

C4195 Log Data Report

Borehole Information:

Borehole: C4195		Site: 216-B-26 Trench			
Coordinates (WA State Plane)		GWL (ft)¹: Not reached		GWL Date: 11/14/2003	
North n/a ³	East n/a	Drill Date Nov. 2003	TOC² Elevation n/a	Total Depth (ft) 40	Type Percussion

Casing Information:

Casing Type	Stickup (ft)	Outer Diameter (in.)	Inside Diameter (in.)	Thickness (in.)	Top (ft)	Bottom (ft)
Threaded Steel	0	6 5/8	5 5/8	1/2	0	
The logging engineer used a caliper 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:

Zero reference is the ground surface. This borehole was logged through the drill pipe. The ground surface between 0 and about 1 ft is compacted gravel that was trucked in to stabilize the ground surface for drilling and logging operations.

Logging Equipment Information:

Logging System: Gamma 2A	Type: 35% HPGe (34-TP20863A)
Calibration Date: 09/2002	Calibration Reference: GJO-2002-383-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	

Logging System: Gamma 2F	Type: Moisture (H380932510)
Calibration Date: 09/2003	Calibration Reference: GJO-2003-520-TAC
Logging Procedure: MAC-HGLP 1.6.5, Rev. 0	

Spectral Gamma Logging System (SGLS) Log Run Information:

Log Run	1	2/Repeat			
Date	11/14/03	11/17/03			
Logging Engineer	Spatz	Spatz			
Start Depth (ft)	39.0	5.0			
Finish Depth (ft)	1.0	1.0			

Log Run	1	2/Repeat			
Count Time (sec)	200	200			
Live/Real	R	R			
Shield (Y/N)	N	N			
MSA Interval (ft)	1.0	1.0			
ft/min	N/A ⁴	N/A			
Pre-Verification	BA217CAB	BA217CAB			
Start File	BA217000	BA217039			
Finish File	BA217038	BA217043			
Post-Verification	BA217CAA	BA217CAA			
Depth Return Error (in.)	0	0			
Comments	No fine-gain adjustment.	Repeat section.			

High Rate Logging System (HRLS) Log Run Information:

Log Run	1	2	3	4/Repeat	
Date	11/25/03	11/25/03	11/25/03	11/25/03	
Logging Engineer	Spatz	Spatz	Spatz	Spatz	
Start Depth (ft)	38.0	25.0	20.0	16.0	
Finish Depth (ft)	36.0	22.0	9.0	14.0	
Count Time (sec)	300	300	300	300	
Live/Real	R	R	R	R	
Shield (Y/N)	NA	NA	NA	NA	
MSA Interval (ft)	1.0	1.0	1.0	1.0	
ft/min	NA	NA	NA	NA	
Pre-Verification	AC081CAB	AC081CAB	AC081CAB	AC081CAB	
Start File	AC081000	AC081003	AC081007	AC081019	
Finish File	AC081002	AC081006	AC081018	AC081021	
Post-Verification	AC083CAA	AC083CAA	AC083CAA	AC083CAA	
Depth Return Error (in.)	N/A	N/A	N/A	0	
Comments	No fine-gain adjustment.	No fine-gain adjustment.	No fine-gain adjustment.	Repeat section.	

Log Run	5	6/Repeat			
Date	11/25/03	11/25/03			
Logging Engineer	Spatz	Spatz			
Start Depth (ft)	14.0	13.0			
Finish Depth (ft)	11.0	12.0			
Count Time (sec)	300	300			
Live/Real	R	R			
Shield (Y/N)	Y - Internal	Y - Internal			
MSA Interval (ft)	1.0	1.0			
ft/min	N/A	N/A			
Pre-Verification	AC081CAB	AC081CAB			
Start File	AC081022	AC081026			
Finish File	AC081025	AC081027			
Post-Verification	AC083CAA	AC083CAA			
Depth Return Error (in.)	N/A	0			
Comments	No fine-gain adjustment.	Repeat section.			

Neutron Moisture Logging System (NMLS) Log Run Information:

Log Run	1	2/Repeat		
Date	11/14/03	11/14/03		
Logging Engineer	Spatz	Spatz		
Start Depth (ft)	0	10.0		
Finish Depth (ft)	39.5	14.0		
Count Time (sec)	N/A	N/A		
Live/Real	N/A	N/A		
Shield (Y/N)	N/A	N/A		
MSA Interval (ft)	0.25	0.25		
ft/min	1.0	1.0		
Pre-Verification	BF115CAB	BF115CAB		
Start File	BF115000	BF115159		
Finish File	BF115158	BF115175		
Post-Verification	BF115CAA	BF115CAA		
Depth Return Error (in.)	N/A	0		
Comments	None	Repeat section.		

Logging Operation Notes:

Zero reference was the ground surface, and the borehole was logged through drill pipe. Logging was performed with a centralizer installed on the sondes.

SGLS data were collected using Gamma 2A. Pre- and post-survey verification measurements employed the Amersham KUT (⁴⁰K, ²³⁸U, and ²³²Th) verifier with serial number 082. Peak counts per second (cps) for ²³²Th (2614 keV) were below acceptance criteria for pre-survey verification file BA218CAB.

HRLS data were collected using Gamma 1C. Pre- and post-survey verification measurements employed the ¹³⁷Cs verifier with serial number 1013.

