UXO Standardized Test Site: YPG Soils Description

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BACKGROUND

The Environmental Security Technology Certification Program (ESTCP) has funded the establishment of two UXO Standardized Test Sites. The second of these sites to be constructed is located on Yuma Proving Ground (YPG); the first site is located at Aberdeen Proving Ground. The U.S. Army Environmental Center (AEC), U.S. Army Aberdeen Test Center (ATC), and U.S. Army Engineer Research and Development Center (ERDC) are the lead agencies in the development of the test sites. This report describes the near-surface soils encountered at the UXO Standardized Test Site on YPG. The soils were collected in support of the geophysical backgrounds characterization study. Both continuous soil cores and surface samples were acquired over a three-day period 5–7 June 2002. The ERDC monitored the soil core acquisition and also collected the surface samples. The U.S. Bureau of Land Management (Phoenix, AZ office) was contracted by ATC to acquire the soil cores.

SITE DESCRIPTION

The YPG UXO Standardized Test Site comprises approximately 8 hectares located in the southwestern region of YPG within the Kofa Range. It is situated immediately east of the Countermine Testing and Training Range and bounded to the north by Pole Line Road (Figure 1). The site contains a Calibration and Blind test grid, Extreme and Mogul areas, and an Open Range area (Figure 2). The position of the Calibration grid was shifted to align with magnetic north after the soils collection and geophysical background surveys had been conducted (identified by the thin solid line).

The elevation varies about 4 m across the site with a general trend of increasing elevation from southwest to northeast (Figure 2). The elevation survey represents conditions at the site prior to construction of the moguls.

GEOLOGIC SETTING

The Yuma Proving Ground is situated within the Sonoran Desert Section of the Basin and Range province (Chamberlin and Richardson 1974). The region is characterized by sub-parallel north-northwest trending mountain ranges with intervening broad and gently sloping alluviated basins (Lashlee et. al 1999). The mountains are rugged and range in age and composition from Precambrian gneiss and schist to relatively recent volcanic lava and ash flows. The basins are comprised of alluvial fan complexes and alluvial plains consisting of sandy or gravelly material. Fan terraces and alluvial plains make up about 70% of the YPG landscape (Lashlee et. al 1999).

The soils within the test site area are identified as the Riverbend-Carrizo complex and the Cristobal-Gunsight complex (Cochran 1991) (Figure 2). Both soil complexes are classified as very deep (greater than 1.5 m). The parent material of the Riverbend-Carrizo complex is a mixed stream alluvium with the Riverbend family associated with stream terraces and the Carrizo family flood plains. The composition of this complex is typically 47% Riverbend, 41% Carrizo, and 12% other. The Riverbend-Carrizo complex is typified by shallow slopes, 1 to 3 %, and gravelly sandy loam and gravelly loamy sand soils. A calcic horizon may be present within the Riverbend soils at a depth of 10 to 50 cm. The Riverbend and Carrizo families are classified as having high and very high permeabilities, respectively.

The Cristobal-Gunsight complex is derived from mixed fan alluvium (Cristobal) and fan alluvium (Gunsight). The Cristobal is found on the fan crest whereas the Gunsight is present along the fan sidelobe. This complex is generally composed of 59% Cristobal soils, 30% Gunsight soils, and 11% other. The Cristobal family consists of gravelly silt loam, silt loam, gravelly loam, and gravelly sandy clay loam. The Gunsight family is predominantly a gravelly sandy loam. Both soil families may have a calcic horizon present at a depth 15 to 50 cm. Slopes of the Cristobal-Gunsight complex range from 1-3% for the Cristobal family and 3-15% for the Gunsight family. A significant difference between this complex and the Riverbend-Carrizo complex is that the permeability of the Cristobal-Gunsight complex is classified as very slow (Cristobal) and moderate (Gunsight).

SOIL SAMPLING and TESTING PROCEDURES

Soil Collection

Both continuous core and surface soil samples were acquired over the site. Fifteen surface samples were interspersed amongst the 13 soil boring locations (Figure 2).

The surface samples comprise the first 5 cm of soil. They were acquired by first removing any surface vegetation and then using a clean shovel to collect the soil. Enough soil was acquired to fill a quart-size plastic bag. The soil was immediately double-bagged in resealable plastic freezer bags and labeled.

The drill crew, familiar with the sand and gravel sediments of the area, arrived at the site with a full-scale drill rig prepared to collect split spoon samples. After discussions pertaining to the requirement that the samples be sealed to retain moisture content, the crew obtained thick walled plastic sample tubes. The application of the four-inch (10.2 cm) tubes provided the necessary sample tube integrity to receive and retain the expected sediment fractions (silt, sand, gravel, and caliche) common in the intermountain valley fill materials. The main concern was the retention of the loose dry granular sediments upon withdrawal of the drill/sampler rods. Figure 3 shows photographs of the drill rig and hollow stem auger.

The sampling apparatus consists of a section of split casing designed to retain the four-inch (10.2 cm) plastic sampler tube. The split casing is held closed with the cutting tip on the down hole end and a coupling sleeve on the up hole end. The beveled steel cutting head is approximately 15 cm in length.

The first sampling test procedure involved pushing the sampler head casing into the surfacial sediments. Initial attempts resulted in the sample falling from the sample tube when the casing was removed. Sample catch/holder devices made of plastic and steel were employed, but the coarse sediments entering the sample tube destroyed the devices. A cutting head with ridges welded into the head withstood the driving of the sample casings and retained the samples during the pulling of the casings to retrieve the samples. The sediments being sampled, in several instances, bent the cutting head and became lodged in the cutting head. In those instances, the casing head was pulled, the cutting head was repaired/replaced, and/or the obstruction removed.

Once the technique was established the rig was moved to each successive site and the samples were collected. The first run of the sampler was done from the surface using the casing with the sampler. Once this sample interval was pierced, the hollow stem auger was employed to auger to the depth of the bottom of the first sample run. The first run sample was then retrieved. The second sample was collected by advancing the casing, with plastic sampler, beyond the auger depth and into the second section to be sampled. The auger was then advanced to the depth of the bottom of the sampler. The casing sampler was then removed. Subsequent samples were done in similar fashion with the sampler pushed, auger advanced, and sample casing removed. At two sample locations the first run of the sampler met refusal due to the sampler encountering a clast (cobble, boulder) being too large to enter the sampler or being too large to be pushed aside by the advancing sampler tip. At these locations, the sampling proceeded at a second sample location within one meter of the first attempt.

At the completion of the sample interval push, the auger was advanced, the casing was pulled, the cutting tip removed, and the casing holding the plastic sample tube was split (opened). The sample tube was immediately sealed on both ends, the up and down hole ends labeled with the appropriate depths, the tube was labeled with black marker, and a paper label attached with clear packing tape. The paper label had the date, time, depth sampled, sample hole number, and location name on it prior to being totally covered by label tape. This procedure was successful at each sample location to the depth of approximately 304 cm (10 ft). Each boring consisted of four 0.76 m (2.5 ft) core sections. All samples were packed into wooden or plastic box containers prior to shipment back to the laboratory for sampling and analysis.

Laboratory Tests

Several laboratory tests were performed on the surface soil samples and soil cores. The water content was determined for all surface samples and each surface sample was subjected to a sieve analysis and magnetic susceptibility measurements. Magnetic susceptibility measurements were also acquired along the length of each core section. Individual soil samples were then extracted from the cores at depths of 5, 25, 50, 100, 150, 200, 250, and 300 cm. Water content, sieve/hydrometer, and magnetic susceptibility tests were conducted on all of the core samples. Of these samples, dielectric permittivity measurements were performed on seven of the 5 cm samples and all of the 50, 100, 200, and 300 cm samples. The dielectric permittivity results will be submitted under separate cover. Four samples representative of the gravelly silty sands, sandy silt, and silty sand were selected for X-ray diffraction analysis. Table 1 summarizes the laboratory tests performed on each soil sample.

Table 1. Laboratory Tests Performed on Soil Samples					
Sample	**Water Content**	**Sieve/Hydrometer**	**Magnetic Susceptibility**	**Dielectric Permittivity**	**X-Ray Diffraction**
Y-CA-SS1 to Y-CA-SS3	X	X	X		
Y-EA-SS1 to Y-EA-SS2	X	X	X		
Y-MA-SS1 to Y-MA-SS2	X	X	X		
Y-OR-SS1 to Y-OR-SS8	X	X	X		
13 soil cores			X		
Y-BL-1* Y-CA-1* Y-EA-1*, Y-EA-2* Y-MA-1, Y-MA-2 Y-OR-1 to Y-OR-7* 0.05m	X	X	X	X*	
0.25m	X	X	X		
0.50m	X	X	X	X	
1.00m	X	X	X	X	
1.50m	X	X	X		
2.00m	X	X	X	X	
2.50m	X	X	X		
3.00m	X	X	X	X	
Y-OR-3 2.00m					X
Y-OR-6 1.00m					X
Y-OR-6 2.50m					X
Y-OR-6 3.00m					X

*Exceptions to laboratory tests performed:
Y-BL-1: no dielectric permittivity measurement at 3.00m (insufficient soil recovery)
Y-CA-1: no dielectric permittivity measurement at 1.00m (insufficient soil recovery)
Y-EA-1: no water content/sieve at 0.50m; no magnetic susceptibility at 0.25, 0.50m; no dielectric permittivity at 0.50m
Y-EA-2: no soil recovery above 1.00m
Y-OR-2: end of push at 2.00m
Y-OR-3: no measurements at 0.25, 0.50m (insufficient soil recovery)
Y-EA-2, Y-MA-2, Y-OR-1, Y-OR-4, Y-OR-5, Y-OR-6: no 5 cm dielectric permittivity measurement

The water content and sieve and hydrometer analyses were performed following standard laboratory practices (U.S. Army Corps of Engineers 1970). The magnetic susceptibility data were acquired following the procedure described by Dearing (1999). Interpretation of X-ray patterns was accomplished using JADE (Materials Data, Inc. X-ray pattern processing software) and the International Centre for Diffraction Data (ICDD) PDF database. Test procedures and analysis of data were based on Brindley and Brown (1980), Klug and Alexander (1974), and those recommended by the Concrete and Materials Branch, Geotechnical and Structures Laboratory, ERDC.

SOIL ANALYSIS

Sieve, Hydrometer, and Water Content

Results of the water content and sieve/hydrometer tests are summarized in Tables 2 and 3 for the surface and core samples, respectively. Approximately 81% of the core samples contain between 10 to 50% gravel-size particles whereas 16.5% of the samples consist of less than 10% gravel while only 2% are comprised of more than 50% gravel. Eight of the soil core samples contain more than 50% fines. These eight samples are distributed among five borings, with boring Y-OR-7 having three of the samples and Y-OR-6 two samples. Six of the high fines content samples are at a depth of 2.5 m or greater. The 3 m sample of boring Y-OR-7 contains almost 91% fines. The soil description is based on a visual classification. Tables 4 and 5 give the soil type based on the USDA soil classification. Using this system, about 56% of the samples are classified as a sandy loam and 30% as a loamy sand (Table 6). Both soil types consist of predominantly sand with the sandy loam having a greater fraction of silt and clay than the loamy sand. Other soil types identified are a silt loam (1%), loam (1%), sandy clay loam (7%), and sand (5%). The sandy clay loam is present at depths greater than 1 m whereas the silt loam and loam are only encountered at a depth of 3 m. Samples classified as sand are found at depths shallower than 1 m.

The majority (43%) of soil core samples have a measured water content between 1 and 2%. The greatest water content measured is 11% in two samples at depths of 2.5 m (Y-BL-1) and 3 m (Y-OR-1); neither of these samples contain gravel-size material. The remaining samples all have a water content less than 7%. The soil samples containing less than 10% gravel below 1 m all have higher water content values (> 3%). Only three samples shallower than 1.5 m have a water content greater than 3%.

Geologic Soil Description of Continuous Cores

Prior to extracting individual samples from the soil cores for further analysis, the intact cores were described based on their physical appearance and texture. Figure 4 shows the boring logs constructed from the geologic descriptions. The depth axis is in units of centimeters and a legend of the soil patterns is shown on the last page of Figure 4. The number in parentheses accompanying each geologic description indicates the thickness in centimeters of that soil layer. The predominant soil type identified is gravel with varying particle sizes. Any cementation of grains occurs below 75 cm, except for boring Y-OR-4 where the silt immediately below the surface contains cemented clumps. Most cementation is observed below 150 cm. Caliche layers at least 10 cm thick are noted in borings Y-BL-1, Y-CA-1, Y-OR-2 and Y-OR-6.

Magnetic Susceptibility

The magnetic susceptibility of a material represents the degree to which the material can be magnetized. For a soil or rock, it is dependent on the amount of magnetic minerals present. The soils present within the first 3 m of the surface of this site are considered to have a moderate magnetic susceptibility (volume susceptibility > 100×10^{-5} SI). Measurements were obtained at both the low frequency (0.465 kHz) and high frequency (4.65 kHz) setting. The high frequency measurement is used to detect the presence of ultrafine (< 0.03 μm) superparamagnetic ferrimagnetic minerals that result from primarily biochemical processes in the soil (Dearing 1999). A high frequency measurement less than the low frequency reading indicates the presence of these minerals, whereas samples without ultrafine minerals present will have similar low and high frequency values. For a sample containing ultrafine minerals, the high frequency measurement is typically within 5 and 15% of the low frequency value. None of the soil samples examined contain ultrafine minerals, as indicated by frequency dependent susceptibility values not greater than 2.1% (refer to Tables 7 and 8).

Loose soil samples

The loose soil samples contain particles that range in size from fine sand to large pebbles. Figure 5 provides a comparison of the various sizes contained in the loose soil samples taken from the cores. The loose soil sample data presented here represents measurements using only material that passed a #16 sieve (1.18 mm opening). To determine the effect of the different particle sizes on the magnetic susceptibility values, seven soil samples from the cores were chosen and each were visually divided into categories of fines (< 1 mm), small pebbles (1-5 mm), medium pebbles (5-10 mm), and large pebbles (> 10 mm). The samples were selected based on sufficient quantity of material for each size category and all samples are from a depth of 150 cm. Measurements were performed on samples containing only medium pebbles, only large pebbles, a mixture of fines and small pebbles, and a mixture of all particle sizes. A summary of the results is provided in Table 9. Reducing the volume of material in the sample container, as when only pebbles are used, results in an underestimation of the magnetic susceptibility. However, if the pebbles contain any magnetic minerals, this would tend to increase the magnetic susceptibility reading. Half of the susceptibility values from the mixtures and pebbles differ no more than 10% from the value measured when using only the fine material, and three-quarters of the values differ less than 15% of the fines measurement. The greatest differences are observed in the medium and large pebbles only measurements. Overall, the various size particles exhibit similar magnetic susceptibility values so the measurements on just the finer fraction are representative of each soil sample.

