Northern Agency Tronox Mines

FINAL
Appendix D
Uranium Equilibrium Report

Response, Assessment, and Evaluation Services (RAES)

Contract No. EP-S9-17-03

Task Order 0001

October 10, 2019

Submitted to

U.S. Environmental Protection Agency

Submitted by

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ACRONYMS AND ABBREVIATIONS

ASTM	ASTM International
AUM	Abandoned uranium mine
bgs	Below ground surface
Bi-214	Bismuth-214
BSA	Background study area
IAEA	International Atomic Energy Agency
Jc	Jurassic Carmel Formation
Jml	Lower Morrison Formation
Jms	Salt Wash Member
Js	Summerville Formation
Jse	Undifferentiated Summerville and Entrada Formation
JseJste	Undifferentiated Entrada Formation and Undifferentiated Summerville, Todilto, and Entrada Formations
Jste	Undifferentiated Summerville, Todilto, and Entrada Formations
N/A	Not applicable
Pb-210	Lead-210
pCi/g	Picocuries per gram
Po-210	Polonium-210
Qa	Quaternary alluvium
R^2	Coefficient of determination
Ra-226	Radium-226
RMSE	Root mean square error
Rn-222	Radon-222
RSD	Relative standard deviation
RSE	Removal Site Evaluation
SD	Standard deviation
Tc	Chuska Sandstone Formation
Tetra Tech	Tetra Tech, Inc.
Th-230	Thorium-230
Th-232	Thorium-232
Trc	Chinle Formation
U-238	Uranium-238
U-234	Uranium-234
U-235	Uranium-235
UCL	Upper confidence level

ACRONYMS AND ABBREVIATIONS (CONTINUED)

USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey
XRF	X-ray fluorescence

EXECUTIVE SUMMARY

The objective of this appendix is to present results of equilibrium studies to determine equilibrium conditions of uranium decay series radionuclides measured in soil and sediment samples collected at the Northern Agency Tronox abandoned uranium mine (AUM) sites during the Removal Site Evaluation (RSE) investigation in 2018. Soil samples had been collected at very few of the AUM sites and Targets prior to the 2018 RSE investigation, as discussed in the Data Gap Analysis Report in the Northern Agency Tronox Mines Removal Site Evaluation Work Plan (RSE Work Plan) (Tetra Tech, Inc. [Tetra Tech] 2018), and the analyses did not evaluate equilibrium conditions of uranium series progeny within soils. The studies involved analyzing soil samples for uranium series isotopes uranium-238 (U-238), thorium-230 (Th-230), radium-226 (Ra-226), and lead-210 (Pb-210), and comparing ratios among them.

Radioactive disequilibrium is not unexpected in soils at AUM sites because of the many geochemical processes affecting uranium ore deposits (Rosholt 1959). Radioactive disequilibrium is the condition whereby the ratio of the activity concentration between a parent isotope and its shorter-lived progeny isotope is not equal to unity. When the isotopic ratio between parent radionuclide and progeny is equal to unity, this equilibrium condition is referred to as secular equilibrium. Based on the methods presented in this report, conditions of secular equilibrium were concluded to exist between U-238 and Th-230 in the samples collected within the Jurassic Carmel (Jc) geology and between Th-230 and Ra-226 in the samples collected within the Summerville Formation (Js). Among the 309 samples analyzed for uranium series isotopes, calculated isotopic ratios spanned both progeny isotope deficiencies and progeny isotope excesses. On average, the samples contained greater activity concentrations of progeny isotopes (Th-230, Ra-226, and Pb-210) than of the parent U-238, resulting in U-238 to progeny isotope ratios less than 1.

Determination of uranium series equilibrium conditions at an AUM can be an important part of the risk assessment process, as the fraction of Ra-226 decay products present in the environment influences a hypothetical receptor's radiation dose and excess lifetime cancer risk. However, assuming secular equilibrium between Ra-226 and its decay products for the purpose of risk assessment is acceptable and conservative, and avoids needing to conclusively determine equilibrium conditions at an AUM. Thus, an inconclusive result or result indicating a departure from secular equilibrium is not a study data gap. The risk assessment phase may still proceed, provided that conservative assumptions are included regarding equilibrium concentrations of Ra-226 decay products. Results from the analysis presented here indicate that, on average, a greater activity concentration of Ra-226 is present than of its progeny Pb-210. This further supports the conservative assumption of secular equilibrium between Ra-226 and its decay products.

1.0 INTRODUCTION

Radioactive equilibrium is defined as a condition whereby a parent nuclide and its decay product are present at a fixed ratio. Secular equilibrium is a condition that occurs when the half-life of a decay-product nuclide is significantly shorter than that of its parent nuclide. After a period of ingrowth equal to approximately seven times the half-life of the decay product, the two nuclides effectively decay with the half-life of the parent. When two radionuclides are in secular equilibrium, their activities are effectively equal.

If the progeny is in secular equilibrium with its parent, a one-to-one relationship is expected; however, an analysis of the equilibrium of the samples within the areas sampled indicated a ratio other than one-to-one. Most commonly, a ratio other than one-to-one results from an environmental process that chemically selects for and transports one nuclide (parent or decay product) away from the other nuclide. Because a consistent fraction of one nuclide has been removed, the two nuclides are present at a fixed ratio other than one-to-one.

Radium-226 (Ra-226), for example, produces a chain of short-lived progeny. These progeny will rapidly approach the activity of the Ra-226 parent if separation from Ra-226 does not occur. From Ra-226, the immediate decay product is the noble gas radon-222 (Rn-222), which may be readily lost prior to decay from non-retentive materials such as soil (International Atomic Energy Agency [IAEA] 2014), and result in radioactive disequilibrium between parent and progeny. Overall, concentrations of Ra-226 daughters depend on retention of Rn-222 and time of separation from lead-210 (Pb-210) and polonium-210 (Po-210).

Determination of secular equilibrium at an abandoned uranium mine (AUM) can be an important part of the risk assessment process, as the assumed fraction of Ra-226 decay products present in the environment influences a hypothetical receptor's radiation dose and excess lifetime cancer risk. However, assuming secular equilibrium between Ra-226 and its decay products for the purpose of risk assessment is acceptable and conservative, and avoids needing to conclusively determine secular equilibrium conditions at an AUM. Thus, an inconclusive result regarding secular equilibrium is not a study data gap. The risk assessment phase may still proceed, provided that conservative assumptions are included regarding equilibrium concentrations of Ra-226 decay products.

1.1 RADIOACTIVE DECAY SERIES

All heavy elements found in nature (atomic number > 83) are radioactive and decay by alpha or beta emission. The heaviest elements decay into successive radioactive daughters, forming a series (or chain) of radionuclides that end when a stable nuclide is produced. Three major decay series are of concern for the AUM project: the uranium series (uranium-238 [U-238] parent), thorium series (thorium-232 [Th-232] parent), and actinium series (uranium-235 [U-235] parent). Each series begins with a long-lived (primordial) radionuclide, decays through a number of intermediate species, and ends in a stable isotope of lead. Examples of the uranium and thorium decay chains are shown on Figure D-1 and Figure D-2. In general, the uranium decay series is in secular equilibrium in the earth's crust (i.e., all decay products are present at the same activity concentration as the parent U-238). However, some uranium ore bodies formed as uranium oxide precipitated from uranium-bearing groundwaters under reducing conditions in porous and permeable rocks (New Mexico Bureau of Geology and Mineral Resources 2018). Such ore bodies, often called "roll front deposits," may not be in secular equilibrium because of the differential mobility of the long-lived members of the uranium decay series (i.e., uranium, thorium, and radium) and the age of the ore body. At the Northern Agency Tronox AUM sites, within the Lukachukai Mountains, mining occurred of uranium-vanadium bearing ore bodies residing in the Salt Wash Member of the Morrison Formation (Chenoweth 1988). These ore deposits differ from typical roll-front sandstone deposits that resulted from oxidizing conditions on the edge of a sandstone tongue, in that deposition of uranium at those AUM sites is believed to have occurred under reduced sandstone conditions (Thamm, Kovschak, and Adams 1981).

Uranium series disequilibrium is common and can affect aerial gamma survey results (Dickson 1995) and dose rate assumptions (IAEA 2014, El-Dine 2007)—and even can be used to date the age of uranium migration in ore-bearing sandstone deposits (Killeen and Carmichael 1976).

In 1959, the U.S. Geological Survey (USGS) investigated disequilibrium of the uranium series within ore deposits across the United States and described the range of disequilibrium conditions discovered, as well as associated geochemical processes resulting in those conditions (Rosholt 1959). Several carnotite ore samples from the Colorado Plateau were found to exhibit a deficiency in daughter product activity.

Degree of equilibrium depends on time elapsed since separation of the uranium from its decay products. Rates at which decay products build up from the parent radionuclide decay are functions of their half-lives. The limiting half-life for the U-238 decay series is 77,000 years (Th-230). Ore bodies older than approximately 500,000 years would be in secular equilibrium, absent any geochemical conditions that would separate the uranium from its decay products. To describe the long-term state of equilibrium of the chain, the relatively longer-lived isotopes U-238, Th-230, Ra-226, and Pb-210 were assessed. U-238 and U-234 are considered present at constant ratios to each other. U-238 is considered representative of U-234 for this study.

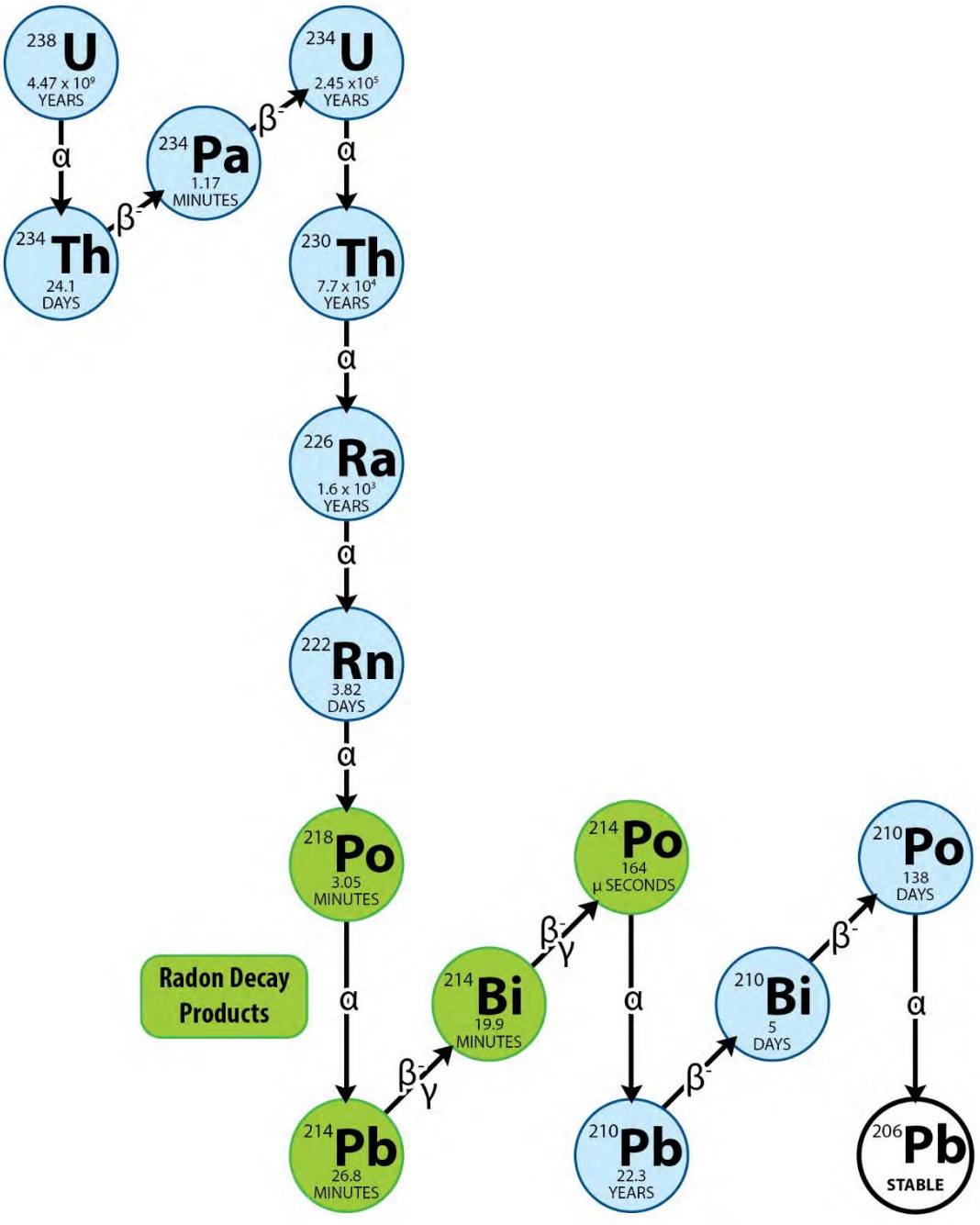

Figure D-1. Uranium Decay Series Including Decay Modes and Half-Lives

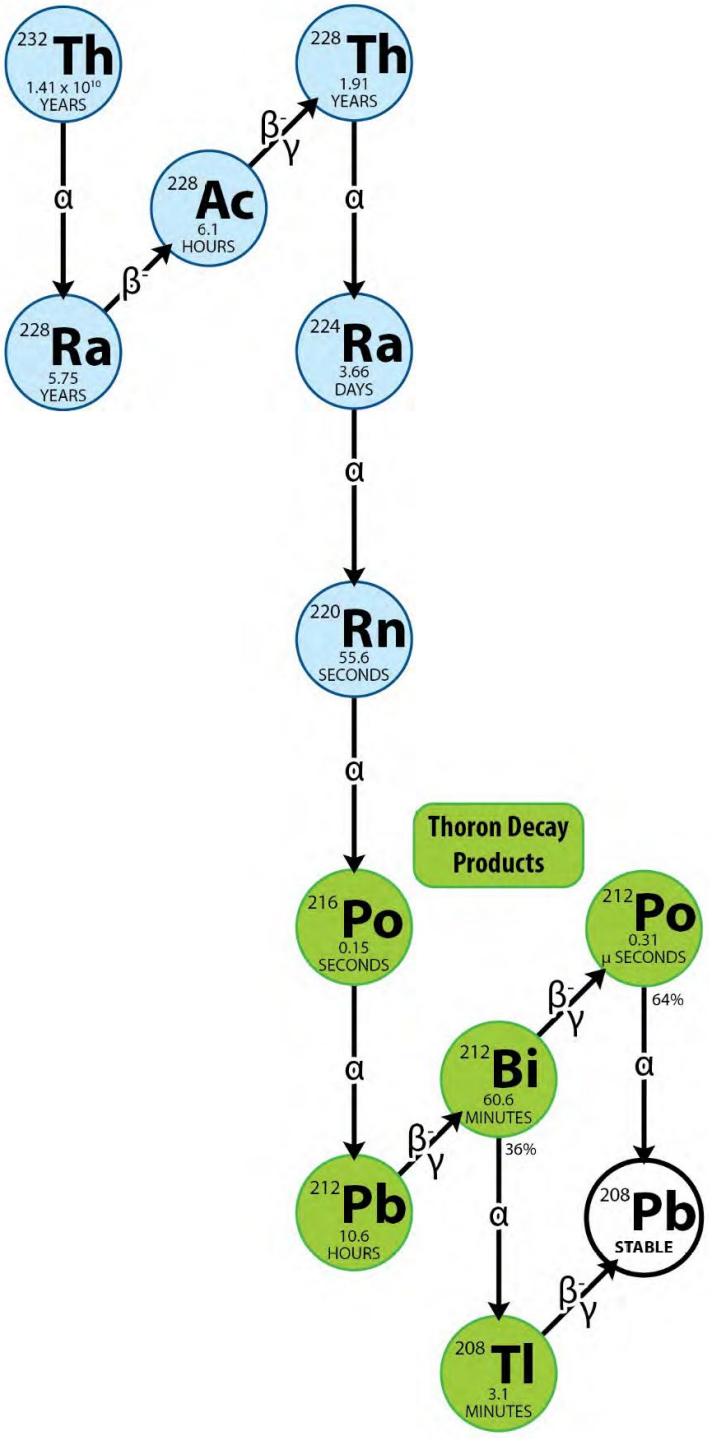

Figure D-2. Thorium Decay Series Including Decay Modes and Half-Lives

1.2 SECULAR EQUILIBRIUM

Secular equilibrium in a decay series (when all decay products are present at the same activity concentration as the parent) can be achieved in a closed system when the parent radionuclide has a half-life much longer than any of the progeny half-lives. A certain amount of time, depending on the half-lives of the progeny, is required to achieve secular equilibrium. When equilibrium is reached, the activity of every member of the decay series is the same. Consider the following straightforward case: Figure D-3 is a plot over time of activities (A_1 and A_2) of two radioisotopes, whereby A_1 is decaying to A_2, and the half-life of A_1 is much greater than that of A_2. T_1 and T_2 in the figure are the half-lives of the parent and daughter isotopes.

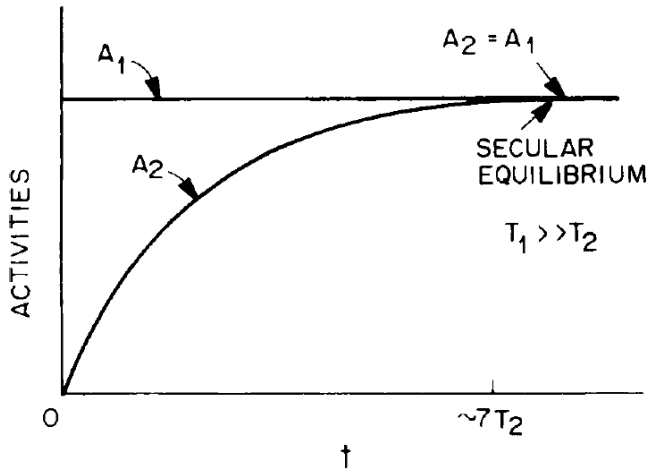

Figure D-3. Activities of Parent (A_1) and Daughter (A_2) Over Time as Secular Equilibrium Is Reached (Turner 2008)

Figure D-3 shows that secular equilibrium is reached after about seven half-lives (T_2) of the decay product (if no daughter activity is present initially). Activity of the decay product equals activity of the parent: production of the decay product by decay of the parent occurs at the same rate as decay of that decay product. If many radionuclides are in a series, such as in the uranium or thorium decay series, given enough time, all radioisotopes in the series will have the same activity, absent any chemical process that separates the elements.

If secular equilibrium exists, knowing the activity of one radioisotope enables indirect determination of the activity of all radioisotopes in the series. For example, measurement of Ra-226 activity via gamma spectroscopy can sometimes be difficult. If secular equilibrium exists, gamma emissions from bismuth-214 (Bi-214) can be measured instead, and used to infer the activity of Ra-226.

2.0 METHODS

All soil samples collected during the RSE Investigation were analyzed for Ra-226. Ten percent of the samples collected were analyzed for U-238, Th-230, and Pb-210 to facilitate an equilibrium analysis. U-238 and Th-230 soil concentrations were measured via ASTM International (ASTM) D3972 (alpha spectroscopy). Pb-210 concentration was measured via the Pb-210 Eichrom method. Ra-226 concentration was measured via U.S. Environmental Protection Agency (USEPA) Method 901.1 (gamma spectroscopy). Results from the gamma spectroscopy measurement represent total activity of a sample aliquot, whereas both alpha spectroscopy counting and the Eichrom method require dissolution of a sample aliquot in order to prepare a counting source or a liquid scintillation cocktail. Complete digestion of the sample is assumed in the following discussion of equilibrium analysis:

The datasets evaluated included all detected data. Some sample results were qualified, and the qualifiers are included with the sample results presented in Attachment D1. Moreover, no analysis of uncertainty or error associated with limited sample sizes occurred during the evaluation of equilibrium conditions.

Equilibrium by geology and sample type was evaluated as follows, with Th-230 and Ra-226 serving as examples:

1. A figure was developed depicting a plot of soil concentrations of Th-230 versus soil concentrations of Ra-226.
2. Simple linear regression was performed on the dataset; the p-value and the coefficient of determination, R^2, were recorded. The resulting linear model and the 95 percent upper confidence level (UCL) bands were plotted on the figure generated in step 1.
3. The line y=x was added to the figure generated in step 2 (representing a 1:1 ratio between Th-230 and Ra-226, indicative of secular equilibrium).
4. An examination of the model and the figure occurred sequentially:

    a. If the p-value for the regression slope was insignificant ($p > 0.05$) or the R^2 did not represent a good linear fit for the data ($R^2 > 0.8$), evidence was insufficient to conclude that Ra-226 and Th-230 were in equilibrium (secular or otherwise).

    b. If the p-value for the regression slope was significant (< 0.05) and the R^2 represented a good linear fit for the data ($R^2 > 0.8$), two conditions were possible, which were evaluated via visual examination of the figure generated in step 3:

        i. If the y=x line fell fully within the bounds of the 95% UCL bands on the regression, that was evidence that Ra-226 and Th-230 were in secular equilibrium at the site.

        ii. If the y=x line fell partially or completely outside the bounds of the 95% UCL bands on the regression, that was evidence that Ra-226 and Th-230 were in equilibrium, but not secular equilibrium at the site.

3.0 RESULTS

3.1 GEOLOGY

The following sections evaluate uranium series equilibria in soil samples collected across numerous geologies project-wide.

3.1.1 Overview

The evaluation of uranium series equilibria in soil samples collected across numerous geologies project-wide included samples from AUM sites, Target sites, and background study areas (BSA). A summary of different isotopic ratios and relevant statistics for each geology is in Table D-1. The ratios include combinations of U-238, Th-230, Ra-226, and Pb-210. Equilibrium conditions for each geology are conveyed in the following subsections.

Table D-1. Isotopic Ratios and Statistics for Soil Samples by Geology Type

Ratio	Parameter	Jc	Jml	Jms	Js	Jse	JseJste	Jste	Qa	Tc	Trc	All
U-238/ Th-230	n	11	142	5	13	66	75	6	11	3	13	270
	Min	0.54	0.20	0.27	0.55	0.52	0.45	0.45	0.41	N/A	0.58	0.2
	Max	1.04	2.25	2.88	1.06	2.03	2.03	0.83	0.89		1.1	2.88
	Mean	0.84	0.79	1.11	0.83	0.92	0.90	0.64	0.68		0.76	0.82
	Median	0.84	0.75	0.90	0.80	0.86	0.84	0.6	0.73		0.69	0.78
	SD	0.14	0.26	1.03	0.14	0.25	0.25	0.15	0.13		0.17	0.28
	RSD	17	33	93	17	27	28	24	19		23	34
	R^2	0.994	0.880	0.989	0.847	0.978	0.978	0.997	0.997		0.604	0.934
U-238/ Ra-226	n	11	131	5	13	61	70	6	10	1	13	251
	Min	0.59	0.2	0.13	0.55	0.26	0.26	0.3	0.25	N/A	0.38	0.13
	Max	0.79	2.8	1.74	1.16	5.23	5.23	0.95	0.84		1.01	5.23
	Mean	0.69	0.68	0.72	0.78	0.86	0.82	0.61	0.57		0.65	0.72
	Median	0.69	0.59	0.62	0.73	0.82	0.71	0.60	0.59		0.57	0.65
	SD	0.07	0.40	0.64	0.20	0.66	0.63	0.23	0.17		0.18	0.45
	RSD	9.4	56	88	26	77	77	37	30		27	62
	R^2	0.990	0.657	0.991	0.836	0.408	0.417	0.998	0.987	1	0.473	0.461
U-238/ Pb-210	n	11	131	5	13	65	74	6	11	N/A	12	255
	Min	0.27	0.11	0.35	0.36	0.21	0.21	0.45	0.47		0.15	0.11
	Max	1.31	4.17	2.17	1.29	6.84	6.84	1.38	1.11		1.26	6.84
	Mean	0.91	0.91	0.89	0.86	1.36	1.32	0.95	0.73		0.59	1.00
	Median	0.93	0.84	0.62	0.83	1.28	1.25	1.06	0.76		0.54	0.88
	SD	0.35	0.57	0.73	0.27	0.96	0.91	0.4	0.19		0.3	0.69
	RSD	39	62	82	32	70	69	42	26		51	69
	R^2	1.00	0.743	0.990	0.734	0.569	0.573	0.998	0.998		0.058	0.581
Th-230/ Ra-226	n	11	131	5	13	61	70	6	10	1	13	251
	Min	0.71	0.3	0.48	0.71	0.25	0.25	0.67	0.61	N/A	0.59	0.25
	Max	1.22	2.08	0.91	1.39	4.20	4.20	1.74	1.15		1.25	4.2
	Mean	0.84	0.85	0.64	0.94	0.91	0.89	0.97	0.84		0.87	0.87
	Median	0.82	0.81	0.61	0.84	0.87	0.86	0.84	0.87		0.85	0.84
	SD	0.15	0.26	0.17	0.22	0.48	0.47	0.39	0.15		0.19	0.32
	RSD	17	30	27	23	53	53	40	18		21	37
	R^2	1.00	0.841	1.00	0.837	0.491	0.503	0.992	0.992		0.707	0.635
Th-230/ Pb-210	n	11	131	5	13	65	74	6	11	1	12	255
	Min	0.38	0.14	0.58	0.34	0.28	0.28	0.7	0.63	N/A	0.22	0.25
	Max	1.67	2.83	1.3	1.46	5.49	5.49	2.54	1.75		1.87	4.2
	Mean	1.08	1.17	0.93	1.06	1.41	1.41	1.49	1.11		0.82	0.88
	Median	1.24	1.2	0.84	1.14	1.45	1.45	1.45	1.20		0.76	0.84
	SD	0.39	0.52	0.3	0.34	0.72	0.70	0.63	0.31		0.42	0.32
	RSD	36	44	32	32	51	49	42	28		51	37
	R^2	1.00	0.900	1.00	0.86	0.653	0.660	0.993	1.00		0.048	0.741

Table D-1. Isotopic Ratios and Statistics for Soil Samples by Geology Type (Continued)

Ratio	Parameter	Jc	Jml	Jms	Js	Jse	JseJste	Jste	Qa	Tc	Trc	All
Ra-226/ Pb-210	n	11	125	5	13	60	69	6	10	1	12	243
	Min	0.45	0.20	0.64	0.41	0.33	0.33	0.86	0.75	N/A	0.3	0.2
	Max	1.77	3.92	2.59	2.00	4.58	4.58	2.03	1.99		1.49	4.58
	Mean	1.31	1.52	1.63	1.17	1.74	1.77	1.55	1.41		0.94	1.51
	Median	1.37	1.58	1.25	1.10	1.78	1.79	1.58	1.40		0.96	1.54
	SD	0.48	0.67	0.86	0.46	0.74	0.75	0.4	0.45		0.35	0.67
	RSD	36	44	53	40	42	42	26	32		37	44
	R^2	1.00	0.919	1.00	0.679	0.914	0.917	1.00	0.985		0.152	0.925

Notes:
Jc Jurassic Carmel Formation
Jml Lower Morrison Formation
Jms Salt Wash Member
Js Summerville Formation
Jse Undifferentiated Summerville and Entrada Formation
JseJste Undifferentiated Summerville and Entrada Formation and Undifferentiated Summerville, Todilto, and Entrada Formations
Jste Undifferentiated Summerville, Todilto, and Entrada Formations
N/A Not applicable
Qa Quaternary alluvium
SD Standard deviation
RSD Relative standard deviation
R^2 Coefficient of determination
Tc Chuska Sandstone
Trc Chinle Formation

3.1.2 Jurassic Carmel Formation (Jc)

Uranium equilibrium was evaluated in 11 of the soil samples collected within the surface geology of the Jurassic Carmel Formation (Jc) of the Lukachukai Mountains. These samples included X-ray fluorescence (XRF) confirmation soil samples (0 to 3 inches below ground surface [bgs]) and surface soil samples (0 to 6 inches bgs) at BSAs, AUM sites, and Targets. Table D1-1 in Attachment D1 lists analytical results from these samples. A summary of different isotopic ratios appears in Section 3.1.1 of this report. In this subsection, a graphical summary shows the evaluation of secular equilibrium for three of these isotopic ratios: (1) U-238/Th-230, (2) U-238/Ra-226, and (3) Th-230/Ra-226.

Figure D-4 shows the evaluation of secular equilibrium between U-238 and Th-230 within the 11 soil samples containing detectable concentrations of both isotopes collected within the Jc geology. The regression p-value is < 0.0001 with an R^2 of 0.994; the y=x line falls entirely within the bounds of the 95% UCL bands on Figure D-4—evidence that U-238 and Th-230 are in secular equilibrium.

Figure D-5 shows the evaluation of secular equilibrium between U-238 and Ra-226 within the 11 soil samples containing detectable concentrations of both isotopes collected within the Jc geology. The regression p-value is < 0.0001 with an R^2 of 0.989; the y=x line falls partially within the bounds of the 95% UCL bands on Figure D-5—evidence that U-238 and Ra-226 are in equilibrium, but not secular equilibrium.

Figure D-6 shows the evaluation of secular equilibrium between Th-230 and Ra-226 within the 11 soil samples containing detectable concentrations of both isotopes collected within the Jc geology. The regression p-value is < 0.0001 with an R^2 of 0.998; the y=x line falls partially within the bounds of the 95% UCL bands on Figure D-6—evidence that Th-230 and Ra-226 are in equilibrium, but not secular equilibrium.

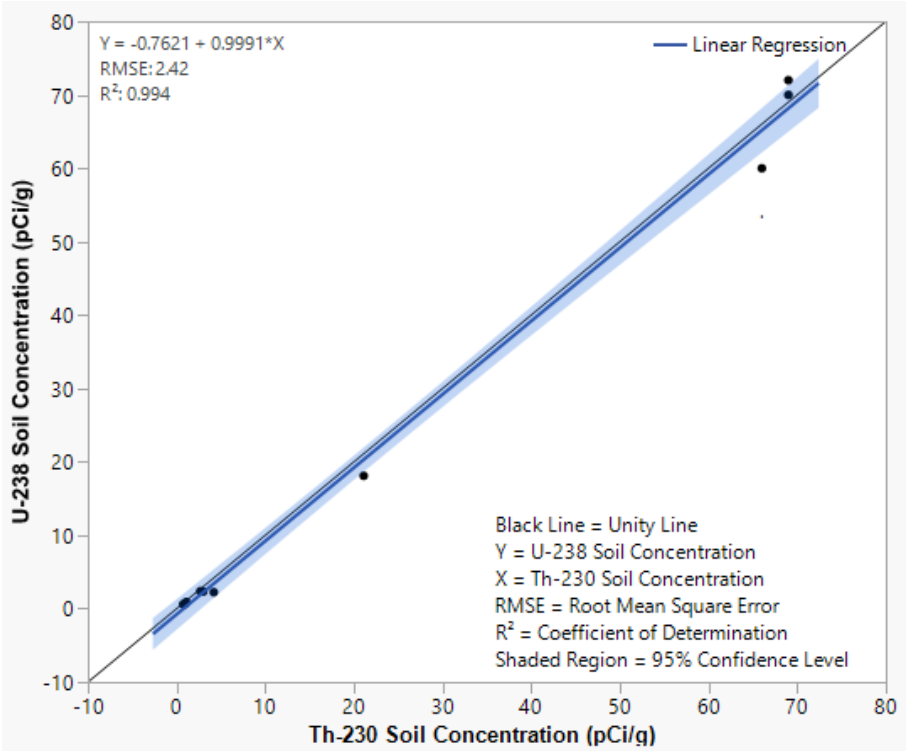

Figure D-4. Evaluation of Secular Equilibrium between U-238 and Th-230 in the Uranium Decay Series for the Jc Geology

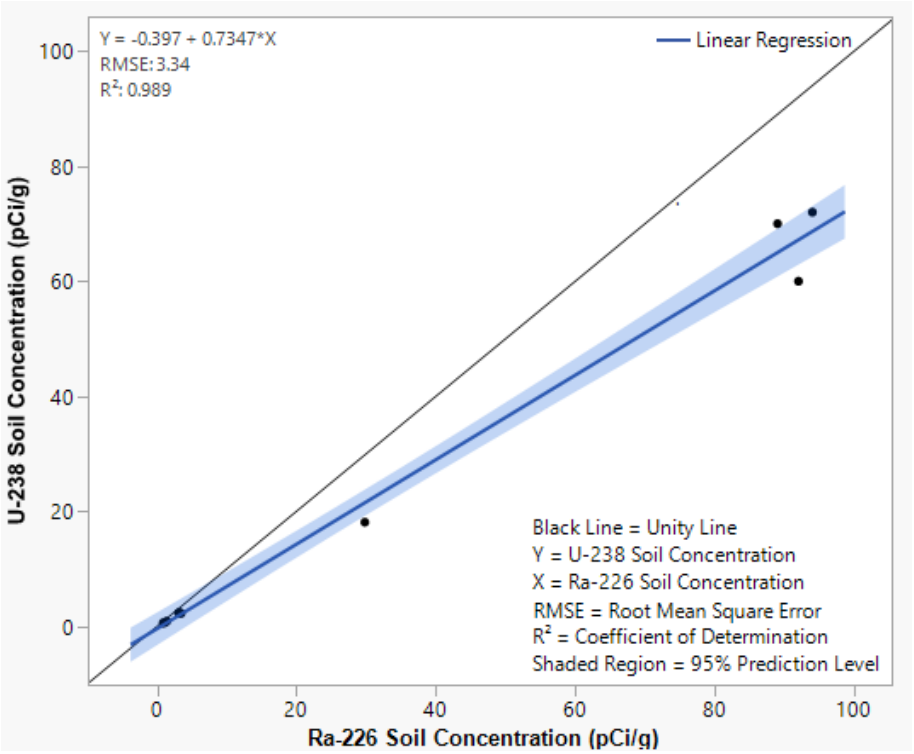

Figure D-5. Evaluation of Secular Equilibrium between U-238 and Ra-226 in the Uranium Decay Series for the Jc Geology

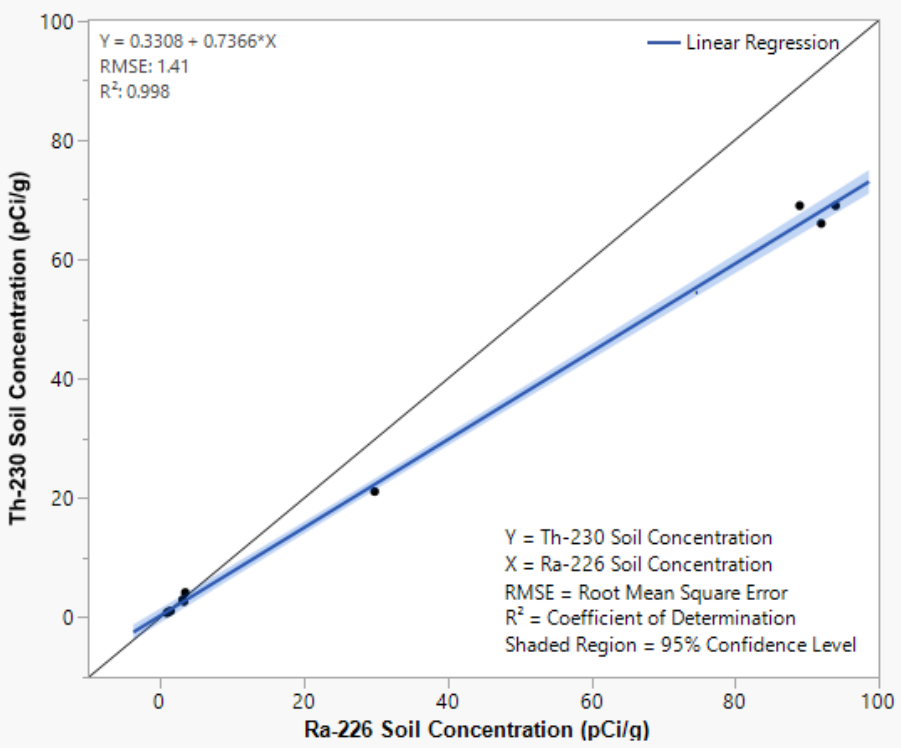

Figure D-6. Evaluation of Secular Equilibrium between Th-230 and Ra-226 in the Uranium Decay Series for the Jc Geology

3.1.3 Lower Morrison Formation (Jml)

Uranium equilibrium was evaluated in 142 of the soil samples collected within the surface geology of the Lower Morrison Formation (Jml) of the Lukachukai Mountains. These samples included XRF confirmation soil samples (0 to 3 inches bgs) and surface soil samples (0 to 6 inches bgs) at BSAs, AUM sites, and Target sites. Table D1-2 in Attachment D1 lists analytical results from these samples. A summary of different isotopic ratios appears in Section 3.1.1 of this report. In this subsection, a graphical summary shows the evaluation of secular equilibrium for three of these isotopic ratios: (1) U-238/Th-230, (2) U-238/Ra-226, and (3) Th-230/Ra-226.

Figure D-7 shows the evaluation of secular equilibrium between U-238 and Th-230 within the 142 soil samples containing detectable concentrations of both isotopes collected within the Jml geology. The regression p-value is < 0.0001 with an R^2 of 0.879; the y=x line falls partially within the bounds of the 95% UCL bands on Figure D-7—evidence that U-238 and Th-230 are in equilibrium, but not secular equilibrium.

Figure D-8 shows the evaluation of secular equilibrium between U-238 and Ra-226 within the 131 soil samples containing detectable concentrations of both isotopes collected within the Jml geology. The regression p-value is < 0.0001 with an R^2 of 0.657; the y=x line falls partially within the bounds of the 95% UCL bands on Figure D-8. Due to the low R^2 value, evidence is insufficient to conclude whether secular equilibrium exists.

Figure D-9 shows the evaluation of secular equilibrium between Th-230 and Ra-226 within the 131 soil samples containing detectable concentrations of both isotopes collected within the Jml geology. The regression p-value is < 0.0001 with an R^2 of 0.841; the y=x line falls partially within the bounds of the 95% UCL bands on Figure D-9—evidence that Th-230 and Ra-226 are in equilibrium, but not secular equilibrium.

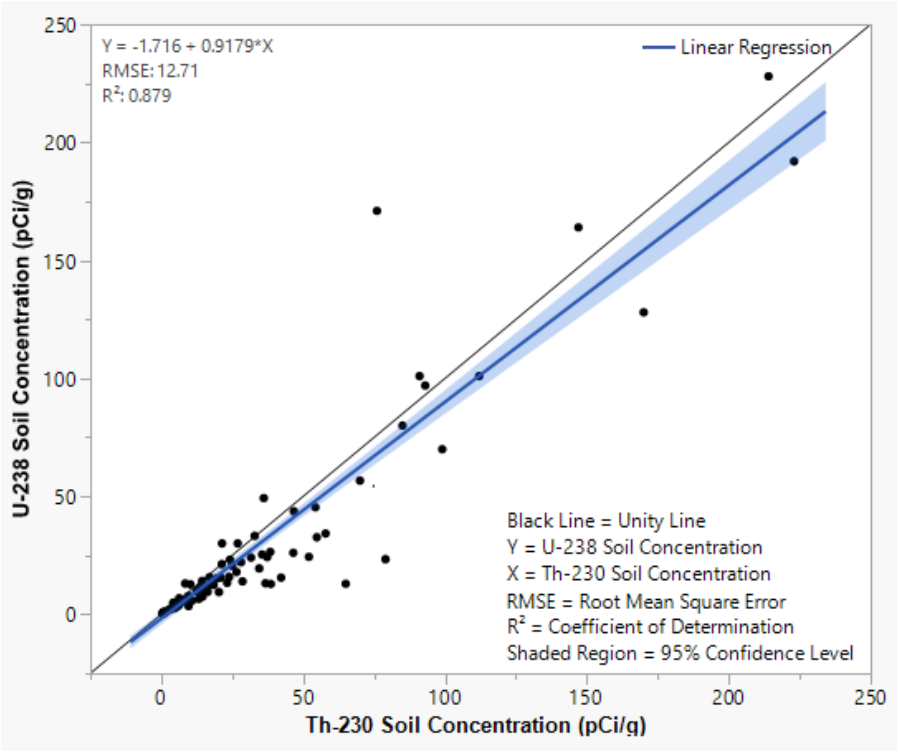

Figure D-7. Evaluation of Secular Equilibrium between U-238 and Th-230 in the Uranium Decay Series for the Jml Geology

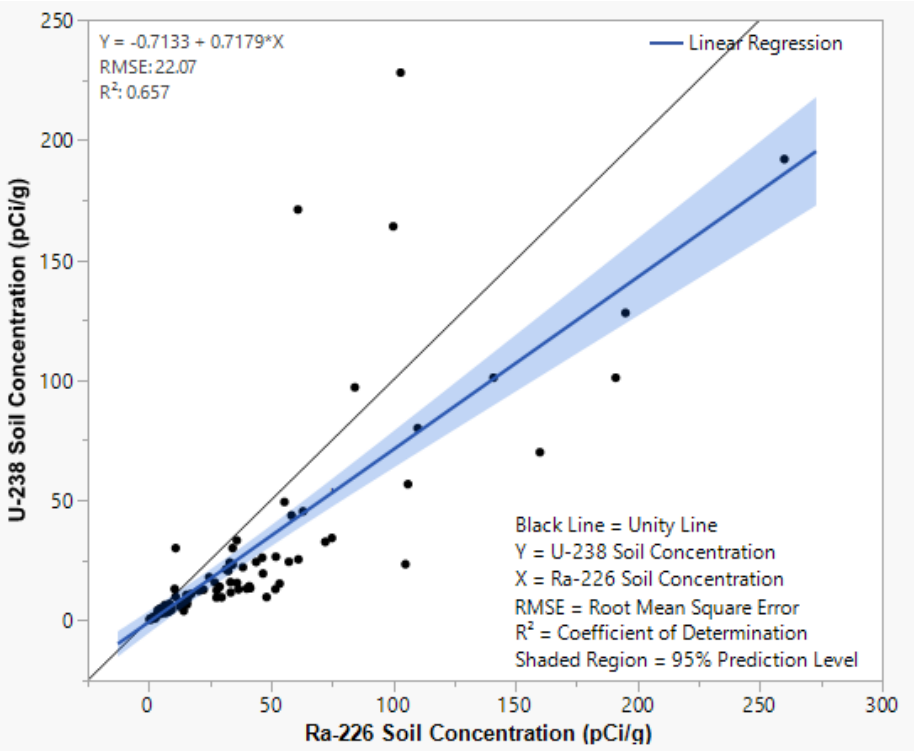

Figure D-8. Evaluation of Secular Equilibrium between U-238 and Ra-226 in the Uranium Decay Series for the Jml Geology

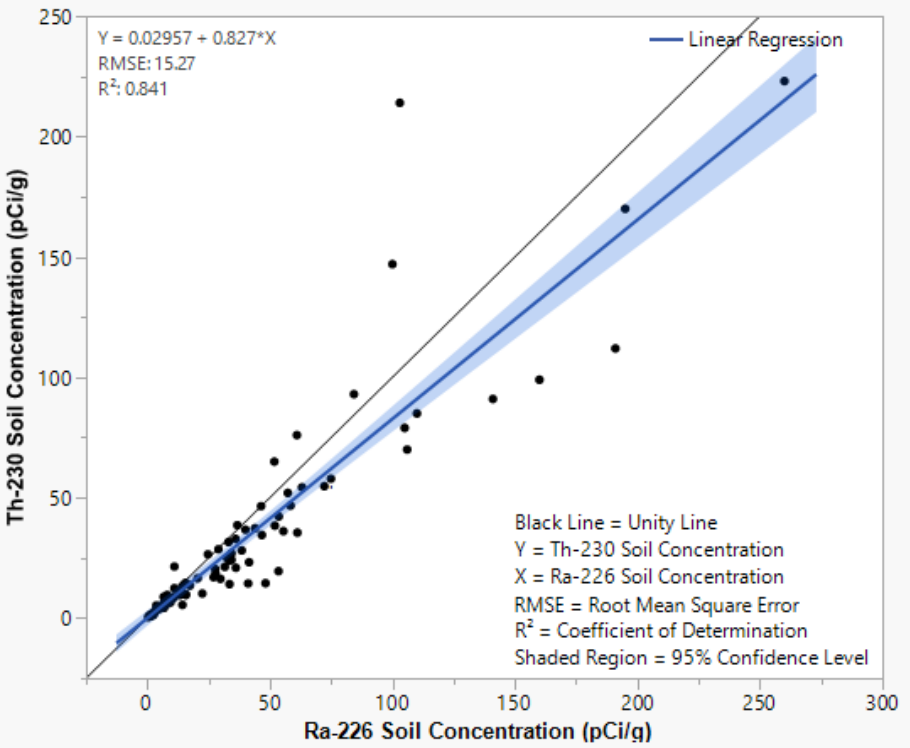

Figure D-9. Evaluation of Secular Equilibrium between Th-230 and Ra-226 in the Uranium Decay Series for the Jml Geology

3.1.4 Salt Wash Member (Jms)

Uranium equilibrium was evaluated in five of the soil samples collected within the surface geology of the Salt Wash Member (Jms) of the Lukachukai Mountains. These samples included XRF confirmation soil samples (0 to 3 inches bgs) and surface soil samples (0 to 6 inches bgs) at BSAs, AUM sites, and Target sites. Table D1-3 in Attachment D1 lists analytical results from these samples. A summary of different isotopic ratios appears in Section 3.1.1 of this report. In this subsection, a graphical summary shows the evaluation of secular equilibrium for three of these isotopic ratios: (1) U-238/Th-230, (2) U-238/Ra-226, and (3) Th-230/Ra-226.

Figure D-10 shows the evaluation of secular equilibrium between U-238 and Th-230 within the five soil samples containing detectable concentrations of both isotopes collected within the Jms geology. The regression p-value is 0.0005 with an R^2 of 0.989; the y=x line falls partially within the bounds of the 95% UCL bands on Figure D-10—evidence that U-238 and Th-230 are in equilibrium, but not secular equilibrium.

