

299-W11-1 (A7275) Log Data Report

Borehole Information:

Borehole: 299-W11-1 (A7275)		Site: 216-T-6 Crib			
Coordinates (WA State Plane)		GWL (ft)¹: 263.65		GWL Date: 1/13/2003	
North 136,652.13 m	East 567,220.38 m	Drill Date March 1950	TOC² Elevation 216.54 m	Total Depth (ft) 314	Type Cable Tool

Casing Information:

Casing Type	Stickup (ft)	Outer Diameter (in.)	Inside Diameter (in.)	Thickness (in.)	Top (ft)	Bottom (ft)
Welded steel	0.75	8 5/8	7 15/16	.344	+0.75	311
The logging engineer measured the casing stick up using a steel tape. A caliper was used to determine the outside casing diameter. The caliper and inside casing diameter were measured using a steel tape. Measurements were rounded to the nearest 1/16 in. Casing thickness was calculated.						

Borehole Notes:

Borehole coordinates, elevation, and well construction information are from measurements by Stoller field personnel, HWIS³, and Ledgerwood (1993). Zero reference is the top of the 8-in. casing. Top of casing is cut evenly. A reference point survey "X" is located on top of the casing stickup.

The borehole was swabbed before logging began, and the presence of radon gas was indicated. Elevated activity was detected on the swab, but after one day, the activity had diminished to background.

Logging Equipment Information:

Logging System: Gamma 1D	Type: SGLS (35%)
Calibration Date: 9/2002	Calibration Reference: GJO-2002-385-TAC
Logging Procedure: MAC-HGLP 1.6.5, Rev. 0	

Spectral Gamma Logging System (SGLS) Log Run Information:

Log Run	1	2	3	4	5/Repeat
Date	1/10/03	1/13/03	1/14/03	1/15/03	1/15/03
Logging Engineer	Spatz	Spatz	Spatz	Spatz	Spatz
Start Depth (ft)	55.0	155.0	269.0	170.0	55.0
Finish Depth (ft)	1.0	54.0	169.0	154.0	20.0
Count Time (sec)	200	200	200	200	200
Live/Real	R	R	R	R	R
Shield (Y/N)	N	N	N	N	N
MSA Interval (ft)	1.0	1.0	1.0	1.0	1.0
ft/min	N/A ⁴	N/A	N/A	N/A	N/A
Pre-Verification	AD042CAB	AD044CAB	AD045CAB	AD046CAB	AD046CAB
Start File	AD043000	AD044000	AD045000	AD046000	AD046017

Log Run	1	2	3	4	5/Repeat
Finish File	AD043054	AD044101	AD045100	AD046016	AD046052
Post-Verification	AD043CAA	AD044CAA	AD045CAA	AD046CAA	AD046CAA
Depth Return Error (in)	-1	-1	-1	NA	-2
Comments	No fine-gain adjustment.	No fine-gain adjustment.	Fine-gain adjustment after file AD45001.	No fine-gain adjustment.	No fine-gain adjustment.

Log Run	6/Test	7/Test			
Date	1/22/03	1/22/03			
Logging Engineer	Spatz	Spatz			
Start Depth (ft)	65.0	65.0			
Finish Depth (ft)	25.0	25.0			
Count Time (sec)	100	150			
Live/Real	R	R			
Shield (Y/N)	N	N			
MSA Interval (ft)	0.5	1.0			
ft/min	N/A	N/A			
Pre-Verification	AD050CAB	AD050CAB			
Start File	AD050000	AD050081			
Finish File	AD050080	AD050121			
Post-Verification	AD050CAA	AD050CAA			
Depth Return Error (in.)	N/A	-1			
Comments	No fine-gain adjustment.	No fine-gain adjustment.			

Logging Operation Notes:

Zero reference was top of the 8-in. casing. Logging was performed with a centralizer installed on the sonde. Pre- and post-survey verification measurements for the SGLS employed the Amersham KUT (⁴⁰K, ²³⁸U, and ²³²Th) verifier with serial number 118. During SGLS logging, one fine-gain adjustment was needed during logging run 3 to maintain the 1460-keV (⁴⁰K) photopeak at a pre-described channel. Each day before logging began, the sonde was run up and down the borehole one time to displace any radon gas if present.

Analysis Notes:

Analyst:	Sobczyk	Date:	01/24/03	Reference:	GJO-HGLP 1.6.3, Rev. 0
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SGLS pre-run and post-run verification spectra were collected at the beginning and end of each day. The verification spectra were all outside the control limits established on 12/05/2002, except for post-run verification spectra AD043CAA and AD044CAA. Pre-run verification spectrum AD042CAB was outside five of six control limits. The value for the 1461 counts per second was within the acceptable range. Pre-run verification spectrum AD044CAB was above the upper control limits for the 609-keV and 1461-keV full-width at half-maximum values and the 609-keV peak counts per second. Pre-run verification spectrum AD045CAB was above the upper control limits for the 609-keV, 1461-keV, and 2615-keV full-width at half-maximum values. Post-run verification spectrum AD045CAA was below the lower control limits for the 609-keV, 1461-keV, and 2615-keV peak counts per second. Spectrum AD046CAB was above the upper control limit for the 609-keV full-width at half-maximum value. Post-run verification spectrum AD046CAA was below the lower control limits for the 609-keV and 2615-keV peak counts per second. Spectrum AD050CAB was above the upper control limits for the 609-keV full-width at half-maximum

value and peak counts per second. Post-run verification spectrum AD050CAA was below the lower control limits for the 1461-keV and 2615-keV peak counts per second. The peak counts per second at the 609-keV, 1461-keV, and 2615-keV photopeaks on the post-run verification spectra as compared to the pre-run verification spectra for each day were between 5 and 14 percent lower at the end of each day. Examinations of spectra indicate that the detector functioned (i.e. decreasing efficiency throughout the day's logging) during all of the logging runs, and the spectra are provisionally accepted.