Measured mass magnetic susceptibility values for all the surface samples and individual core samples are listed in Tables 7 and 8, respectively. The magnetic susceptibility of the surface samples range in value from 95 to 122 $\times 10^{-8}$ SI. These values tend to be lower than the 5 cm measurements taken on the core samples. The majority of the loose core samples have magnetic susceptibility values between 100 to 200 $\times 10^{-8}$ SI, with a general trend of decreasing with depth. Any value less than 100 occurs below 100 cm depth.

Soil cores

Volume magnetic susceptibility measurements were acquired at 5 cm intervals along the length of the soil cores (solid line curve, Figure 6). The curve segments represent measurements along the four sections comprising the 3 m soil boring. The majority of values range between 100-200 $\times 10^{-5}$ SI. Within the Open Range area, borings Y-OR-3 thru Y-OR-7 exhibit values greater than 200×10^{-5} SI between depths 90-180 cm. These elevated readings occur at a greater depth in the two borings on the eastern side (Y-OR-4, 6) than the three on the western side (Y-OR-3, 5, 7). However, the magnitude of the values (> 300 $\times 10^{-5}$ SI) is greater in the three borings in the southern portion of the Open Range (Y-OR-5, 6, 7). Also plotted on Figure 6 are the mass susceptibility measurements obtained on the individual core samples (symbols). The coarser sampled mass magnetic susceptibility measurements generally track the finer sampled volume susceptibility curve.

X-Ray Diffraction

Identification of the mineral constituents in four soil samples visually classified (USCS) as gravelly silty sands, sandy silt, and silty sand was accomplished through X-ray diffraction. A quantitative analysis to determine the percentage of each constituent was not performed. Under the USDA classification the gravelly silty sands are described as sandy clay loam (Y-OR-3 200 cm depth) and sand (Y-OR-6 100 cm depth), whereas the sandy silt (Y-OR-6 250 cm depth) is sandy loam and the silty sand (Y-OR-6 300 cm depth) is loamy sand. Results of the analysis are plotted in Figure 7. These diffraction patterns were obtained on samples ground to pass a 45 micrometer sieve. Samples Y-OR-3 200 cm and Y-OR-6 100 cm were divided based on material passing a #10 sieve (−10) and retained on a #10 sieve (+10). The loamy sand and sandy loam samples have the same mineralogical makeup (Table 10). The sand sample (Y-OR-6 100 cm) shows the addition of plagioclase feldspar and kaolinite, with the −10 sample also having illite and magnetite. The sandy clay loam samples (Y-OR-3 200 cm) have the same mineral constituents found in the −10 sand sample, except the −10 sandy clay loam does not have magnetite. Smectite (general term for clay) is present in all four samples as evidenced by the (horizontal) shift in the 14 angstrom peak when the samples were treated with ethylene glycol (Figure 8). The plot for sample Y-OR-3 200 cm shows two scans for the −10 material and two for the +10 material (before and after ethylene glycol treatment). The scan for the minus 10 material shows a significant shift upon ethylene glycol treatment, whereas the scan for the plus 10 material shows minimum shift after being treated. This suggests that, of the clay fraction, there is more expansive clay in the finer material than the coarser material. Only the plus 10 fraction of sampleY-OR-6 100 cm was scanned and results similar to the plus 10 fraction of sample Y-OR-3 200 cm were obtained. In general, each of the four samples is likely to contain a larger percentage of non-expansive clays than expansive clays.

SUMMARY

Soil samples were collected at the YPG UXO Standardized Test Site to characterize the shallow subsurface (< 3 m). Both surface grab samples (15) and continuous soil borings (13) were acquired. The soils were subjected to several laboratory analyses, including sieve/hydrometer, water content, magnetic susceptibility, dielectric permittivity, x-ray diffraction, and visual description.

There are two soil complexes present within the site, Riverbend-Carrizo and Cristobal-Gunsight. The Riverbend-Carrizo complex is comprised of mixed stream alluvium, whereas the Cristobal-Gunsight complex is derived from fan alluvium. The Cristobal-Gunsight complex covers the majority of the site. Most of the soil samples are classified as either a sandy loam or loamy sand, with most samples containing gravel-size particles. All samples have a measured water content less than 7%, except for two containing 11% moisture. The majority of soil samples have a water content between 1 to 2%. Samples containing more than 3% are generally deeper than 1 m.

An X-ray diffraction analysis on four soil samples indicate a basic mineralogy of quartz, calcite, mica, feldspar, magnetite, and some clay. The presence of magnetite imparts a moderate magnetic susceptibility, with volume susceptibilities generally greater than 100×10^{-5} SI.

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Table 2. Summary of Sieve and Hydrometer Analysis, Surface Samples

Sample	Depth (m)	Visual Classification	Color	% Gravel	% Sand	% Fines	Specific Gravity of Solids (est.)	% Water Content
Calibration								
Y-CA-SS1	Surface	Gravelly silty sand	Brown	41.7	41.8	16.6	2.67	0.6
Y-CA-SS2	Surface	Gravelly clayey sand	Brown	28.5	41.1	30.4	2.67	1.0
Blind								
Y-CA-SS3	Surface	Gravelly clayey sand	Brown	33.7	38.5	27.7	2.67	0.8
Extreme								
Y-EA-SS1	Surface	Sandy silty gravel	Brown	59.9	30.1	10.1	2.67	0.5
Y-EA-SS2	Surface	Gravelly silty sand	Brown	32.4	52.4	15.2	2.67	0.5
Mogul								
Y-MA-SS1	Surface	Gravelly silty sand	Brown	24.1	41.0	35.0	2.67	0.5
Y-MA-SS2	Surface	Sandy silty gravel	Brown	41.5	26.0	32.5	2.67	0.5
Open Range								
YY-OR-SS1	Surface	Gravelly silty sand	Brown	40.2	48.2	11.6	2.67	0.5
YY-OR-SS2	Surface	Gravelly silty sand	Brown	35.2	47.6	17.1	2.67	0.6
YY-OR-SS3	Surface	Gravelly silty sand	Brown	15.5	58.0	26.5	2.67	0.6
YY-OR-SS4	Surface	Gravelly silty sand	Brown	17.3	40.5	42.3	2.67	0.9
YY-OR-SS5	Surface	Sandy silty gravel	Brown	44.8	24.6	30.6	2.67	0.9
YY-OR-SS6	Surface	Gravelly silty sand	Brown	26.5	39.7	33.8	2.67	0.7
YY-OR-SS7	Surface	Gravelly clayey sand	Brown	27.1	46.5	26.4	2.67	0.7
YY-OR-SS8	Surface	Gravelly silty sand	Brown	27.0	31.6	41.5	2.67	0.9

Table 3. Summary of Sieve and Hydrometer Analysis, Core Samples

Sample	Depth (m)	Visual Classification	Color	% Gravel	% Sand	% Fines	Specific Gravity of Solids (est.)	% Water Content
Blind								
Y-BL-1	0.05	Sandy silty gravel	Brown	41.0	28.0	31.1	2.67	1.2
	0.25	Gravelly silty sand	Brown	33.2	56.8	10.0	2.66	1.0
	0.5	Silty sand w/ gravel	Brown	8.7	52.6	38.7	2.66	1.3
	1.0	Gravelly silty sand	Brown	41.3	46.5	12.2	2.66	1.1
	1.5	Sandy silty gravel	Brown	49.0	40.6	10.4	2.66	1.5
	2.0	Gravelly silty sand	Brown	22.0	54.6	23.4	2.66	3.0
	2.5	Sandy silt	Brown	0	40.5	59.5	2.66	11.0
	3.0	Silty sand	Brown	0.8	69.0	30.2	2.65	6.6
Calibration								
Y-CA-1	0.05	Gravelly silty sand	Brown	23.1	41.1	35.8	2.66	1.2
	0.25	Sandy silty gravel	Brown	43.4	35.3	21.3	2.66	1.2
	0.5	Gravelly silty sand	Brown	27.0	44.5	28.6	2.66	1.3
	1.0	Gravelly silty sand	Brown	15.0	52.8	32.2	2.65	1.1
	1.5	Gravelly silty sand	Brown	18.4	55.9	25.8	2.66	0.9
	2.0	Gravelly silty sand	Brown	36.4	48.3	15.3	2.66	1.8
	2.5	Silty sand	Brown	0	64.0	36.0	2.66	4.0
	3.0	Gravelly silty sand	Brown	19.5	64.4	16.1	2.65	1.8
Extreme								
Y-EA-1	0.05	Gravelly silty sand	Brown	32.3	41.3	26.5	2.66	0.8
	0.25	Sandy silty gravel	Brown	46.7	33.4	19.9	2.66	0.8
	0.5	----	Brown	----	----	----	----	----
	1.0	Sandy silty gravel	Brown	57.7	32.7	9.5	2.66	1.3
	1.5	Gravelly silty sand	Brown	33.8	54.8	11.4	2.66	2.8
	2.0	Gravelly silty sand	Brown	22.9	51.9	25.2	2.67	6.2
	2.5	Sandy silty gravel	Brown	48.2	38.4	13.4	2.67	3.2
	3.0	Gravelly silty sand	Brown	19.7	61.8	18.5	2.66	4.3

Table 3. Summary of Sieve and Hydrometer Analysis, Core Samples

Sample	Depth (m)	Visual Classification	Color	% Gravel	% Sand	% Fines	Specific Gravity of Solids (est.)	% Water Content
Y-EA-2	0.05	----	----	----	----	----	----	----
	0.25	----	----	----	----	----	----	----
	0.5	----	----	----	----	----	----	----
	1.0	Gravelly silty sand	Brown	17.2	75.2	7.6	2.65	1.2
	1.5	Gravelly silty sand	Brown	34.3	57.9	7.9	2.65	1.2
	2.0	Sandy silty gravel	Brown	48.0	41.7	10.3	2.65	1.8
	2.5	Gravelly silty sand	Brown	12.8	67.5	19.7	2.66	2.8
	3.0	Gravelly silty sand	Brown	35.1	53.9	11.0	2.65	2.8
Mogul								
Y-MA-1	0.05	Gravelly silty sand	Brown	35.1	43.1	21.8	2.67	1.1
	0.25	Sandy silty gravel	Brown	47.1	44.0	8.9	2.66	0.8
	0.5	Gravelly silty sand	Brown	31.5	43.7	24.8	2.67	0.7
	1.0	Gravelly sand	Brown	22.8	74.8	2.4	2.65	3.5
	1.5	Gravelly silty sand	Brown	24.5	43.9	31.6	2.67	2.5
	2.0	Gravelly silty sand	Brown	34.9	49.8	15.3	2.67	1.1
	2.5	Gravelly silty sand	Brown	25.3	62.9	11.9	2.66	2.3
	3.0	Sandy silt	Brown	0	16.7	83.3	2.69	6.9
Y-MA-2	0.05	Gravelly silty sand	Brown	36.5	41.1	22.4	2.66	1.2
	0.25	Sandy silty gravel	Brown	48.9	41.1	10.0	2.66	1.1
	0.5	Sandy silty gravel	Brown	48.6	40.5	10.9	2.67	2.1
	1.0	Gravelly silty sand	Brown	34.7	52.9	12.3	2.66	1.6
	1.5	Gravelly silty sand	Brown	36.5	42.2	21.3	2.67	4.1
	2.0	Gravelly silty sand	Brown	37.7	40.4	21.9	2.67	2.3
	2.5	Gravelly silty sand	Brown	33.9	51.2	14.9	2.67	2.4
	3.0	Silty sand w/ trace of gravel	Brown	4.3	51.2	44.5	2.67	3.7
Open Range								
Y-OR-1	0.05	Gravelly silty sand	Brown	18.3	48.0	33.6	2.66	1.4

Table 3. Summary of Sieve and Hydrometer Analysis, Core Samples

Sample	Depth (m)	Visual Classification	Color	% Gravel	% Sand	% Fines	Specific Gravity of Solids (est.)	% Water Content
Y-OR-1	0.25	Gravelly silty sand	Brown	18.6	62.0	19.4	2.65	0.9
	0.5	Silty sand w gravel	Brown	11.9	60.0	28.1	2.65	1.4
	1.0	Gravelly silty sand	Brown	26.2	45.5	28.3	2.66	1.3
	1.5	Sandy silty gravel	Brown	49.8	39.2	10.9	2.65	1.3
	2.0	Sandy silty gravel	Brown	54.0	37.7	8.3	2.65	1.5
	2.5	Gravelly silty sand	Brown	25.9	40.5	33.5	2.66	4.1
	3.0	Silty sand	Brown	0	64.9	35.1	2.66	11.0
Y-OR-2	0.05	Gravelly silty sand	Brown	32.2	41.4	26.4	2.67	0.8
	0.25	Gravelly silty sand	Brown	33.5	51.3	15.3	2.66	1.3
	0.5	Gravelly silty sand	Brown	42.2	47.9	9.9	2.66	1.2
	1.0	Gravelly silty sand	Brown	32.7	57.3	10.0	2.66	1.4
	1.5	Gravelly silty sand	Brown	36.6	48.1	15.4	2.66	3.3
	2.0	Silty sand w/ gravel	Brown	10.3	50.9	38.8	2.66	3.5
	2.5	Sandy silty gravel	Brown	44.0	43.0	12.9	2.66	2.3
	3.0	----	----	----	----	----	----	----
Y-OR-3	0.05	Sandy silty gravel	Brown	44.2	40.0	15.8	2.67	0.7
	0.25	----	----	----	----	----	----	----
	0.5	----	----	----	----	----	----	----
	1.0	Sandy silty gravel	Brown	46.9	42.8	10.3	2.66	1.0
	1.5	Gravelly silty sand	Brown	23.4	58.4	18.3	2.67	2.5
	2.0	Gravelly silty sand	Brown	18.0	58.6	23.3	2.67	4.2
	2.5	Sandy silty gravel	Brown	49.7	36.8	13.5	2.66	4.8
	3.0	Gravelly silty sand	Brown	34.1	43.0	22.9	2.66	4.1
Y-OR-4	0.05	Gravelly silty sand	Brown	16.6	44.2	39.2	2.66	1.5
	0.25	Gravelly silty sand	Brown	16.3	45.7	38.0	2.65	1.3
	0.5	Sandy silt	Brown	0.1	33.7	66.2	2.66	1.8
	1.0	Gravelly silty sand	Brown	17.1	62.5	20.5	2.66	1.9
	1.5	Gravelly silty sand	Brown	25.8	59.9	14.3	2.65	1.4

