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# URANIUM PROSPECTING FOR ACCURATE TIME-EFFICIENT SURVEYS OF RADON EMISSIONS IN AIR AND WATER, WITH A COMPARISON TO EARLIER RADON AND HE SURVEYS

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## ABSTRACT

Ur-Energy Inc. is focusing its exploration efforts on discovery of an Athabasca-style unconformity-associated uranium deposit in the Thelon Basin, NWT, Canada. This work describes the exploration methodology and results to date of electret ion chamber (EIC) radon surveys employed in the summer of 2005 in the search for a deeply buried, high grade uranium deposit at Ur-Energy's Screech Lake Property. The survey has demonstrated that accurate radon gas measurements covering sizeable surface areas can be obtained within three days under variable summer field conditions. A total of 433 ground-EIC measurements were completed over a grid measuring 3 km by 1.5 km and centered on Screech Lake. In addition 26 water samples from streams and lakes in the area were measured for radon content. Current work has confirmed, extended, and refined historic results obtained in past explorations that included radon and radiogenic helium surveys. The work was done using commercially available E-PERM® EIC system with one litre chambers. Additionally new radon anomalies have been discovered. This work has rekindled interest in using practical, short duration radon surveys for uranium exploration.

## INTRODUCTION

Ur-Energy Inc. is focusing its exploration efforts on discovery of an Athabasca-style unconformity-associated uranium deposit in the Thelon Basin, NWT, Canada. The exploration efforts were aimed in the search for a deeply buried, high grade uranium deposit at Ur-Energy's Screech Lake Property. This has become important due to recent renewed interest in Nuclear Power. The object was to review the earlier exploration efforts and employ latest technologies to improve upon the previous work with a technique usable in exploration setting and provide fast results.

During the period 1976-80 Screech Lake was the scene of successive exploration efforts by Urangesellschaft Canada Ltd. (UG). Their efforts were directed at exploring for a radioactive source(s) of very anomalous amounts of radon and helium gases emanating from the lake and surroundings. Accordingly, UG completed radon and radiogenic helium surveys on Screech Lake and surrounding area. The 2005 Ur-Energy radon results replicate and refine the UG results.

 

When radon surveys were done during that era, the techniques were not that sophisticated and much data had to be rejected to draw some general conclusions.

Several exploration methodologies are available. These include gamma surveys, radon surveys and He in the soil surveys and radon in water in the streams. Uranium leads to radon gas which penetrates through the soil and releases to air. Gamma ray emitted from deeply buried uranium is another signal, but less specific. The radioactivity associated with uranium release alpha particles, which are simply He atoms and these get adsorbed in the soil. He in the soil is another useful signal. In the current exploration efforts, it was decided to use measurement of radon in air and radon in water in the flowing streams. The results were meant to compare the results with earlier historical data and improve upon them, using later technologies.

When radon survey was done more than 20 years back, the techniques (AT techniques) were not that sophisticated and lots of data had to be rejected to draw some general conclusions.

The present efforts were aimed at getting large number of results in exploration setting in 3 to 4 days with an acceptable accuracy. Large volume (one litre volume) electret ion chambers (EIC) was chosen. Exposure duration was chosen to be about 3 days. Same staff members responsible for deployment and retrieval were able to do the analysis and complete the report with in one week. This has sufficient sensitivity to measure 0.5 pCi/L in 3 days. Rad Elec's standard method was also used for measuring radon in water samples collected from streams.

## PROTOCOL

Large volume (1 litre) Electret ion chamber (HST E-PERM) was enclosed in Tyvek Bag. It is placed into a small pit, 2 feet x 2feet x 6 inches. The pit is covered with a breathable, water resistant sheet and edges were weighted down with soil and pebbles found around that area. The latter step prevents the cover from flying off in frequently found windy conditions. Tyvek being transparent to radon, the enclosed EIC measures radon emanating from the area of the sample site.

Pre-measured electret in cap was loaded to EIC chamber in the field. At the termination of the sampling, electret was removed and covered with cap for later measurement. Assemblies can be used several times. Trial tests were done in a back yard setting before starting a large scale deployment in exploration setting.

Analysis was done using standard spread sheet to calculate the results in any required format and units. Assuming the gamma level of 10 μR/h, the radon calculations were done. This is not exact because gamma background can be higher at certain locations due to the presence of uranium. Since gamma signal over and above normal background of 10 μR/h is another positive signal for the presence of uranium; combined signals may be better suited for the purposes uranium prospecting.

