

**299-W22-32 (A7851)
Log Data Report**

Borehole Information:

Borehole: 299-W22-32 (A7851)		Site: 216-S-7 Crib			
Coordinates (WA State Plane)		GWL (ft)¹: Not deep enough		GWL Date: 3/25/2004	
North	East	Drill Date	TOC² Elevation	Total Depth (ft)	Type
134,173.54 m	567,178.83 m	May 1966	208.2 m	212	Cable Tool

Casing Information:

Casing Type	Stickup (ft)	Outer Diameter (in.)	Inside Diameter (in.)	Thickness (in.)	Top (ft)	Bottom (ft)
Welded steel	+2.75	6 5/8	6	5/16	+2.75	214.75
Welded steel	0	4	unknown	unknown	0	202.75

The logging engineer measured the casing stickup using a steel tape. A caliper was used to determine the outside casing diameter. Inside casing diameter was measured with a steel tape. All measurements were rounded to the nearest 1/16 in. Casing bottom depth is reported from Ledgerwood (1993). Casing thickness was calculated. Measurements for stickup and top of casing are from ground surface.

Borehole Notes:

Borehole coordinates, elevation, and borehole construction information are from measurements by Stoller field personnel, HWIS³, and Ledgerwood (1993). Zero reference is the top of the 6-in. casing.

Logging Equipment Information:

Logging System: Gamma 1G	Type: 35% HPGe (34TP10967A)
Calibration Date: 1/2004	Calibration Reference: GJO-2004-597-TAC
Logging Procedure: MAC-HGLP 1.6.5, Rev. 0	

Logging System: Gamma 1C	Type: High Rate Detector
Calibration Date: 04/2003	Calibration Reference: GJO-2003-429-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	03/30/04	03/30/04	03/30/04	03/30/04	03/30/04
Logging Engineer	Spatz	Spatz	Spatz	Spatz	Spatz
Start Depth (ft)	70.0	58.0	43.0	34.0	21.0
Finish Depth (ft)	59.0	44.0	35.0	22.0	3.0
Count Time (sec)	200	20	200	20	200
Live/Real	R	R	R	R	R

Log Run	1	2	3	4	5
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	AG059CAB	AG059CAB	AG059CAB	AG059CAB	AG059CAB
Start File	AG059000	AG059012	AG059027	AG059036	AG059049
Finish File	AG059011	AG059026	AG059035	AG059048	AG059067
Post-Verification	AG059CAA	AG059CAA	AG059CAA	AG059CAA	AG059CAA
Depth Return Error (in.)	N/A	N/A	N/A	N/A	-1
Comments	No fine-gain adjustment.	High rate zone - Dead time > 40 %. Count time change.	No fine-gain adjustment.	High rate zone - Dead time > 40 %. Count time change.	No fine-gain adjustment.

Log Run	6	7	8 / Repeat	9	
Date	03/31/04	04/01/04	04/02/04	04/02/04	
Logging Engineer	Spatz	Spatz	Spatz	Spatz	
Start Depth (ft)	90.0	215.0	165.0	142.0	
Finish Depth (ft)	69.0	143.0	143.0	89.0	
Count Time (sec)	200	200	200	200	
Live/Real	R	R	R	R	
Shield (Y/N)	N	N	N	N	
MSA Interval (ft)	1.0	1.0	1.0	1.0	
ft/min	N/A	N/A	N/A	N/A	
Pre-Verification	AG060CAB	AG061CAB	AG062CAB	AG062CAB	
Start File	AG060000	AG061000	AG062000	AG062023	
Finish File	AG060021	AG061072	AG062022	AG062076	
Post-Verification	AG060CAA	AG061CAA	AG062CAA	AG062CAA	
Depth Return Error (in.)	0	0	N/A	-1	
Comments	No fine-gain adjustment.	No fine-gain adjustment.	Repeat section.	No fine-gain adjustment.	

High Rate Logging System (HRLS) Log Run Information:

Log Run	1	2	3	4	5
Date	03/31/04	03/31/04	03/31/04	03/31/04	03/31/04
Logging Engineer	Spatz	Spatz	Spatz	Spatz	Spatz
Start Depth (ft)	60.0	56.0	46.0	36.0	34.0
Finish Depth (ft)	57.0	47.0	44.0	35.0	23.0
Count Time (sec)	300	100	300	300	100
Live/Real	R	R	R	R	R
Shield (Y/N)	None	None	None	None	None
MSA Interval (ft)	1.0	1.0	1.0	1.0	1.0
ft/min	N/A	N/A	N/A	N/A	N/A
Pre-Verification	AC096CAB	AC096CAB	AC096CAB	AC096CAB	AC096CAB
Start File	AC096000	AC096004	AC096014	AC096017	AC096019
Finish File	AC096003	AC096013	AC096016	AC096018	AC096030
Post-Verification	AC096CAA	AC096CAA	AC096CAA	AC096CAA	AC096CAA
Depth Return Error (in.)	N/A	N/A	N/A	N/A	N/A
Comments	No fine-gain adjustment.	None	None	None	No fine-gain adjustment.

Log Run	6	7 / Repeat	8		
Date	03/31/04	03/31/04	03/31/04		
Logging Engineer	Spatz	Spatz	Spatz		
Start Depth (ft)	22.0	27.0	*29.0		
Finish Depth (ft)	21.0	23.0	26.0		
Count Time (sec)	300	100	300		
Live/Real	R	R	R		
Shield (Y/N)	None	None	Internal		
MSA Interval (ft)	1.0	1.0	1.0		
ft/min	N/A	N/A	N/A		
Pre-Verification	AC096CAB	AC096CAB	AC096CAB		
Start File	AC096031	AC096032	AC096037		
Finish File	AC096032	AC096036	AC096040		
Post-Verification	AC096CAA	AC096CAA	AC096CAA		
Depth Return Error (in.)	N/A	-1	0		
Comments	None	Repeat section.	Repeat section at 28.0 ft, file -041.		

