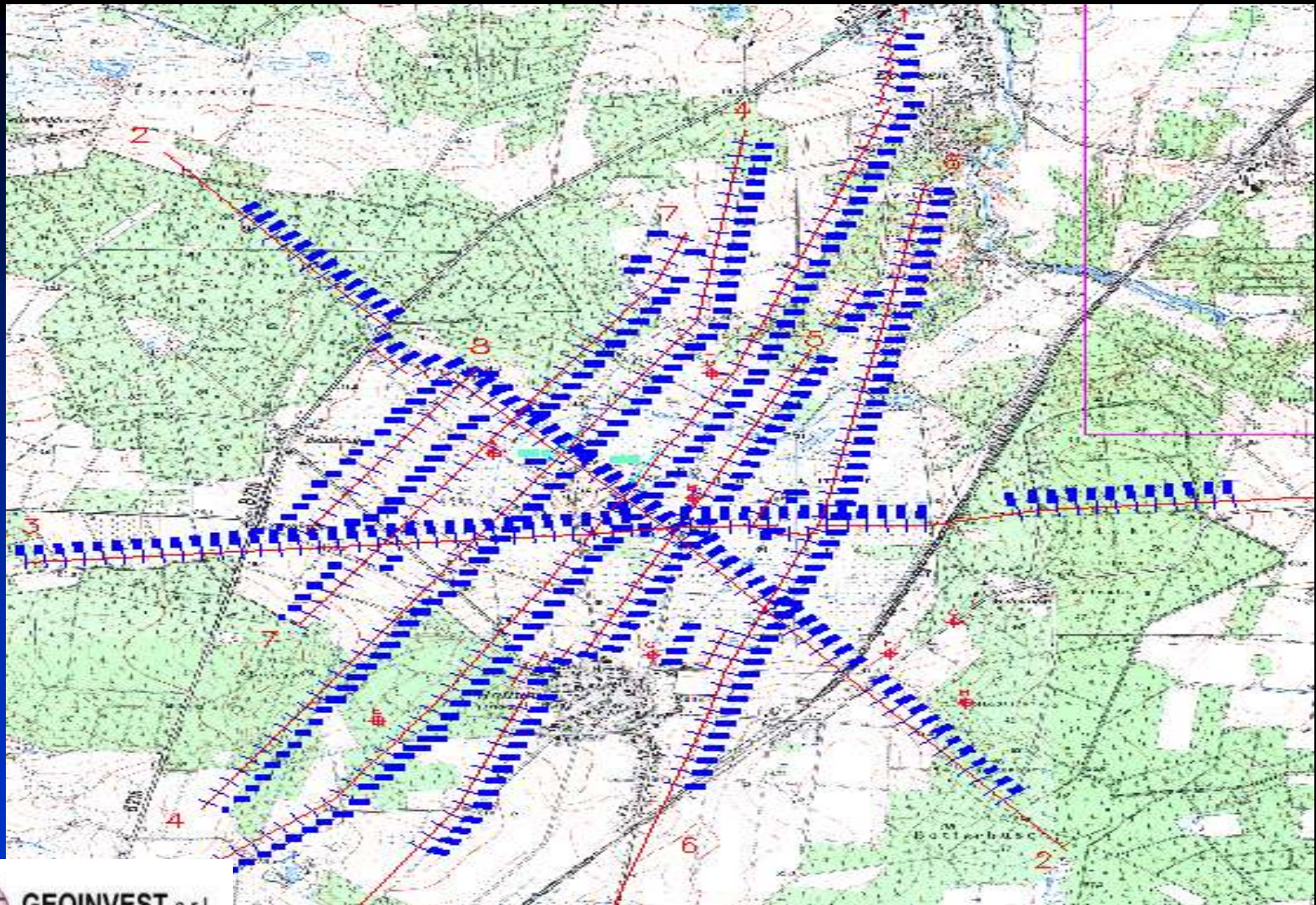
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AMT / MT FIELD ARRAY