Figure D-11 shows the evaluation of secular equilibrium between U-238 and Ra-226 within the five soil samples containing detectable concentrations of both isotopes collected within the Jms geology. The regression p-value is 0.0004 with an R^2 of 0.991; the y=x line falls partially within the bounds of the 95% UCL bands on Figure D-11—evidence that U-238 and Ra-226 are in equilibrium, but not secular equilibrium.

Figure D-12 shows the evaluation of secular equilibrium between Th-230 and Ra-226 within the five soil samples containing detectable concentrations of both isotopes collected within the Jms geology. The regression p-value is < 0.0001 with an R^2 of 1.00; the y=x line falls partially within the bounds of the 95% UCL bands on Figure D-12—evidence that Th-230 and Ra-226 are in equilibrium, but not secular equilibrium.

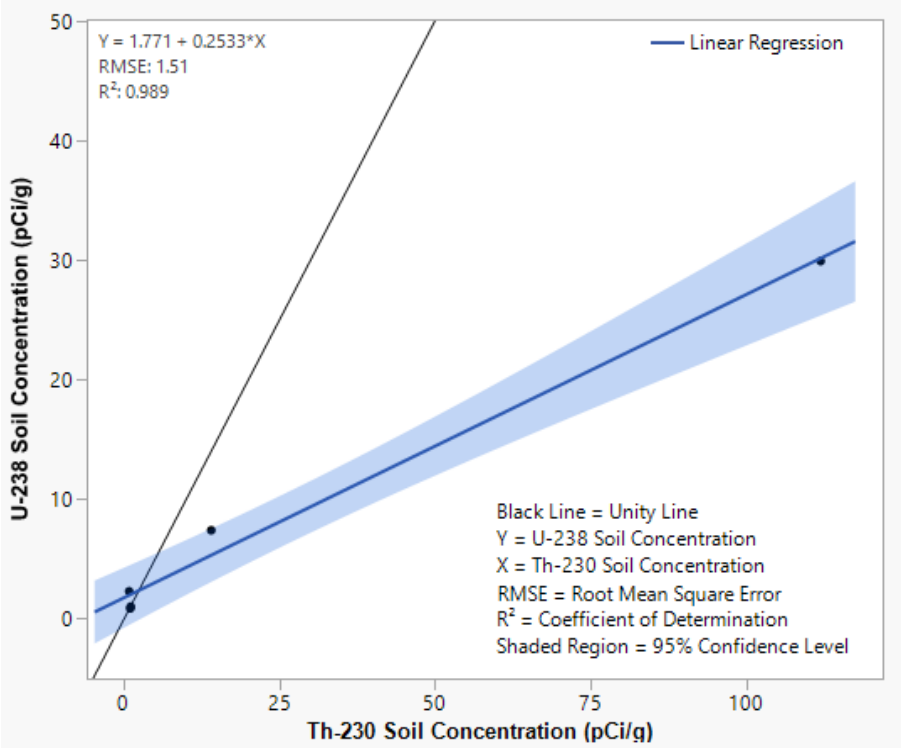

Figure D-10. Evaluation of Secular Equilibrium between U-238 and Th-230 in the Uranium Decay Series for the Jms Geology

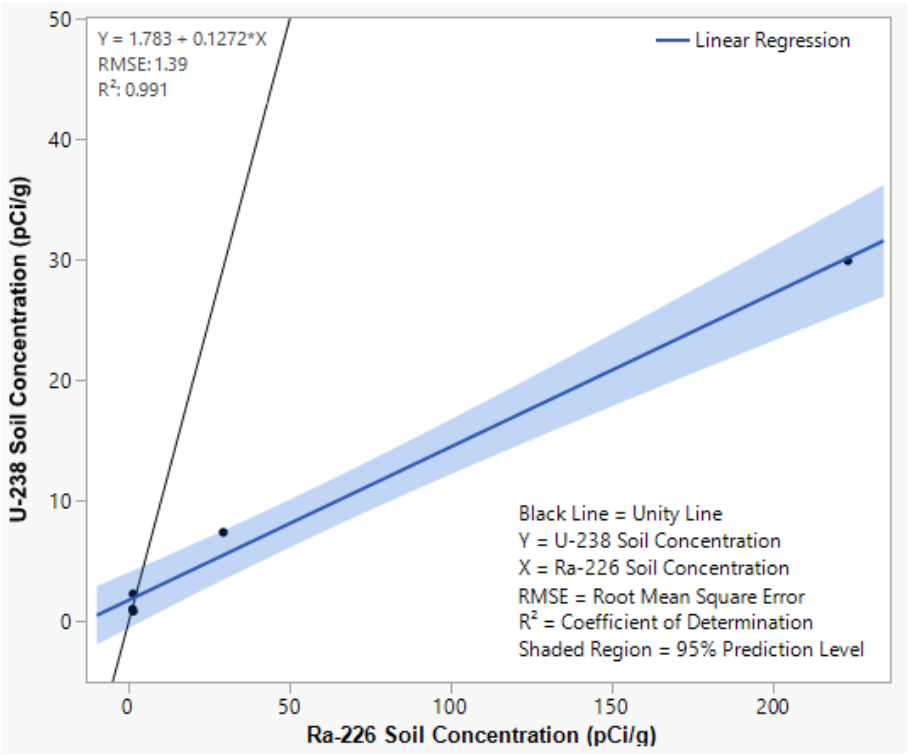

Figure D-11. Evaluation of Secular Equilibrium between U-238 and Ra-226 in the Uranium Decay Series for the Jms Geology

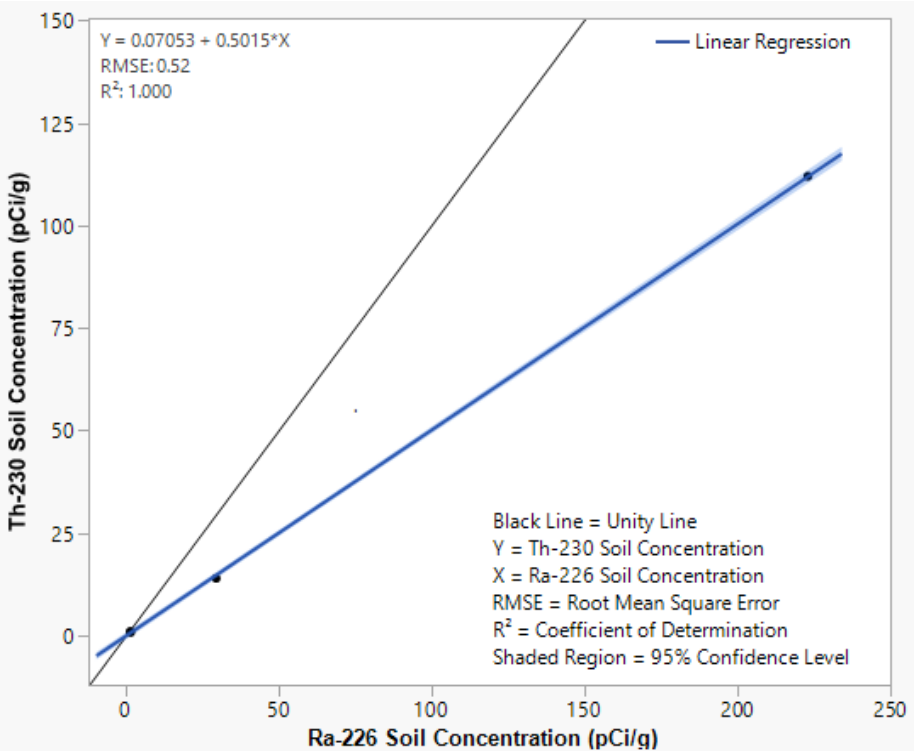

Figure D-12. Evaluation of Secular Equilibrium between Th-230 and Ra-226 in the Uranium Decay Series for the Jms Geology

3.1.5 Summerville Formation (Js)

Uranium equilibrium was evaluated in 13 of the soil samples collected within the surface geology of the Summerville Formation (Js) of the Lukachukai Mountains. These samples included XRF confirmation soil samples (0 to 3 inches bgs) and surface soil samples (0 to 6 inches bgs) at BSAs, AUM sites, and Target sites. Table D1-4 in Attachment D1 lists analytical results from these samples. A summary of different isotopic ratios appears in Section 3.1.1 of this report. In this subsection, a graphical summary shows the evaluation of secular equilibrium for three of these isotopic ratios: (1) U-238/Th-230, (2) U-238/Ra-226, and (3) Th-230/Ra-226.

Figure D-13 shows the evaluation of secular equilibrium between U-238 and Th-230 within the 13 soil samples with detectable concentrations of both isotopes collected within the Js geology. The regression p-value is < 0.0001 with an R^2 of 0.847; the y=x line falls partially within the bounds of the 95% UCL bands on Figure D-13—evidence that U-238 and Th-230 are in equilibrium, but not secular equilibrium.

Figure D-14 shows the evaluation of secular equilibrium between U-238 and Ra-226 within the 13 soil samples with detectable concentrations of both isotopes collected within the Js geology. The regression p-value is < 0.0001 with an R^2 of 0.836; the y=x line falls partially within the bounds of the 95% UCL bands on Figure D-14—evidence that U-238 and Ra-226 are in equilibrium, but not secular equilibrium.

Figure D-15 shows the evaluation of secular equilibrium between Th-230 and Ra-226 within the 13 soil samples with detectable concentrations of both isotopes collected within the Js geology. The regression p-value is < 0.0001 with an R^2 of 0.837; the y=x line falls within the bounds of the 95% UCL bands on Figure D-15 evidence that Th-230 and Ra-226 are in secular equilibrium.

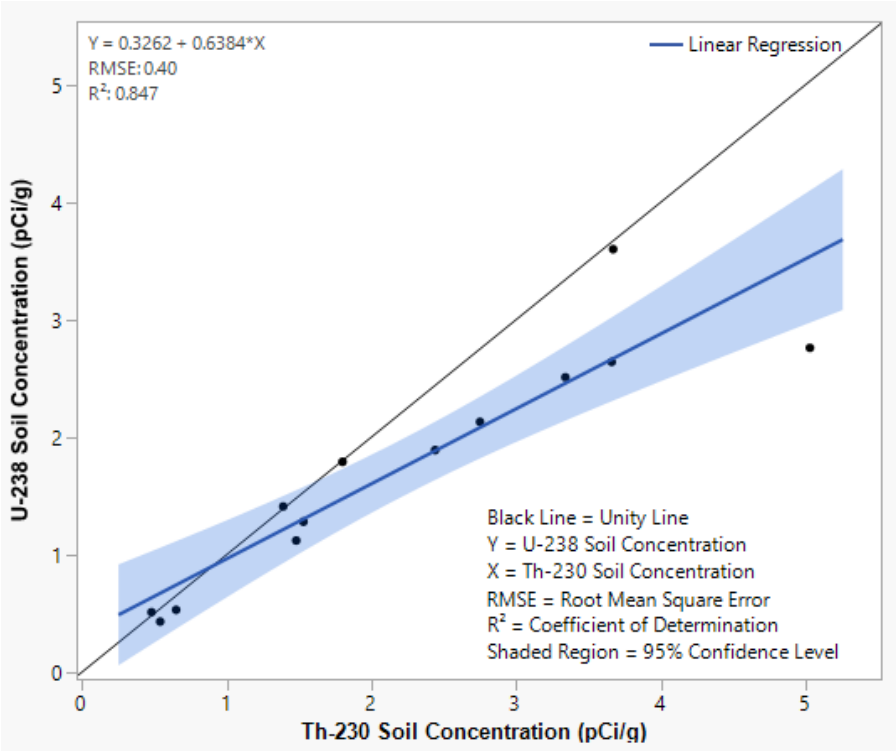

Figure D-13. Evaluation of Secular Equilibrium between U-238 and Th-230 in the Uranium Decay Series for the Js Geology

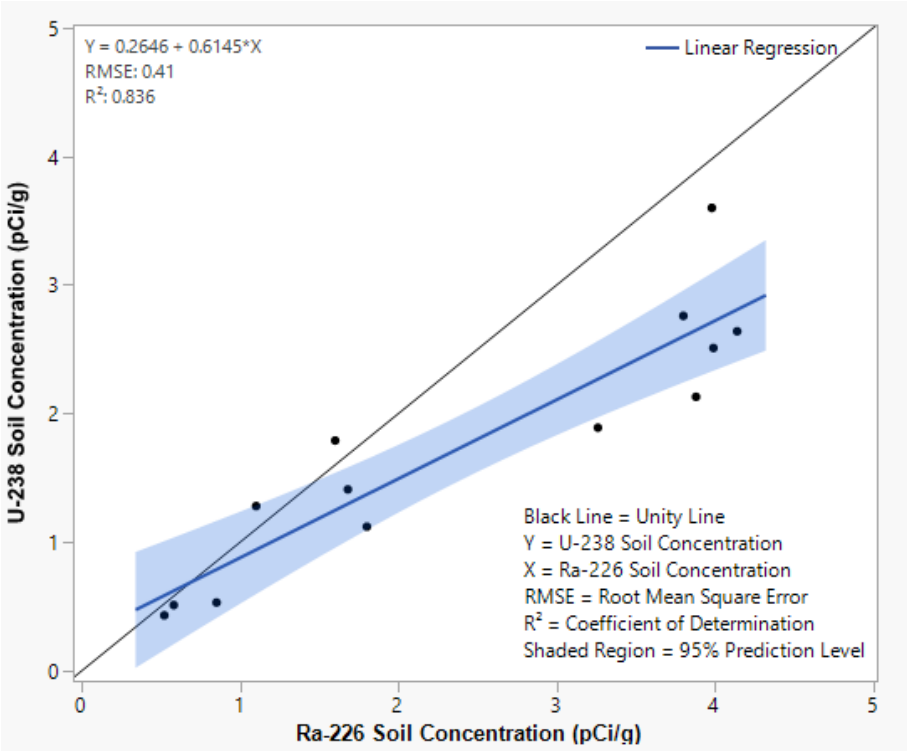

Figure D-14. Evaluation of Secular Equilibrium between U-238 and Ra-226 in the Uranium Decay Series for the Js Geology

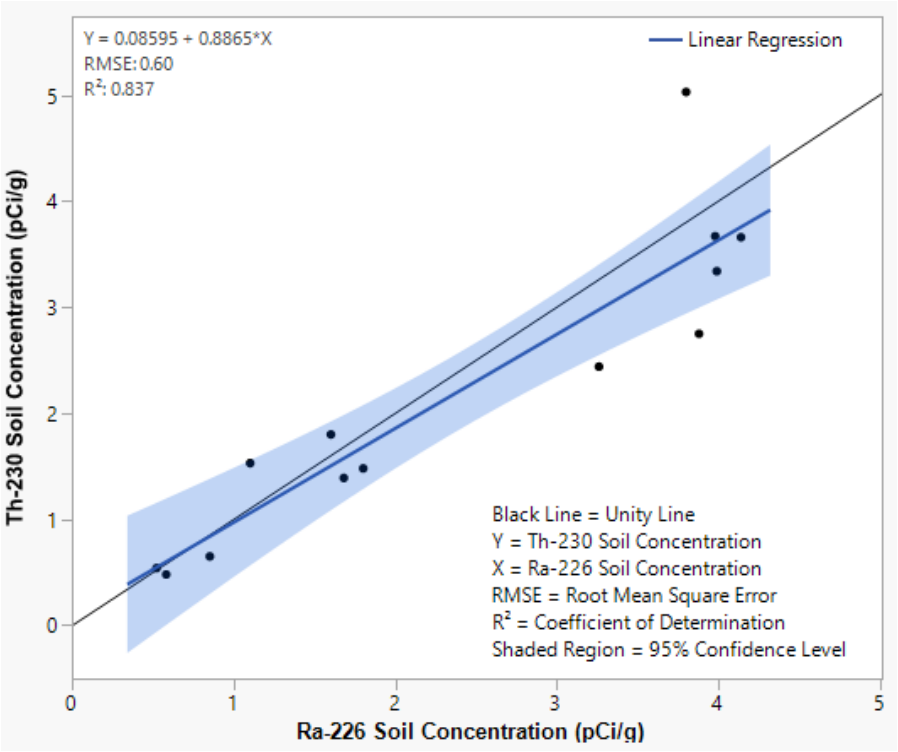

Figure D-15. Evaluation of Secular Equilibrium between Th-230 and Ra-226 in the Uranium Decay Series for the Js Geology

3.1.6 Undifferentiated Summerville and Entrada Formation (Jse)

Uranium equilibrium was evaluated in 66 of the soil samples collected within the surface geology of the Undifferentiated Summerville and Entrada Formation (Jse) of the Lukachukai Mountains. These samples included XRF confirmation soil samples (0 to 3 inches bgs) and surface soil samples (0 to 6 inches bgs) at BSAs, AUM sites, and Target sites. Table D1-5 in Attachment D1 lists analytical results from these samples. A summary of different isotopic ratios appears in Section 3.1.1 of this report. In this subsection, a graphical summary shows the evaluation of secular equilibrium for three of these isotopic ratios: (1) U-238/Th-230, (2) U-238/Ra-226, and (3) Th-230/Ra-226.

Figure D-16 shows the evaluation of secular equilibrium between U-238 and Th-230 within the 66 soil samples with detectable concentrations of both isotopes collected within the Jse geology. The regression p-value is < 0.0001 with an R^2 of 0.978; the y=x line falls partially within the bounds of the 95% UCL bands on Figure D-16—evidence that U-238 and Th-230 are in equilibrium, but not secular equilibrium.

Figure D-17 shows the evaluation of secular equilibrium between U-238 and Ra-226 within the 61 soil samples containing detectable concentrations of both isotopes collected within the Jse geology. The regression p-value is < 0.0001 with an R^2 of 0.408; the y=x line falls entirely within the bounds of the 95% UCL bands on Figure D-17. Due to the low R^2 value, evidence is insufficient to conclude whether secular equilibrium exists.

Figure D-18 shows the evaluation of secular equilibrium between Th-230 and Ra-226 within the 61 soil samples with detectable concentrations of both isotopes collected within the Jse geology. The regression p-value is < 0.0001 with an R^2 of 0.491; the y=x line falls entirely within the bounds of the 95% UCL bands on Figure D-18. Due to the low R^2 value, evidence is insufficient to conclude whether secular equilibrium exists.

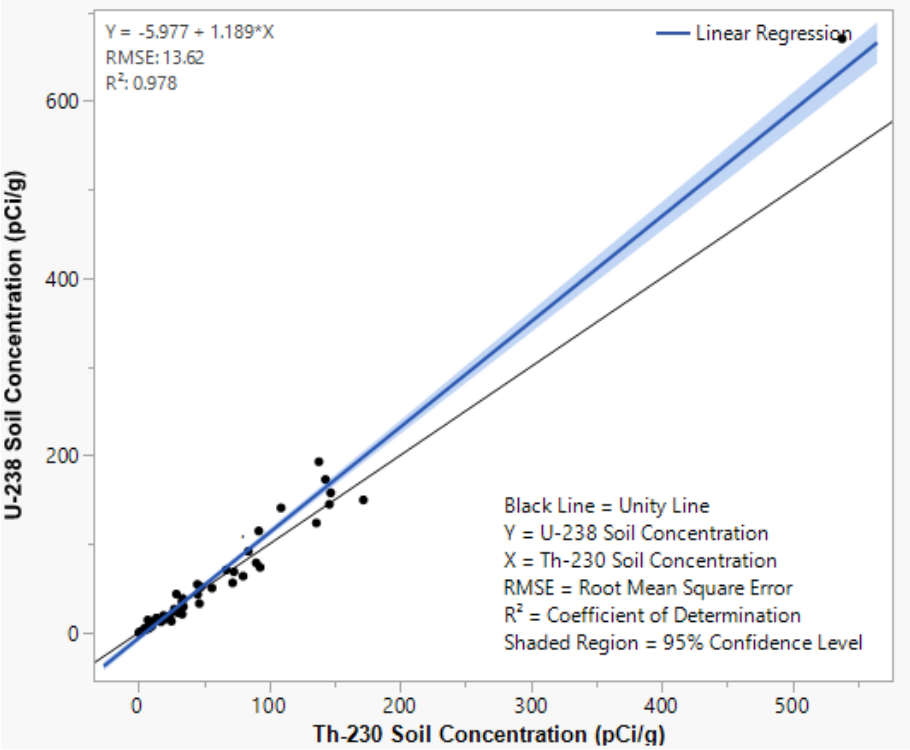

Figure D-16. Evaluation of Secular Equilibrium between U-238 and Th-230 in the Uranium Decay Series for the Jse Geology

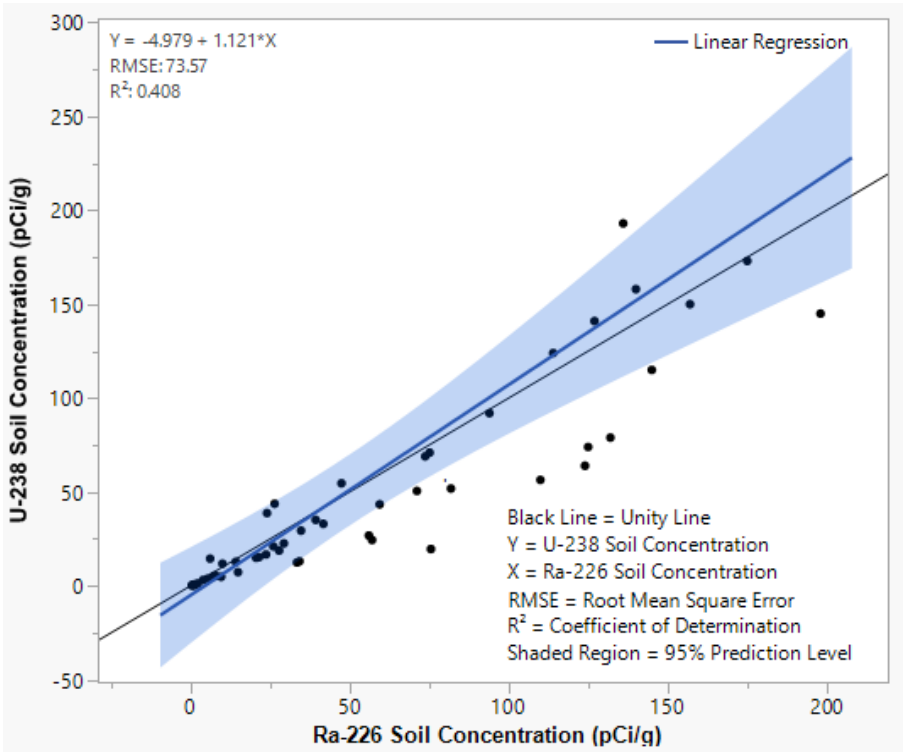

Figure D-17. Evaluation of Secular Equilibrium between U-238 and Ra-226 in the Uranium Decay Series for the Jse Geology

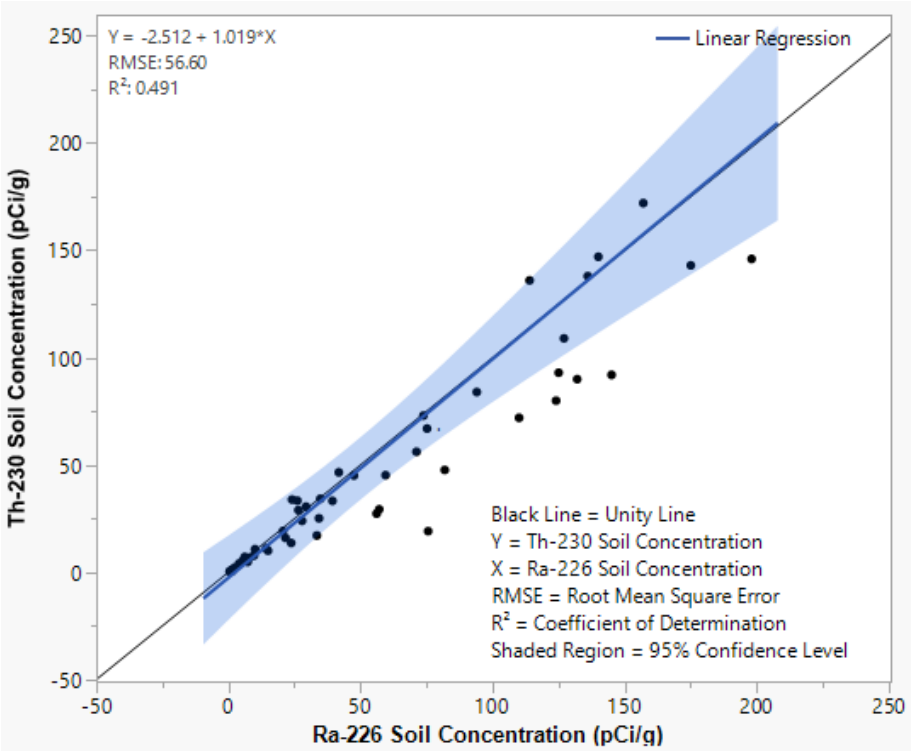

Figure D-18. Evaluation of Secular Equilibrium between Th-230 and Ra-226 in the Uranium Decay Series for the Jse Geology

3.1.7 Undifferentiated Entrada Formation and Undifferentiated Summerville, Todilto, and Entrada Formations (JseJste)

Uranium equilibrium was evaluated in 75 of the soil samples collected within the surface geology of the Undifferentiated Entrada Formation (Jse), as well as within the Undifferentiated Summerville, Todilto, and Entrada Formations (Jste) of the Lukachukai Mountains. These samples included XRF confirmation soil samples (0 to 3 inches bgs) and surface soil samples (0 to 6 inches bgs) at BSAs, AUM sites, and Target sites. Table D1-6 in Attachment D1 lists analytical results from these samples. A summary of different isotopic ratios appears in Section 3.1.1 of this report. In this subsection, a graphical summary shows the evaluation of secular equilibrium for three of these isotopic ratios: (1) U-238/Th-230, (2) U-238/Ra-226, and (3) Th-230/Ra-226.

Figure D-19 shows the evaluation of secular equilibrium between U-238 and Th-230 within the 75 soil samples with detectable concentrations of both isotopes collected within the JseJste geology. The regression p-value is < 0.0001 with an R^2 of 0.978; the y=x line falls partially within the bounds of the 95% UCL bands on Figure D-19—evidence that U-238 and Th-230 are in equilibrium, but not secular equilibrium.

Figure D-20 shows the evaluation of secular equilibrium between U-238 and Ra-226 within the 70 soil samples containing detectable concentrations of both isotopes collected within the JseJste geology. The regression p-value is < 0.0001 with an R^2 of 0.417; the y=x line falls entirely within the bounds of the 95% UCL bands on Figure D-20. Due to the low R^2 value, evidence is insufficient to conclude whether secular equilibrium exists.

Figure D-21 shows the evaluation of secular equilibrium between Th-230 and Ra-226 within the 70 soil samples with detectable concentrations of both isotopes collected within the JseJste geology. The regression p-value is < 0.0001 with an R^2 of 0.503; the y=x line falls entirely within the bounds of the 95% UCL bands on Figure D-21. Due to the low R^2 value, evidence is insufficient to conclude whether secular equilibrium exists.

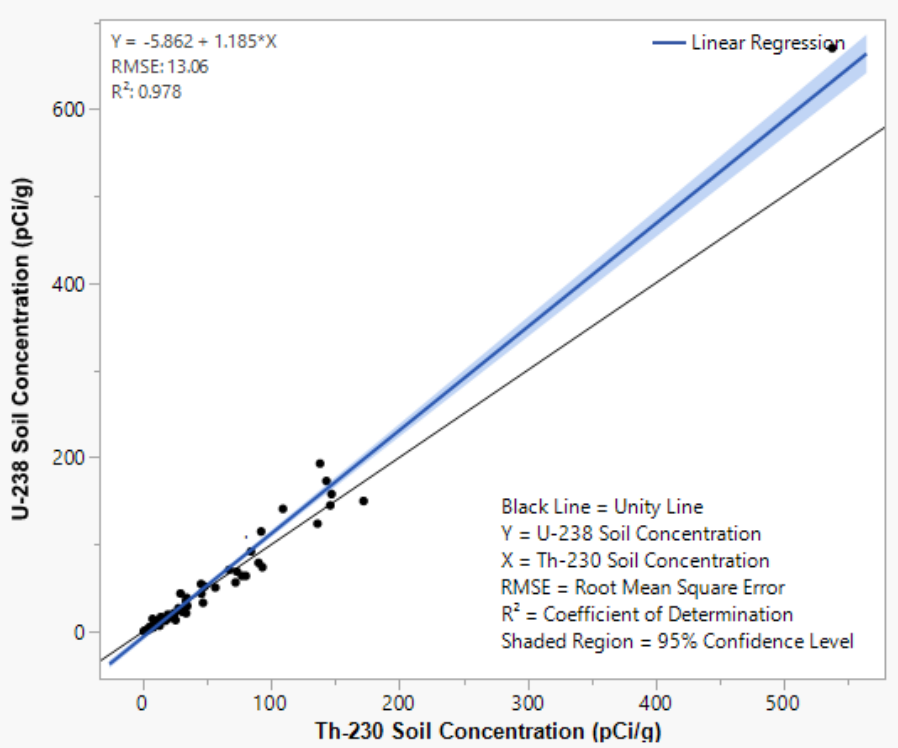

Figure D-19. Evaluation of Secular Equilibrium between U-238 and Th-230 in the Uranium Decay Series for the JseJste Geology

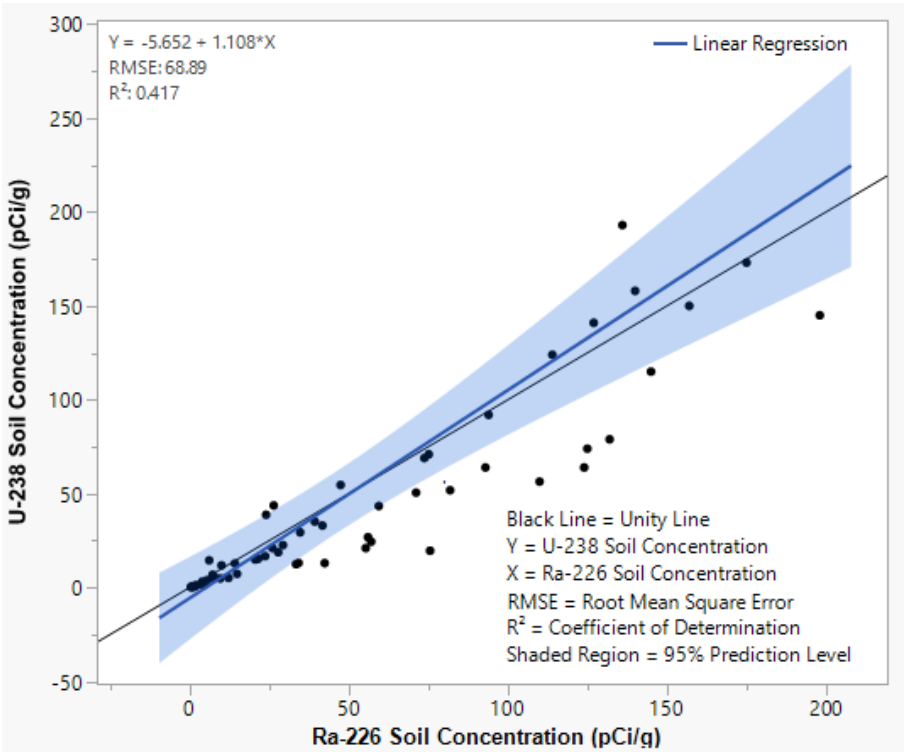

Figure D-20. Evaluation of Secular Equilibrium between U-238 and Ra-226 in the Uranium Decay Series for the JseJste Geology

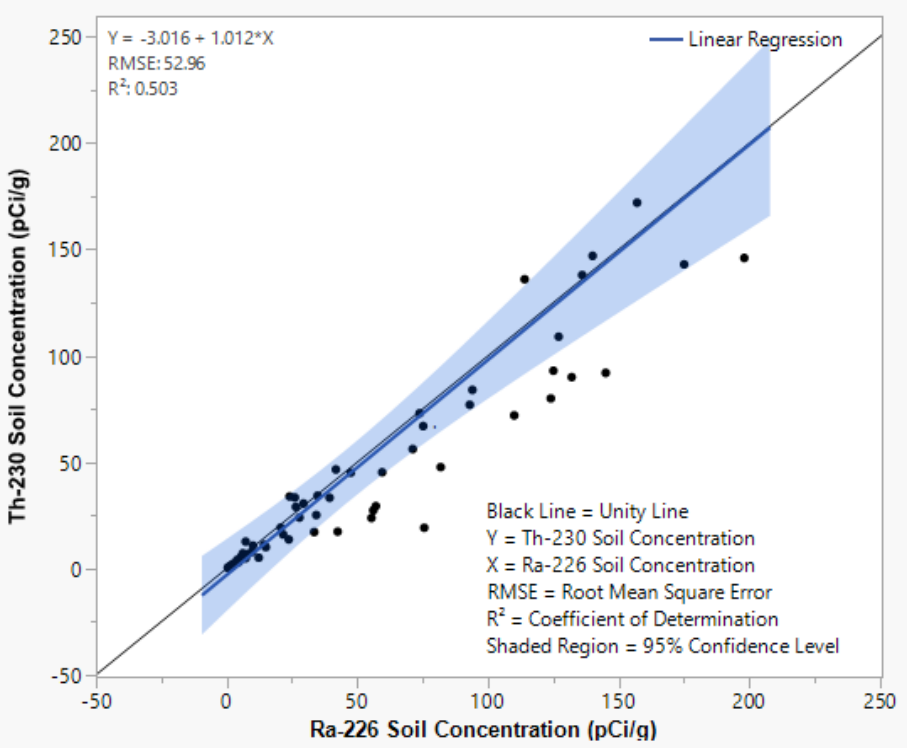

Figure D-21. Evaluation of Secular Equilibrium between Th-230 and Ra-226 in the Uranium Decay Series for the JseJste Geology

3.1.8 Undifferentiated Summerville, Todilto, and Entrada Formations (Jste)

Uranium equilibrium was evaluated in six of the soil samples collected within the surface geology of the Undifferentiated Summerville, Todilto, and Entrada Formations (Jste) of the Lukachukai Mountains. These samples included XRF confirmation soil samples (0 to 3 inches bgs) and surface soil samples (0 to 6 inches bgs) at BSAs, AUM sites, and Target sites. Table D1-7 in Attachment D1 lists analytical results from these samples. A summary of different isotopic ratios appears in Section 3.1.1 of this report. In this subsection, a graphical summary shows the evaluation of secular equilibrium for three of these isotopic ratios: (1) U-238/Th-230, (2) U-238/Ra-226, and (3) Th-230/Ra-226.

Figure D-22 shows the evaluation of secular equilibrium between U-238 and Th-230 within the six soil samples containing detectable concentrations of both isotopes collected within the Jste geology. The regression p-value is < 0.0001 with an R^2 of 0.997; the y=x line falls partially within the bounds of the 95% UCL bands on Figure D-22—evidence that U-238 and Th-230 are in equilibrium, but not secular equilibrium.

Figure D-23 shows the evaluation of secular equilibrium between U-238 and Ra-226 within the six soil samples containing detectable concentrations of both isotopes collected within the Jste geology. The regression p-value is < 0.0001 with an R^2 of 0.998; the y=x line falls partially within the bounds of the 95% UCL bands on Figure D-23—evidence that U-238 and Ra-226 are in equilibrium, but not secular equilibrium.

Figure D-24 shows the evaluation of secular equilibrium between Th-230 and Ra-226 within the six soil samples containing detectable concentrations of both isotopes collected within the Jste geology. The regression p-value is < 0.0001 with an R^2 of 0.992; the y=x line falls partially within the bounds of the 95% UCL bands on Figure D-24—evidence that Th-230 and Ra-226 are in equilibrium, but not secular equilibrium.

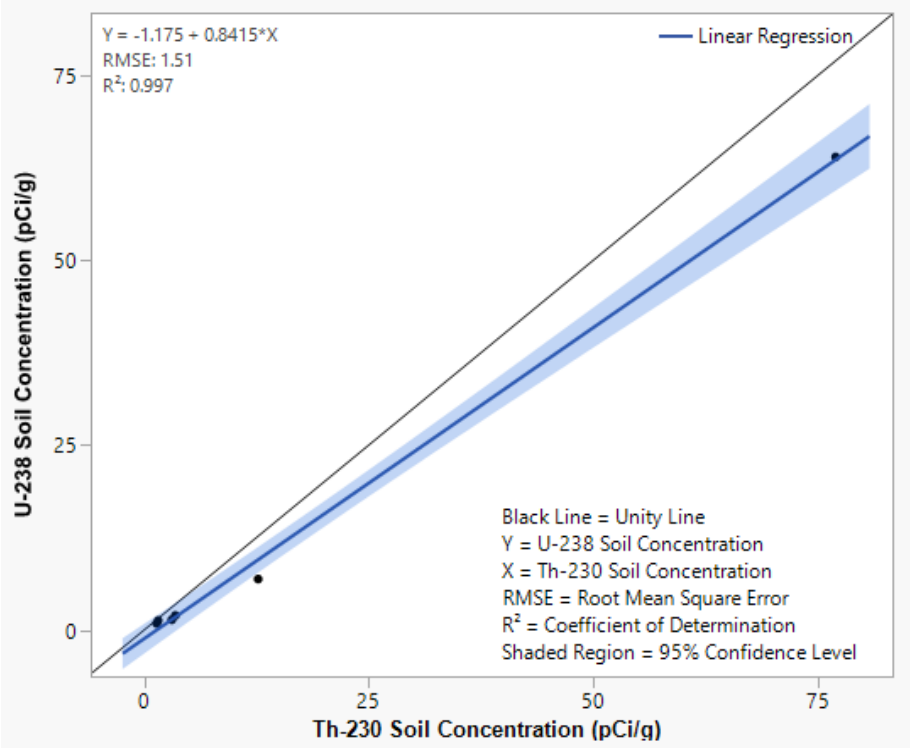

Figure D-22. Evaluation of Secular Equilibrium between U-238 and Th-230 in the Uranium Decay Series for the Jste Geology

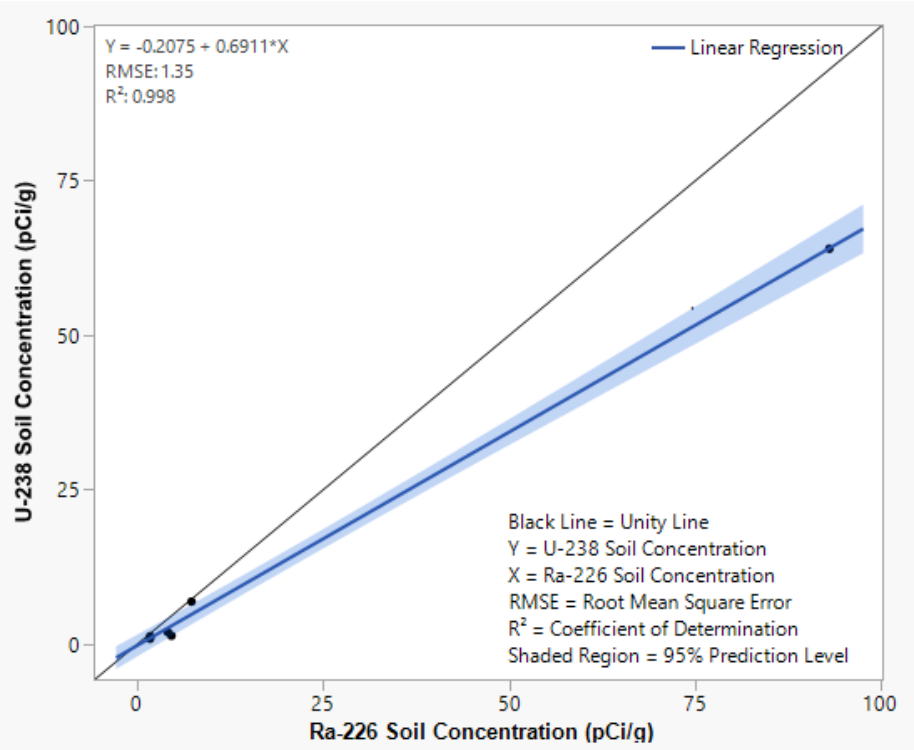

Figure D-23. Evaluation of Secular Equilibrium between U-238 and Ra-226 in the Uranium Decay Series for the Jste Geology

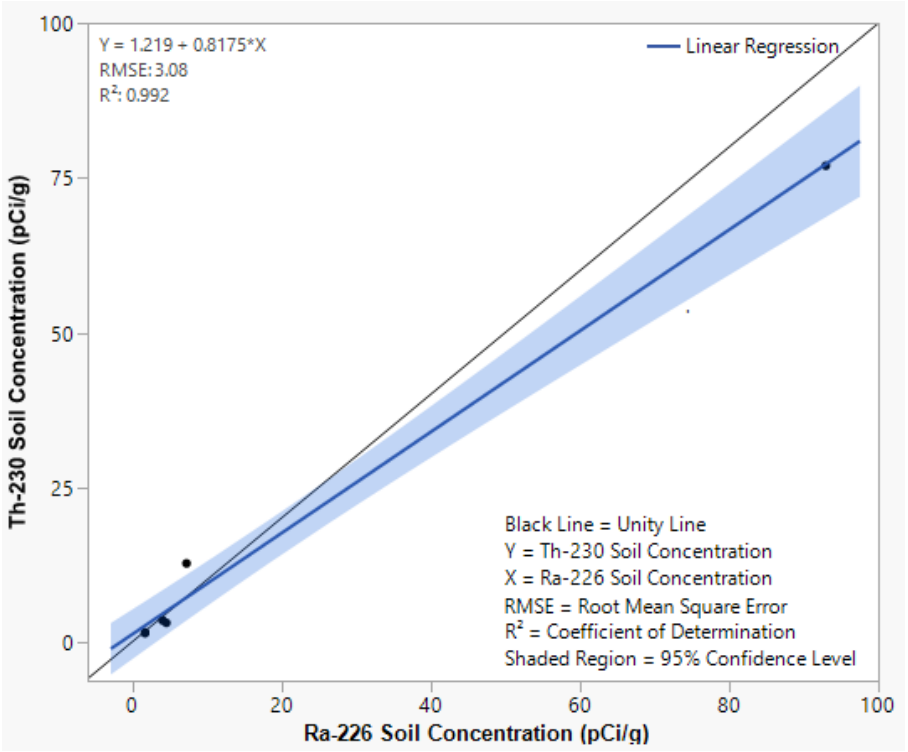

Figure D-24. Evaluation of Secular Equilibrium between Th-230 and Ra-226 in the Uranium Decay Series for the Jste Geology

3.1.9 Quaternary Alluvium (Qa)

Uranium equilibrium was evaluated in 11 of the soil samples collected within the surface geology of the Quaternary alluvium (Qa) of the Lukachukai Mountains. These samples included XRF confirmation soil samples (0 to 3 inches bgs) and surface soil samples (0 to 6 inches bgs) at BSAs, AUM sites, and Target sites. Table D1-8 in Attachment D1 lists analytical results from these samples. A summary of different isotopic ratios appears in Section 3.1.1 of this report. In this subsection, a graphical summary shows the evaluation of secular equilibrium for three of these isotopic ratios: (1) U-238/Th-230, (2) U-238/Ra-226, and (3) Th-230/Ra-226.

Figure D-25 shows the evaluation of secular equilibrium between U-238 and Th-230 within the 11 soil samples containing detectable concentrations of both isotopes collected within the Qa geology. The regression p-value is < 0.0001 with an R^2 of 0.997; the y=x line falls partially within the bounds of the 95% UCL bands on Figure D-25—evidence that U-238 and Th-230 are in equilibrium, but not secular equilibrium.

Figure D-26 shows the evaluation of secular equilibrium between U-238 and Ra-226 within the 10 soil samples containing detectable concentrations of both isotopes collected within the Qa geology. The regression p-value is < 0.0001 with an R^2 of 0.987; the y=x line falls partially within the bounds of the 95% UCL bands on Figure D-26—evidence that U-238 and Ra-226 are in equilibrium, but not secular equilibrium.

Figure D-27 shows the evaluation of secular equilibrium between Th-230 and Ra-226 within the 10 soil samples containing detectable concentrations of both isotopes collected within the Qa geology. The regression p-value is < 0.0001 with an R^2 of 0.992; the y=x line falls partially within the bounds of the 95% UCL bands on Figure D-27—evidence that Th-230 and Ra-226 are in equilibrium, but not secular equilibrium.

