Radionuclide activities in groundwater from Mesozoic sedimentary rocks of Central Portugal – a preliminary dose assessment

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The Portuguese continental territory bedrock is composed by rocks integrated in the Hercynian Massif, mostly granites and metasediments, with sedimentary meso-cenozoic rocks outcropping on its western border. Several studies on radionuclide transfer were already carried out in the Hercynian Massif, namely for ^{222}Rn, ^{226}Ra, ^{234}U and ^{238}U, but information for the marginal sedimentary basins is scarse. An uranium prospecting campaign carried out during the second half of the XX century showed high variability in the U content of groundwater, with an average value of 1.5 ppb and a maximum of 152 ppb. The highest values were found spatially clustered in areas with bedrock that ranges in age from Triassic to Upper Jurassic and Cretaceous.

With the purpose to characterize the groundwater that percolates meso-cenozoic sedimentary formations, and estimate the dose for exposure to ionizing radiation, 91 samples were collected in areas where the early studies showed the occurrence of unusual U contents. Samples were analysed by liquid scintillation counting techniques, and the activity of ^{222}Rn, ^{226}Ra, ^{234}U and ^{238}U was measured.

The maximum ^{222}Rn activity observed was 92 Bq.l-1 and the minimum under the technique's detection limit (0.01 Bq.l^{-1}); the average was 15.4 Bq.l^{-1} and the median 8.9 Bq.l^{-1}. These values are considerably lower than those measured in water that percolates rocks from the Hercynian Massif, where values over 100 Bq.l^{-1} often occur. 226Ra activity varies from below the detection limit (0,01 Bq.l^{-1}) up to a maximum of 0.6 Bq.l^{-1}, with an average of 0.06 Bq.l^{-1} and median of 0.03 Bq.l^{-1}, following a trend similar to that observed for the pre-mesozoic rocks.

The uranium isotopes show the highest variability in the sample set, ranging in the case of the 238U isotope from under than the detection limit (0.01 Bq.l^{-1}) up to 20.8 Bq.l^{-1}, corresponding the later to a uranium concentration of 1678 ppb. This high variability is expressed in the difference between the estimated average and the median (5.1 and 37.9 ppb, respectively, for total U). Around 25% of the samples have concentrations higher than 20 ppb (WHO action limit for drinking waters). Thus, we can conclude that ura-

nium enriched water seems to be more common in the sedimentary rocks of the western border than in the Hercynian Massif.

From radioisotopes activities a preliminary dose assessment was performed for different age-group of the population, assuming daily water consumption variable between 0.7 to 2 liter and using appropriate dose-activity conversion factors. Using the median as an estimator of central tendency, the calculated doses varies between 0.01 up to 0.05 mSv.year^{-1}, well under the national legislation limit; however, for the most enriched uranium samples, the calculated dose can be higher than the limit, with a maximum dose of 4.47 mSv.year^{-1}.

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