Polymodal Grain-size Modes in Long Island Sands, Silts, and Weathered Bedrock.

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by

Courtney Melrose

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Abstract of the Thesis

Polymodal Grain-size Modes in Long Island Sands, Silts, and Weathered Bedrock.

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The purpose of this study is to determine if grain size modes already present in weathered bedrock sediments can be retained and inherited in derived, or processed sediments. To test this theory, weathered bedrock sediment, as well as Cretaceous aged sands and silts, Glacial sands and silts, Loess-like silt sediment, and glacially transported granitic gneisses were collected and analyzed for grain size.

This study is based on the implicit assumption that grain size modes are indicative only of process, and are not reflective of modes present in the parent material of the sediment. A distinct pattern of grain size modes at about 20μm, and 400μm in most if not all pebbly-loess samples from various sites in Suffolk County and modes of 20μm, 80 μm, and 400μm from till and outwash sands on the Stony Brook campus (Zhong, 2002, Kundic, 2005, A. Olaofe, personal communication, 2012 and T. Clare, personal communication 2013). This lead to investigating if these modes are found in other sediment samples. Glacial samples were collected from

Centereach, Long Island, New York, and also were found to display the same pattern of modes seen at Stony Brook. Investigations of Cretaceous sediments from Caumsett State Park also display the same pattern of modes at about 20µm, 80 µm, and 400µm. Analysis of weathered bedrock from Brookhaven, and mechanically crushed rocks, typical of those believed to be the parent rock of the glacial and loessic sediments was also conducted, showing the same mode pattern. Additionally, petrographic analysis of a sample of bedrock, similar to the weathered bedrock in our study, showed silt sized grains already present in the bedrock.

Analysis of possible machine bias towards certain modes was also conducted. All of the samples were analyzed with a Malvern Mastersizer 2000. It appears that the modes seen in sedimentary samples of loess, glacial sands, glacial till, cretaceous sands, weathered bedrock, and manufactured bedrock all show polymodial pattern of modes at about 10.00µm-20.00µm, 100.00µm-200.00µm, and 400.00µm-500.00µm may be inherent in the parent bedrock of the sedimentary material. Furthermore, analysis with a Sediment Grain Size Analyzer program shows that the high rate of 80 micron modes seen in the Mastersizer results are possibly due to a combination of modes seen between 90 microns and 100 microns, regardless of the type sediment.

In conclusion, we can state that grain size modes found in weathered bedrock on Long Island, New York, can be retained as common modes in derived sediments, such as Cretaceous materials, and glacial materials, such that process is not the only determination of the sediment mode characteristics. In addition, we can also state that silt sized particles can in fact be created without the aid of glacial grinding, as seen in the thin section analysis.

Table of Contents

List of Figures/Tables/Illustrations

Acknowledgments

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Section 1 Introduction:

The purpose of this study is to determine if grain size modes already present in weathered bedrock sediments can be retained and inherited in derived, or processed sediments. To test this theory, weathered bedrock sediment, as well as Cretaceous aged sands and silts, Glacial sands and silts, Loess-like silt sediment, and glacially transported granitic gneisses were collected and analyzed for grain size.

This study is based on the implicit assumption that grain size modes are indicative only of process, and are not reflective of modes present in the parent material of the sediment. This assumption can be seen in Xiao et.al. 2009, "*It has been suggested that the grain-size distribution of clastic deposits with a single component formed by only one process should exhibit a symmetric curve on a logarithmic scale and represent a unimodal distribution. ... When the shape of the grain-size distribution is asymmetric or skewed, the total distribution can be considered to be a combination of several unimodal distributions formed by different processes*." The authors are referring to the modes as being indicative of one process, and more then one mode being indicative of more than one process, discounting the possibility that more then one mode may already be present in the sample before being processed. This assumption of an "equal' distribution of grain size in parent material, for which these processes "cull out" their "preferred" sizes, is used as an indicator of what process these sediments underwent. For example, a 20μm mode would be indicative of fine windblown sand, or loess (Pye, 1987).

During a study of an odd, pebbly-loess deposit on the grounds of Stony Brook University, a similarity of modes was observed between the pebbly-loess and the underlying glacial till. As these sediments are believed to have undergone separate processes, an overlap of modes in the 20μm and 400μm range seemed to contradict the assumption that modes are indicative of process. To test this assumption, samples from multiple sediments on Long Island, New York were tested for grain size distribution and mode content. Most importantly, weathered bedrock was analyzed for grain size distribution, as this would create an analogue of the material that would have been processed for the sediment deposits seen on Long Island.

As the grain size modes in the weathered bedrock would show, silt size particles can, in fact, be found in weathered bedrock. This was further reflected in microscopic examination of thin section slides of similar bedrock materials. Once this was established, samples of Cretaceous sediments, which could have been derived from similar bedrock to the north, were analyzed for its mode composition. This was repeated with additional glacial sediments, and combined with the aforementioned glacial and pebbly-loessic material. All of the separate sediment grain size modes were compared, to see if any mode similarities were present in the bedrock and processed sediments. Similarities of modes may indicate inheritance of mode sizes, as opposed to process influence.

All locations sampled are located either in the midline of Long Island, New York, or on the North Shore of Long Island, New York.

Section 1.2 Geologic Background

Long Island is an island, located off of the Eastern portion of the main continent of North America. This island, which was formed during the last glacial advance, is mostly composed of two terminal glacial moraines on the north shore, which are the reason for the steep cliffs that characterize much of the northern shoreline, and unconsolidated glacial outwash south of these moraines, extending to the more level south shore. This glacial outwash of Pleistocene age, overlies deposits of Cretaceous age, such as the Magothy, Raritan, and Lloyd formations, which themselves seem to overlie weathered bedrock. This generalized sequence dips from west to east. This can be seen by the surface appearance of glacially scoured bedrock in Central Park, and its disappearance to the east, at a depth of approximately 1,500 ft. below the surface at Brookhaven in Suffolk County, Long Island, New York (DeLaguna, 1963). Figure 1.1 taken from DeLaguna, 1963 shows this generalized stratigraphy of Long Island.

Section 1.2a Stony Brook University Location

Located west of the parking lot behind the Earth and Space Sciences building at Stony Brook University, are samples of loess-like material dominant in silt sized grains, and glacially deposited sands and till. These deposits of fine quartz rich silt, or pebbly-loess, was sampled at Stony Brook, where this silt overlies a one meter thick glacial till. According to Zhong, 2002, $^{40}Ar/^{39}Ar$ muscovite in the silt gives ages dominantly between 200 and 450 Ma which suggests that the muscovite is derived from basement rocks in New England, consistent with the direction of glacial advance to the south and east. OSL (Optically Stimulated Luminescence) dating for this loess gives an age for deposition of 13 to 14 Ka (Kundic, 2005), long after the last glacier retreated from Long Island at about 20 Ka. This would indicate that the glacier would have been too far north at 14-13 Ka to have been the direct contributor of this sediment. This loess was deposited at about the beginning of the Younger Dryas event (about 13Ka), when the climate returned to near Glacial Maximum conditions which lasted for some 1,500 years.

The rocks utilized for the crushing experiments were collected from the Stony Brook University site, and were most likely deposited by the glacier as glacial till. At the Stony Brook location, a total of three adjacent locations were sampled. These are denoted in the sample figures as SBU 1.X, SBU 2.X, and SBU 3.X, the X denoting the sample number. SBU 1 is located on the north face of the exposure, SBU 2 is the south face of the exposure, and SBU 3 is located around a curve from the north face. Two auger cores were collected from above SBU 1; SBU 1.1 Core 1, and SBU 1.1 Core 2. The samples from SBU 1.1 Core 2 used for this study were collected from the head of the sampling auger.

Section 1.2b Centereach:

This site has exposed beds of glacial sand and silt. There is no age data for the Centereach location. Its placement on the Ronkonkoma moraine lead us to believe that this location may be older then the Stony Brook location which is located on the Harbor Hill moraine to the north. Further field investigation suggested that this site may have been affected by the formation of the moraine, as it appears that some of the layers at this site seem to be thrusted upon other layers, in such a way as to emplace older layers over younger layers repeatedly. This would have to be investigated further, to conclusively determine the correct stratigraphy of this area. Samples of sand and silt were collected at this location. Three cores were collected from this location, labeled as S10, S10a, and S11. They were collected by split spoon coring.

Section 1.2c Caumsett State Park:

At this site are exposed beds of loess, glacial outwash sands and gravels, and Cretaceous sands (Hanson, 2013). Samples were collected at Caumsett State Park from both glacial (Pleistocene age material in a Gilbert Delta Setting) and Cretaceous coarse to fine sands. These Cretaceous deposits are believed to have been thrusted into the surrounding glacial deposits during the last glacial advance, and are similar to the Cretaceous age Magothy, Raritan, and Lloyd formations (Mandell, 1999).

Section 1.2d Brookhaven:

Samples from Brookhaven National Laboratory were collected from two separate cores, S6409 and S6434, collected by the USGS in 1948 for an underground storage study (De Laguna, 1963). There is no data available form the USGS as to the spacing between the two cores, nor is there any data on the exact coring method used. These cores extend from the surface to about 1600ft below the surface. Cores extend through multiple layers, such as the Cretaceous Magothy sands, the Raritan clays, the Lloyd sands, and into the underlying bedrock. Each sample was chosen for its sediment type, and location in depth according to Figure 3 of De Laguna, 1963 (fig 1.1). A total of 17 samples were analyzed, of these, five were from the Magothy layer (256-288ft, 363-383ft, 417-423ft, 562ft, and 899ft), two were from the Raritan Clay layer (1100ft, and 1110ft), four were from the Lloyd layer (1160ft, 1221ft, 1300ft, and 1311ft), and eight were of weathered bedrock (1501-1565ft, 1523ft, 1538ft (a), 1538ft (b), 1548ft (a), 1548ft (b), 1555ft, and 1568ft). The deepest core attained a depth of approximately 1600 feet, but our deepest sample was taken from 1568 feet, and was from USGS core S6409.

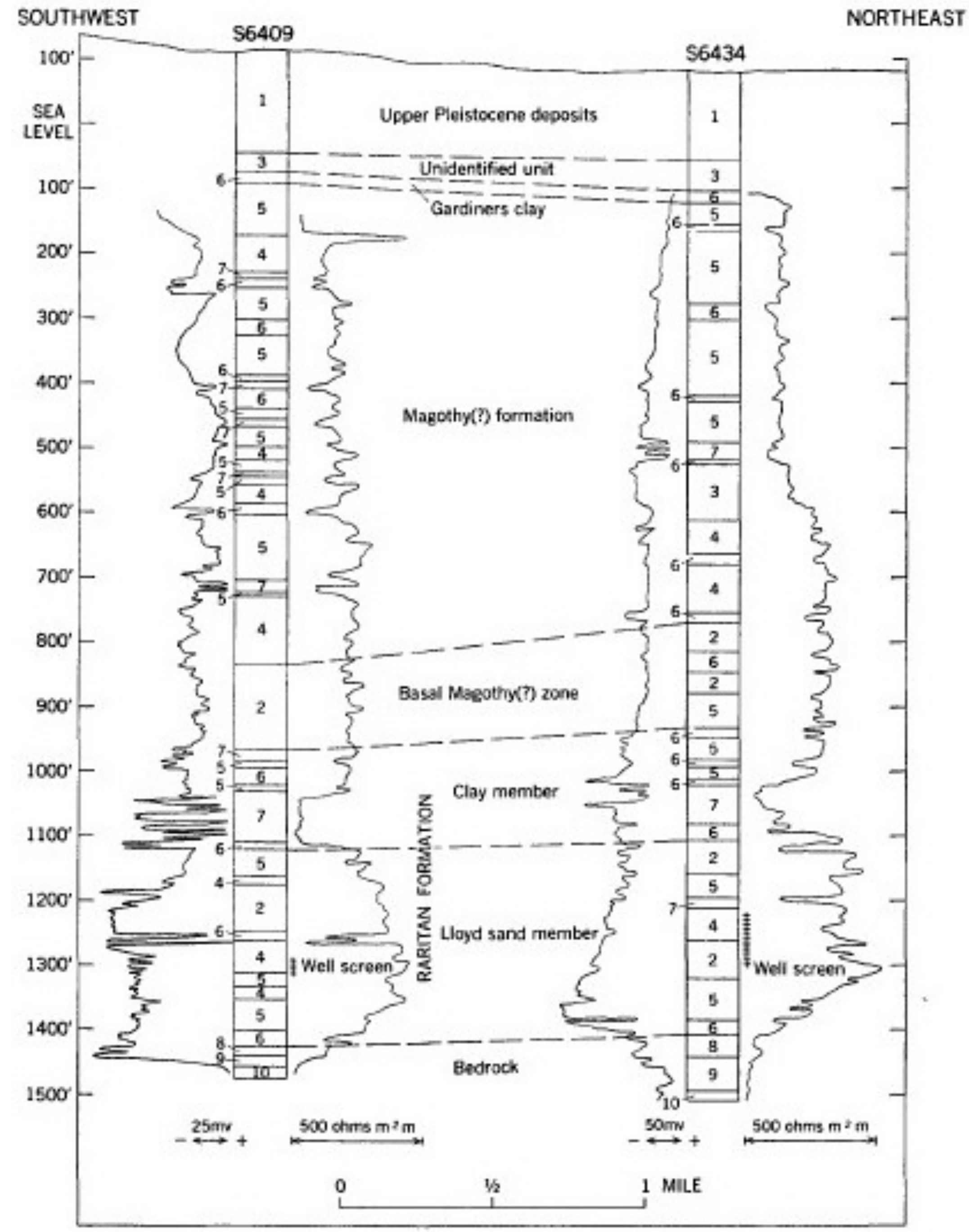


FIGURE 3.—Columnar sections and electric log of deep test wells at Brookhaven National Laboratory.

(Fig 1.1) Figure 3 taken from DeLaguna 1963. A cross-section of the Brookhaven cores in the USGS collection, used for our study to approximate sample location per formation layer.

Section 2 Methods:

Analysis of the sediment samples was done with two different grain analysis programs, the Malvern Mastersizer, and the GrainAnalysis program. These sediments were collected and dried before analysis, and the whole rocks were cut and ground by multiple methods before any grain analysis was done.

Section 2.1 Sampling Protocols:

Section 2.1a Stony Brook University:

The faces of the three outcrops were scrapped clean of outer material, to avoid contamination from other layers, and weather action. Then samples were collected by digging into the face of the outcrop with either a small shovel or a trowel. The sample was then removed and placed into a fresh clean Ziploc and labeled. Approximate depth was taken and recorded, as was GPS location. Images were also taken before and after removal of the sample from the outcrop face. Two cores were also taken from this location, SBU Core 1.1 and SBU Core 1.2. These cores were collected by hand auger, and only material from SBU Core 1.2 was used. The material that was used came from the head of the auger, as to get the appropriate depth measurement, and to prevent contamination from side wall material falling onto the sample.

Three whole rock samples were also collected from this location. These rocks are believed to have been deposited as glacial till. Due to the nature of the area, a GPS location was useless, as these rocks were not collected in place (directly from the till), but were rather gathered from the surrounding area.

Section 2.1b Centereach:

As with the Stony Brook University material, the faces of the outcrops were scrapped clean to remove any contaminated material. Again, samples were extracted from the face with a shovel or a trowel, and placed in a clean, unused, Ziploc bag and labeled. Again, depth from surface, and GPS location were noted. Again, images were taken before removal of the sample, and after. Here, three sets of cores were also collected, labeled S10, S10a, and S11. A total of nine one foot cores were collected. Three cores were taken from site S10, one core was collected from S10a, and four cores were collected from S11. The depth next to each sample name is the depth from the top of the core tube. These cores were collected by a split spoon coring method. This coring process involves a six inch metal core tube, which is detachable into two halves, with a screw-on cone cap at the head, and a screw-on base, which is able to attach to an extension pole, or a slide hammer. A plastic tube sleeve can be placed in between the split spoon halves to allow for collection of the material in the metal core. An image of the split spoon corer can be found in fig 2.1. Each core was placed in a hand-

(Fig 2.1) Image of split spoon corer, with a rock protruding from the head of the corer. Only the core sampler is shown.

(Fig 2.2) Jig used to open the core sleeves from the split spoon corer. Plexiglas cutter visible to the top center of image.

made cutting jig (fig 2.2). The sides were then scored with a Plexiglas cutter, then cut with a utility knife. The core itself was split with a handmade wire “cheese-cutter”.

Section 2.1c Caumsett State Park:

The outcrops at Caumsett State Park are exposed cliffs. Samples were collected here in a similar fashion as the Stony Brook University and Centereach sites. The face was scrapped, and the sample was removed either by trowel, shovel, or, at this location, a metal spoon, and placed into a clean, unused, Ziploc. The sample was removed by sampling into the cliff face. Again, images were taken of the outcrop before and after removal of the sediment sample. No cores were collected from this site. Again, the approximate GPS location was re-corded, but in this case, no depth was recorded, as these samples were taken from the base of a steep cliff, and depth was not as important of a variable as was the deposit from which the sam-ple was removed.

Section 2.1d Brookhaven:

The samples taken from Brookhaven were collected by an unknown coring method in 1948. These were collected for a USGS study concerning underground waste storage, which was published by the USGS (Please see DeLaguna 1963). These cores were broken into pieces, and placed into small glass and plastic jars, labeled with a depth. Samples for our study were collected from these jars by scrapping material off of the core sample, or from material which had already broken up, and filled the bottom of the jar.

Section 2.2 Mastersizer Method:

A Malvern Mastersizer 2000 was used to determine grain size volume percentage for each sample. This data set was then analyzed with a GrainAnalysis statistical program. A sieve set was used to fraction out the coarse material, or the material larger then 1mm (0phi) from each sample before processing with the Malvern Mastersizer. A sieve tower was also used to fractionate samples out into individual half phi sizes.

A Malvern Mastersizer 2000 uses laser diffraction to accurately analyze the grain-size distribution of particles. According to Sperazza et. al. 2004,

> "*During the laser diffraction measurement, particles are passed through a focused laser beam. These particles scatter light at an angle that is inversely proportional to their size. The angular intensity of the scattered light is then measured by a series of photosensitive detectors. The number and positioning of these detectors in the Mastersizer 2000 has been optimized to achieve maximum resolution across a broad range of sizes. The map of scattering intensity versus angle is the primary source of information used to calculate the particle size. The scattering of particles is accurately predicted by the Mie scattering model. This model is rigorously applied within the Mastersizer 200 software, allowing accurate sizing across the widest possible dynamic range*" (http://www.malvern.com/Assets/MRK501.pdf)

The samples were first air dried on clean white paper at least over night. Approximately 5.0 to 10.0 grams of each sample was removed, weighed, and passed through a 1mm sieve. This is a necessary step, as the Mastersizer does not read anything above 1mm. The coarser and finer fractions were weighed to determine the relative abundance of each. The less then 1mm fraction was placed in a 5.5 g/l solution of sodium hexametaphosphate (Na(PO3)6), (a deflocculant), overnight. The Malvern Mastersizer 2000 grain size analyzer was used for grain size analysis, and the procedure is that of Sperazza et. al. 2004. The sample was introduced by pipette into a beaker containing 500ml of sodium hexametaphosphate solution (Dias & Sperazza 2013). Each sample was introduced by pipette into the beaker of solution until the obscuration percent read-out reached between 15% and 23% (Dias & Sperazza 2013). According to Sperazza et.al., a ob-scuration value of approx 20% gives the best results. Therefore, no exact amount added to the beaker can be stated. A simple plastic pipette, with the end cut off to create a larger intake opening (about 3mm) was used. An agitator blade was then lowered into the beaker, which intakes the sample through a tube, and flushes it past a laser. This laser ultimately reads the gain size of the sample. The Mastersizer speed was set to 2000 RPMs, and the sample was sonicated for 60 seconds. These settings were the same as used by Sperazza et. al. 2004 when proper procedure for testing fine grained sediments and instrument uncertainty was tested. No other settings were adjusted for our use. The analyzer was flushed with regular tap water or deionized water between samples. This flushing continued, until no sediment was seen by visual inspection within the beaker. The process would then be repeated for the next sample.

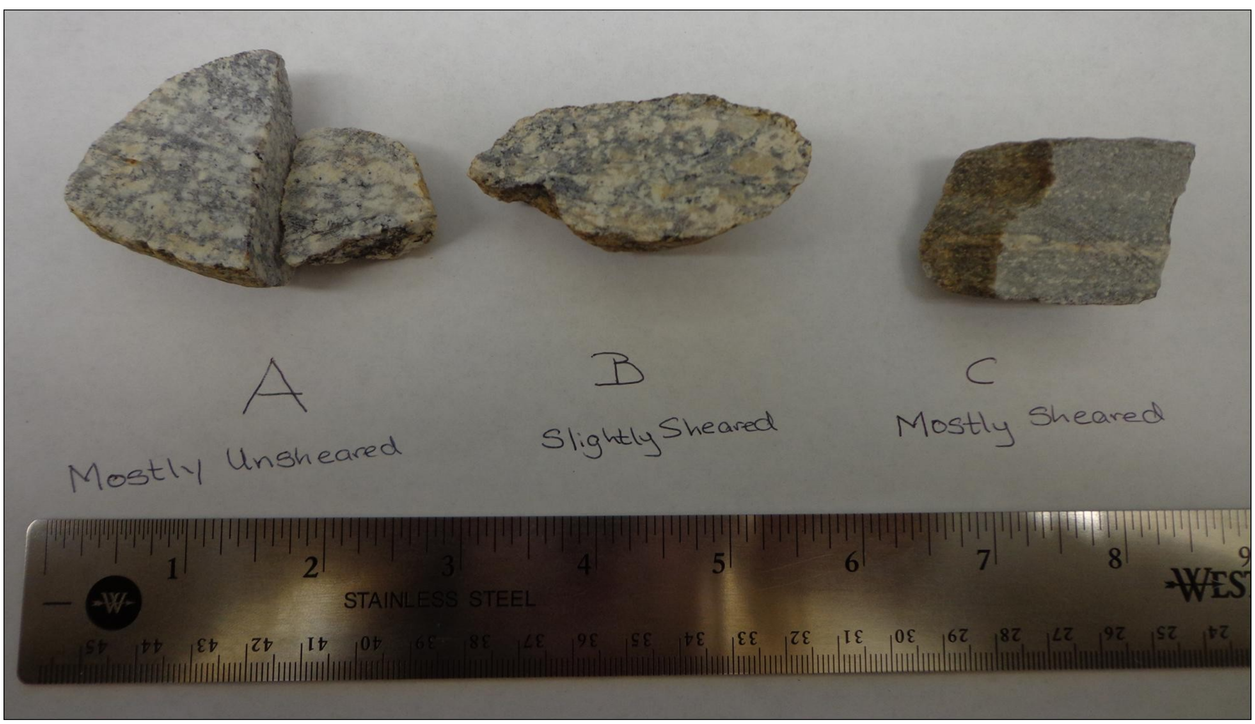
Section 2.3 GrainAnalysis software:

A statistical program was used to determine the true nature of the peaks observed in the Mastersizer analysis. That is to say, the peaks present in the Mastersizer results, are either the true peaks of the sample, or are created by multiple peaks combining to show the resulting peaks. This statistical analysis was done with the program, Sediment Grain Size Analysis System, or GrainAnalysis. Developed by Professor Xiaoguang Qin, (Xiao et.al., 2005), this program inputs the data from the Mastersizer program using an excel spreadsheet, and analyses and determines how many modes are present in the sample, and at what grain size they are located. The program allows you to personally select how many modes you believe are present, and pinpoint the potential location directly on a graph of the sample. Once this is done, the program will run the sample, and return the actual number of the modes, and were they are (fig 4.1). This is done using the mathematical model outlined in Appendix A of Qin 2005. The program also outputs the median size (the mode), the variance, and the content (percent of the sample in that size) for each mode selected. It will also give the error. The final set of numbers is the set with the lowest error. Therefore, any sample with a content values lower then the error, or which came back as "0", was ignored as a false peak. The values for the median sizes or modes were displayed on an excel spreadsheet by the program, and it was these numbers that were used to determine the commonality of mode values across the samples.

Section 2.4 Whole Rock Crushing Experiments:

To investigate if the mode distribution seen in the sediments was created by the grinding action of a glacier on whole rocks, we decided to manually create a sample of fine grained material from rocks analogous to the parent rocks of the naturally deposited fine grained material. For this, three rocks were collected from the area behind Stony Brook University. These rocks were all differently sheared, appeared to be granitic gneisses, and randomly picked. One showed a slightly sheared texture, another, a moderately sheared texture, and the third was mostly sheared. These rocks are believed to have been transported and deposited during the last glacial advance, and are similar to the Stony Creek granite, the presumed parent rock of some of the pebbly-loessic, and glacial sediments.

For the whole rock grinding experiment, four different rock crushing procedures were used to convert the whole rocks into “artificial sediments”. We first either broke or cut sections off of each rock (labeled rock A, rock B, and rock C) (figure 2.3). These sections were first weighed and then crushed by various methods. These methods were designed to try and mimic the effects of glacial action on these rocks. Four sets of samples of each of the three rocks was produced, and four separate crushing regimens were used. Please see figure 2.4 for images of the apparatuses used. For the first set, the sections of rocks were crushed by hand in a metal mortar and pestle. This produced chunky gravel. The second set utilized the metal mortar and pestle as with the first, but also included a secondary grinding by hand, in a ceramic mortar and pestle. The third set included both of the previous grinding methods, but the sample was subsequently placed in an agate shatterbox to pulverize the sample. The shatterbox consists of an agate grinding mill, in which the sample is placed, along with a agate puck. The mill is then placed in the shatterbox apparatus. The shatterbox shakes, which then grinds the sample. Each rock sample (rock A, B, and C), was processed this way for approximately two minutes. This produced very fine-grained material. For the fourth set, the crushing process preformed was a grinding process first by hand with the metal mortar and pestle, then with the agate mortar and pestle. After this, the sample was placed in a metal grinding mill. This grinding mill was run for 30 seconds, and the grinding plates were opened by two turns from the tightest setting. Each rock sample (rock A, B, and C), was processed this way for approximately two minutes. After each grinding regime set was completed, all samples were dried and hand sieved though a 1mm sieve to remove any coarser fraction before being analyzed by the Mastersizer.



(Fig 2.3) The three specimens of granite gneisses collected on the Stony Brook campus, used for whole rock grinding analysis.

(Fig 2.4)

(Top Left) The metal mortar and pestle used for the four grinding regimes.

(Top Right) The agate mill utilized for the third grinding process.

(Bottom Right) The Shatterbox apparatus that the agate mill is placed into for shaking.

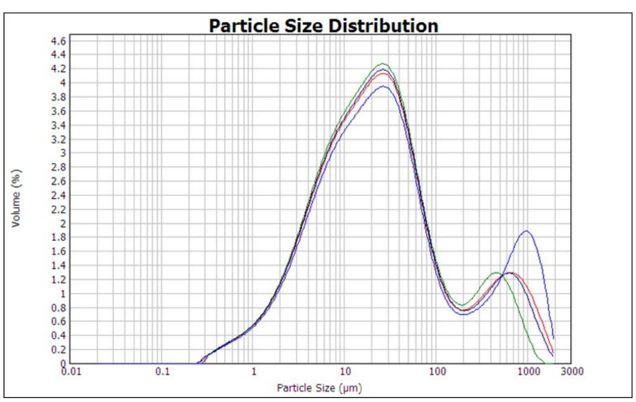
(Bottom Left) Grinding Mill used for the fourth process.

Section 3 Results:

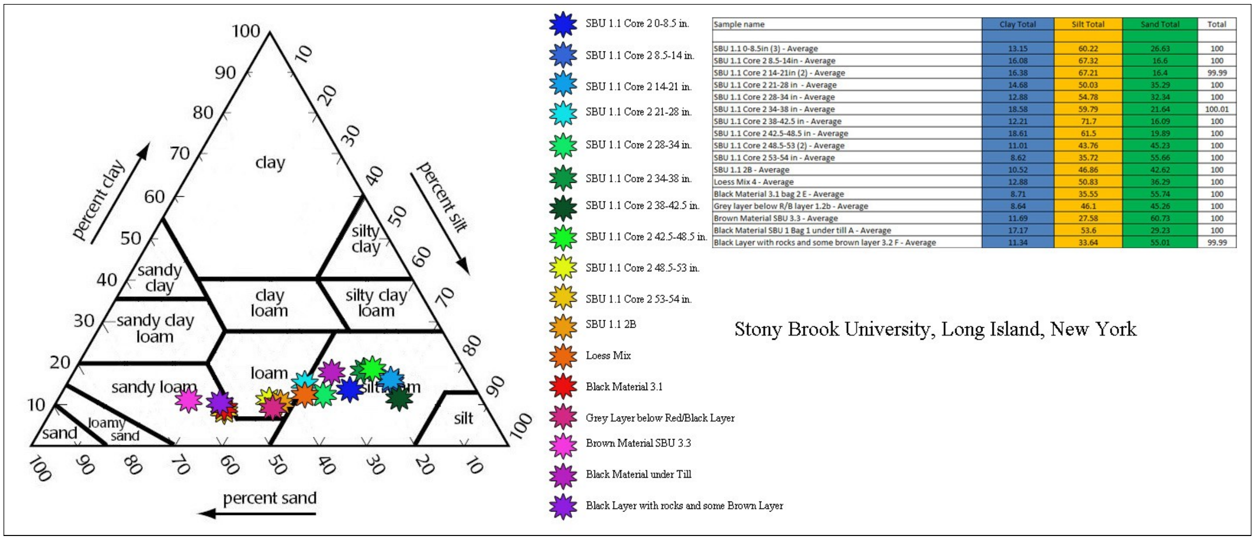
After analysis with the Malvern Mastersizer, polymodial peaks were visible in every sample, with the majority of samples containing modes around 20µm, 100µm, and 400µm. These results were then processed by the GrainAnalysis program, to better refine the appropriate mode grain size. Some samples with large peaks actually contain two closely spaced peaks, that seem to combine to show only one peak. This program clarifies the number and location of modes. For each run, an error is established, and for our results, content percents lower then the error percent, or content percents at “0” were ignored. Based on this, final mode values for each sample were taken from the GrainAnalysis data, as opposed to the visual Mastersizer data. Only the average values of the runs from the Mastersizer data was used for analysis with the GrainAnalysis program. The data from the Mastersizer program was utilized to create the ternary diagram plots.

Section 3.1 Stony Brook University results:

Most of the sediments at the Stony Brook location were pebbly-loss, with a few till samples. Based on the Mastersizer data, almost all of the samples from the pebbly-loess deposit show modes at about 30µm-50µm and 400µm-700µm. Some of these samples also show clay size modes. According to the GrainAnalysis program, the pebbly-loess samples seem to all have modes at around 0.93µm-10µm, 30µm-



(Fig 3.1a) Histogram of a Stony Brook University sample of pebbly-loess SBU 1.1 Core 2 0”-8.5” with modes at about 8µm, 25µm, and 200µm.



Sample name	Clay Total	Silt Total	Sand Total	Total
SBU 1.1 0-8.5in (3) - Average	13.15	60.22	26.63	100
SBU 1.1 Core 2 8.5-14in - Average	16.08	67.32	16.6	100
SBU 1.1 Core 2 14-21in (2) - Average	16.38	67.21	16.4	99.99
SBU 1.1 Core 2 21-28 in - Average	14.68	50.03	35.29	100
SBU 1.1 Core 2 28-34 in - Average	12.88	54.78	32.34	100
SBU 1.1 Core 2 34-38 in - Average	18.58	59.79	21.64	100.01
SBU 1.1 Core 2 38-42.5 in - Average	12.21	71.7	16.09	100
SBU 1.1 Core 2 42.5-48.5 in - Average	18.61	61.5	19.89	100
SBU 1.1 Core 2 48.5-53 (2) - Average	11.01	43.76	45.23	100
SBU 1.1 Core 2 53-54 in - Average	8.62	35.72	55.66	100
SBU 1.1 2B - Average	10.52	46.86	42.62	100
Loess Mix 4 - Average	12.88	50.83	36.29	100
Black Material 3.1 bag 2 E - Average	8.71	35.55	55.74	100
Grey layer below R/B layer 1.2b - Average	8.64	46.1	45.26	100
Brown Material SBU 3.3 - Average	11.69	27.58	60.73	100
Black Material SBU 1 Bag 1 under till A - Average	17.17	53.6	29.23	100
Black Layer with rocks and some brown layer 3.2 F - Average	11.34	33.64	55.01	99.99

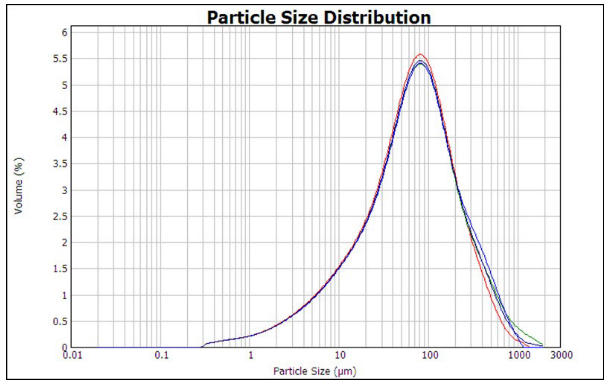
(Fig 3.1b) ternary diagram for pebbly-loess ("SBU 1.1 Core 2 0-8.5in." through "Loess mix") and till samples ("Black Material" through "Black Material with rocks and some Brown Layer") from Stony Brook University. Included is the total clay0silt0sand ratios for each sample used to create the graph, taken from the Mastersizer data.

50µm, and 400µm-700µm. These sizes are consistent with fine windblown silts and sands, with some small amounts of clays.

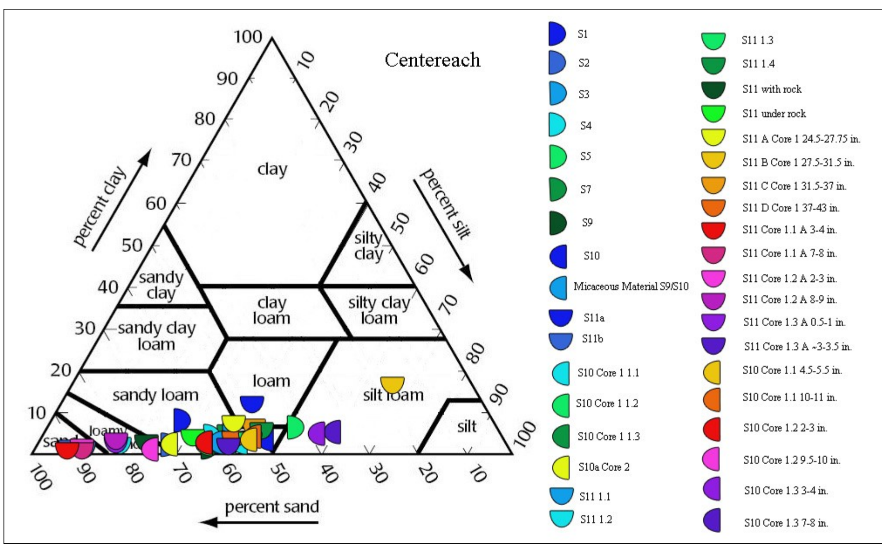
The underlying glacial samples also show modes at approximately 10µm-14µm and 400µm-500µm, with a sample including an additional mode at 60µm (Till from Stony Brook 3.3 Brown Material). According to the GrainAnalysis program, the till had modes around 10µm -20µm, 50µm-60µm, and between 400µm-600µm. This gave the total common modes for the Stony Brook location to be <2.00µm, 2µm-10µm, 30µm-50µm, and 400µm-500µm from data from the GrainAnalysis program. Figure 3.1b is a ternary diagram showing the clay-silt-sand ratios for the samples from Stony Brook. This shows that the samples are mostly silty loams, and a few sandy loams.

<u>Section 3.2 Centereach results:</u>

Similar to the Stony Brook University location, a pattern of modes at about 30µm, 80µm -100µm, and 400µm are repeated in our Centereach samples, in the Mastersizer results. Unlike the Stony Brook University location however, multiple samples from Centereach display only one peak in the Mastersizer data, around 80µm (fig 3.2a), however, one sample (S11 1.1 12”-13.5”) displays a single peak at 400µm, again, based on the Mastersizer data. Like some of the other samples, analysis with the GrainAnalysis shows that this sample actually contains duel peaks creating the seemly single mode at 400µm. According to the GrainAnalysis program, this sample actually contains a mode at 1.7µm, 99.7µm, and two peaks at 352.37µm and 474.98µm (fig 4.1). Some samples from this location also shows peaks in the clay size range (under 2µm). Sample S11 A Core 1 24.5”-27.75” displays grain-size peaks in the clay, silt, and sand sizes at, 0.5µm, 17µm, 55µm, and 400µm, which according the GrainAnalysis program, actually only has peaks at 35.04µm, 87.75µm, and 453.66µm. The discrepancy between the two peaks can be due to the combination of the peaks at 35.04µm and 87.75µm, appearing as peaks at 17µm and 55µm. The sediment at the Cen-



(Fig 3.2a) Histogram of glacial sandy silt from Centereach, with a mode around 80µm. Sample S3



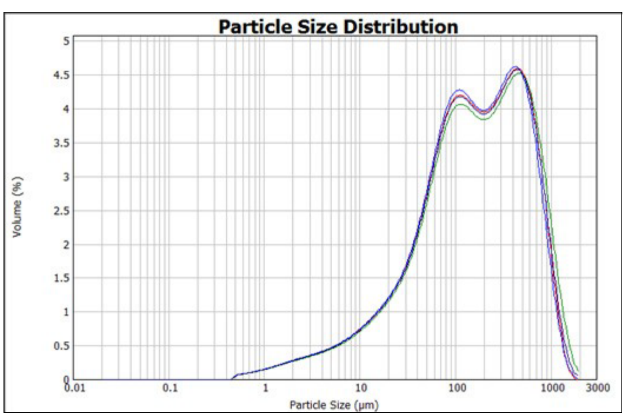
Sample name	Clay Total	Silt Total	Sand Total	Total
Selden 1 - Average	8.32	26.5	65.19	100.01
Selden 2 - Average	3.45	25.75	70.8	100
Selden 3 - Average	4.92	39.22	55.87	100.01
Selden 4 - Average	4.48	35.25	60.27	100
Selden 5 - Average	7.5	50.96	41.54	100
Selden 7 - Average	4.77	37.56	57.67	100
Selden 9 - Average	2.33	34.91	62.76	100
S 10 - Average	3.59	47.09	49.32	100
Micaeous material S9/S10 - Average	2.88	37.07	60.04	99.99
Selden 11a - Average	12.31	39.84	47.84	99.99
Selden 11b - Average	2.35	6.9	90.75	100
S10 Core 1 1.1 - Average	2.94	41.79	55.28	100.01
S10 Core 1 1.2 - Average	1.95	34.46	63.6	100.01
S10 Core 1 1.3 - Average	3.67	39.44	56.88	99.99
S10a Core 2 - Average	1.98	26.54	71.48	100
S11 1.1 - Average	2.27	9.95	87.78	100
S11 1.2 - Average	3.25	16.66	80.08	99.99
S11 1.3 - Average	4.41	42.96	52.63	100
S11 1.4 - Average	5.75	45.2	49.05	100
S11 with rock - Average	3.19	22.32	74.49	100
S11 under rock - Average	4.51	31.16	64.33	100
S11 A Core 1 24.5-27.75 in - Average	7.84	38.46	53.71	100.01
S11 B Core 1 27.5-31.5 in - Average	16.55	66.62	16.83	100
S11 C Core 1 31.5-37 in - Average	6.05	43.3	50.65	100
S11 D Core 1 37-43 in - Average	4.32	40.79	54.89	100
S11 Core 1.1 A 3-4" - Average"	2.28	6.53	91.18	99.99
S11 core 1.1 A 7-8" - Average"	2.64	9.78	87.58	100
S11 Core 1.2 A 2-3" - Average"	2.81	10.92	86.27	100
S11 Core 1.2 A 8-9" - Average"	4.06	15.45	80.5	100.01
S11 Core 1.3 A 0.5-1' - Average"	2.98	14.45	82.57	100
S11 Core 1.3 A ~3-3.5" - Average"	2.58	40.48	56.94	100
S10 Core 1.1 4.5-5.5" - Average"	3.79	42.98	53.23	100
S10 Core 1.1 10-11" - Average"	4.55	43.79	51.66	100
S10 Core 1.2 2-3" - Average"	2.38	35.29	62.34	100.01
S10 Core 1.2 9.5-10" - Average"	1.55	23.88	74.58	100.01
S10 Core 1.3 3-4" - Average"	5.28	56.65	38.06	99.99
S10 Core 1.3 7-8" - Average"	5.56	59.5	34.94	100

(Fig 3.2b) Ternary diagrams for the Centereach location, containing mostly glacial sands and silts.

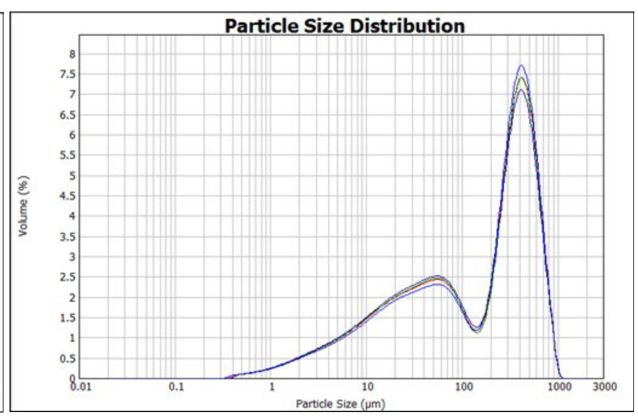
tereach location was mostly glacial sands and silts. The most common modes at this location based on the GrainAnalysis data, were 2µm-30µm, 80µm-200µm, and 400µm-500µm. Based on a ternary diagram (fig 3.2b), most of these samples seem to be high in the sand component, with a mostly low to moderate silt component, with most of the samples between sand, loamy sand, sandy loam, and loam, with just a few corresponding to silt loams.

Section 3.3 Caumsett State Park results:

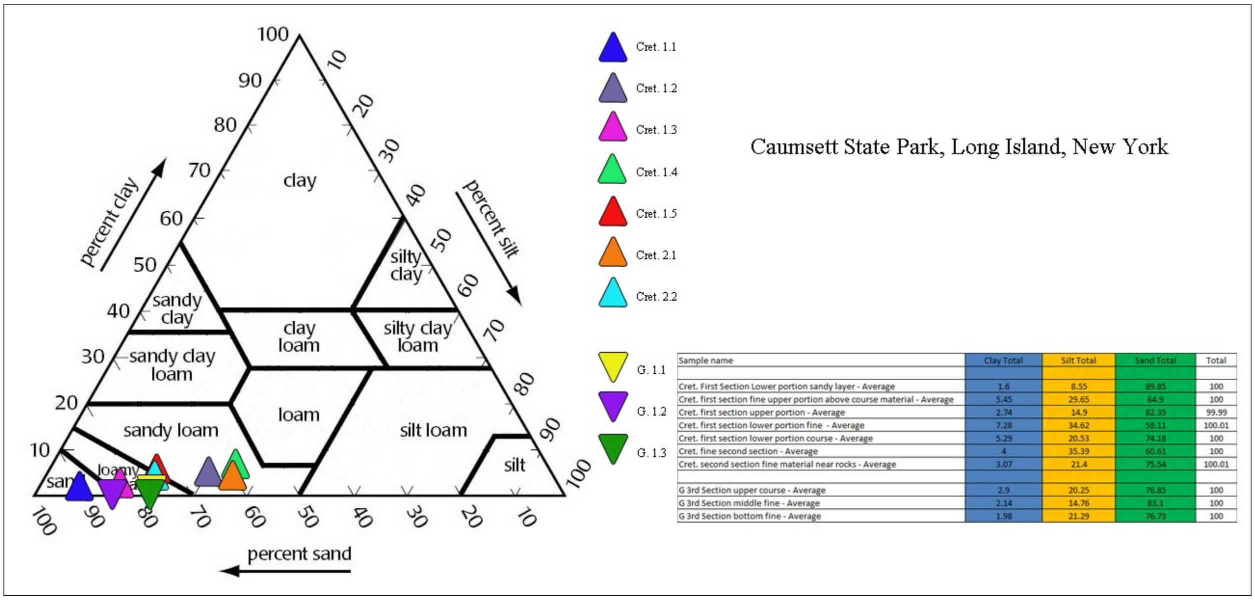
Based on the Mastersizer data, our three glacial samples show two modes in each sample, one at 100µm and 400µm, the second at 125µm and 500µm, and the third at 80µm and 400µm. These modes are in agreement with the GrainAnalysis data, which shows modes between 100µm-200µm, and 400µm-600µm being common modes between these three glacial samples. According to the Mastersizer data, the Cretaceous samples had at least two modes for each sample. Again, these peaks occurred around 20µm, 80µm, and 400µm. Sample Cret. 1.4 and Cret. 1.5 showed modes consistent with clay sized grains (7µm and 6µm respectively). Analysis with the GrainAnalysis program showed that these samples all had at least four modes. All but one sample had a mode between 2µm-10µm. The rest showed common modes at 10µm-30µm, 80µm-90µm, 300µm-500µm, or 600µm-700µm. According to the GrainAnalysis pro-



(Fig 3.3a) Histogram of glacial sand from Caumsett State Park, sample G 1.1 with modes at 100µm and 400µm.



(Fig 3.3b) Histogram of Cretaceous silty sand from Caumsett State Park, sample Cret. 1.2 with peaks around 20µm, 60µm and 300µm.



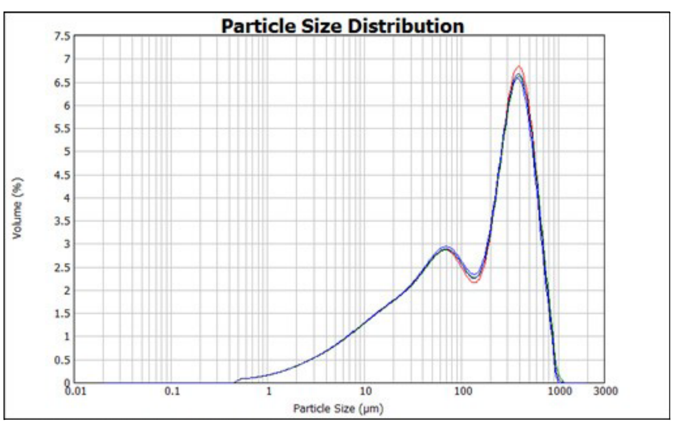
Sample name	Clay Total	Silt Total	Sand Total	Total
Cret. First Section Lower portion sandy layer - Average	1.6	8.55	89.85	100
Cret. first section fine upper portion above course material - Average	5.45	29.65	64.9	100
Cret. first section upper portion - Average	2.74	14.9	82.35	99.99
Cret. first section lower portion fine - Average	7.28	34.62	58.11	100.01
Cret. first section lower portion course - Average	5.29	20.53	74.18	100
Cret. fine second section - Average	4	35.39	60.61	100
Cret. second section fine material near rocks - Average	3.07	21.4	75.54	100.01
G 3rd Section upper course - Average	2.9	20.25	76.85	100
G 3rd Section middle fine - Average	2.14	14.76	83.1	100
G 3rd Section bottom fine - Average	1.98	21.29	76.73	100

(Fig 3.3c) Ternary diagram showing Cretaceous and Glacial sediments from Caumsett State Park.

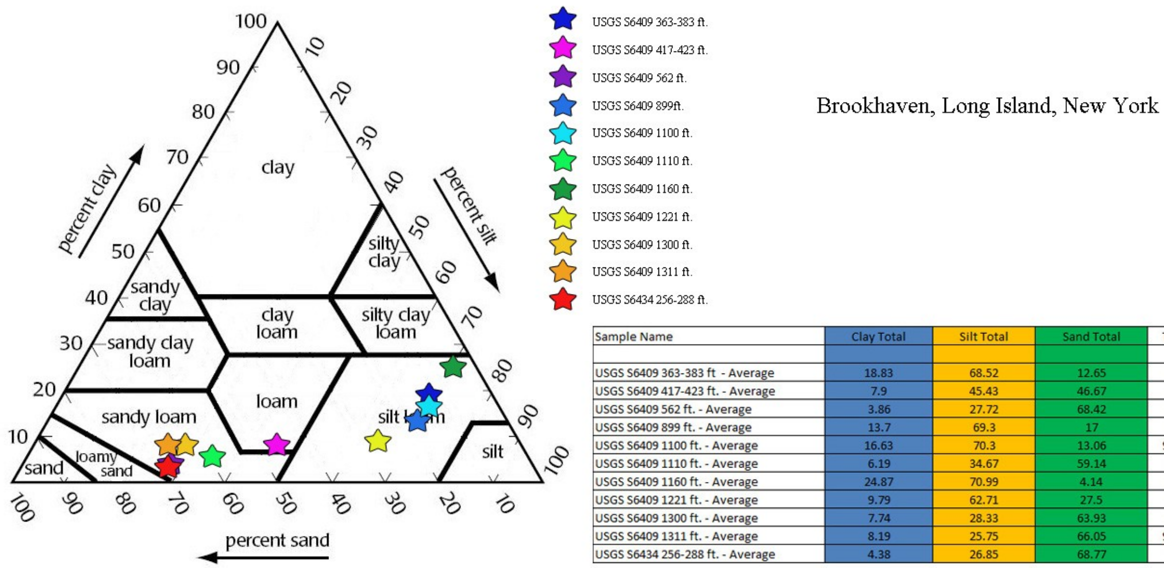
gram, the common modes are 2µm-10µm, 10µm-30µm, 80µm-90µm, 90µm-100µm, and 300µm -700µm. As would be expected, a ternary diagram of the Caumsett materials show all Caumsett samples, Cretaceous and Glacial, to be high in sand, and low in silt.

<u>Section 3.4 Brookhaven Sediment results (above the bedrock):</u>

Our Brookhaven samples came from four different geologic layers. The upper most samples came from the Magothy sands. These samples show common modes in the silt range about 2µm-20µm, 80µm-90µm, and some possibly in the sand range at 100µm-200µm, and 300µm-400µm. The next deepest layer, the Raritan, shows peaks in the silt and sand sizes, with multiple samples showing a peak closer to the very fine silt size range (2µm-10µm). The Lloyd sand



(Fig 3.4a) Histogram of Magothy sand from Brookhaven Core S6409 562 ft., with modes at 70µm and 400µm.



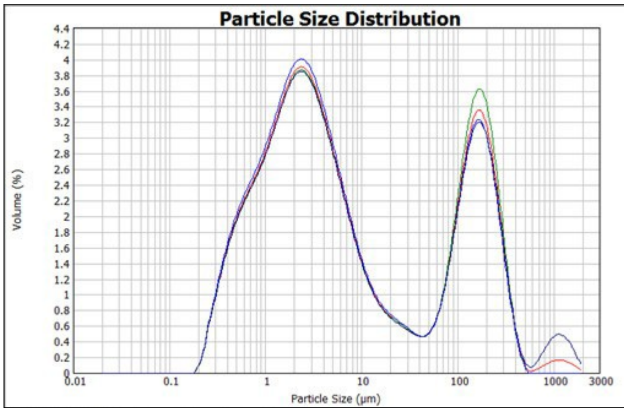
Sample Name	Clay Total	Silt Total	Sand Total	Total
USGS S6409 363-383 ft - Average	18.83	68.52	12.65	100
USGS S6409 417-423 ft. - Average	7.9	45.43	46.67	100
USGS S6409 562 ft. - Average	3.86	27.72	68.42	100
USGS S6409 899 ft. - Average	13.7	69.3	17	100
USGS S6409 1100 ft. - Average	16.63	70.3	13.06	99.99
USGS S6409 1110 ft. - Average	6.19	34.67	59.14	100
USGS S6409 1160 ft. - Average	24.87	70.99	4.14	100
USGS S6409 1221 ft. - Average	9.79	62.71	27.5	100
USGS S6409 1300 ft. - Average	7.74	28.33	63.93	100
USGS S6409 1311 ft. - Average	8.19	25.75	66.05	99.99
USGS S6434 256-288 ft. - Average	4.38	26.85	68.77	100

(Fig 3.4b) Ternary diagram showing the proportions for the Brookhaven sediments above the bedrock.

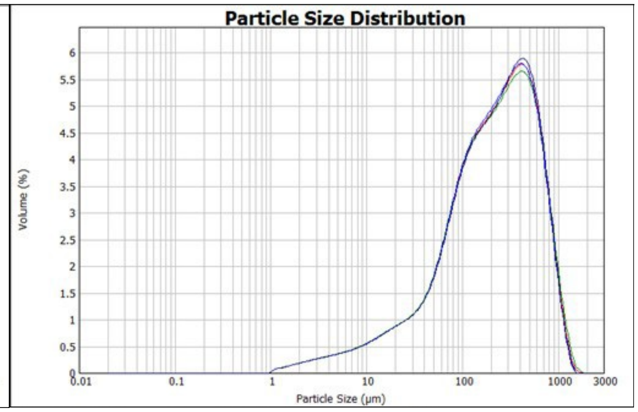
member, mostly had peaks around <2µm, and 2µm-20µm, and 600µm-700µm. Samples S6409 1160 ft., and 1300 ft. display peaks closer to the clay size range (9µm and 7µm respectively) in the Mastersizer data. The modes common to the Brookhaven samples based on data from the GrainAnalysis program are <2µm, 2µm-20µm, 80µm-90µm, 100µm-200µm, and 600µm-700µm. As one can see, modes that may be common in most samples may not be a common modes for one individual set of samples, i.e. Raritan. We had two Raritan samples, but only showed one common mode between the two. Modes higher in grain size were similar to surrounding samples, and thus would factor into the common modes of the Brookhaven samples. After analysis with a ternary diagram, five of the samples seem to be in the silt loam range, and the rest seem to be sandy loam, or loam.