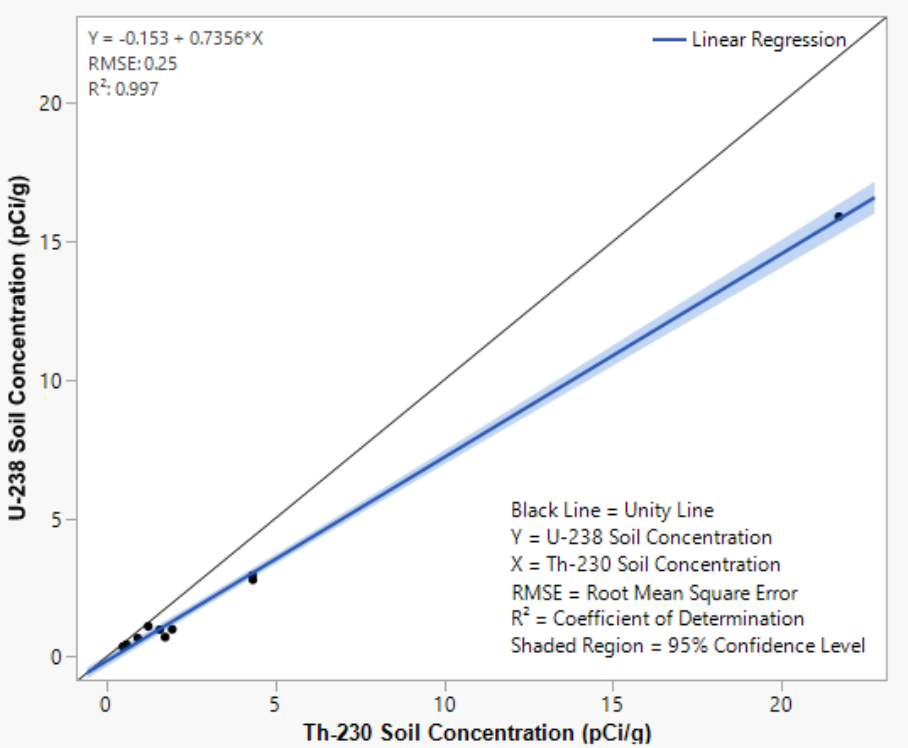

Figure D-25. Evaluation of Secular Equilibrium between U-238 and Th-230 in the Uranium Decay Series for the Qa Geology

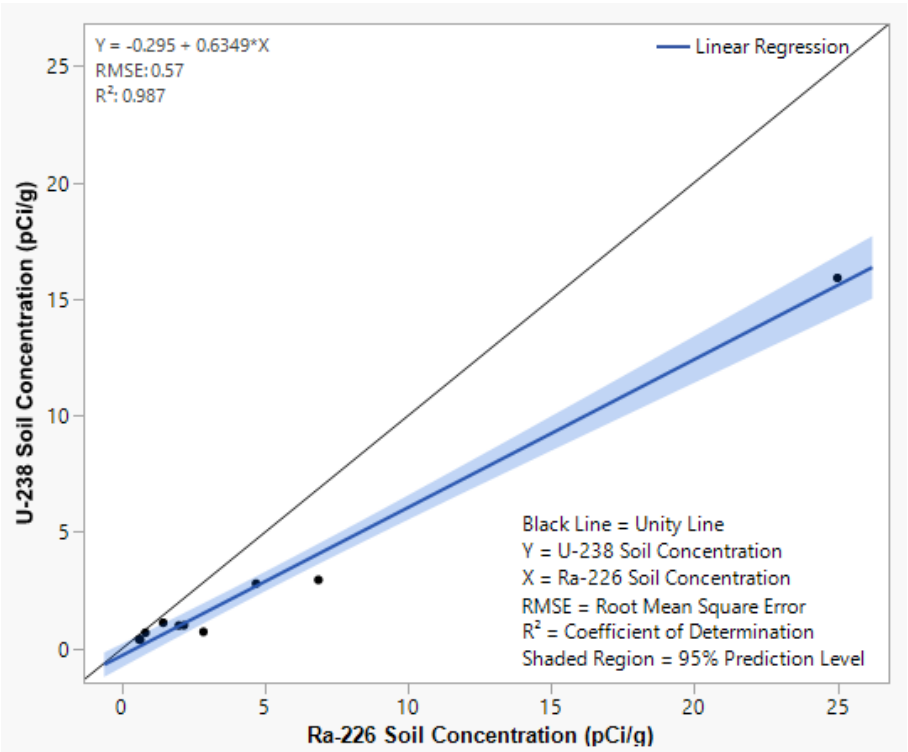

Figure D-26. Evaluation of Secular Equilibrium between U-238 and Ra-226 in the Uranium Decay Series for the Qa Geology

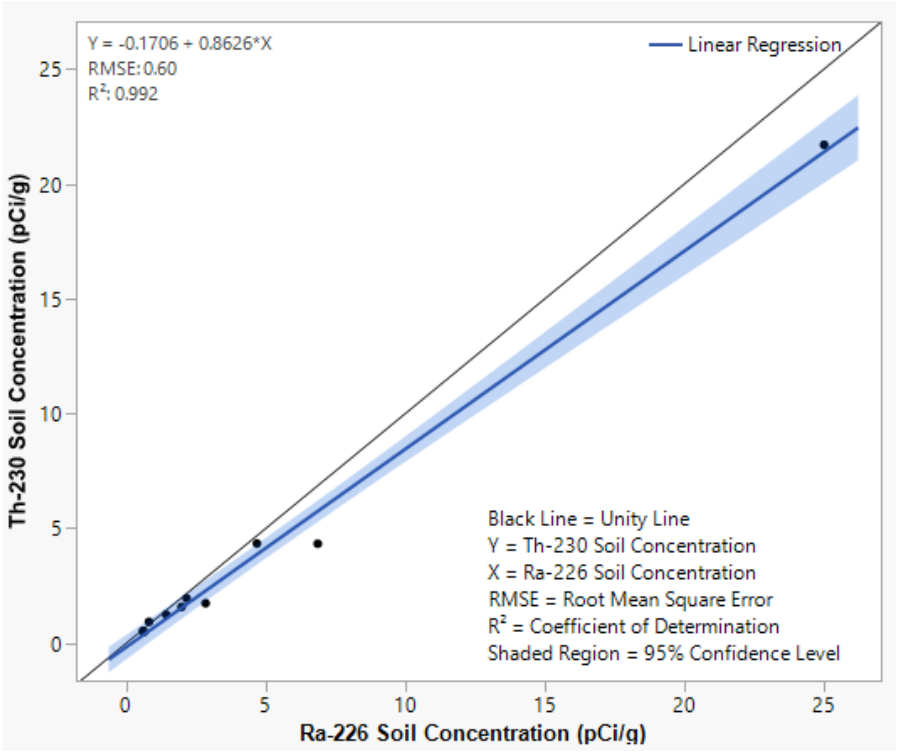

Figure D-27. Evaluation of Secular Equilibrium between Th-230 and Ra-226 in the Uranium Decay Series for the Qa Geology

3.1.10 Chuska Sandstone Formation (Tc)

Only one sample collected within the Chuska Sandstone Formation (Tc) geology contained a detectable level of Ra-226 and/or Pb-210 (Table D1-9 in Attachment D1). Lack of samples collected within this geology precluded an equilibrium analysis.

3.1.11 Chinle Formation (Trc)

Uranium equilibrium was evaluated in 11 of the soil samples collected within the surface geology of the Chinle Formation (Trc) of the Lukachukai Mountains. These samples included XRF confirmation soil samples (0 to 3 inches bgs) and surface soil samples (0 to 6 inches bgs) at BSAs, AUM sites, and Target sites. Table D1-10 in Attachment D1 lists analytical results from these samples. A summary of different isotopic ratios appears in Section 3.1.1 of this report. In this subsection, a graphical summary shows the evaluation of secular equilibrium for three of these isotopic ratios: (1) U-238/Th-230, (2) U-238/Ra-226, and (3) Th-230/Ra-226.

Figure D-28 shows the evaluation of secular equilibrium between U-238 and Th-230 within the 13 soil samples containing detectable concentrations of both isotopes collected within the Trc geology. The regression p-value is 0.0018 with an R^2 of 0.604; the y=x line falls partially within the bounds of the 95% UCL bands on Figure D-28—evidence that U-238 and Th-230 are in equilibrium, but not secular equilibrium.

Figure D-29 shows the evaluation of secular equilibrium between U-238 and Ra-226 within the 13 soil samples containing detectable concentrations of both isotopes collected within the Trc geology. The regression p-value is 0.0094 with an R^2 of 0.473; the y=x line falls mostly within the bounds of the 95% UCL bands on Figure D-29—evidence that U-238 and Ra-226 are in equilibrium, but not secular equilibrium.

Figure D-30 shows the evaluation of secular equilibrium between Th-230 and Ra-226 within the 13 soil samples containing detectable concentrations of both isotopes collected within the Trc geology. The regression p-value is 0.0003 with an R^2 of 0.707; the y=x line falls mostly within the bounds of the 95% UCL bands on Figure D-30—evidence that Th-230 and Ra-226 are in equilibrium, but not secular equilibrium.

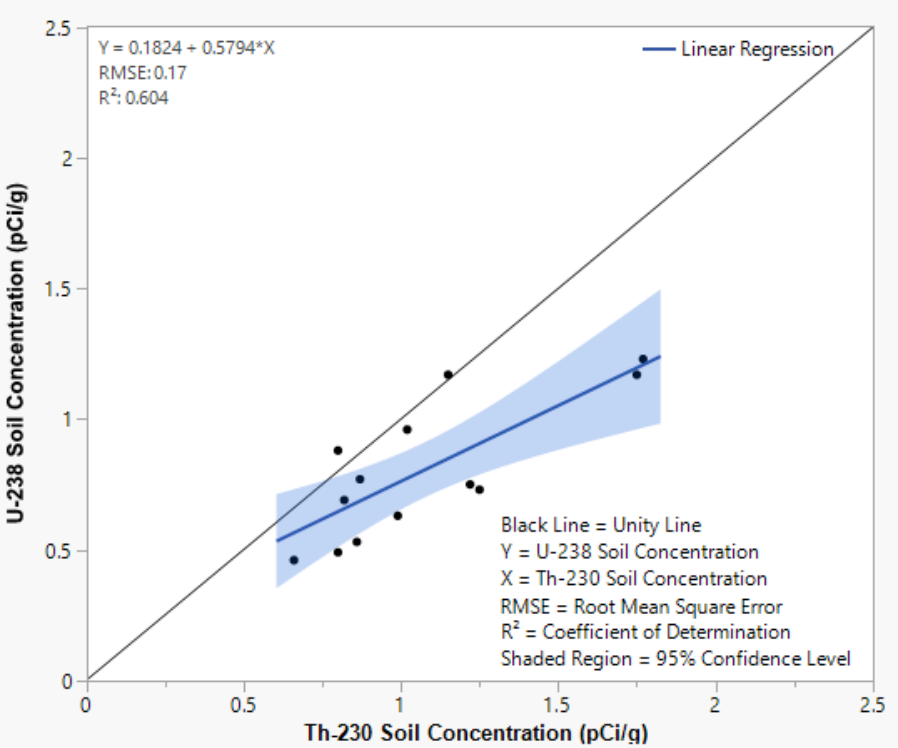

Figure D-28. Evaluation of Secular Equilibrium between U-238 and Th-230 in the Uranium Decay Series for the Trc Geology

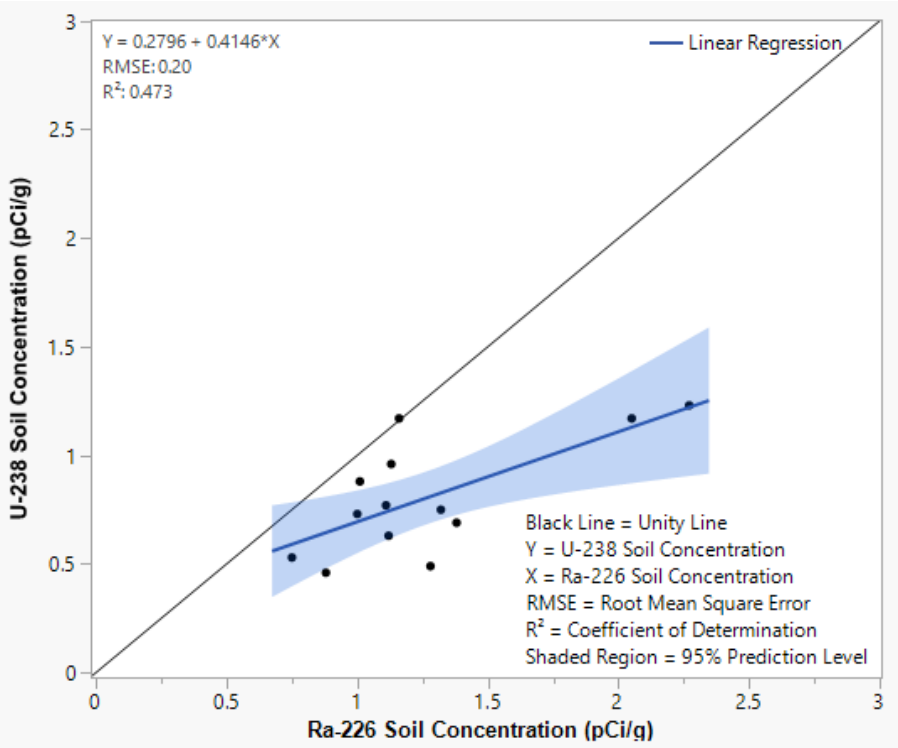

Figure D-29. Evaluation of Secular Equilibrium between U-238 and Ra-226 in the Uranium Decay Series for the Trc Geology

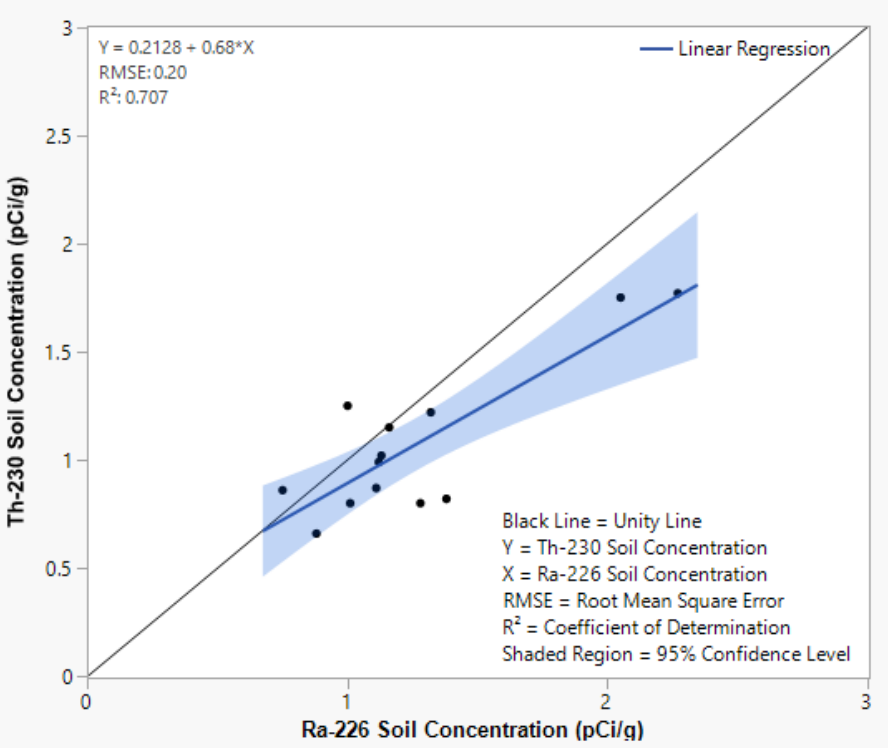

Figure D-30. Evaluation of Secular Equilibrium between Th-230 and Ra-226 in the Uranium Decay Series for the Trc Geology

3.1.12 All Geologies

Uranium equilibrium was evaluated in 270 of the soil samples collected within surface geologies of the Lukachukai Mountains. These samples included XRF confirmation soil samples (0 to 3 inches bgs) and surface soil samples (0 to 6 inches bgs) at BSAs, AUM sites, and Target sites. Table D1-11 in Attachment D1 lists analytical results from these samples. A summary of different isotopic ratios appears in Section 3.1.1 of this report. In this subsection, a graphical summary shows the evaluation of secular equilibrium for three of these isotopic ratios: (1) U-238/Th-230, (2) U-238/Ra-226, and (3) Th-230/Ra-226.

Figure D-31 shows the evaluation of secular equilibrium between U-238 and Th-230 within the 270 soil samples containing detectable concentrations of both isotopes. The regression p-value is < 0.0001 with an R^2 of 0.934; the y=x line falls partially within the bounds of the 95% UCL bands on Figure D-31—evidence that U-238 and Th-230 are in equilibrium, but not secular equilibrium.

Figure D-32 shows the evaluation of secular equilibrium between U-238 and Ra-226 within the 251 soil samples containing detectable concentrations of both isotopes. The regression p-value is < 0.0001 with an R^2 of 0.461; the y=x line falls mostly within the bounds of the 95% UCL bands on Figure D-32—evidence that U-238 and Ra-226 are in equilibrium, but not secular equilibrium.

Figure D-33 shows the evaluation of secular equilibrium between Th-230 and Ra-226 within the 251 soil samples containing detectable concentrations of both isotopes. The regression p-value is < 0.0001 with an R^2 of 0.635; the y=x line falls mostly within the bounds of the 95% UCL bands on Figure D-33—evidence that Th-230 and Ra-226 are in equilibrium, but not secular equilibrium.

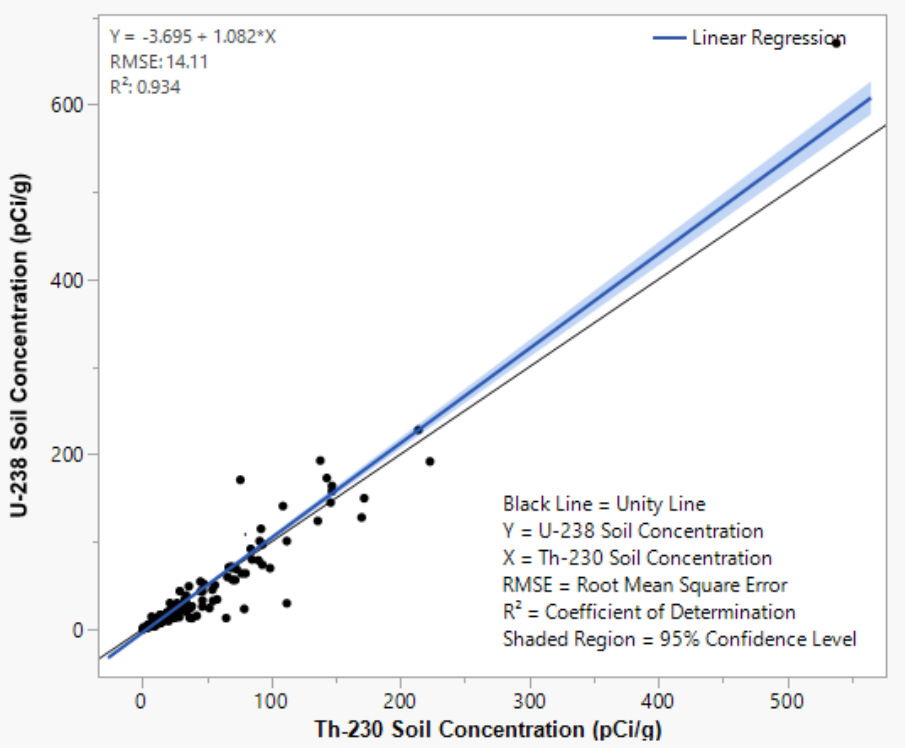

Figure D-31. Evaluation of Secular Equilibrium between U-238 and Th-230 in the Uranium Decay Series for All Geologies

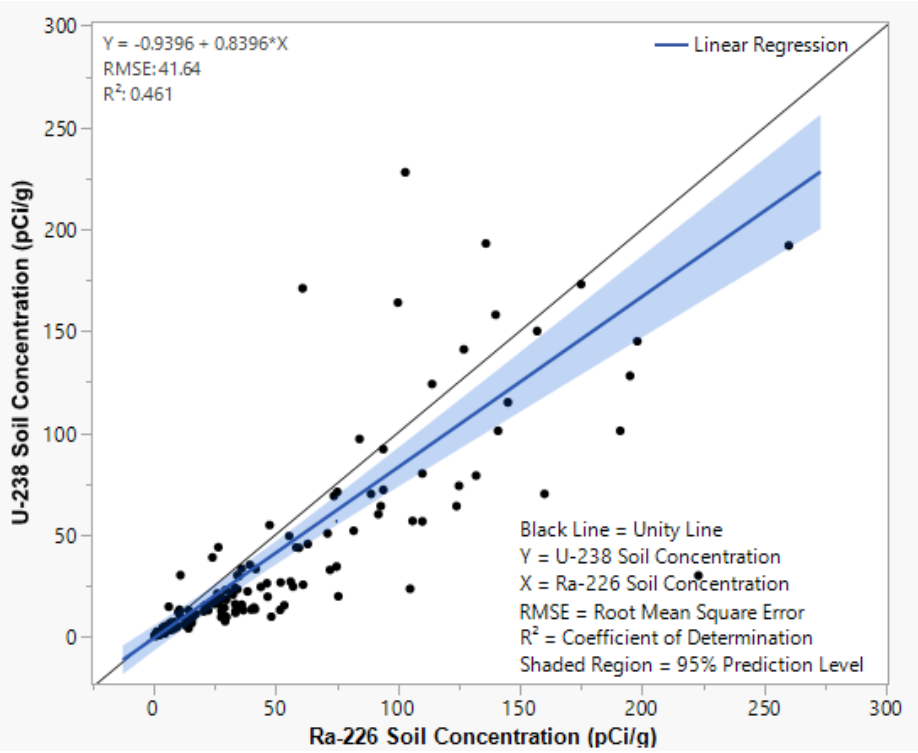

Figure D-32. Evaluation of Secular Equilibrium between U-238 and Ra-226 in the Uranium Decay Series for All Geologies

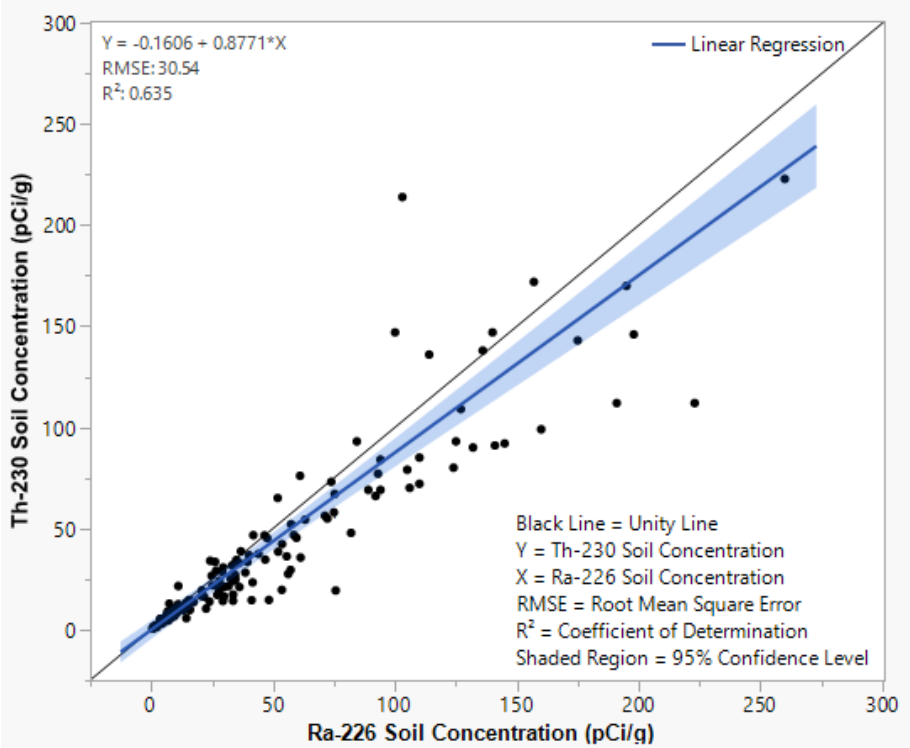

Figure D-33. Evaluation of Secular Equilibrium between Th-230 and Ra-226 in the Uranium Decay Series for All Geologies

3.2 SAMPLE TYPE

The following sections discuss the different sample types collected project-wide.

3.2.1 Overview

Uranium series equilibrium conditions were evaluated in samples from AUM sites, Target sites, and BSAs along with sediment samples collected in drainages. Table D-2 summarizes different isotopic ratios and relevant statistics for each sample type. The ratios include all combinations of U-238, Th-230, Ra-226, and Pb-210. The equilibrium for each sample type is reported in the following subsections.

Table D-2. Isotopic Ratios and Statistics for Samples by Sample Type

Ratio	Parameter	Background	AUM	Target	Sediment	All
U-238/ Th-230	n	114	142	14	39	309
	Min	0.44	0.2	0.27	0.38	0.2
	Max	2.88	2.25	1.10	1.52	2.88
	Mean	0.80	0.85	0.68	0.79	0.82
	Median	0.76	0.8	0.66	0.75	0.78
	SD	0.26	0.3	0.22	0.23	0.27
	RSD	33	34	33	30	33
	R^2	0.860	0.94	0.855	0.986	0.935
U-238/ Ra-226	n	95	142	14	36	287
	Min	0.30	0.2	0.13	0.28	0.13
	Max	1.74	5.23	1.01	2.42	5.23
	Mean	0.70	0.45	0.58	0.69	0.72
	Median	0.65	0.65	0.59	0.58	0.65
	SD	0.22	0.56	0.26	0.37	0.44
	RSD	32	74	44	54	61
	R^2	0.831	0.429	0.822	0.76	0.468
U-238/ Pb-210	n	101	141	13	35	290
	Min	0.11	0.2	0.35	0.47	0.13
	Max	2.17	5.23	1.34	3.28	5.23
	Mean	0.64	0.75	0.83	0.88	0.72
	Median	0.53	0.65	0.79	0.75	0.65
	SD	0.38	0.56	0.31	0.49	0.44
	RSD	60	75	37	56	61
	R^2	0.249	0.549	0.836	0.87	0.585
Th-230/ Ra-226	n	95	142	14	36	287
	Min	0.44	0.25	0.48	0.38	0.25
	Max	1.74	4.2	1.25	2.51	4.2
	Mean	0.89	0.86	0.83	0.93	0.88
	Median	0.86	0.79	0.80	0.85	0.84
	SD	0.19	0.39	0.25	0.43	0.33
	RSD	22	45	30	46	38
	R^2	0.836	0.573	0.996	0.805	0.641
Th-230/ Pb-210	n	101	141	13	35	290
	Min	0.14	0.59	0.97	0.51	0.14
	Max	2.54	5.49	1.87	3.39	5.49
	Mean	0.81	1.48	1.27	1.16	1.2
	Median	0.70	1.41	1.20	1.08	1.22
	SD	0.45	0.5	0.25	0.5	0.56
	RSD	56	33	20	43	47
	R^2	0.281	0.689	0.999	0.906	0.745

Table D-2. Isotopic Ratios and Statistics for Samples by Sample Type (Continued)

Ratio	Parameter	Background	AUM	Target	Sediment	All
Ra-226/ Pb-210	n	89	141	13	33	276
	Min	0.20	0.65	0.84	0.68	0.2
	Max	2.13	4.58	2.59	3.66	4.58
	Mean	0.96	1.84	1.68	1.46	1.51
	Median	0.93	1.78	1.49	1.33	1.5
	SD	0.45	0.57	0.55	0.68	0.67
	RSD	46	31	33	46	45
	R^2	0.412	0.905	0.999	0.923	0.926

Notes:
AUM Abandoned uranium mine
Pb-210 Lead 210
R^2 Coefficient of determination
Ra-226 Radium 226
RSE Relative standard deviation
SD Standard deviation
Th-230 Thorium 230
U-238 Uranium 238

3.2.2 Background Areas

Uranium equilibrium was evaluated in 114 of the soil samples collected within BSAs project-wide. These samples included XRF confirmation soil samples (0 to 3 inches bgs) and surface soil samples (0 to 6 inches bgs) at BSAs. Table D1-12 in Attachment D1 lists analytical results from these samples. A summary of different isotopic ratios appears in Section 3.2.1 of this report. In this subsection, a graphical summary shows the evaluation of secular equilibrium for three of these isotopic ratios: (1) U-238/Th-230, (2) U-238/Ra-226, and (3) Th-230/Ra-226.

Figure D-34 shows the evaluation of secular equilibrium between U-238 and Th-230 within the 114 soil samples containing detectable concentrations of both isotopes collected within BSAs. The regression p-value is < 0.0001 with an R^2 of 0.860; the y=x line falls partially within the bounds of the 95% UCL bands on Figure D-34—evidence that U-238 and Th-230 are in equilibrium, but not secular equilibrium.

Figure D-35 shows the evaluation of secular equilibrium between U-238 and Ra-226 within the 95 soil samples containing detectable concentrations of both isotopes collected within BSAs. The regression p-value is < 0.0001 with an R^2 of 0.831; the y=x line falls outside the bounds of the 95% UCL bands on Figure D-35—evidence that U-238 and Ra-226 are not in equilibrium.

Figure D-36 shows the evaluation of secular equilibrium between Th-230 and Ra-226 within the 95 soil samples containing detectable concentrations of both isotopes collected within the background sites. The regression p-value is < 0.0001 with an R^2 of 0.836; the y=x line falls partially within the bounds of the 95% UCL bands on Figure D-36—evidence that Th-230 and Ra-226 are in equilibrium, but not secular equilibrium.

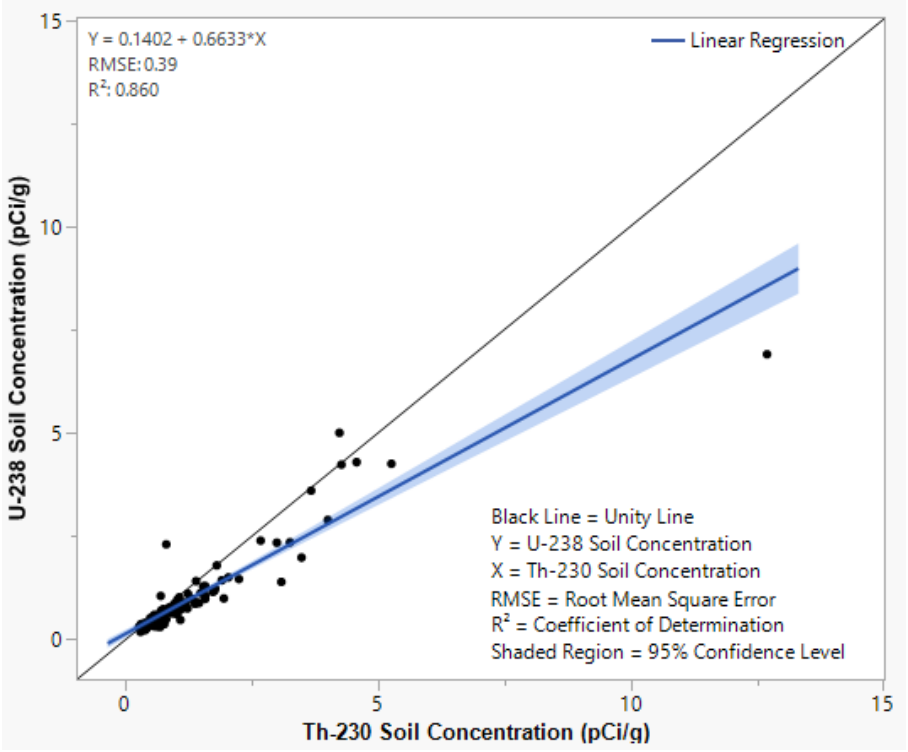

Figure D-34. Evaluation of Secular Equilibrium between U-238 and Th-230 in the Uranium Decay Series for BSA Samples

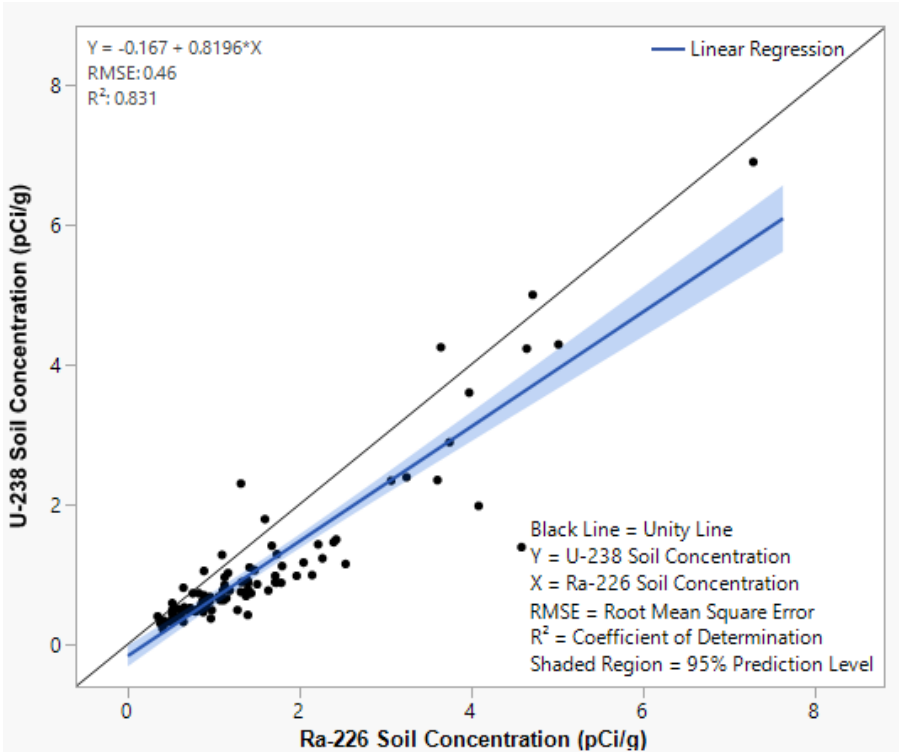

Figure D-35. Evaluation of Secular Equilibrium between U-238 and Ra-226 in the Uranium Decay Series for BSA Samples

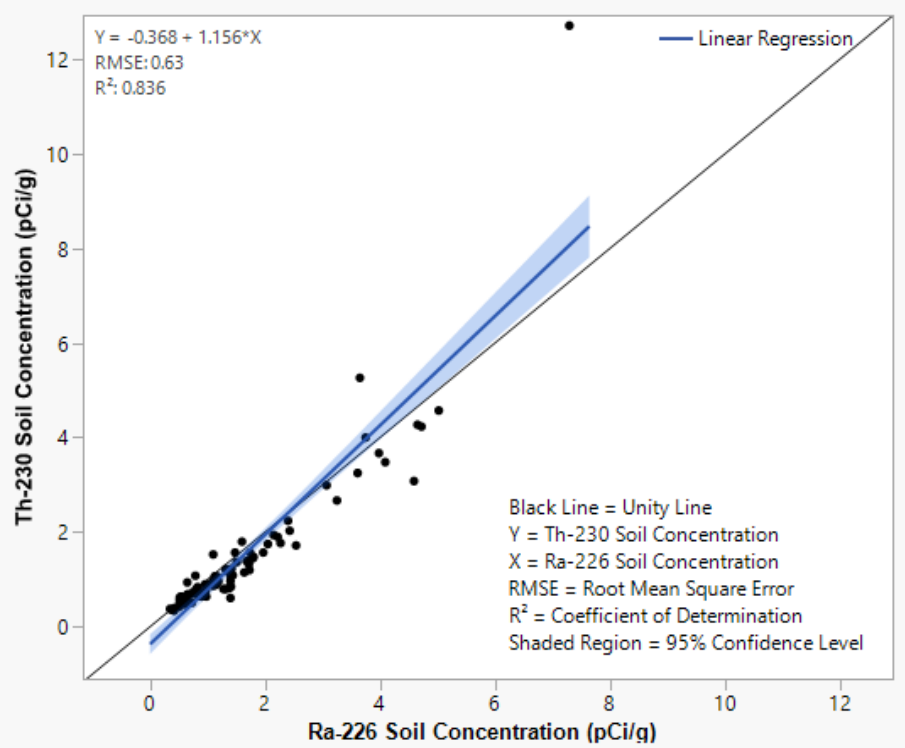

Figure D-36. Evaluation of Secular Equilibrium between Th-230 and Ra-226 in the Uranium Decay Series for BSA Samples

3.2.3 Abandoned Uranium Mines

Uranium equilibrium was evaluated in 142 of the soil samples collected within AUM sites project-wide. These samples included XRF confirmation soil samples (0 to 3 inches bgs) and surface soil samples (0 to 6 inches bgs). Table D1-13 in Attachment D1 lists analytical results from these samples. A summary of different isotopic ratios appears in Section 3.2.1 of this report. In this subsection, a graphical summary shows the evaluation of secular equilibrium for three of these isotopic ratios: (1) U-238/Th-230, (2) U-238/Ra-226, and (3) Th-230/Ra-226.

Figure D-37 shows the evaluation of secular equilibrium between U-238 and Th-230 within the 142 soil samples containing detectable concentrations of both isotopes collected within AUM sites. The regression p-value is < 0.0001 with an R^2 of 0.940; the y=x line falls partially within the bounds of the 95% UCL bands on Figure D-37—evidence that U-238 and Th-230 are in equilibrium, but not secular equilibrium.

Figure D-38 shows the evaluation of secular equilibrium between U-238 and Ra-226 within the 142 soil samples containing detectable concentrations of both isotopes collected within AUM sites. The regression p-value is < 0.0001 with an R^2 of 0.429; the y=x line falls fully within the bounds of the 95% UCL bands on Figure D-38. Due to the low R^2 value, evidence is insufficient to conclude whether secular equilibrium exists.

Figure D-39 shows the evaluation of secular equilibrium between Th-230 and Ra-226 within the 142 soil samples containing detectable concentrations of both isotopes collected within AUM sites. The regression p-value is < 0.0001 with an R^2 of 0.573; the y=x line falls partially within the bounds of the 95% UCL bands on Figure D-39. Due to the low R^2 value, evidence is insufficient to conclude whether secular equilibrium exists.

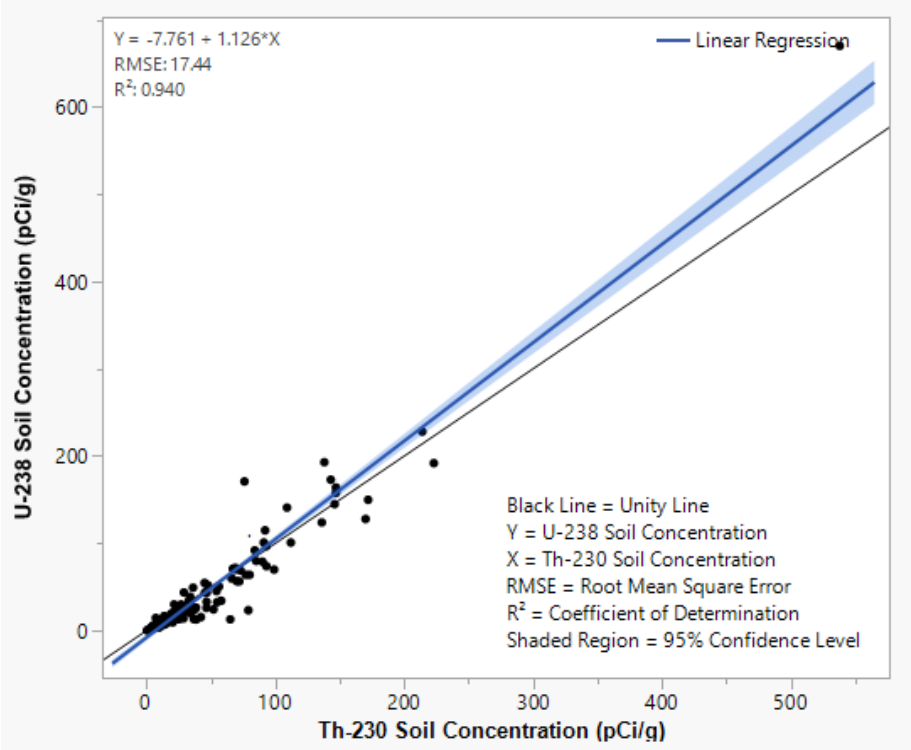

Figure D-37. Evaluation of Secular Equilibrium between U-238 and Th-230 in the Uranium Decay Series for AUM Site Samples

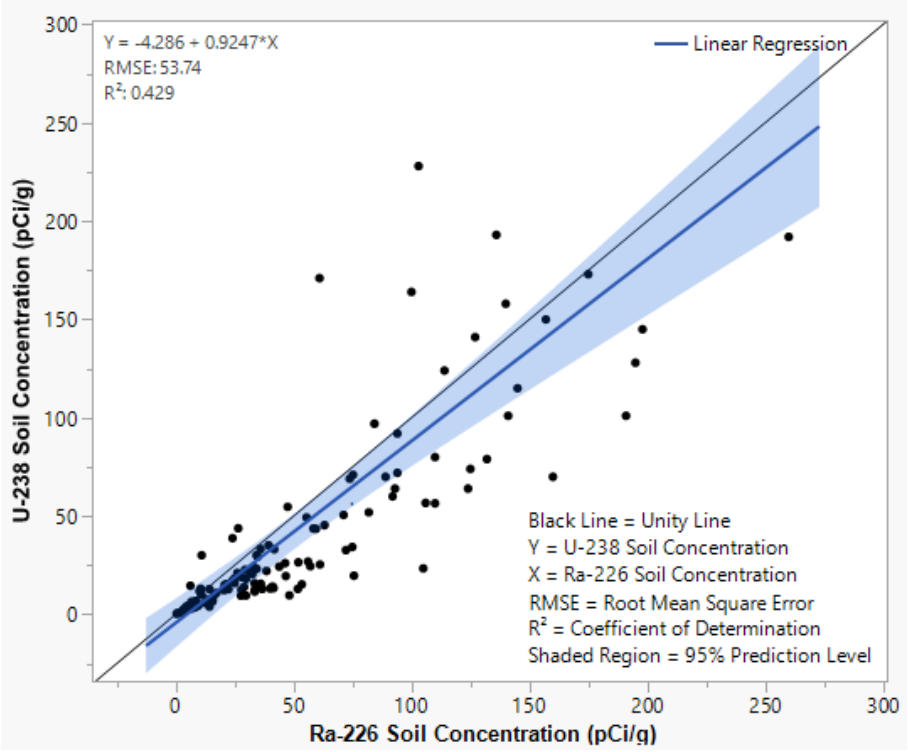

Figure D-38. Evaluation of Secular Equilibrium between U-238 and Ra-226 in the Uranium Decay Series for AUM Site Samples

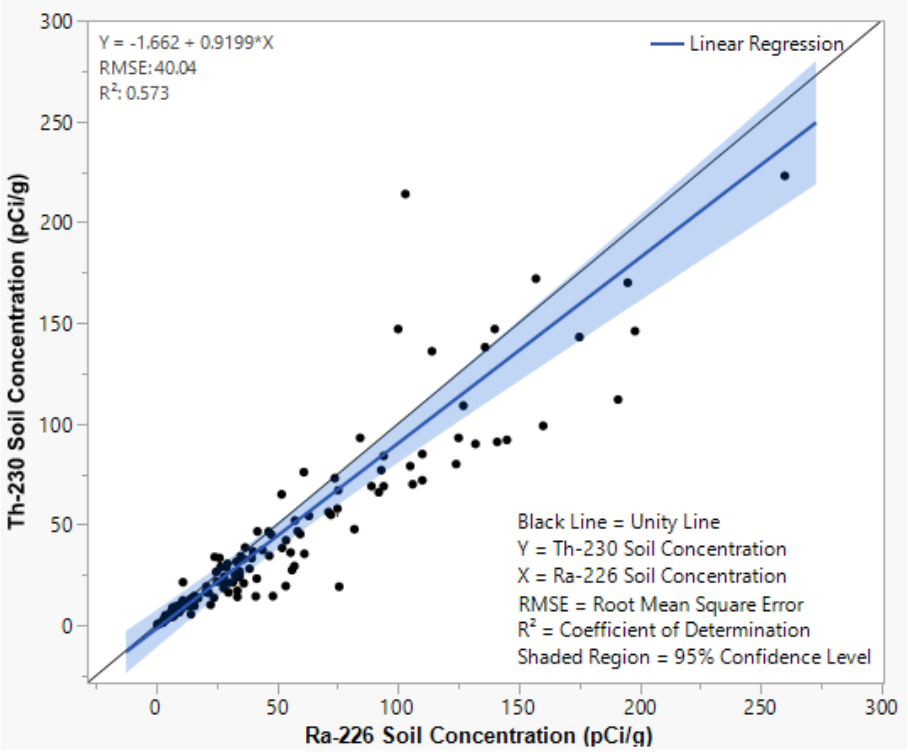

Figure D-39. Evaluation of Secular Equilibrium between Th-230 and Ra-226 in the Uranium Decay Series for AUM Site Samples

3.2.4 Target Sites

Uranium equilibrium was evaluated in 142 of the soil samples collected within Target sites project-wide. These samples included XRF confirmation soil samples (0 to 3 inches bgs) and surface soil samples (0 to 6 inches bgs). Table D1-14 in Attachment D1 lists analytical results from these samples. A summary of different isotopic ratios appears in Section 3.2.1 of this report. In this subsection, a graphical summary shows the evaluation of secular equilibrium for three of these isotopic ratios: (1) U-238/Th-230, (2) U-238/Ra-226, and (3) Th-230/Ra-226.

Figure D-40 shows the evaluation of secular equilibrium between U-238 and Th-230 within the 142 soil samples containing detectable concentrations of both isotopes collected within Target sites. The regression p-value is < 0.0001 with an R^2 of 0.855; the y=x line falls partially within the bounds of the 95% UCL bands on Figure D-40—evidence that U-238 and Th-230 are in equilibrium, but not secular equilibrium.

Figure D-41 shows the evaluation of secular equilibrium between U-238 and Ra-226 within the 142 soil samples containing detectable concentrations of both isotopes collected within Target sites. The regression p-value is < 0.0001 with an R^2 of 0.822; the y=x line falls partially within the bounds of the 95% UCL bands on Figure D-41—evidence that U-238 and Ra-226 are in equilibrium, but not secular equilibrium.

Figure D-42 shows the evaluation of secular equilibrium between Th-230 and Ra-226 within the 142 soil samples containing detectable concentrations of both isotopes collected within Target sites. The regression p-value is < 0.0001 with an R^2 of 0.996; the y=x line falls partially within the bounds of the 95% UCL bands on Figure D-42—evidence that Th-230 and Ra-226 are in equilibrium, but not secular equilibrium.

