299-E29-54 (C5860)
Log Data Report

Borehole Information:

Borehole:	299-E29-54 (C5860)			Site:	200-BP-5, 216-B-6 Reverse Well
Coordinates (WA St Plane)		GWL[1] (ft):	304.7	GWL Date:	02/10/10
North (m)	East (m)	Drill Date	TOC Elevation	Total Depth (ft)	Type
Not available	Not available	02/08/10	Not available	374	Cable

Casing Information:

Casing Type	Stickup (ft)	Outer Diameter (inch)	Inside Diameter (inch)	Thickness (inch)	Top (ft)	Bottom (ft)
Threaded steel	-1.1	13 7/16	12 7/16	1/2	-1.1	104
Threaded steel	-1.1	10 3/4	9 5/8	9/16	-1.1	242
Threaded steel	-1.2	8 11/16	7 9/16	9/16	-1.2	370

Borehole Notes:

Borehole information is taken from the "Well Attributes Report". The logging engineer measured casing diameters and rounded to the nearest 1/16-inch. The plotted ground water depth is based on the Total Gamma plot, at 305.5 feet, 10 inches deeper than the reported depth of 304.7 feet.

Logging Equipment Information:

Logging System:	Gamma 4N		Type: Serial No.:	SGLS HPGe (60%) 45TP22010A
Effective Calibration Date:	2/17/09	Calibration Reference:	HGLP-CC-022, Rev. 2	
		Logging Procedure:	HGLP-MAN-002, Rev. 0	

Logging System:	Gamma 1H (with AmBe source)		Type: Serial No.:	NMLS H310700352
Effective Calibration Date:	04/01/09	Calibration Reference:	HGLP-CC-047, Rev. 1	
		Logging Procedure:	HGLP-MAN-002, Rev. 0	

Logging System:	Gamma 1L		Type: Serial No.:	SGLS HPGe (60%) 47TP32211A
Effective Calibration Date:	03/26/09	Calibration Reference:	HGLP-CC-030, Rev. 1	
		Logging Procedure:	HGLP-MAN-002, Rev. 0	

Logging System:	Gamma 4M (with AmBe source)		Type: Serial No.:	NMLS H340207279
Effective Calibration Date:	02/12/09	Calibration Reference:	HGLP-CC-023, Rev. 1	
		Logging Procedure:	HGLP-MAN-002, Rev. 0	

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Logging System:	Gamma 1M (with AmBe source)	**Type:** **Serial No.:**	NMLS H340207279
Effective Calibration Date:	04/01/09	**Calibration Reference:**	HGLP-CC-032, Rev. 1
		Logging Procedure:	HGLP-MAN-002, Rev. 0

Spectral Gamma Logging System (SGLS) Log Run Information:

Log Run	1	2 Repeat	5	6 Repeat	10
HEIS Number	1014760	1014761	1014762	1014763	1014764
Date	12/02/09	12/02/09	12/21/09	12/21/09	02/09/10
Logging Engineer	Spatz/McClellan	Spatz/McClellan	Spatz/McClellan	Spatz/McClellan	Spatz/Holloway
Start Depth (ft)	0.0	75.0	101.0	190.0	242.0
Finish Depth (ft)	102.0	85.0	243.0	204.0	370.0
Count Time (sec)	100	100	100	100	100
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
Log Speed (ft/min)	N/A	N/A	N/A	N/A	N/A
Pre-Verification	DND21CAB	DND21CAB	AL045CAB	AL045CAB	AL056CAB
Start File	DND21000	DND21103	AL045000	AL045143	AL056000
Finish File	DND21102	DND21113	AL045142	AL045157	AL056128
Post-Verification	DND21CAA	DND21CAA	AL045CAA	AL045CAA	AL056CAA
Depth Return Error (in)	N/A	Low 1	N/A	Low 1	N/A
Comments	No fine gain adjustment.	No fine gain adjustment.	No fine gain adjustment.	No fine gain adjustment.	Fine gain adjustment made after files 001, 046.

Log Run	11 Repeat				
HEIS Number	1014765				
Date	02/09/10				
Logging Engineer	Spatz/Holloway				
Start Depth (ft)	295.0				
Finish Depth (ft)	308.0				
Count Time (sec)	100				
Live/Real	R				
Shield (Y/N)	N				
MSA Interval (ft)	1.0				
Log Speed (ft/min)	NA				
Pre-Verification	AL056CAB				
Start File	AL056129				
Finish File	AL056142				
Post-Verification	AL056CAA				
Depth Return Error (in)	0				
Comments	No fine gain adjustments made.				

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Neutron Moisture Logging System (NMLS) Log Run Information:

Log Run	3	4 Repeat	7	8	9 Repeat
HEIS Number	1014766	1014767	1014768	1014769	1014770
Date	12/02/09	12/02/09	12/21/09	12/21/09	12/21/09
Logging Engineer	Spatz/McClellan	Spatz/McClellan	Spatz/McClellan	Spatz/McClellan	Spatz/McClellan
Start Depth (ft)	0.0	71.0	101.0	200.0	221.0
Finish Depth (ft)	102.5	81.0	201.0	242.5	235.0
Count Time (sec)	15	15	15	15	15
Live/Real	R	R	R	R	R
Shield (Y/N)	N	N	N	N	N
MSA Interval (ft)	0.25	0.25	0.25	0.25	0.25
Log Speed (ft/min)	N/A	N/A	N/A	N/A	N/A
Pre-Verification	DM042CAB	DM042CAB	AH023CAB	AH023CAB	AH023CAB
Start File	DM042000	DM042411	AH023000	AH023401	AH023572
Finish File	DM042410	DM042451	AH023400	AH023571	AH023628
Post-Verification	DM042CAA	DM042CAA	AH023CAA	AH023CAA	AH023CAA
Depth Return Error (in)	N/A	0	N/A	N/A	Low I 1/2
Comments	None	None	None	None	None.

Log Run	12	13 Repeat			
HEIS Number	1014771	1014772			
Date	02/10/10	02/10/10			
Logging Engineer	Spatz/Holloway	Spatz/Holloway			
Start Depth (ft)	241.0	270.0			
Finish Depth (ft)	305.0	280.0			
Count Time (sec)	15	15			
Live/Real	R	R			
Shield (Y/N)	N	N			
MSA Interval (ft)	0.25	0.25			
Log Speed (ft/min)	N/A	N/A			
Pre-Verification	AM063CAB	AM063CAB			
Start File	AM063000	AM063257			
Finish File	AM063256	AM063297			
Post-Verification	AM063CAA	AM063CAA			
Depth Return Error (in)	N/A	Low 3			
Comments	None	None			

Logging Operation Notes:

SGLS data from log runs 1and 2 were collected using Gamma 4 HO 68B-3573. Pre- and post-survey verification measurements were acquired in Amersham KUTh-115 field verifier. A centralizer was installed on the sonde.

SGLS data from log runs 5, 6, 10 and 11 were collected using Gamma 1 HO 68B-3574. Pre- and post-survey verification measurements were acquired in Amersham KUTh-118 field verifier. A centralizer was installed on the sonde.

NMLS data for log runs 3 and 4 were collected using Gamma 4 HO 68B-3573. Pre- and post-survey verification measurements were acquired in the AmBe standard field verifier. A centralizer was installed on the sonde.

NMLS data for log runs 7, 8, 9, 12 and 13 were collected using Gamma 1 HO 68B-3574. Pre- and post-survey verification measurements were acquired in the AmBe standard field verifier. A centralizer was installed on the sonde.

The zero reference is the ground surface.

Analysis Notes:

Analyst:	L. SPINNER	Date:	03/01/10	Reference:	GJO-HGLP 1.6.3, Rev. 0

Pre- and post-survey verification measurements met the acceptance criteria of the established systems.

Casing corrections were applied for the 1/2-inch thick casing to 102 feet, and the 9/16-inch thick casing to 370 feet, during analysis.

SGLS spectra were processed in batch mode in APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Concentrations were calculated in an EXCEL templates identified as AL20090326corr.xls and DN20090217corr.xls, using an efficiency function and corrections for casing, dead time and water as determined by annual calibrations.

During routine processing of gamma spectra, regions of interest are forced at specific energy levels associated with natural and manmade radionuclides that can be anticipated to be present. This processing approach sometimes results in an isolated "detection" near the minimum detection level (MDL) resulting in a false positive. Where these detections occur, the individual spectrum is scrutinized and a determination is made regarding the validity of the detection. If the detection is deemed not representative of a full energy peak, or if confirming peaks are not detected, it is removed from the data set. The integrity of the raw data files and the processed files are maintained should questions arise in the future regarding these determinations.

NMLS spectra were processed in batch mode in APTEC SUPERVISOR to identify counts. NMLS count rates were calculated using EXCEL templates identified as DM20090212.xls, and AM20090401.xls.

Results and Interpretations:

Cs-137 was detected at the ground surface and from 72 to 80 feet in C5860. The maximum concentration was measured at approximately 500 pCi/g at 74 feet.

Radon was observed from approximately 102 to 242 feet in the 2nd casing string, as indicated by the elevated 609 keV energy peak when compared to the 1764 keV energy peak.

The neutron moisture count rates appear to increase as casing diameters decrease from 12 7/16 to 9 5/8 to 7 9/16 inch.

The repeat plots indicate that the respective systems were working properly.

In September 2008, the small diameter borehole, C6911 in the vicinity of C5860 was pushed to a depth of 215 feet. C6911 is located approximately 10.3 feet north of C5860. Both holes are near the 216-B-6 reverse well. C5860 is located approximately 23 feet to the southwest and C6911 is approximately 19.5 feet west-southwest of 216-B-6 reverse well. For a complete report on the 216-B-6-site characterization that focuses on the small diameter logging of C6911, see HGLP-LDR-269, originally issued in 12/08, then revised and re-issued in 4/10 as HGLP-LDR-269, Rev. 2.

C6911 was logged with a Bismuth Germanate (BGO) detector in a small diameter logging system (SDLS). The log for C6911 detected a thin layer of very high gamma activity at the 74.5-foot depth, with a secondary layer at 79.5 feet. Evaluation of the BGO data for C6911 indicated the gamma anomalies at 74.5 foot and 79.5 foot represented equivalent cesium concentrations of 1094 pCi/g and 65.4 pCi/g. Cs-137 is a common gamma emitter in aged fission products and the term "equivalent cesium" (eCs) is used to indicate the gamma activity originating from a uniform, homogeneous, isotropic distribution of Cs-137.

Analysis of SGLS data in C5860 detected Cs-137 at similar depths. With the SGLS, radionuclide identification and assay are based on characteristic gamma decay lines, unlike the SDLS that cannot distinguish gamma decay lines and total counts are converted to equivalent Cesium (eCs). The maximum Cs-137 concentration in C5860 was

reported to be approximately 500 pCi/g at 74 feet and no other manmade gamma-emitting radionuclides were detected.

The Hanford Gamma Unit (HGU) has been proposed as a means to standardize log response between different detectors (McCain, 2009). The HGU is based on a specific measurement at the Hanford borehole calibration facility. One HGU is very nearly equal to typical background activity in Hanford soils. Thus the HGU provides an indication of gamma activity in terms of multiples of background activity, without any assumption as to the isotopic source. Plots showing a comparison of total gamma activity in C6911 and C5860, logged with two different detectors are provided on page 6. The left-hand plot shows gamma activity in terms of cps. On this plot, gross gamma count rates are very different, and it is difficult to directly compare raw count data between the two detectors. The plot on the right shows gamma activity for each log converted to HGU. Over much of the interval, both logs are near 1 HGU, indicating background activity levels with little or no evidence of contamination. At 74 to 75 feet, both logs show very high HGU values, indicating gamma-emitting contaminants are present. The C6911 log indicates a maximum gamma activity of 177 HGU at 74.5 feet. The C5860 log indicates a maximum gamma activity of 63 HGU at the 74-foot depth. These two boreholes are far enough apart that concentrations of Cs-137 could be significantly different, however they are close enough to see the possible effects of the 216-B-6 reverse well at nearly the same depths.

