



Volcanology and geophysical investigations at Vesuvius

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(on behalf of the MURAVES Collaboration)

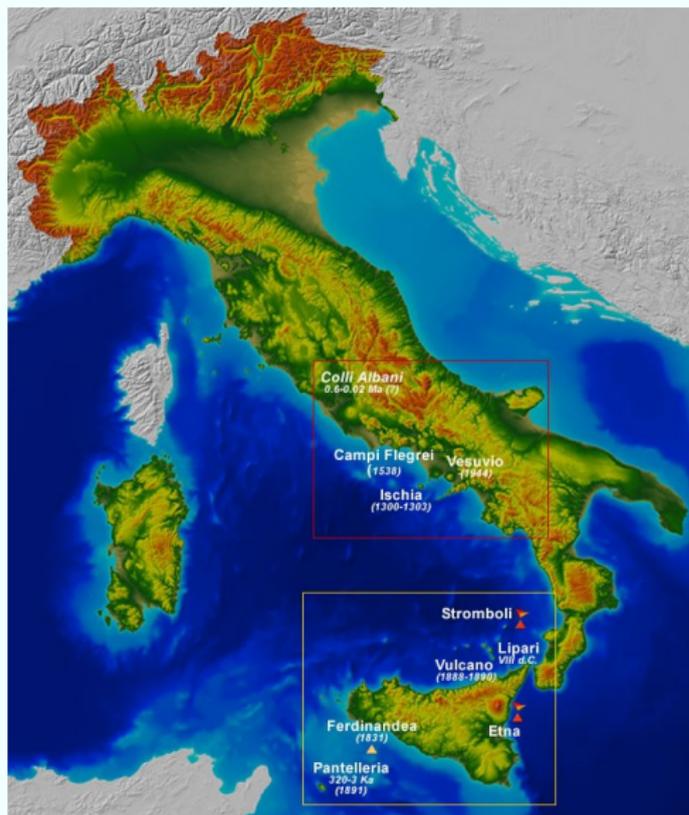
Istituto Nazionale di Geofisica e Vulcanologia
Osservatorio Vesuviano, Naples, Italy

Tokyo, 12 November 2014

Summary

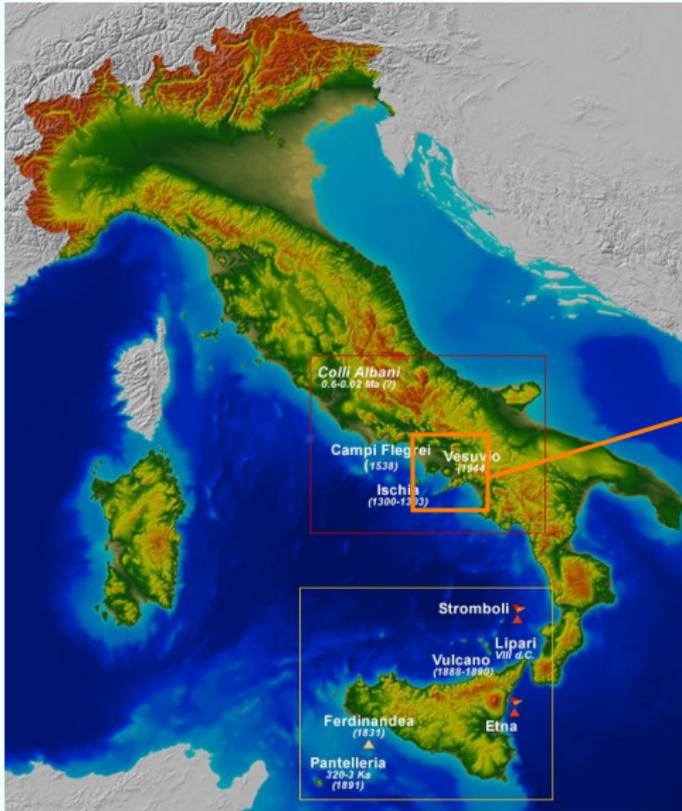
- 1 Active volcanoes in Italy
- 2 The knowledge of the internal structure of Vesuvius
- 3 The MURAVES Project
- 4 Conclusion

