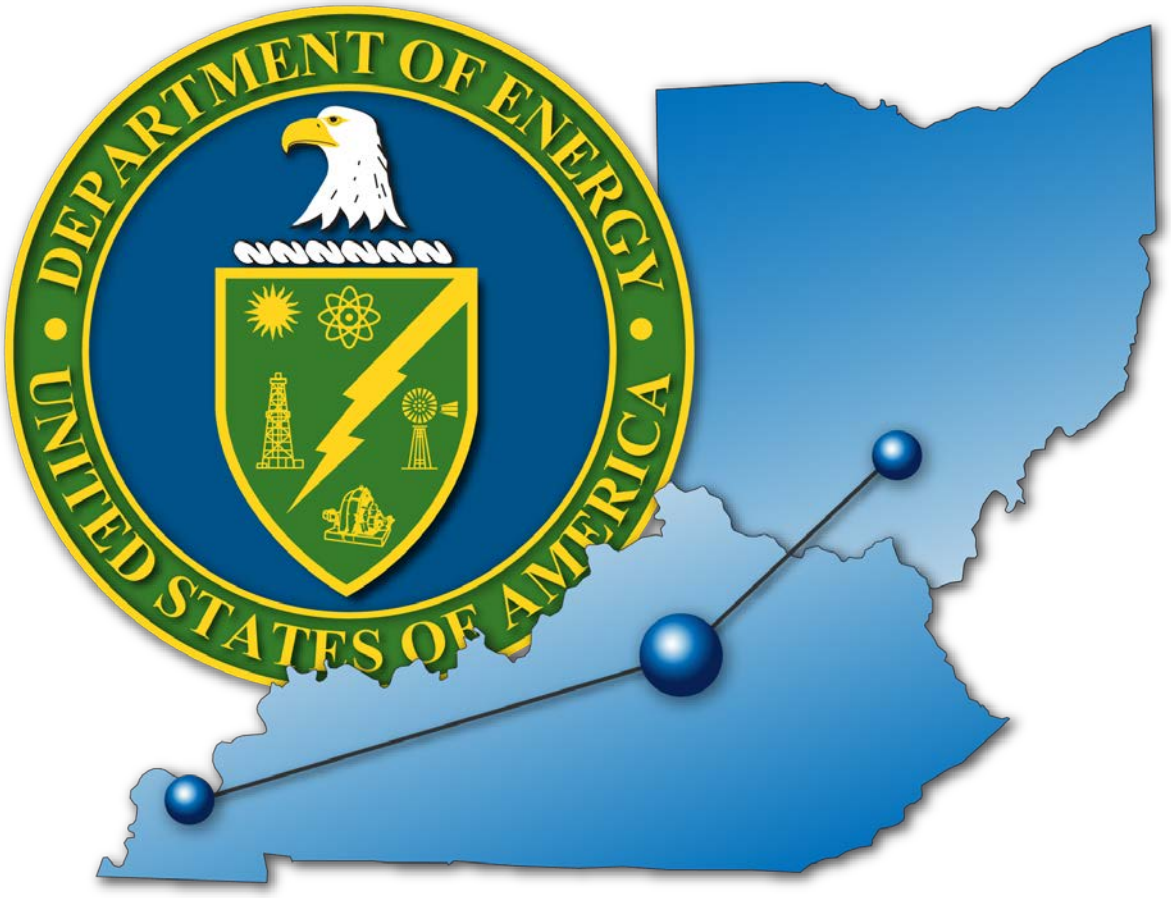
U.S. Department of Energy
Portsmouth/Paducah Project Office

Sampling Analysis Report for Zahn's Corner Middle School Sampling Event

July 2019



Introduction

In response to community concerns, following the release of the Department of Energy's (DOE's) 2017 Annual Site Environmental Report which reported a detection of Np-237 in an air monitor near Zahn's Corner Middle School in Piketon, Ohio and a similar detect of Americium - 241 in the same air monitor in 2018, DOE initiated a sampling event to assess the potential for the contamination. This sampling event also examined reports of enriched uranium and transuranic radionuclides indicated in a report provided by Dr. Michael Ketterer of Northern Arizona University (NAU). DOE requested the Savannah River National Laboratory (SRNL) provide assistance with laboratory analysis of samples collected at Zahn's Corner Middle School. Three groups of samples were obtained by a world-class team of certified health physicists from DOE's National Labs and the National Nuclear Security Administration. Group 1 covered a broad area and samples were collected using statistically based methods; Group 2 focused on sampling the air; and, Group 3 focused on resampling a subset of sites that were discussed in the Ketterer document[1]. Only naturally occurring radionuclides were found in any of these samples; none of the samples indicated any excess radiological risk above background to the public.

Group 1

Sampling Summary

Group 1 samples were collected at the school, using a sampling plan developed under the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)[2] process. Smear samples of 100 cm^2 samples were collected on May 25, 2019, to evaluate the removable contamination present in the Zahn's Corner Middle School. Smear sampling involves wiping a surface using slight pressure with a piece of soft material (in this instance glass fiber filters) to determine if radioactive material can readily be removed from the surface. In the radiation protection industry, smears (also called swipes) are typically taken over an area of approximately 100 – 300 square centimeters (cm^2). These samples were shipped to the Environmental and Bioassay Laboratory at the Savannah River Site for gross alpha/beta analysis. Samples were counted for five minutes on a gas-flow proportional counter. Gas-flow proportional counters are radiation detectors that are commonly used to test for the presence of low-level alpha and beta contamination and to clear sites for reuse and reoccupation.

