Assessing the relationships between soil radon concentrations and the occurrence of shallow underground caverns

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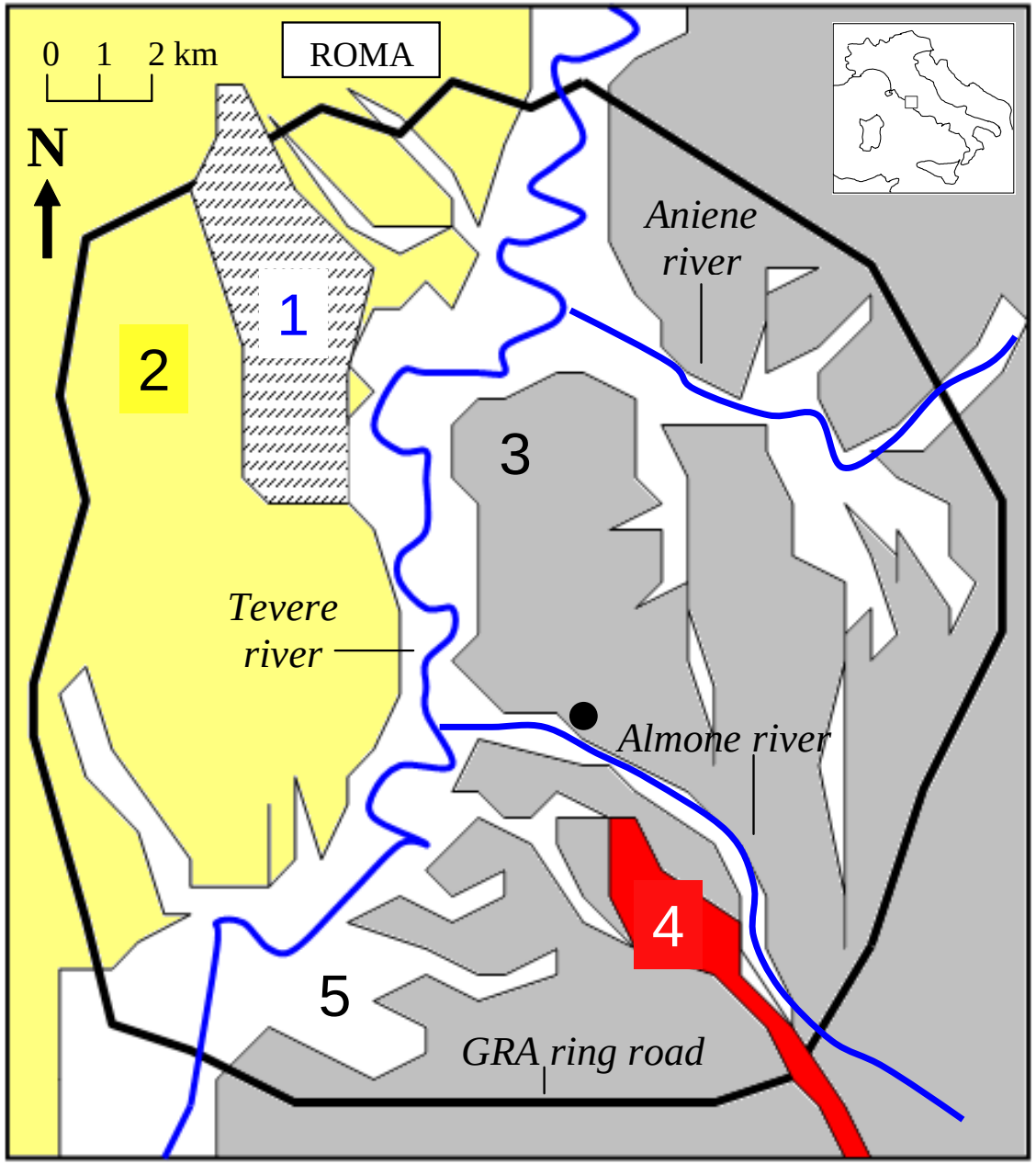


Roma (Italy)

Simplified geological map

1 Plio-Pleistocene marine to transitional deposits

2 Sabatini district volcanites

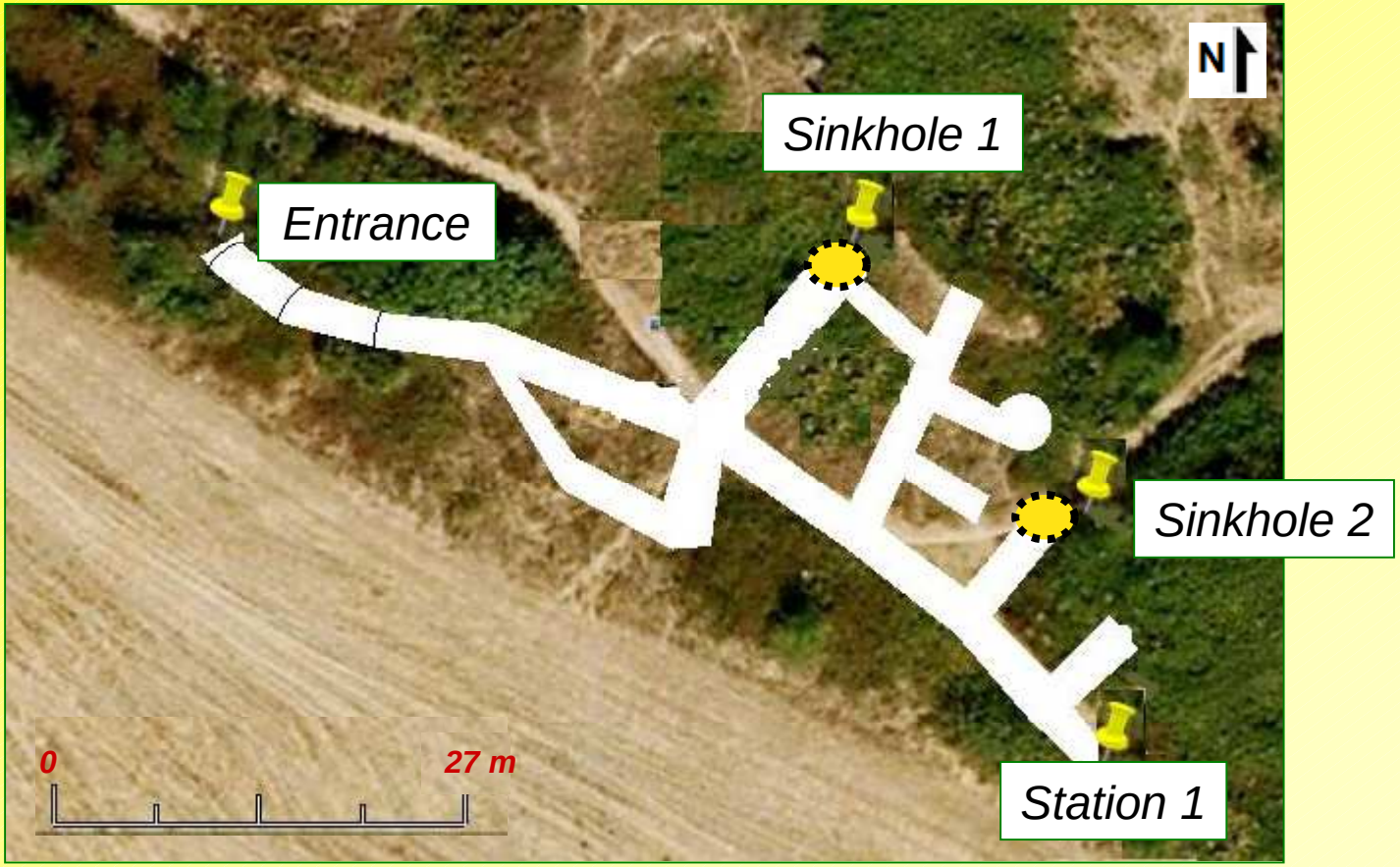
3 Colli Albani district ignimbrites

4 Colli Albani district lavas

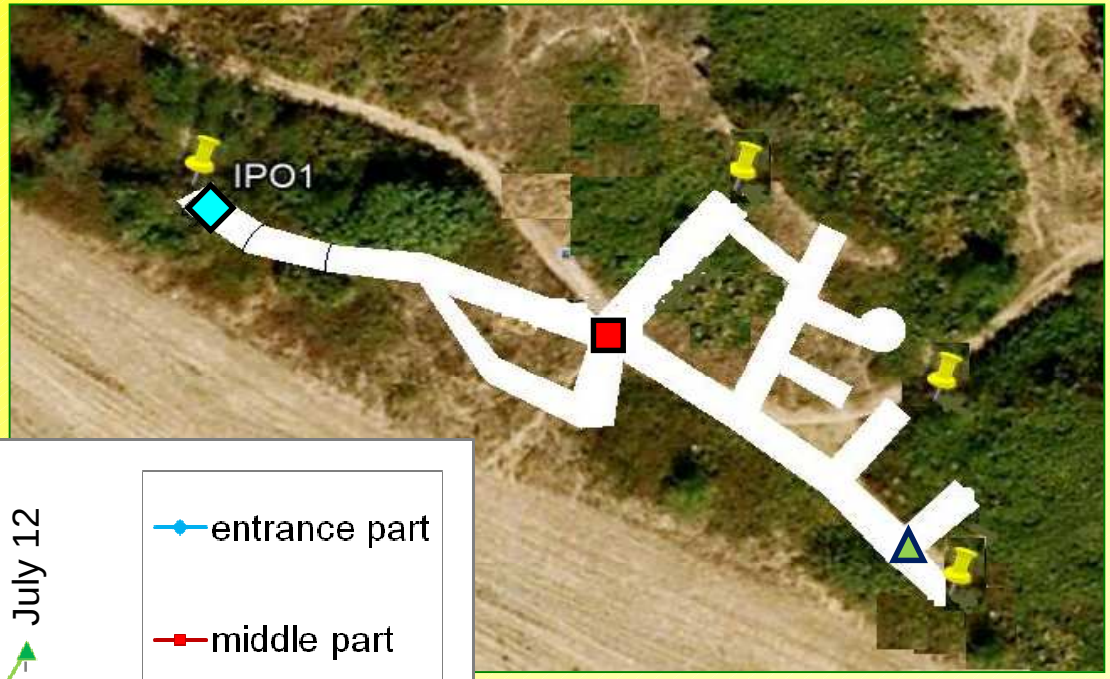
5 Alluvial sediments of Tevere River and its tributaries

