

Measurements of radon activity concentration in water springs in the Cosenza province. A possible regional protocol with reference to the D.Lgs. 15 February 2016, n.28.

(Misurazioni di concentrazioni di attività del gas Radon in acqua ad uso pubblico nella Provincia di Cosenza. Un possibile protocollo regionale ad adempimento del D.Lgs. 15 febbraio 2016, n.28.)

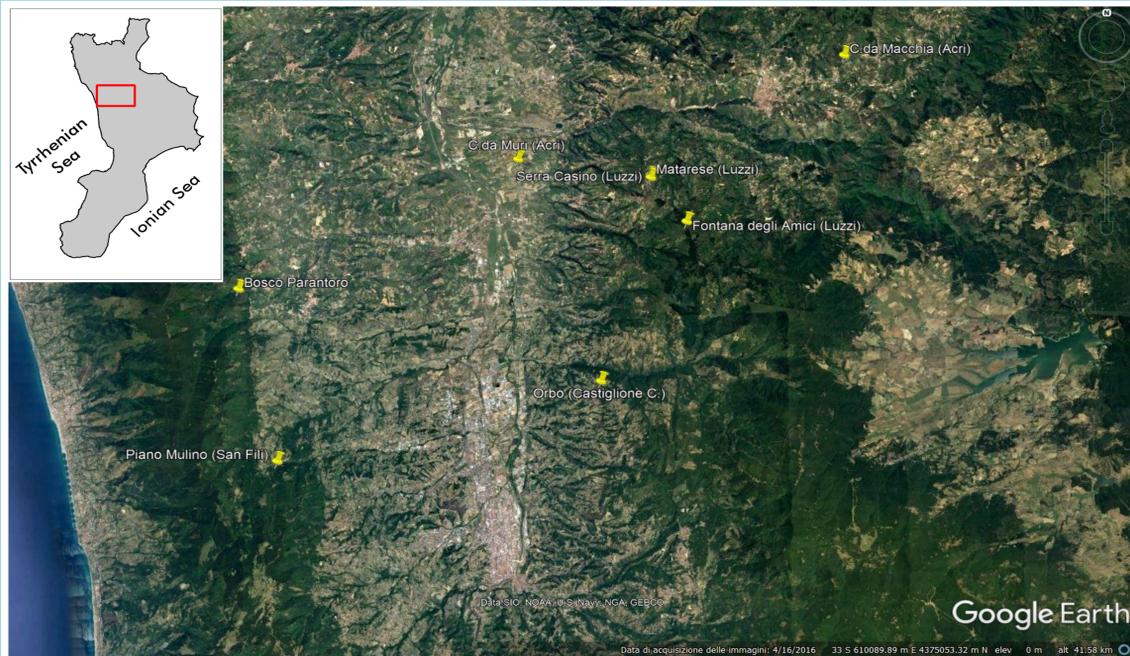
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Motivation

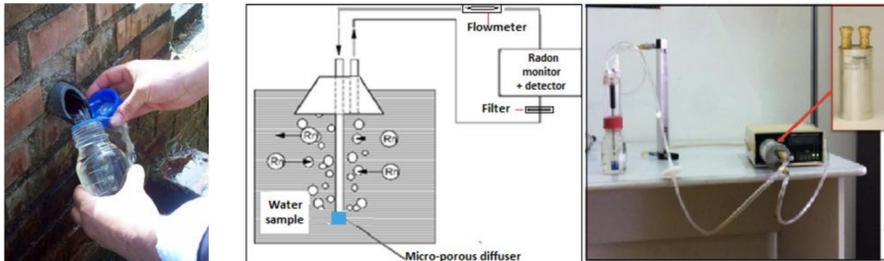
The Italian Law 28/2016 defines some criteria for people's health protection by radon gas and tritium in drinkable water following the directive EURATOM 2013/51. Radon is an alpha-emitting radioactive noble terrestrial gas; it is toxic, colourless, odourless and tasteless. Its main isotopes are ²²²Rn (called radon) and ²²⁰Rn (called thoron), belonging to the ²³⁸U and the ²³²Th series, respectively: their amounts depend on secular equilibrium of decay chains and on primary concentrations of uranium and thorium in parent materials. In general, the most important contribution is from inhaled ²²²Rn and descendants. Though, in some circumstances, exposure to natural radionuclides through drinking water could exceed acceptable levels, and then it becomes a hazard. Anomalously high concentrations of radon are commonly found in soils above highly fractured rocks, such as those associated with faults, active volcanoes and geothermal sources. Soil-gas radon amounts in soils are generally higher over sub-vertical geological structures than those over sub-horizontal ones. Since faults and fractures can act as preferential fluid-flow pathways, their locations can be assessed by detecting gases at surface. At this purpose, He and Rn proved to be the most reliable elements. In this study, geo-structural features and radon concentrations surveyed in the study area are analysed.

Location of water sources



Water sampling and radon measurements

- Collect at least three samples per measurement.
- Realize the measurements during colder and warmer season.
- The sampling technique can represent an increasing of 8-15% of uncertainty if the protocol is not well applied.



