



Centro Tecnológico  
*del mármol*

*del mármol*

# Entrepreneurial Discovery Focus Group on Non Metallic Minerals in Eastern Macedonia and Thrace

*5 May 2015*

*Drama, Greece*

## Innovation in the marble industry

*Javier Fernández Cortés*

*Managing Director*



# Who we are





# Areas of expertise



Testing Laboratory

Safety

Geology and Geophysics

Construction and architecture

R&D and innovation

ICTs

OTRI

Training

## Testing Laboratory





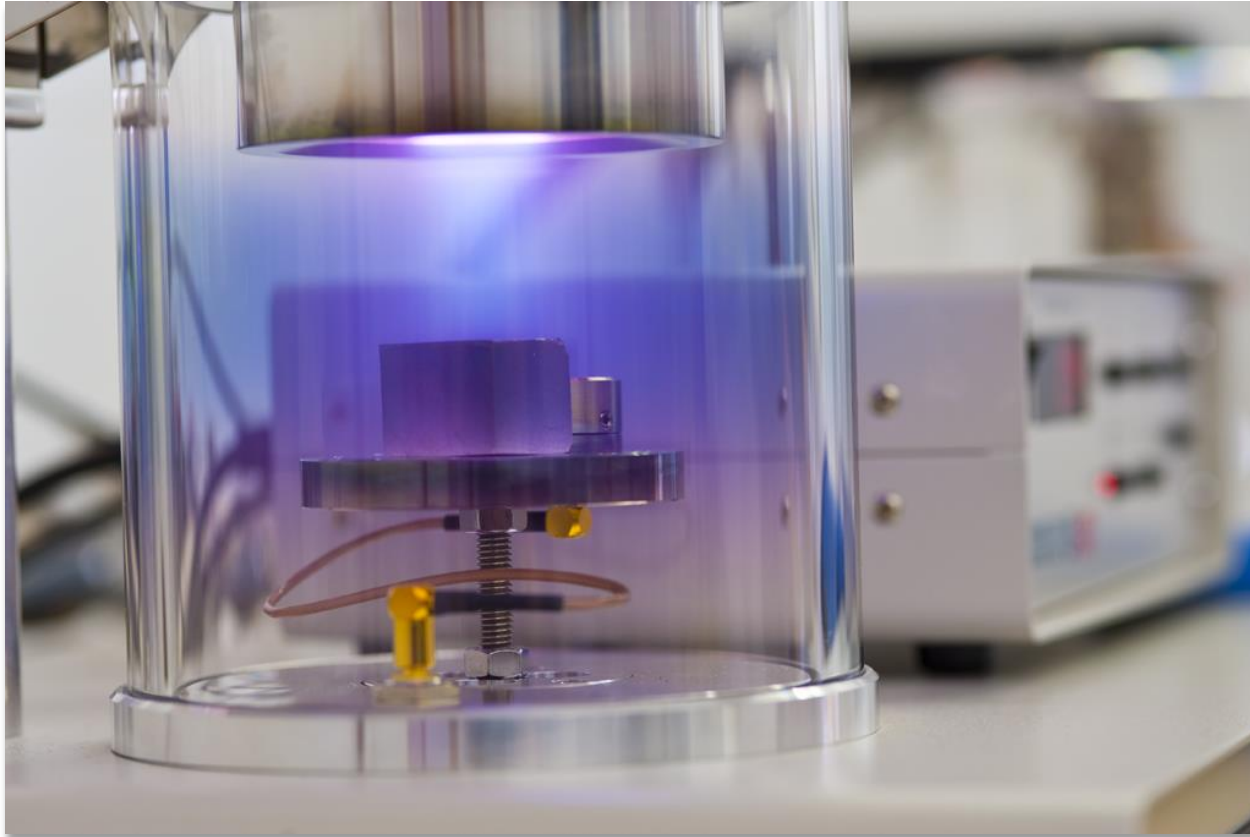
Safety



Construction and architecture

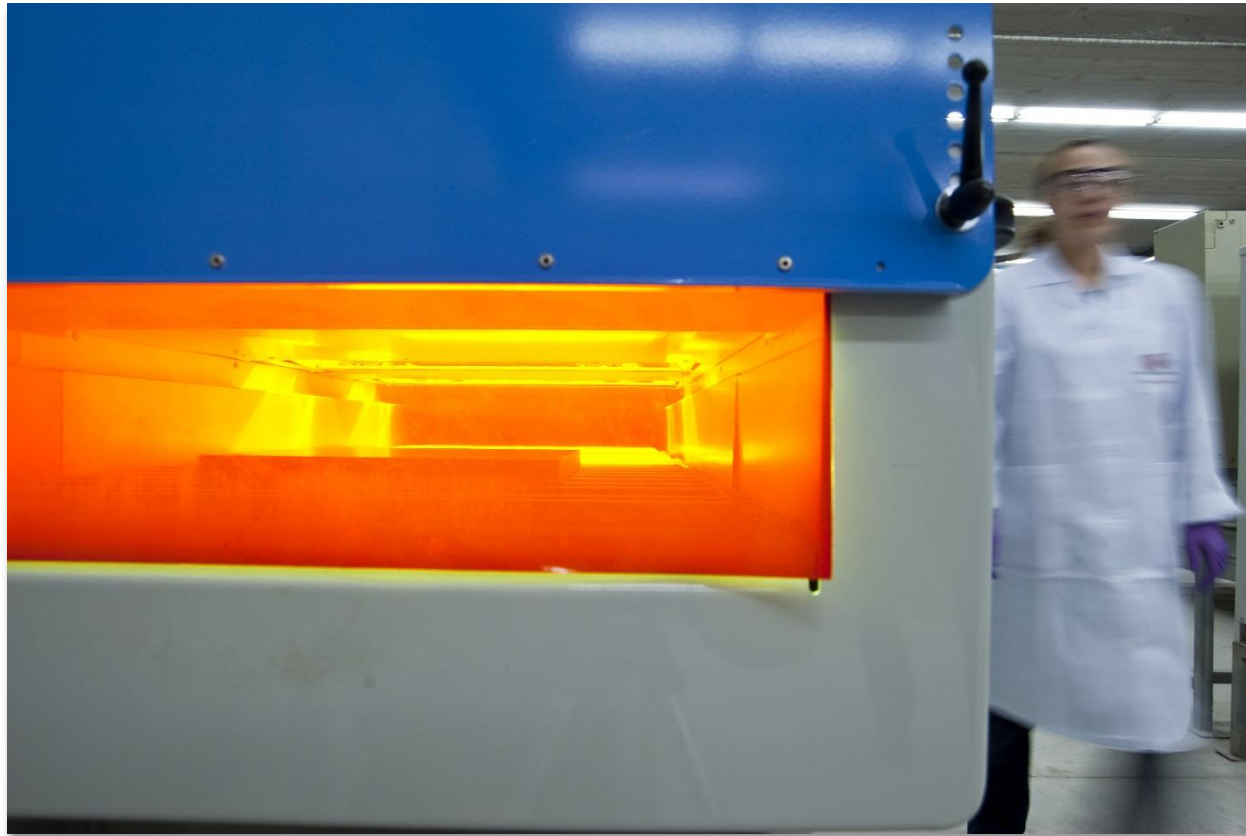


R&D and innovation





ICTs



OTRI



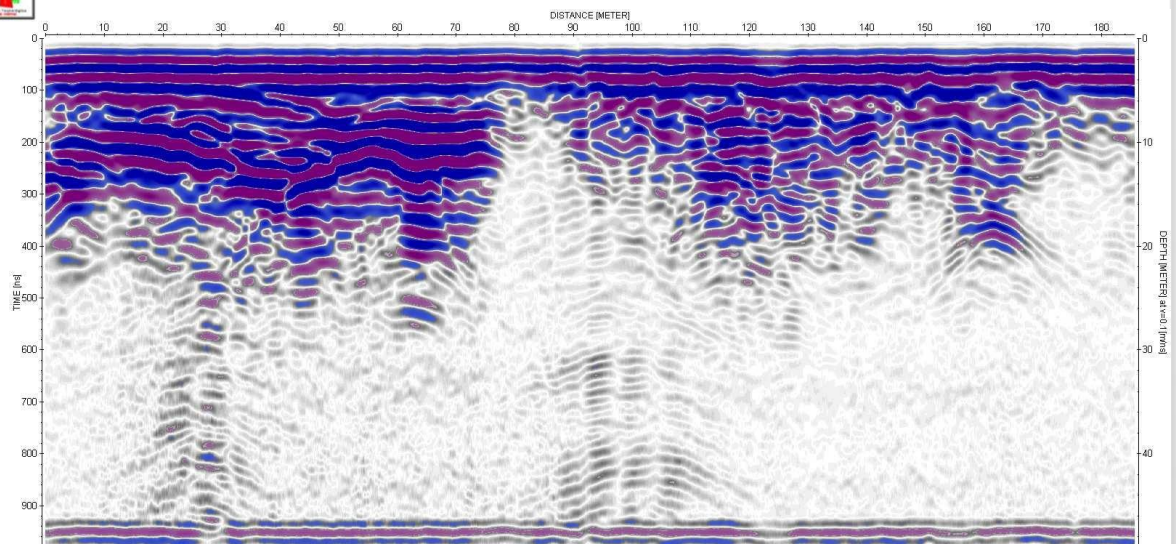
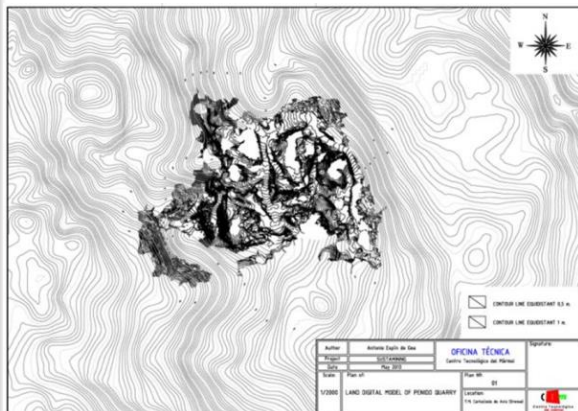
LA OFICINA DE TRANSFERENCIA DE RESULTADOS DE INVESTIGACIÓN  
*THE OFFICE FOR THE TRANSMISSION OF RESEARCH RESULTS*

Training





## Geology and Geophysics



Geology and Geophysics



# SUSTAMINING

SELECTIVE AND SUSTAINABLE EXPLOITATION OF ORNAMENTAL STONES BASED ON DEMAND

## Objectives:

Development of a new methodology for selective exploitation of natural stone quarries according to demand, taking into account the quality requirements of the product on site.



Financed by:



## Duration:

01/01/2013-  
31/12/2015

## Participants:

DNV-German Natural Stone Association (Coordinator)  
EUROROC-Federación Europea e Internacional de Industrias de la Piedra Natural  
EUROMINES- Asociación Europea de Industrias de la Minería, Metales y Minerales Industriales  
FDP- Federación Española de la Piedra Natural  
NVS- Naturstein-Verband Schweiz  
