

299-E13-10 (A4724) Log Data Report

Borehole Information:

Borehole: 299-E13-10 (A4724)		Site: 216-B-52 & -53 Trenches			
Coordinates (WA State Plane)		GWL (ft)¹: 340.9		GWL Date: 12/29/03	
North 134,252.49 m	East 573,194.84 m	Drill Date Sept. 1956	TOC² Elevation 226.312 m	Total Depth (ft) 346	Type Cable Tool

Casing Information:

Casing Type	Stickup (ft)	Outer Diameter (in.)	Inside Diameter (in.)	Thickness (in.)	Top (ft)	Bottom (ft)
Welded steel	2.4	4 1/2	4	1/4	+2.4	105.4
Welded steel	0	unknown	8	unknown	0	344.4

The logging engineer measured the casing stick up using a steel tape. A caliper was used to determine the outside 4-in. 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. Casing depths are from Ledgerwood (1993). Only the 4-in. casing is visible at the ground surface.

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 4-in. casing. Crushed grout is present on the ground surface.

Logging Equipment Information:

Logging System: Gamma 1G	Type: 35% HPGe (34TP10967A)
Calibration Date: 4/2003	Calibration Reference: GJO-2003-438-TAC
Logging Procedure: MAC-HGLP 1.6.5, Rev. 0	

Logging System: Gamma 2A	Type: 35% HPGe (34TP20893A)
Calibration Date: 12/2003	Calibration Reference: GJO-2004-593-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
Date	12/18/03	12/24/03	12/30/03	01/09/04	01/12/04
Logging Engineer	Spatz	Spatz	Spatz	Spatz	Spatz
Start Depth (ft)	39.0	95.0	339.0	130.0	257.0
Finish Depth (ft)	18.0	38.0	256.0	94.0	167.0
Count Time (sec)	200	200	200	200	200
Live/Real	R	R	R	R	R
Shield (Y/N)	N	N	N	N	N

Log Run	1	2	3	4	5
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	AG037CAB	BA223CAB	BA224CAB	BA225CAB	BA226CAB
Start File	AG037000	BA223000	BA224000	BA225000	BA226000
Finish File	AG037021	BA223057	BA224083	BA225036	BA226090
Post-Verification	AG037CAA	BA223CAA	BA224CAA	BA225CAA	BA226CAA
Depth Return Error (in.)	0	0	-2	0	-1
Comments	No fine-gain adjustment.	No fine-gain adjustment.	Fine-gain adjustment after file 003.	No fine-gain adjustment.	Fine-gain adjustment after files 003 and 017.

Log Run	6	7/Repeat	8		
Date	01/14/04	01/14/04	01/15/04		
Logging Engineer	Spatz	Spatz	Spatz		
Start Depth (ft)	168.0	130.0	3.0		
Finish Depth (ft)	129.0	97.0	39.0		
Count Time (sec)	200	200	200		
Live/Real	R	R	R		
Shield (Y/N)	N	N	N		
MSA Interval (ft)	1.0	1.0	1.0		
ft/min	N/A	N/A	N/A		
Pre-Verification	BA227CAB	BA227CAB	BA228CAB		
Start File	BA227000	BA227040	BA228000		
Finish File	BA227039	BA227073	BA228036		
Post-Verification	BA227CAA	BA227CAA	BA228CAA		
Depth Return Error (in.)	N/A	-1	-1		
Comments	No fine-gain adjustment.	Fine-gain adjustment after file 039.	No fine-gain adjustment.		

Logging Operation Notes:

Zero reference was top of the 4-in. casing. Logging was performed without a centralizer installed on the sonde because a 4-in. liner was present. Pre- and post-survey verification measurements for the SGLS employed the Amersham KUT (⁴⁰K, ²³⁸U, and ²³²Th) verifier with serial number 118 for Gamma 1G and Amersham KUT verifier with serial number 082 for Gamma 2A. Maximum logging depth achieved was 339 ft, approximately 1 ft above groundwater.

Analysis Notes:

Analyst:	Sobczyk	Date:	3/08/04	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 the day. All of the verification spectra were within the acceptance criteria except for spectrum BA227CAA. The peak counts per second (cps) 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 17 percent higher and 11 percent lower at the end of the day. Examinations of spectra indicate that the detector functioned normally during logging, and the spectra are 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 SGLS data using APTEC SUPERVISOR. Concentrations were calculated in EXCEL (source files: G1GMay03.xls and G2AFeb04.xls), using parameters determined from analysis of calibration data. Zero reference was the top of the 4-in. casing. On the basis of Ledgerwood (1993), the casing configuration was assumed to be a string of 8-in. casing from the ground surface to the maximum depth of the logging (339 ft) and a string of 4-in. casing to 105.4 ft. Casing correction factors were calculated assuming casing thicknesses of 1/4 in. for the 4-in. casing and 5/16 in. for the 8-in. casing. Because the 8-in. casing wasn't visible at the ground surface, the thickness for 8-in. casing was assumed to be 5/16 in., which was the measured thickness of 8-in. casings at nearby boreholes. Where more than one casing exists at a depth, the casing correction is additive (e.g., $1/4 + 5/16 = 0.563$ is the combined thickness for the 4-in. and 8-in. casings). Water and dead time corrections were not required.

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. 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 less affected by the presence of radon in the borehole.

Results and Interpretations:

^{137}Cs was the only man-made radionuclide detected in this borehole. ^{137}Cs was detected in the intervals from 6 to 8 ft and 329 to 331 ft with concentrations ranging from 0.2 to 0.4 pCi/g. ^{137}Cs was also detected at 28, 87, 100, 106, 123, and 157 ft at concentrations near the MDL (0.2 pCi/g). Examinations of the gamma energy spectra indicate that the occurrences of ^{137}Cs at 28, 87, 100, 106, 123, and 157 ft are probably statistical flukes, because well-defined 662-keV photopeaks are not evident.

The presence of grout has affected the KUT response in this borehole. Grout is present in the annulus between the casings to a depth of 105 ft (Ledgerwood 1993). Grout is also present outside the 8-in. casing to a depth of at least 97 ft (Ledgerwood 1993).

The behavior of the naturally occurring ^{238}U log (measured by ^{214}Bi) 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 . 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 between the original and repeat log runs, and the elevated gamma and ^{238}U values during log run 2 (95 to 38 ft).

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.

The plots of the repeat logs demonstrate reasonable repeatability of the SGLS data. Taking into account the effects of radon, the plots of the repeat logs demonstrate reasonable repeatability of the SGLS data for the natural radionuclides at energy levels of 1461 and 2614 keV. The man-made radionuclide ^{137}Cs (based on 662 keV) was detected at 28, 100, 106, and 123 ft on the original log runs; however, ^{137}Cs was not

detected at these depths on the repeat log runs. Photopeaks at 662 keV were not apparent at these depths on both the repeat and original logs.

Gross gamma logs from Additon et al. (1977) (attached) indicate that the sediments surrounding this borehole contained man-made radionuclides between 1958 and 1976. Elevated gamma relative to background occurs in the intervals between 29 ft (9 m) and 39 ft (12 m). The decay behavior of the gross gamma log between 29 and 39 ft indicates gamma-emitting radionuclides with a very short half-life (~1 year). The SGLS logs did not detect any radionuclides in this interval. In addition, the log from 4/30/76 appears to detect elevated levels of gamma radiation at one point near groundwater at a depth of 344 ft (105 m). The SGLS detected only trace amounts of ¹³⁷Cs in the interval between 329 and 331 ft.

References:

Additon, M.K., K.R. Fecht, T.L. Jones, and G.V. Last, 1978. *Scintillation Probe Profiles From 200 East Area Crib Monitoring Wells*, RHO-LD-28, Rockwell Hanford Operations, Richland, Washington.

