Radiogenic elements in soils from Fogo island (Cape Verde)

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Volcanic soils of Fogo Island (Cape Verde) are fertile and currently used for the cultivation of vineyard, apple, beans, corn and other vegetables. Their contents of the radiogenic elements K, Th and U are being analyzed as part of a project to establish an environmental geochemical atlas of Cape Verde. Radiogenic elements in soils may have an important environmental and health impact, either by the production and emission of ionizing radiation, radon emission or inclusion in food chain through the agricultural activity.

18 soils collected in diverse geological formations of the Fogo Island (carbonatite, nephelinite, pyroclasts and historic lavas), were selected for geochemical study. The present work reports the results of K, Th and U contents obtained from soils and bedrock by instrumental neutron activation analysis (INAA), and gamma spectrometry of non-activated material in the laboratory (HRGS) and in the field (FGS). INAA was used to determine concentrations of 30 major and trace elements for whole samples (< 2 mm). Irradiations of milled samples and standards were made in the core grid of the Portuguese Research Reactor (ITN, Sacavém) for 6 hours. HRGS measurements were made on c. 100 g samples of un-milled sample material using a 40% efficiency cooled HPGe detector. FGS measurements were made at the points of sampling using a HPI Rainbow MCA with 3"x3" NaI probe.

Concentrations of the studied radiogenic elements varied significantly among samples: K = 0.2-2.2%, Th = 4.4-10.7 ppm, and U = 0.7-4.0 ppm. These contents are mostly below the average values estimated for the upper continental crust (K=2.8%, Th=10.7 ppm, U= 2.8 ppm) [1]. Concentrations of the studied elements varied according to geological formation. The highest contents of K were found in soils developed in the more recent lavas and pyroclasts, and the lowest levels in nephelinite soils (pre-caldeira formation). In the soils developed on historic lavas, the measured U contents using FGS in situ were higher than those determined by INAA in the laboratory. In the nephelinite soils (pre-caldera formation) U from FGS was lower but K was higher than from INAA. Tho-

rium was the more consistent in the studied topsoils, regardless the geological formation. The soil developed in the carbonatite is the exception, where the highest levels of Th and also U were found. The observed variations may be explained by chemical and/or physical weathering processes, such as U and/or K leaching and concentration, or deflation/accumulation of weathering products.

References

[1] Rudnick, R.L.; Gao, S. 2003. Composition of the Continental Crust. Treatise on Geochemistry, Vol. 3. Ed: R.L. Rudnick. Elsevier. 1-64.

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