Logging Operation Notes:

Zero reference was top of the 6-in. casing. Logging was performed without 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. HRLS data were collected using Gamma 1C. Pre- and post-survey verification measurements employed the ¹³⁷Cs verifier with serial number 1013. Maximum logging depth achieved was 215 ft.

Analysis Notes:

Analyst:	Sobczyk	Date:	4/06/04	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 each day. All of the verification spectra were within the acceptance criteria. 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 3.3 percent lower and 3.3 percent higher at the end of the day. Examinations of spectra indicate that the detector functioned normally during logging, and the spectra are accepted.

HRLS pre-run and post-run verification spectra were collected at the beginning and end of the day. The post-run verification spectrum was slightly below the lower control limit for the 662-keV photopeak cps and within the HASQARD. Examinations of spectra indicate that the detector functioned normally during logging, and the spectra are accepted.

Log spectra were processed in batch mode using APTEC SUPERVISOR to identify individual energy peaks and determine count rates. The 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 files: G1GJan04.xls [SGLS] and G1CApr03.xls [HRLS]). Zero reference was the top of the 6-in. casing. Based on Ledgerwood (1993), the casing configuration was assumed to be a string of 6-in. casing with a thickness of 5/16 in. to total logging depth (215 ft) and a string of 4-in. casing with a thickness of 0.237 in. to a log depth of 202.75 ft. The 6-in. casing thickness was measured by the logging engineer. A casing thickness of 0.237 in. was assumed for the 4-in. casing. This thickness is the published value for ASTM schedule-40 steel pipe, a commonly used casing material at Hanford. Where more than

one casing exists at a depth, the casing correction is additive (e.g., the correction for both 6-in. and 4-in. casing would be $0.313 + 0.237 = 0.55$). A water correction was not required.

Using the SGLS, dead time greater than 40 percent was encountered in the intervals from 22 to 34 ft and 45 to 59 ft. Data from these regions are considered unreliable. At SGLS dead time greater than 40 percent, peak spreading and pulse pile-up effects may result in underestimation of activities. This effect is not entirely corrected by the dead time correction, and the extent of error increases with increasing dead time. The HRLS was utilized to obtain data where the SGLS dead time exceeded 40 percent. The HRLS's internal shield was used in the interval between 29 and 26 ft. SGLS and HRLS dead time corrections were applied where dead time surpassed 10.5 percent.

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 exhibited slightly higher net counts per second.

Results and Interpretations:

^{137}Cs and ^{60}Co were the man-made radionuclides detected in this borehole. ^{137}Cs was detected throughout almost the entire length of the borehole. Concentrations ranged from the MDL (0.2 pCi/g) to 3,000,000 pCi/g. The maximum concentration of ^{137}Cs was measured at 28 ft. ^{60}Co (based on both 1173 and 1333 keV photopeaks) was detected at 138 ft with a concentration of 0.2 pCi/g.

Recognizable changes in the KUT logs occurred in this borehole. Grout is present between the casings and outside the 6-in. casing from the surface to 200 ft and masks the natural KUT response. Changes of 4 pCi/g or more in apparent ^{40}K concentrations occur at approximately 68, 152, 160, and 207 ft. Changes in ^{232}Th concentrations of approximately 0.4 pCi/g occur at 135, 152, and 160 ft. Between 135 and 152 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 (2 pCi/g), and ^{232}Th (0.4 pCi/g). There is about an 8-pCi/g decrease in ^{40}K concentrations in the interval between 152 and 160 ft. ^{238}U increases by approximately 1.0 pCi/g in the interval between 155 and 158 ft. Based on low ^{40}K concentrations, the carbonate-rich paleosols of the Cold Creek Unit are interpreted as being between 152 and 162 ft. The caliche layer with characteristically high uranium content (greater than 2.0 pCi/g) is present between 155 and 158 ft. The top of the Ringold is picked at 162 ft.

Gross gamma logs from Fecht et al. (1977) (attached) indicate that the sediments surrounding this borehole contained significant amounts of man-made gamma radiation from 1968 through at least 1976. The log from 2/16/68 indicates relatively high gamma activity to the total depth (TD) of the borehole. The log from 5/13/76 indicates relatively high gamma activity in the interval from 23 ft (7 m) to 131 ft (40 m). The highest activities occurred in the interval from 23 ft (7 m) to 56 ft (17 m). The SGLS detected ^{137}Cs at concentrations greater than 1,000 pCi/g in the intervals from 23 to 34 ft and 45 to 59 ft.

The plots of the repeat logs demonstrate reasonable repeatability of the HRLS and SGLS data. ^{137}Cs (662-keV) concentrations are comparable between the repeat and original log runs for the HRLS and SGLS. The natural radionuclides at energy levels of 609, 1461, 1764, and 2614 keV are comparable between the repeat and original SGLS log runs.

Three boreholes, 299-W22-12, 299-W22-13, and 299-W22-14, are located immediately outside the crib boundary, on the west, south, and east. Analyses of data from boreholes 299-W22-32 and 299-W22-33 indicate that zones of very high gamma activity are encountered between depths of 21 to 60 ft and 21 to 54 ft, respectively. Evaluation of historical gross gamma logs from 299-W22-12, 299-W22-13, and 299-W22-14 indicates similar gamma activity profiles in these wells. It appears that gamma activity may have been higher in the boreholes outside the crib. In particular, early logs in 299-W22-13 and 299-W22-14 appear to indicate detector saturation to depths of at least 100 meters. It is likely that breakthrough to groundwater occurred at this site prior to 1963. It is recommended that these boreholes be logged as soon as possible, since they will provide important information on migration of contaminants from this crib. All of these boreholes are on the most recent list of holes to be decommissioned, beginning in October.

References:

Fecht, K.R., G.V. Last, and K.R. Price, 1977. *Evaluation of Scintillation Probe Profiles from 200 Area Crib Monitoring Wells*, ARH-ST-156, Atlantic Richfield Hanford Company, Richland, Washington.