Analysis Notes:

Analyst:	Sobczyk	Date:	12/01/03	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 the day and compared to the control limits. All of the verification spectra were outside the acceptance criteria. The photopeak counts per second (cps) at 2614.5 keV for the pre-run and post-run spectra were below the acceptance criteria. Examinations of spectra indicate that the recorded peak counts per second have slightly reduced calculated concentrations above 1500 keV, and the spectra are provisionally accepted.

HRLS pre-run and post-run verification spectra were collected at the beginning and end of the day. The spectra were within the acceptance criteria for the field verification of the Gamma 1C logging system (HRLS).

NMLS pre-run and post-run verification spectra were collected at the beginning and end of the day and compared to the control limits established on 12/05/2002. The spectra were within the acceptance criteria for the field verification of the Gamma 2F logging system (NMLS).

Log spectra 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 files: G2AFeb03.xls [SGLS] and G1CApr03.xls [HRLS]). Zero reference was the ground surface. On the basis of the measurements supplied by the driller, the casing configuration was

assumed to be one string of 6-in. casing to total logging depth (39 ft). The casing correction factors for the HRLS and SGLS were calculated using a 6-in. casing thickness of 0.5 in. This casing thickness is based upon the field measurement. A water correction was not required.

Using the SGLS, dead time greater than 40 percent was encountered in the intervals from 10 to 15 ft, 18 to 19 ft, 23 to 24 ft, and at 37 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. SGLS and HRLS dead time corrections were applied when dead time surpassed 10.5 percent.

The HRLS was utilized to obtain data where the SGLS dead time exceeded 40 percent. When HRLS dead time exceeds 30 percent, shields are used. At 12 and 13 ft, HRLS dead time exceeded 30 percent, and this interval was logged by the HRLS sonde with an internal shield installed. An energy-dependent efficiency function is not available for the internal shield, but a shield correction factor has been estimated for 662 keV (^{137}Cs). This correction factor is 27.42.

NMLS log spectra were processed in batch mode using APTEC SUPERVISOR to determine count rates. The volume fraction of water was calculated in EXCEL, using parameters determined from analysis of recent calibration data. Zero reference was the ground surface. The neutron moisture calibration is based on a typical 6-in. casing with a thickness of 0.28 in., and the neutron moisture values were corrected for the 0.5-in. casing thickness.

Log Plot Notes:

Separate log plots are provided for gross gamma and dead time, gross gamma and volume fraction of water, 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 was the only man-made radionuclide detected in this borehole. ^{137}Cs was detected throughout the entire length of the borehole at concentrations ranging from the MDL (0.2 pCi/g) to 1.7 million pCi/g. The maximum concentration of ^{137}Cs was measured at 12 ft.

