Assessment of subsoil and groundwater contamination from NAPL (Non-Aqueous Phase Liquids) using soil radon

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FOCUS

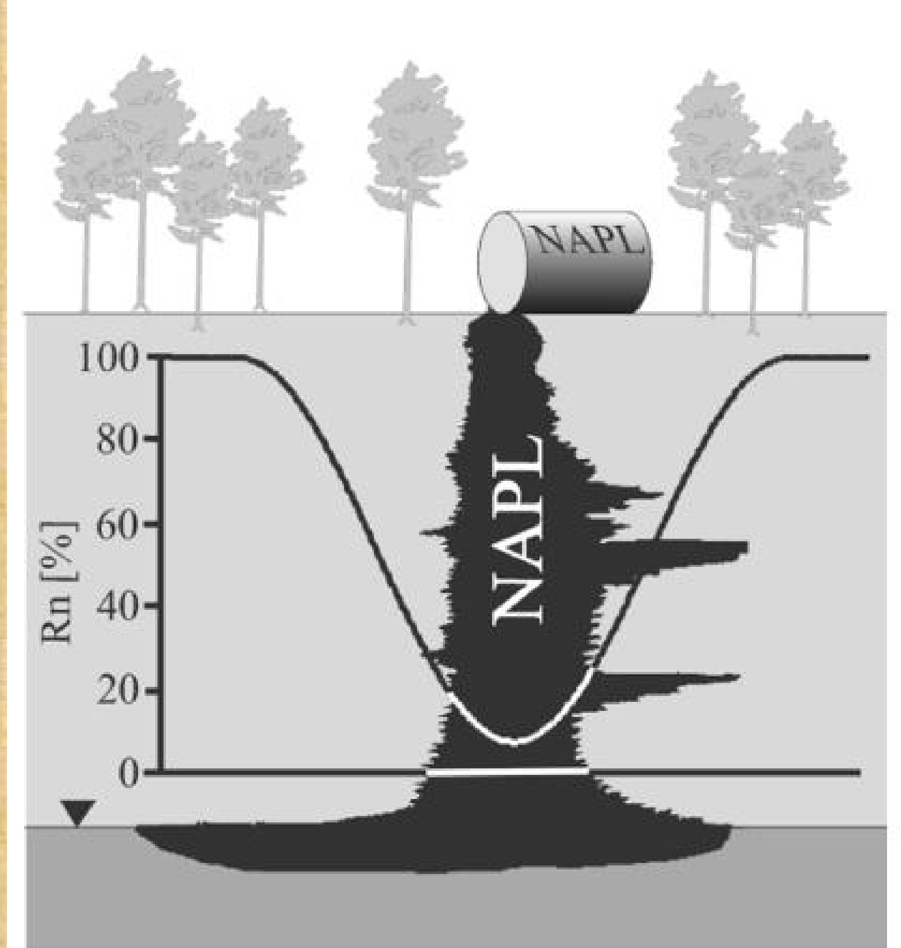
THIS STUDY IS RELATED TO A NEW ANALYSIS TECHNIQUE FOR HYDROCARBON POLLUTED SITES THROUGH THE USE OF RADON GAS.

The focus of our work is the characterization of one or more selected study-areas suffering NAPL pollution, using only low-cost surface Radon-concentration analyses, to identify and constrain localized substratum polluted sites.

Why is 222Rn a NAPL-tracer?

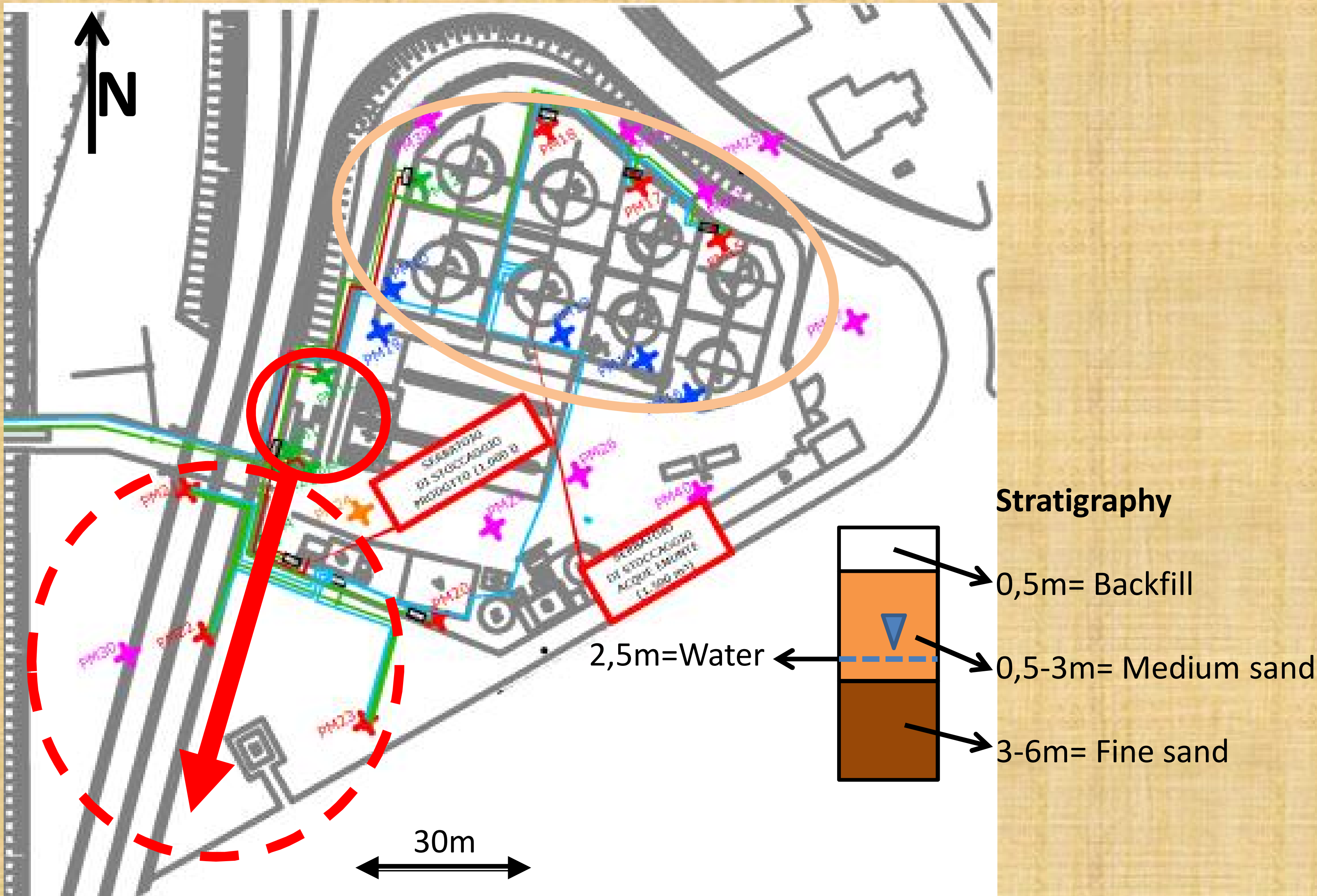
Radon has a high solubility in a wide range of NAPL, so as to form negative anomalies concentration in the soil where the presence of these pollutants is observed