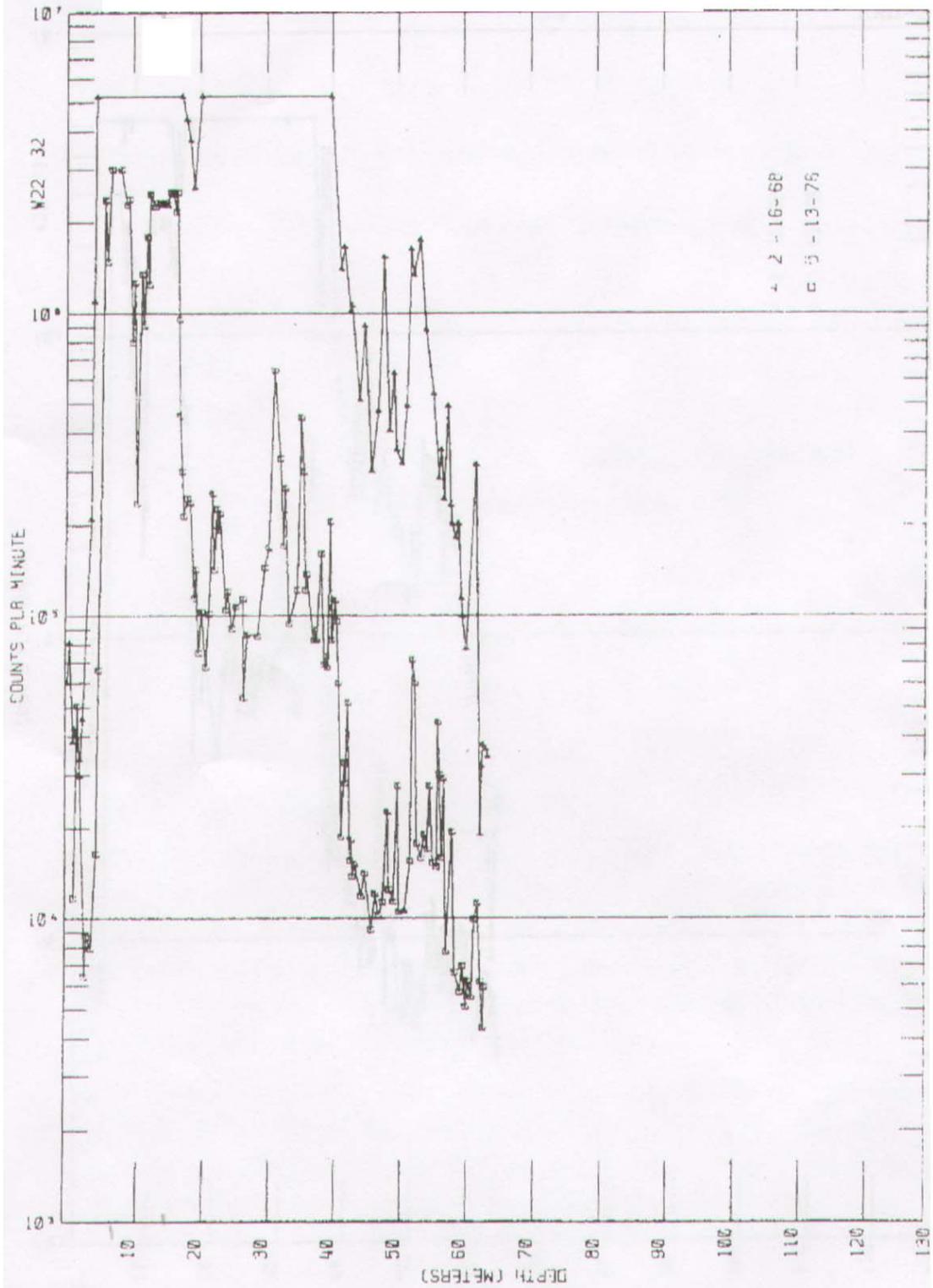
Ledgerwood, R.K., 1993. *Summaries of Well Construction Data and Field Observations for Existing 200-West Resource Protection Wells*, WHC-SD-ER-TI-005, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