Log spectra for the SGLS were processed in batch mode using APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Post-run verification spectra were used to determine the energy and resolution calibration for processing the data using APTEC SUPERVISOR. Concentrations were calculated in EXCEL (source file: G1DSept02.xls), using parameters determined from analysis of recent calibration data. Zero reference was the top of the 8-in. casing. On the basis of information reported in Ledgerwood (1993), the casing configuration was assumed to be one string of 8-in. casing to total log depth (269 ft). The casing correction factor was calculated assuming a casing thickness of 0.344 in. This casing thickness is based upon the field measurement. A water correction was applied to the data below 263.65 ft. Dead time corrections are required when dead time exceeds 10.5 percent. As the dead time did not exceed 10.5 percent, a dead time correction was not needed or applied.

Log Plot Notes:

Separate log plots are provided for gross gamma and dead time, naturally occurring radionuclides (^{40}K , ^{238}U , and ^{232}Th), and man-made radionuclides. Plots of the repeat logs versus the original logs are included. In addition, plots of the naturally occurring radionuclides and ^{137}Cs at different counting times and summary plots of the acquisition test for gross gamma, ^{40}K , ^{238}U , ^{232}Th , and ^{137}Cs are included. For each radionuclide, the energy value of the spectral peak used for quantification is indicated. Unless otherwise noted, all radionuclides are plotted in picocuries per gram (pCi/g). The open circles indicate the minimum detectable level (MDL) for each radionuclide. Error bars on each plot represent error associated with counting statistics only and do not include errors associated with the inverse efficiency function, dead time correction, or casing correction. These errors are discussed in the calibration report. A combination plot is also included to facilitate correlation. The ^{214}Bi peak at 1764 keV was used to determine the naturally occurring ^{238}U concentrations on the combination plot rather than the ^{214}Bi peak at 609 keV because it is probably more representative of the formation.

Results and Interpretations:

^{137}Cs was the only man-made radionuclide detected in this borehole. ^{137}Cs was detected near the ground surface (1-ft log depth) with a concentration of 0.4 pCi/g. The interval between 22 and 29 ft contained the highest concentrations of ^{137}Cs . The highest concentration detected was 9.3 pCi/g at 23 ft. In addition, ^{137}Cs was detected at 16 ft with a concentration of 0.2 pCi/g.

The behavior of the ^{238}U log suggests that radon may be present inside the borehole casing. Determination of ^{238}U is based on measurement of gamma activity at 609 and/or 1764 keV associated with ^{214}Bi , under the assumption of secular equilibrium in the decay chain. However, ^{214}Bi is also a short-term daughter of ^{222}Rn . When radon is present, ^{214}Bi will tend to "plate" onto the casing wall and will quickly reach equilibrium with ^{222}Rn . Because the additional ^{214}Bi resulting from radon is on the inside of the casing, the effect of the casing correction is to amplify the 609 photopeak relative to the 1764 photopeak. (The magnitude of the casing correction factor decreases with increasing energy, but gamma rays originating inside the casing are not attenuated.) The effects of radon are apparent in log run 1 (55.0 to 1.0 ft). The reason for variations in radon content between log runs on successive days is not known. Variations in radon content in boreholes are probably related to variations in surface weather conditions. Radon daughters such as ^{214}Bi may also "plate" onto the sonde itself. When this occurs, there is a gradual increase in total counts as well as photopeak counts associated with ^{214}Bi and ^{214}Pb . This phenomenon appears to best explain the observed discrepancy in ^{238}U values based on 609-keV and 1764-keV photopeaks between run 1 and the repeat section (run 5).

The presence of radon is not an indication of man-made contamination: it is derived from decay of naturally occurring uranium. As a gas, radon moves easily in the subsurface, and concentrations of radon and its associated progeny can change quickly.

In the repeat log, the SGLS showed reasonable repeatability except for the 609-keV and 1764-keV photopeaks. The repeat log run (log run 5) was observed five days after the original log run (log run 1). The ^{238}U values based on 609 keV are consistently lower on the repeat log than on the original log run. This variation is attributed to the effects of radon. The ^{137}Cs , ^{40}K , and ^{232}Th concentrations agree well.

Recognizable changes in the KUT logs occurred in this borehole. Changes of 5 pCi/g or more in apparent ^{40}K concentrations occur at approximately 37, 117, 122, 132, 142, and 155 ft. The increase in ^{40}K activities at about 37 ft may represent the transition from the coarse-grained sediments of the Hanford H1 to the finer grained sediments of the Hanford H2. About a 0.25-pCi/g increase in ^{232}Th concentration occurs at 37 ft, which also corresponds with the H1 to H2 interface. Between 108 and 117 ft, the fine-grained member of the Cold Creek Unit (formerly known as the Early Palouse Soil) is shown by an increase in total gamma (50 cps), ^{40}K (3 pCi/g), and ^{232}Th (0.5 pCi/g). There is about a 10-pCi/g decrease in ^{40}K concentrations in the intervals between 117 through 122 ft and 132 through 142 ft. ^{238}U increases by approximately 1.5 pCi/g in the interval between 135 and 138 ft. On the basis of low ^{40}K concentrations, the carbonate-rich paleosols of the Cold Creek Unit are interpreted as being between 117 and 122 ft. The caliche layer with characteristically high uranium content (greater than 2.0 pCi/g) is present between 135 and 138 ft. ^{232}Th concentrations increase by approximately 0.4 pCi/g or more in the intervals between 143 and 156 ft, 183 and 186 ft, and 201 and 207 ft.

On 1/21/2003 (logging runs 6 and 7), an acquisition test was run to aid in establishing optimal counting times and station intervals to resolve Hanford formation stratigraphy. The data were collected using the following counting times and depth intervals: 100 sec at 0.5 ft and 150 sec at 1 ft. To simulate a 100-sec counting time at 1-ft depth interval, every other data point was removed from data collected at 100-sec counting time at 0.5-ft intervals. The test data were compared to the original log data that were collected with a 200-sec counting time at a 1-ft interval. Results of the test are complicated by variations in detector efficiency and the presence of radon in the borehole.