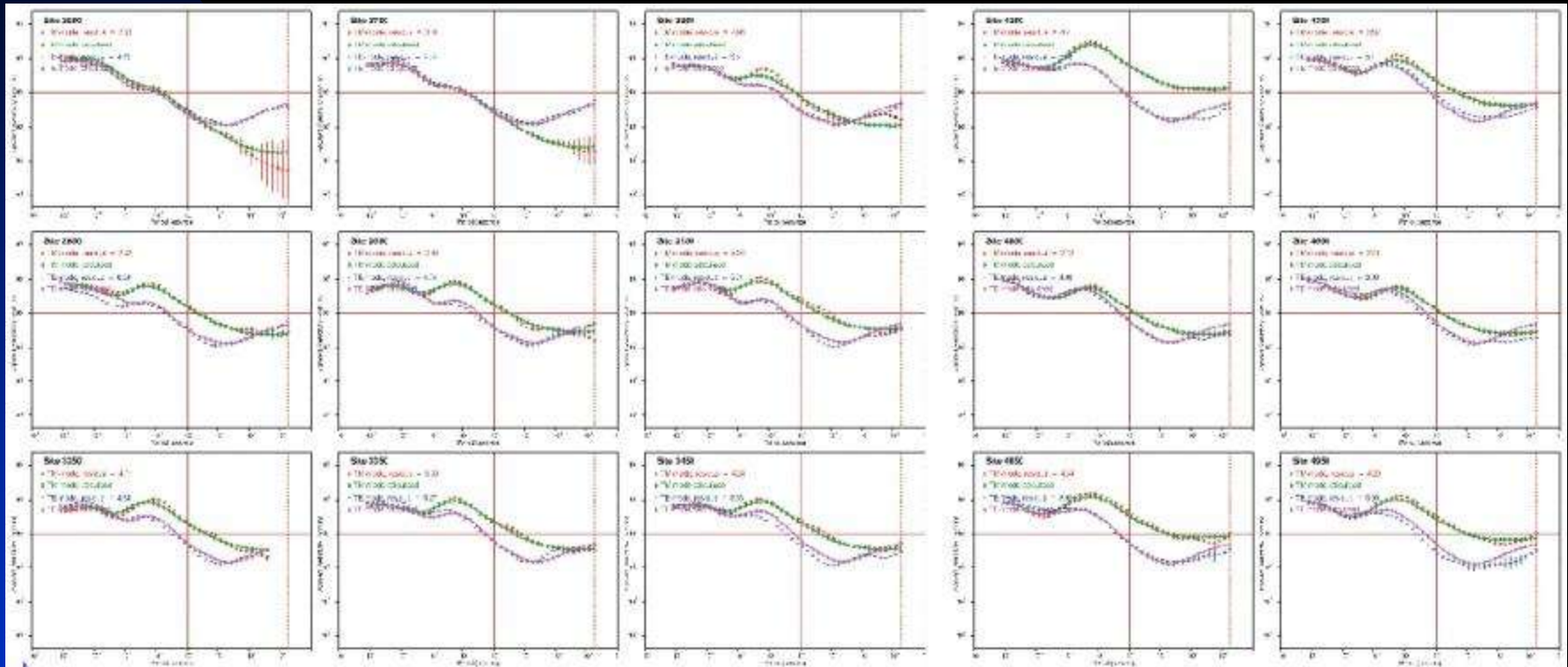
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AMT / MT SURVEY OUTLINE