CTM- Centro Tecnológico del Mármol y la Piedra Natural  
AITEMIN- Asociación para la Investigación y el Desarrollo Industrial de los Recursos Naturales  
MIRO- Mineral Industry Research Organization  
HITUSA TAS.VE MADENCILIK SAN.VE TIC.LTD.STI.  
Girardi Stone Contractors  
Canteras Penido, S.L.

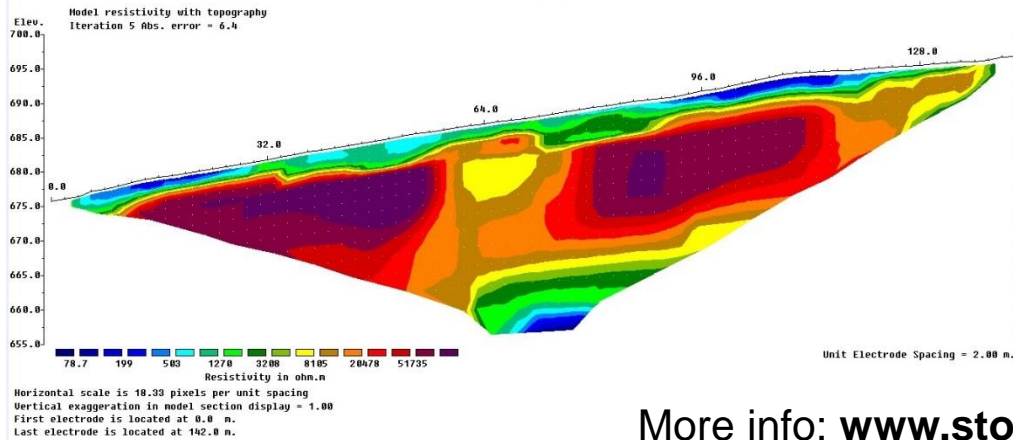
## Budget:

2.556.714€

## Geology and Geophysics



Financed by:



More info: [www.stoneplacing.com](http://www.stoneplacing.com)



Geology and Geophysics

**TECHNIQUES FOR CHARACTERIZATION, AND AUSCULTATION DIAGNOSIS OF THE CONSERVATION OF ARCHITECTURAL HERITAGE**

**Objectives:**

There are situations in which the experimental evaluation of the condition or damage in structural elements of the heritage can cause damage. This project is a study of different methods of non-destructive evaluation to carry out this type of study without damage architectural heritage.

**Participants:**

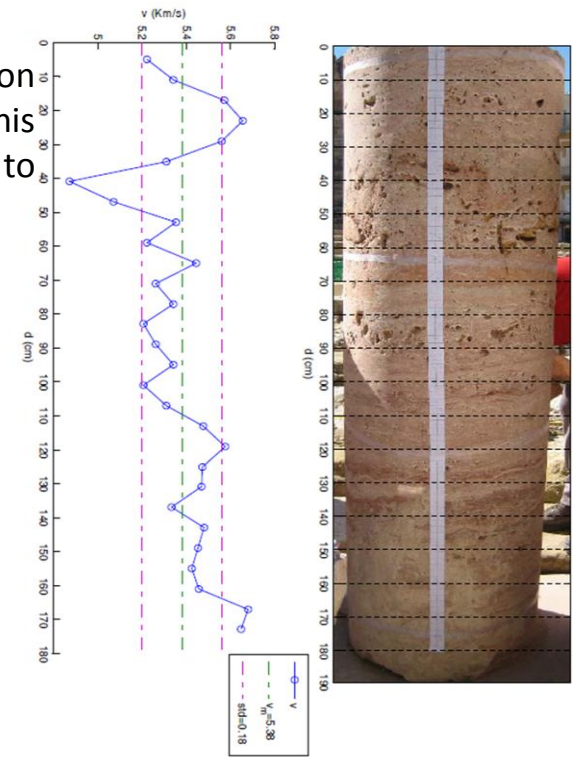
CTM- Spain  
University of Granada- Spain

**Duration:**

01/10/2012- 30/09/2014

**Budget:**

455.927 €



## Geology and Geophysics



Financed by:



# MIPOLARE

**POST-MINED POLLUTED LANDSCAPES RECLAMATION BY MEANS OF VALORIZATION OF DIFFERENT RESIDUES.**

### Objectives:

The main objective of this project is to evaluate, demonstrate and disseminate an alternative sustainable for the reclamation of mining sites using both methods amendment materials and phytostabilization.

### Participants:

CTM, TRAGSA-UPCT, Portman Golf, General Directorate of Environment of Murcia Region.