Table 3. Summary of Sieve and Hydrometer Analysis, Core Samples

Sample	Depth (m)	Visual Classification	Color	% Gravel	% Sand	% Fines	Specific Gravity of Solids (est.)	% Water Content
Y-OR-4	2.0	Gravelly silty sand	Brown	33.7	52.4	13.8	2.65	2.2
	2.5	Silty sand	Brown	0.2	58.0	41.8	2.66	4.4
	3.0	Silty sand	Brown	0.2	53.9	45.9	2.65	6.9
Y-OR-5	0.05	Gravelly silty sand	Brown	31.0	52.6	16.3	2.65	1.0
	0.25	Gravelly silty sand	Brown	30.7	60.3	9.0	2.65	1.1
	0.5	Gravelly silty sand	Brown	41.6	47.4	11.0	2.65	1.9
	1.0	Gravelly silty sand	Brown	37.4	48.4	14.2	2.65	2.1
	1.5	Gravelly silty sand	Brown	37.5	41.6	20.9	2.66	2.4
	2.0	Gravelly silty sand	Brown	13.7	65.8	20.5	2.66	3.1
	2.5	Silty sand w/ gravel	Brown	11.4	66.4	22.2	2.66	3.3
	3.0	Sandy silty gravel	Brown	46.3	38.8	14.9	2.66	3.3
Y-OR-6	0.05	Gravelly silty sand	Brown	12.1	52.4	35.5	2.66	1.1
	0.25	Silty sand w/ gravel	Brown	11.5	57.0	31.5	2.65	1.0
	0.5	Sandy silt	Brown	1.5	47.1	51.4	2.66	1.7
	1.0	Gravelly silty sand	Brown	25.9	62.8	11.3	2.65	1.1
	1.5	Gravelly silty sand	Brown	32.2	54.3	13.5	2.65	1.5
	2.0	Gravelly silty sand	Brown	26.4	55.1	18.5	2.66	1.3
	2.5	Sandy silt	Brown	0	37.5	62.5	2.66	6.4
	3.0	Silty sand	Brown	0	67.6	32.4	2.65	2.6
Y-OR-7	0.05	Sandy silty gravel	Brown	38.2	34.3	27.5	2.66	1.3
	0.25	Gravelly silty sand	Brown	43.8	48.4	7.8	2.65	0.9
	0.5	Gravelly silty sand	Brown	14.8	52.3	32.9	2.66	1.4
	1.0	Silty sand w/ gravel	Brown	10.8	76.3	12.9	2.65	1.1
	1.5	Gravelly silty sand	Brown	26.9	44.8	28.3	2.66	2.9
	2.0	Sandy silt	Brown	0	38.3	61.7	2.66	4.8
	2.5	Sandy silt	Brown	0	28.1	71.9	2.66	5.7
	3.0	Silt w/ sand	Brown	0	9.1	90.9	2.67	5.2

Table 4. USDA Soil Type, Surface Samples

Sample	Depth (m)	% < 2mm	% < 0.05mm	% < 0.002mm	% Sand	% Silt	% Clay	USDA Soil Type
Calibration								
Y-CA-SS1	surface	41	10	3	75.6	17.1	7.3	Sand
Y-CA-SS2	surface	59	19	4	67.8	25.4	6.8	Loamy sand
Blind								
Y-CA-SS3	surface	56	17	4	69.6	23.2	7.1	Loamy sand
Extreme								
Y-EA-SS1	surface	27	5	1	81.5	14.8	3.7	Loamy sand
Y-EA-SS2	surface	51	9	1	82.4	15.7	2	Loamy sand
Mogul								
Y-MA-SS1	surface	64	17	3	73.4	21.9	4.7	Sandy loam
Y-MA-SS1	surface	52	18	3	65.4	28.8	5.8	Sandy loam
Open Range								
Y-OR-SS1	surface	43	5	1	88.4	9.3	2.3	Sandy loam
Y-OR-SS2	surface	50	11	3	78	16	6	Sandy loam
Y-OR-SS3	surface	68	15	2	77.9	19.1	2.9	Sandy loam
Y-OR-SS4	surface	74	28	3	62.2	33.8	4.1	Loamy sand
Y-OR-SS5	surface	48	19	4	60.4	31.3	8.3	Sandy loam
Y-OR-SS6	surface	60	21	3	65	30	5	Loamy sand
Y-OR-SS7	surface	56	14	2	75	21.4	3.6	Sandy loam
Y-OR-SS8	surface	63	24	5	61.9	30.2	7.9	Sandy loam

Table 5. USDA Soil Type, Core Samples

Sample	Depth (m)	% < 2mm	% < 0.05mm	% < 0.002mm	% Sand	% Silt	% Clay	USDA Soil Type
Blind								
Y-BL-1	0.05	53	22	6	58.5	30.2	11.3	Sandy loam
	0.25	53	8	2	84.9	11.3	3.8	Loamy sand
	0.5	82	23	4	72.0	23.2	4.9	Loamy sand
	1.0	48	8	2	83.3	12.5	4.2	Loamy sand
	1.5	38	9	5	76.3	10.5	13.2	Sandy loam
	2.0	58	22	18	62.1	6.9	31.0	Sandy clay loam
	2.5	100	48	26	52.0	22.0	26.0	Sandy clay loam
	3.0	96	17	7	82.3	10.4	7.3	Loamy sand
Calibration								
Y-CA-1	0.1	71	23	4	67.6	26.8	5.6	Sandy loam
	0.25	46	15	2	67.4	28.3	4.3	Sandy loam
	0.5	57	16	3	71.9	22.8	5.3	Sandy loam
	1.0	75	17	3	77.3	18.7	4.0	Loamy sand
	1.5	70	16	3	77.1	18.6	4.3	Loamy sand
	2.0	50	13	8	74.0	10.0	16.0	Sandy loam
	2.5	100	18	4	82.0	14.0	4.0	Loamy sand
	3.0	60	14	7	76.7	11.7	11.7	Sandy loam
Extreme								
Y-EA-1	0.05	59	14	2	76.3	20.3	3.4	Loamy sand
	0.25	44	12	2	72.7	22.7	4.5	Sandy loam
	0.5	----	----	----	----	----	----	--------
	1.0	32	8	3	75.0	15.6	9.4	Sandy loam
	1.5	42	10	6	76.2	9.5	14.3	Sandy loam
	2.0	57	22	11	61.4	19.3	19.3	Sandy loam
	2.5	36	12	8	66.7	11.1	22.2	Sandy clay loam
	3.0	58	15	8	74.1	12.1	13.8	Sandy loam

Table 5. USDA Soil Type, Core Samples

Sample	Depth (m)	% < 2mm	% < 0.05mm	% < 0.002mm	% Sand	% Silt	% Clay	USDA Soil Type
Y-EA-2	0.05	----	----	----	----	----	----	--------
	0.25	----	----	----	----	----	----	--------
	0.5	----	----	----	----	----	----	--------
	1.0	55	5	2	90.9	5.5	3.6	Sand
	1.5	46	6	3	87.0	6.5	6.5	Loamy sand
	2.0	39	8	4	79.5	10.3	10.3	Loamy sand
	2.5	66	16	9	75.8	10.6	13.6	Sandy loam
	3.0	48	9	3	81.3	12.5	6.3	Loamy sand
Mogul								
Y-MA-1	0.05	54	16	3	70.4	24.1	5.6	Sandy loam
	0.25	37	5	1	86.5	10.8	2.7	Loamy sand
	0.5	45	16	5	64.4	24.4	11.1	Sandy loam
	1.0	62	2	0	96.8	3.2	0	Sand
	1.5	61	22	6	63.9	26.2	9.8	Sandy loam
	2.0	48	12	4	75.0	16.7	8.3	Sandy loam
	2.5	47	10	4	78.7	12.8	8.5	Loamy sand
	3.0	100	70	24	30.0	46.0	24.0	Loam
Y-MA-2	0.05	54	12	2	77.8	18.5	3.7	Loamy sand
	0.25	36	6	1	83.3	13.9	2.8	Loamy sand
	0.5	34	11	6	67.6	14.7	17.6	Sandy loam
	1.0	48	12	6	75.0	12.5	12.5	Sandy loam
	1.5	46	20	12	56.5	17.4	26.1	Sandy clay loam
	2.0	47	19	7	59.6	25.5	14.9	Sandy loam
	2.5	47	15	7	68.1	17.0	14.9	Sandy loam
	3.0	88	29	16	67.0	14.8	18.2	Sandy loam
Open Range								
Y-OR-1	0.05	67	22	8	67.2	20.9	11.9	Sandy loam
	0.25	65	10	0	84.6	15.4	0	Loamy sand

Table 5. USDA Soil Type, Core Samples

Sample	Depth (m)	% < 2mm	% < 0.05mm	% < 0.002mm	% Sand	% Silt	% Clay	USDA Soil Type
Y-OR-1	0.5	70	16	8	77.1	11.4	11.4	Sandy loam
	1.0	62	16	5	74.2	17.7	8.1	Sandy loam
	1.5	36	7	3	80.6	11.1	8.3	Loamy sand
	2.0	29	6	3	79.3	10.3	10.3	Sandy loam
	2.5	59	23	9	61.0	23.7	15.3	Sandy loam
	3.0	99	30	20	69.7	10.1	20.2	Sandy loam
Y-OR-2	0.05	56	17	2	69.6	26.8	3.6	Sandy loam
	0.25	49	9	1	81.6	16.3	2.0	Loamy sand
	0.5	40	6	1	85.0	12.5	2.5	Loamy sand
	1.0	41	8	4	80.5	9.8	9.8	Loamy sand
	1.5	48	12	7	75.0	10.4	14.6	Sandy loam
	2.0	79	30	12	62.0	22.8	15.2	Sandy loam
	2.5	38	10	3	73.7	18.4	7.9	Sandy loam
	3.0	----	----	----	----	----	----	--------
Y-OR-3	0.05	41	12	5	70.7	17.1	12.2	Sandy loam
	0.25	----	----	----	----	----	----	--------
	0.5	----	----	----	----	----	----	--------
	1.0	40	10	6	75.0	10.0	15.0	Sandy loam
	1.5	56	18	14	67.9	7.1	25.0	Sandy clay loam
	2.0	58	24	18	58.6	10.3	31.0	Sandy clay loam
	2.5	36	10	6	72.2	11.1	16.7	Sandy loam
	3.0	47	20	12	57.4	17.0	25.5	Sandy clay loam
Y-OR-4	0.05	75	22	3	70.7	25.3	4.0	Sandy loam
	0.25	77	18	1	76.6	22.1	1.3	Loamy sand
	0.5	98	40	5	59.2	35.7	5.1	Sandy loam
	1.0	59	13	9	78.0	6.8	15.3	Sandy loam
	1.5	50	9	3	82.0	12.0	6.0	Loamy sand
	2.0	45	10	6	77.8	8.9	13.3	Sandy loam

Table 5. USDA Soil Type, Core Samples

Sample	Depth (m)	% < 2mm	% < 0.05mm	% < 0.002mm	% Sand	% Silt	% Clay	USDA Soil Type
Y-OR-4	2.5	98	24	8	75.5	16.3	8.2	Sandy loam
	3.0	98	25	8	74.5	17.3	8.2	Sandy loam
Y-OR-5	0.05	56	11	3	80.4	14.3	5.4	Loamy sand
	0.25	49	7	2	85.7	10.2	4.1	Loamy sand
	0.5	50	7	3	86.0	8.0	6.0	Loamy sand
	1.0	46	11	4	76.1	15.2	8.7	Sandy loam
	1.5	49	15	4	69.4	22.4	8.2	Sandy loam
	2.0	67	16	9	76.1	10.4	13.4	Sandy loam
	2.5	68	18	11	73.5	10.3	16.2	Sandy loam
	3.0	39	12	7	69.2	12.8	17.9	Sandy loam
Y-OR-6	0.05	79	19	2	75.9	21.5	2.5	Loamy sand
	0.25	77	16	2	79.2	18.2	2.6	Loamy sand
	0.5	94	32	4	66.0	29.8	4.3	Sandy loam
	1.0	55	6	2	89.1	7.3	3.6	Sand
	1.5	50	8	2	84.0	12.0	4.0	Loamy sand
	2.0	52	13	4	75.0	17.3	7.7	Sandy loam
	2.5	100	47	17	53.0	30.0	17.0	Sandy loam
	3.0	100	19	3	81.0	16.0	3.0	Loamy sand
Y-OR-7	0.05	54	18	8	66.7	18.5	14.8	Sandy loam
	0.25	37	4	0	89.2	10.8	0	Sand
	0.5	68	22	4	67.6	26.5	5.9	Sandy loam
	1.0	74	7	2	90.5	6.8	2.7	Sand
	1.5	54	22	9	59.3	24.1	16.7	Sandy loam
	2.0	100	42	12	58.0	30.0	12.0	Sandy loam
	2.5	100	47	16	53.0	31.0	16.0	Sandy loam
	3.0	100	65	11	35.0	54.0	11.0	Silt loam

Table 6. Summary of USDA Soil Types, Core Samples

	Number of Samples at Depth (m)									
Soil Type	0.05	0.25	0.50	1.00	1.50	2.00	2.50	3.00	Total	% of Total
Silt loam	0	0	0	0	0	0	0	1	1	1.0
Loam	0	0	0	0	0	0	0	1	1	1.0
Sandy clay loam	0	0	0	0	2	2	2	1	7	7.2
Sandy loam	8	2	7	6	6	10	9	6	54	55.7
Loamy sand	4	8	3	3	5	1	2	3	29	29.9
Sand	0	1	0	4	0	0	0	0	5	5.2