K = NAPL/air



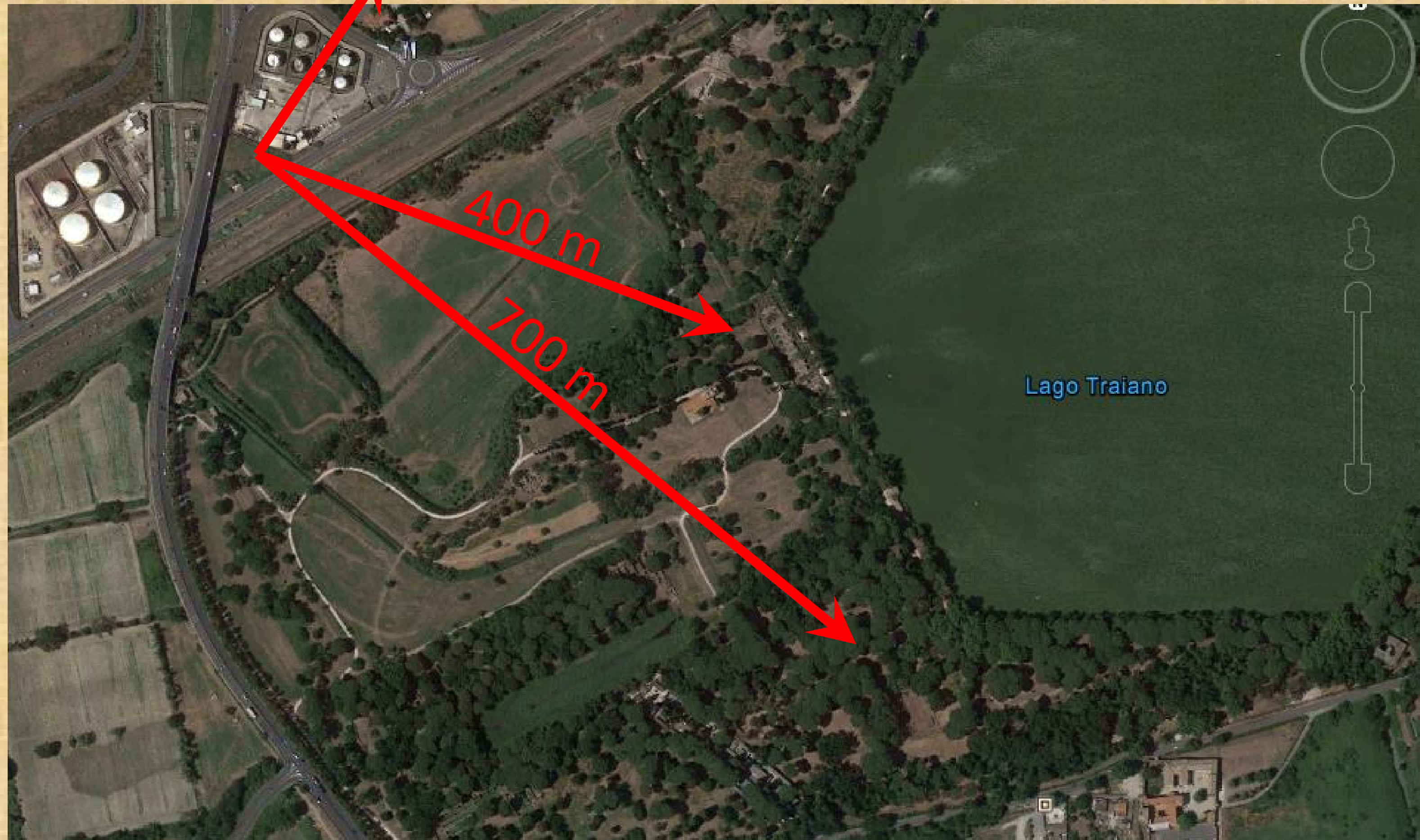
M. Schubert et al. 2002

Study area


N
30m
Stratigraphy
0,5m= Backfill
2,5m=Water
0,5-3m= Medium sand
3-6m= Fine sand

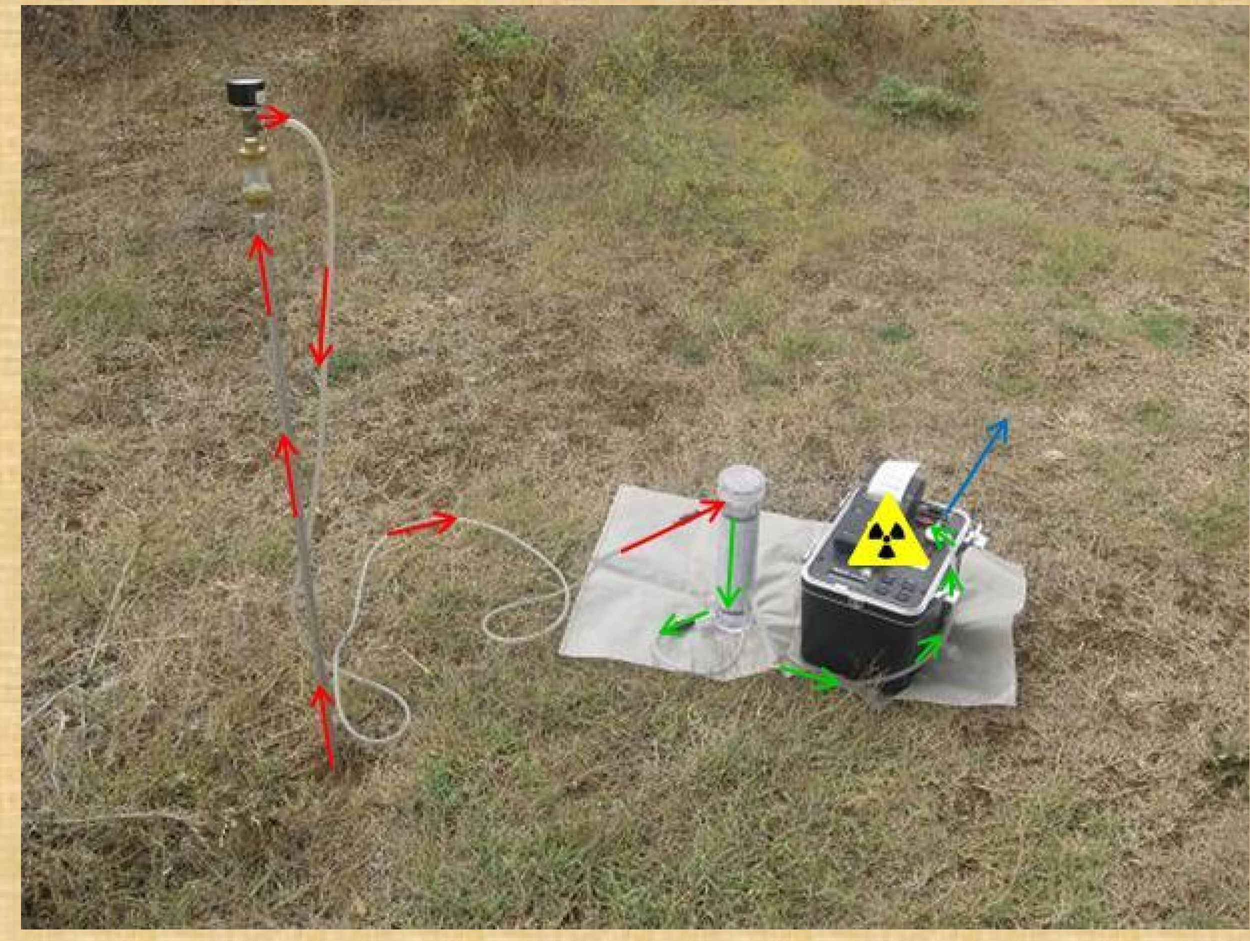
BACKGROUND AREAS

POLLUTED AREA



INSTRUMENTS

Determination of **soil radon**



INSTRUMENTS

Determination of CO_2 e CH_4 concentration

INSTRUMENTS

Determination radon in water

INSTRUMENTS
Determination of soil permeability

Neznal & Neznal, 2005

The time of opening of the expandable cell is related to the intrisic soil permeability (k)