¹ GWL – groundwater level

² TOC – top of casing

³ HWIS – Hanford Well Information System

⁴ N/A – not applicable

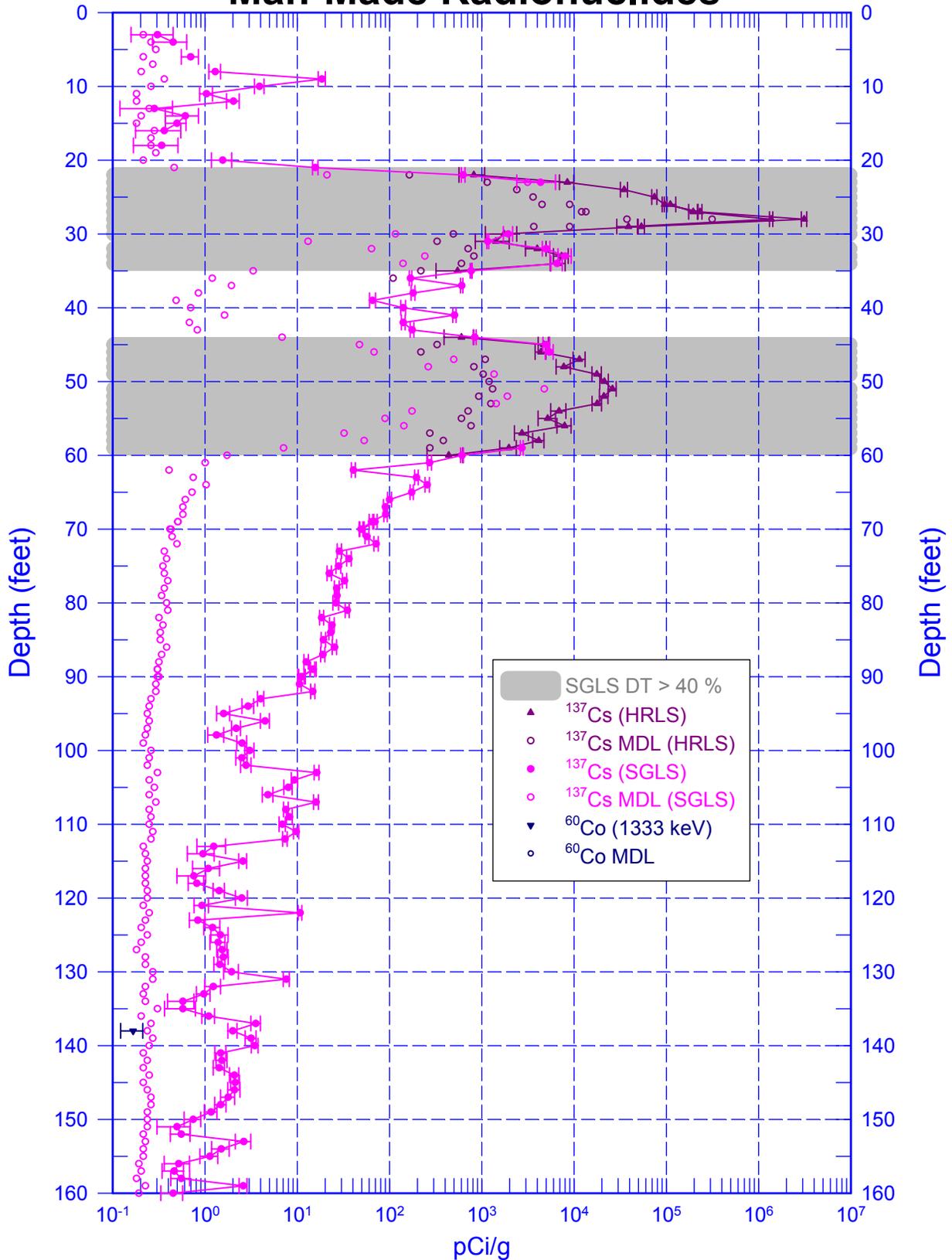


from Fecht et al. (1977)

Scintillation Probe Profiles for Borehole 299-W22-32, Logged on 2/16/68 and 5/13/76

299-W22-32 (A7851)

Man-Made Radionuclides

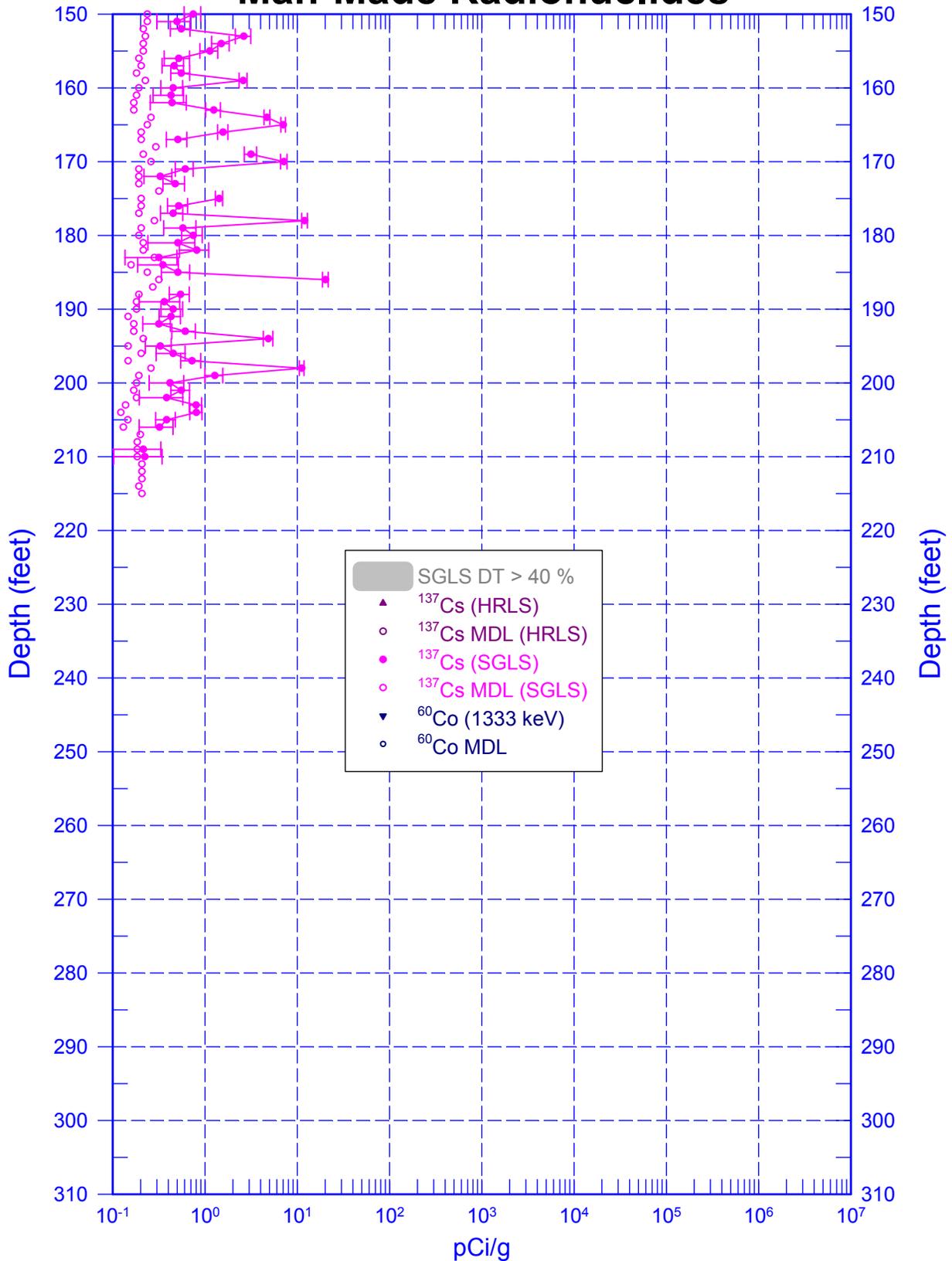


Zero Reference = Top of Casing

Date of Last Logging Run
4/02/2004

299-W22-32 (A7851)