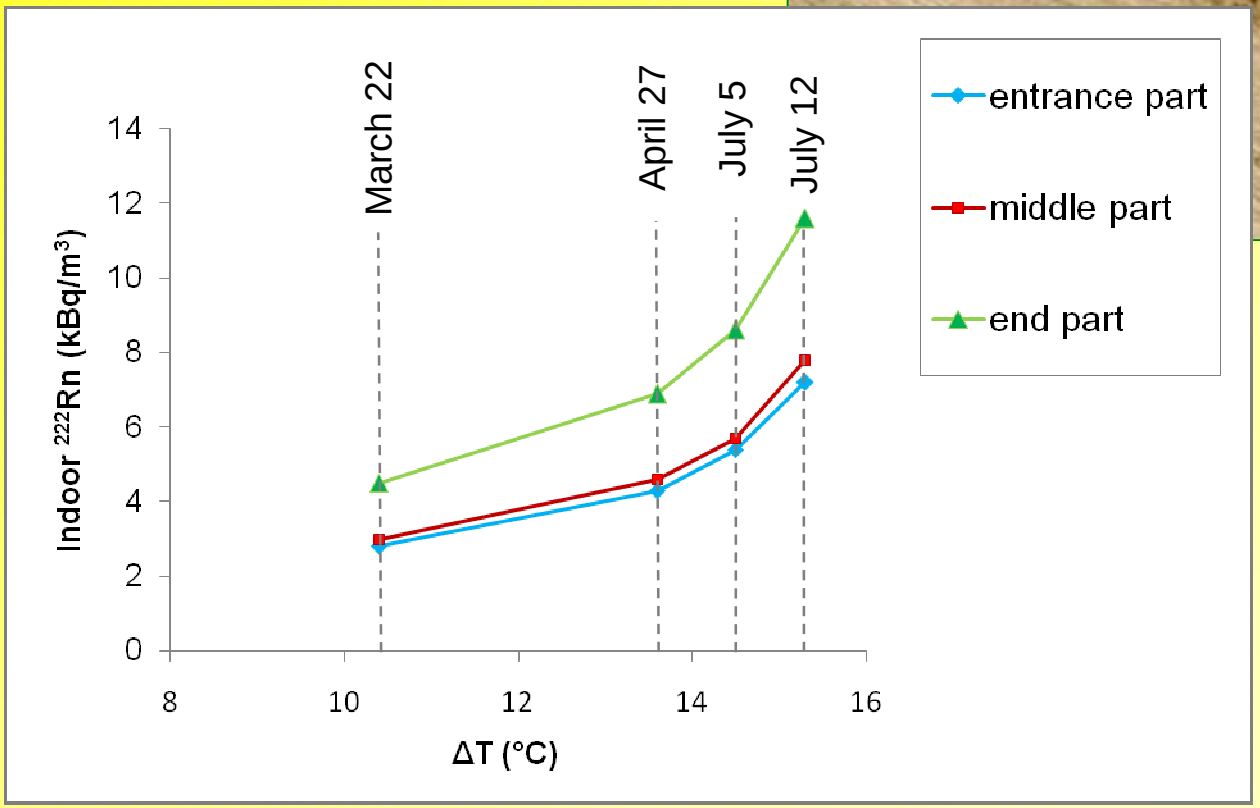
● Tor Marancia - Valle della Caffarella study area

Map of the artificial cave quarried within the ignimbrites from Colli Albani volcano.



Indoor ^{222}Rn and ^{220}Rn along the cave





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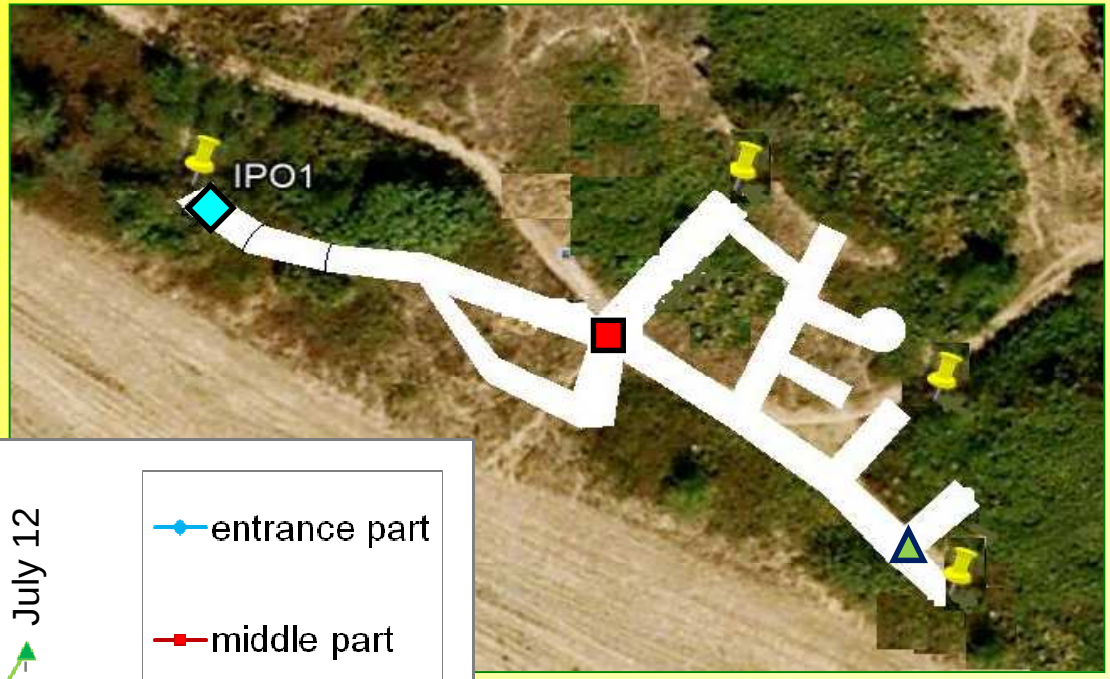
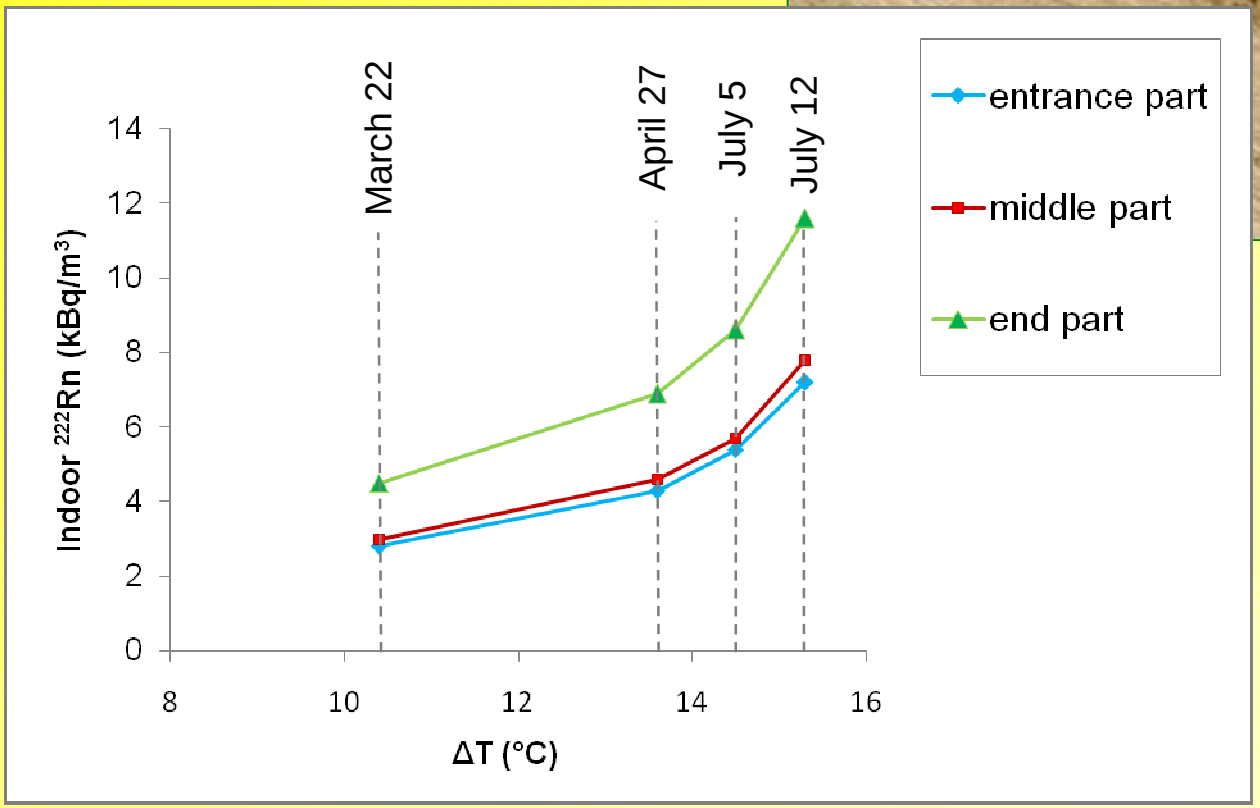
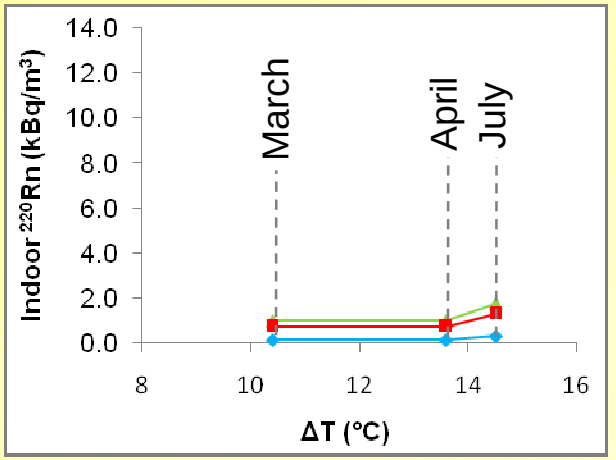
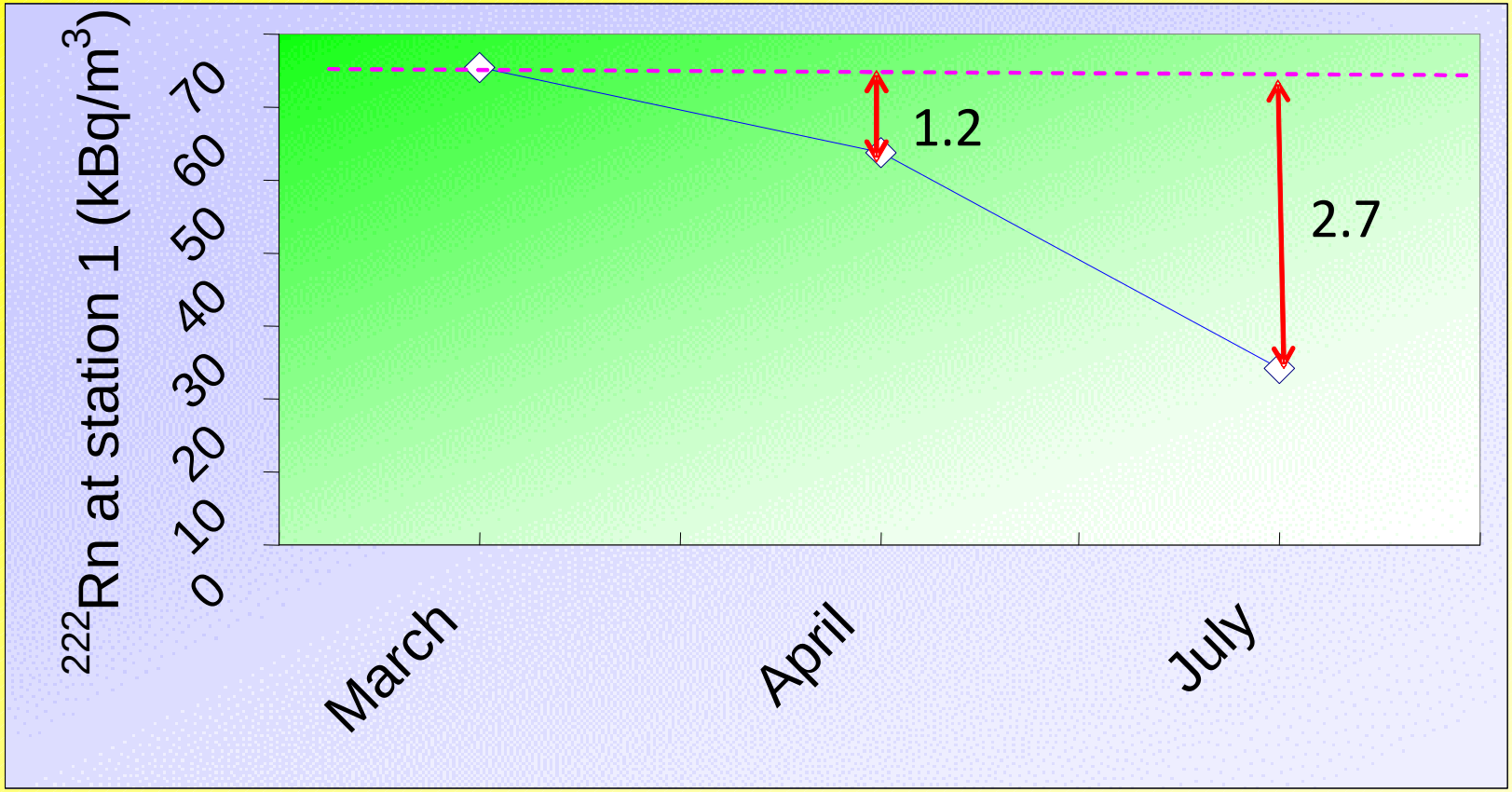


