

Radiological legacy of uranium mining – the case study of Caldas, Minas Gerais, Brazil

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The Brazilian uranium mine of Caldas, Minas Gerais, has produced 1,030 tons of uranium, during twenty years of operation, from 1977 to 1997. Actually, the mine and the mill are deactivated and the decommissioning process is in course. The total mass of ore tailings produced is equal to 108,164,248 tons and the mass of milling solid waste is equal to 2,395,821 tons. The ore tailings are distributed through several piles placed near the mine pit and the milling wastes are deposited in the waste dam. The mine pit and two of the tailing piles generate acid water which requires treatment before the environmental standards are achieved and the water is liberated to the environment. The waste dam also liberates treated water to the environment.

This work presents data, discussions and main conclusions of radiological monitoring of the water liberated by Caldas uranium mine to the environment during the 2013. The complete annual environmental monitoring program requires 1,689 surface water samples; 39 underground water samples; 17 sediment samples; 5 soil samples; 7 farm products and fish samples; and 1,728 direct measurements of pH, temperature, dissolved oxygen, turbidity and salinity. The chemical parameters determined in water samples are: Mg^{2+} , Ca^{2+} , Cr^{n+} , Cu^{n+} , Ni^{2+} , Zn^{2+} , Ba^{2+} , Mn^{n+} , Fe^{n+} , Al^{3+} , SiO_2 , SO_4^{2-} , F^- , Na^+ , K^+ , P , Cl^- , NO_3^{2-} , and N . The radionuclides determined in all samples are: U-238, Th-230, Ra-226, Pb-210, Th-232 and Ra-228. All of the Caldas uranium mine environmental monitoring results will be presented in the INB annual report of the year 2013.

The maximum permissible concentrations of radionuclides in the liquid effluents were determined considering the maximum annual dose constraint of the optimization process for members of the public, which is equal to 0.3 mSv per year. According to the monitoring results of year 2013, the increase in the annual dose of the individual of the critical group is approximately equal to 0.3 mSv per year, which means that it is below the annual public dose limit equal to 1 mSv per year. The higher monitoring results are due to the leakage directly into the environment of untreated acid water from one of the tailing piles, the tailing pile number 4. Corrective measures are been taken in order to mitigate the environmental impacts of Caldas uranium mine.