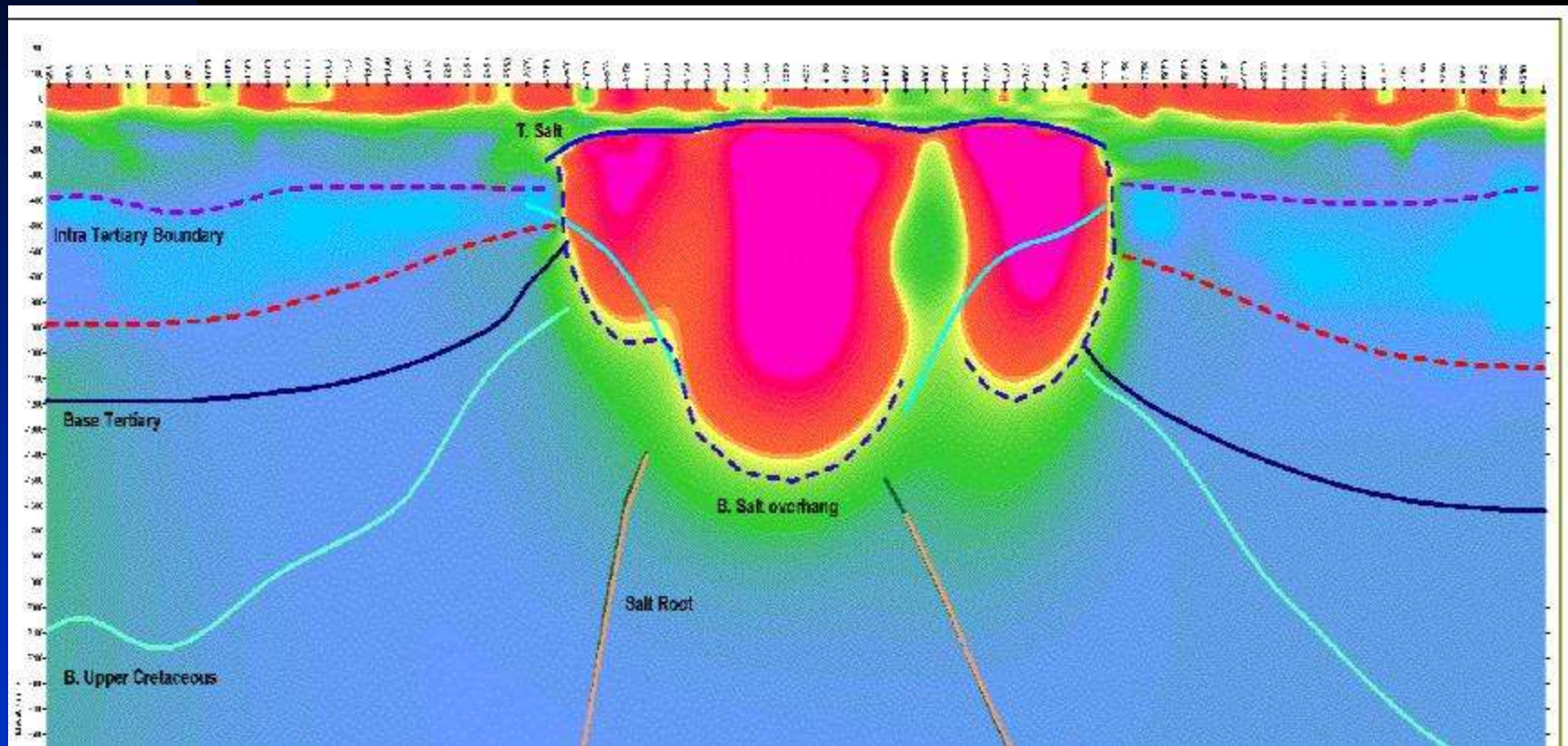


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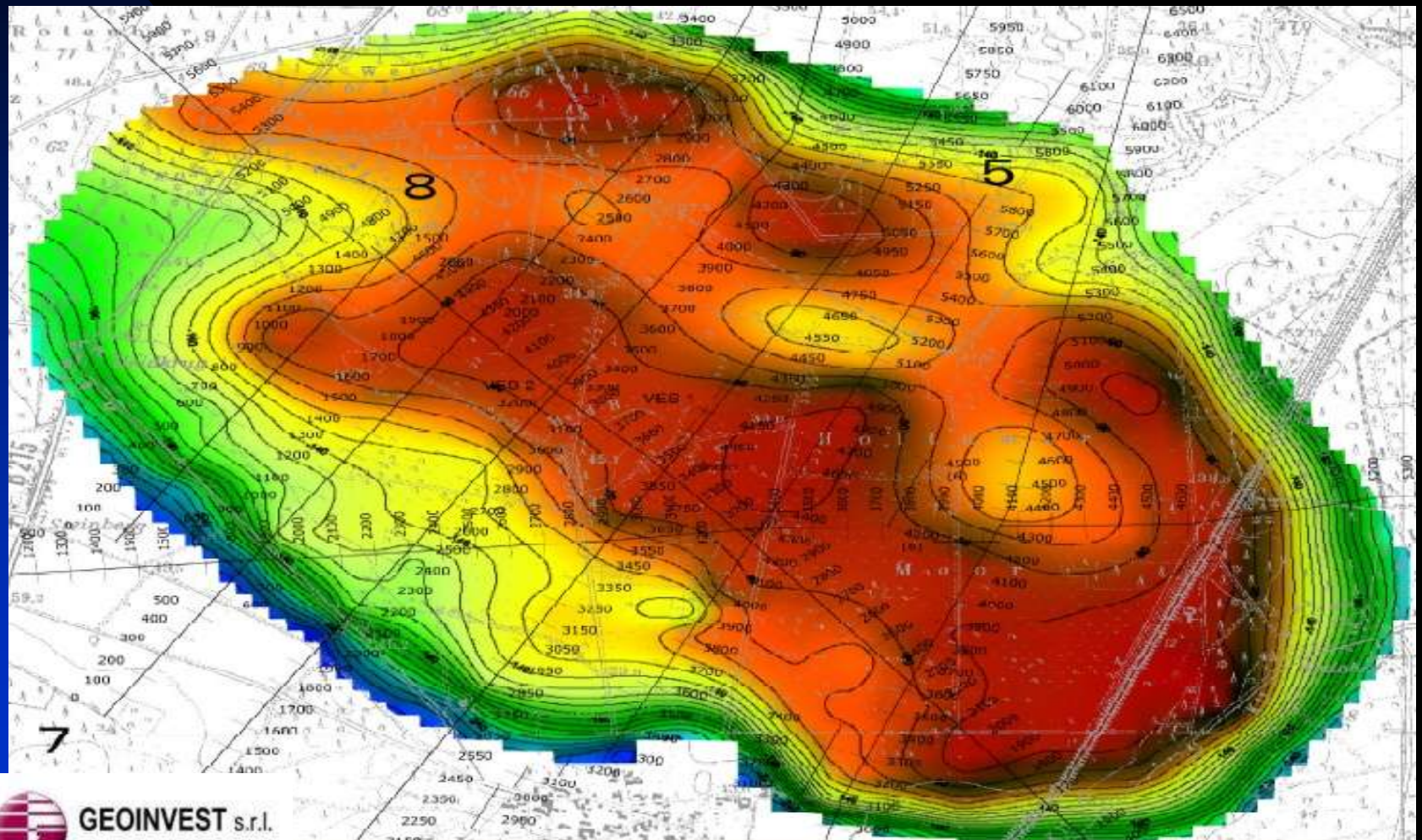
AMT / MT CONTINUOUS PROFILING



AMT / MT CONTINUOUS PROFILING 2D MODEL



AMT / MT SURVEY – TOP OF THE RESISTOR UNIT (SALT DOME)



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Wake up ! This is the end



Thank you



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