Active volcanoes in Italy and Vesuvius

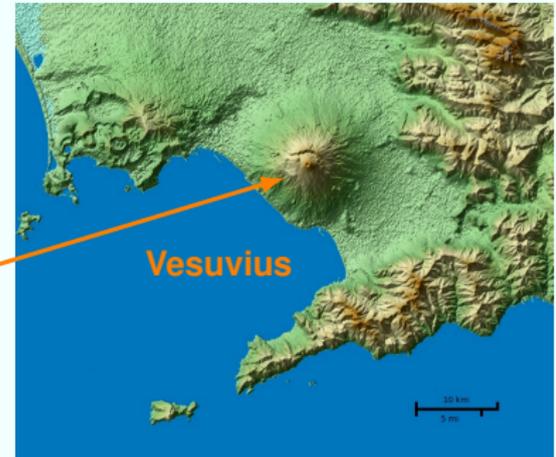


The principal active volcanoes (10)

Active volcanoes in Italy and Vesuvius



The principal active volcanoes (10)



- Last eruption occurred in 1944
- Now the conduit is closed
- Monitored 24/24

Vesuvius has the highest risk

More than 550,000 people live in the “Red Zone” of Vesuvius



Vesuvius today

Knowledge of the internal structure of Vesuvius

What we know about the volcano structure?

- Previous knowledge (Kircher, 1638)
- Active seismic tomography (TOMOVES-1996/MAREVES-1997)
- Passive seismic tomography (based on natural earthquakes)
- Gravimetric field inversion
- Direct observations of the interior of the crater
- Muon radiography

Knowledge of the internal structure of Vesuvius

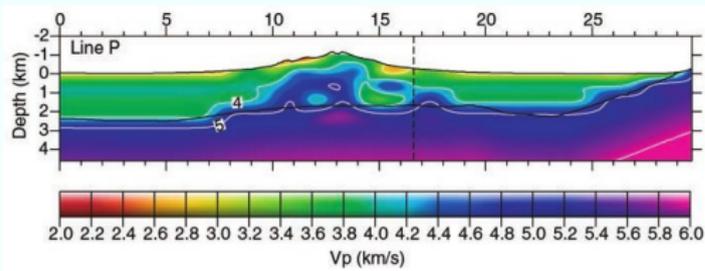
The first studies of Kircher in 1638



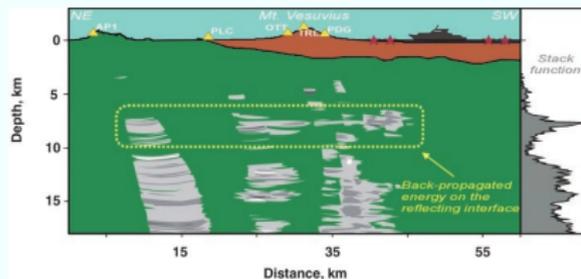
Knowledge of the internal structure of Vesuvius

Seismic active tomography (TOMOVES-1996 and MAREVES-1997 experiments)

- Active seismic tomography
- Spatial resolution $\approx 0.5 - 1$ km



(modified from Di Stefano and Chiarabba, JGR, 2002)

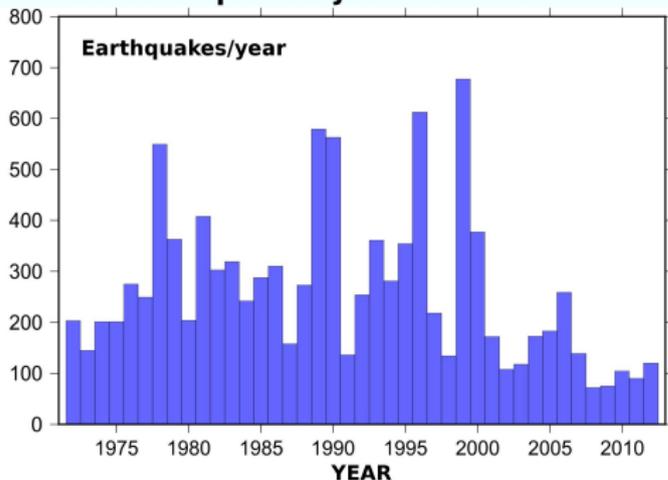


(from Auger et al., Science, 2001)