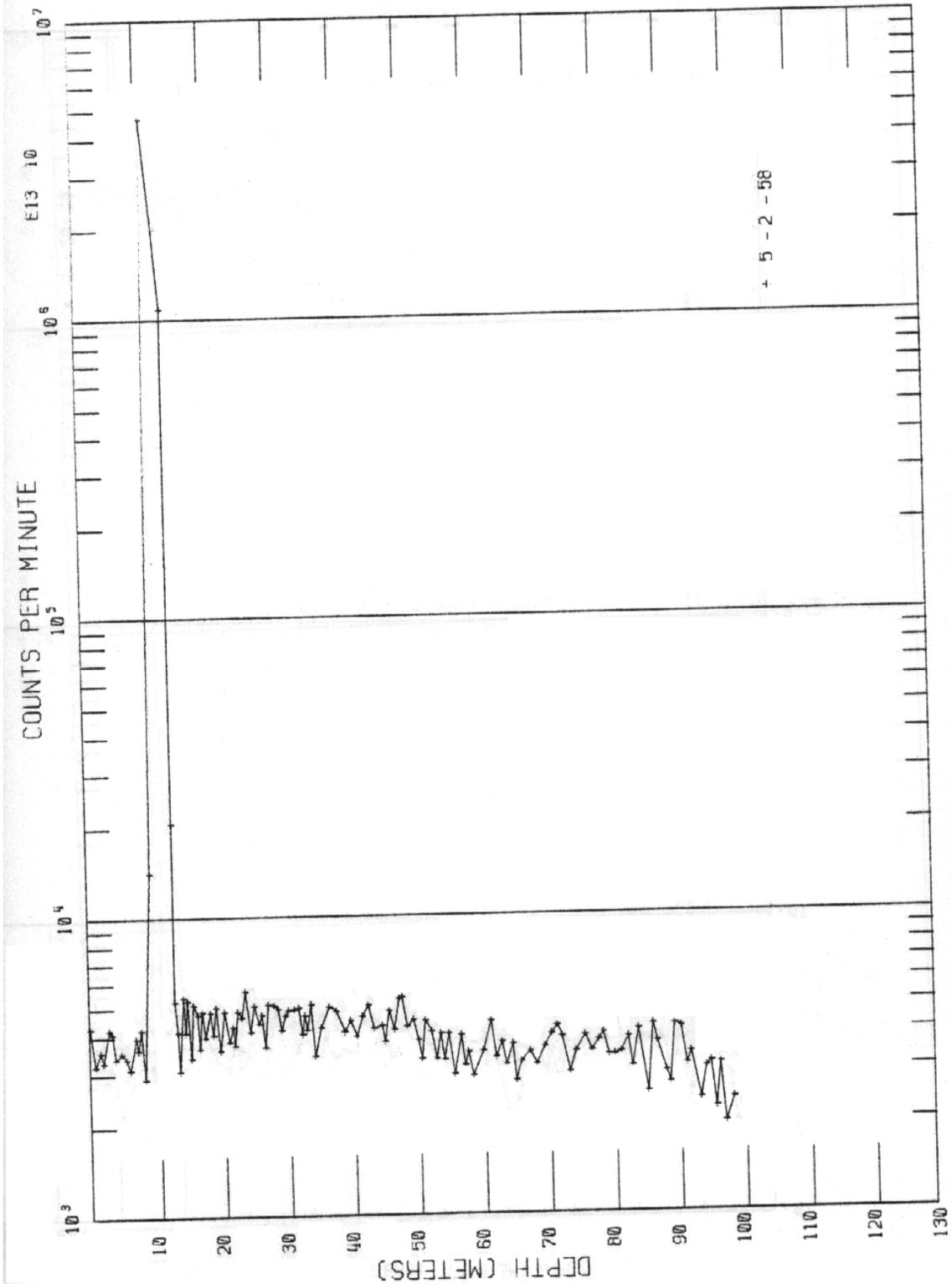
Ledgerwood, R.K., 1993. *Summaries of Well Construction Data and Field Observations for Existing 200-East Resource Protection Wells*, WHC-SD-ER-TI-007, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

¹ GWL – groundwater level

² TOC – top of casing

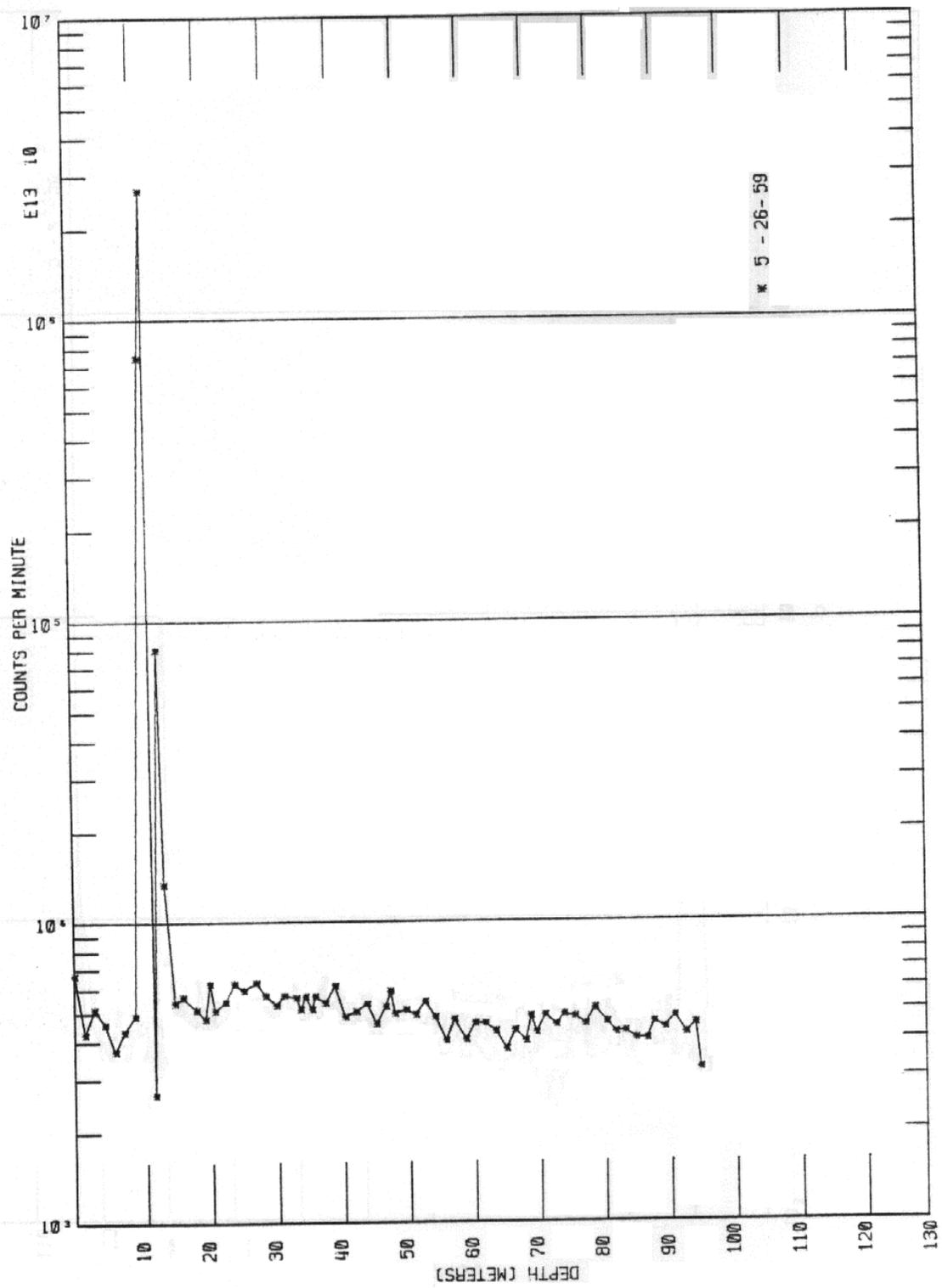
³ HWIS – Hanford Well Information System

⁴ N/A – not applicable



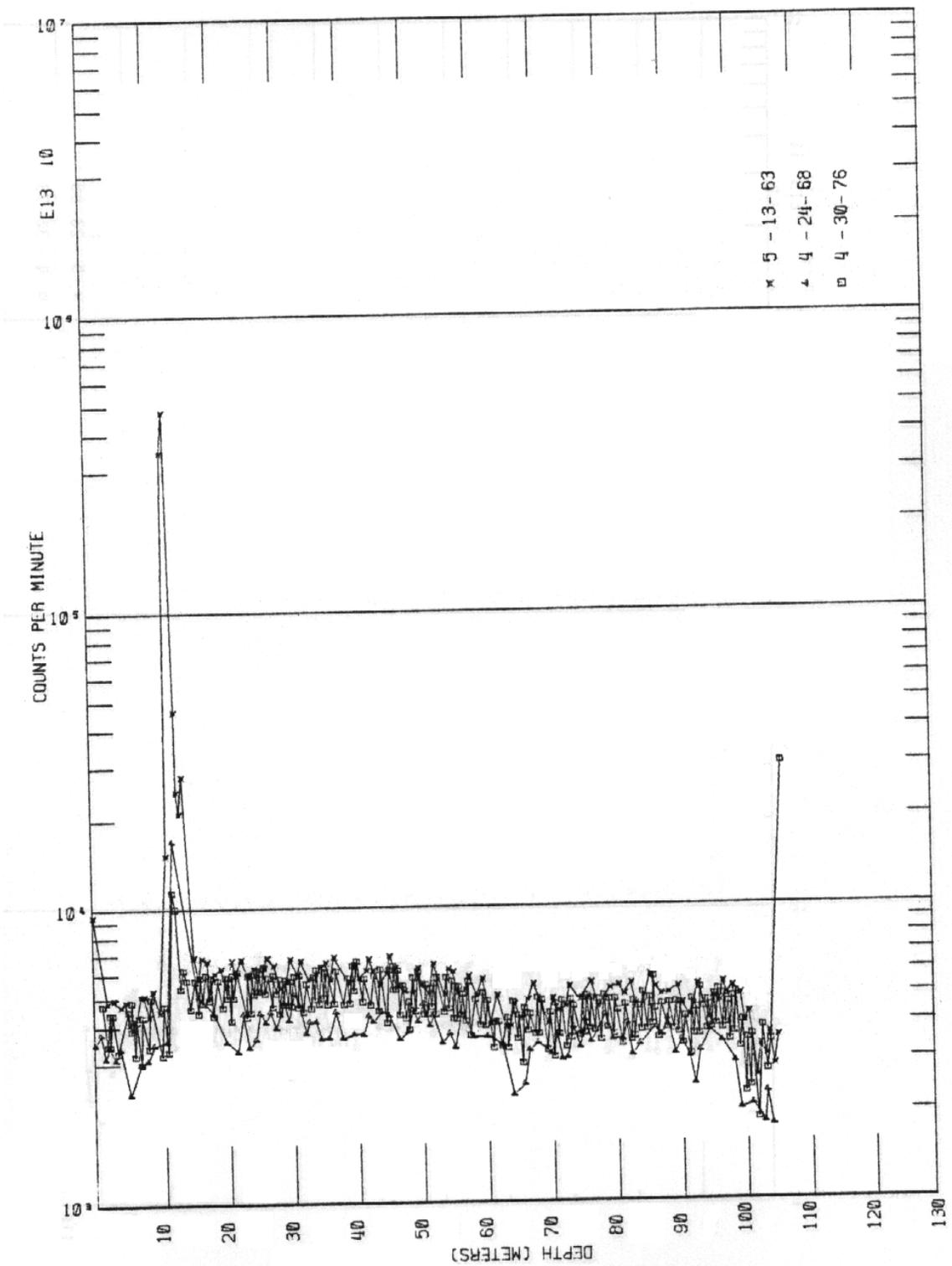
from Additon et al. (1978)