Results Summary

For the smears, 35 of the 39 samples had no radioactive emissions above the detection limits of the equipment. Four (4) samples had beta activity greater than the method detection limit; one of these samples (sampling location: VSP-40) also had alpha activity detected just above the instrument's detection limit. The follow-up radiochemical analysis confirmed that while

[1] https://woub.org/wp-content/uploads/2019/04/Ketterer-Szechenyi-NAU-Piketon-27Apr2019_V7.pdf

[2] The Multi-Agency Radiation Survey and Site Investigation Manual, or MARSSIM, provides detailed guidance for planning, implementing, and evaluating environmental and facility radiological surveys conducted to demonstrate compliance with a dose- or risk-based regulation. It is used by federal agencies and states, site owners, contractors, and the public. MARSSIM was developed collaboratively by the Department of Defense (DOD), the Department of Energy (DOE), the United States Nuclear Regulatory Commission (NRC), and the EPA.

radioactivity was present on the smears, it was due to naturally occurring radionuclides found in the dust and dirt and on the filter media itself.

Figures 1 through 3 depict the results from analysis of the 39 samples for gross alpha and gross beta activity. The minimum detectable activity is shown as a green line. The data are also presented in Tables 1, 2, 3, and 7.

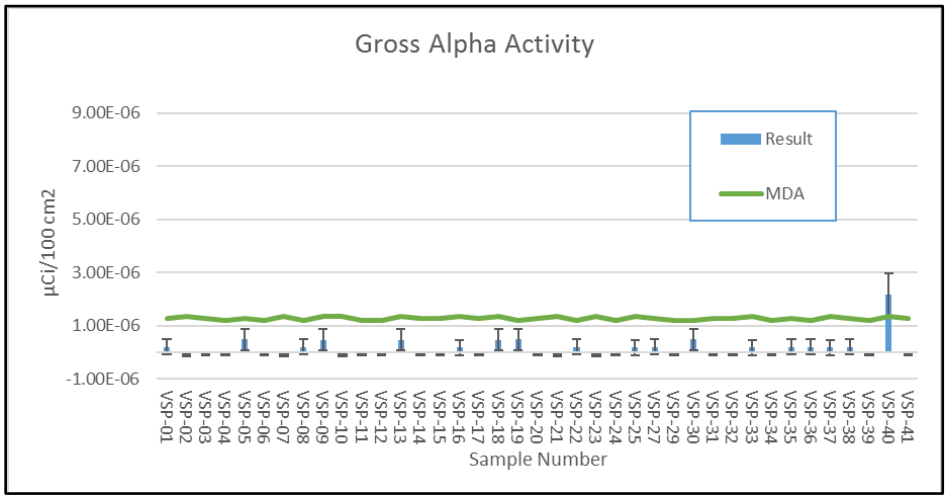


Figure 1: Gross Alpha Activity vs. Minimum Detectable Activity.
For purposes of comparison, alpha activity corresponding to a 100 mrem per year dose would be $2.41X10^{-2}$ µCi/100cm² (off scale)

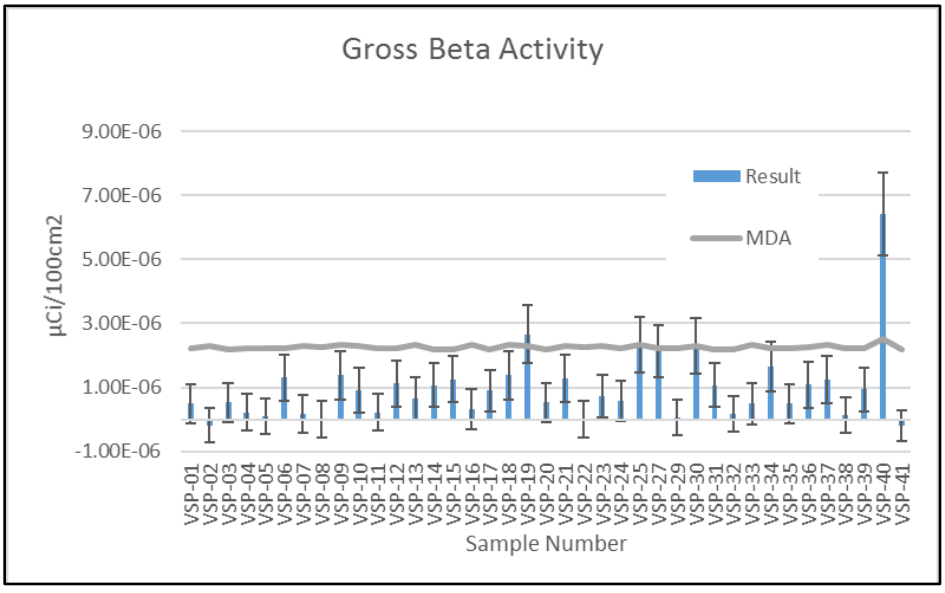


Figure 2: Gross Beta Activity vs. Minimum Detectable Activity.
For purpose of comparison, beta activity corresponding to a 100 mrem per year dose would be $2.09X10^{-4}$ µCi/100cm² (off scale)

