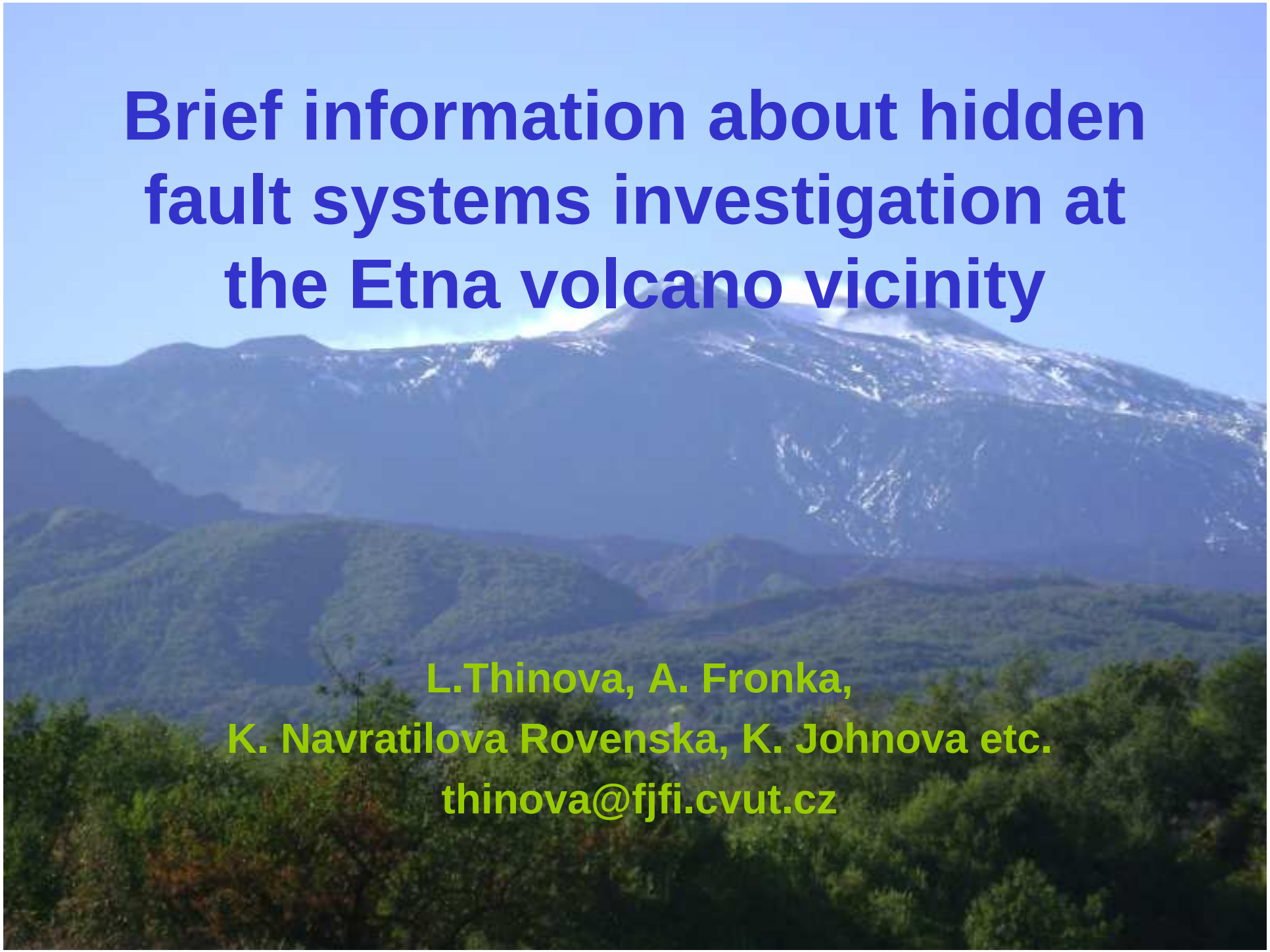


Brief information about hidden fault systems investigation at the Etna volcano vicinity