Scintillation Probe Profile for Borehole 299-E13-10, Logged on 5/2/58



from Additon et al. (1978)

Scintillation Probe Profile for Borehole 299-E13-10, Logged on 5/26/59

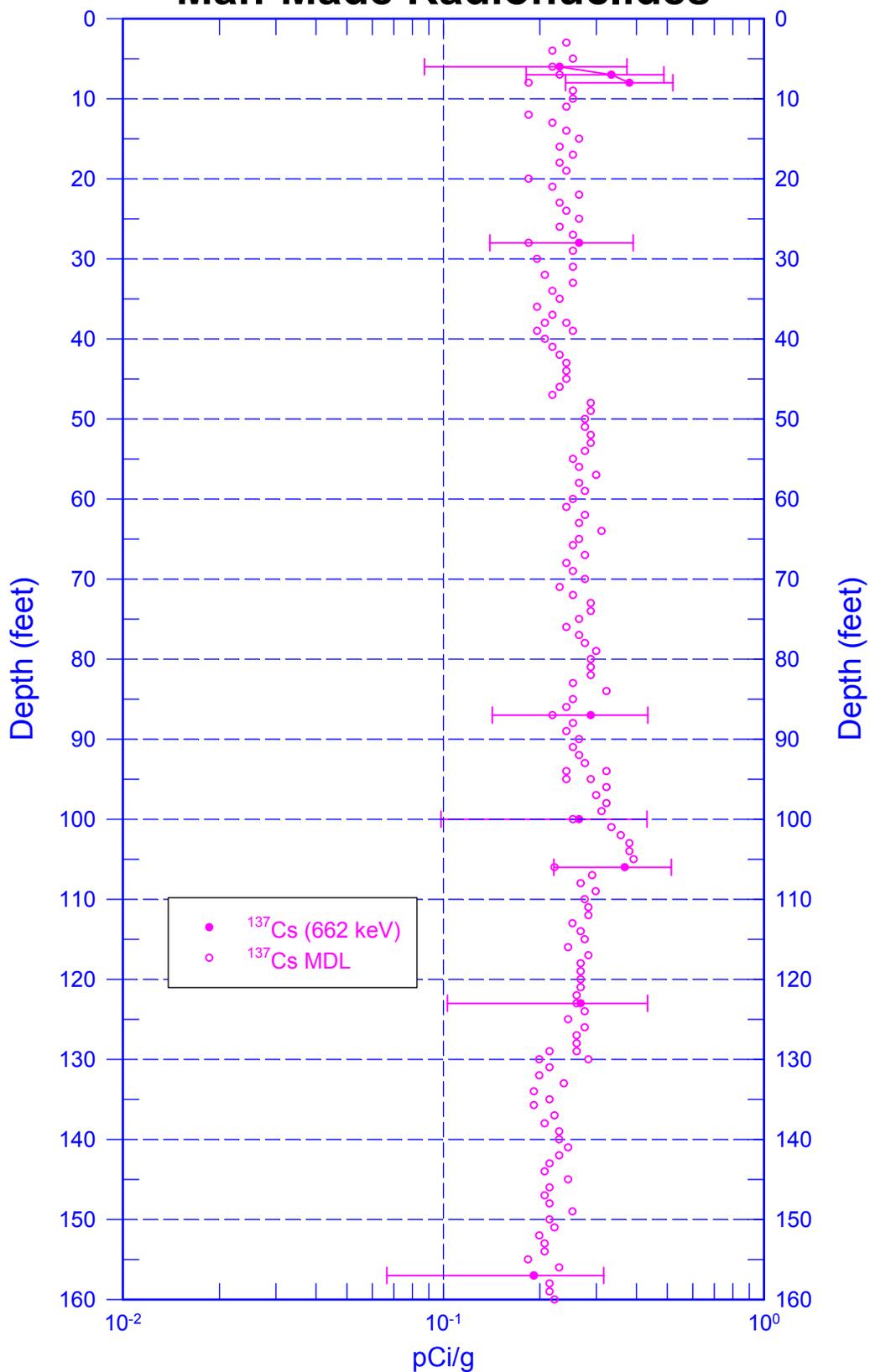


from Additon et al. (1978)

Scintillation Probe Profiles for Borehole 299-E13-10, Logged on 5/13/63, 4/24/68, and 4/30/76

299-E13-10 (A4724)

Man-Made Radionuclides

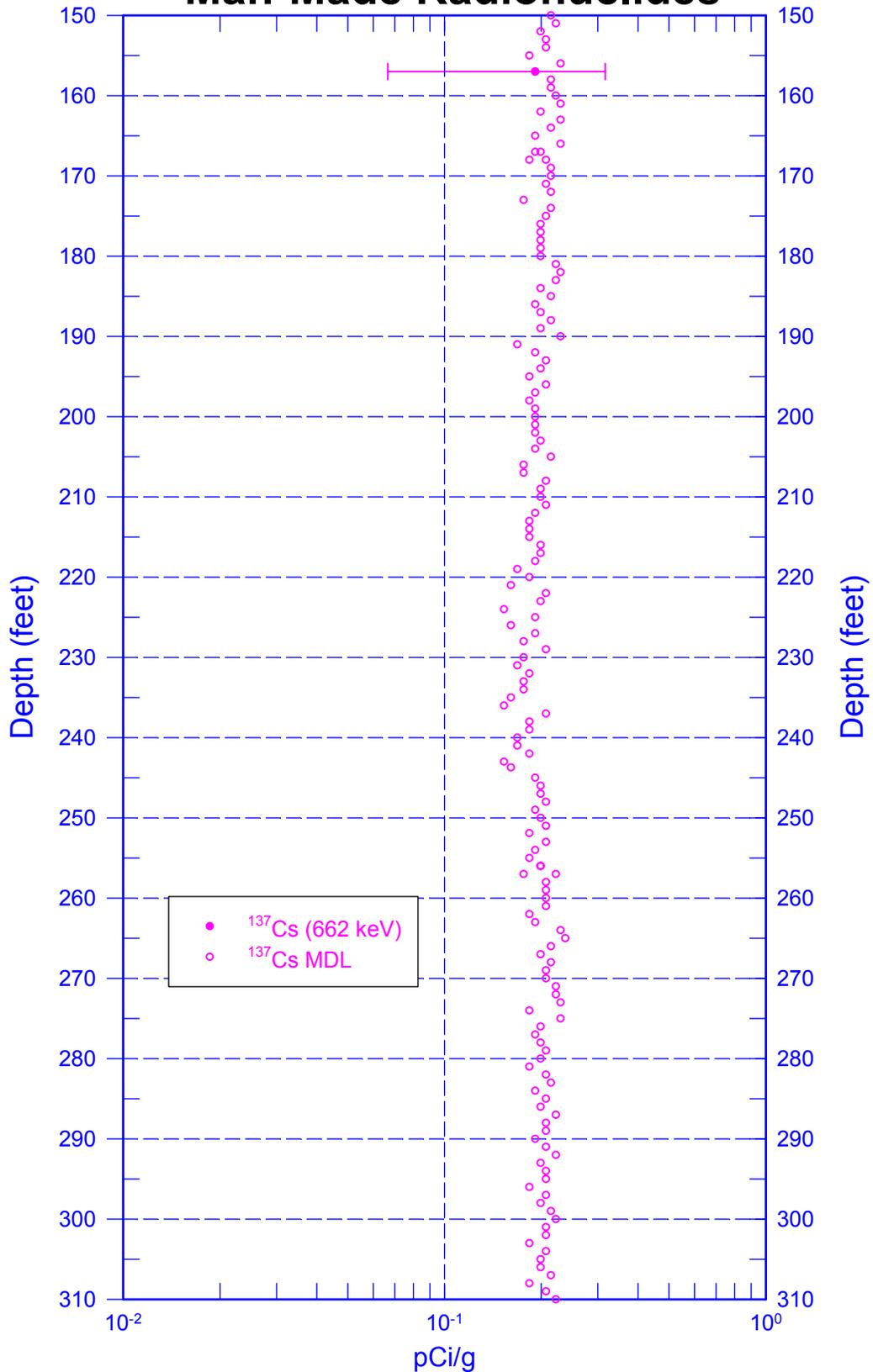


Zero Reference = Top of 4-in. Casing

Date of Last Logging Run
1/15/2004

299-E13-10 (A4724)