Section 3.5 Brookhaven Weathered Bedrock:

The Mastersizer results showed a wide range of modes for the Brookhaven bedrock samples. Five samples showed modes around 0.5µm, seven were between 9µm-19µm, five were

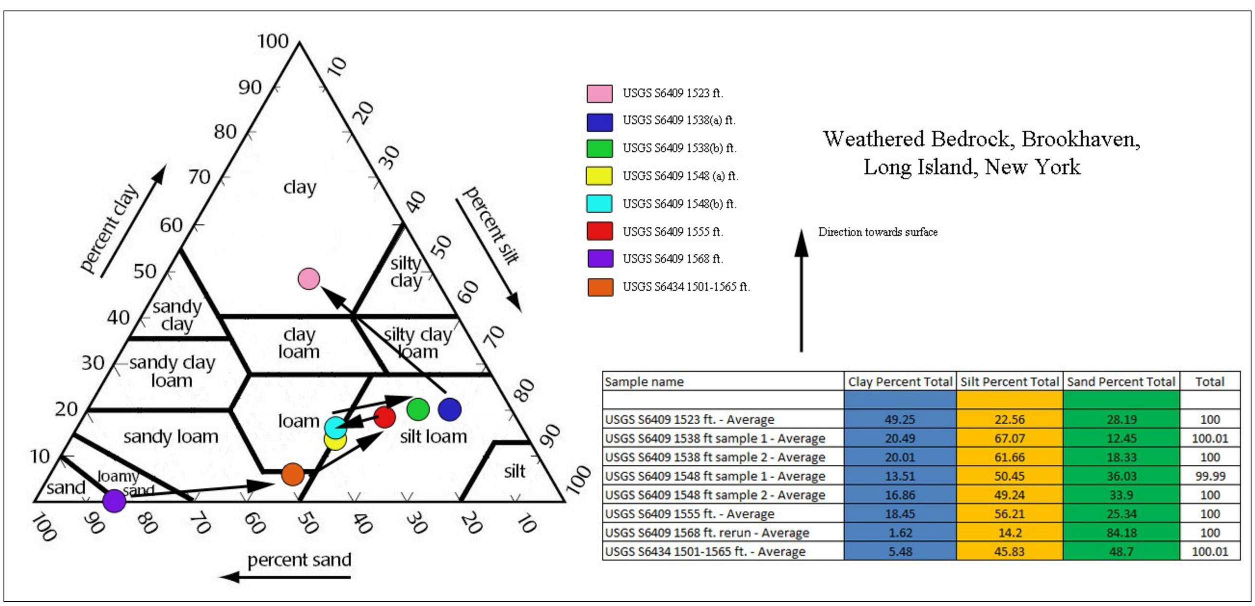


(Fig 3.5a) *Histogram of Weathered Bedrock clay from Brookhaven Core S6409 1523 ft., with modes at 0.5µm, 2.5µm, 175µm, and 1000µm. This sample had our highest amount of clay content, at about 50%.*



(Fig 3.5b) *Histogram of Weathered Bedrock sandy clay from Brookhaven Core S6409 1568 ft., with modes at possibly 17µm, 150µm, and 400µm. This is our deepest core sample, and shows the highest percentage of sand at 49%.*

around 60µm, and all but one had a mode above 400µm. From the GrainAnalysis, the Bedrock samples seem to range mostly in the 2µm-20µm range, with some modes 70µm-80µm, 100µm-200µm, and 600µm-700µm. In light of the GrainAnalysis data, over half of the weathered samples from Brookhaven seem to contain modes around <2µm. Plotting of the weathered bedrock on a ternary diagram (fig 3.5c) showed that one sample, the shallowest sample, was predomi-



Sample name	Clay Percent Total	Silt Percent Total	Sand Percent Total	Total
USGS S6409 1523 ft. - Average	49.25	22.56	28.19	100
USGS S6409 1538 ft sample 1 - Average	20.49	67.07	12.45	100.01
USGS S6409 1538 ft sample 2 - Average	20.01	61.66	18.33	100
USGS S6409 1548 ft sample 1 - Average	13.51	50.45	36.03	99.99
USGS S6409 1548 ft sample 2 - Average	16.86	49.24	33.9	100
USGS S6409 1555 ft. - Average	18.45	56.21	25.34	100
USGS S6409 1568 ft. rerun - Average	1.62	14.2	84.18	100
USGS S6434 1501-1565 ft. - Average	5.48	45.83	48.7	100.01

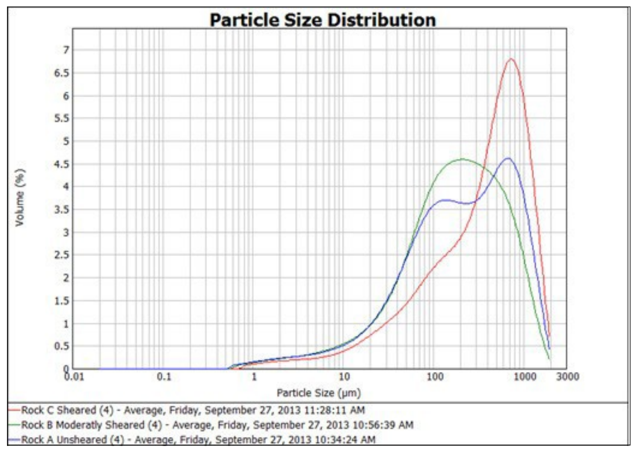
(Fig 3.5c) Ternary diagram showing the weathered bedrock samples from Brookhaven.

nantly clay. The rest of the weathered bedrock samples in this study showed an overall trend towards silt and clay size grains, as the samples got shallower (as shown by the arrows).

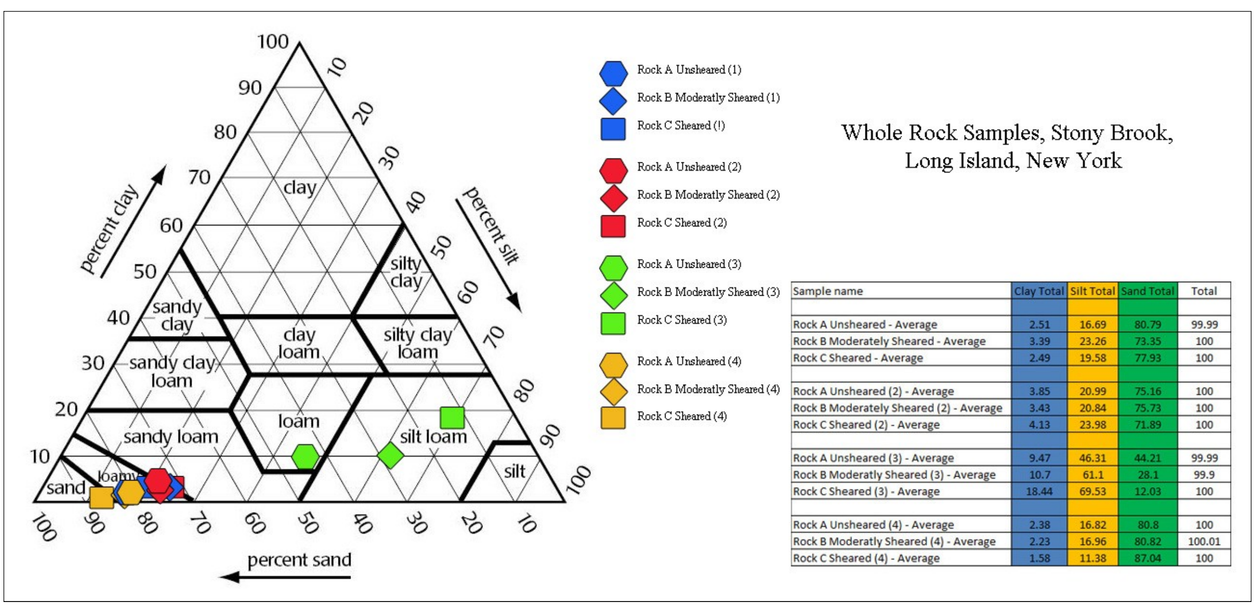
A microscopic analysis of a thin section of a similar granite to the weathered bedrock was also examined under cross-polarized light. This analysis showed small intra-granular quartz grains, at about 30µm or less. This examination also showed that quartz domains existing in this rock, are also very small, again, under 100µm.

<u>Section 3.6 Whole Rock Grinding results:</u>

The Mastersizer modes from the grinding experiments were similar amongst each rock, for each separate grinding experiment. For example, for process 1, Rock A had modes at 100µm and 575µm, Rock B at 20µm, 125µm, and 600µm, and Rock C at 125µm, and 450µm. Please see figure A11 for a com-



(Fig 3.6a) Histogram of rocks A, B, and C, from Stony Brook after the fourth process regime.



Sample name	Clay Total	Silt Total	Sand Total	Total
Rock A Unsheared - Average	2.51	16.69	80.79	99.99
Rock B Moderately Sheared - Average	3.39	23.26	73.35	100
Rock C Sheared - Average	2.49	19.58	77.93	100
Rock A Unsheared (2) - Average	3.85	20.99	75.16	100
Rock B Moderately Sheared (2) - Average	3.43	20.84	75.73	100
Rock C Sheared (2) - Average	4.13	23.98	71.89	100
Rock A Unsheared (3) - Average	9.47	46.31	44.21	99.99
Rock B Moderatly Sheared (3) - Average	10.7	61.1	28.1	99.9
Rock C Sheared (3) - Average	18.44	69.53	12.03	100
Rock A Unsheared (4) - Average	2.38	16.82	80.8	100
Rock B Moderatly Sheared (4) - Average	2.23	16.96	80.82	100.01
Rock C Sheared (4) - Average	1.58	11.38	87.04	100

(Fig 3.6b) Ternary diagram showing the proportions of clay, silt, and sand for the whole rock crushing experiments.

plete list of Mastersizer modes. After analysis with the GrainAnalysis program, for all of the grinding processes, modes around 2µm-10µm, 20µm-30µm, and 100µm-200µm seem to be common throughout each grinding process.

(Fig 3.7) **Stony Brook University, Long Island, New York:**

Sample Name	Visual Type	Age	Location
Stony Brook University	—	—	—
SBU 1.1 Core 2 0-8.5in	Pebbly-Loess	Wisconsonian	40°54’52.0”N / 73°7’44.3”W
SBU 1.1 Core 2 8.5-14in	Pebbly-Loess	Wisconsonian	40°54’52.0”N / 73°7’44.3”W
SBU 1.1 Core 2 14-21in	Pebbly-Loess	Wisconsonian	40°54’52.0”N / 73°7’44.3”W
SBU 1.1 Core 2 21-28in	Pebbly-Loess	Wisconsonian	40°54’52.0”N / 73°7’44.3”W
SBU 1.1 Core 2 28-34in	Pebbly-Loess	Wisconsonian	40°54’52.0”N / 73°7’44.3”W
SBU 1.1 Core 2 34-38in	Pebbly-Loess	Wisconsonian	40°54’52.0”N / 73°7’44.3”W
SBU 1.1 Core 2 38-42.5in	Pebbly-Loess	Wisconsonian	40°54’52.0”N / 73°7’44.3”W
SBU 1.1 Core 2 42.5-48.5in	Pebbly-Loess	Wisconsonian	40°54’52.0”N / 73°7’44.3”W
SBU 1.1 Core 2 48.5-53in	Pebbly-Loess (Coarse)	Wisconsonian	40°54’52.0”N / 73°7’44.3”W
SBU 1.1 Core 2 53-54in	Pebbly-Loess (Coarse)	Wisconsonian	40°54’52.0”N / 73°7’44.3”W
SBU 1.1 2B	Silt	Wisconsonian	40°54’51.8”N / 73°7’44.2”W
SBU 3.1 Black Material	Till	Wisconsonian	40°54’51.8”N / 73°7’44.4”W
SBU 1.2 Grey layer	Sand/Clay	Wisconsonian	40°54’52.0”N / 73°7’44.3”W
SBU 3.3 Brown Layer	Till	Wisconsonian	40°54’51.8”N / 73°7’44.4”W
SBU 1 Black Material Under Till	Till	Wisconsonian	40°54’52.0”N / 73°7’44.3”W
SBU 3.2 Black layer with rocks and some brown layer	Till	Wisconsonian	40°54’51.8”N / 73°7’44.4”W

(Fig 3.8) **Stony Brook University Whole Rocks Samples:**

Sample Name	Metal Mortar	Ceramic Mortar	Shatterbox	Grinding Mill	Grain Size Modes (microns)
Stony Brook University	—	—	—	—	—
Process 1:	—	—	—	—	—
Rock A	X				100µm, 575µm
Rock B	X				20µm, 125µm, 600µm
Rock C	X				125µm, 450µm
Process 2:	—	—	—	—	—
Rock A	X	X			40µm, 350µm,
Rock B	X	X			17µm, 125µm, 800µm
Rock C	X	X			150µm (peak extends to ~500µm)
Process 3:	—	—	—	—	—
Rock A	X	X	X		2µm, 15µm, 85µm
Rock B	X	X	X		2µm, 7µm, 50µm
Rock C	X	X	X		2µm, 10µm, 35µm
Process 4:	—	—	—	—	—
Rock A	X	X		X	125µm, 650µm
Rock B	X	X		X	200µm
Rock C	X	X		X	100µm, 700µm

(Fig 3.9) **Centereach, Long Island, New York:**

Sample Name	Visual Type	Age	Location
Centereach	—	—	—
S 1	Sandy Silt	Wisconsonian	40°50’35.3”N / 73°4’35.6”W
S 2	Sandy Silt	Wisconsonian	40°50’39.2”N / 73°4’36.3”W
S 3	Sandy Silt	Wisconsonian	40°50’39.8”N / 73°4’36.0”W
S 4	Silt	Wisconsonian	40°50’40.3”N / 73°4’35.5”W
S 5	Silt	Wisconsonian	40°50’40.3”N / 73°4’35.5”W
S 7	Silt	Wisconsonian	40°50’40.1”N / 73°4’35.3”W
S 9	Silt	Wisconsonian	40°50’39.1”N / 73°4’35.4”W
S10	Silt	Wisconsonian	40°50’39.1”N / 73°4’35.4”W
S 11a	Sandy Silt	Wisconsonian	40°50’35.2”N / 73°4’35.5”W
S 11b	Pebbly Silt	Wisconsonian	40°50’35.2”N / 73°4’35.5”W
S10 Core 1 1.1	Silt	Wisconsonian	40°50’39.1”N / 73°4’35.4”W
S10 Core 1 1.2	Silt	Wisconsonian	40°50’39.1”N / 73°4’35.4”W
S10 Core 1 1.3	Silt	Wisconsonian	40°50’39.1”N / 73°4’35.4”W
S10a Core 2	Silt	Wisconsonian	40°50’38.5”N / 73°4’35.2”W
Micaceous material S9/S10	Silt	Wisconsonian	40°50’39.1”N / 73°4’35.4”W
S11 1.1	Sand	Wisconsonian	40°50’35.2”N / 73°4’35.5”W
S11 1.2	Sand	Wisconsonian	40°50’35.2”N / 73°4’35.5”W
S11 1.3	Silt	Wisconsonian	40°50’35.2”N / 73°4’35.5”W
S11 1.4	Sand	Wisconsonian	40°50’35.2”N / 73°4’35.5”W
S11 with rock	Sand	Wisconsonian	40°50’35.2”N / 73°4’35.5”W
S11 under rock	Sand	Wisconsonian	40°50’35.2”N / 73°4’35.5”W
S11 A Core 1 24.5-27.75 in	Sand	Wisconsonian	40°50’35.2”N / 73°4’35.5”W
S11 B Core 1 27.5-31.5 in	Sand	Wisconsonian	40°50’35.2”N / 73°4’35.5”W
S11 C Core 1 31.5-37 in	Pebbly Silt	Wisconsonian	40°50’35.2”N / 73°4’35.5”W
S11 D Core 1 37-43 in	Silty Sand	Wisconsonian	40°50’35.2”N / 73°4’35.5”W
S11 Core 1.1 A 3”-4”	Coarse Sand	Wisconsonian	40°50’35.2”N / 73°4’35.5”W
S11 Core 1.1 A 7”-8”	Coarse Sand	Wisconsonian	40°50’35.2”N / 73°4’35.5”W
S11 Core 1.2 A 2”-3”	Silt	Wisconsonian	40°50’35.2”N / 73°4’35.5”W
S11 Core 1.2 A 8”-9”	Silt	Wisconsonian	40°50’35.2”N / 73°4’35.5”W

Sample Name	Visual Type	Age	Location
Centereach	—	—	—
S11 Core 1.3 A 0.5”-1”	Coarse Sand	Wisconsonian	40°50’35.2”N / 73°4’35.5”W
S11 Core 1.3 A ~3”-3.5”	Silt w/ Mica	Wisconsonian	40°50’35.2”N / 73°4’35.5”W
S10 Core 1.1 4.5”-5.5”	Silt	Wisconsonian	40°50’39.1”N / 73°4’35.4”W
S10 Core 1.1 10”-11”	Silt	Wisconsonian	40°50’39.1”N / 73°4’35.4”W
S10 Core 1.2 2”-3”	Silt	Wisconsonian	40°50’39.1”N / 73°4’35.4”W
S10 Core 1.2 9.5”-10”	Sand	Wisconsonian	40°50’39.1”N / 73°4’35.4”W
S10 Core 1.3 3”-4”	Silt	Wisconsonian	40°50’39.1”N / 73°4’35.4”W
S10 Core 1.3 7”-8”	Silt	Wisconsonian	40°50’39.1”N / 73°4’35.4”W

(Fig 3.10) **Caumsett State Park, Long Island, New York:**

Sample Name	Visual Type	Age	Location
Caumsett State Park	—	—	—
Glacial third section upper coarse. G 1.1	Coarse Sand	Glacial	40°56’27.9”N / 73°28’30.8”W
Glacial third section middle fine. G 1.2	Sand	Glacial	40°56’27.9”N / 73°28’30.8”W
Glacial third section bottom fine. G 1.3	Fine Sand	Glacial	40°56’27.9”N / 73°28’30.8”W
Cret. first section lower portion sandy layer. Cret 1.1	Fine & Coarse Sand	Cretaceous	40°56’21.1”N / 73°28’13.7”W
Cret. first section fine upper portion above coarse material. Cret. 1.2	Fine Sand	Cretaceous	40°56’21.1”N / 73°28’13.7”W
Cret. first section upper portion. Cret. 1.3	Fine & coarse Sand	Cretaceous	40°56’21.1”N / 73°28’13.7”W
Cret. first section lower portion fine. Cret. 1.4	Fine Sand	Cretaceous	40°56’21.1”N / 73°28’13.7”W
Cret. first section lower portion coarse. Cret. 1.5	Coarse Sand	Cretaceous	40°56’21.1”N / 73°28’13.7”W
Cret. fine second section. Cret. 2.1	Fine Sand	Cretaceous	40°56’22.6”N / 73°28’18.6”W
Cret. second section fine material near rocks. Cret. 2.2	Fine Sand	Cretaceous	40°56’22.6”N / 73°28’18.6”W

(Fig 3.11) **Brookhaven, Long Island, New York, USGS Samples:**

Sample Name	Visual Type	Age	Location
Brookhaven USGS Core S6409	—	—	—
363-383 ft.	Silt	Magothy	N/A
417-423 ft.	Sand	Magothy	N/A
562 ft.	Sand	Magothy	N/A
899 ft.	Silt	Magothy	N/A
1100 ft.	Clay	Raritan	N/A
1110 ft.	Sandy Silt	Raritan	N/A
1160 ft.	Clay	Lloyd	N/A
1221 ft.	Silty Clay	Lloyd	N/A
1300 ft.	Sandy Silt	Lloyd	N/A
1311 ft.	Sandy Silt	Lloyd	N/A
1523 ft.	Clay	Weathered Bedrock	N/A
1538 ft. sample 1	Sandy Clay	Weathered Bedrock	N/A
1538 ft. sample 2	Sandy Clay	Weathered Bedrock	N/A
1548 ft. sample 1	Sandy Clay	Weathered Bedrock	N/A
1548 ft. sample 2	Sandy Clay	Weathered Bedrock	N/A
1555 ft.	Sandy Clay	Weathered Bedrock	N/A
1568 ft.	Weathered Clay	Weathered Bedrock	N/A
Core S6434	—	—	—
256-288 ft.	Sandy Silt	Magothy	N/A
1501-1565 ft.	Sandy Silt	Weathered Bedrock	N/A

(Fig 3.12) **Stony Brook GrainAnalysis mode values:**

Sample Name	Micron Sizes	Error
SBU 1.1 0-8.5in - Average	10.02, 41.51, 633.78	2.07
SBU 1.1 Core 2 8.5-14in - Average	0.93, 6.78, 37.07, 679	2.04
SBU 1.1 Core 2 14-21in - Average	0.93, 6.78, 39.27	1.37
SBU 1.1 Core 2 21-28 in - Average	5.27, 35.8, 491.85	1.20
SBU 1.1 Core 2 28-34 in - Average	1.1, 6.94, 43.05, 464.6	2.33
SBU 1.1 Core 2 34-38 in - Average	1.12, 5.84, 30.48, 423.08, 1246.42	1.84
SBU 1.1 Core 2 38-42.5 in - Average	1.1, 9.04, 37.93	1.69
SBU 1.1 Core 2 42.5-48.5 in - Average	1.12, 7.96, 48.87	2.25
SBU 1.1 Core 2 48.5-53 - Average	1.25,8.43, 48.29, 520.7	1.83
SBU 1.1 Core 2 53-54 in - Average	9.97, 51.13, 520.7	3.40
SBU 1.1 2B - Average	2.07, 9.67, 63.62, 464.2	1.75
Loess Mix 4 - Average	2.71, 26.9, 96.28, 491.42	1.19
Black Material 3.1 bag 2 E - Average	14.14, 58.09, 491.85	4.35
Grey layer below R/B layer 1.2b - Average	8.04, 54.87, 491.85	2.74
Brown Material SBU 3.3 - Average	9.58, 414.19	5.02
Black Material SBU 1 Bag 1 under till A - Average	12.9, 54.17, 532.79	2.00
Black Layer with rocks and some brown layer 3.2 F - Average	14.8, 428.52	4.29

(Fig 3.13) **Whole Rock Samples, GrainAnalysis mode values:**

Sample Name	Micron Sizes	Error
Rock A Unsheared - Average	3.65, 27.29, 180.54, 670.95	2.08
Rock B Moderately Sheared - Average	6.4, 31.97, 150.62, 743.7	1.54
Rock C Sheared - Average	5.71, 26.94, 154.12, 577.15	2.28
Rock A Unsheared (2) - Average	5.27, 23.51, 92.9, 404.44	3.78
Rock B Moderately Sheared (2) - Average	4.38, 24.79, 140.59, 852.86	1.21
Rock C Sheared (2) - Average	4.91, 20.86, 140.59, 497.31, 805.61	1.13
Rock A Unsheared (3) - Average	4.04, 25.38, 86.79, 143.73	2.42
Rock B Moderately Sheared (3) - Average	2.15, 12.03, 44.05, 68.98	2.35
Rock C Sheared (3) - Average	1.77, 14.97, 37.96, 60.76	2.26
Rock A Unsheared (4) - Average	9.42, 135.77, 508.87, 945.33	1.81
Rock B Moderately Sheared (4) - Average	8.72, 27.55, 101.93, 314.13, 795.38	1.25
Rock C Sheared (4) - Average	7.03, 42.47, 227.55, 825.04	3.12

(Fig 3.14) **Centereach, GrainAnalysis mode values:**

Sample Name	Micron Sizes	Error
Selden 1 - Average	2.96, 21.38, 264.53, 453.27	1.84
Selden 2 - Average	5.07, 15.12, 96.2, 390.57	2.33
Selden 3 - Average	8.15, 66.67, 102.02, 340,87	1.10
Selden 4 - Average	1.95, 11.87, 88.81, 479.85	2.39
Selden 5 - Average	1.21, 9.9, 49.37, 60.87, 604.28	1.95
Selden 7 - Average	2.17, 13.05, 84.82, 404.09	1.43
Selden 9 - Average	12.32, 97.35	2.68
S 10 - Average	14.63, 78.3	2.88
Micaceous material S9/S10 - Average	14.31, 99.61	3.26
Selden 11a - Average	6.4, 49.37, 364.56	3.66
Selden 11b - Average	18.94, 135.77, 395.25	1.75
S10 Core 1 1.1 - Average	16.96, 84.82, 479.85	1.78
S10 Core 1 1.2 - Average	17.92, 83.89	2.10
S10 Core 1 1.3 - Average	2.65, 16.59, 90.87, 480.68	1.07
S10a Core 2 - Average	21.34, 111.74, 491.85	2.43
S11 1.1 - Average	7.1, 99.7, 352.37, 474.98	1.69
S11 1.2 - Average	2.36, 10.82, 98.26, 453.66	1.71
S11 1.3 - Average	7.18, 23.39, 101.93, 453.27	1.30
S11 1.4 - Average	1.16, 18.62, 104.3, 198.43, 626.27	1.71
S11 with rock - Average	1.55, 18.42, 123.85, 453.27	1.74
S11 under rock - Average	35.04, 91.8, 497.31	1.51
S11 A Core 1 24.5-27.75 in - Average	35.04, 87.75, 453.66	2.49
S11 B Core 1 27.5-31.5 in - Average	0.59, 2.61, 18.62, 108, 404.44	0.96

(Fig 3.14) **Centereach, GrainAnalysis mode values:**

Sample Name	Micron Sizes	Error
S11 C Core 1 31.5-37 in - Average	1.53, 23.98, 97.27, 491.42	2.29
S11 D Core 1 37-43 in - Average	1.98, 19.06, 95.14	2.74
S11 Core 1.1 A 3-4" - Average"	9.33, 160.67, 443.36	3.90
S11 core 1.1 A 7-8" - Average"	5.58, 19.27, 185.21, 558.32	4.77
S11 Core 1.2 A 2-3" - Average"	6.4, 198.43	3.50
S11 Core 1.2 A 8-9" - Average"	6.33, 22.9, 128.25, 364.88	4.74
S11 Core 1.3 A 0.5-1' - Average"	26.22, 119.5	4.72
S11 Core 1.3 A ~3-3.5" - Average"	3.73, 26.29, 84.82, 584.57	1.72
S10 Core 1.1 4.5-5.5" - Average"	3.52, 17.59, 88.81, 744.34	1.74
S10 Core 1.1 10-11" - Average"	4.48, 18.2, 82.89, 508.87	1.60
S10 Core 1.2 2-3" - Average"	3.82, 20.4, 101.93, 647.39	1.26
S10 Core 1.2 9.5-10" - Average"	24.16, 101.93, 464.6	2.58
S10 Core 1.3 3-4" - Average"	3.04, 17.58, 75.68	2.05
S10 Core 1.3 7-8" - Average"	3.41, 17.58, 71.49	2.48

(Fig 3.15) **Caumsett State Park GrainAnalysis mode values:**

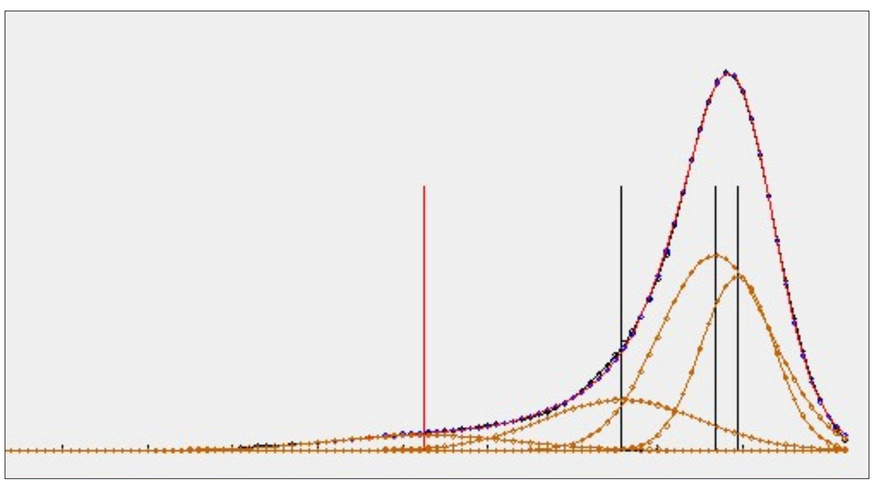
Sample Name	Micron Sizes	Error
G 3rd Section upper coarse. G 1.1 - Average	5.26, 32.65, 125.34, 502.84, 870.42	1.02
G 3rd Section middle fine. G 1.2 - Average	15.67, 94.98, 157.43, 486.02	2.93
G 3rd Section bottom fine. G 1.3 - Average	9.79, 34.22, 139.05, 508.87	2.01
Cret. First Section lower portion sandy layer. Cret. 1.1 - Average	16.97, 87.76, 409.28, 655.15	2.70
Cret. first section fine upper portion above coarse material. Cret. 1.2 - Average	4.59, 18.4, 67.41, 369.25, 603.76	2.29
Cret. first section upper portion. Cret. 1.3 - Average	5.08, 27.76, 81.01, 448.67, 685.36	2.57
Cret. first section lower portion fine. Cret. 1.4 - Average	1.73, 9.35, 50.52, 252.44, 382.03	1.80
Cret. first section lower portion coarse. Cret 1.5 - Average	7.79, 20.93, 122.49, 726.81	2.28
Cret. fine second section Cret. 2.1 - Average	7.6, 22.4, 84.82, 432.91	2.49
Cret. second section fine material near rocks. Cret. 2.2 - Average	5.27, 14.78, 55.43, 336.54, 519.8	2.16

(Fig 3.16) **Brookhaven USGS samples, GrainAnalysis mode values:**

Sample Name	Micron Sizes	Error
USGS S6409 363-383 ft - Average	1.68, 13.2, 187.59	1.36
USGS S6409 417-423 ft. - Average	3.24, 17.99, 84.82, 678.41	2.01
USGS S6409 562 ft. - Average	3.73, 17.79, 86.79, 336.54, 545.17	2.11
USGS S6409 899 ft. - Average	16.6, 89.56	2.48
USGS S6409 1100 ft. - Average	8.29, 13.2, 79.17	2.21
USGS S6409 1110 ft. - Average	9.35, 46.6, 280.05, 404.09	1.82
USGS S6409 1160 ft. - Average	0.85, 2.7, 10.25, 1013.64	1.64
USGS S6409 1221 ft. - Average	1.91, 17.59, 78.23, 687.14	0.97
USGS S6409 1300 ft. - Average	2.15, 10.83, 82.89, 508.87	1.84
USGS S6409 1311 ft. - Average	1.71, 11.47, 104.21, 670.37	2.48
USGS S6409 1523 ft. - Average	0.57, 2.7, 24.12, 181.01	2.47
USGS S6409 1538 ft sample 1 - Average	0.58, 2.33, 11.5, 55.43, 1074.01	1.51
USGS S6409 1538 ft sample 2 - Average	0.61, 2.65, 10.98, 47.72, 647.95	1.42
USGS S6409 1548 ft sample 1 - Average	2.41, 14.11, 71.43, 604.28	3.40
USGS S6409 1548 ft sample 2 - Average	1.08, 11.75, 78.23, 787.32	3.13
USGS S6409 1555 ft. - Average	0.76, 3.14, 13.2, 65.88, 339.7	1.30
USGS S6409 1568 ft. - Average	3.36, 24.81, 174.95, 453.66, 760.32	1.29
USGS S6434 256-288 ft. - Average	4.43, 31.24, 185.21, 307	1.95
USGS S6434 1501-1565 ft. - Average	4.18, 23.43, 85.69, 526.48	1.83

Section 4 Discussion:

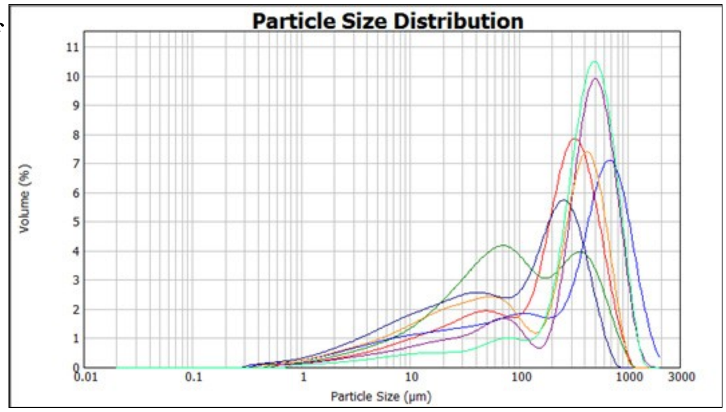
The purpose of this study is to investigate a common mode pattern seen in multiple sediment samples from Long Island, New York. Sediment samples were collected from a pebbly-loess and glacial deposit at Stony Brook University, a glacial deposit at Centereach, a glacial and Cretaceous deposit at Caumsett State Park, and from USGS cores collected at Brookhaven, Our samples were composed predominantly of quartz, and due to the high amount of organics, topsoil was not included in this study. These samples were first prepared, then analyzed by a Malvern Mastersizer 2000, which analyzed grain size modes, and produced polymodial grain size frequency curves for each sample. These samples were also analyzed for exact mode locations, by inputting the Mastersizer data into a statistical program entitled GrainAnalysis. This program returned the location (on a grain size scale), and number of modes found in each sample. The actual modes vary slightly between samples, but still generally occur around 10µm-20µm, 100µm-200µm, and 400µm-500µm. Not every sample analyzed displayed all three of these modes, however, every sample shows a peak at or near one or more of these modes.



(Fig 4.1). Sample S11 1.1 12"-13.5" after being analyzed by the GrainAnalysis program. The black curve is the original curve of the sample from the Mastersizer data, the red curve reflects the average created by the machine, and the yellow curves reflect the four true modes in this sample. The vertical lines delineate the center of the mode peaks.

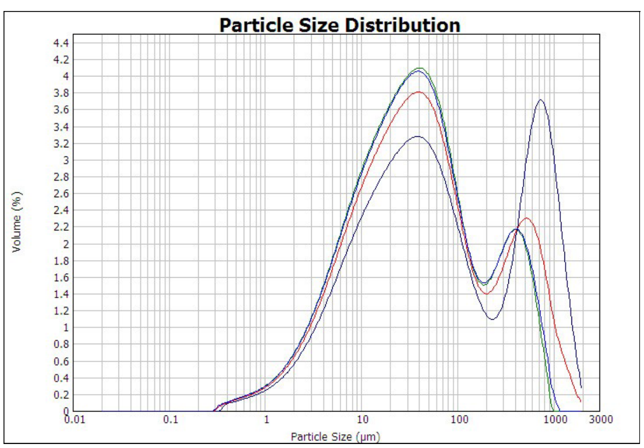
Since the GrainAnalaysis software

shows more precisely were the modes are, and how many modes are present in each sample, as opposed to a visual determination with the Mastersizer frequency curves, the mode ranges were determined by looking at the results of the GrainAnalysis program. The frequency curves provided by the Mastersizer may be broad (please see Whole Rock B, process 4. Fig A12d), or one mode may in fact be two modes combining to create one large peak (fig 4.1).



(Fig 4.2) Sample clustering seen in the Cretaceous samples from Caumsett State Park. This graph shows the average of every Cretaceous sample from Caumsett State Park, used in our study.

Many samples contain a peak between 1μm and 10μm, and this range may also be considered a mode, however, this possible mode is not greatly defined on logarithmic scales for obvious reasons. As these modes are common thought the samples collected, it should be stressed that not every sample contains everyone of these modes. These modes are also ranges, as the actual grain size mode peak for an individual sample displaying one of these common modes falls in this range. This grain size clustering can be seen in the cretaceous samples from Caumsett State Park, in figure 4.2. Additionally, it is also important to note that the graphs on the following pages that show the resulting data for an individual sample, (i.e. Fig 4.3), shows four lines. During analysis with the Mastersizer, the machine will take three measurements of each sample, then cre-



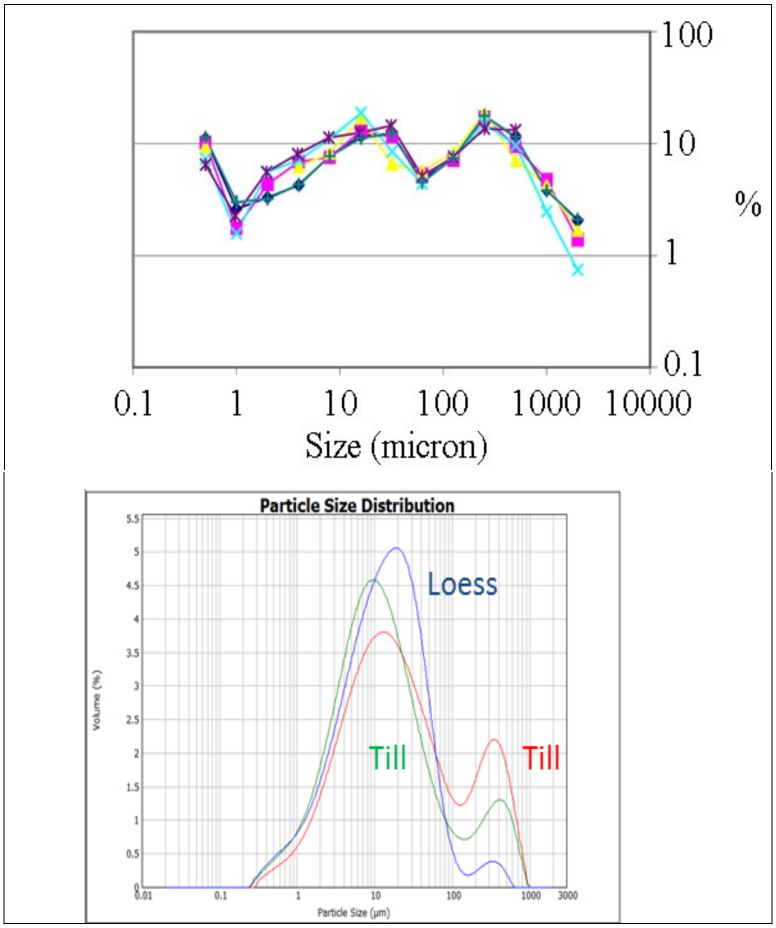
(Fig 4.3) Histogram of glacial silt from Centereach, sample S5 with modes around 40μm and 500μm. This histogram shows three runs of the sample, in blue, green, and black. The red line is the average.

ate an average. These four lines indicate each run, and the average. Every Mastersizer graph is displayed this way unless otherwise stated (i.e. Fig 4.4 and Fig 4.2 above). Figure A12a-12d of the whole rock samples uses the average of each whole rock (Rock A, Rock B, and Rock C) for each graph. The discrepancy between the three runs and the average in some samples could be due to particles becoming stuck during a run, an air bubble becoming introduced into the process, or an issue with the light scattering with the larger particles. The error associated with the Mastersizer is +/- 5% (Dias 2013, Sperazza et.al. 2004).

Section 4.1 Pebbly-Loess and Glacial Sediments:

Initial findings with the Mastersizer program showed that the pebbly-loess material and the underlying glacial till had similar modes. This can be seen in fig 4.3. Even though our pebbly-loess is not traditional loess, this finding would contradict the conventional view of loess formation. Traditional loess is characterized as fine windblown silt, predominantly composed of "quartz, feldspar, mica, clay minerals, and carbonate grains" (Pye 1987). Deposits of loess display a lack of bedding, and are usually dun in color (Pye 1987). According to Pye 1987, "*The grain-size distribution of 'typical' loess shows a pronounced mode in the range 20-40µm, and is positively skewed (i.e. towards the finer sizes). Typical loess often contains up to 10% fine sand (> 63µm), but in cases where the sand content exceeds 20% the term 'sandy loess' is appropriate. Up to 20% clay (< 4µm) is not unusual in typical loess; if the sediment contains more then 20% clay it can be described as clayey loess*". Unlike the classical definition of loess however, the pebbly-loess material we studied contained randomly dispersed pebbles, but still appeared as a thick deposit of fine, windblown silts and sands, with no distinct bedding. Mastersizer analysis of these samples showed a pattern of modes around <1µm, 20µm and 400µm (Fig. 4.4). The modes at 20µm and 400µm were assumed to be due to processes related to sorting by wind. The 400μm fraction would be a result of travel by saltation from proximal sources and the 20μm fraction would be a result of travel by suspension from more distal sources, which would be the case for a potential 1μm mode as well. This assumes that the source of a windblown sediment has a wide range of grain sizes and a well graded distribution of grain sizes from silt through sand. That is, each grain-size fraction has a near equal proportion of grains by weight or volume from the source. As we saw, that is not necessarily the case for the loess that we have studied.

Glacial samples also collected at Stony Brook University show similar grain size modes at 20μm and 400μm in Mastersizer data. This is also evident in the lower histogram in figure 4.3. Here, the pebbly-loess material is plotted on the same graph as two glacial till samples from the same site. Putting both figures together, one can see a definite correlation of 20μm and



(Fig 4.4) Histograms of grain-size for the less than 1 mm particles in loess and till found at one section on the Stony Brook University campus. The upper histogram is based on one phi fractions for 6 samples of loess determined using wet and dry sieving and settling tube pipette (Zhong, 2005). The loess has modes at 250 and 20 and less than one micron.

The lower histogram (Clare, 2012 personal communication) was determined using the Malvern Mastersizer 2000 for loess and till at the same site as that for the samples in the upper graph. Essentially the same three modes are shown in the loess and also in the underlying till at 10 to 20 microns, 400 microns, and a smaller clay mode at about 0.5 microns. Each line is the average of each run.

400μm modes, even when analysis is done with different methods. Clare 2013 utilized a standard Mastersizer analysis and Zhong 2005 utilized standard wet and dry sieving, as well as settling tube pipetting. As these are deposits which underwent separate, different processes, one would not expect to see similar modes between the two.

According to the results from the GrainAnalysis program, our Stony Brook University samples show that the pebbly-loess material has common modes at 2μm-10μm, 30μm-50μm, and 400μm-700μm. Our Till samples have modes at 10μm-20μm, 50μm-60μm, and 400μm-600μm. This mode range would be consistent with clays, silts, and sands in the pebbly-loess deposits, and fine silts to sands in the Till.

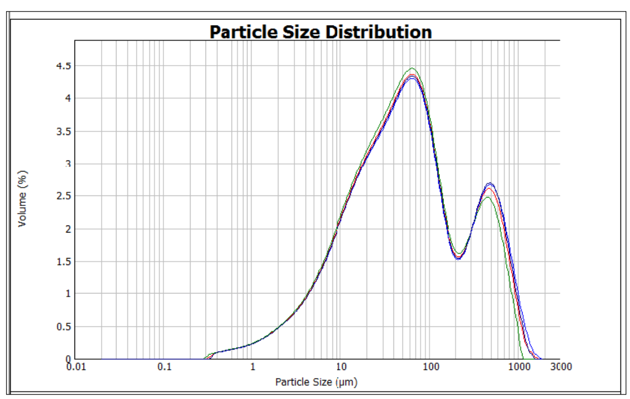
To test to see if the mode pattern in our Stony Brook glacial samples and pebbly-loess samples are consistent with other glacial deposits, glacial sands and silts from Centereach were collected and analyzed. This site is not well studied, and is located on the Ronkonkoma moraine, unlike the Stony Brook University site, which is located on the Harbor Hill moraine. The most common modes found in the Centereach samples are 2μm-30μm, 80μm-200μm, and 400μm-500μm.

It should be noted that in the Centereach sample chart (fig 3.9) samples "S11 Core 1.1 A 3"-4" though S10 Core 1.3 7"-8"" were collected from the split cores. The depth next to each sample name is the depth from the top of the core tube. As the Centereach results show, most of the sediments are high in sand, and low in clay and silt.

Section 4.2 Whole Rock Samples:

One hypothesis is that the modes were produced by the grinding action of the glacier, as these were glacial and fine silt materials. For this reason, we collected and tested the three granitic gneisses collected from the Stony Brook location. According to Kundich, 2005, XRF analysis of loess sediments from Wildwood State Park, Long Island, New York, which is a similar deposit to our Stony Brook University pebbly loess, showed that this material has a similar composition to granite (El-Taher 2012). Wildwood State Park is approximately 17 miles to the east of Stony Brook University, near Wading River. These rocks are believed to have been deposited by the glacier, and would therefore be a good representation of the parent rock of the pebbly-loessic material. These rocks were cut and processed as described in the methods section, in an attempt to mimic the grinding actions of a glacier. We believe that the fourth process was the closest grinding regime to glacial grinding, as it essentially grinded the samples against one another, with more force then human hands, and was not as efficient as the shatterbox. A pattern of modes at roughly 2μm-10μm, 20μm-30μm, and 100μm-200μm was common throughout each rock process. There was some spread of modes from 400μm to 900μm, although there was no common mode range at this size that was common for each whole rock sample. The exact size of the peaks seems to diminish through the different processes. For example, Rock A process 1, has a peak at 180.54μm. This becomes 143.73μm for the third process, and 135.77μm for the fourth process.

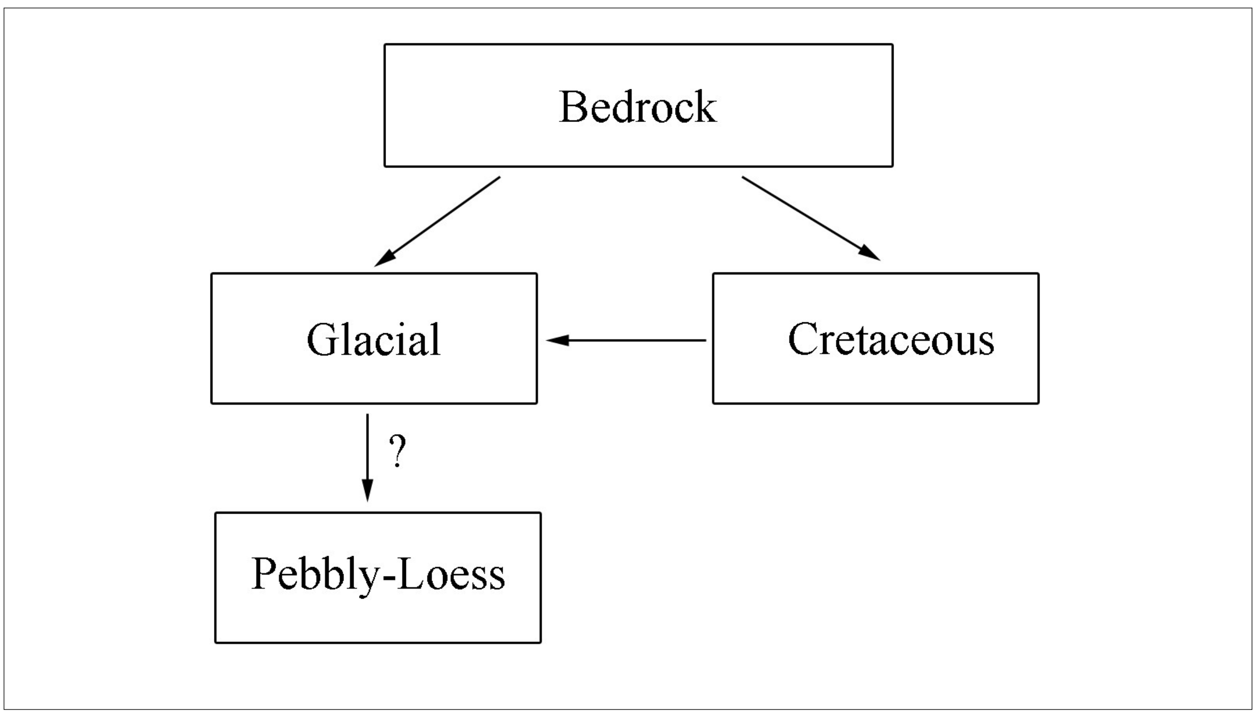
This would support the theory that the modes might either be produced by the grinding action of the glacier, or are potentially inherent in the rocks themselves. This lead us to wonder if modes were already present in the bedrock, before any processing could affect the grain size. Fig 4.6 is a cartoon schematic, showing generally, the perceived process of



*(Fig 4.5) Histogram of the product of weathered granite from USGS core S6409 at a depth of 1501 to 1565 feet which shows the same three modes at about 20*μm*, 65*μm, *and 500*μm.

sediment generation. Sediment from the bedrock may have been reworked and deposited as Cretaceous sediment. This Cretaceous sediment could have been reworked by the glacier, and redeposited as glacial material. Subsequently, the glacial material may also be reworded bedrock, as outcrops of bedrock are present at the surface in some areas. The pebbly loess was deposited sometime after the glacier retreated, and as its origins are not yet fully determined, it is plausible that the pebbly-loess material could be redeposited glacial material.

Additionally, an analysis of grain-size in bedrock, utilizing bedrock similar to what may have been the parent bedrock of our sediments, was done.



(Fig 4.6) A general cartoon schematic showing the potential sediment deposit flow.

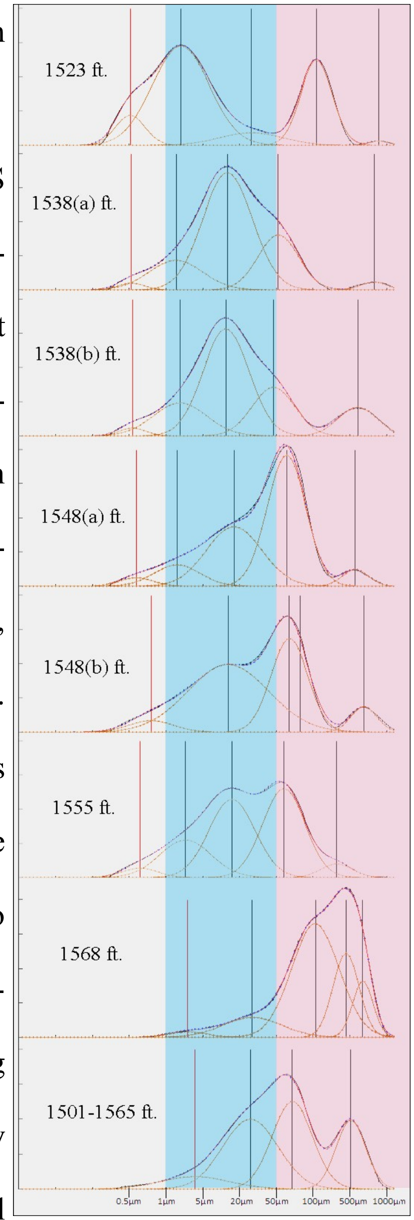
Section 4.3 Brookhaven Weathered Bedrock:

Eight samples of weathered bedrock were collected from Brookhaven National Laboratory. These samples were collected in 1948 for a USGS study, concerning the underground storage of waste. This study was written up in DeLaguna 1963. Figure 4.5 shows modes at approximately 20µm, 65µm and 500µm (more specifically with the GrainAnalysis program, 23.43µm, 85.69µm, and 526.48µm) for one of the weathered remains of granite. This granite is similar to the Stony Creek granite in Connecticut. The pattern of modes seen in the bedrock at Brookhaven, despite the depth, are mostly 2µm-20µm, and some modes around 70µm-80µm, 100µm-200µm, and 600µm-800µm. The large amount of clay and fine silt size fraction was unexpected, as fine silt size grains are commonly believed to be produced by glacial activity. Between the pebbly-loess and glacial till at Stony Brook, the glacial material from Centereach, and the weathered bedrock at Brookhaven, the common modes seemed to be 2µm-30µm, 100µm-200µm, and 400µm-600µm. This would be consistent with clays, course silts and sands.

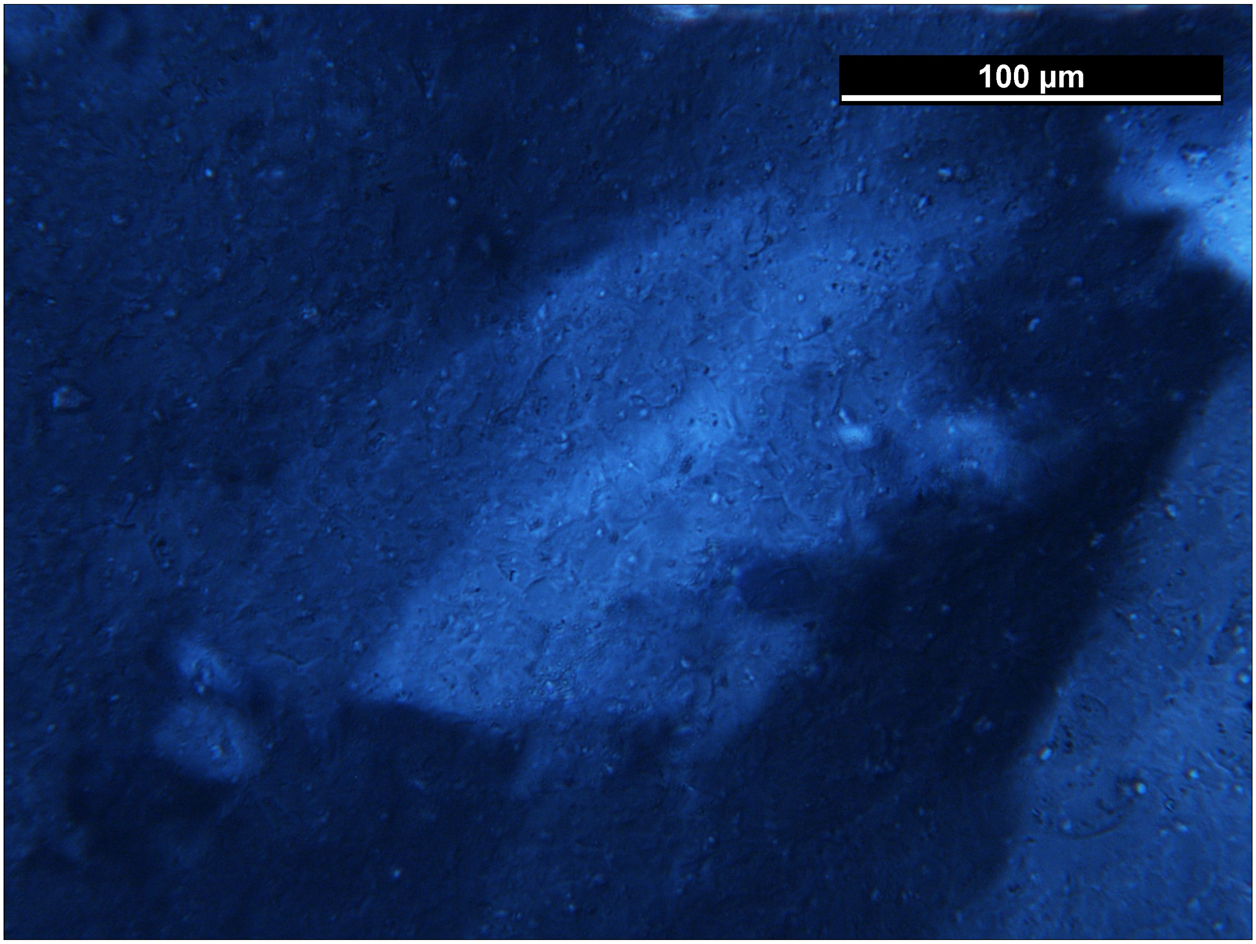
Section 4.4 Explanation of silt in bedrock:

A big question in this study was the occurrence of silt and clay sized particles in our weathered bedrock samples. It is usually assumed that only glacial grinding can produce silt sized grains from bedrock (Muhs, 2007). This weathered bedrock, or saprolite, has experienced chemical weathering, and is believed to have never been directly affected by a glacier, as it is about 1500ft below the surface, under Cretaceous age deposits. The last glacial advance occurred during the Pleistocene, approximately 20,000 years ago. A theory we put forth for the presence of silt sized particles is that these grain sizes may weather out of bedrock. After plotting the bedrock samples on a ternary diagram, one can see a definitive trend of lower silt and clay percentages and higher sand percentages with depth (fig3.6c). This would suggest that the degree of weathering decreases with depth in the bedrock, which would be expected.

