Stoller
Hanford Office

DOE-EM/GJ1302-2006

299-W33-18 (A4844)
Log Data Report

Borehole Information:

Borehole:	299-W13-18 (A4844)		Site:	216-B-A & B Cribs	
Coordinates (WA St Plane)		GWL[1] (ft):	None	GW Date:	03/31/06
North	East	Drill Date	Ground Level Elevation	Total Depth (ft)	Type
137386.064	573779.166	02/50	655.22	278	Cable

*GWL - groundwater level

Casing Information:

Casing Type	Stickup (ft)	Outer Diameter (in.)	Inside Diameter (in.)	Thickness (in.)	Top (ft)	Bottom (ft)
Steel	2.5	8 5/8	8	5/16	2.5	278

Borehole Notes:

A Log Data Report for this borehole has been previously issued in December 2001. This report is an update based on additional logging conducted in August, 2006. In addition to spectral gamma logging, moisture data were also acquired. Moisture data were not collected in earlier logging efforts.

GWL has changed from 252.9 ft in March 2000 to 254.8 ft on August 4, 2006. The total depth of the borehole is reported to be 278 ft. The maximum log depth achieved in 2001 was 274 ft. In 2006, the sonde touched bottom at 269.61 ft.

In 1992, a gross gamma log showed an interval of relatively high total counts between log depths of approximately 230 ft. and 242 ft. On the basis of these data, the RLS was used to collect stationary measurements for 300 seconds at 236 ft. and 252 ft. ^{60}Co was detected at both depths at less than 3 pCi/g. No evidence of $^{235/238}$U or other manmade radionuclides were reported. Groundwater contamination was first reported in borehole 299-E33-18 in 1994. In 1997, the borehole was re-logged with the RLS. In addition to ^{60}Co, $^{235/238}$U were also detected in the vadose zone. Baseline data were collected with the SGLS in November, 2001. Comparison of the 2001 SGLS results with the 1997 data suggests the ^{60}Co (decayed to 2001) is relatively stable, but the $^{235/238}$U concentrations appear to have increased between 1997 and 2001. Geophysical log data in 299-E33-18 and surrounding boreholes were evaluated in the waste site summary report for the 216-B-8 Crib and Adjacent Sites (GJO-2002-343-TAR) and in a later report on the B/BX/BY waste management area that was not issued. Available data indicate that manmade uranium appeared in the deep vadose zone at borehole 299-E33-18 between 1992 and 1997, and that concentrations appear to have increased between 1997 and 2001. The current logging effort is made to re-log the lower portion of the borehole to assess any changes that may have occurred in uranium concentrations since 2001.

Spectral Gamma Logging System (SGLS) Equipment Information:

Logging System:	Gamma 1N		Type:	SGLS (60%) SN: 45-TP22020A
Effective Calibration Date:	04/05/06	Calibration Reference:	DOE/EM-GJ1183-2006	
		Logging Procedure:	GJO-HGLP 1.6.5, Rev. 1	

Neutron Moisture Logging System (NMLS) Equipment Information:

Logging System:	Gamma 1N		**Type:**	NMLS SN: H340207279
Effective Calibration Date:	08/02/06	**Calibration Reference:**	DOE/EM-GJ1283-2006	
		Logging Procedure:	GJO-HGLP 1.6.5, Rev. 1	

Spectral Gamma Logging System (SGLS) Log Run Information:

Log Run	**1**	**2**	**3 Repeat**	
Date	08/03/06	08/04/06	08/04/06	
Logging Engineer	Spatz	Spatz	Spatz	
Start Depth (ft)	269.0	244.0	255.0	
Finish Depth (ft)	243.0	230.0	251.0	
Count Time (sec)	200	200	200	
Live/Real	R	R	R	
Shield (Y/N)	N	N	N	
MSA Interval (ft)	0.5	0.5	0.5	
ft/min	N/A**	N/A	N/A	
Pre-Verification	AN038CAB	AN039CAB	AN039CAB	
Start File	AN038000	AN039000	AN039029	
Finish File	AN038052	AN039028	AN039037	
Post-Verification	AN038CAA	AN039CAA	AN039CAA	
Depth Return Error (in.)	- 0.25	N/A	- 0.5	
Comments	No fine-gain adjustment	No fine-gain adjustment	No fine-gain adjustment	

**N/A – not applicable

Neutron Moisture Logging System (NMLS) Log Run Information:

Log Run	**4**	**5**	**6**	**7 Repeat**
Date	08/09/06	08/09/06	08/09/06	08/10/06
Logging Engineer	Spatz	Spatz	Spatz	Spatz
Start Depth (ft)	2.5	99.0	199.0	233.0
Finish Depth (ft)	100.0	200.0	234.0	254.5
Count Time (sec)	15	15	15	15
Live/Real	R	R	R	R
Shield (Y/N)	N	N	N	N
Sample Interval (ft)	0.25	0.25	0.25	0.25
ft/min	1.0	1.0	1.0	1.0
Pre-Verification	BM001CAB	BM001CAB	BM001CAB	BM002CAB
Start File	BM001000	BM001391	BM001796	BM002000
Finish File	BM001390	BM001795	BM001936	BM002086
Post-Verification	BM001CAA	BM001CAA	BM001CAA	BM002CAA
Depth Return Error (in.)	N/A	N/A	N/A	N/A
Comments	None	Subdirectory change	Subdirectory change	None

Logging Operation Notes:

Logging was conducted with a centralizer on the sonde. Measurements are referenced to the top of casing. Repeat sections were collected in this borehole to evaluate the logging systems' performance.

