ENVIRONMENTAL RADIOLOGICAL MONITORING AROUND URANIUM MINING AND MILLING SITES IN ARGENTINA

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ABSTRACT

Uranium mining and milling development in Argentina started early in the 50´s. Initial exploitation was carried out in underground mines, but, since 1978, open pit mining is the main production process. Environmental monitoring in the vicinity of uranium mills is performed on a routine basis. Natural uranium and radium-226 concentrations in surface waters are measured in grab samples taken at selected points up stream and down stream, in the area of influence of the mining and milling facilities. In addition, radon-222 emanation rates from ore tailings are measured. Up to date, no significant exposure results for the population living in the surrounding areas.

INTRODUCTION

Uranium industry began its development in Argentina in 1950. Since then, several installations have operated in uranium underground mining until the late 70´s, when mines were closed and open pit exploitation was initiated. Milling plants were installed in the mining areas or nearby.

The waste sources at the mills include: a) barren acid liquors which have been stripped of uranium. These liquors were initially discharged to river waters. Nowadays, they are neutralized and piped to large evaporation and seepage ponds. When the evaporation process is not effective enough, the neutralized liquors are discharged to river waters after passing through small holding ponds; b) Ore tailings from the acid-leach process which are deposited at large tailing ponds located some distance from the milling plants and from the water bodies.

In order to assess the possibility of significant environmental contamination by uranium-mill wastes, routine studies of the dissolved radium-226 and natural uranium concentrations in surface waters up stream and down stream from the plants are being conducted. In addition, radon-222 emanation rates from ore tailings are measured at times.

ENVIRONMENTAL MONITORING PROGRAM

The uranium mining and milling areas included in the environmental monitoring program are the following: Don Otto, in the province of Salta; Los Adobes, in the province of Chubut; San Rafael and MalargÜe, in the province of Mendoza; Los Gigantes, in

the province of Córdoba; and La Estela, in the province of San Luis. Figure 1 shows their geographical location.

Water samples are taken from river locations up stream and down stream from uranium mills, according to a special monitoring plan set up for each one of them. The period of exploitation, the annual production of "yellow-cake", the number of sampling points and the number of water samples for each installation are shown in Table 1.

As an example, Figure 2 presents the monitoring area corresponding to the vicinity of the San Rafael mining and milling plant. Water monitoring points are situated at about 10 km, 50 km and 80 km up stream and down stream from the plant. Samples are taken from rivers flowing through the surroundings of the mining and milling area, as well as from streams which they join afterwards. Samples from plant areas are also taken. The location of the sampling points allows the comparison of radium-226 and natural uranium concentrations above and below the plant, providing estimations of the extent and magnitude of water contamination, if there is any.

Dissolved radium-226 in water samples is analysed by the radon emanation technique, while natural uranium concentration is measured by fluorometric procedures [1]. Radon-222 emanation rate from ore tailings is determined by the technique described by Countess [2]. Since 1988, gross alpha counting, using ZnS(Ag) as a detector, is performed on water samples. Only those samples exceeding 70 mBq/l of gross alpha activity are selected for radium-226 analysis.

PRESENTATION OF DATA AND CONCLUSIONS

Figures 3 and 4 show the range of values of radium-226 and the maximum natural uranium concentrations measured in water samples from sampling points located at the San Rafael plant, since 1980. The corresponding ranges of values obtained for all uranium sites, compared with derived limits for drinking water applied in Argentina [3], are presented in Figures 5 and 6. Results before 1980 present a similar pattern [4].

Table 2 shows the radon-222 emanation rates measured at each location. A preliminary evaluation of these results has been presented previously [5].

The application of the statistical test of Wilcoxon [6] demonstrated that no significant difference in the radium-226 and natural uranium concentrations was found between the surface water samples from river locations above and below the milling plants. Besides, the results obtained are well below the derived limits for drinking water. Therefore, it may be concluded that no remarkable exposure occurs for the population living in the vicinity of these areas.