$$k = (V * \mu) / (F * \Delta p * t)$$

5,2 E-14 m² – 1,8-11 m²

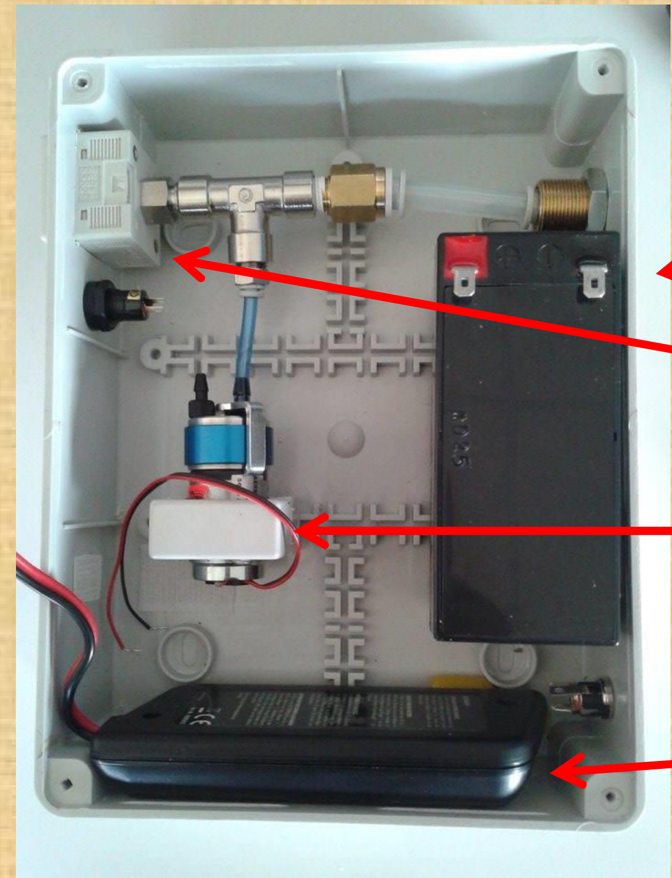
Low:K < 4 E-13 m²

Medium: 4 E-13 m² < K < 4 E-12 m²

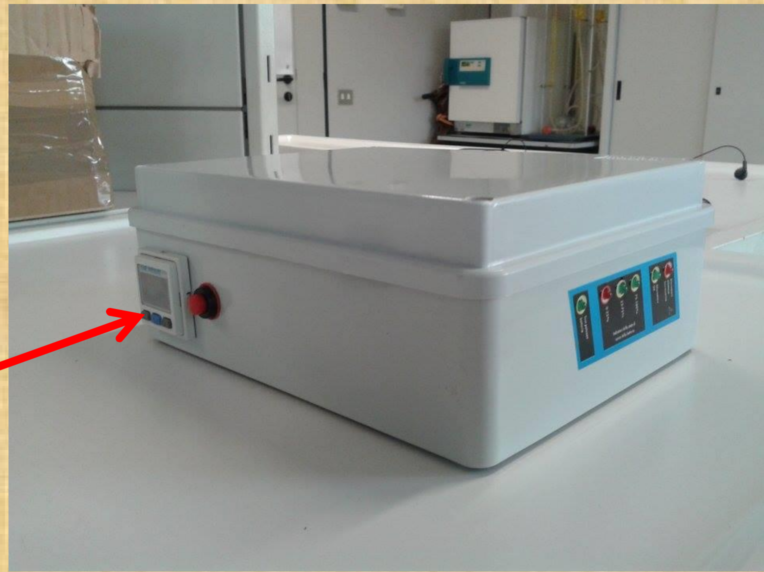
High K > 4 E-12 m²

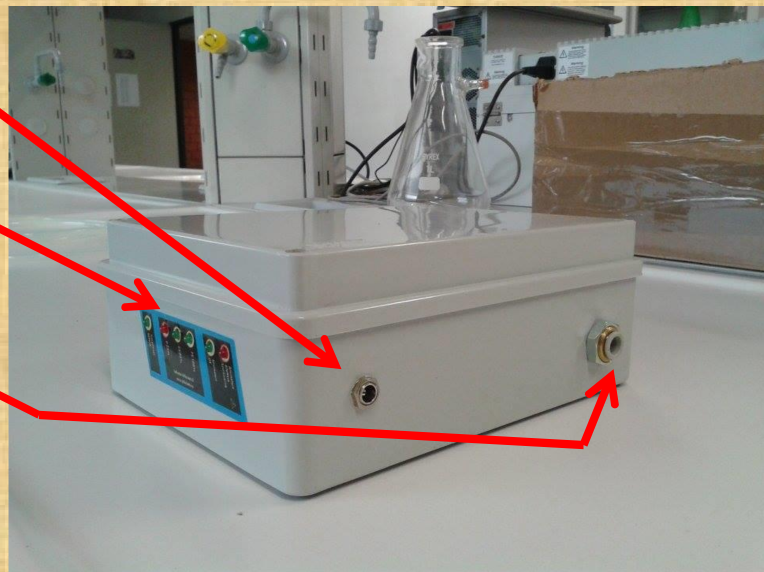
V: air volume in the expandamble cell
μ: air dynamic viscosity at 10°C
F: shape factor of the hollow rod inside the ground
Δp: pressure difference between the surface and the active area of the probe
t: opening cell time

INSTRUMENTS
Determination of soil permeability

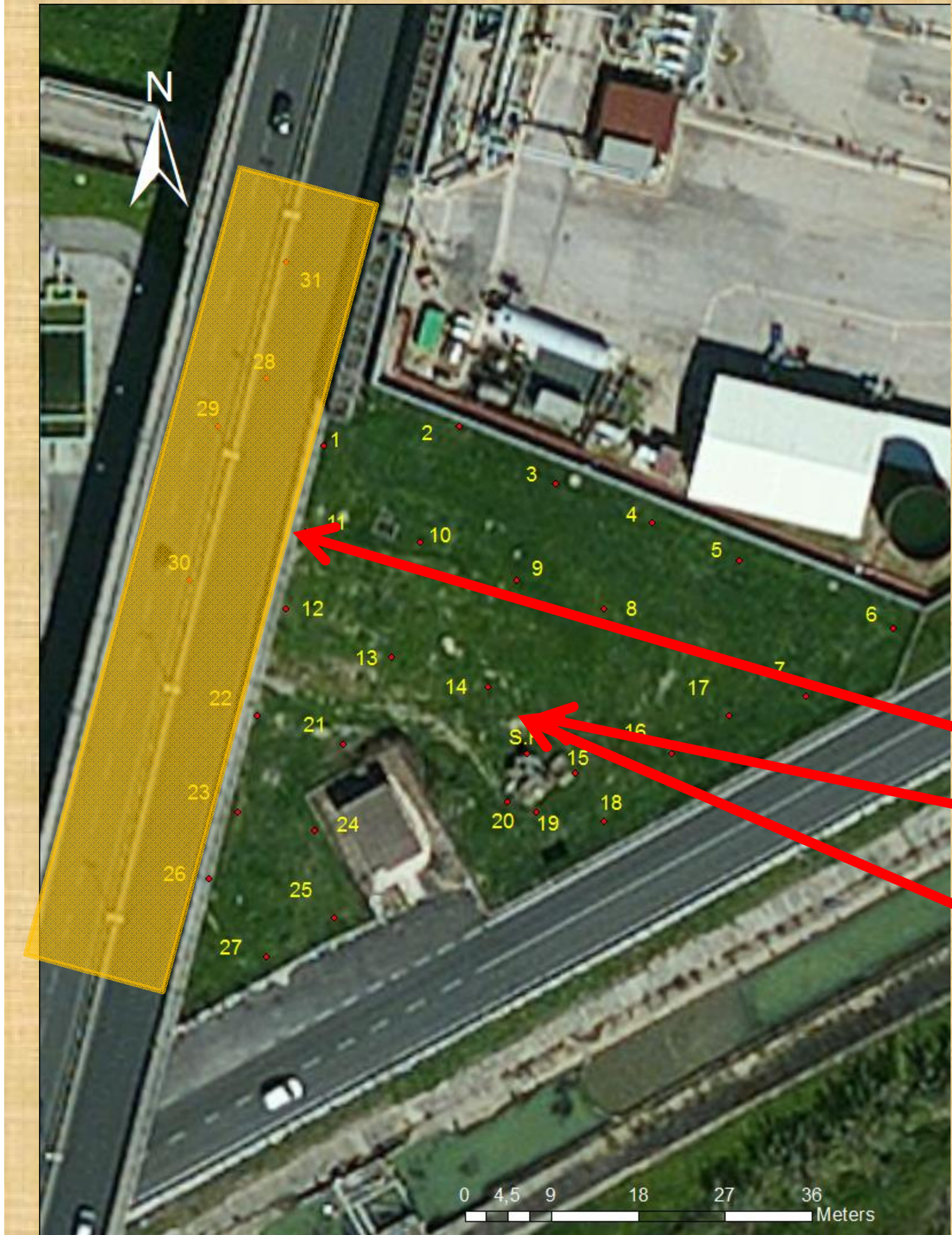


- Battery
- Digital vacuometer
- Pump
- Recharge plug
- Battery level
- Tubing connector





$$k = \left. (V * \mu) \middle/ (F * \Delta p * t) \right.$$



Study area

31 mesurements were carried out at 80 cm depth, in this area of 2980 m^2 , to investigate on concentrations of:

