Comparing Westchester Sediment to Long Island Loess; A Mapping Project

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Abstract

This study is to evaluate the extent and nature of a surface silty sediment considered to be loess that overlies metamorphic bedrock or glacial sediments in Westchester County, NY. Sixty miles to the southeast on Long Island a similar silty surface sediment called, "pebbly loess" is found which is a poorly sorted diamict. Pebbly loess has also been reported in Iowa, Ohio, Minnesota and Alaska.

Loess was found over a large are of Westchester, NY and parts of Fairfield County, CT. Nearly 82% of samples are sandy loam or silt loam. Pebbles were present in 50% of samples. The pebbles were mostly quartz ranging in sphericity from sub angular to sub rounded and are not similar in composition to the underlying metamorphic bedrock which is dominantly gneiss.

Introduction

Ninety four samples were collected throughout the Westchester County NY and adjacent parts of Fairfield County CT to locate and characterize surface silty sediment which has been considered to be loess (Sanders, 1998) with an attempt to make comparisons to the surface silty sediment considered pebbly loess in Suffolk County on Long Island to see if they have similar characteristics.

Besides pebbly loess exposures in Suffolk County NY, locations in Iowa, Ohio, Minnesota and Alaska [GNH1](Kay, 1931; Leverett and Sanderson, 1932)are reported to have pebbly loess. The reason for the occurrence of pebbles in the loess is usually considered to be due to bioturbation or cryoturbation with the pebbles presumably derived from the underlying sediments such as till.

Nieter (1975) described the pebbly loess on the south fork of Suffolk County and considered it to be of eolian origin based on its silty nature, and the presence of ventifacts found as a lag deposit on till underlying the loess. Jian Zhong (2002) and Kundic (2012) did provenance studies using 40Ar/39Ar ages of single biotite and muscovite grains to show that the micas were derived from the bedrock immediately to the north in New England. Loess sediments were dated using Optically Stimulated Luminescence (OSL) and 14C on charcoal grains gave ages consistent with deposition at about the time of the Younger Dryas event between 12,900 and 11,500 calendar years ago (Kundic, 2005).

The procedure used in this study was to collect surface samples throughout Westchester County and adjacent parts of Fairfax County to determine the extent of the loess-like sediments (Fig. 2). The samples were then analyzed using a settling procedure to determine their sand, silt and clay proportions.