General Directorate of Industry, Energy and Mines of Murcia Region (Coordinator)

### Duration:

01/09/2010-31/08/2014

### Budget:

1.791.272,00€

## Geology and Geophysics



Financed by:



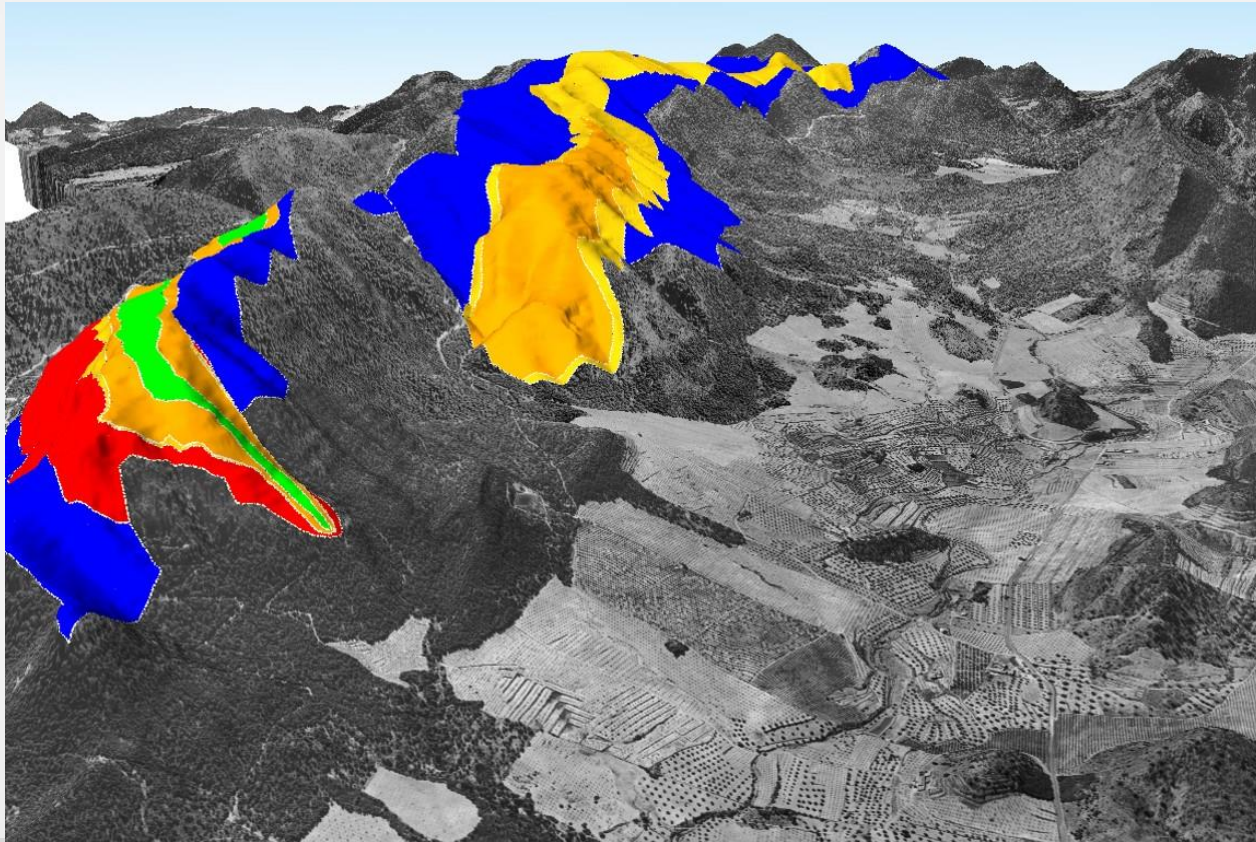
More info: [www.mipolare.eu](http://www.mipolare.eu)



## GEOLOGY AND GEOPHYSICS.

### OBJECTIVES

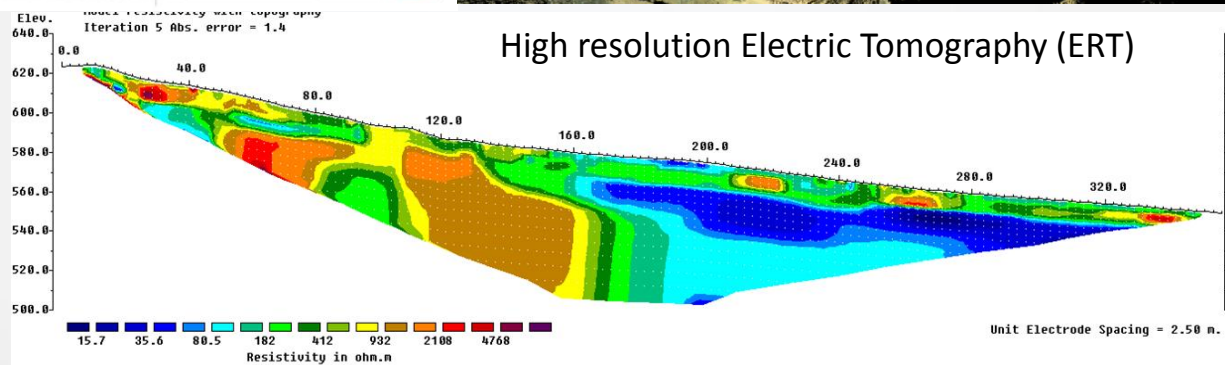
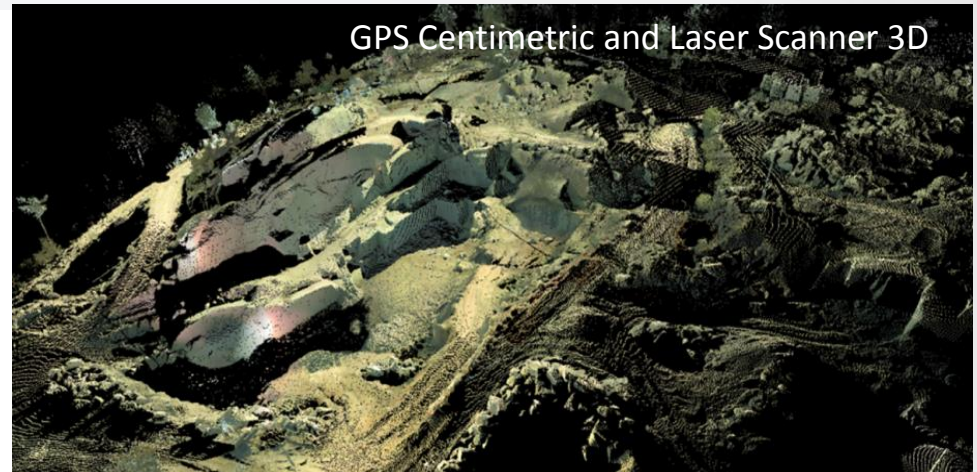
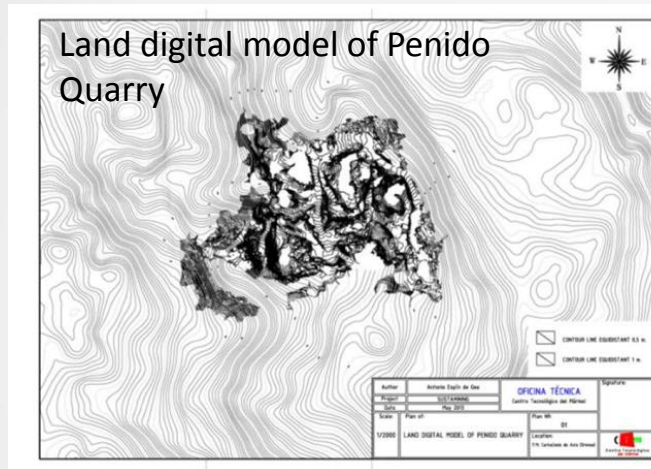
*The main objective of a research project, focused on a mining deposits of ornamental stone, is perfectly characterise its materials, as well as obtaining a geological model that allows us to optimise and rationalise resources to be exploited in a suitable way.*



# GEOLOGY AND GEOPHYSICS.

## OBJECTIVES

*Geophysical techniques used to obtain these data allow us to obtain geometry of the layers in a non-destructive manner, their physical-mechanical properties “in situ”, exploitable reserves, structural situation of massif, etc.*

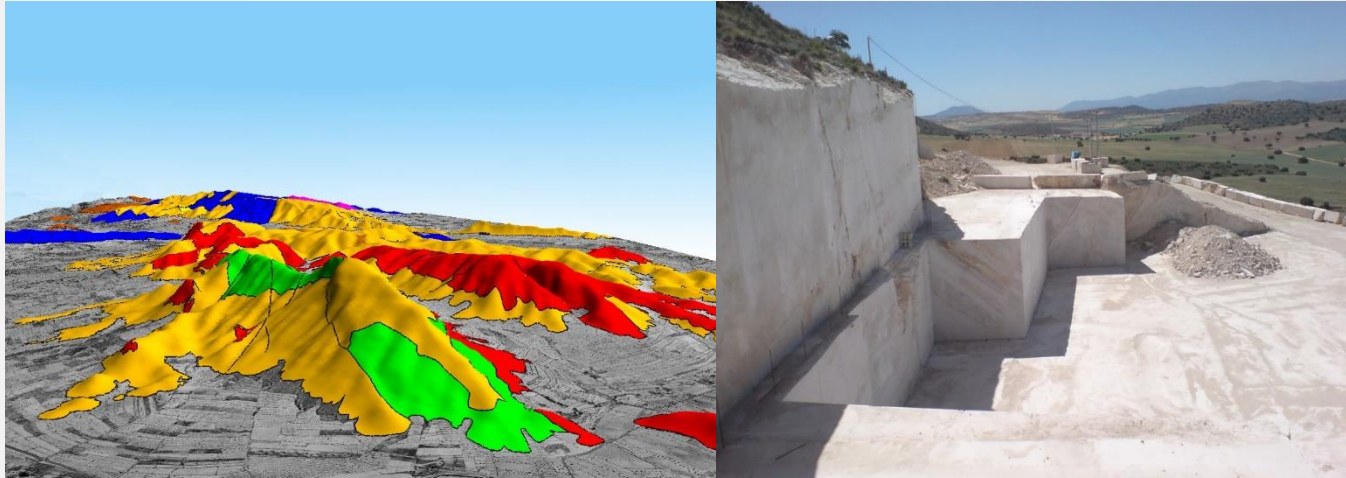




## GEOLOGY AND GEOPHYSICS.

### CURRENT METHODOLOGY

- Detailed geological mapping, where a geological inspection and an interpretation of area into small-scale is carried out and the presence of the layer of material is found.