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

¹ GWL – groundwater level

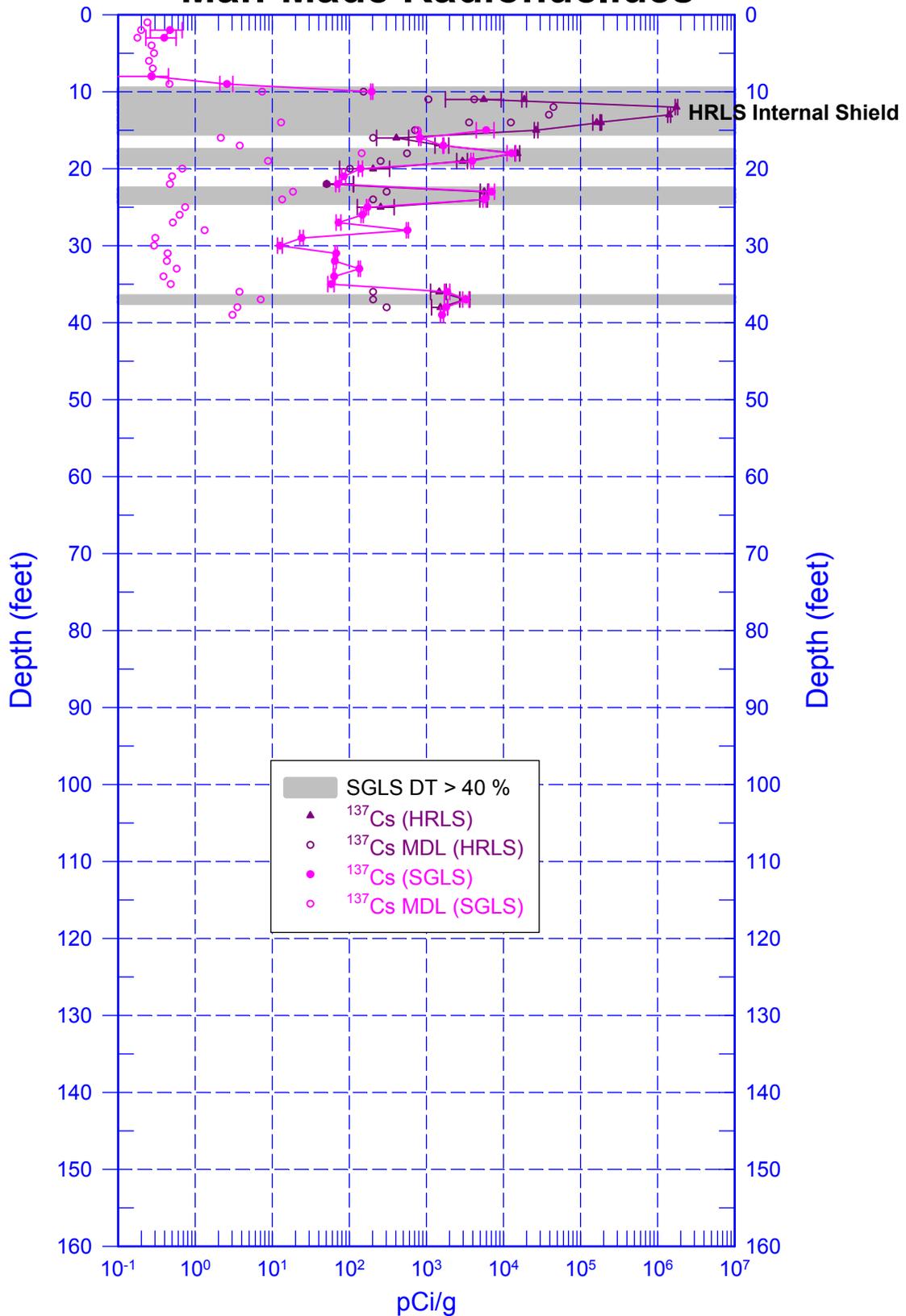
² TOC – top of casing

³ n/a – not available

⁴ N/A – not applicable

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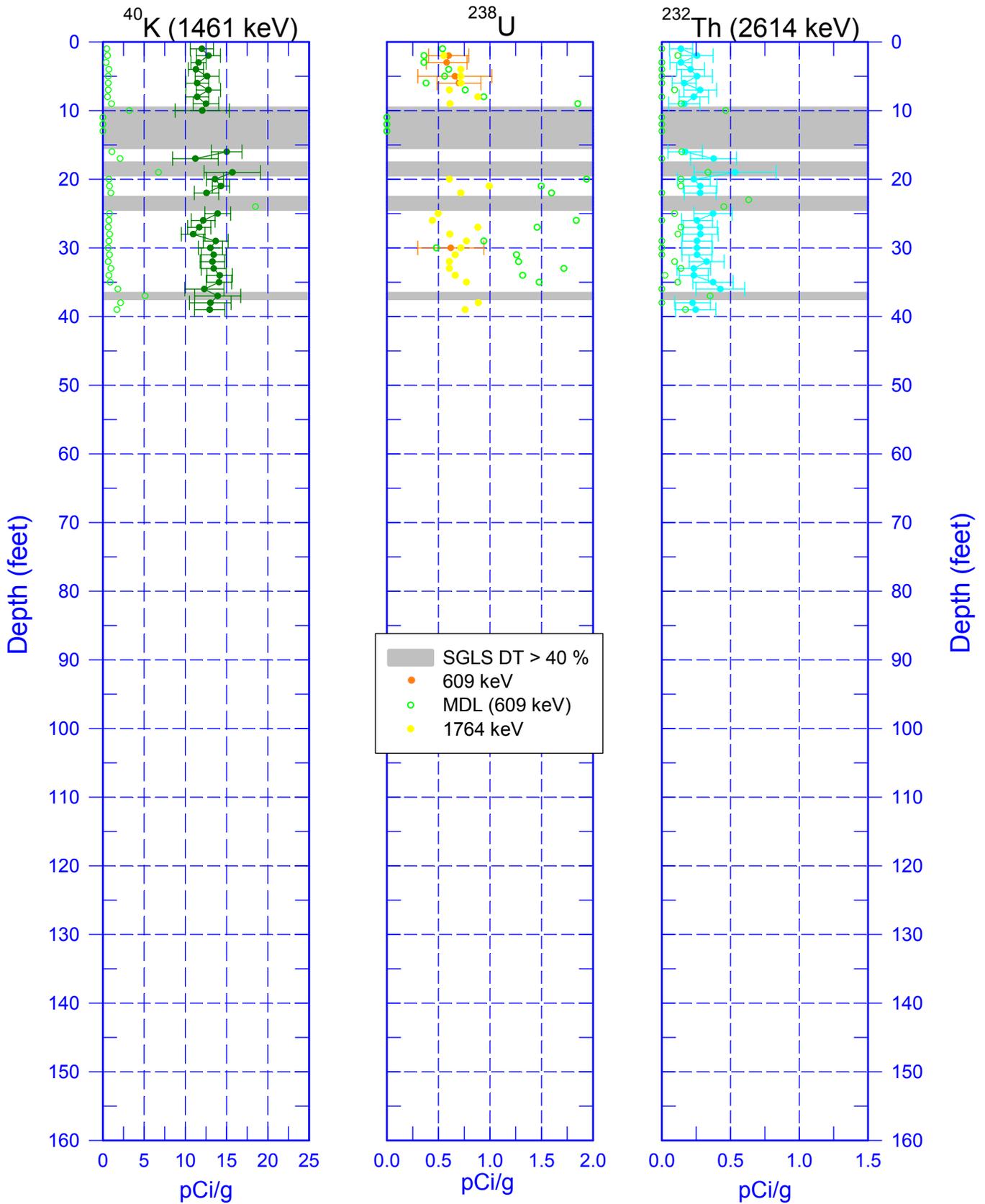
Man-Made Radionuclides