- Radon
- Thoron
- CO_2
- CH_4
- permeability

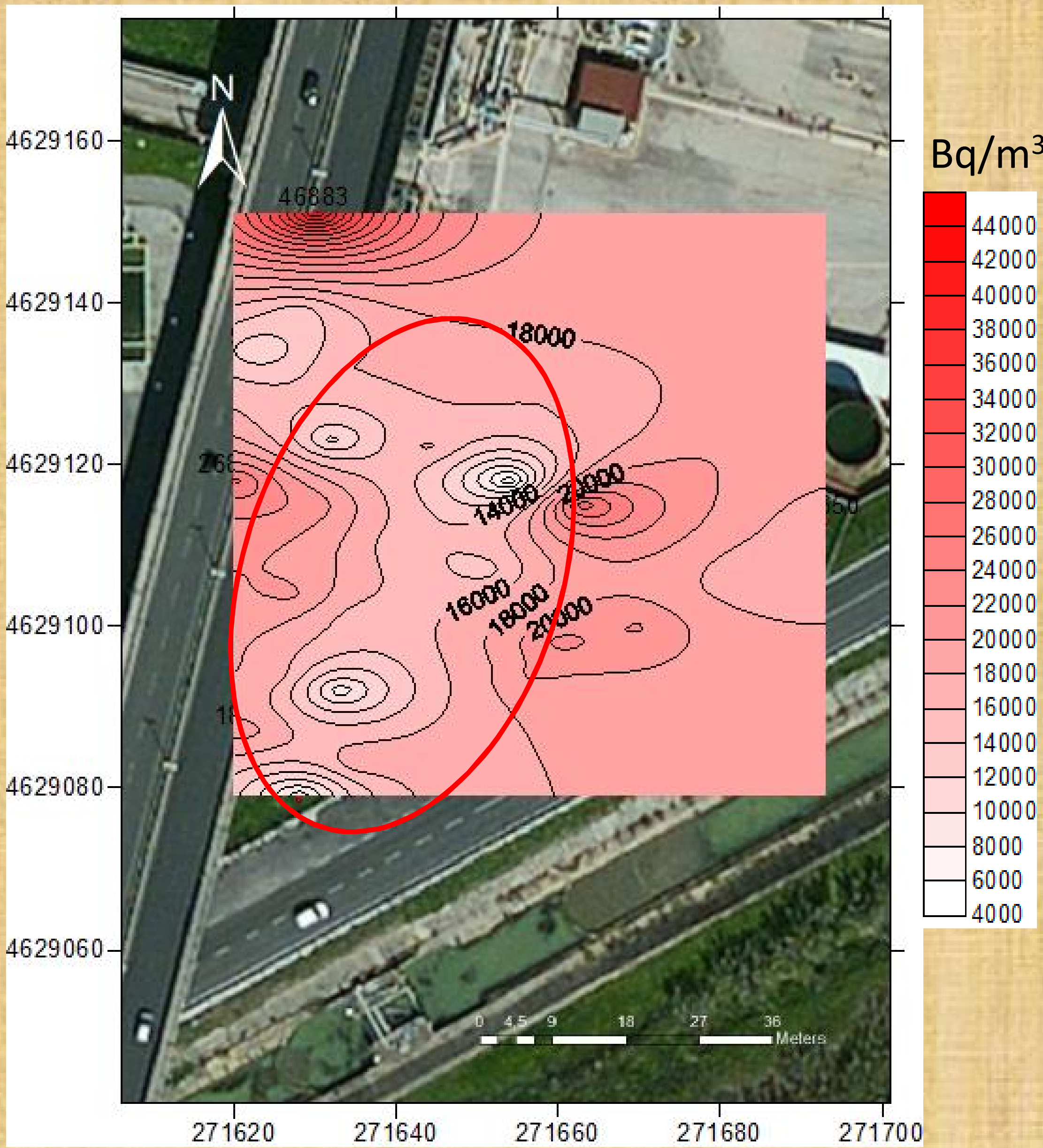
Viaduct

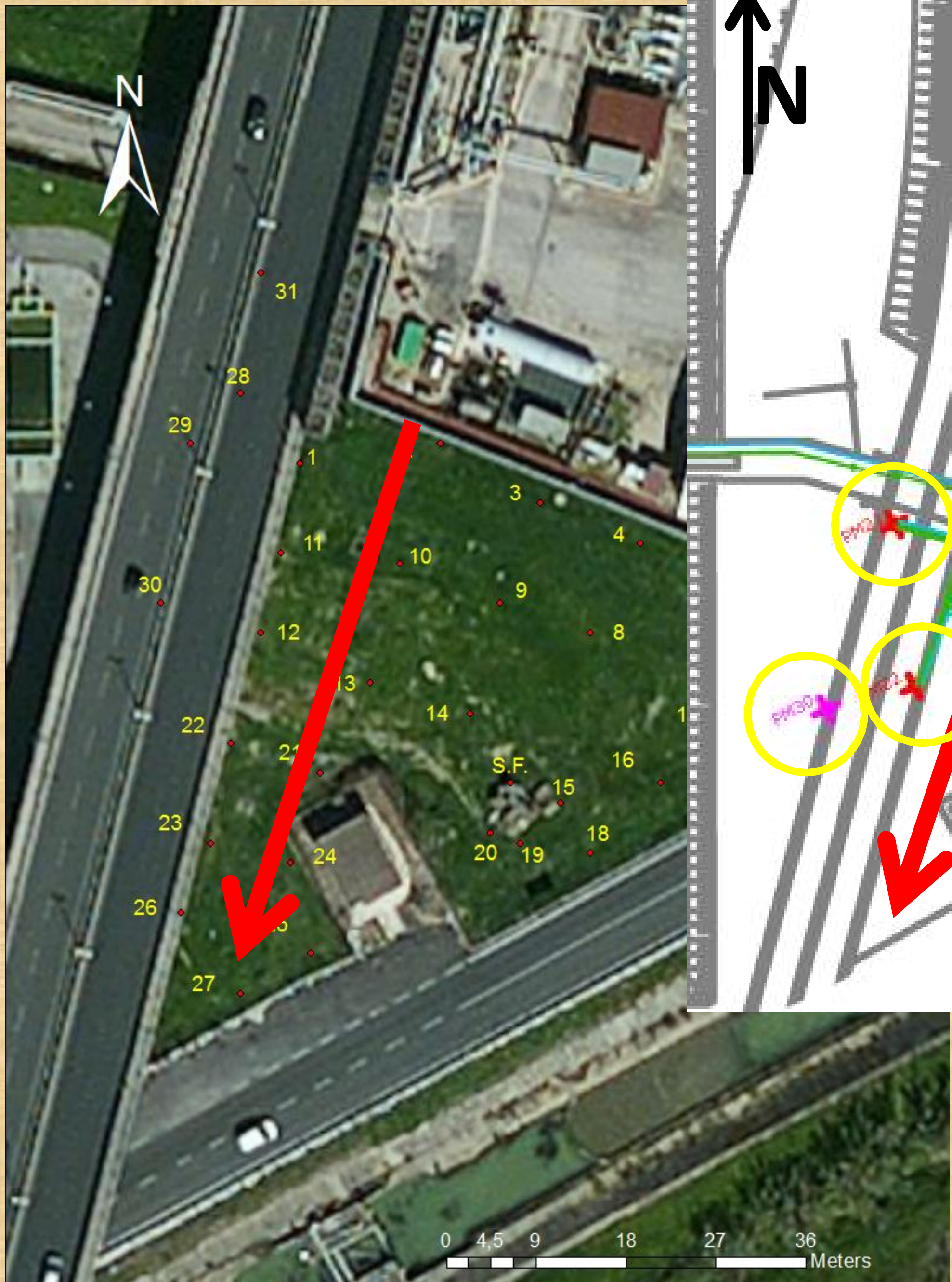
Permanent Station

Permanent sensors of temperature and humidity – at 30cm and 80 cm depth

RADON MAP IN THE STUDY AREA

Winter campaign

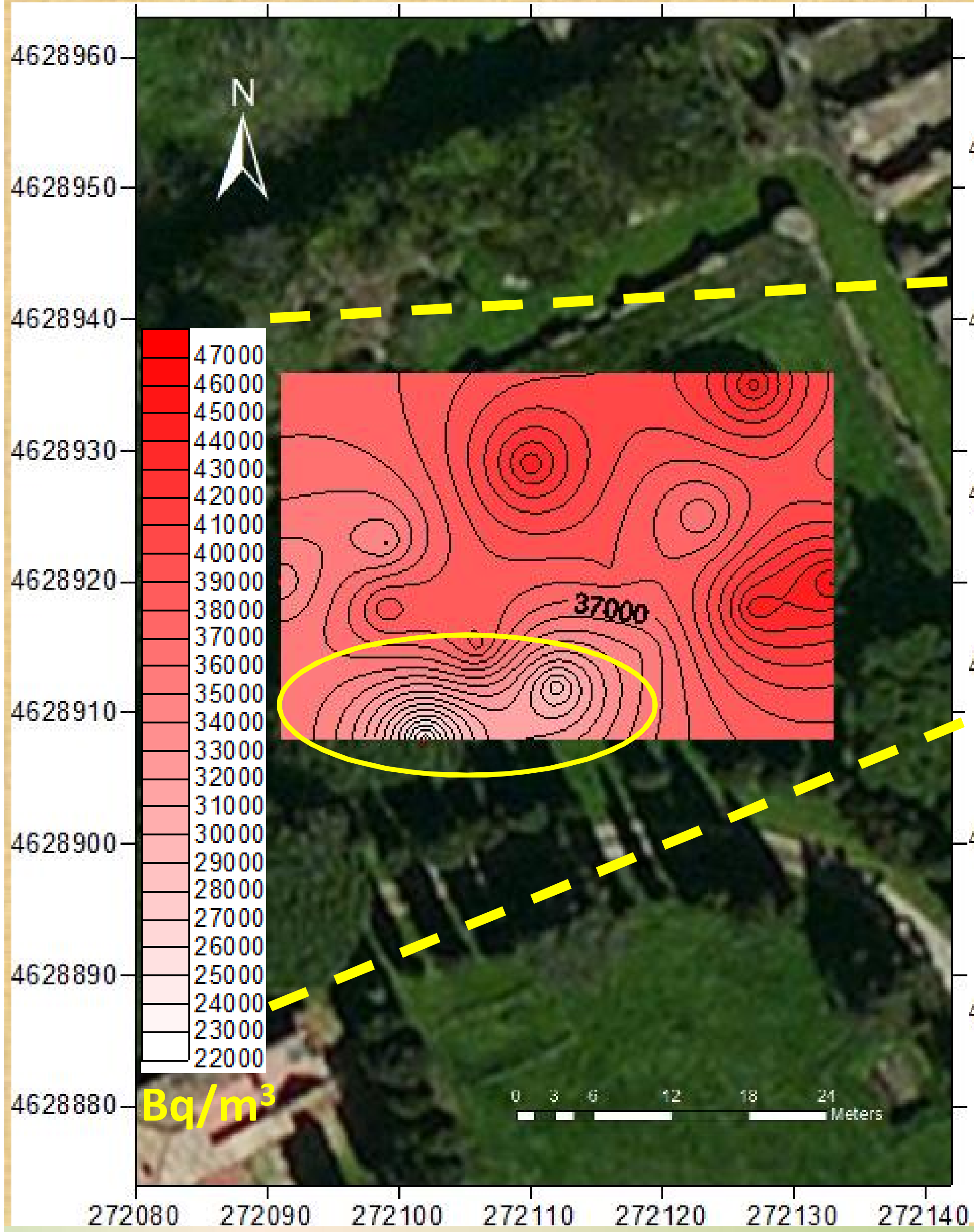



N
31
28
29
1
3
4
11
10
9
30
12
8
13
14
S.F.
15
16
22
23
24
20
19
18
26
27
0 4,5 9 18 27 36
Meters