- Exploration where simple core is recovered, extraction of specific simple cores and verification of this material. Testing laboratories.





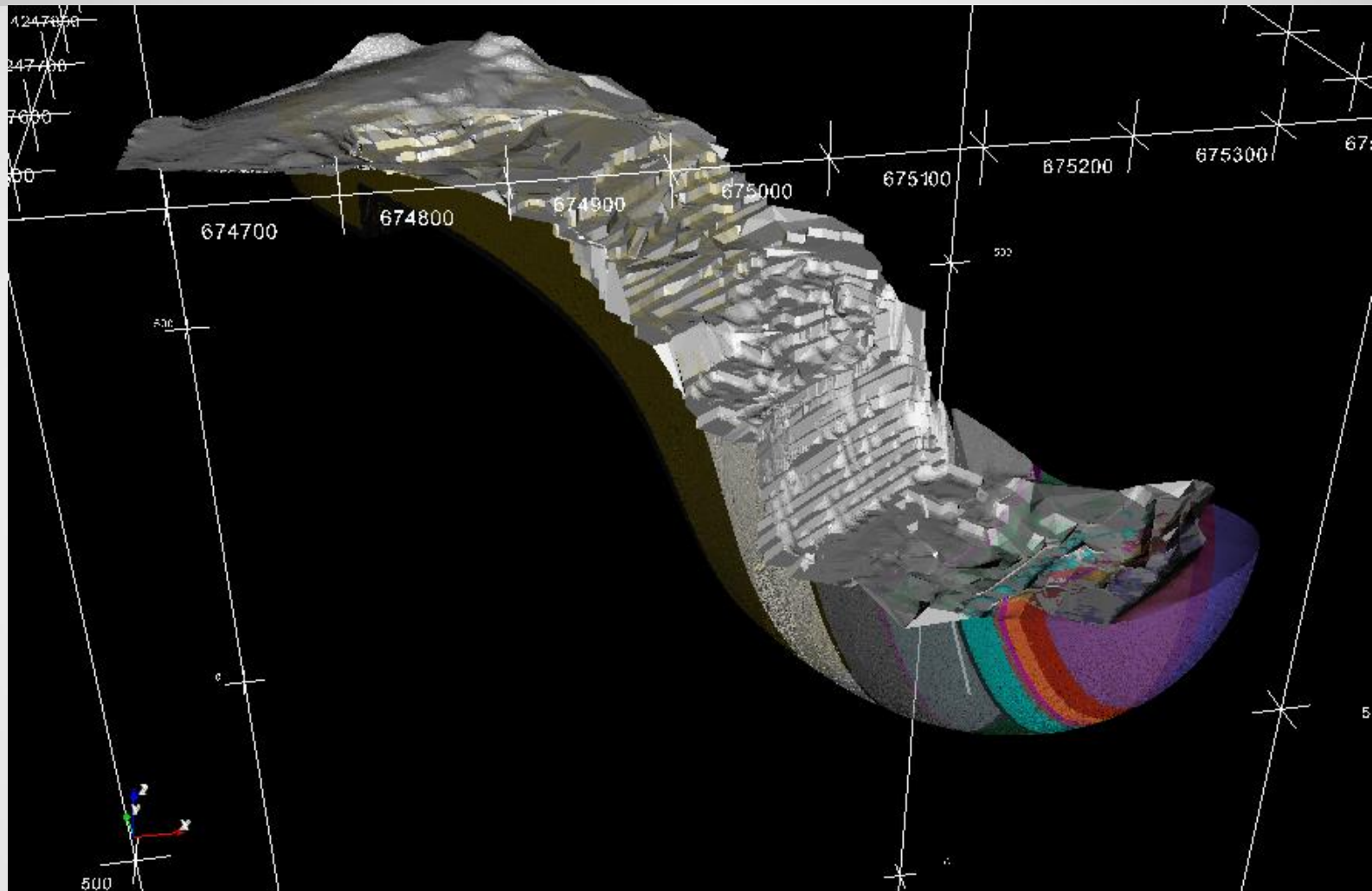
### CURRENT METHODOLOGY

*The current criteria for the design of an exploitation:*

- Geometry: Characteristics and morphology of the area, slope, property boundaries, etc.
- Soil science: Stability and safety of the exploitation during its operating life.
- In operation: Maximum machinery dimensions to operate under appropriate conditions of efficiency and safety, heights between different levels, berms widths and slopes.
- Environmental: Integrating exploitation holes and slag heap, which it facilitates the restoration and reduction of impacts.



# GEOLOGY AND GEOPHYSICS DEPARTMENT



## GEOPHYSICAL TECHNIQUES USED BY THE CTM

Geophysical survey is a set of techniques and methods used to investigate the interior of the Earth and determine the nature and distribution of materials from its physical properties. These techniques complement the traditional and superficial researches.

- **Georadar (Ground Penetrating Radar - GPR)**
- **High-resolution Radar Tomography (ERT)**
- **Seismic reflection, Refraction, Seismic tomography and MASW (Multichannel Analysis of Surface Waves)**

The location of an investigation by Global Positioning System (GPS) with high precision is critical as it allows accurate data and Geographic Information Systems (GIS) allow us to analyse these georeferencing.