Zero Reference = Ground Surface

Date of Last Logging Run
11/25/2003

C4195 Natural Gamma Logs

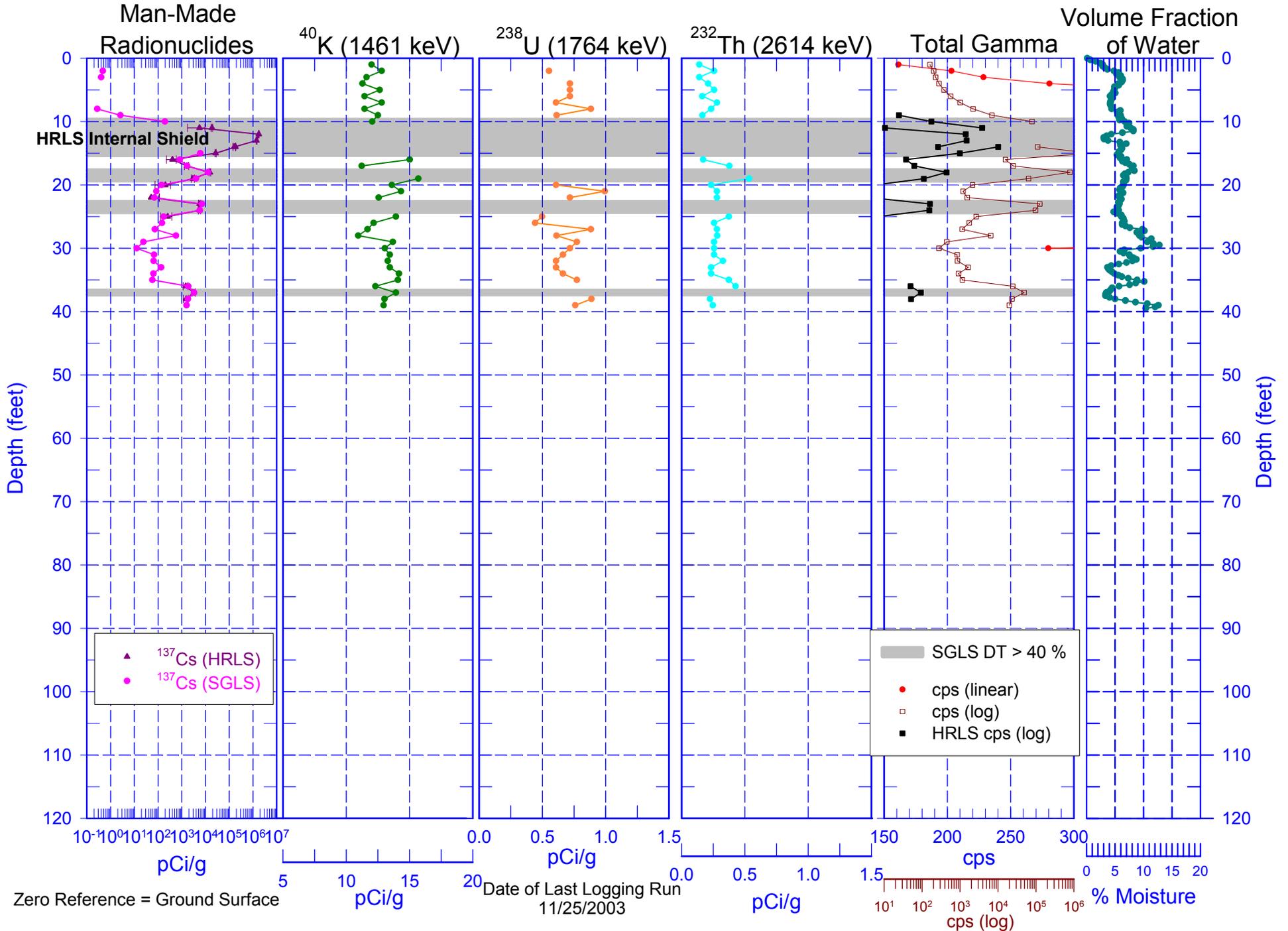


○ MDL

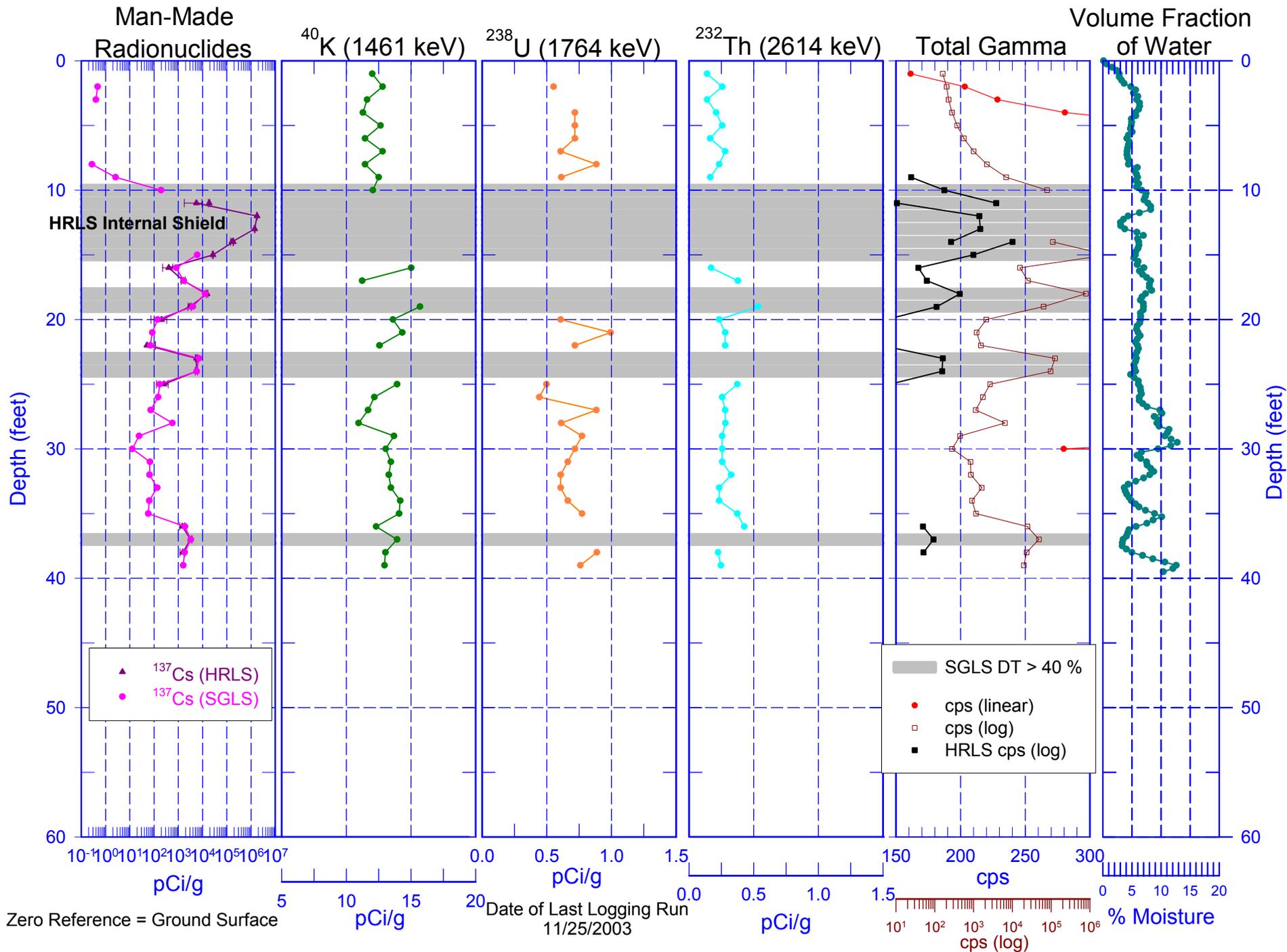