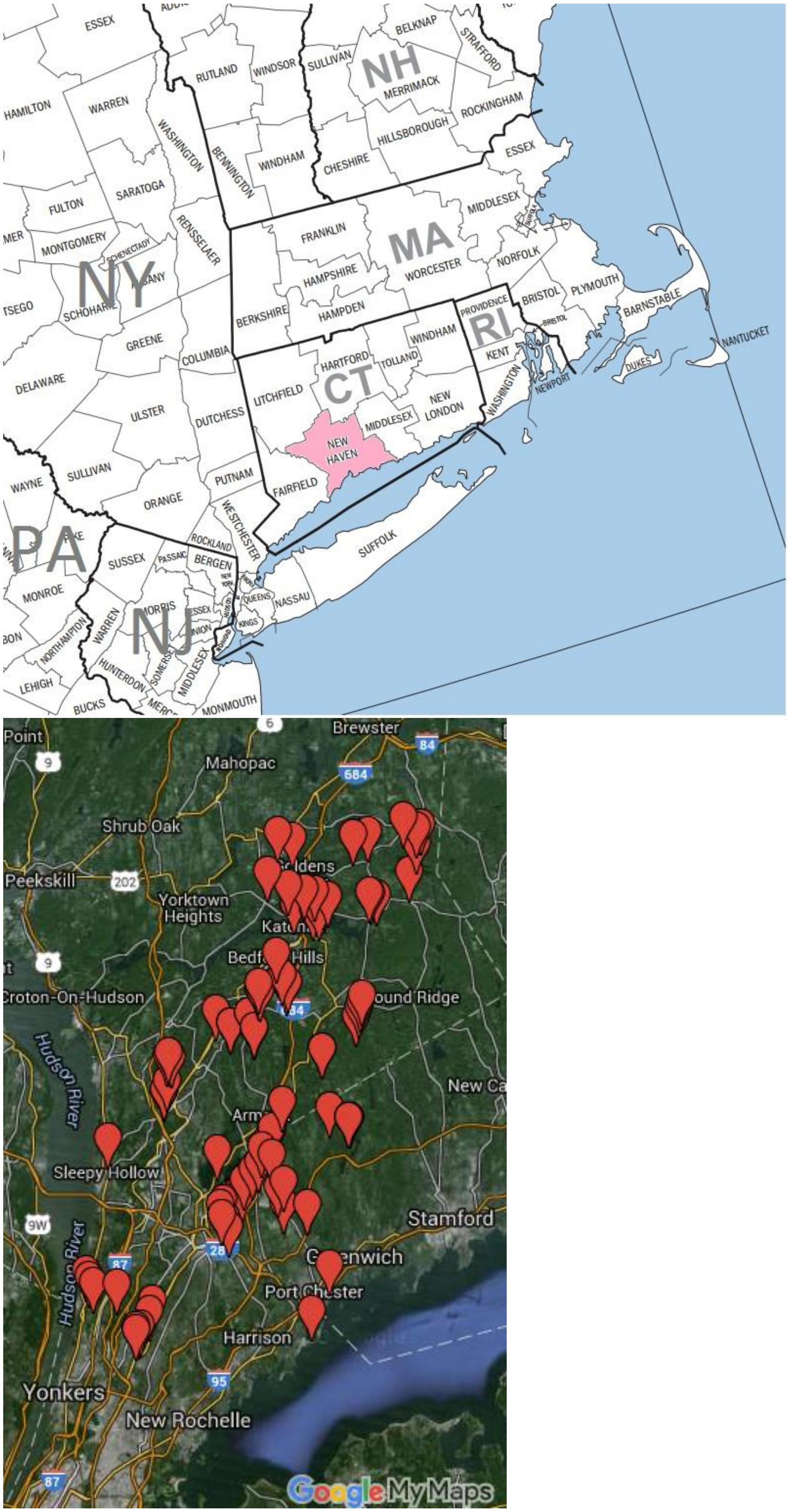

Figure 1: Location of Westchester, Fairfield and Suffolk Counties.

