

B.3.9 Geochemical and mineral exploration

SG6158E



Dedicated kit	
Description	pp.
SP5640 GammaEDU	183



Requirements

No other tools are needed.

Difficulty	Execution Time	Data Analysis	Radioactive Sources
    	   	YES	NO

Equipment

SP5640 - Backpack Detector

Model	SP5640
Description	Backpack Detector



p. 183

Purpose of the experiment

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

See the
Application



Fundamentals

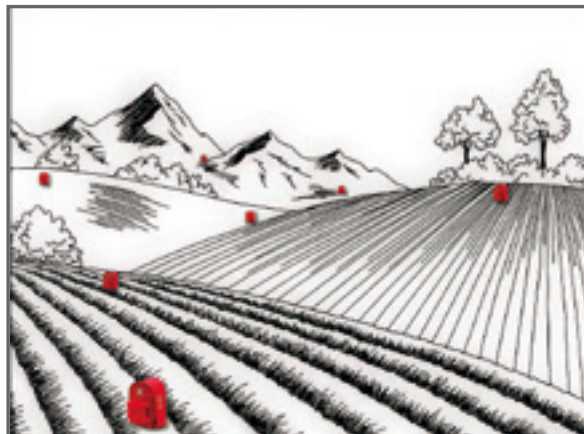
A geochemical exploration campaign aims at locating economic mineral deposits through the recognition of concentrations of chemical components, to be called as geochemical anomaly, in surface materials such as rocks, soils, stream sediments, glacial till, water, plants, and air. The radiological characterization 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 .

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 .

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 1m 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.

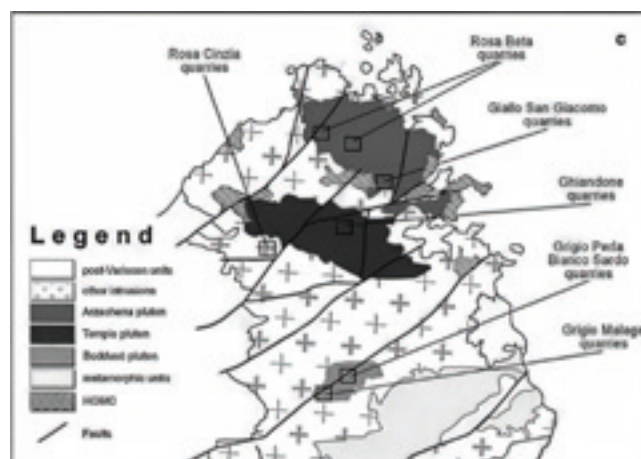


Experimental setup block diagram.

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) ().*

(*) Radiological characterization of granitoid outcrops and dimension stones of the Variscan Corsica-Sardinia Batholith, Puccini, A., Xhixha, G., Cuccuru, S., Oggiano, G., Xhixha, M. K., Mantovani, F., Alvarez, C. R., and Casini, L., Environmental Earth Sciences, 71, 393-405, (2014).



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.