Zero Reference = Ground Surface

Date of Last Logging Run
11/14/2003

C4195 Combination Plot

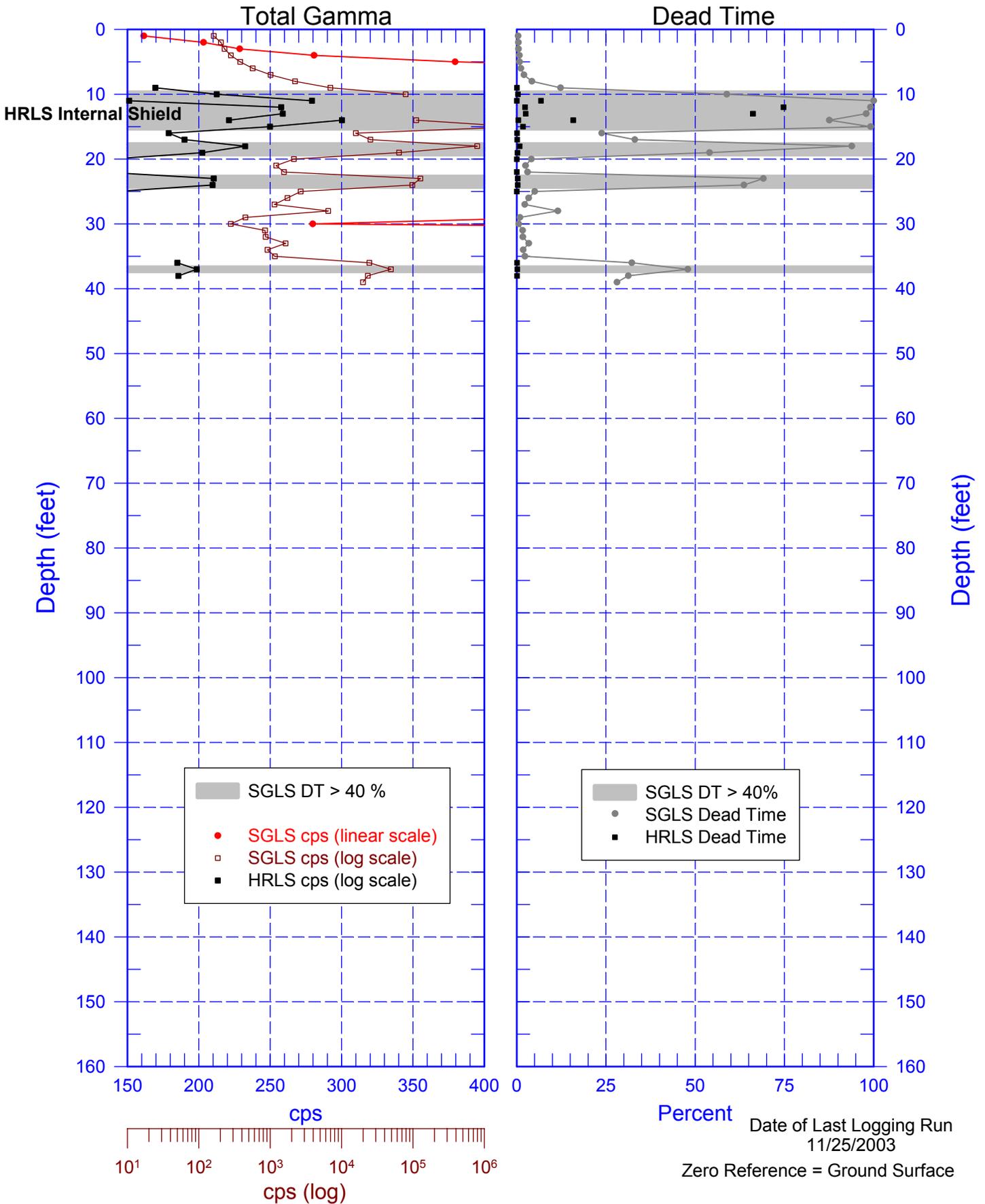


C4195 Combination Plot