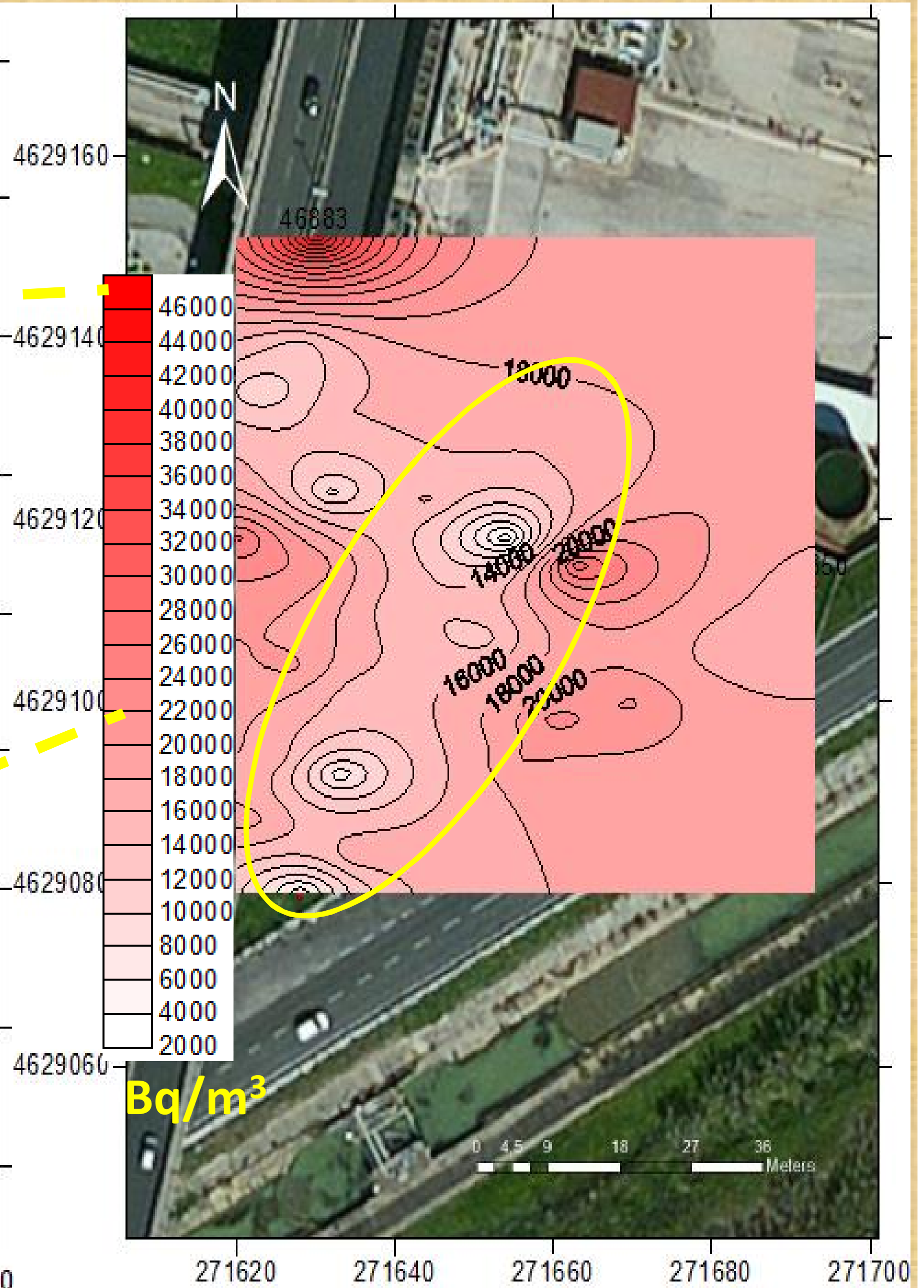

N
30m

Study area

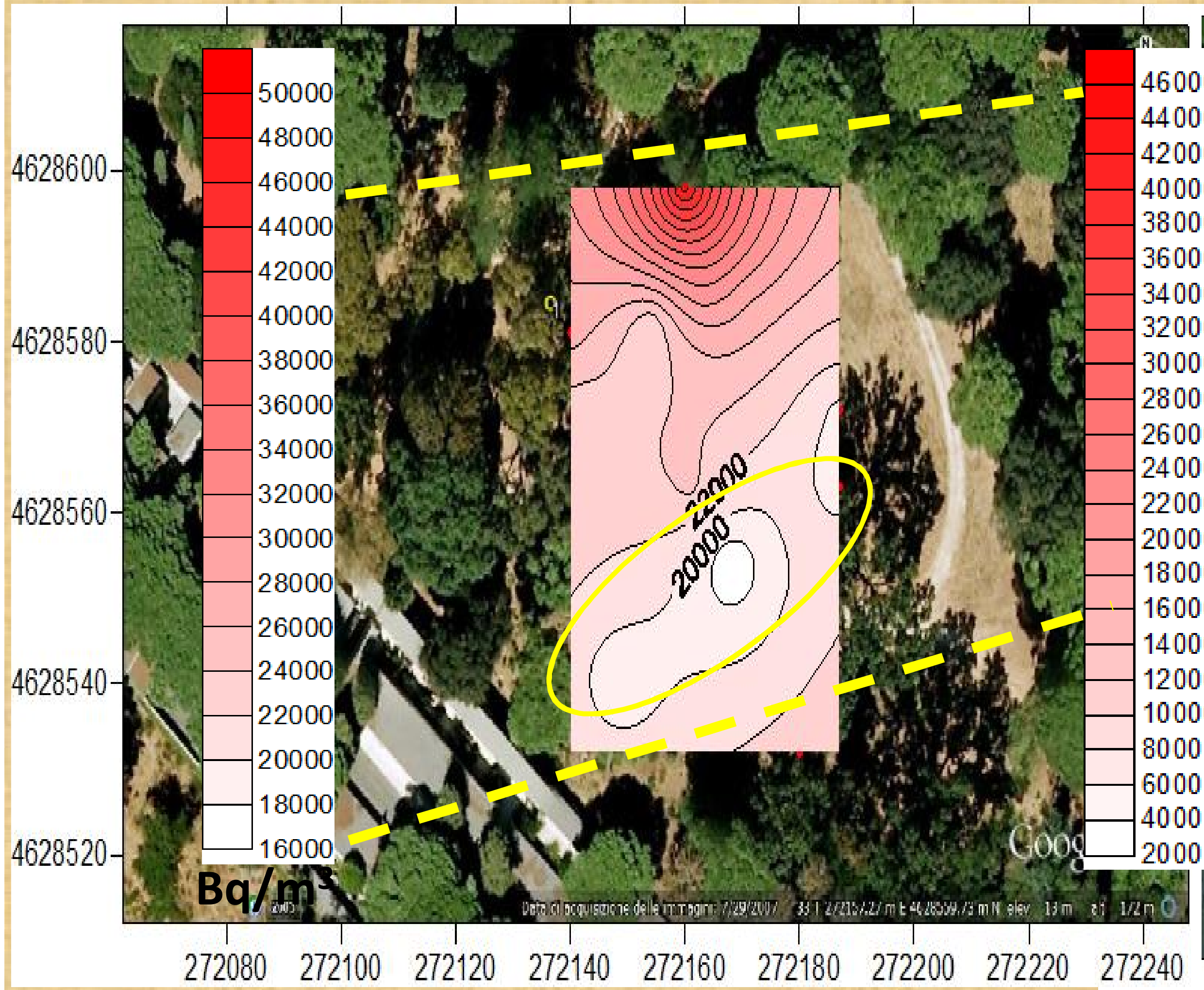
RADON IN THE BACKGROUND AREA 1-WINTER



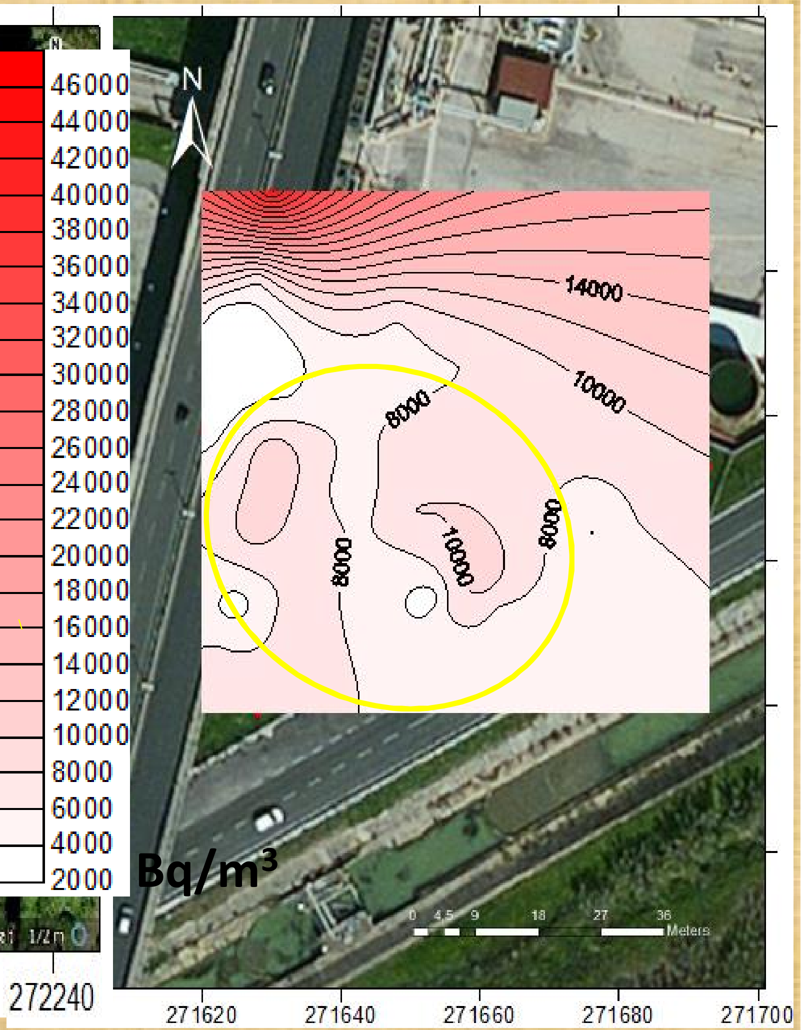
RADON IN THE STUDY AREA-WINTER



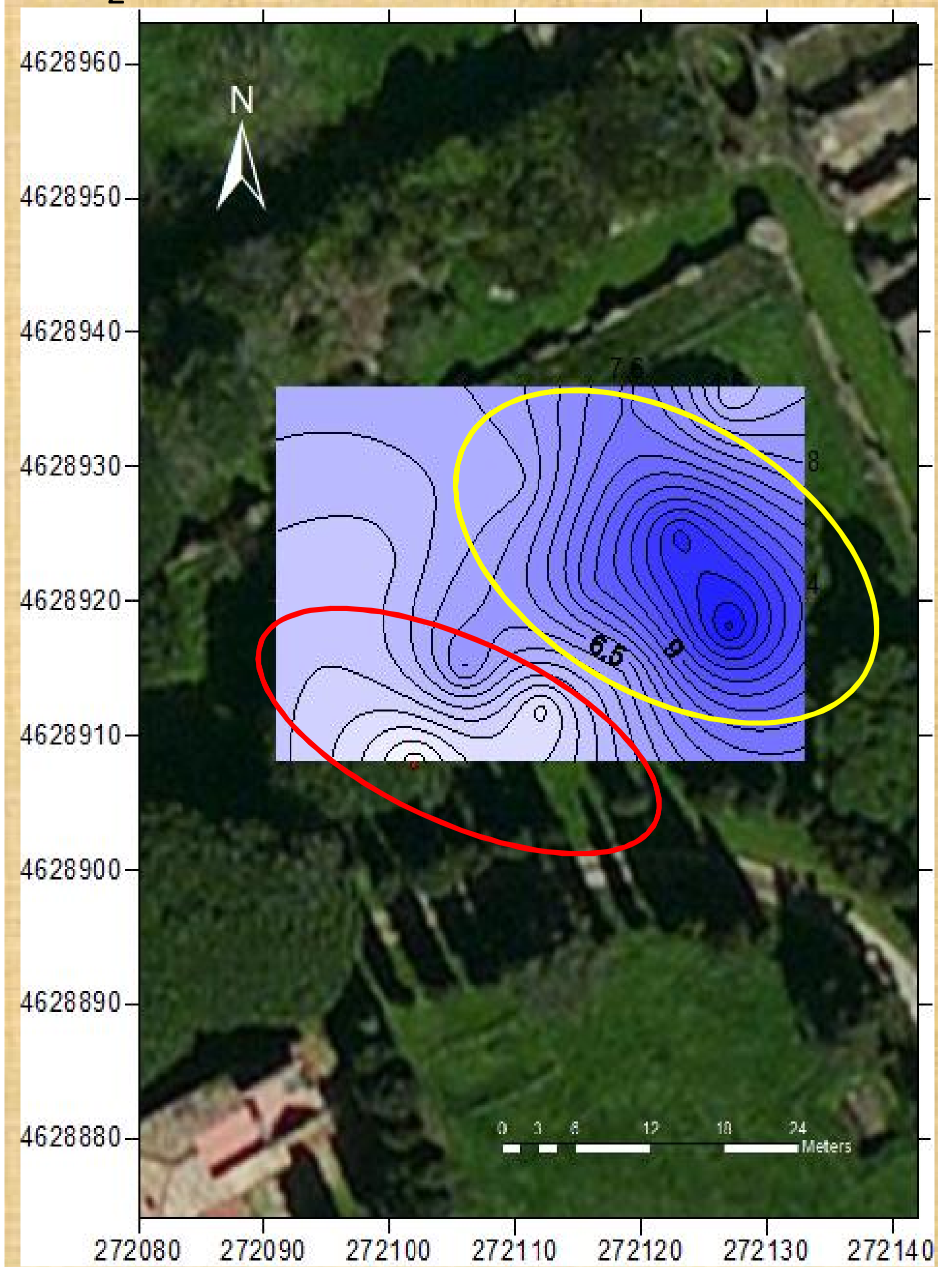