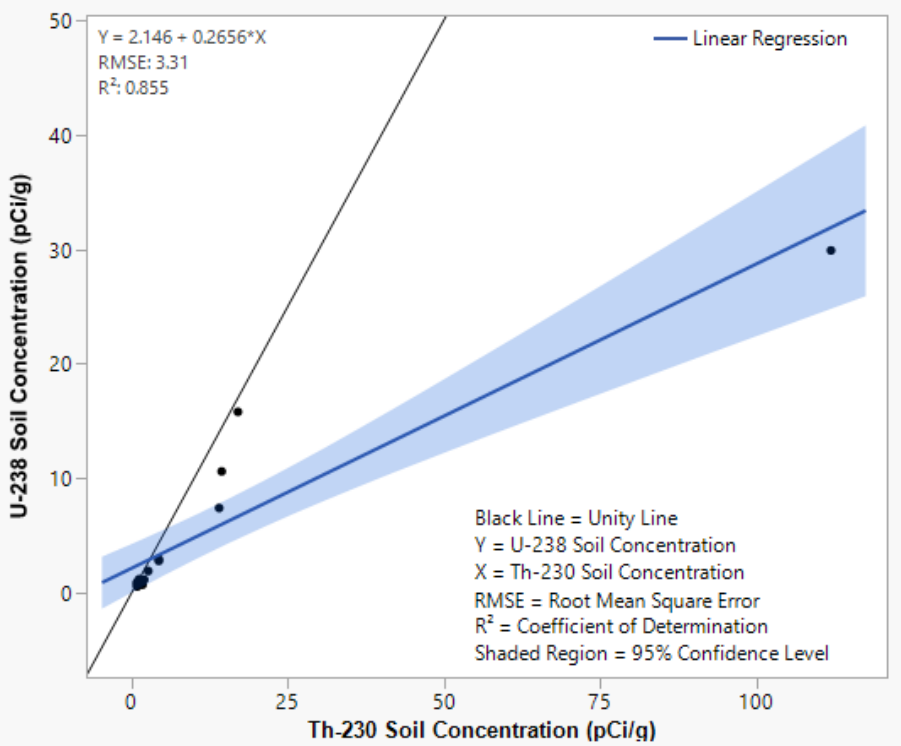

Figure D-40. Evaluation of Secular Equilibrium between U-238 and Th-230 in the Uranium Decay Series for Target Site Samples

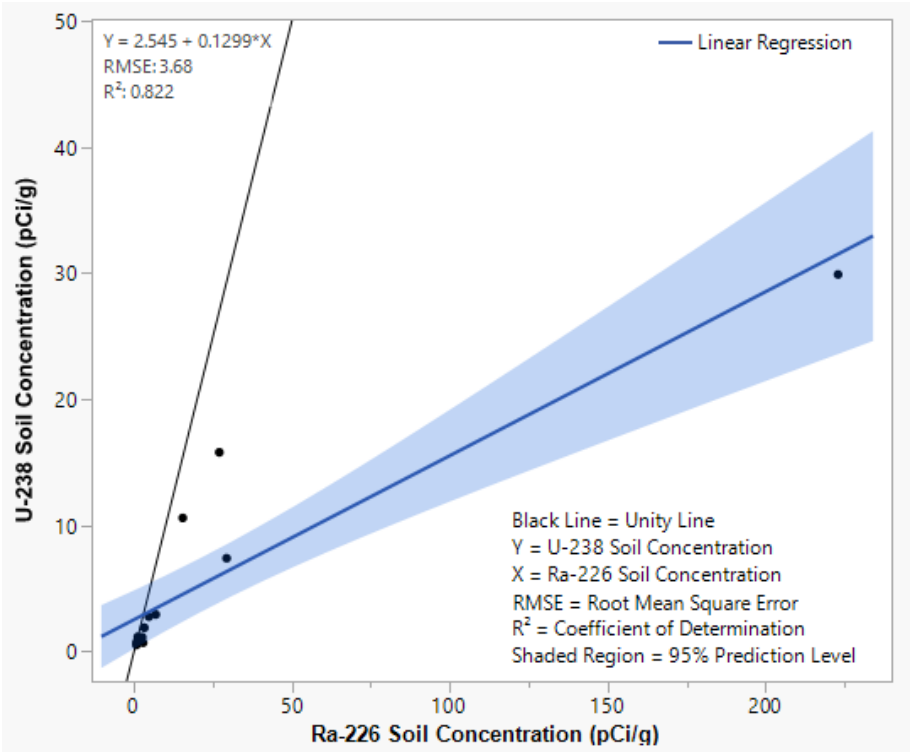

Figure D-41. Evaluation of Secular Equilibrium between U-238 and Ra-226 in the Uranium Decay Series for Target Site Samples

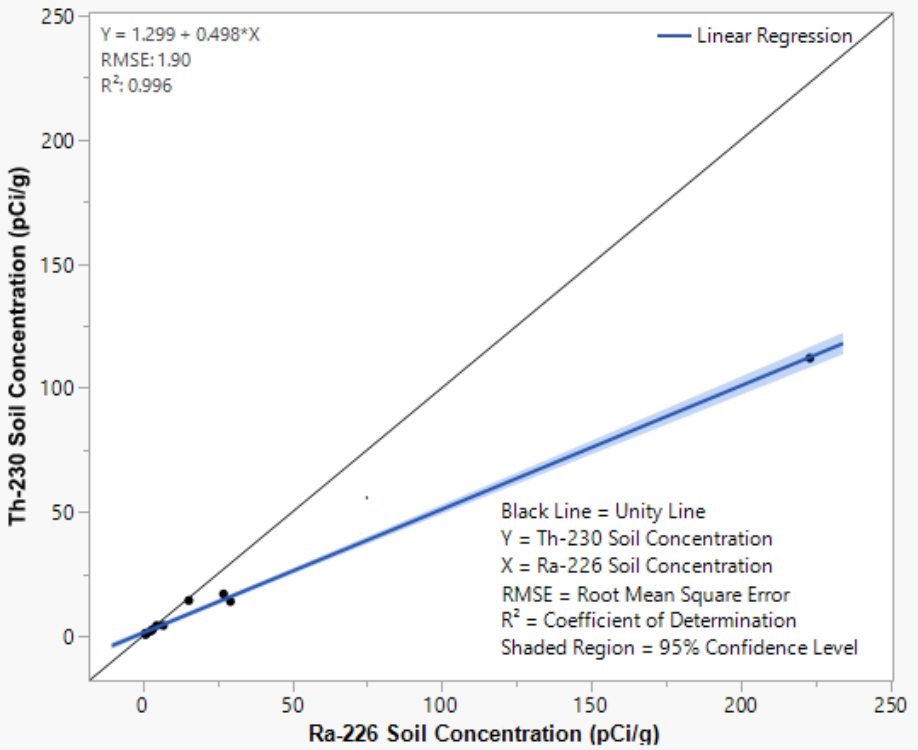

Figure D-42. Evaluation of Secular Equilibrium between Th-230 and Ra-226 in the Uranium Decay Series for Target Site Samples

3.2.5 Sediment Samples

Uranium equilibrium was evaluated in 39 of the sediment samples collected from within drainages project-wide. Table D1-15 in Attachment D1 lists analytical results from these samples. A summary of different isotopic ratios appears in Section 3.2.1 of this report. In this subsection, a graphical summary shows the evaluation of secular equilibrium for three of these isotopic ratios: (1) U-238/Th-230, (2) U-238/Ra-226, and (3) Th-230/Ra-226.

Figure D-43 shows the evaluation of secular equilibrium between U-238 and Th-230 within the 39 sediment samples containing detectable concentrations of both isotopes collected within the drainages. The regression p-value is < 0.0001 with an R^2 of 0.986; the y=x line falls partially within the bounds of the 95% UCL bands on Figure D-43—evidence that U-238 and Th-230 are in equilibrium, but not secular equilibrium.

Figure D-44 shows the evaluation of secular equilibrium between U-238 and Ra-226 within the 36 sediment samples containing detectable concentrations of both isotopes collected within the drainages. The regression p-value is < 0.0001 with an R^2 of 0.760; the y=x line falls partially within the bounds of the 95% UCL bands on Figure D-44. Due to the low R^2 value, evidence is insufficient to conclude whether secular equilibrium exists.

Figure D-45 shows the evaluation of secular equilibrium between Th-230 and Ra-226 within the 36 sediment samples containing detectable concentrations of both isotopes collected within the drainages. The regression p-value is < 0.0001 with an R^2 of 0.805; the y=x line falls partially within the bounds of the 95% UCL bands on Figure D-45—evidence that Th-230 and Ra-226 are in equilibrium, but not secular equilibrium.

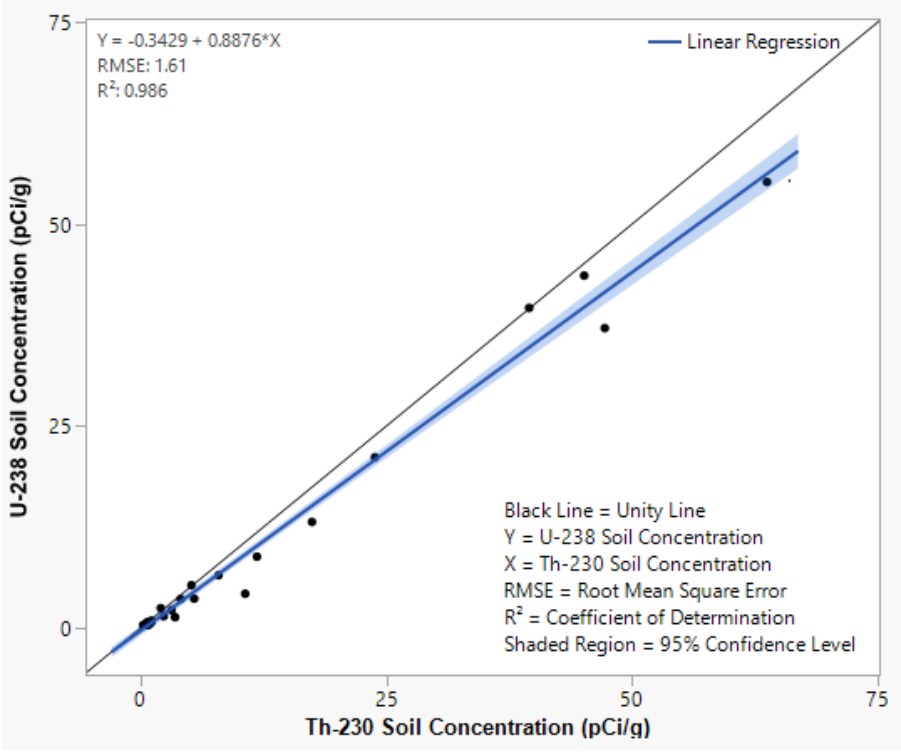

Figure D-43. Evaluation of Secular Equilibrium between U-238 and Th-230 in the Uranium Decay Series for Sediment Samples

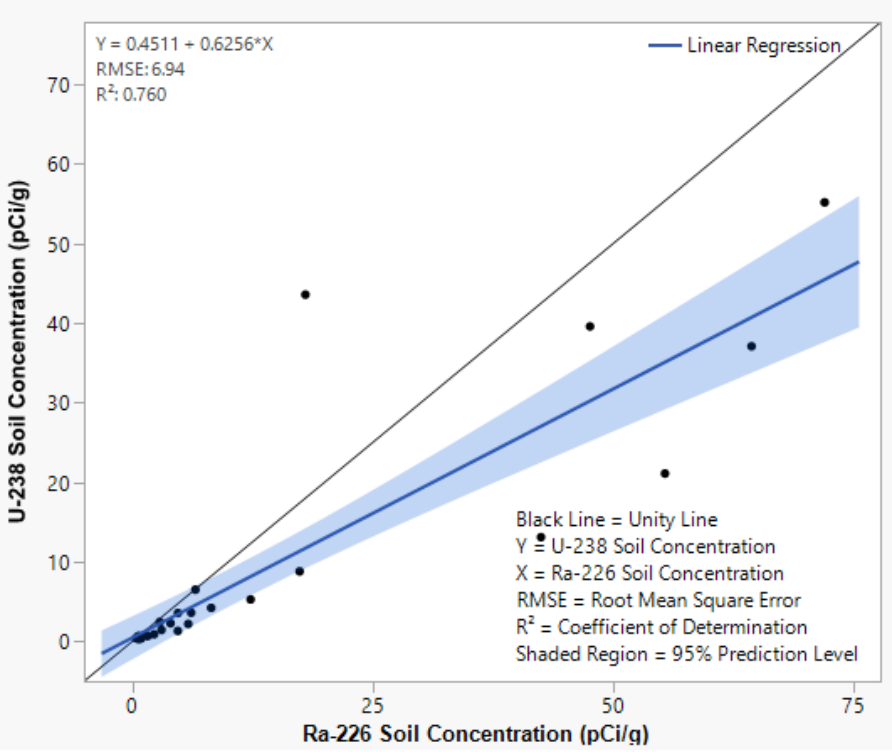

Figure D-44. Evaluation of Secular Equilibrium between U-238 and Ra-226 in the Uranium Decay Series for Sediment Samples

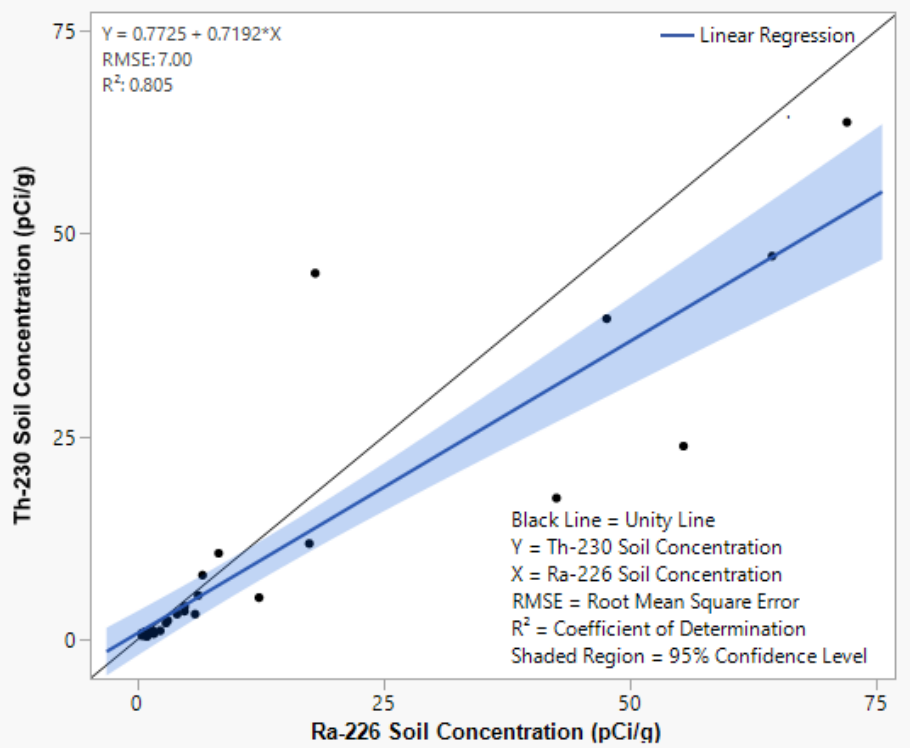

Figure D-45. Evaluation of Secular Equilibrium between Th-230 and Ra-226 in the Uranium Decay Series for Sediment Samples

3.2.6 All Sample Types

Uranium equilibrium was evaluated in 309 of the soil and sediment samples collected project-wide. These samples included XRF confirmation soil samples (0 to 3 inches bgs) and surface soil samples (0 to 6 inches bgs) at BSAs, AUM sites, and Target sites along with drainage sediment samples. Table D1-16 in Attachment D1 lists analytical results from these samples. A summary of different isotopic ratios appears in Section 3.2.1 of this report. In this subsection, a graphical summary shows the evaluation of secular equilibrium for three of these isotopic ratios: (1) U-238/Th-230, (2) U-238/Ra-226, and (3) Th-230/Ra-226.

Figure D-46 shows the evaluation of secular equilibrium between U-238 and Th-230 within the 309 soil and sediment samples containing detectable concentrations of both isotopes (all sample types). The regression p-value is < 0.0001 with an R^2 of 0.935; the y=x line falls partially within the bounds of the 95% UCL bands on Figure D-46—evidence that U-238 and Th-230 are in secular equilibrium.

Figure D-47 shows the evaluation of secular equilibrium between U-238 and Ra-226 within the 287 soil and sediment samples containing detectable concentrations of both isotopes (all sample types). The regression p-value is < 0.0001 with an R^2 of 0.468; the y=x line falls partially within the bounds of the 95% UCL bands on Figure D-47. Due to the low R^2 value, evidence is insufficient to conclude whether secular equilibrium exists.

Figure D-48 shows the evaluation of secular equilibrium between Th-230 and Ra-226 within the 287 soil and sediment samples containing detectable concentrations of both isotopes (all sample types). The regression p-value is < 0.0001 with an R^2 of 0.641; the y=x line falls partially within the bounds of the 95% UCL bands on Figure D-48. Due to the low R^2 value, evidence is insufficient to conclude whether secular equilibrium exists.

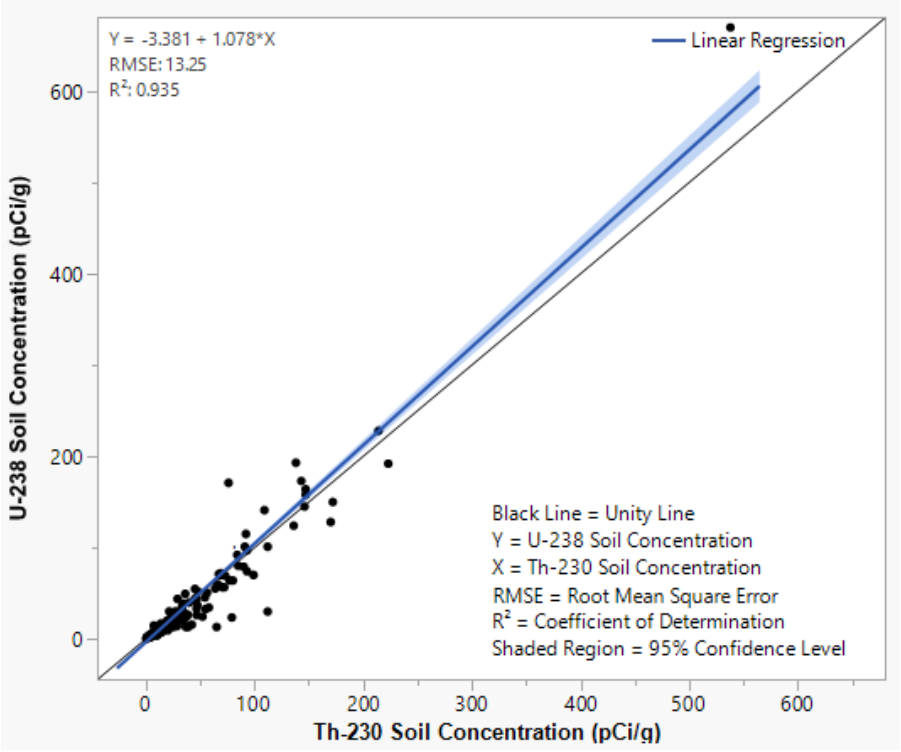

Figure D-46. Evaluation of Secular Equilibrium between U-238 and Th-230 in the Uranium Decay Series for All Sample Types

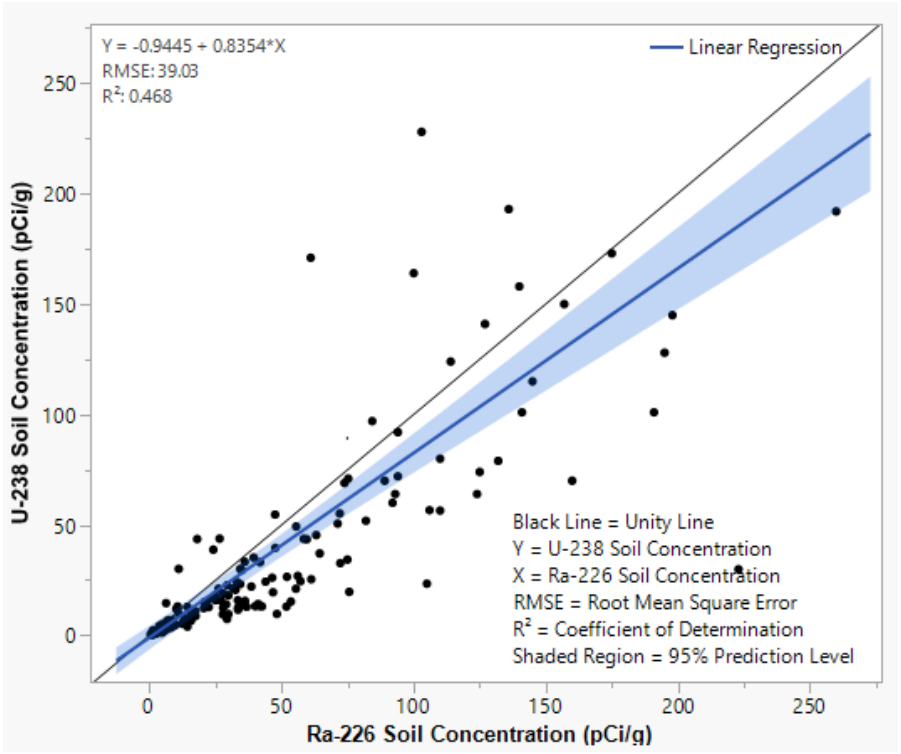

Figure D-47. Evaluation of Secular Equilibrium between U-238 and Ra-226 in the Uranium Decay Series for All Sample Types

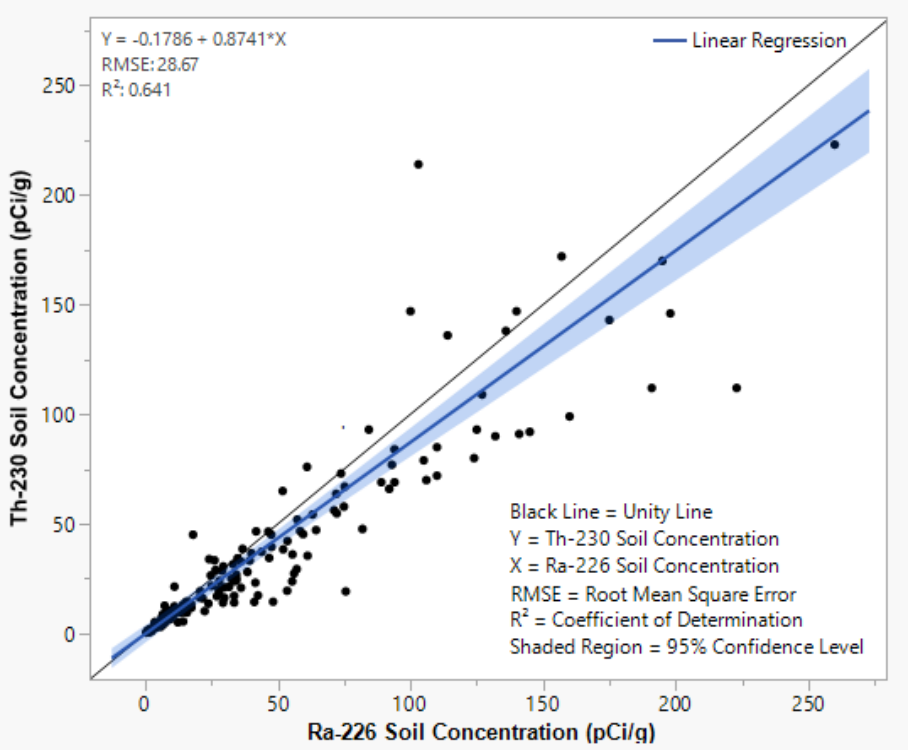

Figure D-48. Evaluation of Secular Equilibrium between Th-230 and Ra-226 in the Uranium Decay Series for All Sample Types

4.0 CONCLUSIONS

A total of 309 soil and sediment samples were evaluated for equilibrium conditions among the uranium series isotopes U-238, Th-230, Ra-226, and Pb-210. The range of calculated isotopic ratios include daughter product deficiencies and parent deficiencies. The mean isotopic ratio across the entire dataset identified a deficiency in the parent isotope U-238 as compared with daughter activity concentrations of Th-230, Ra-226, and Pb-210 (mean isotopic ratios of 0.82, 0.72, and 0.72, respectively). In contrast, the average isotopic ratio between Ra-226 and daughter Pb-210 (mean isotopic ratio of 1.51) indicates a deficiency of Pb-210 activity as compared with the parent Ra-226. Based on the methods presented in this report, conditions of secular equilibrium were concluded to exist between U-238 and Th-230 in the samples collected within the Jurassic Carmel (Jc) geology and between Th-230 and Ra-226 is the samples collected within the Summerville Formation (Js).

Measurements of carnotite ore deposits have indicated daughter product deficiencies related to preferential leaching of radium and the mineral makeup of ore in promoting fixation of uranium (Rosholt 1959). Results obtained under equilibrium conditions in the samples collected during the 2018 RSE investigation did not, on average, indicate a uranium-series daughter product deficiency, but this condition was found in some cases. Samples collected during the RSE investigation came from areas with elevated radionuclide concentrations and areas exhibiting background levels of radiation, and samples of many differing soil types were collected not purely representative of the carnotite uranium bearing ore considered in Rosholt (1959).

Determination of secular equilibrium at an AUM can be an important part of the risk assessment process because the assumed fraction of Ra-226 decay products present in the environment greatly influences a hypothetical receptor's radiation dose and lifetime excess cancer risk. However, assuming secular equilibrium between Ra-226 and its decay products for the purpose of risk assessment is acceptable and conservative, and avoids need to conclusively determine secular equilibrium conditions at an AUM. Thus, an inconclusive result regarding secular equilibrium is not a study data gap, as the risk assessment phase may still proceed, provided that conservative assumptions are included regarding equilibrium concentrations of Ra-226 decay products. On average, measured activity concentration of Ra-226 was greater than that of its daughter isotope Pb-210, further substantiating the assumption that secular equilibrium between Ra-226 and its decay products is conservative.

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ATTACHMENT D1

EQUILIBRIUM GROUP SAMPLE TABLES

Table D1-1. Tabulated Jurassic Carmel Formation (Jc) Geology Sample Results

Sample ID	Isotope Ratios						Pb-210 (pCi/g)	Pb-210 Qualifier	Ra-226 (pCi/g)	Ra-226 Qualifier	Th-230 (pCi/g)	Th-230 Qualifier	U-238 (pCi/g)	U-238 Qualifier
	U-238/ Th-230	U-238/ Ra-226	U-238/ Pb-210	Th-230/ Ra-226	Th-230/ Pb-210	Ra-226/ Pb-210								
B18-SB11-01-052518	0.81	0.7	0.34	0.86	0.42	0.49	1.79		0.87	LT	0.75	M3	0.61	
B18-SS11-01-052518	0.69	0.59	0.27	0.86	0.38	0.45	2.47		1.11		0.95	M3	0.66	
B18-SS23-01-052518	0.84	0.65	0.87	0.77	1.03	1.33	1.05		1.4		1.08	M3	0.91	
B23-SS08-01-060618	0.82	0.69	0.72	0.84	0.87	1.04	0.85	LT	0.88	LT	0.74	M3	0.61	
B23-SB18-01-060618	0.9	0.74	1.19	0.82	1.33	1.62	2.01		3.25		2.67	M3	2.39	
B23-SS18-01-060618	0.78	0.76	0.93	0.97	1.19	1.22	2.51		3.07		2.99	M3	2.34	
M13-SB114-1230-01-091518	0.54	0.66	0.9	1.22	1.67	1.37	2.51		3.43		4.19	M3	2.25	
M13-SS114-01-091518	0.86	0.61	1.06	0.71	1.24	1.75	17		29.8		21.1	M3	18.1	
M14-SB37-0612-01-091818	1.01	0.79	1.27	0.78	1.25	1.62	55		89	M3	69	M3	70	
M14-SB37-1218-01-091818	1.04	0.77	1.31	0.73	1.25	1.71	55		94		69	M3	72	
M14-SS37-01-091818	0.91	0.65	1.15	0.72	1.27	1.77	52		92	J-	66	M3	60	

Notes:

J- Estimated value, may be biased low.
LT Result less than requested minimum detectable concentration, but greater than sample-specific detectable concentration.
M3 The requested minimum detected concentration was not met, but the reported activity is greater than the reported minimum detected concentration.
Pb-210 Lead 210
pCi/g Picocuries per gram
Ra-226 Radium 226
Th-230 Thorium 230
U-238 Uranium 238

Table D1-2. Tabulated Lower Morrison Formation (Jml) Geology Sample Results

Sample ID	Isotope Ratios						Pb-210 (pCi/g)	Pb-210 Qualifier	Ra-226 (pCi/g)	Ra-226 Qualifier	Th-230 (pCi/g)	Th-230 Qualifier	U-238 (pCi/g)	U-238 Qualifier
	U-238/ Th-230	U-238/ Ra-226	U-238/ Pb-210	Th-230/ Ra-226	Th-230/ Pb-210	Ra-226/ Pb-210								
B12-SS01-01-050818	0.73	0.51	0.47	0.69	0.64	0.93	1.87		1.73	J+	1.2	M3	0.88	
B12-SB11-01-050818	0.72	0.56	0.56	0.78	0.78	1.00	1.4		1.4		1.09	M3	0.78	
B12-SS11-01-050818	0.67	0.47	0.45	0.70	0.66	0.95	1.73		1.64		1.15	M3	0.77	
B9-SS03-01-050718	0.68	0.58	0.49	0.85	0.72	0.84	1.28		1.08		0.92	M3	0.63	
B9-SB21-01-050718	0.79	0.75	1.37	0.95	1.73	1.82	0.62	Y1,LT	1.13		1.07	M3	0.85	
B9-SS21-01-050718	0.87	0.88	1.78	1.01	2.05	2.02	0.41	U	0.83	LT	0.84	M3	0.73	
B13-SS08-01-071518	0.73	0.48	0.11	0.66	0.14	0.22	5.2		1.14	UJ	0.75	M3	0.55	
B13-SB16-01-071518	0.76	0.71	1.31	0.94	1.73	1.85	0.52	U	0.96	LT	0.9	M3	0.68	
B13-SS16-01-071518	0.99	0.96	0.43	0.97	0.44	0.45	1.68		0.76	J+	0.74	M3	0.73	
B13-SS23-01-071518	0.84	0.65	0.14	0.77	0.16	0.21	4.5		0.96	LT	0.74	M3	0.62	
B14-SS13-01-071518	0.58	0.69	0.26	1.19	0.46	0.39	1.4		0.54	J+	0.64	M3	0.37	
B14-SB27-01-071518	1.03		0.64		0.62	0.00	0.47	U	0	U	0.29	M3	0.3	
B14-SS27-01-071518	0.62	0.67	0.32	1.07	0.52	0.48	0.56	LT	0.27	U	0.29	M3	0.181	
B17-SS06-01-052418	0.73	0.77	0.15	1.05	0.21	0.20	3.24		0.64	J+	0.67	M3	0.49	
B17-SB21-01-052418	1.52	1.18	0.68	0.78	0.45	0.57	1.55		0.89	LT	0.69	M3	1.05	
B17-SS21-01-052418	0.60	0.87	0.12	1.46	0.20	0.14	5.1	J	0.7	UJ	1.02	J	0.61	
B17-SS21-02-052418	0.69	0.73	0.35	1.06	0.50	0.47	1.39	J	0.66	LT	0.7	J	0.48	
B20-SB01-01-052318	0.79	0.66	0.43	0.84	0.55	0.65	0.77	LT	0.5	LT	0.42	M3	0.33	
B20-SS01-01-052318	0.58	0.49	0.28	0.85	0.48	0.57	1.14		0.65	LT	0.55	M3	0.32	
B20-SS12-01-052318	0.68	0.65	0.41	0.96	0.60	0.63	1.15		0.72	LT	0.69	M3	0.47	
B21-SB04-01-062118	0.94	0.85	1.24	0.91	1.32	1.45	3.46		5.02		4.57	M3	4.29	
B21-SS04-02-062118	1.18	1.06	1.76	0.90	1.49	1.66	2.84		4.72		4.23	M3	5	
B21-SS13-01-062118	0.99	0.91	1.52	0.92	1.53	1.67	2.79		4.65		4.27	M3	4.23	
B21-SB14-01-062118	0.72	0.65	1.09	0.90	1.50	1.67	2.16		3.61		3.25	M3	2.35	
B21-SS14-02-062118	0.81	1.16	1.44	1.44	1.78	1.24	2.95		3.65		5.26	M3	4.25	
B21-SB26-01-062118	0.72	0.77	1.19	1.07	1.65	1.55	2.42		3.75		4	M3	2.89	
B22-SS04-01-052418	0.67	0.51	0.26	0.76	0.39	0.51	2.82		1.44		1.09	M3	0.73	
B22-SS16-01-052418	1.00	0.79	0.86	0.79	0.86	1.10	0.81	LT	0.89	LT	0.7	J	0.7	
B22-SS16-02-052418	0.44	0.59	0.53	1.37	1.23	0.90	0.88	LT	0.79	LT	1.08	J	0.47	
B25-SS04-01-060418	0.75	0.64	0.62	0.86	0.83	0.97	2.29		2.22		1.9	M3	1.43	
B25-SB12-01-060418	0.74	0.57	0.69	0.77	0.93	1.20	0.96	LT	1.15	J+	0.89	M3	0.66	
B25-SS12-01-060418	0.80	0.65	0.66	0.81	0.83	1.03	1.16		1.19	J+	0.96	M3	0.77	
B26-SS07-01-091418	0.61	0.49	0.26	0.81	0.42	0.52	3.43		1.79	J+	1.45	M3	0.88	
B26-SS09-01-060518	0.67	0.45	0.54	0.68	0.81	1.19	2.13		2.54		1.72	M3	1.15	
B26-SB29-01-060518	0.63	0.57	1.21	0.91	1.93	2.13	0.71	LT	1.51	J+	1.37	M3	0.86	
B26-SS29-01-060518	0.74	0.57	0.50	0.77	0.67	0.87	1.97		1.72		1.32	M3	0.98	
B27-SB07-01-061018	0.77	0.50	0.37	0.65	0.48	0.74	1.32		0.98	LT	0.64	M3	0.49	
B27-SS07-01-061018	0.78	0.58	0.37	0.75	0.48	0.64	1.42		0.91	J+	0.68	M3	0.53	

Table D1-2. Tabulated Lower Morrison Formation (Jml) Geology Sample Results (Continued)

Sample ID	Isotope Ratios						Pb-210 (pCi/g)	Pb-210 Qualifier	Ra-226 (pCi/g)	Ra-226 Qualifier	Th-230 (pCi/g)	Th-230 Qualifier	U-238 (pCi/g)	U-238 Qualifier
	U-238/ Th-230	U-238/ Ra-226	U-238/ Pb-210	Th-230/ Ra-226	Th-230/ Pb-210	Ra-226/ Pb-210								
B27-SS16-01-061018	0.86	0.60	0.51	0.70	0.59	0.84	1.08		0.91	LT	0.64	M3	0.55	
B29-SS01-01-071018	0.64	1.00	0.41	1.58	0.65	0.41	0.63	LT	0.26	U	0.41	M3	0.261	
B29-SS06-01-071018	0.86	1.02	0.94	1.19	1.09	0.91	0.47	U	0.43	UJ	0.51	M3	0.44	
B29-SS11-01-071318	0.44	0.65	2.00	1.48	4.53	3.07	0.15	U	0.46	UJ	0.68	M3	0.3	
B29-SS20-01-071118	1.05	1.14	0.78	1.09	0.75	0.69	0.51	U	0.35	LT	0.38	M3	0.4	
B29-SS23-01-071318	1.23	1.23	1.28	1.00	1.03	1.03	0.29	U	0.3	U	0.3	M3	0.37	
B29-SS26-01-071118	0.77	0.66	0.73	0.85	0.95	1.11	0.56	U	0.62	LT	0.53	M3	0.41	
B30-SS11-01-071018	1.18	1.07	1.82	0.90	1.54	1.71	0.17	U	0.29	U	0.262	M3	0.31	
B30-SB21-01-071018	0.59	0.55	0.42	0.93	0.72	0.77	0.53	U	0.41	LT	0.38	M3	0.224	
B30-SS21-01-071018	0.83	0.79	0.40	0.95	0.48	0.51	0.75	LT	0.38	LT	0.36	M3	0.3	
B30-SS21-02-071018	1.00	0.81	0.46	0.81	0.46	0.57	0.74	LT	0.42	LT	0.34	M3	0.34	
B31-SS06-01-071318	0.51	0.60	0.17	1.17	0.33	0.28	1.86		0.52	U	0.61	M3	0.31	
B31-SS18-01-071318	0.49	0.38	0.19	0.78	0.39	0.49	1.97		0.97	J+	0.76	M3	0.37	
B31-SB30-01-071318	0.79	1.00	0.25	1.27	0.31	0.25	1.81		0.45	UJ	0.57	M3	0.45	
B31-SS30-01-071318	0.95	1.13	0.27	1.19	0.28	0.24	2.2		0.52	J+	0.62	M3	0.59	
B33-SB12-01-071618	0.86	1.25	0.60	1.45	0.69	0.48	1.36		0.65	LT	0.94	M3	0.81	
B33-SS12-01-071618	0.89	0.54	0.59	0.60	0.66	1.10	1.28		1.41		0.85	M3	0.76	
B33-SS18-01-071618	0.68	0.72	0.80	1.06	1.19	1.12	1.32		1.48		1.57	M3	1.06	
M5-SD1-01-062318	0.79	0.58	1.11	0.73	1.42	1.93	33.3		64.4		47.2	M3	37.1	
M7-SD2-01-081418	1.52	0.97	1.14	0.64	0.75	1.18	0.28	U	0.33	U	0.21	M3	0.32	
M3-SB51-0612-01-091618	0.79	0.61	1.49	0.77	1.89	2.44	2.73		6.67		5.16	M3	4.07	
M3-SB51-1218-01-091618	0.72	0.45	1.00	0.63	1.38	2.21	3.05		6.75		4.22	M3	3.04	
M3-SS51-01-091618	0.80	0.42	0.86	0.53	1.07	2.04	1.13		2.3		1.21	M3	0.97	
M4-SB81-0612-01-091818	0.72	0.42	0.79	0.58	1.10	1.90	32.2		61.2		35.5	M3	25.4	
M4-SB81-1218-01-091818	0.57	0.42	0.66	0.74	1.17	1.58	29.6		46.7	M3	34.5	M3	19.5	
M4-SS81-01-091818	0.65	0.55	0.90	0.85	1.38	1.62	27.1		43.9	M3	37.3	M3	24.3	
M5-SB149-0612-01-093018	0.99	0.35	1.04	0.35	1.05	3.00	13.7		41.1	M3	14.4	M3	14.2	
M5-SS149-01-093018	1.01	0.93	1.41	0.91	1.39	1.53	23.6		36		32.9	M3	33.3	
M5-SB479-0612-01-093018	0.87	0.91	0.78	1.04	0.89	0.85	0.89	LT	0.76	LT	0.79	M3	0.69	
M5-SS479-01-093018	1.08	1.13	0.90	1.05	0.83	0.79	0.77	LT	0.61	LT	0.64	M3	0.69	
M6-SS174-01-092718	0.80	0.90	1.00	1.13	1.25	1.11	9.9	J	11		12.4	M3	9.9	
M6-SB285-0612-01-091618	0.82	0.35	0.61	0.42	0.74	1.75	19.1		33.5		14.1	M3	11.6	
M6-SB285-1218-01-091618	1.12	0.88	1.21	0.78	1.08	1.38	24.9		34.3		26.9	M3	30.1	
M6-SS285-01-091618	0.80	0.58	0.47	0.72	0.59	0.82	16.1		13.2		9.5	M3	7.6	
M7-SB161-0612-01-091618	0.60	0.45	0.84	0.76	1.41	1.86	38.8		72.2	M3	54.8	M3	32.7	
M7-SB161-1218-01-091618	0.78	0.29	0.81	0.36	1.03	2.83	18.9		53.5	M3	19.5	M3	15.3	
M7-SB161-1824-01-091618	0.75	0.43	0.88	0.58	1.18	2.04	17.7		36.1	J-	20.9	M3	15.6	
M7-SB161-2430-01-091618	0.84	0.72	1.06	0.86	1.26	1.47	43		63.1	M3	54.3	M3	45.4	

Table D1-2. Tabulated Lower Morrison Formation (Jml) Geology Sample Results (Continued)

Sample ID	Isotope Ratios						Pb-210 (pCi/g)	Pb-210 Qualifier	Ra-226 (pCi/g)	Ra-226 Qualifier	Th-230 (pCi/g)	Th-230 Qualifier	U-238 (pCi/g)	U-238 Qualifier
	U-238/ Th-230	U-238/ Ra-226	U-238/ Pb-210	Th-230/ Ra-226	Th-230/ Pb-210	Ra-226/ Pb-210								
M7-SS161-01-091618	0.81	0.53	0.91	0.66	1.13	1.71	62		106		70	M3	56.7	
M8-SS52-01-091818	1.56	1.24	1.70	0.79	1.09	1.38	7.7		10.6		8.4	J	13.1	
M8-SS120-01-092718	0.37	0.43	0.62	1.19	1.68	1.42	5.7		8.1		9.6	M3	3.51	
T17-SB258-018090-01-092518	0.58	0.45	0.66	0.78	1.14	1.47	1.74		2.56		1.99	M3	1.15	
M11-SB35-0612-01-092818	0.58	0.32	0.64	0.56	1.10	1.97	21.1		41.5	M3	23.2	M3	13.4	
M11-SS35-01-092818	0.36	0.33	0.43	0.92	1.20	1.31	30.5		40		36.7	M3	13.2	
M12-SS33-01-092818	0.55	0.56	0.57	1.02	1.03	1.01	4.7		4.74	J-	4.82	M3	2.66	
M9-SS19-01-093018	0.65	0.34	0.51	0.52	0.78	1.49	1.79	J	2.67	J-	1.39	M3	0.91	
M15-SS14-01-091518	0.68	0.52	1.04	0.77	1.53	1.99	2.51		5		3.83	M3	2.61	
M15-SB84-0612-01-091418	0.69	0.50	0.96	0.73	1.39	1.90	7.1		13.5		9.9	M3	6.8	
M15-SS84-01-091418	0.81	0.64	1.09	0.78	1.34	1.71	10.1		17.3		13.5	M3	11	
M16-SB193-0612-01-091318	0.96	0.68	1.31	0.71	1.37	1.94	17.7		34.3		24.2	M3	23.2	
M16-SB193-1218-01-091318	0.76	0.73	1.24	0.95	1.63	1.71	19.4		33.1		31.6	M3	24.1	
M16-SS193-01-091318	0.82	0.63	1.38	0.77	1.68	2.18	14.9		32.5	M3	25	M3	20.6	
M18-SB145-0612-01-091418	0.86	0.74	1.61	0.86	1.87	2.18	119		260	M3	223	M3	192	M3
M18-SS145-01-091418	0.71	0.44	1.25	0.62	1.77	2.86	56		160	M3	99	M3	70	
T23-SS32-01-091418	0.72	0.59	0.75	0.81	1.04	1.28	2.54		3.24		2.63	M3	1.9	
M23-SB54-0612-01-092718	0.67	0.20	0.79	0.30	1.18	3.92	12.3		48.2	M3	14.5	M3	9.7	
M23-SB54-1218-01-092718	1.10	0.81	1.35	0.74	1.24	1.67	5.1		8.5		6.3	M3	6.9	
M23-SS54-01-092718	0.49	0.48	0.74	0.99	1.51	1.53	19		29		28.6	M3	14	
M25-SB50-0612-01-092818	1.04	1.15	1.83	1.10	1.75	1.59	53		84.3	M3	93	M3	97	M3
M25-SB50-1218-01-092818	1.25	0.57	1.47	0.46	1.17	2.57	8.7	J	22.4		10.2	M3	12.8	
M25-SS50-01-092818	1.00	0.67	1.40	0.67	1.40	2.08	15.2		31.6		21.3	M3	21.3	
M26-SB28-0612-01-092618	0.52	0.48	0.94	0.93	1.81	1.95	8		15.6		14.5	M3	7.5	
M26-SS28-01-092618	0.50	0.46	0.78	0.93	1.55	1.67	8.5		14.2		13.2	M3	6.6	
M27-SB51-0612-01-092618	0.37	0.29	0.51	0.79	1.39	1.76	30.4		53.6		42.2	M3	15.6	
M27-SS51-01-092618	0.20	0.25	0.52	1.25	2.59	2.06	25.1		51.8		65	M3	13	
M30-SS180-01-092918	0.66	0.59	1.04	0.89	1.58	1.78	9		16		14.2	M3	9.4	
M31-SS9-01-092918	1.07	2.21	2.51	2.08	2.35	1.13	91		103	M3	214	M3	228	J
M31-SB37-0612-01-092918	0.47	0.43	0.58	0.91	1.24	1.36	42		57.3	M3	52	M3	24.4	
M31-SS37-01-092918	1.41	2.74	2.37	1.95	1.69	0.87	12.7		11		21.4	M3	30.1	
M32-SS56-01-092918	2.25	2.80	4.17	1.25	1.85	1.49	41		61	M3	76	M3	171	J
M32-SB89-0612-01-092918	1.12	1.64	3.15	1.47	2.83	1.92	52		100		147	M3	164	J
M32-SS89-01-092918	1.11	0.72	2.02	0.65	1.82	2.82	50		141	M3	91	M3	101	M3
M35-SB22-0612-01-092718	0.68	0.47	0.88	0.69	1.30	1.88	5	J	9.4		6.5	M3	4.42	
M35-SS22-01-092718	0.81	0.66	1.23	0.82	1.53	1.87	4.7	J	8.8		7.2	M3	5.8	
M38-SB2-0612-01-092718	0.30	0.22	0.60	0.75	2.04	2.71	38.8		105	M3	79	M3	23.4	
M38-SB2-1218-01-092718	0.59	0.46	0.92	0.77	1.56	2.01	37.2		74.9	M3	57.9	M3	34.3	

Table D1-2. Tabulated Lower Morrison Formation (Jml) Geology Sample Results (Continued)

Sample ID	Isotope Ratios						Pb-210 (pCi/g)	Pb-210 Qualifier	Ra-226 (pCi/g)	Ra-226 Qualifier	Th-230 (pCi/g)	Th-230 Qualifier	U-238 (pCi/g)	U-238 Qualifier
	U-238/ Th-230	U-238/ Ra-226	U-238/ Pb-210	Th-230/ Ra-226	Th-230/ Pb-210	Ra-226/ Pb-210								
M38-SS2-01-092718	0.33	0.35	0.53	1.05	1.58	1.50	24.4		36.7		38.6	M3	12.9	
M3-XS34-01-043018	0.88	0.65	1.10	0.73	1.25	1.70	4.6		7.8		5.73	M3	5.06	
M3-XS36-01-043018	0.80	0.49	1.22	0.61	1.52	2.49	6.3		15.7		9.6	M3	7.7	
M4-XS238-01-051018	0.72	0.28	0.76	0.38	1.06	2.75	5.2		14.3		5.49	M3	3.96	
M6-XSG13A-01-091618	0.68	0.73	1.22	1.07	1.80	1.68	14.7		24.7		26.5	M3	18	
M6-XS269-01-042618	0.67	0.42	0.74	0.63	1.11	1.75	8.9		15.6		9.9	M3	6.6	
M7-XSR1-01-093018	0.79	0.72	0.93	0.91	1.19	1.30	2.29		2.98		2.72	M3	2.14	
M7-XS162A-01-081518	0.75	0.66	1.01	0.87	1.34	1.54	127		195	M3	170	M3	128	
M7-XS181-01-051018	0.59	0.32	0.72	0.55	1.23	2.24	13.3		29.8		16.3	M3	9.6	J
M7-XS181-02-051018	0.68	0.45	0.84	0.66	1.24	1.88	14.8		27.8		18.4	M3	12.5	J
M8-XS102-01-050918	0.95	0.90	1.15	0.94	1.20	1.27	3.64		4.64		4.37	M3	4.17	
T14-XS27-01-050818	0.75	0.86	0.79	1.15	1.05	0.91	0.81	LT	0.74	LT	0.85	M3	0.64	
T17-XS143-01-042618	0.93	0.59	1.34	0.63	1.44	2.29	11.8		27		17	M3	15.8	
T17-XS377-01-042818	0.74	0.69	1.22	0.94	1.66	1.77	8.7		15.4		14.4	M3	10.6	M3
M11-XS11-01-071118	0.90	0.53	0.99	0.59	1.10	1.87	102		191	M3	112	M3	101	
M11-XSG25-01-092818	0.73	0.97	1.23	1.33	1.69	1.28	5.2	J+	6.63		8.8	M3	6.4	
M9-XS19A-01-081718	0.71	0.49	0.67	0.69	0.95	1.38	1.28		1.76		1.21	J	0.86	
M9-XS28A-01-081718	0.94	0.73	1.18	0.77	1.25	1.62	68	Y1	110	J-	85	M3	80	
M15-XS3-01-052118	0.75	0.60	1.24	0.80	1.67	2.07	9.9		20.5		16.5	M3	12.3	
M16-XS30-01-052118	0.47	0.34	0.73	0.73	1.55	2.11	13.1		27.7		20.3	M3	9.5	
M16-XS177-01-052618	0.67	0.48	1.20	0.72	1.80	2.51	13.3		33.4		23.9	M3	15.9	
M25-XS88-01-071718	0.54	0.46	0.84	0.85	1.57	1.84	6.9		12.7		10.8	M3	5.8	
M26-XS25-01-061818	0.79	0.57	1.38	0.73	1.76	2.41	16		38.5		28.1	M3	22.1	
M27-XS38-01-061918	1.37	0.89	1.59	0.65	1.16	1.79	31		55.5	M3	36.1	M3	49.3	
M27-XS275-01-061918	0.56	0.56	1.13	1.00	2.02	2.02	23		46.4		46.5	M3	26.1	
M27-XS283-01-061818	0.69	0.51	0.97	0.74	1.41	1.91	27.2		52		38.4	M3	26.5	
M30-XSG61-01-092918	0.97	0.77	0.73	0.79	0.76	0.95	0.41	U	0.39	LT	0.31	M3	0.3	
M30-XS170-01-071618	0.94	0.75	1.30	0.80	1.39	1.73	33.7		58.4		46.7	M3	43.7	
M31-XS8-01-092918	0.76	0.65	0.90	0.85	1.18	1.38	4.1	J+	5.67		4.83	M3	3.67	
M31-XS39-01-092918	0.61	0.56	0.92	0.92	1.51	1.64	3.9	J+	6.4		5.88	M3	3.58	

Notes:

J Estimated value
J- Estimated value, may be biased low.
J+ Estimated value, may be biased high.
LT Result less than requested minimum detectable concentration, but greater than sample-specific detectable concentration.
M3 The requested minimum detected concentration was not met, but the reported activity is greater than the reported minimum detected concentration.
Pb-210 Lead 210
pCi/g Picocuries per gram
Ra-226 Radium 226
Th-230 Thorium 230
U-238 Uranium 238
U Not detected. The associated value is the reporting limit.
UJ Not considered detected. The associated value is the reported concentration, which is estimated.
Y1 Chemical yield is in control at 100% - 110%. Quantitative yield is assumed.