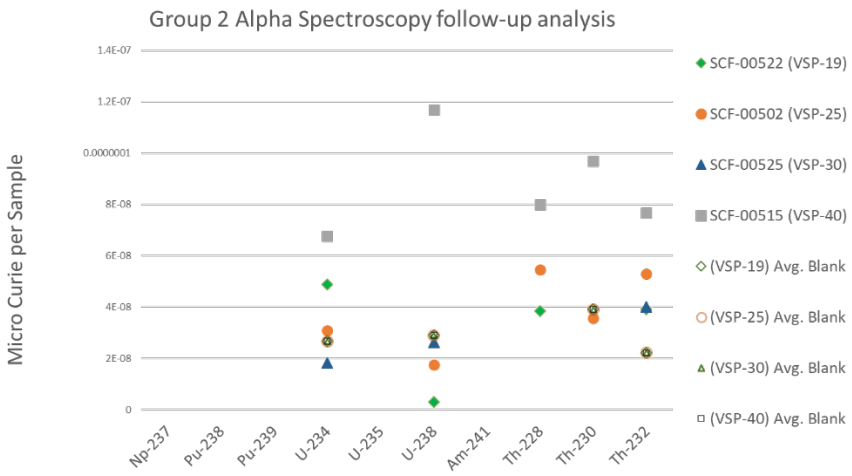


Figure 3: Comparison of radionuclide activities in the Group 1 alpha spectroscopy follow-up samples

Method and Analysis Summary

Results were received from 39 samples. For gross alpha activity, 38 samples were below minimum detectable activity. The alpha activity was above the minimum detectable activity (MDA) for one sample (see Figure 1), but within twice the uncertainty of the MDA value for this sample. That is to say, the measurement uncertainty of the result overlapped the minimum detectable activity. This means that the measured value is not statistically different than the MDA. This result was roughly 1/10,000 of the calculated deposited activity that would result in a member of the public receiving 100 mrem per year, based on the isotopic ratio observed by Moody, et. al. (1995) for samples from the Portsmouth site. For the gross beta activity, 35 samples were below minimum detectable activity. Four samples were above the minimum detectable activity for beta.

All four samples with measurements above the detection limits of gross alpha/beta counting were sent for additional investigation using destructive analysis followed by alpha spectroscopy. Alpha spectroscopy is a laboratory technique used to specifically identify an alpha-emitting radionuclide and quantify the amount that is present. Alpha spectroscopy is generally used following a laborious chemical separation process that is needed to remove material that would interfere with obtaining a clean alpha spectrum.

Follow up analysis via digestion, radiochemical separation, and alpha spectroscopy on samples taken at VSP-19, VSP-25, VSP-30, and VSP-40 showed that no artificial radionuclides (Np-237, Pu-238, Pu-239, or Am-241) were detected above the method detection limits. For the naturally-occurring isotopes of uranium and thorium, the measured values on the smears were consistent with the natural activity of uranium and thorium in the smear media itself. The ratio of U-234 to U-238 was consistent with what would be expected in natural uranium. In all smear samples, U-235 was not measured above the method detection limit. The follow-up radiochemical analysis confirmed that while radioactivity was present on the smears, it was due to naturally occurring radionuclides found in the dust and dirt and on the filter media itself.

Table 1: Gross Alpha/Beta results for smears from Group 1 Statistically Directed Sampling

VSP #	Nuclide	Result	Uncertainty (1 sigma)	MDA	Unit	Nuclide	Result	Uncertainty (1 sigma)	MDA	Unit
VSP-01	Gross Alpha	1.95E-07	2.85E-07	1.29E-06	µCi/Sample	Gross Beta	4.95E-07	6.10E-07	2.21E-06	µCi/Sample
VSP-02	Gross Alpha	-1.05E-07	3.52E-08	1.34E-06	µCi/Sample	Gross Beta	-1.84E-07	5.32E-07	2.29E-06	µCi/Sample
VSP-03	Gross Alpha	-8.88E-08	2.84E-08	1.29E-06	µCi/Sample	Gross Beta	5.33E-07	6.09E-07	2.18E-06	µCi/Sample
VSP-04	Gross Alpha	-6.91E-08	3.78E-08	1.20E-06	µCi/Sample	Gross Beta	2.25E-07	5.83E-07	2.23E-06	µCi/Sample
VSP-05	Gross Alpha	4.78E-07	4.03E-07	1.29E-06	µCi/Sample	Gross Beta	9.42E-08	5.54E-07	2.24E-06	µCi/Sample
VSP-06	Gross Alpha	-6.92E-08	3.78E-08	1.20E-06	µCi/Sample	Gross Beta	1.30E-06	7.33E-07	2.23E-06	µCi/Sample
VSP-07	Gross Alpha	-1.05E-07	3.52E-08	1.34E-06	µCi/Sample	Gross Beta	1.81E-07	5.92E-07	2.29E-06	µCi/Sample
VSP-08	Gross Alpha	2.07E-07	2.79E-07	1.20E-06	µCi/Sample	Gross Beta	6.27E-09	5.56E-07	2.26E-06	µCi/Sample
VSP-09	Gross Alpha	4.64E-07	4.05E-07	1.34E-06	µCi/Sample	Gross Beta	1.37E-06	7.69E-07	2.35E-06	µCi/Sample
VSP-10	Gross Alpha	-1.05E-07	3.52E-08	1.34E-06	µCi/Sample	Gross Beta	9.10E-07	6.96E-07	2.29E-06	µCi/Sample
VSP-11	Gross Alpha	-6.91E-08	3.78E-08	1.20E-06	µCi/Sample	Gross Beta	2.25E-07	5.83E-07	2.23E-06	µCi/Sample
VSP-12	Gross Alpha	-6.91E-08	3.78E-08	1.20E-06	µCi/Sample	Gross Beta	1.12E-06	7.10E-07	2.23E-06	µCi/Sample
VSP-13	Gross Alpha	4.64E-07	4.05E-07	1.34E-06	µCi/Sample	Gross Beta	6.45E-07	6.74E-07	2.35E-06	µCi/Sample
VSP-14	Gross Alpha	-8.90E-08	2.84E-08	1.29E-06	µCi/Sample	Gross Beta	1.08E-06	6.87E-07	2.18E-06	µCi/Sample