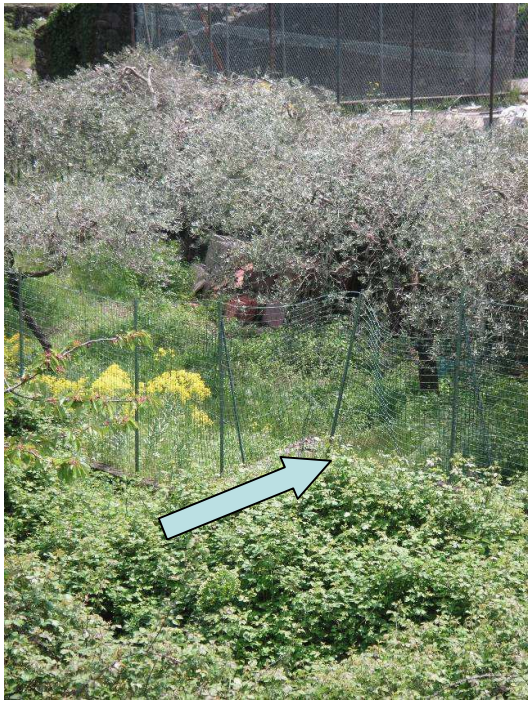
L.Thinova, A. Fronka,
K. Navratilova Rovenska, K. Johnova etc.
thinova@fjfi.cvut.cz

Collaboration

- ☺ **Department of Dosimetry** - FNSPE CTU in Prague
- ☺ **Radon expert group - NRPI Prague**
- ☺ **Dipartimento di Fisica e Astronomia** - Università degli Studi di Catania (represented by G. Immé and R. Catalano)
- ☺ **INFN Sezione di Catania** (represented by D. Morelli)
- ☺ **INGV Sezione di Catania** (represented by S. Giammanco, M. Neri)

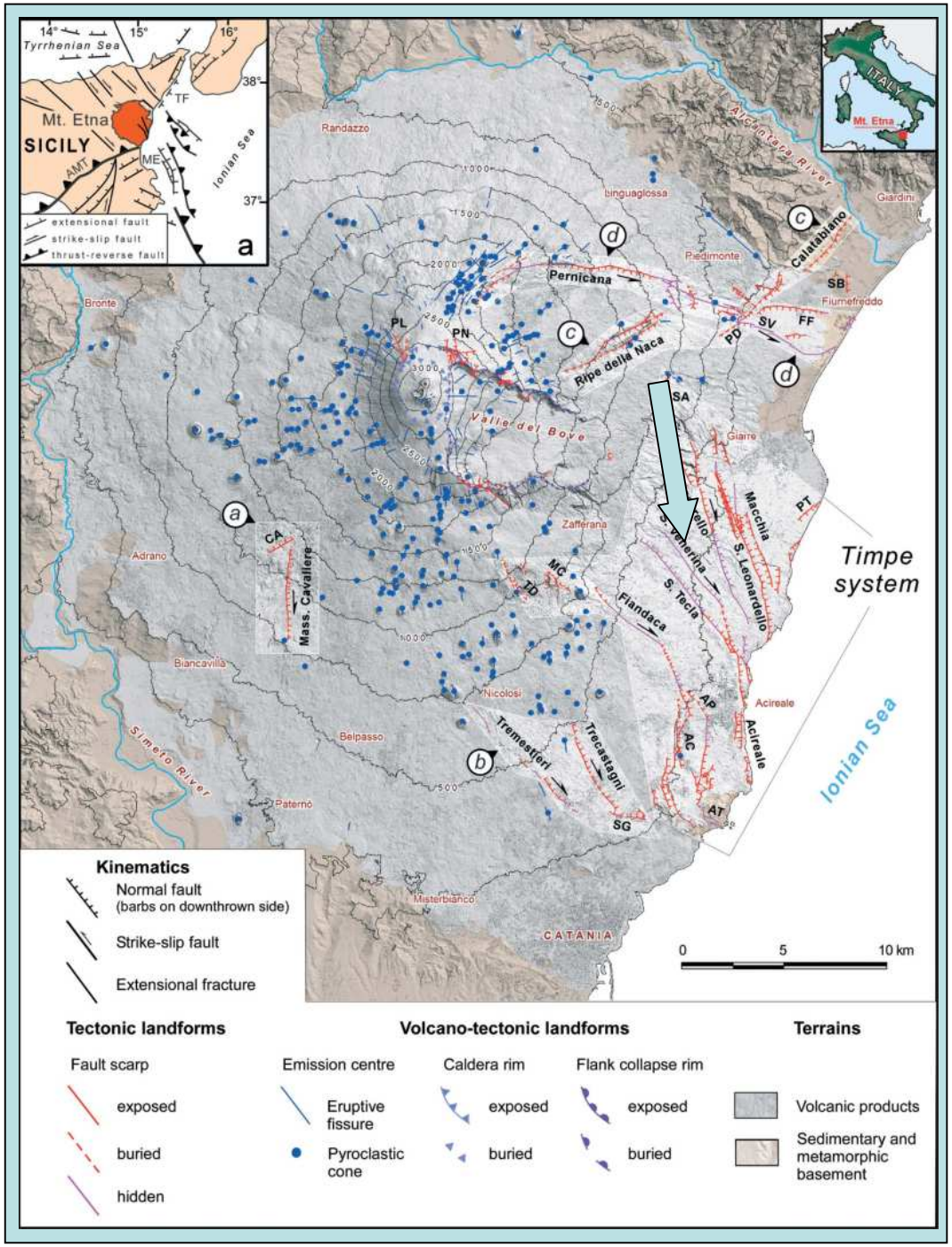
The main aim of the realized measurements