References:

Ledgerwood, R.K., 1993. *Summaries of Well Construction Data and Field Observations for Existing 200-West Resource Protection Wells*, WHC-SD-ER-TI-005, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

¹ GWL – groundwater level

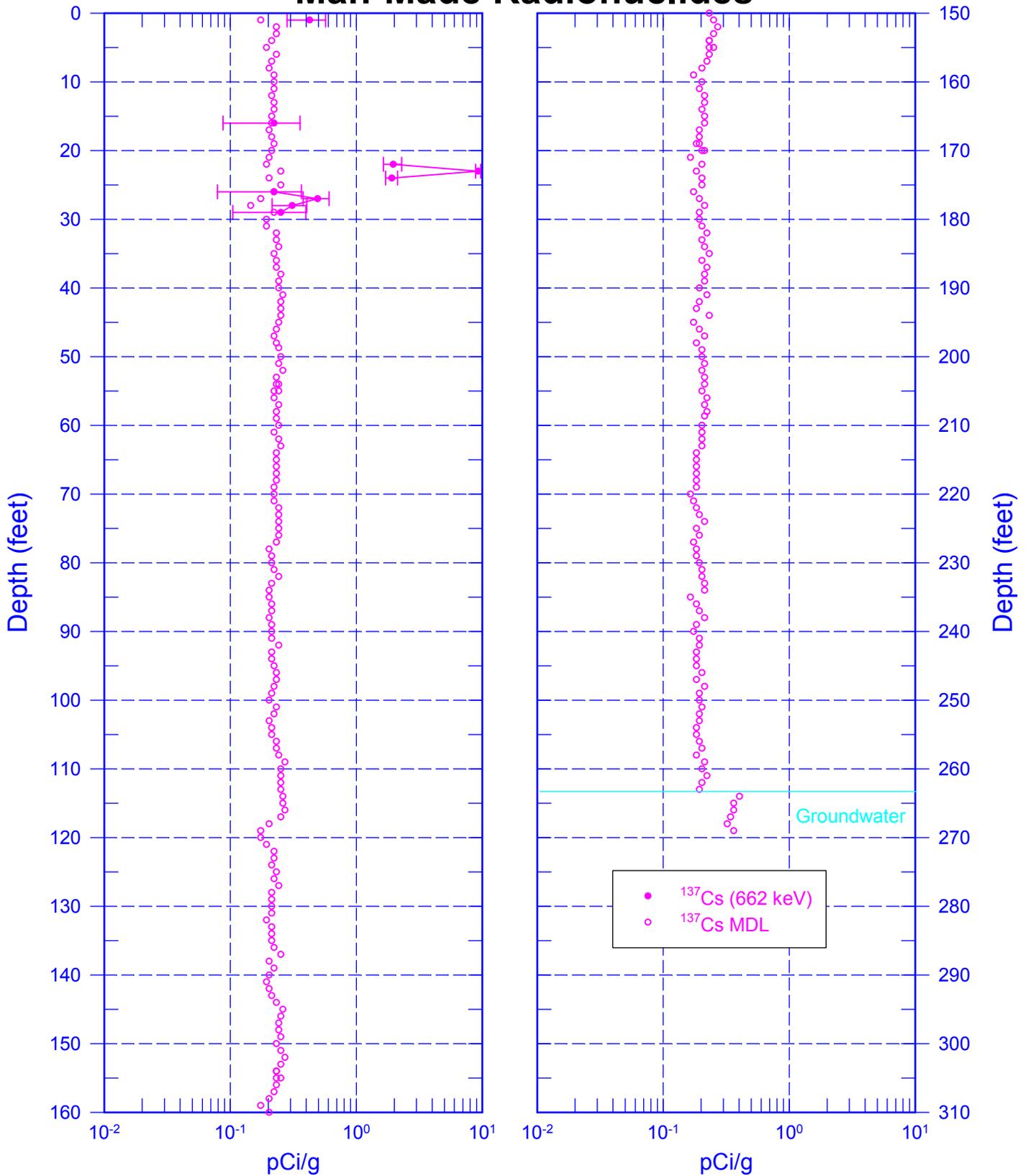
² TOC – top of casing

³ HWIS – Hanford Well Information System

⁴ N/A – not applicable

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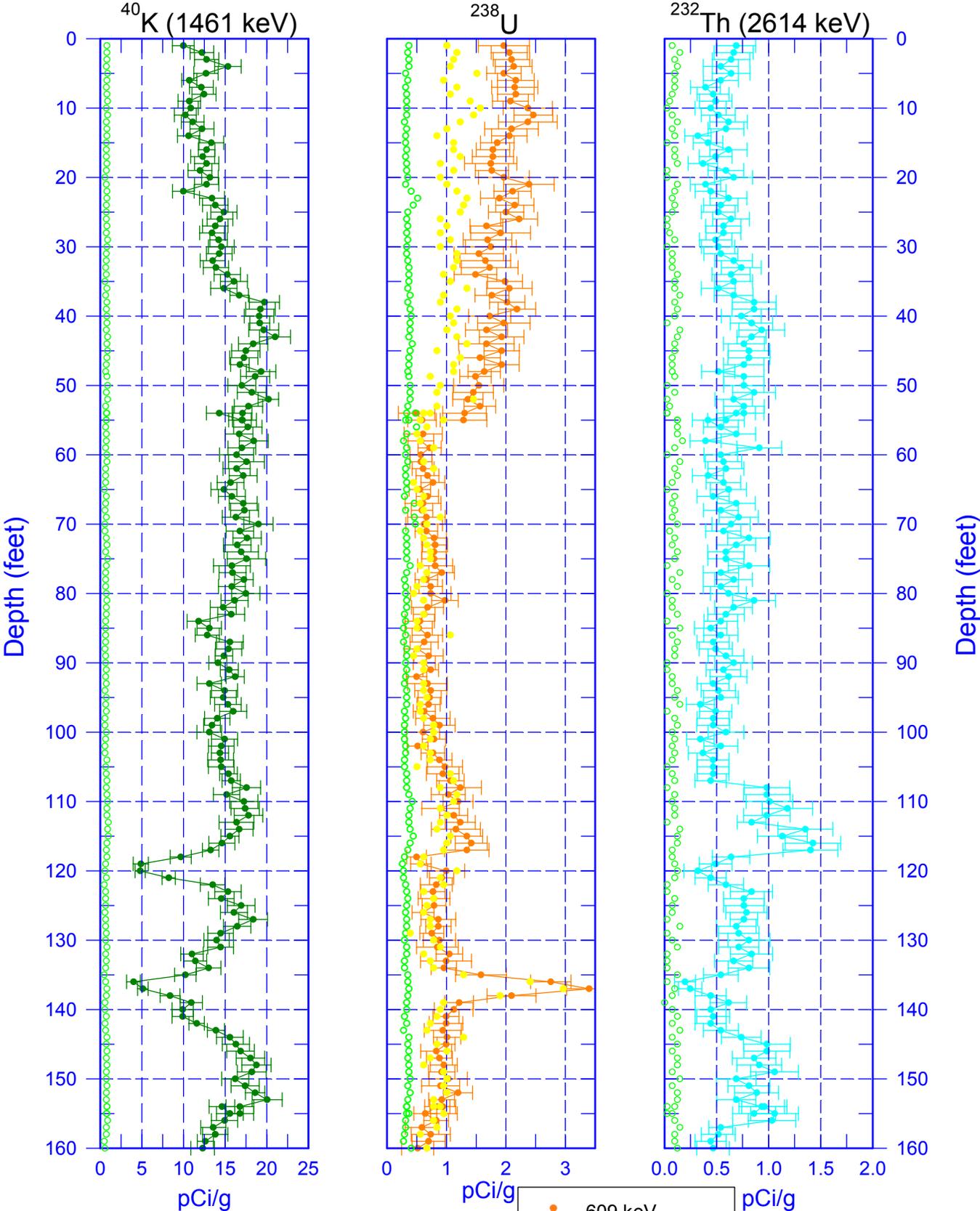
Man-Made Radionuclides