To further support this, our deepest core sample, USGS S6409 1568ft.(fig 3.5b), had 0% clay, but had the highest percent of sand for any of our weathered bedrock samples, at about 49%. Figure 4.7 shows the eight weathered bedrock samples vertically, with the shallowest sample at the top. This diagram clearly displays the overall shift of low clay and silt compositions, but high sand compositions of the of the deeper samples, to the high clay and silt compositions of the shallower samples. This would indicate that the deeper samples experienced less weathering, and would therefore have less silt component, while the shallower samples, those closer to the Lloyd contact, seem to be more weathered, which is evidenced by the higher silt composition. Our shallowest bedrock sample, USGS S6409 1523ft (fig 3.5a), is predominantly clay, and had the highest amount of clay in any of our samples, including our pebbly-loess and glacial samples..It should be noted that one sample, labeled USGS S6434 1501ft-1565ft, comes from a range between 1501ft to 1565ft, with no definitive location, and could be from any depth in that range. For this reason, we treat 1523ft as our shallowest sample, and after plotting on a ternary diagram, 1501ft-1565ft appears to have grain percentages between the characteristics of 1548ft and 1568ft.

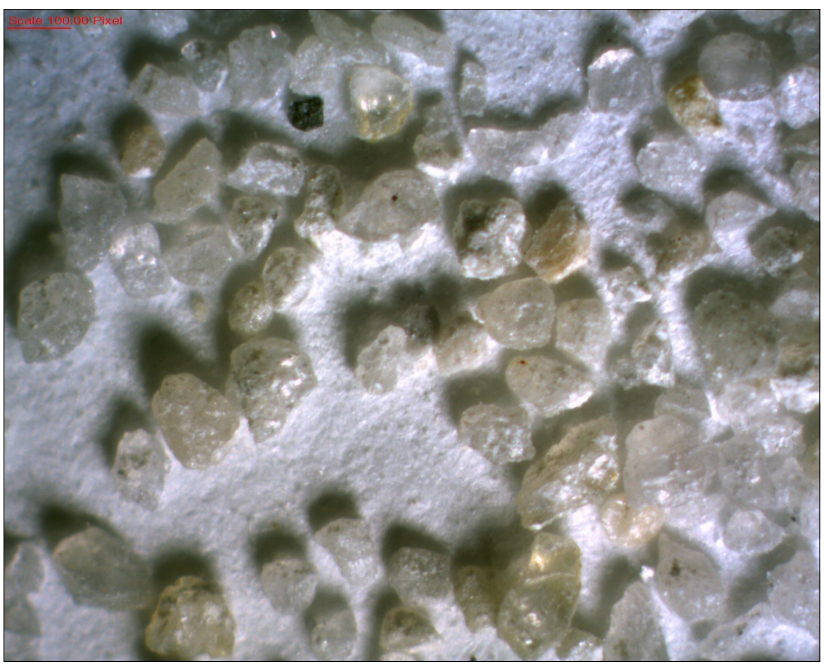


(Fig 4.7) All eight bedrock samples showing a shift from higher clay percentage to higher sand percentage with depth.



(Fig 4.8) Crossed polarized microscopic image of a quartz grain displaying intragranular quartz grains, and quartz domains less then 50µm.

This shift could be explained as weathering out of small quartz and feldspar particles. As quartz is a late addition to metamorphic or igneous rocks, it fills in the spaces between already formed minerals, and can take many shapes and sizes (Zalasiewicz 2010). As granite is a feldspathic material, based on the Goldich dissolution series, feldspar forms early, and would therefore be less stable. However, certain forms of feldspar (Orthoclase), are more stable, and would be expected to weather slower. As the rock undergoes chemical weathering, the less stable materials will weather out first, freeing the hardier quartz grains, and some more stable forms of feldspar. Additionally, the quartz grains may break along the crystal domains in the individual quartz grains. After noting the occurrence of these fine grained, and clay sized particles, a thin section of a granitic gneiss from a rock similar to the Stony Creek Granite, which would be analogous to the parent material of the sediments, as well as to the weathered bedrock underneath Brookhaven, was microscopically analyzed. This rock was composed of 30% quartz, 50% microcline, and 12% plagioclase (rock number 22 in Pacholik, 2000), with quartz being the predominate material in our sediments. Under cross polarized light, it was observed that there are intragranular quartz grains, which are about 30μm in size (Fig 4.8). Additionally, quartz domains in the individual quartz grains are also less then 50μm in at least one direction. This shows that it is possible to have silt sized particles already present in bedrock, without any glacial interference, and can be potentially weathered out as silt sized particles of quartz and feldspar.



(Fig 4.9) Photo-microscope image of Cretaceous sands from Caumsett State Park showing the angularity of the grains.

Section 4.5 Cretaceous:

To investigate if these silt sized particles can be found in other sediments derived from this, or similar bedrock material, sediments of Cretaceous age were collected and analyzed. Some of these Cretaceous samples were collected from Caumsett State Park, and showed peaks at around 2μm-10μm, 10μm-30μm, 80μm-90μm, 300μm-500μm, and 600μm-700μm, which would indicate a wide range of clays through sands. Since these deposits are believed to have been deposited by erosion, and not glacial activity, this would further support that these modes are more then likely not produced by the grinding action of a glacier, but may actually be inherent in the source bedrocks of these clastic sediments. These Cretaceous deposits also showed angular grains, which suggests that these deposits come from a local source. Figure 4.9 is a photomicroscope image of a sample from Caumsett showing the angularity of the grains.

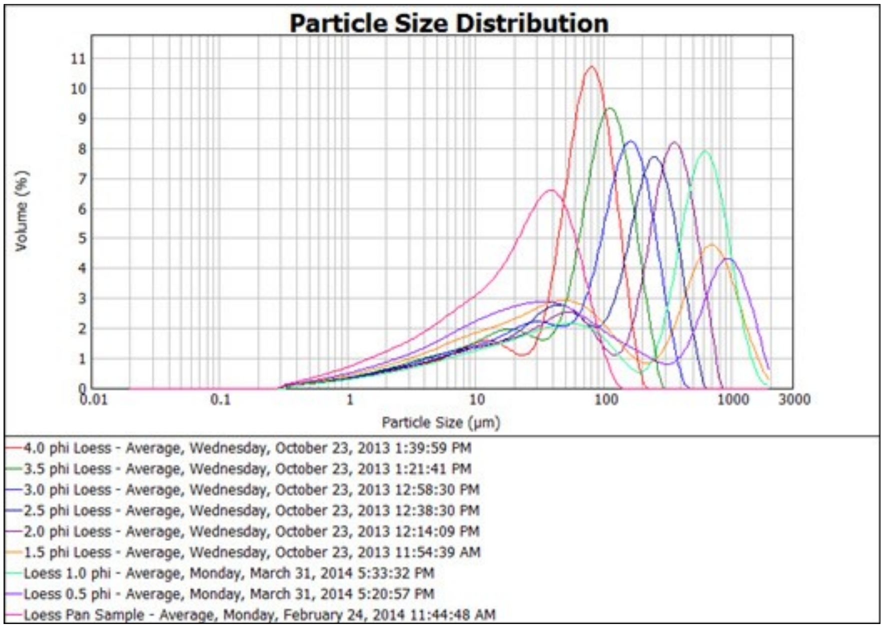
Additional Cretaceous aged materials were collected from the same Brookhaven USGS cores as the weathered bedrock. These samples came from the Magothy, Raritan, and Lloyd deposits. These common modes are <2µm, 2µm-20µm, 80µm-90µm, 100µm-200µm, and 600µm-700µm.

Section 4.6 Additional Glacial sediments:

When Cretaceous beds at Caumsett state park were sampled, a third glacial deposit was also sampled. Unlike the previous glacial deposits, this deposit was formed in a Gilbert delta setting. The glacial sediments from Caumsett State Park display modes at 2µm-10µm, 30µm-40µm, 100µm-200µm, and 500µm-600µm. This would be consistent with the glacial sediments at Stony Brook and Centereach.

Section 4.7 Other Potential Sources of Modes:

Finally, to test to see if the Mastersizer itself could potentially produce modes, or have a mode bias, some pebbly-loess was collected from the base of the pebbly-loessic deposit at Stony Brook. This sediment was then measured out and sieved through a sieve tower to remove the pebbly fraction and differentiate it into each respective phi size between 0 phi and 4.0 phi. Anything below 4.0 phi was considered pan, and included in our analysis. Since the Mastersizer cannot read above 1mm, anything in the 0 phi size was disregarded from the Mastersizer analysis, however, its weight was recorded as weight percent data. It should be noted however, sieves



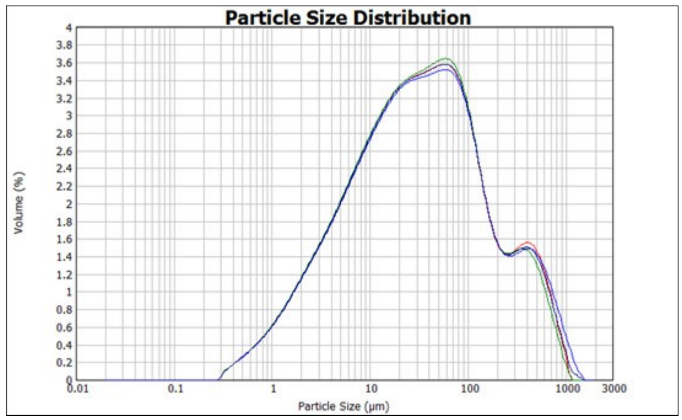
(Fig 4.10) Loess from Stony Brook University location with every half phi size between 0.5 and 4.0, including pan. The lower portion of the figure displays the color associated with each size. Graph obtained with the Mastersizer.

are not perfect, and some oblong grains, which would appear in one cross-section as <1mm and in another cross-section as >1mm , can conceivably pass through the mesh, and appear as a grain larger then 1mm in the results. Each sample was processed through the Mastersizer, and the results showed a distinct peak were expected for that particular phi size, along with a peak around 20µm (fig 4.10). This showed up for each and every separate phi size. Through microscopic examination, small grains were found to adhere to the larger grains, even after wet and dry sieving experiments, but the consistency of the peak at 20µm cannot be attributed to the presence of these small adhering grains alone. The individual phi size samples were not analyzed with the GrainAnalysis program.

A sample created from the Stony Brook pebbly-loess, consisting of an equal amount of each phi size, (1.00 gram each of 0.5 phi to 4.0 phi, including pan), resulted in peaks at about 20µm, 60µm, and 400µm (figure 4.11), more specifically with the GrainAnalysis, 2.71µm, 26.9µm, 96.28µm, 419.42µm (fig 4.12). Again using the GrainAnalysis program, the typical pattern of modes for our loess samples was 2µm-10µm, 30µm-50µm, and 400µm-700µm. This showed that the peaks are more than likely not produced by the Mastersizer machine itself, but again might be inherent in the material analyzed. Since this is one sample created as an average of 1.00 gram each of every half phi size between 0.5phi and 4.0phi (including pan), the 96.28μm mode is considered an anomalous mode that is not common amongst the pebbly-loess samples.

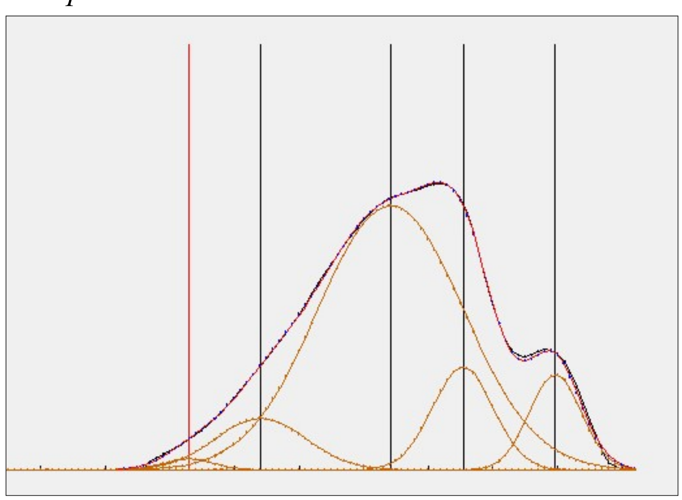
In summary, the Bedrock modes take a relatively broader range, having mostly modes between 2μm-20μm, with some modes 70μm-80μm, 100μm-200μm, and 600μm-700μm. It would be understandable to have clay size material in weathered bedrock, as silt sized particles were observed in a thin section (fig 4.8) of bedrock from the Stony Creek Granite, found to the north, from which a portion of the Cretaceous and glacial sediment is derived. The Cretaceous material contains modes mostly between 2μm-20μm, with some modes between 10μm-30μm, 80μm-90μm, 300μm-500μm, and 600μm-700μm. Our glacial sand material, collected at both Caumsett State Park, and Centereach, show modes at 2μm-20μm, 100μm-200μm, and 400μm-600μm.

As you can see, the further derived from the bedrock the material is, (the glacial material may be reprocessed Cretaceous aged materials) the more narrow the

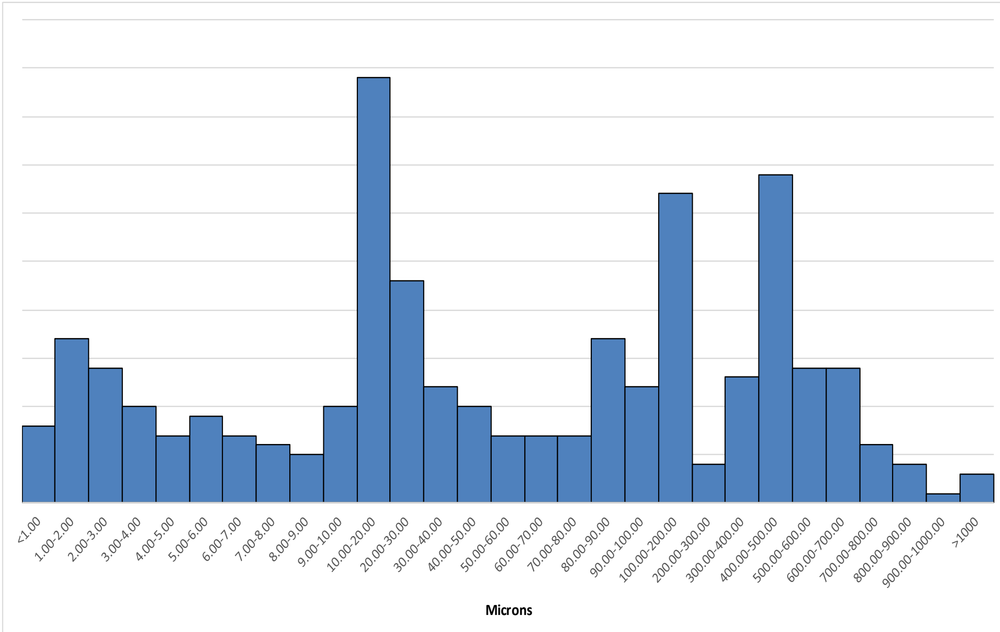


(Fig 4.11) Loess mix from Stony Brook University location made with equal amounts of every half phi size between 0.5 to 4.0 and pan. Peaks are visible at 20μm, 60μm, and 400μm. Graph obtained from the Mastersizer.

(Fig 4.12) Graph from GrainAnalysis program showing five mode peaks for the equal loess mix sample.



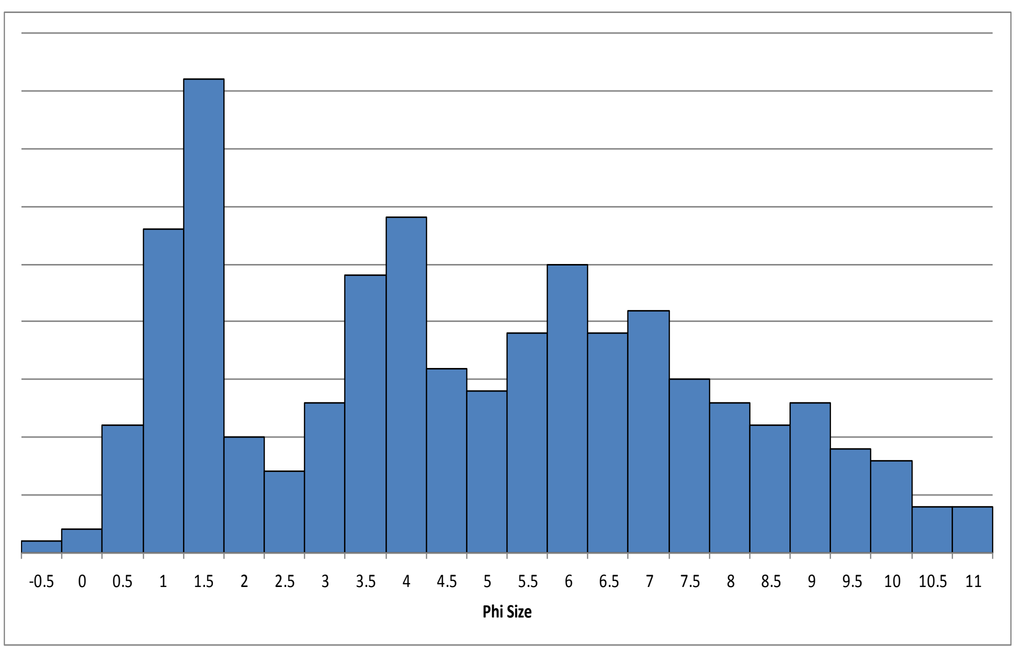
range becomes. The whole rock grinding experiments show that the common modes for these gneisses, which were collected from the glacial material at Stony Brook, were 2μm-10μm, 20μm-30μm, and 100μm-200μm. These modes are similar to, but not exactly the same as the weathered bedrock. The weathered bedrock has a much broader range, whereas the whole rock grinding has a more refined range. The till has common ranges at 10μm-20μm, 50μm-60μm, and 400μm-600μm. The overlying loessic material has common modes at 2μm-10μm, 30μm-50μm, and 400μm-700μm. Overall, the most common modes appear to be 10μm-20μm, 100μm-200μm, and 400μm-500μm. In phi size terms, this would be equivalent to 1.5 phi, 3.5 phi-4.0 phi, and 6 phi. This was determined by assigning each mode detected to a bin representing <2.00μm, 2μm-10μm, 10μm-20μm,...100μm-200μm, 200μm-300μm,...900μm-1000μm, and 1000μm, in an excel spreadsheet. The total number of modes in each bin was recorded, and placed on a graph (fig 4.13 above). This was repeated with each bin representing a phi size (fig 4.13 below).



(Figure 4.13)

(Above) Showing the largest peaks at 10.00-20.00 microns, 100.00-200.00 microns (or possibly 80.00-200.00 microns), and 400.00-500.00 microns. The peaks shown on the Mastersizer readout shows peaks around 90 microns. In some samples, this is due to duel peaks at around 80.00 and 100.00 microns, combining to create one large peak at about 90.00 microns. The peak at 1.00-2.00 microns can also be considered a mode peak, but it is far less pronounced compared to the other three peaks.

(Below) Graph showing phi size peaks at 1.5 phi (355.00-500.00), 3.5 phi to 4.0 phi (90.00-125.00 and 63.00-90.00), and 6 phi (15.60-22.00). These graphs, plus the distribution of peaks produced by the Grain Size Analysis Program, shows that there are common peaks occurring at about 400 microns, abou100 microns, and about 20 microns.



Section 5 Conclusion:

After grain size analysis of Pleistocene and Cretaceous sediments, weathering products of granite and mechanically crushed granite, from the north shore and midline of Long Island, New York, it has been shown that modes in the ranges of 10µm-20µm, 100µm-200µm, and 400µm-500µm are common throughout these sediments, and seem to be retained throughout all processes, such as weathering, erosion, and glacial grinding. It has also been shown that these modes may be inherent in the parent bedrock of these sediments, though the appearance of intragranular quartz grains in unweathered bedrock.

The presence of silt sized particles in the weathered bedrock was recorded in the grain size data, and was investigated by thin section analysis. This microscopic examination proved that silt sized grains can already be present in bedrock, and may not be created solely by glacial grinding, as was previously assumed. In addition, our study finds that parent bedrock may have a mode bias before any process can affect it, meaning that mode content found in sediments, may not be completely indicative of process. However, the individual modes for individual samples might be indicative of process.

In conclusion, we can state that grain size modes found in weathered bedrock on Long Island, New York, can be retained as common modes in derived sediments, such as Cretaceous materials, and glacial materials, such that process is not the only determination of the sediment mode characteristics. In addition, we can also state that silt sized particles can in fact be created without the aid of glacial grinding, as seen in the thin section analysis.

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Appendix:

(Fig A1) **Stony Brook University, Long Island, New York:**

Sample Name	Type	Age	Location
Stony Brook University	—	—	—
SBU 1.1 Core 2 0-8.5in	Loess	Wisconsonian	40°54’52.0”N / 73°7’44.3”W
SBU 1.1 Core 2 8.5-14in	Loess	Wisconsonian	40°54’52.0”N / 73°7’44.3”W
SBU 1.1 Core 2 14-21in	Loess	Wisconsonian	40°54’52.0”N / 73°7’44.3”W
SBU 1.1 Core 2 21-28in	Loess	Wisconsonian	40°54’52.0”N / 73°7’44.3”W
SBU 1.1 Core 2 28-34in	Loess	Wisconsonian	40°54’52.0”N / 73°7’44.3”W
SBU 1.1 Core 2 34-38in	Loess	Wisconsonian	40°54’52.0”N / 73°7’44.3”W
SBU 1.1 Core 2 38-42.5in	Loess	Wisconsonian	40°54’52.0”N / 73°7’44.3”W
SBU 1.1 Core 2 42.5-48.5in	Loess	Wisconsonian	40°54’52.0”N / 73°7’44.3”W
SBU 1.1 Core 2 48.5-53in	Loess (Coarse)	Wisconsonian	40°54’52.0”N / 73°7’44.3”W
SBU 1.1 Core 2 53-54in	Loess (Coarse)	Wisconsonian	40°54’52.0”N / 73°7’44.3”W
SBU 1.1 2B	Silt	Wisconsonian	40°54’51.8”N / 73°7’44.2”W
SBU 3.1 Black Material	Till	Wisconsonian	40°54’51.8”N / 73°7’44.4”W
SBU 1.2 Grey layer	Sand/Clay	Wisconsonian	40°54’52.0”N / 73°7’44.3”W
SBU 3.3 Brown Layer	Till	Wisconsonian	40°54’51.8”N / 73°7’44.4”W
SBU 1 Black Material Under Till	Till	Wisconsonian	40°54’52.0”N / 73°7’44.3”W
SBU 3.2 Black layer with rocks and some brown layer	Till	Wisconsonian	40°54’51.8”N / 73°7’44.4”W

(Fig A2) **Centereach, Long Island, New York:**

Sample Name	Type	Age	Location
Centereach	—	—	—
S 1	Sandy Silt	Wisconsonian	40°50’35.3”N / 73°4’35.6”W
S 2	Sandy Silt	Wisconsonian	40°50’39.2”N / 73°4’36.3”W
S 3	Sandy Silt	Wisconsonian	40°50’39.8”N / 73°4’36.0”W
S 4	Silt	Wisconsonian	40°50’40.3”N / 73°4’35.5”W
S 5	Silt	Wisconsonian	40°50’40.3”N / 73°4’35.5”W
S 7	Silt	Wisconsonian	40°50’40.1”N / 73°4’35.3”W
S 9	Silt	Wisconsonian	40°50’39.1”N / 73°4’35.4”W
S10	Silt	Wisconsonian	40°50’39.1”N / 73°4’35.4”W
S 11a	Sandy Silt	Wisconsonian	40°50’35.2”N / 73°4’35.5”W
S 11b	Pebbly Silt	Wisconsonian	40°50’35.2”N / 73°4’35.5”W
S10 Core 1 1.1	Silt	Wisconsonian	40°50’39.1”N / 73°4’35.4”W
S10 Core 1 1.2	Silt	Wisconsonian	40°50’39.1”N / 73°4’35.4”W
S10 Core 1 1.3	Silt	Wisconsonian	40°50’39.1”N / 73°4’35.4”W
S10a Core 2	Silt	Wisconsonian	40°50’38.5”N / 73°4’35.2”W
Micaceous material S9/S10	Silt	Wisconsonian	40°50’39.1”N / 73°4’35.4”W
S11 1.1	Sand	Wisconsonian	40°50’35.2”N / 73°4’35.5”W
S11 1.2	Sand	Wisconsonian	40°50’35.2”N / 73°4’35.5”W
S11 1.3	Silt	Wisconsonian	40°50’35.2”N / 73°4’35.5”W
S11 1.4	Sand	Wisconsonian	40°50’35.2”N / 73°4’35.5”W
S11 with rock	Sand	Wisconsonian	40°50’35.2”N / 73°4’35.5”W
S11 under rock	Sand	Wisconsonian	40°50’35.2”N / 73°4’35.5”W
S11 A Core 1 24.5-27.75 in	Sand	Wisconsonian	40°50’35.2”N / 73°4’35.5”W
S11 B Core 1 27.5-31.5 in	Sand	Wisconsonian	40°50’35.2”N / 73°4’35.5”W
S11 C Core 1 31.5-37 in	Pebbly Silt	Wisconsonian	40°50’35.2”N / 73°4’35.5”W
S11 D Core 1 37-43 in	Silty Sand	Wisconsonian	40°50’35.2”N / 73°4’35.5”W
S11 Core 1.1 A 3”-4”	Course Sand	Wisconsonian	40°50’35.2”N / 73°4’35.5”W
S11 Core 1.1 A 7”-8”	Course Sand	Wisconsonian	40°50’35.2”N / 73°4’35.5”W
S11 Core 1.2 A 2”-3”	Silt	Wisconsonian	40°50’35.2”N / 73°4’35.5”W
S11 Core 1.2 A 8”-9”	Silt	Wisconsonian	40°50’35.2”N / 73°4’35.5”W

Sample Name	Type	Age	Location
Centereach	—	—	—
S11 Core 1.3 A 0.5”-1”	Course Sand	Wisconsonian	40°50’35.2”N / 73°4’35.5”W
S11 Core 1.3 A ~3”-3.5”	Silt w/ Mica	Wisconsonian	40°50’35.2”N / 73°4’35.5”W
S10 Core 1.1 4.5”-5.5”	Silt	Wisconsonian	40°50’39.1”N / 73°4’35.4”W
S10 Core 1.1 10”-11”	Silt	Wisconsonian	40°50’39.1”N / 73°4’35.4”W
S10 Core 1.2 2”-3”	Silt	Wisconsonian	40°50’39.1”N / 73°4’35.4”W
S10 Core 1.2 9.5”-10”	Sand	Wisconsonian	40°50’39.1”N / 73°4’35.4”W
S10 Core 1.3 3”-4”	Silt	Wisconsonian	40°50’39.1”N / 73°4’35.4”W
S10 Core 1.3 7”-8”	Silt	Wisconsonian	40°50’39.1”N / 73°4’35.4”W

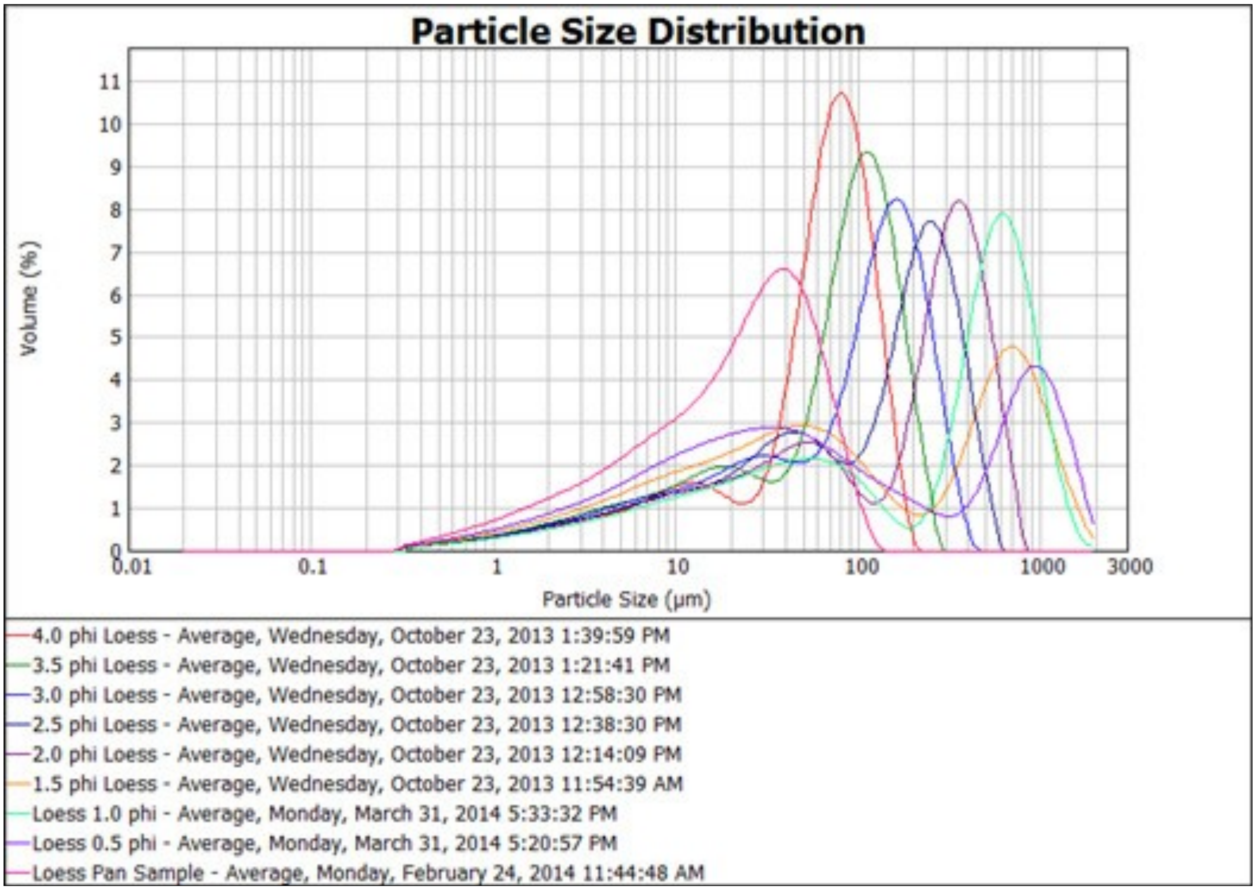
(Fig A3) **Caumsett State Park, Long Island, New York:**

Sample Name	Type	Age	Location
Caumsett State Park	—	—	—
Glacial third section upper course. G 1.1	Course Sand	Glacial	40°56’27.9”N / 73°28’30.8”W
Glacial third section middle fine. G 1.2	Sand	Glacial	40°56’27.9”N / 73°28’30.8”W
Glacial third section bottom fine. G 1.3	Fine Sand	Glacial	40°56’27.9”N / 73°28’30.8”W
Cret. first section lower portion sandy layer. Cret 1.1	Fine & Course Sand	Cretaceous	40°56’21.1”N / 73°28’13.7”W
Cret. first section fine upper portion above course material. Cret. 1.2	Fine Sand	Cretaceous	40°56’21.1”N / 73°28’13.7”W
Cret. first section upper portion. Cret. 1.3	Fine & Course Sand	Cretaceous	40°56’21.1”N / 73°28’13.7”W
Cret. first section lower portion fine. Cret. 1.4	Fine Sand	Cretaceous	40°56’21.1”N / 73°28’13.7”W
Cret. first section lower portion course. Cret. 1.5	Course Sand	Cretaceous	40°56’21.1”N / 73°28’13.7”W
Cret. fine second section. Cret. 2.1	Fine Sand	Cretaceous	40°56’22.6”N / 73°28’18.6”W
Cret. second section fine material near rocks. Cret. 2.2	Fine Sand	Cretaceous	40°56’22.6”N / 73°28’18.6”W

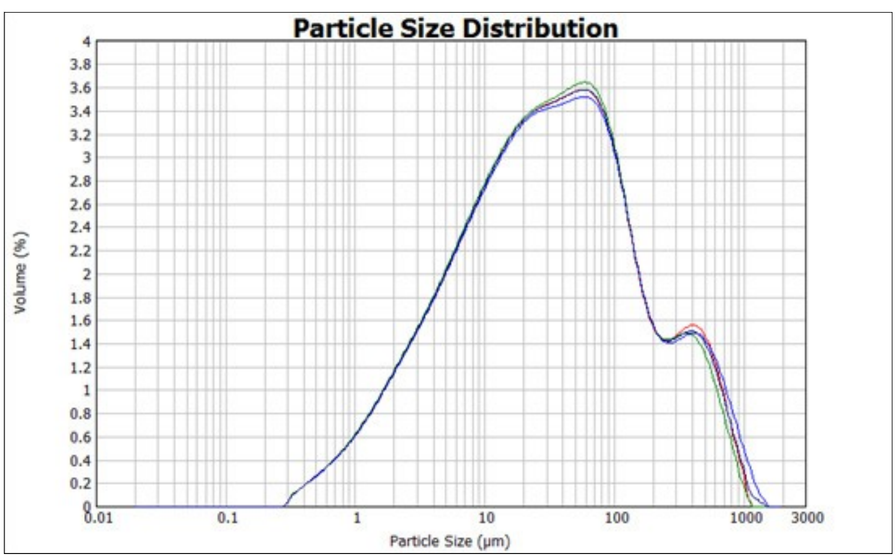
(Fig A4) **Brookhaven, Long Island, New York, USGS Samples:**

Sample Name	Type	Age	Location
Brookhaven USGS Core S6409	—	—	—
363-383 ft.	Silt	Magothy	N/A
417-423 ft.	Sand	Magothy	N/A
562 ft.	Sand	Magothy	N/A
899 ft.	Silt	Magothy	N/A
1100 ft.	Clay	Raritan	N/A
1110 ft.	Sandy Silt	Raritan	N/A
1160 ft.	Clay	Lloyd	N/A
1221 ft.	Silty Clay	Lloyd	N/A
1300 ft.	Sandy Silt	Lloyd	N/A
1311 ft.	Sandy Silt	Lloyd	N/A
1523 ft.	Clay	Weathered Bedrock	N/A
1538 ft. sample 1	Sandy Clay	Weathered Bedrock	N/A
1538 ft. sample 2	Sandy Clay	Weathered Bedrock	N/A
1548 ft. sample 1	Sandy Clay	Weathered Bedrock	N/A
1548 ft. sample 2	Sandy Clay	Weathered Bedrock	N/A
1555 ft.	Sandy Clay	Weathered Bedrock	N/A
1568 ft.	Weathered Clay	Weathered Bedrock	N/A
Core S6434	—	—	—
256-288 ft.	Sandy Silt	Magothy	N/A
1501-1565 ft.	Sandy Silt	Weathered Bedrock	N/A

Stony Brook University Loess sieved into individual half phi sizes



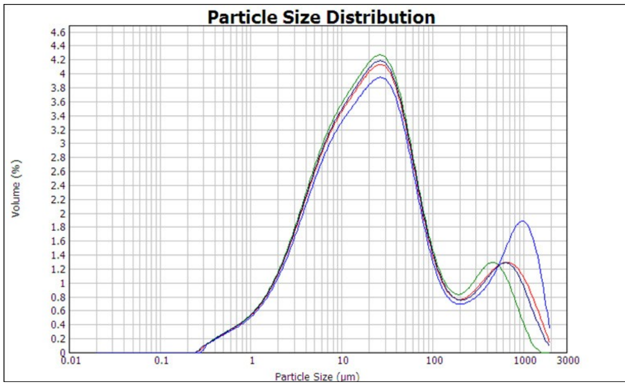
(Fig A5 Above) Loess from Stony Brook University location with every half phi size between 0.5 and 4.0, including pan. The lower portion of the figure displays the color associated with each size.



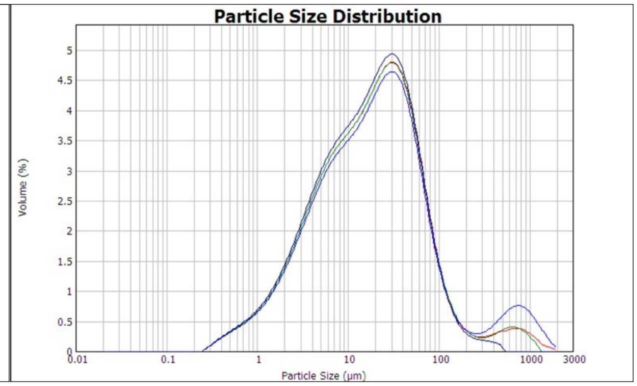
(Fig A6 Left) Loess mix from the Stony Brook University location made with equal amounts of every half phi size between 0.5 to 4.0 and pan. Peaks are visible at 20μm, 60μm, and 400μm

(Fig A7) **Stony Brook University, Long Island, New York:**

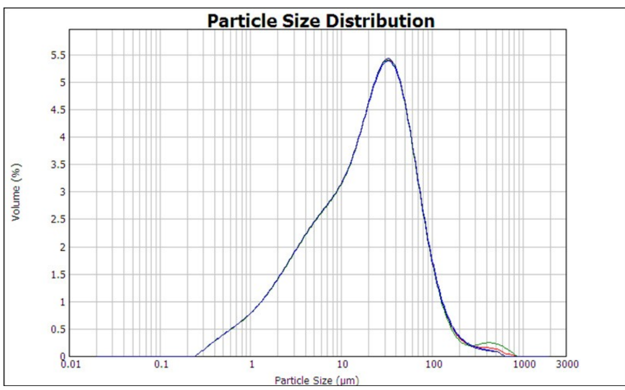
Sample Name	Type	Grain Size Modes (microns)
Stony Brook University	—	—
SBU 1.1 Core 2 0-8.5in	Loess	8μm, 25μm, 200μm
SBU 1.1 Core 2 8.5-14in	Loess	7μm, 30μm, 750μm
SBU 1.1 Core 2 14-21in	Loess	4μm, 33μm, 450μm
SBU 1.1 Core 2 21-28in	Loess	0.6μm, 25μm, 450μm
SBU 1.1 Core 2 28-34in	Loess	5μm, 39μm, 450μm
SBU 1.1 Core 2 34-38in	Loess	20μm, 300μm, 1010μm
SBU 1.1 Core 2 38-42.5in	Loess	30μm
SBU 1.1 Core 2 42.5-48.5in	Loess	8μm, 40μm, 500μm
SBU 1.1 Core 2 48.5-53in	Loess	40μm, 500μm
SBU 1.1 Core 2 53-54in	Loess	40μm, 450μm
SBU 1.1 2B	Silt	7μm, 50μm, 400μm
SBU 3.1 Black Material	Till	7μm, 45μm, 450μm
SBU 1.2 Grey layer	Sandy clay	45μm, 400μm
SBU 3.3 Brown Layer	Till	10μm, 60μm, 400μm
SBU 1 Black Material Under Till	Till	10μm, 30μm, 450μm
SBU 3.2 Black layer with rocks and some brown layer	Till	15μm, 400μm



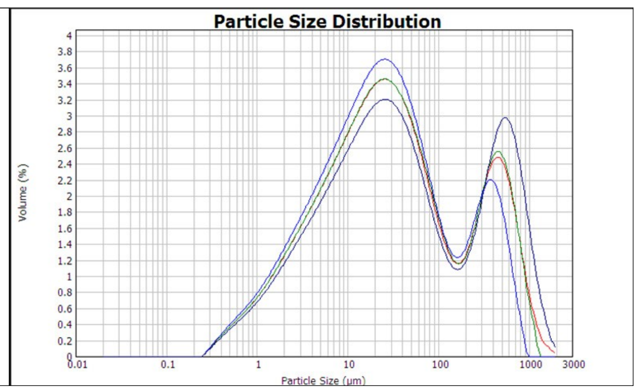
(Fig A8a) Histogram of loess from Stony Brook 1.1 core 2 0”-8.5” with modes at 8μm, 25μm, and 200μm.



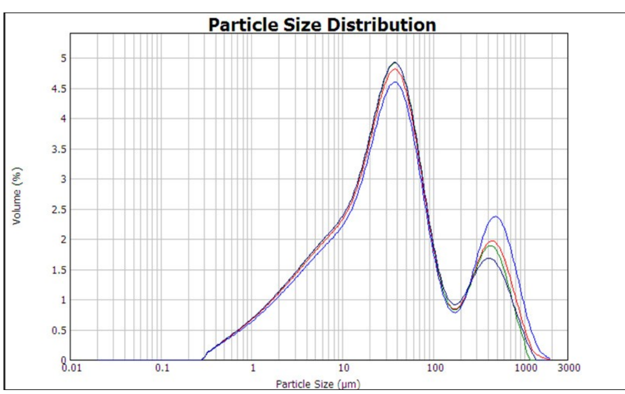
(Fig A8b) Histogram of loess from Stony Brook 1.1 core 2 8.5”-14” with modes at 7μm, 30μm, and 750μm.



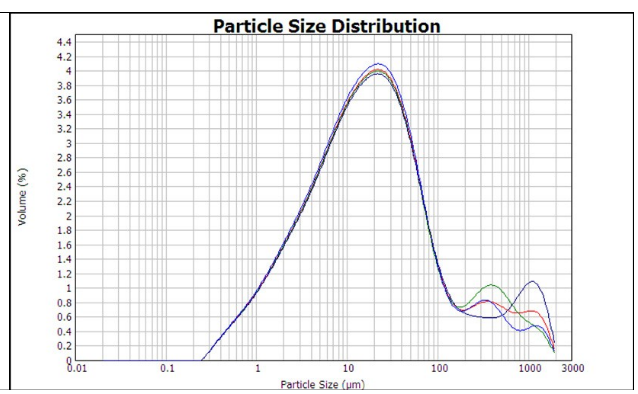
(Fig A8c) Histogram of loess from Stony Brook 1.1 core 2 14”-21” with modes at 4μm, 33μm and 450μm.



(Fig A8d) Histogram of loess from Stony Brook 1.1 core 2 21”-28” with modes at 0.6μm, 25μm and 450μm.

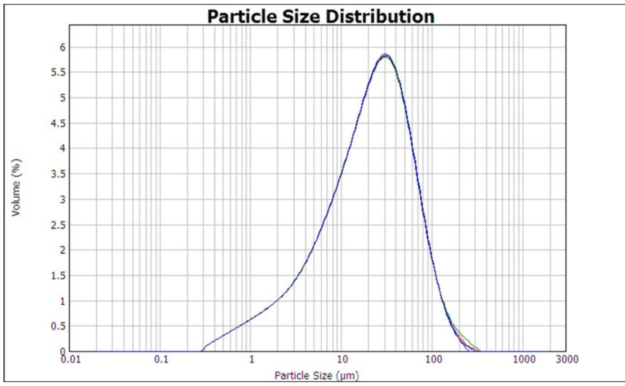


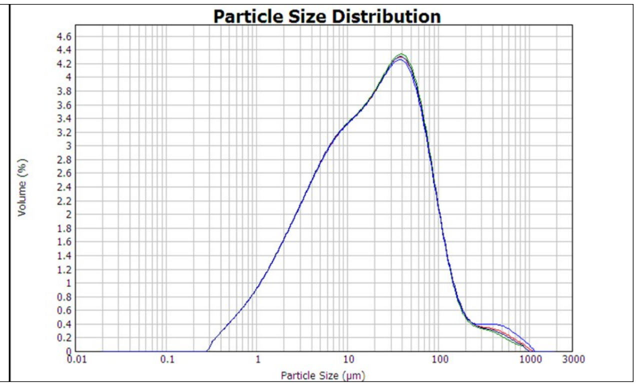
(Fig A8e) Histogram of loess from Stony Brook 1.1 core 2 28”-34” with modes at 5μm, 39μm and 450μm.



(Fig A8f) Histogram of loess from Stony Brook 1.1 core 2 34”-38” with modes at 20μm, 300μm and 1010μm.

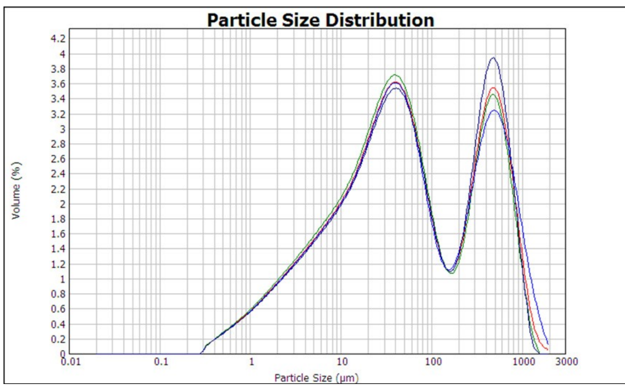
Stony Brook University

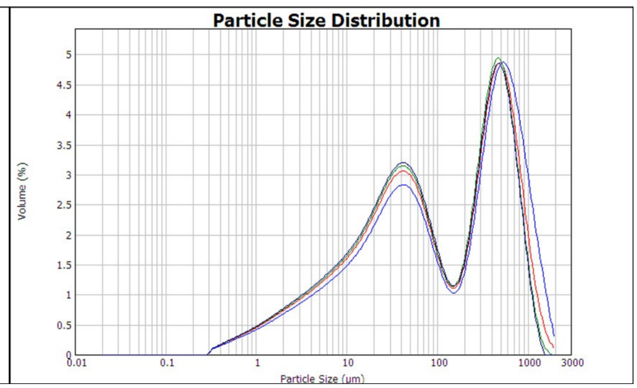




(Fig A8g) Histogram of loess from Stony Brook 1.1 core 2 38”-42.5” with a mode at 30µm.

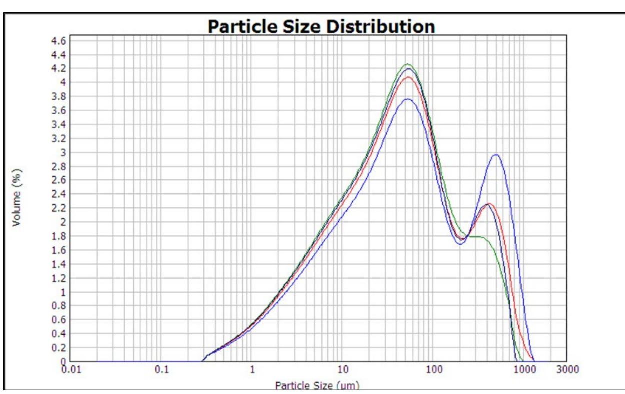
(Fig A8h) Histogram of loess from Stony Brook 1.1 core 2 42.5”-48.5” with modes at 8µm, 40µm, and 500µm.



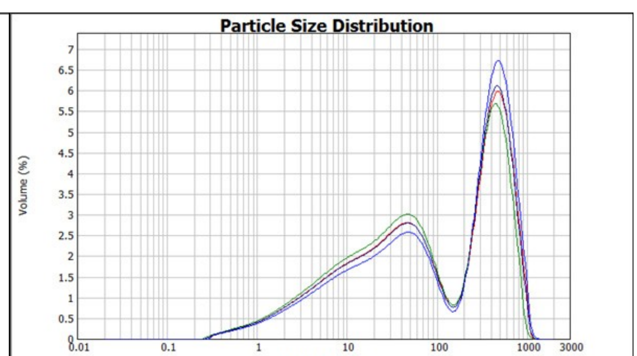


(Fig A8i) Histogram of loess from Stony Brook 1.1 core 2 48.5”-53” with modes at 40µm, and 500µm.

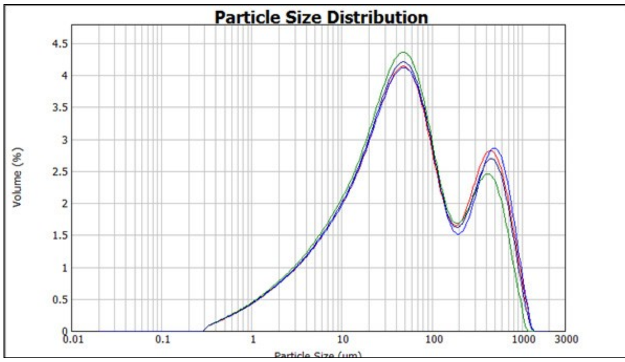
(Fig A8j) Histogram of loess from Stony Brook 1.1 core 2 53”-54” with modes at 40µm, and 450µm.



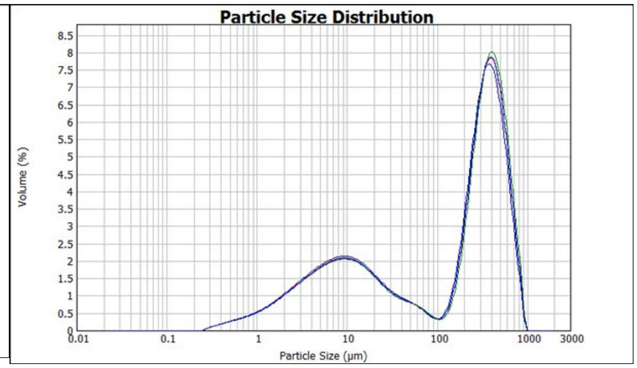
(Fig A8k) Histogram of silt from Stony Brook 1.1 2B with modes at 7µm, 50µm, and 400µm.



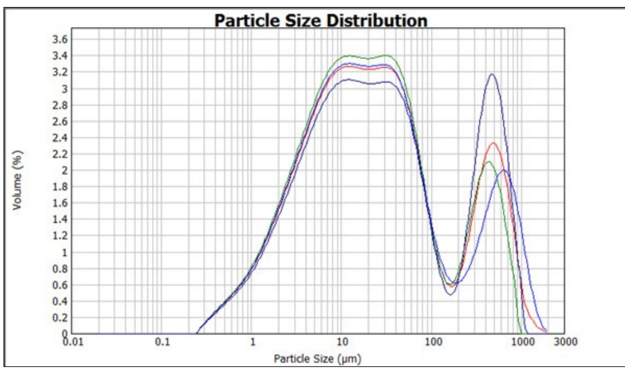
(Fig A8l) Histogram of till from Stony Brook 3.1 with modes at 7µm, 45µm, and 450µm.



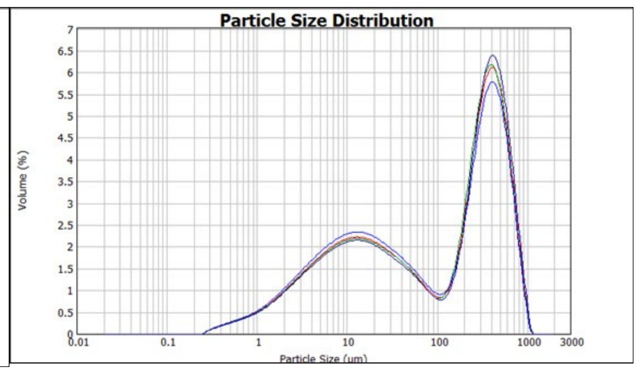
(Fig A8m) Histogram of sandy clay from Stony Brook 1.2 Grey layer with modes at 45μm, and 400μm.



(Fig A8n) Histogram of till from Stony Brook 3.3 Brown material with modes at 10μm, 60μm and 400μm.

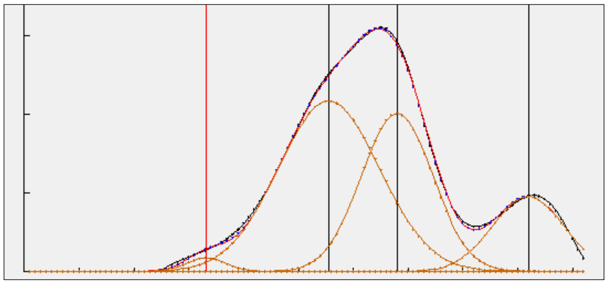


(Fig A8o) Histogram of till from Stony Brook 1 Black material under till with modes at 10μm, 30μm and 450μm.

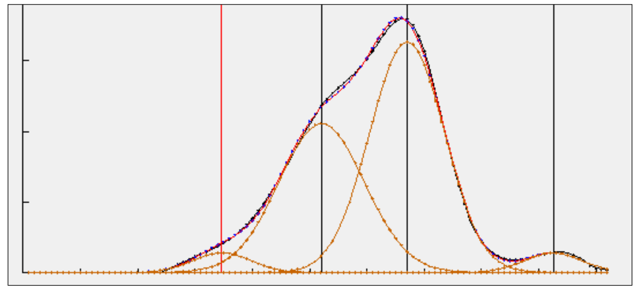


(Fig A8p) Histogram of till from Stony Brook 3.2 Black layer with rocks and some brown material with modes at 15μm, and 400μm.