Table 7. Mass Magnetic Susceptibility, Surface Samples				
Location	**Depth (m)**	**Mass Magnetic Susceptibility ($x10^{-8}$ m^3 / kg) Low Frequency**	**High Frequency**	**Frequency Dependent Susceptibility X_{fd}%**
Calibration				
Y-CA-SS1	surface	111.9	110.5	1.3
Y-CA-SS2	surface	99.0	97.4	1.6
Blind				
Y-CA-SS3	surface	105.0	103.4	1.5
Extreme				
Y-EA-SS1	surface	118.5	116.9	1.4
Y-EA-SS2	surface	96.9	95.8	1.1
Mogul				
Y-MA-SS1	surface	115.4	115.5	0.1
Y-MA-SS1	surface	117.8	117.0	0.7
Open Range				
Y-OR-SS1	surface	120.7	121.5	0.7
Y-OR-SS2	surface	95.7	95.7	0.0
Y-OR-SS3	surface	112.2	111.5	0.6
Y-OR-SS4	surface	113.9	113.3	0.5
Y-OR-SS5	surface	120.7	120.5	0.2
Y-OR-SS6	surface	114.0	114.0	0.0
Y-OR-SS7	surface	103.1	102.8	0.3
Y-OR-SS8	surface	111.9	111.1	0.7

Table 8. Mass Magnetic Susceptibility, Core Samples				
Location	**Depth (m)**	**Mass Magnetic Susceptibility ($x10^{-8}$ m^3 / kg)**		**Frequency Dependent Susceptibility χ_{fd}%**
		Low Frequency	**High Frequency**	
Blind				
Y-BL-1	0.05	172.3	170.7	0.9
	0.25	146.2	145.2	0.7
	0.5	126.3	125.1	1.0
	1.0	150.5	148.5	1.3
	1.5	94.3	92.9	1.5
	2.0	110.9	109.6	1.2
	2.5	90.6	89.2	1.6
	3.0	133.3	132.0	1.0
Calibration				
Y-CA-1	0.1	161.2	160.2	0.6
	0.25	147.9	146.5	1.0
	0.5	140.2	138.8	1.0
	1.0	152.5	151.0	1.0
	1.5	145.3	144.0	0.9
	2.0	125.3	124.2	0.9
	2.5	96.9	95.4	1.6
	3.0	112.4	111.3	1.0
Extreme				
Y-EA-1	0.05	184.1	182.5	0.9
	0.25	----	----	----
	0.5	----	----	----
	1.0	119.3	118.3	0.8
	1.5	84.6	83.0	1.9
	2.0	73.0	71.6	1.9
	2.5	100.0	98.9	1.1
	3.0	123.2	121.5	1.4
Y-EA-2	0.05	----	----	----
	0.25	----	----	----
	0.5	----	----	----
	1.0	122.9	121.9	0.8
	1.5	89.5	88.2	1.5
	2.0	163.3	162.0	0.8
	2.5	108.5	106.4	1.9
	3.0	139.0	136.9	1.5
Mogul				
Y-MA-1	0.05	194.8	193.2	0.8
	0.25	161.0	159.6	0.9
	0.5	134.8	133.7	0.8
	1.0	123.6	122.4	1.0
	1.5	102.2	101.3	0.9
	2.0	88.1	86.5	1.8
	2.5	88.7	86.8	2.1
	3.0	55.4	54.9	0.9
Y-MA-2	0.05	159.0	161.5	1.6

Table 8. Mass Magnetic Susceptibility, Core Samples				
Location	**Depth (m)**	**Mass Magnetic Susceptibility ($x10^{-8}$ m^3 / kg)** Low Frequency	High Frequency	**Frequency Dependent Susceptibility X_{fd}%**
	0.25	159.0	157.8	0.8
	0.5	131.1	128.8	1.8
	1.0	116.2	114.8	1.2
	1.5	101.7	100.7	1.0
	2.0	104.0	102.7	1.3
	2.5	100.6	100.8	0.2
	3.0	136.1	135.1	0.7
Open Range				
Y-OR-1	0.05	151.1	149.3	1.2
	0.25	127.8	126.6	0.9
	0.5	136.0	134.6	1.0
	1.0	117.7	116.8	0.8
	1.5	112.6	111.3	1.2
	2.0	110.6	109.2	1.3
	2.5	84.5	83.2	1.5
	3.0	113.0	111.4	1.4
Y-OR-2	0.05	156.2	155.8	0.3
	0.25	139.6	138.4	0.9
	0.5	113.9	112.9	0.9
	1.0	87.7	86.3	1.6
	1.5	95.9	94.5	1.5
	2.0	96.5	95.1	1.5
	2.5	110.0	108.3	1.6
	3.0	----	----	----
Y-OR-3	0.05	153.7	152.3	0.9
	0.25	----	----	----
	0.5	----	----	----
	1.0	161.8	161.1	0.4
	1.5	98.9	97.2	1.7
	2.0	98.7	96.6	2.1
	2.5	85.3	83.6	2.0
	3.0	110.3	108.0	2.1
Y-OR-4	0.05	157.1	155.5	1.0
	0.25	152.3	151.2	0.7
	0.5	145.0	143.4	1.1
	1.0	92.7	91.6	1.2
	1.5	88.6	87.5	1.2
	2.0	90.9	89.6	1.4
	2.5	78.3	77.3	1.3
	3.0	84.8	83.9	1.1
Y-OR-5	0.05	174.9	173.4	0.9
	0.25	165.7	163.2	1.5
	0.5	148.6	146.7	1.3
	1.0	142.2	141.3	0.6
Y-OR-5	1.5	120.7	119.4	1.1
	2.0	185.5	184.4	0.6

Table 8. Mass Magnetic Susceptibility, Core Samples

Location	Depth (m)	Mass Magnetic Susceptibility ($x10^{-8}$ m^3 / kg) Low Frequency	High Frequency	Frequency Dependent Susceptibility X_{fd}%
	2.5	100.2	98.9	1.3
	3.0	118.1	116.4	1.4
Y-OR-6	0.05	----	----	----
	0.25	165.8	164.7	0.7
	0.5	152.3	150.9	0.9
	1.0	119.9	119.1	0.7
	1.5	131.0	128.5	1.9
	2.0	139.0	137.6	1.0
	2.5	91.1	90.3	0.9
	3.0	100.2	99.4	0.8
Y-OR-7	0.05	162.4	160.5	1.2
	0.25	150.8	150.8	0.0
	0.5	144.8	143.7	0.8
	1.0	116.7	115.7	0.9
	1.5	88.0	86.9	1.3
	2.0	136.1	134.5	1.2
	2.5	74.6	74.1	0.7
	3.0	58.8	58.7	0.2

Table 9. Mass Magnetic Susceptibility Comparison of Different Particle Size Samples

	Fines			Mixture of All			Small Pebbles + Fines			Medium Pebbles Only			Large Pebbles Only		
Sample	**Low f**	**High f**	χ_{fd}%	**Low f**	**High f**	χ_{fd}%	**Low f**	**High f**	χ_{fd}%	**Low f**	**High f**	χ_{fd}%	**Low f**	**High f**	χ_{fd}%
Y-CA-1 150 cm	145.3	144.0	0.9	115.4	113.8	1.4	122.1	120.7	1.1	96.2	95.0	1.2	161.4	156.7	2.9
Y-BL-1 150 cm	94.3	92.9	1.5	96.8	94.9	2.0	103.9	102.2	1.6	88.4	86.7	1.9	88.4	86.8	1.8
Y-EA-1 150 cm	84.6	83.0	1.9	84.6	83.2	1.7	86.5	86.0	0.6	93.5	92.2	1.4	84.1	82.7	1.7
Y-EA-2 150 cm	89.5	88.2	1.5	89.1	84.2	5.5	85.1	83.7	1.6	89.9	88.2	1.9	169.4	166.5	1.7
Y-MA-1 150 cm	102.2	101.3	0.9	85.8	84.3	1.7	88.7	87.8	1.0	104.0	103.2	0.8	91.4	89.3	2.3
Y-MA-2 150 cm	104.0	100.7	3.2	92.4	91.2	1.3	105.3	105.1	0.2	92.2	90.5	1.8	98.8	97.7	1.1
Y-OR-3 150 cm	98.9	97.2	1.7	95.3	92.0	3.5	104.8	103.7	1.0	82.6	79.6	3.6	149.3	146.8	1.7

Table 10. Mineralogy by X-ray Diffraction

Mineral Constituents	Sample					
	Y-OR-6 300	Y-OR-6 250	Y-OR-6 100 +10	Y-OR-6 100 -10	Y-OR-3 200 +10	Y-OR-3 200 -10
Quartz	X	X	X	X	X	X
Calcite	X	X	X	X	X***	X
Illite (mica)	---	---	---	X	X	X
Plagioclase feldspar	---	---	X	X	X	X
Potassium feldspar	X	X	X	X	X	X
Kaolinite	---	---	X	X	X	X
Magnetite*	X	X	---	X	X	---
14 Å (Angstrom) clay** (Smectite)	X	X	X	X	X	X

* Identified using a magnet
** Expansive clays
*** Detected by dilute HCL treatment

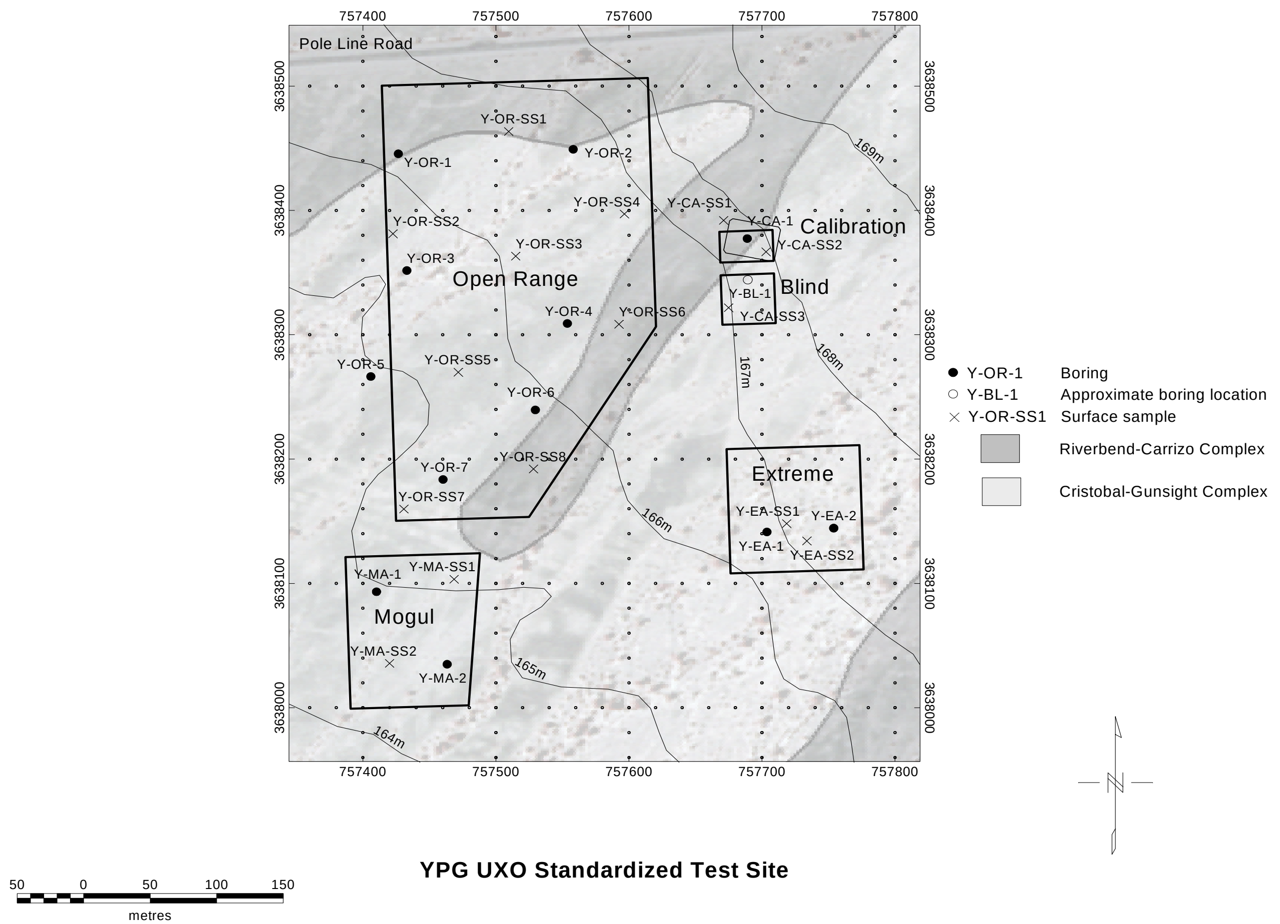


Figure 2. Site attributes: location of grids and soil samples; soils map; elevation contours

Figure 3. Pictures of drill rig and hollow stem auger used to retrieve soil cores