Table 1: Gross Alpha/Beta results for smears from Group 1 Statistically Directed Sampling

VSP #	Nuclide	Result	Uncertainty (1 sigma)	MDA	Unit	Nuclide	Result	Uncertainty (1 sigma)	MDA	Unit
VSP-15	Gross Alpha	-8.90E-08	2.84E-08	1.29E-06	µCi/Sample	Gross Beta	1.26E-06	7.11E-07	2.18E-06	µCi/Sample
VSP-16	Gross Alpha	1.80E-07	2.87E-07	1.34E-06	µCi/Sample	Gross Beta	3.22E-07	6.21E-07	2.32E-06	µCi/Sample
VSP-17	Gross Alpha	-8.89E-08	2.84E-08	1.29E-06	µCi/Sample	Gross Beta	8.96E-07	6.62E-07	2.18E-06	µCi/Sample
VSP-18	Gross Alpha	4.64E-07	4.05E-07	1.34E-06	µCi/Sample	Gross Beta	1.37E-06	7.69E-07	2.35E-06	µCi/Sample
VSP-19	Gross Alpha	4.83E-07	3.93E-07	1.20E-06	µCi/Sample	Gross Beta	2.66E-06	9.01E-07	2.28E-06	µCi/Sample
VSP-20	Gross Alpha	-8.88E-08	2.84E-08	1.29E-06	µCi/Sample	Gross Beta	5.33E-07	6.09E-07	2.18E-06	µCi/Sample
VSP-21	Gross Alpha	-1.06E-07	3.52E-08	1.34E-06	µCi/Sample	Gross Beta	1.27E-06	7.44E-07	2.29E-06	µCi/Sample
VSP-22	Gross Alpha	2.07E-07	2.79E-07	1.20E-06	µCi/Sample	Gross Beta	6.27E-09	5.56E-07	2.26E-06	µCi/Sample
VSP-23	Gross Alpha	-1.05E-07	3.52E-08	1.34E-06	µCi/Sample	Gross Beta	7.28E-07	6.72E-07	2.29E-06	µCi/Sample
VSP-24	Gross Alpha	-6.91E-08	3.78E-08	1.20E-06	µCi/Sample	Gross Beta	5.84E-07	6.37E-07	2.23E-06	µCi/Sample
VSP-25	Gross Alpha	1.79E-07	2.87E-07	1.34E-06	µCi/Sample	Gross Beta	2.33E-06	8.74E-07	2.32E-06	µCi/Sample
VSP-27	Gross Alpha	1.94E-07	2.85E-07	1.29E-06	µCi/Sample	Gross Beta	2.13E-06	8.24E-07	2.21E-06	µCi/Sample
VSP-29	Gross Alpha	-6.90E-08	3.78E-08	1.20E-06	µCi/Sample	Gross Beta	4.57E-08	5.55E-07	2.23E-06	µCi/Sample
VSP-30	Gross Alpha	4.83E-07	3.93E-07	1.20E-06	µCi/Sample	Gross Beta	2.30E-06	8.62E-07	2.28E-06	µCi/Sample

Table 1: Gross Alpha/Beta results for smears from Group 1 Statistically Directed Sampling