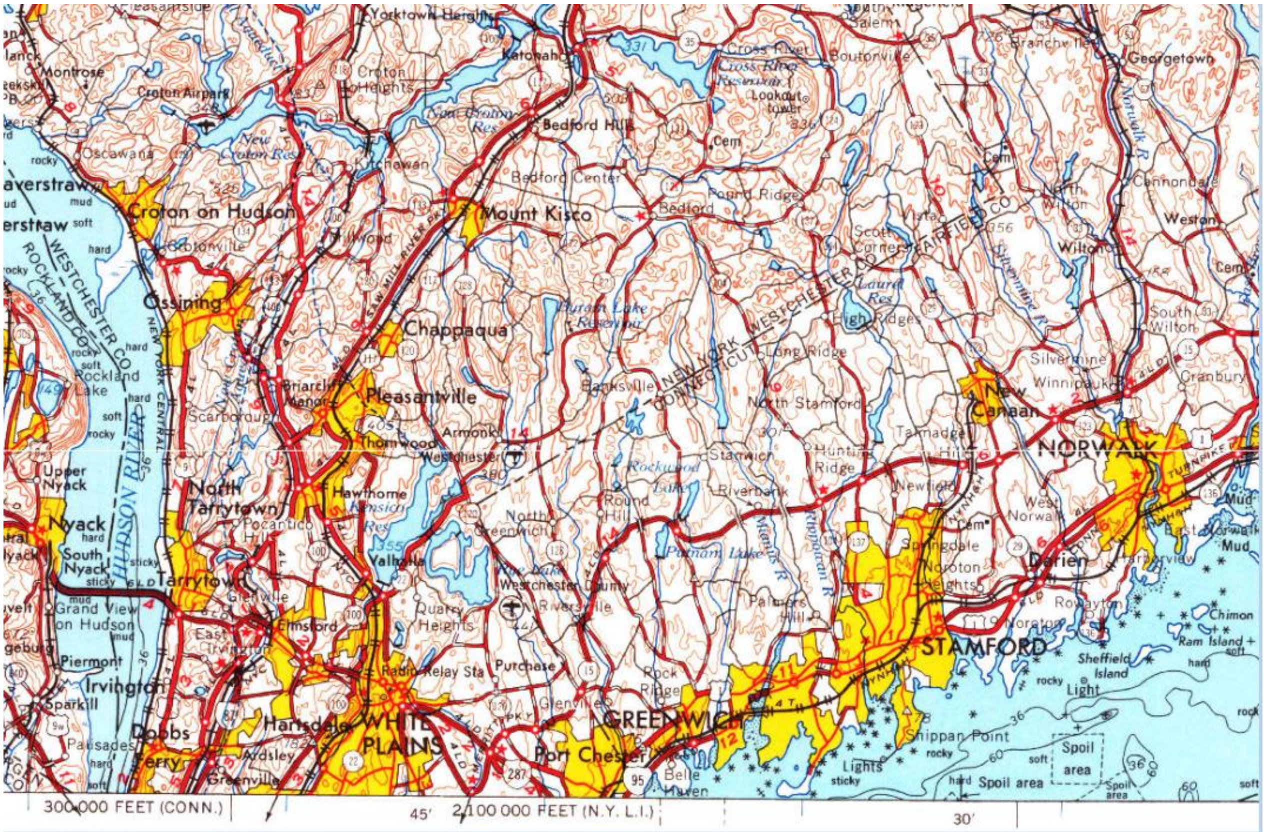

Figure 2: Map of location where samples were collected from.

Figure 3: Hartford, CT. USGS Survey Historical Topographic Map Collection, scale 1:250,000

Methods

Samples were collected at 94 sites where land was wooded and flat. Sites were undisturbed to rule out other factors in data analysis. The nature of the thin loess-like layer can be seen in the roots of a recently uprooted tree in Fig. 4. The O layer was removed then samples were collected from the A layer, bagged and labeled according to latitude, longitude and date. Coordinates were obtained from the GPS cell phone app, “My Altitude” see Fig.5. Immediately following collection, soil was dried out and analyzed for grain size.

Procedure for grain size determination involved placing 15 mL of sediment into a centrifuge tube (Fig. 6), adding 1 mL of dispersant, and adding tap water to reach 45 mL volume. Samples were placed in an ultrasonic cleaner for 5 minutes to declump the sediment (Fig 7). Each test tube was vigorously shaken for 2 minutes and settling rates were recorded. Sediment that fell within the first 30 seconds was called sand, silt settled over the next 30 minutes, and additional sediment counted the next day was clay. The procedure originated from Soil Texture of Fracture protocol and was modified based on suggestions from Dr. Gilbert Hanson (ecoplexity.org). To precisely record the amount of sand and silt, a bright light was shone onto the centrifuge tube to help read the volume through the still unsettled sample. It should be stated that the centrifuge tubes did not start its markings until 5 mL, however, no samples had less than 5 mL of sand, therefor, precision was not put at risk.

Sampling sites were distributed over Westchester County and part of Fairfield County. Sites were separated by a minimum of 0.5 miles. When more than 1 sample was taken within a preserve, sites were at times only 0.1 miles apart due to travelling by foot. Consistency of sampling sites was limited due to road access and availability to pull off areas. At some locations an auger was used to extract soil where the loess layer was deeper. Determining how far down to dig was based on Sanders' (1998), looking specifically for "grayish- to yellowish-brown deposits". Pebbles were noted in regards to abundance, composition, size and sphericity. Sphericity values were assigned using Power's Scale of Roundness (1953).

Figure 4: Chestnut Ridge Racquet Club (41.1979N, 73.6895W) exposure of sediment.