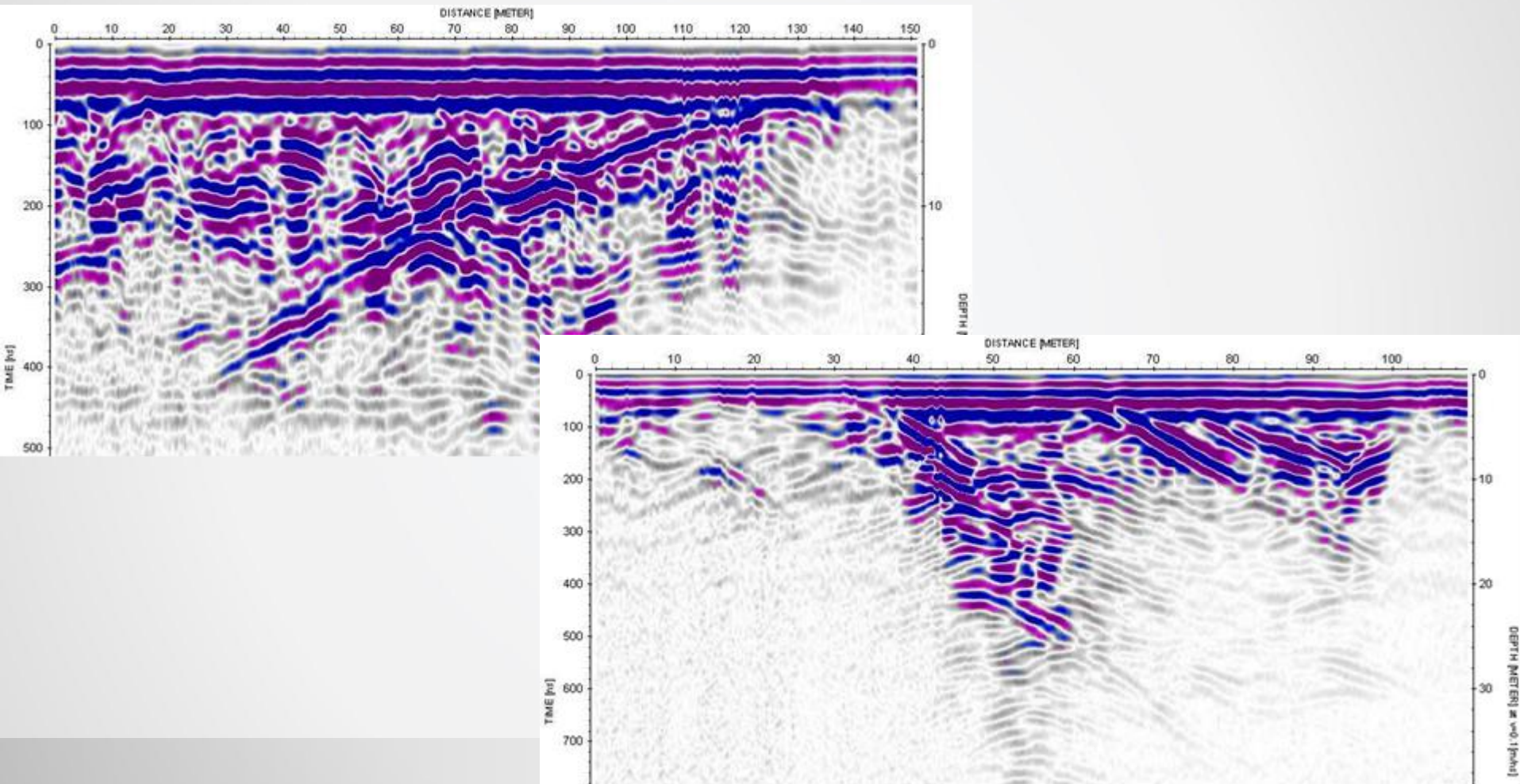


### Ground Penetrating Radar (GPR)

It is an electromagnetic system for non-destructive subsoil study. It is based on radiation of a transient electromagnetic signal which penetrate in the ground. Part of this radiation is reflected towards the surface when it interacts with a discontinuity and this signal is collected and processed accurately obtaining subsoil information.

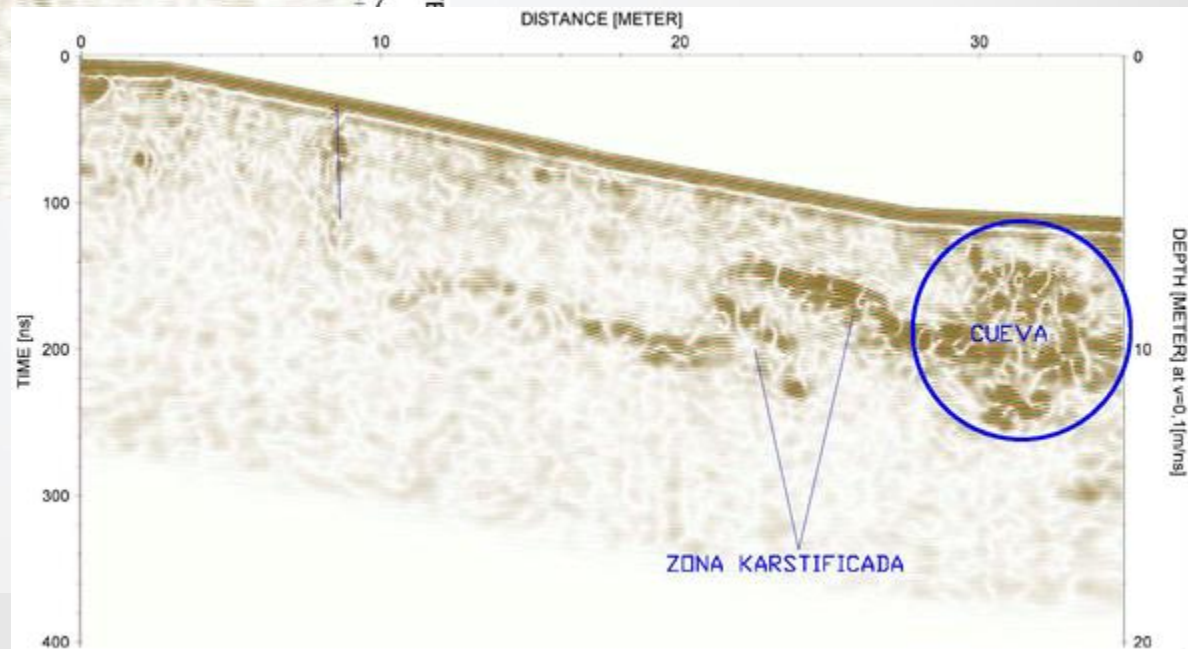
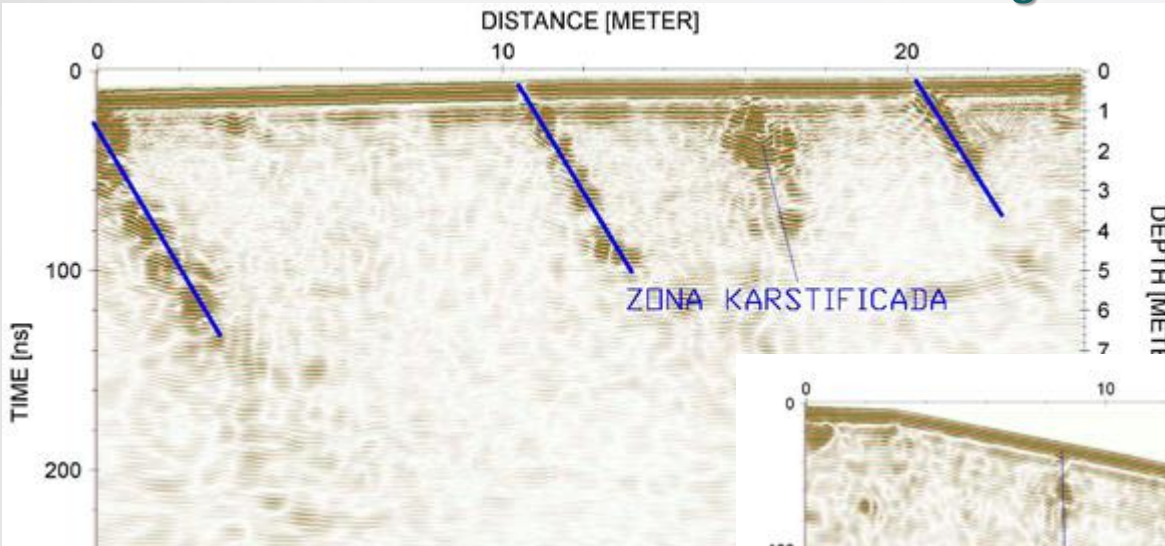


## Ground Penetrating Radar (GPR)



# GEOPHYSICAL TECHNIQUES USED BY THE CTM

## Ground Penetrating Radar (GPR)





### Ground Penetrating Radar (GPR)

- Archaeology
- Construction
- Mining
- Detection of buried utility services
- Criminology

Highly versatile when confronting a study due to its easy handling and speed in data collection.

Presence of fine material absorbs the signal and not allowed to penetrate into the ground, which causes poor results.

## High-resolution Radar Tomography (ERT)

It is a geophysical technique that specifically aims to determine the real distribution of the electrical resistivity of the subsoil in depth and in a profile measure.



