Magnetic susceptibility of sands from a river beach for forensic applications

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Soil studies are often undertaken in forensic investigation because its particles are normally tranferred to the surfaces in contact with them, providing important information. Soil is composed by organic and inorganic materials and its history is reflected in its bio-physicochemical characteristics, including low-field magnetic susceptibility (MS). MS is defined as the ratio of the material magnetization (per unit mass) to the weak external magnetic field, and in soils, it is directly proportional to the quantity, composition and grain size of minerals in the sample (which can be diamagnetic, paramagnetic or ferromagnetic species).

In order to investigate the variability of this property in Areinho, a fluvial river beach in Porto region (Northern Portugal), twenty four samples were collected along a transect perpendicular to the river side and prepared for magnetic susceptibility analysis. MS was measured on 1g of dry bulk samples, applying them an external magnetic field of 300 A/m, and a Kappabridge model KLY4S of Agico balance equipped with the Sumean software was used. Before each measurement the equipment was calibrated. The MS of Areinho sands is low with values ranging between $0.68x10^{-8}m^3/Kg$ and $18.09x10^{-8}m^3/Kg$ which is an agreement with its mineralogical composition. All measurement results were reproducible. From this study we conclude that MS protocol is suitable for the analysis of sands with the advantage of being fast and non-destructive.

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Radionuclides in uranium milling tailings and environment remediation

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The environmental and public health risks posed by legacy uranium mine sites and milling tailings in Portugal was assessed in order to allow for decision making regarding environmental remediation and for radiological protection measures of the population.

Most of old uranium mine sites did not pose noticeable ionizing radiation and contamination risks to the environment and population, especially the sites operated as open pits and without *in situ* chemical operations. The mines where *in situ* ore leaching with sulfuric acid was operated and the ore milling tailings are the sites with higher ambient radioactivity and contamination with radioactive and stable metals [1]. Over some waste piles the radiation dose attained 30 mSv y^{-1}, higher than the annual limit for members of the public, 1 mSv y^{-1}. Confinement and coverage of these uranium waste piles was necessary and allowed for reducing radon exhalation, dispersal of radioactive materials in soils, and abatement of surface runoff and radionuclide leaching with acid drainage. *in situ* formation of H_2SO_4 in waste piles still generates radioactive leachates in underground mines and in milling tailings that require continued treatment. Irrigation of agriculture plots in the mine areas with mine drainage and water from contaminated wells is the main pathway to transfer radionuclides, especially ^{226}Ra, into locally grown vegetables and into the food chain [1,2].

Milling tailings with high radioactivity must be confined to reduce dispersion of radionuclides and exposure of biota and the public. Water from rivers that received past discharges of acid mine drainage have contaminated sediments that may require removal. Mine drainage and underground waters in the area of former mines shall be monitored to avoid exposure of the public to acid, metals and radionuclides. Withouth suitable monitoring and abatement measures, radiological exposure of members of the public may be many times about radiation exposure legal limits.

[1] FP Carvalho, J M Oliveira, I Lopes, A Batista, *J Environ Radioactivity* **98**(2007)*:298-31*. [2] FP Carvalho, JM Oliveira, M Malta, *J Radional Nuc Chemistry* **281** (2009)*:479-484*.