REFERENCES

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5. Ciallella, H.E. et al., 1988, Radon Emanation Measurements from Uranium Ore Tailings in Argentina, 7th. Int. Congress of I.R.P.A., Sydney, Vol. 1, 373-376.
6. Conover, W.J., Practical Non Parametric Statistics, 1985, Edited By J. Wiley & Sons, 215-216.

TABLE 1

Mininig and/or Milling sites	Exploitation period (year)	Average anual production of yellow-cake (tons)	Sample points	Number of samples (Ra226+U)
Don Otto	1955-1981	23	45	95
Los Adobes	1977-1981	25	28	110
San Rafael	1980-1990	57	24	200
Malargue	1955-1986	50	33	120
Los Gigantes	1982-1990	25	17	170
La Estela	1982-1991	4	16	100

TABLE 2

Measuments of Rn-222 emanation rate from uranium ore tailings		
Mining and/or Milling sites	Period (year)	Emanation rate (Bq/m2.s)
Don Otto	1984-1986	20-43
Los Adobes	1984-1986	3-8
San Rafael	1983-1986	8-12
Malargue	1984-1987	6-12
Los Gigantes	1985-1986	<1
La Estela	1986	11

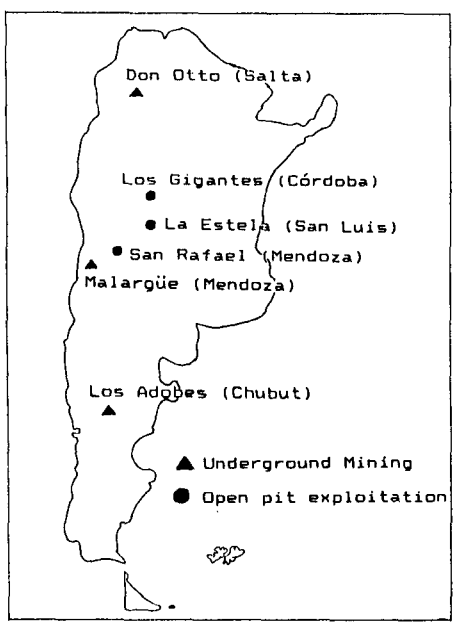

FIGURE 1: Uranium mining and milling sites in Argentina.

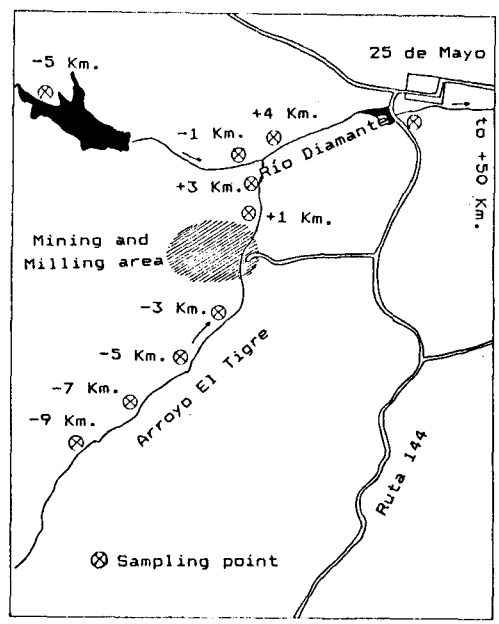

FIGURE 2: San Rafael (Mendoza). Uranium mining and milling area. Sampling points.