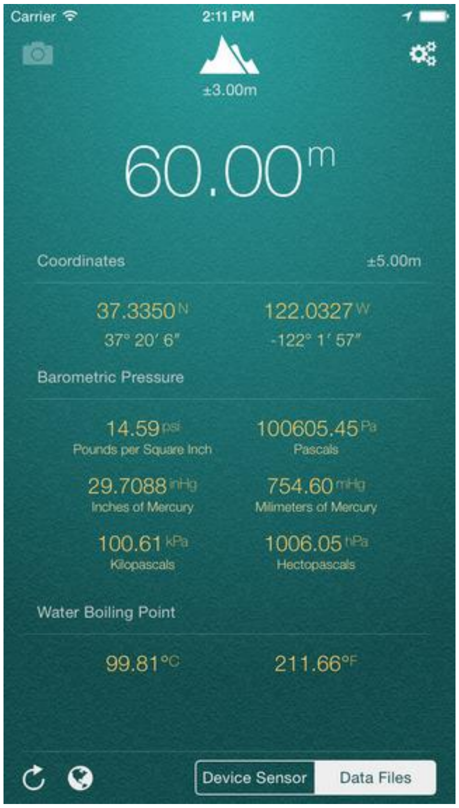

Figure 5: Example of My Altitude App screen, used to obtain coordinates and altitude for all sites.

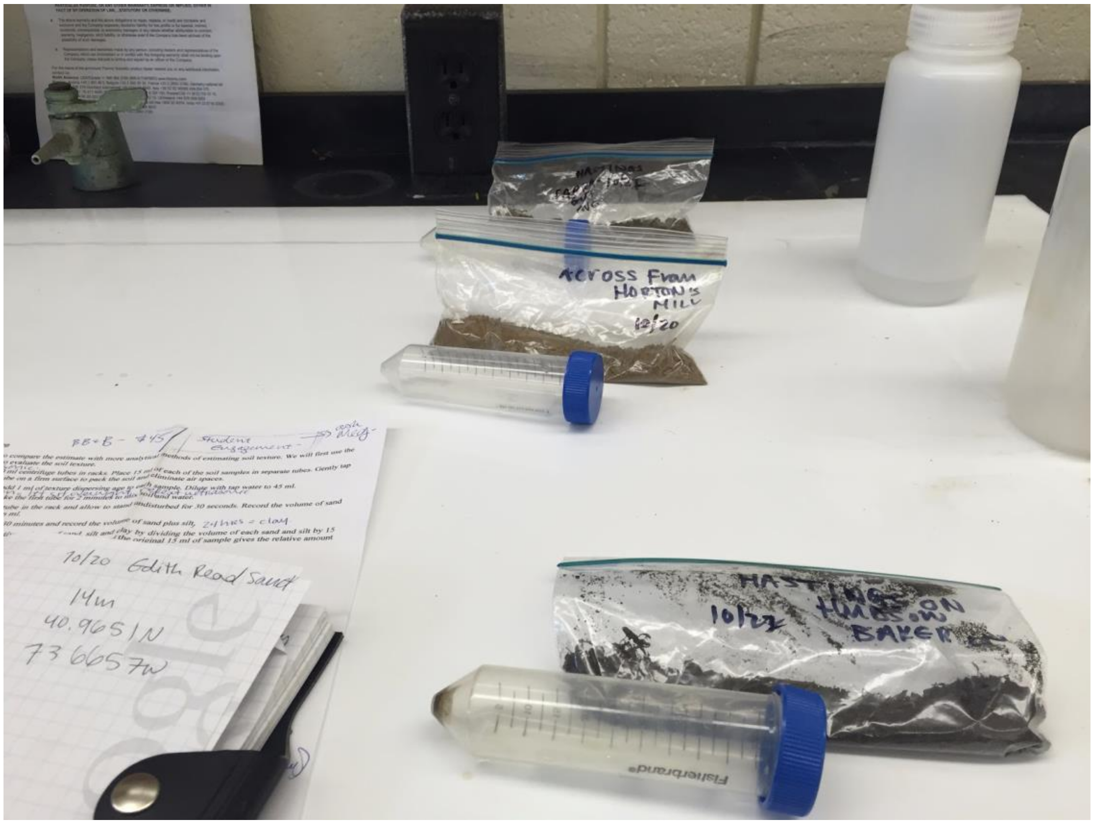

Figure 6: Data Analysis. Centrifuge test tube used for shaking and settling.