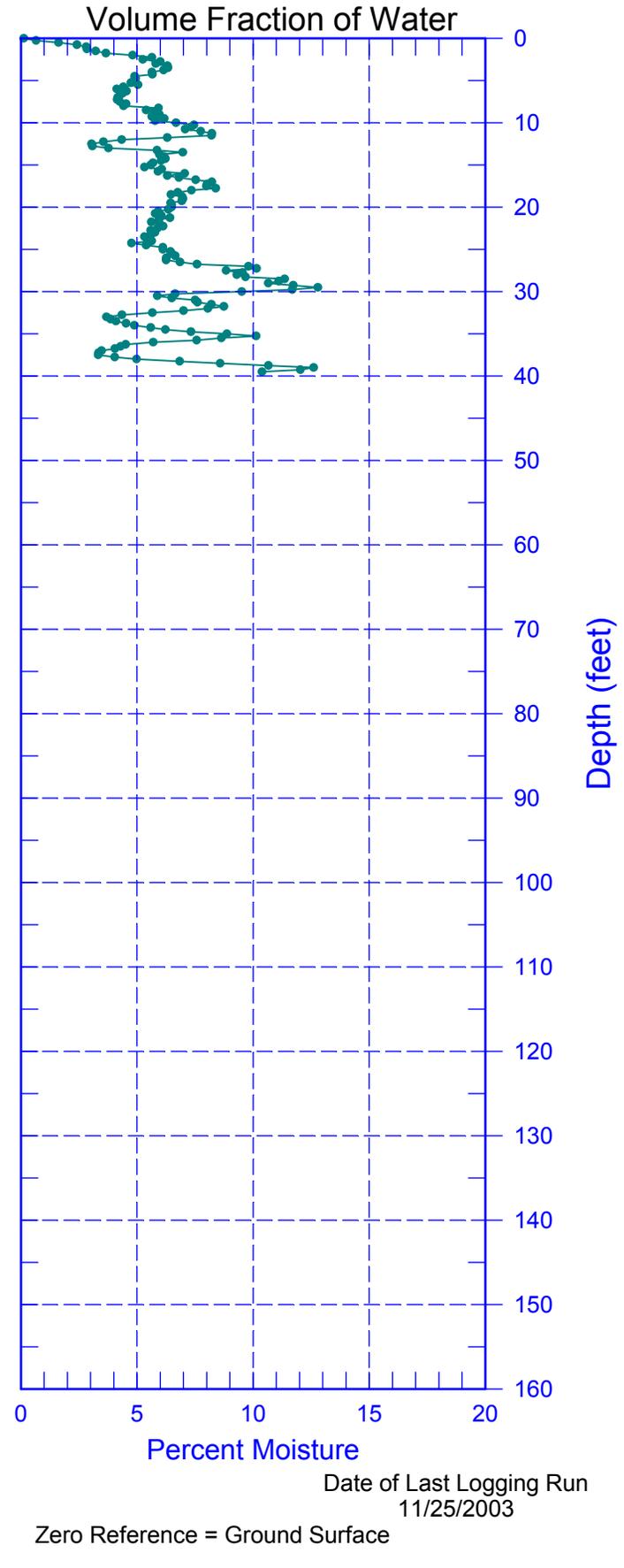
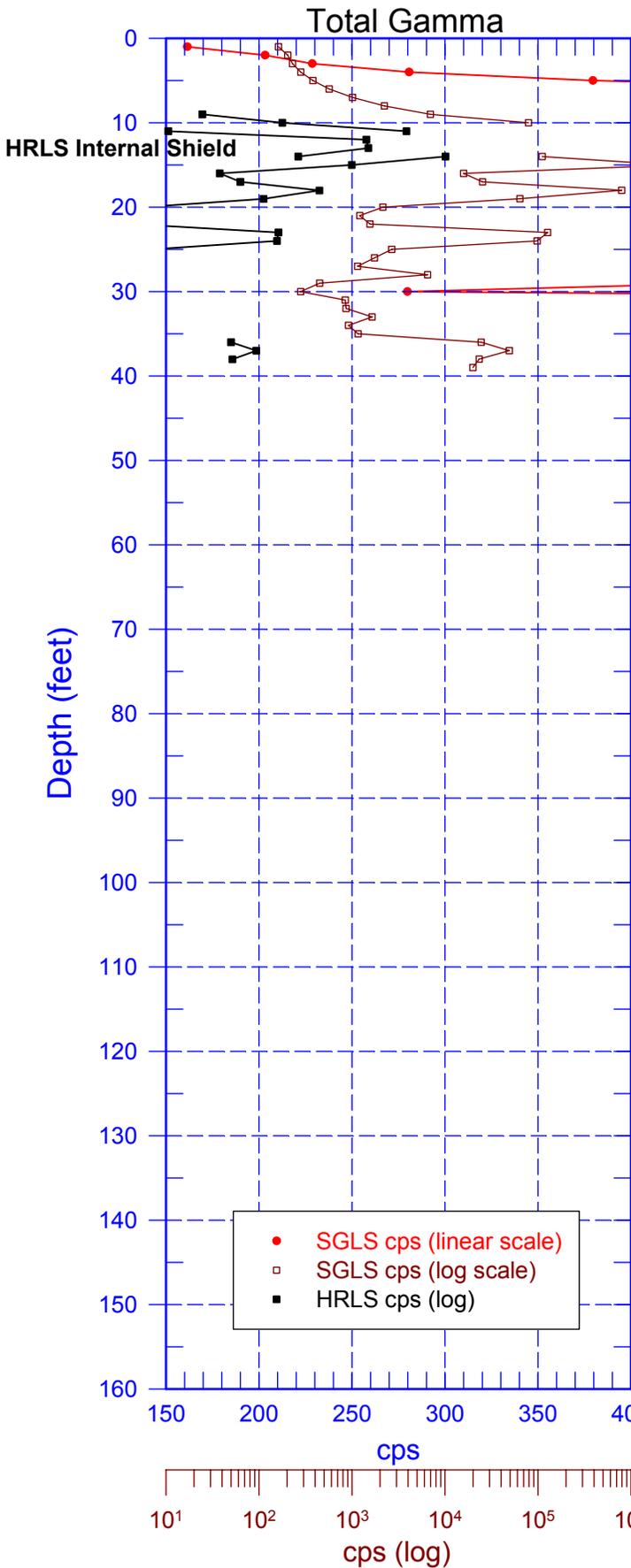
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Total Gamma & Dead Time