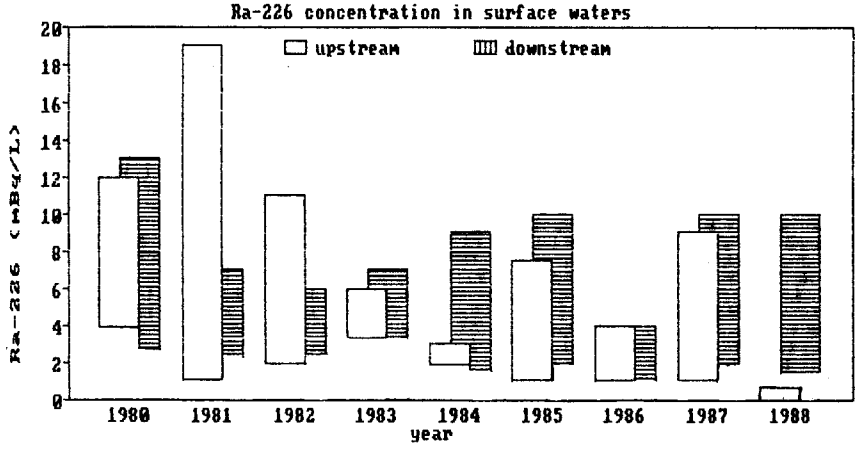

Figure 3: Range of values ((10 Km. upstream and (50 Km. downstream from the discharge point) in San Rafael plant (Mendoza)

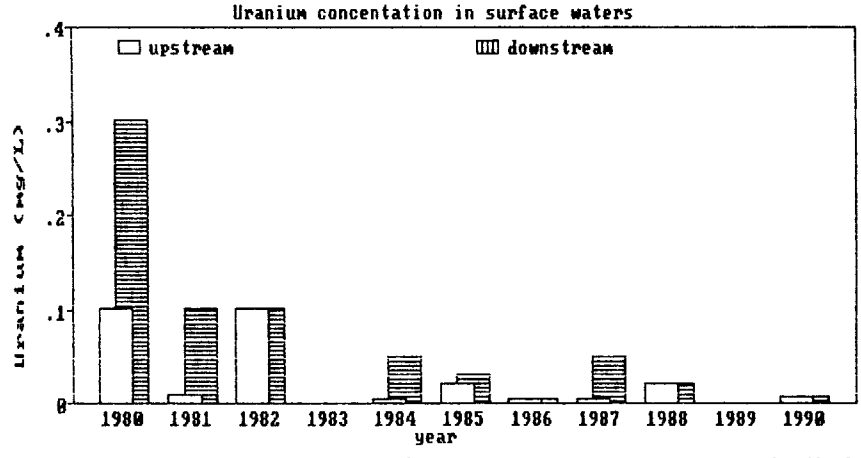

Figure 4: Maximum values measured((10 Km. upstream and (50 Km. downstream from the discharge point) in San Rafael plant (Mendoza)

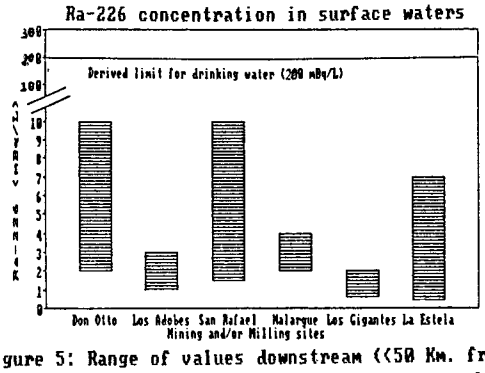

Figure 5: Range of values downstream ((50 Km. from the discharge point) for the last year assessed

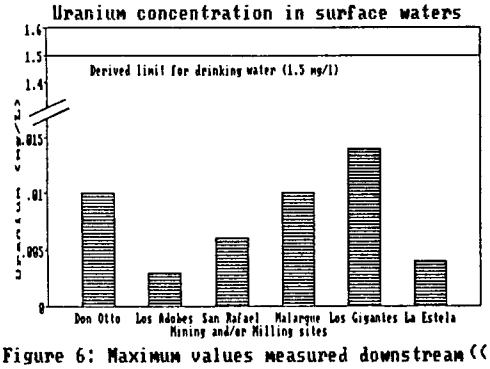

Figure 6: Maximum values measured downstream ((50 Km. from the discharge point)for the last year assessed