In the HGU comparison plot, the HGU values for C5860 appear to be slightly elevated from approximately 102 to 242 feet in comparison to C6911 at the same depths. This slight elevation is due to radon observed in C5860 at the time of logging.

The WIDS data sheet for 216-B-6 indicates some uncertainty as to the correct depth for 216-B-6 reverse well. Depths of 302 feet, 160 feet and 75 feet are cited in various reports. From the logging results of C6911 and C5860, it is clear that the depth of waste injection for 216-B-6 is 75 feet, and that the correct depth of the well is also 75 feet.

List of Log Plots:

Depth Reference is ground surface.

299-E29-54 (C5860) & C6911 Total Gamma
Manmade Radionuclides (3 pages)
Natural Gamma Logs (3 pages)
Combination Plot (4 pages)
Combination Plot (0 to 380 ft)
Total Gamma & Moisture (0 to 380 ft)
Total Gamma & Dead Time (0 to 380 ft)
Repeat of Manmade Radionuclides (75 to 85 ft)
Repeat Section of Natural Gamma Logs (75 to 85 ft)
Repeat Section of Natural Gamma Logs (190 to 204 ft)
Repeat Section of Natural Gamma Logs (295 to 308 ft)
Repeat Section for Moisture (71 to 81 ft)
Repeat Section for Moisture (221 to 235 ft)
Repeat Section for Moisture (270 to 280 ft)

References:

McCain, R.G. 2009; *The Hanford Gamma Unit: A Means to Standardize Gamma Log Response at the Hanford Site*. HGLP-OTH-004, Rev. 0. S M Stoller Corp, Richland, Washington.

[1] GWL – groundwater level

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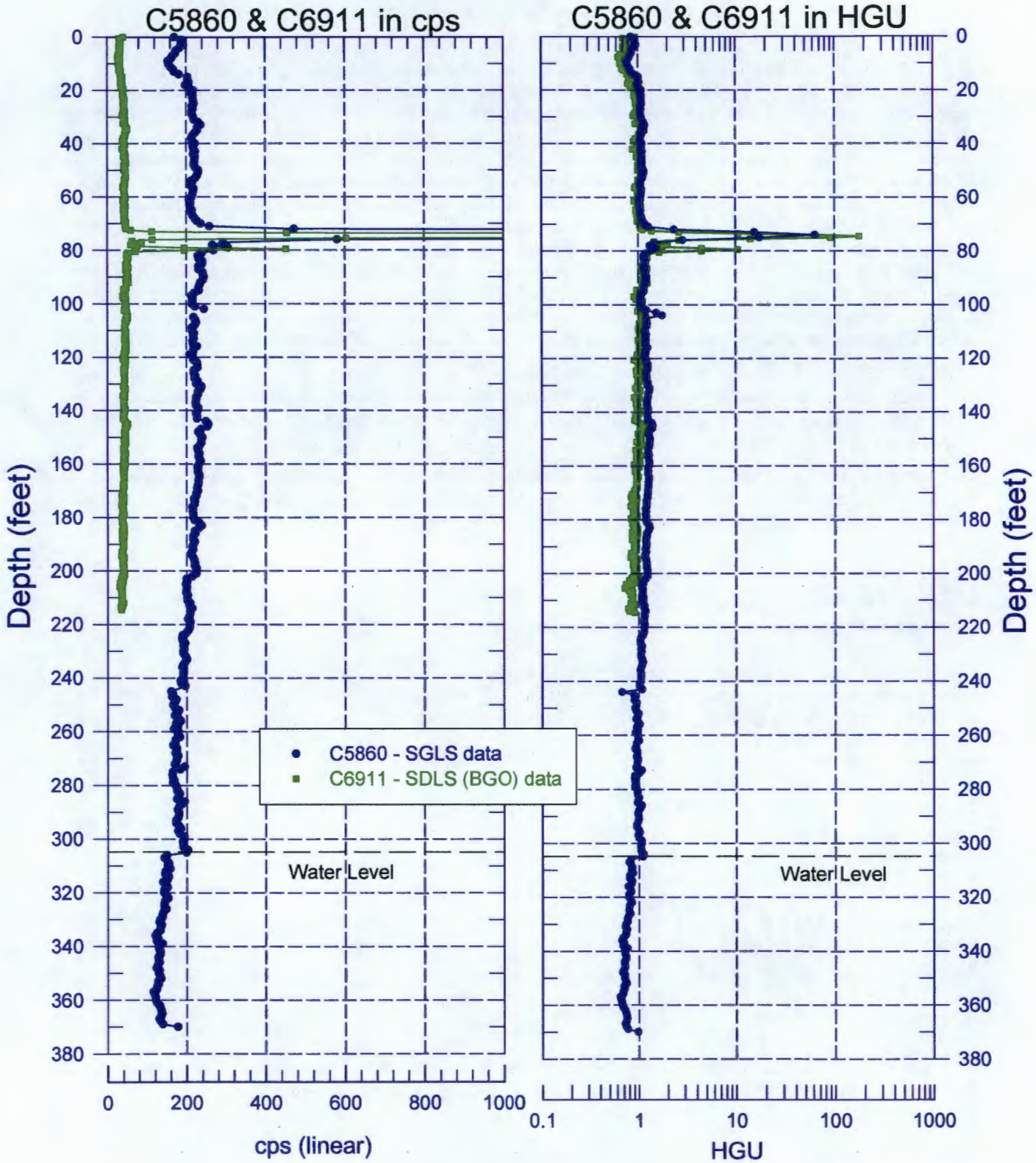
299-E29-54 (C5860) & C6911
Total Gamma



Zero Reference = Ground Surface

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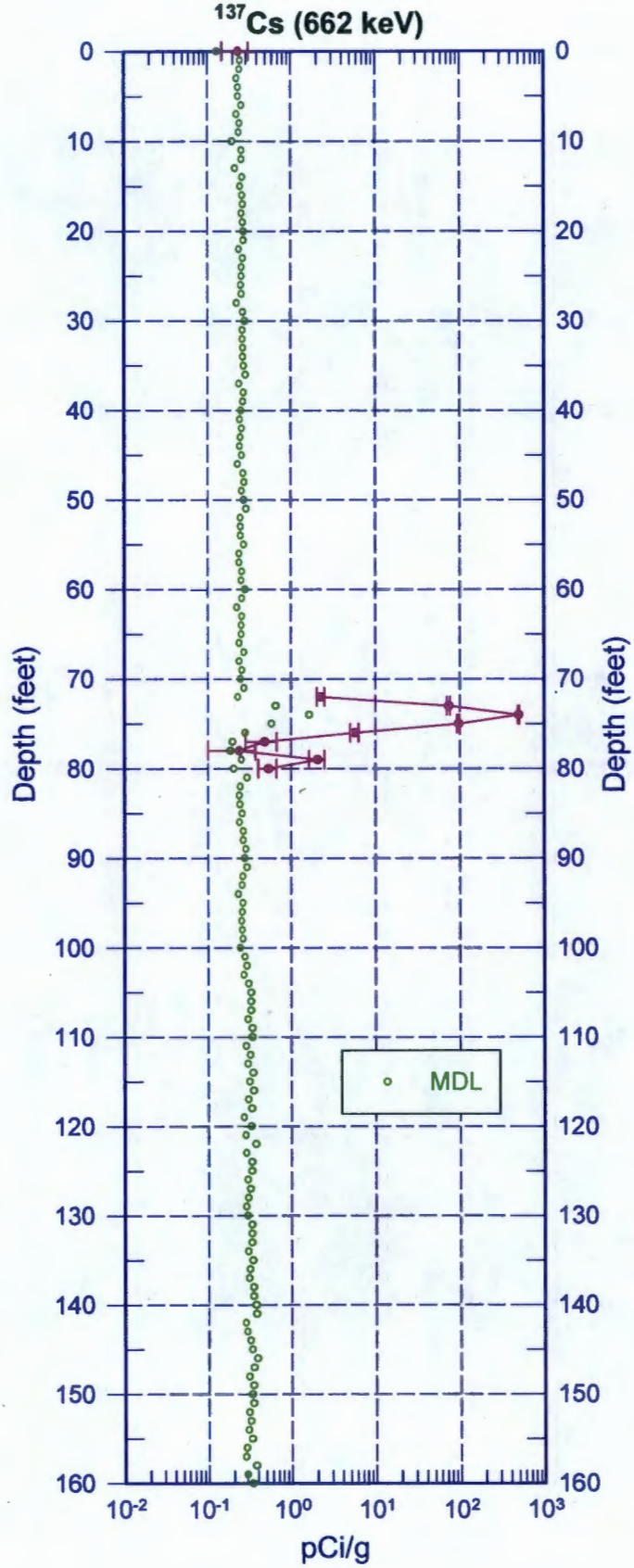
299-E29-54 (C5860)
Man-Made Radionuclides



Zero Reference - Ground surface

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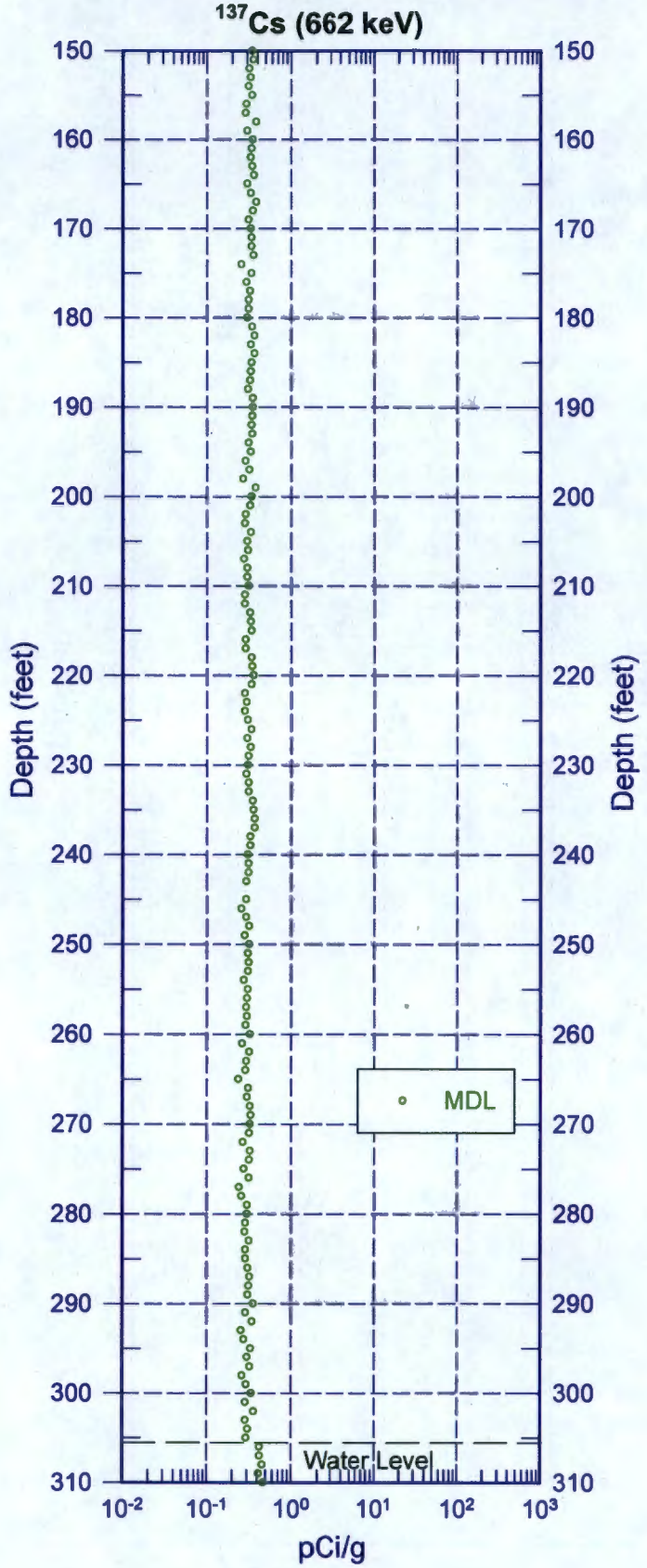
299-E29-54 (C5860)
Man-Made Radionuclides