Analysis Notes:

Analyst:	Henwood	Date:	08/30/06	Reference:	GJO-HGLP 1.6.3, Rev. 0

Pre-run and post-run verifications for the logging systems were performed before and after each day's data acquisition. Acceptance criteria were met.

SGLS spectra were processed in batch mode using APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Concentrations were calculated using the EXCEL worksheet template identified as G1NApr06.xls. A casing correction for 0.322-in.-thick casing was applied to the SGLS data. This casing thickness is the same used to correct the 2001 data. A correction for water was applied to the data below 255 ft.

Results and Interpretations:

Manmade radionuclides detected in this borehole for the current logging event (between 230 and 269 ft) are ^{238}U, ^{235}U, and ^{60}Co. The original SGLS logging event in 2001 also detected ^{137}Cs near the ground surface, in addition to these contaminants.

Evidence of processed uranium (^{238}U and ^{235}U) exists from 232 to 264 ft. ^{238}U concentrations are determined by the ^{234m}Pa energy peak at 1001 keV. ^{235}U is directly measured by the 185.72 keV energy peak. The maximum concentrations for ^{238}U and ^{235}U are approximately 1237 and 104 pCi/g, respectively at 236 ft. The maximum concentrations in 2001 were approximately 650 and 50 pCi/g.

^{60}Co is detected between 232 and 264 ft at a maximum concentration of approximately 1 pCi/g at 241 ft.

Moisture logging results indicate a grout surface seal from the ground surface to approximately 20 ft. From 20 ft to 218 ft some variation in moisture is evident and moisture content ranges between approximately four and ten percent. From 219 to approximately 238 ft, a significant increase in moisture content to near saturation (e.g., approximately 20 to 35 percent) is evident. The driller's log reports a "clay" from 210 to 239 ft, roughly consistent with the high moisture. Below 239 ft, moisture remains relatively high (10 to 25 percent) until groundwater is reached at approximately 255 ft. The highest moisture content appears at the same depths as the highest uranium concentrations.

The naturally occurring KUT log data indicate potential fine-grained sediment layers that may act as "perching" horizons. For example, the ^{40}K and ^{232}Th profiles suggest a relatively thick fine-grained interval from 238 to 246 ft. The driller's log refers to these sediments as "coarse sand and some clay." This interval lies just below the sediments that exhibit the highest moisture content. A ^{232}Th increase at approximately 264 ft appears to indicate a lithology change that coincides with the lowest depth extent of contamination. The driller's log refers to "lava rock" at this depth.

Comparisons of spectral gamma log data of manmade radionuclides acquired in 1992, 1997, 2001, and 2006 are included in the table below and a plot. The uranium data in the table are the maximum concentrations reported in the respective years.

YEAR	1992	1997	2001	2006
^{238}U	None detected	439 pCi/g	623 pCi/g	1237 pCi/g
^{235}U	None detected	25 pCi/g	51 pCi/g	104 pCi/g

In 1992, no uranium was detected. ^{60}Co was detected at a few depths where stationary measurements were made to document the existence of ^{60}Co at less than 3 pCi/g. Continuous logging at consecutive depth intervals, as conducted in subsequent logging events, was not performed in 1992. Between 1992 and 1997, an influx of uranium was detected from 235 to 252 ft. Uranium concentrations continued to increase in 2001 and 2006. The uranium also is detected deeper in the vadose zone for each subsequent logging event and now appears to reach groundwater.

The manmade uranium appears to be associated with a moisture anomaly. It is postulated that some or all of the observed uranium may be dissolved in the pore fluid, and is migrating in a perched zone just above the groundwater level. The reported concentrations in the log data are based on activity per unit weight of soil. At 236 ft in depth, the total ^{238}U concentration is 1237 pCi/g, and the volumetric moisture content is approximately 34%. Assuming all of the uranium is dissolved in the pore fluid, the equivalent fluid concentration is estimated to be about 2.2 microcuries per liter. ^{238}U represents most of the uranium present, and this indicates a total uranium chemical concentration on the order of 6600 milligrams per liter, or about 6600 ppm total U in the pore fluid.