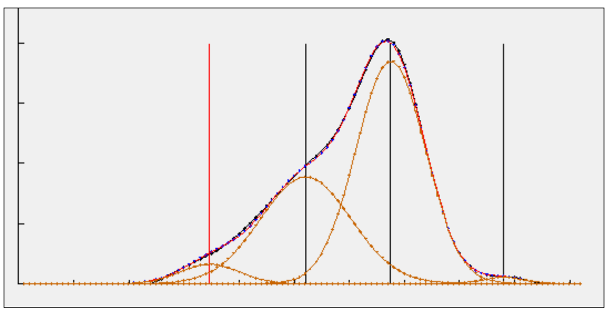
<u>Stony Brook University GrainAnalysis Graphs:</u>



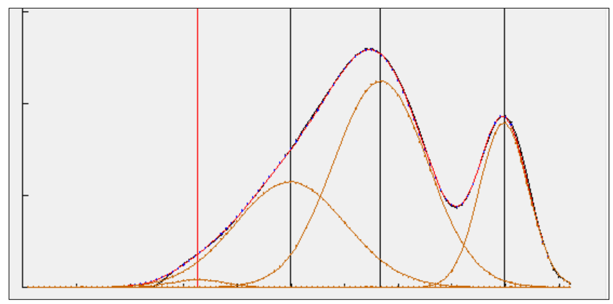
(Fig A8aa) Graph for SBU 1.1 Core 2 0”-8.5”



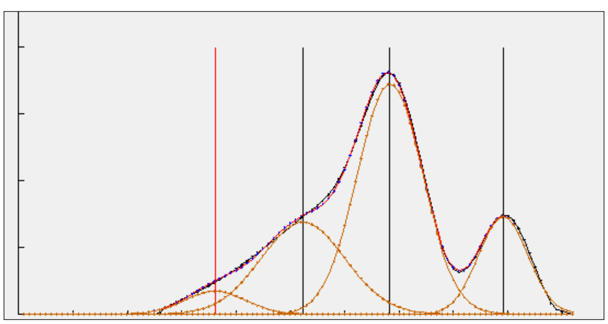
(Fig A8bb) Graph for SBU 1.1 Core 2 8.5”-14”



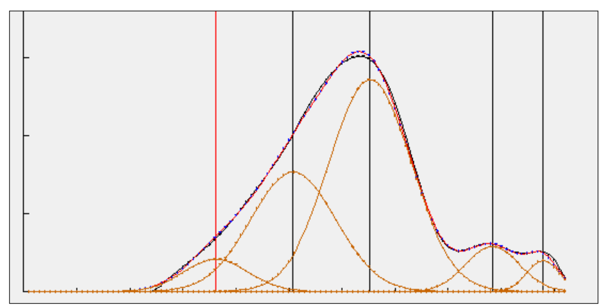
(Fig A8cc) Graph for SBU 1.1 Core 2 14”-21”



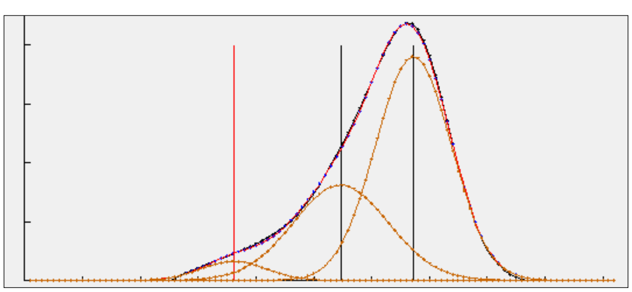
(Fig A8dd) Graph for SBU 1.1 Core 2 21”-28”



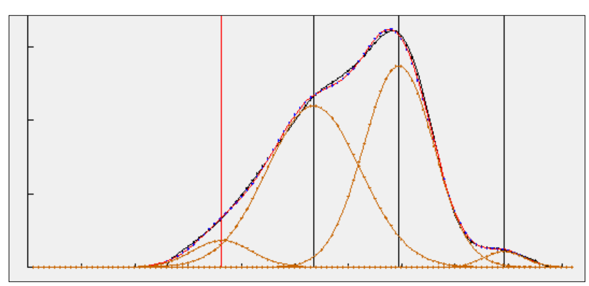
(Fig A8ee) Graph for SBU 1.1 Core 2 28”-34”



(Fig A8ff) Graph for SBU 1.1 Core 2 34”-38”

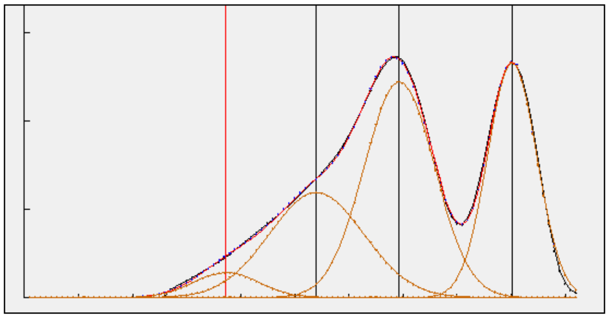


(Fig A8gg) Graph for SBU 1.1 Core 2 38”-42.5”

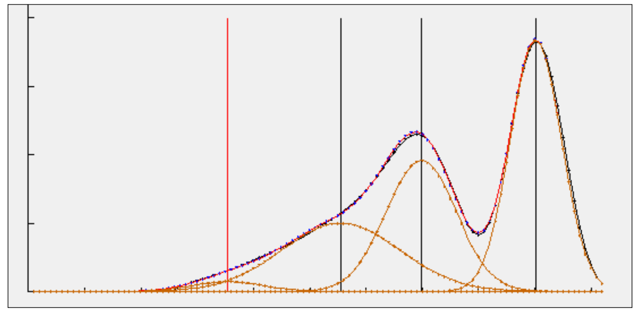


(Fig A8hh) Graph for SBU 1.1 Core 2 42.5”-48.5”

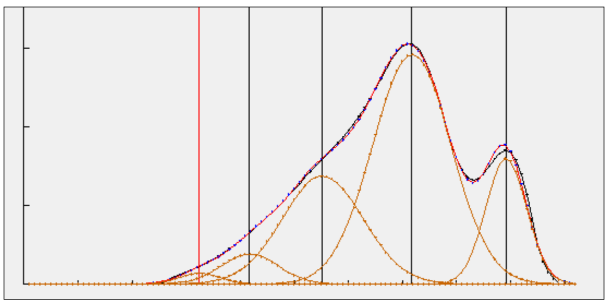
Stony Brook University GrainAnalysis Graphs:



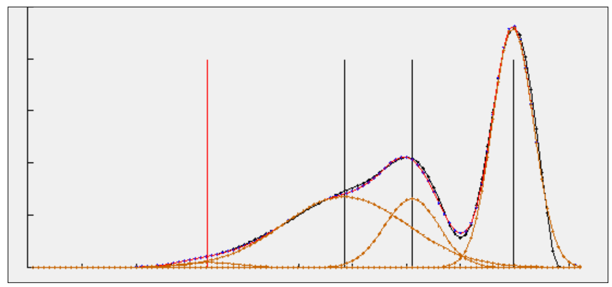
(Fig A8ii) Graph for SBU 1.1 Core 2 48.5”-53”



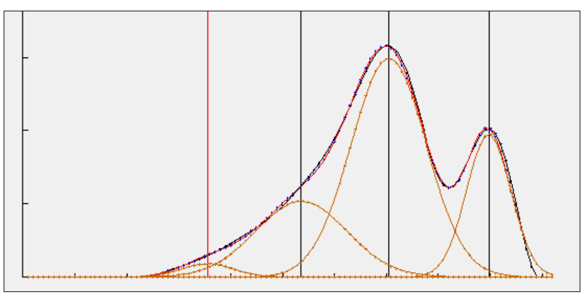
(Fig A8jj) Graph for SBU 1.1 Core 2 53”-54”



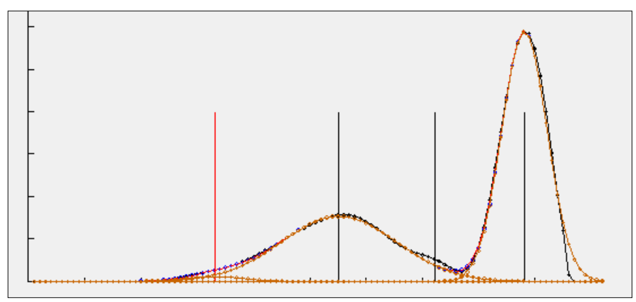
(Fig A8kk) Graph for SBU 1.1 2B



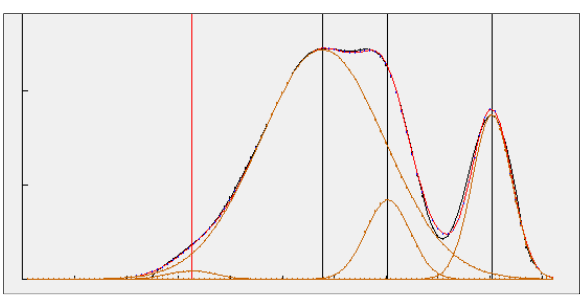
(Fig A8ll) Graph for Black Material 3.1



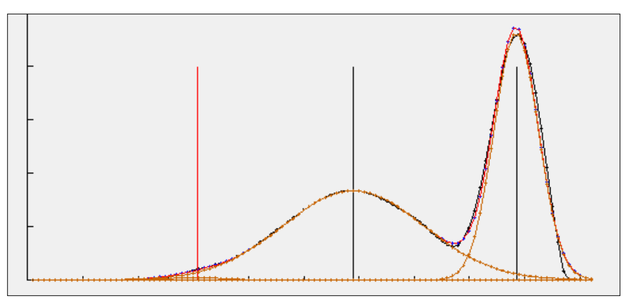
(Fig A8mm) Graph for Grey Layer 1.2



(Fig A8nn) Graph for Brown Material SBU 3.3

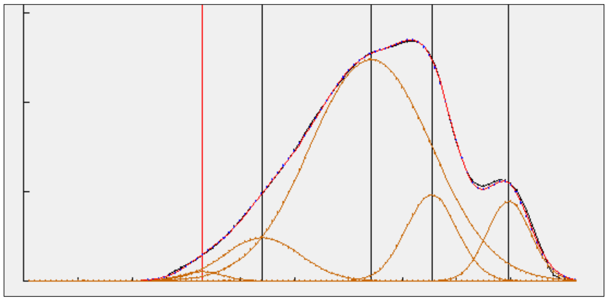


(Fig A8oo) Graph for Black Material SBU 1 Under Till



(Fig A8pp) Graph for Black Layer with Rocks and Some Brown Layer SBU 3.2

Stony Brook University GrainAnalysis Graphs:



(Fig A8qq) Graph for Loess Mix

(Fig A9) **Stony Brook University Samples:** Phi size percent distributions over half phi sizes.

Phi size	SBU 1.1 Core 2 0 – 8.5 in.	SBU 1.1 Core 2 8.5 – 14 in.	SBU 1.1 Core 2 14 – 21 in.	SBU 1.1 Core 2 21 – 28 in.	SBU 1.1 Core 2 28 – 34 in.	SBU 1.1 Core 2 34 – 38 in.
-1.0 - -0.5	0.86 %	0.14 %	0.00 %	0.23 %	0.06 %	0.88 %
-0.5 – 0.0	1.99 %	0.47 %	0.00 %	1.03 %	0.56 %	1.50 %
0.0 – 0.5	2.75 %	0.81 %	0.02 %	2.90 %	2.14 %	1.49 5
0.5 – 1.0	2.88 %	0.81 %	0.18 %	4.95 %	3.82 %	1.57 %
1.0 – 1.5	2.53 %	0.68 %	0.34 %	5.51 %	4.37 %	1.79 %
1.5 – 2.0	2.04 %	0.55 %	0.40 %	4.39 %	3.46 %	1.78 %
2.0 – 2.5	1.74 %	0.72 %	0.70 %	3.01 %	2.21 %	1.60 %
2.5 – 3.0	1.99 %	1.42 %	1.64 %	2.72 %	2.15 %	1.79 %
3.0 – 3.5	3.04 %	3.04 %	3.65 %	3.64 %	3.93 %	2.82 %
3.5 – 4.0	4.92 %	5.69 %	6.77 %	5.10 %	6.95 %	4.63 %
4.0 – 4.5	7.15 %	8.64 %	10.09 %	6.49 %	9.77 %	6.67 %
4.5 – 5.0	8.81 %	10.51 %	12.01 %	7.44 %	10.81 %	8.24 %
5.0 – 5.5	9.31 %	10.66 %	11.71 %	7.80 %	9.75 %	8.98 %
5.5 – 6.0	8.97 %	9.75 %	9.97 %	7.55 %	7.74 %	9.01 %
6.0 – 6.5	8.33 %	8.76 %	8.13 %	6.89 %	6.07 %	8.58 %
6.5 – 7.0	7.63 %	8.05 %	6.89 %	6.09 %	5.10 %	7.82 %
7.0 – 7.5	6.71 %	7.32 %	6.09 %	5.30 %	4.50 %	6.83 %
7.5 – 8.0	5.51 %	6.27 %	5.33 %	4.53 %	3.93 %	5.76 %
8.0 – 8.5	4.18 %	4.95 %	4.46 %	3.81 %	3.32 %	4.80 %
8.5 – 9.0	2.98 %	3.65 %	3.55 %	3.12 %	2.74 %	3.95 %
9.0 – 9.5	2.04 %	2.56 %	2.71 %	2.46 %	2.19 %	3.14 %
9.5 – 10.0	1.39 %	1.76 %	2.01 %	1.87 %	1.69 %	2.40 %
10.0 – 10.5	0.98 %	1.23 %	1.48 %	1.39 %	1.25 %	1.77 %
10.5 – 11.0	0.70 %	0.87 %	1.05 %	0.99 %	0.87 %	1.25 %
11.0 – 11.5	0.44 %	0.54 %	0.64 %	0.60 %	0.50 %	0.74 %
11.5 – 12.0	0.13 %	0.17 %	0.20 %	0.18 %	0.09 %	0.21 %
12.0 – 12.5	0.00 %	0.00 %	0.00 %	0.00 %	0.00 %	0.00 %
Total:	100.00 %	100.02 %	100.02 %	99.99 %	99.97 %	100.00 %

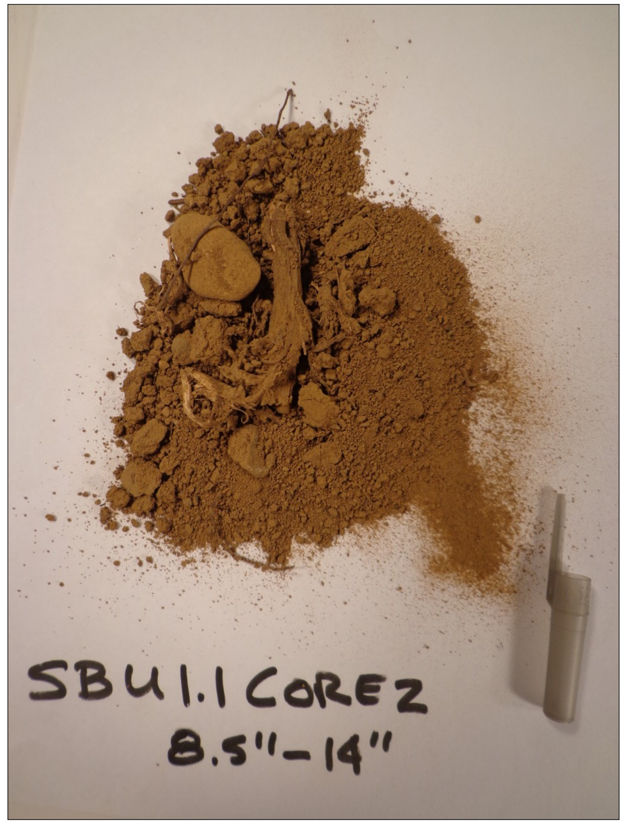
Stony Brook University Samples: Phi size percent distributions over half phi sizes.

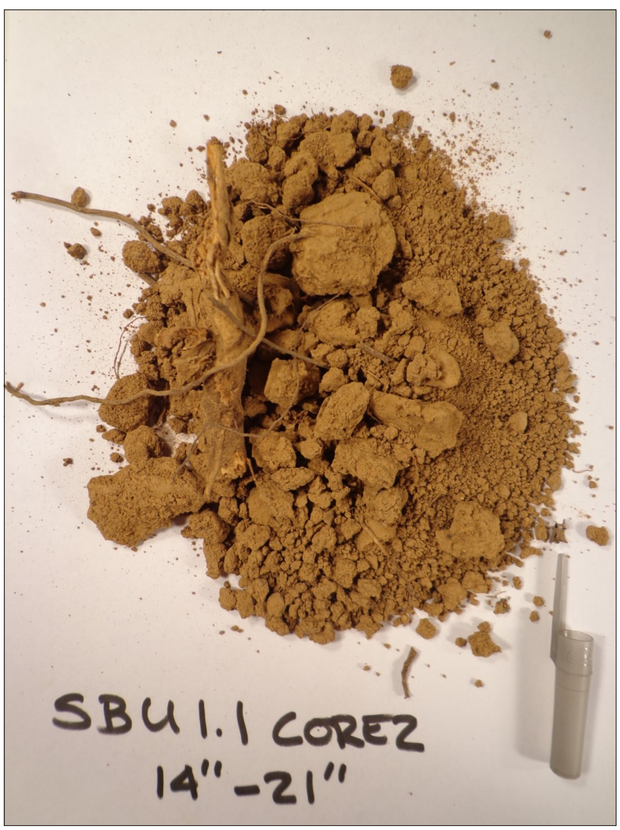
Phi size	SBU 1.1 Core 2 38 – 42.5 in.	SBU 1.1 Core 2 42.5 – 48.5 in.	SBU 1.1 Core 2 48.5 – 53 in.	SBU 1.1 Core 2 53 – 54 in.	SBU 1.1 2B
-1.0 - -0.5	0.00 %	0.00 %	0.29 %	0.72 %	0.00 %
-0.5 – 0.0	0.00 %	0.01 %	1.67 %	2.90 %	0.22 %
0.0 – 0.5	0.00 %	0.25 %	4.69 %	6.80 %	1.62 %
0.5 – 1.0	0.00 %	0.52 %	7.40 %	10.26 %	4.13 %
1.0 – 1.5	0.00 %	0.72 %	7.67 %	10.43 %	5.04 %
1.5 – 2.0	0.09 %	0.81 %	5.53 %	7.29 %	4.47 %
2.0 – 2.5	0.57 %	1.10 %	3.20 %	3.82 %	4.03 %
2.5 – 3.0	1.69 %	2.25 %	2.61 %	2.58 %	4.92 %
3.0 – 3.5	3.84 %	4.50 %	3.93 %	3.59 %	6.87 %
3.5 – 4.0	7.09 %	7.16 %	6.07 %	5.38 %	8.59 %
4.0 – 4.5	10.57 %	9.12 %	7.73 %	6.64 %	9.15 %
4.5 – 5.0	12.79 %	9.67 %	8.12 %	6.81 %	8.53 %
5.0 – 5.5	12.90 %	9.15 %	7.37 %	6.08 %	7.41 %
5.5 – 6.0	11.41 %	8.41 %	6.19 %	5.04 %	6.38 %
6.0 – 6.5	9.38 %	7.86 %	5.16 %	4.14 %	5.58 %
6.5 – 7.0	7.47 %	7.40 %	4.41 %	3.49 %	4.91 %
7.0 – 7.5	5.92 %	6.81 %	3.84 %	2.99 %	4.25 %
7.5 – 8.0	4.41 %	5.99 %	3.31 %	2.56 %	3.58 %
8.0 – 8.5	3.30 %	5.04 %	2.81 %	2.16 %	2.94 %
8.5 – 9.0	2.53 %	4.09 %	2.34 %	1.81 %	2.35 %
9.0 – 9.5	1.99 %	3.19 %	1.89 %	1.46 %	1.80 %
9.5 – 10.0	1.57 %	2.37 %	1.45 %	1.14 %	1.31 %
10.0 – 10.5	1.20 %	1.69 %	1.07 %	0.86 %	0.92 %
10.5 – 11.0	0.84 %	1.14 %	0.75 %	0.61 %	0.61 %
11.0 – 11.5	0.47 %	0.64 %	0.44 %	0.37 %	0.34 %
11.5 – 12.0	0.08 %	0.11 %	0.08 %	0.07 %	0.06 %
12.0 – 12.5	0.00 %	0.00 %	0.00 %	0.00 %	0.00 %
Total:	100.11 %	100.00 %	100.02 %	100.00 %	100.01 %

Stony Brook University Samples: Phi size percent distributions over half phi sizes.

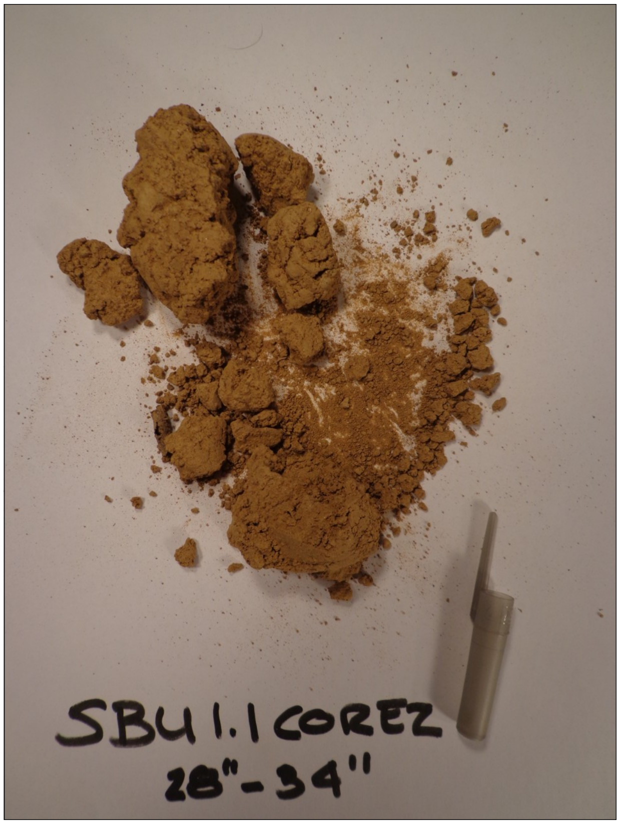
Phi size	SBU 3.1 Black Material	SBU 1.2b Grey Layer	SBU 3.3 Brown Layer	SBU 1 Black Material Under Till	SBU 3.2 Black Layer with rocks and some Brown Layer
-1.0 - -0.5	0.00 %	0.00 %	0.00 %	0.11 %	0.00 %
-0.5 – 0.0	0.35 %	0.52 %	0.00 %	0.67 %	0.16 %
0.0 – 0.5	5.58 %	3.00 %	3.49 %	2.75 %	4.25 %
0.5 – 1.0	11.99 %	5.39 %	12.00 %	4.83 %	10.49 %
1.0 – 1.5	13.27 %	5.97 %	17.28 %	4.97 %	13.62 %
1.5 – 2.0	8.82 %	4.88 %	14.99 %	3.38 %	11.54 %
2.0 – 2.5	3.62 %	3.79 %	7.99 %	1.73 %	6.67 %
2.5 – 3.0	1.85 %	4.26 %	2.47 %	1.46 %	2.97 %
3.0 – 3.5	3.22 %	6.28 %	0.81 %	2.76 %	1.94 %
3.5 – 4.0	5.23 %	8.41 %	1.21 %	4.79 %	2.47 %
4.0 – 4.5	6.24 %	9.43 %	1.77 %	6.49 %	3.27 %
4.5 – 5.0	6.10 %	9.11 %	2.20 %	7.27 %	3.91 %
5.0 – 5.5	5.44 %	7.91 %	2.88 %	7.34 %	4.45 %
5.5 – 6.0	4.84 %	6.50 %	3.78 %	7.32 %	4.86 %
6.0 – 6.5	4.42 %	5.28 %	4.48 %	7.38 %	5.03 %
6.5 – 7.0	4.01 %	4.33 %	4.71 %	7.27 %	4.88 %
7.0 – 7.5	3.52 %	3.56 %	4.50 %	6.77 %	4.47 %
7.5 – 8.0	2.96 %	2.90 %	3.98 %	5.90 %	3.89 %
8.0 – 8.5	2.41 %	2.34 %	3.32 %	4.86 %	3.22 %
8.5 – 9.0	1.91 %	1.87 %	2.61 %	3.83 %	2.52 %
9.0 – 9.5	1.44 %	1.47 %	1.93 %	2.86 %	1.86 %
9.5 – 10.0	1.05 %	1.11 %	1.37 %	2.04 %	1.32 %
10.0 – 10.5	0.75 %	0.80 %	0.96 %	1.43 %	0.93 %
10.5 – 11.0	0.54 %	0.54 %	0.68 %	0.99 %	0.67 %
11.0 – 11.5	0.35 %	0.31 %	0.43 %	0.61 %	0.43 %
11.5 – 12.0	0.09 %	0.05 %	0.15 %	0.21 %	0.16 %
12.0 – 12.5	0.00 %	0.00 %	0.00 %	0.00 %	0.00 %
Total:	100.00 %	100.01 %	99.99 %	100.02 %	99.98 %

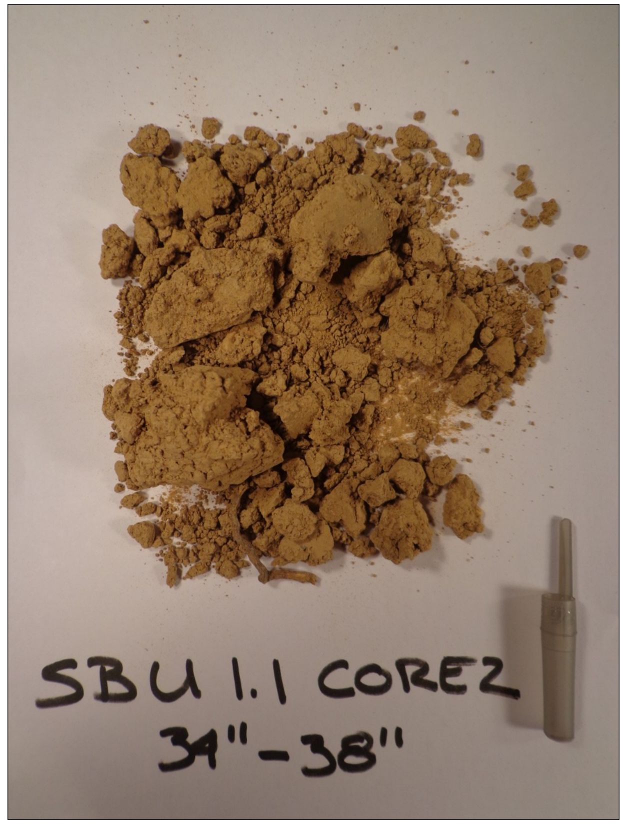
Stony Brook University *(Fig A10a-d)*

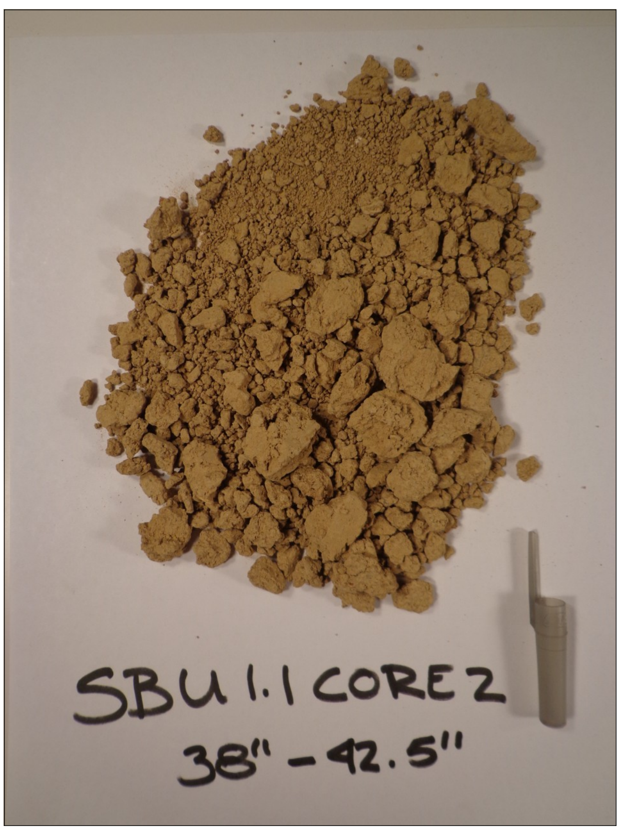


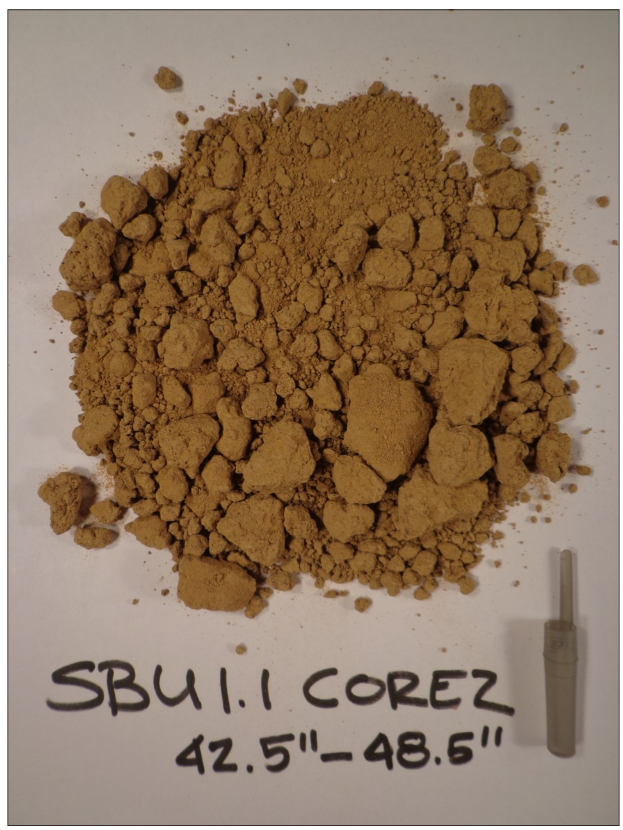


Stony Brook University *(Fig A10e-h)*



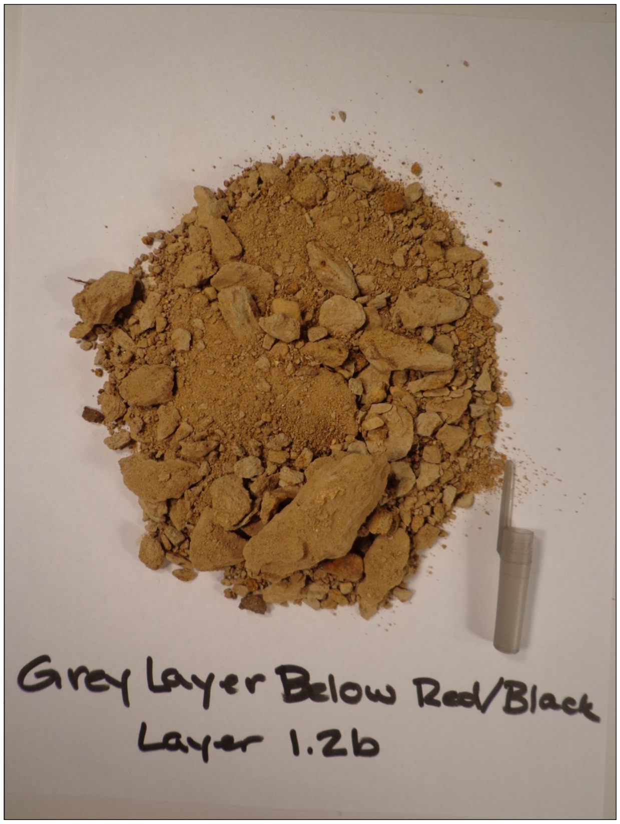






Stony Brook University *(Fig A10i-l)*

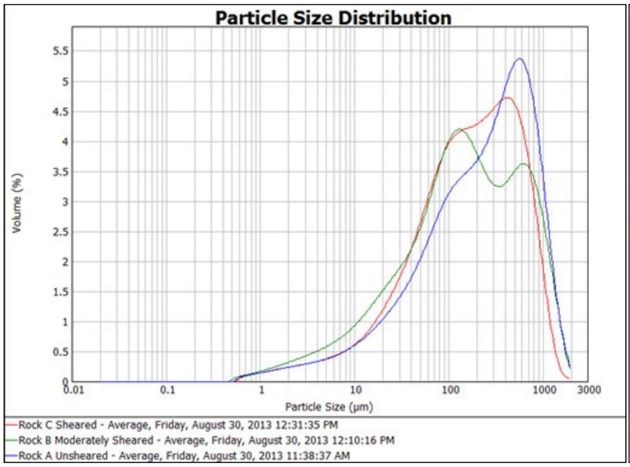
Stony Brook University *(Fig A10m-p)*



(Fig A11) **Stony Brook University Whole Rocks Samples:**

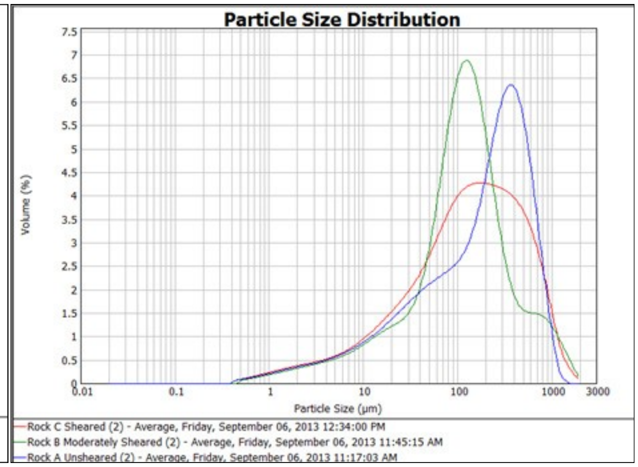
Sample Name	Metal Mortar	Ceramic Mortar	Shatterbox	Grinding Mill	Grain Size Modes (microns)
Stony Brook University	—	—	—	—	—
Process 1:	—	—	—	—	—
Rock A	X				100μm, 575μm
Rock B	X				20μm, 125μm, 600μm
Rock C	X				125μm, 450μm
Process 2:	—	—	—	—	—
Rock A	X	X			40μm, 350μm,
Rock B	X	X			17μm, 125μm, 800μm
Rock C	X	X			150μm (peak extends to ~500μm)
Process 3:	—	—	—	—	—
Rock A	X	X	X		2μm, 15μm, 85μm
Rock B	X	X	X		2μm, 7μm, 50μm
Rock C	X	X	X		2μm, 10μm, 35μm
Process 4:	—	—	—	—	—
Rock A	X	X		X	125μm, 650μm
Rock B	X	X		X	200μm
Rock C	X	X		X	100μm, 700μm

Whole Rock Samples:



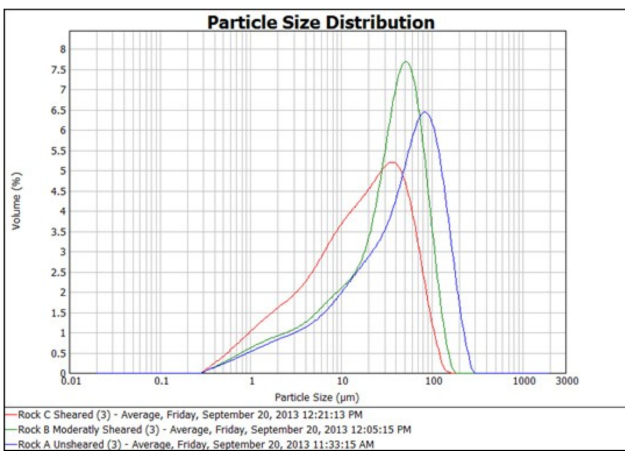
(Fig A12a) Histogram of rocks A, B, and C, from Stony Brook after the first process regime:

Crushed by hand in a metal mortar and pestle.



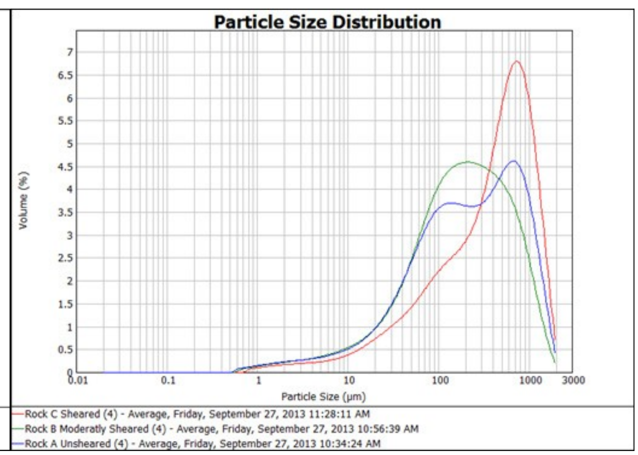
(Fig A12b) Histogram of rocks A, B, and C, from Stony Brook after the second process regime:

Crushed by hand in a metal mortar and pestle, and a ceramic mortar and pestle.



(Fig A12c) Histogram of rocks A, B, and C, from Stony Brook after the third process regime:

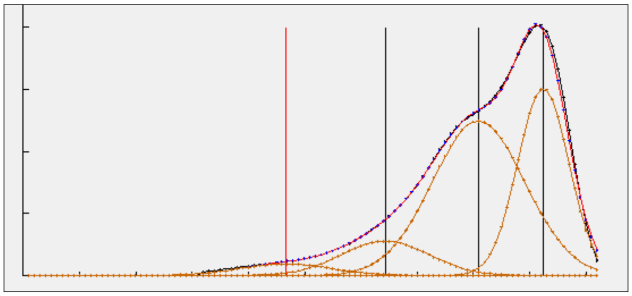
Crushing by hand in a metal mortar and pestle, a ceramic mortar and pestle, and then placed in an agate shatterbox.



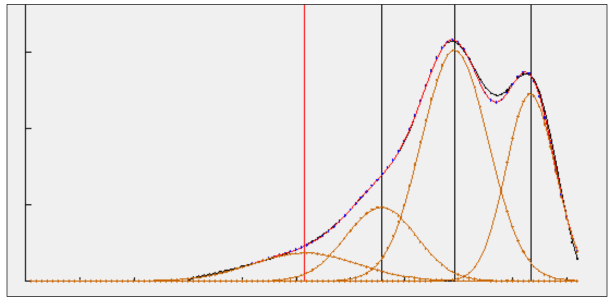
(Fig A12d) Histogram of rocks A, B, and C, from Stony Brook after the fourth process regime:

Crushing by hand in a metal mortar and pestle, a ceramic mortar and pestle, and then placed in a grinding mill.

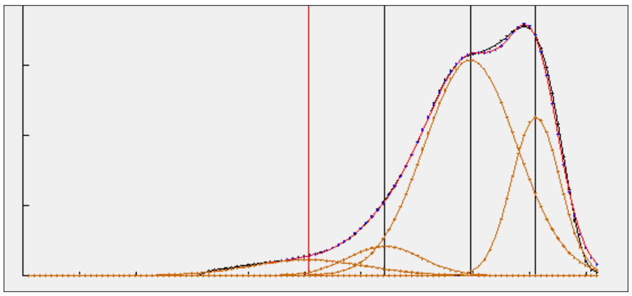
Whole Rock Samples GrainAnalysis Graphs:



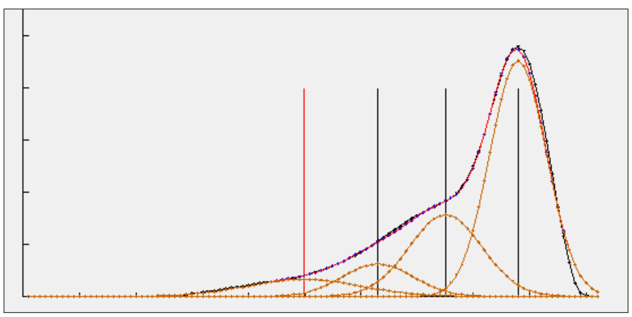
(Fig A12e) Graph for Rock A Unsheared Process 1



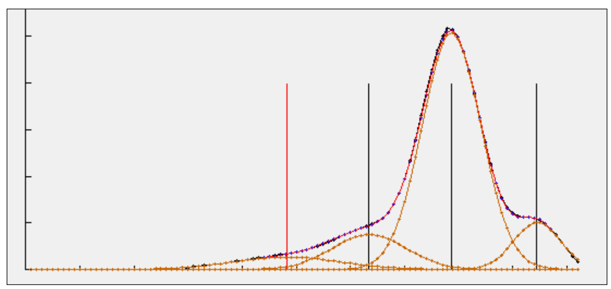
(Fig A12f) Graph for Rock B Moderately Sheared Process 1



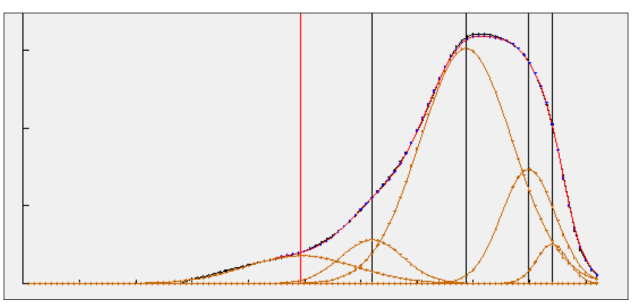
(Fig A12g) Graph for Rock C Sheared Process 1



(Fig A12h) Graph for Rock A Unsheared Process 2

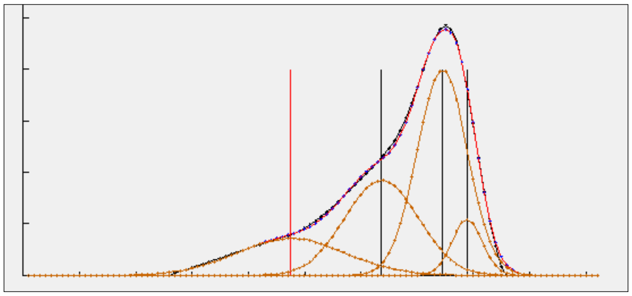


(Fig A12i) Graph for Rock B Moderately Sheared Process 2

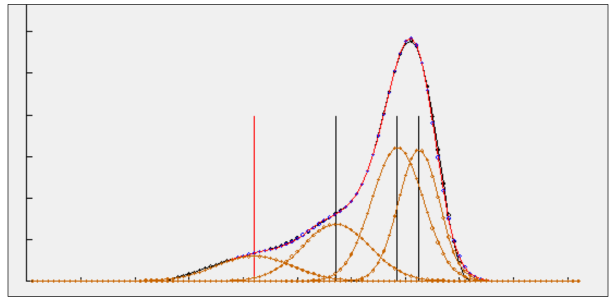


(Fig A12j) Graph for Rock C Sheared Process 2

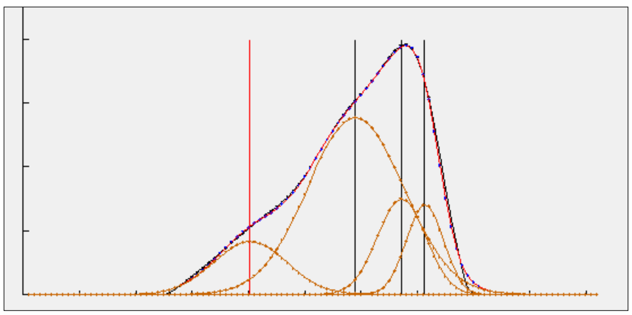
Whole Rock Samples GrainAnalysis Graphs:



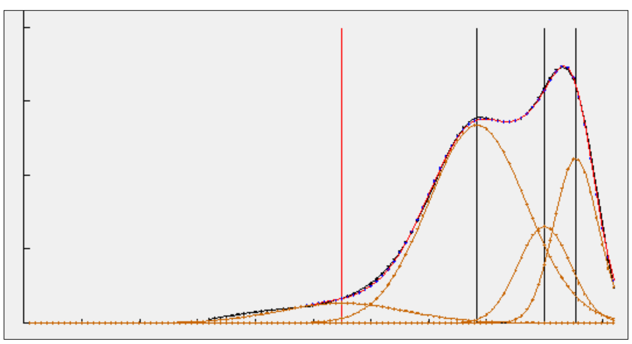
(Fig A12k) Graph for Rock A Unsheared Process 3



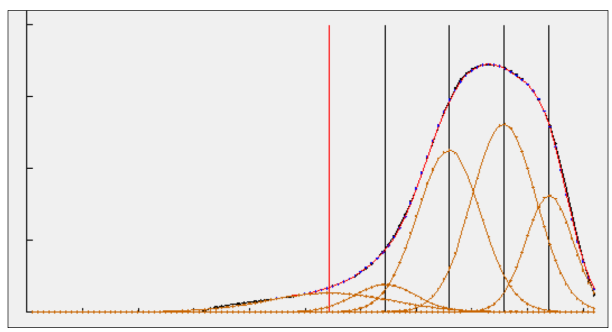
(Fig A12l) Graph for Rock B Moderately Sheared Process 3



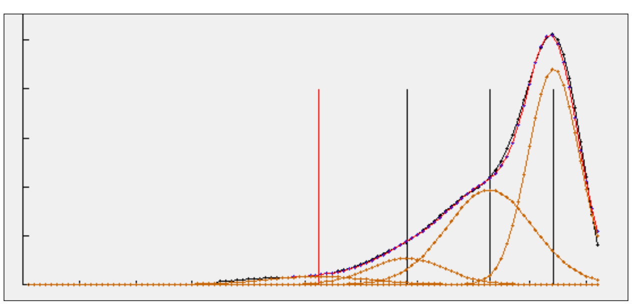
(Fig A12m) Graph for Rock C Sheared Process 3



(Fig A12n) Graph for Rock A Unsheared Process 4



(Fig A12o) Graph for Rock B Moderately Sheared Process 4



(Fig A12p) Graph for Rock C Sheared Process 4

(Fig A13) **Stony Brook University Whole Rock Samples:** Phi size percent distributions over half phi sizes.

Phi size	Process 1 Rock A	Process 1 Rock B	Process 1 Rock C	Process 2 Rock A	Process 2 Rock B	Process 2 Rock C
-1.0 - -0.5	1.56 %	1.64 %	0.32 %	0.01 %	0.89 %	0.57 %
-0.5 – 0.0	5.42 %	4.66 %	2.47 %	0.99 %	2.21 %	2.16 %
0.0 – 0.5	9.95 %	7.38 %	6.49 %	5.26 %	3.15 %	5.16 %
0.5 – 1.0	12.03 %	8.12 %	9.67 %	10.69 %	3.41 %	7.56 %
1.0 – 1.5	11.25 %	7.55 %	10.64 %	14.01 %	4.15 %	8.83 %
1.5 – 2.0	9.59 %	7.48 %	10.24 %	13.49 %	6.94 %	9.38 %
2.0 – 2.5	8.43 %	8.41 %	9.73 %	10.42 %	11.43 %	9.62 %
2.5 – 3.0	7.81 %	9.35 %	9.49 %	7.50 %	14.94 %	9.61 %
3.0 – 3.5	7.15 %	9.14 %	9.03 %	5.97 %	14.86 %	9.10 %
3.5 – 4.0	6.06 %	7.67 %	7.84 %	5.32 %	11.29 %	7.86 %
4.0 – 4.5	4.77 %	5.96 %	6.19 %	4.83 %	6.96 %	6.32 %
4.5 – 5.0	3.68 %	4.76 %	4.66 %	4.25 %	4.20 %	5.02 %
5.0 – 5.5	2.86 %	3.96 %	3.45 %	3.60 %	3.09 %	4.07 %
5.5 – 6.0	2.21 %	3.26 %	2.50 %	2.94 %	2.65 %	3.29 %
6.0 – 6.5	1.68 %	2.56 %	1.77 %	2.35 %	2.22 %	2.59 %
6.5 – 7.0	1.28 %	1.98 %	1.28 %	1.87 %	1.76 %	2.00 %
7.0 – 7.5	1.00 %	1.55 %	0.99 %	1.50 %	1.38 %	1.56 %
7.5 – 8.0	0.81 %	1.24 %	0.80 %	1.21 %	1.13 %	1.25 %
8.0 – 8.5	0.68 %	1.00 %	0.68 %	1.00 %	0.94 %	1.05 %
8.5 – 9.0	0.58 %	0.80 %	0.57 %	0.85 %	0.79 %	0.91 %
9.0 – 9.5	0.48 %	0.61 %	0.48 %	0.70 %	0.63 %	0.76 %
9.5 – 10.0	0.37 %	0.44 %	0.37 %	0.54 %	0.47 %	0.59 %
10.0 – 10.5	0.26 %	0.30 %	0.26 %	0.38 %	0.33 %	0.42 %
10.5 – 11.0	0.10 %	0.17 %	0.08 %	0.24 %	0.20 %	0.26 %
11.0 – 11.5	0.00 %	0.00 %	0.00 %	0.07 %	0.00 %	0.07 %
11.5 – 12.0	0.00 %	0.00 %	0.00 %	0.00 %	0.00 %	0.00 %
12.0 – 12.5	0.00 %	0.00 %	0.00 %	0.00 %	0.00 %	0.00 %
Total:	100.01 %	99.99 %	100.00 %	99.99 %	100.02 %	100.01 %

Stony Brook University Whole Rock Samples: Phi size percent distributions over half phi sizes.