Zero Reference = Top of Casing

Date of Last Logging Run
1/15/2003

299-W11-1 (A7275) Natural Gamma Logs



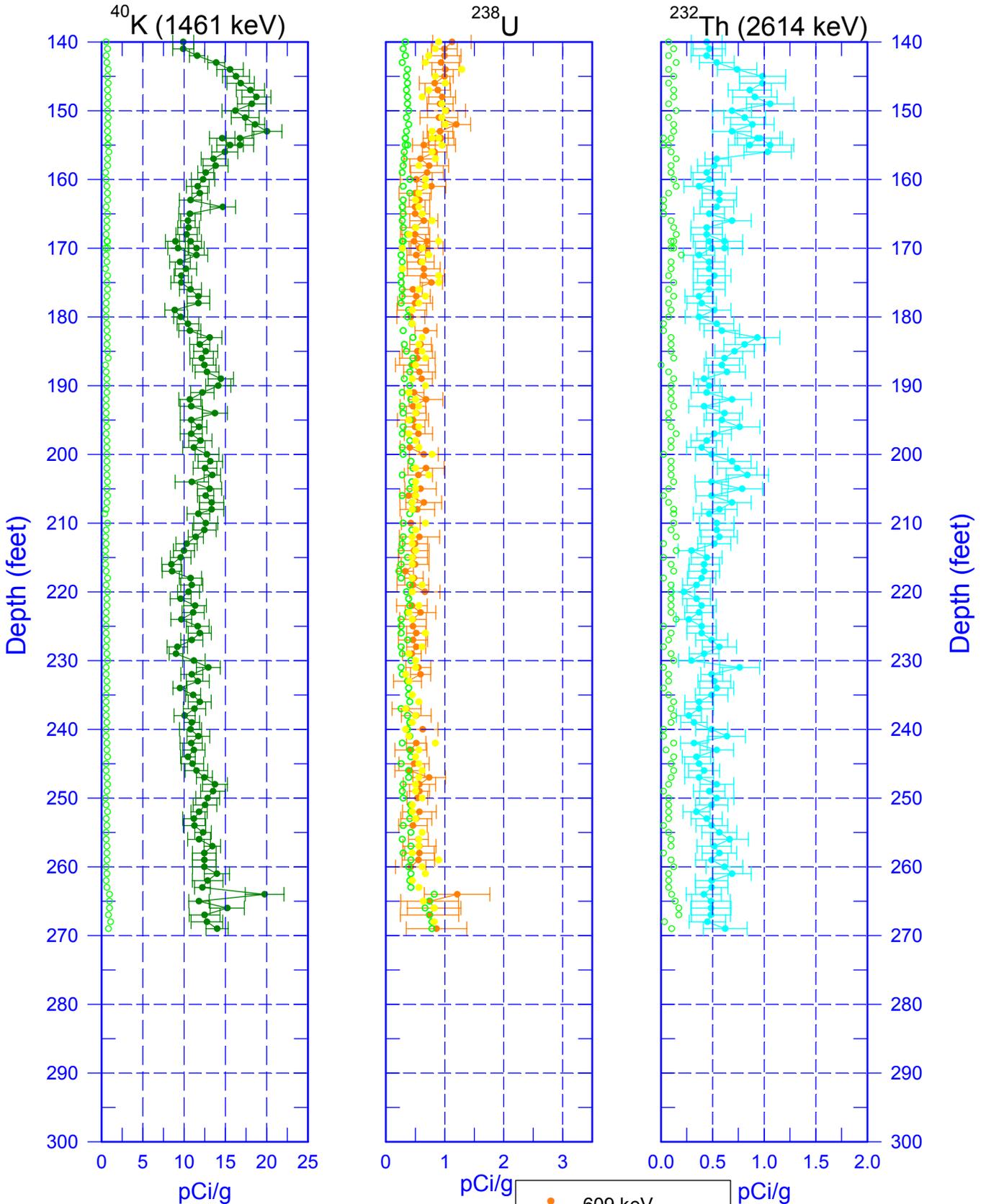
○ MDL

- 609 keV
- MDL (609 keV)