Zero Reference - Ground surface

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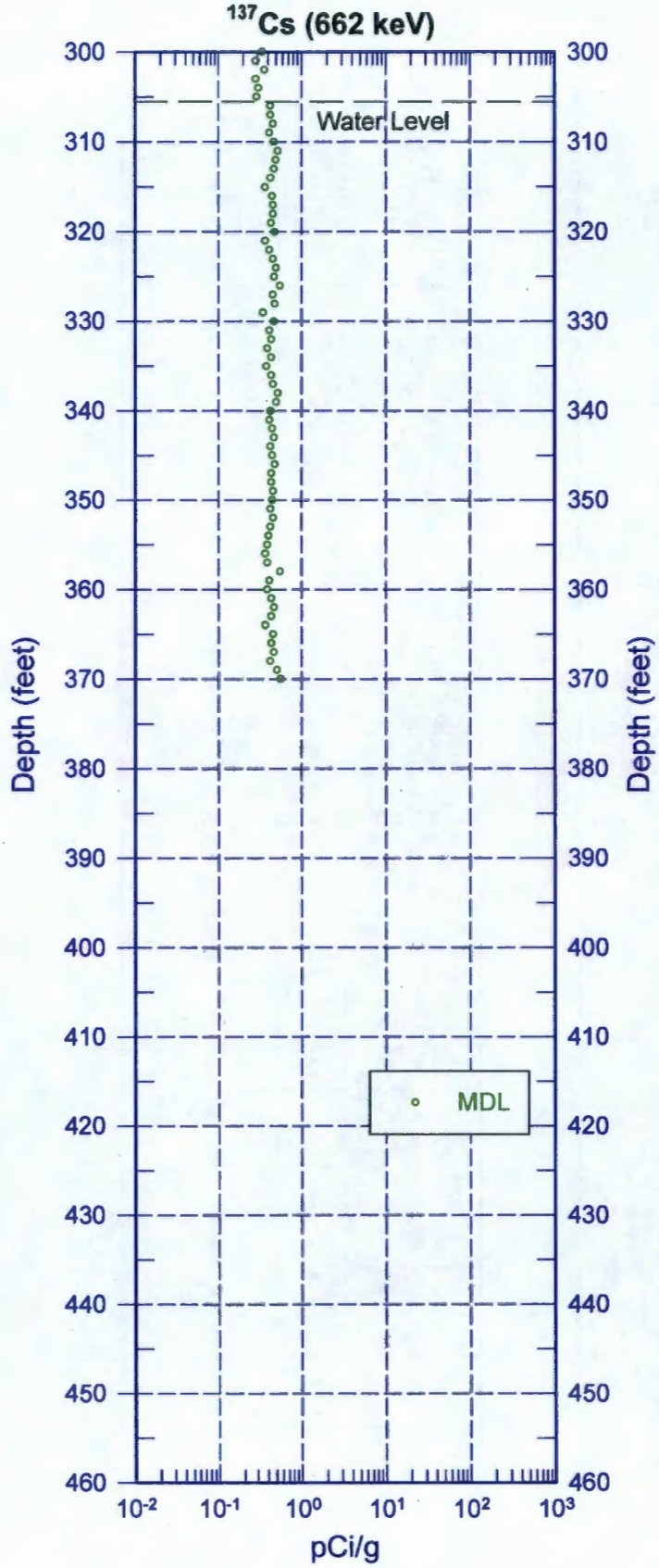
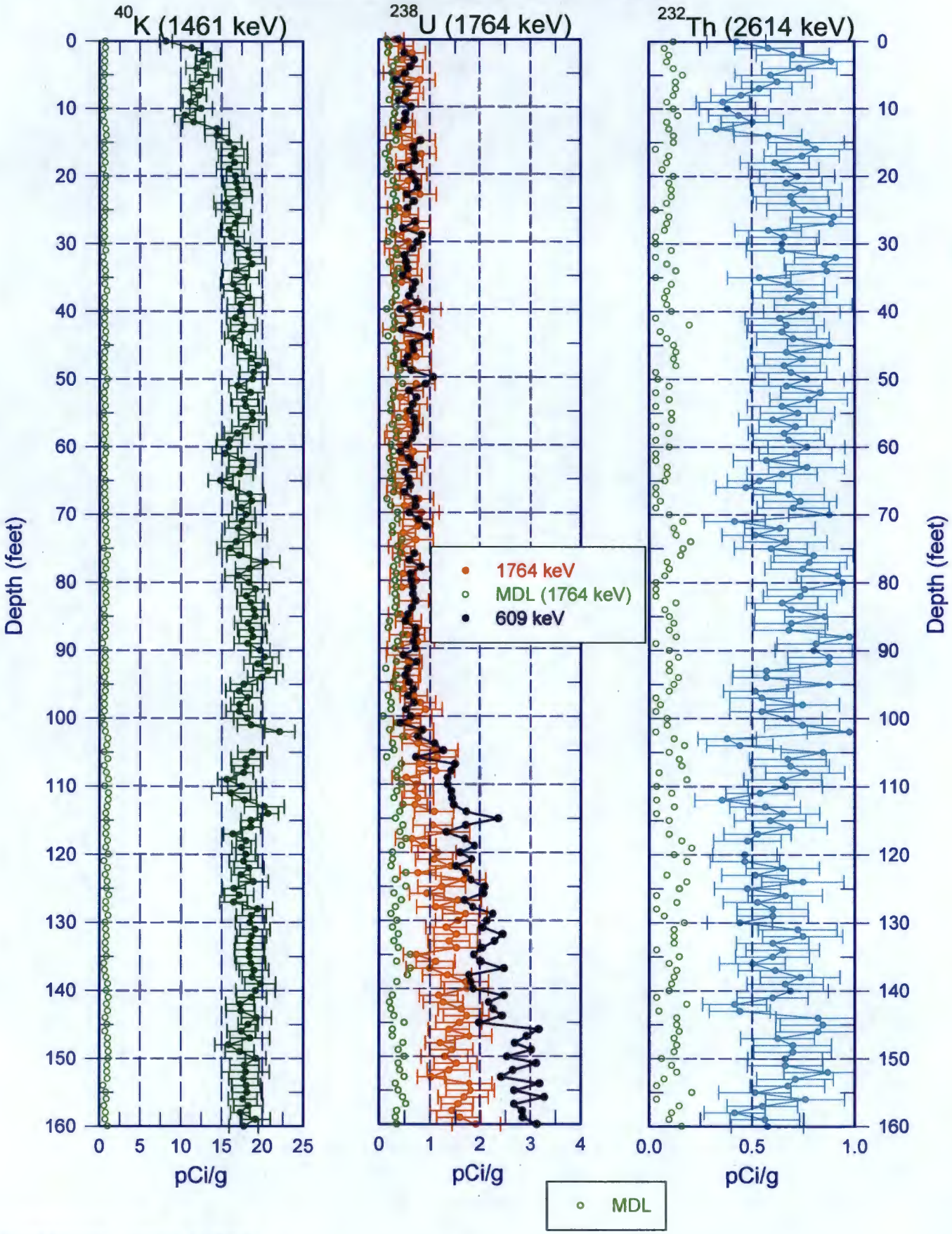
299-E29-54 (C5860)
Man-Made Radionuclides