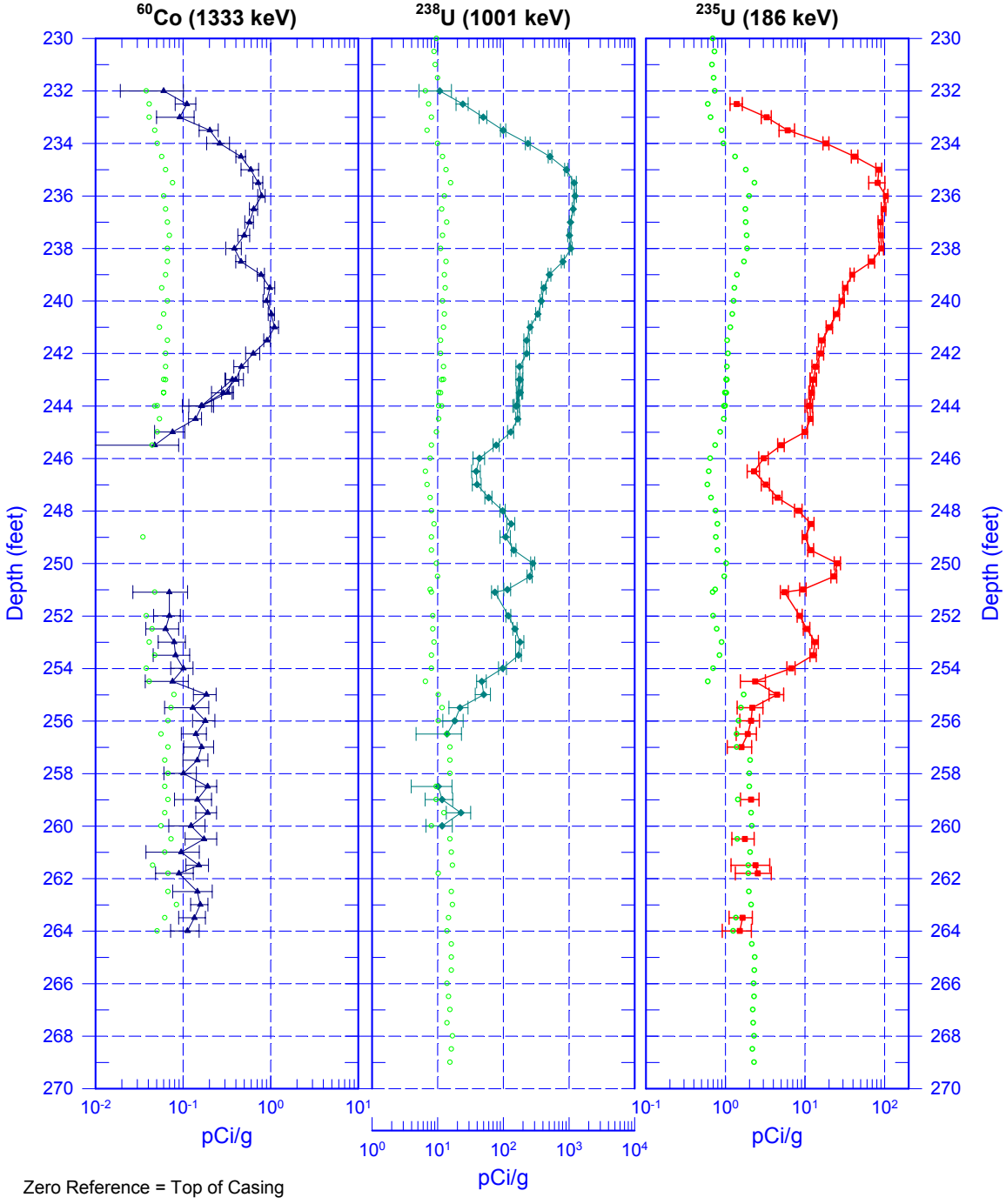
^{60}Co concentrations after correction for decay indicate possible increases between 232 and 242 ft in depth since 1992.

The repeat sections for the SGLS and NMLS indicate good agreement for the naturally occurring and man-made radionuclides.

List of Log Plots:

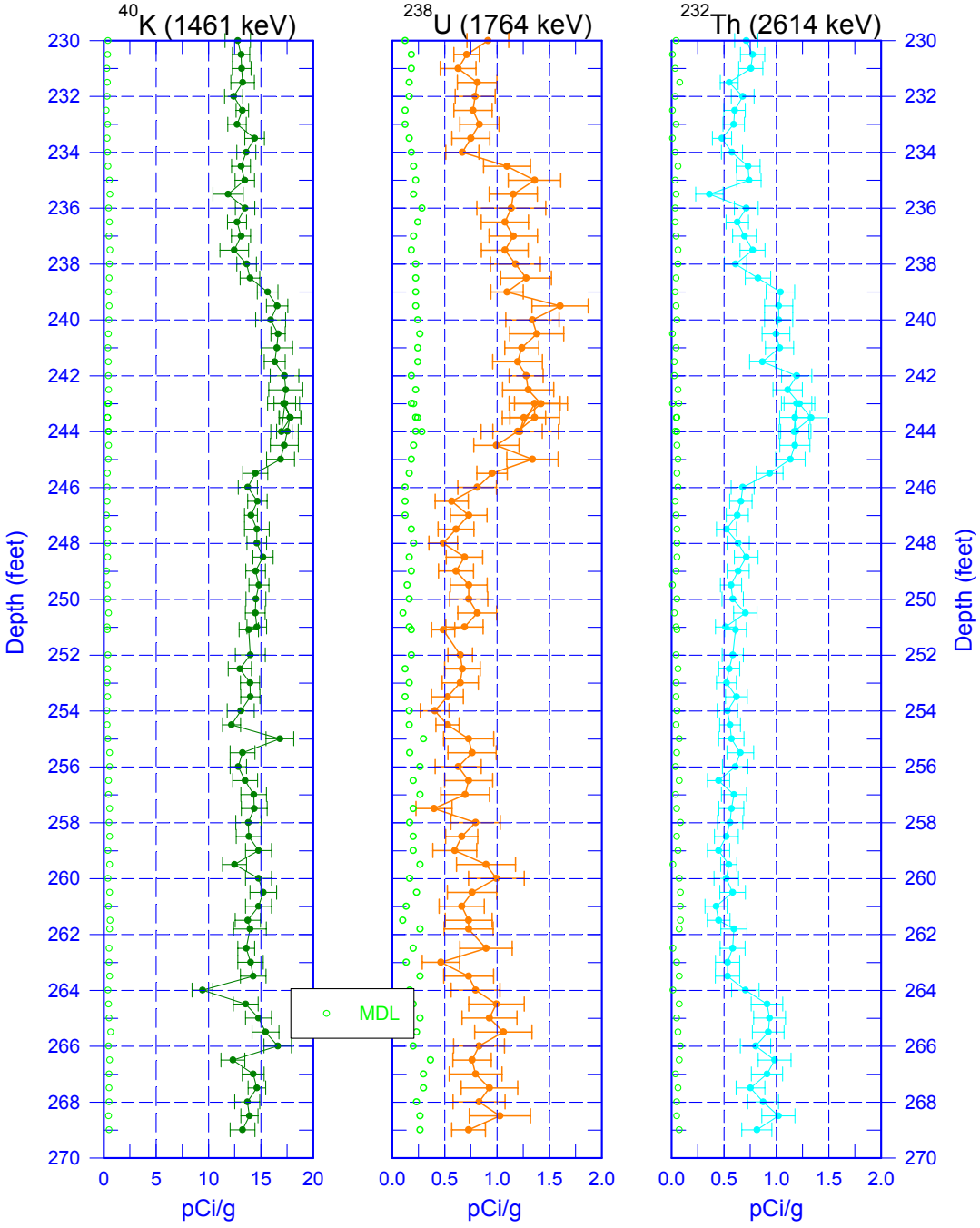
Man-Made Radionuclides
Natural Gamma Logs
Combination Plot
Total Gamma & Moisture
Comparison of Man-made Radionuclides (1992 to 2006)
Repeat Section of Man-made Radionuclide
Repeat Section of Natural Gamma Logs
Repeat Section for Total Gamma & Moisture