- 1764 keV

Zero Reference = Top of Casing

Date of Last Logging Run
1/15/2003

299-W11-1 (A7275) Natural Gamma Logs

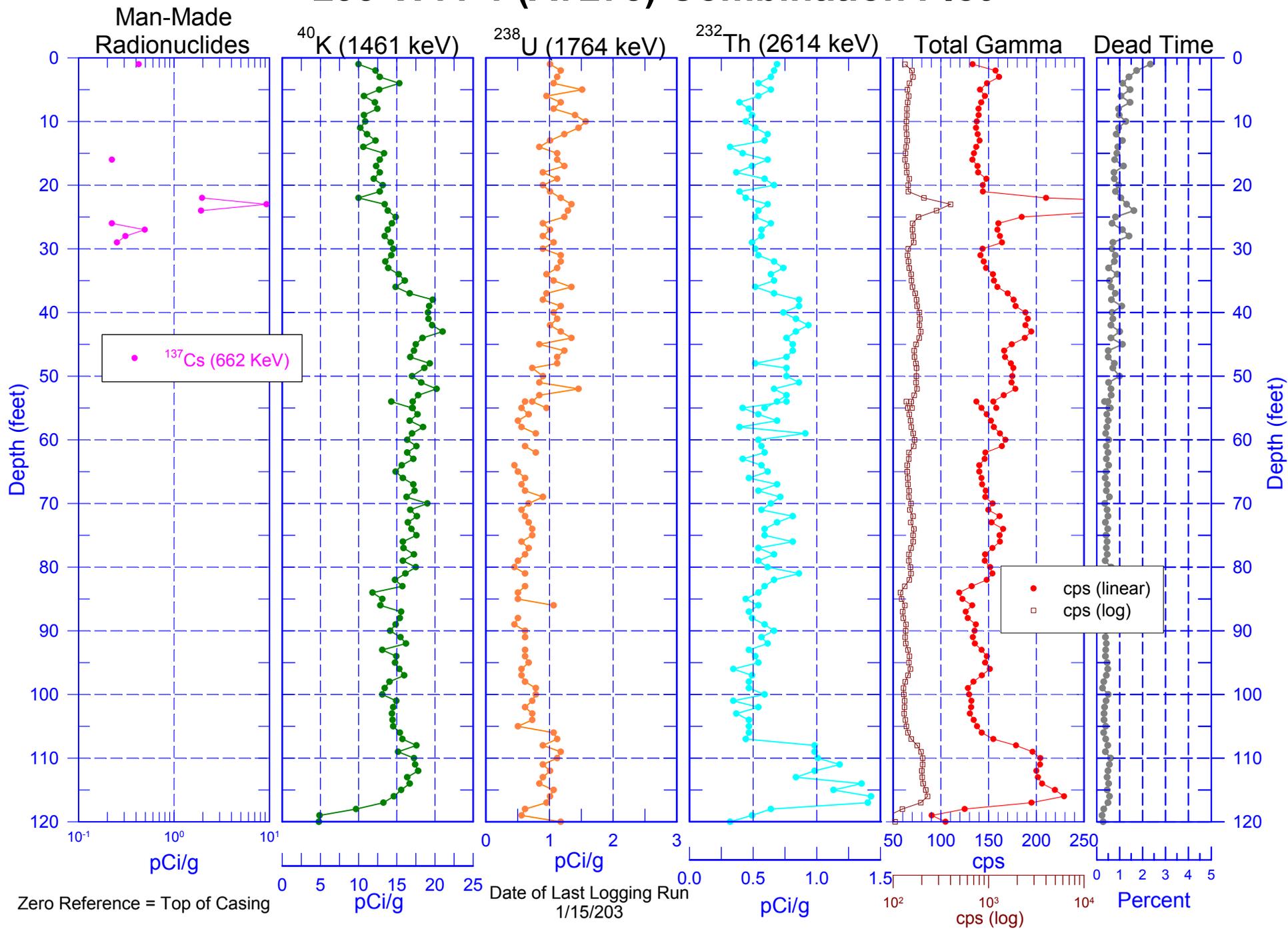


Zero Reference = Top of Casing