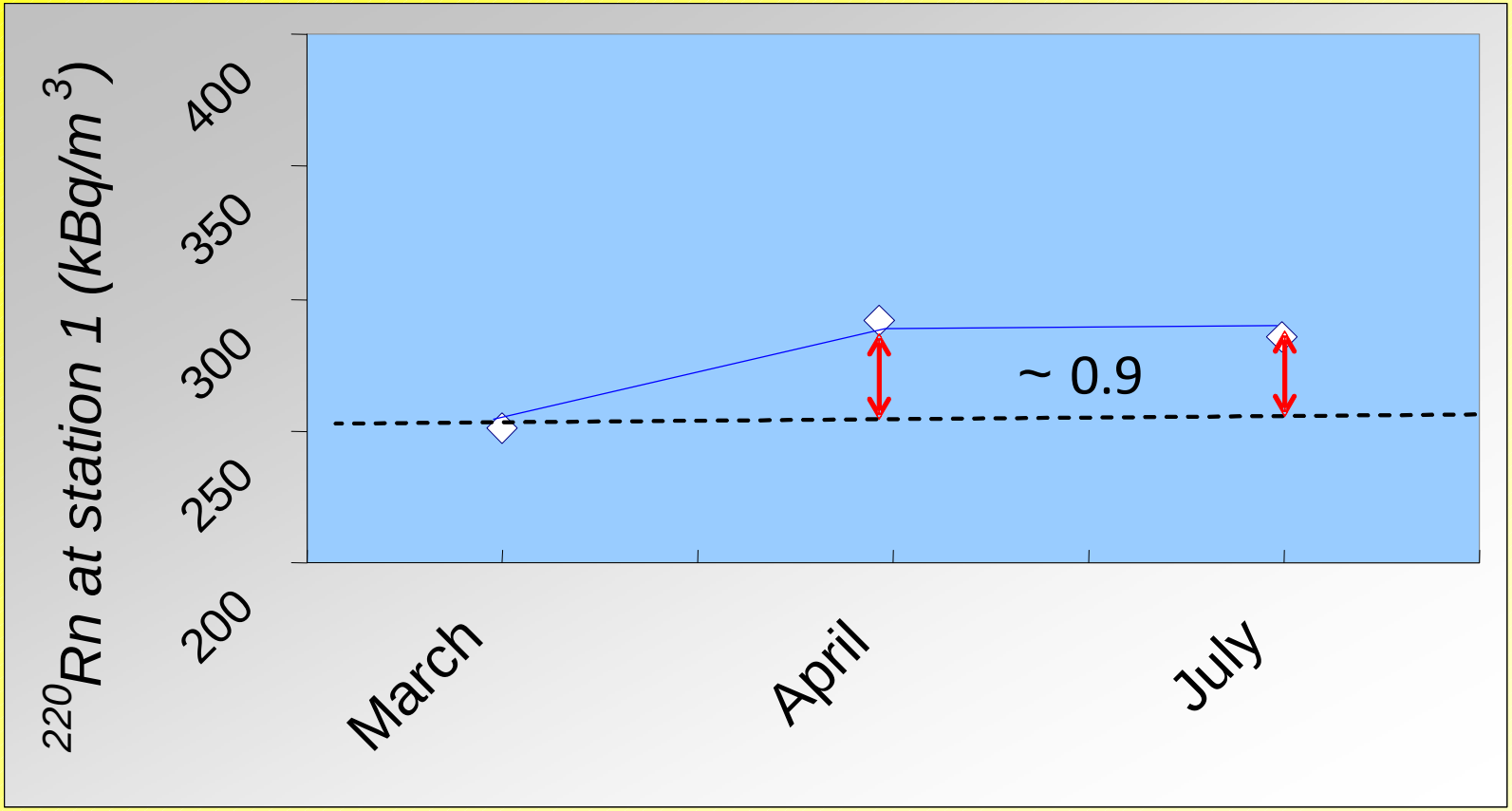




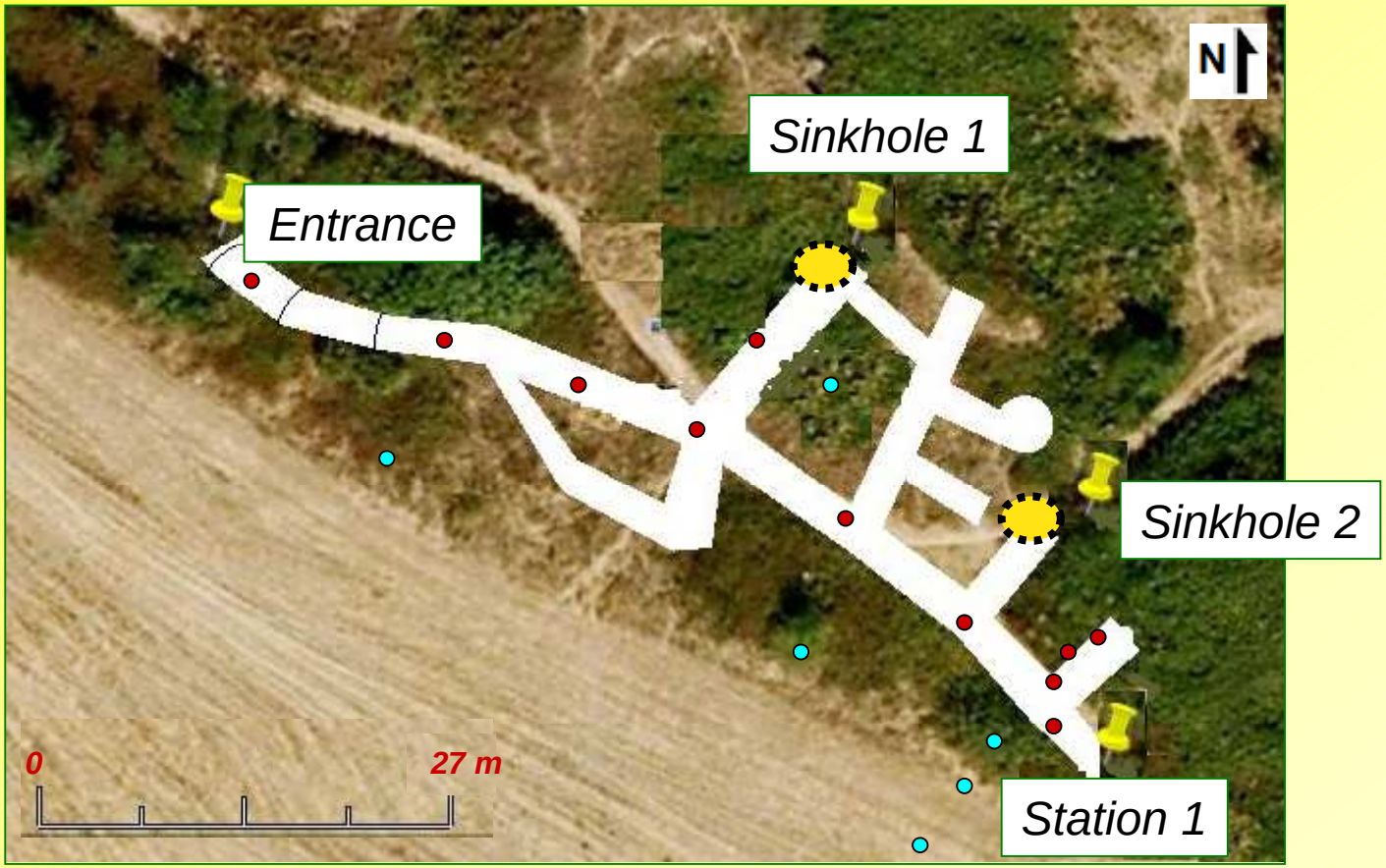
Corrections for soil ^{222}Rn seasonal changes using a permanent station