299-E33-18 (A4844)
Man-Made Radionuclides



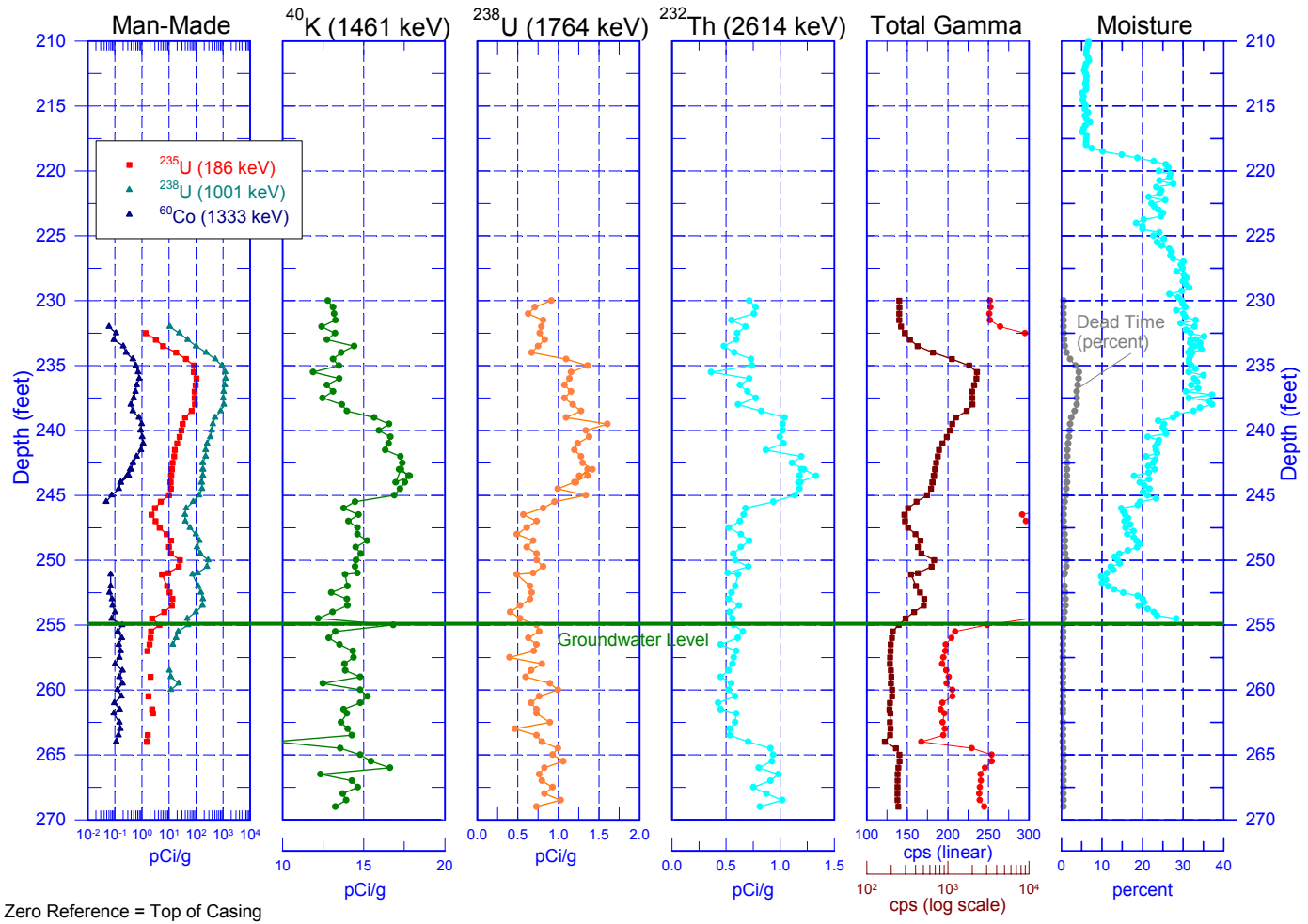
Zero Reference = Top of Casing

299-E33-18 (A4844)
Natural Gamma Logs



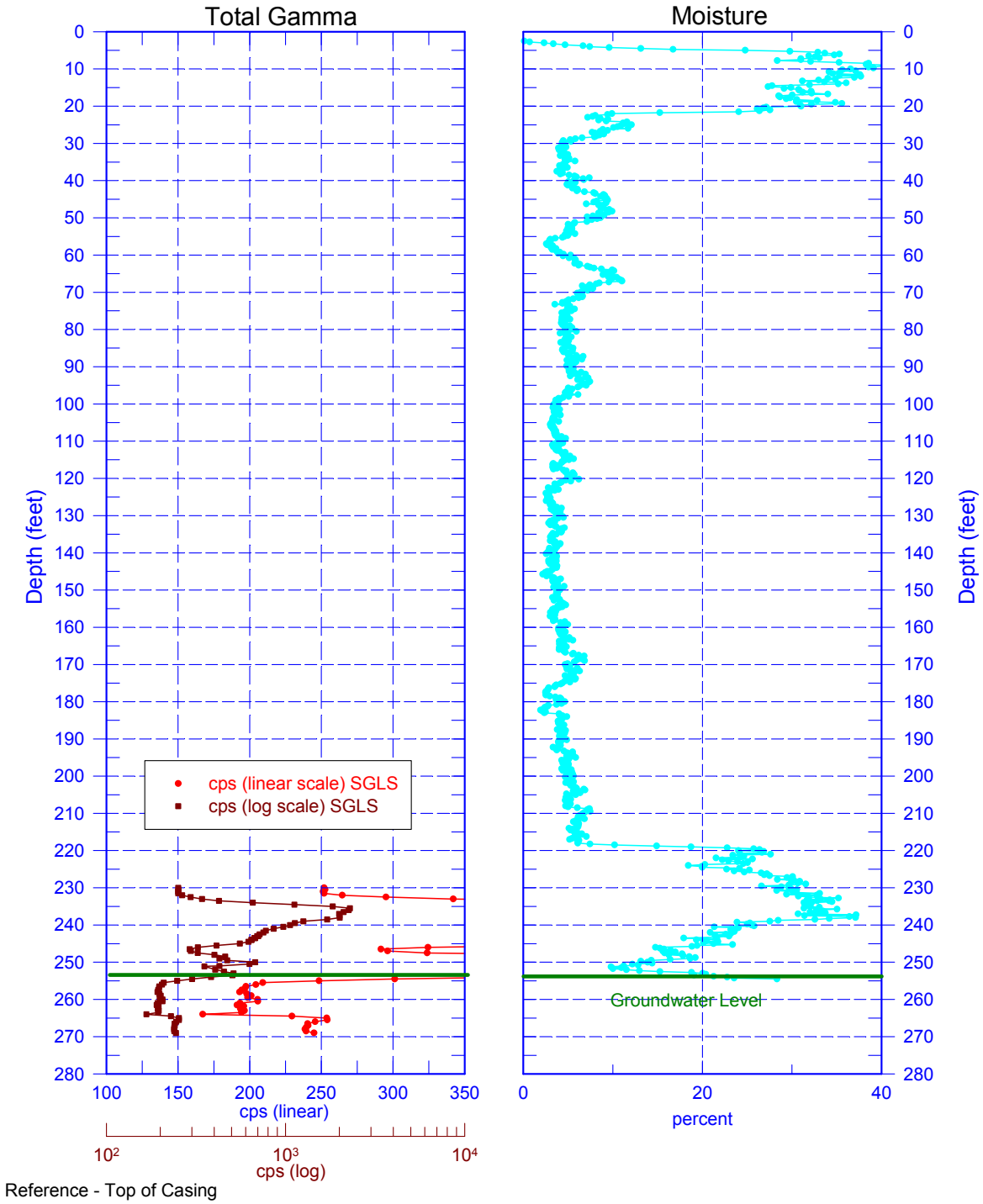
