Derivation of soil screening levels (SSLs) for uranium

[a,b]Caetano A L, [a,b]Gavina C, [c] Carvalho F P, [d]Sousa J P, [a,b]Gonçalves F, [e]Ferreira da Silva E, [f,b]Pereira

For decades Portugal had in mining exploration one of its main economic incomes, particularly with radioactive metals, radio salts, uranium and wolfram. Due to its considerable representation in the country and importance in industry of nuclear energy production, the uranium exploration has occurred at large-scale during most of the last century in our country, which for some times was ranked as a main producer. Nowadays all the national uranium mines are closed, however, the accumulation of tons of waste with a high toxicity level resulting from the exploration and treatment of the uranium ore are inducing serious aquatic and soil contamination problems, thus compromising the environment quality and therefore the general public health.

To identify and regulate the management of contaminated land with metals, many countries have adopted generic quality standards, the soil screening values (SSVs). SSVs are concentration thresholds above which certain actions are recommended or enforced, to guarantee a level of protection to terrestrial species and ecological functions of the soil, being particularly useful for the first tier of Ecological Risk Assessment (ERA). In case of Portugal, SSVs have never been established for any metal or other organic contaminant, to fill this gap was objective of this work deriving uranium SSVs for national assessments of contaminated sites. Hence, a Portuguese natural soil (PTRS1), representing one of the dominant types of soil from granitic regions (cambisol), was characterized in physico-chemical terms and the functions of the soil using the habitat performance of invertebrate (Eisenia andrei, Folsomia candida, Enchytraeus crypticus) and plants species (Avena sativa, Lycopersicon esculentum, Zea mays, Lycopersicon esculentum) was also tested.

After this deep characterization, the soil was used to perform sub-lethal ecotoxicological tests with the same species of invertebrates and plants aimed at deriving NOEC, LOEC, EC20 and EC50 values for uranium. Eisenia andrei proved to be less sensitive than Folsomia candida to uranium contamination. For plants, since concentrations till 1000 mg kg^{-1} were tested, we can say that uranium does not yield a toxic effect in the endpoints evaluated in these species.

[a] *Department of Biology, University of Aveiro, Campus Universitário de Santiago 3810-193 Aveiro, Portugal (ana.caetano@ua.pt)*
[b] *CESAM, University of Aveiro. Campus Universitário de Santiago. 3810-193 Aveiro. Portugal*
[c] *Nuclear and Technological Institute (ITN) Department of Radiological Protection and Nuclear Safety 2686-953 Sacavém, Portugal*
[d] *IMAR-CMA, Department of Life Sciences, University of Coimbra 3004-517 Coimbra, Portugal*
[e] *Department of Geosciences, University of Aveiro, GeoBioTec Research Center, Campus Universitário de Santiago, 3810-193 Aveiro, Portugal*
[f] *Department of Biology of the Sciences Faculty at the University of Porto. Rua do Campo Alegre, 4169-007 Porto, Portugal*