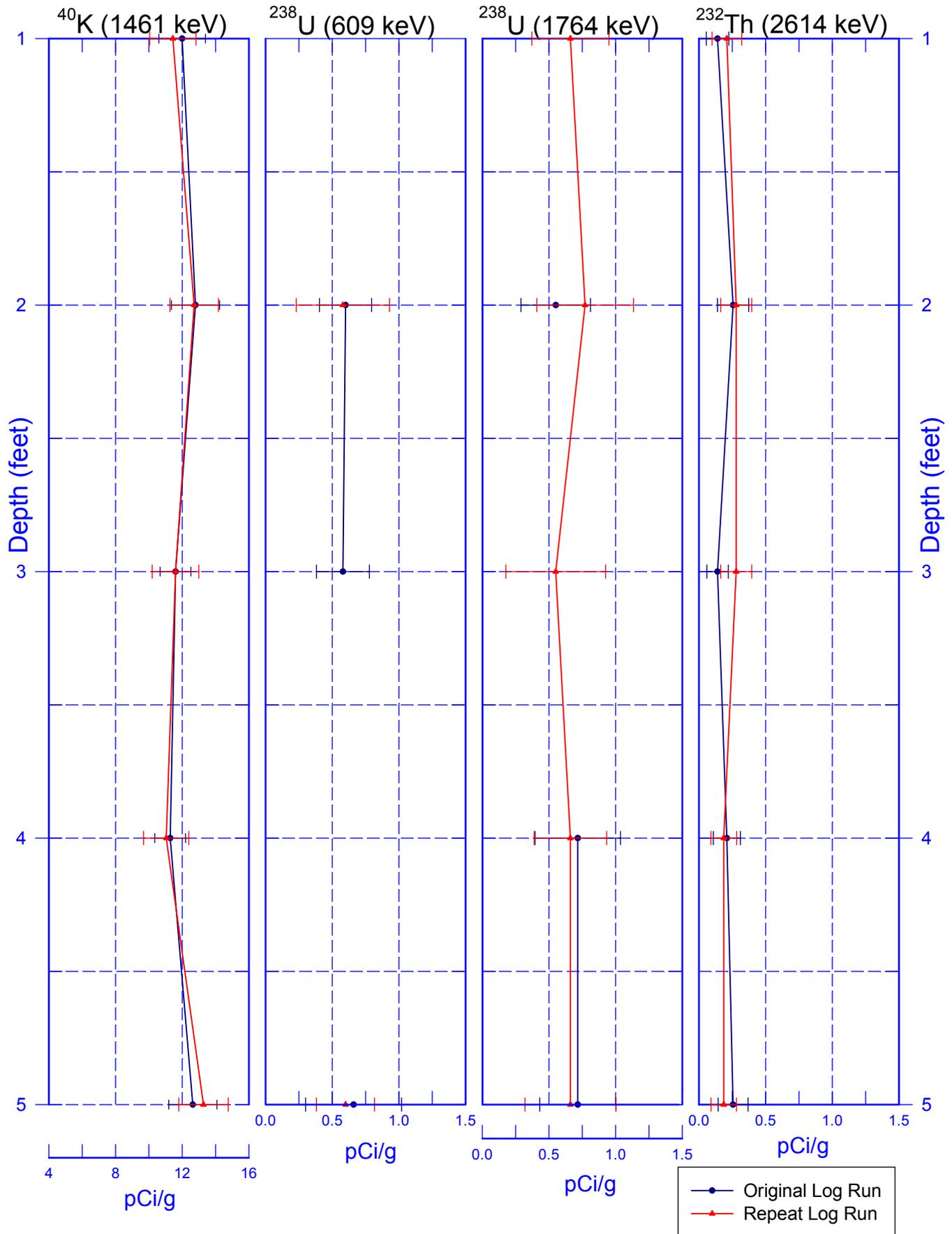
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Total Gamma & Neutron