RADON IN THE BACKGROUND AREA 2-SUMMER



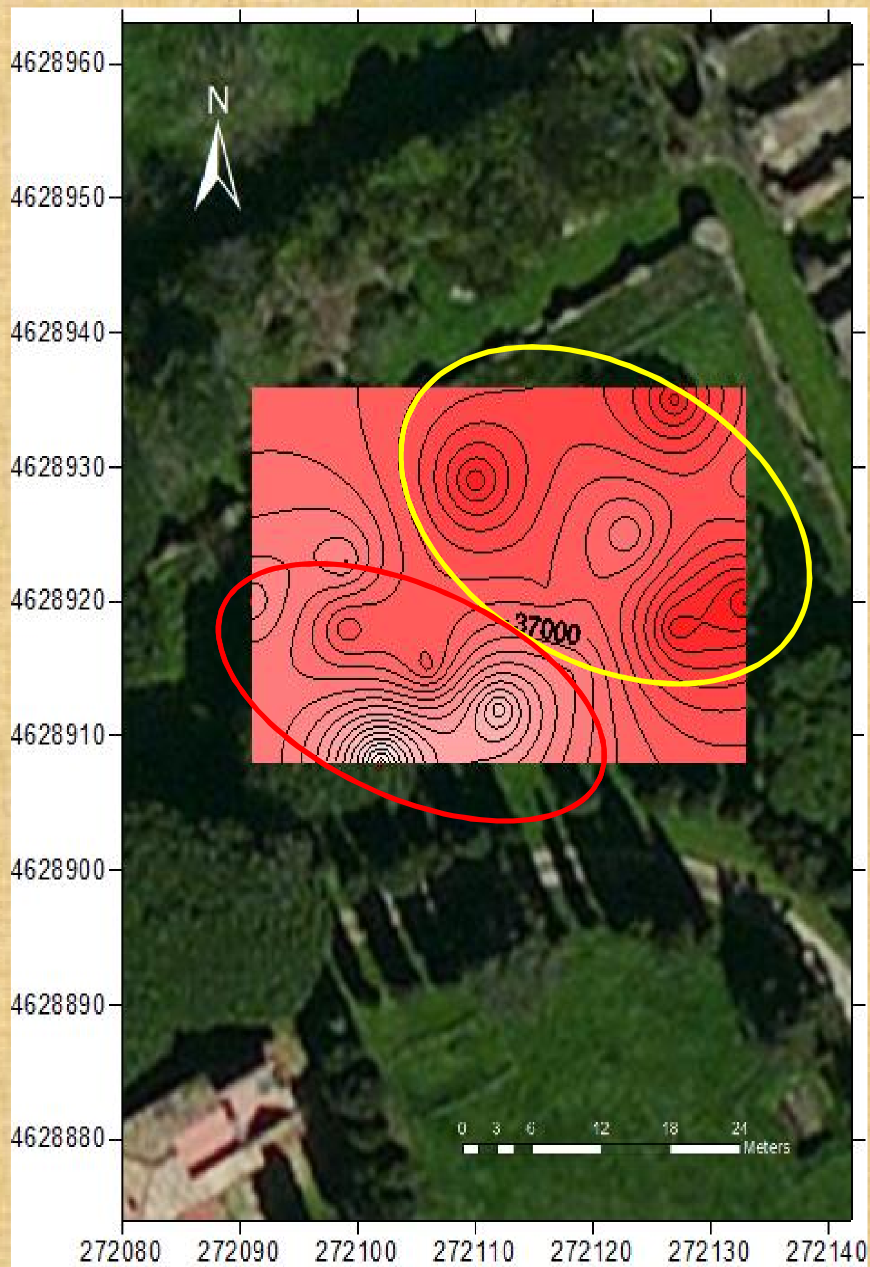
RADON IN THE STUDY AREA-SUMMER



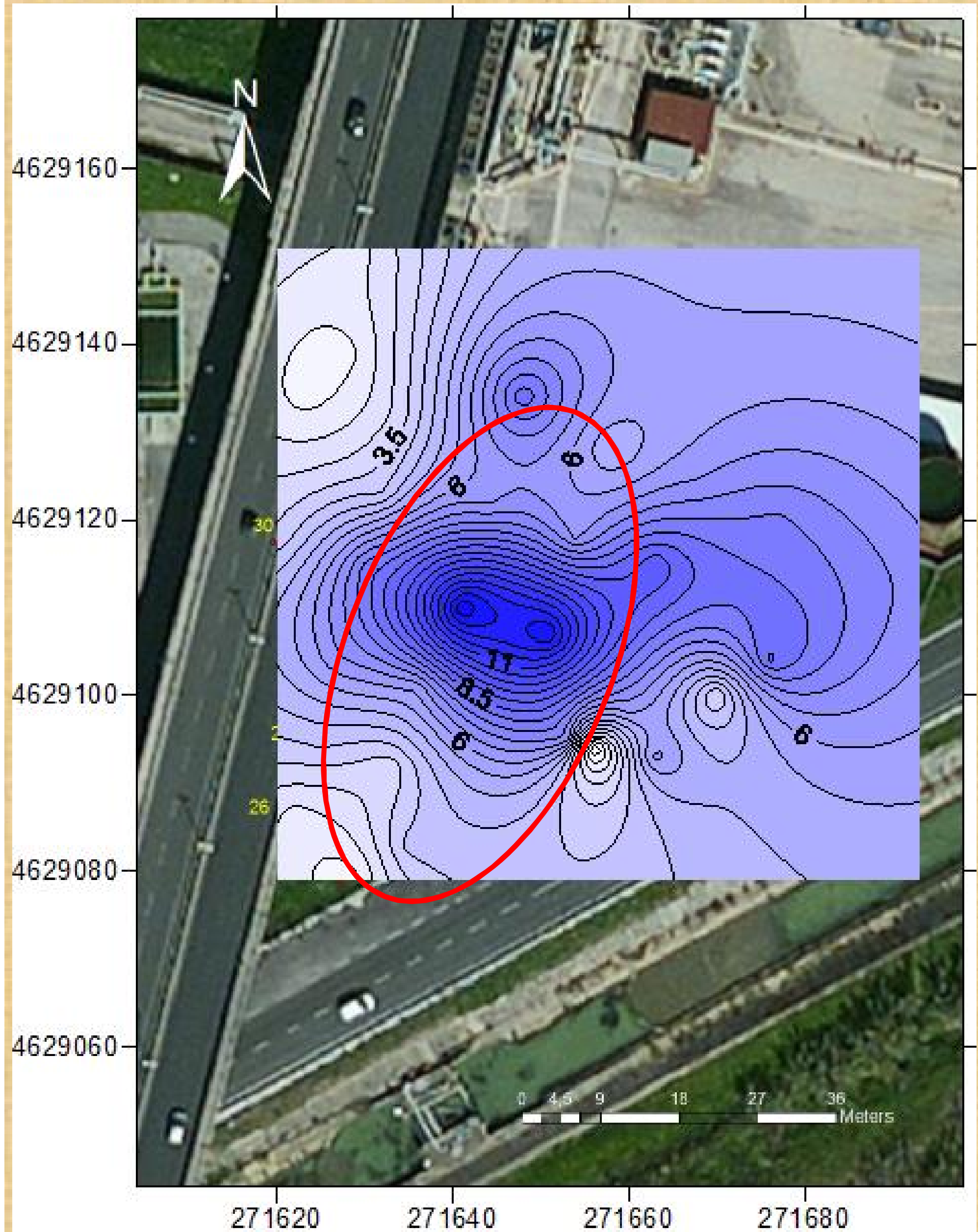
CO_2 in the background area1-winter



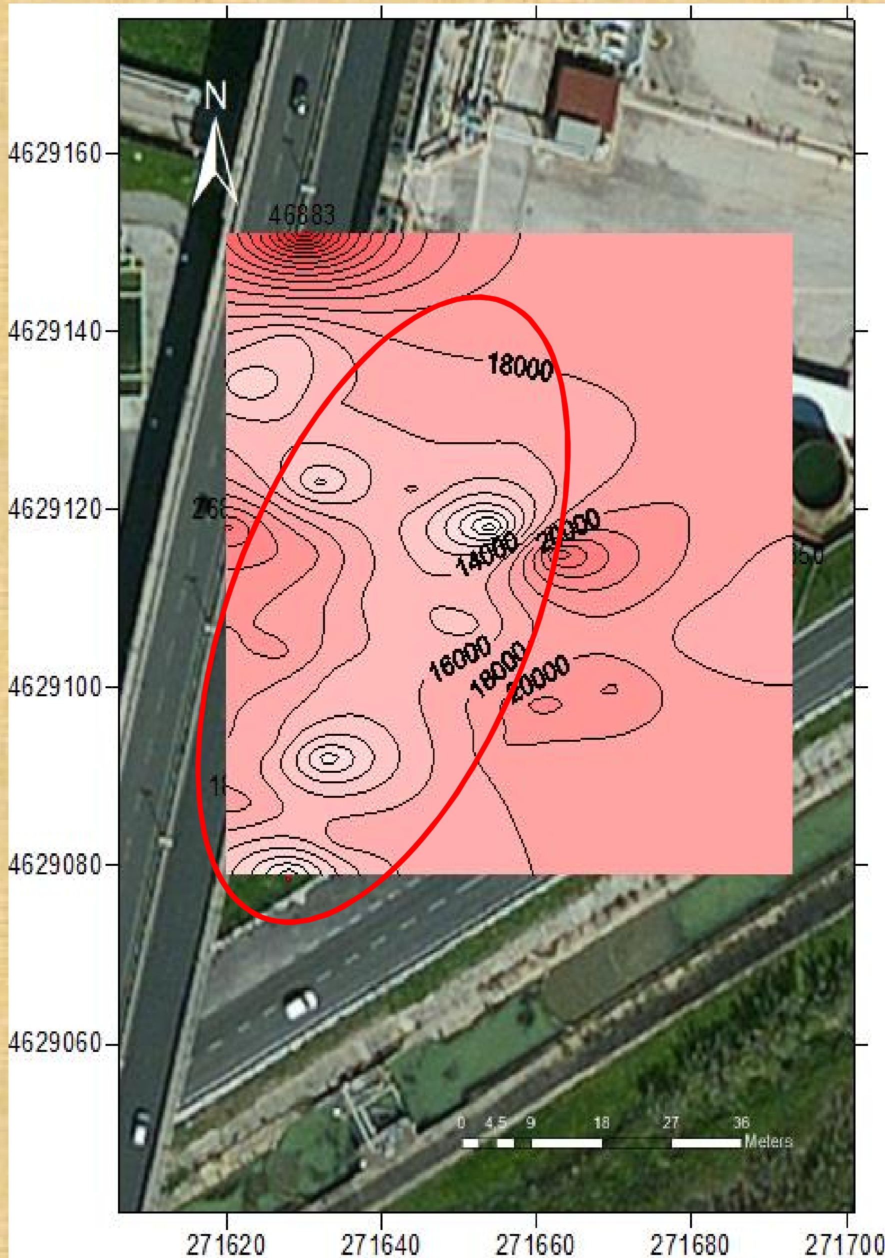