 

## RESULTS

Table 1 gives typical sample set of results of Radon in air.
Table 2 gives typical sample set of results of radon in water.
Figure 1 gives Location of exploration.
Figure 2 gives partial contour map.

A total of 433 ground-EIC measurements were completed over a grid measuring 3 km by 1.5 km and centered on Screech Lake. In addition 26 water samples from streams and lakes in the area were measured for radon content. Current work has confirmed, extended, and refined historic results obtained in past explorations that included radon and radiogenic helium surveys. A detailed project report is available for those interested in further details.

Results revealed overlapping conductive horizons both deep within the Thelon sandstones and at the sandstone/basement unconformity. These conductors may reflect a deep zone of intensive clay alteration perched within the sandstones and a conductive thick regolith horizon. A pronounced ovoid magnetic feature, present in the basement rocks, underlies the Screech Lake area. Geophysical results indicate basement depths of 600 meters beneath Screech Lake.

The radon anomalies appear at surface as linear features. The radon survey results, when integrated with the structural interpretation, suggest that radon is rising to surface along structures from deep source(s) within the Thelon sandstone or from the Thelon/basement unconformity. Ur-Energy's work in 2005 has confirmed, extended, and refined historic results obtained in past exploration at Screech Lake.

## FUTURE DIRECTIONS

In 2006 exploration, Ur-Energy has expanded the current method to include the use of radon flux monitors (RFM) which use EIC technology. Ur-Energy has successfully introduced the use of the radon flux monitor (RFM) system, thereby reducing a 3-day reading period to an 8-hour reading period. Both systems are now being utilized

Use of the HST system on a reconnaissance basis, on a completely separate property (from Screech) Ur-Energy has located a very high radon concentration in a sandstone-unconformity style geological setting, which will become the focus of a more detailed program next year.

 

The RFM system is more difficult to use in difficult sampling conditions such as rocky soil and wet vegetation such as peat, and the local conditions must be accounted for in each sample reading.

Ur-Energy's testing to date indicate that measuring radon flux from ground may be a more suitable and time efficient substitute for measuring radon at ground level. Future explorations may utilize this method.

## CONCLUSIONS

Relatively low priced radon measurement technology is usable for accurate time-efficient surveys of radon emissions in air and water. The EIC technology, when applied to uranium exploration, is proving to be a highly efficient method for locating radon anomalies, which may originate in primary uranium concentrations.

It is concluded that radon is rising to surface along structures from deep source(s) within the Thelon sandstone and/or from the Thelon/basement unconformity. A structural interpretation of the Screech Lake area has resulted from the 2005 EIC radon survey. The survey has provided reinforcement for deep exploration drilling for unconformity-type uranium mineralization at Screech Lake.

 