- To find out hidden faults using a set of geophysical methods while none of them alone is capable to reveal the fault with certainty.
- To select the best combination of methods, which are able to identify fault structures, and find their limitations.



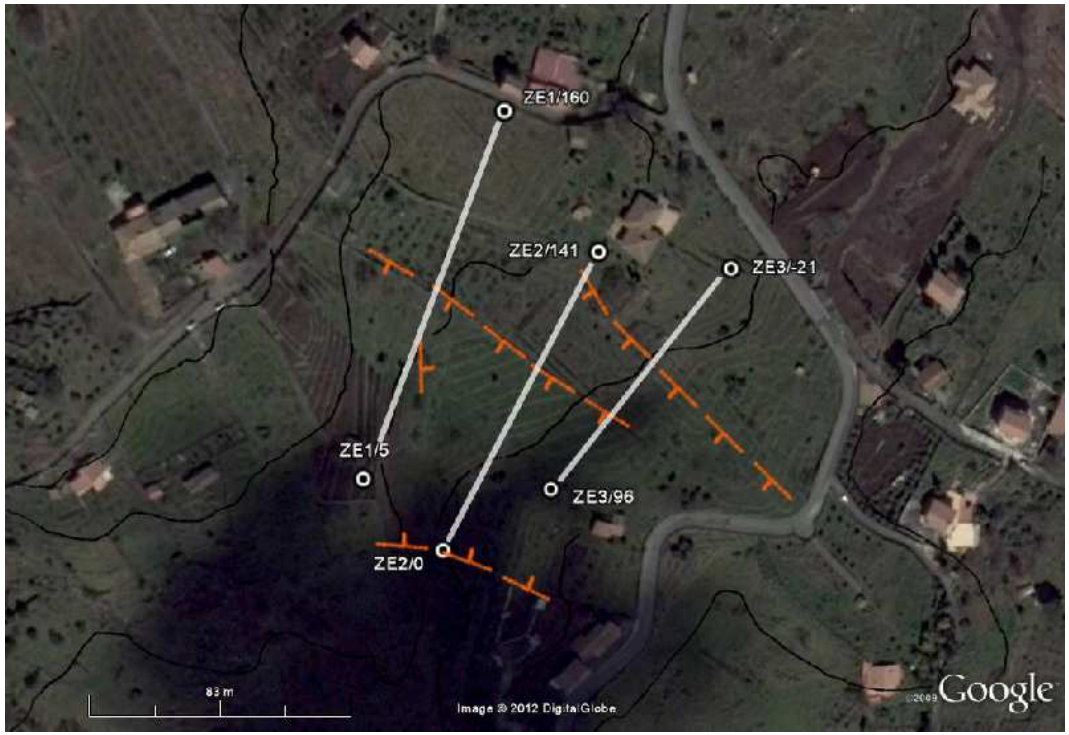
Tectonic situation

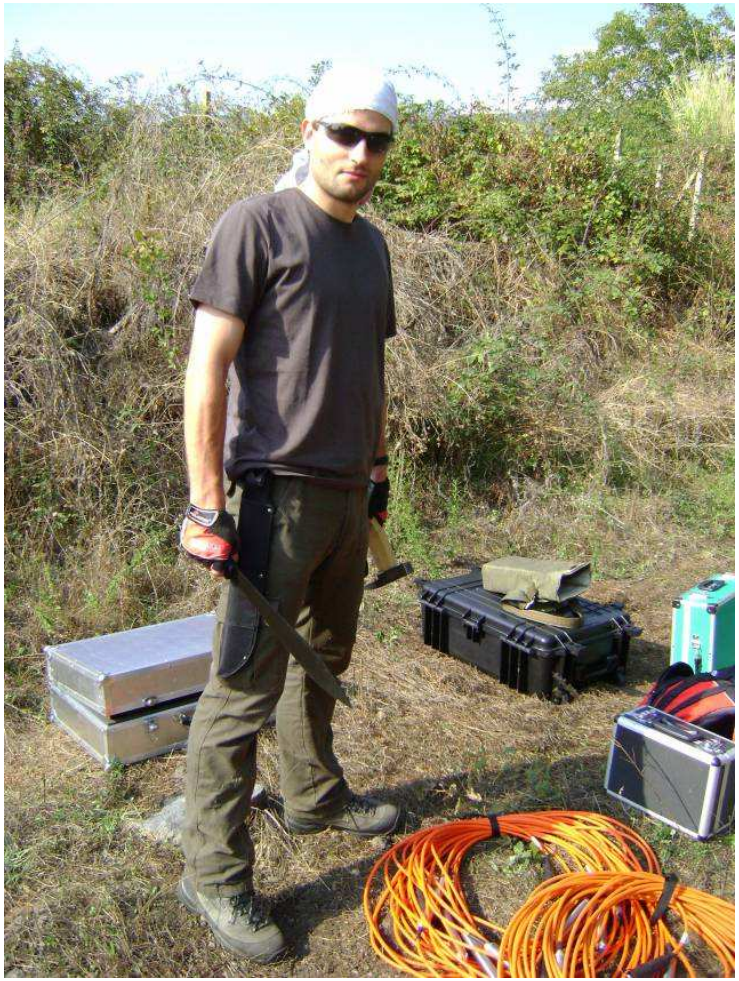
Etna vicinity



Investigated locations

- Primoti - 2 profiles
- San Venerina – 2 profiles
- Zafferana Etnea – 3 profiles





Materials and methods

- Soil gas measurement: radon concentration and permeability of soil
- ERT - resistivity measurement
- In situ gamma spectrometry measurement (on the surface)