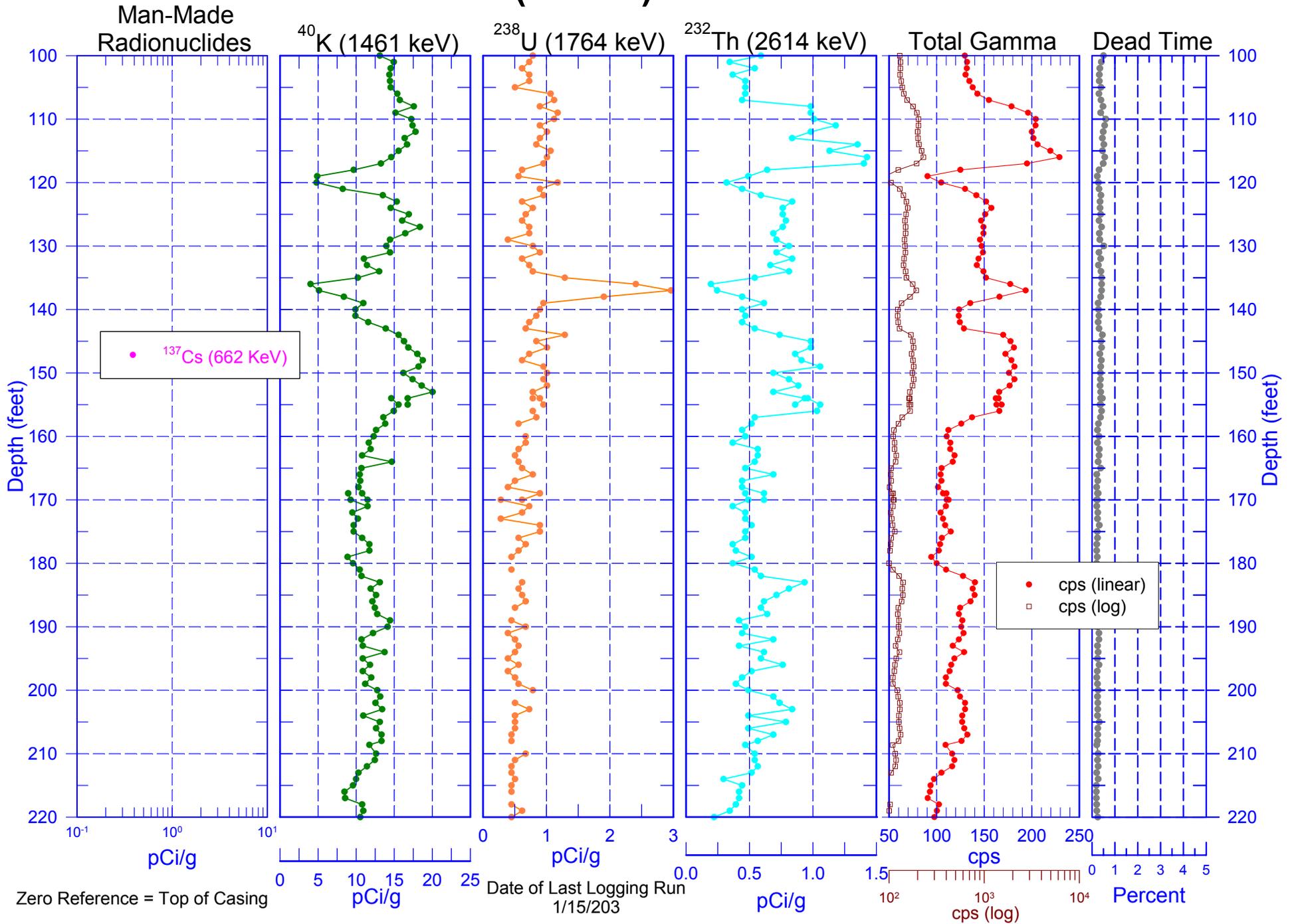
- 609 keV
- MDL (609 keV)
- 1764 keV

Date of Last Logging Run
1/15/2003

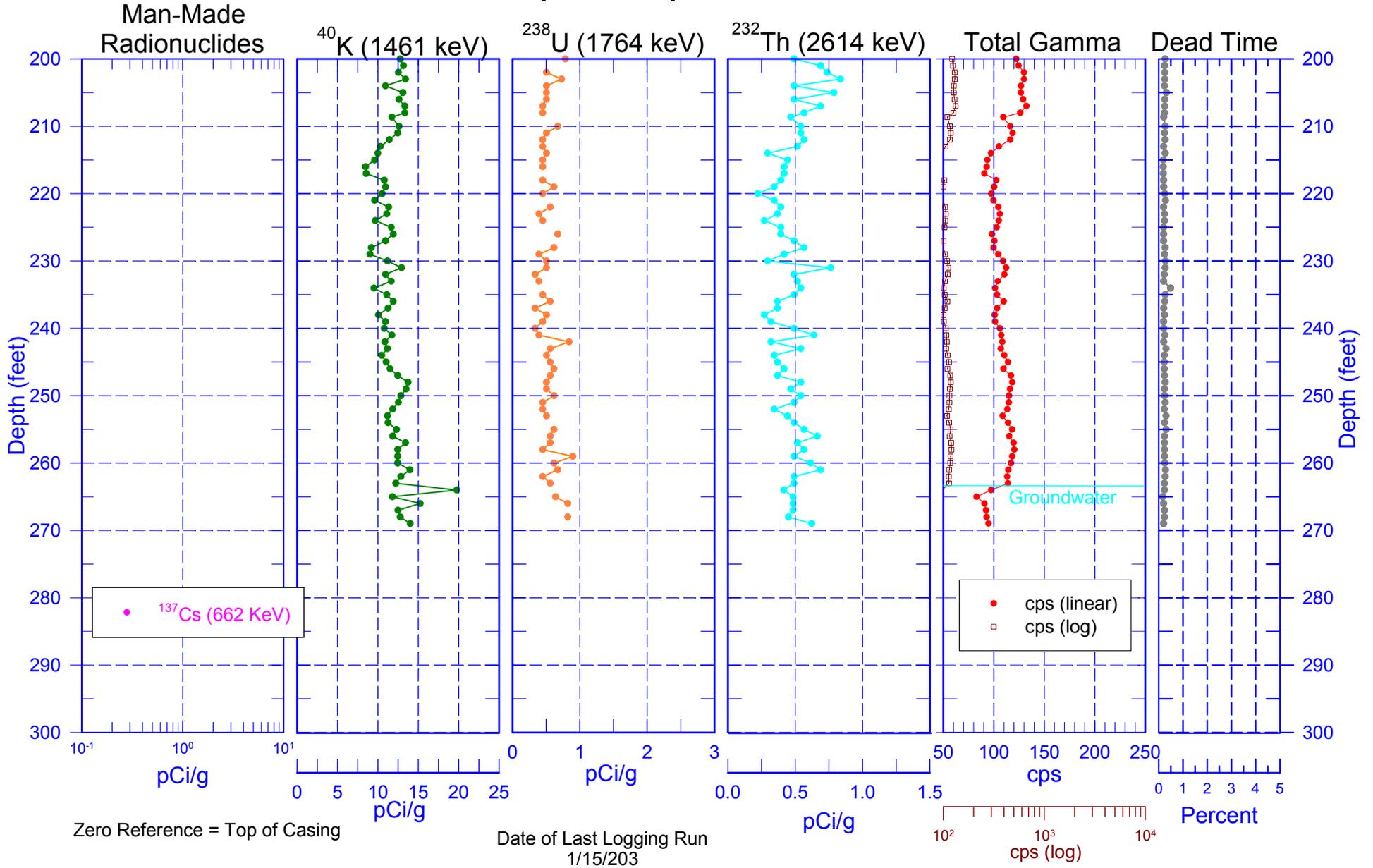
299-W11-1 (A7275) Combination Plot