Phi size	Process 3 Rock A	Process 3 Rock B	Process 3 Rock C	Process 4 Rock A	Process 4 Rock B	Process 4 Rock C
-1.0 - -0.5	0.00 %	0.00 %	0.00 %	2.70 %	1.38 %	4.47 %
-0.5 – 0.0	0.00 %	0.00 %	0.00 %	6.82 %	4.10 %	10.83 %
0.0 – 0.5	0.00 %	0.00 %	0.00 %	9.83 %	7.01 %	14.87 %
0.5 – 1.0	0.00 %	0.00 %	0.00 %	10.23 %	8.87 %	14.45 %
1.0 – 1.5	0.00 %	0.00 %	0.00 %	9.16 %	9.76 %	11.31 %
1.5 – 2.0	0.20 %	0.00 %	0.00 %	8.35 %	10.21 %	8.35 %
2.0 – 2.5	3.37 %	0.00 %	0.00 %	8.22 %	10.37 %	6.64 %
2.5 – 3.0	9.02 %	1.58 %	0.16 %	8.35 %	10.15 %	5.77 %
3.0 – 3.5	13.56 %	7.32 %	2.47 %	8.14 %	9.32 %	5.07 %
3.5 – 4.0	14.21 %	14.13 %	6.63 %	7.16 %	7.73 %	4.19 %
4.0 – 4.5	11.87 %	17.20 %	10.35 %	5.64 %	5.77 %	3.30 %
4.5 – 5.0	9.15 %	14.96 %	11.71 %	4.11 %	4.04 %	2.59 %
5.0 – 5.5	7.38 %	10.43 %	11.11 %	2.88 %	2.80 %	2.04 %
5.5 – 6.0	6.27 %	7.00 %	10.03 5	2.00 %	2.00 %	1.54 %
6.0 – 6.5	5.26 %	5.38 %	9.07 %	1.43 %	1.49 %	1.11 %
6.5 – 7.0	4.25 %	4.57 %	8.04 %	1.08 %	1.15 %	0.79 %
7.0 – 7.5	3.38 %	3.82 %	6.78 %	0.85 %	0.91 %	0.60 %
7.5 – 8.0	2.74 %	3.08 %	5.53 %	0.71 %	0.74 %	0.50 %
8.0 – 8.5	2.32 %	2.55 %	4.57 %	0.61 %	0.62 %	0.44 %
8.5 – 9.0	1.99 %	2.20 %	3.89 %	0.54 %	0.53 %	0.40 %
9.0 – 9.5	1.68 %	1.91 %	3.29 %	0.47 %	0.44 %	0.34 %
9.5 – 10.0	1.33 %	1.56 %	2.61 %	0.37 %	0.33 %	0.25 %
10.0 – 10.5	0.98 %	1.16 %	1.90 %	0.26 %	0.23 %	0.12 %
10.5 – 11.0	0.64 %	0.75 %	1.21 %	0.10 %	0.04 %	0.00 %
11.0 – 11.5	0.33 %	0.36 %	0.58 %	0.00 %	0.00 %	0.00 %
11.5 – 12.0	0.04 %	0.04 %	0.08 %	0.00 %	0.00 %	0.00 %
12.0 – 12.5	0.00 %	0.00 %	0.00 %	0.00 %	0.00 %	0.00 %
Total:	99.97 %	100.00 %	100.01 %	100.01 %	99.99 %	99.97 %

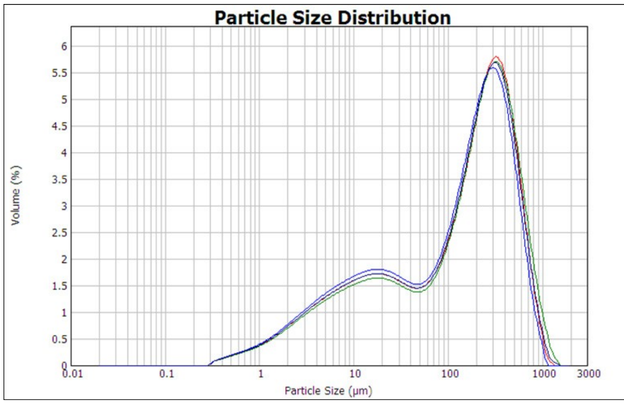
(Fig A14) **Centereach, Long Island, New York:**

Sample Name	Type	Grain Size Modes (microns)
Centereach	—	—
S 1	Glacial sandy silt	17µm, 300µm
S 2	Glacial sandy silt	10µm, 80µm, 300µm
S 3	Glacial sandy silt	80µm
S 4	Glacial sandy silt	10µm, 80µm, 350µm
S 5	Glacial silt	40µm, 500µm
S 7	Glacial silt	10µm, 75µm, 350µm
S 9	Glacial silt	90µm
S10	Glacial silt	70µm
S 11a	Glacial sandy silt	0.5µm, 5µm, 30 µm, 325µm
S 11b	Glacial pebbly silt	5µm, 350µm
S10 Core 1 1.1	Glacial silt	75µm
S10 Core 1 1.2	Glacial silt	10µm, 75µm, 500µm
S10 Core 1 1.3	Glacial silt	15µm, 80µm, 500µm
S10a Core 2	Glacial silt	15µm 95µm
Micaceous material S9/S10	Glacial silt	15µm, 80µm, 500µm
S11 1.1	Glacial sand	400µm
S11 1.2	Glacial sand	15µm, 70µm, 400µm
S11 1.3	Glacial silt	20µm, 90µm, 600µm
S11 1.4	Glacial sand	17µm, 90µm
S11 with rock	Glacial sand	90µm, 350µm

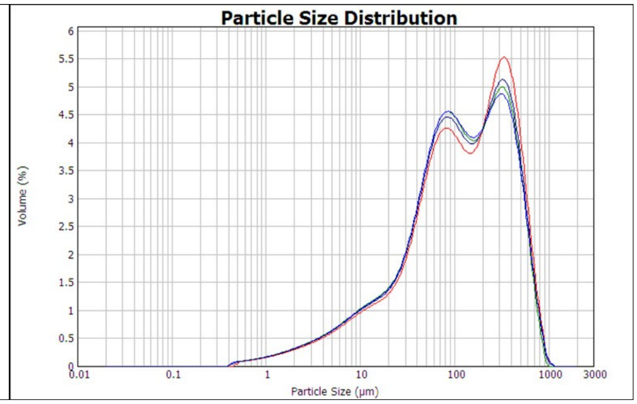
Centereach, Long Island, New York:

Sample Name	Type	Grain Size Modes (microns)
Centereach	—	—
S11 under rock	Glacial sand	20µm, 60µm, 425µm
S11 A Core 1 24.5-27.75 in	Glacial sand	0.5µm, 17µm, 55µm, 400µm
S11 B Core 1 27.5-31.5 in	Glacial sand	0.5µm, 17µm, 400µm
S11 C Core 1 31.5-37 in	Glacial pebbly silt	15µm, 80µm, 400µm
S11 D Core 1 37-43 in	Glacial silty sand	15µm, 80µm
S11 Core 1.1 A 3”-4”	Glacial coarse sand	7.5µm, 400µm
S11 Core 1.1 A 7”-8”	Glacial coarse sand	15µm, 100µm, 500µm
S11 Core 1.2 A 2”-3”	Glacial silt	4µm, 20µm, 175µm
S11 Core 1.2 A 8”-9”	Glacial silt	10µm, 300µm
S11 Core 1.3 A 0.5”-1”	Glacial course Sand	20µm, 80µm, 400µm
S11 Core 1.3 A ~3”-3.5”	Glacial micaceous silt	75µm, 700µm
S10 Core 1.1 4.5”-5.5”	Glacial silt	10µm, 80µm, 1000µm
S10 Core 1.1 10”-11”	Glacial silt	10µm, 75µm, 450µm
S10 Core 1.2 2”-3”	Glacial silt	90µm, 700µm
S10 Core 1.2 9.5”-10”	Glacial sand	15v, 29µm, 90µm, 600µm
S10 Core 1.3 3”-4”	Glacial silt	10µm, 65µm, 600µm
S10 Core 1.3 7”-8”	Glacial silt	10µm, 60µm, 500µm

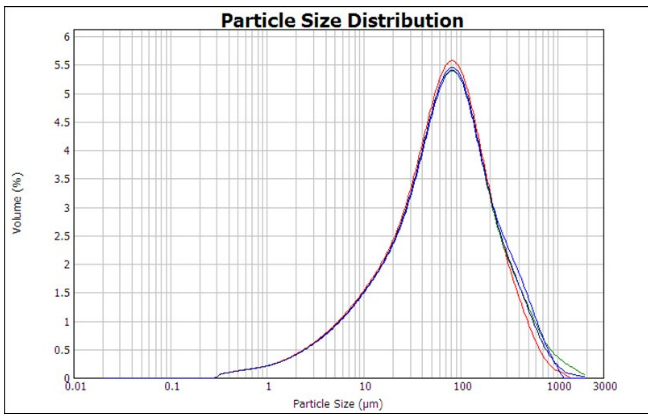
Centereach, Long Island, New York



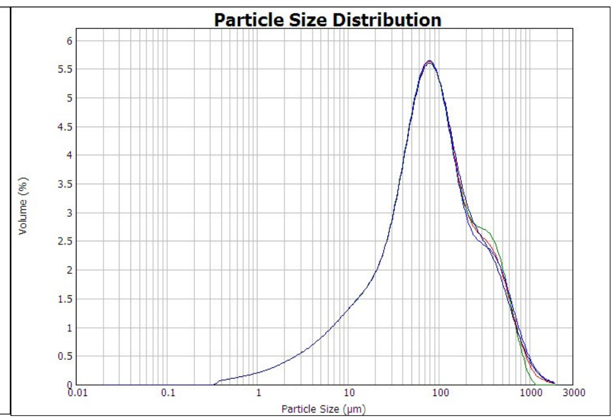
(Fig A15a) Histogram of glacial sandy silt from Centereach, with modes around 17µm and 300µm. Sample S1



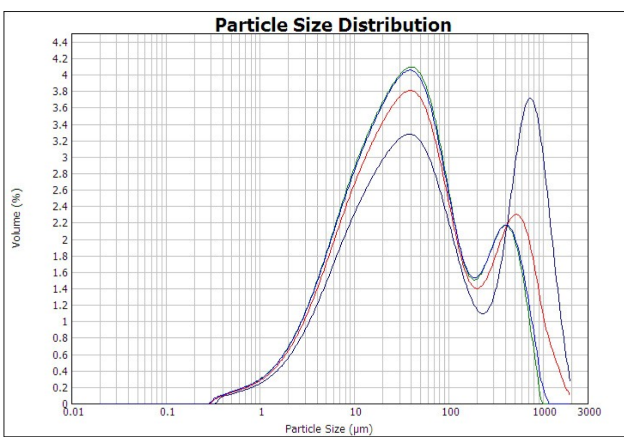
(Fig A15b) Histogram of glacial sandy silt from Centereach, with modes around 10µm, 80µm and 300µm. Sample S2



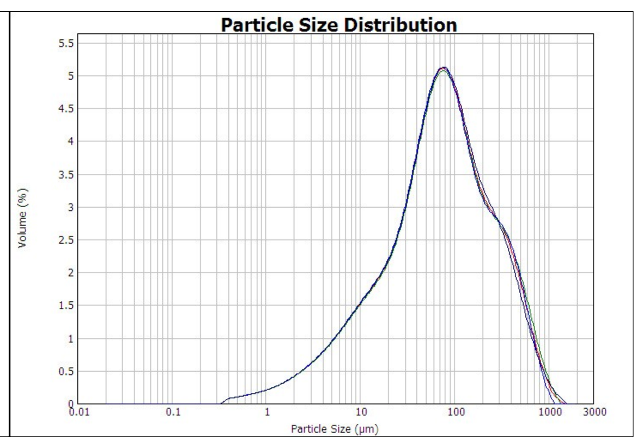
(Fig A15c) Histogram of glacial sandy silt from Centereach, with a mode around 80µm. Sample S3



(Fig A15d) Histogram of glacial sandy silt from Centereach, with modes around 10µm, 80µm, and 350µm. Sample S4

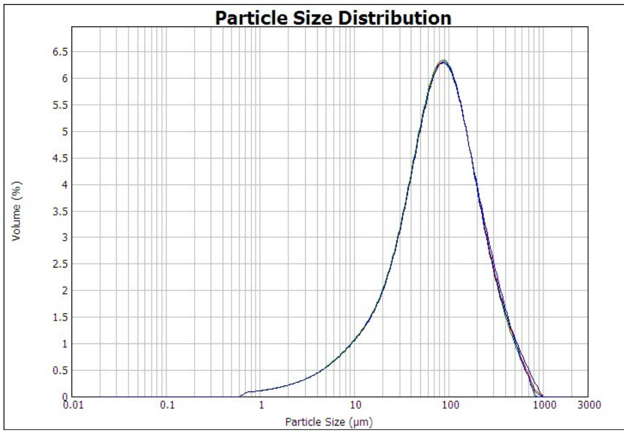


(Fig A15e) Histogram of glacial silt from Centereach, with modes around 40µm and 500µm. Sample S5

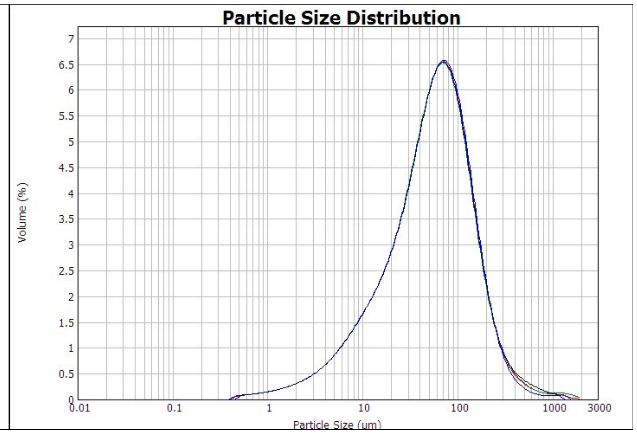


(Fig A15f) Histogram of glacial silt from Centereach, with modes around 10µm, 75µm and 350µm. Sample S7

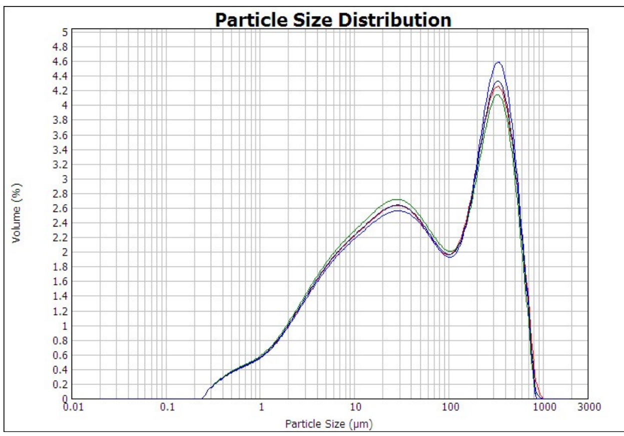
<u>Centereach, Long Island, New York</u>



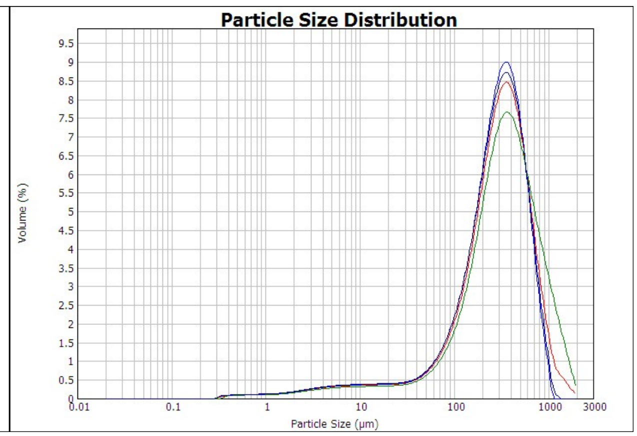
(Fig A15g) Histogram of glacial silt from Centereach, with a mode around 90µm. Sample S9



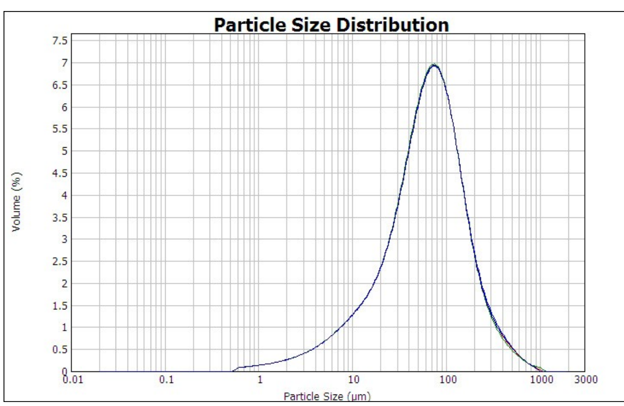
(Fig A15h) Histogram of glacial silt from Centereach, with a mode around 70µm. Sample S10



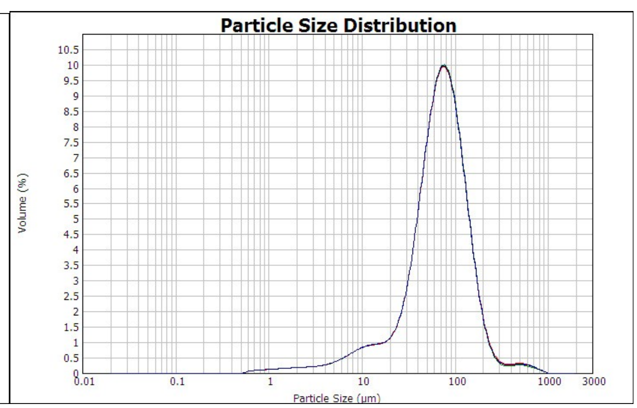
(Fig A15i) Histogram of glacial sandy silt from Centereach, with modes around 0.5µm, 5µm, 30µm, and 325µm. Sample S11a



(Fig A15j) Histogram of glacial pebbly silt from Centereach, with modes around 5µm and 350µm. Sample S11b

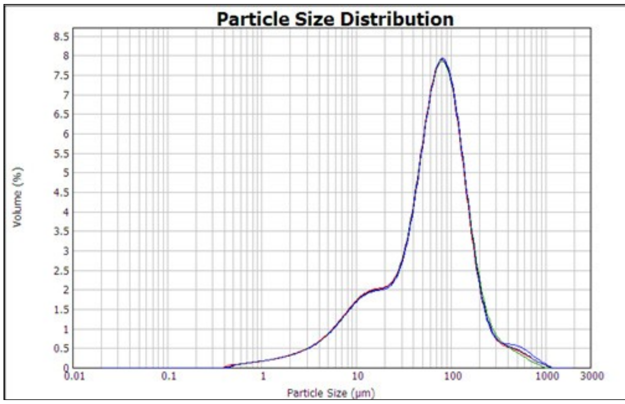


(Fig A15k) Histogram of glacial silt from Centereach, with a mode around 75µm. Sample S10 Core 1.1 12"-13.5"

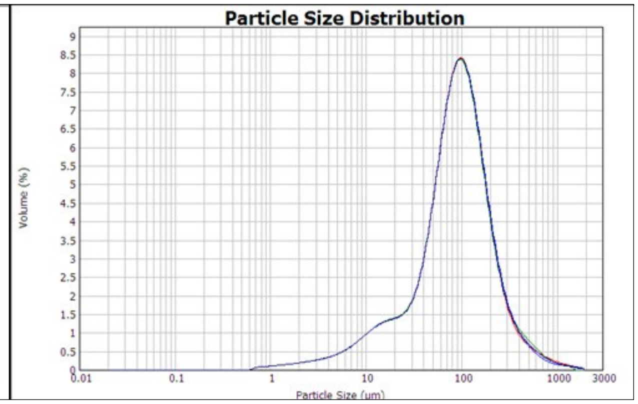


(Fig A15l) Histogram of glacial silt from Centereach, with modes around 10µm, 75µm, and 500µm. Sample S10 Core 1.2 25.5"-27.5"

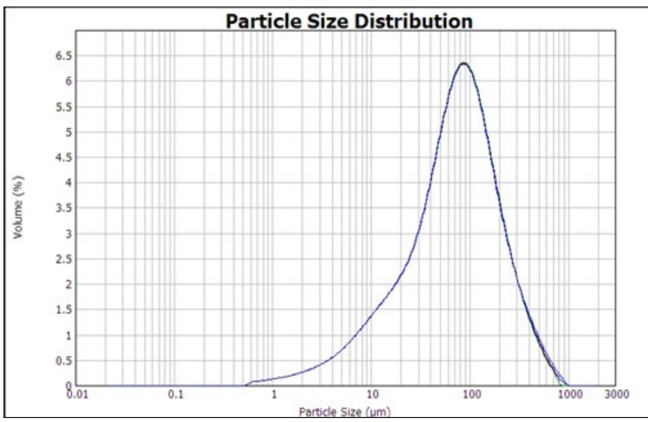
Centereach, Long Island, New York



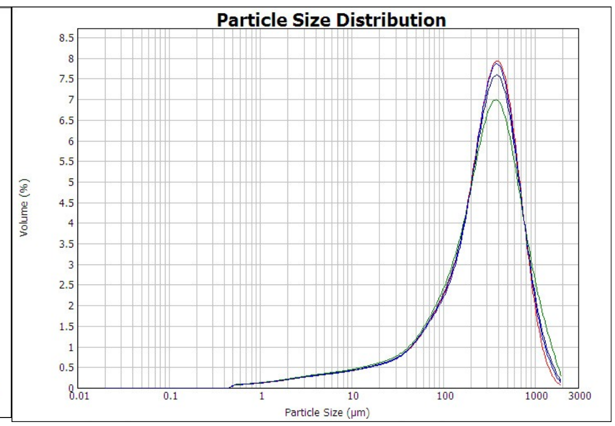
(Fig A15m) Histogram of glacial silt from Centereach, with modes around 15µm, 80µm, and 500µm. Sample S10 Core 1.3 39"-40.5"



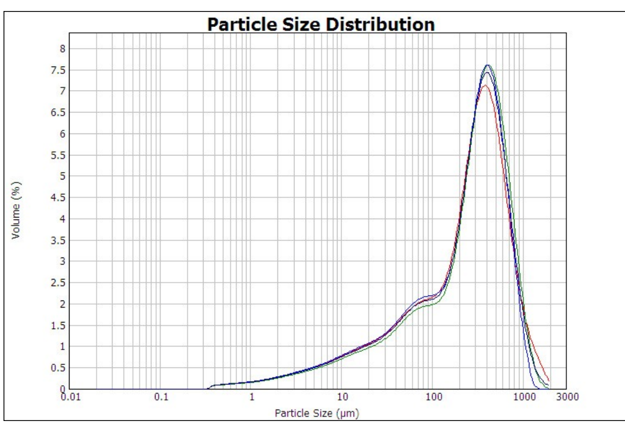
(Fig A15n) Histogram of glacial silt from Centereach, with modes around 15µm, and 95µm. Sample S10a Core 2



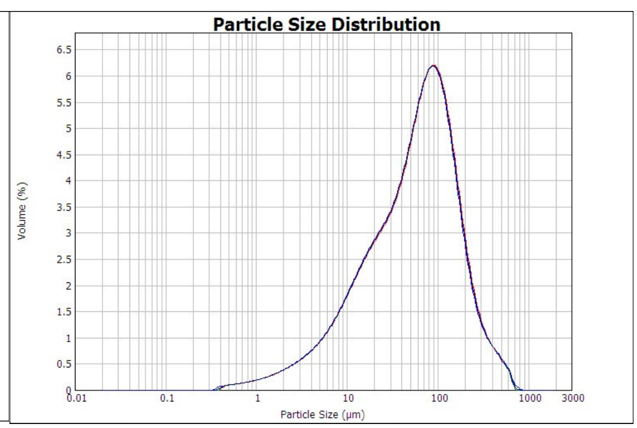
(Fig A15o) Histogram of glacial silt from Centereach, with modes around 15µm, 80µm, and 500µm. Sample Micaceous material S9/ S10



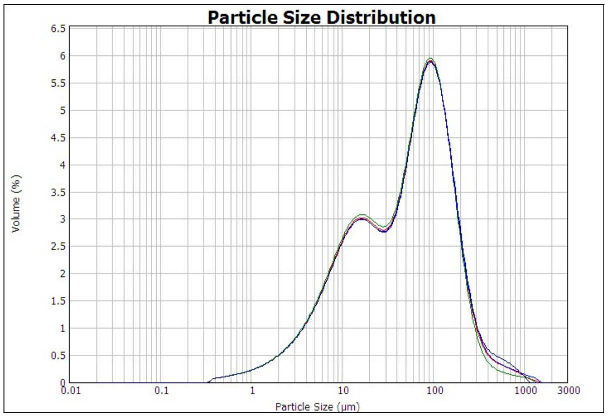
(Fig A15p) Histogram of glacial sand from Centereach, with a mode around 400µm. Sample S11 1.1 12"-13.5"



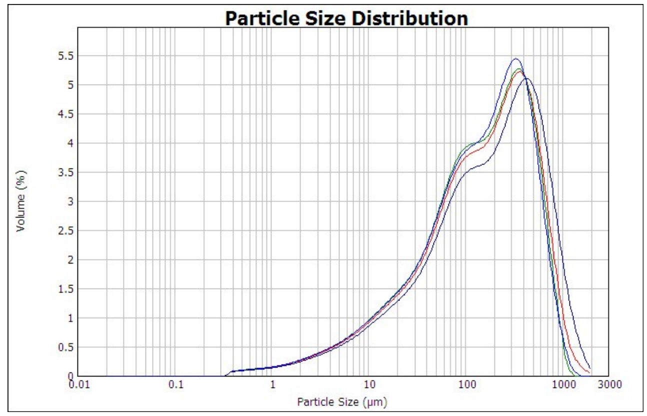
(Fig A15q) Histogram of glacial sand from Centereach, with modes around 15µm, 70µm, and 400µm. Sample S11 1.2 25.5"-27"



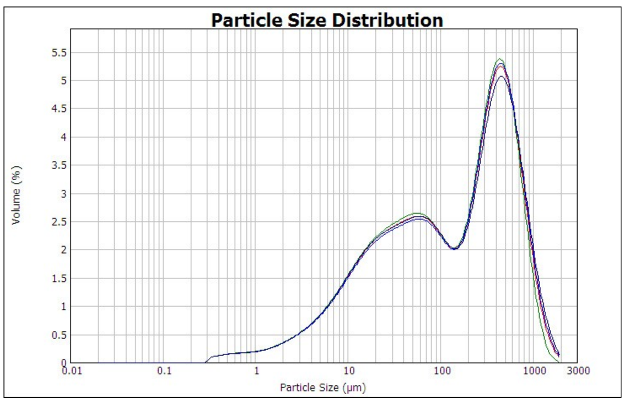
(Fig A15r) Histogram of glacial silt from Centereach, with modes around 20µm, 90µm, and 600µm. Sample S11 1.3 54.5"-56"



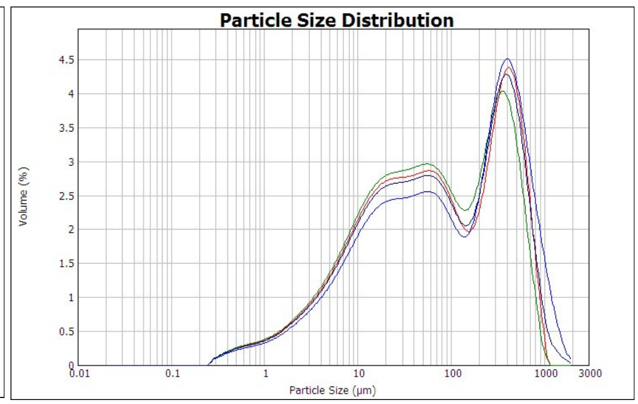
(Fig A15s) Histogram of glacial sand from Centereach, with modes around 17µm, and 90µm. Sample S11 1.4 68”-69.5”



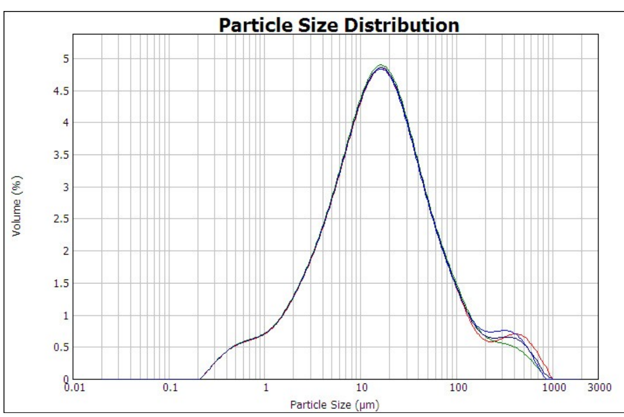
(Fig A15t) Histogram of glacial sand from Centereach, with modes around 90µm, and 350µm. Sample S11 with rock 27”-39”



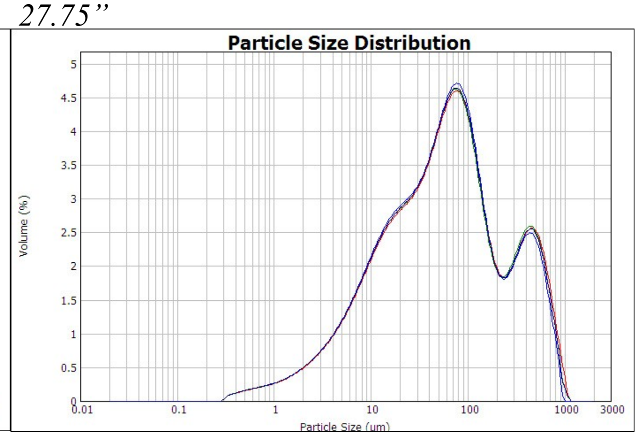
(Fig A15u) Histogram of glacial sand from Centereach, with modes around 20µm, 60µm, and 425µm. Sample S11 under rock 39”-42.5”



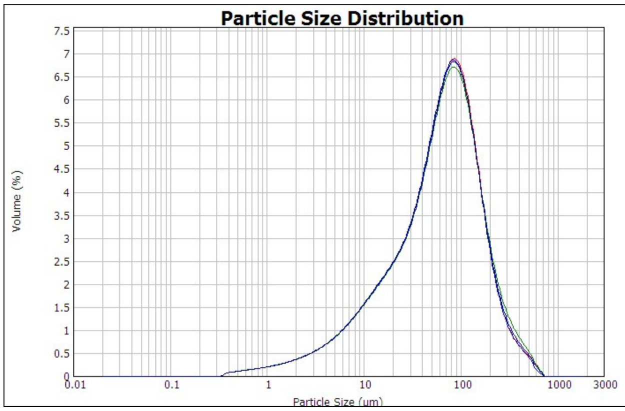
(Fig A15v) Histogram of glacial sand from Centereach, with modes around 0.5µm, 17µm, 55µm, and 400µm. Sample S11 A Core 1 4.5”-27.75”



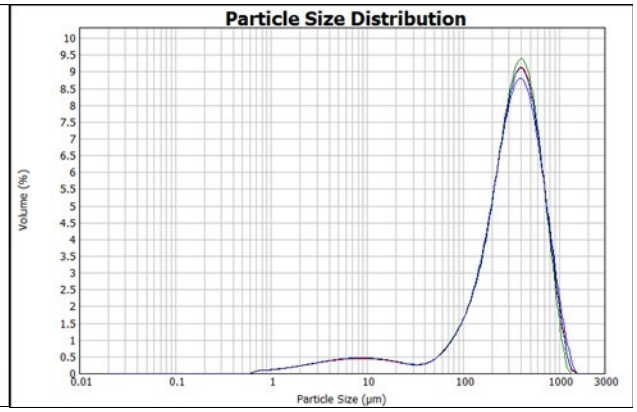
(Fig A15w) Histogram of glacial sand from Centereach, with modes around 0.5µm, 17µm, and 400µm. Sample S11 B Core 1 27.5”-31.5”



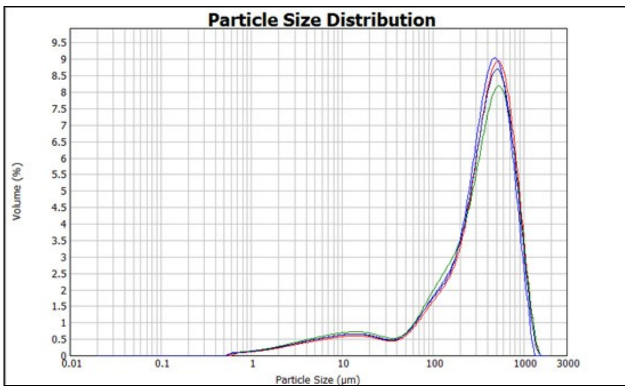
(Fig A15x) Histogram of glacial pebbly silt from Centereach, with modes around 15µm, 80µm, and 400µm. Sample S11 C Core 1 31.5”-37”



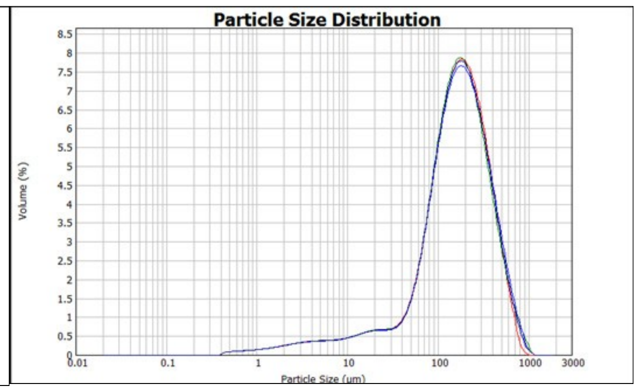
(Fig A15y) Histogram of glacial silty sand from Centereach, with modes around 15µm, and 80µm. Sample S11 D Core 1 37"-43"



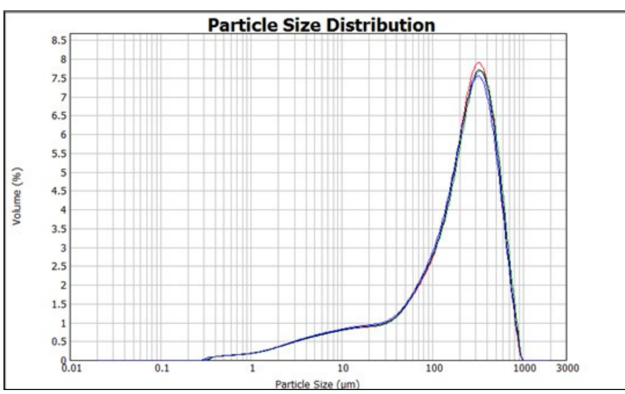
(Fig A15z) Histogram of glacial coarse sand from Centereach, with modes around 7.5µm, and 400µm. Sample S11 Core 1.1 A 3"-4"



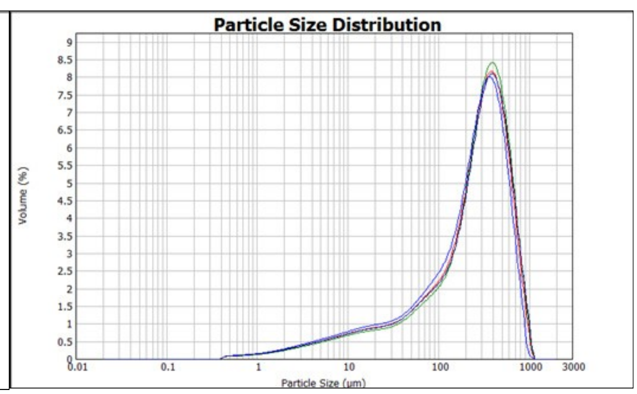
(Fig A15aa) Histogram of glacial coarse sand from Centereach, with modes around 15µm, 100µm, and 500µm. Sample S11 Core 1.1 A 7"-8"



(Fig A15ab) Histogram of glacial silt from Centereach, with modes around 4µm, 20µm, and 175µm. Sample S11 Core 1.2 A 2"-3"

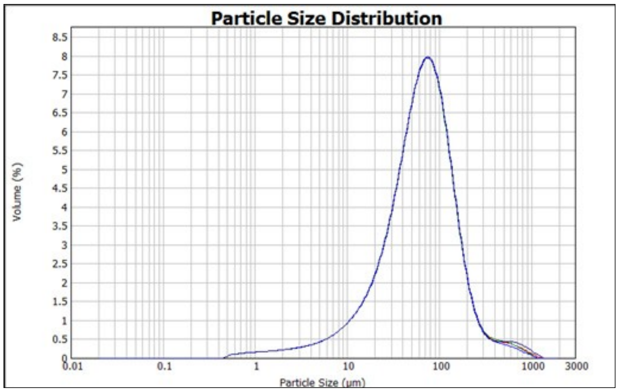


(Fig A15ac) Histogram of glacial silt from Centereach, with modes around 10µm and 300µm. Sample S11 Core 1.2 A 8"-9"

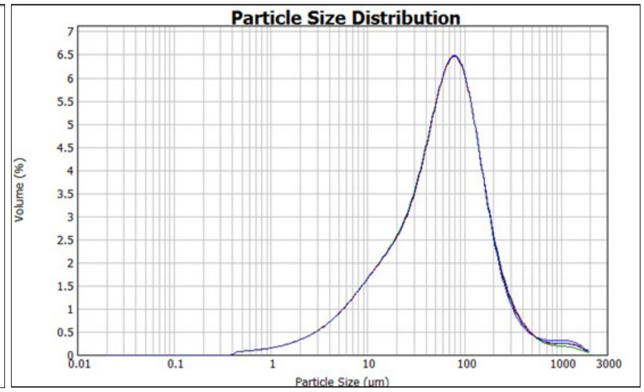


(Fig A15ad) Histogram of glacial coarse sand from Centereach, with modes around 20µm, maybe 80µm and 400µm. Sample S11 Core 1.3 A 0.5"-1"

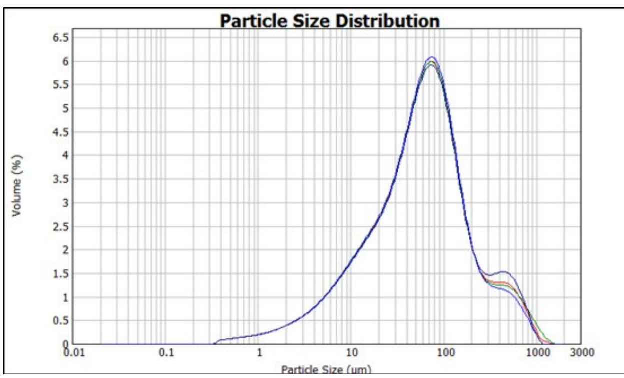
<u>Centereach, Long Island, New York</u>



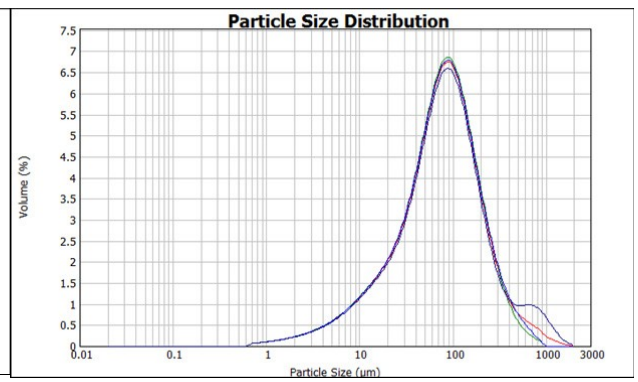
(Fig A15ae) Histogram of glacial micaceous silt from Centereach, with modes around 75µm, and 700µm. Sample S11 Core 1.3 A ~3"-3.5"



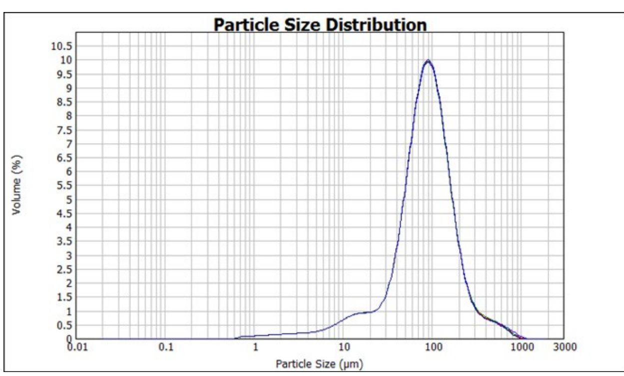
(Fig A15af) Histogram of glacial silt from Centereach, with modes around 10µm, 80µm and 1000µm.
Sample S10 Core 1.1 4.5"-5.5"



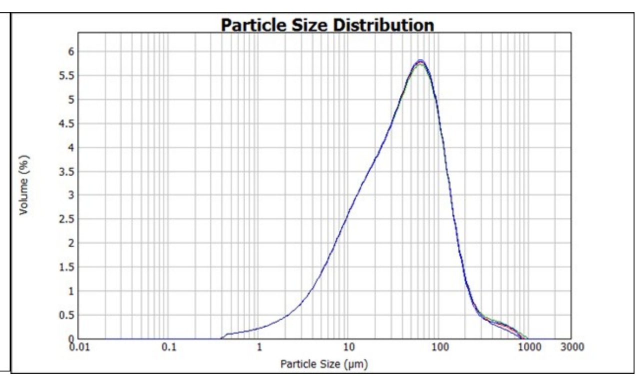
(Fig A15ag) Histogram of glacial silt from Centereach, with modes around 10µm, 75µm and 450µm. Sample S10 Core 1.1 10"-11"



(Fig A15ah) Histogram of glacial silt from Centereach, with modes around 90µm and 700µm. Sample S10 Core 1.2 2"-3"

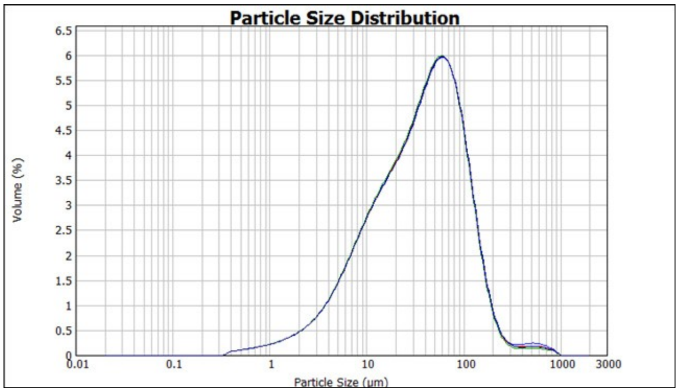


(Fig A15ai) Histogram of glacial sand from Centereach, with modes around 15µm, 29µm, 90µm, and 600µm. Sample S10 Core 1.2 9.5"-10"



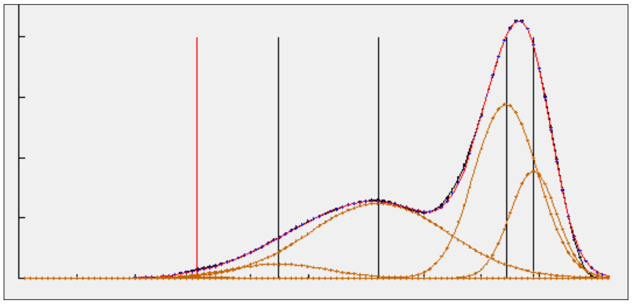
(Fig A15aj) Histogram of glacial silt from Centereach, with modes around 10µm, 65µm, and 600µm. Sample S10 Core 1.3 3"-4"

Centereach, Long Island, New York

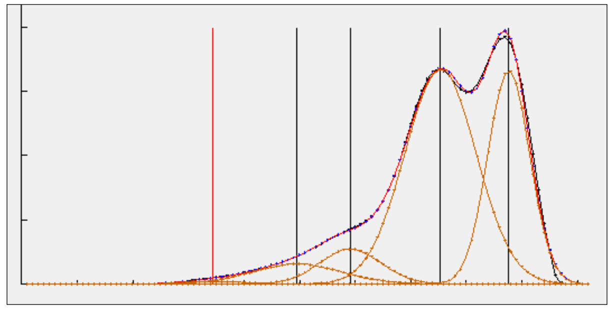


(Fig A15ak) Histogram of glacial silt from Centereach, with modes around 10μm, 60μm and 500μm. Sample S10 Core 1.3 7"-8"

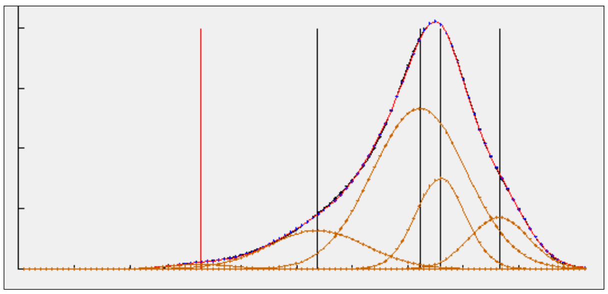
Centereach, Long Island, New York GrainAnalysis Graphs:



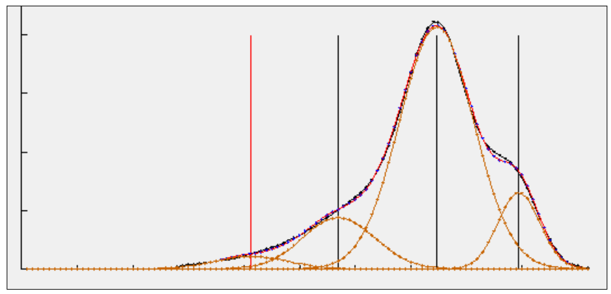
(Fig A15aa) Graph for S1



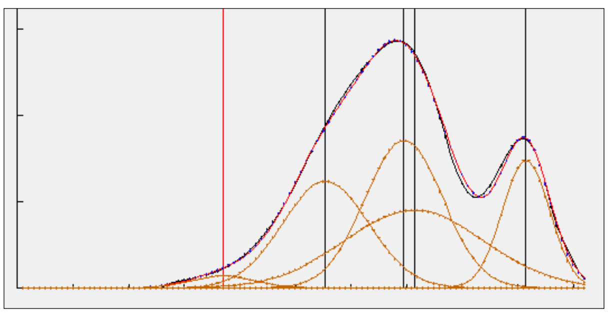
(Fig A15bb) Graph for S2



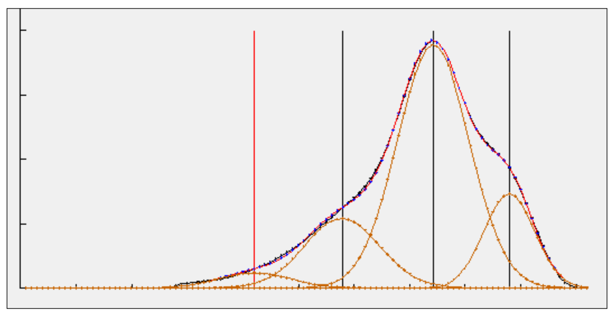
(Fig A15cc) Graph for S3



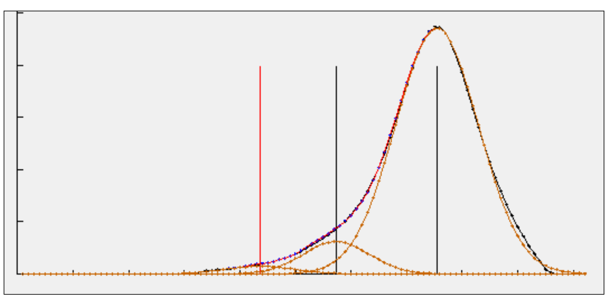
(Fig A15dd) Graph for S4



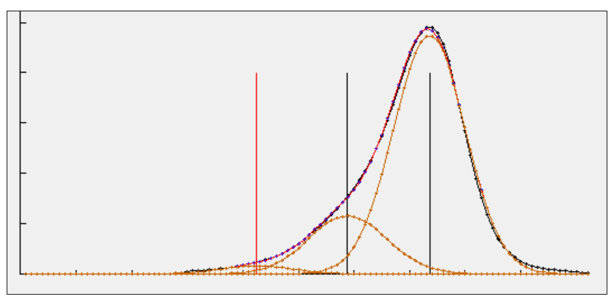
(Fig A15ee) Graph for S5



(Fig A15ff) Graph for S7

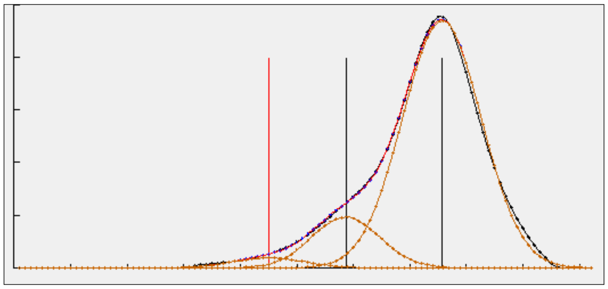


(Fig A15gg) Graph for S9

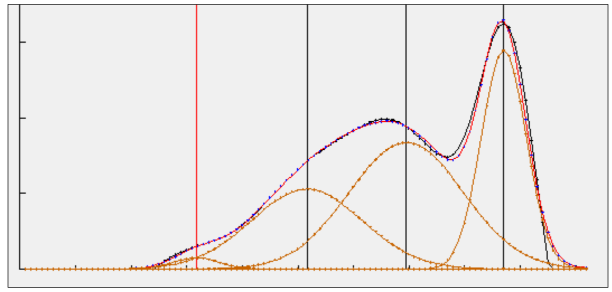


(Fig A15hh) Graph for S10

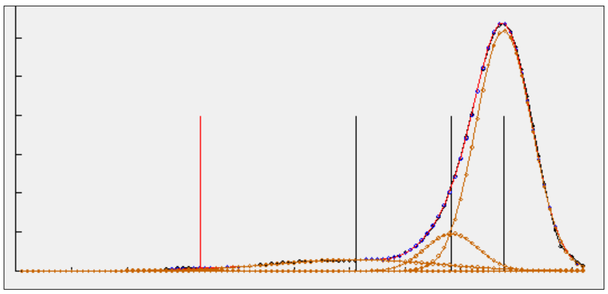
<u>Centereach, Long Island, New York GrainAnalysis Graphs:</u>



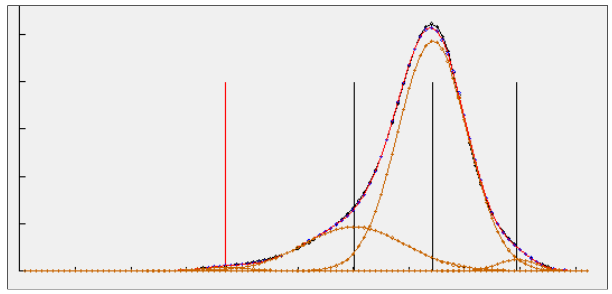
(Fig A15ii) Graph for Micaceous material S9/S10



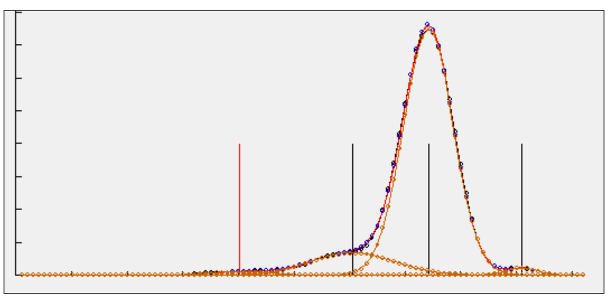
(Fig A15jj) Graph for S11a



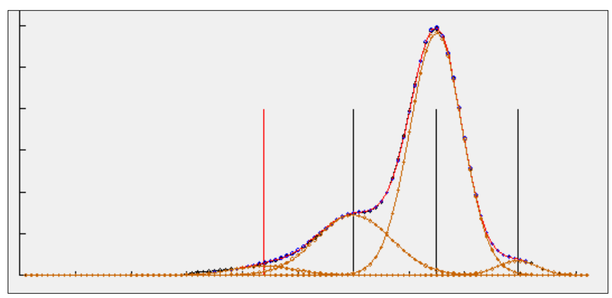
(Fig A15kk) Graph for S11b



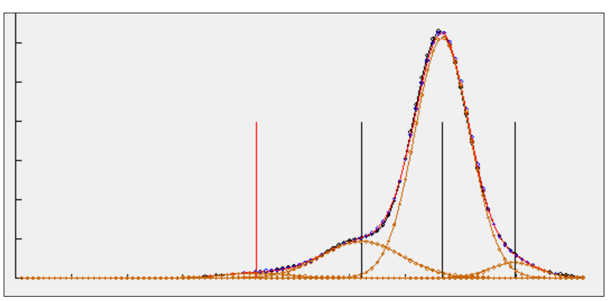
(Fig A15ll) Graph for S10 Core 1 1.1



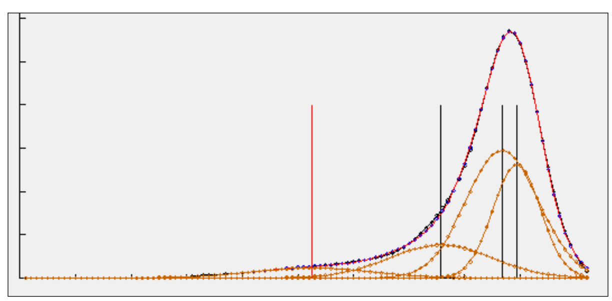
(Fig A15mm) Graph for S10 Core 1 1.2



(Fig A15nn) Graph for S10 Core 1 1.3

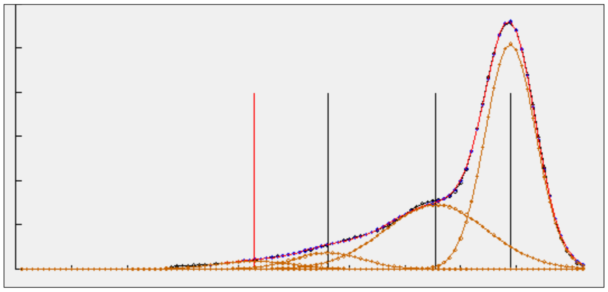


(Fig A15oo) Graph for S10a Core 2

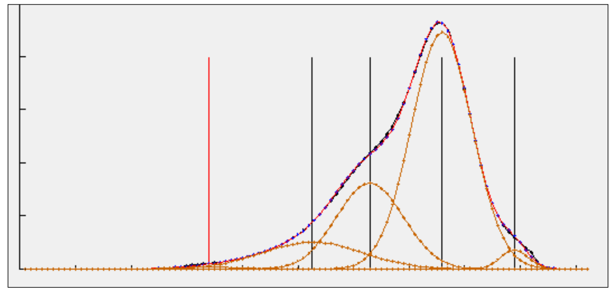


(Fig A15pp) Graph for S11 1.1

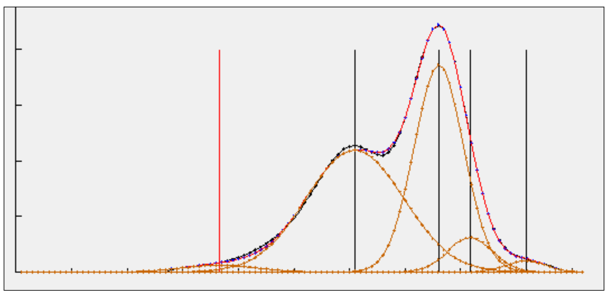
Centereach, Long Island, New York GrainAnalysis Graphs:



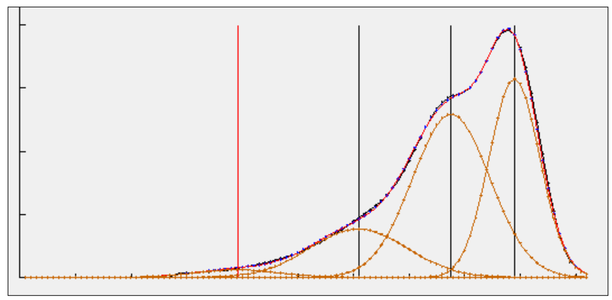
(Fig A15qq) Graph for S11 1.2



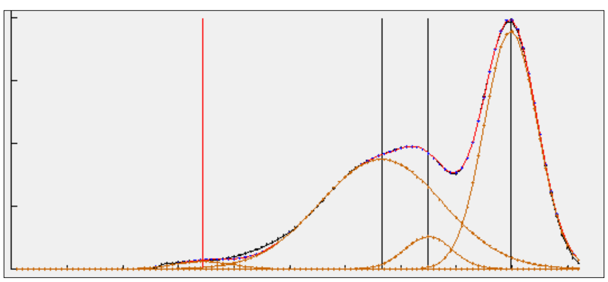
(Fig A15rr) Graph for S11 1.3



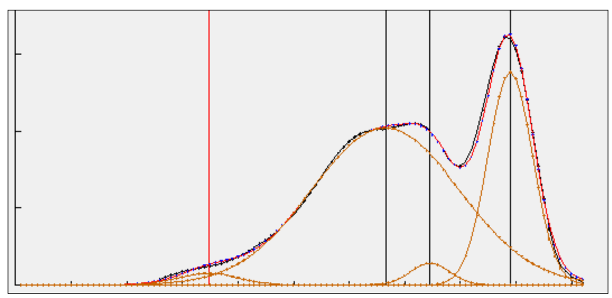
(Fig A15ss) Graph for S11 1.4



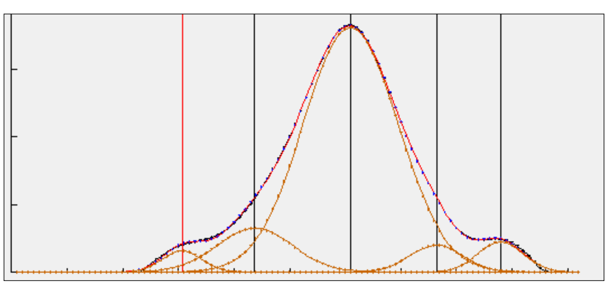
(Fig A15tt) Graph for S11 with Rock



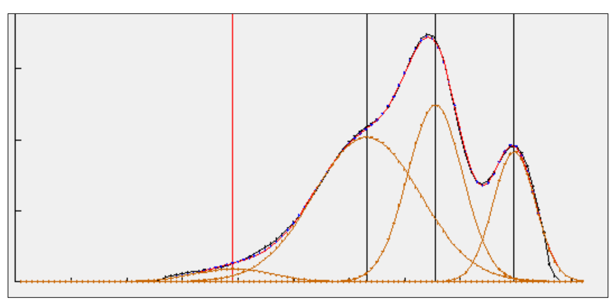
(Fig A15uu) Graph for S11 Under Rock



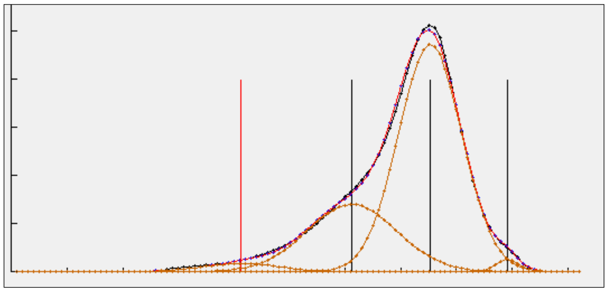
(Fig A15vv) Graph for S11 A Core 1 24.5”-27.75”



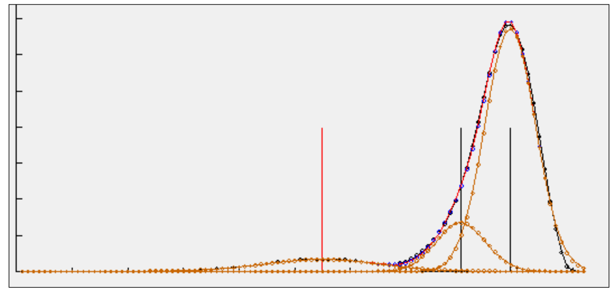
(Fig A15ww) Graph for S11 B Core 1 27.5”-31.5”



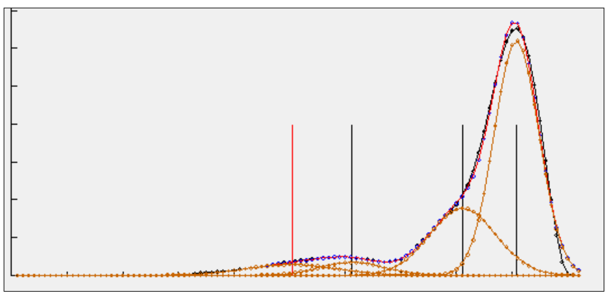
(Fig A15xx) Graph for S11 C Core 1 31.5”-37”



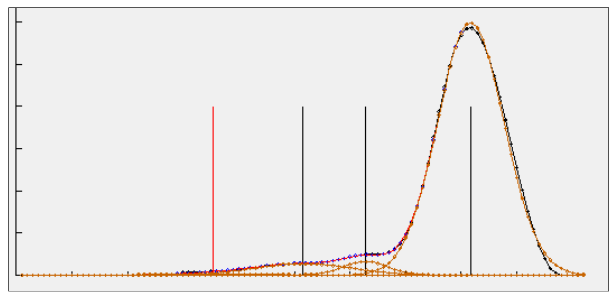
(Fig A15yy) Graph for S11 D Core 1 37”-43”



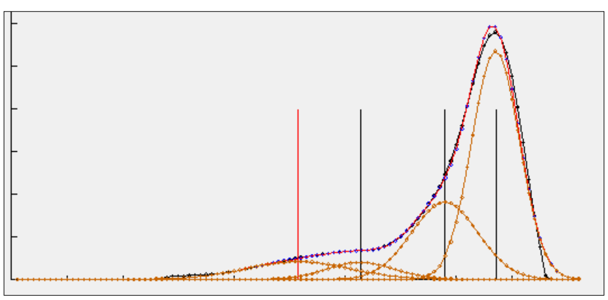
(Fig A15zz) Graph for S11 Core 1.1 A 3”-4”



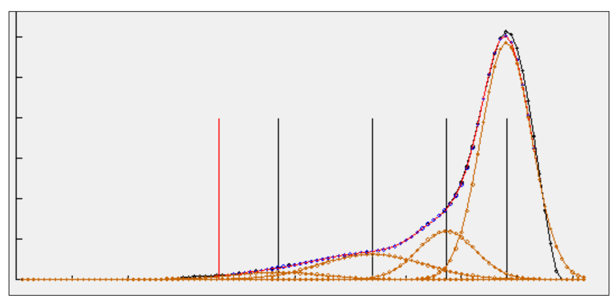
(Fig A15aaaa) Graph for S11 Core 1.1 A 7”-8”



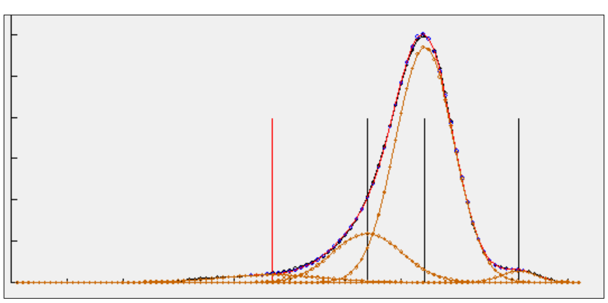
(Fig A15aabb) Graph for S11 Core 1.2 A 2”-3”



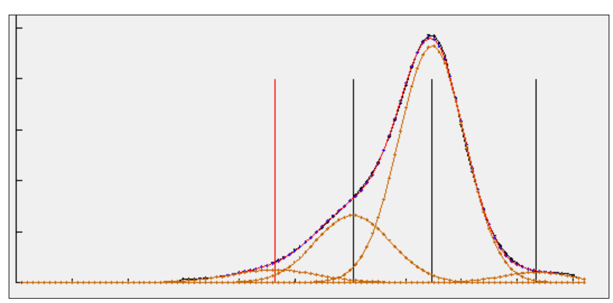
(Fig A15aacc) Graph for S11 Core 1.2 A 8”-9”



(Fig A15aadd) Graph for S11 Core 1.3 A 0.5”-1”

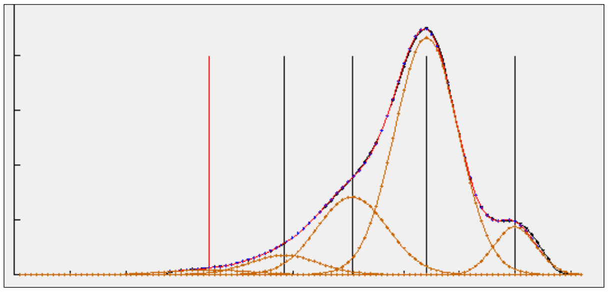


(Fig A15aaee) Graph for S11 Core 1.3 A ~3”-3.5”

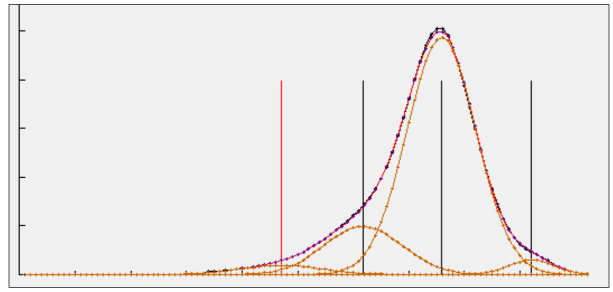


(Fig A15aaff) Graph for S10 Core 1.1 4.5”-5.5”

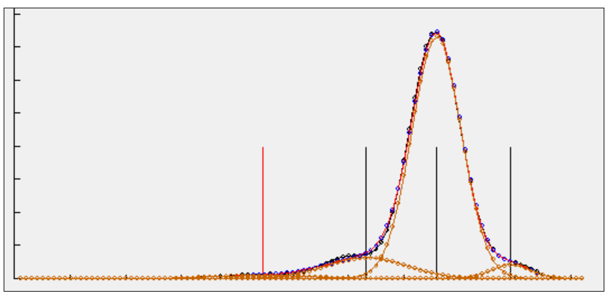
Centereach, Long Island, New York GrainAnalysis Graphs:



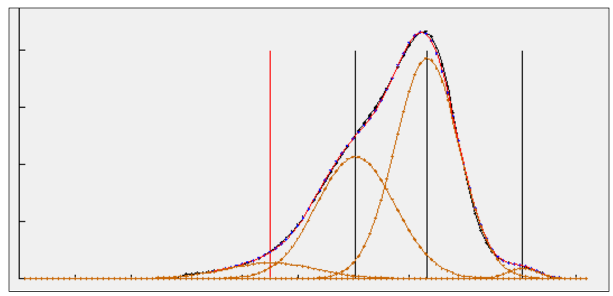
(Fig A15aagg) Graph for S10 Core 1.1 10”-11”



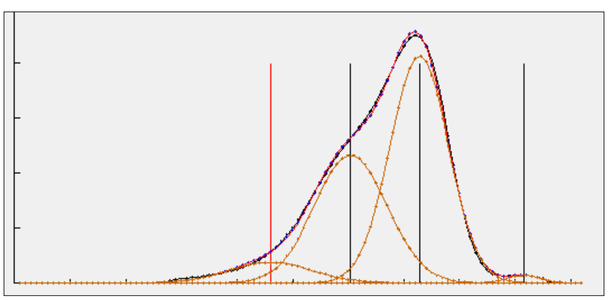
(Fig A15aahh) Graph for S10 Core 1.2 2”-3”



(Fig A15aaii) Graph for S10 Core 1.2 9.5”-10”



(Fig A15aajj) Graph for S10 Core 1.3 3”-4”



(Fig A15aakk) Graph for S10 Core 1.3 7”-8”

(Fig A16) **Centereach, Long Island, New York Samples:** Phi size percent distributions over half phi sizes.

