Sampling of Utility Room air to determine the 222Rn Level

042

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Introduction

A understanding of the level of 222Rn in the background air within the utility room is required to determine the effects of small leaks to the background of the SNO H2O and D2O systems. While the factors affecting the underground 222Rn levels are not all known, it is known that this level is not constant during the day and from day to day. For ventilation, air from the surface is drawn down through out the mine. It is believed that the level of 222Rn is dependent on the ventilation flow rate within the mine. 222Rn is emitted from the rock surfaces so a lower ventilation rate will result in a build up of 222Rn. The variation of 222Rn over a period of approximately 9 months was determined using a ZnS-coated scintillation cell ("Lucas Cell").

Procedure

The Lucas cell is evacuated with a vacuum pump for approximately two hours to zero the radon within the cell. A background count on the cell was then made by counting for at least a day. It was then brought underground where it was again evacuated briefly to remove outgasing that has occurred. Shortly before its return to the surface, the cell was filled with the utility room air by connecting the cell to an open ended Quick Connect.

The cell was then brought to surface where it was counted for a period of 1 to-2 days, with the number of counts and the duration of counting being periodically recorded. Another background count was also made after evacuating the Lucas cell for a third time.

Analysis

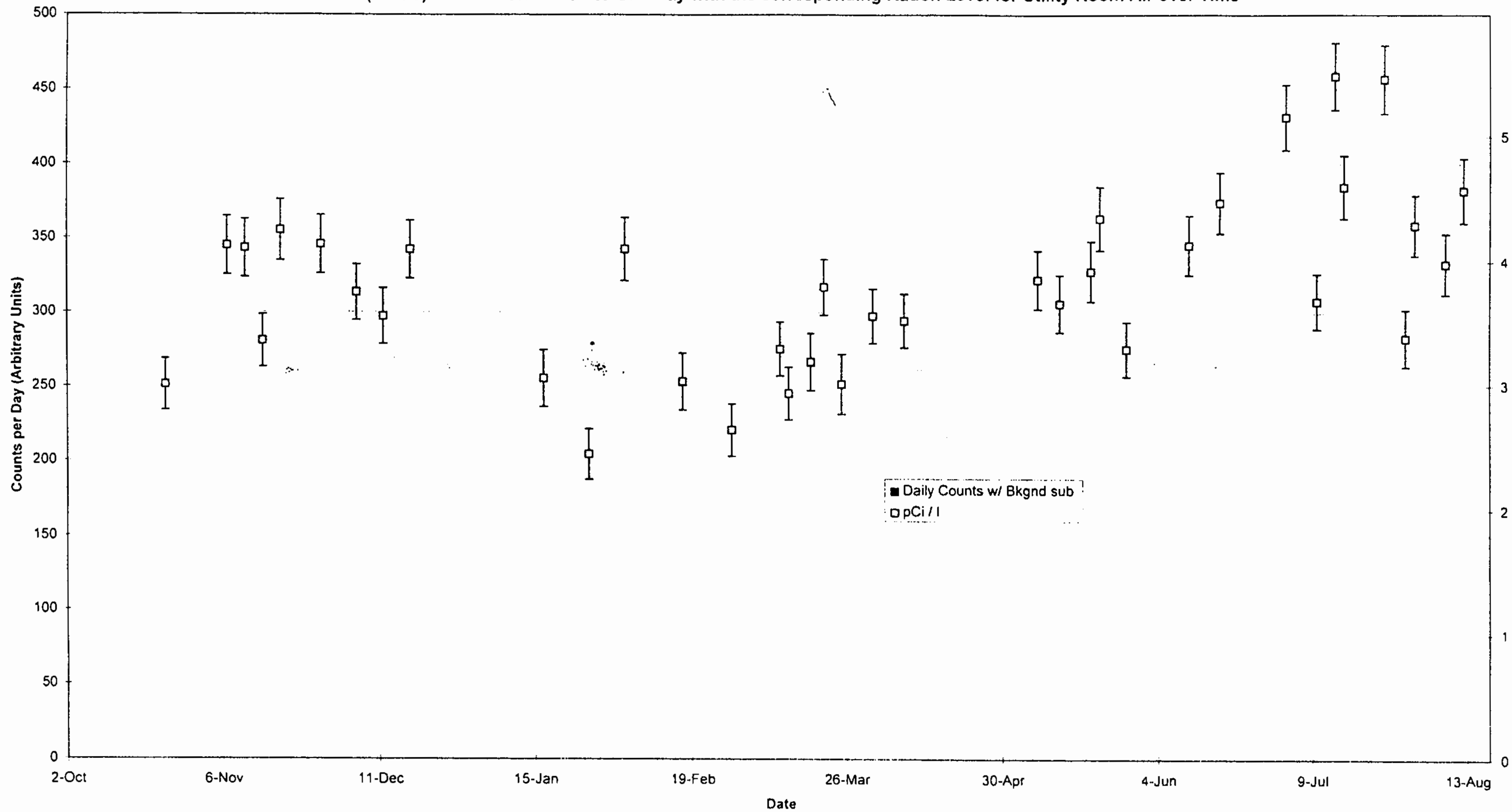
Since 222Rn has a half life of approximately 3.8 day and the cell counting was started within a couple of hours of filling, there is no correction made for the radon that decayed (about 2%) before the start of counting.

Each measurement was obtained at a different time of the day and counted for various lengths of time, thus a normalization to one day of counting was used to compare results. The gross counts after T seconds of counting was normalized to one day by dividing by (1-exp(-lambda*T)) where lambda is (ln2/3.8days). Typically the gross counts in one day was 350 to 425 counts.

The background counts were found to be linear with time so a linear interpolation was used to obtain the background counts normalized to one day. Typical background counts were 25 to 35 for one day. This value was subtracted from the gross counts in one day to get the net counts in one day of counting.

To obtain the corresponding 222Rn level in pCi/l from the net counts in one day, we use the fact that for each Rn atom decay there are 3

Lucas Cell #12 (old #5) Counts normalized to One Day with the corresponding Radon Level for Utility Room Air over Time



alphas (from 222Rn, 218Po and 214Po) emitted, the detection efficiency of an alpha is 63% for the Lucas cell and the cell volume is 15 cm3. At a level of 3 pCi/l there would be 750 Rn atoms in the cell at the ɿart of filling.

A plot of the measurements is found on the following page. The error bars are based on the square root of the number of radon atoms initially in the cell. Significant periods to note are a INCO strike between June 2 and June 30 and a INCO mine shutdown between July 1 and 22 (the ventilation was not turned down during this shutdown). The radon level ranges from 3 to 5 pCi/l over the nine months of measurements done on randomly selected days. It is not known how representative one sample of radon for the day is (did we sample during the high or low part of that day ?).

If there is a need, real time monitoring using other types of radon detectors could be done to look in more detail at the radon variation during the day and day-to-day.