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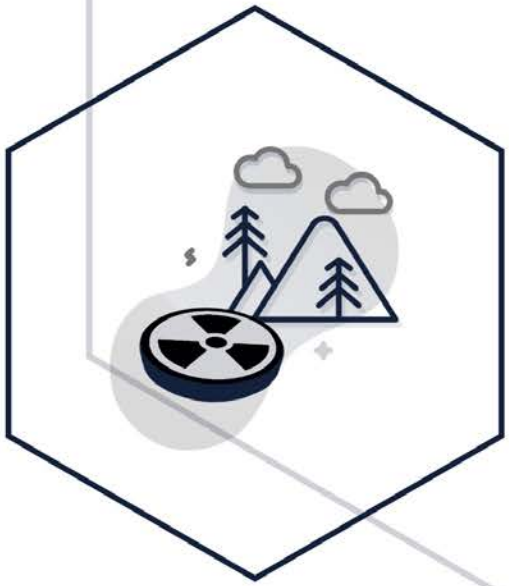

HANDBOOK OF EXPERIMENTS

SG6158E Environmental Radioactivity Outdoor

Geochemical and mineral exploration

Environmental radioactivity

EDUCATIONAL KIT

SP5640

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Geochemical and mineral exploration

Categories: CAEN Experiments, Environmental radioactivity | Tags: Gamma detection, Gamma rays, Nuclear Physics, γ Spectroscopy

Difficult	Execution Time	Data Analysis	Radioactive Sources
⛁ ⛁ ⛁ ⛁	⧖ ⧖ ⧖ ⧖ ⧖	Yes	No

Hardware setup

This experiment guide is referred to the **SP5640** educational kit.

Equipment: SP5640 – Backpack Detector

Model	**SP5640**
Description	Backpack Detector

Purpose of the experiment

Large area survey to evaluate the radioactivity concentration of Uranium, Thorium, and Potassium.

Fundamentals

A geochemical exploration campaign aims at locating economic mineral deposits through the recognition of concentrations of chemical components, to be called as geochemical anomaly, in surface materials such as rocks, soils, stream sediments, glacial till, water, plants, and air. The radiological characterization of surface soil, in terms of Uranium, Thorium and Potassium, proves to be also a good tool to direct excavations for mines. The main advantages of using in situ measurements are quick feedback, a large sample size, immediate repeatability of the measurement and low management costs. The areas with an enormous geodiversity have a considerable variety of stone materials that can be used both as building materials and as ornamental elements. This enormous variety also corresponds to considerable variability in the abundance of radionuclides. The world average radioactivity content in the upper continental crust is (33 ± 7) Bq/kg for ^{238}U, (43 ± 4) Bq/kg for ^{232}Th and (727 ± 60) Bq/kg for ^{40}K. Igneous plutonic rocks are characterized by relatively high concentrations of natural radionuclides varying over a wide range of up to 2000 Bq/kg for ^{40}K, 600 Bq/kg for ^{238}U and 900 Bq/kg for ^{232}Th.

Requirements

No other tool is needed.

Carrying out the experiment

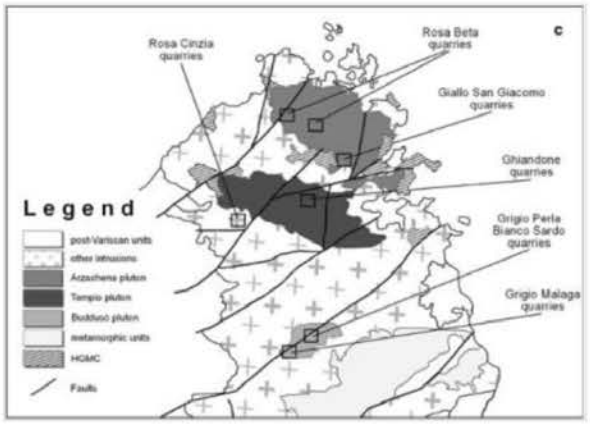
- Power on the *γ-stream* inside the red backpack.
- Power on the tablet and associate the two devices via Bluetooth.
- Take care that the γ-stream internal battery is charged, otherwise use the external power system.
- Start the measurement campaign in land field and place the backpack on the floor almost 1 m far from the trees, manhole or other construction.
- Set the acquisition time to about 5 minutes and see the results. If the statistic is not enough increasing the acquisition time.
- Repeat the measurements along the survey area.



Experimental setup block diagram.

Results

Exemplary of in situ survey performed by using a portable *NaI(Tl)* scintillation detector for the determination of the radioactivity concentration of ^{40}K, ^{238}U and ^{232}Th on intrusive granite outcrops in Corsica-Sardinia (FR-IT).



Position of extractive districts in Sardinia where in situ measurements were performed.

Granite Quarries	^{40}K [Bq/kg]	^{238}U [Bq/kg]	^{232}Th [Bq/kg]
Rosa Beta	1144 ± 120	42.3 ± 7.1	55.0 ± 6.3
Ghiandone	1092 ± 198	56.3 ± 12.7	68.9 ± 10.4
G. San Giacomo	1335 ± 206	50.1 ± 13.8	61.9 ±9.4
Rosa Cinzia	1313 ± 64	56.0 ± 6.8	69.4 ± 3.4
Grigio Malaga	848 ± 121	34.5 ± 4.6	61.1 ± 5.5
Grigio Perla	1222 ± 155	39.1 ±5.2	60.6 ±5.7
Bianco Sardo	1269 ±64	44.8 ±7.1	51.6 ±8.8

Activity concentration of ^{40}K, ^{238}U and ^{232}Th in situ measurements.

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