VSP #	Nuclide	Result	Uncertainty (1 sigma)	MDA	Unit	Nuclide	Result	Uncertainty (1 sigma)	MDA	Unit
VSP-31	Gross Alpha	-8.90E-08	2.84E-08	1.29E-06	µCi/Sample	Gross Beta	1.08E-06	6.87E-07	2.18E-06	µCi/Sample
VSP-32	Gross Alpha	-8.86E-08	2.84E-08	1.29E-06	µCi/Sample	Gross Beta	1.71E-07	5.52E-07	2.18E-06	µCi/Sample
VSP-33	Gross Alpha	1.80E-07	2.87E-07	1.34E-06	µCi/Sample	Gross Beta	5.04E-07	6.47E-07	2.32E-06	µCi/Sample
VSP-34	Gross Alpha	-6.92E-08	3.78E-08	1.20E-06	µCi/Sample	Gross Beta	1.66E-06	7.77E-07	2.23E-06	µCi/Sample
VSP-35	Gross Alpha	1.95E-07	2.85E-07	1.29E-06	µCi/Sample	Gross Beta	4.95E-07	6.10E-07	2.21E-06	µCi/Sample
VSP-36	Gross Alpha	2.07E-07	2.79E-07	1.20E-06	µCi/Sample	Gross Beta	1.08E-06	7.11E-07	2.26E-06	µCi/Sample
VSP-37	Gross Alpha	1.79E-07	2.87E-07	1.34E-06	µCi/Sample	Gross Beta	1.23E-06	7.45E-07	2.32E-06	µCi/Sample
VSP-38	Gross Alpha	1.95E-07	2.85E-07	1.29E-06	µCi/Sample	Gross Beta	1.32E-07	5.53E-07	2.21E-06	µCi/Sample
VSP-39	Gross Alpha	-6.91E-08	3.78E-08	1.20E-06	µCi/Sample	Gross Beta	9.42E-07	6.86E-07	2.23E-06	µCi/Sample
VSP-40	Gross Alpha	2.17E-06	8.13E-07	1.35E-06	µCi/Sample	Gross Beta	6.42E-06	1.29E-06	2.50E-06	µCi/Sample
VSP-41	Gross Alpha	-8.85E-08	2.84E-08	1.29E-06	µCi/Sample	Gross Beta	-1.92E-07	4.89E-07	2.18E-06	µCi/Sample

Table 2: Alpha Spectroscopy results for follow-up analysis from Group 1 Statistically Directed Sampling

Results	SCF-00502 (VSP-25)	Avg. Blank	SCF-00515 (VSP-40)	Avg. Blank	SCF-00522 (VSP-19)	Avg. Blank	SCF-00525 (VSP-30)	Avg. Blank	Unit
Np-237	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	uCi/sample
Pu-238	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	uCi/sample
Pu-239	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	uCi/sample
U-234	3.09E-08	2.67E-08	6.78E-08	2.67E-08	4.89E-08	2.67E-08	1.82E-08	2.67E-08	uCi/sample
U-235	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	uCi/sample
U-238	1.76E-08	2.89E-08	1.17E-07	2.89E-08	3.01E-09	2.89E-08	2.63E-08	2.89E-08	uCi/sample
Am-241	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	uCi/sample
Th-228	5.46E-08	<MDA	8.00E-08	<MDA	3.85E-08	<MDA	<MDA	<MDA	uCi/sample
Th-230	3.57E-08	3.91E-08	9.69E-08	3.91E-08	<MDA	3.91E-08	<MDA	3.91E-08	uCi/sample
Th-232	5.29E-08	2.22E-08	7.67E-08	2.22E-08	3.91E-08	2.22E-08	4.01E-08	2.22E-08	uCi/sample

Table 3: Average Minimum Detectable Activity for follow-up Alpha Spectroscopy analysis, Group 1

Analyte	**Avg. MDA (uCi/sample)**
Np-237	1.29E-08
Pu-238	1.36E-08
Pu-239	1.42E-08
U-234	1.62E-08
U-235	1.53E-08
U-238	1.16E-08
Am-241	1.70E-08
Th-228	3.99E-08
Th-230	1.82E-08
Th-232	1.67E-08

Group 2

Sampling Summary

Based on the sampling plan discussed for Group 1 samples, three high-volume and four low-volume air samples were collected inside and around the Zahn's Corner Middle School to evaluate the potential for airborne contamination[3]. These samples, along with several air filter media blanks, were shipped to the Environmental and Bioassay Laboratory at the Savannah River Site for radiochemical separation and analysis by alpha spectroscopy.

Results Summary

For the air samples collected, no artificial radionuclides (Np-237, Pu-238, Pu-239, or Am-241) were detected above the method detection limits. The method detection limits were at most, 1/10th the activity in the air that would result in a member of the public receiving 100 mrem per year, based on applying the isotopic ratios published by Moody, et. al. (1995) for samples from the Portsmouth site. For the naturally-occurring isotopes of uranium and thorium, the measured values on the air filters were consistent with the natural activity of uranium and thorium in the filter media itself. The presence of these isotopes, therefore, cannot be attributed to the air. The ratio of U-234 to U-238 was consistent with what would be expected in natural uranium. In all air samples, U-235 was not measured above the method detection limit.