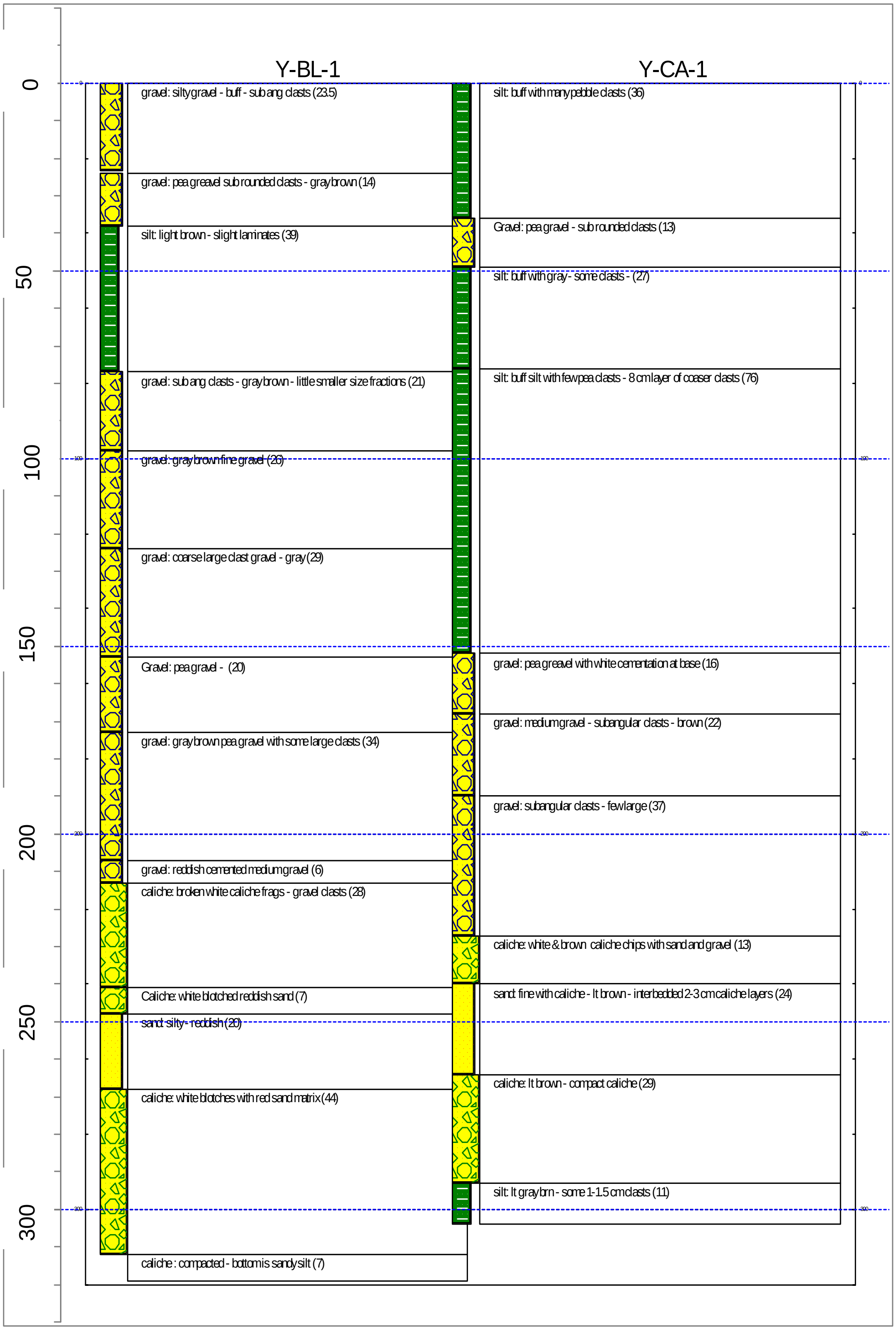


Figure 4. Geologic description of soil borings

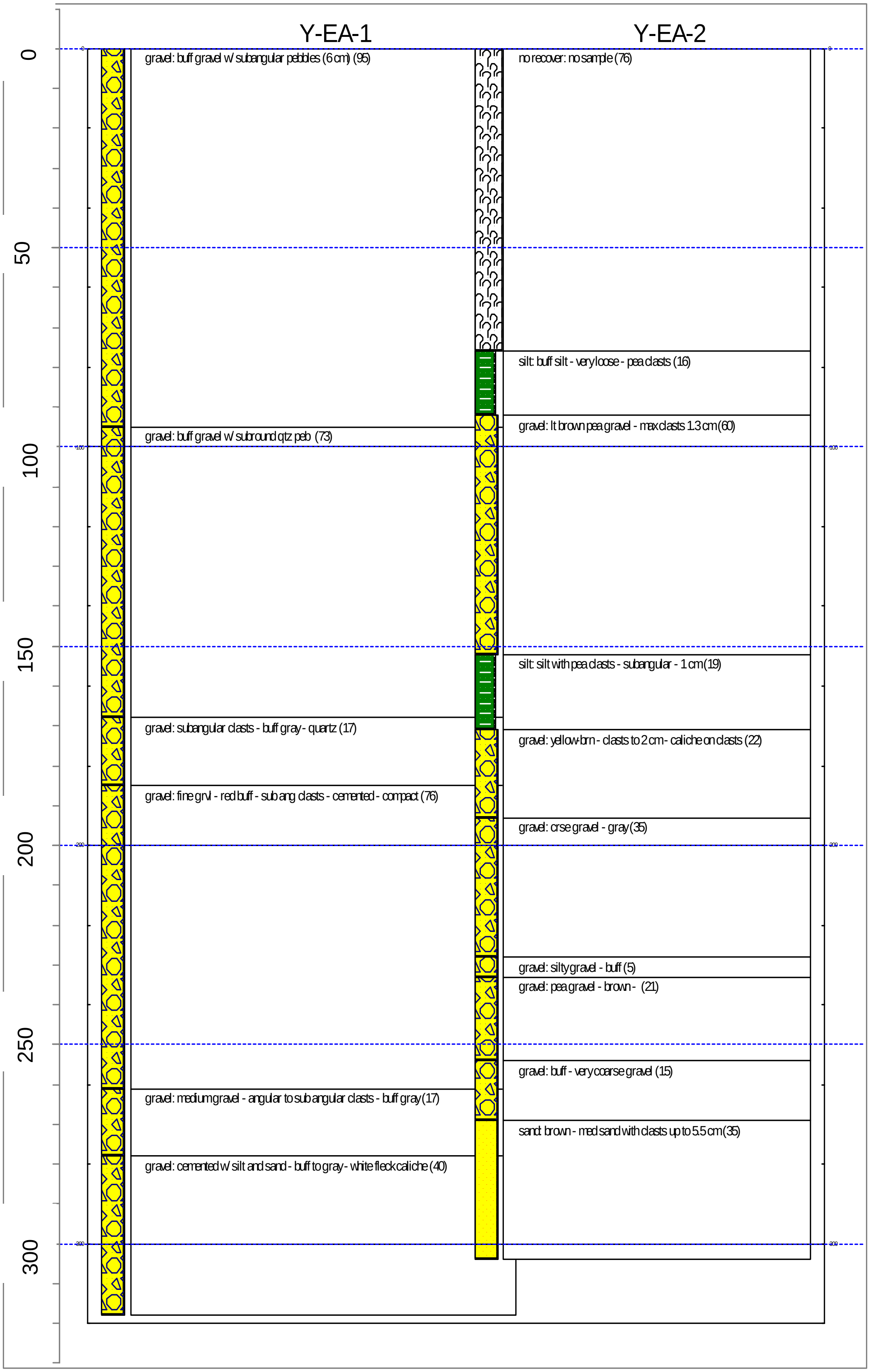


Figure 4. Continued

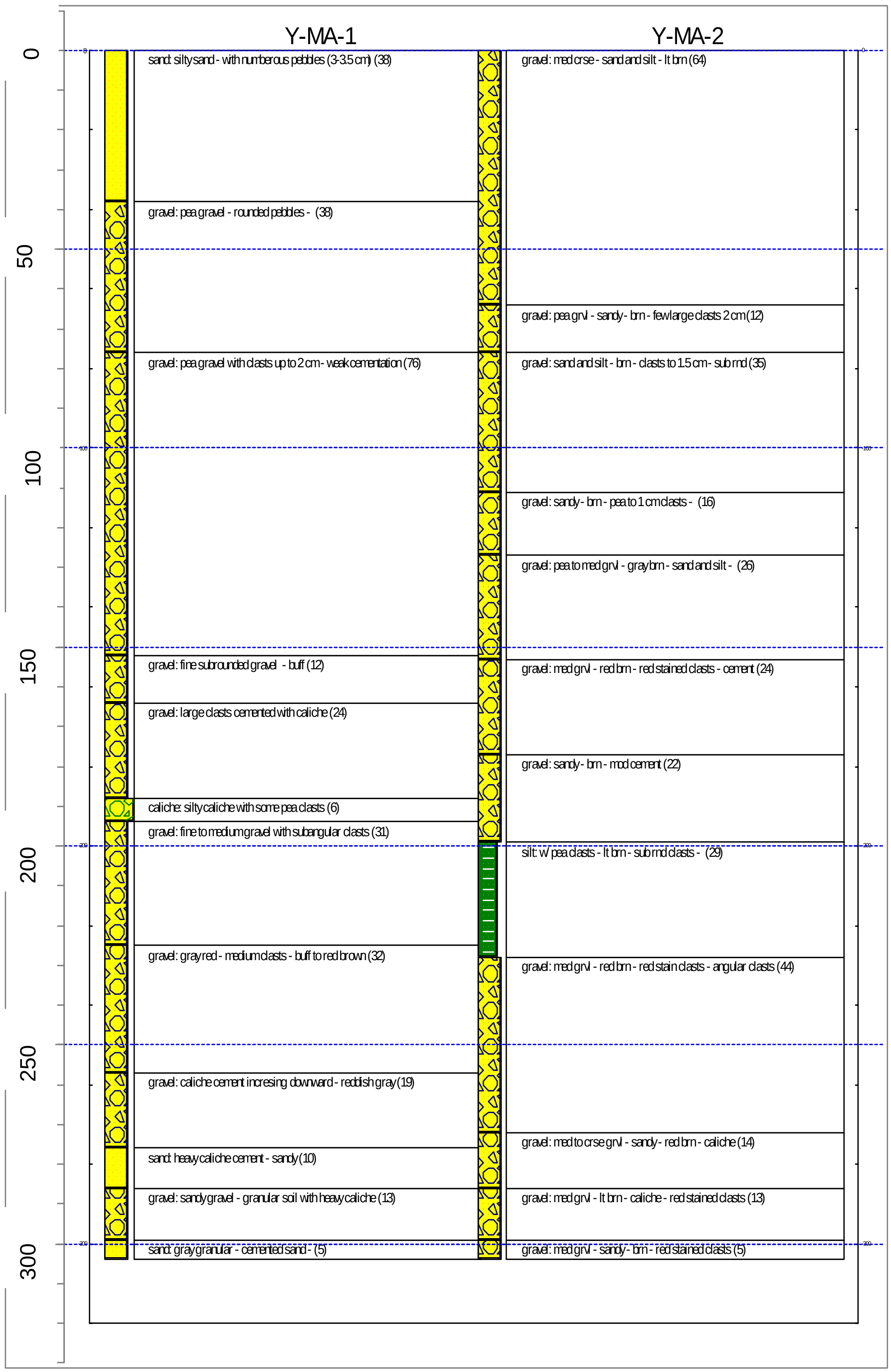
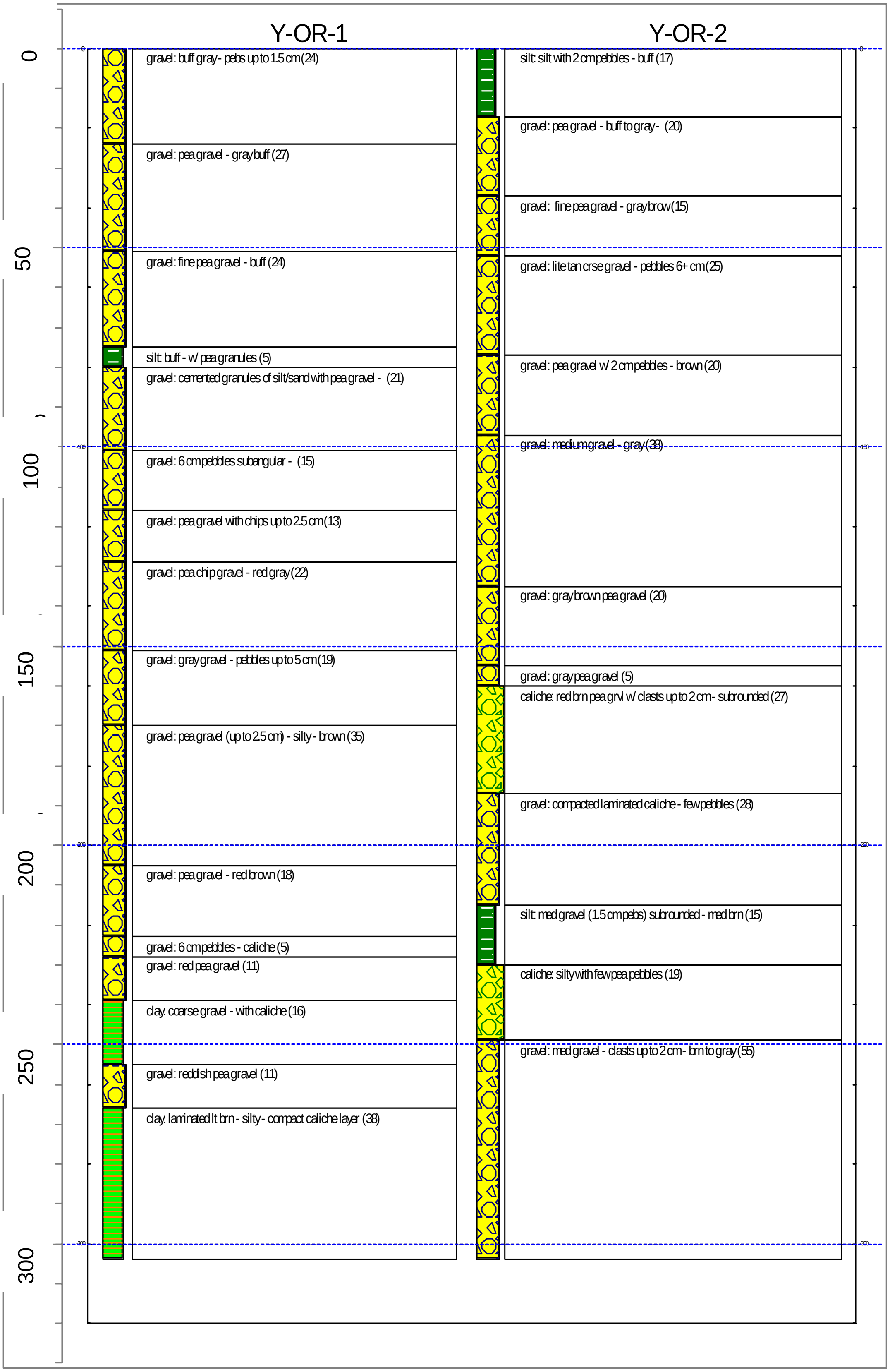