Radon in the background area1-winter



CO_2 STUDY AREA-WINTER



RADON STUDY AREA-WINTER

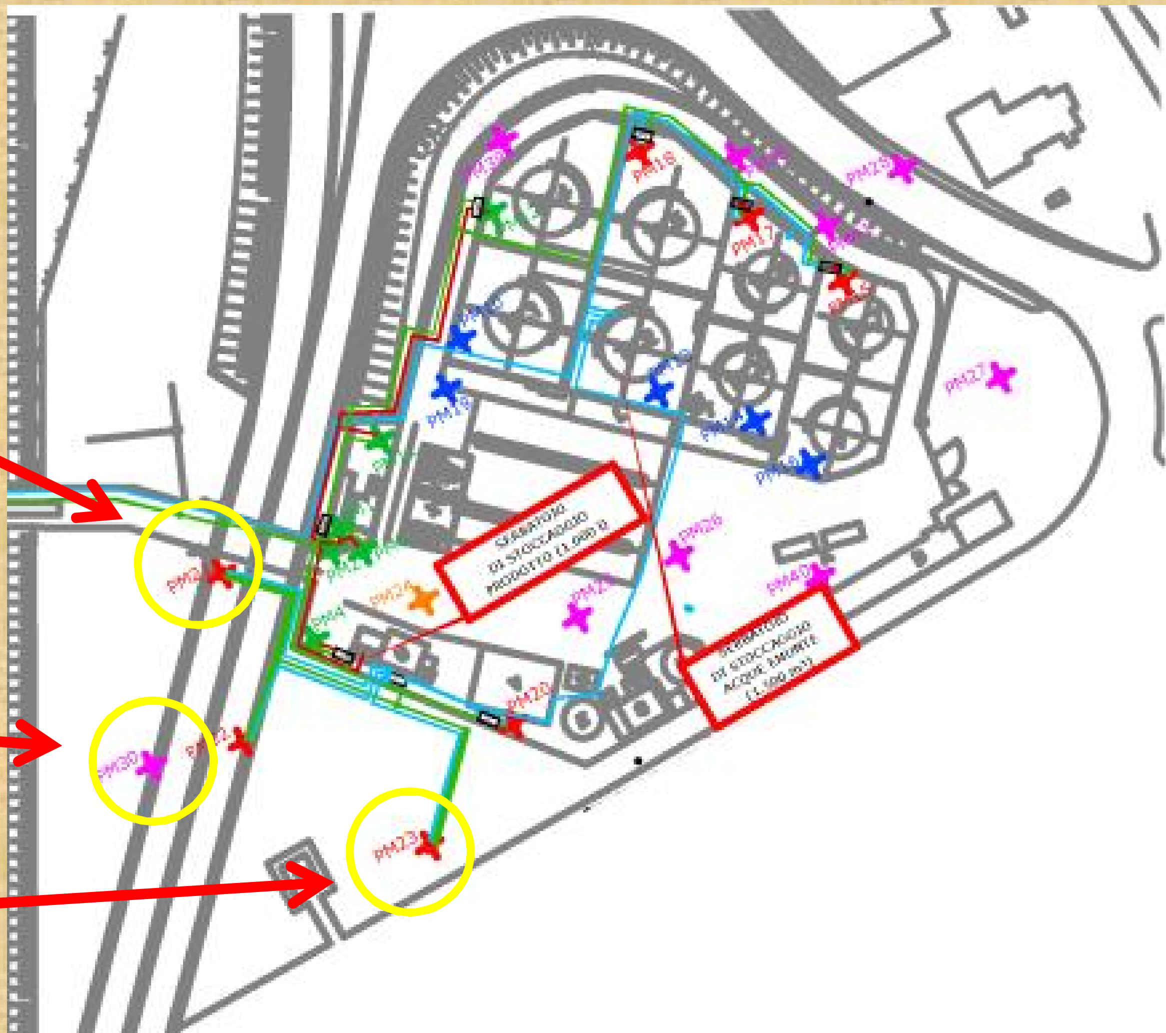


RADON IN WATER-OCTOBER 2013

PM 21: 5715±290 Bq/m^3

PM 30: 6451±320 Bq/m^3

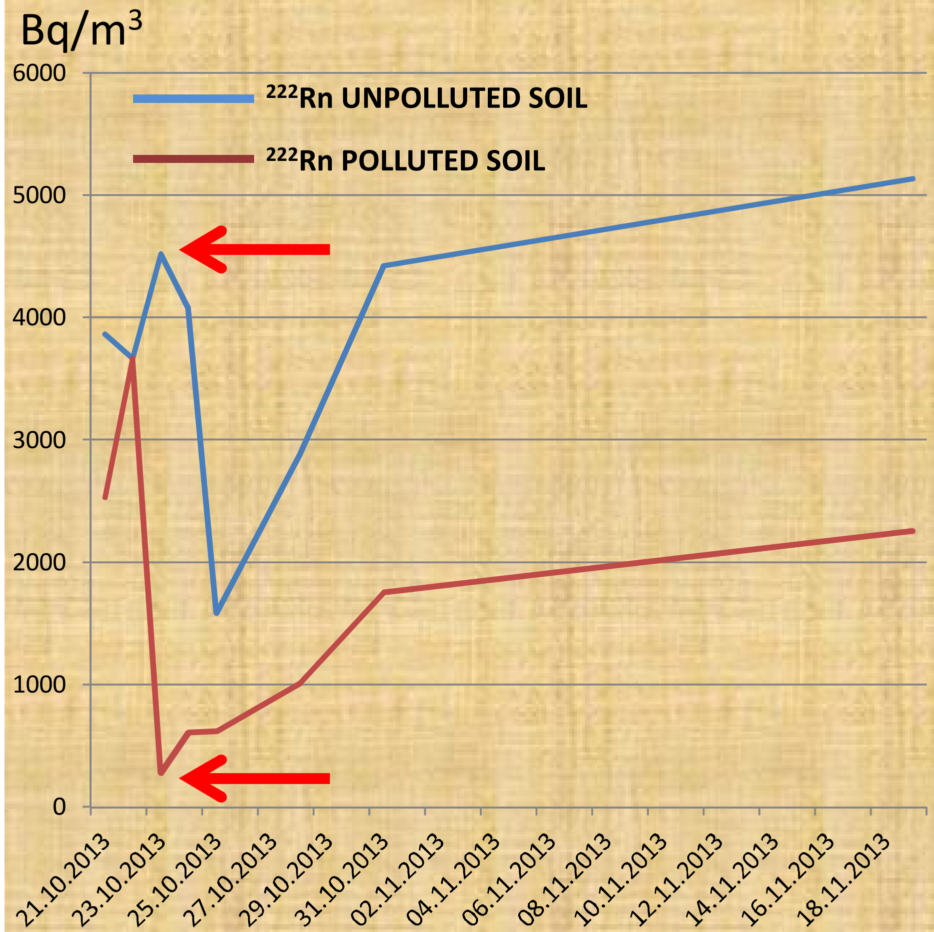