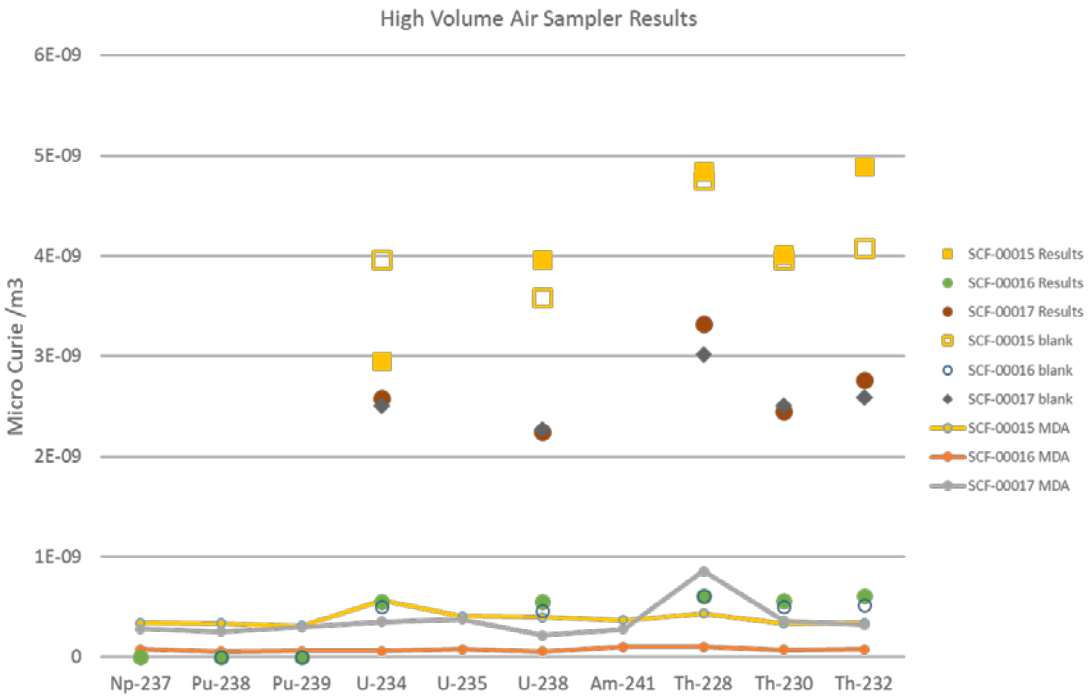


Figure 4: Group 2 High Volume Sampling Results

[3] High volume air samplers rapidly collect large volumes of air through a filter media; flow rates can be on the order of one cubic meter per minute; low volume air samplers operate at substantially lower flow rates – on the order of one cubic meter per hour.

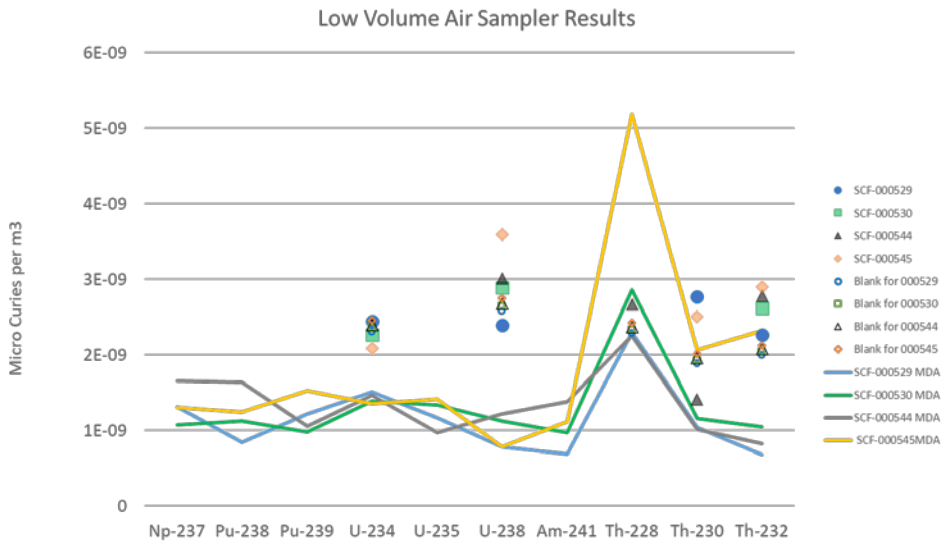


Figure 5: Group 2 Low Volume Air Sampling Results

Method and Analysis Summary

Three high volume and four low volume air samples were collected inside and around the Zahn's Corner Middle School to evaluate the potential for airborne contamination. These samples, along with several air filter media blanks, underwent radiochemical separation and analysis by alpha spectroscopy.

Analysis of the air filter samples began with the rigorous digestion of the filter matrix using strong acid at elevated temperature, followed by extraction chromatography to separate the isotopes by element and remove potential spectral interferences between the actinide isotopes. The separated fractions were then precipitated onto the alpha spectroscopy substrate for analysis. Samples were counted for 36 hours to reach sufficiently low detection limits within a reasonable time period. Details of the extraction methods used can be found in Maxwell, et.al. (2010).

Results are shown in Tables 4 and 5, and include data for the samples and blank (unused) filter media. Analysis of the blank filters show that the filter media contains trace levels of uranium and thorium which occur naturally in the feedstock material used for the filters.