- Laboratory gamma spectrometry measurement of collected samples
- VLF method measurement (using Norwegian radio-transmitter)
- Atmogeochemistry measurement in selected locations (0.5 m above the ground)
- Solid state nuclear track detectors located inside plastic boxes, placed in selected locations (burried in the depth of 30 cm for one week)

Soil gas measurement:
radon concentration and permeability of soil

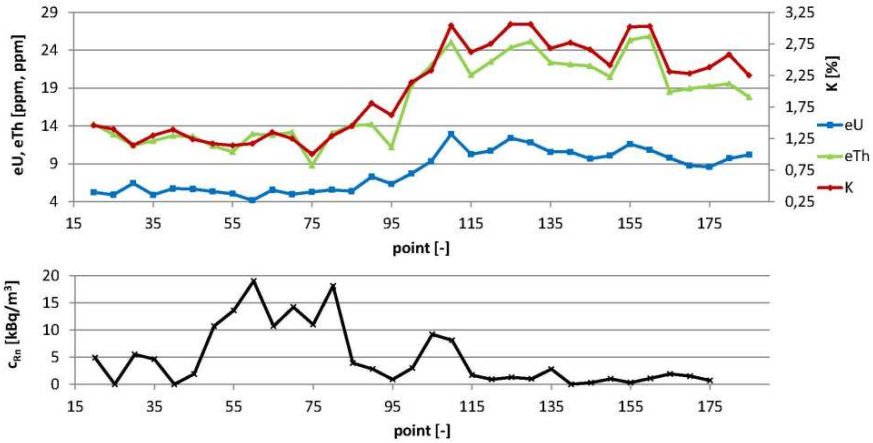
The RM-2 measurement system and the “lost tip” sampling method was used for measurement of radon concentration in the soil gas. The sampling depth was 0.8 m in ideal terrain conditions, in rocky soil between 0.5 and 0.8 m.