Man-Made Radionuclides

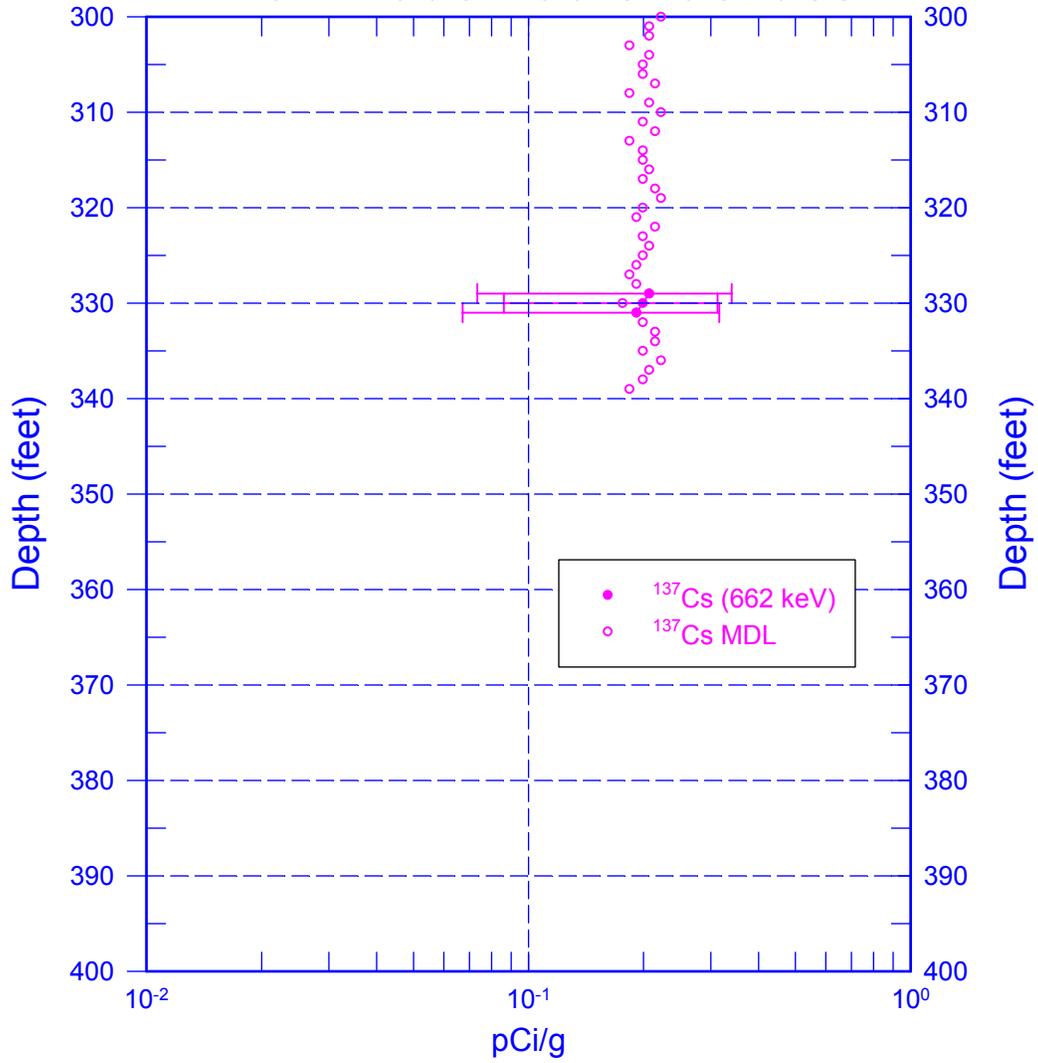


Zero Reference = Top of 4-in. Casing

Date of Last Logging Run
1/15/2004

299-E13-10 (A4724)

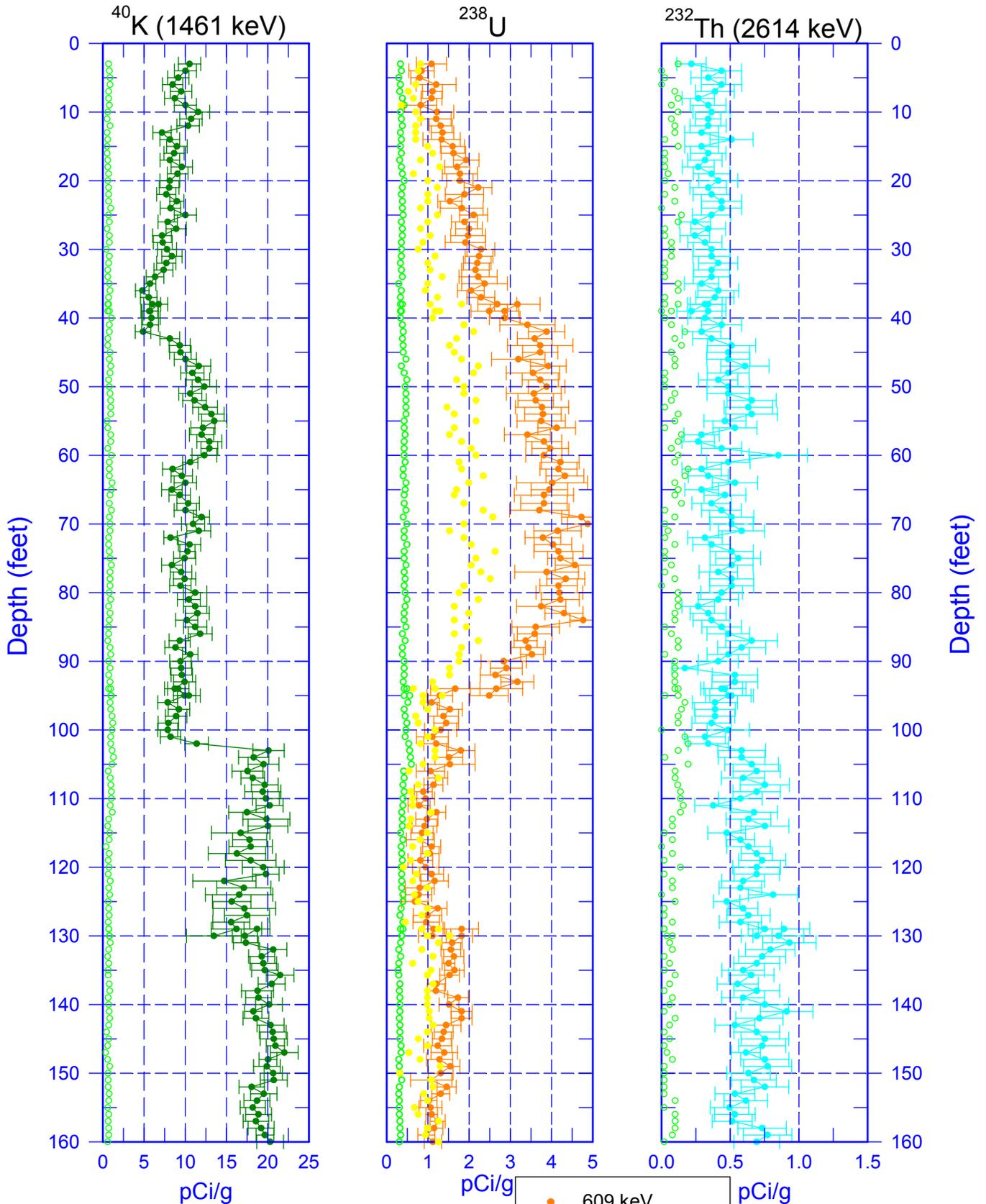
Man-Made Radionuclides



Zero Reference = Top of 4-in. Casing

Date of Last Logging Run
1/15/2004

299-E13-10 (A4724) Natural Gamma Logs



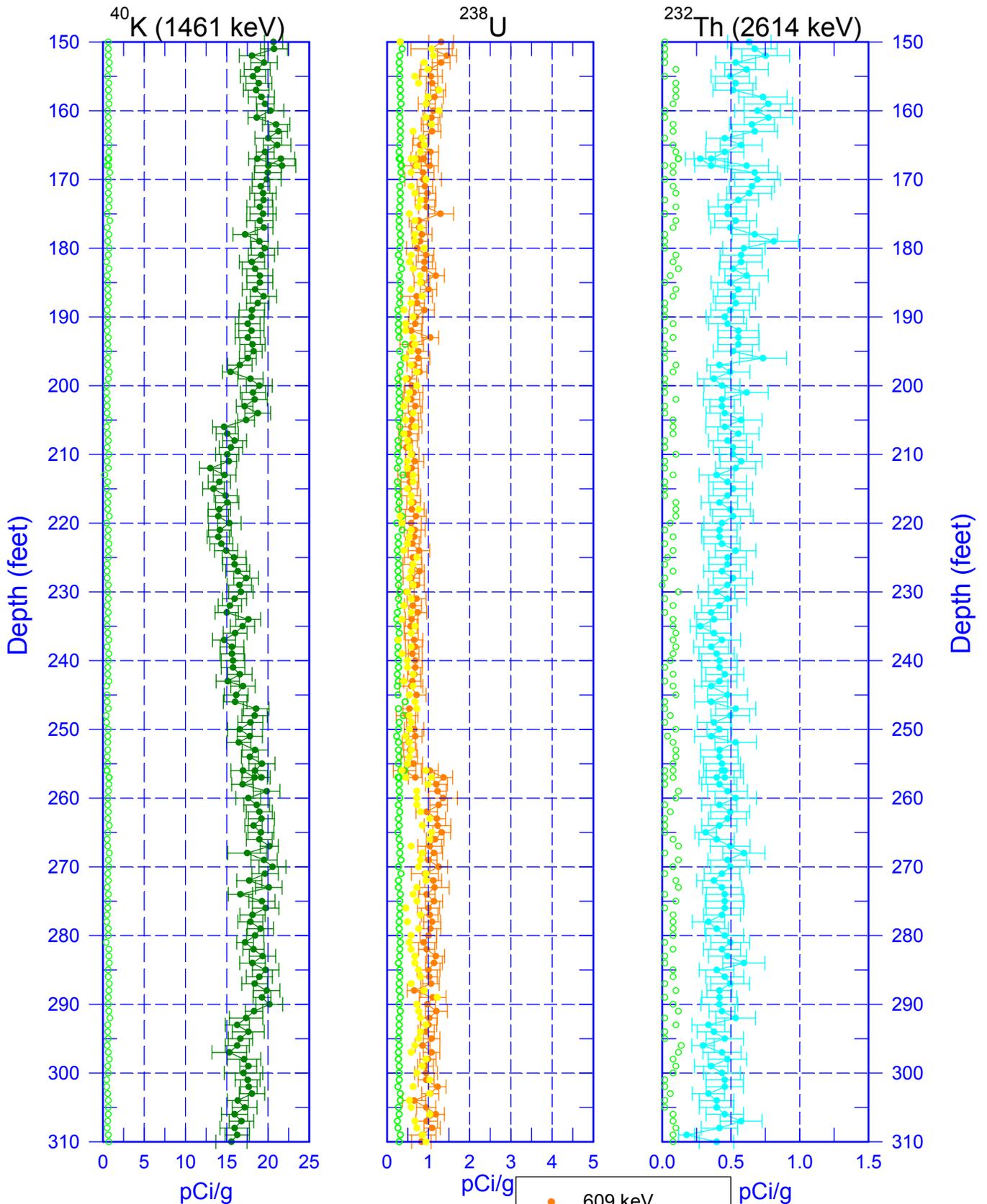
Zero Reference = Top of 4-in. Casing

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

Date of Last Logging Run
1/15/2004

299-E13-10 (A4724)