Man-Made Radionuclides

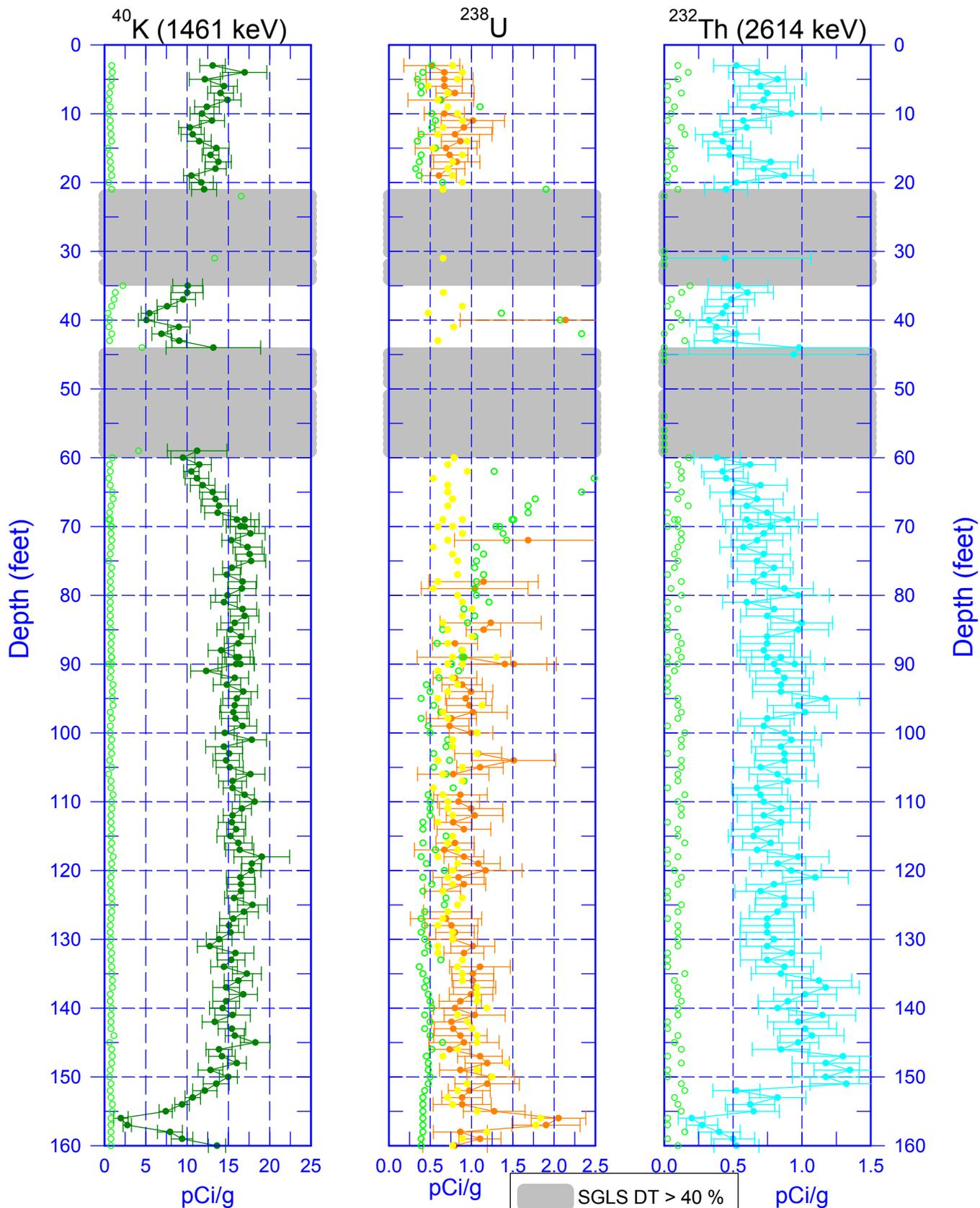


Zero Reference = Top of Casing

Date of Last Logging Run
4/02/2004

299-W22-32 (A7851)