The internal structure of Vesuvius

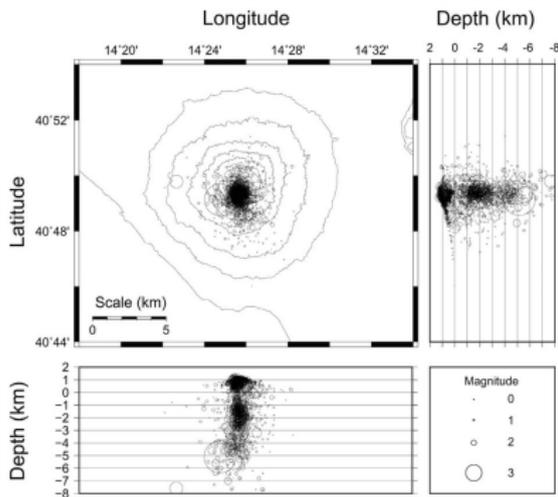
Study of the natural seismicity

Vesuvius earthquakes/year 1971-2012



- Typical magnitude $M_L < 2.0$
- Largest earthquake $M_L = 3.6$

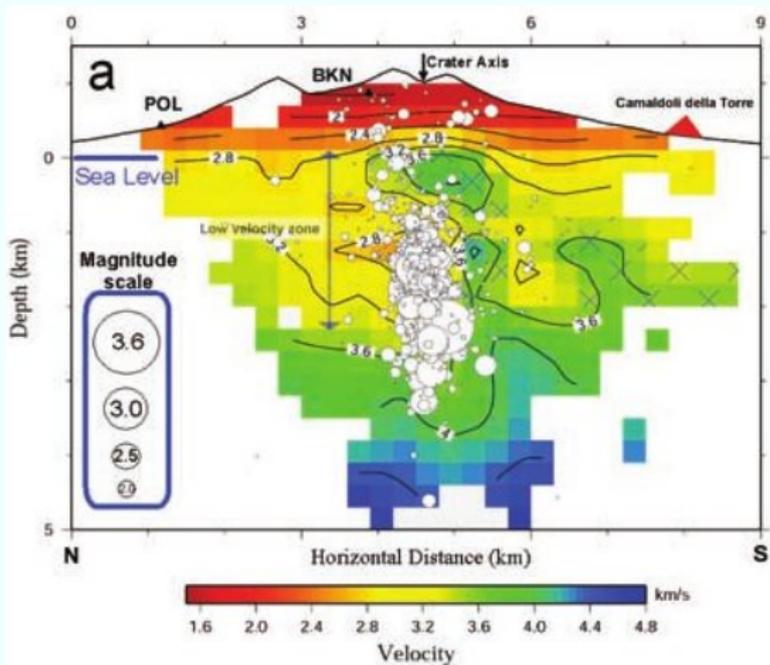
Earthquakes locations 1999-2012



(from D'Auria et al., Annals of Geophysics, 2013)