Phi size	S1	S2	S3	S4	S5	S7
-1.0 - -0.5	0.01 %	0.00 %	0.08 %	0.09 %	0.61 %	0.00 %
-0.5 – 0.0	0.52 %	0.03 %	0.27 %	0.42 %	1.73 %	0.28 %
0.0 – 0.5	3.16 %	1.61 %	0.90 %	1.57 %	3.59 %	1.43 %
0.5 – 1.0	7.56 %	6.14 %	2.05 %	3.48 %	5.04 %	3.29 %
1.0 – 1.5	11.56 %	10.42 %	3.51 %	5.11 %	4.88 %	5.13 %
1.5 – 2.0	12.70 %	11.36 %	5.06 %	5.86 %	3.88 %	6.26 %
2.0 – 2.5	10.93 %	9.85 %	7.04 %	6.80 %	3.22 %	7.12 %
2.5 – 3.0	8.10 %	9.07 %	9.59 %	9.08 %	3.73 %	8.71 %
3.0 – 3.5	5.63 %	9.75 %	11.76 %	11.75 %	5.33 %	10.69 %
3.5 – 4.0	4.01 %	9.87 %	12.18 %	12.59 %	7.13 %	11.47 %
4.0 – 4.5	3.33 %	8.23 %	10.77 %	10.89 %	8.31 %	10.32 %
4.5 – 5.0	3.41 %	5.74 %	8.55 %	7.99 %	8.59 %	8.06 %
5.0 – 5.5	3.72 %	3.85 %	6.54 %	5.58 %	8.23 %	6.01 %
5.5 – 6.0	3.88 %	2.95 %	5.10 %	4.19 %	7.58 %	4.73 %
6.0 – 6.5	3.79 %	2.54 %	4.07 %	3.43 %	6.76 %	3.95 %
6.5 – 7.0	3.53 %	2.15 %	3.23 %	2.81 %	5.80 %	3.28 %
7.0 – 7.5	3.20 %	1.72 %	2.53 %	2.23 %	4.70 %	2.61 %
7.5 – 8.0	2.80 %	1.33 %	1.94 %	1.73 %	3.58 %	1.99 %
8.0 – 8.5	2.35 %	1.03 %	1.46 %	1.32 %	2.56 %	1.49 %
8.5 – 9.0	1.87 %	0.79 %	1.07 %	1.00 %	1.74 %	1.08 %
9.0 – 9.5	1.39 %	0.59 %	0.76 %	0.74 %	1.15 %	0.77 %
9.5 – 10.0	0.99 %	0.42 %	0.54 %	0.53 %	0.75 %	0.53 %
10.0 – 10.5	0.70 %	0.30 %	0.40 %	0.38 %	0.51 %	0.38 %
10.5 – 11.0	0.49 %	0.20 %	0.31 %	0.27 %	0.36 %	0.27 %
11.0 – 11.5	0.30 %	0.05 %	0.22 %	0.15 %	0.22 %	0.15 %
11.5 – 12.0	0.05 %	0.00 %	0.04 %	0.00 %	0.03 %	0.00 %
12.0 – 12.5	0.00 %	0.00 %	0.00 %	0.00 %	0.00 %	0.00 %
Total:	99.98 %	99.99 %	99.97 %	99.99 %	100.01 %	100.00 %

Centereach, Long Island, New York Samples: Phi size percent distributions over half phi sizes.

Phi size	S9	S10	S11a	S11b	S10 Core 1 1.1	S10 Core 1 1.2
-1.0 - -0.5	0.00 %	0.06 %	0.00 %	0.74 %	0.00 %	0.00 %
-0.5 – 0.0	0.00 %	0.20 %	0.00 %	2.19 %	0.00 %	0.00 %
0.0 – 0.5	0.34 %	0.29 %	0.73 %	6.86 %	0.28 %	0.21 %
0.5 – 1.0	1.67 %	0.50 %	5.16 %	13.52 %	0.83 %	0.58 %
1.0 – 1.5	3.39 %	1.01 %	8.90 %	18.36 %	1.71 %	0.61 %
1.5 – 2.0	5.65 %	2.17 %	9.49 %	18.14 %	3.08 %	0.93 %
2.0 – 2.5	8.53 %	4.68 %	7.46 %	13.77 %	5.64 %	3.65 %
2.5 – 3.0	11.65 %	8.68 %	5.28 %	8.70 %	9.76 %	10.49 %
3.0 – 3.5	13.87 %	12.77 %	4.49 %	5.04 %	13.93 %	18.82 %
3.5 – 4.0	13.87 %	14.68 %	4.79 %	2.85 %	15.58 %	22.23 %
4.0 – 4.5	11.75 %	13.72 %	5.41 %	1.65 %	13.96 %	17.93 %
4.5 – 5.0	8.74 %	11.02 %	5.85 %	1.08 %	10.52 %	10.09 %
5.0 – 5.5	6.05 %	8.20 %	5.94 %	0.89 %	7.20 %	4.44 %
5.5 – 6.0	4.19 %	6.09 %	5.72 %	0.84 %	4.94 %	2.41 %
6.0 – 6.5	3.03 %	4.63 %	5.34 %	0.82 %	3.59 %	2.08 %
6.5 – 7.0	2.23 %	3.50 %	4.94 %	0.79 %	2.70 %	1.74 %
7.0 – 7.5	1.62 %	2.55 %	4.48 %	0.76 %	1.99 %	1.17 %
7.5 – 8.0	1.15 %	1.78 %	3.92 %	0.69 %	1.41 %	0.72 %
8.0 – 8.5	0.80 %	1.21 %	3.26 %	0.58 %	0.98 %	0.50 %
8.5 – 9.0	0.57 %	0.82 %	2.56 %	0.45 %	0.69 %	0.42 %
9.0 – 9.5	0.40 %	0.57 %	1.91 %	0.33 %	0.49 %	0.36 %
9.5 – 10.0	0.28 %	0.39 %	1.42 %	0.26 %	0.35 %	0.30 %
10.0 – 10.5	0.20 %	0.27 %	1.12 %	0.24 %	0.25 %	0.23 %
10.5 – 11.0	0.02 %	0.19 %	0.91 %	0.23 %	0.11 %	0.09 %
11.0 – 11.5	0.00 %	0.04 %	0.65 %	0.18 %	0.00 %	0.00 %
11.5 – 12.0	0.00 %	0.00 %	0.26 %	0.03 %	0.00 %	0.00 %
12.0 – 12.5	0.00 %	0.00 %	0.00 %	0.00 %	0.00 %	0.00 %
Total:	100.00 %	100.02 %	99.99 %	99.99 %	99.99 %	100.00 %

Centereach, Long Island, New York Samples: Phi size percent distributions over half phi sizes.

Phi size	S10 Core 1 1.3	S10a Core 2	Micaceous Material S9/S10	S11 1.1	S11 1.2	S11 1.3
-1.0 - -0.5	0.00 %	0.10 %	0.00 %	1.02 %	0.45 %	0.00 %
-0.5 – 0.0	0.02 %	0.30 %	0.00 %	3.39 %	2.28 %	0.00 %
0.0 – 0.5	0.33 %	0.59 %	0.29 %	7.81 %	7.01 %	0.02 %
0.5 – 1.0	0.83 %	1.20 %	1.35 %	13.41 %	13.20 %	0.87 %
1.0 – 1.5	1.21 %	2.19 %	2.87 %	16.86 %	16.58 %	1.81 %
1.5 – 2.0	1.86 %	4.27 %	4.95 %	15.72 %	14.49 %	3.12 %
2.0 – 2.5	4.49 %	8.66 %	7.81 %	11.62 %	9.52 %	6.01 %
2.5 – 3.0	10.10 %	14.76 %	11.23 %	7.78 %	5.93 %	10.29 %
3.0 – 3.5	16.00 %	18.64 %	13.84 %	5.40 %	4.81 %	13.48 %
3.5 – 4.0	17.43 %	16.82 %	13.93 %	3.86 %	4.56 %	13.44 %
4.0 – 4.5	13.55 %	11.04 %	11.56 %	2.71 %	3.98 %	11.08 %
4.5 – 5.0	8.33 %	5.91 %	8.43 %	1.92 %	3.20 %	8.68 %
5.0 – 5.5	5.33 %	3.62 %	6.06 %	1.49 %	2.62 %	7.22 %
5.5 – 6.0	4.58 %	3.08 %	4.67 %	1.25 %	2.26 %	6.20 %
6.0 – 6.5	4.33 %	2.68 %	3.74 %	1.08 %	1.94 %	5.05 %
6.5 – 7.0	3.62 %	2.00 %	2.90 %	0.93 %	1.61 %	3.79 %
7.0 – 7.5	2.63 %	1.32 %	2.10 %	0.82 %	1.31 %	2.71 %
7.5 – 8.0	1.77 %	0.88 %	1.46 %	0.72 %	1.06 %	1.93 %
8.0 – 8.5	1.19 %	0.64 %	1.00 %	0.62 %	0.86 %	1.39 %
8.5 – 9.0	0.83 %	0.48 %	0.69 %	0.51 %	0.68 %	1.00 %
9.0 – 9.5	0.60 %	0.36 %	0.48 %	0.40 %	0.52 %	0.71 %
9.5 – 10.0	0.43 %	0.26 %	0.33 %	0.30 %	0.40 %	0.49 %
10.0 – 10.5	0.31 %	0.18 %	0.22 %	0.23 %	0.32 %	0.35 %
10.5 – 11.0	0.19 %	0.02 %	0.09 %	0.17 %	0.26 %	0.25 %
11.0 – 11.5	0.02 %	0.00 %	0.00 %	0.00 %	0.17 %	0.10 %
11.5 – 12.0	0.00 %	0.00 %	0.00 %	0.00 %	0.00 %	0.00 %
12.0 – 12.5	0.00 %	0.00 %	0.00 %	0.00 %	0.00 %	0.00 %
Total:	99.98 %	100.00 %	100.00 %	100.02 %	100.02 %	99.99 %

Centereach, Long Island, New York Samples: Phi size percent distributions over half phi sizes.

Phi size	S11 1.4	S11 with rock	S11 under rock	S11A Core 1 24.5-27.75 in.	S11B Core 1 27.5-31.5 in.	S11C Core 1 31.5-37 in.
-1.0 - -0.5	0.00 %	0.29 %	0.62 %	0.20 %	0.00 %	0.00 %
-0.5 – 0.0	0.14 %	1.37 %	2.60 %	0.87 %	0.00 %	0.08 %
0.0 – 0.5	0.42 %	4.54 %	6.46 %	3.42 %	0.23 %	1.97 %
0.5 – 1.0	0.69 %	8.75 %	10.46 %	7.22 %	0.96 %	4.82 %
1.0 – 1.5	1.09 %	11.46 %	11.65 %	9.50 %	1.40 %	5.65 %
1.5 – 2.0	2.45 %	11.32 %	9.33 %	8.53 %	1.46 %	4.64 %
2.0 – 2.5	5.67 %	9.79 %	6.09 %	5.98 %	1.50 %	4.36 %
2.5 – 3.0	10.08 %	8.88 %	4.64 %	4.72 %	2.02 %	6.43 %
3.0 – 3.5	13.02 %	8.52 %	5.04 %	5.28 %	3.11 %	9.33 %
3.5 – 4.0	12.36 %	7.59 %	5.70 %	6.11 %	4.49 %	10.41 %
4.0 – 4.5	9.32 %	6.04 %	5.83 %	6.30 %	6.13 %	9.36 %
4.5 – 5.0	6.88 %	4.60 %	5.59 %	6.16 %	8.04 %	7.81 %
5.0 – 5.5	6.39 %	3.64 %	5.27 %	6.07 %	9.84 %	6.87 %
5.5 – 6.0	6.76 %	3.01 %	4.81 %	5.88 %	10.86 %	6.33 %
6.0 – 6.5	6.58 %	2.46 %	4.10 %	5.35 %	10.67 %	5.59 %
6.5 – 7.0	5.53 %	1.94 %	3.23 %	4.49 %	9.42 %	4.53 %
7.0 – 7.5	4.13 %	1.51 %	2.41 %	3.54 %	7.67 %	3.42 %
7.5 – 8.0	2.88 %	1.17 %	1.76 %	2.72 %	5.95 %	2.49 %
8.0 – 8.5	1.96 %	0.90 %	1.27 %	2.09 %	4.51 %	1.80 %
8.5 – 9.0	1.33 %	0.68 %	0.91 %	1.59 %	3.33 %	1.29 %
9.0 – 9.5	0.89 %	0.50 %	0.65 %	1.18 %	2.39 %	0.92 %
9.5 – 10.0	0.59 %	0.37 %	0.48 %	0.89 %	1.76 %	0.67 %
10.0 – 10.5	0.40 %	0.29 %	0.40 %	0.72 %	1.45 %	0.51 %
10.5 – 11.0	0.27 %	0.24 %	0.36 %	0.60 %	1.28 %	0.40 %
11.0 – 11.5	0.15 %	0.16 %	0.28 %	0.44 %	0.98 %	0.27 %
11.5 – 12.0	0.00 %	0.00 %	0.06 %	0.18 %	0.49 %	0.05 %
12.0 – 12.5	0.00 %	0.00 %	0.00 %	0.00 %	0.04 %	0.00 %
Total:	99.98 %	100.02 %	100.00 %	100.03 %	99.98 %	100.00 %

Centereach, Long Island, New York Samples: Phi size percent distributions over half phi sizes.

Phi size	S11D Core 1 37-43 in.	S11 Core 1.1 A 3”-4”	S11 Core 1.1 A 7”-8”	S11 Core 1.2 A 2”-3”	S11 Core 1.2 A 8”-9”
-1.0 - -0.5	0.00 %	0.02 %	0.02 %	0.00 %	0.00 %
-0.5 – 0.0	0.00 %	1.86 %	3.47 %	0.06 %	0.00 %
0.0 – 0.5	0.00 %	8.60 %	12.28 %	1.27 %	2.39 %
0.5 – 1.0	0.57 %	16.40 %	18.75 %	4.68 %	9.70 %
1.0 – 1.5	1.54 %	20.32 %	18.33 %	9.45 %	15.84 %
1.5 – 2.0	2.90 %	18.08 %	13.26 %	14.22 %	17.00 %
2.0 – 2.5	5.85 %	12.32 %	8.32 %	17.18 %	13.68 %
2.5 – 3.0	10.52 %	7.12 %	5.64 %	16.89 %	9.45 %
3.0 – 3.5	14.53 %	3.95 %	4.18 %	13.20 %	6.56 %
3.5 – 4.0	14.97 %	2.12 %	2.76 %	7.89 %	4.73 %
4.0 – 4.5	12.22 %	1.04 %	1.57 %	3.71 %	3.37 %
4.5 – 5.0	8.91 %	0.61 %	1.09 %	1.86 %	2.50 %
5.0 – 5.5	6.65 %	0.64 %	1.20 %	1.52 %	2.13 %
5.5 – 6.0	5.31 %	0.82 %	1.41 %	1.44 %	2.02 %
6.0 – 6.5	4.28 %	0.96 %	1.47 %	1.21 %	1.91 %
6.5 – 7.0	3.30 %	1.01 %	1.38 %	0.98 %	1.76 %
7.0 – 7.5	2.44 %	0.99 %	1.23 %	0.88 %	1.58 %
7.5 – 8.0	1.77 %	0.90 %	1.05 %	0.83 %	1.38 %
8.0 – 8.5	1.28 %	0.75 %	0.85 %	0.76 %	1.15 %
8.5 – 9.0	0.94 %	0.57 %	0.65 %	0.62 %	0.90 %
9.0 – 9.5	0.69 %	0.41 %	0.46 %	0.47 %	0.65 %
9.5 – 10.0	0.51 %	0.28 %	0.32 %	0.35 %	0.45 %
10.0 – 10.5	0.38 %	0.20 %	0.23 %	0.27 %	0.34 %
10.5 – 11.0	0.28 %	0.02 %	0.07 %	0.21 %	0.28 %
11.0 – 11.5	0.16 %	0.00 %	0.00 %	0.08 %	0.19 %
11.5 – 12.0	0.00 %	0.00 %	0.00 %	0.00 %	0.01 %
12.0 – 12.5	0.00 %	0.00 %	0.00 %	0.00 %	0.00 %
Total:	100.00 %	99.99 %	99.99 %	100.03 %	99.97 %

Centereach, Long Island, New York Samples: Phi size percent distributions over half phi sizes.

Phi size	S11 Core 1.3 A 0.5”-1”	S11 Core 1.3 A ~3”-3.5”	S10 Core 1.1 4.5”-5.5”	S10 Core 1.1 10”-11”	S10 Core 1.2 2”-3”
-1.0 - -0.5	0.00 %	0.00 %	0.30 %	0.00 %	0.08 %
-0.5 – 0.0	0.22 %	0.09 %	0.53 %	0.21 %	0.33 %
0.0 – 0.5	5.31 %	0.49 %	0.58 %	1.34 %	0.87 %
0.5 – 1.0	13.29 %	0.85 %	0.78 %	2.53 %	1.43 %
1.0 – 1.5	18.03 %	1.03 %	1.43 %	2.95 %	2.34 %
1.5 – 2.0	16.62 %	1.75 %	2.83 %	3.11 %	4.42 %
2.0 – 2.5	11.56 %	4.47 %	5.47 %	4.51 %	7.77 %
2.5 – 3.0	7.25 %	9.82 %	9.48 %	7.91 %	11.75 %
3.0 – 3.5	5.15 %	15.57 %	13.32 %	11.80 %	14.73 %
3.5 – 4.0	4.09 %	17.82 %	14.47 %	13.45 %	14.70 %
4.0 – 4.5	3.18 %	15.61 %	12.56 %	12.14 %	11.92 %
4.5 – 5.0	2.48 %	11.23 %	9.50 %	9.49 %	8.46 %
5.0 – 5.5	2.14 %	7.23 %	7.04 %	7.21 %	5.87 %
5.5 – 6.0	1.98 %	4.53 %	5.52 %	5.74 %	4.31 %
6.0 – 6.5	1.80 %	2.90 %	4.48 %	4.69 %	3.28 %
6.5 – 7.0	1.57 %	1.90 %	3.53 %	3.70 %	2.44 %
7.0 – 7.5	1.32 %	1.27 %	2.63 %	2.77 %	1.75 %
7.5 – 8.0	1.09 %	0.89 %	1.86 %	2.00 %	1.22 %
8.0 – 8.5	0.88 %	0.67 %	1.29 %	1.42 %	0.85 %
8.5 – 9.0	0.67 %	0.53 %	0.87 %	1.01 %	0.59 %
9.0 – 9.5	0.49 %	0.44 %	0.59 %	0.71 %	0.40 %
9.5 – 10.0	0.35 %	0.37 %	0.40 %	0.50 %	0.27 %
10.0 – 10.5	0.26 %	0.31 %	0.28 %	0.37 %	0.19 %
10.5 – 11.0	0.20 %	0.21 %	0.20 %	0.28 %	0.02 %
11.0 – 11.5	0.07 %	0.00 %	0.07 %	0.17 %	0.00 %
11.5 – 12.0	0.00 %	0.00 %	0.00 %	0.00 %	0.00 %
12.0 – 12.5	0.00 %	0.00 %	0.00 %	0.00 %	0.00 %
Total:	100.00 %	99.98 %	100.01 %	100.01 %	99.99 %

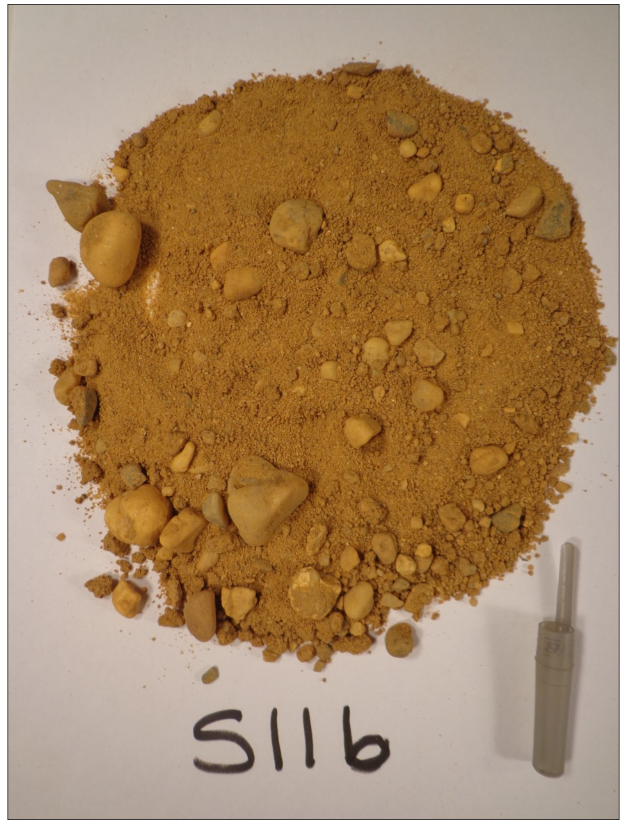
Centereach, Long Island, New York Samples: Phi size percent distributions over half phi sizes.

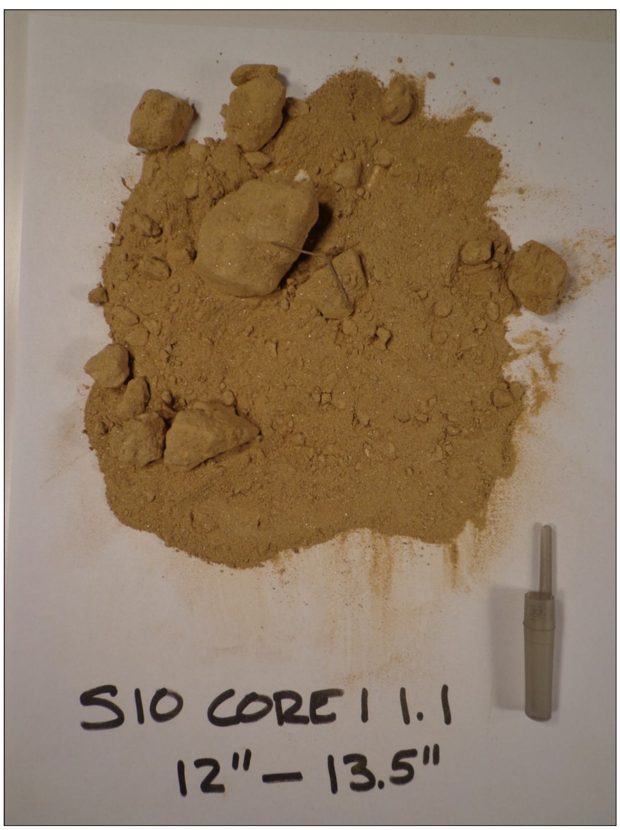
Phi size	S10 Core 1.2 9.5”-10”	S10 Core 1.3 3”-4”	S10 Core 1.3 7”-8”
-1.0 - -0.5	0.00 %	0.00 %	0.00 %
-0.5 – 0.0	0.00 %	0.00 %	0.00 %
0.0 – 0.5	0.38 %	0.14 %	0.20 %
0.5 – 1.0	1.11 %	0.52 %	0.39 %
1.0 – 1.5	1.62 %	0.76 %	0.39 %
1.5 – 2.0	2.81 %	1.19 %	0.54 %
2.0 – 2.5	6.95 %	2.69 %	1.78 %
2.5 – 3.0	14.71 %	6.00 %	5.07 %
3.0 – 3.5	21.42 %	10.18 %	9.66 %
3.5 – 4.0	20.70 %	12.72 %	12.87 %
4.0 – 4.5	13.35 %	12.65 %	13.25 %
4.5 – 5.0	6.04 %	11.10 %	11.69 %
5.0 – 5.5	2.69 %	9.47 %	9.84 %
5.5 – 6.0	2.10 %	8.16 %	8.45 %
6.0 – 6.5	1.91 %	6.90 %	7.25 %
6.5 – 7.0	1.36 %	5.52 %	5.88 %
7.0 – 7.5	0.81 %	4.07 %	4.35 %
7.5 – 8.0	0.52 %	2.80 %	2.96 %
8.0 – 8.5	0.43 %	1.84 %	1.92 %
8.5 – 9.0	0.37 %	1.21 %	1.25 %
9.0 – 9.5	0.30 %	0.81 %	0.84 %
9.5 – 10.0	0.23 %	0.55 %	0.57 %
10.0 – 10.5	0.17 %	0.38 %	0.40 %
10.5 – 11.0	0.02 %	0.26 %	0.28 %
11.0 – 11.5	0.00 %	0.09 %	0.16 %
11.5 – 12.0	0.00 %	0.00 %	0.00 %
12.0 – 12.5	0.00 %	0.00 %	0.00 %
Total:	100.00 %	100.01 %	99.99 %

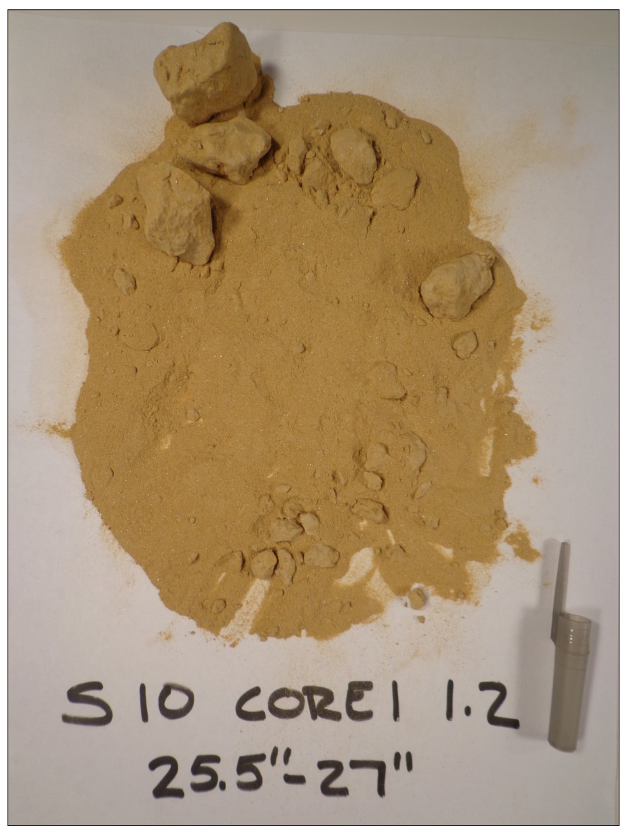
Centereach, Long Island, New York *(Fig A17a-d)*

<u>Centereach, Long Island, New York</u> *(Fig A17e-h)*

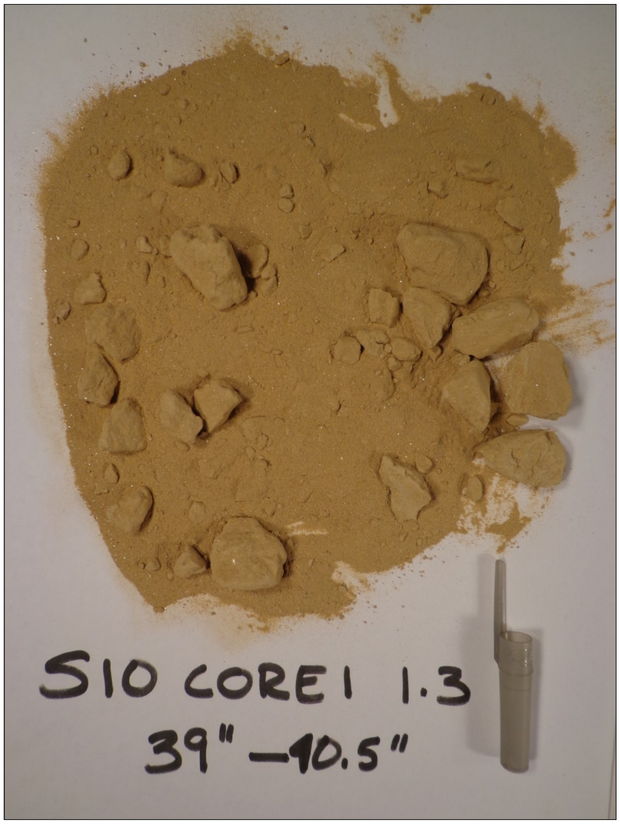
Centereach, Long Island, New York *(Fig A17i-l)*

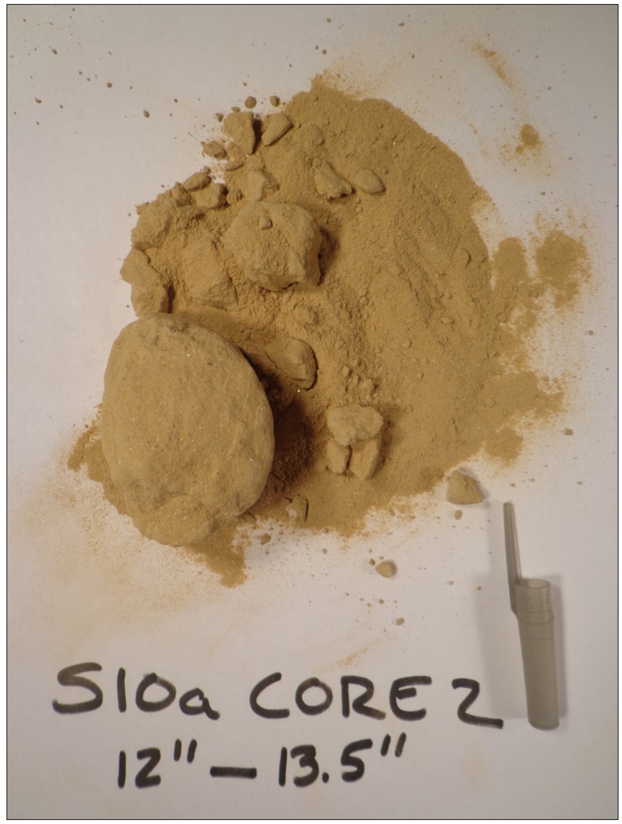


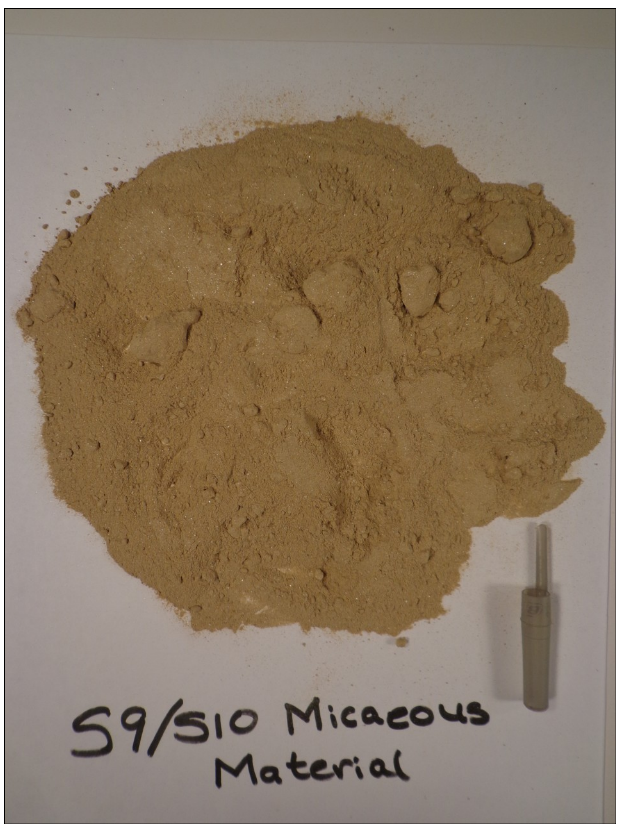




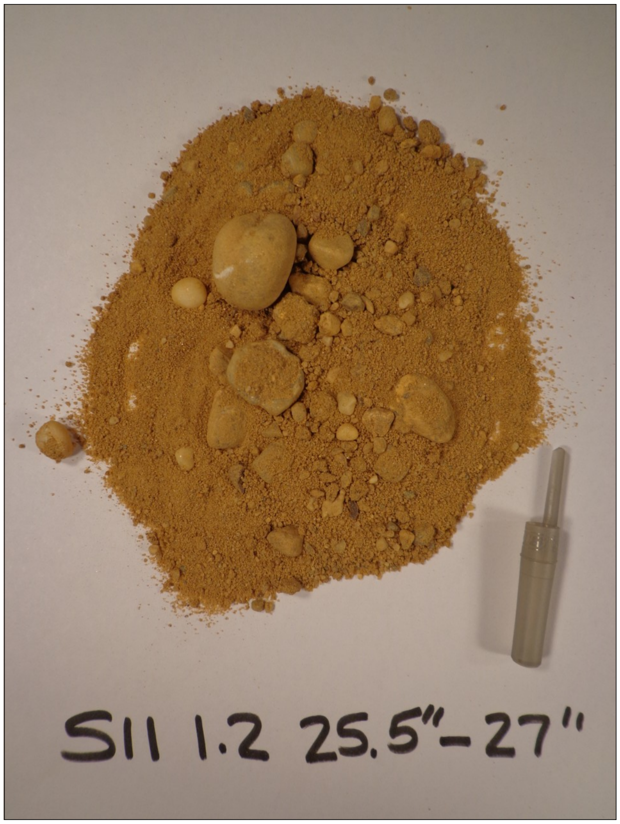
Centereach, Long Island, New York *(Fig A17m-p)*

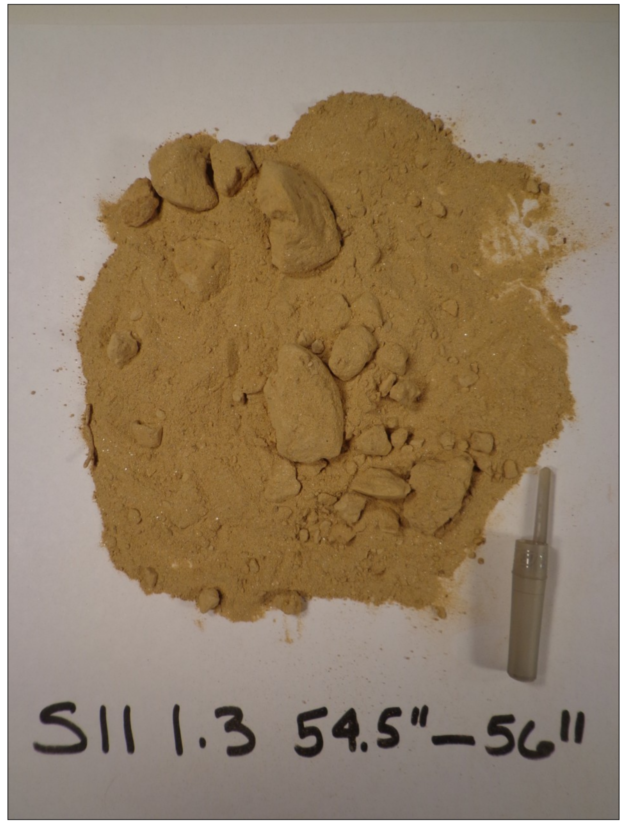


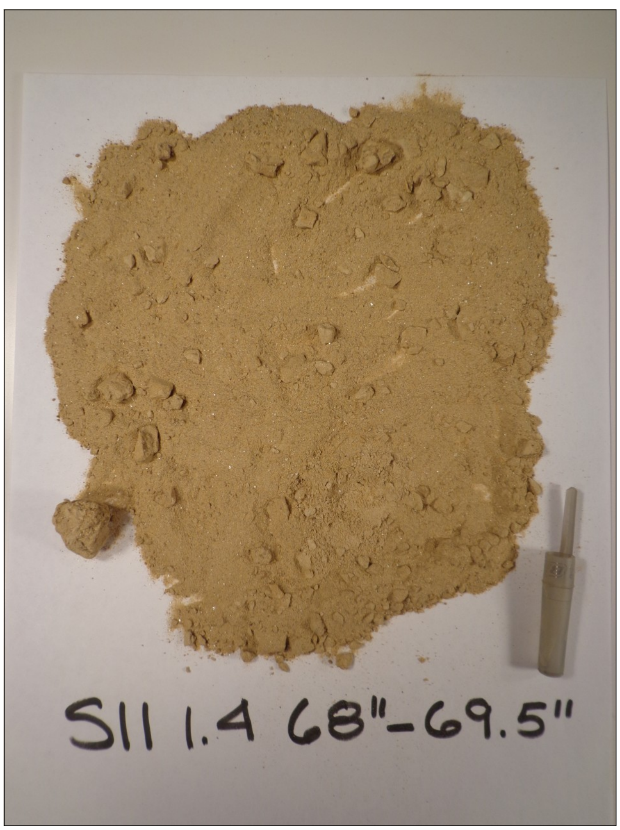


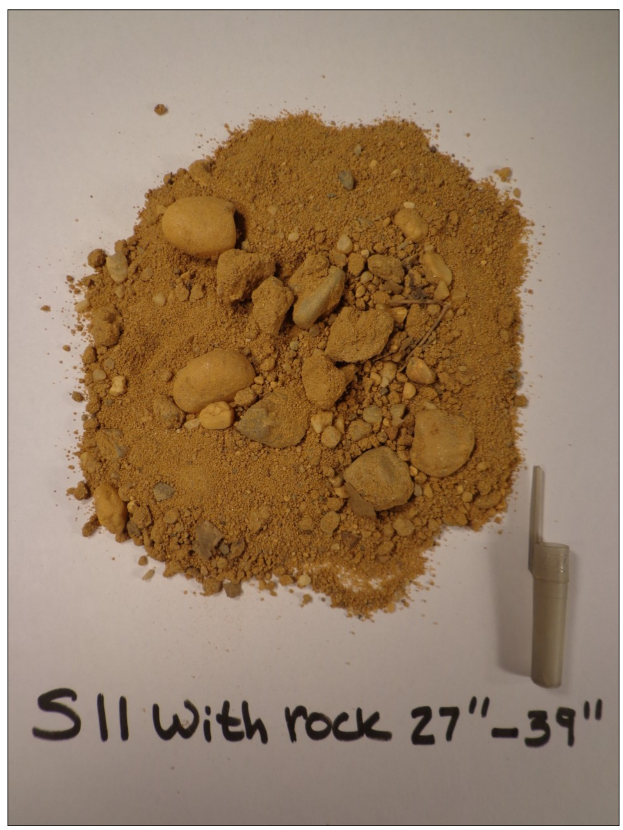


Centereach, Long Island, New York *(Fig A17q-t)*

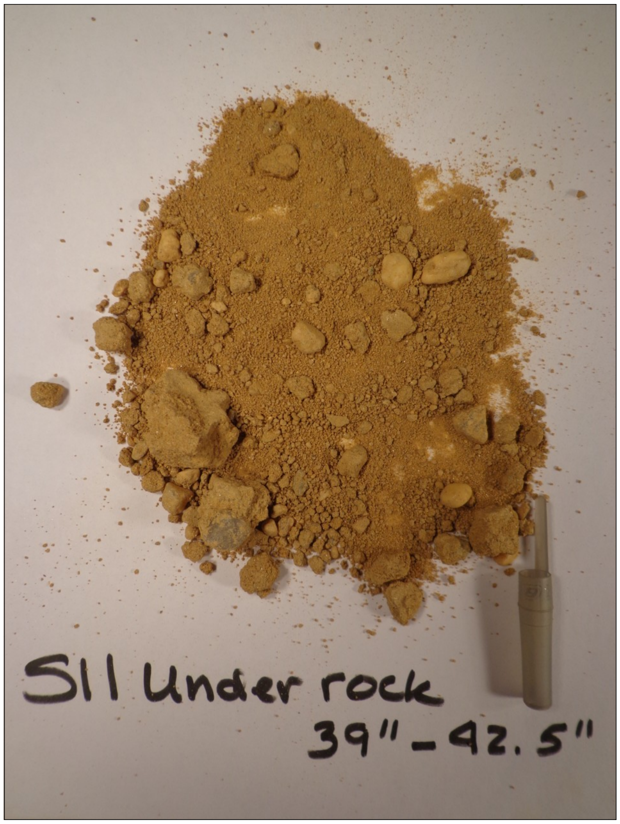




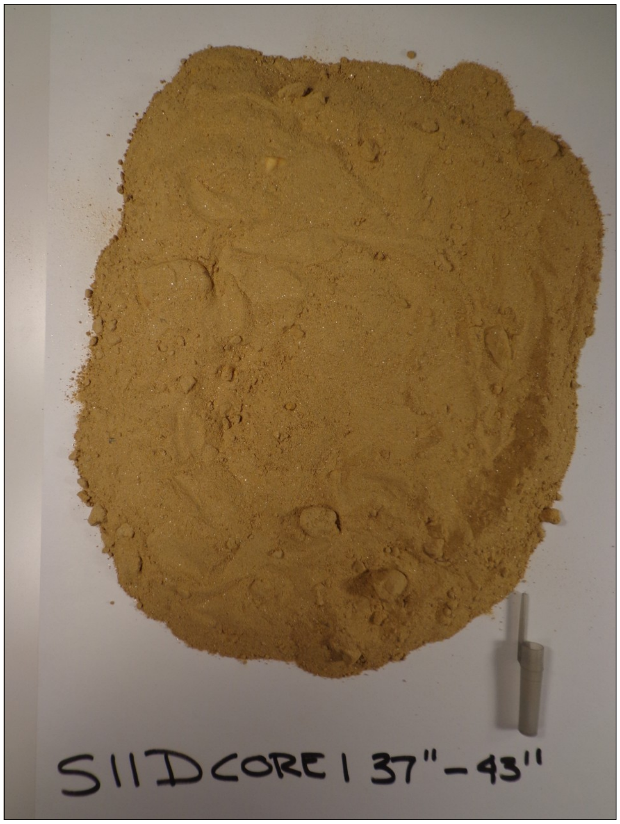




Centereach, Long Island, New York *(Fig A17u-x)*



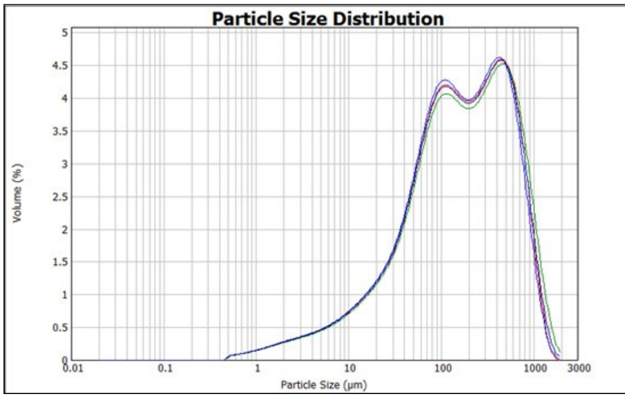
Centereach, Long Island, New York *(Fig A17y)*



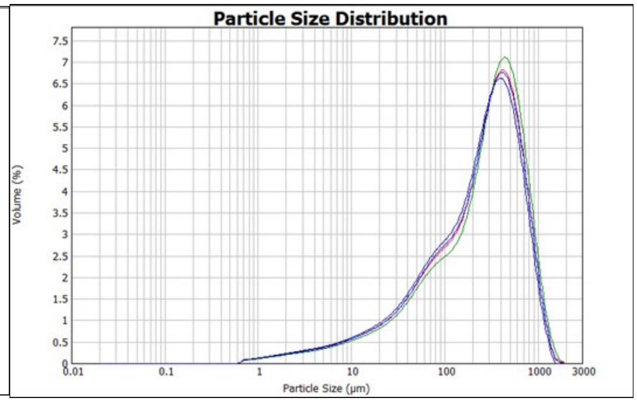
(Fig A18) **Caumsett State Park, Long Island, New York:**

Sample Name	Type	Grain Size Modes (microns)
Caumsett State Park	—	—
Glacial third section upper course. G 1.1	Glacial Course Sand	100µm, 400µm
Glacial third section middle fine. G 1.2	Glacial Sand	80µm, 400µm
Glacial third section bottom fine. G 1.3	Glacial Fine Sand	125µm, 500µm
Cret. first section lower portion sandy layer. Cret 1.1	Cretaceous Fine & Course Sand	20µm, 80µm, 300µm
Cret. first section fine upper portion above course material. Cret. 1.2	Cretaceous Fine Sand	20µm, 60µm, 300µm
Cret. first section upper portion. Cret. 1.3	Cretaceous Fine & Course Sand	20µm, 70µm, 500µm
Cret. first section lower portion fine. Cret. 1.4	Cretaceous Fine Sand	7µm, 40µm, 250µm
Cret. first section lower portion course. Cret. 1.5	Cretaceous Course Sand	6µm, 120µm, 650µm
Cret. fine second section. Cret. 2.1	Cretaceous Fine Sand	70µm, 350µm
Cret. second section fine material near rocks. Cret. 2.2	Cretaceous Fine Sand	50µm, 300µm

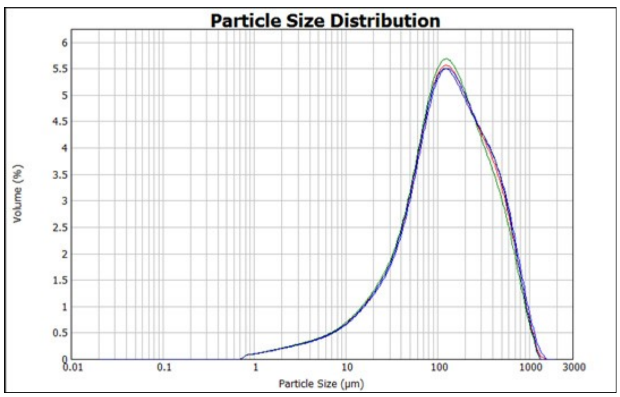
Caumsett State Park Grain Size Graphs
Glacial:



(Fig A19a) Histogram of glacial sand from Caumsett State Park with modes at 100µm and 400µm. Sample G 1.1

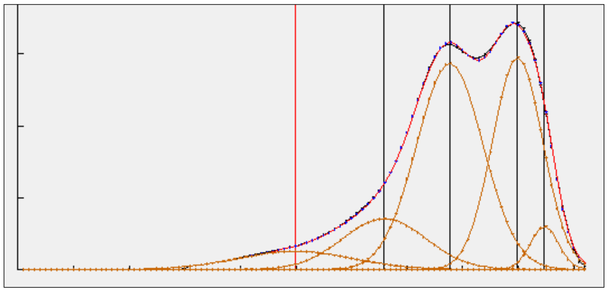


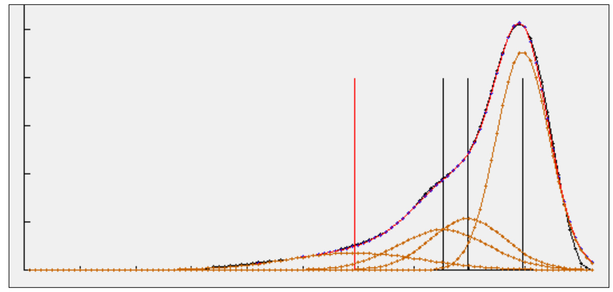
(Fig A19b) Histogram of glacial sand from Caumsett State Park with modes at around 80µm, and 400µm. Sample G 1.2

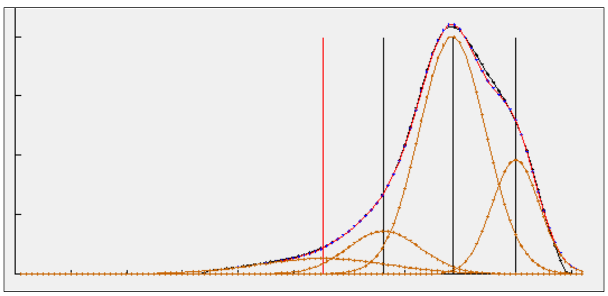


(Fig A19c) Histogram of glacial sand from Caumsett State Park with modes at 125µm and 500µm. Sample G 1.3

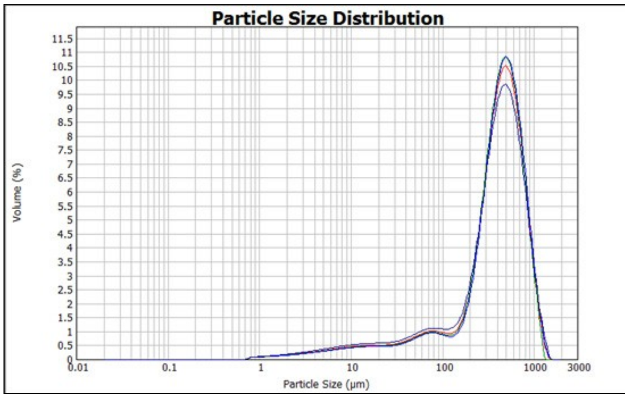
Caumsett State Park Grain Size GrainAnalysis Graphs
Glacial:


(Fig A19aa) Graph for G 1.1

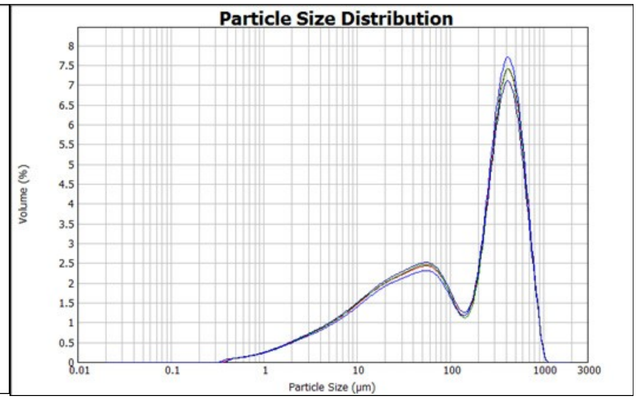

(Fig A19bb) Graph for G 1.2


(Fig A19cc) Graph for G 1.3

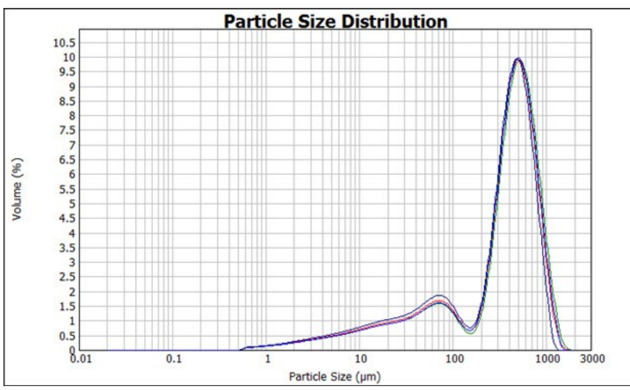
Caumsett State Park Grain Size Graphs
Cretaceous:



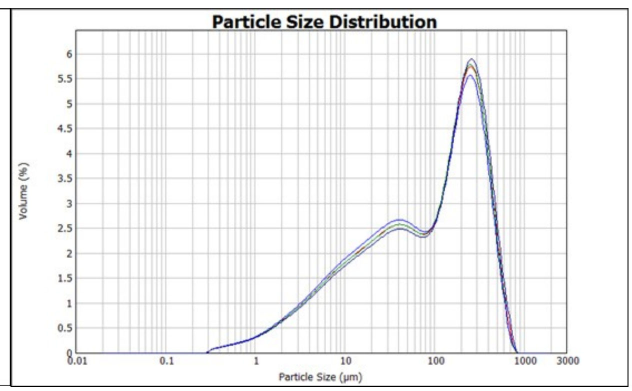
(Fig A20a) Histogram of Cretaceous sand from Caumsett State Park, with modes around 80µm and 300µm, with a small peak possible at 15µm. Sample Cret. 1.1



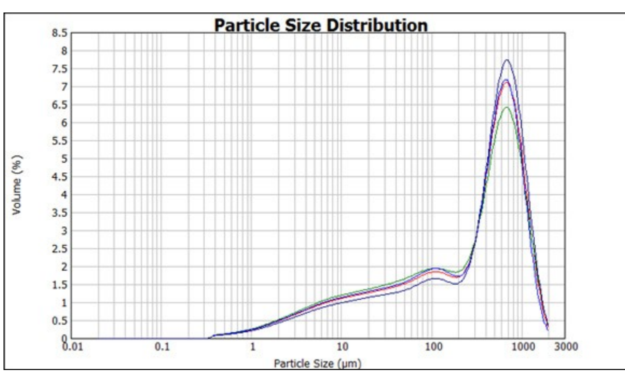
(Fig A20b) Histogram of Cretaceous silty sand from Caumsett State Park, with peaks around 20µm, 60µm and 300µm. Sample Cret. 1.2



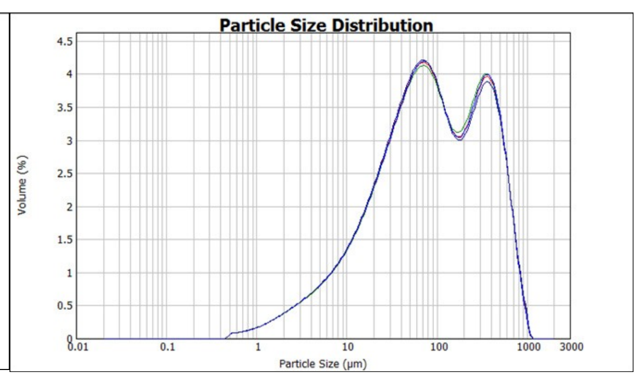
(Fig A20c) Histogram of Cretaceous sand from Caumsett State Park, with modes around 20µm, 70µm and 500µm. Sample Cret. 1.3



(Fig A20d) Histogram of Cretaceous fine sand from Caumsett State Park, with modes around 7µm, 40µm and 250µm. Sample Cret. 1.4

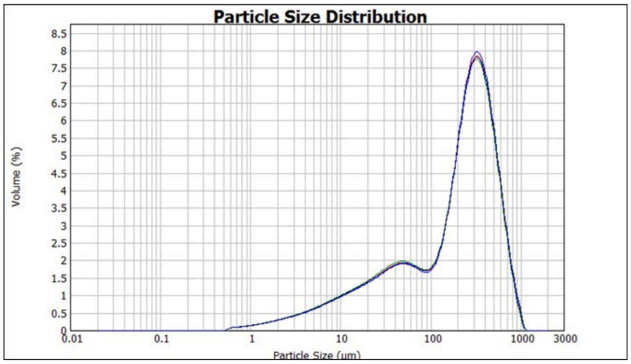


(Fig A20e) Histogram of Cretaceous sand from Caumsett State Park, with modes around 6µm, 120µm and 650µm. Sample Cret. 1.5

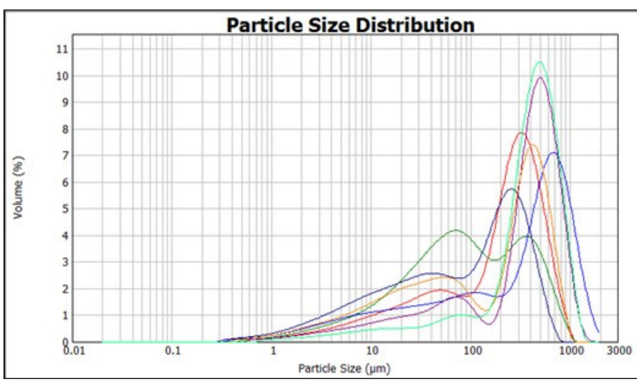


(Fig A20f) Histogram of Cretaceous fine sands from Caumsett State Park, with modes around 70µm and 350µm. Sample Cret. 2.1

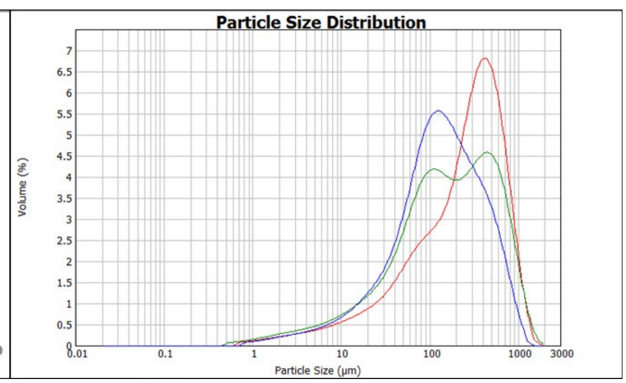
<u>Caumsett State Park Grain Size Graphs</u>
<u>Cretaceous:</u>



(Fig A20g) Histogram of Cretaceous fine sands from Caumsett State Park, with modes around 50µm and 300µm. Sample Cret. 2.2

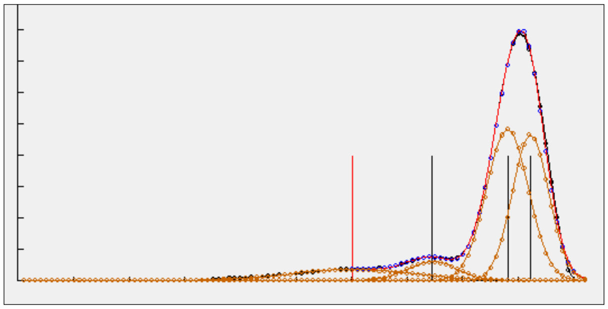


(Fig A21) Histogram of the Cretaceous samples from Caumsett State Park, showing the particle size variation between samples, with a clustering at about 80µm and 400µm.

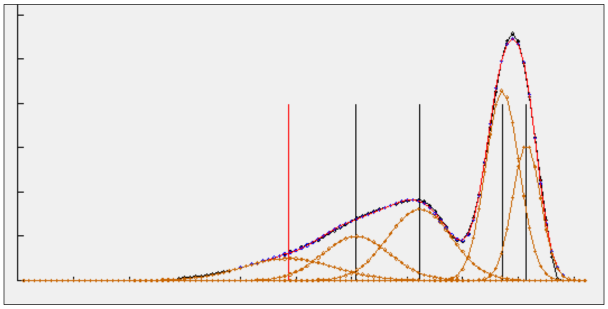


(Fig A22) Histogram of the Glacial samples from Caumsett State Park, showing the particle size variation between samples, with a clustering at about 80µm and 400µm.

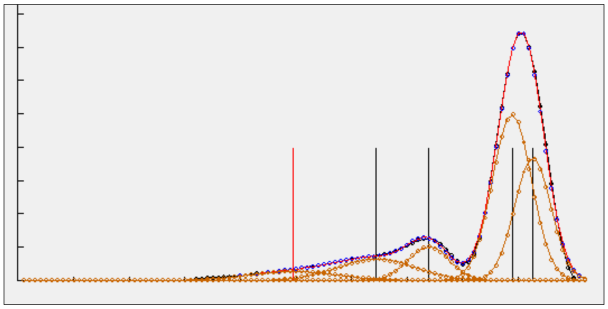
Caumsett State Park Grain Size GrainAnalysis Graphs
Cretaceous:



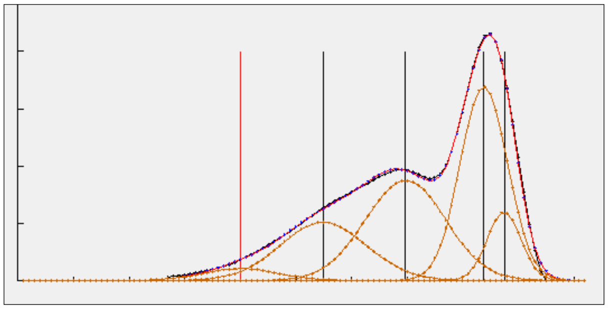
(Fig A20aa) Graph for Cret 1.1



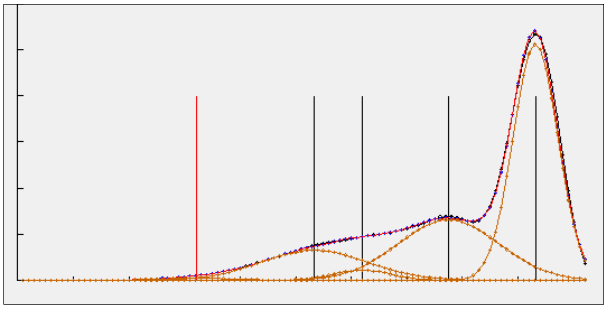
(Fig A20bb) Graph for Cret 1.2



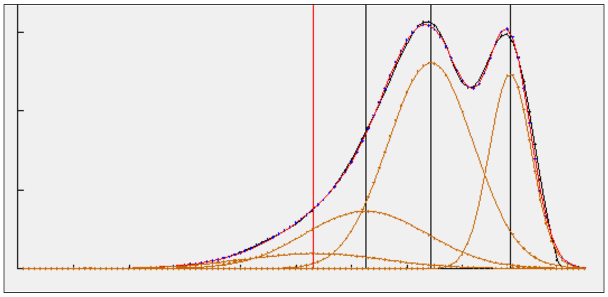
(Fig A20cc) Graph for Cret 1.3



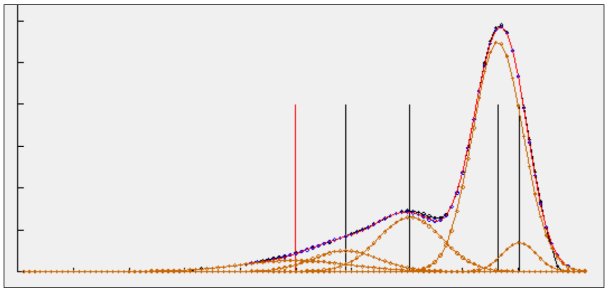
(Fig A20dd) Graph for Cret 1.4



(Fig A20ee) Graph for Cret 1.5



(Fig A20ff) Graph for Cret 2.1



(Fig A20gg) Graph for Cret 2.2

(Fig A23) **Caumsett State Park, Long Island, New York Samples:** Phi size percent distributions over half phi sizes.

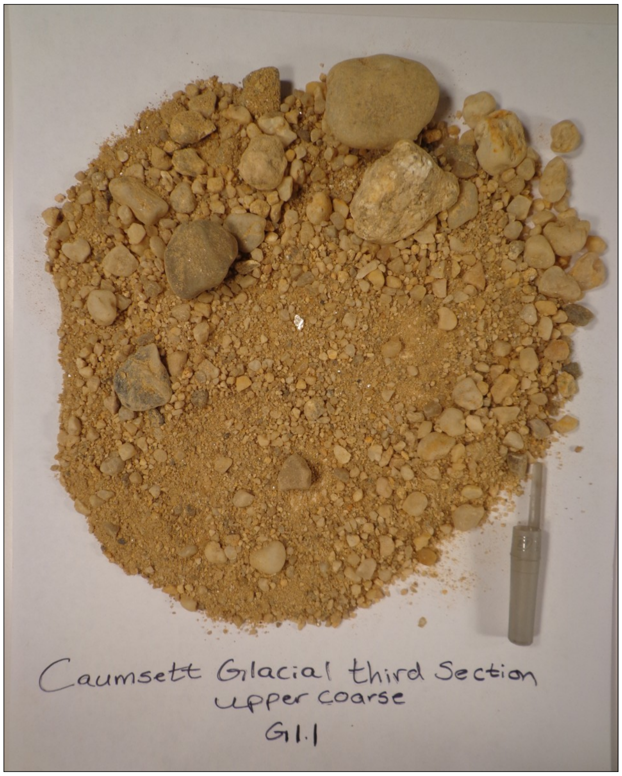
Phi size	G 1.1	G 1.2	G 1.3	Cret. 1.1	Cret. 1.2	Cret. 1.3
-1.0 - -0.5	0.44 %	0.19 %	0.01 %	0.02 %	0.00 %	0.10 %
-0.5 – 0.0	2.68 %	2.69	0.74 %	3.45 %	0.06 %	3.19 %
0.0 – 0.5	6.50 %	7.96 %	3.27 %	13.22 %	4.25 %	12.32 %
0.5 – 1.0	9.52 %	13.20 %	6.24 %	21.97 %	12.40 %	20.80 %
1.0 – 1.5	10.27 %	15.27 %	8.34 %	22.31 %	16.43 %	20.56 %
1.5 – 2.0	9.52 %	13.49 %	9.74 %	14.73 %	12.59 %	12.09 %
2.0 – 2.5	8.92 %	9.99 %	11.13 %	6.52 %	5.92 %	4.00 %
2.5 – 3.0	9.16 %	7.36 %	12.32 %	2.63 %	2.84 %	1.63 %
3.0 – 3.5	9.38 %	6.18 %	12.23 %	2.14 %	3.68 %	2.83 %
3.5 – 4.0	8.34 %	5.37 %	10.23 %	2.25 %	5.10 %	3.75 %
4.0 – 4.5	6.36 %	4.30 %	7.36 %	1.88 %	5.47 %	3.39 %
4.5 – 5.0	4.50 %	3.20 %	5.02 %	1.41 %	5.20 %	2.69 %
5.0 – 5.5	3.28 %	2.39 %	3.57 %	1.18 %	4.83 %	2.29 %
5.5 – 6.0	2.53 %	1.88 %	2.64 %	1.14 %	4.38 %	2.07 %
6.0 – 6.5	1.99 %	1.50 %	1.94 %	1.10 %	3.79 %	1.81 %
6.5 – 7.0	1.55 %	1.20 %	1.41 %	0.99 %	3.13 %	1.52 %
7.0 – 7.5	1.22 %	0.96 %	1.06 %	0.84 %	2.54 %	1.25 %
7.5 – 8.0	0.99 %	0.78 %	0.82 %	0.67 %	2.06 %	1.04 %
8.0 – 8.5	0.82 %	0.64 %	0.65 %	0.53 %	1.65 %	0.84 %
8.5 – 9.0	0.68 %	0.53 %	0.51 %	0.40 %	1.29 %	0.66 %
9.0 – 9.5	0.53 %	0.41 %	0.38 %	0.30 %	0.95 %	0.49 %
9.5 – 10.0	0.38 %	0.30 %	0.26 %	0.22 %	0.64 %	0.35 %
10.0 – 10.5	0.26 %	0.20 %	0.13 %	0.11 %	0.42 %	0.25 %
10.5 – 11.0	0.17 %	0.02 %	0.00 %	0.00 %	0.27 %	0.10 %
11.0 – 11.5	0.00 %	0.00 %	0.00 %	0.00 %	0.11 %	0.00 %
11.5 – 12.0	0.00 %	0.00 %	0.00 %	0.00 %	0.00 %	0.00 %
12.0 – 12.5	0.00 %	0.00 %	0.00 %	0.00 %	0.00 %	0.00 %
Total :	99.99 %	100.01 %	100.00 %	100.01 %	100.00 %	100.02 %

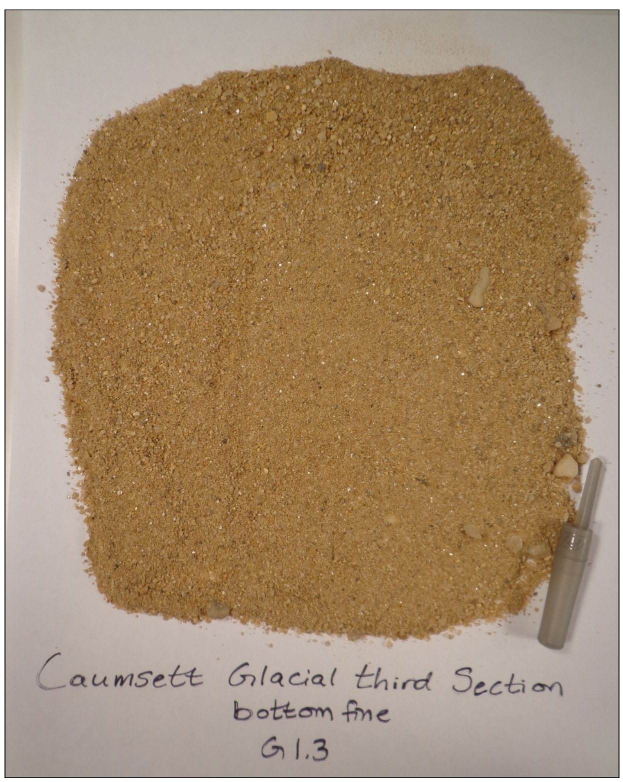
Caumsett State Park, Long Island, New York Samples: Phi size percent distributions over half phi sizes.

Phi size	Cret. 1.4	Cret. 1.5	Cret. 2.1	Cret. 2.2
-1.0 - -0.5	0.00 %	2.37 %	0.00 %	0.00 %
-0.5 – 0.0	0.00 %	8.25 %	0.11 %	0.15 %
0.0 – 0.5	0.19 %	14.52 %	2.31 %	3.34 %
0.5 – 1.0	3.11 %	15.33 %	5.99 %	9.59 %
1.0 – 1.5	8.40 %	10.73 %	8.58 %	15.79 %
1.5 – 2.0	12.40 %	5.90 %	8.52 %	17.26 %
2.0 – 2.5	12.07 %	3.97 %	7.24 %	12.88 %
2.5 – 3.0	8.77 %	4.00 %	7.19 %	7.08 %
3.0 – 3.5	6.09 %	4.16 %	8.53 %	4.18 %
3.5 – 4.0	5.41 %	3.86 %	9.39 %	4.00 %
4.0 – 4.5	5.70 %	3.47 %	8.92 %	4.34 %
4.5 – 5.0	5.78 %	3.20 %	7.67 %	4.14 %
5.0 – 5.5	5.43 %	3.01 %	6.24 %	3.58 %
5.5 – 6.0	4.95 %	2.82 %	4.90 %	3.02 %
6.0 – 6.5	4.47 %	2.64 %	3.75 %	2.55 %
6.5 – 7.0	3.96 %	2.45 %	2.85 %	2.11 %
7.0 – 7.5	3.38 %	2.21 %	2.20 %	1.69 %
7.5 – 8.0	2.76 %	1.90 %	1.70 %	1.31 %
8.0 – 8.5	2.18 %	1.56 %	1.31 %	1.00 %
8.5 – 9.0	1.67 %	1.21 %	0.98 %	0.75 %
9.0 – 9.5	1.20 %	0.89 %	0.69 %	0.54 %
9.5 – 10.0	0.82 %	0.62 %	0.45 %	0.37 %
10.0 – 10.5	0.56 %	0.43 %	0.28 %	0.24 %
10.5 – 11.0	0.39 %	0.30 %	0.19 %	0.09 %
11.0 – 11.5	0.25 %	0.17 %	0.00 %	0.00 %
11.5 – 12.0	0.05 %	0.00 %	0.00 %	0.00 %
12.0 – 12.5	0.00 %	0.00 %	0.00 %	0.00 %
Total:	99.99 %	99.97 %	99.99 %	100.00 %

Caumsett State Park Samples:

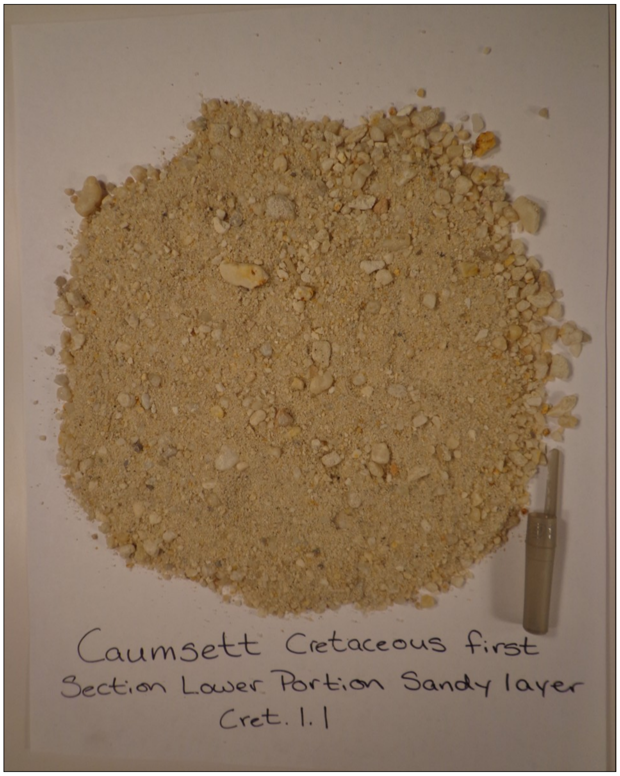
Glacial Samples *(Fig A24a-c)*

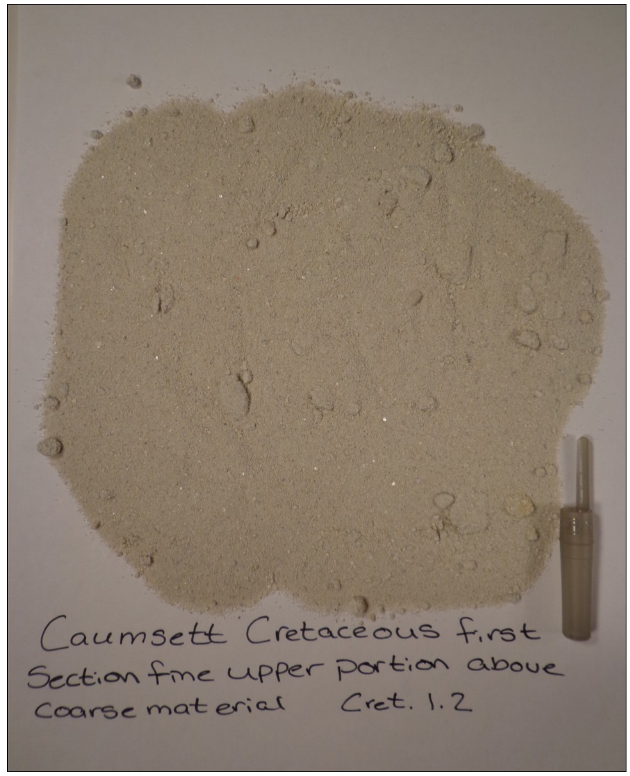


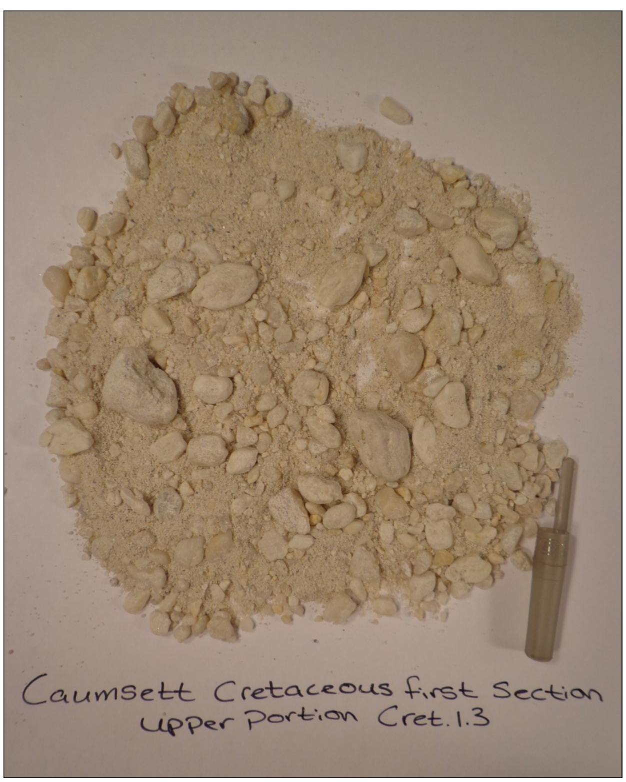


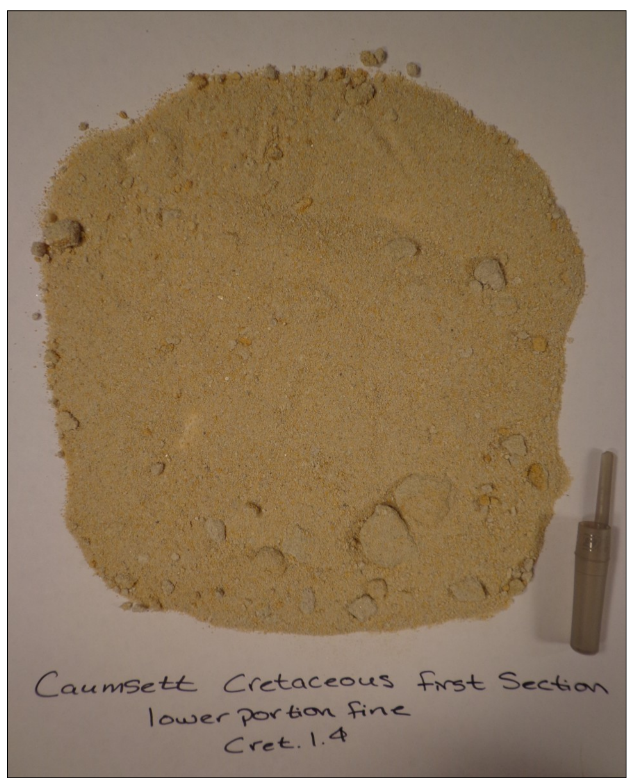
Caumsett State Park Samples:

Cretaceous Samples *(Fig A25a-d)*



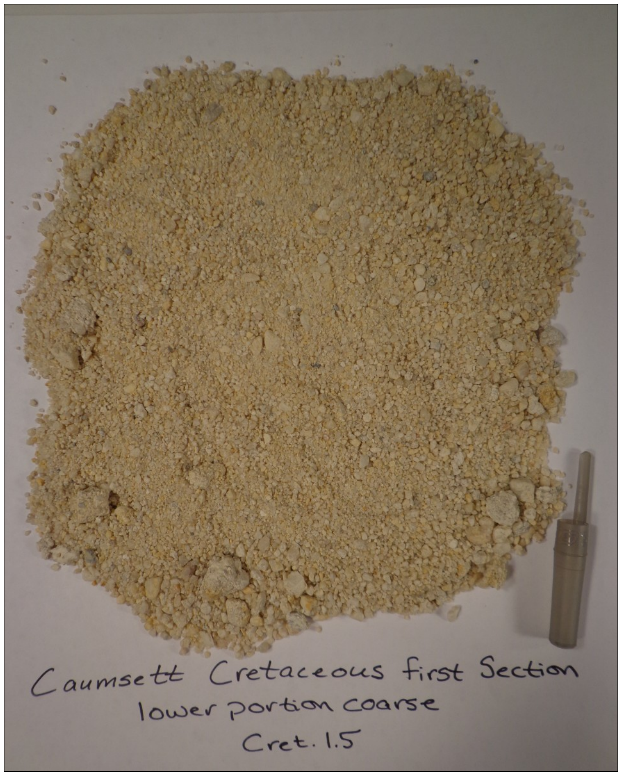


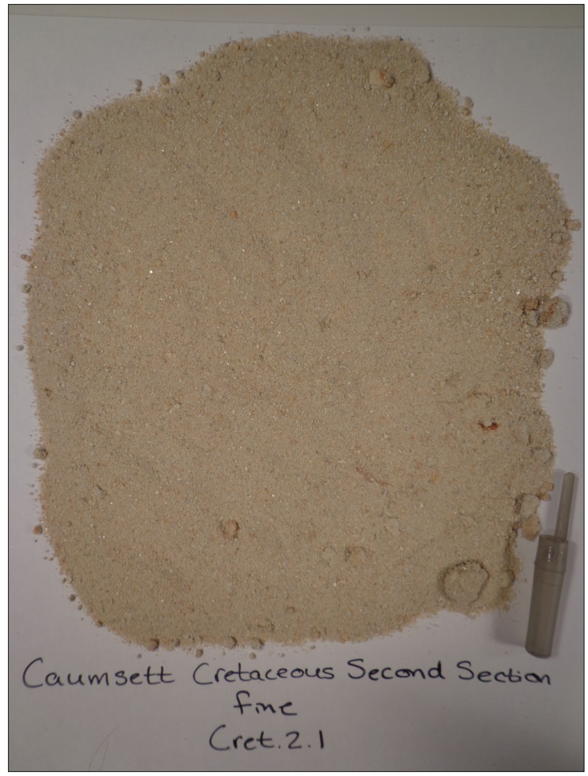


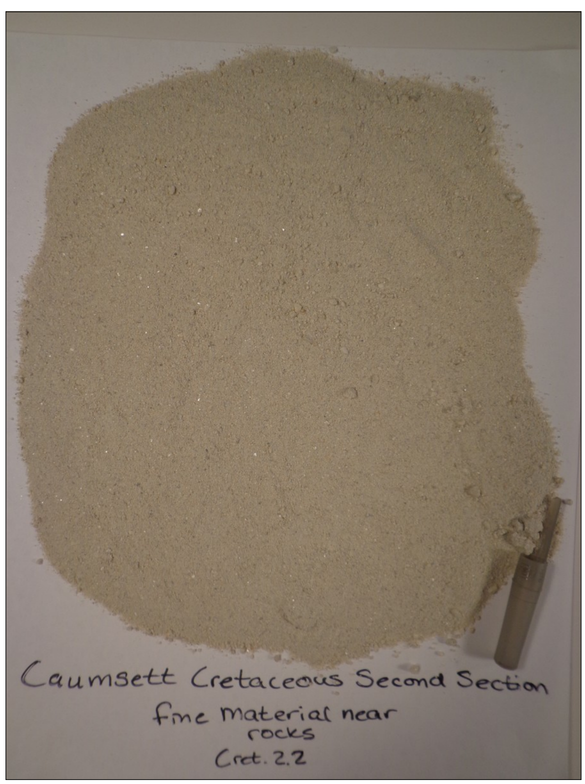


Caumsett State Park Samples:

Cretaceous Samples *(Fig A25e-g)*



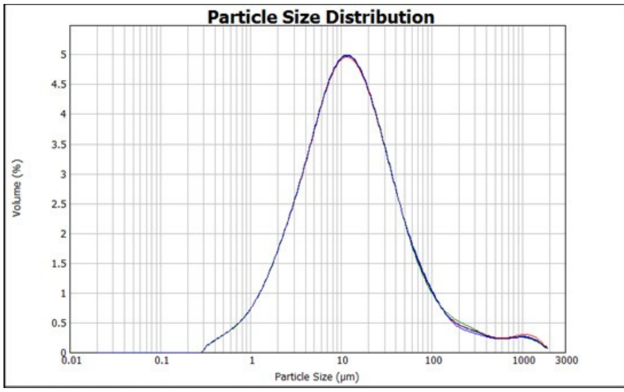




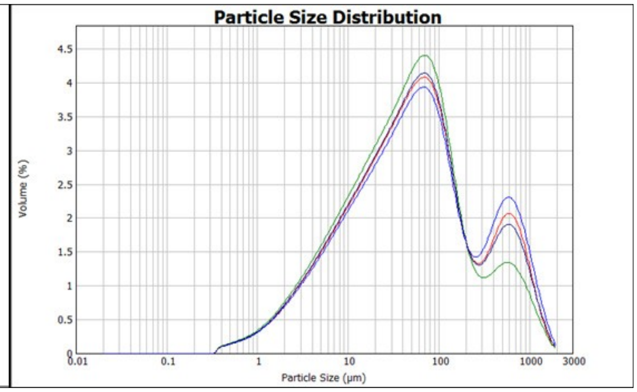
(Fig A26) **Brookhaven, Long Island, New York, USGS Samples:**

Sample Name	Type	Grain Size Modes (microns)
Brookhaven USGS Core S6409	—	—
363-383 ft.	Magothy Silt	12µm, 1000µm
417-423 ft.	Magothy Sand	70µm, 600µm
562 ft.	Magothy Sand	70µm, 400µm
899 ft.	Magothy Silt	15µm, 300µm
1100 ft.	Raritan Clay	12µm, 900µm
1110 ft.	Raritan Sandy Silt	7µm, 30µm, 250µm
1160 ft.	Lloyd Clay	9µm, 1000µm
1221 ft.	Lloyd Silty Clay	15µm, 45µm, 800µm
1300 ft.	Lloyd Sandy Silt	7µm, 70µm, 450µm
1311 ft.	Lloyd Sandy Silt	15µm, 80µm, 600v
1523 ft.	Weathered Bedrock Clay	0.5µm, 2.5µm, 175µm, 1000µm
1538 ft. sample 1	Bedrock Sandy Clay	0.5µm, 10µm, 60µm, 1000µm
1538 ft. sample 2	Bedrock Sandy Clay	0.5µm, 10µm, 600µm
1548 ft. sample 1	Bedrock Sandy Clay	9µm, 65µm, 500µm
1548 ft. sample 2	Bedrock Sandy Clay	0.5µm, 9µm, 65µm, 700µm
1555 ft.	Bedrock Sandy Clay	0.5µm, 12µm, 55µm, 300µm
1568 ft.	Bedrock Weathered Clay	17µm, 150µm, 400µm
Core S6434	—	—
256-288 ft.	Magothy Sandy Silt	28µm, 200µm
1501-1565 ft.	Bedrock Sandy Silt	19µm, 60µm, 450µm

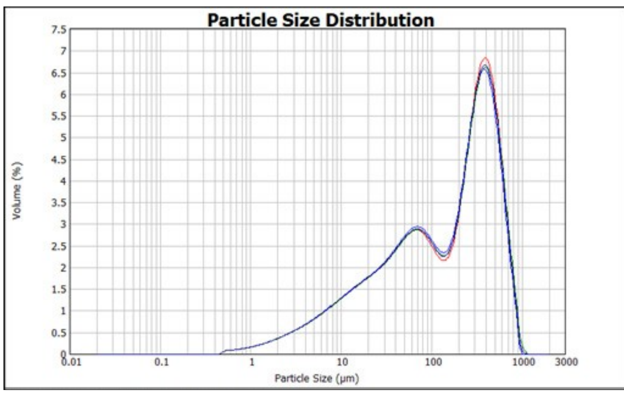
<u>USGS Brookhaven Core S6409 Graphs:</u>



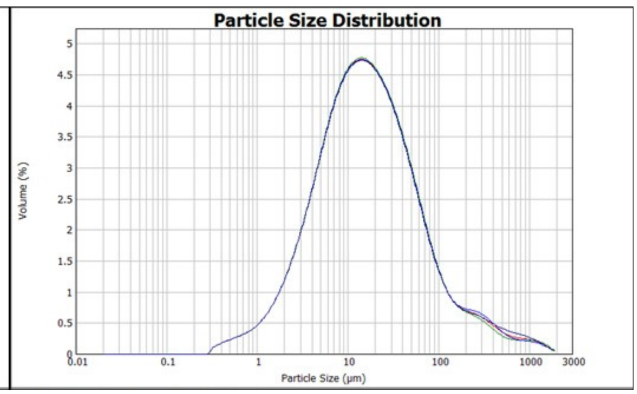
(Fig A 27a) Histogram of Magothy silt from Brookhaven Core with modes at 12µm and 1000µm. Brookhaven Core S6409 363-383 ft.



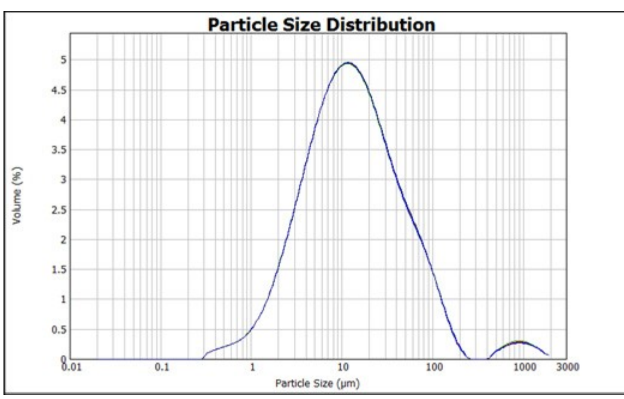
(Fig A27b) Histogram of Magothy sand from Brookhaven Core with modes at 70µm and 600µm. Brookhaven Core S6409 417-423 ft.



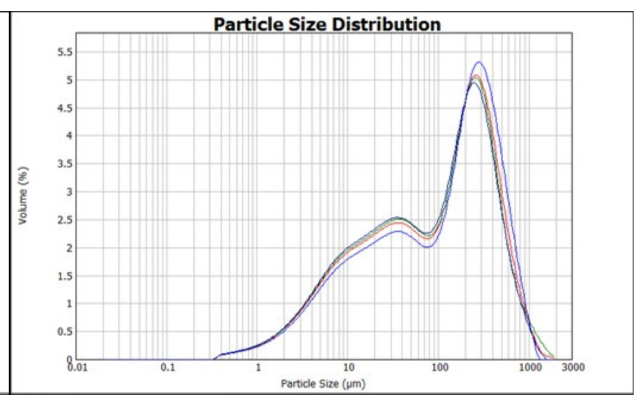
(Fig A27c) Histogram of Magothy sand from Brookhaven Core with modes at 70µm and 400µm. Brookhaven Core S6409 562 ft.



(Fig A27d) Histogram of Magothy silt from Brookhaven Core with modes at 15µm and 300µm. Brookhaven Core S6409 899 ft.

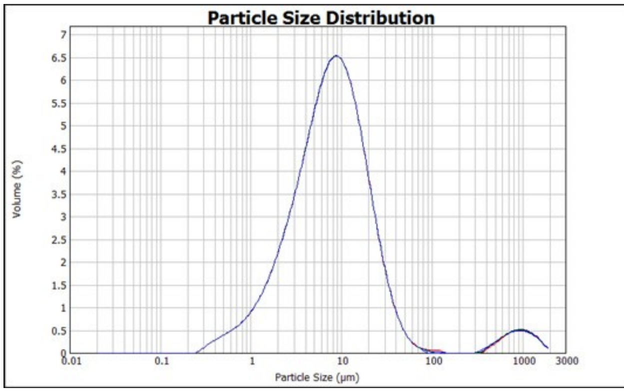


(Fig A27e) Histogram of Raritan clay from Brookhaven Core with modes at 12µm and 900µm. Brookhaven Core S6409 1100 ft.

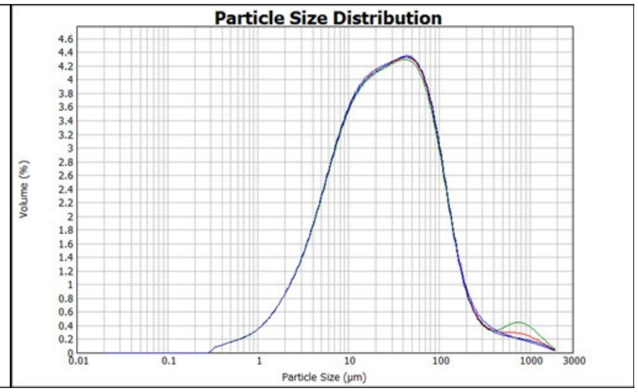


(Fig A27f) Histogram of Raritan silt from Brookhaven Core with modes at 7µm, 30µm and 250µm. Brookhaven Core S6409 1110 ft.

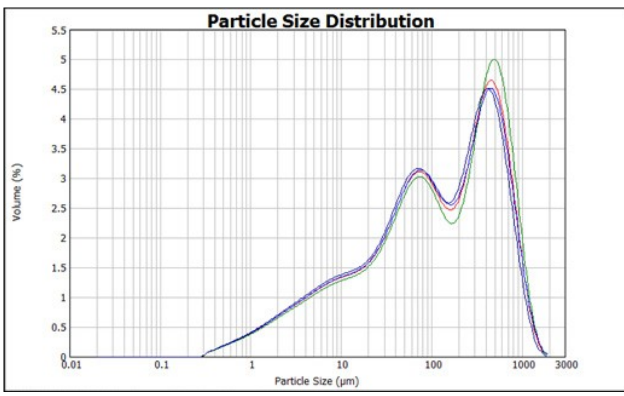
USGS Brookhaven Core S6409 Graphs:



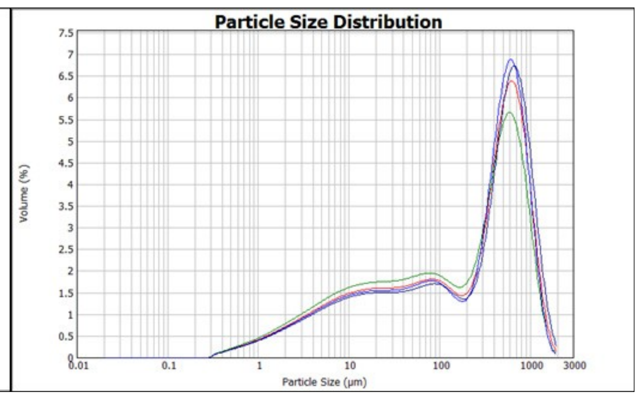
(Fig A27g) Histogram of Lloyd clay from Brookhaven Core with modes at 9μm and 1000μm. Brookhaven Core S6409 1160 ft.



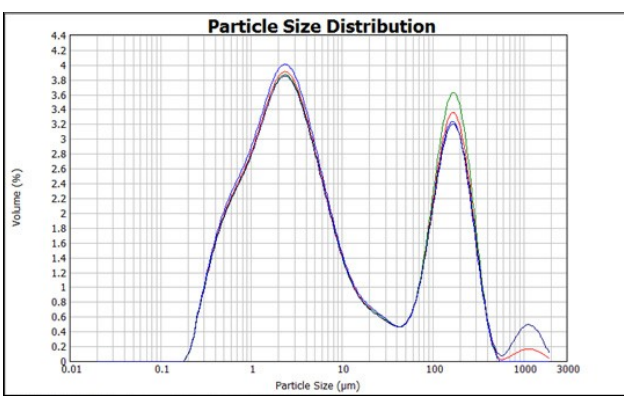
(Fig A27h) Histogram of Lloyd clay from Brookhaven Core with modes at 15μm, 45μm, and 800μm. Brookhaven Core S6409 1221 ft.



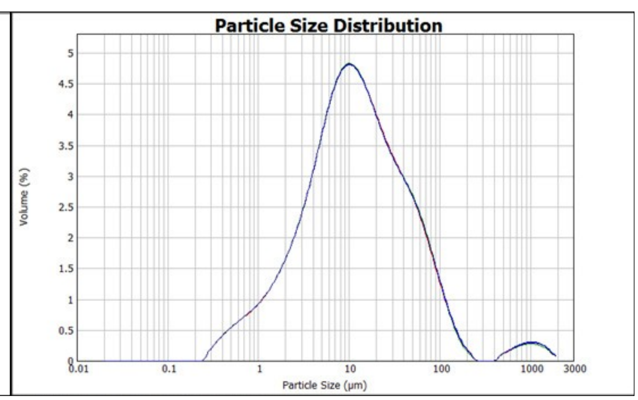
(Fig A27i) Histogram of Lloyd silt from Brookhaven Core with modes at 7μm, 70μm and 450μm. Brookhaven Core S6409 1300 ft.



(Fig A27j) Histogram of Lloyd silt from Brookhaven Core with modes at 15μm, 80μm and 600μm. Brookhaven Core S6409 1311 ft.

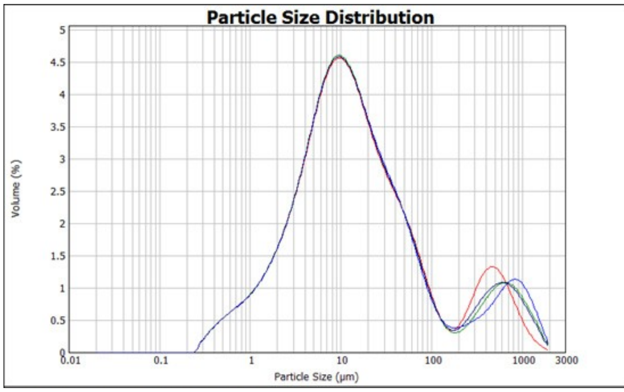


(Fig A27k) Histogram of Weathered Bedrock clay from Brookhaven Core with modes at 0.5μm, 2.5μm, 175μm, and 1000μm. Brookhaven Core S6409 1523 ft.

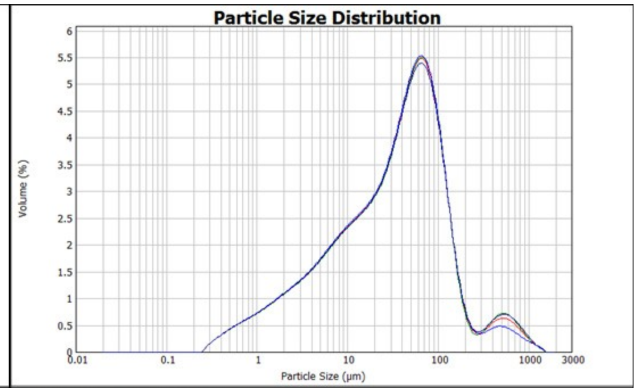


(Fig A27l) Histogram of Weathered Bedrock sandy clay from Brookhaven Core with modes at 0.5μm, 10μm, 60μm and 1000μm. Brookhaven Core S6409 1538 ft. sample 1.

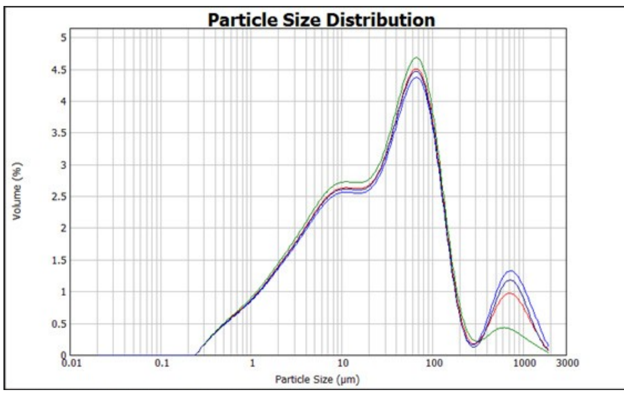
<u>USGS Brookhaven Core S6409 Graphs:</u>



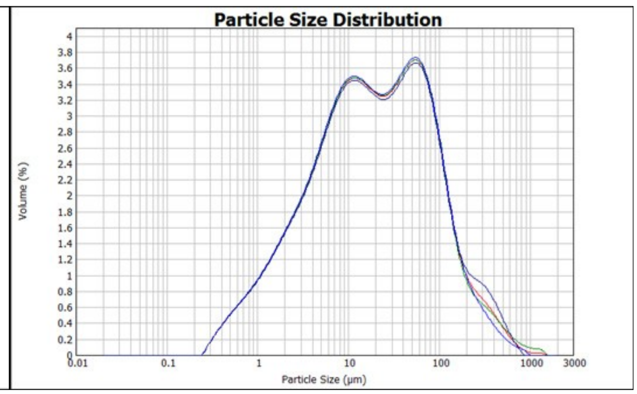
(Fig A27m) Histogram of Weathered Bedrock sandy clay from Brookhaven Core with modes at 0.5µm, 10µm and 600µm. Brookhaven Core S6409 1538 ft. sample 2.



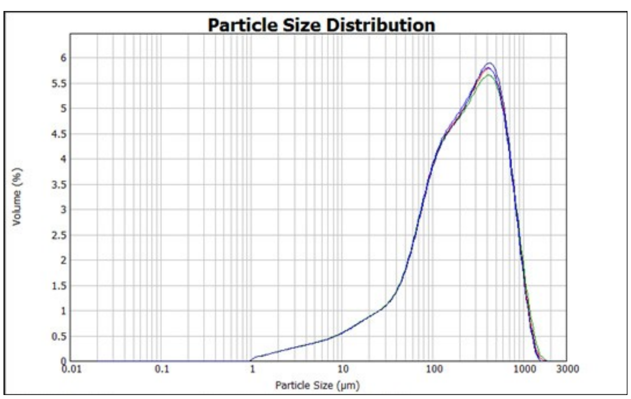
(Fig A27n) Histogram of Weathered Bedrock sandy clay from Brookhaven Core with modes at 9µm, 65µm, and 500µm. Brookhaven Core S6409 1548 ft. sample 1.



(Fig A27o) Histogram of Weathered Bedrock sandy clay from Brookhaven Core with modes at 0.5µm, 9µm, 65µm, and 700µm. Brookhaven Core S6409 1548 ft. sample 2.

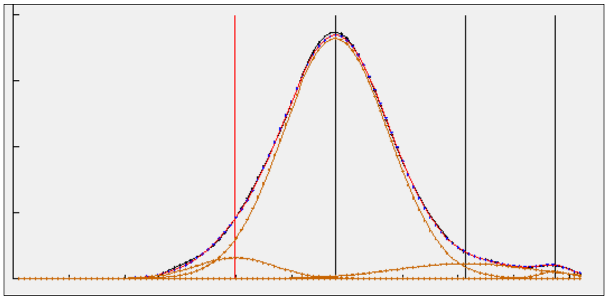


(Fig A27p) Histogram of Weathered Bedrock sandy clay from Brookhaven Core with modes at 0.5µm, 12µm, 55µm and maybe at 300µm. Brookhaven Core S6409 1555 ft.

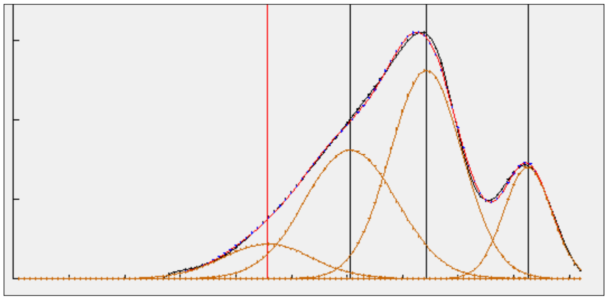


(Fig A27q) Histogram of Weathered Bedrock sandy clay from Brookhaven Core with modes at possibly 17µm, 150µm, and 400µm. Brookhaven Core S6409 1568 ft.

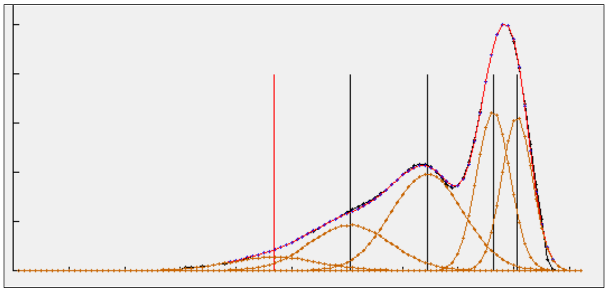
USGS Brookhaven Core S6409 GrainAnalysis Graphs:



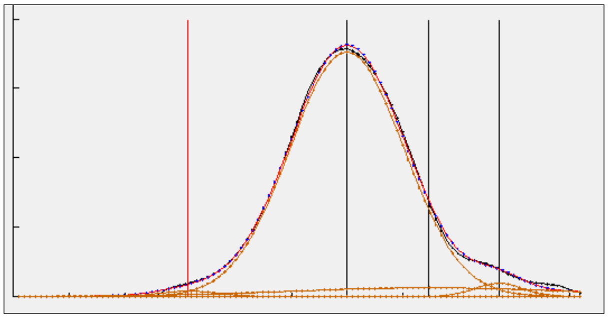
(Fig A 27aa) Graph for 363– 383 ft.



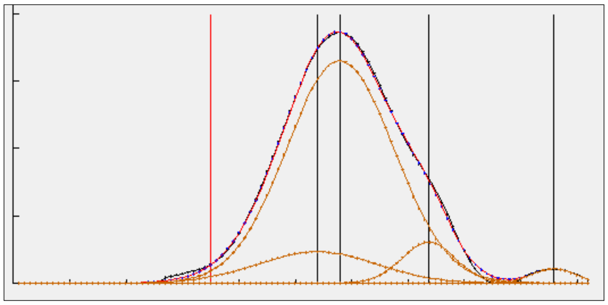
(Fig A 27bb) Graph for 417-423 ft.