299-W11-1 (A7275) Combination Plot

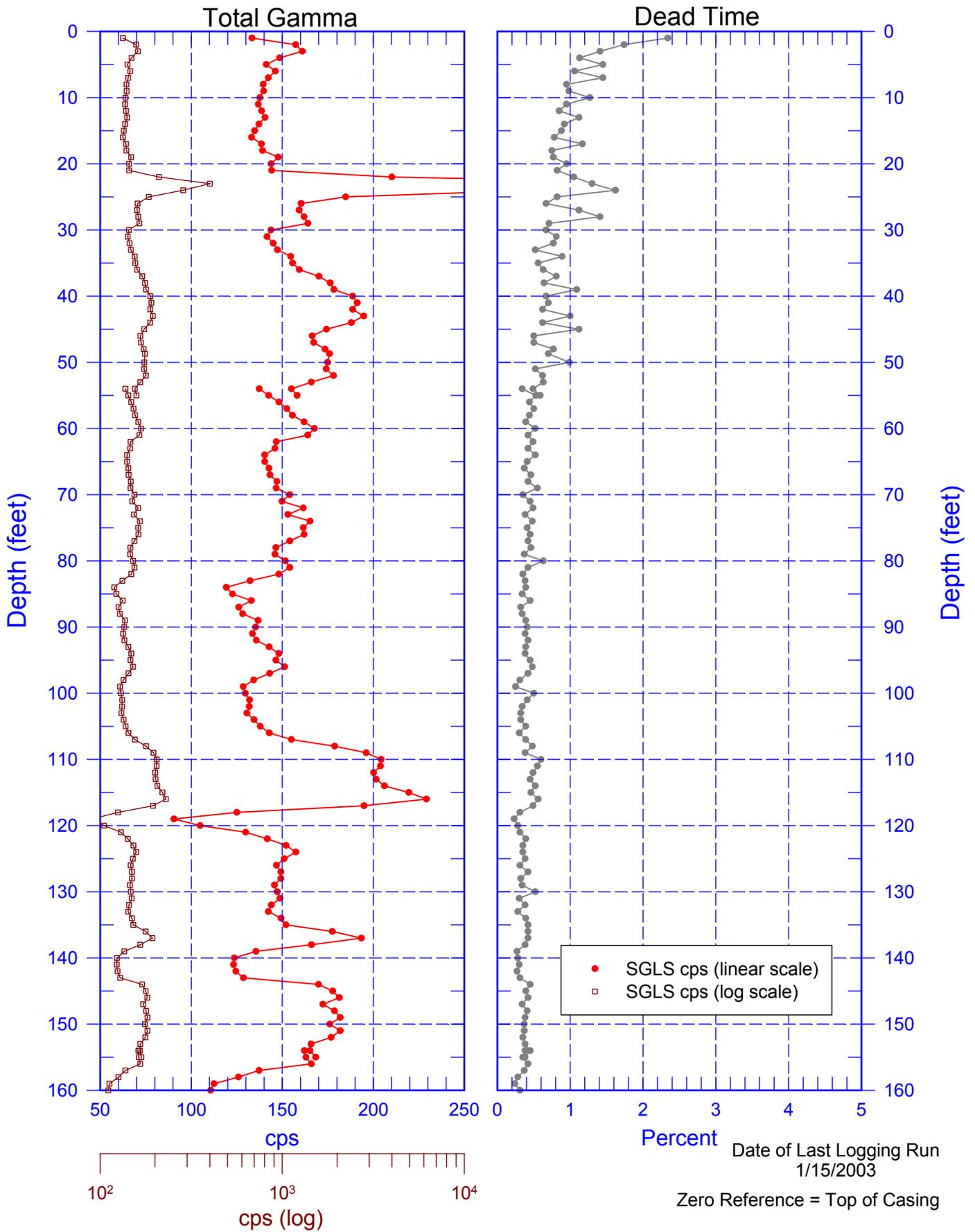


299-W11-1 (A7275) Combination Plot



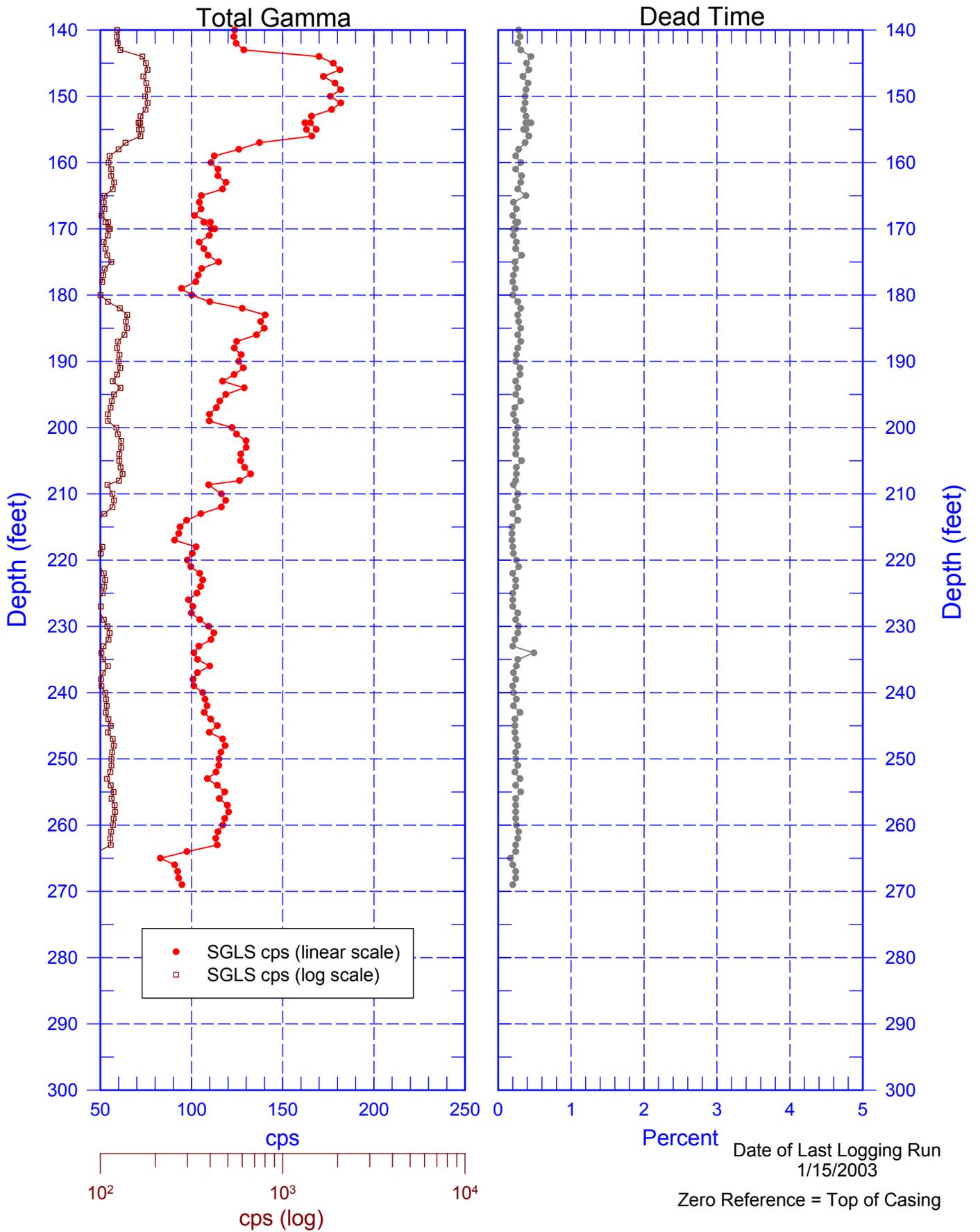
299-W11-1 (A7275)