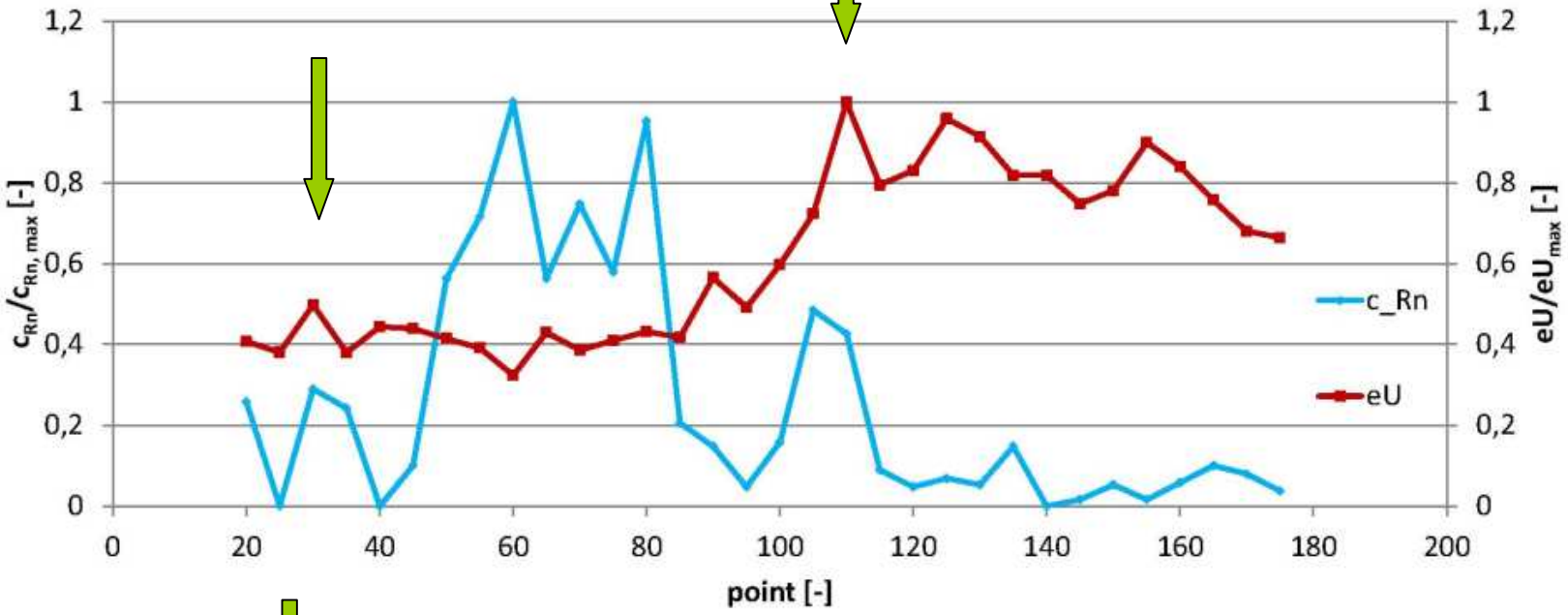
Radon JOK system was used for soil permeability measurement

In situ gamma spectrometry measurement (on the surface)

A portable Gamma Surveyor spectrometer was used for in-situ determination of the **K (%), U (ppm eU) and Th (ppm eTh)** concentrations. The spectrometer consists of the probe (equipped with a 3”x3” NaI(Tl) detector), GPS and control panel. The sampling time was selected to be 4 min at each of the measurement point and the data were recorded automatically.