## High-resolution Radar Tomography (ERT)

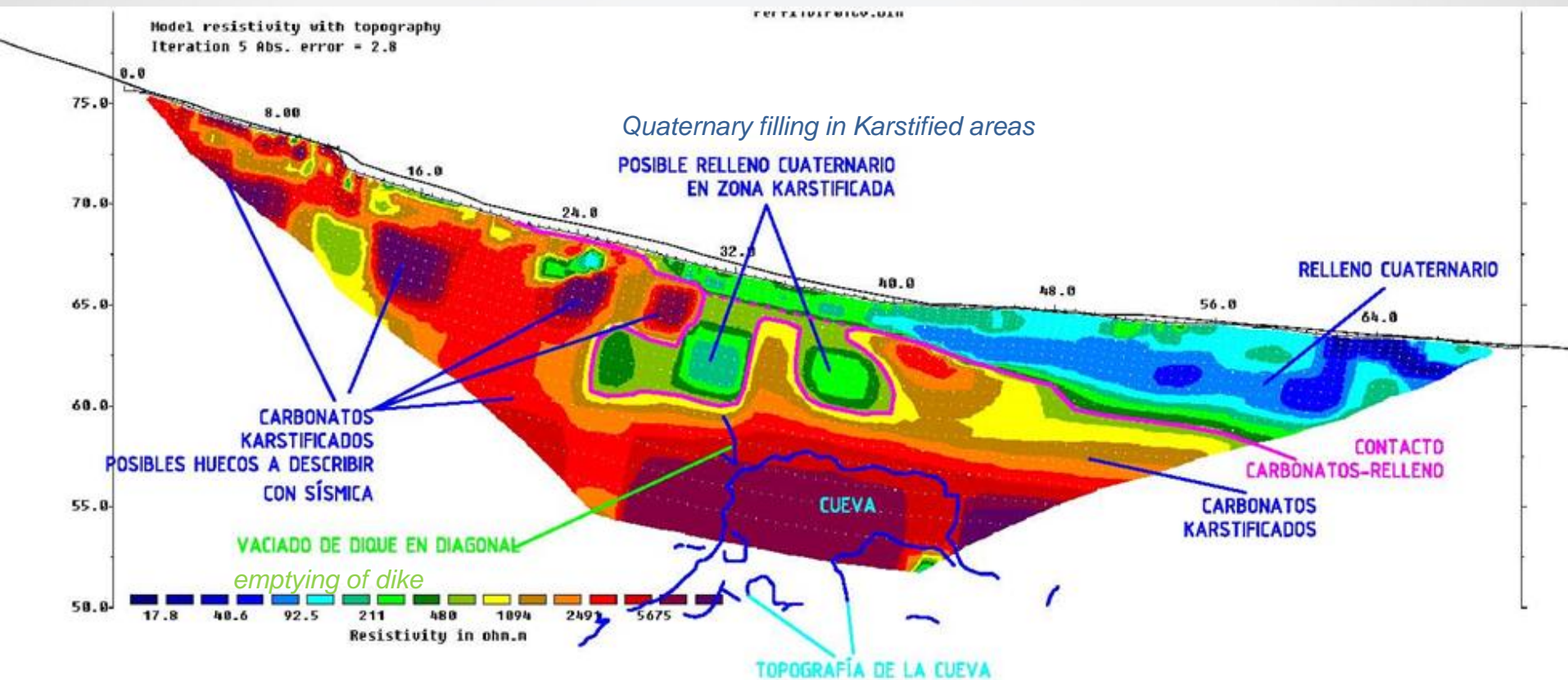
The Tomography method consists of introducing a continuous electrical current on the surface through two “current electrodes”. The voltage is measured by another pair of electrodes called “potential electrode”.

From the value of the current introduced and the voltage measured, “apparent resistivity” of the material is obtained at a certain point of the subsoil, called “attribution point”, which depends on the position of the electrodes.





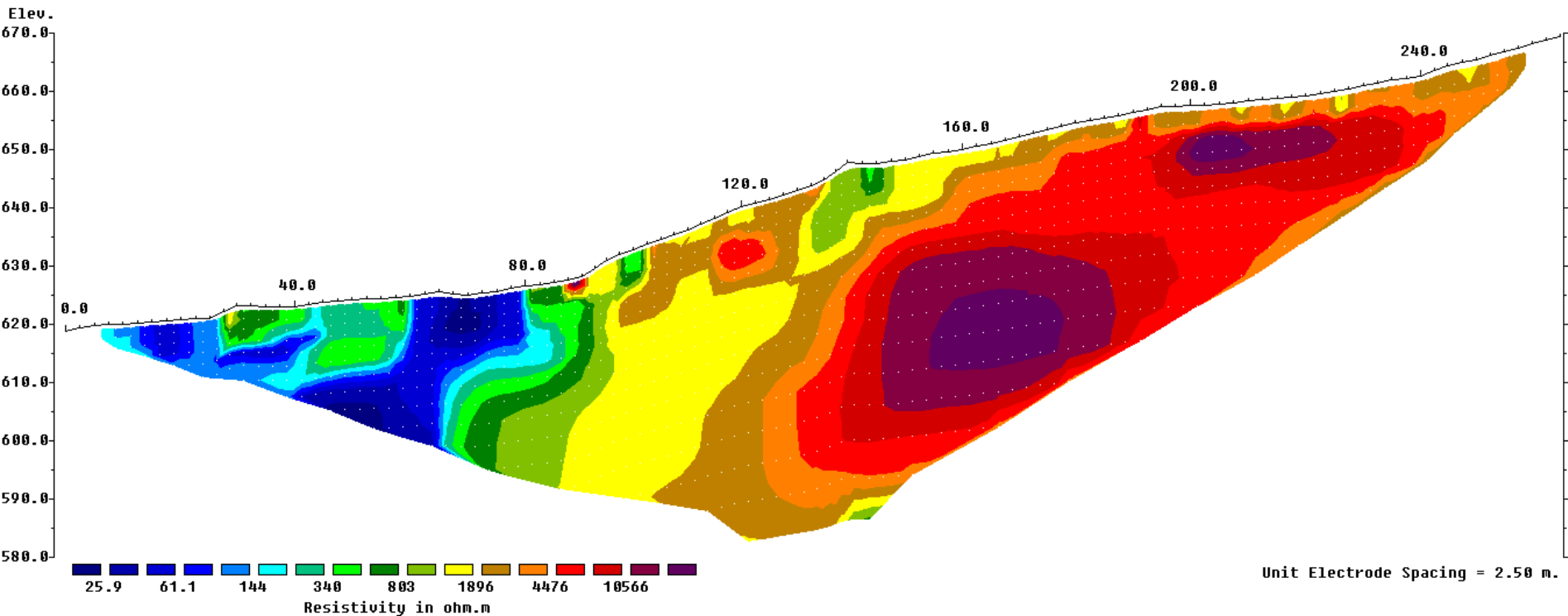
## High-resolution Radar Tomography (ERT)



## High-resolution Radar Tomography (ERT)

Perfil13.bin

Model resistivity with topography  
Iteration 5 Abs. error = 4.4



Horizontal scale is 12.49 pixels per unit spacing  
Vertical exaggeration in model section display = 1.00  
First electrode is located at 0.0 m.  
Last electrode is located at 265.0 m.

### High-resolution Radar Tomography (ERT)

- Definition of contacts between subsoil materials.
- Detection of the bedrock.
- Detection of the water table.
- Detection of cavities or old mines of water.
- Detection of palaeochannels.
- Identification of fractured zones and discontinuities
- Locating areas contaminated with leachates.
- Definition of the areas affected by saline intrusion