The internal structure of Vesuvius

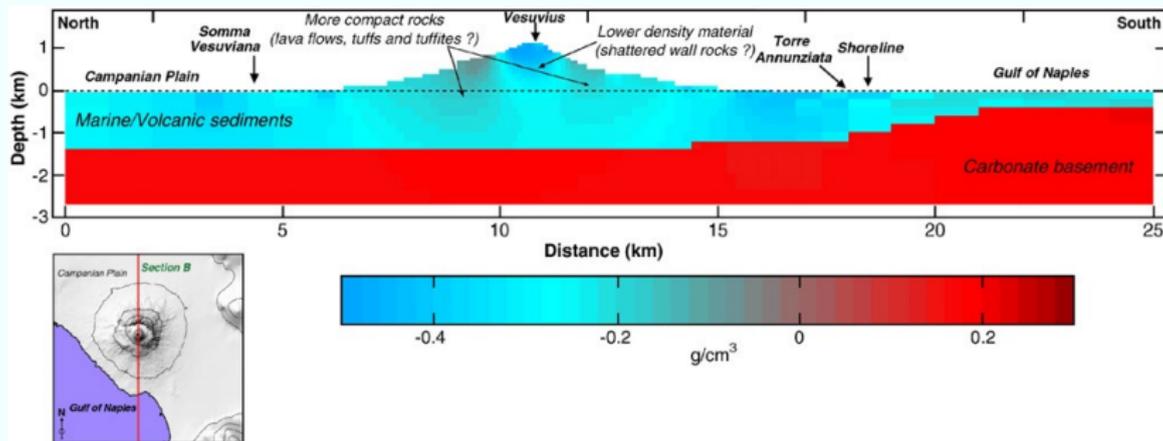
High resolution passive seismic tomography (300-500 m)



(from Scarpa et al., GRL, 2002)

The internal structure of Vesuvius

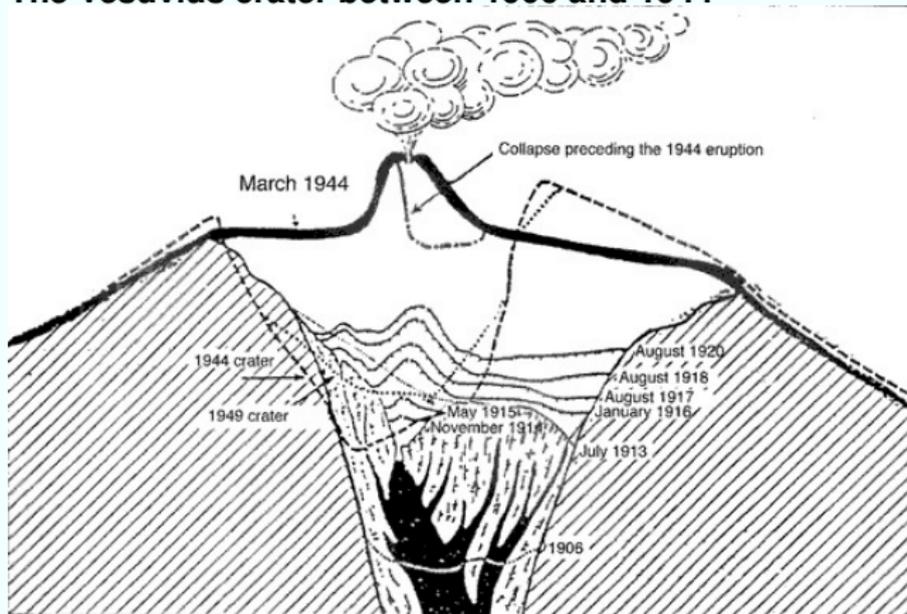
Gravimetric field inversion (spatial resolution $\approx 250\text{-}500\text{ m}$)



(from Cella et al., JVGR, 2007)