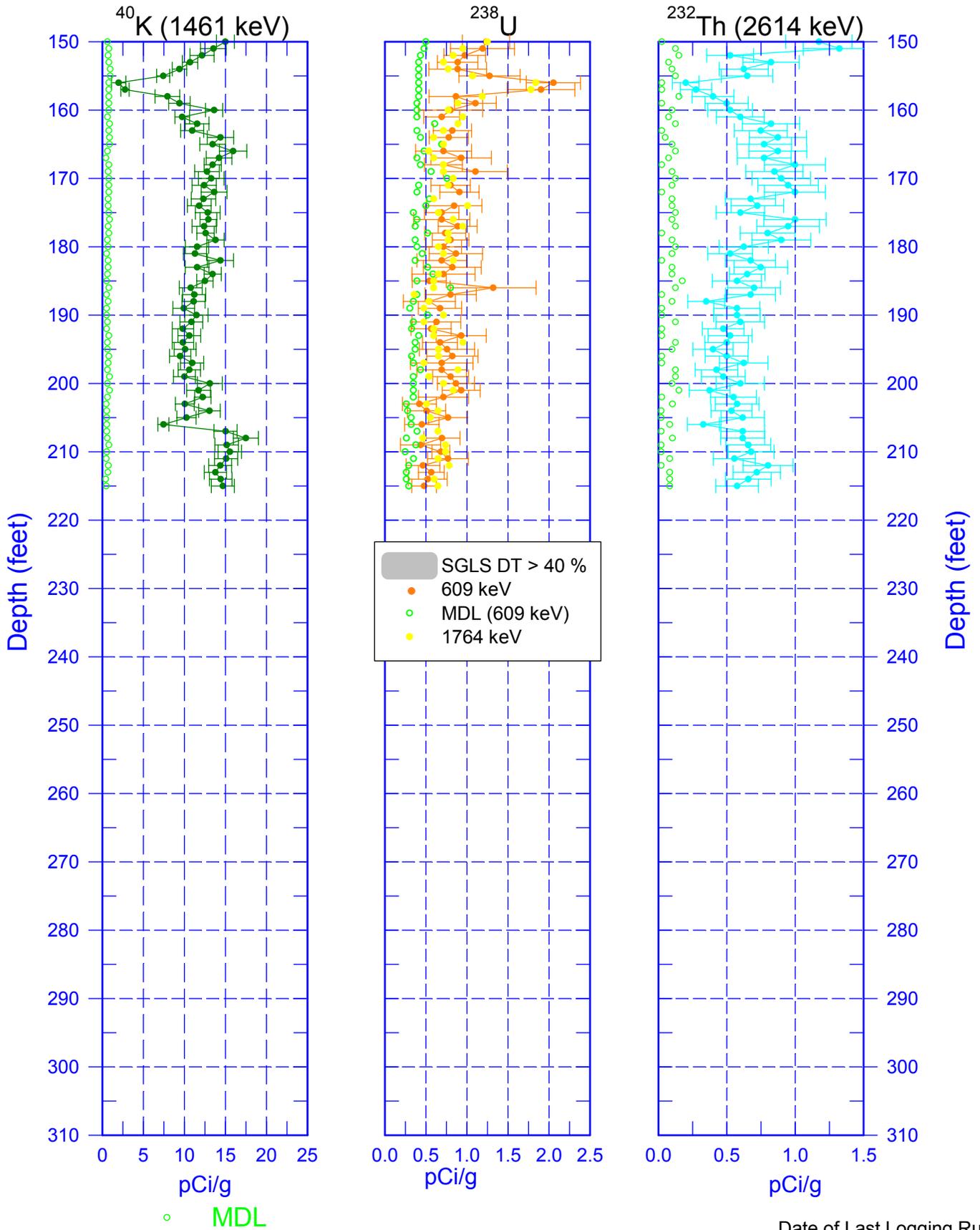
Natural Gamma Logs



Zero Reference = Top of Casing

Date of Last Logging Run
4/02/2004

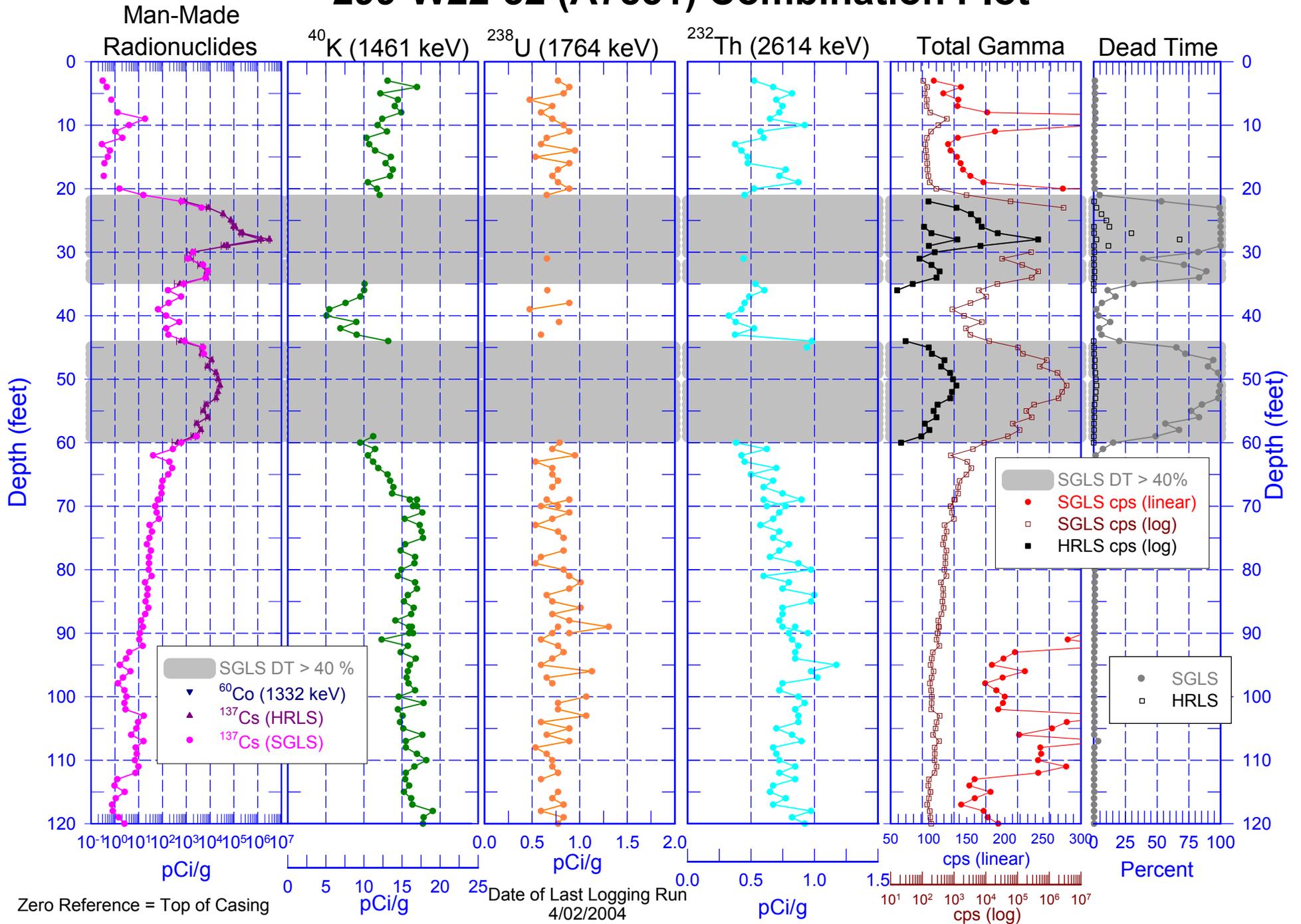
299-W22-32 (A7851) Natural Gamma Logs