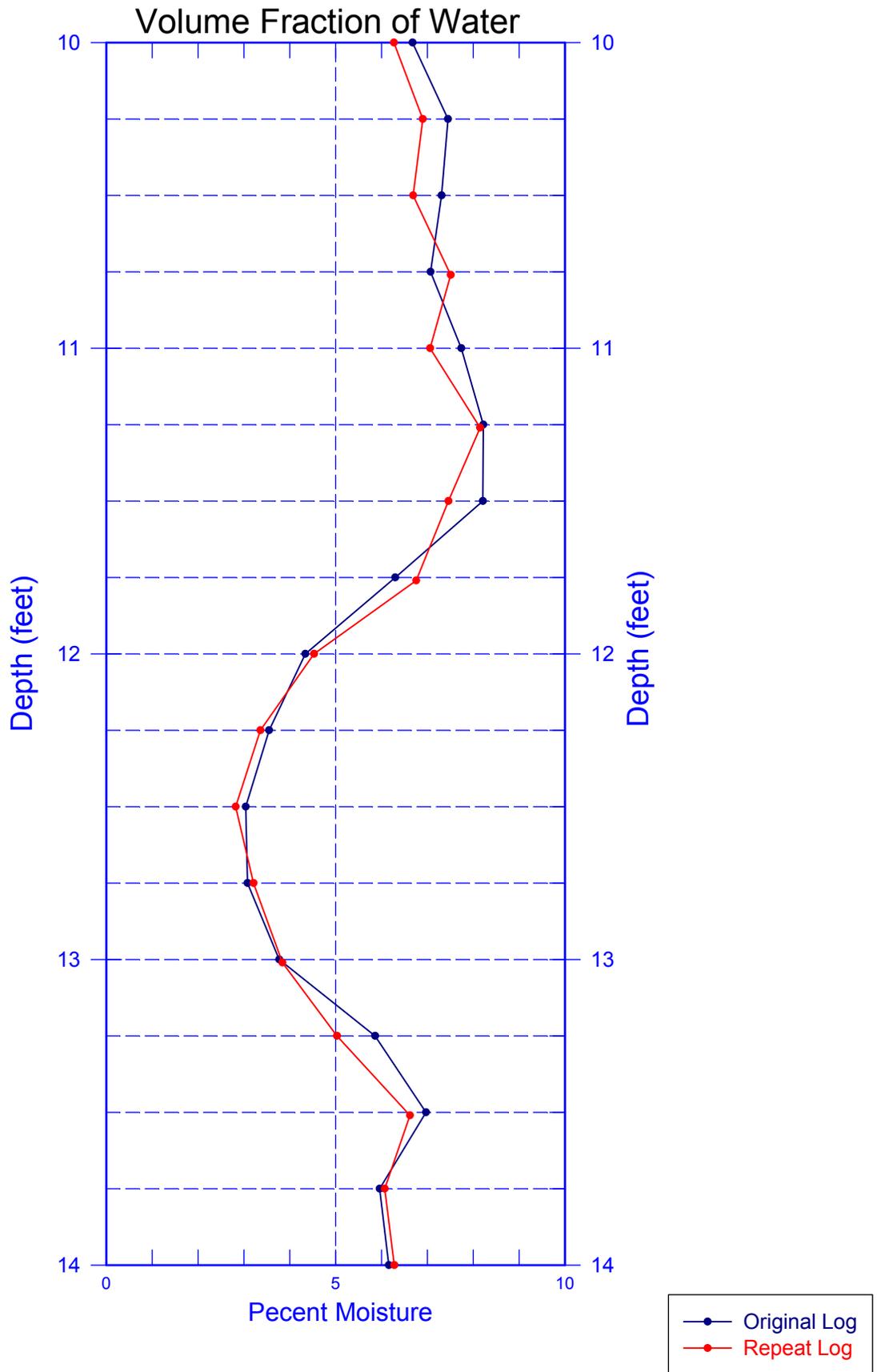
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Rerun of Natural Gamma Logs (5.0 to 1.0 ft)



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Rerun of Neutron-Moisture Log (10.0 to 14.0 ft)



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Rerun of Man-Made Radionuclides