Table 4a: High Volume Air Sample Results

Nuclide	SCF-00015	Blank for 00015	SCF-00016	Blank for 00016	SCF-00017	Blank for 00017	Unit
Np-237	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	uCi/m3
Pu-238	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	uCi/m3
Pu-239	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	uCi/m3
U-234	2.95E-09	3.96E-09	5.51E-10	5.04E-10	2.58E-09	2.51E-09	uCi/m3
U-235	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	uCi/m3
U-238	3.96E-09	3.58E-09	5.49E-10	4.56E-10	2.24E-09	2.27E-09	uCi/m3
Am-241	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	uCi/m3
Th-228	4.84E-09	4.76E-09	6.11E-10	6.06E-10	3.32E-09	3.02E-09	uCi/m3
Th-230	4.01E-09	3.96E-09	5.58E-10	5.05E-10	2.45E-09	2.51E-09	uCi/m3
Th-232	4.89E-09	4.08E-09	6.04E-10	5.20E-10	2.76E-09	2.59E-09	uCi/m3

Table 4b: Low Volume Air Sample Results

Nuclide	SCF-000529	Blank for 000529	SCF-000530	Blank for 000530	SCF-000544	Blank for 000544	SCF-000545	Blank for 000545	Unit
Np-237	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	uCi/m3
Pu-238	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	uCi/m3
Pu-239	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	uCi/m3
U-234	2.45E-09	2.31E-09	2.27E-09	2.37E-09	<MDA	2.40E-09	2.09E-09	2.46E-09	uCi/m3
U-235	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	uCi/m3
U-238	2.4E-09	2.58E-09	2.89E-09	2.65E-09	3.01E-09	2.68E-09	3.59E-09	2.75E-09	uCi/m3
Am-241	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	uCi/m3
Th-228	<MDA	2.29E-09	<MDA	2.34E-09	2.67E-09	2.37E-09	<MDA	2.43E-09	uCi/m3
Th-230	2.77E-09	1.89E-09	<MDA	1.94E-09	1.41E-09	1.96E-09	2.51E-09	2.02E-09	uCi/m3
Th-232	2.27E-09	2.00E-09	2.62E-09	2.05E-09	2.78E-09	2.08E-09	2.9E-09	2.13E-09	uCi/m3

Table 5a: Method Detection Limits for High-Volume Air Samples

Nuclide	SCF-00015	SCF-00016	SCF-00017	Unit
Np-237	3.39E-10	7.42E-11	2.82E-10	uCi/m3
Pu-238	3.33E-10	5.52E-11	2.52E-10	uCi/m3
Pu-239	3.10E-10	6.05E-11	2.97E-10	uCi/m3
U-234	5.62E-10	5.87E-11	3.52E-10	uCi/m3
U-235	4.05E-10	7.56E-11	3.75E-10	uCi/m3
U-238	3.96E-10	5.43E-11	2.17E-10	uCi/m3
Am-241	3.66E-10	9.96E-11	2.79E-10	uCi/m3
Th-228	4.32E-10	9.90E-11	8.58E-10	uCi/m3
Th-230	3.35E-10	7.05E-11	3.58E-10	uCi/m3
Th-232	3.39E-10	7.70E-11	3.24E-10	uCi/m3

Table 5b: Method Detection Limits for Low-Volume Air Samples

Nuclide	SCF-000529	SCF-000530	SCF-000544	SCF-000545	Unit
Np-237	1.32E-09	1.08E-09	1.66E-09	1.31E-09	uCi/m3
Pu-238	8.50E-10	1.13E-09	1.64E-09	1.25E-09	uCi/m3
Pu-239	1.22E-09	9.81E-10	1.06E-09	1.53E-09	uCi/m3
U-234	1.51E-09	1.39E-09	1.47E-09	1.36E-09	uCi/m3
U-235	1.17E-09	1.34E-09	9.76E-10	1.42E-09	uCi/m3
U-238	7.87E-10	1.13E-09	1.22E-09	7.89E-10	uCi/m3
Am-241	6.95E-10	9.76E-10	1.38E-09	1.12E-09	uCi/m3
Th-228	2.30E-09	2.86E-09	2.26E-09	5.19E-09	uCi/m3
Th-230	1.04E-09	1.16E-09	1.02E-09	2.07E-09	uCi/m3
Th-232	6.83E-10	1.05E-09	8.31E-10	2.32E-09	uCi/m3

Group 3

Sampling Summary

The Group 3 samples were taken to assess the validity of results previously presented by Michael Ketterer of Northern Arizona University (NAU) to Elizabeth Lamerson of Piketon County, OH[4]. Sampling locations were identified based on information provided by a community member who was involved in the initial NAU collection effort. The locations were pointed out during a school walkthrough. New samples were collected by means of taking dry 'smear' samples. Five distinct locations were sampled in triplicate by smearing side-by-side locations. Care was taken so as to not overlap sampling areas. One set of these smear samples was sent to SRNL for analysis, where Inductively Coupled Mass Spectrometry (ICP-MS) was used. This procedure was employed by SRNL because it was the methodology used by Ketterer in his report. The

[4] https://woub.org/wp-content/uploads/2019/04/Ketterer-Szechenyi-NAU-Piketon-27Apr2019_V7.pdf

other two sets of smears (five each) were transferred to the state and county for independent analysis by their own preferred methods.