Natural Gamma Logs

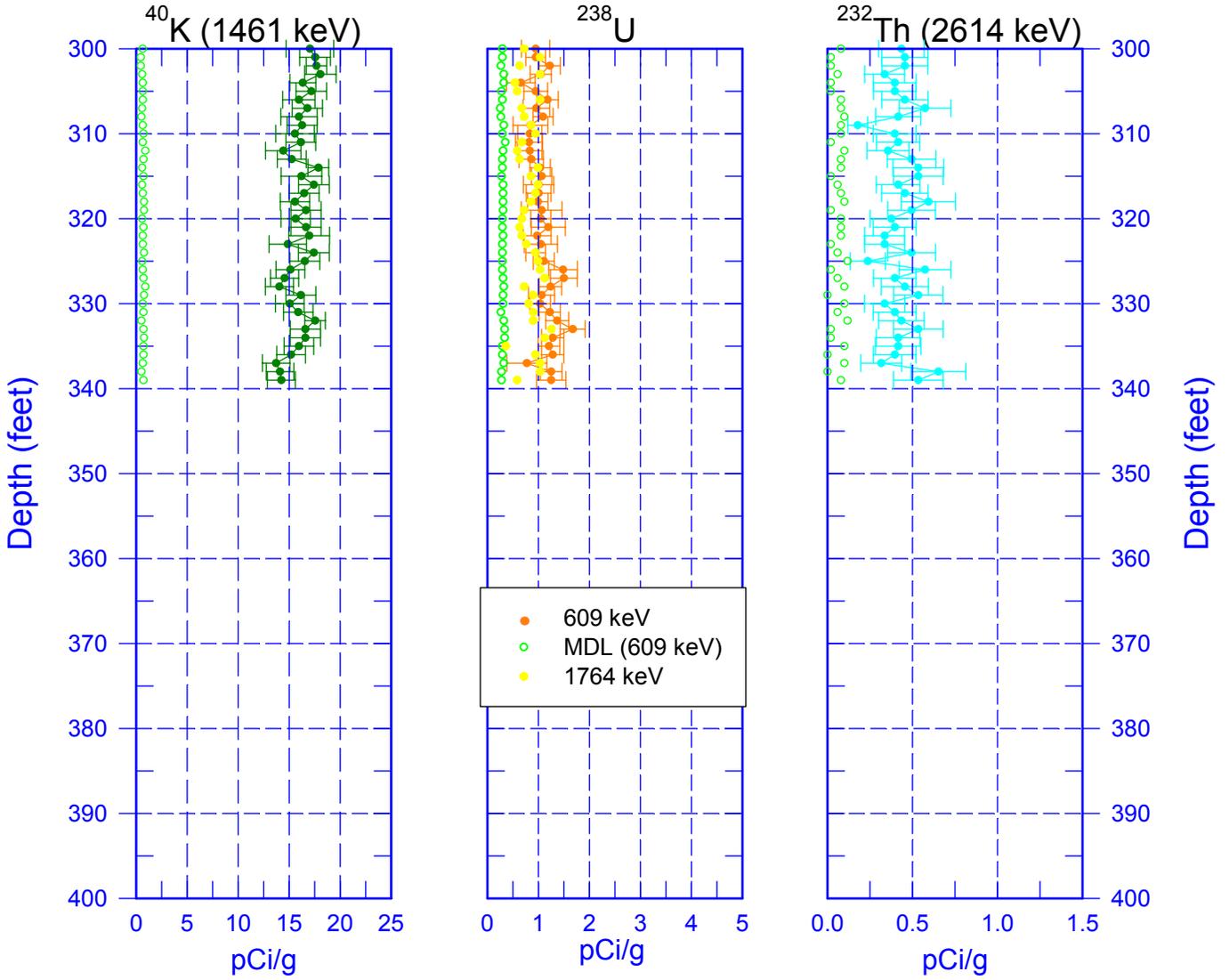


Zero Reference = Top of 4-in. Casing

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

Date of Last Logging Run
1/15/2004

299-E13-10 (A4724) Natural Gamma Logs

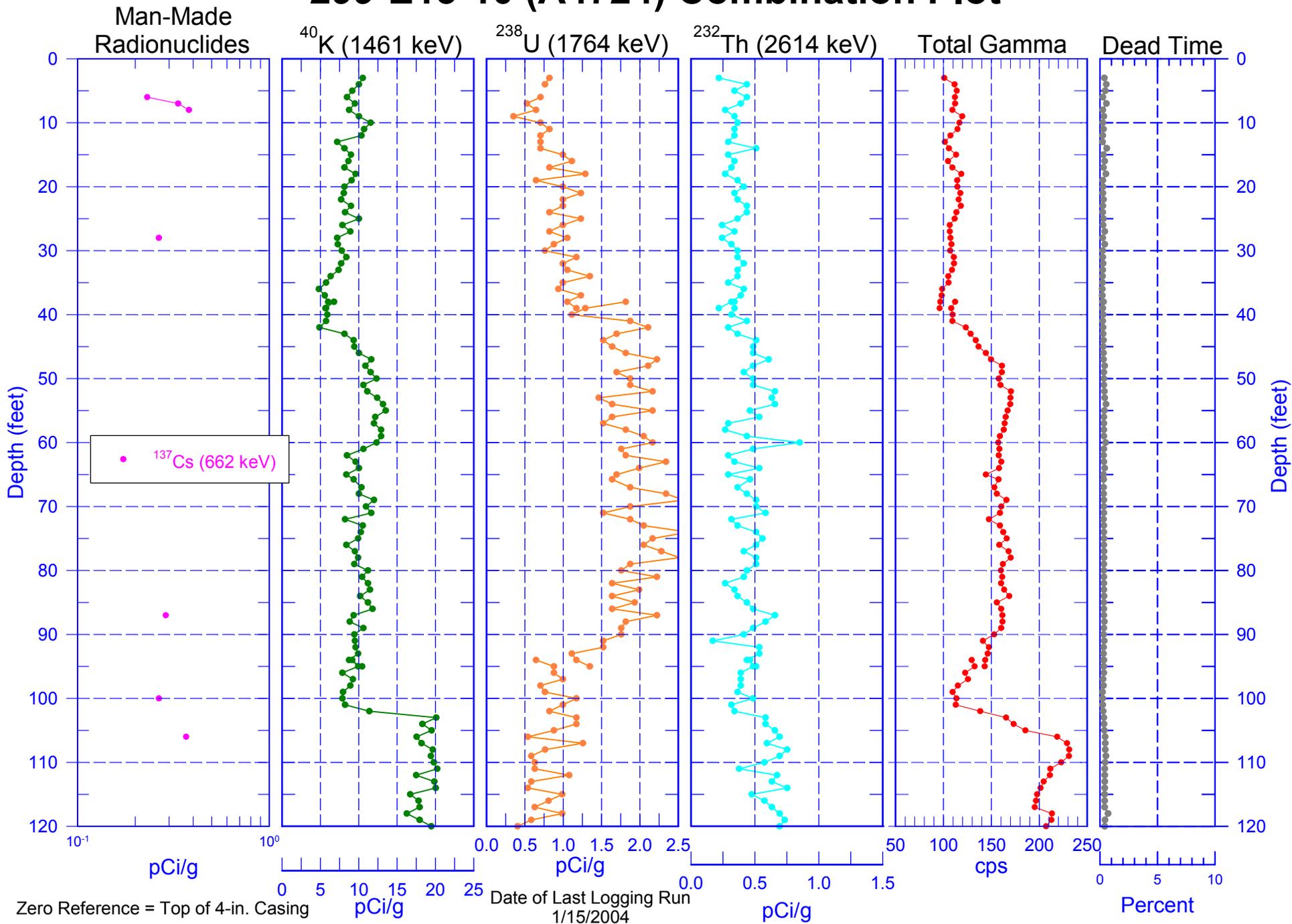


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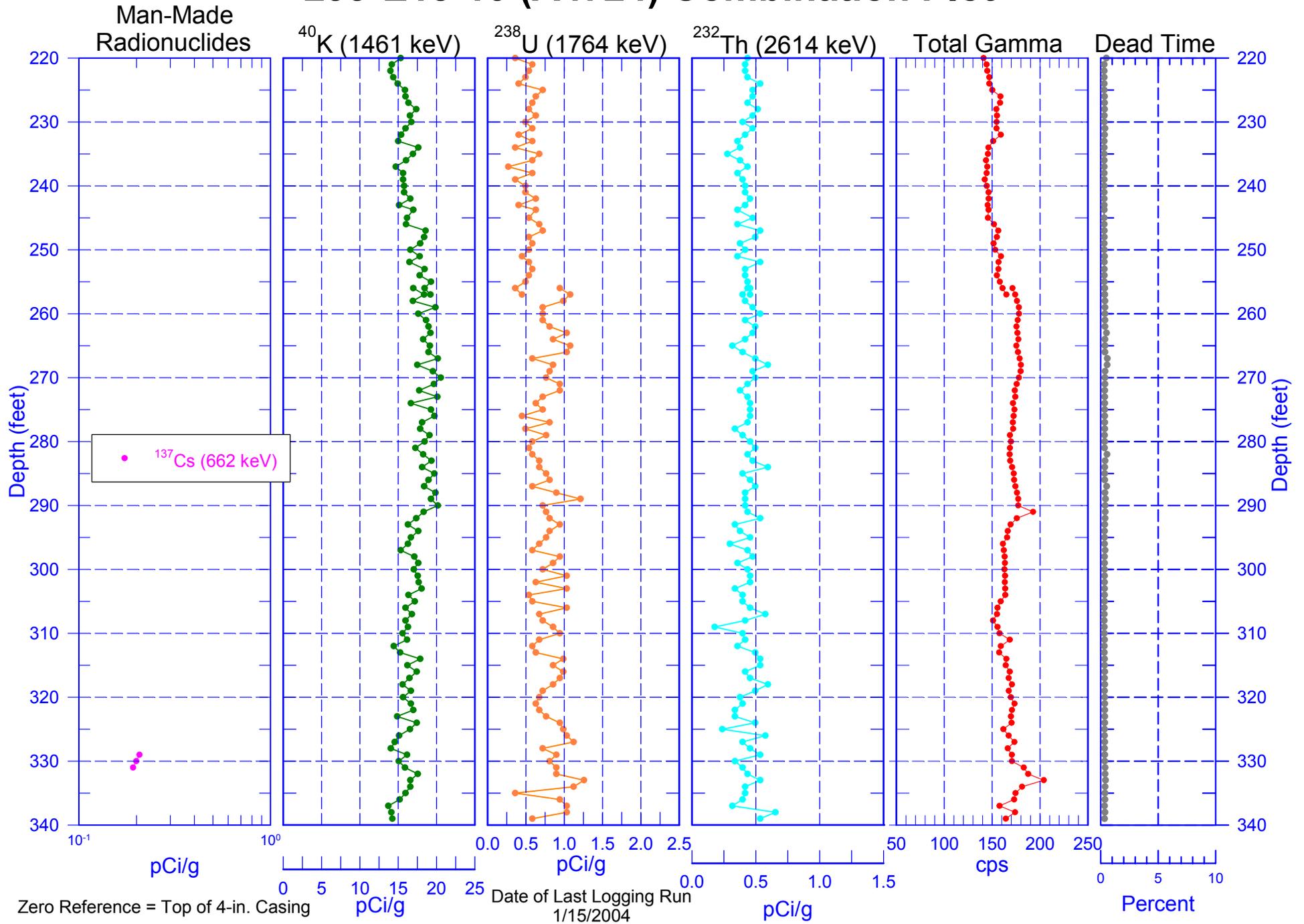