Zero Reference = Top of Casing

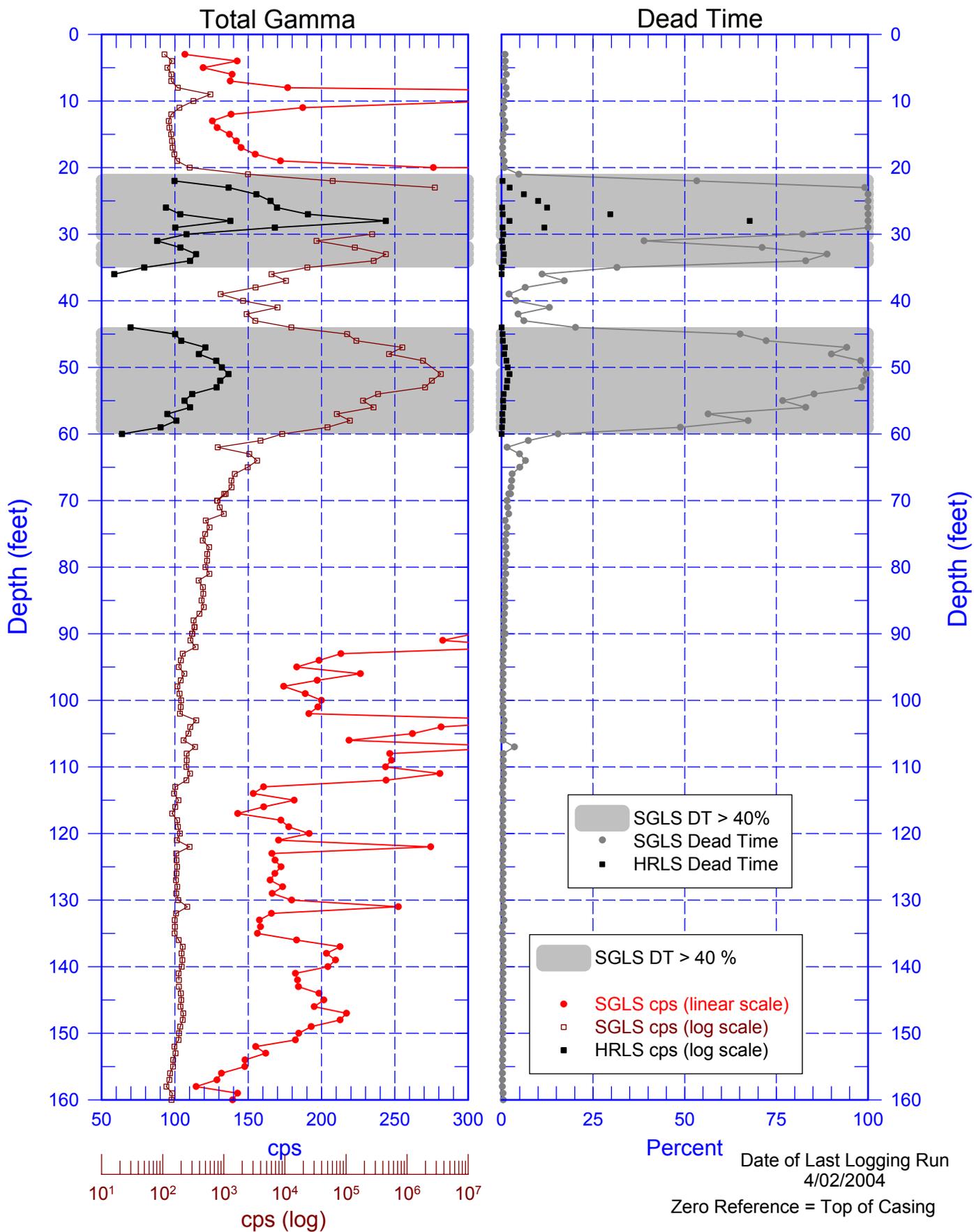
Date of Last Logging Run
4/02/2004

299-W22-32 (A7851) Combination Plot



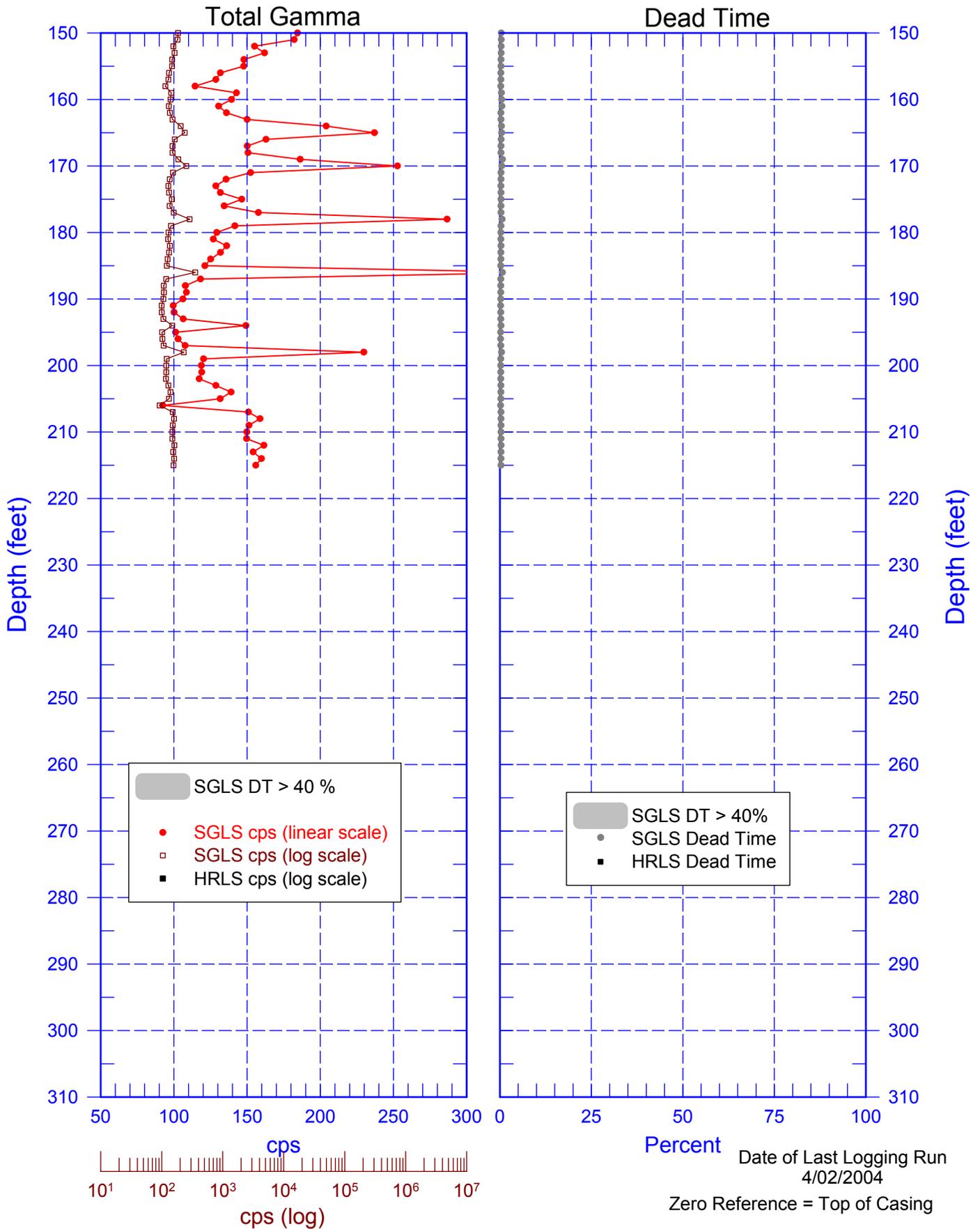
299-W22-32 (A7851)