Figure 4. Continued



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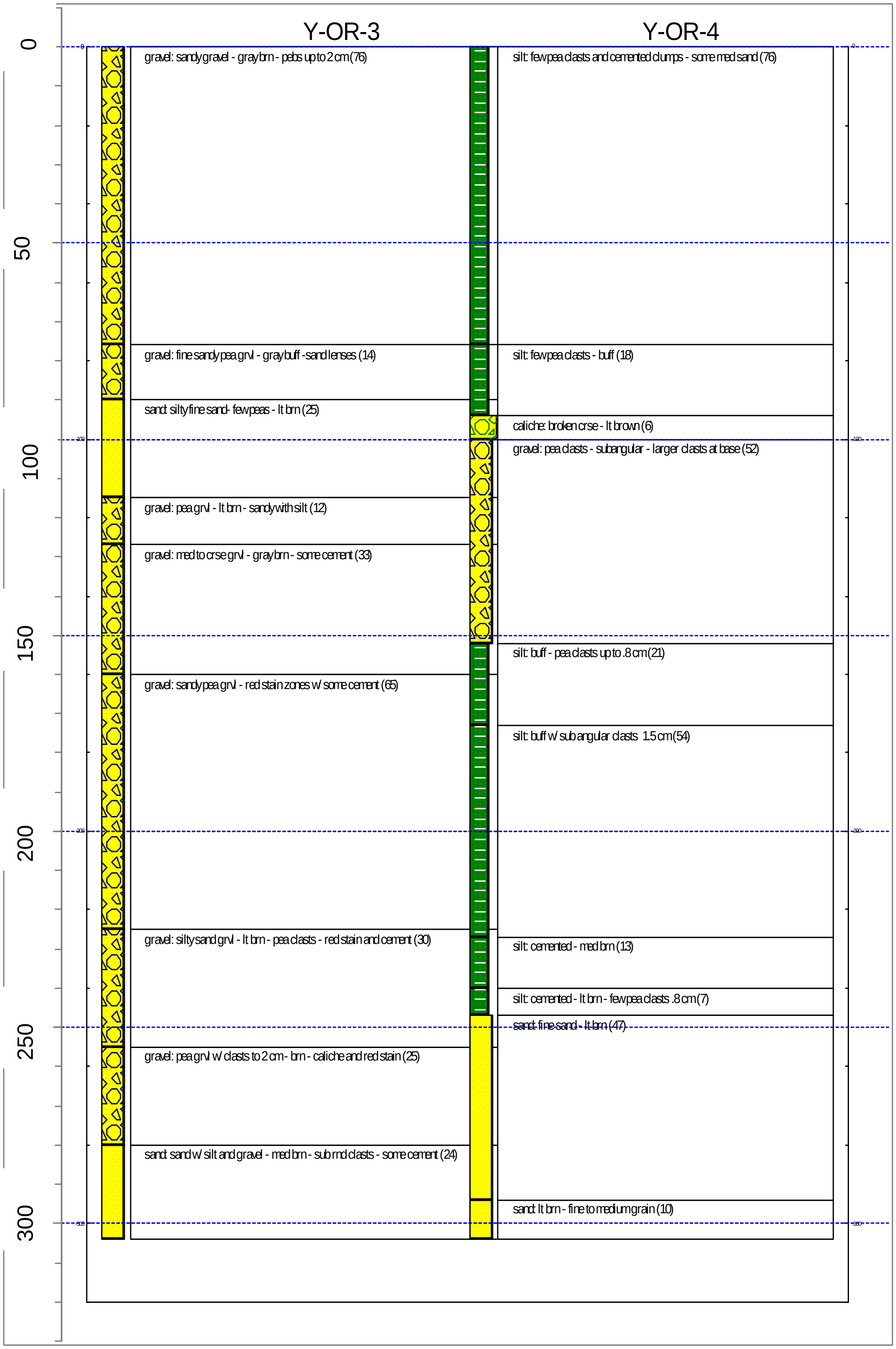

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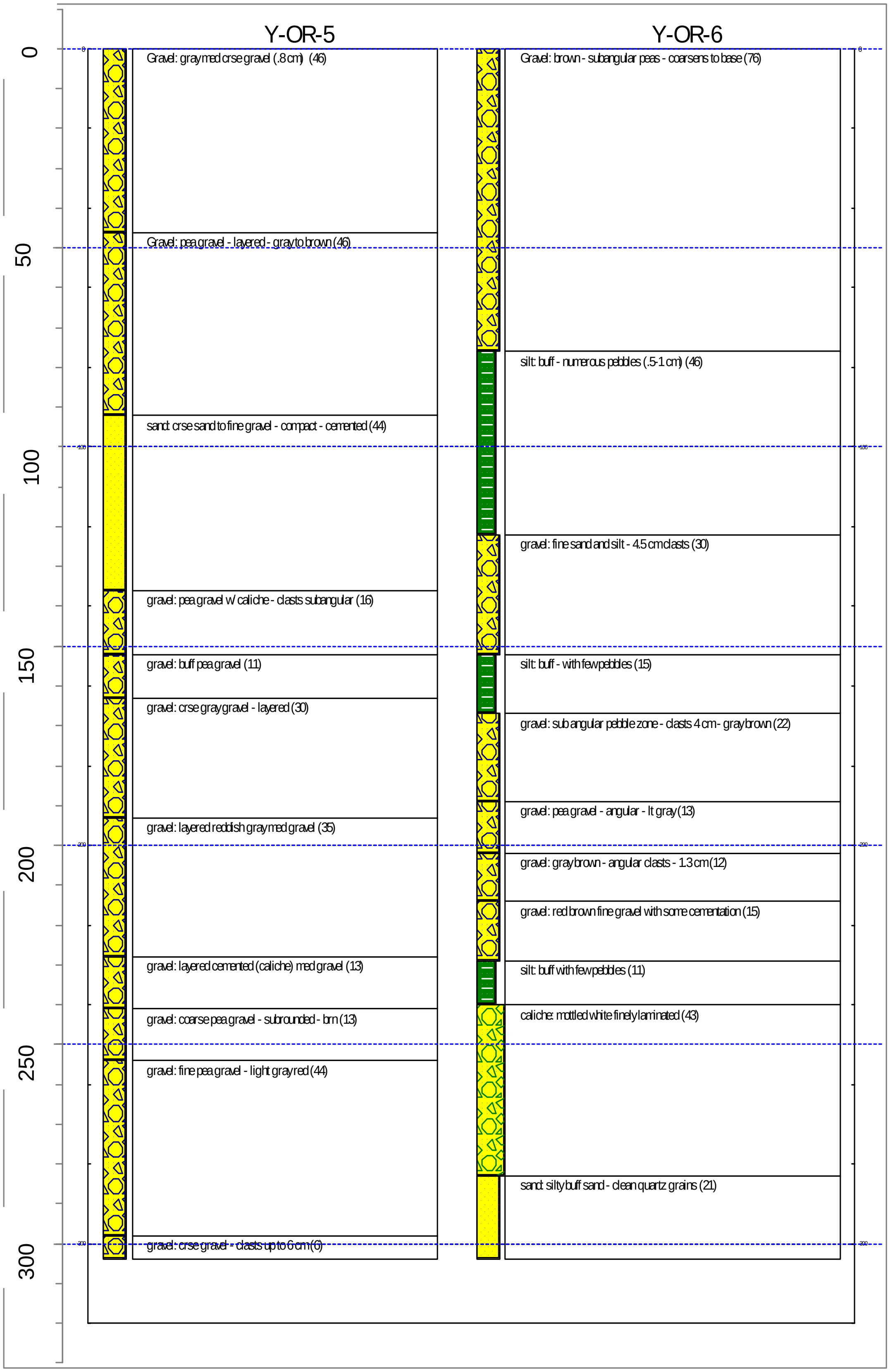

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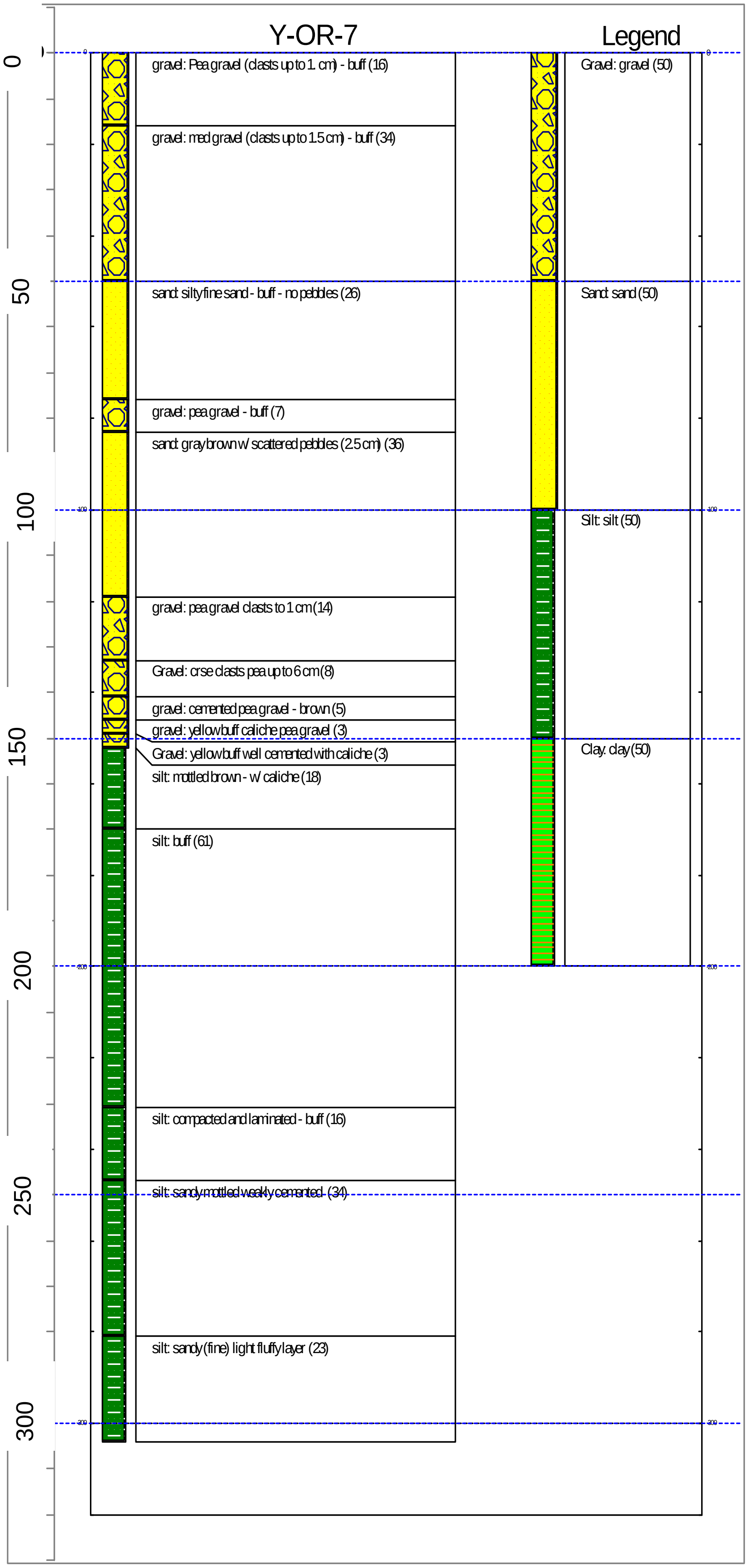

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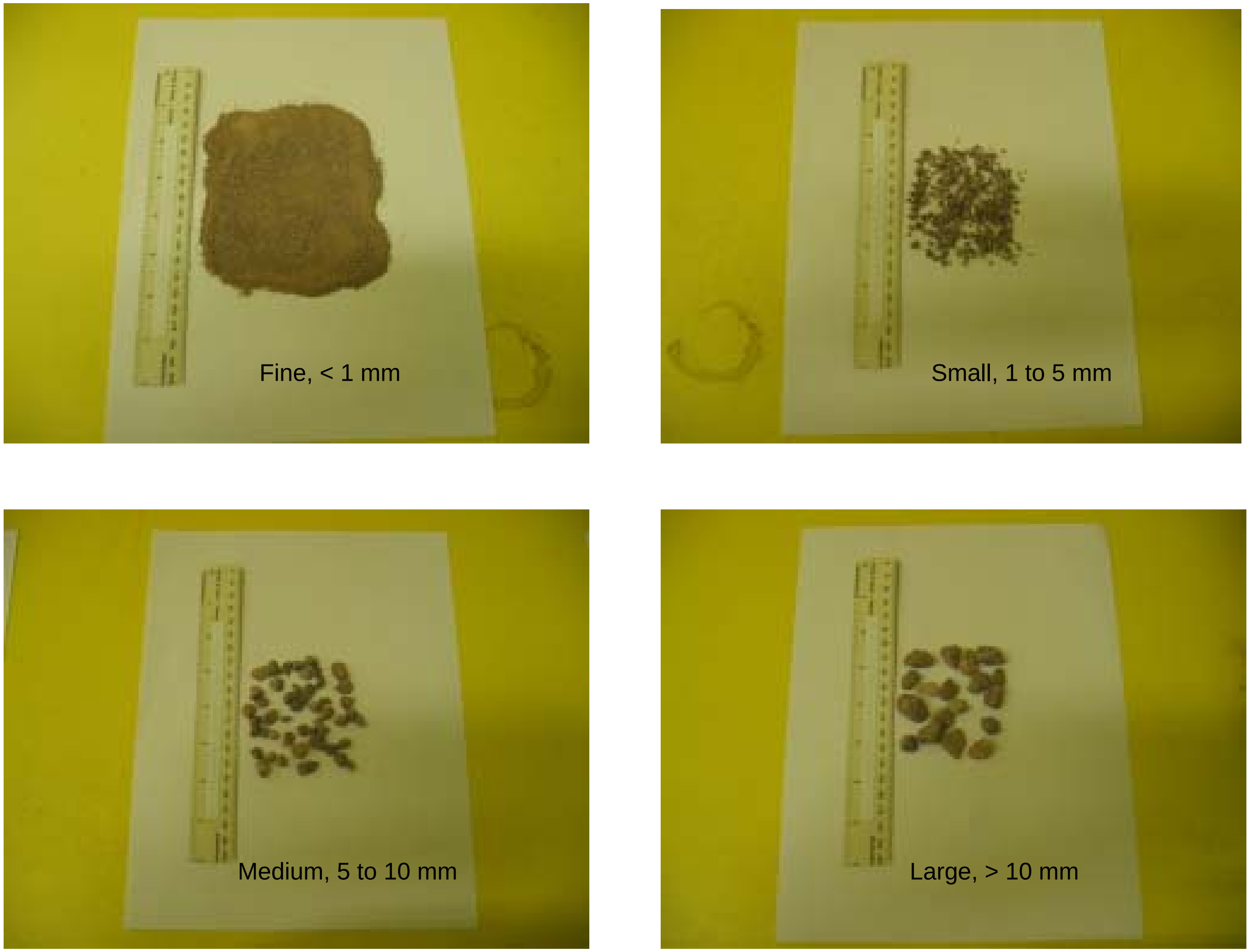