Table D1-3. Tabulated Salt Wash Member (Jms) Geology Sample Results

Sample ID	Isotope Ratios						Pb-210 (pCi/g)	Pb-210 Qualifier	Ra-226 (pCi/g)	Ra-226 Qualifier	Th-230 (pCi/g)	Th-230 Qualifier	U-238 (pCi/g)	U-238 Qualifier
	U-238/ Th-230	U-238/ Ra-226	U-238/ Pb-210	Th-230/ Ra-226	Th-230/ Pb-210	Ra-226/ Pb-210								
B1-SS04-01-051218	0.96	0.87	0.55	0.91	0.58	0.64	1.84		1.17		1.06	M3	1.02	
B1-SB24-01-051218	0.90	0.62	0.75	0.69	0.84	1.21	1.16		1.4		0.97	M3	0.87	
B1-SS24-01-051218	2.88	1.74	2.17	0.61	0.75	1.25	1.06		1.32		0.8	M3	2.3	
T4-XS15A-01-081918	0.27	0.13	0.35	0.50	1.30	2.59	86		223	M3	112	M3	29.9	
T4-XSG50A-01-081918	0.53	0.25	0.62	0.48	1.18	2.46	11.9		29.3		14	M3	7.4	

Notes:
M3 The requested minimum detected concentration was not met, but the reported activity is greater than the reported minimum detected concentration.
Pb-210 Lead 210
pCi/g Picocuries per gram
Ra-226 Radium 226
Th-230 Thorium 230
U-238 Uranium 238

Table D1-4. Tabulated Summerville Formation (Js) Geology Sample Results

Sample ID	Isotope Ratios						Pb-210 (pCi/g)	Pb-210 Qualifier	Ra-226 (pCi/g)	Ra-226 Qualifier	Th-230 (pCi/g)	Th-230 Qualifier	U-238 (pCi/g)	U-238 Qualifier
	U-238/ Th-230	U-238/ Ra-226	U-238/ Pb-210	Th-230/ Ra-226	Th-230/ Pb-210	Ra-226/ Pb-210								
B3-SS03-01-091618	0.99	1.12	0.98	1.13	0.99	0.88	1.82		1.6		1.8	M3	1.79	
B3-SS10-01-051218	0.98	0.90	1.29	0.92	1.31	1.42	2.8		3.98	J-	3.67	M3	3.6	
B3-SB17-01-051218	1.01	0.84	1.16	0.83	1.14	1.38	1.22		1.68		1.39	M3	1.41	J
B3-SS17-01-051218	0.76	0.62	0.57	0.82	0.76	0.92	1.96		1.8		1.48	M3	1.12	
B3-SS17-01-091618	0.84	1.16	0.70	1.39	0.84	0.60	1.82		1.1		1.53	M3	1.28	
B4-SB06-01-051318	0.80	0.83	0.83	1.04	1.04	1.00	0.52	LT	0.52	LT	0.54	M3	0.43	
B4-SS06-01-051318	1.06	0.88	0.36	0.83	0.34	0.41	1.43		0.58	LT	0.48	M3	0.51	
B4-SS25-01-051318	0.82	0.62	0.51	0.76	0.63	0.82	1.04		0.85	LT	0.65	M3	0.53	
M1-SB36-0612-01-091618	0.72	0.64	0.82	0.88	1.14	1.29	3.21		4.14		3.66	M3	2.64	
M1-SB36-1218-01-091618	0.77	0.55	1.10	0.71	1.42	2.00	1.94		3.88		2.75	M3	2.13	
M1-SB36-1824-01-091618	0.75	0.63	1.10	0.84	1.46	1.75	2.28		3.99		3.34	M3	2.51	
M1-SB36-2436-01-091618	0.77	0.58	0.95	0.75	1.22	1.63	2		3.26		2.44	M3	1.89	
M1-SS36-01-091618	0.55	0.73	0.80	1.32	1.45	1.10	3.46		3.8		5.03	M3	2.76	

Notes:
J Estimated value
J- Estimated value, may be biased low.
LT Result less than requested minimum detectable concentration, but greater than sample-specific detectable concentration.
Pb-210 Lead 210
pCi/g Picocuries per gram
Ra-226 Radium 226
Th-230 Thorium 230
U-238 Uranium 238

Table D1-5. Tabulated Undifferentiated Summerville and Entrada Formation (Jse) Geology Sample Results

Sample ID	Isotope Ratios						Pb-210 (pCi/g)	Pb-210 Qualifier	Ra-226 (pCi/g)	Ra-226 Qualifier	Th-230 (pCi/g)	Th-230 Qualifier	U-238 (pCi/g)	U-238 Qualifier
	U-238/ Th-230	U-238/ Ra-226	U-238/ Pb-210	Th-230/ Ra-226	Th-230/ Pb-210	Ra-226/ Pb-210								
B10-SS04-01-050818	0.75	0.67	1.25	0.89	1.68	1.87	0.71	LT	1.33		1.19	M3	0.89	
B10-SB21-01-050818	0.65	0.61	0.60	0.93	0.91	0.98	2.45		2.4		2.24	M3	1.46	
B10-SS21-01-050818	0.74	0.62	0.60	0.84	0.82	0.98	2.48		2.43	J	2.03	M3	1.5	
B11-SB15-01-051118	0.84	0.94	0.78	1.12	0.92	0.83	0.63	LT	0.52	LT	0.58	M3	0.49	
B11-SS15-01-051118	0.70	0.61	0.44	0.88	0.63	0.72	1.11		0.8	LT	0.7	M3	0.49	
B11-SS24-01-051118	1.05	0.84	0.43	0.80	0.41	0.51	1.36		0.7	UJ	0.56	M3	0.59	
B15-SS05-01-071118	0.74	0.64	0.50	0.87	0.68	0.79	1.35		1.06		0.92	M3	0.68	
B15-SS09-01-071118	0.76	0.63	0.21	0.82	0.28	0.33	3.2		1.07	J+	0.88	M3	0.67	
B15-SB16-01-071118	0.61	0.60	0.86	0.99	1.40	1.42	0.57	U	0.81	LT	0.8	J	0.49	
B15-SB16-02-071118	1.02	0.71	0.55	0.70	0.54	0.78	0.94	LT	0.73	LT	0.51	J	0.52	
B15-SS16-01-071118	0.85	0.97	0.38	1.14	0.45	0.39	1.68		0.66	UJ	0.75	M3	0.64	
B15-SS19-01-071118	0.76	0.66	0.74	0.87	0.97	1.12	0.77	LT	0.86	LT	0.75	M3	0.57	
B19-SS02-01-052618	0.84	0.76	0.41	0.90	0.48	0.53	1.18		0.63	LT	0.57	M3	0.48	
B19-SB11-01-052618	0.64	0.68	0.80	1.07	1.25	1.18	0.51	LT	0.6	UJ	0.64	M3	0.41	
B19-SS11-01-052618	0.81	1.02	0.62	1.26	0.77	0.61	0.69	LT	0.42	UJ	0.53	M3	0.43	
B24-SB05-01-071618	1.06	0.61	0.47	0.57	0.44	0.78	0.72	LT	0.56	UJ	0.32	M3	0.34	
B24-SS05-01-071618	0.76	0.69	0.32	0.91	0.42	0.46	0.98	LT	0.45	LT	0.41	M3	0.31	
B24-SS23-01-071618	0.69	0.30	0.31	0.44	0.45	1.02	1.37		1.4		0.61	M3	0.42	
M10-SD1-01-081718	0.89	0.38	1.09	0.43	1.23	2.87	19.3		55.4		23.8	M3	21.1	
M21-SD2-01-091218	0.75	0.31	0.77	0.41	1.02	2.49	17.1		42.5		17.4	M3	13.1	
M28-SD1-01-092618	1.03	0.43	1.57	0.42	1.53	3.66	3.36		12.3		5.13	M3	5.27	
HS1-SS3-01-062018	1.51	1.65	2.46	1.09	1.63	1.49	17.8		26.5	M3	29	M3	43.8	
HS1-SB8-1215-01-062018	1.15	0.90	1.61	0.78	1.40	1.79	8		14.3		11.2	M3	12.9	
M10-SB10-0612-01-092818	1.06	0.89	1.33	0.85	1.26	1.49	26.5	J	39.4		33.3	M3	35.2	
M10-SS10-01-092818	0.86	0.85	1.66	0.99	1.93	1.96	17.8	J	34.8		34.3	M3	29.5	
M17-SB64-0612-01-091318	0.88	0.60	1.30	0.68	1.48	2.16	61		132	M3	90	M3	79	
M17-SB64-1218-01-091318	0.80	0.59	1.16	0.74	1.45	1.95	64		125	M3	93	M3	74	
M17-SS64-01-091318	0.80	0.52	1.21	0.65	1.51	2.34	53		124	M3	80	M3	64	
M19-SB36-0612-01-091818	1.07	1.13	1.93	1.05	1.79	1.71	82		140	M3	147	M3	158	M3
M19-SB36-1218-01-091818	0.91	1.09	1.75	1.19	1.92	1.61	71		114	M3	136	M3	124	M3
M19-SS36-01-091818	0.87	0.96	1.65	1.10	1.89	1.73	91		157	M3	172	M3	150	M3
M20-SB59-0612-01-091718	0.79	0.68	1.08	0.86	1.37	1.59	17.5		27.9		24	M3	18.9	
M20-SB59-1218-01-091718	1.10	1.18	1.51	1.07	1.37	1.28	7.9		10.1		10.8	M3	11.9	
M20-SS59-01-091718	0.96	0.73	1.35	0.76	1.41	1.85	32.2		59.5	M3	45.3	M3	43.5	
M21-SS46-01-091718	0.99	0.73	1.67	0.74	1.68	2.28	87		198	M3	146	M3	145	M3
M21-SB528-0612-01-091218	1.03	0.26	1.19	0.25	1.16	4.58	16.5		75.6	M3	19.2	M3	19.7	
M21-SB528-1218-01-091218	0.98	0.48	1.21	0.49	1.23	2.52	22.3		56.1	M3	27.4	M3	26.9	
M21-SS528-01-091218	1.14	1.61	1.72	1.41	1.51	1.07	22.5		24.1		33.9	M3	38.8	
M22-SB104-0612-01-091718	0.73	0.37	0.87	0.51	1.19	2.33	14.4		33.5		17.2	M3	12.5	

Table D1-5. Tabulated Undifferentiated Summerville and Entrada Formation (Jse) Geology Sample Results (Continued)

Sample ID	Isotope Ratios						Pb-210 (pCi/g)	Pb-210 Qualifier	Ra-226 (pCi/g)	Ra-226 Qualifier	Th-230 (pCi/g)	Th-230 Qualifier	U-238 (pCi/g)	U-238 Qualifier
	U-238/ Th-230	U-238/ Ra-226	U-238/ Pb-210	Th-230/ Ra-226	Th-230/ Pb-210	Ra-226/ Pb-210								
M22-SS104-01-091718	0.73	0.49	1.12	0.67	1.53	2.27	6.6		15	J+	10.1	M3	7.4	
M24-SB76-0612-01-092518	0.82	0.72	1.53	0.87	1.86	2.14	3.7		7.9		6.9	M3	5.66	
M24-SB76-1218-01-092518	0.79	0.80	1.58	1.01	2.00	1.98	2.04		4.03		4.08	M3	3.23	
M24-SS76-01-092518	1.08	0.72	1.28	0.66	1.18	1.78	4.1		7.3		4.83	M3	5.23	
M28-SS30-01-092618	1.29	1.11	2.01	0.86	1.56	1.81	70		127	M3	109	M3	141	M3
M28-SSG7-01-092618	2.03	2.34	3.65	1.16	1.80	1.56	4		6.23		7.2	M3	14.6	
M28-SB30-0612-01-092618	1.21	0.99	1.54	0.82	1.28	1.56	112		175	M3	143	M3	173	M3
M29-SS48-01-092518	0.96	0.71	1.69	0.75	1.77	2.37	9.1		21.6		16.1	M3	15.4	
M34-SS97-01-092718	0.78	0.72	1.14	0.93	1.46	1.57	13.2		20.7		19.3	M3	15	
M36-SS24-01-092718	0.72	0.72	1.07	1.00	1.48	1.47	3.7		5.45		5.47	M3	3.95	
M37-SS44-01-092718	1.23	0.71	2.33	0.58	1.90	3.31	7.2		23.8		13.7	M3	16.8	
M17-XS79-01-091318	0.71	0.79	1.58	1.11	2.22	1.99	21		41.8	M3	46.6	M3	33.1	
M19-XSR2-01-093018	0.57	0.58	0.42	1.03	0.75	0.73	1.06		0.77	LT	0.79	M3	0.45	
M19-XSR2-02-093018	0.68	0.76	0.49	1.12	0.73	0.65	1.02		0.66	LT	0.74	M3	0.5	
M19-XSG19-01-091318	0.63	0.81	1.44	1.28	2.27	1.78	14.7		26.1		33.4	M3	21.1	
M20-XS146-01-091718	1.25	5.23	6.84	4.20	5.49	1.31	98		128	M3	538	M3	670	J
M20-XS243-01-091718	1.06	0.94	1.84	0.89	1.74	1.95	38.5		75.2	M3	67	M3	71	
M20-XS267-01-091718	0.95	0.93	1.57	0.99	1.66	1.68	44		73.8		73	M3	69	
M20-XS365-01-060618	0.83	0.43	1.06	0.51	1.27	2.46	23.2		57.1	M3	29.4	M3	24.5	M3
M21-XS46-01-060818	0.78	0.51	1.26	0.65	1.60	2.44	45		110	M3	72	M3	56.5	
M21-XS302-02-060918	0.74	0.77	1.41	1.04	1.90	1.83	16.1		29.4	J	30.6	M3	22.7	
M21-XS323-01-091218	0.52	0.38	0.87	0.73	1.67	2.27	15.1		34.3		25.2	M3	13.2	
M22-XS87-01-060418	0.63	0.51	0.91	0.80	1.44	1.80	5.4		9.7		7.8	M3	4.9	
M28-XSG7-01-092618	1.40	1.42	2.84	1.01	2.03	2.00	68		136	M3	138	M3	193	M3
M28-XS29-01-092618	1.09	0.63	1.43	0.58	1.31	2.25	36.4		81.9	M3	47.7	M3	51.9	
M28-XS148-01-062018	1.10	0.98	1.51	0.89	1.38	1.54	61		94	M3	84	M3	92	
M28-XS162-01-092818	1.10	0.69	1.63	0.63	1.48	2.35	3.23	J+	7.6		4.77	M3	5.27	
M34-XS110-01-081218	0.90	0.71	1.49	0.79	1.66	2.10	33.9		71.2		56.2	M3	50.6	
M37-XS44-01-081318	1.21	1.15	2.21	0.95	1.82	1.92	24.8		47.5		45.1	M3	54.7	
M37-XS124A-01-081318	1.25	0.79	2.50	0.63	2.00	3.15	46		145	M3	92	M3	115	

Notes:

J Estimated value
J+ Estimated value, may be biased high.
LT Result less than requested minimum detectable concentration, but greater than sample-specific detectable concentration.
M3 The requested minimum detected concentration was not met, but the reported activity is greater than the reported minimum detected concentration.
Pb-210 Lead 210
pCi/g Picocuries per gram
Ra-226 Radium 226
Th-230 Thorium 230
U Not detected. The associated value is the reporting limit.
U-238 Uranium 238
UJ Not considered detected. The associated value is the reported concentration, which is estimated.

Table D1-6. Tabulated Undifferentiated Summerville and Entrada Formation and Undifferentiated Summerville, Todilto, and Entrada Formations (JseJste) Geology Sample Results

Sample ID	Isotope Ratios						Pb-210 (pCi/g)	Pb-210 Qualifier	Ra-226 (pCi/g)	Ra-226 Qualifier	Th-230 (pCi/g)	Th-230 Qualifier	U-238 (pCi/g)	U-238 Qualifier
	U-238/ Th-230	U-238/ Ra-226	U-238/ Pb-210	Th-230/ Ra-226	Th-230/ Pb-210	Ra-226/ Pb-210								
B10-SS04-01-050818	0.75	0.67	1.25	0.89	1.68	1.87	0.71	LT	1.33		1.19	M3	0.89	
B10-SB21-01-050818	0.65	0.61	0.60	0.93	0.91	0.98	2.45		2.4		2.24	M3	1.46	
B10-SS21-01-050818	0.74	0.62	0.60	0.84	0.82	0.98	2.48		2.43	J	2.03	M3	1.5	
B11-SB15-01-051118	0.84	0.94	0.78	1.12	0.92	0.83	0.63	LT	0.52	LT	0.58	M3	0.49	
B11-SS15-01-051118	0.70	0.61	0.44	0.88	0.63	0.72	1.11		0.8	LT	0.7	M3	0.49	
B11-SS24-01-051118	1.05	0.84	0.43	0.80	0.41	0.51	1.36		0.7	UJ	0.56	M3	0.59	
B15-SS05-01-071118	0.74	0.64	0.50	0.87	0.68	0.79	1.35		1.06		0.92	M3	0.68	
B15-SS09-01-071118	0.76	0.63	0.21	0.82	0.28	0.33	3.2		1.07	J+	0.88	M3	0.67	
B15-SB16-01-071118	0.61	0.60	0.86	0.99	1.40	1.42	0.57	U	0.81	LT	0.8	J	0.49	
B15-SB16-02-071118	1.02	0.71	0.55	0.70	0.54	0.78	0.94	LT	0.73	LT	0.51	J	0.52	
B15-SS16-01-071118	0.85	0.97	0.38	1.14	0.45	0.39	1.68		0.66	UJ	0.75	M3	0.64	
B15-SS19-01-071118	0.76	0.66	0.74	0.87	0.97	1.12	0.77	LT	0.86	LT	0.75	M3	0.57	
B19-SS02-01-052618	0.84	0.76	0.41	0.90	0.48	0.53	1.18		0.63	LT	0.57	M3	0.48	
B19-SB11-01-052618	0.64	0.68	0.80	1.07	1.25	1.18	0.51	LT	0.6	UJ	0.64	M3	0.41	
B19-SS11-01-052618	0.81	1.02	0.62	1.26	0.77	0.61	0.69	LT	0.42	UJ	0.53	M3	0.43	
B24-SB05-01-071618	1.06	0.61	0.47	0.57	0.44	0.78	0.72	LT	0.56	UJ	0.32	M3	0.34	
B24-SS05-01-071618	0.76	0.69	0.32	0.91	0.42	0.46	0.98	LT	0.45	LT	0.41	M3	0.31	
B24-SS23-01-071618	0.69	0.30	0.31	0.44	0.45	1.02	1.37		1.4		0.61	M3	0.42	
M10-SD1-01-081718	0.89	0.38	1.09	0.43	1.23	2.87	19.3		55.4		23.8	M3	21.1	
M21-SD2-01-091218	0.75	0.31	0.77	0.41	1.02	2.49	17.1		42.5		17.4	M3	13.1	
M28-SD1-01-092618	1.03	0.43	1.57	0.42	1.53	3.66	3.36		12.3		5.13	M3	5.27	
HS1-SS3-01-062018	1.51	1.65	2.46	1.09	1.63	1.49	17.8		26.5	M3	29	M3	43.8	
HS1-SB8-1215-01-062018	1.15	0.90	1.61	0.78	1.40	1.79	8		14.3		11.2	M3	12.9	
M10-SB10-0612-01-092818	1.06	0.89	1.33	0.85	1.26	1.49	26.5	J	39.4		33.3	M3	35.2	
M10-SS10-01-092818	0.86	0.85	1.66	0.99	1.93	1.96	17.8	J	34.8		34.3	M3	29.5	
M17-SB64-0612-01-091318	0.88	0.60	1.30	0.68	1.48	2.16	61		132	M3	90	M3	79	
M17-SB64-1218-01-091318	0.80	0.59	1.16	0.74	1.45	1.95	64		125	M3	93	M3	74	
M17-SS64-01-091318	0.80	0.52	1.21	0.65	1.51	2.34	53		124	M3	80	M3	64	
M19-SB36-0612-01-091818	1.07	1.13	1.93	1.05	1.79	1.71	82		140	M3	147	M3	158	M3
M19-SB36-1218-01-091818	0.91	1.09	1.75	1.19	1.92	1.61	71		114	M3	136	M3	124	M3
M19-SS36-01-091818	0.87	0.96	1.65	1.10	1.89	1.73	91		157	M3	172	M3	150	M3
M20-SB59-0612-01-091718	0.79	0.68	1.08	0.86	1.37	1.59	17.5		27.9		24	M3	18.9	
M20-SB59-1218-01-091718	1.10	1.18	1.51	1.07	1.37	1.28	7.9		10.1		10.8	M3	11.9	
M20-SS59-01-091718	0.96	0.73	1.35	0.76	1.41	1.85	32.2		59.5	M3	45.3	M3	43.5	
M21-SS46-01-091718	0.99	0.73	1.67	0.74	1.68	2.28	87		198	M3	146	M3	145	M3
M21-SB528-0612-01-091218	1.03	0.26	1.19	0.25	1.16	4.58	16.5		75.6	M3	19.2	M3	19.7	
M21-SB528-1218-01-091218	0.98	0.48	1.21	0.49	1.23	2.52	22.3		56.1	M3	27.4	M3	26.9	
M21-SS528-01-091218	1.14	1.61	1.72	1.41	1.51	1.07	22.5		24.1		33.9	M3	38.8	
M22-SB104-0612-01-091718	0.73	0.37	0.87	0.51	1.19	2.33	14.4		33.5		17.2	M3	12.5	

Table D1-6. Tabulated Undifferentiated Summerville and Entrada Formation and Undifferentiated Summerville, Todilto, and Entrada Formations (JseJste) Geology Sample Results (Continued)

Sample ID	Isotope Ratios						Pb-210 (pCi/g)	Pb-210 Qualifier	Ra-226 (pCi/g)	Ra-226 Qualifier	Th-230 (pCi/g)	Th-230 Qualifier	U-238 (pCi/g)	U-238 Qualifier
	U-238/ Th-230	U-238/ Ra-226	U-238/ Pb-210	Th-230/ Ra-226	Th-230/ Pb-210	Ra-226/ Pb-210								
M22-SS104-01-091718	0.73	0.49	1.12	0.67	1.53	2.27	6.6		15	J+	10.1	M3	7.4	
M24-SB76-0612-01-092518	0.82	0.72	1.53	0.87	1.86	2.14	3.7		7.9		6.9	M3	5.66	
M24-SB76-1218-01-092518	0.79	0.80	1.58	1.01	2.00	1.98	2.04		4.03		4.08	M3	3.23	
M24-SS76-01-092518	1.08	0.72	1.28	0.66	1.18	1.78	4.1		7.3		4.83	M3	5.23	
M28-SS30-01-092618	1.29	1.11	2.01	0.86	1.56	1.81	70		127	M3	109	M3	141	M3
M28-SSG7-01-092618	2.03	2.34	3.65	1.16	1.80	1.56	4		6.23		7.2	M3	14.6	
M28-SB30-0612-01-092618	1.21	0.99	1.54	0.82	1.28	1.56	112		175	M3	143	M3	173	M3
M29-SS48-01-092518	0.96	0.71	1.69	0.75	1.77	2.37	9.1		21.6		16.1	M3	15.4	
M34-SS97-01-092718	0.78	0.72	1.14	0.93	1.46	1.57	13.2		20.7		19.3	M3	15	
M36-SS24-01-092718	0.72	0.72	1.07	1.00	1.48	1.47	3.7		5.45		5.47	M3	3.95	
M37-SS44-01-092718	1.23	0.71	2.33	0.58	1.90	3.31	7.2		23.8		13.7	M3	16.8	
M17-XS79-01-091318	0.71	0.79	1.58	1.11	2.22	1.99	21		41.8	M3	46.6	M3	33.1	
M19-XSR2-01-093018	0.57	0.58	0.42	1.03	0.75	0.73	1.06		0.77	LT	0.79	M3	0.45	
M19-XSR2-02-093018	0.68	0.76	0.49	1.12	0.73	0.65	1.02		0.66	LT	0.74	M3	0.5	
M19-XSG19-01-091318	0.63	0.81	1.44	1.28	2.27	1.78	14.7		26.1		33.4	M3	21.1	
M20-XS146-01-091718	1.25	5.23	6.84	4.20	5.49	1.31	98		128	M3	538	M3	670	J
M20-XS243-01-091718	1.06	0.94	1.84	0.89	1.74	1.95	38.5		75.2	M3	67	M3	71	
M20-XS267-01-091718	0.95	0.93	1.57	0.99	1.66	1.68	44		73.8		73	M3	69	
M20-XS365-01-060618	0.83	0.43	1.06	0.51	1.27	2.46	23.2		57.1	M3	29.4	M3	24.5	M3
M21-XS46-01-060818	0.78	0.51	1.26	0.65	1.60	2.44	45		110	M3	72	M3	56.5	
M21-XS302-02-060918	0.74	0.77	1.41	1.04	1.90	1.83	16.1		29.4	J	30.6	M3	22.7	
M21-XS323-01-091218	0.52	0.38	0.87	0.73	1.67	2.27	15.1		34.3		25.2	M3	13.2	
M22-XS87-01-060418	0.63	0.51	0.91	0.80	1.44	1.80	5.4		9.7		7.8	M3	4.9	
M28-XSG7-01-092618	1.40	1.42	2.84	1.01	2.03	2.00	68		136	M3	138	M3	193	M3
M28-XS29-01-092618	1.09	0.63	1.43	0.58	1.31	2.25	36.4		81.9	M3	47.7	M3	51.9	
M28-XS148-01-062018	1.10	0.98	1.51	0.89	1.38	1.54	61		94	M3	84	M3	92	
M28-XS162-01-092818	1.10	0.69	1.63	0.63	1.48	2.35	3.23	J+	7.6		4.77	M3	5.27	
M34-XS110-01-081218	0.90	0.71	1.49	0.79	1.66	2.10	33.9		71.2		56.2	M3	50.6	
M37-XS44-01-081318	1.21	1.15	2.21	0.95	1.82	1.92	24.8		47.5		45.1	M3	54.7	
M37-XS124A-01-081318	1.25	0.79	2.50	0.63	2.00	3.15	46		145	M3	92	M3	115	
B32-SS06-01-071218	0.64	0.52	0.45	0.81	0.70	0.86	2		1.72	J+	1.4	M3	0.89	
B32-SS08-01-071218	0.45	0.30	0.49	0.67	1.08	1.61	2.85		4.59		3.08	M3	1.39	
B32-SS16-01-071218	0.82	0.74	1.14	0.90	1.39	1.54	1.13		1.74		1.57	M3	1.29	
B32-SB30-01-071218	0.54	0.95	1.38	1.74	2.54	1.46	5		7.29		12.7	M3	6.9	
B32-SS30-01-071218	0.57	0.48	0.99	0.85	1.73	2.03	2.01		4.09		3.48	M3	1.98	
M33-SS86-01-091818	0.83	0.69	1.25	0.83	1.51	1.82	51		93		77	M3	64	

Table D1-6. Tabulated Undifferentiated Summerville and Entrada Formation and Undifferentiated Summerville, Todilto, and Entrada Formations (JseJste) Geology Sample Results (Continued)

Notes:

J	Estimated value
J+	Estimated value, may be biased high.
LT	Result less than requested minimum detectable concentration, but greater than sample-specific detectable concentration.
M3	The requested minimum detected concentration was not met, but the reported activity is greater than the reported minimum detected concentration.
Pb-210	Lead 210
pCi/g	Picocuries per gram
Ra-226	Radium 226
Th-230	Thorium 230
U-238	Uranium 238
UJ	Not considered detected. The associated value is the reported concentration, which is estimated.

Table D1-7. Tabulated Undifferentiated Summerville, Todilto, and Entrada Formations (Jste) Geology Sample Results

Sample ID	Isotope Ratios						Pb-210 (pCi/g)	Pb-210 Qualifier	Ra-226 (pCi/g)	Ra-226 Qualifier	Th-230 (pCi/g)	Th-230 Qualifier	U-238 (pCi/g)	U-238 Qualifier
	U-238/ Th-230	U-238/ Ra-226	U-238/ Pb-210	Th-230/ Ra-226	Th-230/ Pb-210	Ra-226/ Pb-210								
B32-SS06-01-071218	0.64	0.52	0.45	0.81	0.70	0.86	2		1.72	J+	1.4	M3	0.89	
B32-SS08-01-071218	0.45	0.30	0.49	0.67	1.08	1.61	2.85		4.59		3.08	M3	1.39	
B32-SS16-01-071218	0.82	0.74	1.14	0.90	1.39	1.54	1.13		1.74		1.57	M3	1.29	
B32-SB30-01-071218	0.54	0.95	1.38	1.74	2.54	1.46	5		7.29		12.7	M3	6.9	
B32-SS30-01-071218	0.57	0.48	0.99	0.85	1.73	2.03	2.01		4.09		3.48	M3	1.98	
M33-SS86-01-091818	0.83	0.69	1.25	0.83	1.51	1.82	51		93		77	M3	64	

Notes:
J+ Estimated value, may be biased high.
M3 The requested minimum detected concentration was not met, but the reported activity is greater than the reported minimum detected concentration.
Pb-210 Lead 210
pCi/g Picocuries per gram
Ra-226 Radium 226
Th-230 Thorium 230
U-238 Uranium 238

Table D1-8. Tabulated Quaternary Alluvium (Qa) Geology Sample Results

Sample ID	Isotope Ratios						Pb-210 (pCi/g)	Pb-210 Qualifier	Ra-226 (pCi/g)	Ra-226 Qualifier	Th-230 (pCi/g)	Th-230 Qualifier	U-238 (pCi/g)	U-238 Qualifier
	U-238/ Th-230	U-238/ Ra-226	U-238/ Pb-210	Th-230/ Ra-226	Th-230/ Pb-210	Ra-226/ Pb-210								
B2-SS01-01-051218	0.73	0.54	0.52	0.75	0.72	0.96	0.82	LT	0.79	UJ	0.59	M3	0.43	
B2-SB29-01-051218	0.75	0.58	0.47	0.77	0.63	0.82	0.76	LT	0.62	LT	0.48	M3	0.36	
B2-SS29-01-051218	0.75	0.67	0.76	0.90	1.02	1.14	0.51	LT	0.58	LT	0.52	M3	0.39	
B5-SB01-01-042418	0.51	0.46	0.89	0.90	1.75	1.94	1.11		2.15		1.94	M3	0.99	
B5-SS01-01-042418	0.62	0.50	0.82	0.80	1.31	1.64	1.2		1.97		1.57	M3	0.98	
B5-SS23-01-042418	0.89	0.77	1.11	0.87	1.24	1.43	0.99	LT	1.42		1.23	M3	1.1	
T1-SS14-01-091618	0.68	0.43	0.82	0.63	1.20	1.90	3.6		6.85		4.32	M3	2.94	
M2-SB51-090108-01-091718	0.73	0.84	0.63	1.15	0.87	0.75	1.06		0.8	LT	0.92	M3	0.67	
M2-SB55-072090-01-091618	0.73	0.64	0.74	0.87	1.01	1.17	21.4		25	J-	21.7	M3	15.9	
T1-XSG5A-01-081918	0.41	0.25	0.50	0.61	1.22	1.99	1.42		2.83		1.73	J	0.71	
T1-XSG49A-01-081918	0.64	0.60	0.81	0.93	1.26	1.36	3.43		4.67		4.33	M3	2.78	M3

Notes:

J	Estimated value
J-	Estimated value, may be biased low.
LT	Result less than requested minimum detectable concentration, but greater than sample-specific detectable concentration.
M3	The requested minimum detected concentration was not met, but the reported activity is greater than the reported minimum detected concentration.
Pb-210	Lead 210
pCi/g	Picocuries per gram
Ra-226	Radium 226
Th-230	Thorium 230
U-238	Uranium 238
UJ	Not considered detected. The associated value is the reported concentration, which is estimated.

Table D1-9. Tabulated Chuska Sandstone Formation (Tc) Geology Sample Results

Sample ID	Isotope Ratios						Pb-210 (pCi/g)	Pb-210 Qualifier	Ra-226 (pCi/g)	Ra-226 Qualifier	Th-230 (pCi/g)	Th-230 Qualifier	U-238 (pCi/g)	U-238 Qualifier
	U-238/ Th-230	U-238/ Ra-226	U-238/ Pb-210	Th-230/ Ra-226	Th-230/ Pb-210	Ra-226/ Pb-210								
B16-SB01-01-060918	0.88	0.94	0.88	1.06	1.00	0.94	0.33	U	0.31	U	0.33	M3	0.29	
B16-SS01-01-060918	0.61	0.85	0.94	1.38	1.54	1.11	0.35	U	0.39	U	0.54	M3	0.33	
B16-SS07-01-060918	0.77	0.80	0.61	1.05	0.79	0.76	0.87	LT	0.66	LT	0.69	M3	0.53	

Notes:
LT Result less than requested minimum detectable concentration, but greater than sample-specific detectable concentration.
M3 The requested minimum detected concentration was not met, but the reported activity is greater than the reported minimum detected concentration.
Pb-210 Lead 210
pCi/g Picocuries per gram
Ra-226 Radium 226
Th-230 Thorium 230
U Not detected. The associated value is the reporting limit.
U-238 Uranium 238

Table D1-10. Tabulated Chinle Formation (Trc) Geology Sample Results

Sample ID	Isotope Ratios						Pb-210 (pCi/g)	Pb-210 Qualifier	Ra-226 (pCi/g)	Ra-226 Qualifier	Th-230 (pCi/g)	Th-230 Qualifier	U-238 (pCi/g)	U-238 Qualifier
	U-238/ Th-230	U-238/ Ra-226	U-238/ Pb-210	Th-230/ Ra-226	Th-230/ Pb-210	Ra-226/ Pb-210								
B6-SB11-01-052218	0.64	0.56	0.60	0.88	0.94	1.07	1.05		1.12		0.99	M3	0.63	
B6-SS11-01-052218	0.61	0.38	0.38	0.63	0.62	0.99	1.29		1.28		0.8	M3	0.49	
B6-SS27-01-071418	0.94	0.85	0.51	0.90	0.54	0.60	1.88		1.13		1.02	M3	0.96	
B7-SS03-01-052218	0.69	0.54	0.51	0.78	0.73	0.93	2.43		2.27		1.77	M3	1.23	
B7-SB21-01-052218	0.61	0.57	0.48	0.92	0.78	0.85	1.56		1.32		1.22	M3	0.75	
B7-SS21-01-052218	0.67	0.57	0.59	0.85	0.88	1.03	1.99		2.05		1.75	M3	1.17	
B8-SS14-01-052218	0.70	0.52	0.15	0.75	0.22	0.30	2.97		0.88	LT	0.66	M3	0.46	
B8-SB21-01-052218	0.84	0.50	0.57	0.59	0.67	1.13	1.22		1.38		0.82	M3	0.69	
B8-SS21-01-052218	0.89	0.69	0.39	0.78	0.44	0.56	1.99		1.11		0.87	M3	0.77	
T37-SS94-01-091318	1.10	0.87	1.26	0.79	1.14	1.44	0.7	LT	1.01	J-	0.8	M3	0.88	
T9-SS67-01-091118	1.02	1.01	2.29	0.99	2.25	2.27	0.51	U	1.16		1.15	M3	1.17	
T10-XS20-01-042518	0.62	0.71	0.60	1.15	0.97	0.84	0.89	LT	0.75	LT	0.86	M3	0.53	
T9-XS217-01-042518	0.58	0.73	1.09	1.25	1.87	1.49	0.67	LT	1		1.25	M3	0.73	

Notes:
J- Estimated value, may be biased low.
LT Result less than requested minimum detectable concentration, but greater than sample-specific detectable concentration.
M3 The requested minimum detected concentration was not met, but the reported activity is greater than the reported minimum detected concentration.
Pb-210 Lead 210
pCi/g Picocuries per gram
Ra-226 Radium 226
Th-230 Thorium 230
U Not detected. The associated value is the reporting limit.
U-238 Uranium 238

Table D1-11. Tabulated All Geology Sample Results (No Sediment Samples)

Sample ID	Isotope Ratios						Pb-210 (pCi/g)	Pb-210 Qualifier	Ra-226 (pCi/g)	Ra-226 Qualifier	Th-230 (pCi/g)	Th-230 Qualifier	U-238 (pCi/g)	U-238 Qualifier
	U-238/ Th-230	U-238/ Ra-226	U-238/ Pb-210	Th-230/ Ra-226	Th-230/ Pb-210	Ra-226/ Pb-210								
B10-SB21-01-050818	0.65	0.61	0.60	0.93	0.91	0.98	2.45		2.4		2.24	M3	1.46	
B10-SS04-01-050818	0.75	0.67	1.25	0.89	1.68	1.87	0.71	LT	1.33		1.19	M3	0.89	
B10-SS21-01-050818	0.74	0.62	0.60	0.84	0.82	0.98	2.48		2.43	J	2.03	M3	1.5	
B11-SB15-01-051118	0.84	0.94	0.78	1.12	0.92	0.83	0.63	LT	0.52	LT	0.58	M3	0.49	
B11-SS15-01-051118	0.70	0.61	0.44	0.88	0.63	0.72	1.11		0.8	LT	0.7	M3	0.49	
B11-SS24-01-051118	1.05	0.84	0.43	0.80	0.41	0.51	1.36		0.7	UJ	0.56	M3	0.59	
B12-SB11-01-050818	0.72	0.56	0.56	0.78	0.78	1.00	1.4		1.4		1.09	M3	0.78	
B12-SS01-01-050818	0.73	0.51	0.47	0.69	0.64	0.93	1.87		1.73	J+	1.2	M3	0.88	
B12-SS11-01-050818	0.67	0.47	0.45	0.70	0.66	0.95	1.73		1.64		1.15	M3	0.77	
B13-SB16-01-071518	0.76	0.71	1.31	0.94	1.73	1.85	0.52	U	0.96	LT	0.9	M3	0.68	
B13-SS08-01-071518	0.73	0.48	0.11	0.66	0.14	0.22	5.2		1.14	UJ	0.75	M3	0.55	
B13-SS16-01-071518	0.99	0.96	0.43	0.97	0.44	0.45	1.68		0.76	J+	0.74	M3	0.73	
B13-SS23-01-071518	0.84	0.65	0.14	0.77	0.16	0.21	4.5		0.96	LT	0.74	M3	0.62	
B14-SB27-01-071518	1.03		0.64		0.62	0.00	0.47	U	0	U	0.29	M3	0.3	
B14-SS13-01-071518	0.58	0.69	0.26	1.19	0.46	0.39	1.4		0.54	J+	0.64	M3	0.37	
B14-SS27-01-071518	0.62	0.67	0.32	1.07	0.52	0.48	0.56	LT	0.27	U	0.29	M3	0.181	
B15-SB16-01-071118	0.61	0.60	0.86	0.99	1.40	1.42	0.57	U	0.81	LT	0.8	J	0.49	
B15-SB16-02-071118	1.02	0.71	0.55	0.70	0.54	0.78	0.94	LT	0.73	LT	0.51	J	0.52	
B15-SS05-01-071118	0.74	0.64	0.50	0.87	0.68	0.79	1.35		1.06		0.92	M3	0.68	
B15-SS09-01-071118	0.76	0.63	0.21	0.82	0.28	0.33	3.2		1.07	J+	0.88	M3	0.67	
B15-SS16-01-071118	0.85	0.97	0.38	1.14	0.45	0.39	1.68		0.66	UJ	0.75	M3	0.64	
B15-SS19-01-071118	0.76	0.66	0.74	0.87	0.97	1.12	0.77	LT	0.86	LT	0.75	M3	0.57	
B16-SB01-01-060918	0.88	0.94	0.88	1.06	1.00	0.94	0.33	U	0.31	U	0.33	M3	0.29	
B16-SS01-01-060918	0.61	0.85	0.94	1.38	1.54	1.11	0.35	U	0.39	U	0.54	M3	0.33	
B16-SS07-01-060918	0.77	0.80	0.61	1.05	0.79	0.76	0.87	LT	0.66	LT	0.69	M3	0.53	
B17-SB21-01-052418	1.52	1.18	0.68	0.78	0.45	0.57	1.55		0.89	LT	0.69	M3	1.05	
B17-SS06-01-052418	0.73	0.77	0.15	1.05	0.21	0.20	3.24		0.64	J+	0.67	M3	0.49	
B17-SS21-01-052418	0.60	0.87	0.12	1.46	0.20	0.14	5.1	J	0.7	UJ	1.02	J	0.61	
B17-SS21-02-052418	0.69	0.73	0.35	1.06	0.50	0.47	1.39	J	0.66	LT	0.7	J	0.48	
B18-SB11-01-052518	0.81	0.70	0.34	0.86	0.42	0.49	1.79		0.87	LT	0.75	M3	0.61	
B18-SS11-01-052518	0.69	0.59	0.27	0.86	0.38	0.45	2.47		1.11		0.95	M3	0.66	
B18-SS23-01-052518	0.84	0.65	0.87	0.77	1.03	1.33	1.05		1.4		1.08	M3	0.91	
B19-SB11-01-052618	0.64	0.68	0.80	1.07	1.25	1.18	0.51	LT	0.6	UJ	0.64	M3	0.41	
B19-SS02-01-052618	0.84	0.76	0.41	0.90	0.48	0.53	1.18		0.63	LT	0.57	M3	0.48	
B19-SS11-01-052618	0.81	1.02	0.62	1.26	0.77	0.61	0.69	LT	0.42	UJ	0.53	M3	0.43	
B1-SB24-01-051218	0.90	0.62	0.75	0.69	0.84	1.21	1.16		1.4		0.97	M3	0.87	
B1-SS04-01-051218	0.96	0.87	0.55	0.91	0.58	0.64	1.84		1.17		1.06	M3	1.02	