Zero Reference = Top of Casing

299-E33-18 (A4844) Combination Plot

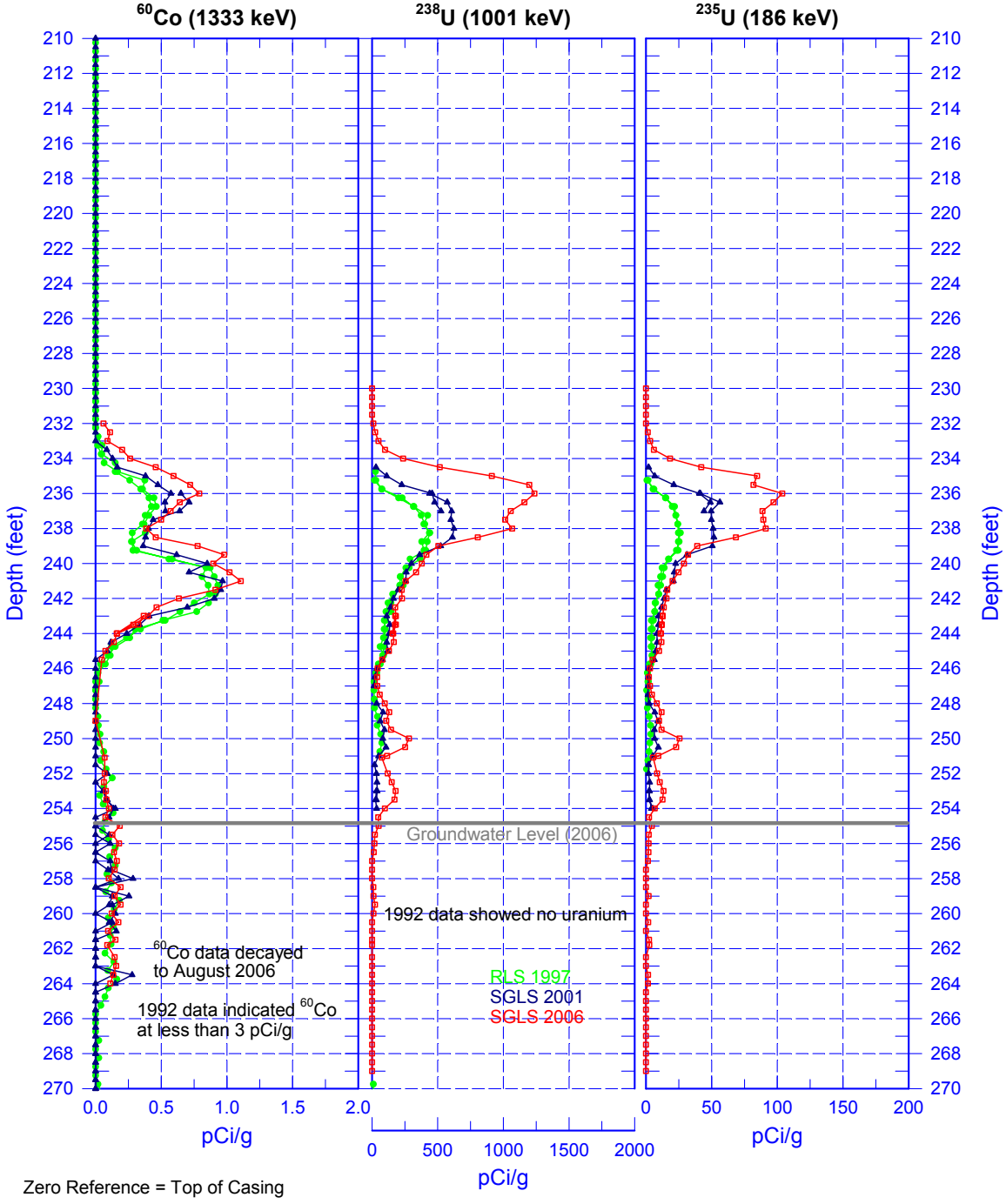


Zero Reference = Top of Casing

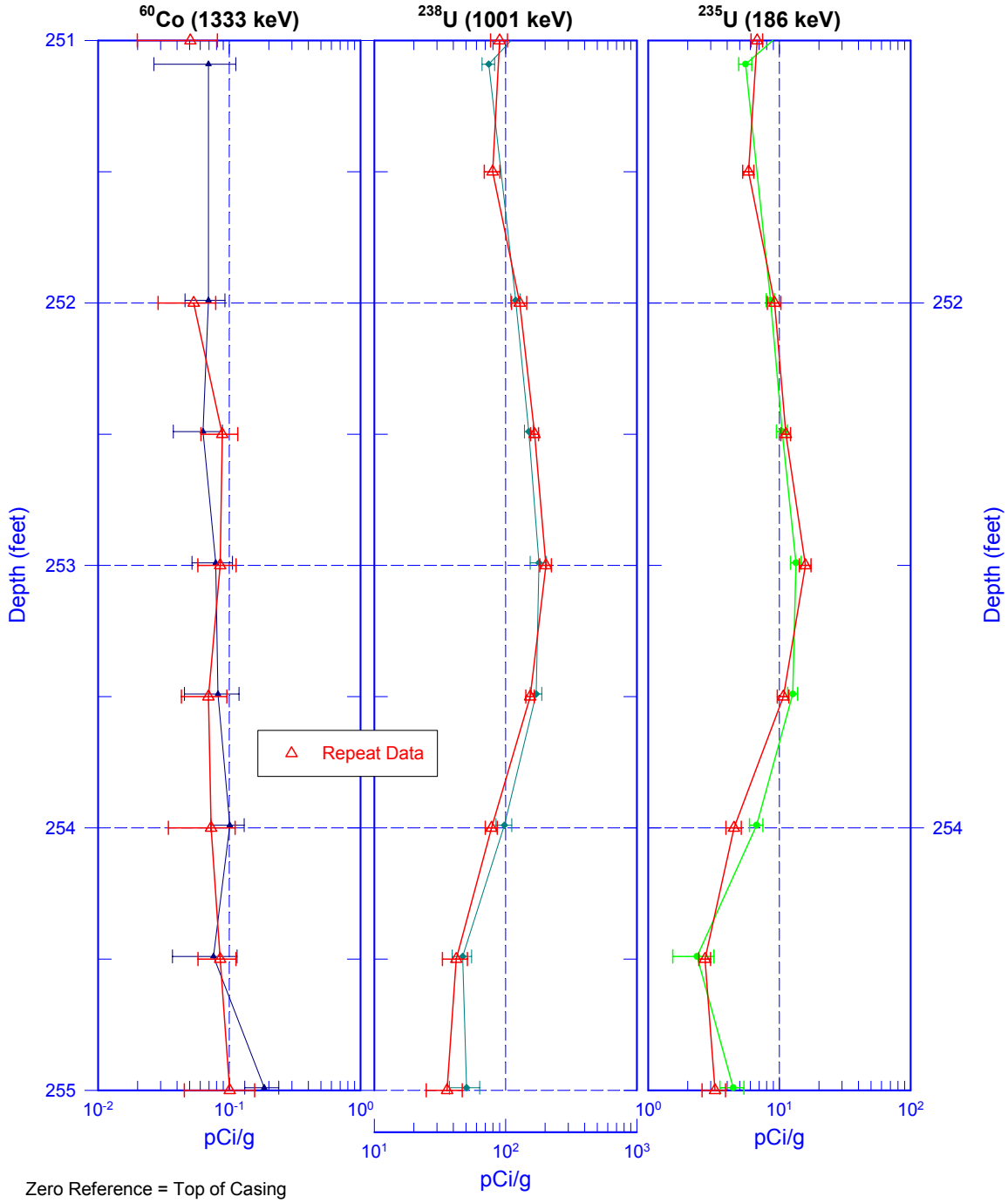
299-E33-18 (A4844)