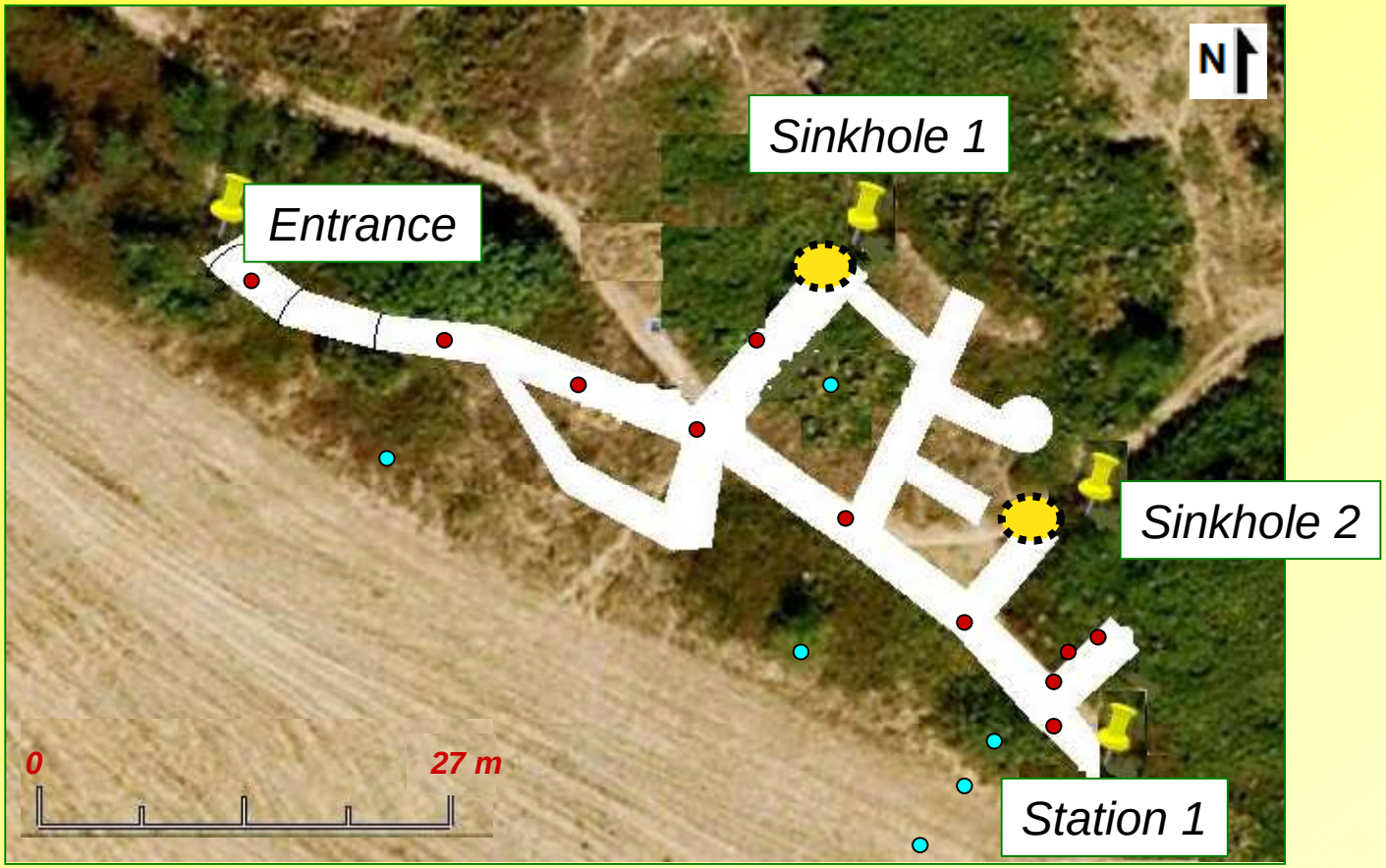
Corrections for soil ^{220}Rn seasonal changes using a permanent station



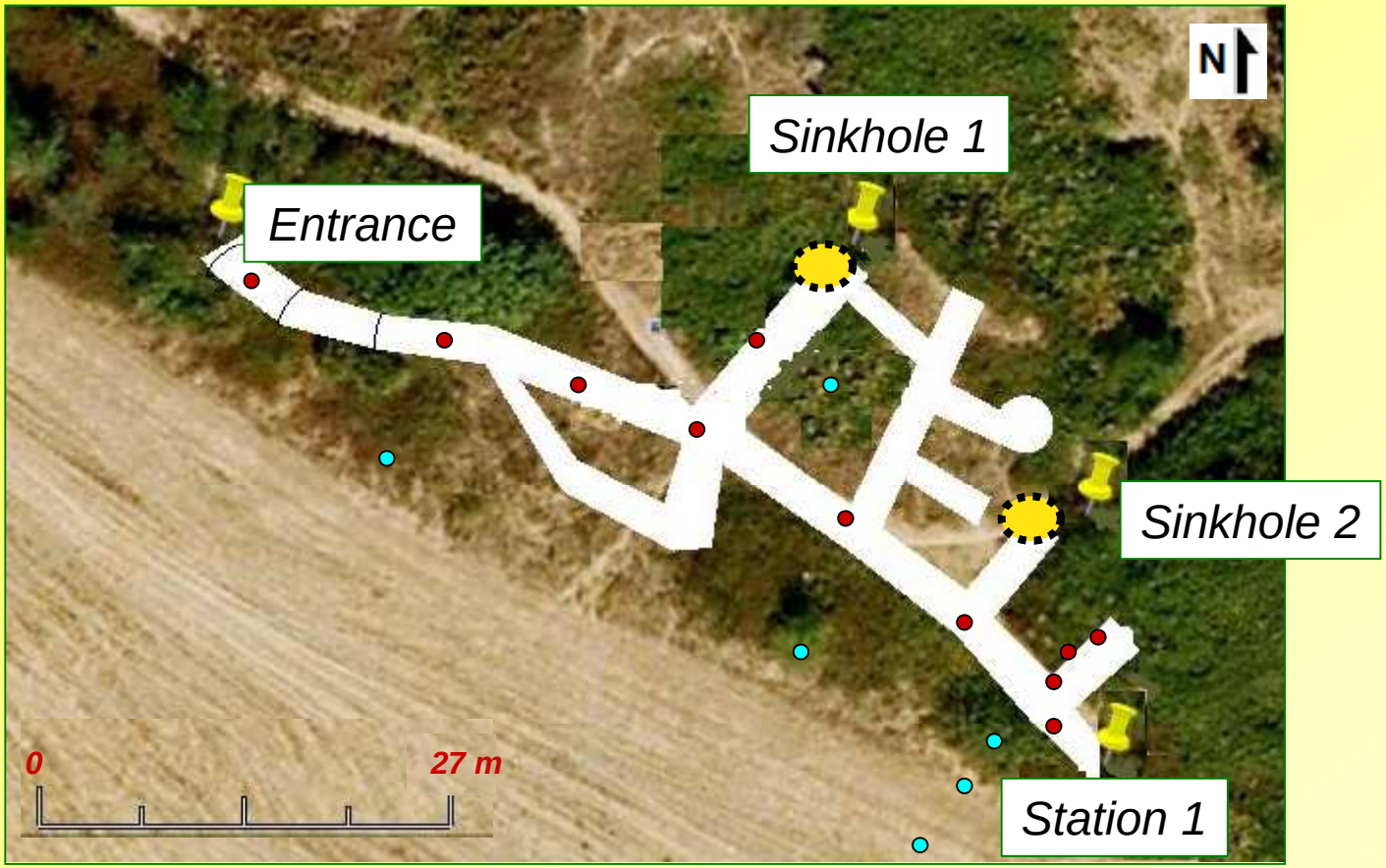
- **52 kBq/m^3** — **Average soil ^{222}Rn on top of the cave**
- **36 kBq/m^3** — **Average soil ^{222}Rn where the cavern is not present underneath**



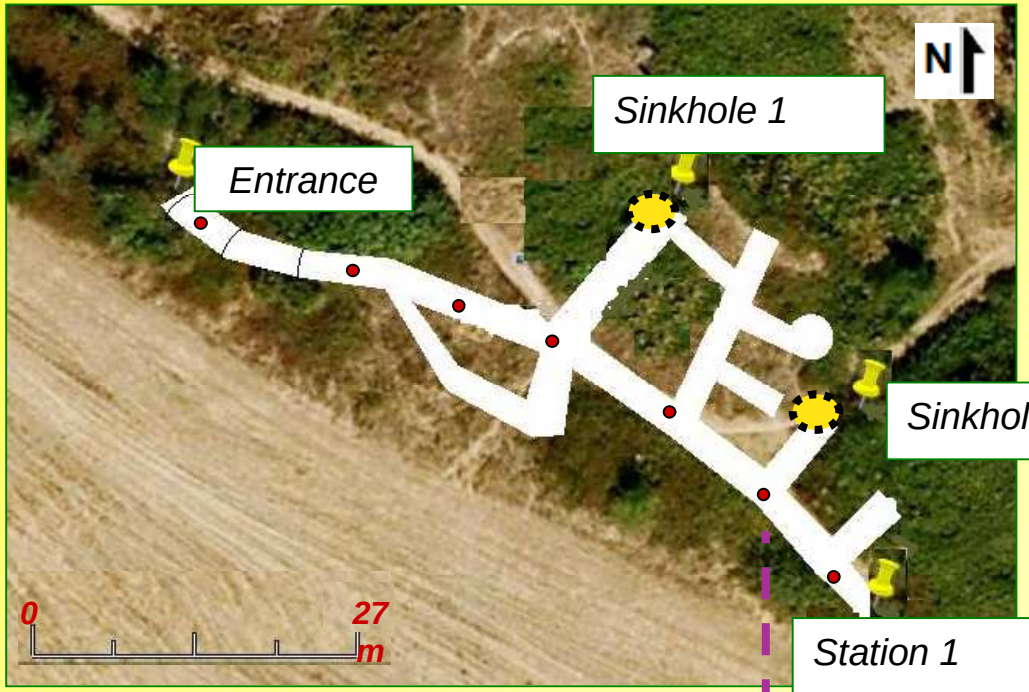
- **185 kBq/m^3** **Average soil ^{220}Rn on top of the cave**
- **201 kBq/m^3** **Average soil ^{220}Rn where the cavern is not present underneath**