Figure 5. Comparison of soil particle sizes

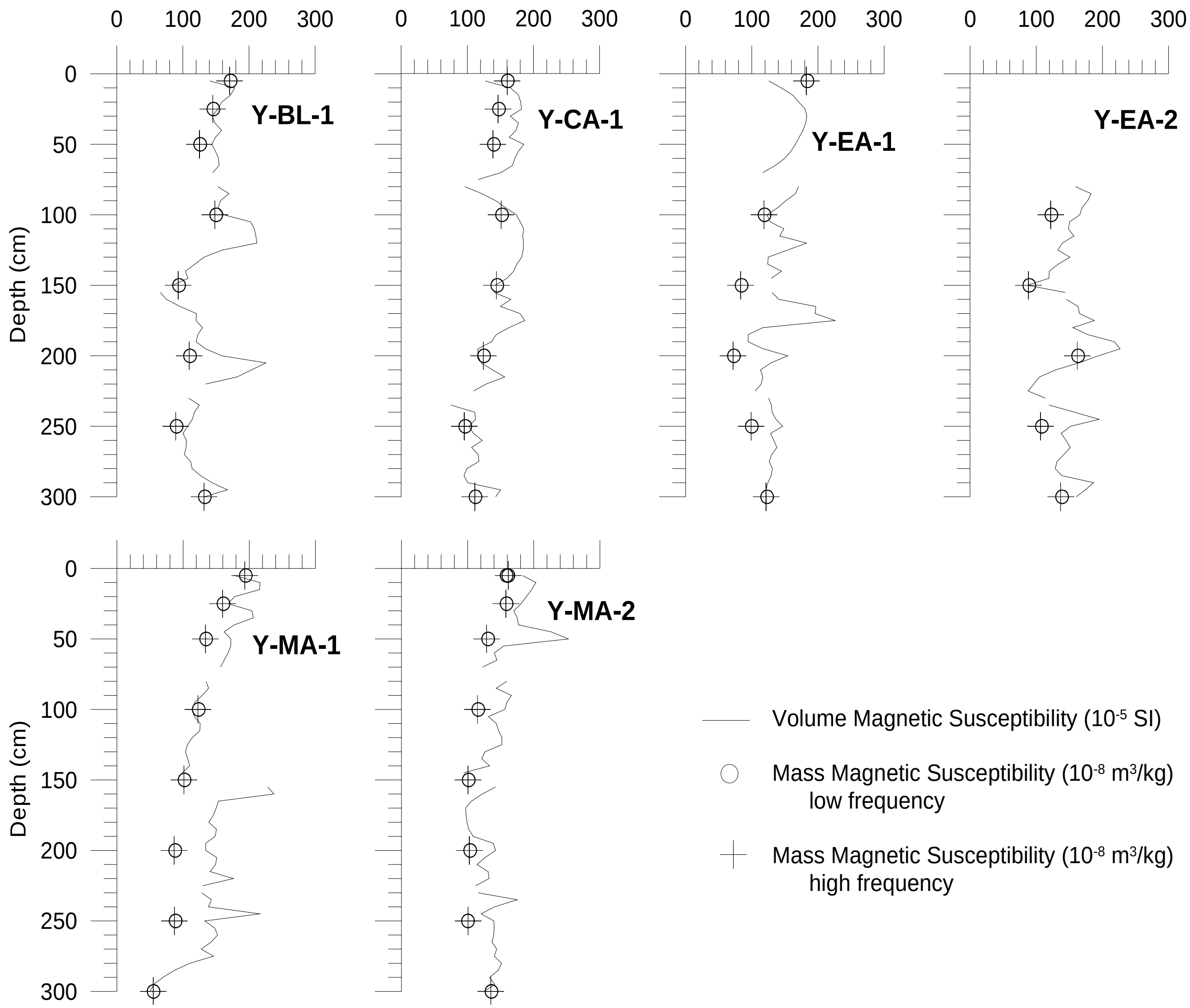
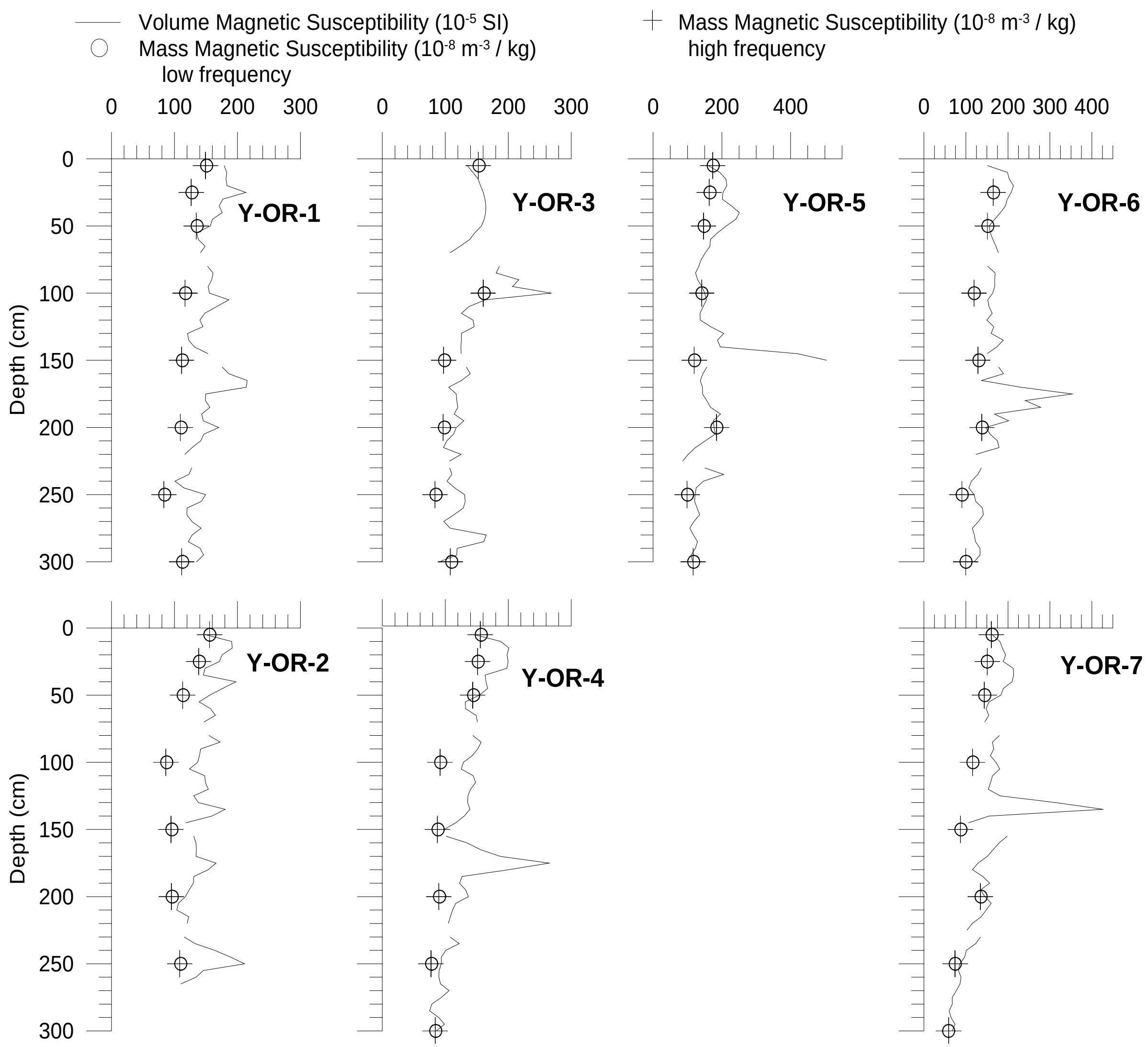


Figure 6. Results of magnetic susceptibility measurements on soil cores



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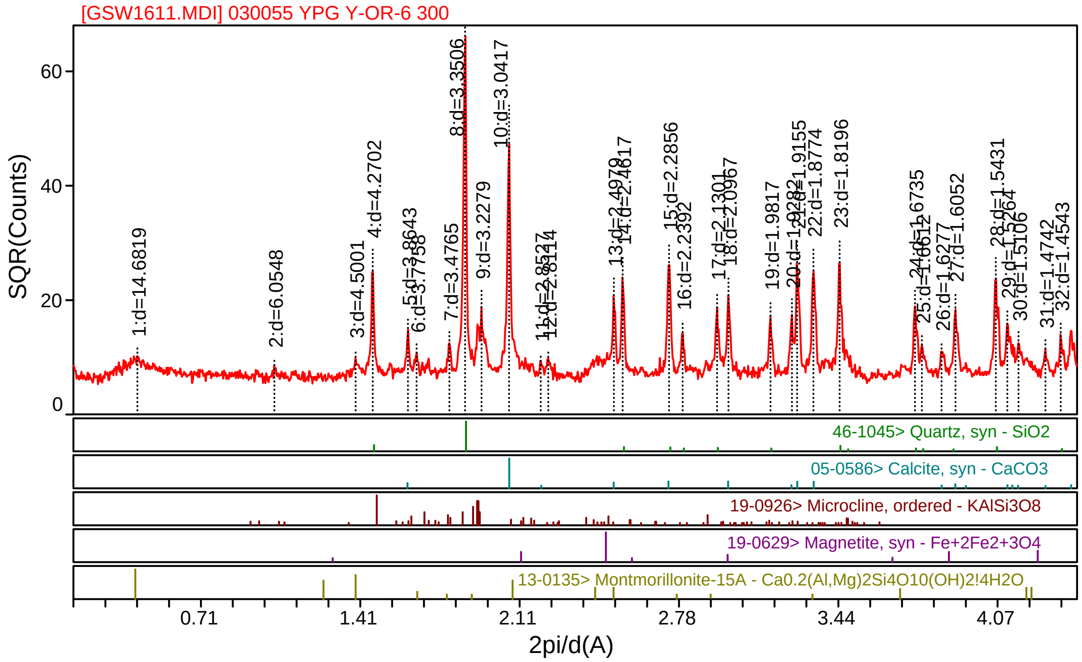


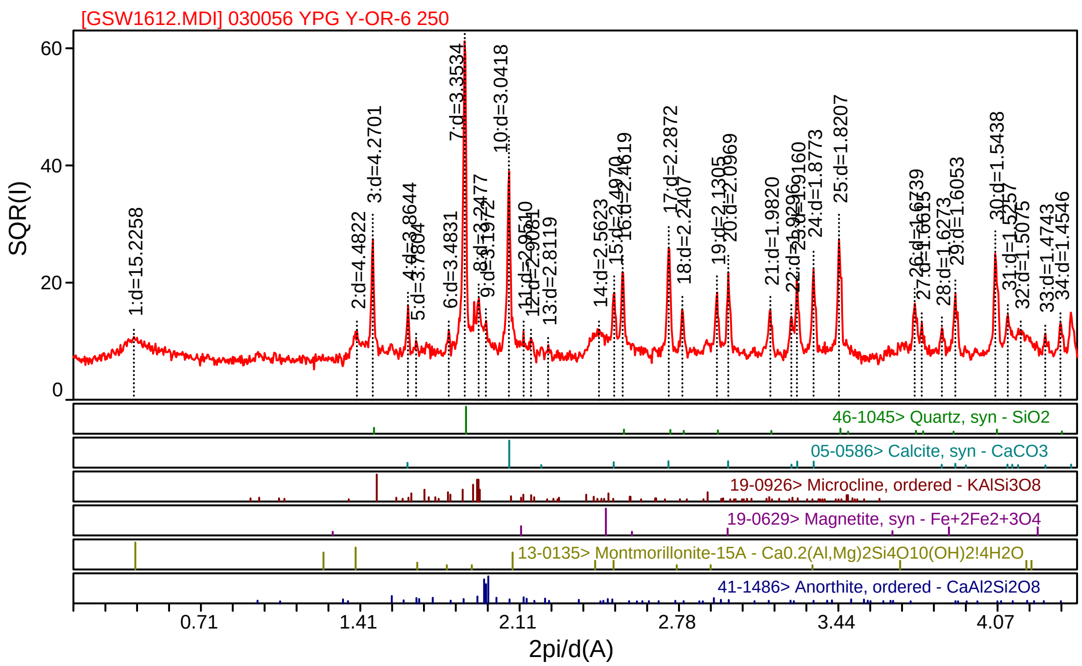
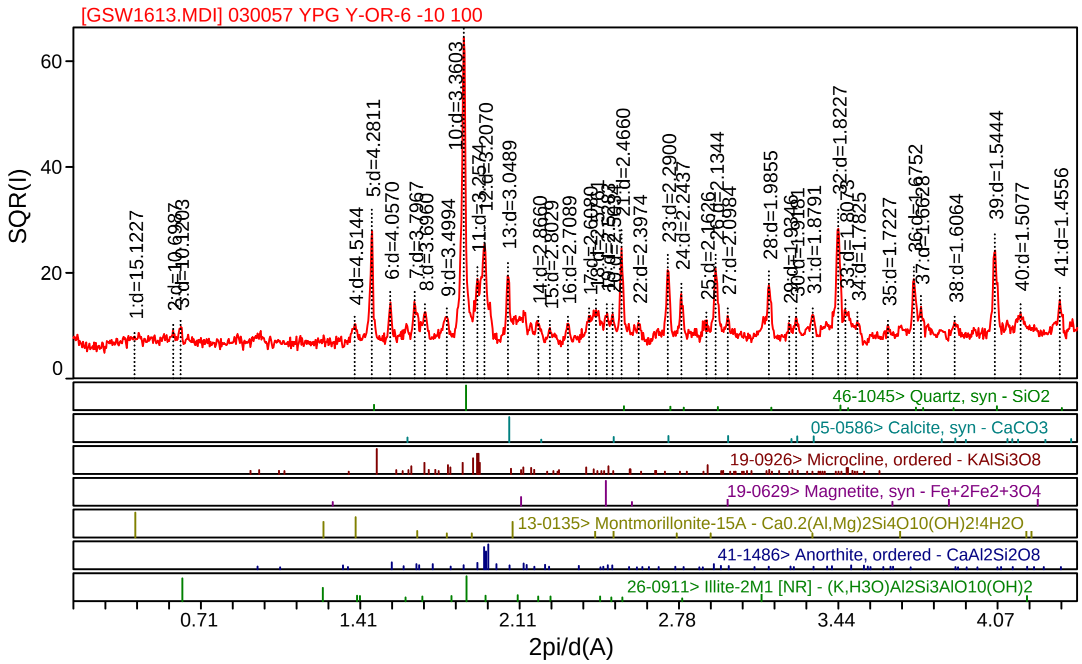
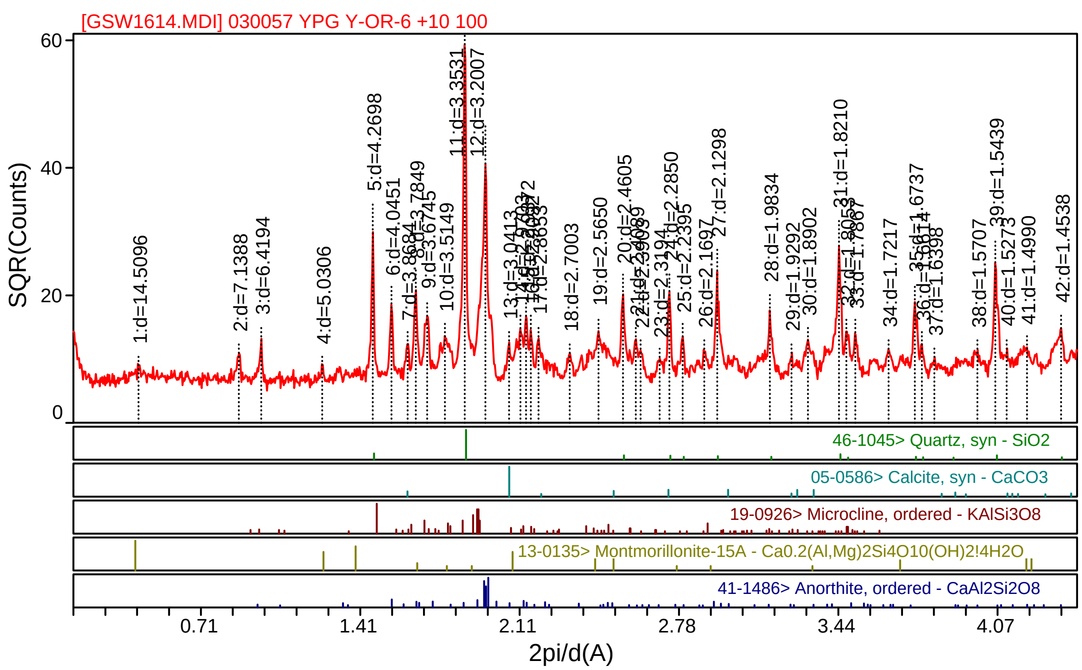