In situ gamma spectrometry and radon in soil gas measurement : results





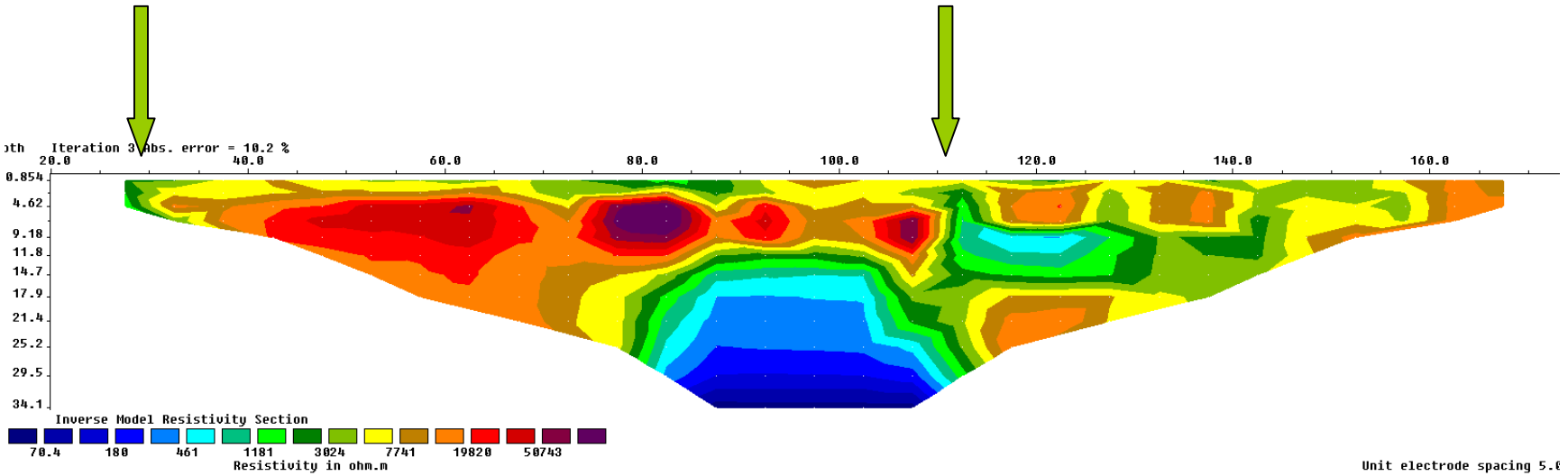
Fault indication (example Santa Venerina, profile 4)

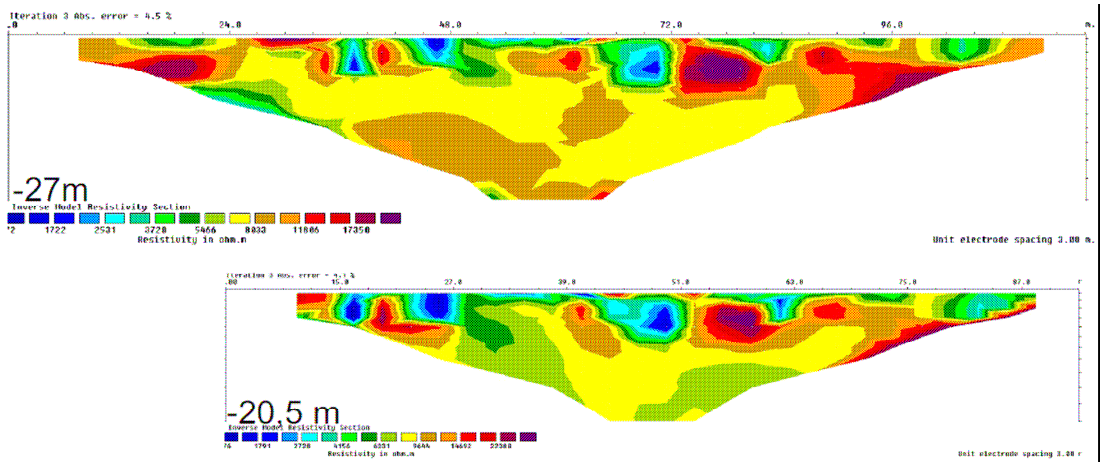
ERT - resistivity measurement

For determination of the potential fault system, permeable zones or water presence in underground caverns, the ARES (Automatic Resistivity System - main unit with standard accessories, the multi-electrode cable sections MCS5) was used in Schlumberger and Dipole- Dipole arrays with the distance from 3 to 5 meters between electrodes. The maximum length of the profile was 200m due to the very complicated terrain.

ERT - resistivity measurement: results

Fault indication (example Santa Venerina, profile 4)