Radon measurement systems:

- RAD7 Radon Detector
- Pylon AB-5
- Gamma spectrometry

Preliminary results from the analyzed water sources

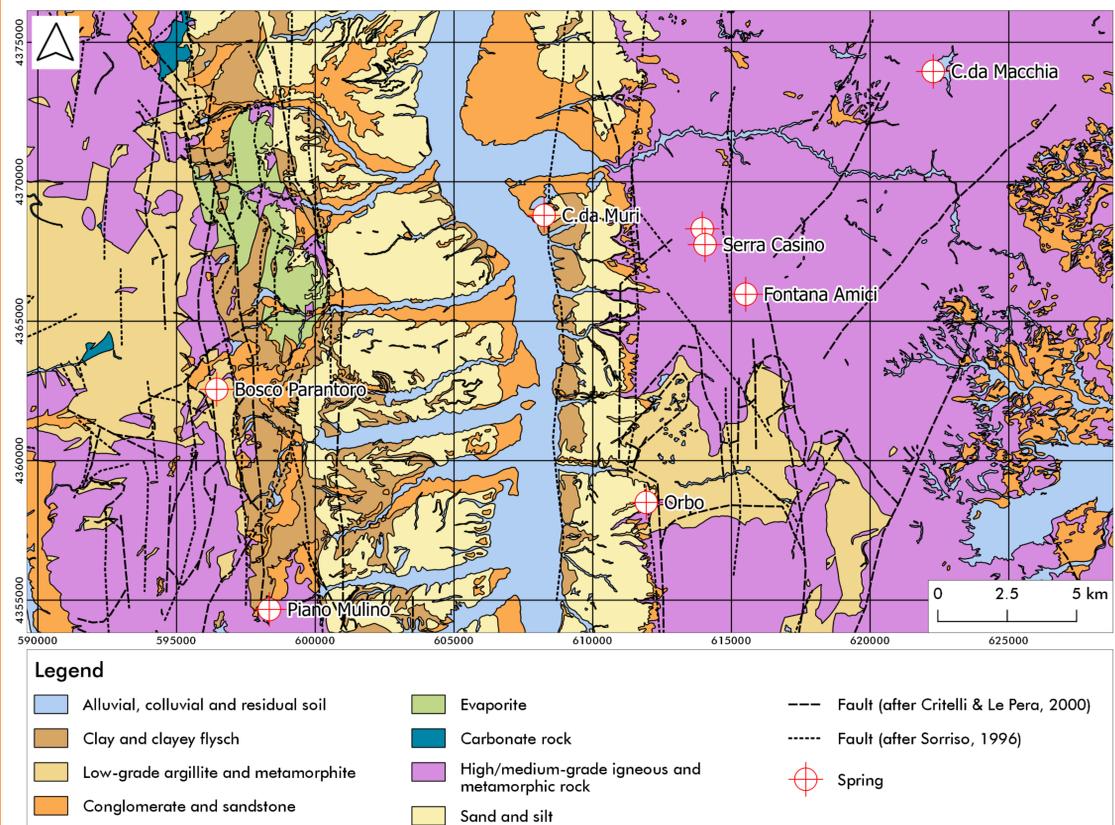
March to August 2015	February to August 2016	October 2016
H ₂ O Rn Kit + RAD7	Mi.am degassing system + Lucas Cell	Gamma spectrometry
62 ± 6% Bq/l	63 ± 6% Bq/l	60 ± 2% Bq/l

Orbo spring results show a good agreement between measurements and methods.

Gamma spectrometry detector provides smaller uncertainties and more information but requires at least three days for one measurement. Lucas cell is more appropriate for an extended campaign.

Source location	C_{Rn} [Bq/l]
Vurgano Schito	b.m.d.
Macchia	47 ± 4
Pertina	11 ± 1
Pompio	13 ± 1
Romana	8 ± 1
Castania	b.m.d.
Pime	b.m.d.
Pristini	140 ± 12
Orbo	63 ± 1
Mangeto	8 ± 1
Celico	b.m.d.
Settimo	12 ± 1
Parenti	11 ± 1
Qualata	24 ± 2
Versino	b.m.d.
Presila	9 ± 1
Fontana Lauro	172 ± 7

Geology of the study area



The study area is located in Northern Calabria, in the southern portion of the Crati graben. The geological basement of the graben, bounded by the horst of the Sila Massif on the east and the Coastal Chain on the west, is made of Palaeozoic units belonging to the Alpine and Hercynian Chains, including gneiss, schist, granite and granodiorite, and, subordinately, phyllite. Upon them, a thick cover of Miocene and Pliocene–Pleistocene deposits and Holocene sediments are to be found. The graben is filled by a thick series of marine and continental terrains, spanning from Miocene to Holocene. The neotectonic setting of the area is characterized by active and recent fault systems trending ca. N–S and WNW–ESE. N–S normal faults represent the main structures of the study area: they guided the sinking of the graben with respect to the Sila Massif (to the east) and the Coastal Chain (to the west). The WNW–ESE system is made of normal and left-lateral faults.

Conclusions

- A measurements campaign is underway on the eastern and western flanks of the graben.
- The sampling and measurement protocol is being refined.
- Geology and radon concentration show some correlations but further investigations are still needed.
- With reference to Law 28/2016, this study will help to draw up a plan of measurements in Calabria for proper regional screening.