Results Summary

At SRNL, after leaching the filters with acid to remove material of interest, ICP-MS was used to analyze for isotopes of thorium, uranium, neptunium, plutonium, and americium. In all of the samples, only uranium 235 and 238 isotopes were detectable. Additionally, the quantity of uranium measured in each sample was consistent with uranium leached from the glass filter media, suggesting that there was no additional removable uranium in the collected dust.

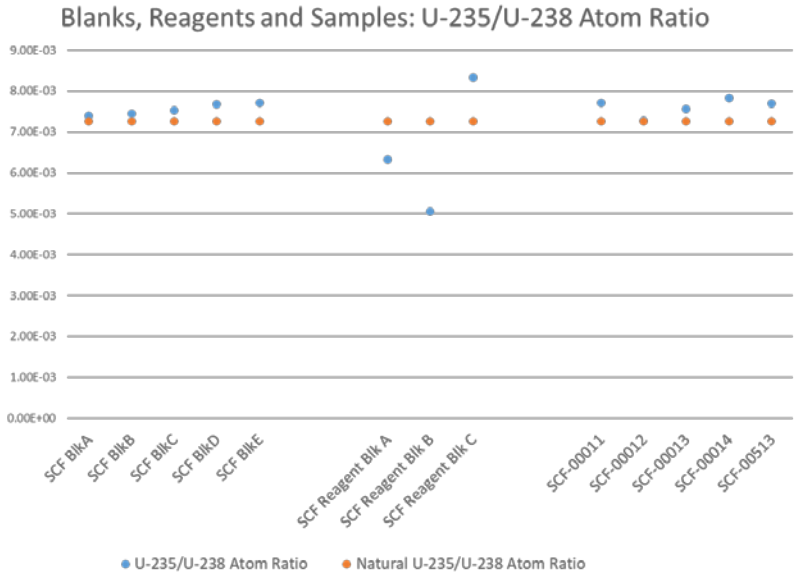


Figure 6: Comparison of U235/238 ratios in samples, reagents, and blanks

Method and Analysis Summary

At SRNL, the samples were cut in half prior to processing for analysis. The first half was reserved for future investigations. The second half were placed in acid to leach the radionuclides from the collection material. Extremely pure (optima-grade), low background nitric acid was used in the leaching process. This was intended to maximize recovery of the thorium, uranium, neptunium, plutonium, and americium, while minimizing any contributions of radioactivity from the filter or solutions used in the analysis. The leached solution was evaporated to concentrate it, and then reconstituted by adding 20 ml of dilute nitric acid. From this solution 10ml was injected into the ICP-MS, and the remaining 10ml was archived for future investigations. As part of the quality control process, unused (blank) glass fiber material was processed alongside the samples, as were samples of the reagents used in the analysis. The purpose was to determine if any radionuclides might be present in the sampling and analysis material itself, as all natural material has some radioactive content.

The results of the sample analysis, along with the average values measured for the smear blanks, are shown below in Table 6. Results are provided as $\mu Ci/100cm^2$, which is a commonly used unit of measurement when reporting information on radioactive contamination. The method

detection limits (MDLs) for each isotope are shown in Table 7, first in traditional radiation protection units and then in mass per area (picograms, or 1/1,000,000,000,000 of a gram). Since uranium 235 and 238 were detected in both the reagent blank and sample matrix blanks, it is more appropriate to examine the measured activity relative to the matrix blank than the instrument detection limit (as U-235 and -238 was measureable in all samples).

For all five locations that were sampled, only U-235 and U-238 were measured above the detection limits of the ICP/MS equipment. The amount of U-235 and -238 observed in all five samples was statistically no different from that found in the glass fiber collection material.

Table 6: Group 3 SRNL ICP-MS Sample Results

	Activity (µCi/100cm^2)								
Sample	**U-233**	**U-234**	**U-235**	**U-236**	**Np-237**	**U-238**	**Pu-239**	**Pu-240**	**Am-241**
SCF-00011	<MDL	<MDL	8.15E-10	<MDL	<MDL	1.66E-08	<MDL	<MDL	<MDL
SCF-00012	<MDL	<MDL	4.89E-10	<MDL	<MDL	1.06E-08	<MDL	<MDL	<MDL
SCF-00013	<MDL	<MDL	6.58E-10	<MDL	<MDL	1.37E-08	<MDL	<MDL	<MDL
SCF-00014	<MDL	<MDL	7.02E-10	<MDL	<MDL	1.41E-08	<MDL	<MDL	<MDL
SCF-00513	<MDL	<MDL	7.06E-10	<MDL	<MDL	1.44E-08	<MDL	<MDL	<MDL
Blank (avg)	<MDL	<MDL	7.93E-10	<MDL	<MDL	1.65E-08	<MDL	<MDL	<MDL

Table 7: Group 3 SRNL Method Detection Limits

Detection Limit [µCi/100cm^2]		**Detection limit, expressed as picograms/100 cm^2**
U-233	1.21E-06	1.26E+02
U-234	6.44E-08	1.04E+01
U-235	Matrix Limited	Matrix Limited
U-236	1.28E-08	1.98E+02
Np-237	1.40E-07	1.99E+02
U-238	Matrix Limited	Matrix Limited
Pu-239	1.23E-05	1.98E+02
Pu-240	4.50E-05	1.96E+02
Am-241	6.80E-04	1.98E+02

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