Table D1-11. Tabulated All Geology Sample Results (No Sediment Samples) (Continued)

Sample ID	Isotope Ratios						Pb-210 (pCi/g)	Pb-210 Qualifier	Ra-226 (pCi/g)	Ra-226 Qualifier	Th-230 (pCi/g)	Th-230 Qualifier	U-238 (pCi/g)	U-238 Qualifier
	U-238/ Th-230	U-238/ Ra-226	U-238/ Pb-210	Th-230/ Ra-226	Th-230/ Pb-210	Ra-226/ Pb-210								
B1-SS24-01-051218	2.88	1.74	2.17	0.61	0.75	1.25	1.06		1.32		0.8	M3	2.3	
B20-SB01-01-052318	0.79	0.66	0.43	0.84	0.55	0.65	0.77	LT	0.5	LT	0.42	M3	0.33	
B20-SS01-01-052318	0.58	0.49	0.28	0.85	0.48	0.57	1.14		0.65	LT	0.55	M3	0.32	
B20-SS12-01-052318	0.68	0.65	0.41	0.96	0.60	0.63	1.15		0.72	LT	0.69	M3	0.47	
B21-SB04-01-062118	0.94	0.85	1.24	0.91	1.32	1.45	3.46		5.02		4.57	M3	4.29	
B21-SB14-01-062118	0.72	0.65	1.09	0.90	1.50	1.67	2.16		3.61		3.25	M3	2.35	
B21-SB26-01-062118	0.72	0.77	1.19	1.07	1.65	1.55	2.42		3.75		4	M3	2.89	
B21-SS04-02-062118	1.18	1.06	1.76	0.90	1.49	1.66	2.84		4.72		4.23	M3	5	
B21-SS13-01-062118	0.99	0.91	1.52	0.92	1.53	1.67	2.79		4.65		4.27	M3	4.23	
B21-SS14-02-062118	0.81	1.16	1.44	1.44	1.78	1.24	2.95		3.65		5.26	M3	4.25	
B22-SS04-01-052418	0.67	0.51	0.26	0.76	0.39	0.51	2.82		1.44		1.09	M3	0.73	
B22-SS16-01-052418	1.00	0.79	0.86	0.79	0.86	1.10	0.81	LT	0.89	LT	0.7	J	0.7	
B22-SS16-02-052418	0.44	0.59	0.53	1.37	1.23	0.90	0.88	LT	0.79	LT	1.08	J	0.47	
B23-SB18-01-060618	0.90	0.74	1.19	0.82	1.33	1.62	2.01		3.25		2.67	M3	2.39	
B23-SS08-01-060618	0.82	0.69	0.72	0.84	0.87	1.04	0.85	LT	0.88	LT	0.74	M3	0.61	
B23-SS18-01-060618	0.78	0.76	0.93	0.97	1.19	1.22	2.51		3.07		2.99	M3	2.34	
B24-SB05-01-071618	1.06	0.61	0.47	0.57	0.44	0.78	0.72	LT	0.56	UJ	0.32	M3	0.34	
B24-SS05-01-071618	0.76	0.69	0.32	0.91	0.42	0.46	0.98	LT	0.45	LT	0.41	M3	0.31	
B24-SS23-01-071618	0.69	0.30	0.31	0.44	0.45	1.02	1.37		1.4		0.61	M3	0.42	
B25-SB12-01-060418	0.74	0.57	0.69	0.77	0.93	1.20	0.96	LT	1.15	J+	0.89	M3	0.66	
B25-SS04-01-060418	0.75	0.64	0.62	0.86	0.83	0.97	2.29		2.22		1.9	M3	1.43	
B25-SS12-01-060418	0.80	0.65	0.66	0.81	0.83	1.03	1.16		1.19	J+	0.96	M3	0.77	
B26-SB29-01-060518	0.63	0.57	1.21	0.91	1.93	2.13	0.71	LT	1.51	J+	1.37	M3	0.86	
B26-SS07-01-091418	0.61	0.49	0.26	0.81	0.42	0.52	3.43		1.79	J+	1.45	M3	0.88	
B26-SS09-01-060518	0.67	0.45	0.54	0.68	0.81	1.19	2.13		2.54		1.72	M3	1.15	
B26-SS29-01-060518	0.74	0.57	0.50	0.77	0.67	0.87	1.97		1.72		1.32	M3	0.98	
B27-SB07-01-061018	0.77	0.50	0.37	0.65	0.48	0.74	1.32		0.98	LT	0.64	M3	0.49	
B27-SS07-01-061018	0.78	0.58	0.37	0.75	0.48	0.64	1.42		0.91	J+	0.68	M3	0.53	
B27-SS16-01-061018	0.86	0.60	0.51	0.70	0.59	0.84	1.08		0.91	LT	0.64	M3	0.55	
B29-SS01-01-071018	0.64	1.00	0.41	1.58	0.65	0.41	0.63	LT	0.26	U	0.41	M3	0.261	
B29-SS06-01-071018	0.86	1.02	0.94	1.19	1.09	0.91	0.47	U	0.43	UJ	0.51	M3	0.44	
B29-SS11-01-071318	0.44	0.65	2.00	1.48	4.53	3.07	0.15	U	0.46	UJ	0.68	M3	0.3	
B29-SS20-01-071118	1.05	1.14	0.78	1.09	0.75	0.69	0.51	U	0.35	LT	0.38	M3	0.4	
B29-SS23-01-071318	1.23	1.23	1.28	1.00	1.03	1.03	0.29	U	0.3	U	0.3	M3	0.37	
B29-SS26-01-071118	0.77	0.66	0.73	0.85	0.95	1.11	0.56	U	0.62	LT	0.53	M3	0.41	
B2-SB29-01-051218	0.75	0.58	0.47	0.77	0.63	0.82	0.76	LT	0.62	LT	0.48	M3	0.36	

Table D1-11. Tabulated All Geology Sample Results (No Sediment Samples) (Continued)

Sample ID	Isotope Ratios						Pb-210 (pCi/g)	Pb-210 Qualifier	Ra-226 (pCi/g)	Ra-226 Qualifier	Th-230 (pCi/g)	Th-230 Qualifier	U-238 (pCi/g)	U-238 Qualifier
	U-238/ Th-230	U-238/ Ra-226	U-238/ Pb-210	Th-230/ Ra-226	Th-230/ Pb-210	Ra-226/ Pb-210								
B2-SS01-01-051218	0.73	0.54	0.52	0.75	0.72	0.96	0.82	LT	0.79	UJ	0.59	M3	0.43	
B2-SS29-01-051218	0.75	0.67	0.76	0.90	1.02	1.14	0.51	LT	0.58	LT	0.52	M3	0.39	
B30-SB21-01-071018	0.59	0.55	0.42	0.93	0.72	0.77	0.53	U	0.41	LT	0.38	M3	0.224	
B30-SS11-01-071018	1.18	1.07	1.82	0.90	1.54	1.71	0.17	U	0.29	U	0.262	M3	0.31	
B30-SS21-01-071018	0.83	0.79	0.40	0.95	0.48	0.51	0.75	LT	0.38	LT	0.36	M3	0.3	
B30-SS21-02-071018	1.00	0.81	0.46	0.81	0.46	0.57	0.74	LT	0.42	LT	0.34	M3	0.34	
B31-SB30-01-071318	0.79	1.00	0.25	1.27	0.31	0.25	1.81		0.45	UJ	0.57	M3	0.45	
B31-SS06-01-071318	0.51	0.60	0.17	1.17	0.33	0.28	1.86		0.52	U	0.61	M3	0.31	
B31-SS18-01-071318	0.49	0.38	0.19	0.78	0.39	0.49	1.97		0.97	J+	0.76	M3	0.37	
B31-SS30-01-071318	0.95	1.13	0.27	1.19	0.28	0.24	2.2		0.52	J+	0.62	M3	0.59	
B32-SB30-01-071218	0.54	0.95	1.38	1.74	2.54	1.46	5		7.29		12.7	M3	6.9	
B32-SS06-01-071218	0.64	0.52	0.45	0.81	0.70	0.86	2		1.72	J+	1.4	M3	0.89	
B32-SS08-01-071218	0.45	0.30	0.49	0.67	1.08	1.61	2.85		4.59		3.08	M3	1.39	
B32-SS16-01-071218	0.82	0.74	1.14	0.90	1.39	1.54	1.13		1.74		1.57	M3	1.29	
B32-SS30-01-071218	0.57	0.48	0.99	0.85	1.73	2.03	2.01		4.09		3.48	M3	1.98	
B33-SB12-01-071618	0.86	1.25	0.60	1.45	0.69	0.48	1.36		0.65	LT	0.94	M3	0.81	
B33-SS12-01-071618	0.89	0.54	0.59	0.60	0.66	1.10	1.28		1.41		0.85	M3	0.76	
B33-SS18-01-071618	0.68	0.72	0.80	1.06	1.19	1.12	1.32		1.48		1.57	M3	1.06	
B3-SB17-01-051218	1.01	0.84	1.16	0.83	1.14	1.38	1.22		1.68		1.39	M3	1.41	J
B3-SS03-01-091618	0.99	1.12	0.98	1.13	0.99	0.88	1.82		1.6		1.8	M3	1.79	
B3-SS10-01-051218	0.98	0.90	1.29	0.92	1.31	1.42	2.8		3.98	J-	3.67	M3	3.6	
B3-SS17-01-051218	0.76	0.62	0.57	0.82	0.76	0.92	1.96		1.8		1.48	M3	1.12	
B3-SS17-01-091618	0.84	1.16	0.70	1.39	0.84	0.60	1.82		1.1		1.53	M3	1.28	
B4-SB06-01-051318	0.80	0.83	0.83	1.04	1.04	1.00	0.52	LT	0.52	LT	0.54	M3	0.43	
B4-SS06-01-051318	1.06	0.88	0.36	0.83	0.34	0.41	1.43		0.58	LT	0.48	M3	0.51	
B4-SS25-01-051318	0.82	0.62	0.51	0.76	0.63	0.82	1.04		0.85	LT	0.65	M3	0.53	
B5-SB01-01-042418	0.51	0.46	0.89	0.90	1.75	1.94	1.11		2.15		1.94	M3	0.99	
B5-SS01-01-042418	0.62	0.50	0.82	0.80	1.31	1.64	1.2		1.97		1.57	M3	0.98	
B5-SS23-01-042418	0.89	0.77	1.11	0.87	1.24	1.43	0.99	LT	1.42		1.23	M3	1.1	
B6-SB11-01-052218	0.64	0.56	0.60	0.88	0.94	1.07	1.05		1.12		0.99	M3	0.63	
B6-SS11-01-052218	0.61	0.38	0.38	0.63	0.62	0.99	1.29		1.28		0.8	M3	0.49	
B6-SS27-01-071418	0.94	0.85	0.51	0.90	0.54	0.60	1.88		1.13		1.02	M3	0.96	
B7-SB21-01-052218	0.61	0.57	0.48	0.92	0.78	0.85	1.56		1.32		1.22	M3	0.75	
B7-SS03-01-052218	0.69	0.54	0.51	0.78	0.73	0.93	2.43		2.27		1.77	M3	1.23	
B7-SS21-01-052218	0.67	0.57	0.59	0.85	0.88	1.03	1.99		2.05		1.75	M3	1.17	
B8-SB21-01-052218	0.84	0.50	0.57	0.59	0.67	1.13	1.22		1.38		0.82	M3	0.69	

Table D1-11. Tabulated All Geology Sample Results (No Sediment Samples) (Continued)

Sample ID	Isotope Ratios						Pb-210 (pCi/g)	Pb-210 Qualifier	Ra-226 (pCi/g)	Ra-226 Qualifier	Th-230 (pCi/g)	Th-230 Qualifier	U-238 (pCi/g)	U-238 Qualifier
	U-238/ Th-230	U-238/ Ra-226	U-238/ Pb-210	Th-230/ Ra-226	Th-230/ Pb-210	Ra-226/ Pb-210								
B8-SS14-01-052218	0.70	0.52	0.15	0.75	0.22	0.30	2.97		0.88	LT	0.66	M3	0.46	
B8-SS21-01-052218	0.89	0.69	0.39	0.78	0.44	0.56	1.99		1.11		0.87	M3	0.77	
B9-SB21-01-050718	0.79	0.75	1.37	0.95	1.73	1.82	0.62	Y1,LT	1.13		1.07	M3	0.85	
B9-SS03-01-050718	0.68	0.58	0.49	0.85	0.72	0.84	1.28		1.08		0.92	M3	0.63	
B9-SS21-01-050718	0.87	0.88	1.78	1.01	2.05	2.02	0.41	U	0.83	LT	0.84	M3	0.73	
HS1-SB8-1215-01-062018	1.15	0.90	1.61	0.78	1.40	1.79	8		14.3		11.2	M3	12.9	
HS1-SS3-01-062018	1.51	1.65	2.46	1.09	1.63	1.49	17.8		26.5	M3	29	M3	43.8	
M10-SB10-0612-01-092818	1.06	0.89	1.33	0.85	1.26	1.49	26.5	J	39.4		33.3	M3	35.2	
M10-SS10-01-092818	0.86	0.85	1.66	0.99	1.93	1.96	17.8	J	34.8		34.3	M3	29.5	
M11-SB35-0612-01-092818	0.58	0.32	0.64	0.56	1.10	1.97	21.1		41.5	M3	23.2	M3	13.4	
M11-SS35-01-092818	0.36	0.33	0.43	0.92	1.20	1.31	30.5		40		36.7	M3	13.2	
M11-XS11-01-071118	0.90	0.53	0.99	0.59	1.10	1.87	102		191	M3	112	M3	101	
M11-XSG25-01-092818	0.73	0.97	1.23	1.33	1.69	1.28	5.2	J+	6.63		8.8	M3	6.4	
M12-SS33-01-092818	0.55	0.56	0.57	1.02	1.03	1.01	4.7		4.74	J-	4.82	M3	2.66	
M13-SB114-1230-01-091518	0.54	0.66	0.90	1.22	1.67	1.37	2.51		3.43		4.19	M3	2.25	
M13-SS114-01-091518	0.86	0.61	1.06	0.71	1.24	1.75	17		29.8		21.1	M3	18.1	
M14-SB37-0612-01-091818	1.01	0.79	1.27	0.78	1.25	1.62	55		89	M3	69	M3	70	
M14-SB37-1218-01-091818	1.04	0.77	1.31	0.73	1.25	1.71	55		94		69	M3	72	
M14-SS37-01-091818	0.91	0.65	1.15	0.72	1.27	1.77	52		92	J-	66	M3	60	
M15-SB84-0612-01-091418	0.69	0.50	0.96	0.73	1.39	1.90	7.1		13.5		9.9	M3	6.8	
M15-SS14-01-091518	0.68	0.52	1.04	0.77	1.53	1.99	2.51		5		3.83	M3	2.61	
M15-SS84-01-091418	0.81	0.64	1.09	0.78	1.34	1.71	10.1		17.3		13.5	M3	11	
M15-XS3-01-052118	0.75	0.60	1.24	0.80	1.67	2.07	9.9		20.5		16.5	M3	12.3	
M16-SB193-0612-01-091318	0.96	0.68	1.31	0.71	1.37	1.94	17.7		34.3		24.2	M3	23.2	
M16-SB193-1218-01-091318	0.76	0.73	1.24	0.95	1.63	1.71	19.4		33.1		31.6	M3	24.1	
M16-SS193-01-091318	0.82	0.63	1.38	0.77	1.68	2.18	14.9		32.5	M3	25	M3	20.6	
M16-XS177-01-052618	0.67	0.48	1.20	0.72	1.80	2.51	13.3		33.4		23.9	M3	15.9	
M16-XS30-01-052118	0.47	0.34	0.73	0.73	1.55	2.11	13.1		27.7		20.3	M3	9.5	
M17-SB64-0612-01-091318	0.88	0.60	1.30	0.68	1.48	2.16	61		132	M3	90	M3	79	
M17-SB64-1218-01-091318	0.80	0.59	1.16	0.74	1.45	1.95	64		125	M3	93	M3	74	
M17-SS64-01-091318	0.80	0.52	1.21	0.65	1.51	2.34	53		124	M3	80	M3	64	
M17-XS79-01-091318	0.71	0.79	1.58	1.11	2.22	1.99	21		41.8	M3	46.6	M3	33.1	
M18-SB145-0612-01-091418	0.86	0.74	1.61	0.86	1.87	2.18	119		260	M3	223	M3	192	M3
M18-SS145-01-091418	0.71	0.44	1.25	0.62	1.77	2.86	56		160	M3	99	M3	70	
M19-SB36-0612-01-091818	1.07	1.13	1.93	1.05	1.79	1.71	82		140	M3	147	M3	158	M3
M19-SB36-1218-01-091818	0.91	1.09	1.75	1.19	1.92	1.61	71		114	M3	136	M3	124	M3

Table D1-11. Tabulated All Geology Sample Results (No Sediment Samples) (Continued)

Sample ID	Isotope Ratios						Pb-210 (pCi/g)	Pb-210 Qualifier	Ra-226 (pCi/g)	Ra-226 Qualifier	Th-230 (pCi/g)	Th-230 Qualifier	U-238 (pCi/g)	U-238 Qualifier
	U-238/ Th-230	U-238/ Ra-226	U-238/ Pb-210	Th-230/ Ra-226	Th-230/ Pb-210	Ra-226/ Pb-210								
M19-SS36-01-091818	0.87	0.96	1.65	1.10	1.89	1.73	91		157	M3	172	M3	150	M3
M19-XSG19-01-091318	0.63	0.81	1.44	1.28	2.27	1.78	14.7		26.1		33.4	M3	21.1	
M19-XSR2-01-093018	0.57	0.58	0.42	1.03	0.75	0.73	1.06		0.77	LT	0.79	M3	0.45	
M19-XSR2-02-093018	0.68	0.76	0.49	1.12	0.73	0.65	1.02		0.66	LT	0.74	M3	0.5	
M1-SB36-0612-01-091618	0.72	0.64	0.82	0.88	1.14	1.29	3.21		4.14		3.66	M3	2.64	
M1-SB36-1218-01-091618	0.77	0.55	1.10	0.71	1.42	2.00	1.94		3.88		2.75	M3	2.13	
M1-SB36-1824-01-091618	0.75	0.63	1.10	0.84	1.46	1.75	2.28		3.99		3.34	M3	2.51	
M1-SB36-2436-01-091618	0.77	0.58	0.95	0.75	1.22	1.63	2		3.26		2.44	M3	1.89	
M1-SS36-01-091618	0.55	0.73	0.80	1.32	1.45	1.10	3.46		3.8		5.03	M3	2.76	
M20-SB59-0612-01-091718	0.79	0.68	1.08	0.86	1.37	1.59	17.5		27.9		24	M3	18.9	
M20-SB59-1218-01-091718	1.10	1.18	1.51	1.07	1.37	1.28	7.9		10.1		10.8	M3	11.9	
M20-SS59-01-091718	0.96	0.73	1.35	0.76	1.41	1.85	32.2		59.5	M3	45.3	M3	43.5	
M20-XS146-01-091718	1.25	5.23	6.84	4.20	5.49	1.31	98		128	M3	538	M3	670	J
M20-XS243-01-091718	1.06	0.94	1.84	0.89	1.74	1.95	38.5		75.2	M3	67	M3	71	
M20-XS267-01-091718	0.95	0.93	1.57	0.99	1.66	1.68	44		73.8		73	M3	69	
M20-XS365-01-060618	0.83	0.43	1.06	0.51	1.27	2.46	23.2		57.1	M3	29.4	M3	24.5	M3
M21-SB528-0612-01-091218	1.03	0.26	1.19	0.25	1.16	4.58	16.5		75.6	M3	19.2	M3	19.7	
M21-SB528-1218-01-091218	0.98	0.48	1.21	0.49	1.23	2.52	22.3		56.1	M3	27.4	M3	26.9	
M21-SS46-01-091718	0.99	0.73	1.67	0.74	1.68	2.28	87		198	M3	146	M3	145	M3
M21-SS528-01-091218	1.14	1.61	1.72	1.41	1.51	1.07	22.5		24.1		33.9	M3	38.8	
M21-XS302-02-060918	0.74	0.77	1.41	1.04	1.90	1.83	16.1		29.4	J	30.6	M3	22.7	
M21-XS323-01-091218	0.52	0.38	0.87	0.73	1.67	2.27	15.1		34.3		25.2	M3	13.2	
M21-XS46-01-060818	0.78	0.51	1.26	0.65	1.60	2.44	45		110	M3	72	M3	56.5	
M22-SB104-0612-01-091718	0.73	0.37	0.87	0.51	1.19	2.33	14.4		33.5		17.2	M3	12.5	
M22-SS104-01-091718	0.73	0.49	1.12	0.67	1.53	2.27	6.6		15	J+	10.1	M3	7.4	
M22-XS87-01-060418	0.63	0.51	0.91	0.80	1.44	1.80	5.4		9.7		7.8	M3	4.9	
M23-SB54-0612-01-092718	0.67	0.20	0.79	0.30	1.18	3.92	12.3		48.2	M3	14.5	M3	9.7	
M23-SB54-1218-01-092718	1.10	0.81	1.35	0.74	1.24	1.67	5.1		8.5		6.3	M3	6.9	
M23-SS54-01-092718	0.49	0.48	0.74	0.99	1.51	1.53	19		29		28.6	M3	14	
M24-SB76-0612-01-092518	0.82	0.72	1.53	0.87	1.86	2.14	3.7		7.9		6.9	M3	5.66	
M24-SB76-1218-01-092518	0.79	0.80	1.58	1.01	2.00	1.98	2.04		4.03		4.08	M3	3.23	
M24-SS76-01-092518	1.08	0.72	1.28	0.66	1.18	1.78	4.1		7.3		4.83	M3	5.23	
M25-SB50-0612-01-092818	1.04	1.15	1.83	1.10	1.75	1.59	53		84.3	M3	93	M3	97	M3
M25-SB50-1218-01-092818	1.25	0.57	1.47	0.46	1.17	2.57	8.7	J	22.4		10.2	M3	12.8	
M25-SS50-01-092818	1.00	0.67	1.40	0.67	1.40	2.08	15.2		31.6		21.3	M3	21.3	
M25-XS88-01-071718	0.54	0.46	0.84	0.85	1.57	1.84	6.9		12.7		10.8	M3	5.8	

Table D1-11. Tabulated All Geology Sample Results (No Sediment Samples) (Continued)

Sample ID	Isotope Ratios						Pb-210 (pCi/g)	Pb-210 Qualifier	Ra-226 (pCi/g)	Ra-226 Qualifier	Th-230 (pCi/g)	Th-230 Qualifier	U-238 (pCi/g)	U-238 Qualifier
	U-238/ Th-230	U-238/ Ra-226	U-238/ Pb-210	Th-230/ Ra-226	Th-230/ Pb-210	Ra-226/ Pb-210								
M26-SB28-0612-01-092618	0.52	0.48	0.94	0.93	1.81	1.95	8		15.6		14.5	M3	7.5	
M26-SS28-01-092618	0.50	0.46	0.78	0.93	1.55	1.67	8.5		14.2		13.2	M3	6.6	
M26-XS25-01-061818	0.79	0.57	1.38	0.73	1.76	2.41	16		38.5		28.1	M3	22.1	
M27-SB51-0612-01-092618	0.37	0.29	0.51	0.79	1.39	1.76	30.4		53.6		42.2	M3	15.6	
M27-SS51-01-092618	0.20	0.25	0.52	1.25	2.59	2.06	25.1		51.8		65	M3	13	
M27-XS275-01-061918	0.56	0.56	1.13	1.00	2.02	2.02	23		46.4		46.5	M3	26.1	
M27-XS283-01-061818	0.69	0.51	0.97	0.74	1.41	1.91	27.2		52		38.4	M3	26.5	
M27-XS38-01-061918	1.37	0.89	1.59	0.65	1.16	1.79	31		55.5	M3	36.1	M3	49.3	
M28-SB30-0612-01-092618	1.21	0.99	1.54	0.82	1.28	1.56	112		175	M3	143	M3	173	M3
M28-SS30-01-092618	1.29	1.11	2.01	0.86	1.56	1.81	70		127	M3	109	M3	141	M3
M28-SSG7-01-092618	2.03	2.34	3.65	1.16	1.80	1.56	4		6.23		7.2	M3	14.6	
M28-XS148-01-062018	1.10	0.98	1.51	0.89	1.38	1.54	61		94	M3	84	M3	92	
M28-XS162-01-092818	1.10	0.69	1.63	0.63	1.48	2.35	3.23	J+	7.6		4.77	M3	5.27	
M28-XS29-01-092618	1.09	0.63	1.43	0.58	1.31	2.25	36.4		81.9	M3	47.7	M3	51.9	
M28-XSG7-01-092618	1.40	1.42	2.84	1.01	2.03	2.00	68		136	M3	138	M3	193	M3
M29-SS48-01-092518	0.96	0.71	1.69	0.75	1.77	2.37	9.1		21.6		16.1	M3	15.4	
M2-SB51-090108-01-091718	0.73	0.84	0.63	1.15	0.87	0.75	1.06		0.8	LT	0.92	M3	0.67	
M2-SB55-072090-01-091618	0.73	0.64	0.74	0.87	1.01	1.17	21.4		25	J-	21.7	M3	15.9	
M30-SS180-01-092918	0.66	0.59	1.04	0.89	1.58	1.78	9		16		14.2	M3	9.4	
M30-XS170-01-071618	0.94	0.75	1.30	0.80	1.39	1.73	33.7		58.4		46.7	M3	43.7	
M30-XSG61-01-092918	0.97	0.77	0.73	0.79	0.76	0.95	0.41	U	0.39	LT	0.31	M3	0.3	
M31-SB37-0612-01-092918	0.47	0.43	0.58	0.91	1.24	1.36	42		57.3	M3	52	M3	24.4	
M31-SS37-01-092918	1.41	2.74	2.37	1.95	1.69	0.87	12.7		11		21.4	M3	30.1	
M31-SS9-01-092918	1.07	2.21	2.51	2.08	2.35	1.13	91		103	M3	214	M3	228	J
M31-XS39-01-092918	0.61	0.56	0.92	0.92	1.51	1.64	3.9	J+	6.4		5.88	M3	3.58	
M31-XS8-01-092918	0.76	0.65	0.90	0.85	1.18	1.38	4.1	J+	5.67		4.83	M3	3.67	
M32-SB89-0612-01-092918	1.12	1.64	3.15	1.47	2.83	1.92	52		100		147	M3	164	J
M32-SS56-01-092918	2.25	2.80	4.17	1.25	1.85	1.49	41		61	M3	76	M3	171	J
M32-SS89-01-092918	1.11	0.72	2.02	0.65	1.82	2.82	50		141	M3	91	M3	101	M3
M33-SS86-01-091818	0.83	0.69	1.25	0.83	1.51	1.82	51		93		77	M3	64	
M34-SS97-01-092718	0.78	0.72	1.14	0.93	1.46	1.57	13.2		20.7		19.3	M3	15	
M34-XS110-01-081218	0.90	0.71	1.49	0.79	1.66	2.10	33.9		71.2		56.2	M3	50.6	
M35-SB22-0612-01-092718	0.68	0.47	0.88	0.69	1.30	1.88	5	J	9.4		6.5	M3	4.42	
M35-SS22-01-092718	0.81	0.66	1.23	0.82	1.53	1.87	4.7	J	8.8		7.2	M3	5.8	
M36-SS24-01-092718	0.72	0.72	1.07	1.00	1.48	1.47	3.7		5.45		5.47	M3	3.95	
M37-SS44-01-092718	1.23	0.71	2.33	0.58	1.90	3.31	7.2		23.8		13.7	M3	16.8	

Table D1-11. Tabulated All Geology Sample Results (No Sediment Samples) (Continued)

Sample ID	Isotope Ratios						Pb-210 (pCi/g)	Pb-210 Qualifier	Ra-226 (pCi/g)	Ra-226 Qualifier	Th-230 (pCi/g)	Th-230 Qualifier	U-238 (pCi/g)	U-238 Qualifier
	U-238/ Th-230	U-238/ Ra-226	U-238/ Pb-210	Th-230/ Ra-226	Th-230/ Pb-210	Ra-226/ Pb-210								
M37-XS124A-01-081318	1.25	0.79	2.50	0.63	2.00	3.15	46		145	M3	92	M3	115	
M37-XS44-01-081318	1.21	1.15	2.21	0.95	1.82	1.92	24.8		47.5		45.1	M3	54.7	
M38-SB2-0612-01-092718	0.30	0.22	0.60	0.75	2.04	2.71	38.8		105	M3	79	M3	23.4	
M38-SB2-1218-01-092718	0.59	0.46	0.92	0.77	1.56	2.01	37.2		74.9	M3	57.9	M3	34.3	
M38-SS2-01-092718	0.33	0.35	0.53	1.05	1.58	1.50	24.4		36.7		38.6	M3	12.9	
M3-SB51-0612-01-091618	0.79	0.61	1.49	0.77	1.89	2.44	2.73		6.67		5.16	M3	4.07	
M3-SB51-1218-01-091618	0.72	0.45	1.00	0.63	1.38	2.21	3.05		6.75		4.22	M3	3.04	
M3-SS51-01-091618	0.80	0.42	0.86	0.53	1.07	2.04	1.13		2.3		1.21	M3	0.97	
M3-XS34-01-043018	0.88	0.65	1.10	0.73	1.25	1.70	4.6		7.8		5.73	M3	5.06	
M3-XS36-01-043018	0.80	0.49	1.22	0.61	1.52	2.49	6.3		15.7		9.6	M3	7.7	
M4-SB81-0612-01-091818	0.72	0.42	0.79	0.58	1.10	1.90	32.2		61.2		35.5	M3	25.4	
M4-SB81-1218-01-091818	0.57	0.42	0.66	0.74	1.17	1.58	29.6		46.7	M3	34.5	M3	19.5	
M4-SS81-01-091818	0.65	0.55	0.90	0.85	1.38	1.62	27.1		43.9	M3	37.3	M3	24.3	
M4-XS238-01-051018	0.72	0.28	0.76	0.38	1.06	2.75	5.2		14.3		5.49	M3	3.96	
M5-SB149-0612-01-093018	0.99	0.35	1.04	0.35	1.05	3.00	13.7		41.1	M3	14.4	M3	14.2	
M5-SB479-0612-01-093018	0.87	0.91	0.78	1.04	0.89	0.85	0.89	LT	0.76	LT	0.79	M3	0.69	
M5-SS149-01-093018	1.01	0.93	1.41	0.91	1.39	1.53	23.6		36		32.9	M3	33.3	
M5-SS479-01-093018	1.08	1.13	0.90	1.05	0.83	0.79	0.77	LT	0.61	LT	0.64	M3	0.69	
M6-SB285-0612-01-091618	0.82	0.35	0.61	0.42	0.74	1.75	19.1		33.5		14.1	M3	11.6	
M6-SB285-1218-01-091618	1.12	0.88	1.21	0.78	1.08	1.38	24.9		34.3		26.9	M3	30.1	
M6-SS174-01-092718	0.80	0.90	1.00	1.13	1.25	1.11	9.9	J	11		12.4	M3	9.9	
M6-SS285-01-091618	0.80	0.58	0.47	0.72	0.59	0.82	16.1		13.2		9.5	M3	7.6	
M6-XS269-01-042618	0.67	0.42	0.74	0.63	1.11	1.75	8.9		15.6		9.9	M3	6.6	
M6-XSG13A-01-091618	0.68	0.73	1.22	1.07	1.80	1.68	14.7		24.7		26.5	M3	18	
M7-SB161-0612-01-091618	0.60	0.45	0.84	0.76	1.41	1.86	38.8		72.2	M3	54.8	M3	32.7	
M7-SB161-1218-01-091618	0.78	0.29	0.81	0.36	1.03	2.83	18.9		53.5	M3	19.5	M3	15.3	
M7-SB161-1824-01-091618	0.75	0.43	0.88	0.58	1.18	2.04	17.7		36.1	J-	20.9	M3	15.6	
M7-SB161-2430-01-091618	0.84	0.72	1.06	0.86	1.26	1.47	43		63.1	M3	54.3	M3	45.4	
M7-SS161-01-091618	0.81	0.53	0.91	0.66	1.13	1.71	62		106		70	M3	56.7	
M7-XS162A-01-081518	0.75	0.66	1.01	0.87	1.34	1.54	127		195	M3	170	M3	128	
M7-XS181-01-051018	0.59	0.32	0.72	0.55	1.23	2.24	13.3		29.8		16.3	M3	9.6	J
M7-XS181-02-051018	0.68	0.45	0.84	0.66	1.24	1.88	14.8		27.8		18.4	M3	12.5	J
M7-XSR1-01-093018	0.79	0.72	0.93	0.91	1.19	1.30	2.29		2.98		2.72	M3	2.14	
M8-SS120-01-092718	0.37	0.43	0.62	1.19	1.68	1.42	5.7		8.1		9.6	M3	3.51	
M8-SS52-01-091818	1.56	1.24	1.70	0.79	1.09	1.38	7.7		10.6		8.4	J	13.1	
M8-XS102-01-050918	0.95	0.90	1.15	0.94	1.20	1.27	3.64		4.64		4.37	M3	4.17	

Table D1-11. Tabulated All Geology Sample Results (No Sediment Samples) (Continued)

Sample ID	Isotope Ratios						Pb-210 (pCi/g)	Pb-210 Qualifier	Ra-226 (pCi/g)	Ra-226 Qualifier	Th-230 (pCi/g)	Th-230 Qualifier	U-238 (pCi/g)	U-238 Qualifier
	U-238/ Th-230	U-238/ Ra-226	U-238/ Pb-210	Th-230/ Ra-226	Th-230/ Pb-210	Ra-226/ Pb-210								
M9-SS19-01-093018	0.65	0.34	0.51	0.52	0.78	1.49	1.79	J	2.67	J-	1.39	M3	0.91	
M9-XS19A-01-081718	0.71	0.49	0.67	0.69	0.95	1.38	1.28		1.76		1.21	J	0.86	
M9-XS28A-01-081718	0.94	0.73	1.18	0.77	1.25	1.62	68	Y1	110	J-	85	M3	80	
T10-XS20-01-042518	0.62	0.71	0.60	1.15	0.97	0.84	0.89	LT	0.75	LT	0.86	M3	0.53	
T14-XS27-01-050818	0.75	0.86	0.79	1.15	1.05	0.91	0.81	LT	0.74	LT	0.85	M3	0.64	
T17-SB258-018090-01-092518	0.58	0.45	0.66	0.78	1.14	1.47	1.74		2.56		1.99	M3	1.15	
T17-XS143-01-042618	0.93	0.59	1.34	0.63	1.44	2.29	11.8		27		17	M3	15.8	
T17-XS377-01-042818	0.74	0.69	1.22	0.94	1.66	1.77	8.7		15.4		14.4	M3	10.6	M3
T1-SS14-01-091618	0.68	0.43	0.82	0.63	1.20	1.90	3.6		6.85		4.32	M3	2.94	
T1-XSG49A-01-081918	0.64	0.60	0.81	0.93	1.26	1.36	3.43		4.67		4.33	M3	2.78	M3
T1-XSG5A-01-081918	0.41	0.25	0.50	0.61	1.22	1.99	1.42		2.83		1.73	J	0.71	
T23-SS32-01-091418	0.72	0.59	0.75	0.81	1.04	1.28	2.54		3.24		2.63	M3	1.9	
T37-SS94-01-091318	1.10	0.87	1.26	0.79	1.14	1.44	0.7	LT	1.01	J-	0.8	M3	0.88	
T4-XS15A-01-081918	0.27	0.13	0.35	0.50	1.30	2.59	86		223	M3	112	M3	29.9	
T4-XSG50A-01-081918	0.53	0.25	0.62	0.48	1.18	2.46	11.9		29.3		14	M3	7.4	
T9-SS67-01-091118	1.02	1.01	2.29	0.99	2.25	2.27	0.51	U	1.16		1.15	M3	1.17	
T9-XS217-01-042518	0.58	0.73	1.09	1.25	1.87	1.49	0.67	LT	1		1.25	M3	0.73	

Notes:

J	Estimated value
J-	Estimated value, may be biased low.
J+	Estimated value, may be biased high.
LT	Result less than requested minimum detectable concentration, but greater than sample-specific detectable concentration.
M3	The requested minimum detected concentration was not met, but the reported activity is greater than the reported minimum detected concentration.
Pb-210	Lead 210
pCi/g	Picocuries per gram
Ra-226	Radium 226
Th-230	Thorium 230
U	Not detected. The associated value is the reporting limit.
U-238	Uranium 238
UJ	Not considered detected. The associated value is the reported concentration, which is estimated.
Y1	Chemical yield is in control at 100% - 110%. Quantitative yield is assumed.

Table D1-12. Tabulated Background Site Sample Results

Sample ID	Isotope Ratios						Pb-210 (pCi/g)	Pb-210 Qualifier	Ra-226 (pCi/g)	Ra-226 Qualifier	Th-230 (pCi/g)	Th-230 Qualifier	U-238 (pCi/g)	U-238 Qualifier
	U-238/ Th-230	U-238/ Ra-226	U-238/ Pb-210	Th-230/ Ra-226	Th-230/ Pb-210	Ra-226 /Pb-210								
B29-SS06-01-071018	0.86	1.02	0.94	1.19	1.09	0.91	0.47	U	0.43	UJ	0.51	M3	0.44	
B29-SS11-01-071318	0.44	0.65	2.00	1.48	4.53	3.07	0.15	U	0.46	UJ	0.68	M3	0.3	
B2-SS01-01-051218	0.73	0.54	0.52	0.75	0.72	0.96	0.82	LT	0.79	UJ	0.59	M3	0.43	
B19-SB11-01-052618	0.64	0.68	0.80	1.07	1.25	1.18	0.51	LT	0.6	UJ	0.64	M3	0.41	
B19-SS11-01-052618	0.81	1.02	0.62	1.26	0.77	0.61	0.69	LT	0.42	UJ	0.53	M3	0.43	
B24-SB05-01-071618	1.06	0.61	0.47	0.57	0.44	0.78	0.72	LT	0.56	UJ	0.32	M3	0.34	
B17-SS21-01-052418	0.60	0.87	0.12	1.46	0.20	0.14	5.1	J	0.7	UJ	1.02	J	0.61	
B11-SS24-01-051118	1.05	0.84	0.43	0.80	0.41	0.51	1.36		0.7	UJ	0.56	M3	0.59	
B13-SS08-01-071518	0.73	0.48	0.11	0.66	0.14	0.22	5.2		1.14	UJ	0.75	M3	0.55	
B15-SS16-01-071118	0.85	0.97	0.38	1.14	0.45	0.39	1.68		0.66	UJ	0.75	M3	0.64	
B31-SB30-01-071318	0.79	1.00	0.25	1.27	0.31	0.25	1.81		0.45	UJ	0.57	M3	0.45	
B14-SB27-01-071518	1.03		0.64		0.62	0.00	0.47	U	0	U	0.29	M3	0.3	
B16-SB01-01-060918	0.88	0.94	0.88	1.06	1.00	0.94	0.33	U	0.31	U	0.33	M3	0.29	
B16-SS01-01-060918	0.61	0.85	0.94	1.38	1.54	1.11	0.35	U	0.39	U	0.54	M3	0.33	
B29-SS23-01-071318	1.23	1.23	1.28	1.00	1.03	1.03	0.29	U	0.3	U	0.3	M3	0.37	
B30-SS11-01-071018	1.18	1.07	1.82	0.90	1.54	1.71	0.17	U	0.29	U	0.262	M3	0.31	
B14-SS27-01-071518	0.62	0.67	0.32	1.07	0.52	0.48	0.56	LT	0.27	U	0.29	M3	0.181	
B29-SS01-01-071018	0.64	1.00	0.41	1.58	0.65	0.41	0.63	LT	0.26	U	0.41	M3	0.261	
B31-SS06-01-071318	0.51	0.60	0.17	1.17	0.33	0.28	1.86		0.52	U	0.61	M3	0.31	
B9-SS21-01-050718	0.87	0.88	1.78	1.01	2.05	2.02	0.41	U	0.83	LT	0.84	M3	0.73	
B13-SB16-01-071518	0.76	0.71	1.31	0.94	1.73	1.85	0.52	U	0.96	LT	0.9	M3	0.68	
B15-SB16-01-071118	0.61	0.60	0.86	0.99	1.40	1.42	0.57	U	0.81	LT	0.8	J	0.49	
B29-SS20-01-071118	1.05	1.14	0.78	1.09	0.75	0.69	0.51	U	0.35	LT	0.38	M3	0.4	
B29-SS26-01-071118	0.77	0.66	0.73	0.85	0.95	1.11	0.56	U	0.62	LT	0.53	M3	0.41	
B30-SB21-01-071018	0.59	0.55	0.42	0.93	0.72	0.77	0.53	U	0.41	LT	0.38	M3	0.224	
B2-SB29-01-051218	0.75	0.58	0.47	0.77	0.63	0.82	0.76	LT	0.62	LT	0.48	M3	0.36	
B2-SS29-01-051218	0.75	0.67	0.76	0.90	1.02	1.14	0.51	LT	0.58	LT	0.52	M3	0.39	
B4-SB06-01-051318	0.80	0.83	0.83	1.04	1.04	1.00	0.52	LT	0.52	LT	0.54	M3	0.43	
B11-SB15-01-051118	0.84	0.94	0.78	1.12	0.92	0.83	0.63	LT	0.52	LT	0.58	M3	0.49	
B15-SB16-02-071118	1.02	0.71	0.55	0.70	0.54	0.78	0.94	LT	0.73	LT	0.51	J	0.52	
B15-SS19-01-071118	0.76	0.66	0.74	0.87	0.97	1.12	0.77	LT	0.86	LT	0.75	M3	0.57	
B16-SS07-01-060918	0.77	0.80	0.61	1.05	0.79	0.76	0.87	LT	0.66	LT	0.69	M3	0.53	
B20-SB01-01-052318	0.79	0.66	0.43	0.84	0.55	0.65	0.77	LT	0.5	LT	0.42	M3	0.33	
B22-SS16-01-052418	1.00	0.79	0.86	0.79	0.86	1.10	0.81	LT	0.89	LT	0.7	J	0.7	
B22-SS16-02-052418	0.44	0.59	0.53	1.37	1.23	0.90	0.88	LT	0.79	LT	1.08	J	0.47	
B23-SS08-01-060618	0.82	0.69	0.72	0.84	0.87	1.04	0.85	LT	0.88	LT	0.74	M3	0.61	
B24-SS05-01-071618	0.76	0.69	0.32	0.91	0.42	0.46	0.98	LT	0.45	LT	0.41	M3	0.31	

Table D1-12. Tabulated Background Site Sample Results (Continued)