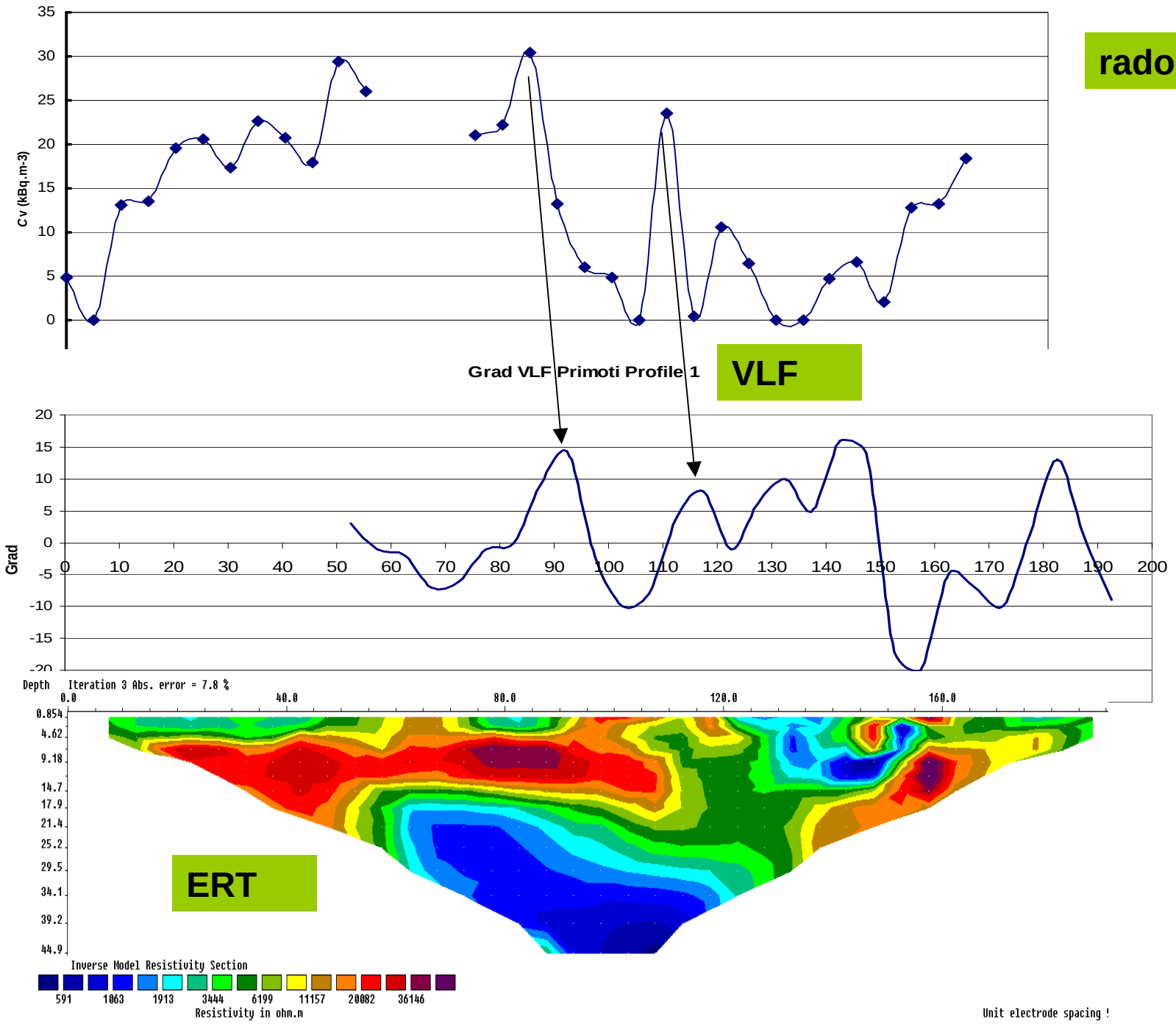




Zafferana Etnea – profile 3 – example of the method's reliability

VLF method measurement (using Norwegian radio-transmitter)

All measurements were carried out with EM 16 and EDA instruments. The Norwegian station JXN (Helgeland) transmits the radio waves with frequency 16.4 kHz.



VLF method (using Norwegian radio-transmitter) +radon +ERT: results Primoti profile 1

Laboratory gamma spectrometry measurement of collected samples

A coaxial HPGe (35%) detector was used for laboratory gamma spectrometry measurement of samples in the Marinelli containers 0.6 l volume geometry. The mass activities of naturally radioactive elements U, Ra, K and Th in Bq/kg were determined by GENIE2000 SW.

Primoti profile 1

location 105	K	eU	eTh	
	2,79	12,10	22,33	in situ ppm, %
	K	U	Th	
Bq/kg	873,27	148,83	90,66	in situ recalcul.
Bq/kg	347,43	52,1	43,32	soil sample
Bqlkg	886,1	118,9	94,4	rock sample

location 180	K	eU	eTh	
	1,11	5,05	10,67	in situ ppm, %
	K	U	Th	
Bq/kg	347,43	62,12	43,32	in situ recalcul.
Bq/kg	396	52,1	44,3	soil sample
Bqlkg	849	115,6	92,2	rock sample

Atmogeochemistry measurement in selected locations (0.5 m above the ground)

