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Sudbury Neutrino Observatory

Underground Radon Measurements at the Creighton Mine:

I - Radon Emanation from Shotcrete

J. Bigu* and E.D. Hallman
Laurentian University SNO Group

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Radon (222Rn) emanations from the rock and sprayed concrete surfaces near the SNO cavity on the 6800 ft level of the Creighton Mine, have been measured by several techniques. This report summarizes measurements made using monitoring equipment from the Elliot Lake Laboratory (CANMET), with two techniques: A - accumulator method, in which the build-up of radon in a sealed canister is monitored continuously as the emanation and subsequent radon decay occurs, and B - open-loop/electret method in which radon additions to the air flowing through the canister is monitored by means of two electret detectors. Initial measurements were made on a natural ("popcorn" finish) shotcrete surface, at the approximate mid-point of the west wall of the control room drift (Location 1). The rough, uneven nature of the surface made the sealing of the canisters to the wall difficult and some small air leaks may have been present. A second set of measurements were made on a flat specially-prepared ("trowelled and broomed") shotcrete surface approximately 20 feet from the entrance of the personnel drift, about 5 ft from the drift floor on the west wall (Location 2). In both locations, a shotcrete layer of from 4 - 6 inches thick had been sprayed on the norite rock of the drift and no voids were evident. Results were analyzed using standard techniques to give radon emanations as listed in Table 1.

Table 1: Radon Flux Density from Shotcrete/Rock Wall Surfaces

Date	Location	Radon Flux Density J(Rn)	Technique
April 1992	1	7.92 x 102 atoms.m-2.s-1 1.67 x 10-3 Bq.m-2.s-1 4.50 x 10-2 pCi.m-2.s-1	A
[redacted]l 1992	1	2.1 x 103 atoms.m-2.s-1	B
August 27, 1992	2	5.29 x 103 atoms.m-2.s-1	A and B**

** For these measurements, results using both techniques were identical to

in location 1 is felt to be related to the difficulty in sealing the canisters to the surface at this location.

Since the radon emanating from the shotcrete surfaces has diffused from uranium/radium sites in the shotcrete or underlying rock, measurements of uranium concentrations in these materials were made, so that diffusion lengths for radon in the wall surfaces could be estimated. Table 2 lists uranium (U238 and thorium (Th232) concentrations in the shotcrete mix used at location 2, and for norite rock (averaged) in this vicinity. Assuming a value of the radon flu density of 5000 atoms.m-2.s-1, and using a value of 2.0 ug/g for the U238 concentration (assumed in equilibrium with its decay products), a diffusion depth of order 10 cm can be estimated for this geometry. Approximately 60,000 decays of the uranium (and of each of the decay products) occur per m3 per s.

Table 2: Concentrations of U and Th in wall materials at the monitoring sites

Material	Location	Concentrations (ug/g) U	Th
shotcrete (dry mix)	2	2.60 +/- .36	6.11 +/- .17
norite	SNO cavity (4 sample average)	1.15 +/- .3	5.50 +/- .5

A report summarizing all radon in mine air and surface emanation measurements made to date at the SNO sites in the Creighton Mine is in preparation.

* Research Scientist, Elliot Lake Laboratories, CANMET