Radioisotope concentrations for fluid mobility in sedimentary rocks for potential radioactive waste storage

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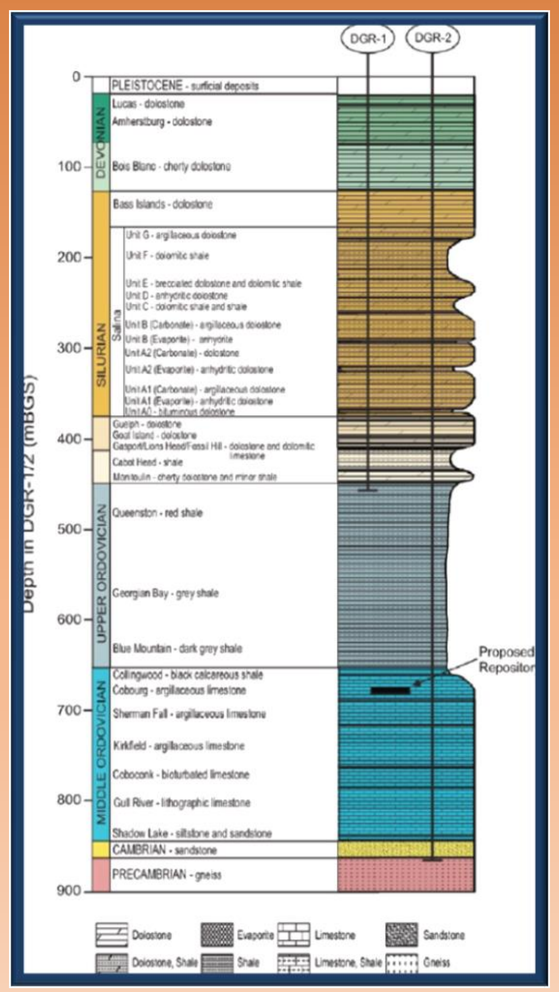
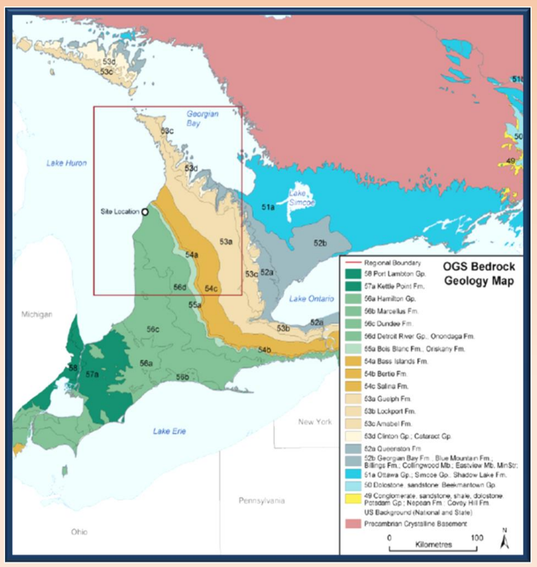
Abstract

The Bruce Deep Geologic Repository (DGR) is a proposed storage site for low and intermediate level radioactive waste. It is located on the Bruce Peninsula and the repository will be located ~800 m underground in the argillaceous limestone of the Cobourg Formation of the Michigan Basin. The purpose of this research is to analyse 236U, 238U, 36Cl, and 129I in core samples to determine if they occur in their mathematically predicted proportions, known as secular equilibrium. This information is required for the assessment of fluid mobility in a potential nuclear waste site on the Bruce Peninsula and can be used as a potential age constraint on pore fluids in the Michigan Basin. 12 sedimentary core samples from a variety of sedimentary units in the Michigan Basin were pulverised, and 129I was extracted using by leaching with de-ionized water, extraction of 129I into hexane via a redox protocol and precipitation as AgI. The AgI will then be analysed by the Accelerator Mass Spectrometer (AMS), which counts individual radioisotopes to determine the concentration of 129I. 36Cl and 236U will also be analyzed by AMS and 238U by ICP-MS at the University of Ottawa André E. Lalonde AMS Laboratory.

Methodology

The following is the cross section of the sedimentary sequence of the Bruce Peninsula showing the proposed nuclear waste repository site and depths of two cores. Our research is attempting to are fill in gaps by getting more data to explain some things we don't fully understand relating to fluid mobility within these rock units.





Geological Map showing rock formations and the DGR site.

1. The first step was to grind the outer edge off the core samples to remove possible drilling fluid contamination.

Angle grinder, wedge and hammer used for preprocessing core samples.

2. Then a small of a sample was broken off, and run through the jaw-crusher, and disc mill, this was also to reduce contamination. After the pre-sample was pulverized, real sample was processed.

Jaw-crusher (left) and disc-mill (right, being cleaned by Matt)

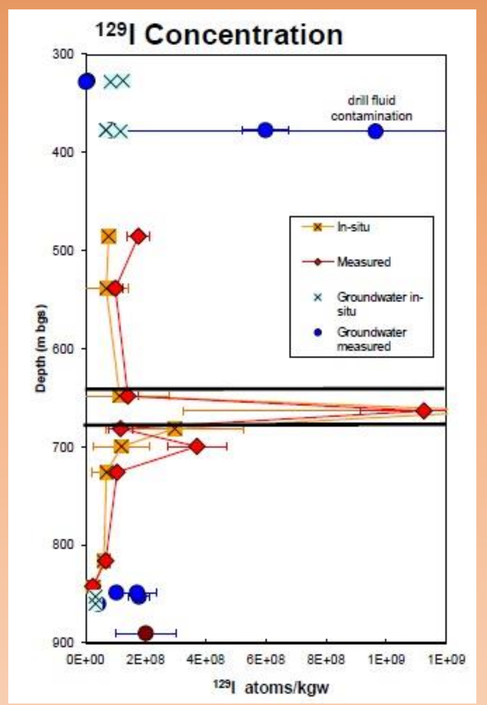
3. When the sample was satisfactorily crushed it was put into a labeled zip lock bag, and placed aside.

Pulverized samples and pre-samples from one day in the rock crushing lab.

4. Once a sample was pulverized, a rigorous cleaning routine was done on both of the rock crushing machines. This involved a shop-vac and many spiffy attachments, plus ethanol and kim wipes. This cleaning process took place between every sample and was time intensive.

5. When all 12 core samples had be crushed, we moved to the graduate students lab for the leaching and 129I extraction using de-ionized water, and hexane via redox protocol and precipitation of AgI. The AgI will be analyzed by the AMS in February or March to find the radioisotope concentrations.

Use of the new AMS is the last stage of this process, AgI will be analyzed in it to determine concentrations of 129I. Once the results are in, they will be compared with calculated theoretical values to determine the mobility of fluids in the rock formations that were sampled. The graph below are the results from a previous similar project and roughly what our results are expected to be.



129I concentration with depth using AMS measurements on core samples from the Bruce Peninsula, used in analyzing fluid mobility in sedimentary rocks.

Acknowledgments

I'd like to send a huge thank you to Matt Herod for being an excellent and empowering educator. To Ian Clark for overseeing and helping along the way and supporting this collaborative project. To the UROP program for the funding and framework for this fantastic chance to be involved in current research. Also thanks to George and Dave for rock crushing instructions, and for companionship and help from many others in the lab.

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2014-2015