PM 23: 2082±180 Bq/m^3

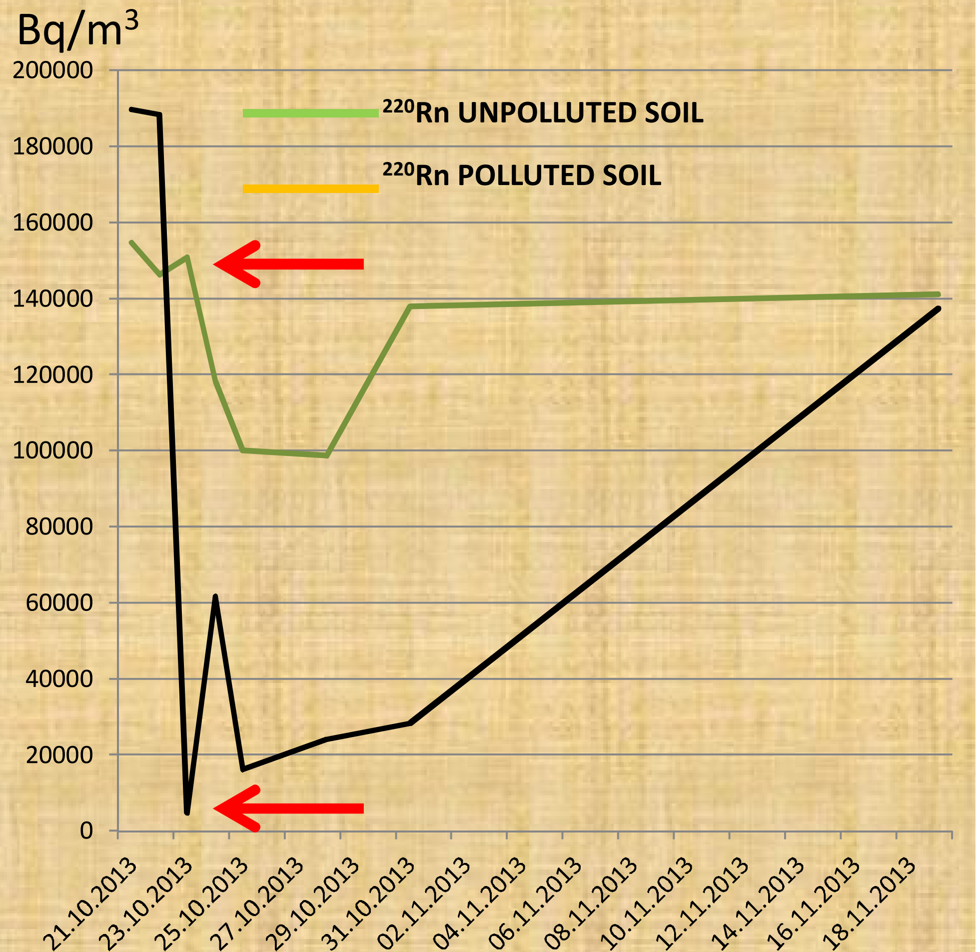


Laboratory experiment

Insertion of ½ liter of gasoline

EVOLUTION OF SOIL RADON IN THE GARBAGE BIN





Thank you for your attention

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