Zero Reference - Ground surface

Stoller
Hanford Office

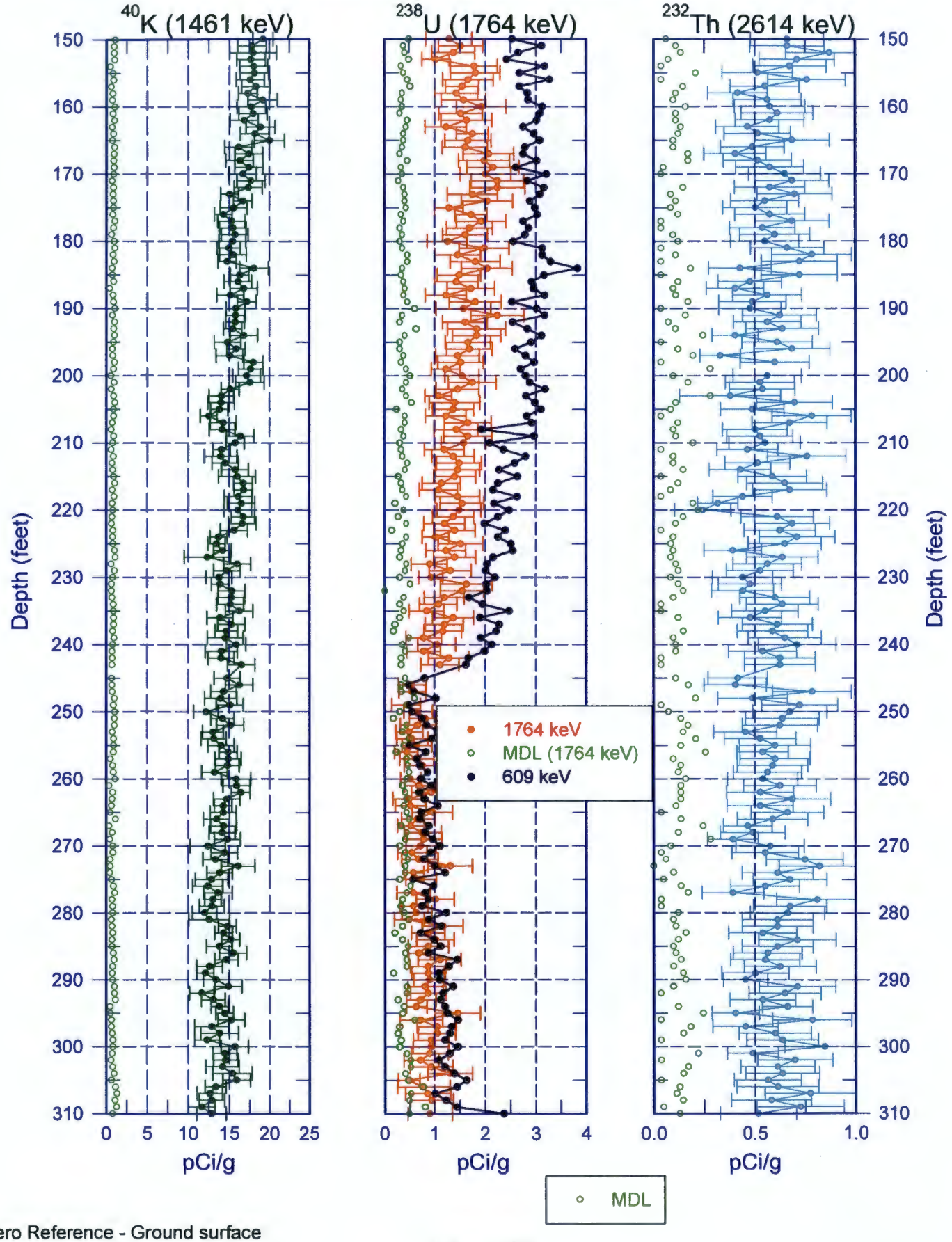
299-E29-54 (C5860)
Natural Gamma Logs



Zero Reference - Ground surface

Stoller Hanford Office

299-E29-54 (C5860)
Natural Gamma Logs



Zero Reference - Ground surface

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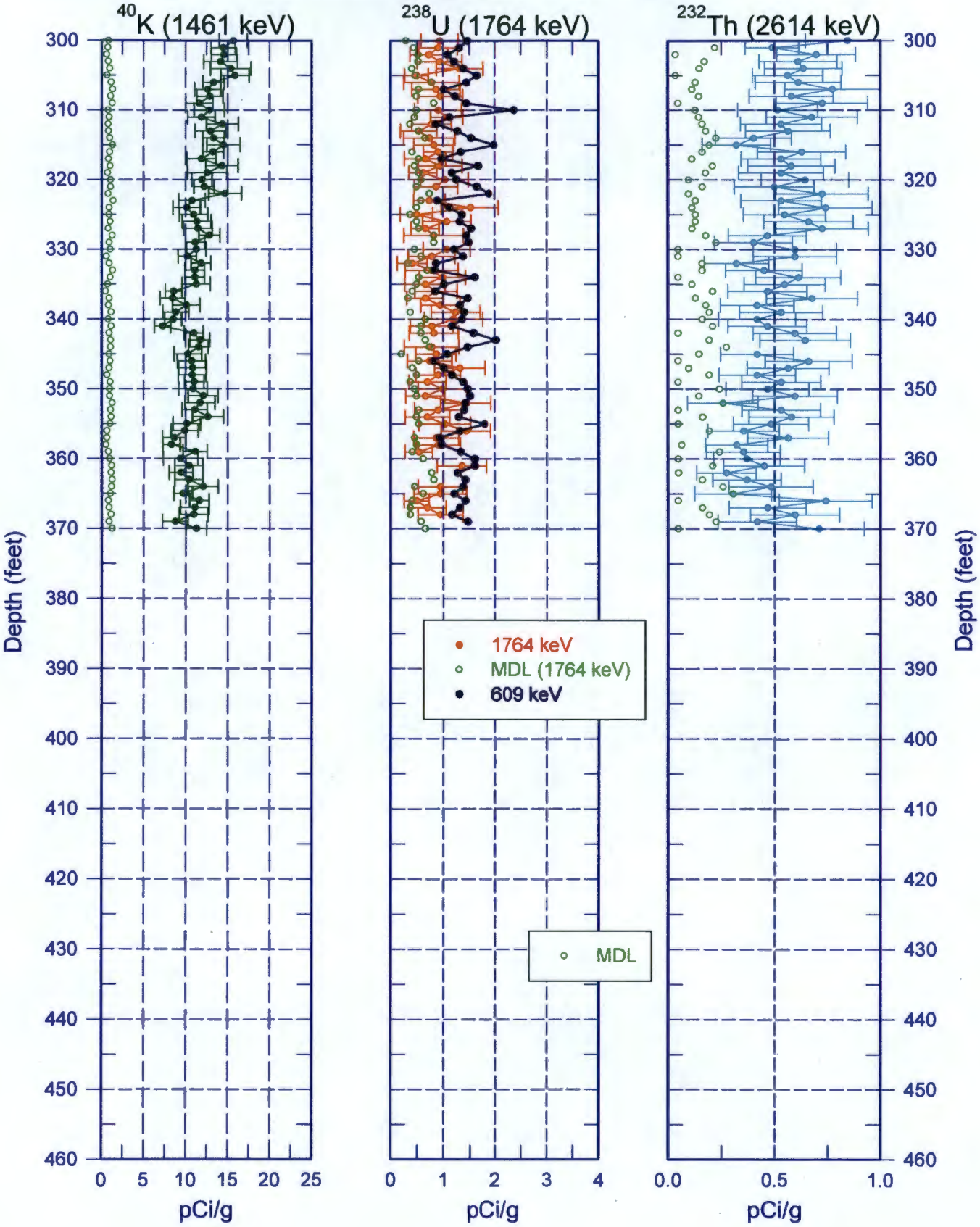
299-E29-54 (C5860)
Natural Gamma Logs



Zero Reference - Ground surface

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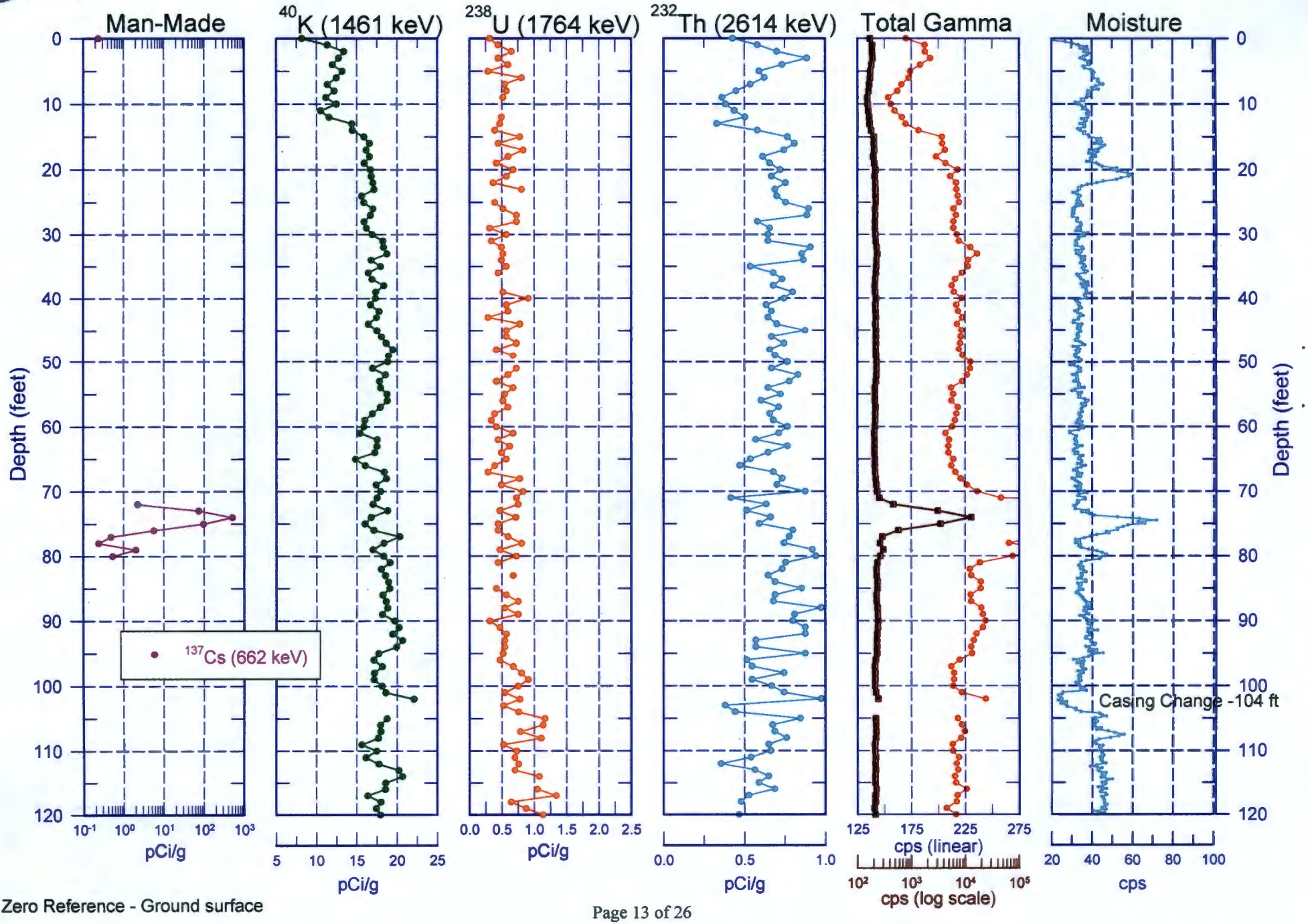
299-E29-54 (C5860) Combination Plot



Zero Reference - Ground surface

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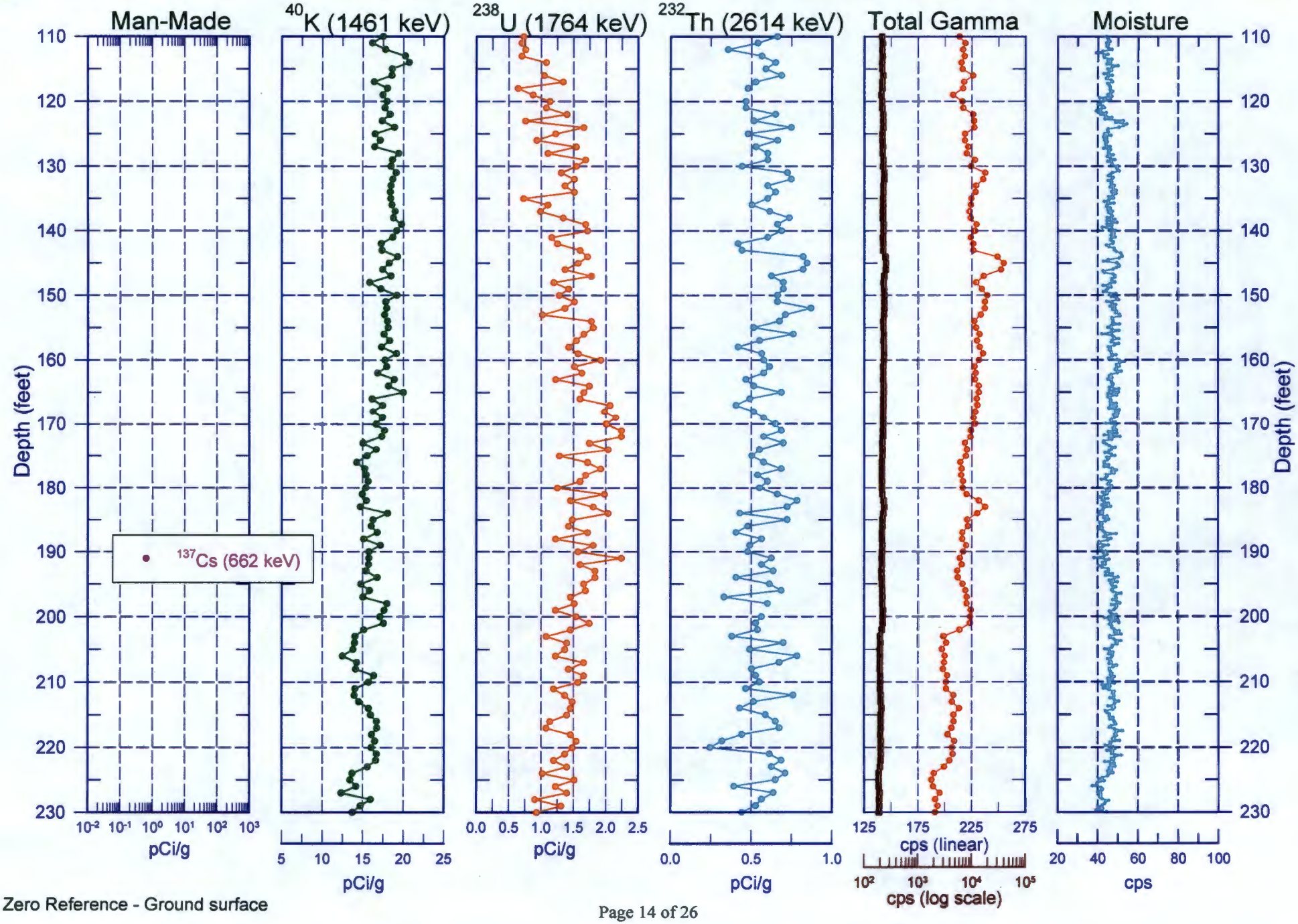
299-E29-54 (C5860) Combination Plot