Total Gamma & Dead Time



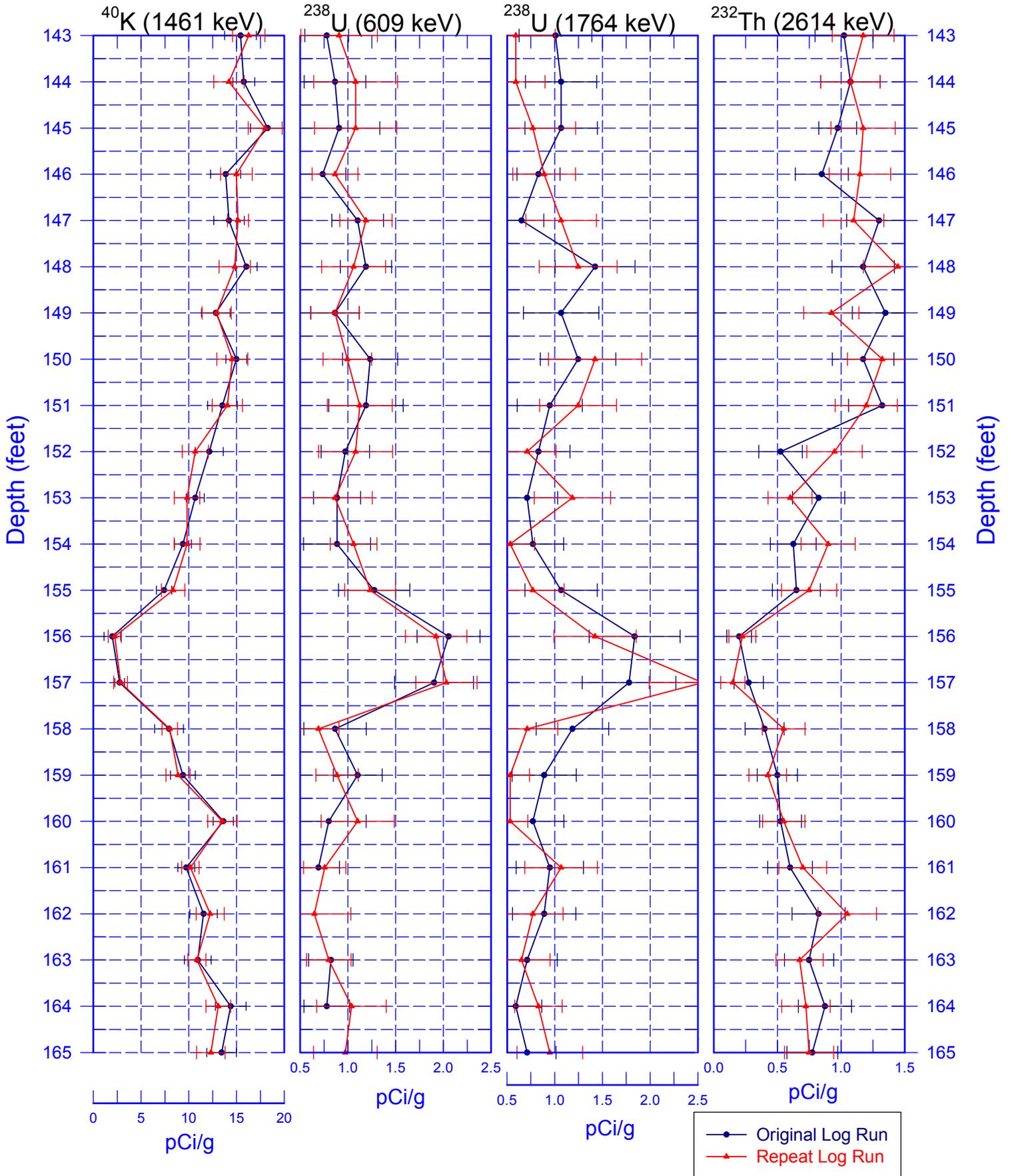
299-W22-32 (A7851)

Total Gamma & Dead Time



299-W22-32 (A7851)

Rerun of Natural Gamma Logs (165 to 143 ft)



299-W22-32 (A7851)

Rerun of ^{137}Cs