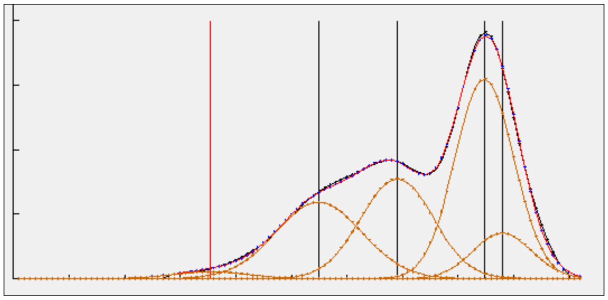
(Fig A 27cc) Graph for 562 ft.



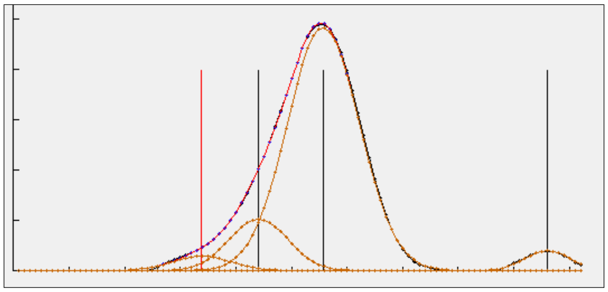
(Fig A 27dd) Graph for 899 ft.



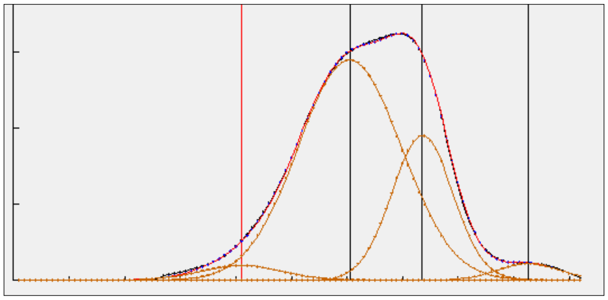
(Fig A 27ee) Graph for 1100 ft.



(Fig A 27ff) Graph for 1110 ft.

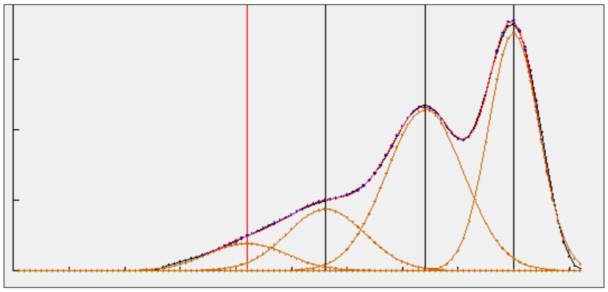


(Fig A 27gg) Graph for 1160 ft.

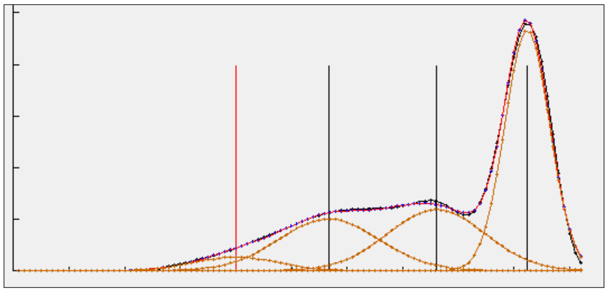


(Fig A 27hh) Graph for 1221 ft.

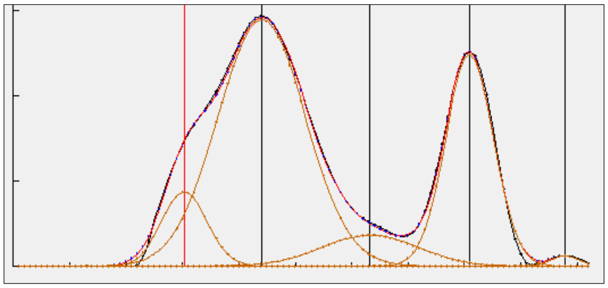
USGS Brookhaven Core S6409 GrainAnalysis Graphs:



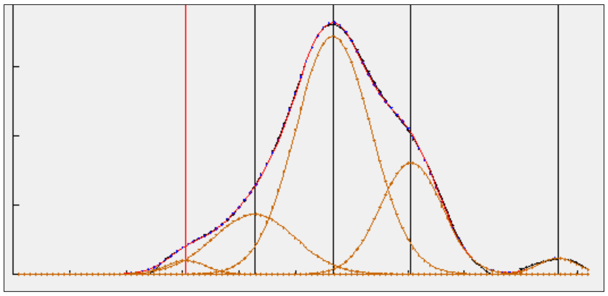
(Fig A 27ii) Graph for 1300 ft.



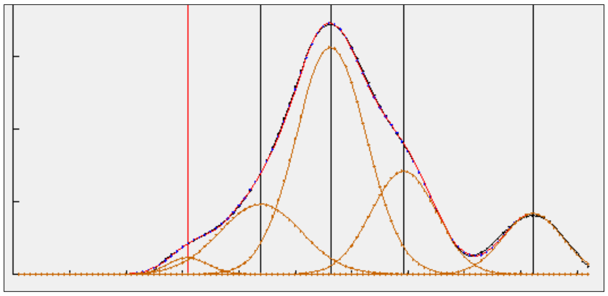
(Fig A 27jj) Graph for 1311 ft.



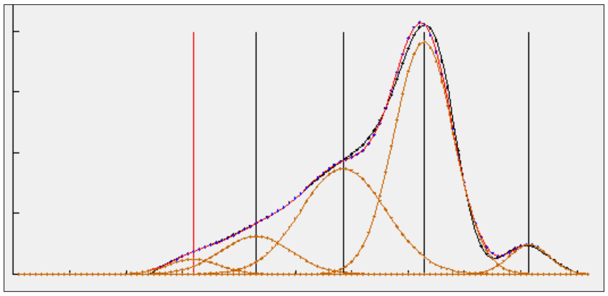
(Fig A 27kk) Graph for 1523 ft.



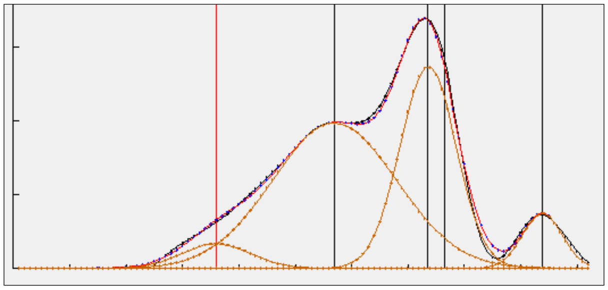
(Fig A 27ll) Graph for 1538 (1) ft.



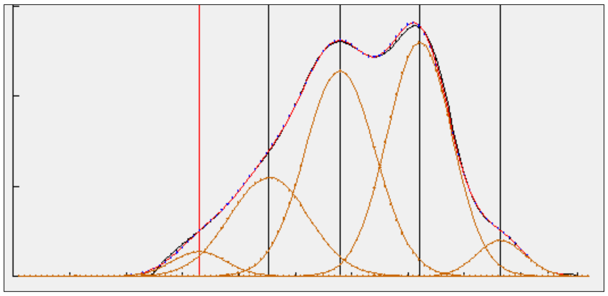
(Fig A 27mm) Graph for 1538 (2) ft.



(Fig A 27nn) Graph for 1548 (1) ft.

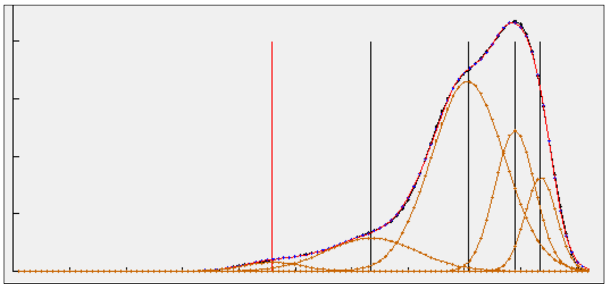


(Fig A 27oo) Graph for 1548 (2) ft.



(Fig A 27pp) Graph for 1555 ft.

USGS Brookhaven Core S6409 GrainAnalysis Graphs:



(Fig A 27qq) Graph for 1568 ft.

(Fig A28) **Brookhaven, Long Island, New York USGS Samples:** Phi size percent distributions over half phi sizes.

USGS Core S6409

Phi size	USGS S6409 363-383 ft.	USGS S6409 417-423 ft.	USGS S6409 562 ft.	USGS S6409 899 ft.	USGS S6409 1100 ft.	USGS S6409 1110 ft.
-1.0 - -0.5	0.31 %	0.61 %	0.00 %	0.22 %	0.26 %	0.11 %
-0.5 – 0.0	0.57 %	1.96 %	0.02 %	0.46 %	0.54 %	0.81 %
0.0 – 0.5	0.58 %	3.56 %	3.08 %	0.56 %	0.61 %	2.56 %
0.5 – 1.0	0.52 %	4.26 %	10.20 %	0.69 %	0.43 %	5.26 %
1.0 – 1.5	0.61 %	3.72 %	14.72 %	0.99 %	0.08 %	8.73 %
1.5 – 2.0	0.81 %	3.02 %	12.98 %	1.34 %	0.00 %	11.19 %
2.0 – 2.5	1.02 %	3.59 %	8.04 %	1.56 %	0.37 %	10.64 %
2.5 – 3.0	1.44 %	5.73 %	5.30 %	1.92 %	1.53 %	7.87 %
3.0 – 3.5	2.22 %	8.17 %	5.69 %	2.93 %	3.12 %	5.55 %
3.5 – 4.0	3.32 %	9.29 %	6.47 %	4.59 %	4.54 %	4.91 %
4.0 – 4.5	4.82 %	9.00 %	6.14 %	6.55 %	5.77 %	5.25 %
4.5 – 5.0	6.68 %	8.14 %	5.23 %	8.34 %	7.20 %	5.50 %
5.0 – 5.5	8.63 %	7.24 %	4.45 %	9.70 %	8.88 %	5.33 %
5.5 – 6.0	10.27 %	6.41 %	3.88 %	10.51 %	10.35 %	4.96 %
6.0 – 6.5	11.15 %	5.58 %	3.34 %	10.69 %	11.10 %	4.60 %
6.5 – 7.0	10.97 %	4.78 %	2.77 %	10.11 %	10.94 %	4.20 %
7.0 – 7.5	9.75 %	3.99 %	2.21 %	8.71 %	9.90 %	2.62 %
7.5 – 8.0	7.94 %	3.23 %	1.71 %	6.78 %	8.19 %	2.86 %
8.0 – 8.5	6.11 %	2.52 %	1.29 %	4.85 %	6.18 %	2.09 %
8.5 – 9.0	4.50 %	1.88 %	0.94 %	3.25 %	4.22 %	1.45 %
9.0 – 9.5	3.13 %	1.32 %	0.65 %	2.07 %	2.58 %	0.97 %
9.5 – 10.0	2.02 %	0.86 %	0.43 %	1.27 %	1.44 %	0.64 %
10.0 – 10.5	1.27 %	0.56 %	0.28 %	0.83 %	0.81 %	0.43 %
10.5 – 11.0	0.81 %	0.38 %	0.19 %	0.59 %	0.53 %	0.30 %
11.0 – 11.5	0.47 %	0.21 %	0.00 %	0.39 %	0.35 %	0.17 %
11.5 – 12.0	0.08 %	0.00 %	0.00 %	0.08 %	0.07 %	0.00 %
12.0 – 12.5	0.00 %	0.00 %	0.00 %	0.00 %	0.00 %	0.00 %
Total :	100.00 %	100.01 %	100.01 %	99.98 %	99.99 %	99.00 %

Brookhaven, Long Island, New York USGS Samples: Phi size percent distributions over half phi sizes.

USGS Core S6409

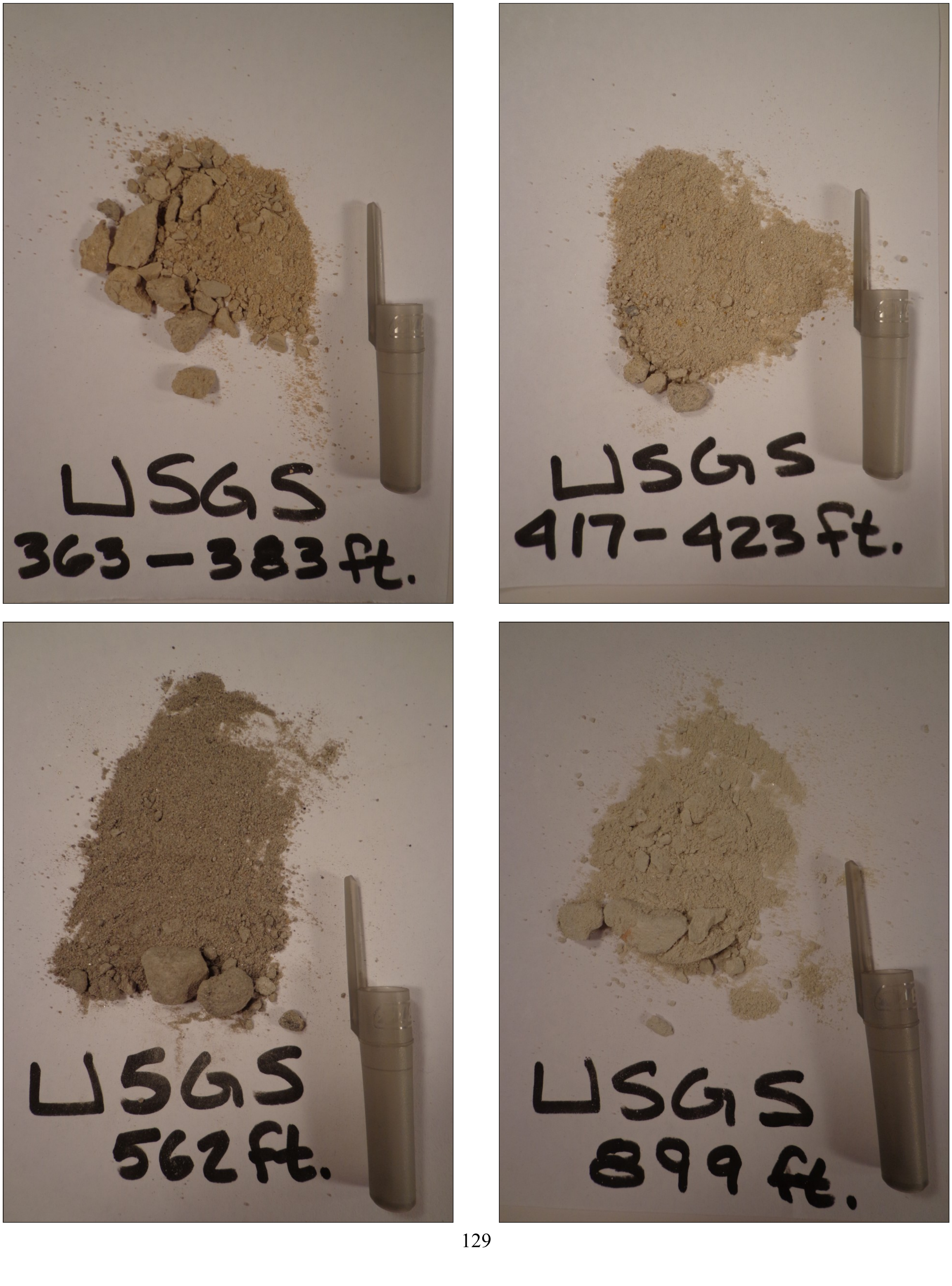
Phi size	USGS S6409 1160 ft.	USGS S6409 1221 ft.	USGS S6409 1300 ft.	USGS S6409 1311 ft.	USGS S6409 1523 ft.	USGS S6409 1538 ft. Sample 1
-1.0 - -0.5	0.51 %	0.18 %	0.30 %	1.23 %	0.20 %	0.35 %
-0.5 – 0.0	1.02 %	0.44 %	2.17 %	5.83 %	0.36 %	0.63 %
0.0 – 0.5	1.10 %	0.61 %	5.90 %	12.05 %	0.25 %	0.60 %
0.5 – 1.0	0.75 %	0.67 %	9.44 %	14.15 %	0.08 %	0.38 %
1.0 – 1.5	0.28 %	0.72 %	10.30 %	10.72 %	1.07 %	0.07 %
1.5 – 2.0	0.00 %	1.03 %	8.41 %	5.98 %	3.93 %	0.00 %
2.0 – 2.5	0.00 %	1.93 %	6.21 %	3.53 %	6.83 %	0.33 %
2.5 – 3.0	0.00 %	3.85 %	5.69 %	3.41 %	7.29 %	1.22 %
3.0 – 3.5	0.06 %	6.53 %	6.48 %	3.93 %	5.16 %	2.75 %
3.5 – 4.0	0.25 %	8.70 %	7.00 %	4.05 %	2.58 %	4.48 %
4.0 – 4.5	0.93 %	9.66 %	6.45 %	3.85 %	1.24 %	5.91 %
4.5 – 5.0	2.64 %	9.73 %	5.25 %	3.68 %	1.11 %	6.95 %
5.0 – 5.5	5.69 %	9.51 %	4.13 %	3.62 %	1.39 %	8.01 %
5.5 – 6.0	9.62 %	9.24 %	3.46 %	3.59 %	1.73 %	9.35 %
6.0 – 6.5	13.08 %	8.73 %	3.16 %	3.49 %	2.38 %	10.53 %
6.5 – 7.0	14.66 %	7.78 %	2.96 %	3.28 %	3.58 %	10.80 %
7.0 – 7.5	13.83 %	6.37 %	2.71 %	2.97 %	5.18 %	9.76 %
7.5 – 8.0	11.33 %	4.78 %	2.37 %	2.58 %	6.86 %	7.81 %
8.0 – 8.5	8.44 %	3.39 %	2.02 %	2.17 %	8.26 %	5.82 %
8.5 – 9.0	5.92 %	2.33 %	1.68 %	1.78 %	8.80 %	4.27 %
9.0 – 9.5	3.93 %	1.53 %	1.33 %	1.40 %	8.15 %	3.15 %
9.5 – 10.0	2.48 %	0.96 %	1.01 %	1.06 %	6.88 %	2.34 %
10.0 – 10.5	1.58 %	0.61 %	0.73 %	0.77 %	5.79 %	1.80 %
10.5 – 11.0	1.06 %	0.41 %	0.50 %	0.53 %	4.88 %	1.40 %
11.0 – 11.5	0.65 %	0.26 %	0.28 %	0.30 %	3.68 %	0.94 %
11.5 – 12.0	0.20 %	0.05 %	0.04 %	0.05 %	2.02 %	0.34 %
12.0 – 12.5	0.00 %	0.00 %	0.00 %	0.00 %	0.31 %	0.00 %
Total :	100.01 %	100.00 %	99.98 %	100.00 %	99.99 %	99.99 %

Brookhaven, Long Island, New York USGS Samples: Phi size percent distributions over half phi sizes.

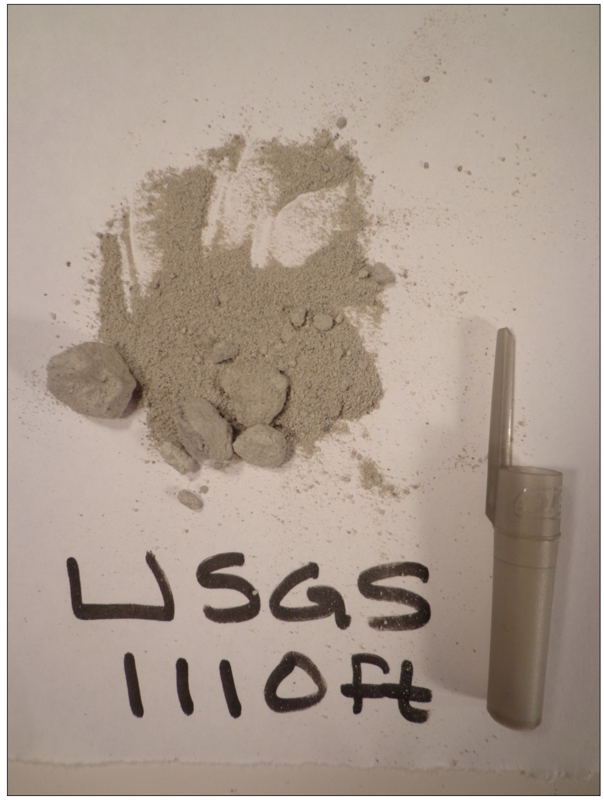
USGS Core S6409

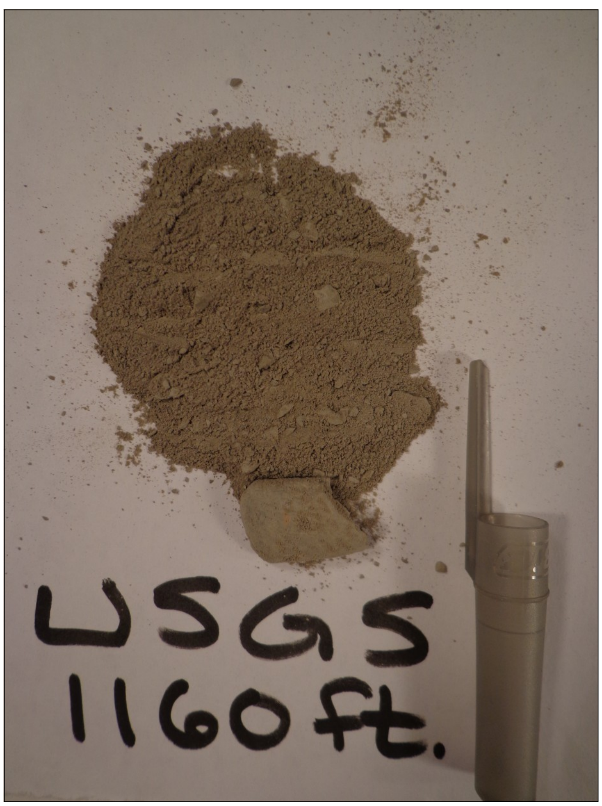
Phi size	USGS S6409 1538 ft. Sample 2	USGS S6409 1548 ft. Sample 1	USGS S6409 1548 ft. Sample 2	USGS S6409 1555 ft.	USGS S6409 1568 ft.
-1.0 - -0.5	0.58 %	0.02 %	0.45 %	0.00 %	0.07 %
-0.5 – 0.0	1.43 %	0.33 %	1.28 %	0.06 %	2.07 %
0.0 – 0.5	2.16 %	0.87 %	2.05 %	0.17 %	6.87 %
0.5 – 1.0	2.42 %	1.36 %	2.00 %	0.55 %	11.41 %
1.0 – 1.5	2.12 %	1.26 %	1.09 %	1.11 %	13.00 %
1.5 – 2.0	1.48 %	0.84 %	0.45 %	1.61 %	12.27 %
2.0 – 2.5	0.90 %	1.56 %	1.35 %	2.18 %	11.15 %
2.5 – 3.0	0.91 %	4.75 %	4.28 %	3.55 %	10.27 %
3.0 – 3.5	1.80 %	9.31 %	7.95 %	5.85 %	8.92 %
3.5 – 4.0	3.27 %	12.09 %	10.00 %	7.78 %	6.64 %
4.0 – 4.5	4.71 %	11.72 %	9.64 %	8.32 %	4.32 %
4.5 – 5.0	5.86 %	9.58 %	8.02 %	7.83 %	2.89 %
5.0 – 5.5	7.03 %	7.58 %	6.61 %	7.38 %	2.26 %
5.5 – 6.0	8.49 %	6.40 %	6.00 %	7.49 %	1.88 %
6.0 – 6.5	9.84 %	5.73 %	5.94 %	7.81 %	1.51 %
6.5 – 7.0	10.31 %	5.13 %	5.90 %	7.67 %	1.17 %
7.0 – 7.5	9.46 %	4.45 %	5.54 %	6.84 %	0.93 %
7.5 – 8.0	7.64 %	3.73 %	4.86 %	5.67 %	0.77 %
8.0 – 8.5	5.72 %	3.13 %	4.12 %	4.62 %	0.63 %
8.5 – 9.0	4.19 %	2.65 %	3.44 %	3.80 %	0.48 %
9.0 – 9.5	3.07 %	2.21 %	2.78 %	3.06 %	0.32 %
9.5 – 10.0	2.27 %	1.79 %	2.18 %	2.37 %	0.15 %
10.0 – 10.5	1.75 %	1.43 %	1.70 %	1.81 %	0.00 %
10.5 – 11.0	1.36 %	1.10 %	1.27 %	1.34 %	0.00 %
11.0 – 11.5	0.92 %	0.73 %	0.82 %	0.86 %	0.00 %
11.5 – 12.0	0.33 %	0.26 %	0.28 %	0.29 %	0.00 %
12.0 – 12.5	0.00 %	0.00 %	0.00 %	0.00 %	0.00 %
Total :	100.02 %	100.01 %	100.00 %	100.02 %	99.98 %

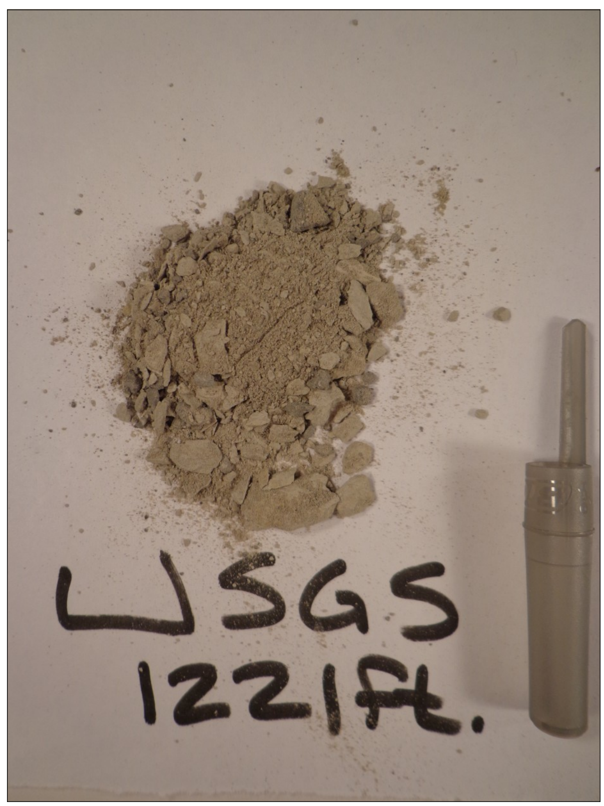
USGS Brookhaven Sample Core S6409 *(Fig A29a-d)*



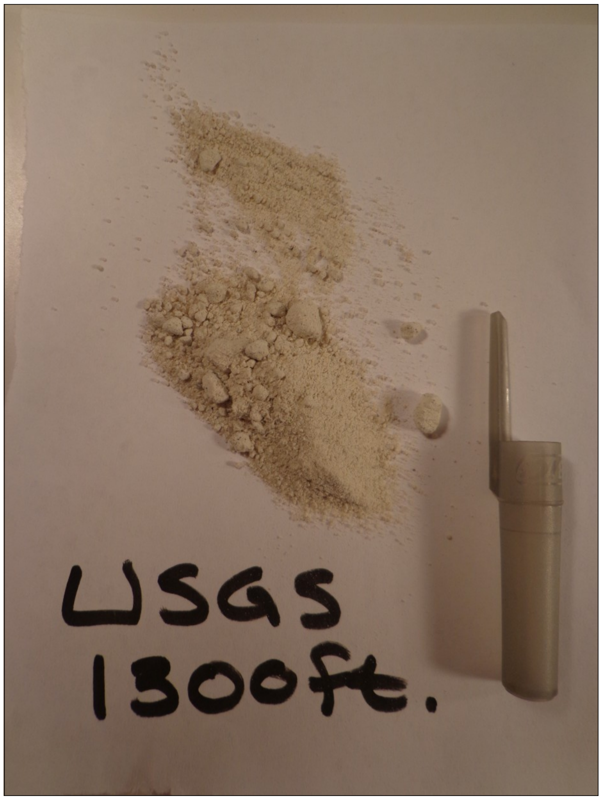
USGS Brookhaven Sample Core S6409*(Fig A29e-h)*

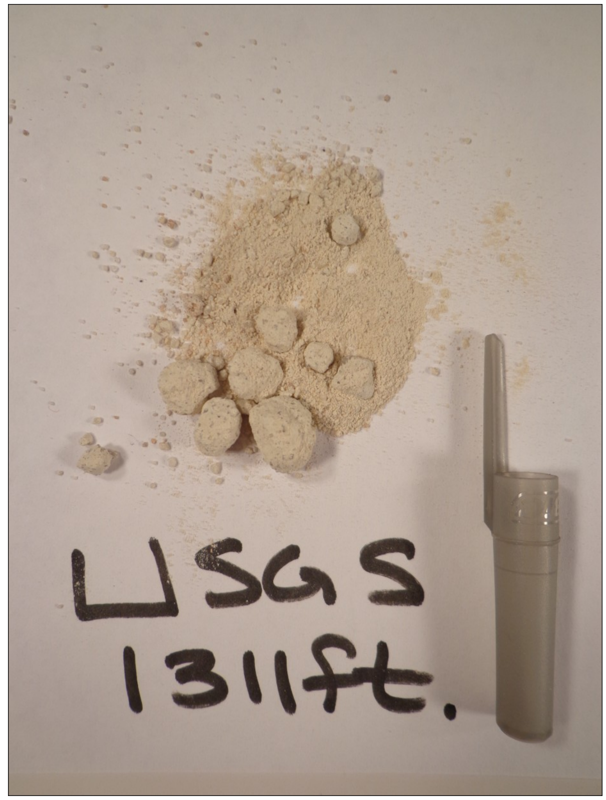


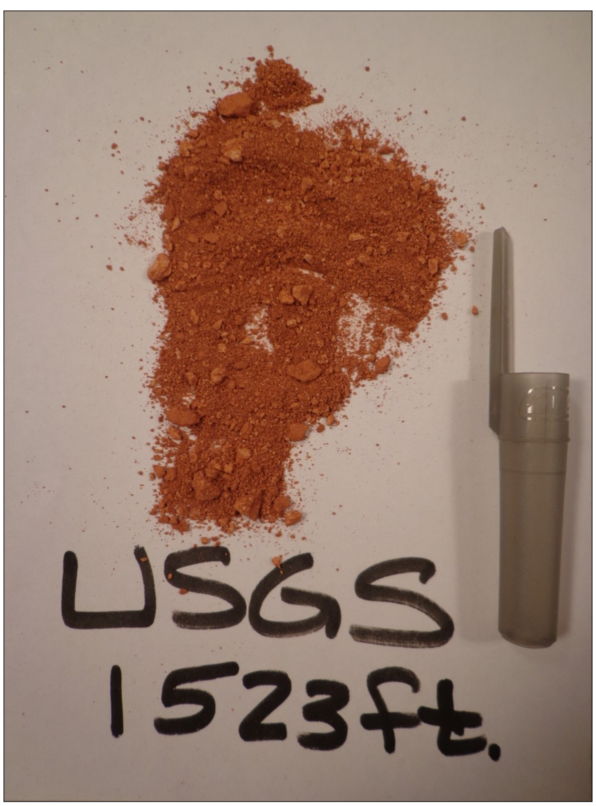


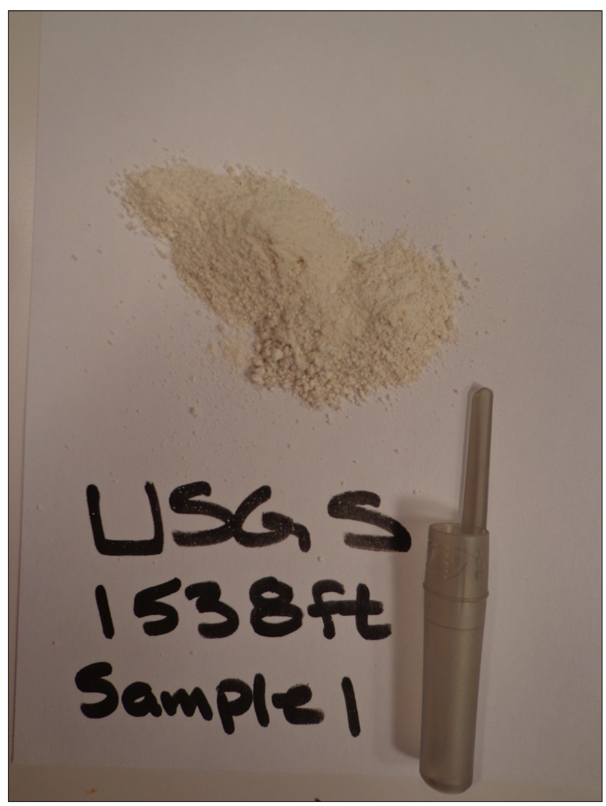


<u>USGS Brookhaven Sample Core S6409 </u>*(Fig A29i-j)*

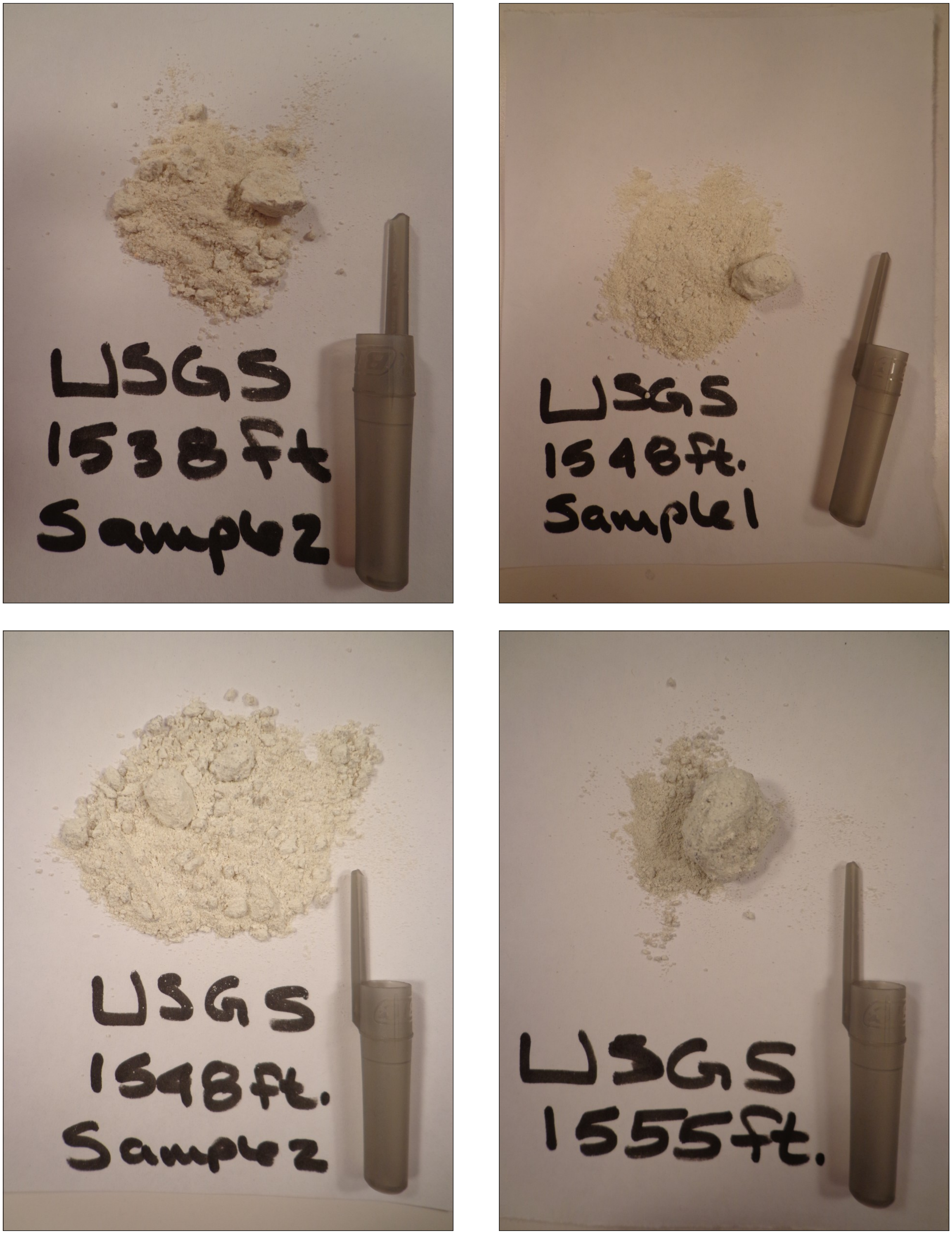




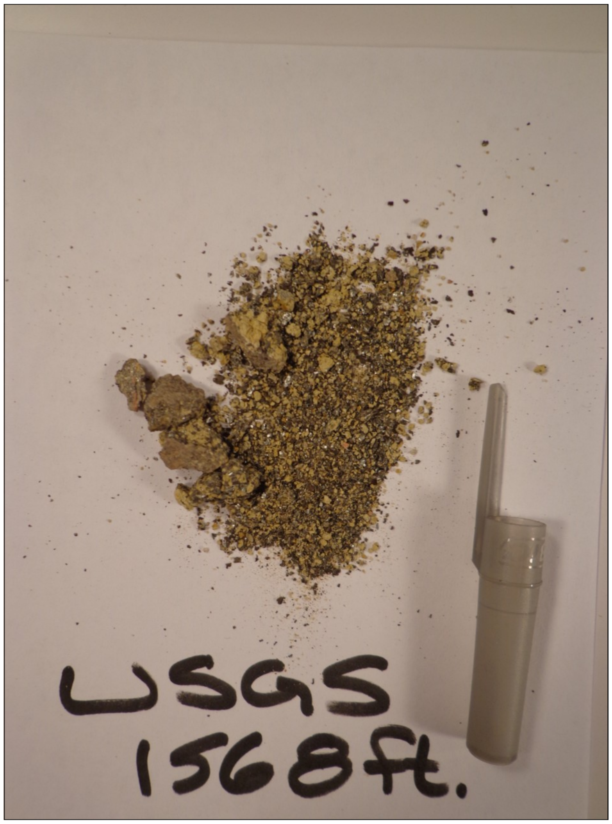




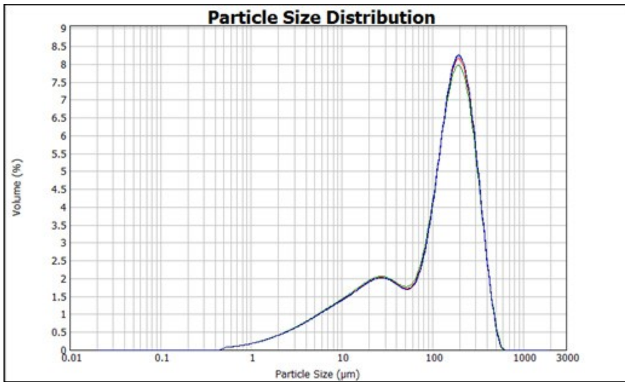
USGS Brookhaven Sample Core S6409 *(Fig A29k-n)*



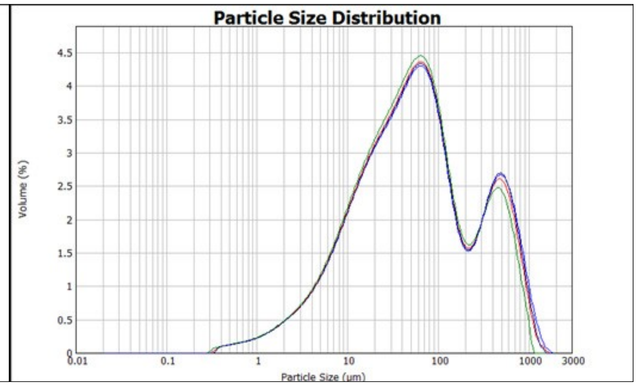
USGS Brookhaven Sample Core S6409 *(Fig A29o)*



USGS Brookhaven Core S6434 Graphs:

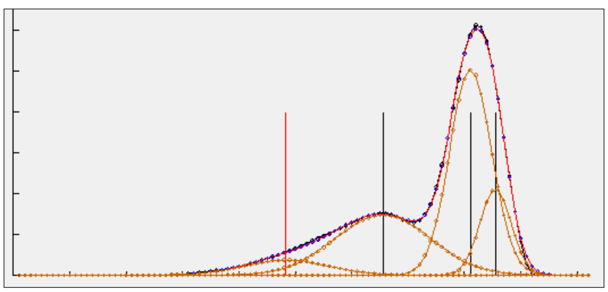


(Fig A30a) Histogram of Magothy sandy silt from Brookhaven Core with modes at 28µm and 200µm.
Brookhaven Core S6434 256-288 ft.

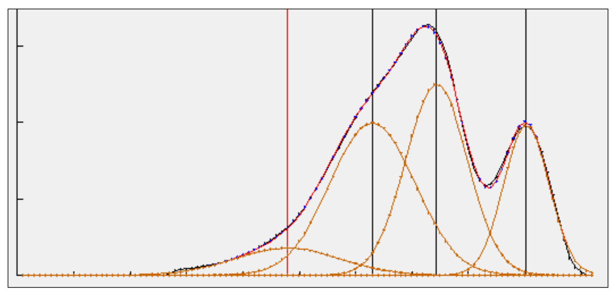


(Fig A30b) Histogram of Weathered Bedrock sandy silt from Brookhaven Core with modes at 19µm, 60µm, and 450µm.
Brookhaven Core S6434 1501-1565 ft.

USGS Brookhaven Core S6434 GrainAnalysis Graphs:



(Fig A30aa) Graph for 256-288 ft.



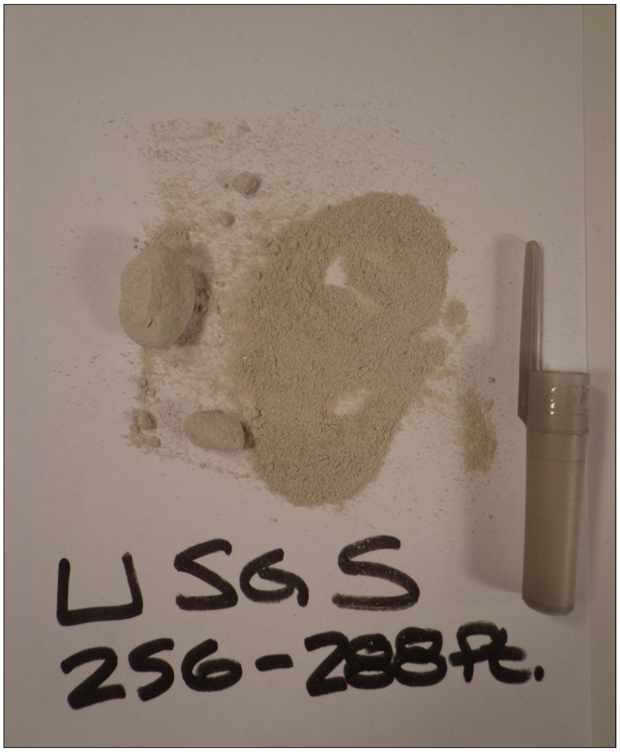
(Fig A30bb) Graph for 1501-1565 ft.

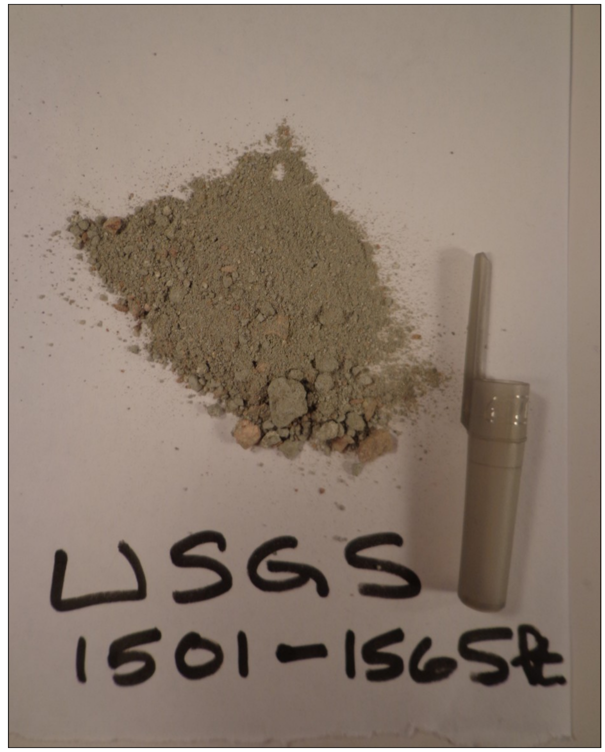
(Fig A31) **Brookhaven, Long Island, New York USGS Samples:** Phi size percent distributions over half phi sizes.

USGS Core S6434

Phi size	USGS S6434 256-288 ft.	USGS S6434 1501-1565 ft.
-1.0 - -0.5	0.00 %	0.05 %
-0.5 – 0.0	0.00 %	0.81 %
0.0 – 0.5	0.00 %	3.17 %
0.5 – 1.0	0.33 %	5.38 %
1.0 – 1.5	4.95 %	5.66 %
1.5 – 2.0	12.98 %	4.35 %
2.0 – 2.5	18.01 %	3.64 %
2.5 – 3.0	16.00 %	5.13 %
3.0 – 3.5	9.99 %	7.92 %
3.5 – 4.0	5.32 %	9.66 %
4.0 – 4.5	3.95 %	9.60 %
4.5 – 5.0	4.32 %	8.68 %
5.0 – 5.5	4.56 %	7.75 %
5.5 – 6.0	4.21 %	6.85 %
6.0 – 6.5	3.60 %	5.76 %
6.5 – 7.0	3.04 %	4.52 %
7.0 – 7.5	2.51 %	3.34 %
7.5 – 8.0	1.98 %	2.39 %
8.0 – 8.5	1.49 %	1.71 %
8.5 – 9.0	1.08 %	1.23 %
9.0 – 9.5	0.74 %	0.87 %
9.5 – 10.0	0.48 %	0.59 %
10.0 – 10.5	0.30 %	0.42 %
10.5 – 11.0	0.18 %	0.31 %
11.0 – 11.5	0.00 %	0.21 %
11.5 – 12.0	0.00 %	0.01 %
12.0 – 12.5	0.00 %	0.00 %
Total :	100.02 %	100.01 %

<u>USGS Brookhaven Samples Core S6434</u> *(Fig A32a-b)*





(Fig A33) Graph showing distribution of modes between <1.00 micron and >1000 microns. Data from GrainAnalysis program.

<1.00	1.00 - 2.00	2.00 - 3.00	3.00 - 4.00	4.00 - 5.00	5.00 - 6.00	6.00 - 7.00	7.00 - 8.00	8.00 - 9.00	9.00-10.00	10.00-20.00	10.00-20.00 Cont	20.00-30.00	30.00-40.00	40.00-50.00	50.00 -	60.00 -
0.57	1.08	2.07	3.04	4.04	5.07	6.33	7.03	8.04	9.04	10.02		20.4	30.48	41.51	50.52	60.87
0.58	1.1	2.15	3.14	4.18	5.08	6.4	7.1	8.15	9.33	10.25		20.86	31.24	42.47	51.13	60.76
0.59	1.1	2.15	3.24	4.38	5.26	6.4	7.18	8.29	9.35	10.82	16.6	20.93	31.97	43.05	54.17	63.62
0.61	1.12	2.17	3.36	4.43	5.27	6.4	7.6	8.43	9.35	10.83	16.96	21.34	32.65	44.05	54.87	65.88
0.76	1.12	2.33	3.41	4.48	5.27	6.78	7.79	8.72	9.42	10.98	16.97	21.38	34.22	46.6	55.43	66.67
0.85	1.16	2.36	3.52	4.59	5.27	6.78	7.96		9.58	11.47	17.58	22.4	35.04	47.72	55.43	67.41
0.93	1.21	2.41	3.65	4.91	5.58	6.94			9.67	11.5	17.58	22.9	35.04	48.87	58.09	68.98
0.93	1.25	2.61	3.73		5.71				9.79	11.75	17.59	23.39	35.8	48.29		
	1.53	2.65	3.73		5.84				9.9	11.87	17.59	23.43	37.07	49.37		
	1.55	2.65	3.82						9.97	12.03	17.79	23.51	37.93	49.37		
	1.68	2.7								12.32	17.92	23.98	37.96			
	1.71	2.7								12.9	17.99	24.12	39.27			
	1.73	2.71								13.05	18.2	24.16				
	1.77	2.96								13.2	18.4	24.79				
	1.91									13.2	18.42	24.81				
	1.95									13.2	18.62	25.38				
	1.98									14.11	18.62	26.9				
										14.14	18.94	26.22				
										14.31	19.06	26.29				
										14.63	19.27	26.94				
										14.78		27.29				
										14.8		27.55				
										14.97		27.76				
										15.12						
										15.67						
										16.59						

70.00-80.00	80.00-90.00	90.00-100.00	100.00-200.00	100.00-200.00 Cont.	200.00-300.00	300.00-400.00	400.00-500.00	400.00-500.00 Cont.	500.00-600.00	600.00-700.00
71.49	81.01	90.87	101.93		227.55	307	404.44		502.84	603.76
71.43	82.89	91.8	101.93		252.44	314.13	404.44		508.87	604.28
75.68	82.89	92.9	101.93	187.59	264.53	336.54	404.09	491.85	508.87	604.28
78.3	83.89	94.98	101.93	198.43	280.05	336.54	404.09	491.85	508.87	626.27
78.23	84.82	95.14	102.02	198.43		339.7	409.28	491.85	508.87	633.78
78.23	84.82	96.2	104.21			340.87	414.19	497.31	519.8	647.39
79.17	84.82	96.28	104.3			352.37	423.08	497.31	520.7	647.95
	84.82	97.27	108			364.56	428.52		520.7	655.15
	84.82	97.35	111.74			364.88	432.91		526.48	670.37
	85.69	98.26	119.5			369.25	443.36		532.79	670.95
	86.79	99.61	122.49			382.03	448.67		545.17	678.41
	86.79	99.7	123.85			390.57	453.27		558.32	679
	87.75		125.34			395.25	453.27		577.15	685.36
	87.76		128.25				453.27		584.57	687.14
	88.81		135.77				453.66			
	88.81		135.77				453.66			
	89.56		139.05				453.66			
			140.59				453.66			
			140.59				464.2			
			143.73				464.6			
			150.62				464.6			
			154.12				474.98			
			157.43				479.85			
			160.67				479.85			
			174.95				480.68			
			180.54				486.02			
			181.01				491.42			
			185.21				491.42			
			185.21				491.85			

700.00-800.00	800.00-900.00	900.00-1000.00	>1000
726.81	805.61	945.33	1013.64
743.7	825.04		1074.01
744.34	852.86		1246.42
760.32	870.42		
787.32			
795.38			

(Fig A34) Chart showing distribution of modes between -0.5 phi and 11phi. Data from GarianAnalysis program.

-0.5	0	0.5	1	1.5		2	2.5	3	3.5	4		4.5
1246.42	1013.64	726.81	502.84	352.37		227.55	180.54	125.34	90.87	63.62		44.05
	1074.01	743.7	508.87	364.56		252.44	181.01	128.25	91.8	65.88		46.6
		744.34	508.87	364.88	474.98	264.53	185.21	135.77	92.9	66.67	89.56	47.72
		760.32	508.87	369.25	479.85	280.05	185.21	135.77	94.98	67.41		48.87
		787.32	508.87	382.03	479.85	307	187.59	139.05	95.14	68.98		48.29
		795.38	519.8	390.57	480.68	314.13	198.43	140.59	96.2	71.49		49.37
		805.61	520.7	395.25	486.02	336.54	198.43	140.59	96.28	71.43		49.37
		825.04	520.7	404.44	491.42	336.54		143.73	97.27	75.68		50.52
		852.86	526.48	404.44	491.42	339.7		150.62	97.35	78.3		51.13
		870.42	532.79	404.09	491.85	340.87		154.12	98.26	78.23		54.17
		945.33	545.17	404.09	491.85			157.43	99.61	78.23		54.87
			558.32	409.28	491.85			160.67	99.7	79.17		55.43
			577.15	414.19	491.85			174.95	101.93	81.01		55.43
			584.57	423.08	497.31				101.93	82.89		58.09
			603.76	428.52	497.31				101.93	82.89		60.87
			604.28	432.91					101.93	83.89		60.76
			604.28	443.36					102.02	84.82		
			626.27	448.67					104.21	84.82		
			633.78	453.27					104.3	84.82		
			647.39	453.27					108	84.82		
			647.95	453.27					111.74	84.82		
			655.15	453.66					119.5	85.69		
			670.37	453.66					122.49	86.79		
			670.95	453.66					123.85	86.79		
			678.41	453.66						87.75		
			679	464.2						87.76		
			685.36	464.6						88.81		
			687.14	464.6						88.81		

5	5.5	6	6.5	7	7.5	8	8.5	9	9.5	10	10.5	11
31.24	22.9	15.67	11.47	7.6	5.58	4.04	2.96	2.07	1.53	1.08	0.76	0.57
31.97	22.4	16.59	11.5	8.04	5.71	4.18	3.04	2.15	1.55	1.1	0.85	0.58
32.65	23.98	16.6	11.75	8.15	5.84	4.38	3.14	2.15	1.68	1.1	0.93	0.59
34.22	23.51	16.96	11.87	8.29	6.33	4.43	3.24	2.17	1.71	1.12	0.93	0.61
35.8	23.43	16.97	12.03	8.43	6.4	4.48	3.36	2.33	1.73	1.12		
35.04	23.39	17.59	12.32	8.72	6.4	4.59	3.41	2.36	1.77	1.16		
35.04	24.16	17.92	12.9	9.04	6.4	4.91	3.52	2.41	1.91	1.21		
37.07	24.79	17.58	13.05	9.33	6.78	5.07	3.65	2.61	1.95	1.25		
37.93	24.12	17.58	13.2	9.35	6.78	5.08	3.73	2.65	1.98			
37.96	24.81	17.99	13.2	9.35	6.94	5.26	3.73	2.65				
39.27	25.38	17.79	13.2	9.42	7.03	5.27	3.82	2.7				
41.51	26.9	17.59	14.11	9.58	7.1	5.27		2.7				
42.47	26.29	18.2	14.14	9.67	7.18	5.27		2.71				
43.05	26.22	18.94	14.31	9.79	7.79							
	26.94	18.62	14.63	9.9	7.96							
	27.29	18.42	14.78	9.97								
	27.55	18.62	14.8	10.02								
	27.76	18.4	14.97	10.25								
	30.48	19.06	15.12	10.82								
		19.27		10.83								
		20.4		10.98								
		20.86										
		20.93										
		21.38										
		21.34										