Observations of the upper part of Vesuvius

The Vesuvius crater between 1906 and 1944



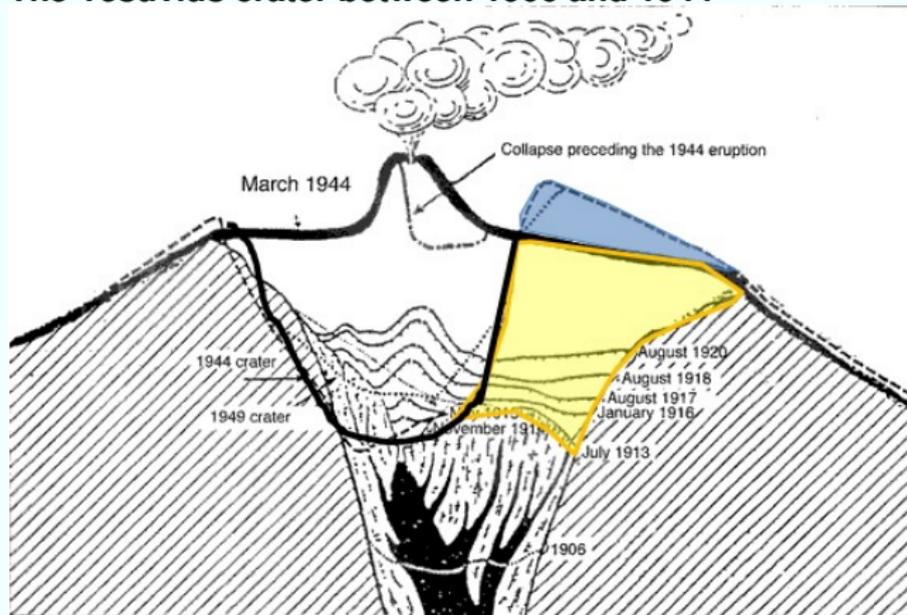
(from Imbò, 1949)

Vesuvius crater in 1944



Observations of the upper part of Vesuvius

The Vesuvius crater between 1906 and 1944



(from Imbò, 1949)

Vesuvius crater in 1944



Vesuvius crater today



The MURAVES Project

Muon radiography of Vesuvius

Investigation of the internal structure of Vesuvius by using **cosmic muons**

Map of the rock thickness of Vesuvius (possible radiography)



Objectives of the MURAVES Project

Objectives

- To develop a **synergy between geophysics and particle physics**
- Achieve an **integrated model of the Vesuvius' structure** based on muon radiography, gravimetric and seismological data

Method

- Build of **new telescopes** for volcano radiography using cosmic muons with better resolution and background suppression than previous experiments
- Development of an **innovative model** for the integration of data from muon radiography, gravimetry and seismology

Muon radiography of Vesuvius

The MURAVES Project

Previous projects

- MU-RAY Project (INFN, INGV, UNINA)
- MURAY2 Project (INFN, in collaboration with INGV)