○ MDL

Date of Last Logging Run
1/15/2004

299-E13-10 (A4724) Combination Plot

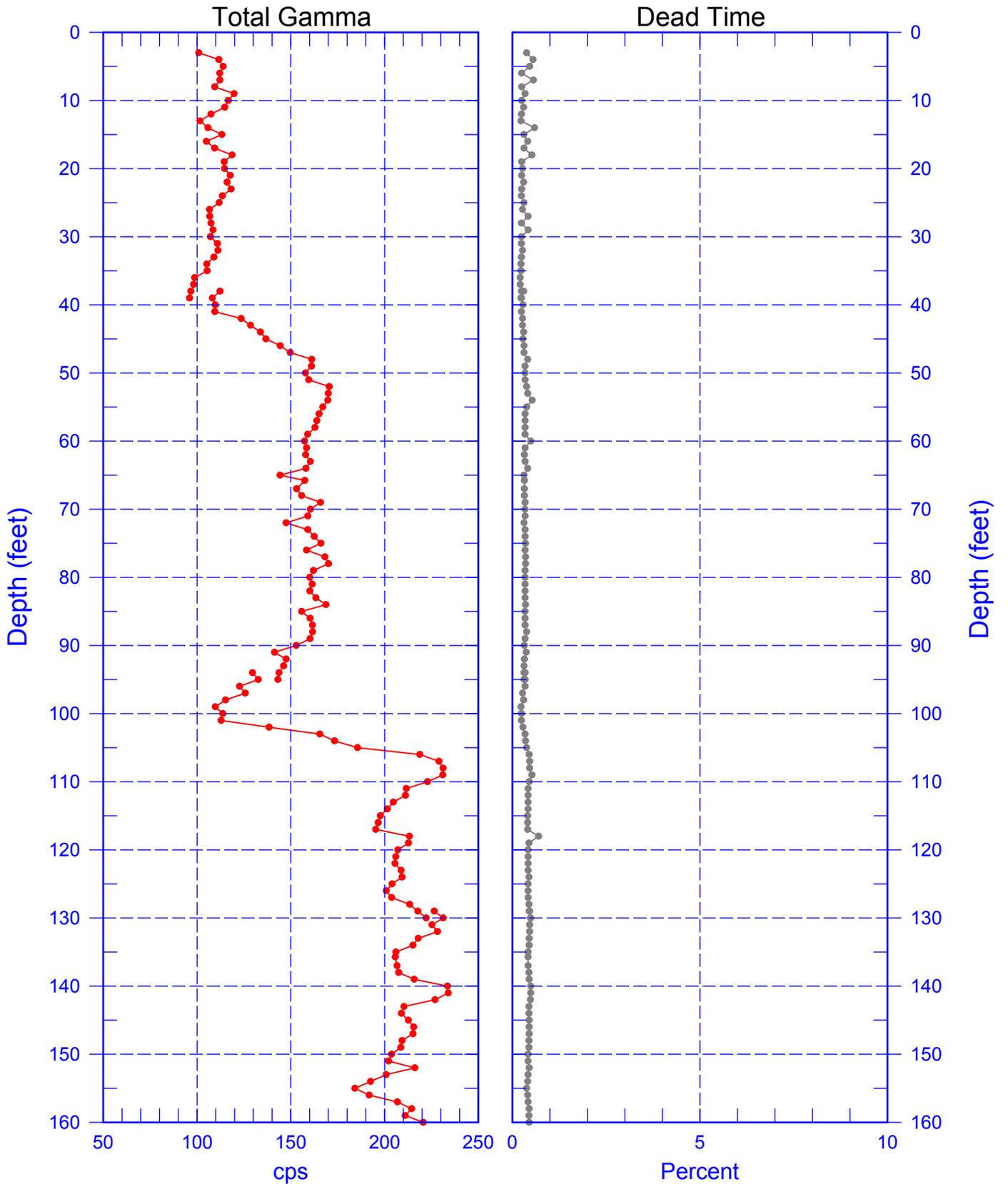


299-E13-10 (A4724) Combination Plot



299-E13-10 (A4724)

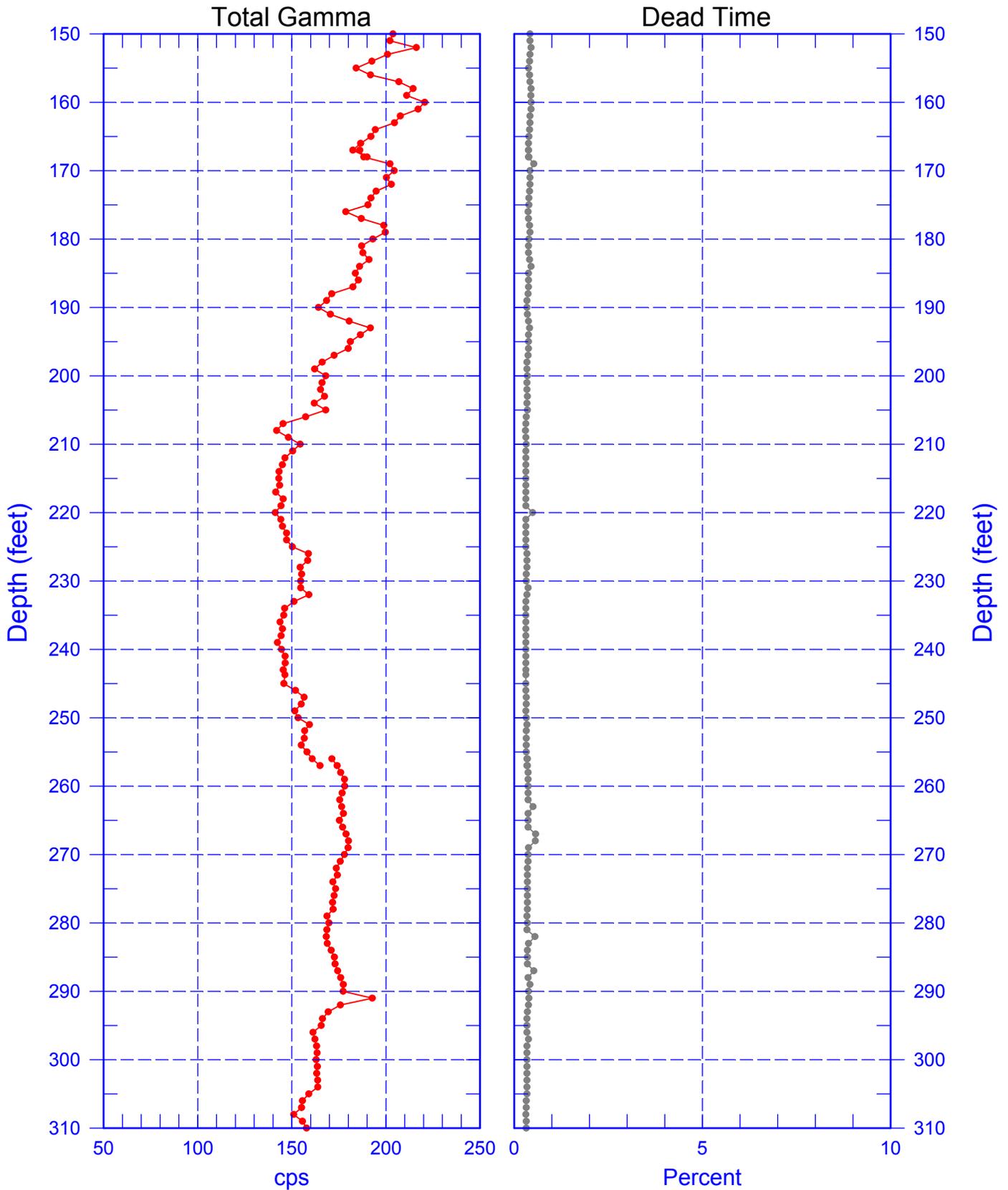
Total Gamma & Dead Time



Zero Reference = Top of 4-in. Casing
Date of Last Logging Run
1/15/2004

299-E13-10 (A4724)