Figure 7. Results of X-ray diffraction analysis on composite powder samples. Sample label at top of each plot





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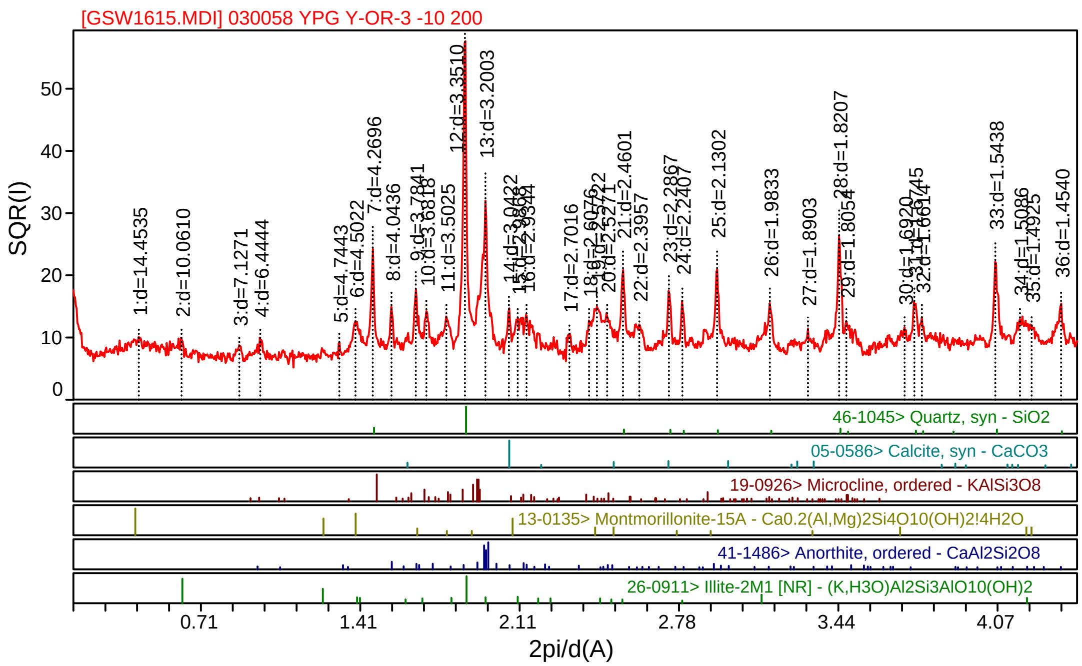

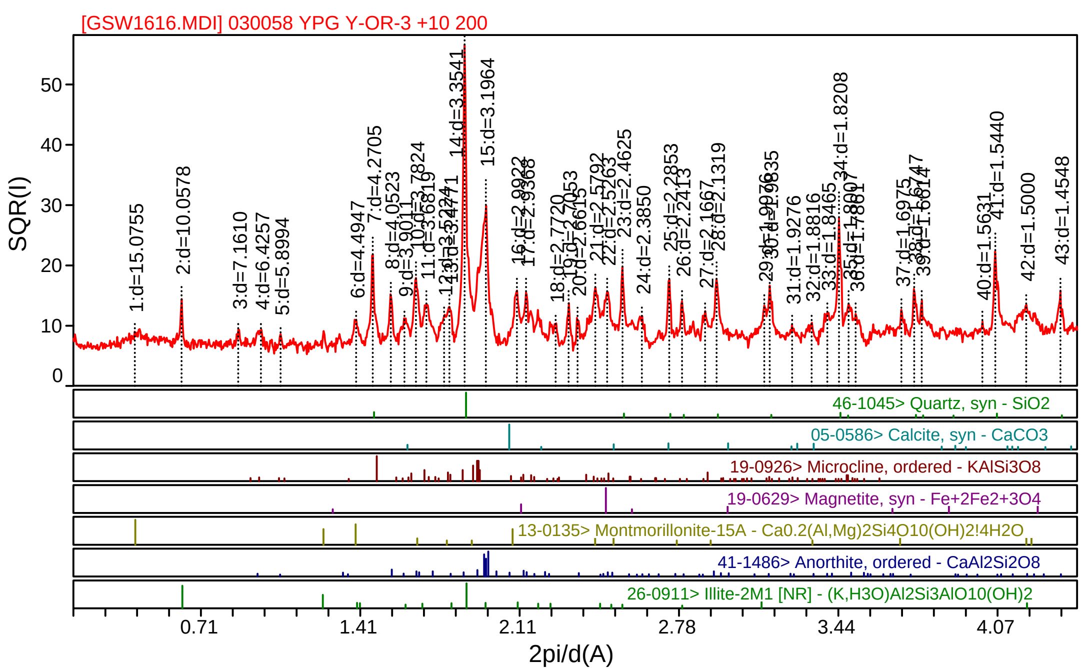

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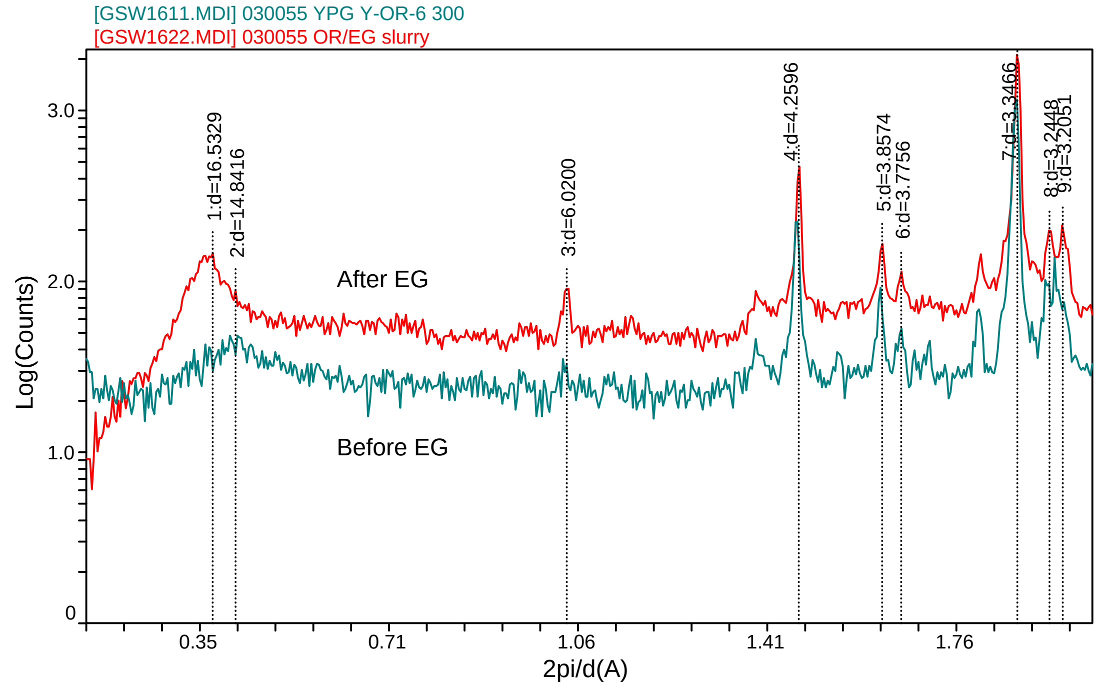

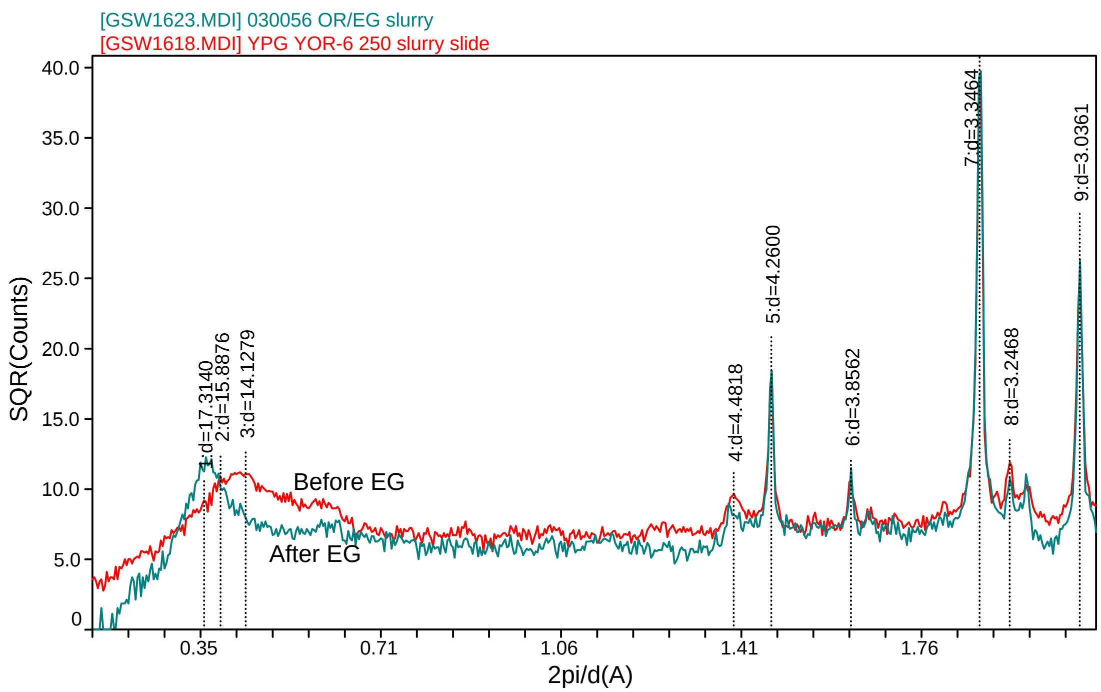

Figure 8. X-ray diffraction slurry slide followed by ethylene glycol treatment (OR/EG). Sample label at top of each plot

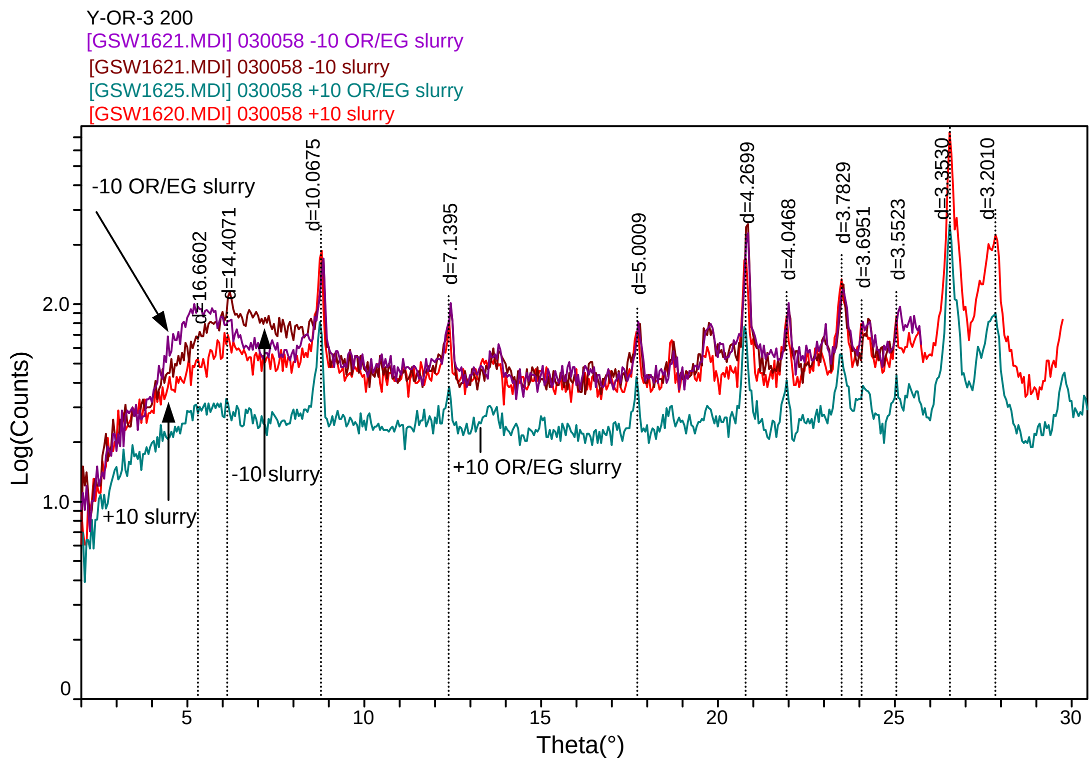

Figure 8. Concluded