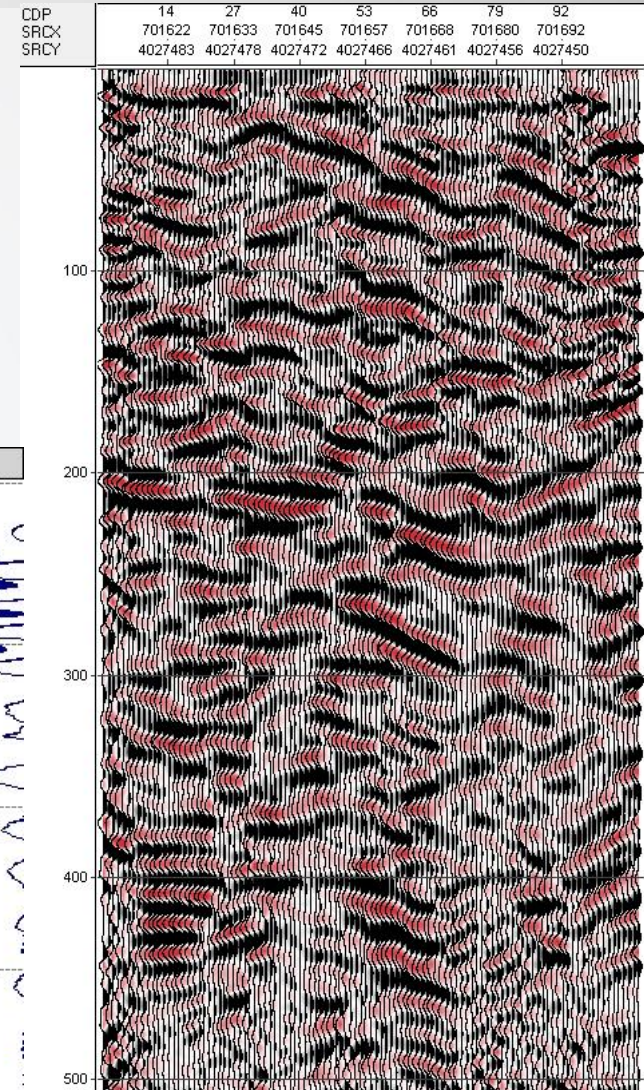
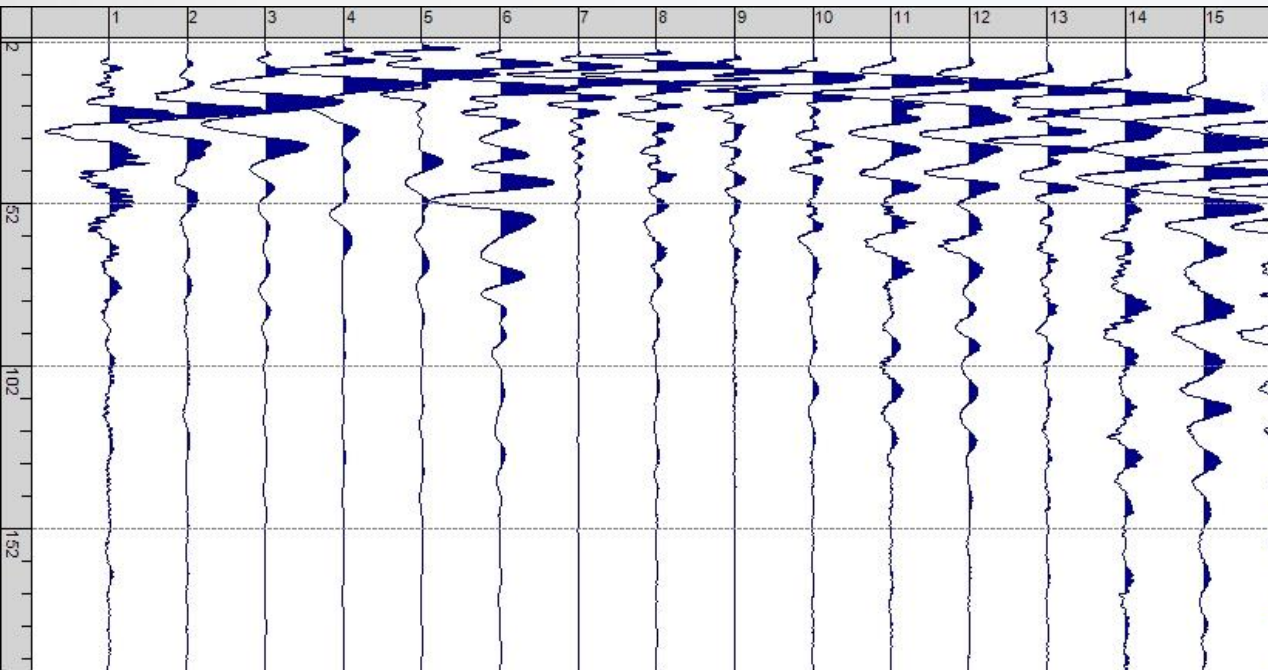


### Seismic reflection, Refraction, Seismic tomography and MASW

Seismic methods study the subsoil from the propagation of seismic waves that occur on the ground by a falling weight or using an explosive, as in the case of earthquakes, but with much less energy. The speed of propagation of different seismic waves is a good indicator of the geotechnical characteristics of the materials that are present in the study area.

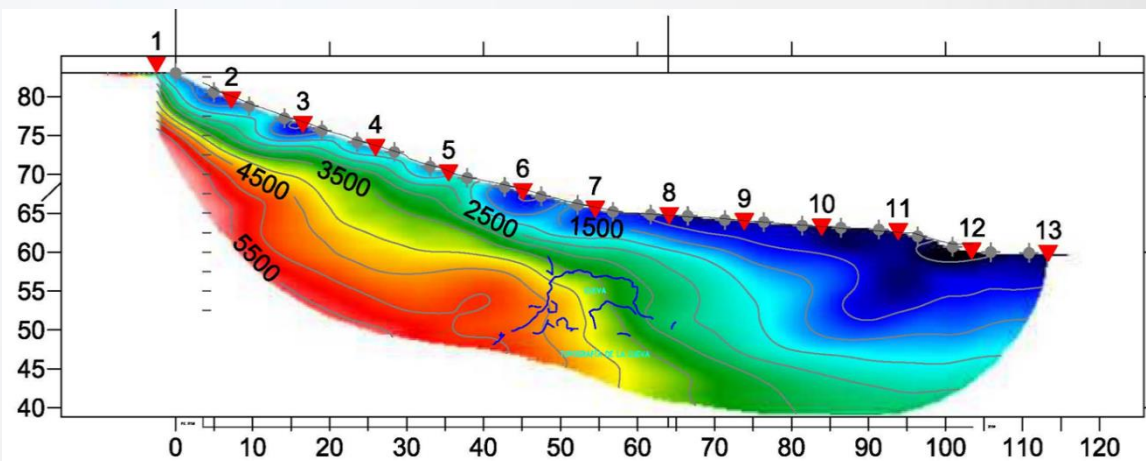
## Seismic Reflection

Seismic reflection consists of to record the wave front on the ground surface that it has been produced by a controlled explosion, looking from among all trajectories that have occurred due to reflections in the subsoil layers.



## Seismic Refraction and Seismic tomography

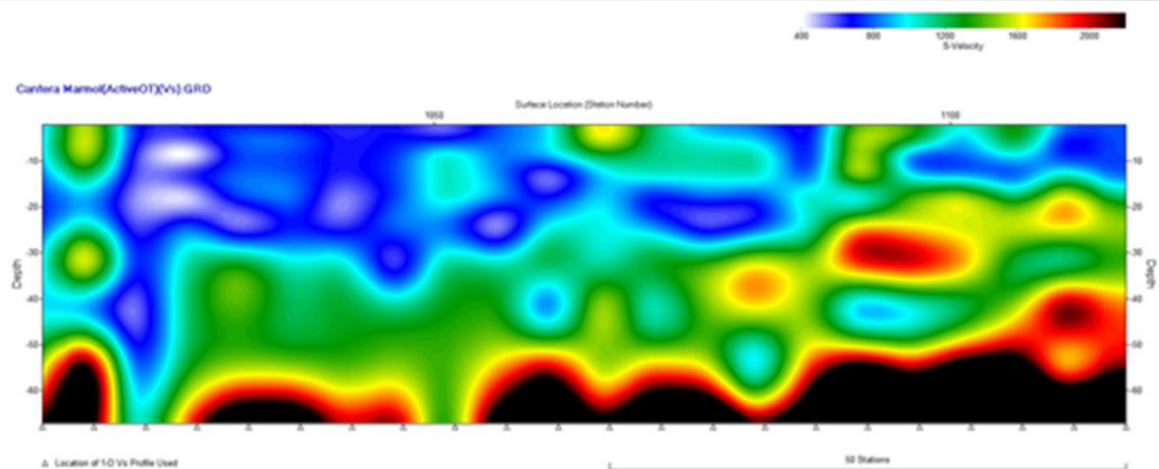
- Seismic refraction is based on determining the travel times of P waves from a known reference point (seismic source) to a number of receivers (geophones) that are located along a line acquisition.
- Seismic tomography is based on the inversion of waste (difference between the travel times of P waves observed and theoretical).





## MASW (Multichannel Analysis of Surface Waves)

It is a geophysical method based on the dispersion of surface waves that have been generated in an active (by mace, vibrating or explosive, etc.) or passive manner (traffic, wind, tides, etc.).