Zero Reference - Ground surface

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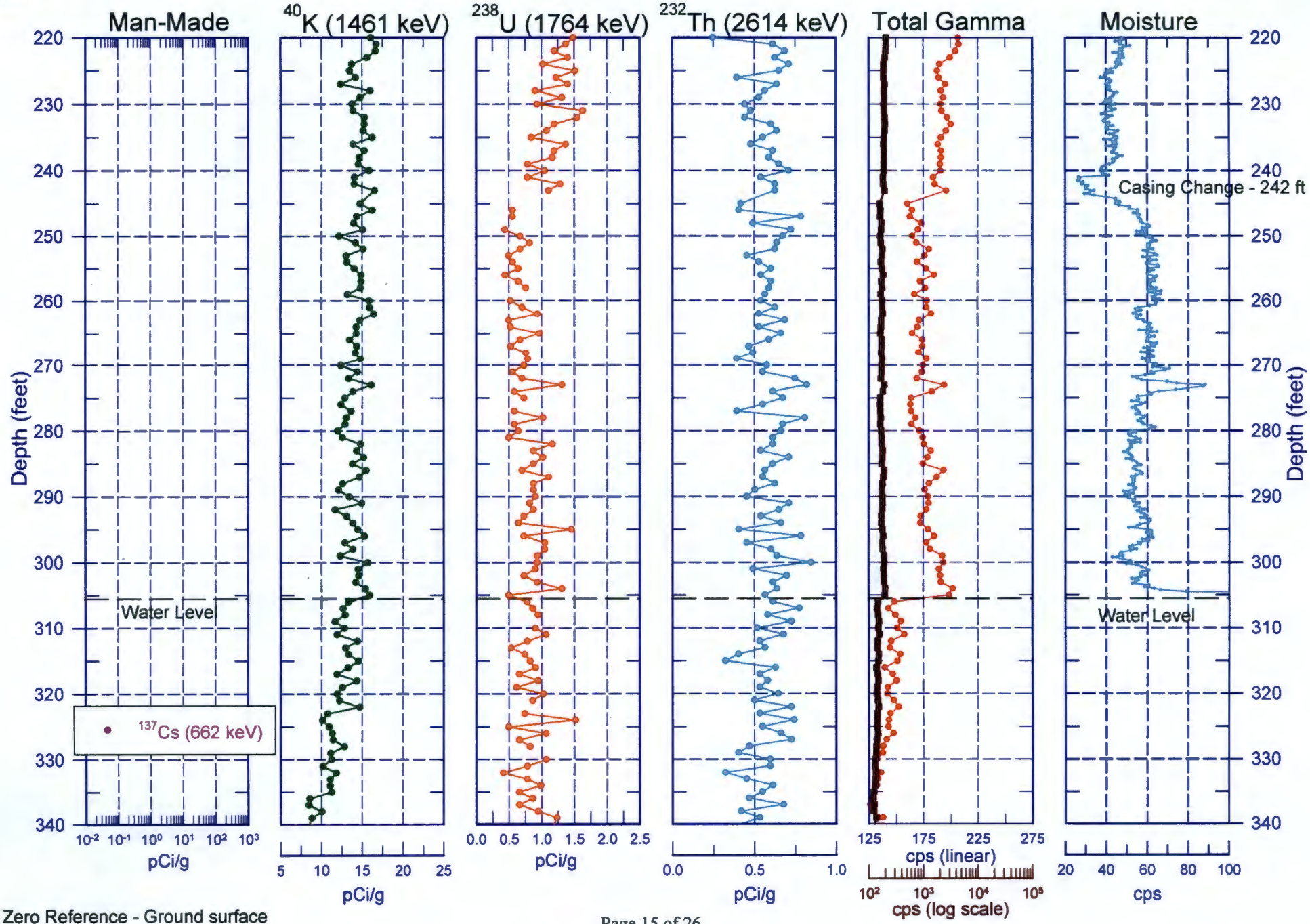
299-E29-54 (C5860) Combination Plot



Zero Reference - Ground surface

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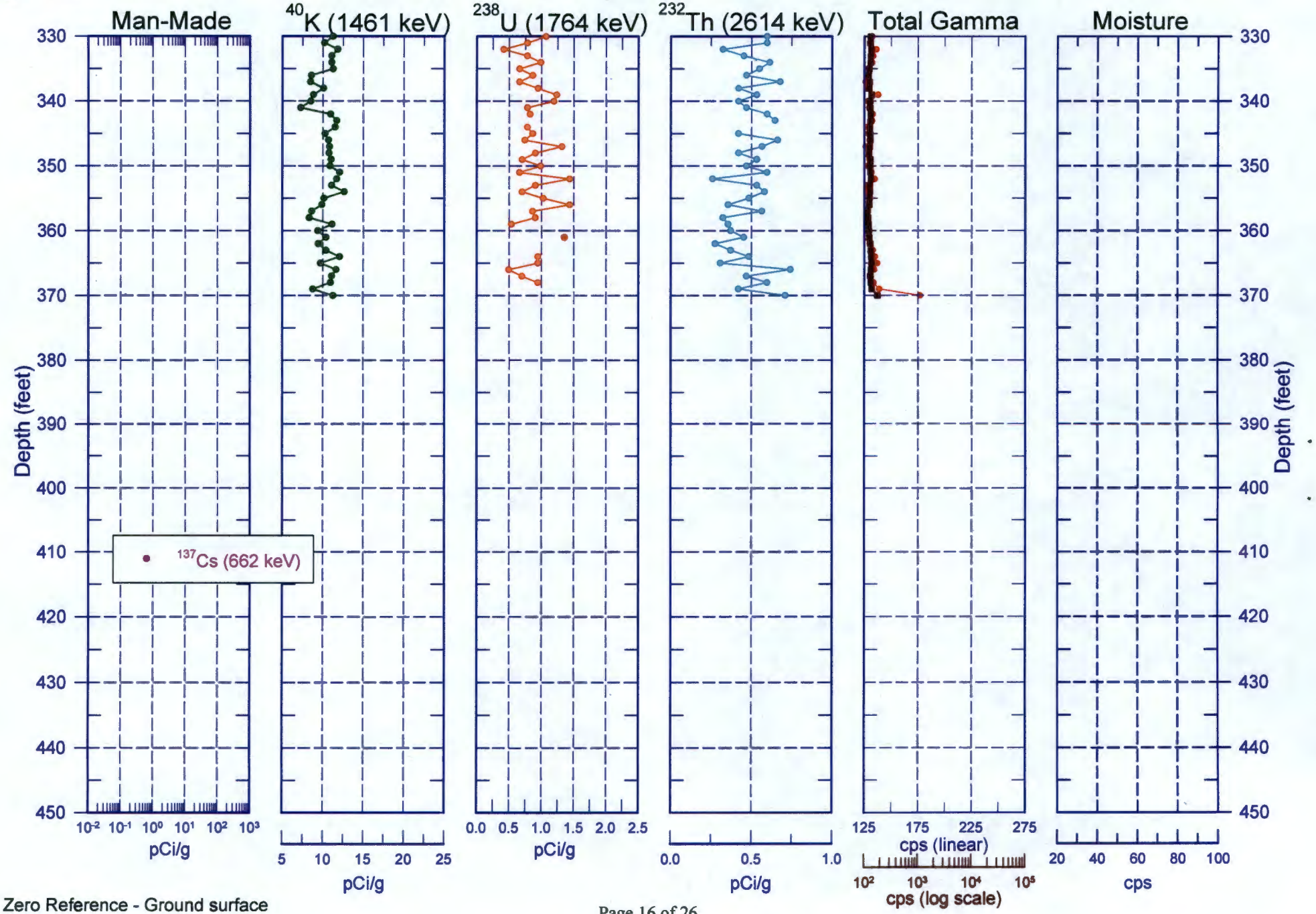
299-E29-54 (C5860) Combination Plot



Zero Reference - Ground surface

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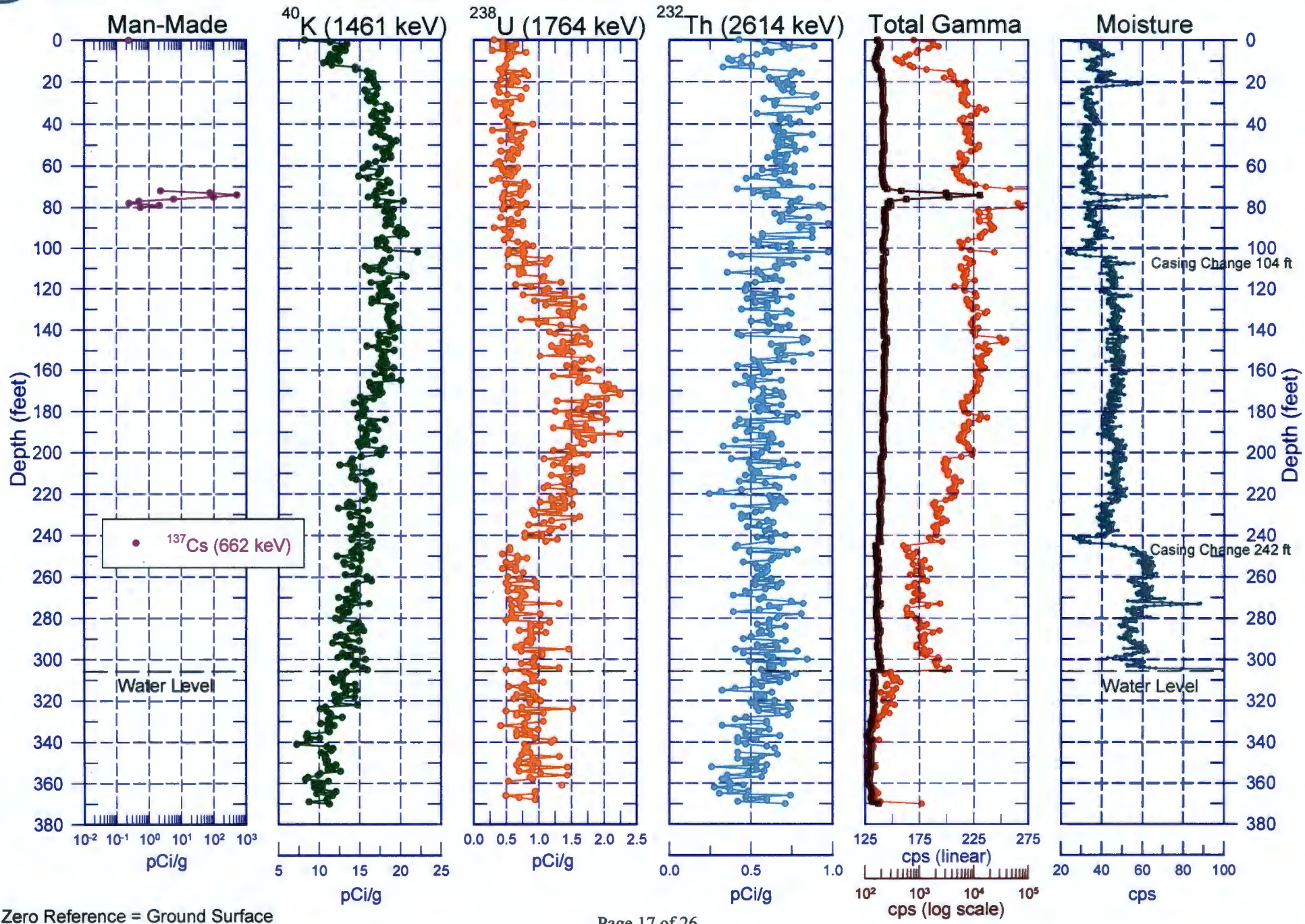
299-E29-54 (C5860) Combination Plot