Total Gamma & Moisture



299-E33-18 (A4844)
Comparison of Man-Made Radionuclides (1991 to 2006)



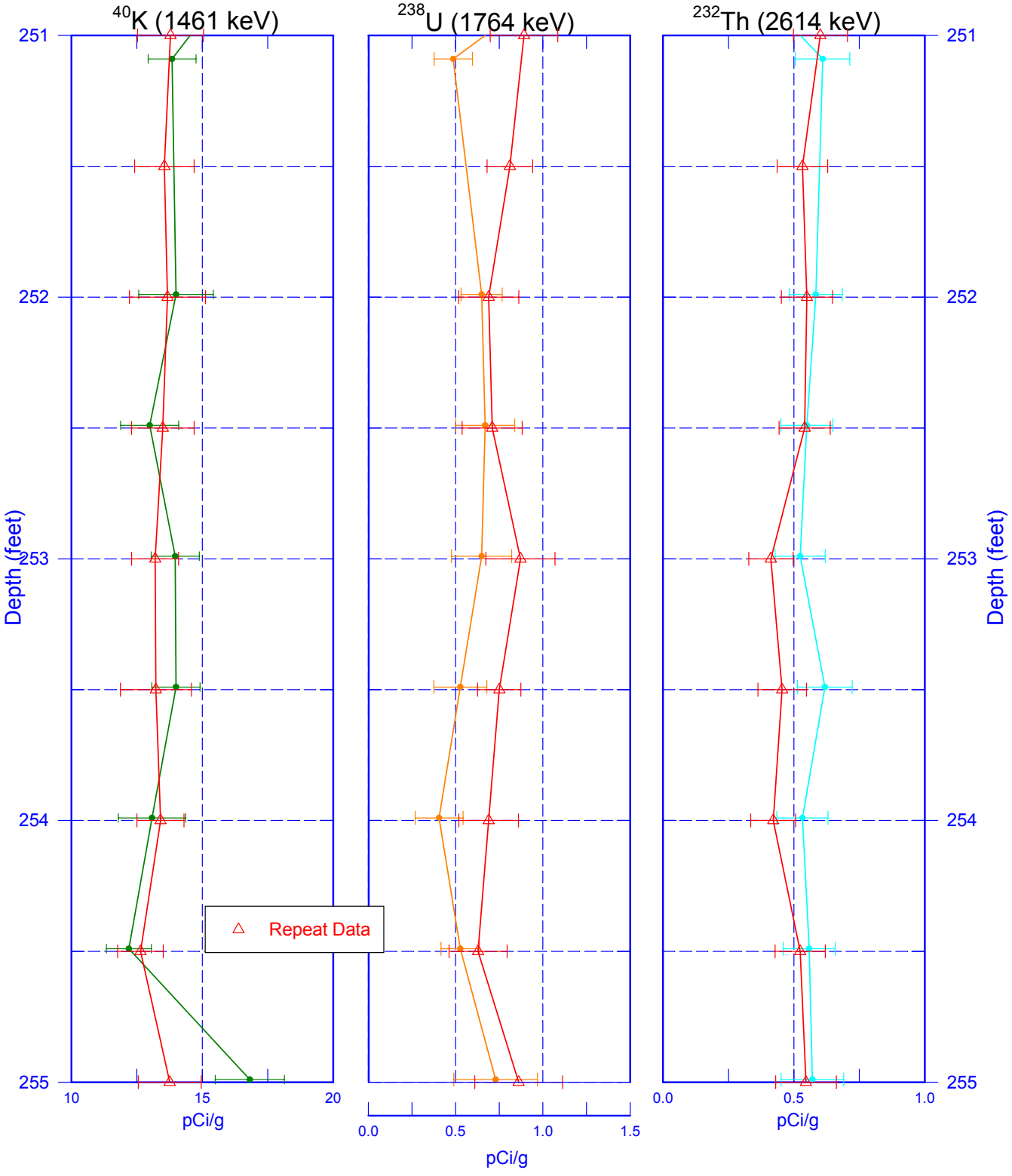
299-E33-18 (A4844)
Repeat Section for Man-Made Radionuclides