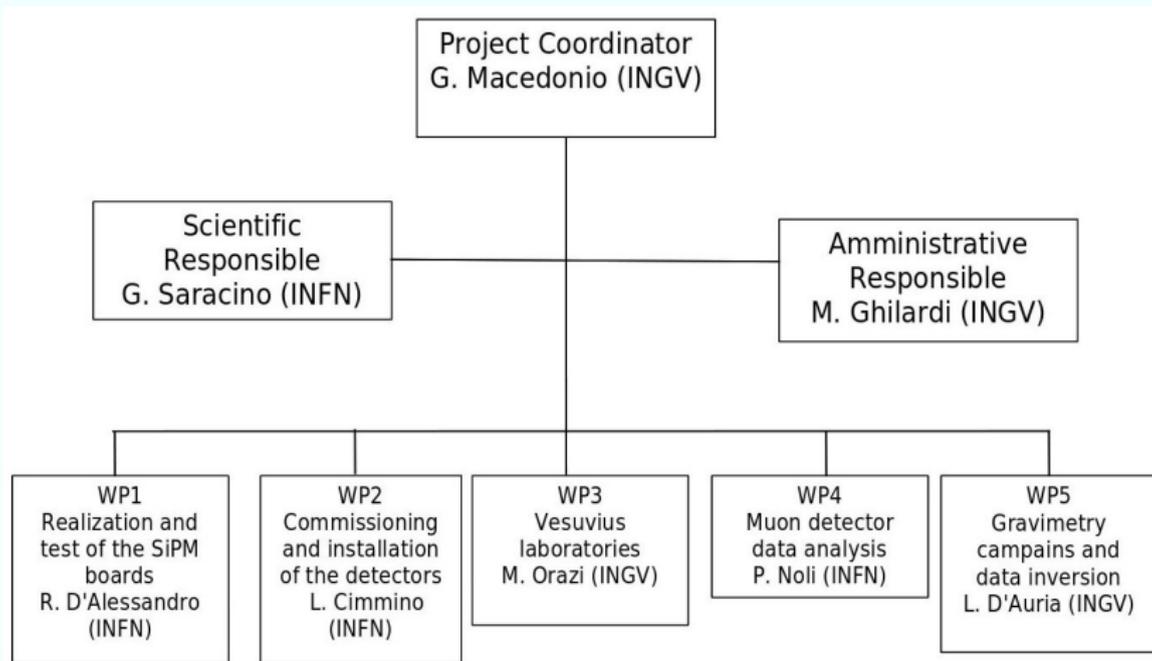
MURAVES Project

- Funded by MIUR (Project “Premiale 2012”)
- **INGV** (host institution) + **INFN** (main partner)
- Budget 860 kEuro

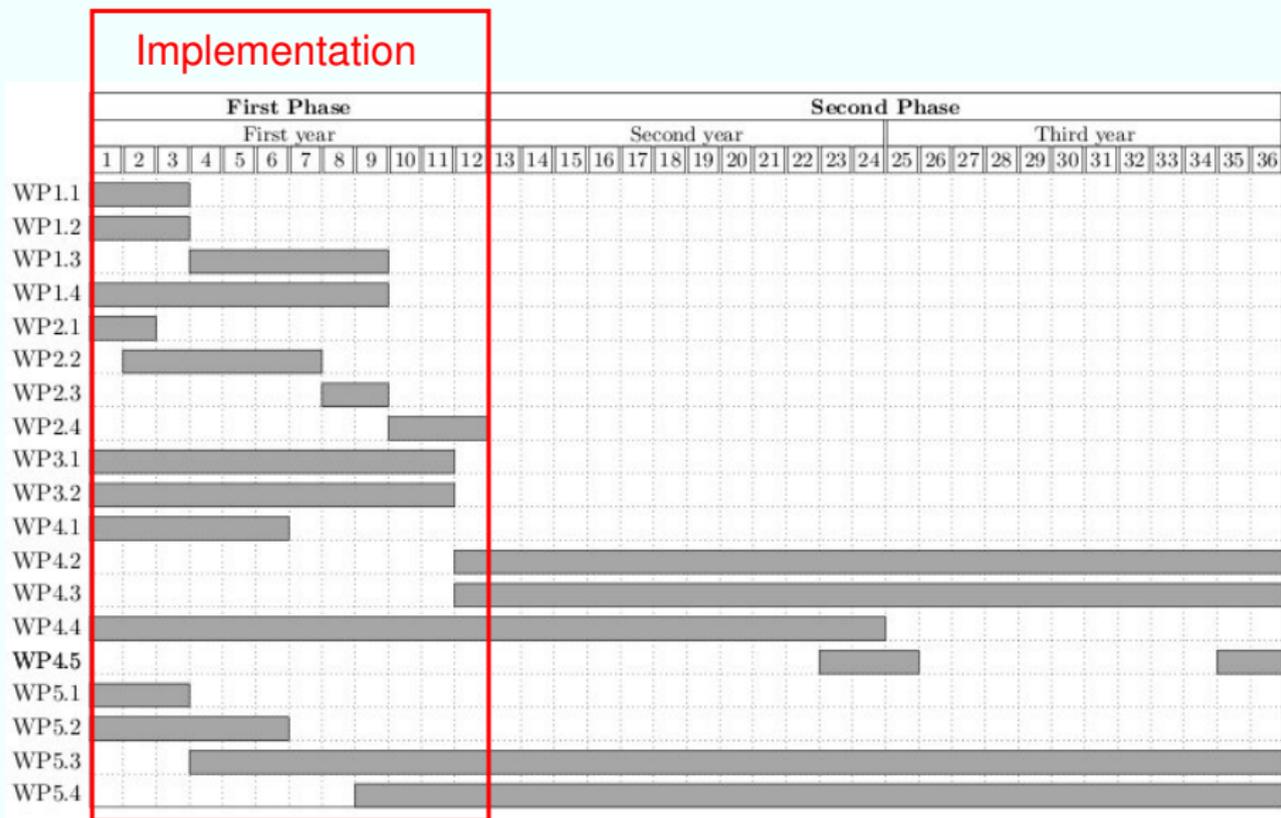
Project duration: **3 years**

- First year: Laboratory setup on Vesuvius, beginning of data acquisition
- Following years: Data acquisition and analysis

