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 $^{222}\text{Rn}$ 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.

$$K = \frac{\text{NAPL}}{\text{air}}$$

M. Schubert et al. 2002
Study area

Stratigraphy
- 0,5m = Backfill
- 0,5-3m = Medium sand
- 3-6m = Fine sand

2,5m = Water

30m

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INSTRUMENTS

Determination of soil radon
INSTRUMENTS

Determination of CO₂ and CH₄ concentration
INSTRUMENTS

Determination radon in water
INSTRUMENTS

Determination of soil permeability

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

\[ k = \frac{V \cdot \mu}{(F \cdot \Delta p \cdot t)} \]

5.2 \times 10^{-14} \text{ m}^2 - 1.8 \times 10^{-11} \text{ m}^2

Low: \( K < 4 \times 10^{-13} \text{ m}^2 \)

Medium: \( 4 \times 10^{-13} \text{ m}^2 < K < 4 \times 10^{-12} \text{ m}^2 \)

High \( K > 4 \times 10^{-12} \text{ m}^2 \)

V: air volume in the expandable cell
\( \mu \): air dynamic viscosity at 10°C
F: shape factor of the hollow rod inside the ground
\( \Delta p \): pressure difference between the surface and the active area of the probe
\( t \): opening cell time

Neznal & Neznal, 2005

Radon Jok
INSTRUMENTS
Determination of soil permeability

\[ k = \frac{(V \times \mu)}{(F \times \Delta p \times t)} \]
Study area

31 measurements were carried out at 80 cm depth, in this area of 2980 m², to investigate on concentrations of:
- Radon
- Thoron
- CO₂
- CH₄
- Permeability

Viaduct
Permanent Station
Permanent sensors of temperature and humidity – at 30 cm and 80 cm depth
RADON MAP IN THE STUDY AREA

Winter campaign

Bq/m³

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Study area
RADON IN THE BACKGROUND AREA - WINTER

RADON IN THE STUDY AREA - WINTER

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CO$_2$ in the background area 1-winter

Radon in the background area 1-winter
CO₂ STUDY AREA - WINTER

RADON STUDY AREA - WINTER

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RADON IN WATER-OCTOBER 2013

PM 21: 5715±290 Bq/m³

PM 30: 6451±320 Bq/m³

PM 23: 2082±180 Bq/m³
Laboratory experiment

Insertion of ½ liter of gasoline
EVOLUTION OF SOIL RADON IN THE GARBAGE BIN
Thank you for your attention
REFERENCES


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