

Natural gamma radioactivity in some Venezuelan cavities

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A portable differential gamma ray spectrometer with four active windows (Total, K, U and Th) was used to characterize the natural radioactivity in several cavities either natural or artificial, and with different bedrock types. The readings were taken inside the cavities and also outside as a reference. The localities selected are as:

Aroa Mines (Yaracuy St.): Three different tunnels were measured (Santa Barbara, Polvorín, San Antonio). The bedrock is schist and marble, but the ground is covered by thick deposits of bat guano.

Ricardo Zuloaga Cave (Miranda State). Bedrock is a Late Jurassic dolomitic marble. A thick bat guano deposit is present.

Pardillal Cave (Aragua State). With Paleocene limestone and also presents bat guano.

Santa Isabel Mines (Guárico State). Measurements were taken in two tunnels opened in metavolcanic rocks.

Old "Central Railroad" (Miranda State). Readings were taken along the route, outside and inside tunnels.

Summary of measurements (in counts per second)

Locality	Place	#	Dist. (m)	Total			k			u			th		
				Aver	Min.	Max.	Aver	Min.	Max.	Aver	Min.	Max.	Aver	Min.	Max.
Aroa,	inside	5	5	61.1	50.4	70.3	4.5	3.5	5.5	1.8	1.2	2.4	0.2	0.1	0.3
Sta. Bárbara	outside	4	5	32.4	30.4	35.2	2.3	2.3	3.5	1.0	0.5	1.3	0.3	0.1	0.5
Aroa,	inside	5	5	22.6	8.9	30.4	1.7	1.1	1.9	0.7	0.5	1.0	0.1	0.0	0.2
Polvorin	outside	4	10	31.1	29.1	32.3	2.2	2.0	2.5	0.8	0.7	0.8	0.2	0.0	0.4
Aroa,	inside	24	5	50.5	35.9	70.9	3.8	2.2	4.9	2.0	1.0	3.0	0.3	0.0	0.6
San Antonio	outside	7	5	31.8	26.0	36.4	2.6	1.8	3.2	1.0	0.5	1.3	0.3	0.1	0.6
Pardillal C.	inside	25	1	12.9	8.3	24.2	1.1	0.4	2.4	0.5	0.4	2.4	0.2	0.0	0.5
	outside	25	15	12.0	7.2	17.1	1.3	0.5	2.2	0.7	0.2	1.2	0.1	0.0	0.3
Central	inside	218	15	48.1	29.7	68.1	4.6	2.2	9.6	1.3	0.3	2.8	0.5	0.0	1.1
Railroad	outside	41	3	68.2	37.6	86.9	6.7	3.3	6.8	1.8	1.0	2.4	0.6	0.1	1.4
Ric. Zul. C.	S. del Arpa	61	3	41.3	15.9	55.6	3.1	1.5	4.8	1.6	0.6	2.7	0.2	0.0	0.4
Santa	tunnel 1	36	3	29.9	4.8	55.8	3.4	0.5	6.0	0.9	0.3	1.8	0.1	0.0	0.3
Isabel	tunnel 2	57	3	36.9	11.1	72.7	4.2	0.9	9.4	1.1	0.3	2.4	0.1	0.0	0.4

#: Number of measurements. Dist.: distance between readings.
total, k, u, th: Measurement windows for total, K, U y Th. Aver., min,
max: Average, minimum, maximum.

The effect of lithology is shown with largest cps in rocks containing mica and feldspar as in the Aroa tunnels with schist and marble, against lower values in the metavolcanics of Santa Isabel mines. Largest values are also detected in cavities with bat guano.

Carbonate minerals have low primary concentrations of K, U y Th, so they show low counts, but in caves with bat guano the radioactivity increases (Ricardo Zuloaga C. > Pardillal C.), due to the input of K, U y Th in the organic matter.

The geometric effect also is clearly seen, so been equal other parameters, the radioactivity is higher inside than outside.

Even with the relatively higher natural radioactivity inside cavities the values measured are low and present no danger for cavers.