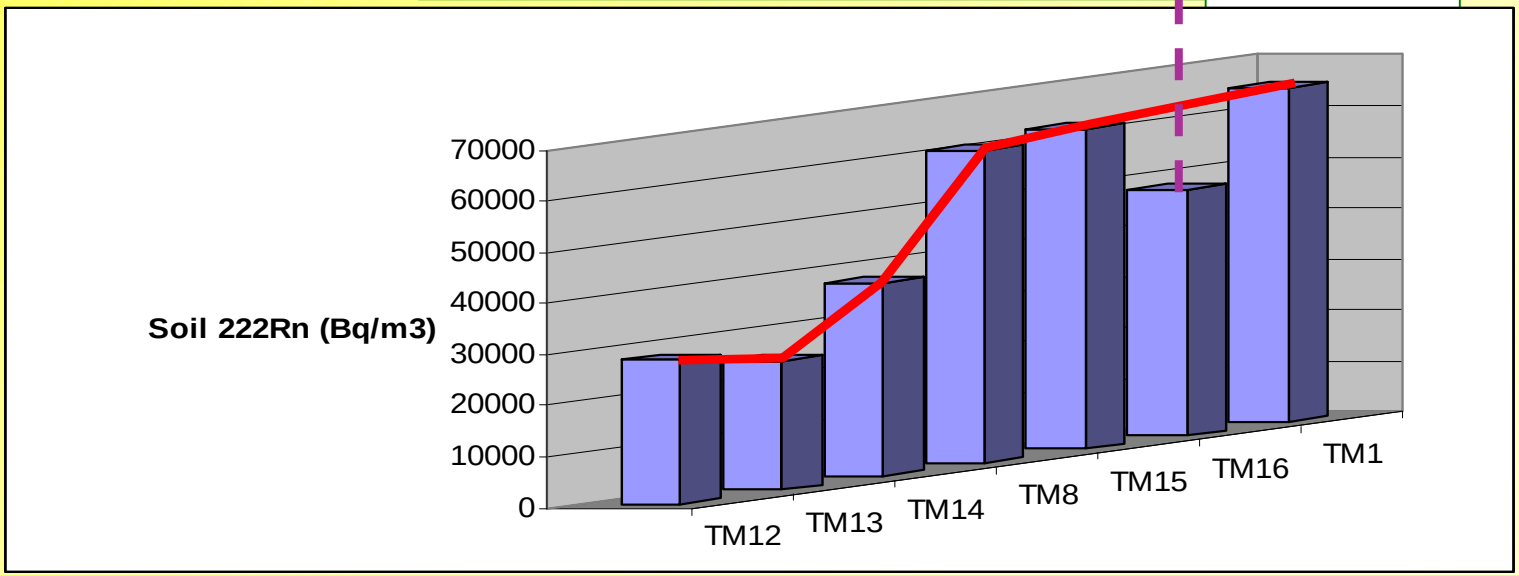


- **0.31** — **Average soil ^{222}Rn / ^{220}Rn on top of the cave**
- **0.21** — **Average soil ^{222}Rn /^{220} Rn where the cavern is not present underneath**

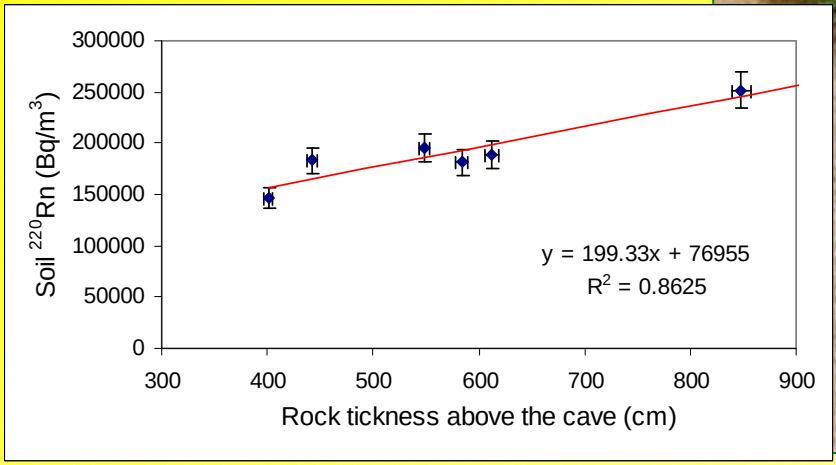


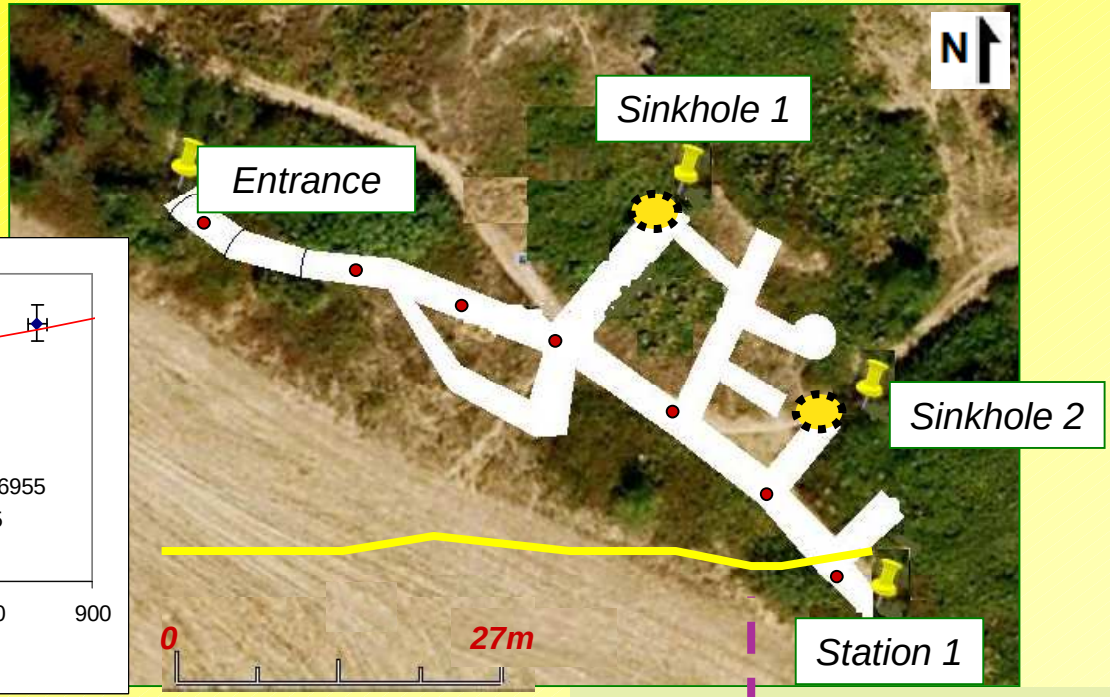
Variability of soil ^{222}Rn on top of the cave along the cavern path



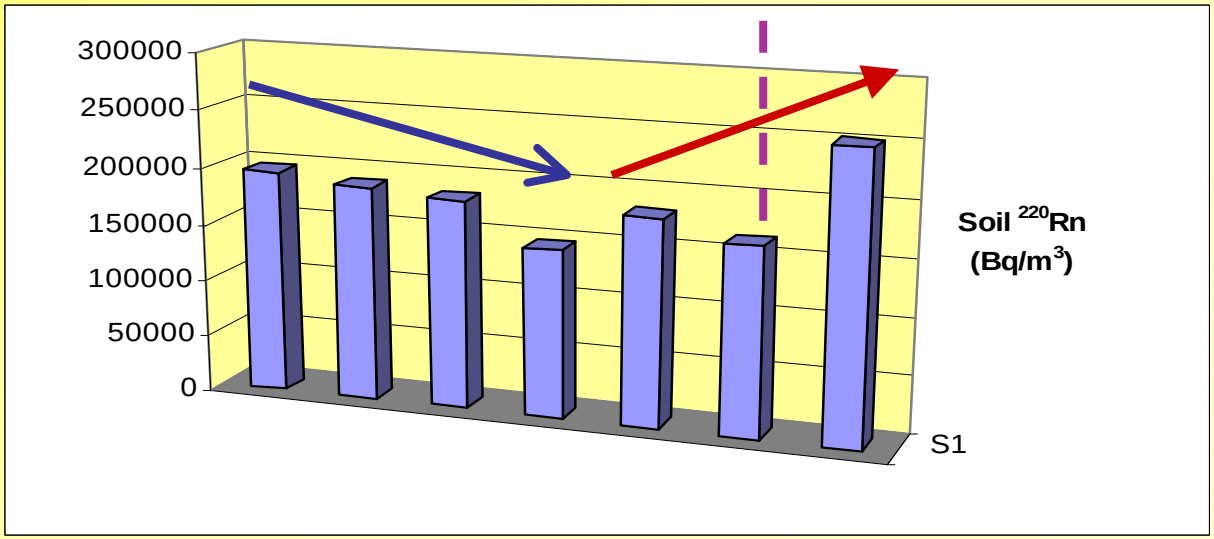


Variability of soil ^{220}Rn on top of the cave along the cavern path





Decreasing rock tickness **Increasing rock tickness**



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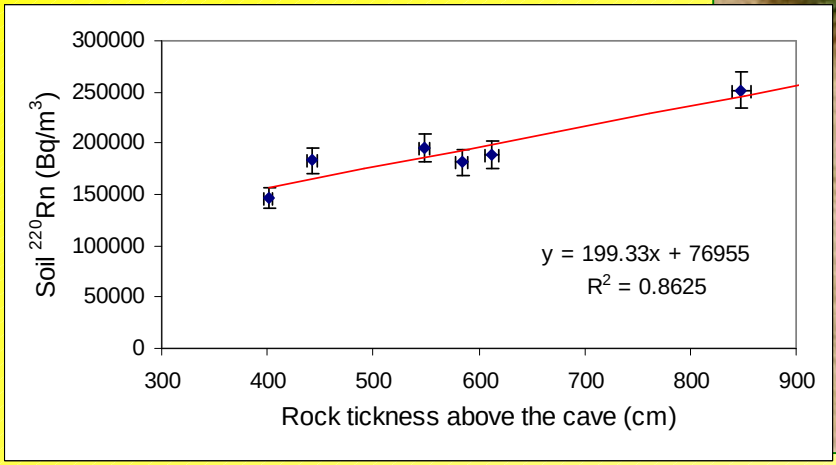
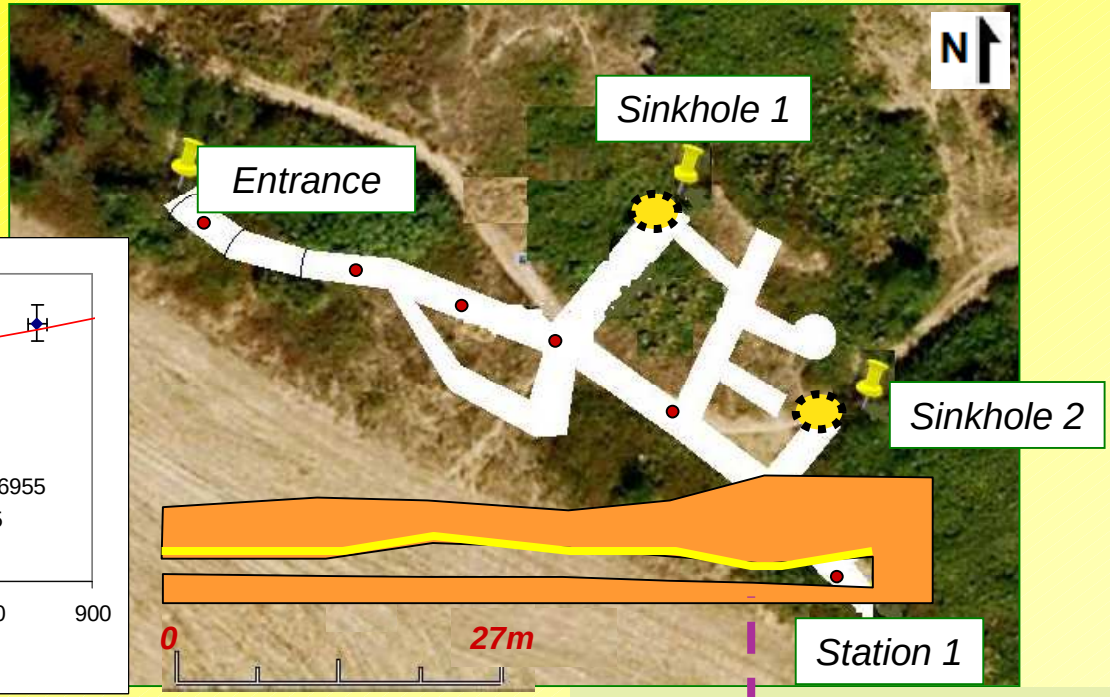
Variability of soil ^{220}Rn on top of the cave along the cavern path