Figure 7: Ultrasonic cleaner to decrease surface tension and clumping of soil.

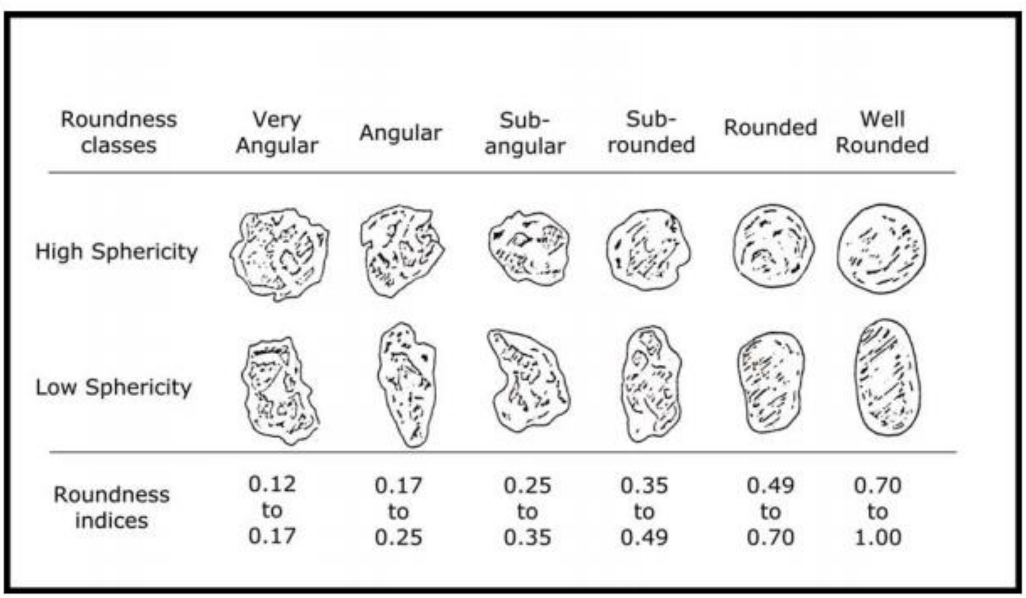

Figure 8: Chart for estimating the roundness and sphericity of sedimentary particles based upon comparisons with particles of known sphericity and roundness (based on Powers, 1953).

Results: Soil Texture Analysis

A table with the locations, grain-size data, comments and soil texture class for each of the samples is in Appendx A. Samples were initially plotted on 3 separate soil texture diagrams because only 30 samples could be plotted without overlap. A soil texture diagram was printed onto a transparency and all of the data on the initial 3 diagrams shown in Appendix B was transposed onto the transparency (Fig. 9). The master copy is color coded to reflect the initial 3 diagrams.

Pebbles were found in about one-half of the samples and ranged from angular to rounded, however, majority fell into the sub angular to sub rounded category. As pebble sized increased, sphericity generally increased. All pebbles were quartz.

Recent work on Long Island loess categorizes sediment from Stony Brook, Suffolk County Farm, North Street and Dwarf Pine Plains as having sandy loam, loamy sand and silt loam texture (Dominguez, 2015). Slight variation in texture between locations is also seen in Westchester data. The three textures most common textures found on Long Island were also found in Westchester. Clay was of low abundance in Westchester samples. The loess consists of a yellowish-brown color and typically unconsolidated sediment.

The 3 most common soil textures were sandy loam (64.9%), silt loam (17%) and loamy sand (9.6%) Fig., 10 and 11.