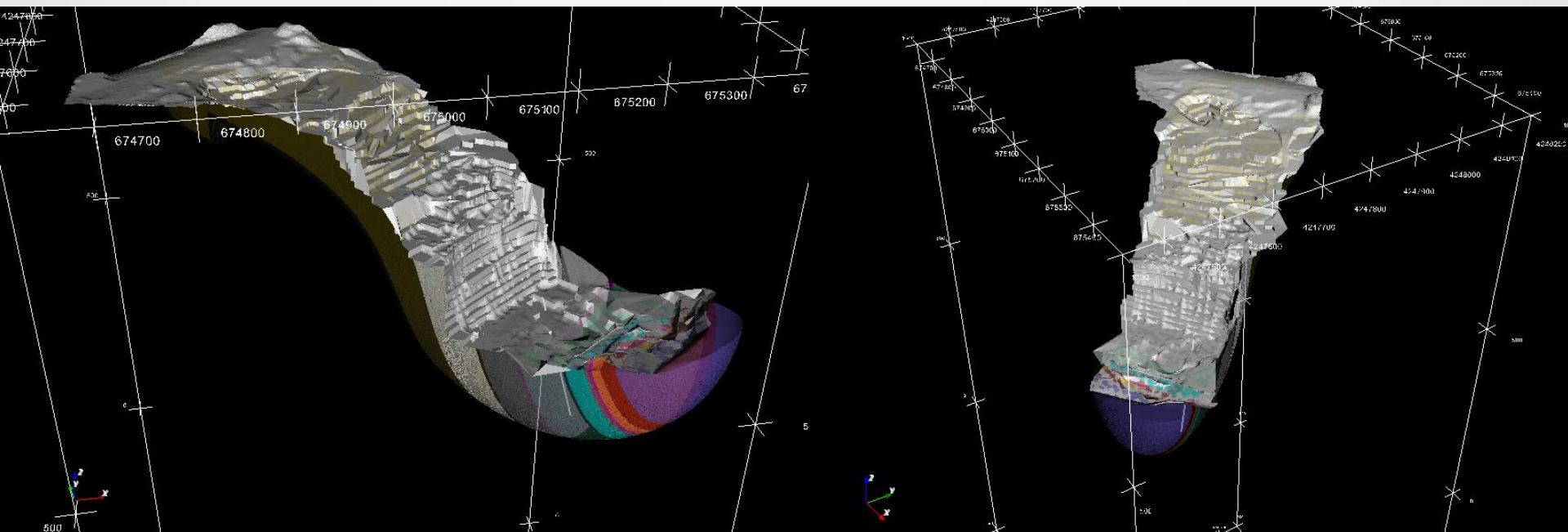


### Seismic Methods

- Degree of alteration, rippability of rock formations (Geotechnical and Civil Engineering).
- Study of aquifers (Hydrogeology, Environment).
- Location and study of fractures and faults (Civil Engineering, Geotechnical Engineering and Natural Hazards)
- Slope stability (Natural Hazards).
- Location of cavities, landslides studies (Natural Hazards).
- Obtaining speed of S wave propagation (Geotechnical, Seismology).
- Characterization of geological structures (Geology).

## 3D GEOLOGICAL MODELLING

Geophysical techniques described above and data collection with traditional methods of geology allows us to obtain the closest-to-reality geological-geophysical model and make 3D representations of deposits. It is crucial because it can help us to take decisions needed in the day-to-day operation of a quarry.





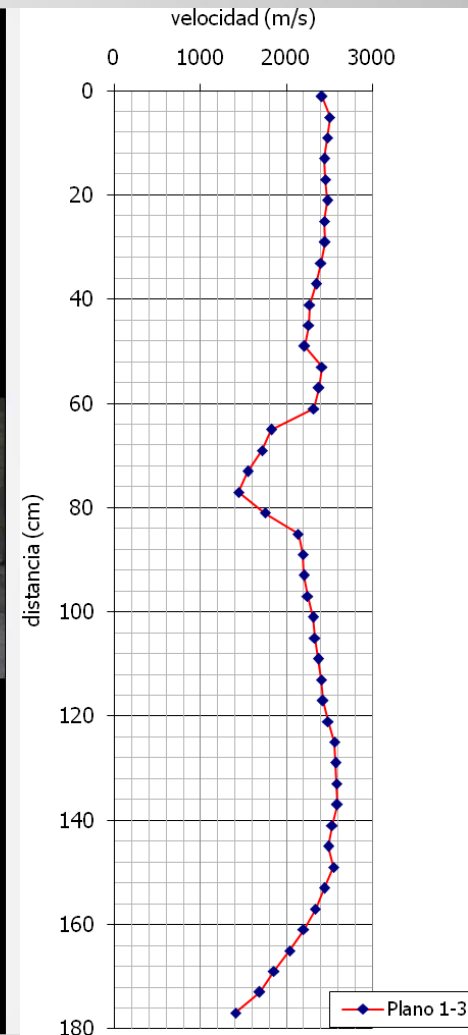
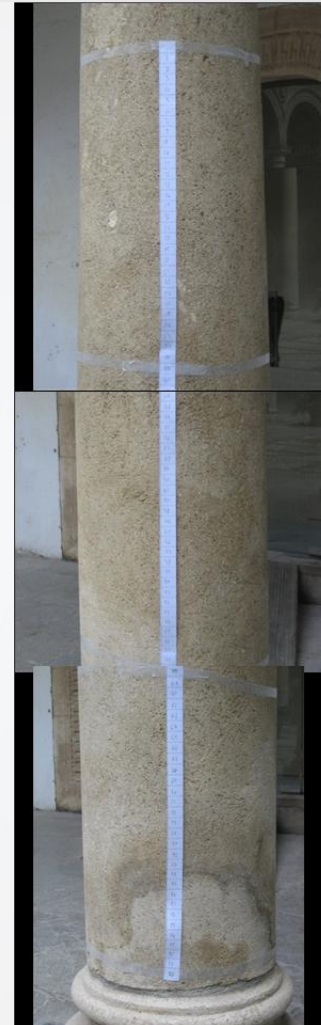
## RESEARCHING ARCHITECTURAL HERITAGE

To preserve architectonical and cultural heritage



## Ultrasound

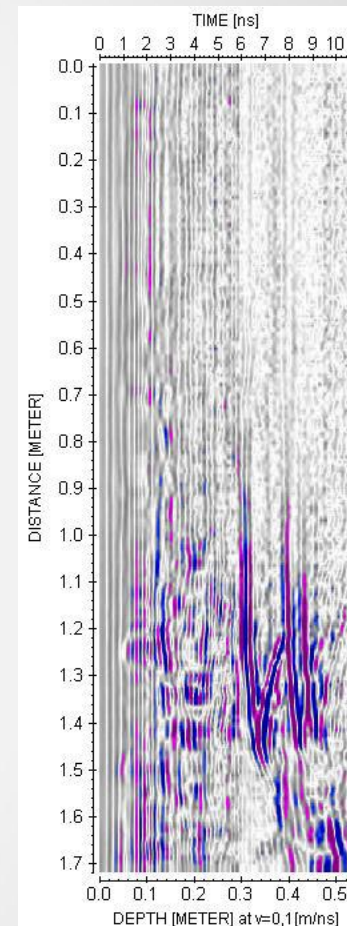
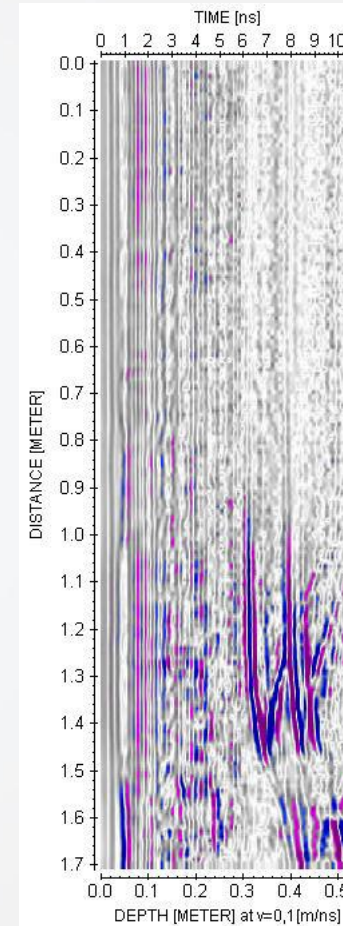
Ultrasonic methods are similar to seismic methods, where the dominant frequency is the main difference. They are commonly used in structures, sample cores for the calculation of the elastic modulus and auscultation of cultural heritage items.





## Ground Penetrating Radar (GPR)

Measures high frequency antennas are made, such as 2.6GHz, where the receiver and the transmitter are on the same side of a cultural heritage item.







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[www.ctmarmol.es](http://www.ctmarmol.es)

[info@ctmarmol.es](mailto:info@ctmarmol.es)

**Javier Fernández Cortés. Director of CTM**

[Javier.fernandez@ctmarmol.es](mailto:Javier.fernandez@ctmarmol.es)