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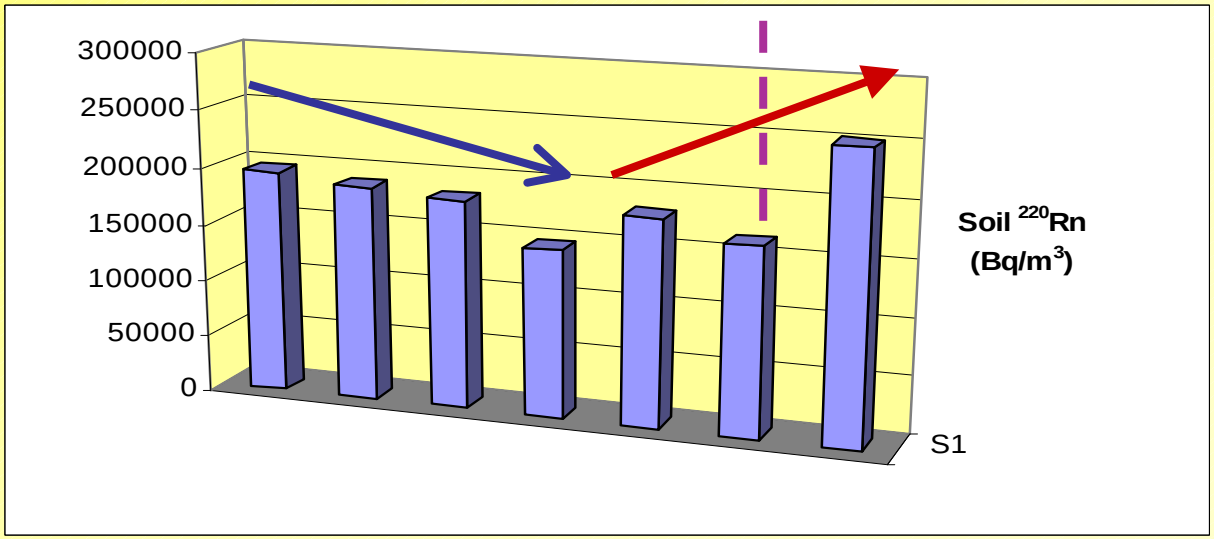

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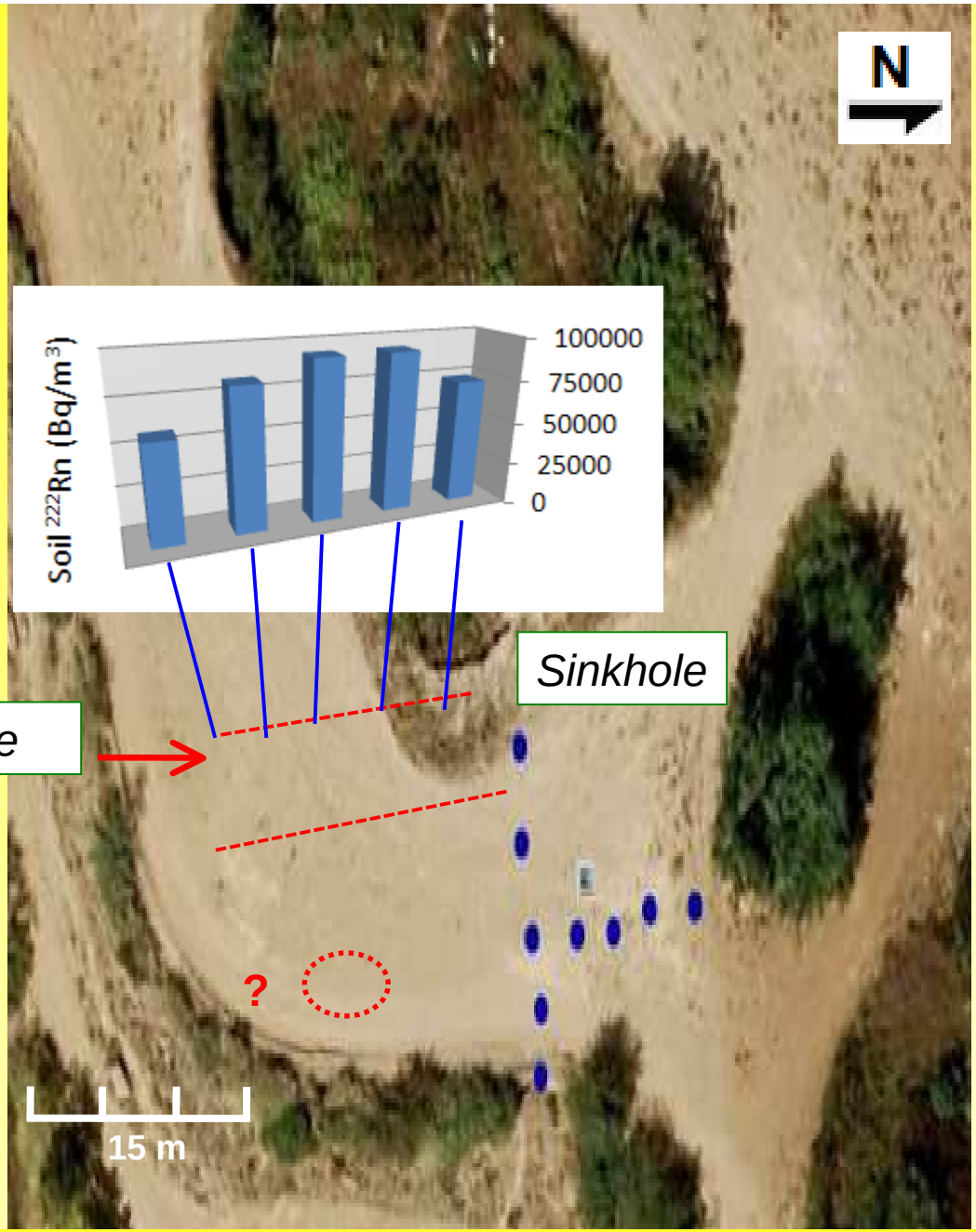
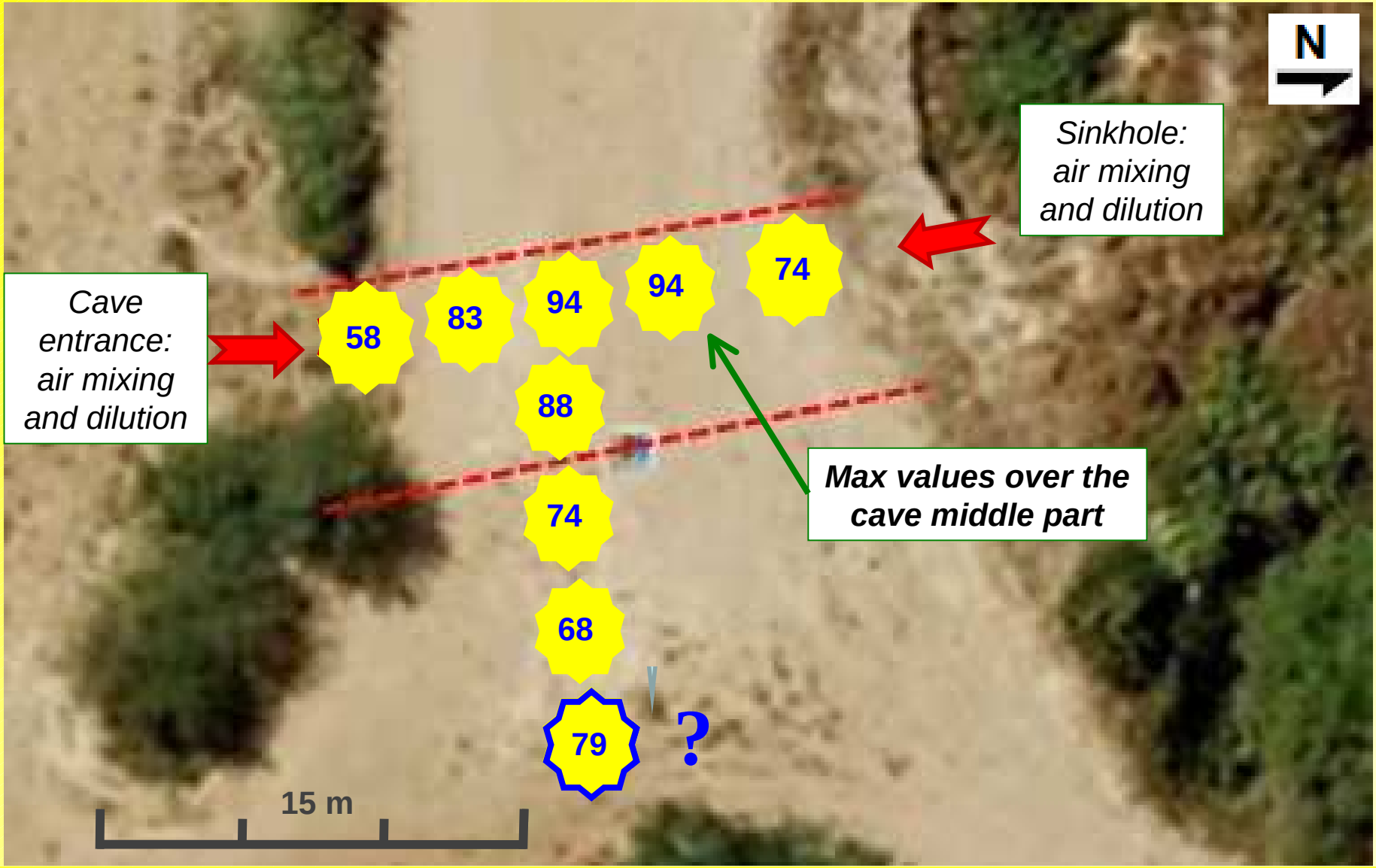
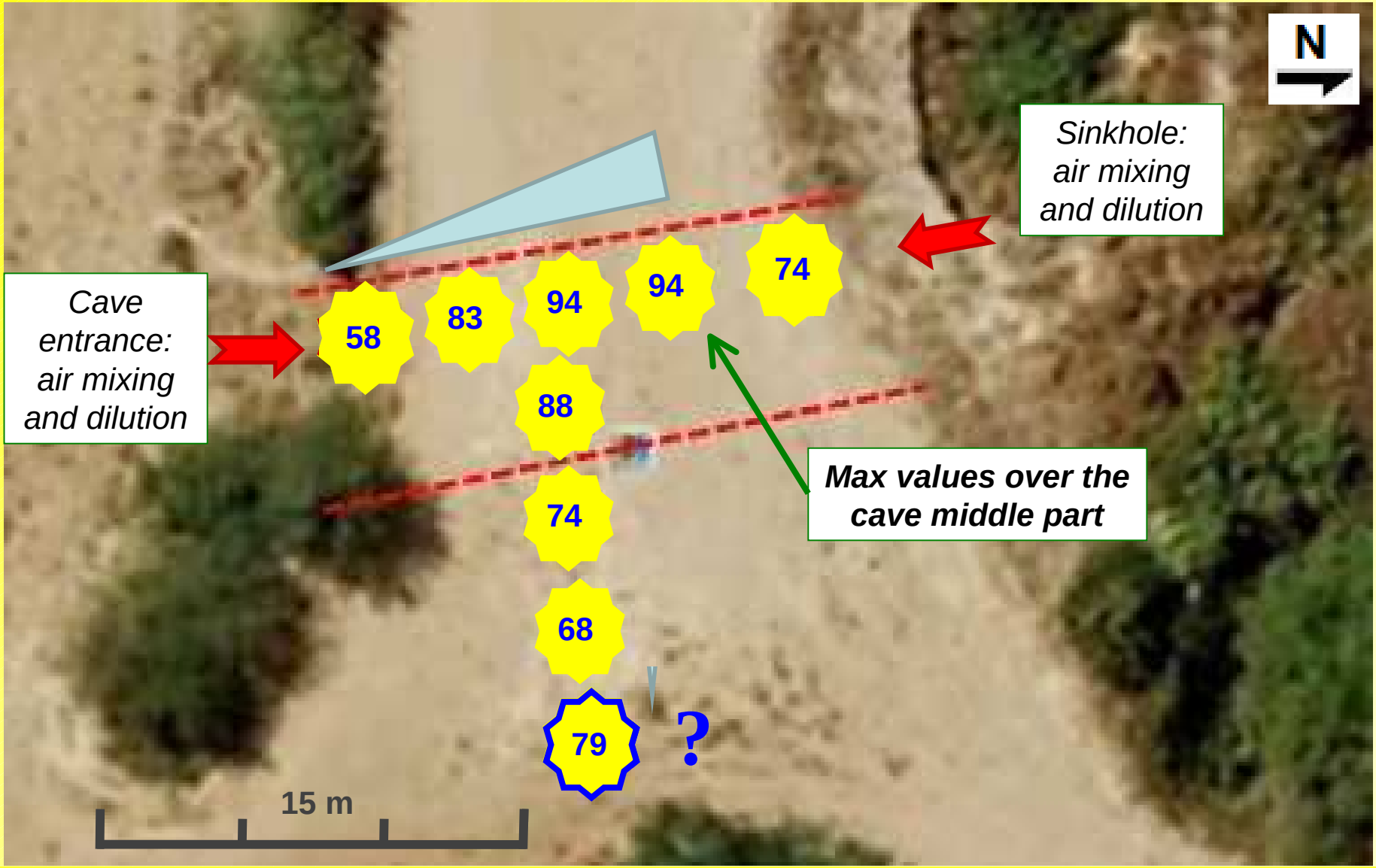
Variability of soil ^{222}Rn on top of a cave in Valle della Caffarella