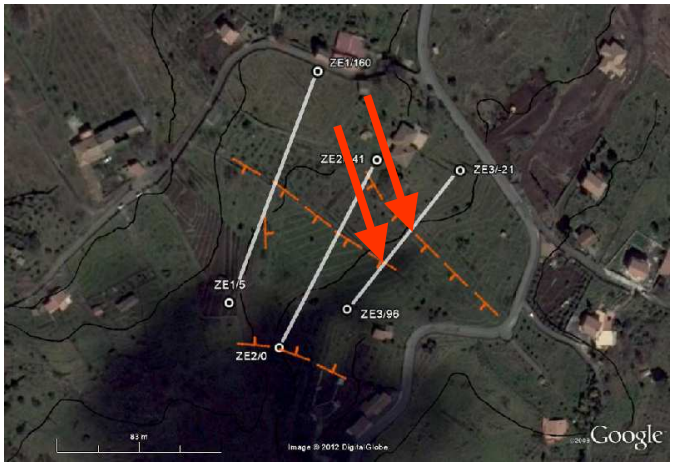
The content of Hg and other elements (V, Cu, Se, Mn, Cr, Fe..) was investigated using atomic mass spectrometry measurement in the laboratory of the Department of Nuclear Chemistry FNSPE CTU in Prague. This type of measurement was carried out on the selected locations, near the supposed fault.

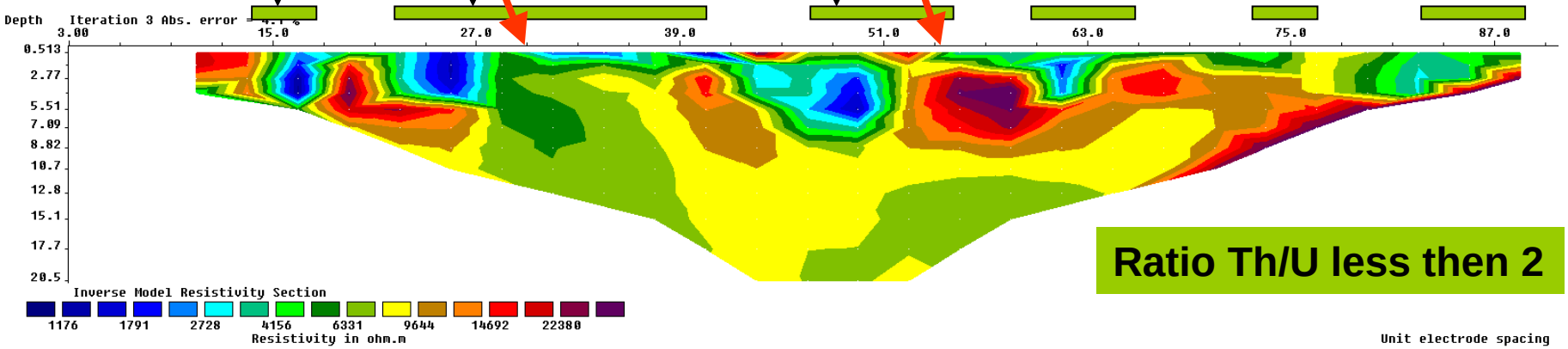
Laboratory gamma spectrometry measurement of collected samples and atmogeochemistry results

Hg min
Mn max
Fe max
Cu max
Se max!
Cr max!

Hg max
Se max

Hg min
Mn max!
Fe max!
Cu max!
Se max





Ratio Th/U less then 2

Zafferana Etnea profile 3

Summary

Many thanks to our Italian colleagues for enable us the opportunity carried out the measurement

- The best methods were:
  - ERT
  - VLF
  - Radon in soil gas measurement (IT, CZ)
  - CO_2 measurement (IT)
  - Thoron in soil gas measurement (IT)
  - Atmogeochemistry (Hg, Se, Fe, Mn, Cu, Cr)
  - In situ gamma spectrometry


Thank you for your attention!

Dear radon scientists,

it’s pleasure for us to announce the

7th International Conference on Protection against Radon at Home and at Work

www.radon2013.cz

radon@radon2013.cz

which will be held

from 2nd to 6th September 2013

in the Czech Republic and continue in the long tradition of Radon conferences. The conference comprises: technical exhibition, oral and poster presentation, papers publishing in a prestige scientific journal, comparison measurement of radon and thoron in NRPI radon chamber etc.

We are looking forward to meet you in Prague.

Best regards,

Lenka Thinova and Katerina Navratilova Rovenska

Conference organizing committee