**Table-1**
**Typical sample set of Data**
**Radon in Air**

| | UTM | | | | Gamma | | | | Radon | (+/-) | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample# | Easting | Northing | Electret# | Days. | Micro R/h | IV | FV | CF | pCi/L | pCi/L | Sample Site Conditions |
| 282 | *516800* | *6957100* | SBM134 | 3.03 | 10.00 | 728 | 703 | 10.3670 | 0.10 | 0.1 | Peat - near Lake |
| 283 | *516700* | *6956800* | SBM138 | 3.03 | 10.00 | 731 | 702 | 10.3713 | 0.22 | 0.1 | Sandy Gravel |
| 284 | *516700* | *6956700* | SBM145 | 3.03 | 10.00 | 711 | 686 | 10.2941 | 0.10 | 0.1 | Wet Sandy Gravel |
| 285 | *516700* | *6956600* | SBM165 | 3.03 | 10.00 | 708 | 670 | 10.2533 | 0.52 | 0.1 | Cobbly Gravel |
| 286 | *516700* | *6956500* | SBM269 | 3.03 | 10.00 | 608 | 578 | 9.8411 | 0.30 | 0.1 | Sandy Gravel |
| 287 | *516600* | *6956427* | SBL946 | 3.03 | 10.00 | 723 | 707 | 10.3649 | -0.19 | -0.1 | Peat - besides small lake |
| 288 | *516600* | *6956500* | SBL957 | 3.02 | 10.00 | 738 | 710 | 10.4035 | 0.19 | 0.1 | Fine Sand - Frostboil |
| 289 | *516600* | *6956600* | SBL979 | 3.02 | 10.00 | 721 | 690 | 10.3241 | 0.29 | 0.1 | Gravel and Sand and Boulders |
| 290 | *516600* | *6956697* | SCA039 | 3.03 | 10.00 | 637 | 613 | 9.9785 | 0.09 | 0.1 | Sandy Gravel - besides swamp |
| 291 | *516600* | *6956800* | SCA080 | 3.02 | 10.00 | 648 | 624 | 10.0257 | 0.09 | 0.1 | Bouldery gravelly Till |
| 292 | *516500* | *6956800* | SCA144 | 3.02 | 10.00 | 727 | 586 | 10.1138 | 3.91 | 0.2 | Gravelly Till |
| 293 | *516500* | *6956700* | SCA043 | 3.02 | 10.00 | 610 | 581 | 9.8519 | 0.27 | 0.1 | Peat and Boulders |
| 294 | *516500* | *6956600* | SCA012 | 3.02 | 10.00 | 643 | 616 | 9.9978 | 0.19 | 0.1 | Gravelly Sand |
| 295 | *516500* | *6956500* | SCA058 | 2.99 | 10.00 | 624 | 577 | 9.8733 | 0.89 | 0.1 | Gravelly Sand |
| 296 | *516500* | *6956400* | SCA013 | 2.99 | 10.00 | 603 | 580 | 9.8347 | 0.08 | 0.1 | Gravelly Sand |
| 297 | *516500* | *6956300* | SCA128 | 2.99 | 10.00 | 548 | 523 | 9.5943 | 0.17 | 0.1 | Cobbly Gravel |
| 298 | *516400* | *6956300* | SCA034 | 2.99 | 10.00 | 521 | 495 | 9.4762 | 0.22 | 0.1 | Fine Sand - Frostboil |
| 299 | *516400* | *6956400* | SCA025 | 2.99 | 10.00 | 669 | 644 | 10.1138 | 0.13 | 0.1 | Peat and Boulders and Sand - swampy spot |
| 300 | *516400* | *6956533* | SCA066 | 2.99 | 10.00 | 719 | 488 | 9.8862 | 7.13 | 0.4 | Sandy Gravel - north side of pond |
| 301 | *516400* | *6956600* | SBZ563 | 2.99 | 10.00 | 697 | 646 | 10.1781 | 0.98 | 0.1 | Sandy Gravel |
| 302 | *516400* | *6956700* | SBZ438 | 2.98 | 10.00 | 708 | 680 | 10.2747 | 0.21 | 0.1 | Bouldery, Gravelly Till |
| 303 | *516400* | *6956800* | SBZ574 | 2.98 | 10.00 | 653 | 623 | 10.0343 | 0.30 | 0.1 | Gravelly Sand |
| 304 | *516200* | *6956800* | SBZ445 | 2.98 | 10.00 | 685 | 663 | 10.1889 | 0.02 | 0.1 | Silty Gravel |
| 305 | *516200* | *6956700* | SBZ619 | 2.98 | 10.00 | 722 | 686 | 10.3177 | 0.47 | 0.1 | Silty Gravel |
| 306 | *516200* | *6956600* | SBZ442 | 2.98 | 10.00 | 612 | 582 | 9.8583 | 0.32 | 0.1 | Silty Gravel |
| 307 | *516200* | *6956500* | SBZ996 | 2.98 | 10.00 | 640 | 618 | 9.9957 | 0.04 | 0.1 | Bouldery Cobbly Till |
| 308 | *516200* | *6956400* | SBZ617 | 2.98 | 10.00 | 667 | 648 | 10.1180 | -0.07 | -0.1 | Gravelly Sand |
| 309 | *516200* | *6956300* | SBZ957 | 2.98 | 10.00 | 706 | 682 | 10.2747 | 0.08 | 0.1 | Gravelly Cobbles |
| 310 | *515800* | *6956800* | SCA088 | 3.00 | 10.00 | 694 | 590 | 10.0515 | 2.75 | 0.2 | Gravelly Sand Till |
| 311 | *515800* | *6956700* | SCA049 | 3.00 | 10.00 | 702 | 623 | 10.1395 | 1.90 | 0.1 | Gravelly Sand Till |
| 312 | *515800* | *6956600* | SCA059 | 3.00 | 10.00 | 390 | 359 | 8.9031 | 0.46 | 0.1 | Bouldery Till |