Zero Reference = Ground Surface

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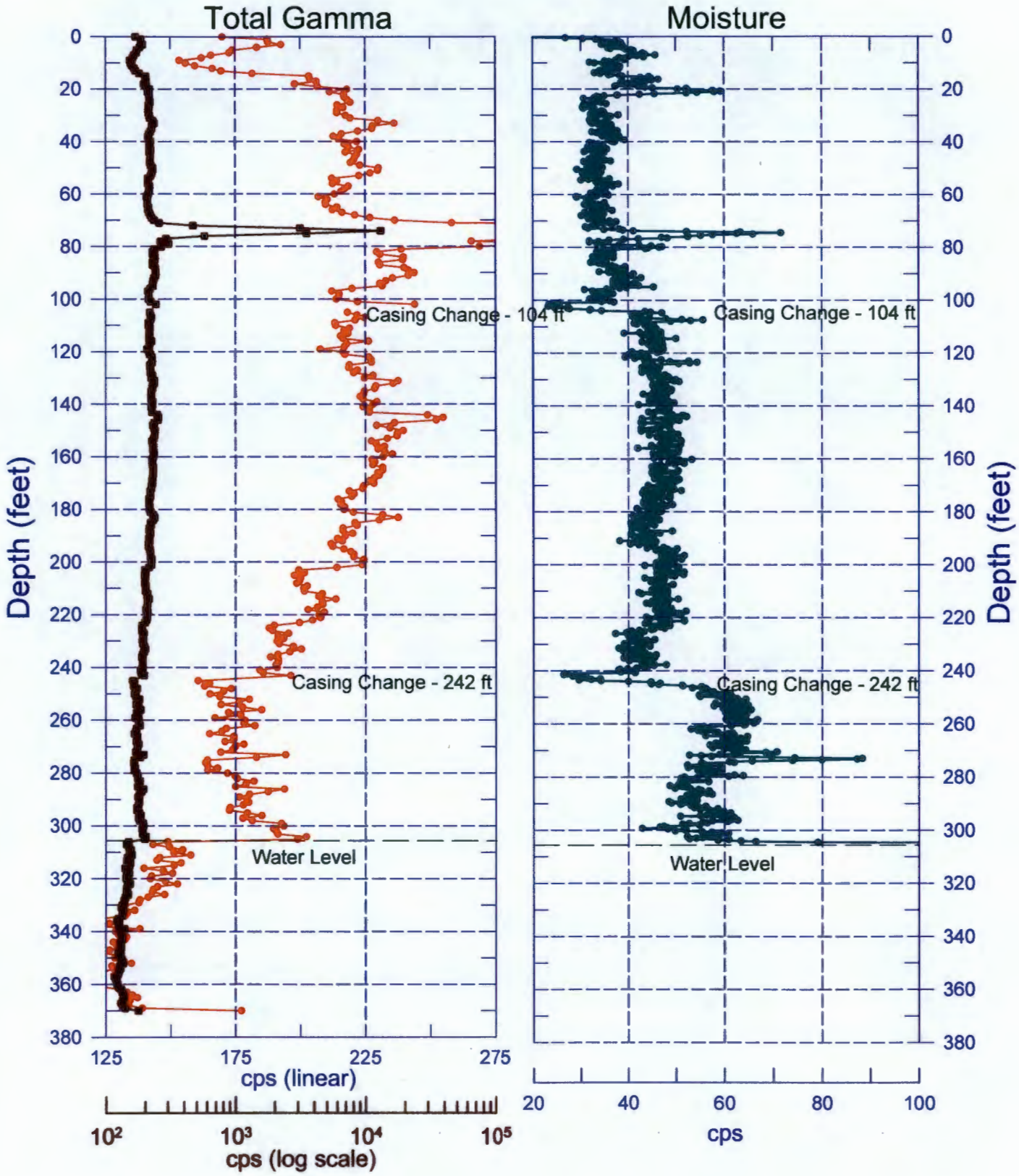
299-E29-54 (C5860)
Total Gamma & Moisture



Zero Reference = Ground Surface

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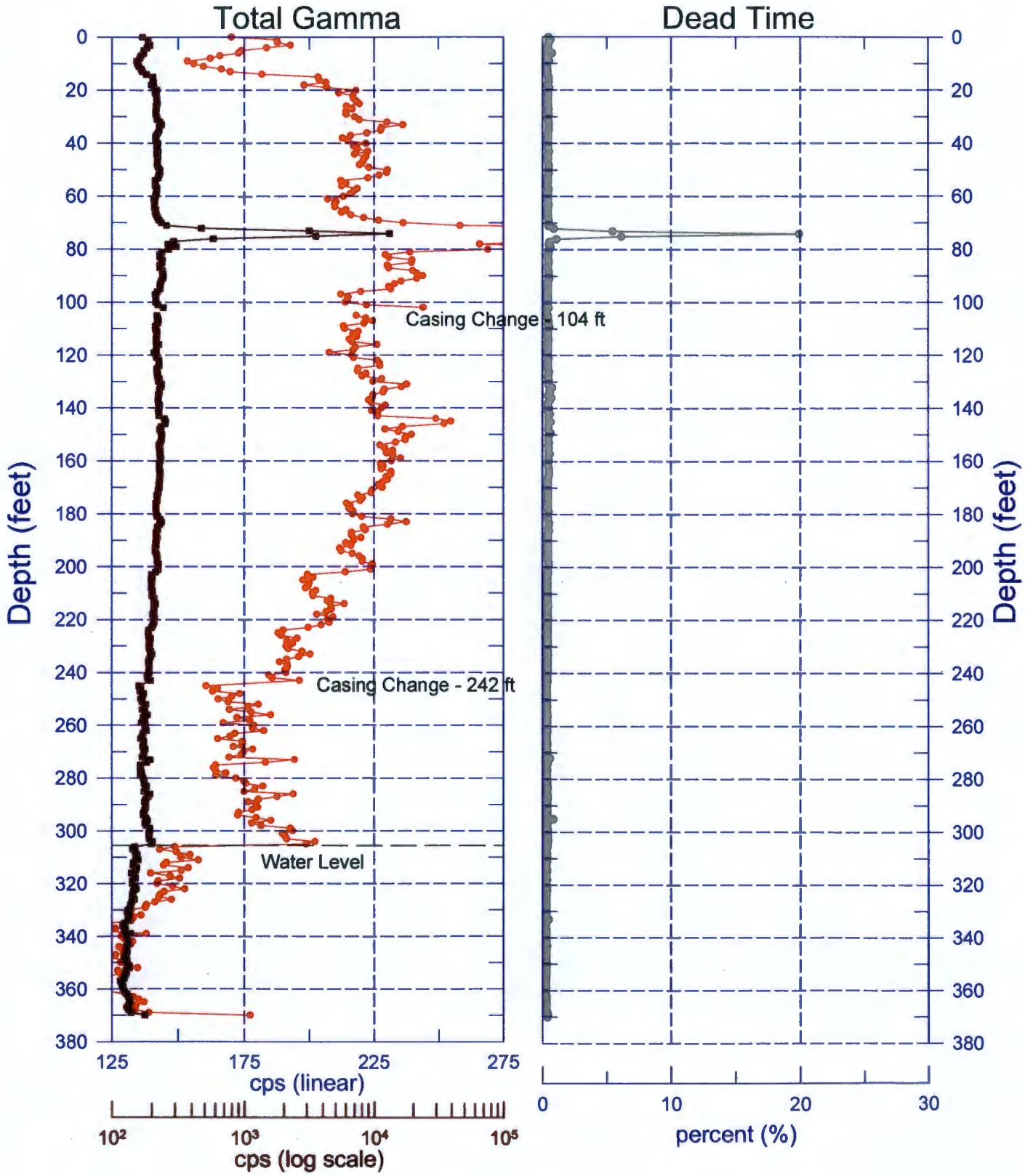
299-E29-54 (C5860)
Total Gamma & Dead Time



Zero Reference = Ground Surface

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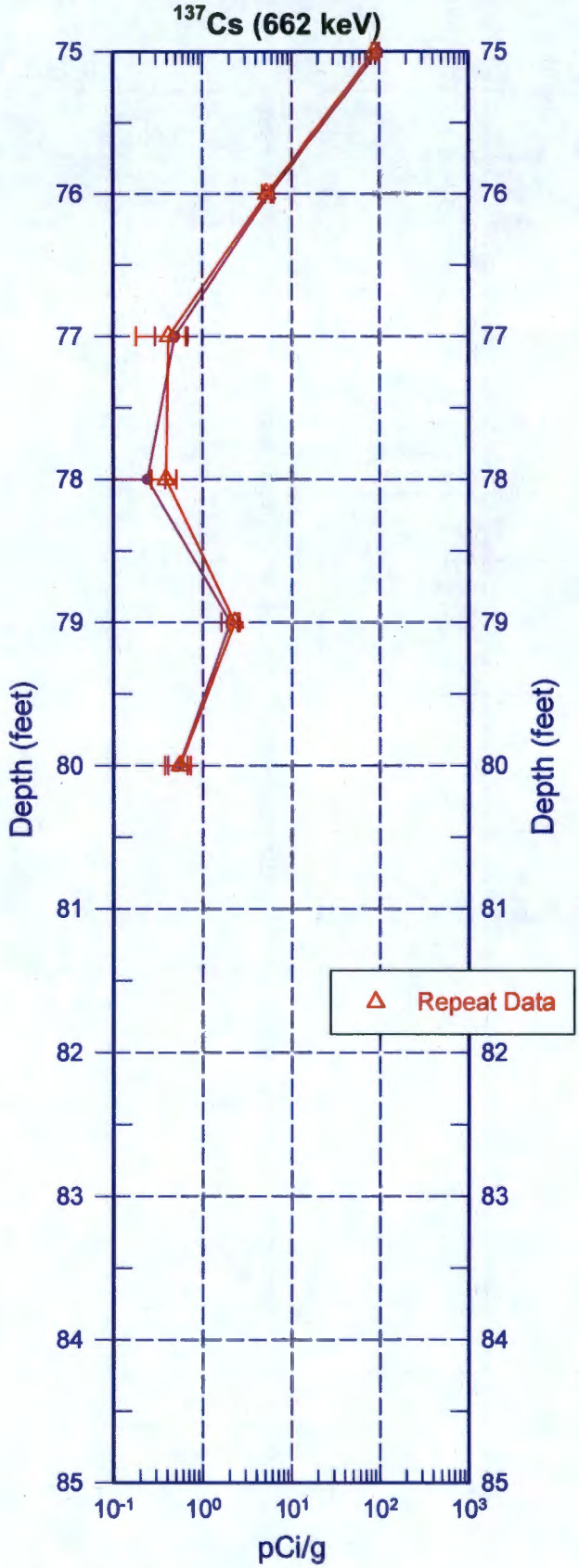
299-E29-54 (C5860)
Repeat of Manmade Radionuclides



