

GEOCHEMISTRY AND FIELD RADIOMETRIC MEASUREMENTS OF NATURALLY OCCURRING RADIONUCLIDES IN SEVERAL LITHOLOGIES OF FORNOS DE ALGODRES AREA (CENTRAL PORTUGAL)



M.J. Trindade^(1,3), M.I. Prudêncio^(1,3), M.I. Dias^(1,3), C.I. Burbidge^(1,3), G. Cardoso^(1,3), R. Marques^(1,3), F. Rocha^(1,3)
 (1) IST/ITN, Universidade Técnica de Lisboa; (2) Dep. Geociências, Universidade de Aveiro; (3) GeoBioTec Research Center, Universidade de Aveiro

17-B : Fornos de Algodres

SAMPLING

- Schist-greywacke complex ("Grupo do Douro")
- Granite ("Granito da Muxagata")
- Granite + Aplite vein
- Aplite vein
- Dolerite vein

METHODS

- X-RAY DIFFRACTION (DRX) Mineralogy
- INST. NEUTRON ACTIVAT. ANAL. (INAA) Geochemistry (K, Th, U)
- FIELD GAMMA SPECTROMETRY (FGS) (K, Th, U)

INTRODUCTION / OBJECTIVES

The concentrations of natural radionuclides (K, Th, U) in rocks vary greatly as a function of lithology and other geological factors. Ionizing radiation and especially radon emission from decay of U, may have significant environmental impact.

This work presents natural radiogenic elemental distributions in various lithologies from the Sobral Pichorro area (Central Portugal), located in the Beira uraniferous province. The aim is to contribute to the compilation of data for evaluation of radon emanation from rocks in the national territory.

RESULTS

1. SCHIST-GREYWACKE COMPLEX

SCHIST-GREYWACKE COMPLEX

INAA	K (%)	Th (ppm)	U (ppm)
Min-Max	1.1 - 4.1	10 - 37	3.4 - 13.9
Average	2.8 ± 1.2	17.2 ± 13.2	7.0 ± 4.8

FGS	K (%)	Th (ppm)	U (ppm)
*1	2.4 ± 0.03	8.4 ± 0.79	3.3 ± 0.33
*2	1.9 ± 0.03	8.6 ± 0.8	3.2 ± 0.32

INAA / FGS

Quartz (Qz) - plagioclase (Pl) - K-feldspar (kF) - mica (M) - clay minerals (CM) - amphibole (A) - pyroxene (P) - magnetite (Mt)

2. GRANITE

3. GRANITE

GRANITE

INAA	K (%)	Th (ppm)	U (ppm)
Min-Max	1.4 - 4.2	10 - 19	3.1 - 28
Average	3.4 ± 1.1	15.4 ± 3.4	12.3 ± 9.2

FGS	K (%)	Th (ppm)	U (ppm)
*3	3.5 ± 0.04	12.2 ± 1.1	13.9 ± 1.3

DRX

Quartz (Qz) - plagioclase (Pl) - K-feldspar (kF) - mica (M) - clay minerals (CM)

3. APLITE VEIN

4. APLITE VEIN

APLITE

INAA	K (%)	Th (ppm)	U (ppm)
Min-Max	2.6 - 7.3	5.7 - 30.1	4.5 - 62.8
Average	4.6 ± 1.5	13.2 ± 8.0	26.1 ± 23.7

FGS	K (%)	Th (ppm)	U (ppm)
*4	3.7 ± 0.04	13.4 ± 1.2	18.5 ± 1.7
*5	2.8 ± 0.03	9.0 ± 0.84	10 ± 0.93
*6	2.1 ± 0.03	7.1 ± 0.67	12.1 ± 1.1

DRX

Quartz (Qz) - K-feldspar (kF) - plagioclase (Pl) - mica (M) - clay minerals (CM)

5. DOLERITE VEIN

DOLERITE

INAA	K (%)	Th (ppm)	U (ppm)
Min-Max	1.4 - 5.2	3.5 - 25.7	1.2 - 33.2
Average	2.4 ± 1.5	10 ± 8.7	10.8 ± 9.8

FGS	K (%)	Th (ppm)	U (ppm)
*7	1.3 ± 0.02	4.6 ± 0.44	1.8 ± 0.19
*8	1.3 ± 0.02	5.8 ± 0.55	1.7 ± 0.18
*9	2.2 ± 0.03	12.4 ± 1.1	3.0 ± 0.3

DRX

SOIL: Quartz - K-feldspar - plagioclase - mica - clay minerals (CM)
 SEDIMENT: Clay minerals (smectite-Sm, talc-Tc, serpentinite-Sp, mica-M) - plagioclase (Pl) - K-feldspar (kF) - Quartz (Qz) - ankerite (Ank) - magnetite (Mt)

SOME CONCLUSIONS

- Beyond a slight enrichment in clay minerals towards the top, no significant mineralogical differences were found in the clay-rich sediments below the topsoil.
- The soil samples have higher amounts of quartz and feldspars, even the soil above dolerite veins, suggesting a distinct source area for detrital components of the soil.
- INAA and FGS results were commonly similar, despite spatial variability evident in the INAA results. Slightly lower values from the field measurements are related to in situ water. Occasional large differences in values for uranium are indicative of radon loss (INAA measures the U; FGS measures its post-radon daughters).
- The concentrations of natural radionuclides in the studied area are highly variable; in general higher than average upper continental crust values, UCC (K₂O = 2.8 %, Th = 10.5 ppm and U = 2.7 ppm, Rudnick and Gao, 2003).
- The soil samples of the various lithologies show higher concentrations of Th and K than the sediments below, which in association with the higher amount of sand fraction, suggest that the soils were not fully developed in situ; abundant detrital components came probably from a different weathered source area, most likely granites.
- In general, the clay-rich sediments have higher U contents than the soils, and frequently are considerably enriched in U. The highest concentrations of U were found in one aplite vein, with a U concentration about 20 times UCC. Therefore, the aplite has higher potential to release radon that can have environmental impact.