Total Gamma & Dead Time



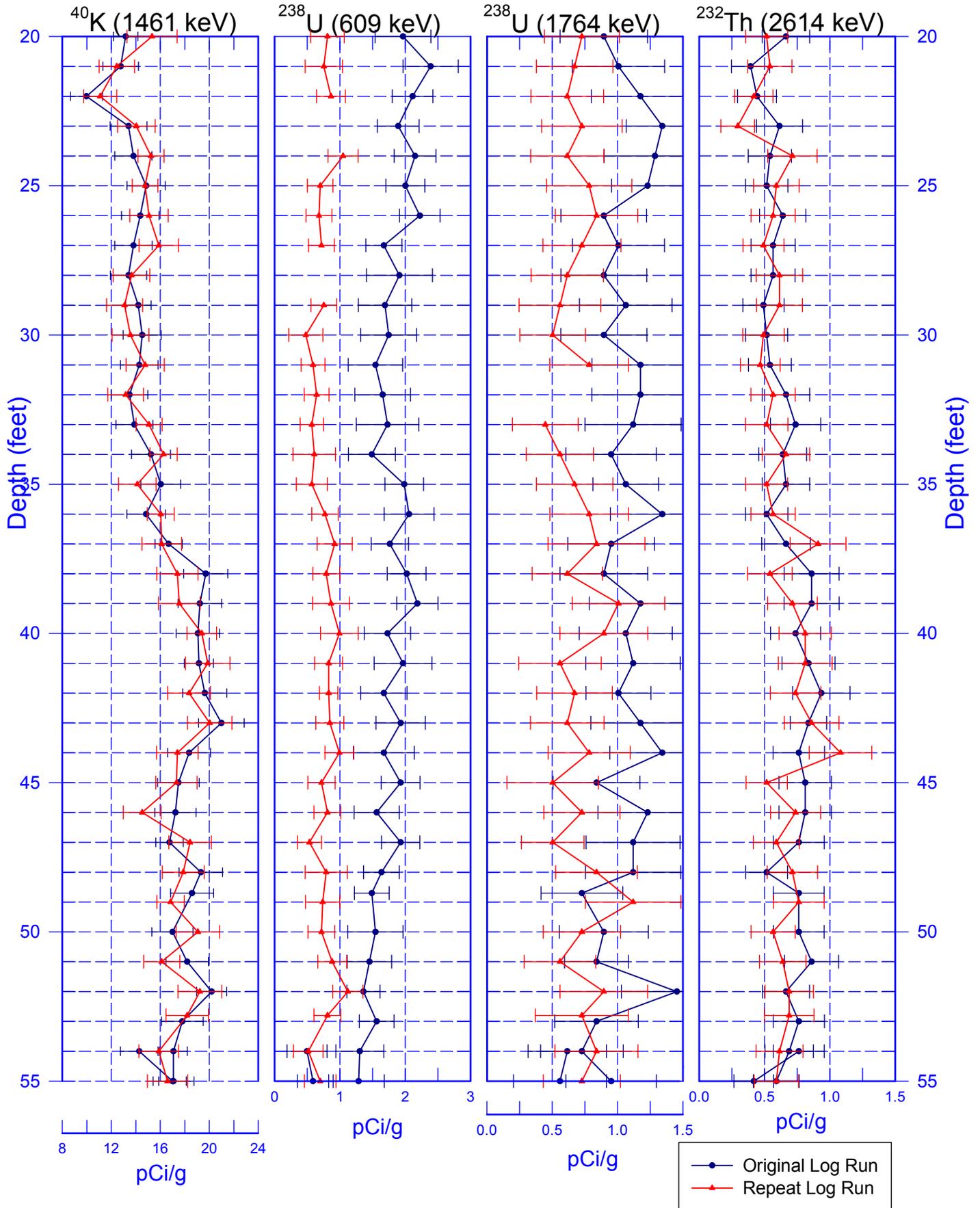
299-W11-1 (A7275)

Total Gamma & Dead Time



299-W11-1 (A7275)

Rerun of Natural Gamma Logs (55.0 to 20.0 ft)



299-W11-1 (A7275)

Rerun of Man-Made Radionuclides (55.0 to 20.0 ft)