Zero Reference - Ground surface

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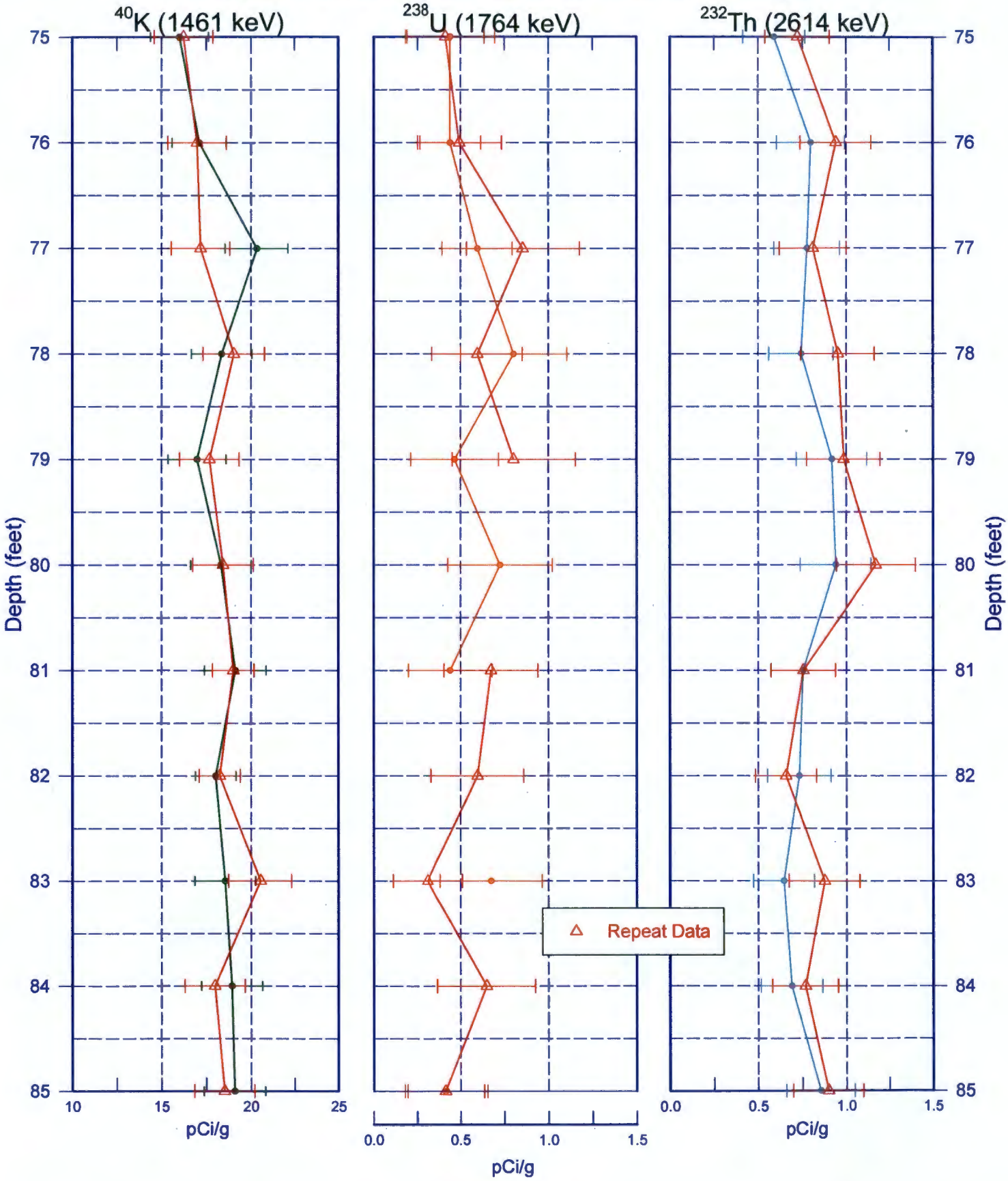
299-E29-54 (C5860)

Repeat Section of Natural Gamma Logs



Zero Reference - Ground surface

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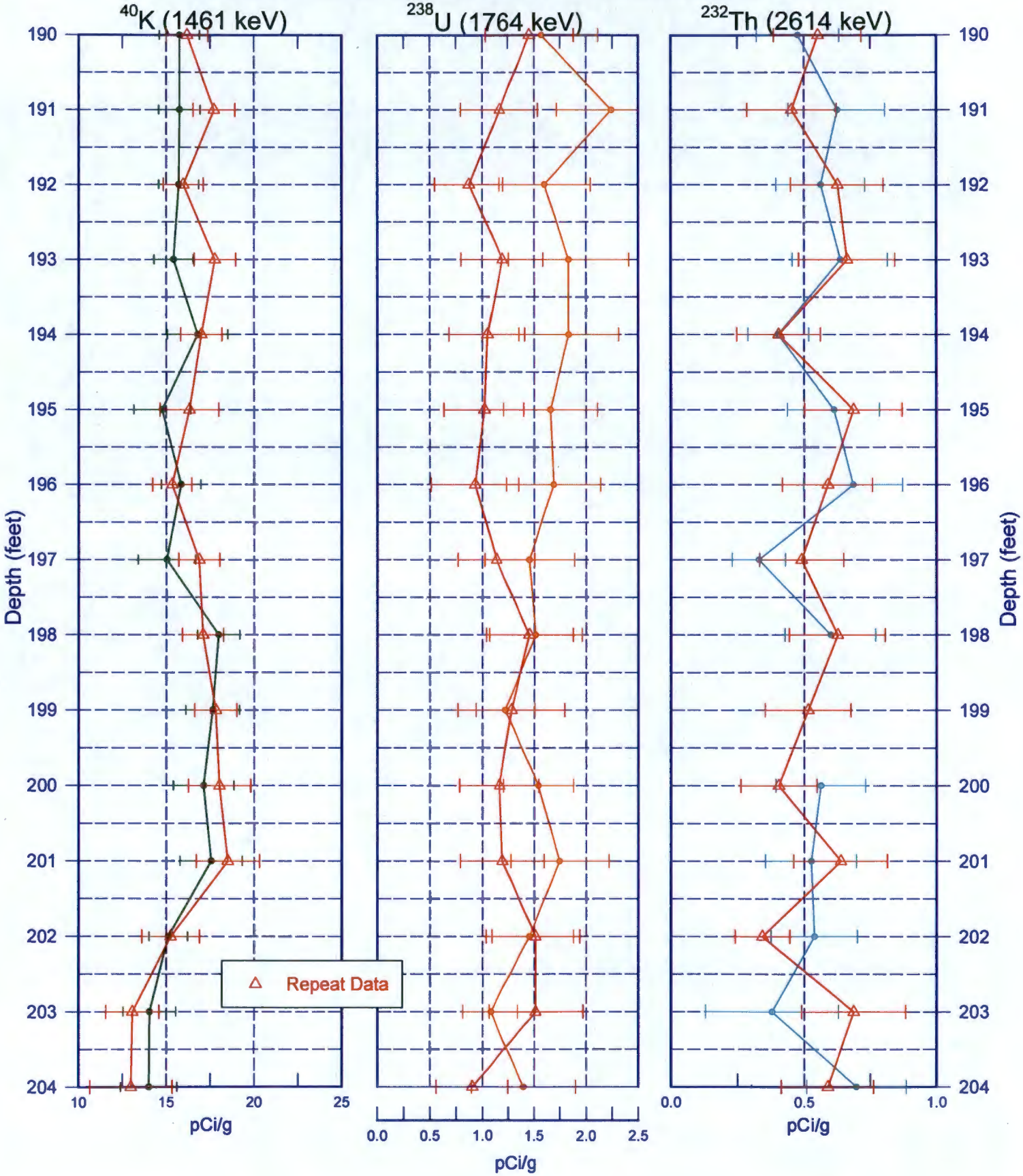
299-E29-54 (C5860)

Repeat Section of Natural Gamma Logs

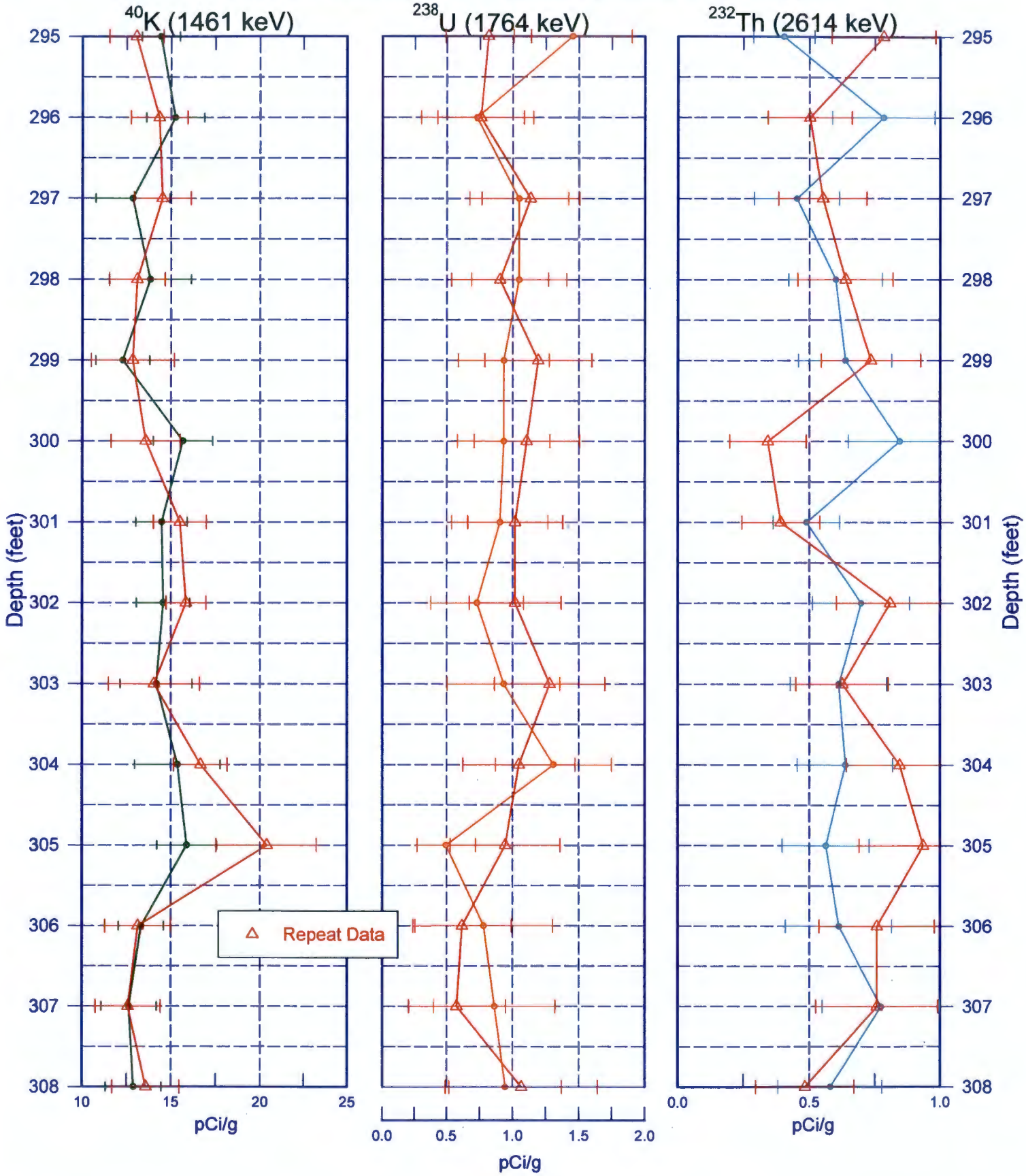


Zero Reference - Ground surface

Stoller Hanford Office

299-E29-54 (C5860)