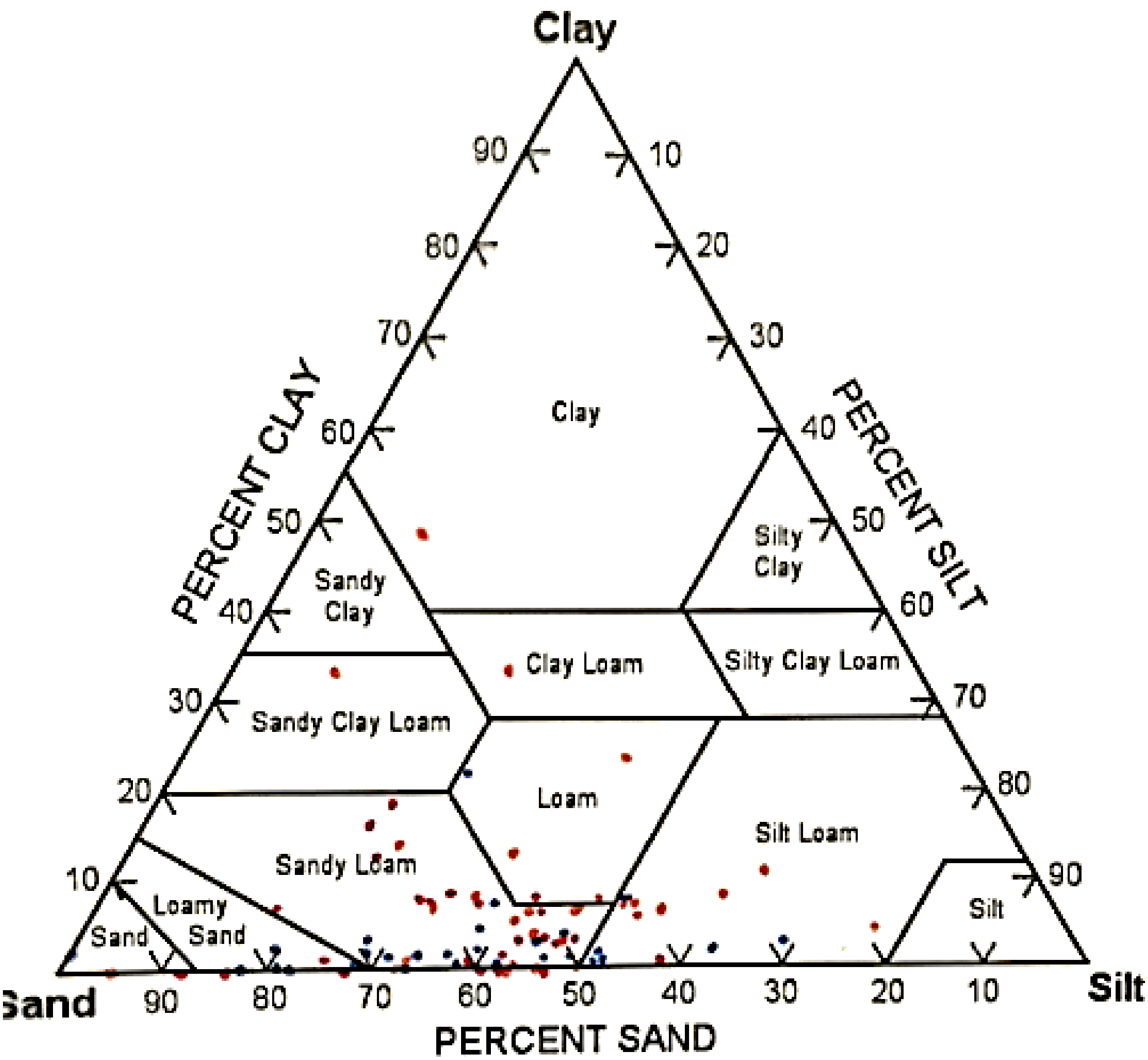

Figure 9: Soil texture diagram of all 94 samples.