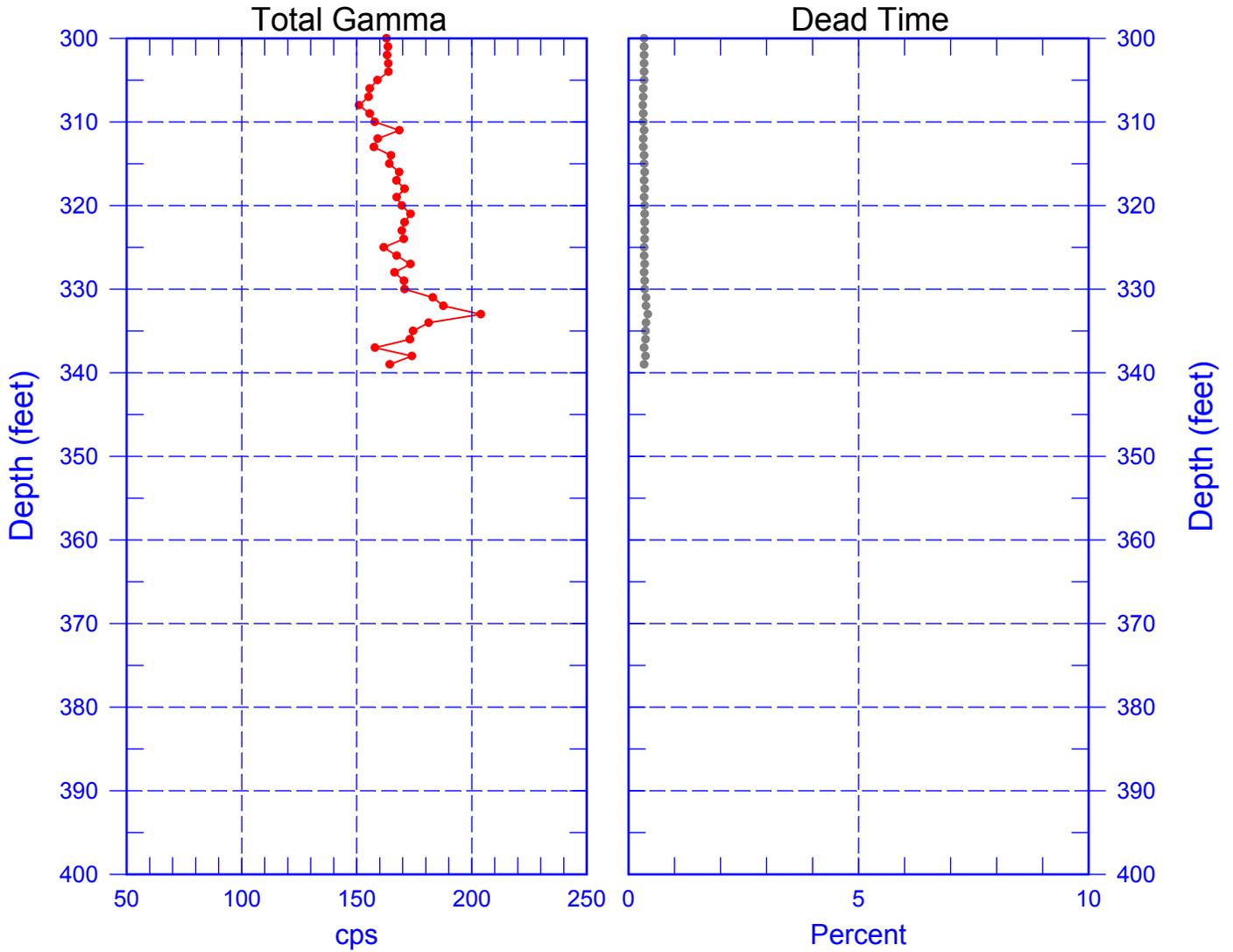
Total Gamma & Dead Time



Zero Reference = Top of 4-in. Casing
Date of Last Logging Run
1/15/2004

299-E13-10 (A4724)