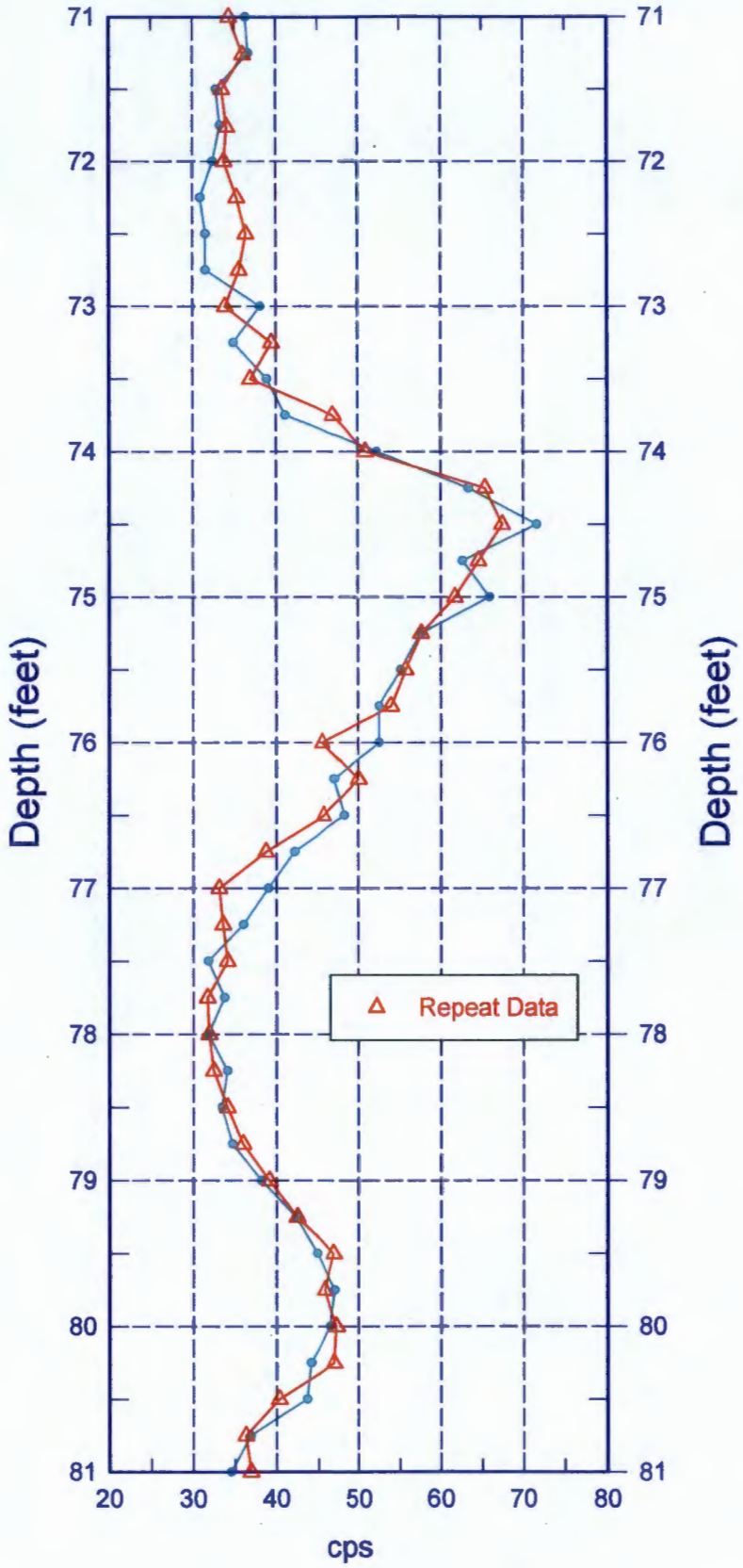
Repeat Section of Natural Gamma Logs



Zero Reference - Ground surface

299-E29-54 (C5860)

Repeat Section for Moisture (71 - 81 feet)



Reference - Ground surface

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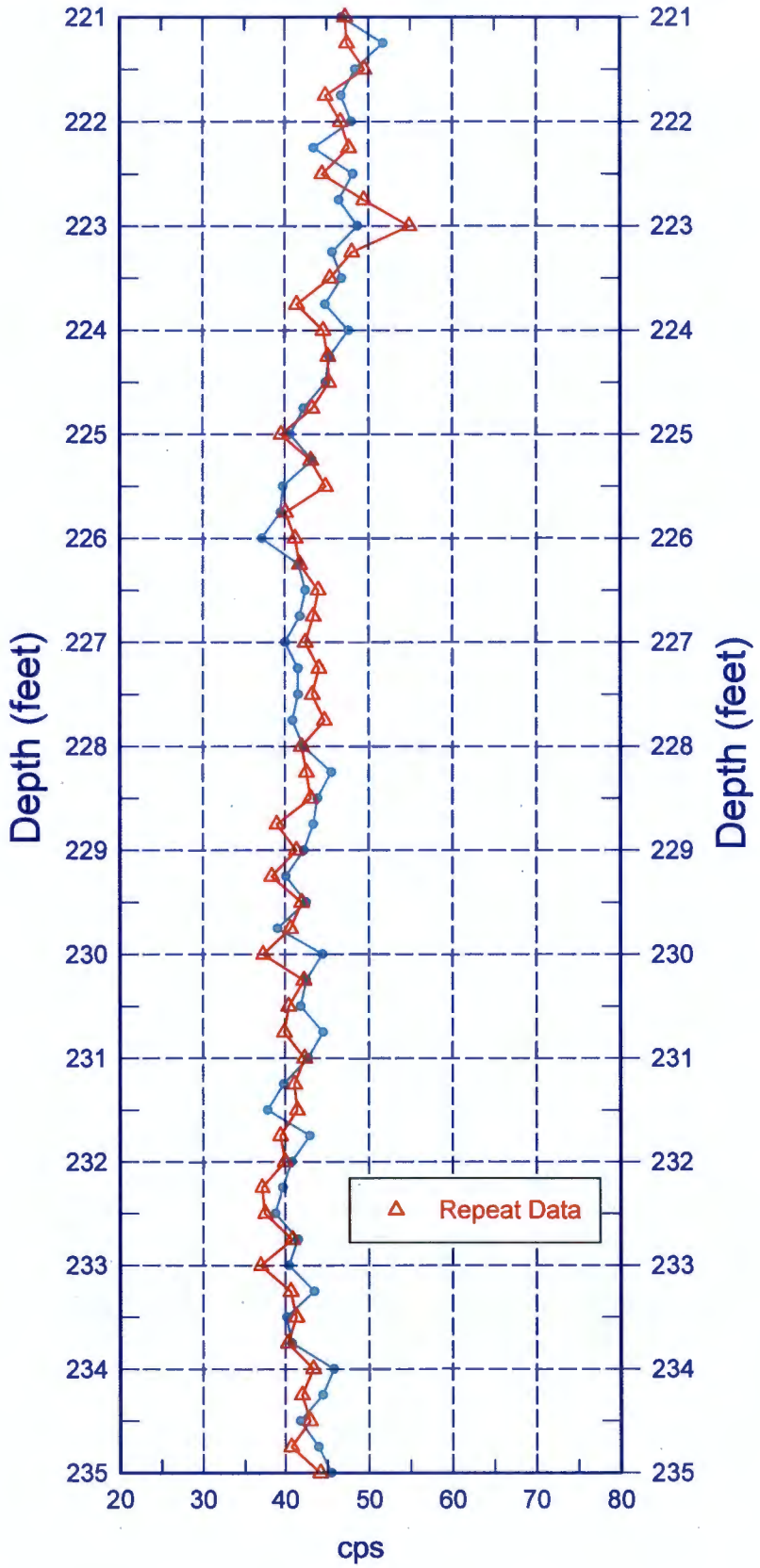
299-E29-54 (C5860)

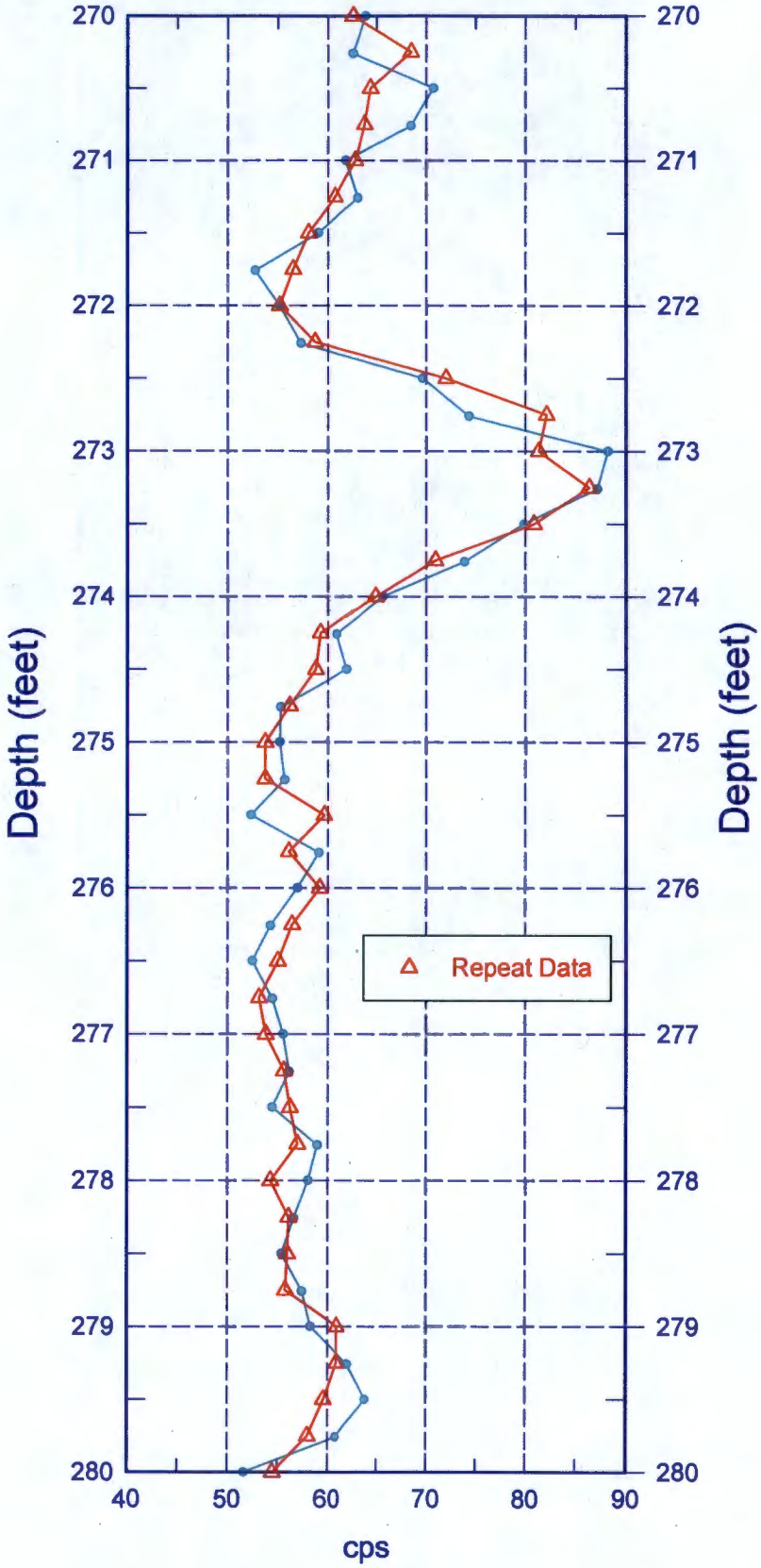
Repeat Section for Moisture (221 - 235 feet)



Reference - Ground surface

299-E29-54 (C5860)

Repeat Section for Moisture (270 - 280 feet)



Reference - Ground surface