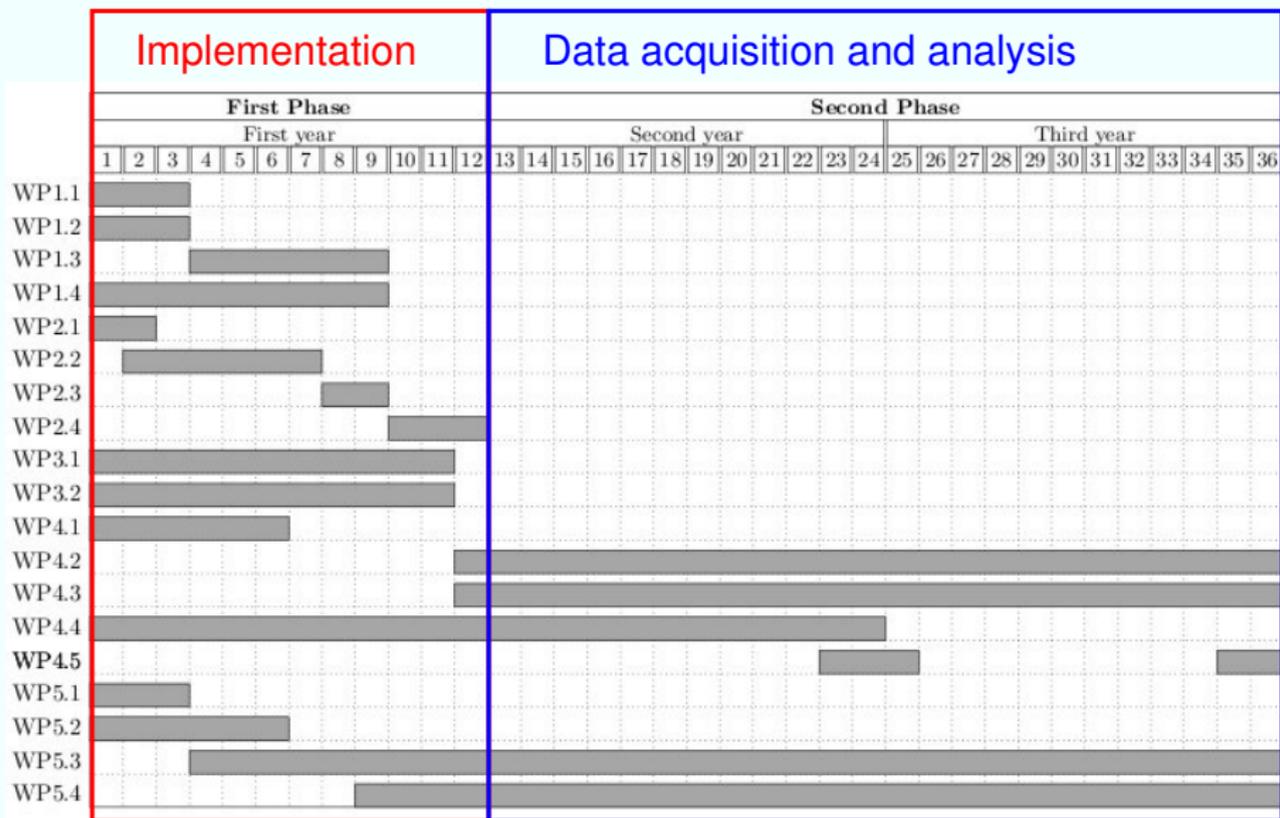
The MURAVES Project structure



The MURAVES Project Gantt



The MURAVES Project Gantt



Conclusion

The challenge

- The investigation of the internal structure of Vesuvius using cosmic muons is a **challenge**
- The integration between seismic, gravimetric and muon radiography data is completely **innovative**
- The **cooperation** between INGV, INFN and ERI is an important step to begin this challenge