 

**Table-2**
**Typical sample set of results**
**Radon in Water**

| Sample | UTM | | Electret | | | | Gamma | | | | Conversion | Radon in water |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| # | Northing | Easting | # | StartTest | Finish Test | Days | Micro R/h | IV | FV | CF | constant | pCi/L |
| Verification Test | | | SP4308 | 23/01/2001 11:00 | 26/01/2001 19:00 | 3.33 | 10.00 | 700 | 650 | 2.0842 | 73.9603 | 468.0 |
| | | | SP4319 | 23/01/2001 11:00 | 25/01/2001 17:00 | 2.25 | 10.00 | 695 | 653 | 2.0836 | 67.5945 | 546.8 |
| 1W | 516273 | 6957069 | SCA014 | 31/07/2005 16:50 | 01/08/2005 17:00 | 1.01 | 10.00 | 756 | 540 | 2.0687 | 60.7230 | 6243.7 |
| 2W | 516208 | 6957079 | SCA024 | 01/08/2005 20:35 | 02/08/2005 21:45 | 1.05 | 10.00 | 735 | 233 | 1.9748 | 60.9458 | 14721.1 |
| 3W | Algae | Algae | SCA033 | 31/07/2005 16:50 | 01/08/2005 17:00 | 1.01 | 10.00 | 738 | 553 | 2.0673 | 60.7230 | 5343.8 |
| 4W | 516258 | 6957071 | SCA087 | 01/08/2005 20:35 | 02/08/2005 21:45 | 1.05 | 10.00 | 737 | 501 | 2.0521 | 60.9458 | 6631.0 |
| 5W | 516050 | 6957084 | SBM398 | 02/08/2005 20:45 | 03/08/2005 20:52 | 1.00 | 10.00 | 459 | 434 | 1.9534 | 60.7119 | 720.4 |
| 6W | 516148 | 6957105 | SCA033 | 02/08/2005 20:50 | 03/08/2005 20:55 | 1.00 | 10.00 | 551 | 482 | 1.9934 | 60.7045 | 2041.1 |
| 7W | 516200 | 6959400 | SBM228 | 03/08/2005 21:05 | 04/08/2005 21:02 | 1.00 | 10.00 | 689 | 680 | 2.0896 | 60.6748 | 209.1 |
| 8W | 516400 | 6959770 | SBM385 | 03/08/2005 21:05 | 04/08/2005 21:05 | 1.00 | 10.00 | 671 | 666 | 2.0804 | 60.6860 | 93.1 |

**Figure 1**
**Location of Exploration**

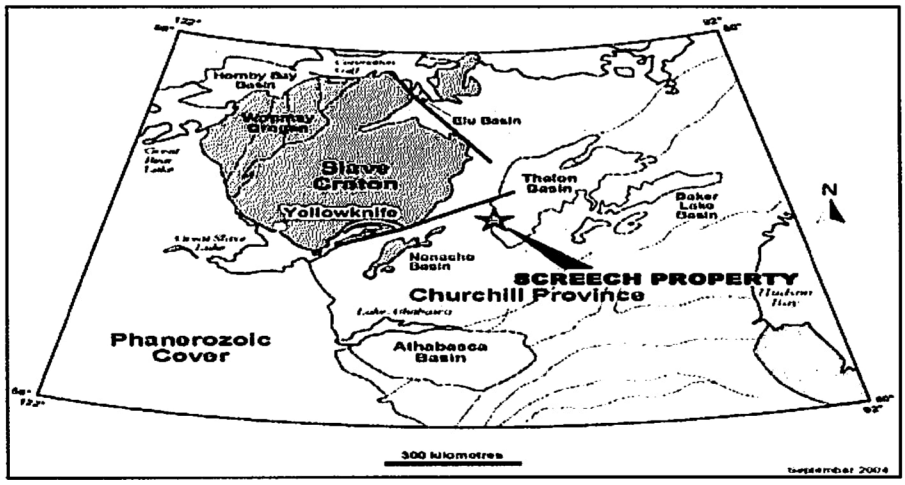


 

**Figure 2**
**Portions of the results presented in contour format**