- Samples 1 – 33
- Sample 34 – 60
- Samples 61 - 94

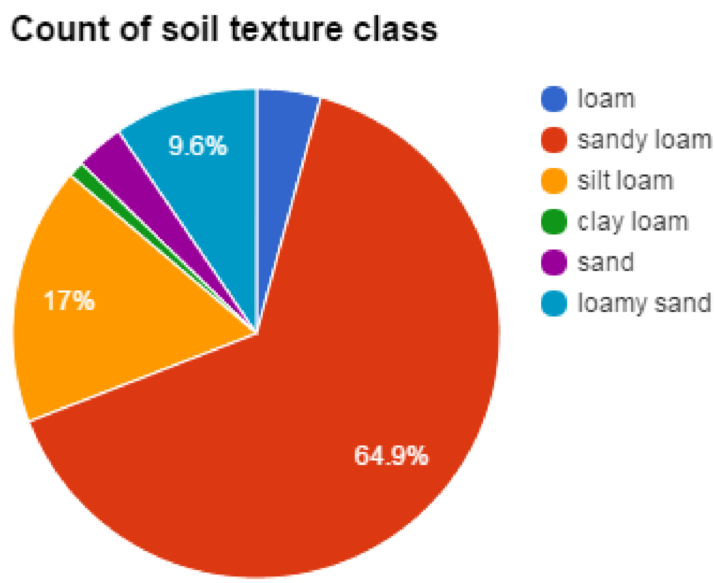

Figure 11: Pie chart representation of soil texture class breakdown

Discussion

The loess-like sediment in Westchester County has a yellowish brown color, is unconsolidated and varies mainly from sandy loam to silt loam. It is usually underlain by highly metamorphosed bedrock.

In both Long Island and Westchester County, the 3 most dominant soil textures are sandy loam, silt loam and loamy sand. They both contain pebbles in some samples. Making the assumption that similar composition suggests a similar formation. If so, since the Long Island loess exposures are dated at the time of the Younger Dryas the Westchester samples may have formed then also. If the Westchester loess did not form during the Younger Dryas event, "when did it form?". Roughly half of the sites had pebbles. Of those pebbles, composition was dominantly quartz, but sphericity varied from angular to rounded. As pebble diameter increased, sphericity generally increased. Due to the discontinuity of the bedrock and pebble composition, pebbles are believed to have been transported by the glacier.

Quartz veins are common in New England bedrock and could have been the source for the pebbles. Smaller pebbles were generally fractured, although rounded which can be interpreted as having been rounded within the glacier as particles interact with other particles and the bed of the glacier itself (Benn and Evans, 1998).

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Conclusion

The similarity of the pebbly loess in Suffolk and Westchester counties may be more than coincidental. Both locations have sandy loam, silt loam and loamy sand dominant and contain pebbles. Exposures of Westchester show textbook loess, "a loosely compacted yellowish-gray deposit of windblown sediment of which extensive deposits occur", therefore, it can be said with confidence that it too has a layer of loess (nationalgeographic.org). The loess in Westchester is characteristically yellowish-brown and unconsolidated. Similarities with the Long Island pebbly loess suggest that it may have formed during the same event.

References

Benn, Douglas I., and Evans, David, J.A., Glaciers and Glaciation, 203-207, pp., 1998

Clare, Timothy, D., 2013, Grain Size Analysis of Loess and Glacial Sediments at Stony Brook University.

CT_Hartford_461617. USGS Survey Historical Topographic Map Collection, scale 1:250,000. (1965 Edition). http://ngmdb.usgs.gov/maps/TopoView/viewer/#9/40.8533/-74.3568

Danz, Alexandra, 2015, Beginning Stages to Determining the Primary Erosive Force that Shaped the Pebbles on Long Island, Site Location: Suffolk County Farm, Yaphank, NYStony Brook University, Stony Brook, NY.

Dominguez, Katherine, 2015, Grain size analysis and soil stratigraphy across Suffolk County: Proxy for classification of sediment as a diamict, 18, p.

Hanson, G., 2015, Stony Brook University, personal communication.