Zero Reference = Top of Casing

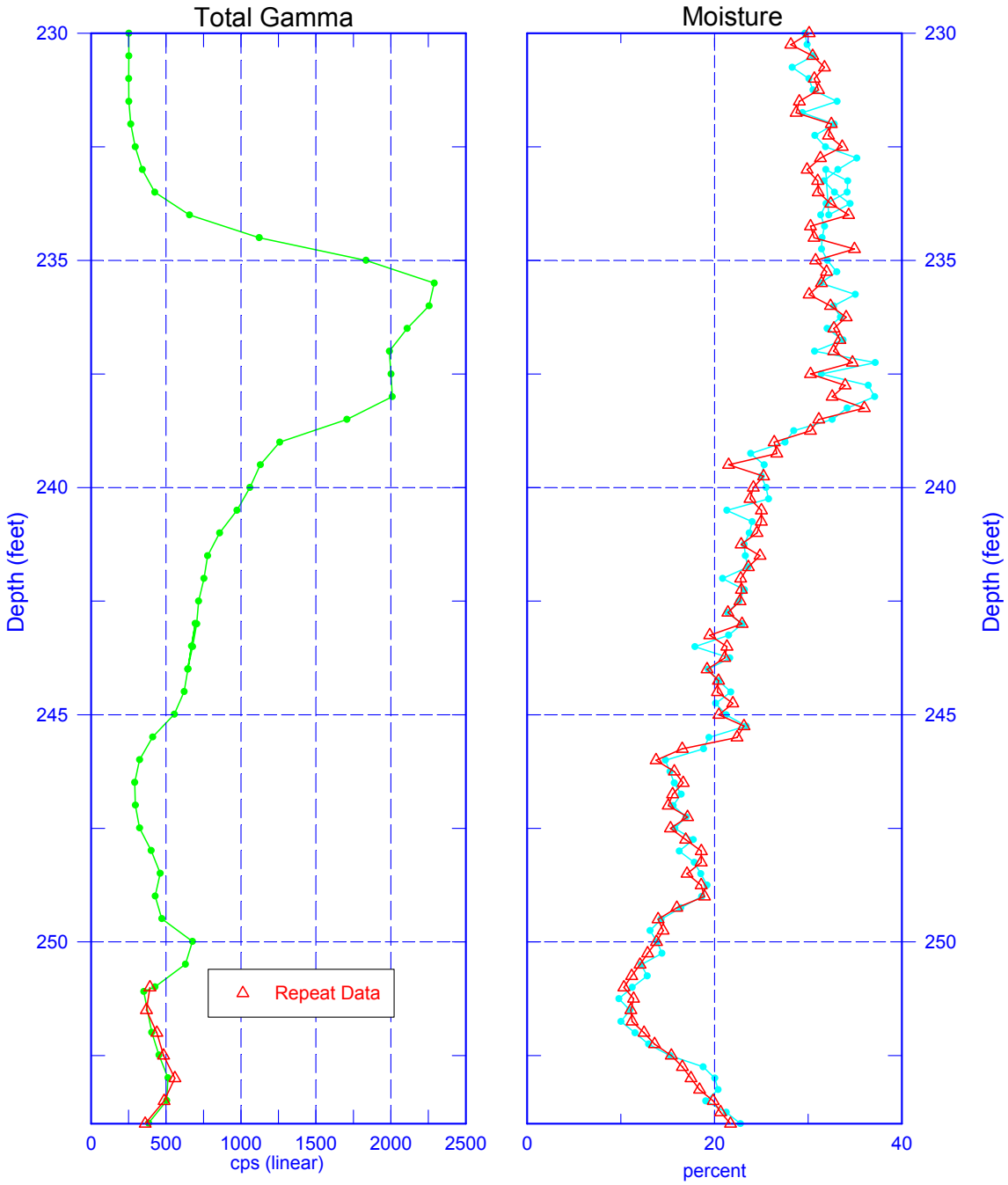
299-E33-18 (A4844)

Repeat Section of Natural Gamma Logs



Zero Reference = Top of Casing

299-E33-18 (A4844)
Repeat Section for Total Gamma & Moisture



Reference - Top of Casing