Detection of Radioactivity in Black Organic Shale

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Project Description: This project concerns measuring the amount of naturally occurring radioactivity found within black organic shale family. This type of shale is common in Eastern Kentucky, so it is important to measure the amount of radiation as a first step towards understanding the impact it could have on the surrounding environment. To detect this radiation, we are using a group of Gamma-Scout detectors. The Gamma-Scout detects alpha, beta and gamma radiation in fixed time intervals and stores the results in memory for later analysis. Two local sites will be used in this project, the Ohio Shale Outcrop and the Sunbury Shale Outcrop, both located within a few miles of Morehead State University. This poster will focus on the use of the Gamma-Scout and the upcoming data collection and analysis.

Background

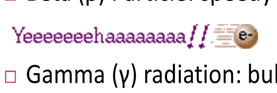
The black organic shale family is the most radioactive rocks in the Kentucky soil. The purpose of this research is to see how much radiation the shale emits locally. Radioactive decay can be broken down into three different components. They are alpha, beta, and gamma particles. These three different types of radiation are considered ionizing and if they are absorbed by the body they can damage or mutate cells or DNA in the and can eventually lead to cancer.

Nuclear Decay:

- Alpha (α) Particle (2 protons, 2 neutrons)

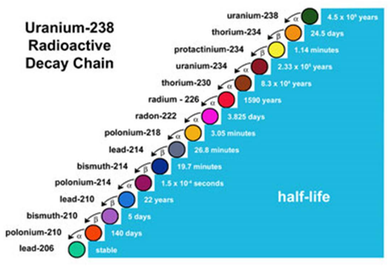
^4_2He =>

- Beta (β) Particle: speedy electron



- Gamma (γ) radiation: bullets of light

These particles are commonly found in most natural environments and are found in the outcrop of Ohio Shale that we are interested in. The amount of radiation in the natural environment varies based upon the uranium-radium element found in the environment. The uranium-radium series begins with Uranium-238 that has a half-life of 4.47 billion years and ends with a stable Pb-206. This means that the radioactivity of the Ohio Shale will persist for a long time.



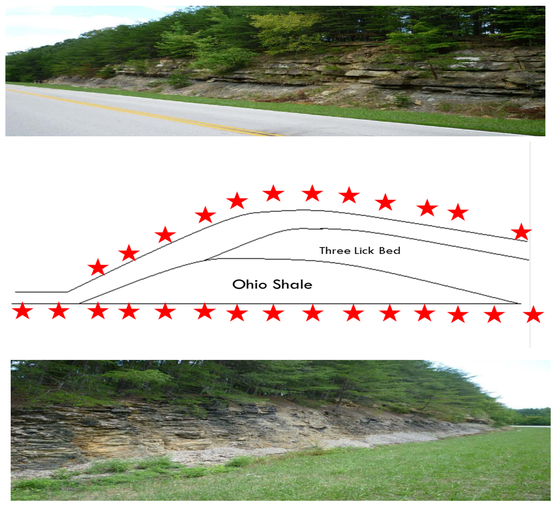
The Experiment

Over the summer, we will be using the Gamma-Scout to detect radiation found within black organic shale outcrops found within Morehead, Ky. We will calibrate the detectors during the present semester and be building lead cavities to hold the Gamma-Scouts.

Once the calibration and cavities are finished, we will then take the Gamma-Scouts out to specified locations, bury them and then let the Gamma-Scout detect and record the radiation.

The Outcrop of Ohio Shale

Located in northern part of Cave Run Lake approximately 125 meters long at base.

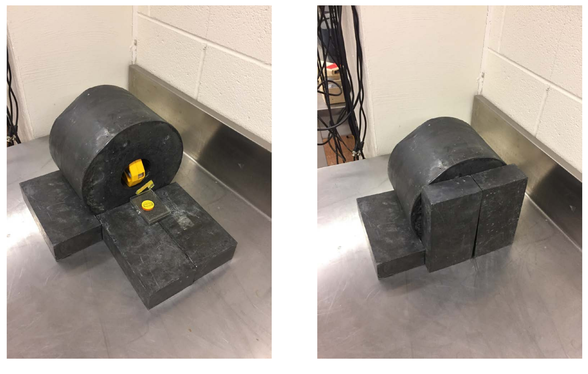


The Gamma Scout

The Gamma-Scout is a radiation detector that will be used in our experiments. The device is equipped with a Geiger-Muller counter tube and has three shield settings which allow for alpha, beta and gamma detection. The device has an internal memory storage. We will set a sample rate of one hour for three days to collect data. The device measures radiation in raw counts, microsievert(mSv) or microrem(mRem).

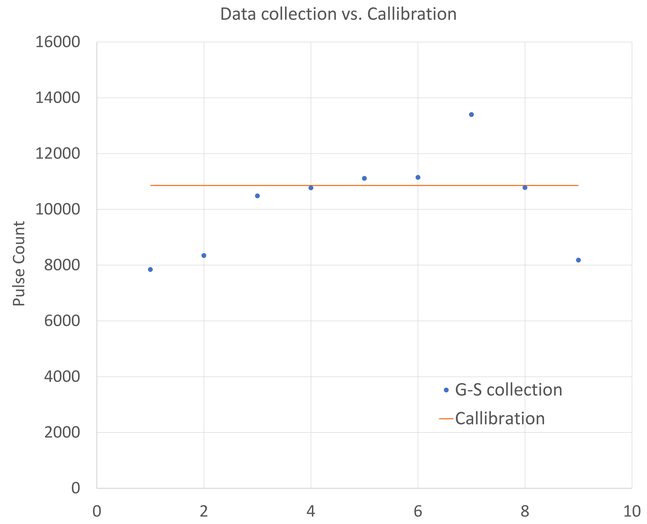
Cavities

Lead cavities has be built in house to calibrate the Gamma-Scout using a CS-137 source.



Calibration and Data

We ran the Gamma-Scouts for two hours each and collected data in ten minute intervals.



Detector	Pulse Count	Calibration	Diff. factor
A-1	7844	10859	3015
B-2	8343	10859	2516
C-3	10483	10859	376
D-4	10771	10859	88
E-5	11110	10859	-251
F-6	11147	10859	-288
4-7	13399	10859	-2540
6-8	10782	10859	77
7-9	8179	10859	2680

Present and Future Work

The present iteration of this project will see the building of lead cavities and the calibration of the Gamma-Scouts. When the calibration are finished, we will take them to two locations within Morehead.

References

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