Sample ID	Isotope Ratios						Pb-210 (pCi/g)	Pb-210 Qualifier	Ra-226 (pCi/g)	Ra-226 Qualifier	Th-230 (pCi/g)	Th-230 Qualifier	U-238 (pCi/g)	U-238 Qualifier
	U-238/ Th-230	U-238/ Ra-226	U-238/ Pb-210	Th-230/ Ra-226	Th-230/ Pb-210	Ra-226 /Pb-210								
B30-SS21-01-071018	0.83	0.79	0.40	0.95	0.48	0.51	0.75	LT	0.38	LT	0.36	M3	0.3	
B30-SS21-02-071018	1.00	0.81	0.46	0.81	0.46	0.57	0.74	LT	0.42	LT	0.34	M3	0.34	
B17-SS21-02-052418	0.69	0.73	0.35	1.06	0.50	0.47	1.39	J	0.66	LT	0.7	J	0.48	
B4-SS06-01-051318	1.06	0.88	0.36	0.83	0.34	0.41	1.43		0.58	LT	0.48	M3	0.51	
B4-SS25-01-051318	0.82	0.62	0.51	0.76	0.63	0.82	1.04		0.85	LT	0.65	M3	0.53	
B8-SS14-01-052218	0.70	0.52	0.15	0.75	0.22	0.30	2.97		0.88	LT	0.66	M3	0.46	
B11-SS15-01-051118	0.70	0.61	0.44	0.88	0.63	0.72	1.11		0.8	LT	0.7	M3	0.49	
B13-SS23-01-071518	0.84	0.65	0.14	0.77	0.16	0.21	4.5		0.96	LT	0.74	M3	0.62	
B17-SB21-01-052418	1.52	1.18	0.68	0.78	0.45	0.57	1.55		0.89	LT	0.69	M3	1.05	
B18-SB11-01-052518	0.81	0.70	0.34	0.86	0.42	0.49	1.79		0.87	LT	0.75	M3	0.61	
B19-SS02-01-052618	0.84	0.76	0.41	0.90	0.48	0.53	1.18		0.63	LT	0.57	M3	0.48	
B20-SS01-01-052318	0.58	0.49	0.28	0.85	0.48	0.57	1.14		0.65	LT	0.55	M3	0.32	
B20-SS12-01-052318	0.68	0.65	0.41	0.96	0.60	0.63	1.15		0.72	LT	0.69	M3	0.47	
B27-SB07-01-061018	0.77	0.50	0.37	0.65	0.48	0.74	1.32		0.98	LT	0.64	M3	0.49	
B27-SS16-01-061018	0.86	0.60	0.51	0.70	0.59	0.84	1.08		0.91	LT	0.64	M3	0.55	
B33-SB12-01-071618	0.86	1.25	0.60	1.45	0.69	0.48	1.36		0.65	LT	0.94	M3	0.81	
B25-SB12-01-060418	0.74	0.57	0.69	0.77	0.93	1.20	0.96	LT	1.15	J+	0.89	M3	0.66	
B26-SB29-01-060518	0.63	0.57	1.21	0.91	1.93	2.13	0.71	LT	1.51	J+	1.37	M3	0.86	
B12-SS01-01-050818	0.73	0.51	0.47	0.69	0.64	0.93	1.87		1.73	J+	1.2	M3	0.88	
B13-SS16-01-071518	0.99	0.96	0.43	0.97	0.44	0.45	1.68		0.76	J+	0.74	M3	0.73	
B14-SS13-01-071518	0.58	0.69	0.26	1.19	0.46	0.39	1.4		0.54	J+	0.64	M3	0.37	
B15-SS09-01-071118	0.76	0.63	0.21	0.82	0.28	0.33	3.2		1.07	J+	0.88	M3	0.67	
B17-SS06-01-052418	0.73	0.77	0.15	1.05	0.21	0.20	3.24		0.64	J+	0.67	M3	0.49	
B25-SS12-01-060418	0.80	0.65	0.66	0.81	0.83	1.03	1.16		1.19	J+	0.96	M3	0.77	
B26-SS07-01-091418	0.61	0.49	0.26	0.81	0.42	0.52	3.43		1.79	J+	1.45	M3	0.88	
B27-SS07-01-061018	0.78	0.58	0.37	0.75	0.48	0.64	1.42		0.91	J+	0.68	M3	0.53	
B31-SS18-01-071318	0.49	0.38	0.19	0.78	0.39	0.49	1.97		0.97	J+	0.76	M3	0.37	
B31-SS30-01-071318	0.95	1.13	0.27	1.19	0.28	0.24	2.2		0.52	J+	0.62	M3	0.59	
B32-SS06-01-071218	0.64	0.52	0.45	0.81	0.70	0.86	2		1.72	J+	1.4	M3	0.89	
B3-SS10-01-051218	0.98	0.90	1.29	0.92	1.31	1.42	2.8		3.98	J-	3.67	M3	3.6	
B10-SS21-01-050818	0.74	0.62	0.60	0.84	0.82	0.98	2.48		2.43	J	2.03	M3	1.5	
B9-SB21-01-050718	0.79	0.75	1.37	0.95	1.73	1.82	0.62	Y1,LT	1.13		1.07	M3	0.85	
B5-SS23-01-042418	0.89	0.77	1.11	0.87	1.24	1.43	0.99	LT	1.42		1.23	M3	1.1	
B10-SS04-01-050818	0.75	0.67	1.25	0.89	1.68	1.87	0.71	LT	1.33		1.19	M3	0.89	
B1-SS04-01-051218	0.96	0.87	0.55	0.91	0.58	0.64	1.84		1.17		1.06	M3	1.02	
B1-SB24-01-051218	0.90	0.62	0.75	0.69	0.84	1.21	1.16		1.4		0.97	M3	0.87	

Table D1-12. Tabulated Background Site Sample Results (Continued)

Sample ID	Isotope Ratios						Pb-210 (pCi/g)	Pb-210 Qualifier	Ra-226 (pCi/g)	Ra-226 Qualifier	Th-230 (pCi/g)	Th-230 Qualifier	U-238 (pCi/g)	U-238 Qualifier
	U-238/ Th-230	U-238/ Ra-226	U-238/ Pb-210	Th-230/ Ra-226	Th-230/ Pb-210	Ra-226 /Pb-210								
B1-SS24-01-051218	2.88	1.74	2.17	0.61	0.75	1.25	1.06		1.32		0.8	M3	2.3	
B3-SS03-01-091618	0.99	1.12	0.98	1.13	0.99	0.88	1.82		1.6		1.8	M3	1.79	
B3-SB17-01-051218	1.01	0.84	1.16	0.83	1.14	1.38	1.22		1.68		1.39	M3	1.41	J
B3-SS17-01-051218	0.76	0.62	0.57	0.82	0.76	0.92	1.96		1.8		1.48	M3	1.12	
B3-SS17-01-091618	0.84	1.16	0.70	1.39	0.84	0.60	1.82		1.1		1.53	M3	1.28	
B5-SB01-01-042418	0.51	0.46	0.89	0.90	1.75	1.94	1.11		2.15		1.94	M3	0.99	
B5-SS01-01-042418	0.62	0.50	0.82	0.80	1.31	1.64	1.2		1.97		1.57	M3	0.98	
B6-SB11-01-052218	0.64	0.56	0.60	0.88	0.94	1.07	1.05		1.12		0.99	M3	0.63	
B6-SS11-01-052218	0.61	0.38	0.38	0.63	0.62	0.99	1.29		1.28		0.8	M3	0.49	
B6-SS27-01-071418	0.94	0.85	0.51	0.90	0.54	0.60	1.88		1.13		1.02	M3	0.96	
B7-SS03-01-052218	0.69	0.54	0.51	0.78	0.73	0.93	2.43		2.27		1.77	M3	1.23	
B7-SB21-01-052218	0.61	0.57	0.48	0.92	0.78	0.85	1.56		1.32		1.22	M3	0.75	
B7-SS21-01-052218	0.67	0.57	0.59	0.85	0.88	1.03	1.99		2.05		1.75	M3	1.17	
B8-SB21-01-052218	0.84	0.50	0.57	0.59	0.67	1.13	1.22		1.38		0.82	M3	0.69	
B8-SS21-01-052218	0.89	0.69	0.39	0.78	0.44	0.56	1.99		1.11		0.87	M3	0.77	
B10-SB21-01-050818	0.65	0.61	0.60	0.93	0.91	0.98	2.45		2.4		2.24	M3	1.46	
B12-SB11-01-050818	0.72	0.56	0.56	0.78	0.78	1.00	1.4		1.4		1.09	M3	0.78	
B12-SS11-01-050818	0.67	0.47	0.45	0.70	0.66	0.95	1.73		1.64		1.15	M3	0.77	
B9-SS03-01-050718	0.68	0.58	0.49	0.85	0.72	0.84	1.28		1.08		0.92	M3	0.63	
B15-SS05-01-071118	0.74	0.64	0.50	0.87	0.68	0.79	1.35		1.06		0.92	M3	0.68	
B18-SS11-01-052518	0.69	0.59	0.27	0.86	0.38	0.45	2.47		1.11		0.95	M3	0.66	
B18-SS23-01-052518	0.84	0.65	0.87	0.77	1.03	1.33	1.05		1.4		1.08	M3	0.91	
B21-SB04-01-062118	0.94	0.85	1.24	0.91	1.32	1.45	3.46		5.02		4.57	M3	4.29	
B21-SS04-02-062118	1.18	1.06	1.76	0.90	1.49	1.66	2.84		4.72		4.23	M3	5	
B21-SS13-01-062118	0.99	0.91	1.52	0.92	1.53	1.67	2.79		4.65		4.27	M3	4.23	
B21-SB14-01-062118	0.72	0.65	1.09	0.90	1.50	1.67	2.16		3.61		3.25	M3	2.35	
B21-SS14-02-062118	0.81	1.16	1.44	1.44	1.78	1.24	2.95		3.65		5.26	M3	4.25	
B21-SB26-01-062118	0.72	0.77	1.19	1.07	1.65	1.55	2.42		3.75		4	M3	2.89	
B22-SS04-01-052418	0.67	0.51	0.26	0.76	0.39	0.51	2.82		1.44		1.09	M3	0.73	
B23-SB18-01-060618	0.90	0.74	1.19	0.82	1.33	1.62	2.01		3.25		2.67	M3	2.39	
B23-SS18-01-060618	0.78	0.76	0.93	0.97	1.19	1.22	2.51		3.07		2.99	M3	2.34	
B24-SS23-01-071618	0.69	0.30	0.31	0.44	0.45	1.02	1.37		1.4		0.61	M3	0.42	
B25-SS04-01-060418	0.75	0.64	0.62	0.86	0.83	0.97	2.29		2.22		1.9	M3	1.43	
B26-SS09-01-060518	0.67	0.45	0.54	0.68	0.81	1.19	2.13		2.54		1.72	M3	1.15	
B26-SS29-01-060518	0.74	0.57	0.50	0.77	0.67	0.87	1.97		1.72		1.32	M3	0.98	
B32-SS08-01-071218	0.45	0.30	0.49	0.67	1.08	1.61	2.85		4.59		3.08	M3	1.39	

Table D1-12. Tabulated Background Site Sample Results (Continued)

Sample ID	Isotope Ratios						Pb-210 (pCi/g)	Pb-210 Qualifier	Ra-226 (pCi/g)	Ra-226 Qualifier	Th-230 (pCi/g)	Th-230 Qualifier	U-238 (pCi/g)	U-238 Qualifier
	U-238/ Th-230	U-238/ Ra-226	U-238/ Pb-210	Th-230/ Ra-226	Th-230/ Pb-210	Ra-226 /Pb-210								
B32-SS16-01-071218	0.82	0.74	1.14	0.90	1.39	1.54	1.13		1.74		1.57	M3	1.29	
B32-SB30-01-071218	0.54	0.95	1.38	1.74	2.54	1.46	5		7.29		12.7	M3	6.9	
B32-SS30-01-071218	0.57	0.48	0.99	0.85	1.73	2.03	2.01		4.09		3.48	M3	1.98	
B33-SS12-01-071618	0.89	0.54	0.59	0.60	0.66	1.10	1.28		1.41		0.85	M3	0.76	
B33-SS18-01-071618	0.68	0.72	0.80	1.06	1.19	1.12	1.32		1.48		1.57	M3	1.06	

Notes:
J Estimated value
J- Estimated value, may be biased low.
J+ Estimated value, may be biased high.
LT Result less than requested minimum detectable concentration, but greater than sample-specific detectable concentration.
M3 The requested minimum detected concentration was not met, but the reported activity is greater than the reported minimum detected concentration.
Pb-210 Lead 210
pCi/g Picocuries per gram
Ra-226 Radium 226
Th-230 Thorium 230
U Not detected. The associated value is the reporting limit.
U-238 Uranium 238
UJ Not considered detected. The associated value is the reported concentration, which is estimated.
Y1 Chemical yield is in control at 100% - 110%. Quantitative yield is assumed.

Table D1-13. Tabulated Abandoned Uranium Mine Site Sample Results

Sample ID	Isotope Ratios						Pb-210 (pCi/g)	Pb-210 Qualifier	Ra-226 (pCi/g)	Ra-226 Qualifier	Th-230 (pCi/g)	Th-230 Qualifier	U-238 (pCi/g)	U-238 Qualifier
	U-238/ Th-230	U-238/ Ra-226	U-238/ Pb-210	Th-230/ Ra-226	Th-230/ Pb-210	Ra-226/ Pb-210								
M9-XS28A-01-081718	0.94	0.73	1.18	0.77	1.25	1.62	68	Y1	110	J-	85	M3	80	
M30-XSG61-01-092918	0.97	0.77	0.73	0.79	0.76	0.95	0.41	U	0.39	LT	0.31	M3	0.3	
M5-SB479-0612-01-093018	0.87	0.91	0.78	1.04	0.89	0.85	0.89	LT	0.76	LT	0.79	M3	0.69	
M5-SS479-01-093018	1.08	1.13	0.90	1.05	0.83	0.79	0.77	LT	0.61	LT	0.64	M3	0.69	
M31-XS8-01-092918	0.76	0.65	0.90	0.85	1.18	1.38	4.1	J+	5.67		4.83	M3	3.67	
M31-XS39-01-092918	0.61	0.56	0.92	0.92	1.51	1.64	3.9	J+	6.4		5.88	M3	3.58	
M28-XS162-01-092818	1.10	0.69	1.63	0.63	1.48	2.35	3.23	J+	7.6		4.77	M3	5.27	
M11-XSG25-01-092818	0.73	0.97	1.23	1.33	1.69	1.28	5.2	J+	6.63		8.8	M3	6.4	
M9-SS19-01-093018	0.65	0.34	0.51	0.52	0.78	1.49	1.79	J	2.67	J-	1.39	M3	0.91	
M6-SS174-01-092718	0.80	0.90	1.00	1.13	1.25	1.11	9.9	J	11		12.4	M3	9.9	
M35-SB22-0612-01-092718	0.68	0.47	0.88	0.69	1.30	1.88	5	J	9.4		6.5	M3	4.42	
M35-SS22-01-092718	0.81	0.66	1.23	0.82	1.53	1.87	4.7	J	8.8		7.2	M3	5.8	
M25-SB50-1218-01-092818	1.25	0.57	1.47	0.46	1.17	2.57	8.7	J	22.4		10.2	M3	12.8	
M10-SB10-0612-01-092818	1.06	0.89	1.33	0.85	1.26	1.49	26.5	J	39.4		33.3	M3	35.2	
M10-SS10-01-092818	0.86	0.85	1.66	0.99	1.93	1.96	17.8	J	34.8		34.3	M3	29.5	
M7-SB161-0612-01-091618	0.60	0.45	0.84	0.76	1.41	1.86	38.8		72.2	M3	54.8	M3	32.7	
M7-SB161-1218-01-091618	0.78	0.29	0.81	0.36	1.03	2.83	18.9		53.5	M3	19.5	M3	15.3	
M7-SB161-2430-01-091618	0.84	0.72	1.06	0.86	1.26	1.47	43		63.1	M3	54.3	M3	45.4	
M7-XS162A-01-081518	0.75	0.66	1.01	0.87	1.34	1.54	127		195	M3	170	M3	128	
M5-SB149-0612-01-093018	0.99	0.35	1.04	0.35	1.05	3.00	13.7		41.1	M3	14.4	M3	14.2	
M4-SB81-1218-01-091818	0.57	0.42	0.66	0.74	1.17	1.58	29.6		46.7	M3	34.5	M3	19.5	
M4-SS81-01-091818	0.65	0.55	0.90	0.85	1.38	1.62	27.1		43.9	M3	37.3	M3	24.3	
M38-SB2-0612-01-092718	0.30	0.22	0.60	0.75	2.04	2.71	38.8		105	M3	79	M3	23.4	
M38-SB2-1218-01-092718	0.59	0.46	0.92	0.77	1.56	2.01	37.2		74.9	M3	57.9	M3	34.3	
M37-XS124A-01-081318	1.25	0.79	2.50	0.63	2.00	3.15	46		145	M3	92	M3	115	
M32-SS56-01-092918	2.25	2.80	4.17	1.25	1.85	1.49	41		61	M3	76	M3	171	J
M32-SS89-01-092918	1.11	0.72	2.02	0.65	1.82	2.82	50		141	M3	91	M3	101	M3
M31-SS9-01-092918	1.07	2.21	2.51	2.08	2.35	1.13	91		103	M3	214	M3	228	J
M31-SB37-0612-01-092918	0.47	0.43	0.58	0.91	1.24	1.36	42		57.3	M3	52	M3	24.4	
M28-SS30-01-092618	1.29	1.11	2.01	0.86	1.56	1.81	70		127	M3	109	M3	141	M3
M28-SB30-0612-01-092618	1.21	0.99	1.54	0.82	1.28	1.56	112		175	M3	143	M3	173	M3
M28-XSG7-01-092618	1.40	1.42	2.84	1.01	2.03	2.00	68		136	M3	138	M3	193	M3
M28-XS29-01-092618	1.09	0.63	1.43	0.58	1.31	2.25	36.4		81.9	M3	47.7	M3	51.9	
M28-XS148-01-062018	1.10	0.98	1.51	0.89	1.38	1.54	61		94	M3	84	M3	92	
M27-XS38-01-061918	1.37	0.89	1.59	0.65	1.16	1.79	31		55.5	M3	36.1	M3	49.3	
M25-SB50-0612-01-092818	1.04	1.15	1.83	1.10	1.75	1.59	53		84.3	M3	93	M3	97	M3
M23-SB54-0612-01-092718	0.67	0.20	0.79	0.30	1.18	3.92	12.3		48.2	M3	14.5	M3	9.7	
M21-SS46-01-091718	0.99	0.73	1.67	0.74	1.68	2.28	87		198	M3	146	M3	145	M3
M21-SB528-0612-01-091218	1.03	0.26	1.19	0.25	1.16	4.58	16.5		75.6	M3	19.2	M3	19.7	

Table D1-13. Tabulated Abandoned Uranium Mine Site Sample Results (Continued)

Sample ID	Isotope Ratios						Pb-210 (pCi/g)	Pb-210 Qualifier	Ra-226 (pCi/g)	Ra-226 Qualifier	Th-230 (pCi/g)	Th-230 Qualifier	U-238 (pCi/g)	U-238 Qualifier
	U-238/ Th-230	U-238/ Ra-226	U-238/ Pb-210	Th-230/ Ra-226	Th-230/ Pb-210	Ra-226/ Pb-210								
M21-SB528-1218-01-091218	0.98	0.48	1.21	0.49	1.23	2.52	22.3		56.1	M3	27.4	M3	26.9	
M21-XS46-01-060818	0.78	0.51	1.26	0.65	1.60	2.44	45		110	M3	72	M3	56.5	
M20-SS59-01-091718	0.96	0.73	1.35	0.76	1.41	1.85	32.2		59.5	M3	45.3	M3	43.5	
M20-XS146-01-091718	1.25	5.23	6.84	4.20	5.49	1.31	98		128	M3	538	M3	670	J
M20-XS243-01-091718	1.06	0.94	1.84	0.89	1.74	1.95	38.5		75.2	M3	67	M3	71	
M20-XS365-01-060618	0.83	0.43	1.06	0.51	1.27	2.46	23.2		57.1	M3	29.4	M3	24.5	M3
M19-SB36-0612-01-091818	1.07	1.13	1.93	1.05	1.79	1.71	82		140	M3	147	M3	158	M3
M19-SB36-1218-01-091818	0.91	1.09	1.75	1.19	1.92	1.61	71		114	M3	136	M3	124	M3
M19-SS36-01-091818	0.87	0.96	1.65	1.10	1.89	1.73	91		157	M3	172	M3	150	M3
M18-SB145-0612-01-091418	0.86	0.74	1.61	0.86	1.87	2.18	119		260	M3	223	M3	192	M3
M18-SS145-01-091418	0.71	0.44	1.25	0.62	1.77	2.86	56		160	M3	99	M3	70	
M17-SB64-0612-01-091318	0.88	0.60	1.30	0.68	1.48	2.16	61		132	M3	90	M3	79	
M17-SB64-1218-01-091318	0.80	0.59	1.16	0.74	1.45	1.95	64		125	M3	93	M3	74	
M17-SS64-01-091318	0.80	0.52	1.21	0.65	1.51	2.34	53		124	M3	80	M3	64	
M17-XS79-01-091318	0.71	0.79	1.58	1.11	2.22	1.99	21		41.8	M3	46.6	M3	33.1	
M16-SS193-01-091318	0.82	0.63	1.38	0.77	1.68	2.18	14.9		32.5	M3	25	M3	20.6	
M14-SB37-0612-01-091818	1.01	0.79	1.27	0.78	1.25	1.62	55		89	M3	69	M3	70	
M11-SB35-0612-01-092818	0.58	0.32	0.64	0.56	1.10	1.97	21.1		41.5	M3	23.2	M3	13.4	
M11-XS11-01-071118	0.90	0.53	0.99	0.59	1.10	1.87	102		191	M3	112	M3	101	
HS1-SS3-01-062018	1.51	1.65	2.46	1.09	1.63	1.49	17.8		26.5	M3	29	M3	43.8	
M2-SB51-090108-01-091718	0.73	0.84	0.63	1.15	0.87	0.75	1.06		0.8	LT	0.92	M3	0.67	
M19-XSR2-01-093018	0.57	0.58	0.42	1.03	0.75	0.73	1.06		0.77	LT	0.79	M3	0.45	
M19-XSR2-02-093018	0.68	0.76	0.49	1.12	0.73	0.65	1.02		0.66	LT	0.74	M3	0.5	
M22-SS104-01-091718	0.73	0.49	1.12	0.67	1.53	2.27	6.6		15	J+	10.1	M3	7.4	
M7-SB161-1824-01-091618	0.75	0.43	0.88	0.58	1.18	2.04	17.7		36.1	J-	20.9	M3	15.6	
M2-SB55-072090-01-091618	0.73	0.64	0.74	0.87	1.01	1.17	21.4		25	J-	21.7	M3	15.9	
M14-SS37-01-091818	0.91	0.65	1.15	0.72	1.27	1.77	52		92	J-	66	M3	60	
M12-SS33-01-092818	0.55	0.56	0.57	1.02	1.03	1.01	4.7		4.74	J-	4.82	M3	2.66	
M21-XS302-02-060918	0.74	0.77	1.41	1.04	1.90	1.83	16.1		29.4	J	30.6	M3	22.7	
M9-XS19A-01-081718	0.71	0.49	0.67	0.69	0.95	1.38	1.28		1.76		1.21	J	0.86	
M8-SS52-01-091818	1.56	1.24	1.70	0.79	1.09	1.38	7.7		10.6		8.4	J	13.1	
M8-SS120-01-092718	0.37	0.43	0.62	1.19	1.68	1.42	5.7		8.1		9.6	M3	3.51	
M8-XS102-01-050918	0.95	0.90	1.15	0.94	1.20	1.27	3.64		4.64		4.37	M3	4.17	
M7-SS161-01-091618	0.81	0.53	0.91	0.66	1.13	1.71	62		106		70	M3	56.7	
M7-XSR1-01-093018	0.79	0.72	0.93	0.91	1.19	1.30	2.29		2.98		2.72	M3	2.14	
M7-XS181-01-051018	0.59	0.32	0.72	0.55	1.23	2.24	13.3		29.8		16.3	M3	9.6	J
M7-XS181-02-051018	0.68	0.45	0.84	0.66	1.24	1.88	14.8		27.8		18.4	M3	12.5	J
M6-SB285-0612-01-091618	0.82	0.35	0.61	0.42	0.74	1.75	19.1		33.5		14.1	M3	11.6	

Table D1-13. Tabulated Abandoned Uranium Mine Site Sample Results (Continued)

Sample ID	Isotope Ratios						Pb-210 (pCi/g)	Pb-210 Qualifier	Ra-226 (pCi/g)	Ra-226 Qualifier	Th-230 (pCi/g)	Th-230 Qualifier	U-238 (pCi/g)	U-238 Qualifier
	U-238/ Th-230	U-238/ Ra-226	U-238/ Pb-210	Th-230/ Ra-226	Th-230/ Pb-210	Ra-226/ Pb-210								
M6-SB285-1218-01-091618	1.12	0.88	1.21	0.78	1.08	1.38	24.9		34.3		26.9	M3	30.1	
M6-SS285-01-091618	0.80	0.58	0.47	0.72	0.59	0.82	16.1		13.2		9.5	M3	7.6	
M6-XSG13A-01-091618	0.68	0.73	1.22	1.07	1.80	1.68	14.7		24.7		26.5	M3	18	
M6-XS269-01-042618	0.67	0.42	0.74	0.63	1.11	1.75	8.9		15.6		9.9	M3	6.6	
M5-SS149-01-093018	1.01	0.93	1.41	0.91	1.39	1.53	23.6		36		32.9	M3	33.3	
M4-SB81-0612-01-091818	0.72	0.42	0.79	0.58	1.10	1.90	32.2		61.2		35.5	M3	25.4	
M4-XS238-01-051018	0.72	0.28	0.76	0.38	1.06	2.75	5.2		14.3		5.49	M3	3.96	
M38-SS2-01-092718	0.33	0.35	0.53	1.05	1.58	1.50	24.4		36.7		38.6	M3	12.9	
M37-SS44-01-092718	1.23	0.71	2.33	0.58	1.90	3.31	7.2		23.8		13.7	M3	16.8	
M37-XS44-01-081318	1.21	1.15	2.21	0.95	1.82	1.92	24.8		47.5		45.1	M3	54.7	
M36-SS24-01-092718	0.72	0.72	1.07	1.00	1.48	1.47	3.7		5.45		5.47	M3	3.95	
M34-SS97-01-092718	0.78	0.72	1.14	0.93	1.46	1.57	13.2		20.7		19.3	M3	15	
M34-XS110-01-081218	0.90	0.71	1.49	0.79	1.66	2.10	33.9		71.2		56.2	M3	50.6	
M33-SS86-01-091818	0.83	0.69	1.25	0.83	1.51	1.82	51		93		77	M3	64	
M32-SB89-0612-01-092918	1.12	1.64	3.15	1.47	2.83	1.92	52		100		147	M3	164	J
M31-SS37-01-092918	1.41	2.74	2.37	1.95	1.69	0.87	12.7		11		21.4	M3	30.1	
M30-SS180-01-092918	0.66	0.59	1.04	0.89	1.58	1.78	9		16		14.2	M3	9.4	
M30-XS170-01-071618	0.94	0.75	1.30	0.80	1.39	1.73	33.7		58.4		46.7	M3	43.7	
M3-SB51-0612-01-091618	0.79	0.61	1.49	0.77	1.89	2.44	2.73		6.67		5.16	M3	4.07	
M3-SB51-1218-01-091618	0.72	0.45	1.00	0.63	1.38	2.21	3.05		6.75		4.22	M3	3.04	
M3-SS51-01-091618	0.80	0.42	0.86	0.53	1.07	2.04	1.13		2.3		1.21	M3	0.97	
M3-XS34-01-043018	0.88	0.65	1.10	0.73	1.25	1.70	4.6		7.8		5.73	M3	5.06	
M3-XS36-01-043018	0.80	0.49	1.22	0.61	1.52	2.49	6.3		15.7		9.6	M3	7.7	
M29-SS48-01-092518	0.96	0.71	1.69	0.75	1.77	2.37	9.1		21.6		16.1	M3	15.4	
M28-SSG7-01-092618	2.03	2.34	3.65	1.16	1.80	1.56	4		6.23		7.2	M3	14.6	
M27-SB51-0612-01-092618	0.37	0.29	0.51	0.79	1.39	1.76	30.4		53.6		42.2	M3	15.6	
M27-SS51-01-092618	0.20	0.25	0.52	1.25	2.59	2.06	25.1		51.8		65	M3	13	
M27-XS275-01-061918	0.56	0.56	1.13	1.00	2.02	2.02	23		46.4		46.5	M3	26.1	
M27-XS283-01-061818	0.69	0.51	0.97	0.74	1.41	1.91	27.2		52		38.4	M3	26.5	
M26-SB28-0612-01-092618	0.52	0.48	0.94	0.93	1.81	1.95	8		15.6		14.5	M3	7.5	
M26-SS28-01-092618	0.50	0.46	0.78	0.93	1.55	1.67	8.5		14.2		13.2	M3	6.6	
M26-XS25-01-061818	0.79	0.57	1.38	0.73	1.76	2.41	16		38.5		28.1	M3	22.1	
M25-SS50-01-092818	1.00	0.67	1.40	0.67	1.40	2.08	15.2		31.6		21.3	M3	21.3	
M25-XS88-01-071718	0.54	0.46	0.84	0.85	1.57	1.84	6.9		12.7		10.8	M3	5.8	
M24-SB76-0612-01-092518	0.82	0.72	1.53	0.87	1.86	2.14	3.7		7.9		6.9	M3	5.66	
M24-SB76-1218-01-092518	0.79	0.80	1.58	1.01	2.00	1.98	2.04		4.03		4.08	M3	3.23	
M24-SS76-01-092518	1.08	0.72	1.28	0.66	1.18	1.78	4.1		7.3		4.83	M3	5.23	
M23-SB54-1218-01-092718	1.10	0.81	1.35	0.74	1.24	1.67	5.1		8.5		6.3	M3	6.9	

Table D1-13. Tabulated Abandoned Uranium Mine Site Sample Results (Continued)

Sample ID	Isotope Ratios						Pb-210 (pCi/g)	Pb-210 Qualifier	Ra-226 (pCi/g)	Ra-226 Qualifier	Th-230 (pCi/g)	Th-230 Qualifier	U-238 (pCi/g)	U-238 Qualifier
	U-238/ Th-230	U-238/ Ra-226	U-238/ Pb-210	Th-230/ Ra-226	Th-230/ Pb-210	Ra-226/ Pb-210								
M23-SS54-01-092718	0.49	0.48	0.74	0.99	1.51	1.53	19		29		28.6	M3	14	
M22-SB104-0612-01-091718	0.73	0.37	0.87	0.51	1.19	2.33	14.4		33.5		17.2	M3	12.5	
M22-XS87-01-060418	0.63	0.51	0.91	0.80	1.44	1.80	5.4		9.7		7.8	M3	4.9	
M21-SS528-01-091218	1.14	1.61	1.72	1.41	1.51	1.07	22.5		24.1		33.9	M3	38.8	
M21-XS323-01-091218	0.52	0.38	0.87	0.73	1.67	2.27	15.1		34.3		25.2	M3	13.2	
M20-SB59-0612-01-091718	0.79	0.68	1.08	0.86	1.37	1.59	17.5		27.9		24	M3	18.9	
M20-SB59-1218-01-091718	1.10	1.18	1.51	1.07	1.37	1.28	7.9		10.1		10.8	M3	11.9	
M20-XS267-01-091718	0.95	0.93	1.57	0.99	1.66	1.68	44		73.8		73	M3	69	
M19-XSG19-01-091318	0.63	0.81	1.44	1.28	2.27	1.78	14.7		26.1		33.4	M3	21.1	
M16-SB193-0612-01-091318	0.96	0.68	1.31	0.71	1.37	1.94	17.7		34.3		24.2	M3	23.2	
M16-SB193-1218-01-091318	0.76	0.73	1.24	0.95	1.63	1.71	19.4		33.1		31.6	M3	24.1	
M16-XS30-01-052118	0.47	0.34	0.73	0.73	1.55	2.11	13.1		27.7		20.3	M3	9.5	
M16-XS177-01-052618	0.67	0.48	1.20	0.72	1.80	2.51	13.3		33.4		23.9	M3	15.9	
M15-SS14-01-091518	0.68	0.52	1.04	0.77	1.53	1.99	2.51		5		3.83	M3	2.61	
M15-SB84-0612-01-091418	0.69	0.50	0.96	0.73	1.39	1.90	7.1		13.5		9.9	M3	6.8	
M15-SS84-01-091418	0.81	0.64	1.09	0.78	1.34	1.71	10.1		17.3		13.5	M3	11	
M15-XS3-01-052118	0.75	0.60	1.24	0.80	1.67	2.07	9.9		20.5		16.5	M3	12.3	
M14-SB37-1218-01-091818	1.04	0.77	1.31	0.73	1.25	1.71	55		94		69	M3	72	
M13-SB114-1230-01-091518	0.54	0.66	0.90	1.22	1.67	1.37	2.51		3.43		4.19	M3	2.25	
M13-SS114-01-091518	0.86	0.61	1.06	0.71	1.24	1.75	17		29.8		21.1	M3	18.1	
M11-SS35-01-092818	0.36	0.33	0.43	0.92	1.20	1.31	30.5		40		36.7	M3	13.2	
M1-SB36-0612-01-091618	0.72	0.64	0.82	0.88	1.14	1.29	3.21		4.14		3.66	M3	2.64	
M1-SB36-1218-01-091618	0.77	0.55	1.10	0.71	1.42	2.00	1.94		3.88		2.75	M3	2.13	
M1-SB36-1824-01-091618	0.75	0.63	1.10	0.84	1.46	1.75	2.28		3.99		3.34	M3	2.51	
M1-SB36-2436-01-091618	0.77	0.58	0.95	0.75	1.22	1.63	2		3.26		2.44	M3	1.89	
M1-SS36-01-091618	0.55	0.73	0.80	1.32	1.45	1.10	3.46		3.8		5.03	M3	2.76	
HS1-SB8-1215-01-062018	1.15	0.90	1.61	0.78	1.40	1.79	8		14.3		11.2	M3	12.9	

Notes:

J	Estimated value
J-	Estimated value, may be biased low.
J+	Estimated value, may be biased high.
LT	Result less than requested minimum detectable concentration, but greater than sample-specific detectable concentration.
M3	The requested minimum detected concentration was not met, but the reported activity is greater than the reported minimum detected concentration.
Pb-210	Lead 210
pCi/g	Picocuries per gram
Ra-226	Radium 226
Th-230	Thorium 230
U	Not detected. The associated value is the reporting limit.
U-238	Uranium 238
Y1	Chemical yield is in control at 100% - 110%. Quantitative yield is assumed.

Table D1-14. Tabulated Target Site Sample Results

Sample ID	Isotope Ratios						Pb-210 (pCi/g)	Pb-210 Qualifier	Ra-226 (pCi/g)	Ra-226 Qualifier	Th-230 (pCi/g)	Th-230 Qualifier	U-238 (pCi/g)	U-238 Qualifier
	U-238/ Th-230	U-238/ Ra-226	U-238/ Pb-210	Th-230/ Ra-226	Th-230/ Pb-210	Ra-226/ Pb-210								
T9-SS67-01-091118	1.02	1.01	2.29	0.99	2.25	2.27	0.51	U	1.16		1.15	M3	1.17	
T10-XS20-01-042518	0.62	0.71	0.60	1.15	0.97	0.84	0.89	LT	0.75	LT	0.86	M3	0.53	
T14-XS27-01-050818	0.75	0.86	0.79	1.15	1.05	0.91	0.81	LT	0.74	LT	0.85	M3	0.64	
T37-SS94-01-091318	1.10	0.87	1.26	0.79	1.14	1.44	0.7	LT	1.01	J-	0.8	M3	0.88	
T9-XS217-01-042518	0.58	0.73	1.09	1.25	1.87	1.49	0.67	LT	1		1.25	M3	0.73	
T1-SS14-01-091618	0.68	0.43	0.82	0.63	1.20	1.90	3.6		6.85		4.32	M3	2.94	
T1-XSG5A-01-081918	0.41	0.25	0.50	0.61	1.22	1.99	1.42		2.83		1.73	J	0.71	
T1-XSG49A-01-081918	0.64	0.60	0.81	0.93	1.26	1.36	3.43		4.67		4.33	M3	2.78	M3
T17-SB258-018090-01-092518	0.58	0.45	0.66	0.78	1.14	1.47	1.74		2.56		1.99	M3	1.15	
T17-XS143-01-042618	0.93	0.59	1.34	0.63	1.44	2.29	11.8		27		17	M3	15.8	
T17-XS377-01-042818	0.74	0.69	1.22	0.94	1.66	1.77	8.7		15.4		14.4	M3	10.6	M3
T23-SS32-01-091418	0.72	0.59	0.75	0.81	1.04	1.28	2.54		3.24		2.63	M3	1.9	
T4-XS15A-01-081918	0.27	0.13	0.35	0.50	1.30	2.59	86		223	M3	112	M3	29.9	
T4-XSG50A-01-081918	0.53	0.25	0.62	0.48	1.18	2.46	11.9		29.3		14	M3	7.4	

Notes:

J- Estimated value, may be biased low.
LT Result less than requested minimum detectable concentration, but greater than sample-specific detectable concentration.
M3 The requested minimum detected concentration was not met, but the reported activity is greater than the reported minimum detected concentration.
Pb-210 Lead 210
pCi/g Picocuries per gram
Ra-226 Radium 226
Th-230 Thorium 230
U Not detected. The associated value is the reporting limit.
U-238 Uranium 238

Table D1-15. Tabulated Sediment Sample Results

Sample ID	Isotope Ratios						Pb-210 (pCi/g)	Pb-210 Qualifier	Ra-226 (pCi/g)	Ra-226 Qualifier	Th-230 (pCi/g)	Th-230 Qualifier	U-238 (pCi/g)	U-238 Qualifier
	U-238/ Th-230	U-238/ Ra-226	U-238/ Pb-210	Th-230/ Ra-226	Th-230/ Pb-210	Ra-226 /Pb-210								
DB34-SD5-01-062118	0.92	0.76	0.63	0.83	0.68	0.82	0.72	LT	0.59	UJ	0.49	M3	0.45	
DCWN-SD28A-01-062418	0.74	1.03	0.68	1.39	0.93	0.67	0.57	LT	0.38	UJ	0.53	M3	0.39	
M7-SD2-01-081418	1.52	0.97	1.14	0.64	0.75	1.18	0.28	U	0.33	U	0.21	M3	0.32	
DC1A-SD7A-0612-01-062018	1.00	0.83	1.29	0.83	1.28	1.55	30.8		47.6	M3	39.5	M3	39.6	
DM33-SD14-01-081818	0.96	0.98	1.45	1.03	1.52	1.48	0.44	U	0.65	LT	0.67	M3	0.64	
DM39-SD12-01-081618	0.48	0.69	1.00	1.43	2.09	1.46	0.46	U	0.67	LT	0.96	M3	0.46	
DB34-SB14-01-062218	0.71	0.58	0.50	0.81	0.70	0.86	0.74	LT	0.64	LT	0.52	M3	0.37	
DB35-SD21-01-062318	0.58	0.78	0.75	1.33	1.29	0.97	0.69	LT	0.67	LT	0.89	M3	0.52	
DB35-SD27-01-062318	0.79	0.95	0.82	1.21	1.04	0.87	0.67	LT	0.58	LT	0.7	M3	0.55	
DC2A-SD22-01-062118	0.73	0.89	0.69	1.21	0.94	0.78	0.9	LT	0.7	LT	0.85	M3	0.62	
DC3-SD16-01-062318	1.06	0.40	0.54	0.38	0.51	1.33	0.69	LT	0.92	LT	0.35	M3	0.37	
DC3E-SD9-01-081718	0.93	1.05	0.71	1.13	0.77	0.68	0.94	LT	0.64	LT	0.72	M3	0.67	
DM1-SD6-01-081918	1.02	1.10	1.31	1.07	1.29	1.20	0.35	U	0.42	J-	0.45	M3	0.46	
DB34-SD14-01-062218	0.55	0.47	0.60	0.85	1.08	1.27	0.52	LT	0.66	J-	0.56	M3	0.31	
DB35-SB1-01-062318	1.06	0.69	0.68	0.65	0.64	0.97	0.77	LT	0.75	J-	0.49	M3	0.52	
DB35-SD1-01-062318	0.51	0.64	0.67	1.27	1.33	1.04	0.67	LT	0.7	J-	0.89	M3	0.45	
DC1G-SD3-01-062118	0.66	0.64	0.47	0.97	0.71	0.73	0.92	LT	0.67	J-	0.65	M3	0.43	
DM1-SD17-01-081918	0.53	1.00	0.72	1.90	1.37	0.72	0.54	LT	0.39	J-	0.74	M3	0.39	
DM39-SD15-01-081618	0.47	0.56	0.76	1.19	1.63	1.37	0.59	LT	0.81	J-	0.96	M3	0.45	
DM39-SD17-01-081618	0.65	0.58	0.61	0.89	0.94	1.06	0.72	LT	0.76	J-	0.68	M3	0.44	
DC1-SD8A-01-062118	0.40	0.51	0.58	1.29	1.45	1.12	7.3		8.2	J-	10.6	M3	4.21	
DC1A-SD3-01-062018	0.75	0.51	1.22	0.68	1.64	2.42	7.2		17.4	J-	11.8	M3	8.8	
DC1A-SD7A-01-062018	0.87	0.77	1.15	0.88	1.33	1.50	48		72	J-	63.7	M3	55.2	
DC3G-SD2-01-062318	1.00	0.43	0.60	0.43	0.60	1.41	1.15		1.62	J-	0.69	M3	0.69	
DM35-SD17-01-082018	0.84	0.39	0.87	0.47	1.04	2.22	1.02		2.26	J-	1.06	M3	0.89	
DT9-SD3-01-062418	0.62	0.48	0.63	0.76	1.02	1.33	2.27		3.03	J-	2.31	M3	1.44	
DC2-SD8-01-062118	0.38	0.28	0.47	0.73	1.24	1.70	2.79		4.73	J	3.46	M3	1.31	
DC3B-SD5-01-061918	0.88	0.75	0.91	0.85	1.03	1.22	3.9		4.74	J	4.03	M3	3.56	
DC1-SD24-01-062318	0.74	0.57	1.00	0.78	1.35	1.73	2.29		3.97		3.1	M3	2.28	
DC1B-SD3-01-062118	0.67	0.59	1.08	0.88	1.62	1.83	3.34		6.12		5.41	M3	3.6	
DC2-SD13-01-062118	1.21	0.85	0.81	0.71	0.67	0.95	3		2.85		2.01	M3	2.43	
DC2B-SD8-01-062218	0.97	2.42	3.28	2.51	3.39	1.35	13.3		18		45.1	M3	43.6	
DC3E-SD4-01-062318	0.82	0.99	1.08	1.20	1.32	1.09	6		6.56		7.9	M3	6.5	
DC3F-SD2-01-062318	0.71	0.38	0.80	0.53	1.13	2.12	2.74		5.81		3.1	M3	2.19	
DCWN-SD28-01-062418	0.67	0.48	0.52	0.71	0.77	1.09	1.37		1.49		1.06	M3	0.71	
M5-SD1-01-062318	0.79	0.58	1.11	0.73	1.42	1.93	33.3		64.4		47.2	M3	37.1	
M10-SD1-01-081718	0.89	0.38	1.09	0.43	1.23	2.87	19.3		55.4		23.8	M3	21.1	

Table D1-15. Tabulated Sediment Sample Results (Continued)

Sample ID	Isotope Ratios						Pb-210 (pCi/g)	Pb-210 Qualifier	Ra-226 (pCi/g)	Ra-226 Qualifier	Th-230 (pCi/g)	Th-230 Qualifier	U-238 (pCi/g)	U-238 Qualifier
	U-238/ Th-230	U-238/ Ra-226	U-238/ Pb-210	Th-230/ Ra-226	Th-230/ Pb-210	Ra-226 /Pb-210								
M21-SD2-01-091218	0.75	0.31	0.77	0.41	1.02	2.49	17.1		42.5		17.4	M3	13.1	
M28-SD1-01-092618	1.03	0.43	1.57	0.42	1.53	3.66	3.36		12.3		5.13	M3	5.27	

Notes:

J	Estimated value
J-	Estimated value, may be biased low.
LT	Result less than requested minimum detectable concentration, but greater than sample-specific detectable concentration.
M3	The requested minimum detected concentration was not met, but the reported activity is greater than the reported minimum detected concentration.
Pb-210	Lead 210
pCi/g	Picocuries per gram
Ra-226	Radium 226
Th-230	Thorium 230
U	Not detected. The associated value is the reporting limit.
U-238	Uranium 238
UJ	Not considered detected. The associated value is the reported concentration, which is estimated.