Valle della Caffarella cave – Soil Radon (kBq/m^3)



Valle della Caffarella cave – Soil Radon (kBq/m³)



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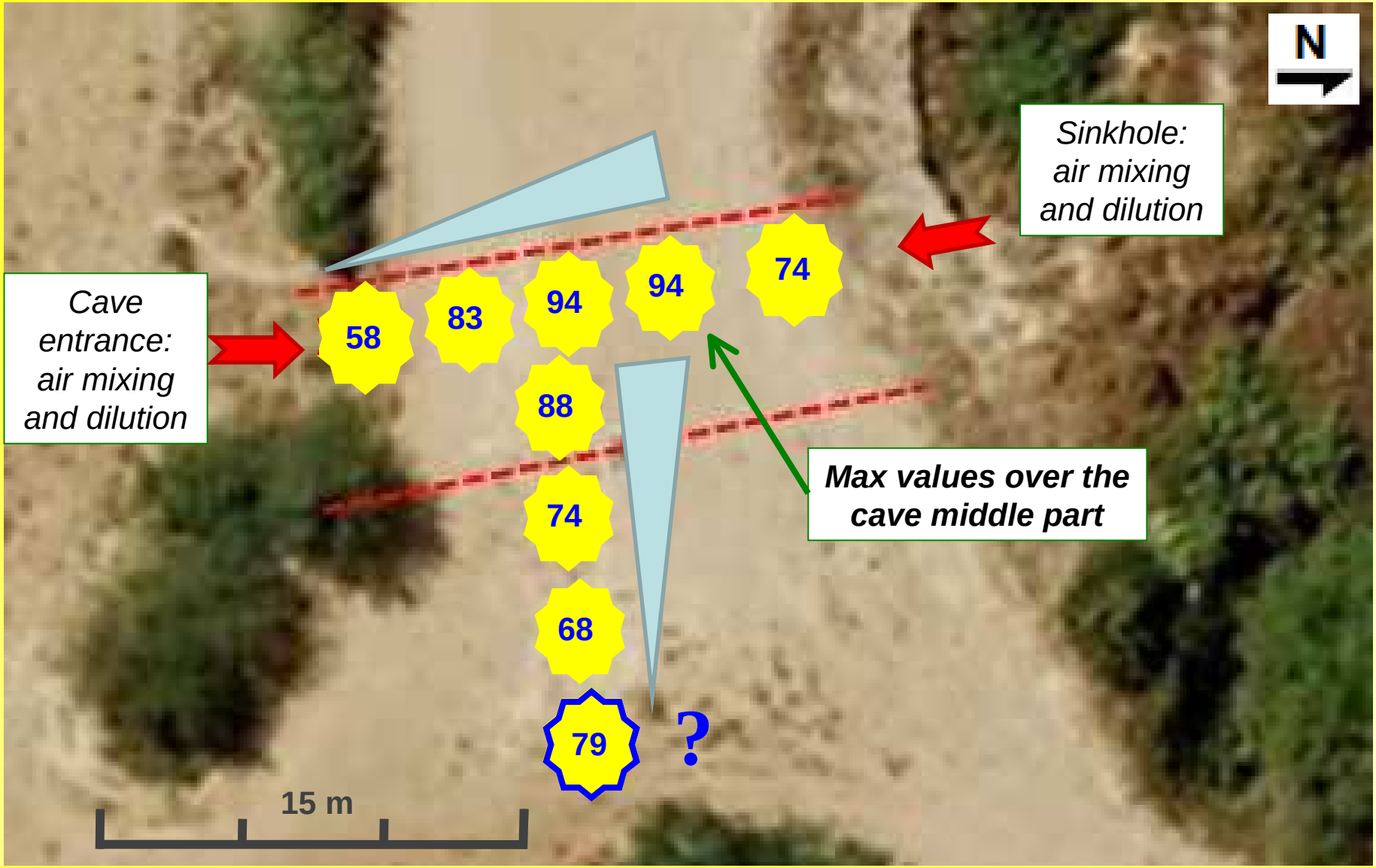

