

Environmental distribution and cycling of radionuclides from legacy uranium mine wastes in the Sortelha valley, near Sabugal, Portugal

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uring the 20th century four uranium mines were exploited near Sortelha, in the county of Sabugal, centre of Portugal. All the uranium mineralizations extracted were aligned in NNE-SSW fractures along the valley. The most extended were the Mine of Vale de Arca and Mine of Bica, both extracted by underground works, while Carrasca and Pedreiros also underground were smaller mines. Sulphuric acid was used in the Bica Mine for uranium in situ leaching in underground extraction. Mine drainage and surface runoff with sandy materials from the waste piles are carried down the valley by two water streams that merge further downstream into a larger river, Zêzere River, a main water supply for the region. Uranium mine operations ceased in the 1980s, and till present a water treatment station has been operated in the Bica Mine facilities to neutralize acid and radioactive mine drainage pumped from the underground mine. The radioactive water treatment sludge is dumped nearby on surface. Uranium series radionuclides particularly the alpha emitters were determined in the mine waste from waste piles, in mine water, water and sediments from the surface streams, and in soil and agriculture products from agricultural

areas near the villages in the valley, in order to assess the dispersal of radionuclides from the legacy waste piles and the radiological risk to the population. The concentrations of radionuclides in the waste piles are very high, and left uncovered have the potential to further spread contamination into streams and soils. Determination of radionuclide concentrations of the uranium series, including uranium, thorium, radium, lead and polonium in stream sediments and water are reported and discussed. Several irrigation wells near the Bica Mine showed enhanced radionuclide concentrations and the water is not suitable for human and animal consumption. Preventing radionuclide leaching from the respective waste heaps by e.g. capping may make the waters useable eventually. However, in the long run, mining wastes and sludge from mine water treatment, especially at the Bica Mine, should be capped in order to stop their weathering and ensuing leaching of radionuclides into the environment.

Key words: Uranium, thorium, radium-226, lead-210, polonium-210, sea water, residence times.

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