Total Gamma & Dead Time

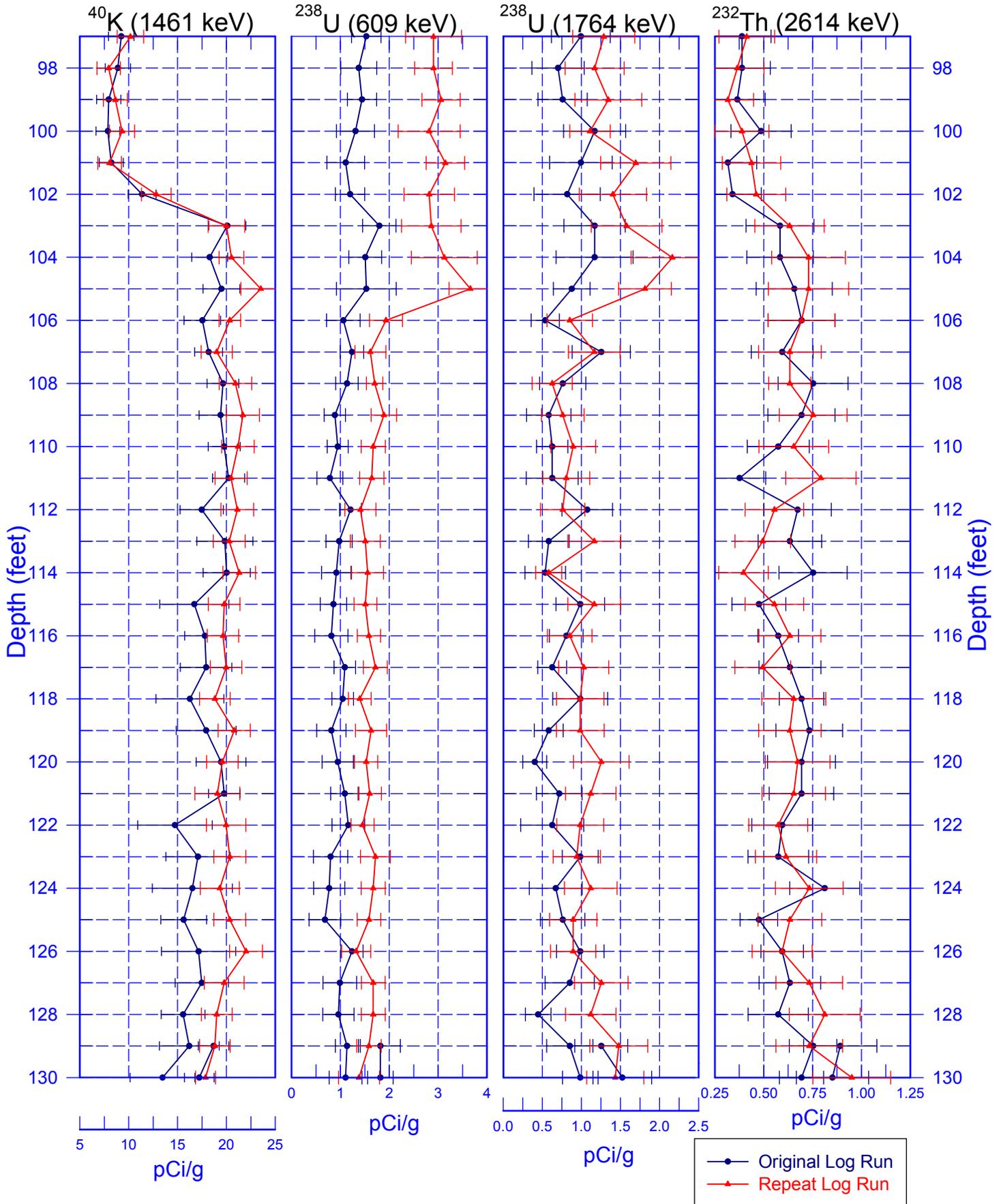


Zero Reference = Top of 4-in. Casing

Date of Last Logging Run
1/15/2004

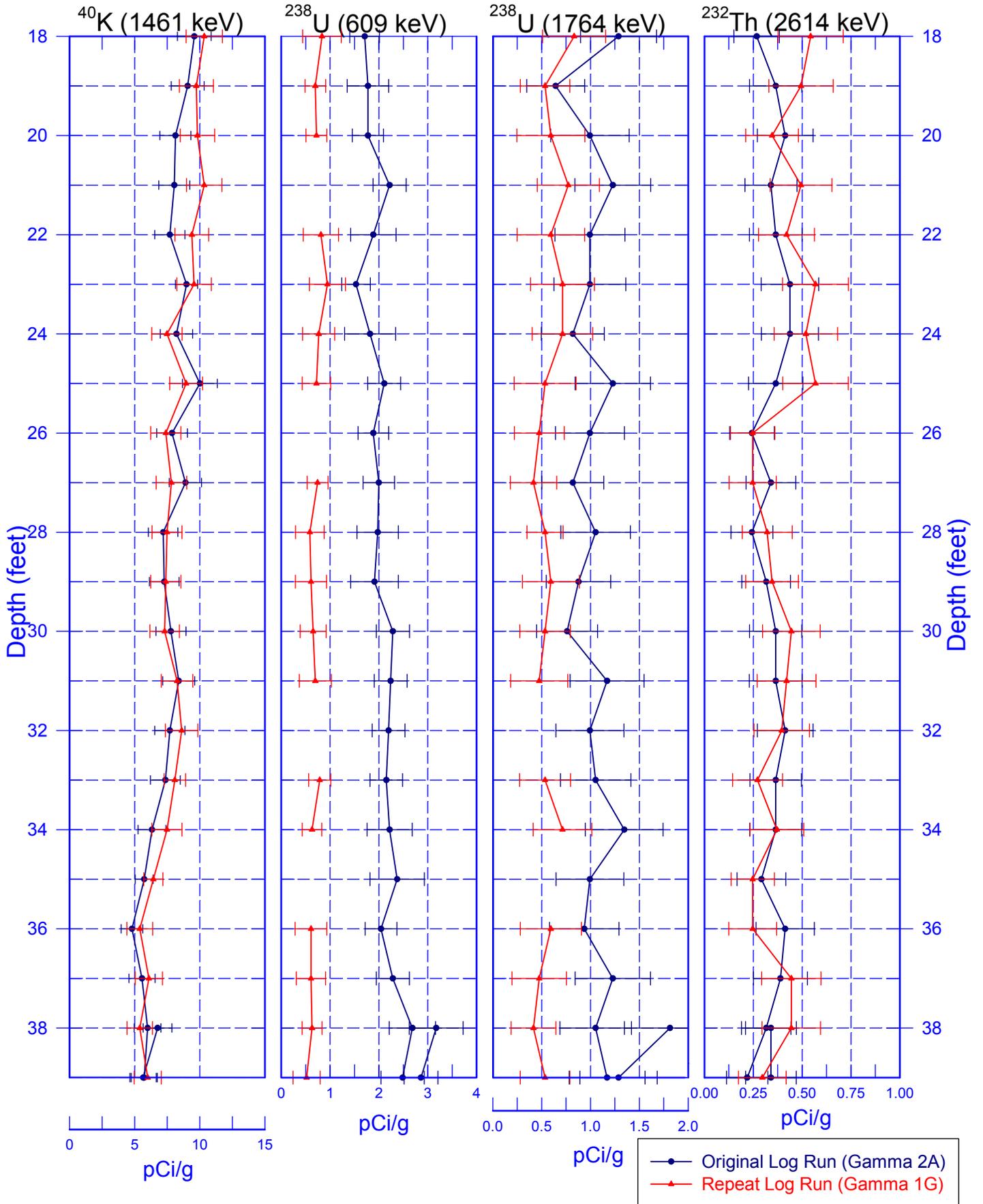
299-E13-10 (A4724)

Rerun of Natural Gamma Logs (130.0 to 97.0 ft)



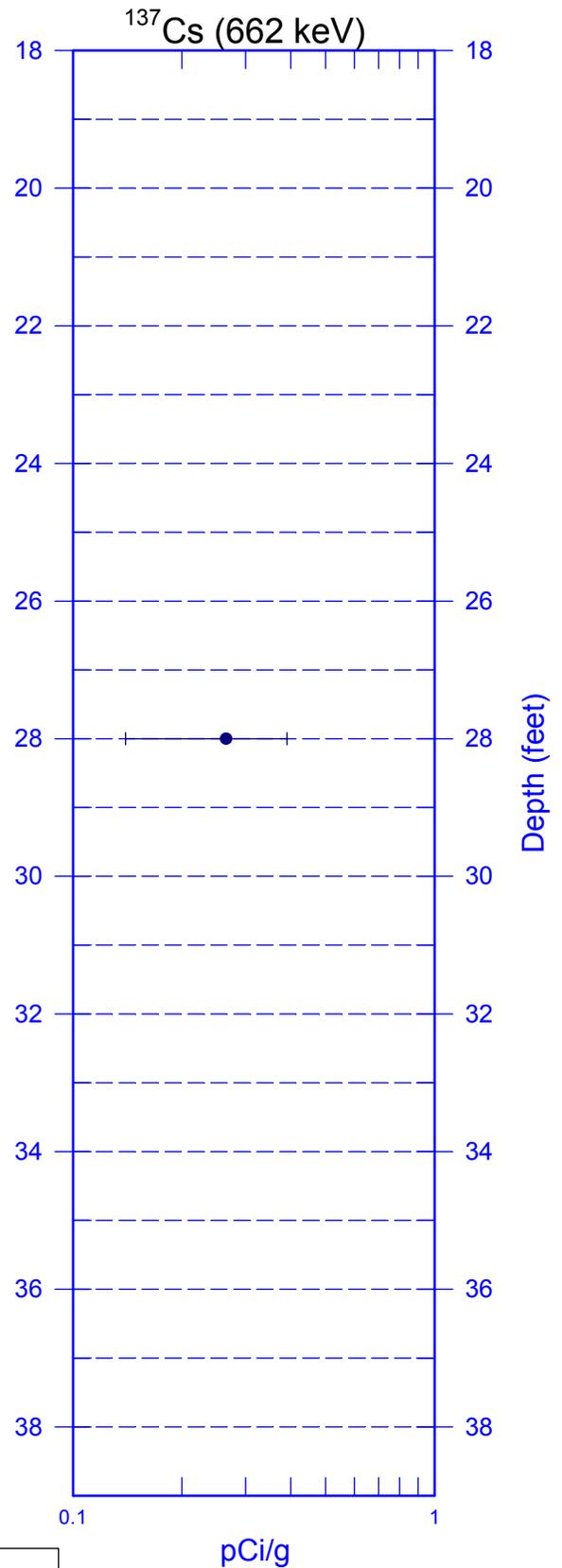
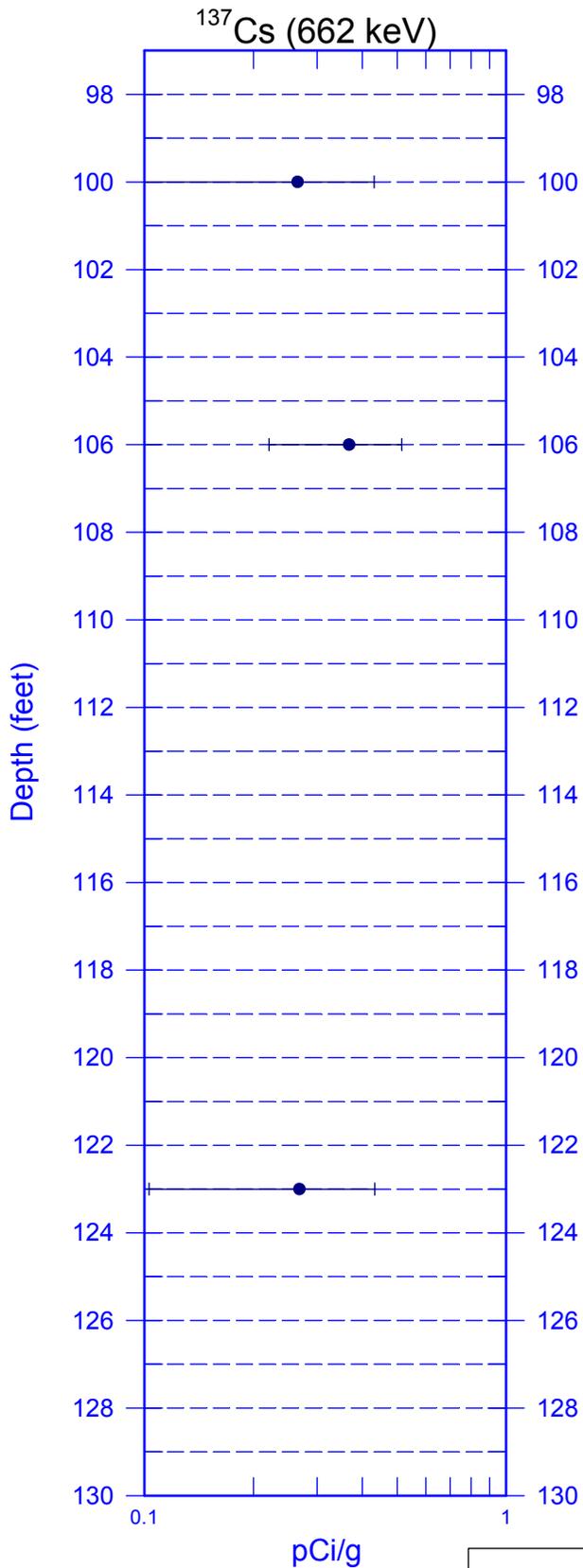
299-E13-10 (A4724)

Rerun of Natural Gamma Logs (39.0 to 18.0 ft)



299-E13-10 (A4724)

Rerun of Man-Made Radionuclides



● Original Log Run
▲ Repeat Log Run