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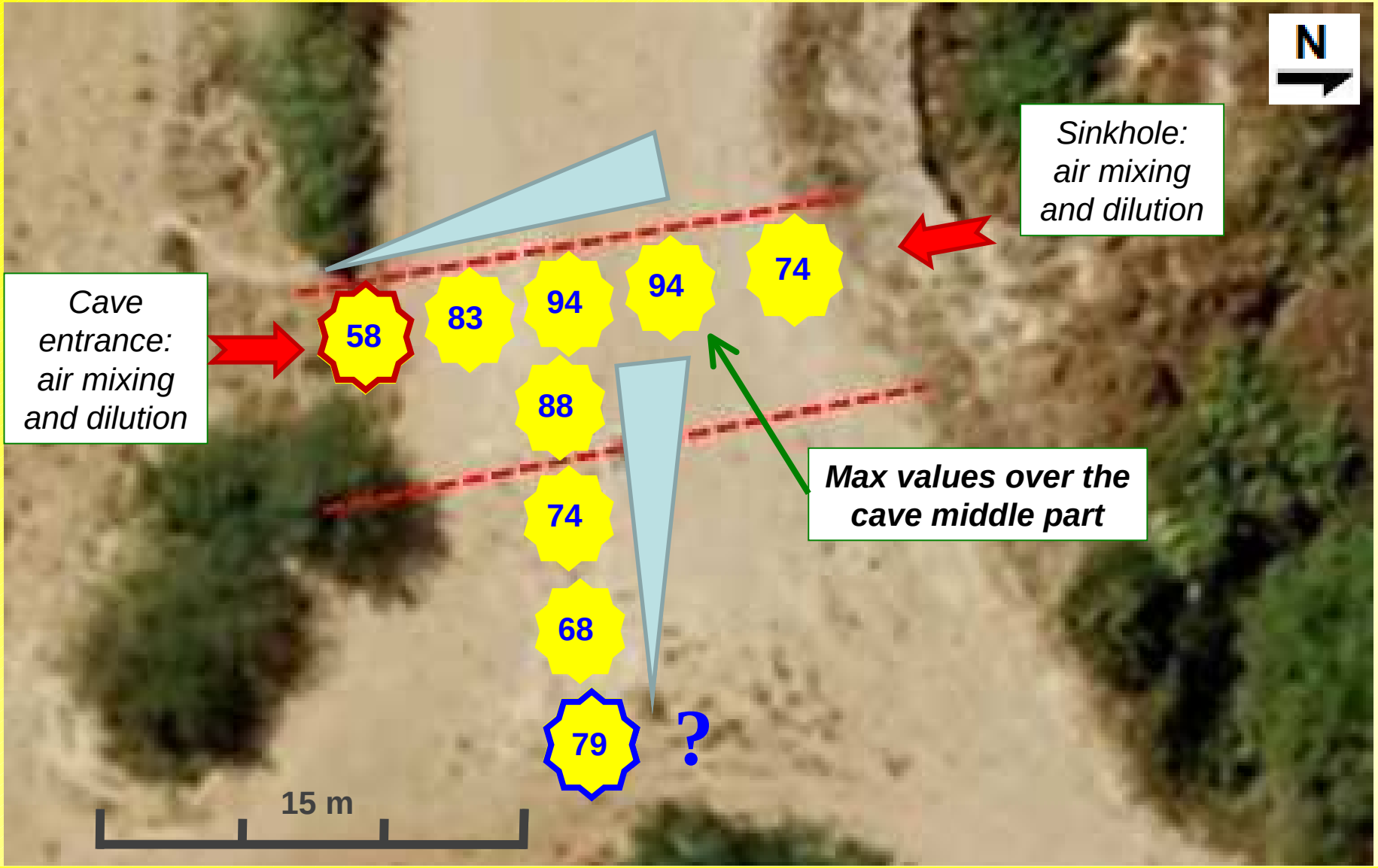
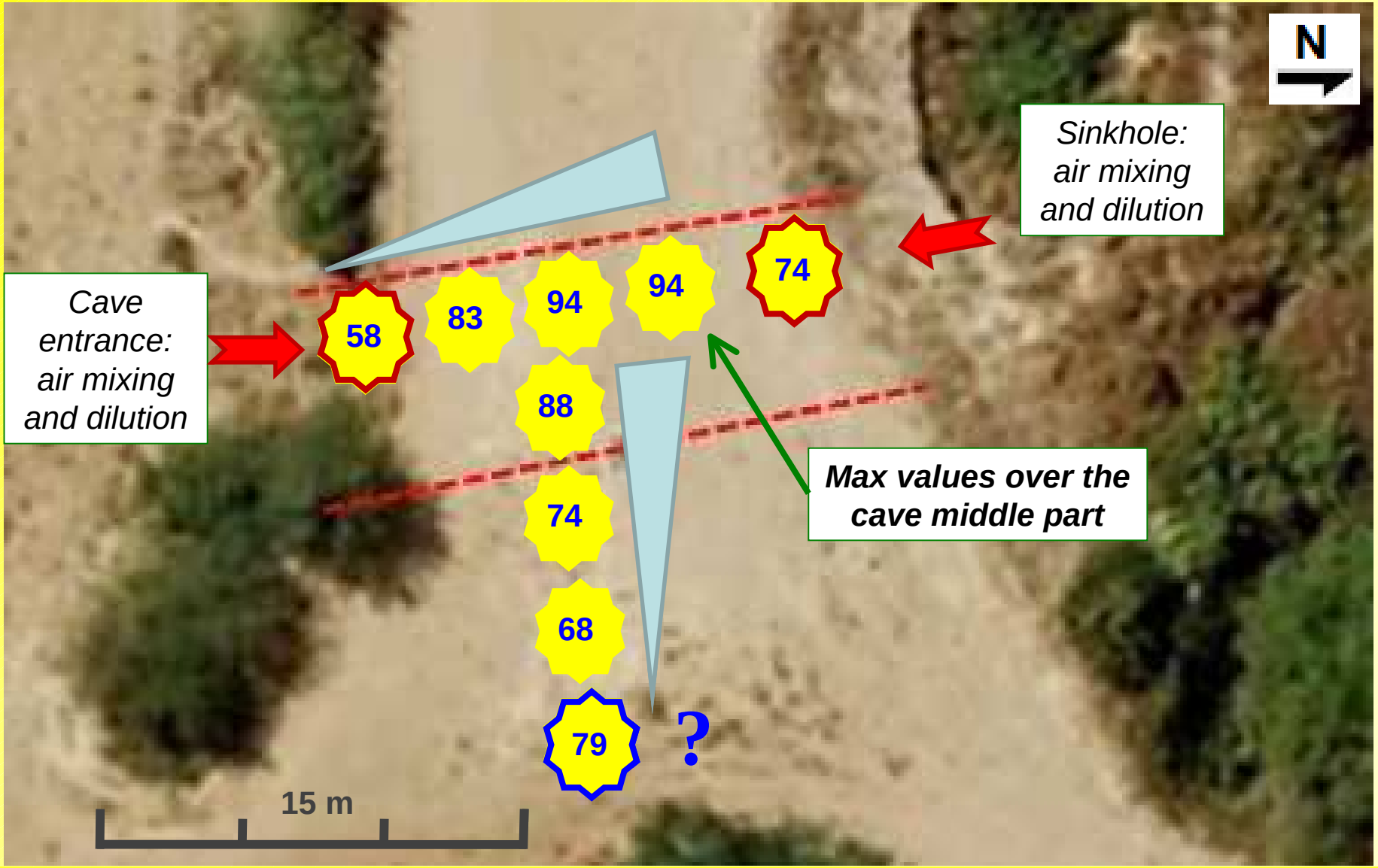


Valle della Caffarella cave – Soil Radon (kBq/m³)



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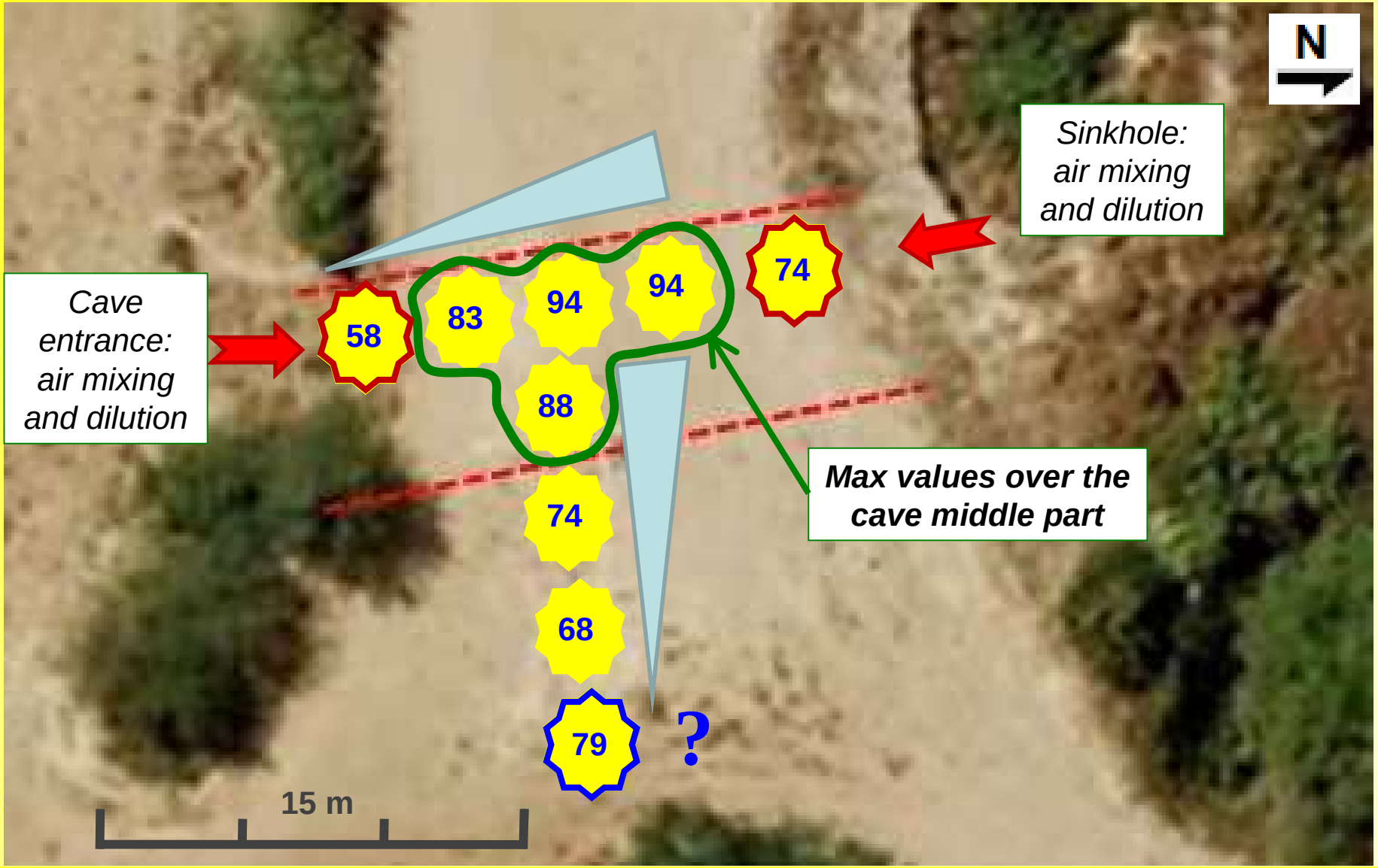


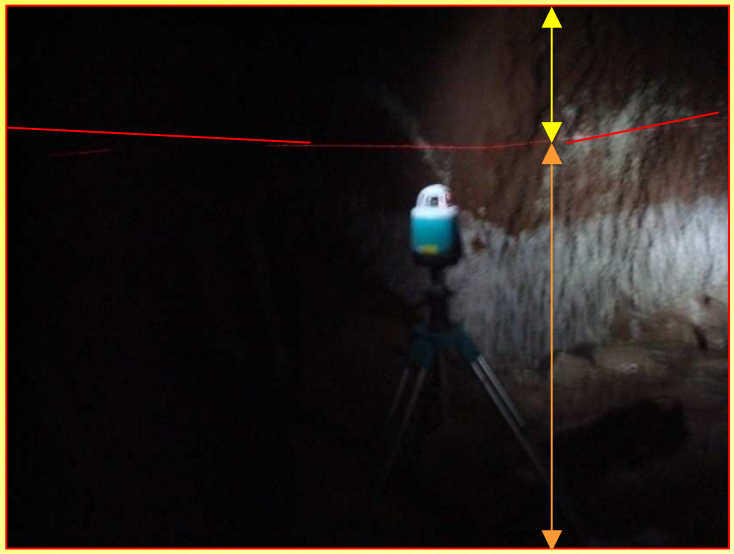
Conclusions

• Indoor ^{222}Rn and ^{220}Rn concentrations in the cavern depend on the distance from the cave entrance and from the temperature gradient between outside and inside air (changing throughout the year and addressing air flux direction whitin the cave)

• Shallow underground caverns supply extra ^{222}Rn to the soil gas sampled some metres on top. This supplementary fraction may enhance radon accumulation in indoor environments placed above, increasing the risk for inhabitants.

• Soil ^{220}Rn concentration on top of the cave is affected by low indoor thoron content inside the cave and is directly proportional to the rock thickness above the cave roof.

ACKNOWLEDGEMENTS



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