Table D1-16. Tabulated All Sample Type Results (Including Sediments)

Sample ID	Isotope Ratios						Pb-210 (pCi/g)	Pb-210 Qualifier	Ra-226 (pCi/g)	Ra-226 Qualifier	Th-230 (pCi/g)	Th-230 Qualifier	U-238 (pCi/g)	U-238 Qualifier
	U-238/ Th-230	U-238/ Ra-226	U-238/ Pb-210	Th-230/ Ra-226	Th-230/ Pb-210	Ra-226/ Pb-210								
B10-SB21-01-050818	0.65	0.61	0.60	0.93	0.91	0.98	2.45		2.4		2.24	M3	1.46	
B10-SS04-01-050818	0.75	0.67	1.25	0.89	1.68	1.87	0.71	LT	1.33		1.19	M3	0.89	
B10-SS21-01-050818	0.74	0.62	0.60	0.84	0.82	0.98	2.48		2.43	J	2.03	M3	1.5	
B11-SB15-01-051118	0.84	0.94	0.78	1.12	0.92	0.83	0.63	LT	0.52	LT	0.58	M3	0.49	
B11-SS15-01-051118	0.70	0.61	0.44	0.88	0.63	0.72	1.11		0.8	LT	0.7	M3	0.49	
B11-SS24-01-051118	1.05	0.84	0.43	0.80	0.41	0.51	1.36		0.7	UJ	0.56	M3	0.59	
B12-SB11-01-050818	0.72	0.56	0.56	0.78	0.78	1.00	1.4		1.4		1.09	M3	0.78	
B12-SS01-01-050818	0.73	0.51	0.47	0.69	0.64	0.93	1.87		1.73	J+	1.2	M3	0.88	
B12-SS11-01-050818	0.67	0.47	0.45	0.70	0.66	0.95	1.73		1.64		1.15	M3	0.77	
B13-SB16-01-071518	0.76	0.71	1.31	0.94	1.73	1.85	0.52	U	0.96	LT	0.9	M3	0.68	
B13-SS08-01-071518	0.73	0.48	0.11	0.66	0.14	0.22	5.2		1.14	UJ	0.75	M3	0.55	
B13-SS16-01-071518	0.99	0.96	0.43	0.97	0.44	0.45	1.68		0.76	J+	0.74	M3	0.73	
B13-SS23-01-071518	0.84	0.65	0.14	0.77	0.16	0.21	4.5		0.96	LT	0.74	M3	0.62	
B14-SB27-01-071518	1.03		0.64		0.62	0.00	0.47	U	0	U	0.29	M3	0.3	
B14-SS13-01-071518	0.58	0.69	0.26	1.19	0.46	0.39	1.4		0.54	J+	0.64	M3	0.37	
B14-SS27-01-071518	0.62	0.67	0.32	1.07	0.52	0.48	0.56	LT	0.27	U	0.29	M3	0.181	
B15-SB16-01-071118	0.61	0.60	0.86	0.99	1.40	1.42	0.57	U	0.81	LT	0.8	J	0.49	
B15-SB16-02-071118	1.02	0.71	0.55	0.70	0.54	0.78	0.94	LT	0.73	LT	0.51	J	0.52	
B15-SS05-01-071118	0.74	0.64	0.50	0.87	0.68	0.79	1.35		1.06		0.92	M3	0.68	
B15-SS09-01-071118	0.76	0.63	0.21	0.82	0.28	0.33	3.2		1.07	J+	0.88	M3	0.67	
B15-SS16-01-071118	0.85	0.97	0.38	1.14	0.45	0.39	1.68		0.66	UJ	0.75	M3	0.64	
B15-SS19-01-071118	0.76	0.66	0.74	0.87	0.97	1.12	0.77	LT	0.86	LT	0.75	M3	0.57	
B16-SB01-01-060918	0.88	0.94	0.88	1.06	1.00	0.94	0.33	U	0.31	U	0.33	M3	0.29	
B16-SS01-01-060918	0.61	0.85	0.94	1.38	1.54	1.11	0.35	U	0.39	U	0.54	M3	0.33	
B16-SS07-01-060918	0.77	0.80	0.61	1.05	0.79	0.76	0.87	LT	0.66	LT	0.69	M3	0.53	
B17-SB21-01-052418	1.52	1.18	0.68	0.78	0.45	0.57	1.55		0.89	LT	0.69	M3	1.05	
B17-SS06-01-052418	0.73	0.77	0.15	1.05	0.21	0.20	3.24		0.64	J+	0.67	M3	0.49	
B17-SS21-01-052418	0.60	0.87	0.12	1.46	0.20	0.14	5.1	J	0.7	UJ	1.02	J	0.61	
B17-SS21-02-052418	0.69	0.73	0.35	1.06	0.50	0.47	1.39	J	0.66	LT	0.7	J	0.48	
B18-SB11-01-052518	0.81	0.70	0.34	0.86	0.42	0.49	1.79		0.87	LT	0.75	M3	0.61	
B18-SS11-01-052518	0.69	0.59	0.27	0.86	0.38	0.45	2.47		1.11		0.95	M3	0.66	
B18-SS23-01-052518	0.84	0.65	0.87	0.77	1.03	1.33	1.05		1.4		1.08	M3	0.91	
B19-SB11-01-052618	0.64	0.68	0.80	1.07	1.25	1.18	0.51	LT	0.6	UJ	0.64	M3	0.41	
B19-SS02-01-052618	0.84	0.76	0.41	0.90	0.48	0.53	1.18		0.63	LT	0.57	M3	0.48	
B19-SS11-01-052618	0.81	1.02	0.62	1.26	0.77	0.61	0.69	LT	0.42	UJ	0.53	M3	0.43	
B1-SB24-01-051218	0.90	0.62	0.75	0.69	0.84	1.21	1.16		1.4		0.97	M3	0.87	
B1-SS04-01-051218	0.96	0.87	0.55	0.91	0.58	0.64	1.84		1.17		1.06	M3	1.02	

Table D1-16. Tabulated All Sample Type Results (Including Sediments) (Continued)

Sample ID	Isotope Ratios						Pb-210 (pCi/g)	Pb-210 Qualifier	Ra-226 (pCi/g)	Ra-226 Qualifier	Th-230 (pCi/g)	Th-230 Qualifier	U-238 (pCi/g)	U-238 Qualifier
	U-238/ Th-230	U-238/ Ra-226	U-238/ Pb-210	Th-230/ Ra-226	Th-230/ Pb-210	Ra-226/ Pb-210								
B1-SS24-01-051218	2.88	1.74	2.17	0.61	0.75	1.25	1.06		1.32		0.8	M3	2.3	
B20-SB01-01-052318	0.79	0.66	0.43	0.84	0.55	0.65	0.77	LT	0.5	LT	0.42	M3	0.33	
B20-SS01-01-052318	0.58	0.49	0.28	0.85	0.48	0.57	1.14		0.65	LT	0.55	M3	0.32	
B20-SS12-01-052318	0.68	0.65	0.41	0.96	0.60	0.63	1.15		0.72	LT	0.69	M3	0.47	
B21-SB04-01-062118	0.94	0.85	1.24	0.91	1.32	1.45	3.46		5.02		4.57	M3	4.29	
B21-SB14-01-062118	0.72	0.65	1.09	0.90	1.50	1.67	2.16		3.61		3.25	M3	2.35	
B21-SB26-01-062118	0.72	0.77	1.19	1.07	1.65	1.55	2.42		3.75		4	M3	2.89	
B21-SS04-02-062118	1.18	1.06	1.76	0.90	1.49	1.66	2.84		4.72		4.23	M3	5	
B21-SS13-01-062118	0.99	0.91	1.52	0.92	1.53	1.67	2.79		4.65		4.27	M3	4.23	
B21-SS14-02-062118	0.81	1.16	1.44	1.44	1.78	1.24	2.95		3.65		5.26	M3	4.25	
B22-SS04-01-052418	0.67	0.51	0.26	0.76	0.39	0.51	2.82		1.44		1.09	M3	0.73	
B22-SS16-01-052418	1.00	0.79	0.86	0.79	0.86	1.10	0.81	LT	0.89	LT	0.7	J	0.7	
B22-SS16-02-052418	0.44	0.59	0.53	1.37	1.23	0.90	0.88	LT	0.79	LT	1.08	J	0.47	
B23-SB18-01-060618	0.90	0.74	1.19	0.82	1.33	1.62	2.01		3.25		2.67	M3	2.39	
B23-SS08-01-060618	0.82	0.69	0.72	0.84	0.87	1.04	0.85	LT	0.88	LT	0.74	M3	0.61	
B23-SS18-01-060618	0.78	0.76	0.93	0.97	1.19	1.22	2.51		3.07		2.99	M3	2.34	
B24-SB05-01-071618	1.06	0.61	0.47	0.57	0.44	0.78	0.72	LT	0.56	UJ	0.32	M3	0.34	
B24-SS05-01-071618	0.76	0.69	0.32	0.91	0.42	0.46	0.98	LT	0.45	LT	0.41	M3	0.31	
B24-SS23-01-071618	0.69	0.30	0.31	0.44	0.45	1.02	1.37		1.4		0.61	M3	0.42	
B25-SB12-01-060418	0.74	0.57	0.69	0.77	0.93	1.20	0.96	LT	1.15	J+	0.89	M3	0.66	
B25-SS04-01-060418	0.75	0.64	0.62	0.86	0.83	0.97	2.29		2.22		1.9	M3	1.43	
B25-SS12-01-060418	0.80	0.65	0.66	0.81	0.83	1.03	1.16		1.19	J+	0.96	M3	0.77	
B26-SB29-01-060518	0.63	0.57	1.21	0.91	1.93	2.13	0.71	LT	1.51	J+	1.37	M3	0.86	
B26-SS07-01-091418	0.61	0.49	0.26	0.81	0.42	0.52	3.43		1.79	J+	1.45	M3	0.88	
B26-SS09-01-060518	0.67	0.45	0.54	0.68	0.81	1.19	2.13		2.54		1.72	M3	1.15	
B26-SS29-01-060518	0.74	0.57	0.50	0.77	0.67	0.87	1.97		1.72		1.32	M3	0.98	
B27-SB07-01-061018	0.77	0.50	0.37	0.65	0.48	0.74	1.32		0.98	LT	0.64	M3	0.49	
B27-SS07-01-061018	0.78	0.58	0.37	0.75	0.48	0.64	1.42		0.91	J+	0.68	M3	0.53	
B27-SS16-01-061018	0.86	0.60	0.51	0.70	0.59	0.84	1.08		0.91	LT	0.64	M3	0.55	
B29-SS01-01-071018	0.64	1.00	0.41	1.58	0.65	0.41	0.63	LT	0.26	U	0.41	M3	0.261	
B29-SS06-01-071018	0.86	1.02	0.94	1.19	1.09	0.91	0.47	U	0.43	UJ	0.51	M3	0.44	
B29-SS11-01-071318	0.44	0.65	2.00	1.48	4.53	3.07	0.15	U	0.46	UJ	0.68	M3	0.3	
B29-SS20-01-071118	1.05	1.14	0.78	1.09	0.75	0.69	0.51	U	0.35	LT	0.38	M3	0.4	
B29-SS23-01-071318	1.23	1.23	1.28	1.00	1.03	1.03	0.29	U	0.3	U	0.3	M3	0.37	
B29-SS26-01-071118	0.77	0.66	0.73	0.85	0.95	1.11	0.56	U	0.62	LT	0.53	M3	0.41	
B2-SB29-01-051218	0.75	0.58	0.47	0.77	0.63	0.82	0.76	LT	0.62	LT	0.48	M3	0.36	

Table D1-16. Tabulated All Sample Type Results (Including Sediments) (Continued)

Sample ID	Isotope Ratios						Pb-210 (pCi/g)	Pb-210 Qualifier	Ra-226 (pCi/g)	Ra-226 Qualifier	Th-230 (pCi/g)	Th-230 Qualifier	U-238 (pCi/g)	U-238 Qualifier
	U-238/ Th-230	U-238/ Ra-226	U-238/ Pb-210	Th-230/ Ra-226	Th-230/ Pb-210	Ra-226/ Pb-210								
B2-SS01-01-051218	0.73	0.54	0.52	0.75	0.72	0.96	0.82	LT	0.79	UJ	0.59	M3	0.43	
B2-SS29-01-051218	0.75	0.67	0.76	0.90	1.02	1.14	0.51	LT	0.58	LT	0.52	M3	0.39	
B30-SB21-01-071018	0.59	0.55	0.42	0.93	0.72	0.77	0.53	U	0.41	LT	0.38	M3	0.224	
B30-SS11-01-071018	1.18	1.07	1.82	0.90	1.54	1.71	0.17	U	0.29	U	0.262	M3	0.31	
B30-SS21-01-071018	0.83	0.79	0.40	0.95	0.48	0.51	0.75	LT	0.38	LT	0.36	M3	0.3	
B30-SS21-02-071018	1.00	0.81	0.46	0.81	0.46	0.57	0.74	LT	0.42	LT	0.34	M3	0.34	
B31-SB30-01-071318	0.79	1.00	0.25	1.27	0.31	0.25	1.81		0.45	UJ	0.57	M3	0.45	
B31-SS06-01-071318	0.51	0.60	0.17	1.17	0.33	0.28	1.86		0.52	U	0.61	M3	0.31	
B31-SS18-01-071318	0.49	0.38	0.19	0.78	0.39	0.49	1.97		0.97	J+	0.76	M3	0.37	
B31-SS30-01-071318	0.95	1.13	0.27	1.19	0.28	0.24	2.2		0.52	J+	0.62	M3	0.59	
B32-SB30-01-071218	0.54	0.95	1.38	1.74	2.54	1.46	5		7.29		12.7	M3	6.9	
B32-SS06-01-071218	0.64	0.52	0.45	0.81	0.70	0.86	2		1.72	J+	1.4	M3	0.89	
B32-SS08-01-071218	0.45	0.30	0.49	0.67	1.08	1.61	2.85		4.59		3.08	M3	1.39	
B32-SS16-01-071218	0.82	0.74	1.14	0.90	1.39	1.54	1.13		1.74		1.57	M3	1.29	
B32-SS30-01-071218	0.57	0.48	0.99	0.85	1.73	2.03	2.01		4.09		3.48	M3	1.98	
B33-SB12-01-071618	0.86	1.25	0.60	1.45	0.69	0.48	1.36		0.65	LT	0.94	M3	0.81	
B33-SS12-01-071618	0.89	0.54	0.59	0.60	0.66	1.10	1.28		1.41		0.85	M3	0.76	
B33-SS18-01-071618	0.68	0.72	0.80	1.06	1.19	1.12	1.32		1.48		1.57	M3	1.06	
B3-SB17-01-051218	1.01	0.84	1.16	0.83	1.14	1.38	1.22		1.68		1.39	M3	1.41	J
B3-SS03-01-091618	0.99	1.12	0.98	1.13	0.99	0.88	1.82		1.6		1.8	M3	1.79	
B3-SS10-01-051218	0.98	0.90	1.29	0.92	1.31	1.42	2.8		3.98	J-	3.67	M3	3.6	
B3-SS17-01-051218	0.76	0.62	0.57	0.82	0.76	0.92	1.96		1.8		1.48	M3	1.12	
B3-SS17-01-091618	0.84	1.16	0.70	1.39	0.84	0.60	1.82		1.1		1.53	M3	1.28	
B4-SB06-01-051318	0.80	0.83	0.83	1.04	1.04	1.00	0.52	LT	0.52	LT	0.54	M3	0.43	
B4-SS06-01-051318	1.06	0.88	0.36	0.83	0.34	0.41	1.43		0.58	LT	0.48	M3	0.51	
B4-SS25-01-051318	0.82	0.62	0.51	0.76	0.63	0.82	1.04		0.85	LT	0.65	M3	0.53	
B5-SB01-01-042418	0.51	0.46	0.89	0.90	1.75	1.94	1.11		2.15		1.94	M3	0.99	
B5-SS01-01-042418	0.62	0.50	0.82	0.80	1.31	1.64	1.2		1.97		1.57	M3	0.98	
B5-SS23-01-042418	0.89	0.77	1.11	0.87	1.24	1.43	0.99	LT	1.42		1.23	M3	1.1	
B6-SB11-01-052218	0.64	0.56	0.60	0.88	0.94	1.07	1.05		1.12		0.99	M3	0.63	
B6-SS11-01-052218	0.61	0.38	0.38	0.63	0.62	0.99	1.29		1.28		0.8	M3	0.49	
B6-SS27-01-071418	0.94	0.85	0.51	0.90	0.54	0.60	1.88		1.13		1.02	M3	0.96	
B7-SB21-01-052218	0.61	0.57	0.48	0.92	0.78	0.85	1.56		1.32		1.22	M3	0.75	
B7-SS03-01-052218	0.69	0.54	0.51	0.78	0.73	0.93	2.43		2.27		1.77	M3	1.23	
B7-SS21-01-052218	0.67	0.57	0.59	0.85	0.88	1.03	1.99		2.05		1.75	M3	1.17	
B8-SB21-01-052218	0.84	0.50	0.57	0.59	0.67	1.13	1.22		1.38		0.82	M3	0.69	

Table D1-16. Tabulated All Sample Type Results (Including Sediments) (Continued)

Sample ID	Isotope Ratios						Pb-210 (pCi/g)	Pb-210 Qualifier	Ra-226 (pCi/g)	Ra-226 Qualifier	Th-230 (pCi/g)	Th-230 Qualifier	U-238 (pCi/g)	U-238 Qualifier
	U-238/ Th-230	U-238/ Ra-226	U-238/ Pb-210	Th-230/ Ra-226	Th-230/ Pb-210	Ra-226/ Pb-210								
B8-SS14-01-052218	0.70	0.52	0.15	0.75	0.22	0.30	2.97		0.88	LT	0.66	M3	0.46	
B8-SS21-01-052218	0.89	0.69	0.39	0.78	0.44	0.56	1.99		1.11		0.87	M3	0.77	
B9-SB21-01-050718	0.79	0.75	1.37	0.95	1.73	1.82	0.62	Y1,LT	1.13		1.07	M3	0.85	
B9-SS03-01-050718	0.68	0.58	0.49	0.85	0.72	0.84	1.28		1.08		0.92	M3	0.63	
B9-SS21-01-050718	0.87	0.88	1.78	1.01	2.05	2.02	0.41	U	0.83	LT	0.84	M3	0.73	
DB34-SB14-01-062218	0.71	0.58	0.50	0.81	0.70	0.86	0.74	LT	0.64	LT	0.52	M3	0.37	
DB34-SD14-01-062218	0.55	0.47	0.60	0.85	1.08	1.27	0.52	LT	0.66	J-	0.56	M3	0.31	
DB34-SD5-01-062118	0.92	0.76	0.63	0.83	0.68	0.82	0.72	LT	0.59	UJ	0.49	M3	0.45	
DB35-SB1-01-062318	1.06	0.69	0.68	0.65	0.64	0.97	0.77	LT	0.75	J-	0.49	M3	0.52	
DB35-SD1-01-062318	0.51	0.64	0.67	1.27	1.33	1.04	0.67	LT	0.7	J-	0.89	M3	0.45	
DB35-SD21-01-062318	0.58	0.78	0.75	1.33	1.29	0.97	0.69	LT	0.67	LT	0.89	M3	0.52	
DB35-SD27-01-062318	0.79	0.95	0.82	1.21	1.04	0.87	0.67	LT	0.58	LT	0.7	M3	0.55	
DC1A-SD3-01-062018	0.75	0.51	1.22	0.68	1.64	2.42	7.2		17.4	J-	11.8	M3	8.8	
DC1A-SD7A-01-062018	0.87	0.77	1.15	0.88	1.33	1.50	48		72	J-	63.7	M3	55.2	
DC1A-SD7A-0612-01-062018	1.00	0.83	1.29	0.83	1.28	1.55	30.8		47.6	M3	39.5	M3	39.6	
DC1B-SD3-01-062118	0.67	0.59	1.08	0.88	1.62	1.83	3.34		6.12		5.41	M3	3.6	
DC1G-SD3-01-062118	0.66	0.64	0.47	0.97	0.71	0.73	0.92	LT	0.67	J-	0.65	M3	0.43	
DC1-SD24-01-062318	0.74	0.57	1.00	0.78	1.35	1.73	2.29		3.97		3.1	M3	2.28	
DC1-SD8A-01-062118	0.40	0.51	0.58	1.29	1.45	1.12	7.3		8.2	J-	10.6	M3	4.21	
DC2A-SD22-01-062118	0.73	0.89	0.69	1.21	0.94	0.78	0.9	LT	0.7	LT	0.85	M3	0.62	
DC2B-SD8-01-062218	0.97	2.42	3.28	2.51	3.39	1.35	13.3		18		45.1	M3	43.6	
DC2-SD13-01-062118	1.21	0.85	0.81	0.71	0.67	0.95	3		2.85		2.01	M3	2.43	
DC2-SD8-01-062118	0.38	0.28	0.47	0.73	1.24	1.70	2.79		4.73	J	3.46	M3	1.31	
DC3B-SD5-01-061918	0.88	0.75	0.91	0.85	1.03	1.22	3.9		4.74	J	4.03	M3	3.56	
DC3E-SD4-01-062318	0.82	0.99	1.08	1.20	1.32	1.09	6		6.56		7.9	M3	6.5	
DC3E-SD9-01-081718	0.93	1.05	0.71	1.13	0.77	0.68	0.94	LT	0.64	LT	0.72	M3	0.67	
DC3F-SD2-01-062318	0.71	0.38	0.80	0.53	1.13	2.12	2.74		5.81		3.1	M3	2.19	
DC3G-SD2-01-062318	1.00	0.43	0.60	0.43	0.60	1.41	1.15		1.62	J-	0.69	M3	0.69	
DC3-SD16-01-062318	1.06	0.40	0.54	0.38	0.51	1.33	0.69	LT	0.92	LT	0.35	M3	0.37	
DCWN-SD28-01-062418	0.67	0.48	0.52	0.71	0.77	1.09	1.37		1.49		1.06	M3	0.71	
DCWN-SD28A-01-062418	0.74	1.03	0.68	1.39	0.93	0.67	0.57	LT	0.38	UJ	0.53	M3	0.39	
DM1-SD17-01-081918	0.53	1.00	0.72	1.90	1.37	0.72	0.54	LT	0.39	J-	0.74	M3	0.39	
DM1-SD6-01-081918	1.02	1.10	1.31	1.07	1.29	1.20	0.35	U	0.42	J-	0.45	M3	0.46	
DM33-SD14-01-081818	0.96	0.98	1.45	1.03	1.52	1.48	0.44	U	0.65	LT	0.67	M3	0.64	
DM35-SD17-01-082018	0.84	0.39	0.87	0.47	1.04	2.22	1.02		2.26	J-	1.06	M3	0.89	
DM39-SD12-01-081618	0.48	0.69	1.00	1.43	2.09	1.46	0.46	U	0.67	LT	0.96	M3	0.46	

Table D1-16. Tabulated All Sample Type Results (Including Sediments) (Continued)

Sample ID	Isotope Ratios						Pb-210 (pCi/g)	Pb-210 Qualifier	Ra-226 (pCi/g)	Ra-226 Qualifier	Th-230 (pCi/g)	Th-230 Qualifier	U-238 (pCi/g)	U-238 Qualifier
	U-238/ Th-230	U-238/ Ra-226	U-238/ Pb-210	Th-230/ Ra-226	Th-230/ Pb-210	Ra-226/ Pb-210								
DM39-SD15-01-081618	0.47	0.56	0.76	1.19	1.63	1.37	0.59	LT	0.81	J-	0.96	M3	0.45	
DM39-SD17-01-081618	0.65	0.58	0.61	0.89	0.94	1.06	0.72	LT	0.76	J-	0.68	M3	0.44	
DT9-SD3-01-062418	0.62	0.48	0.63	0.76	1.02	1.33	2.27		3.03	J-	2.31	M3	1.44	
HS1-SB8-1215-01-062018	1.15	0.90	1.61	0.78	1.40	1.79	8		14.3		11.2	M3	12.9	
HS1-SS3-01-062018	1.51	1.65	2.46	1.09	1.63	1.49	17.8		26.5	M3	29	M3	43.8	
M10-SB10-0612-01-092818	1.06	0.89	1.33	0.85	1.26	1.49	26.5	J	39.4		33.3	M3	35.2	
M10-SD1-01-081718	0.89	0.38	1.09	0.43	1.23	2.87	19.3		55.4		23.8	M3	21.1	
M10-SS10-01-092818	0.86	0.85	1.66	0.99	1.93	1.96	17.8	J	34.8		34.3	M3	29.5	
M11-SB35-0612-01-092818	0.58	0.32	0.64	0.56	1.10	1.97	21.1		41.5	M3	23.2	M3	13.4	
M11-SS35-01-092818	0.36	0.33	0.43	0.92	1.20	1.31	30.5		40		36.7	M3	13.2	
M11-XS11-01-071118	0.90	0.53	0.99	0.59	1.10	1.87	102		191	M3	112	M3	101	
M11-XSG25-01-092818	0.73	0.97	1.23	1.33	1.69	1.28	5.2	J+	6.63		8.8	M3	6.4	
M12-SS33-01-092818	0.55	0.56	0.57	1.02	1.03	1.01	4.7		4.74	J-	4.82	M3	2.66	
M13-SB114-1230-01-091518	0.54	0.66	0.90	1.22	1.67	1.37	2.51		3.43		4.19	M3	2.25	
M13-SS114-01-091518	0.86	0.61	1.06	0.71	1.24	1.75	17		29.8		21.1	M3	18.1	
M14-SB37-0612-01-091818	1.01	0.79	1.27	0.78	1.25	1.62	55		89	M3	69	M3	70	
M14-SB37-1218-01-091818	1.04	0.77	1.31	0.73	1.25	1.71	55		94		69	M3	72	
M14-SS37-01-091818	0.91	0.65	1.15	0.72	1.27	1.77	52		92	J-	66	M3	60	
M15-SB84-0612-01-091418	0.69	0.50	0.96	0.73	1.39	1.90	7.1		13.5		9.9	M3	6.8	
M15-SS14-01-091518	0.68	0.52	1.04	0.77	1.53	1.99	2.51		5		3.83	M3	2.61	
M15-SS84-01-091418	0.81	0.64	1.09	0.78	1.34	1.71	10.1		17.3		13.5	M3	11	
M15-XS3-01-052118	0.75	0.60	1.24	0.80	1.67	2.07	9.9		20.5		16.5	M3	12.3	
M16-SB193-0612-01-091318	0.96	0.68	1.31	0.71	1.37	1.94	17.7		34.3		24.2	M3	23.2	
M16-SB193-1218-01-091318	0.76	0.73	1.24	0.95	1.63	1.71	19.4		33.1		31.6	M3	24.1	
M16-SS193-01-091318	0.82	0.63	1.38	0.77	1.68	2.18	14.9		32.5	M3	25	M3	20.6	
M16-XS177-01-052618	0.67	0.48	1.20	0.72	1.80	2.51	13.3		33.4		23.9	M3	15.9	
M16-XS30-01-052118	0.47	0.34	0.73	0.73	1.55	2.11	13.1		27.7		20.3	M3	9.5	
M17-SB64-0612-01-091318	0.88	0.60	1.30	0.68	1.48	2.16	61		132	M3	90	M3	79	
M17-SB64-1218-01-091318	0.80	0.59	1.16	0.74	1.45	1.95	64		125	M3	93	M3	74	
M17-SS64-01-091318	0.80	0.52	1.21	0.65	1.51	2.34	53		124	M3	80	M3	64	
M17-XS79-01-091318	0.71	0.79	1.58	1.11	2.22	1.99	21		41.8	M3	46.6	M3	33.1	
M18-SB145-0612-01-091418	0.86	0.74	1.61	0.86	1.87	2.18	119		260	M3	223	M3	192	M3
M18-SS145-01-091418	0.71	0.44	1.25	0.62	1.77	2.86	56		160	M3	99	M3	70	
M19-SB36-0612-01-091818	1.07	1.13	1.93	1.05	1.79	1.71	82		140	M3	147	M3	158	M3
M19-SB36-1218-01-091818	0.91	1.09	1.75	1.19	1.92	1.61	71		114	M3	136	M3	124	M3
M19-SS36-01-091818	0.87	0.96	1.65	1.10	1.89	1.73	91		157	M3	172	M3	150	M3

Table D1-16. Tabulated All Sample Type Results (Including Sediments) (Continued)

Sample ID	Isotope Ratios						Pb-210 (pCi/g)	Pb-210 Qualifier	Ra-226 (pCi/g)	Ra-226 Qualifier	Th-230 (pCi/g)	Th-230 Qualifier	U-238 (pCi/g)	U-238 Qualifier
	U-238/ Th-230	U-238/ Ra-226	U-238/ Pb-210	Th-230/ Ra-226	Th-230/ Pb-210	Ra-226/ Pb-210								
M19-XSG19-01-091318	0.63	0.81	1.44	1.28	2.27	1.78	14.7		26.1		33.4	M3	21.1	
M19-XSR2-01-093018	0.57	0.58	0.42	1.03	0.75	0.73	1.06		0.77	LT	0.79	M3	0.45	
M19-XSR2-02-093018	0.68	0.76	0.49	1.12	0.73	0.65	1.02		0.66	LT	0.74	M3	0.5	
M1-SB36-0612-01-091618	0.72	0.64	0.82	0.88	1.14	1.29	3.21		4.14		3.66	M3	2.64	
M1-SB36-1218-01-091618	0.77	0.55	1.10	0.71	1.42	2.00	1.94		3.88		2.75	M3	2.13	
M1-SB36-1824-01-091618	0.75	0.63	1.10	0.84	1.46	1.75	2.28		3.99		3.34	M3	2.51	
M1-SB36-2436-01-091618	0.77	0.58	0.95	0.75	1.22	1.63	2		3.26		2.44	M3	1.89	
M1-SS36-01-091618	0.55	0.73	0.80	1.32	1.45	1.10	3.46		3.8		5.03	M3	2.76	
M20-SB59-0612-01-091718	0.79	0.68	1.08	0.86	1.37	1.59	17.5		27.9		24	M3	18.9	
M20-SB59-1218-01-091718	1.10	1.18	1.51	1.07	1.37	1.28	7.9		10.1		10.8	M3	11.9	
M20-SS59-01-091718	0.96	0.73	1.35	0.76	1.41	1.85	32.2		59.5	M3	45.3	M3	43.5	
M20-XS146-01-091718	1.25	5.23	6.84	4.20	5.49	1.31	98		128	M3	538	M3	670	J
M20-XS243-01-091718	1.06	0.94	1.84	0.89	1.74	1.95	38.5		75.2	M3	67	M3	71	
M20-XS267-01-091718	0.95	0.93	1.57	0.99	1.66	1.68	44		73.8		73	M3	69	
M20-XS365-01-060618	0.83	0.43	1.06	0.51	1.27	2.46	23.2		57.1	M3	29.4	M3	24.5	M3
M21-SB528-0612-01-091218	1.03	0.26	1.19	0.25	1.16	4.58	16.5		75.6	M3	19.2	M3	19.7	
M21-SB528-1218-01-091218	0.98	0.48	1.21	0.49	1.23	2.52	22.3		56.1	M3	27.4	M3	26.9	
M21-SD2-01-091218	0.75	0.31	0.77	0.41	1.02	2.49	17.1		42.5		17.4	M3	13.1	
M21-SS46-01-091718	0.99	0.73	1.67	0.74	1.68	2.28	87		198	M3	146	M3	145	M3
M21-SS528-01-091218	1.14	1.61	1.72	1.41	1.51	1.07	22.5		24.1		33.9	M3	38.8	
M21-XS302-02-060918	0.74	0.77	1.41	1.04	1.90	1.83	16.1		29.4	J	30.6	M3	22.7	
M21-XS323-01-091218	0.52	0.38	0.87	0.73	1.67	2.27	15.1		34.3		25.2	M3	13.2	
M21-XS46-01-060818	0.78	0.51	1.26	0.65	1.60	2.44	45		110	M3	72	M3	56.5	
M22-SB104-0612-01-091718	0.73	0.37	0.87	0.51	1.19	2.33	14.4		33.5		17.2	M3	12.5	
M22-SS104-01-091718	0.73	0.49	1.12	0.67	1.53	2.27	6.6		15	J+	10.1	M3	7.4	
M22-XS87-01-060418	0.63	0.51	0.91	0.80	1.44	1.80	5.4		9.7		7.8	M3	4.9	
M23-SB54-0612-01-092718	0.67	0.20	0.79	0.30	1.18	3.92	12.3		48.2	M3	14.5	M3	9.7	
M23-SB54-1218-01-092718	1.10	0.81	1.35	0.74	1.24	1.67	5.1		8.5		6.3	M3	6.9	
M23-SS54-01-092718	0.49	0.48	0.74	0.99	1.51	1.53	19		29		28.6	M3	14	
M24-SB76-0612-01-092518	0.82	0.72	1.53	0.87	1.86	2.14	3.7		7.9		6.9	M3	5.66	
M24-SB76-1218-01-092518	0.79	0.80	1.58	1.01	2.00	1.98	2.04		4.03		4.08	M3	3.23	
M24-SS76-01-092518	1.08	0.72	1.28	0.66	1.18	1.78	4.1		7.3		4.83	M3	5.23	
M25-SB50-0612-01-092818	1.04	1.15	1.83	1.10	1.75	1.59	53		84.3	M3	93	M3	97	M3
M25-SB50-1218-01-092818	1.25	0.57	1.47	0.46	1.17	2.57	8.7	J	22.4		10.2	M3	12.8	
M25-SS50-01-092818	1.00	0.67	1.40	0.67	1.40	2.08	15.2		31.6		21.3	M3	21.3	
M25-XS88-01-071718	0.54	0.46	0.84	0.85	1.57	1.84	6.9		12.7		10.8	M3	5.8	

Table D1-16. Tabulated All Sample Type Results (Including Sediments) (Continued)

Sample ID	Isotope Ratios						Pb-210 (pCi/g)	Pb-210 Qualifier	Ra-226 (pCi/g)	Ra-226 Qualifier	Th-230 (pCi/g)	Th-230 Qualifier	U-238 (pCi/g)	U-238 Qualifier
	U-238/ Th-230	U-238/ Ra-226	U-238/ Pb-210	Th-230/ Ra-226	Th-230/ Pb-210	Ra-226/ Pb-210								
M26-SB28-0612-01-092618	0.52	0.48	0.94	0.93	1.81	1.95	8		15.6		14.5	M3	7.5	
M26-SS28-01-092618	0.50	0.46	0.78	0.93	1.55	1.67	8.5		14.2		13.2	M3	6.6	
M26-XS25-01-061818	0.79	0.57	1.38	0.73	1.76	2.41	16		38.5		28.1	M3	22.1	
M27-SB51-0612-01-092618	0.37	0.29	0.51	0.79	1.39	1.76	30.4		53.6		42.2	M3	15.6	
M27-SS51-01-092618	0.20	0.25	0.52	1.25	2.59	2.06	25.1		51.8		65	M3	13	
M27-XS275-01-061918	0.56	0.56	1.13	1.00	2.02	2.02	23		46.4		46.5	M3	26.1	
M27-XS283-01-061818	0.69	0.51	0.97	0.74	1.41	1.91	27.2		52		38.4	M3	26.5	
M27-XS38-01-061918	1.37	0.89	1.59	0.65	1.16	1.79	31		55.5	M3	36.1	M3	49.3	
M28-SB30-0612-01-092618	1.21	0.99	1.54	0.82	1.28	1.56	112		175	M3	143	M3	173	M3
M28-SD1-01-092618	1.03	0.43	1.57	0.42	1.53	3.66	3.36		12.3		5.13	M3	5.27	
M28-SS30-01-092618	1.29	1.11	2.01	0.86	1.56	1.81	70		127	M3	109	M3	141	M3
M28-SSG7-01-092618	2.03	2.34	3.65	1.16	1.80	1.56	4		6.23		7.2	M3	14.6	
M28-XS148-01-062018	1.10	0.98	1.51	0.89	1.38	1.54	61		94	M3	84	M3	92	
M28-XS162-01-092818	1.10	0.69	1.63	0.63	1.48	2.35	3.23	J+	7.6		4.77	M3	5.27	
M28-XS29-01-092618	1.09	0.63	1.43	0.58	1.31	2.25	36.4		81.9	M3	47.7	M3	51.9	
M28-XSG7-01-092618	1.40	1.42	2.84	1.01	2.03	2.00	68		136	M3	138	M3	193	M3
M29-SS48-01-092518	0.96	0.71	1.69	0.75	1.77	2.37	9.1		21.6		16.1	M3	15.4	
M2-SB51-090108-01-091718	0.73	0.84	0.63	1.15	0.87	0.75	1.06		0.8	LT	0.92	M3	0.67	
M2-SB55-072090-01-091618	0.73	0.64	0.74	0.87	1.01	1.17	21.4		25	J-	21.7	M3	15.9	
M30-SS180-01-092918	0.66	0.59	1.04	0.89	1.58	1.78	9		16		14.2	M3	9.4	
M30-XS170-01-071618	0.94	0.75	1.30	0.80	1.39	1.73	33.7		58.4		46.7	M3	43.7	
M30-XSG61-01-092918	0.97	0.77	0.73	0.79	0.76	0.95	0.41	U	0.39	LT	0.31	M3	0.3	
M31-SB37-0612-01-092918	0.47	0.43	0.58	0.91	1.24	1.36	42		57.3	M3	52	M3	24.4	
M31-SS37-01-092918	1.41	2.74	2.37	1.95	1.69	0.87	12.7		11		21.4	M3	30.1	
M31-SS9-01-092918	1.07	2.21	2.51	2.08	2.35	1.13	91		103	M3	214	M3	228	J
M31-XS39-01-092918	0.61	0.56	0.92	0.92	1.51	1.64	3.9	J+	6.4		5.88	M3	3.58	
M31-XS8-01-092918	0.76	0.65	0.90	0.85	1.18	1.38	4.1	J+	5.67		4.83	M3	3.67	
M32-SB89-0612-01-092918	1.12	1.64	3.15	1.47	2.83	1.92	52		100		147	M3	164	J
M32-SS56-01-092918	2.25	2.80	4.17	1.25	1.85	1.49	41		61	M3	76	M3	171	J
M32-SS89-01-092918	1.11	0.72	2.02	0.65	1.82	2.82	50		141	M3	91	M3	101	M3
M33-SS86-01-091818	0.83	0.69	1.25	0.83	1.51	1.82	51		93		77	M3	64	
M34-SS97-01-092718	0.78	0.72	1.14	0.93	1.46	1.57	13.2		20.7		19.3	M3	15	
M34-XS110-01-081218	0.90	0.71	1.49	0.79	1.66	2.10	33.9		71.2		56.2	M3	50.6	
M35-SB22-0612-01-092718	0.68	0.47	0.88	0.69	1.30	1.88	5	J	9.4		6.5	M3	4.42	
M35-SS22-01-092718	0.81	0.66	1.23	0.82	1.53	1.87	4.7	J	8.8		7.2	M3	5.8	
M36-SS24-01-092718	0.72	0.72	1.07	1.00	1.48	1.47	3.7		5.45		5.47	M3	3.95	

Table D1-16. Tabulated All Sample Type Results (Including Sediments) (Continued)

Sample ID	Isotope Ratios						Pb-210 (pCi/g)	Pb-210 Qualifier	Ra-226 (pCi/g)	Ra-226 Qualifier	Th-230 (pCi/g)	Th-230 Qualifier	U-238 (pCi/g)	U-238 Qualifier
	U-238/ Th-230	U-238/ Ra-226	U-238/ Pb-210	Th-230/ Ra-226	Th-230/ Pb-210	Ra-226/ Pb-210								
M37-SS44-01-092718	1.23	0.71	2.33	0.58	1.90	3.31	7.2		23.8		13.7	M3	16.8	
M37-XS124A-01-081318	1.25	0.79	2.50	0.63	2.00	3.15	46		145	M3	92	M3	115	
M37-XS44-01-081318	1.21	1.15	2.21	0.95	1.82	1.92	24.8		47.5		45.1	M3	54.7	
M38-SB2-0612-01-092718	0.30	0.22	0.60	0.75	2.04	2.71	38.8		105	M3	79	M3	23.4	
M38-SB2-1218-01-092718	0.59	0.46	0.92	0.77	1.56	2.01	37.2		74.9	M3	57.9	M3	34.3	
M38-SS2-01-092718	0.33	0.35	0.53	1.05	1.58	1.50	24.4		36.7		38.6	M3	12.9	
M3-SB51-0612-01-091618	0.79	0.61	1.49	0.77	1.89	2.44	2.73		6.67		5.16	M3	4.07	
M3-SB51-1218-01-091618	0.72	0.45	1.00	0.63	1.38	2.21	3.05		6.75		4.22	M3	3.04	
M3-SS51-01-091618	0.80	0.42	0.86	0.53	1.07	2.04	1.13		2.3		1.21	M3	0.97	
M3-XS34-01-043018	0.88	0.65	1.10	0.73	1.25	1.70	4.6		7.8		5.73	M3	5.06	
M3-XS36-01-043018	0.80	0.49	1.22	0.61	1.52	2.49	6.3		15.7		9.6	M3	7.7	
M4-SB81-0612-01-091818	0.72	0.42	0.79	0.58	1.10	1.90	32.2		61.2		35.5	M3	25.4	
M4-SB81-1218-01-091818	0.57	0.42	0.66	0.74	1.17	1.58	29.6		46.7	M3	34.5	M3	19.5	
M4-SS81-01-091818	0.65	0.55	0.90	0.85	1.38	1.62	27.1		43.9	M3	37.3	M3	24.3	
M4-XS238-01-051018	0.72	0.28	0.76	0.38	1.06	2.75	5.2		14.3		5.49	M3	3.96	
M5-SB149-0612-01-093018	0.99	0.35	1.04	0.35	1.05	3.00	13.7		41.1	M3	14.4	M3	14.2	
M5-SB479-0612-01-093018	0.87	0.91	0.78	1.04	0.89	0.85	0.89	LT	0.76	LT	0.79	M3	0.69	
M5-SD1-01-062318	0.79	0.58	1.11	0.73	1.42	1.93	33.3		64.4		47.2	M3	37.1	
M5-SS149-01-093018	1.01	0.93	1.41	0.91	1.39	1.53	23.6		36		32.9	M3	33.3	
M5-SS479-01-093018	1.08	1.13	0.90	1.05	0.83	0.79	0.77	LT	0.61	LT	0.64	M3	0.69	
M6-SB285-0612-01-091618	0.82	0.35	0.61	0.42	0.74	1.75	19.1		33.5		14.1	M3	11.6	
M6-SB285-1218-01-091618	1.12	0.88	1.21	0.78	1.08	1.38	24.9		34.3		26.9	M3	30.1	
M6-SS174-01-092718	0.80	0.90	1.00	1.13	1.25	1.11	9.9	J	11		12.4	M3	9.9	
M6-SS285-01-091618	0.80	0.58	0.47	0.72	0.59	0.82	16.1		13.2		9.5	M3	7.6	
M6-XS269-01-042618	0.67	0.42	0.74	0.63	1.11	1.75	8.9		15.6		9.9	M3	6.6	
M6-XSG13A-01-091618	0.68	0.73	1.22	1.07	1.80	1.68	14.7		24.7		26.5	M3	18	
M7-SB161-0612-01-091618	0.60	0.45	0.84	0.76	1.41	1.86	38.8		72.2	M3	54.8	M3	32.7	
M7-SB161-1218-01-091618	0.78	0.29	0.81	0.36	1.03	2.83	18.9		53.5	M3	19.5	M3	15.3	
M7-SB161-1824-01-091618	0.75	0.43	0.88	0.58	1.18	2.04	17.7		36.1	J-	20.9	M3	15.6	
M7-SB161-2430-01-091618	0.84	0.72	1.06	0.86	1.26	1.47	43		63.1	M3	54.3	M3	45.4	
M7-SD2-01-081418	1.52	0.97	1.14	0.64	0.75	1.18	0.28	U	0.33	U	0.21	M3	0.32	
M7-SS161-01-091618	0.81	0.53	0.91	0.66	1.13	1.71	62		106		70	M3	56.7	
M7-XS162A-01-081518	0.75	0.66	1.01	0.87	1.34	1.54	127		195	M3	170	M3	128	
M7-XS181-01-051018	0.59	0.32	0.72	0.55	1.23	2.24	13.3		29.8		16.3	M3	9.6	J
M7-XS181-02-051018	0.68	0.45	0.84	0.66	1.24	1.88	14.8		27.8		18.4	M3	12.5	J
M7-XSR1-01-093018	0.79	0.72	0.93	0.91	1.19	1.30	2.29		2.98		2.72	M3	2.14	

Table D1-16. Tabulated All Sample Type Results (Including Sediments) (Continued)

Sample ID	Isotope Ratios						Pb-210 (pCi/g)	Pb-210 Qualifier	Ra-226 (pCi/g)	Ra-226 Qualifier	Th-230 (pCi/g)	Th-230 Qualifier	U-238 (pCi/g)	U-238 Qualifier
	U-238/ Th-230	U-238/ Ra-226	U-238/ Pb-210	Th-230/ Ra-226	Th-230/ Pb-210	Ra-226/ Pb-210								
M8-SS120-01-092718	0.37	0.43	0.62	1.19	1.68	1.42	5.7		8.1		9.6	M3	3.51	
M8-SS52-01-091818	1.56	1.24	1.70	0.79	1.09	1.38	7.7		10.6		8.4	J	13.1	
M8-XS102-01-050918	0.95	0.90	1.15	0.94	1.20	1.27	3.64		4.64		4.37	M3	4.17	
M9-SS19-01-093018	0.65	0.34	0.51	0.52	0.78	1.49	1.79	J	2.67	J-	1.39	M3	0.91	
M9-XS19A-01-081718	0.71	0.49	0.67	0.69	0.95	1.38	1.28		1.76		1.21	J	0.86	
M9-XS28A-01-081718	0.94	0.73	1.18	0.77	1.25	1.62	68	Y1	110	J-	85	M3	80	
T10-XS20-01-042518	0.62	0.71	0.60	1.15	0.97	0.84	0.89	LT	0.75	LT	0.86	M3	0.53	
T14-XS27-01-050818	0.75	0.86	0.79	1.15	1.05	0.91	0.81	LT	0.74	LT	0.85	M3	0.64	
T17-SB258-018090-01-092518	0.58	0.45	0.66	0.78	1.14	1.47	1.74		2.56		1.99	M3	1.15	
T17-XS143-01-042618	0.93	0.59	1.34	0.63	1.44	2.29	11.8		27		17	M3	15.8	
T17-XS377-01-042818	0.74	0.69	1.22	0.94	1.66	1.77	8.7		15.4		14.4	M3	10.6	M3
T1-SS14-01-091618	0.68	0.43	0.82	0.63	1.20	1.90	3.6		6.85		4.32	M3	2.94	
T1-XSG49A-01-081918	0.64	0.60	0.81	0.93	1.26	1.36	3.43		4.67		4.33	M3	2.78	M3
T1-XSG5A-01-081918	0.41	0.25	0.50	0.61	1.22	1.99	1.42		2.83		1.73	J	0.71	
T23-SS32-01-091418	0.72	0.59	0.75	0.81	1.04	1.28	2.54		3.24		2.63	M3	1.9	
T37-SS94-01-091318	1.10	0.87	1.26	0.79	1.14	1.44	0.7	LT	1.01	J-	0.8	M3	0.88	
T4-XS15A-01-081918	0.27	0.13	0.35	0.50	1.30	2.59	86		223	M3	112	M3	29.9	
T4-XSG50A-01-081918	0.53	0.25	0.62	0.48	1.18	2.46	11.9		29.3		14	M3	7.4	
T9-SS67-01-091118	1.02	1.01	2.29	0.99	2.25	2.27	0.51	U	1.16		1.15	M3	1.17	
T9-XS217-01-042518	0.58	0.73	1.09	1.25	1.87	1.49	0.67	LT	1		1.25	M3	0.73	

Notes:

J	Estimated value
J-	Estimated value, may be biased low.
J+	Estimated value, may be biased high.
LT	Result less than requested minimum detectable concentration, but greater than sample-specific detectable concentration.
M3	The requested minimum detected concentration was not met, but the reported activity is greater than the reported minimum detected concentration.
Pb-210	Lead 210
pCi/g	Picocuries per gram
Ra-226	Radium 226
Th-230	Thorium 230
U	Not detected. The associated value is the reporting limit.
U-238	Uranium 238
UJ	Not considered detected. The associated value is the reported concentration, which is estimated.
Y1	Chemical yield is in control at 100% - 110%. Quantitative yield is assumed.