Index, Iowa Geological Survey Annual Report, vol. 26 issue 1, Iowa Geological Survey Annual Report: Vol. 26: p. 447-457, 1915

Kay, George, F., May-Jun., 1931, Origin of the Pebble Band on Iowan Till, The Journal of Geology, Vol. 39, No. 4, 377-380, pp.

Kundic, Vesna, Age and Provenance of Long Island Loess. Stony Brook University Master Thesis, 2014.

Leverett, Frank, and Sanderson, Frederick, William, 1932. Quaternary Geology of Minnesota and Parts of Adjacent States.

Lewis RS, and Stone JR, 1991. Late Quaternary Stratigraphy and Depositional History of the Long Island Sound Basin: Connecticut and New York. Journal of Coastal Research, Special Issue No. 11, p. 1-23.

Loess, http://education.nationalgeographic.org/encyclopedia/loess/

Melrose, Courtney, Polymodal Grain-size Modes in Long Island Sands, Silts, and Weathered Bedrock, Stony Brook University Master Thesis, 2014.

New Haven County, https://familysearch.org/learn/wiki/en/New_Haven_County,_Connecticut_Genealogy

New York_130814. Survey Historical Topographic Map Collection, scale 1:250,000. (1969 Edition). http://ngmdb.usgs.gov/maps/TopoView/viewer/#9/40.8533/-74.3568

Nieter, William, A Late Wisconsian Loess Deposit in Southeastern Long Island, New York, Queens College Master Thesis, 1975

Protocol Soil Texture or Fractions, http://ecoplexity.org/?q=node/183

Rodrigues Zavala, Juan, Manuel, Particle Shape Quantities and Influence on Geotechnical Properties, A Review.

Sanders, J. E., and Merguerian, Charles, 1994b, The glacial geology of New York City and vicinity, p. 93-200 in A. I. Benimoff, ed., The Geology of Staten Island, New York, Field guide and proceedings, The Geological Association of New Jersey, XI Annual Meeting, 296 p.

Sanders, J. E., and Merguerian, Charles, 1994b, The glacial geology of New York City and vicinity, p. 93-200 in A. I. Benimoff, ed., The Geology of Staten Island, New York, Field guide and proceedings, The Geological Association of New Jersey, XI Annual Meeting, 296 p.

Tvelia, Sean, 2015, Structure of Long Island's Carolina Bays and Their Potential Relationship to the Proposed Younger Dryas Impact Event

Zhong, Jian, Evaluation of Ar-Ar ages of Individual Mica Grains for Provenance Studies of Loess, Long Island, NY, Stony Brook University Master Thesis, 2002.

Appendix A

	site	date	latitude	longitude	Elev.m	sand (mL)	silt (mL)	clay (mL)	comments	% sand	% silt	% clay	soil texture class
1	silver lake preserve A layer	9/4/15	41.050322N	73.740091W	90	7.5	5.5	2	dark red/brown loess, no pebbles, little layering	50	37	13	loam
2	silver lake preserve B layer	9/4/15	41.050322N	73.740091W	90	8	6	1		53	40	7	sandy loam
3	sleepy hollow to OCA trail A layer	9/18/15	41.088708N	73.856437W	48	10	5	0		67	33	0	sandy loam
4	sleepy hollow OCA trail B layer	9/18/15	41.088708N	73.856437W	48	9	5	1		60	33	7	sandy loam
5	cranberry lake preserve	9/18/15	41.080029N	73.755726W	142	7.5	7	0.5	bedrock Harrison gneiss, thick O layer	50	47	3	sandy loam
6	lake street across from quarry	10/6/15	41.052180N	73.736634W	68	10	5	0	3 cm pebbles, sub angular	67	33	0	sandy loam
7	Barnes lane pull off	10/6/15	41.054044N	73.732688W	72	4.5	9.1	1	hit bedrock at end of auger cylinder	31	62	7	silt loam
8	Augusta Ct	10/6/15	41.051251N	73.732513W	73	6	8	1		40	53	7	silt loam
9	Purchase Loop 1	10/6/15	41.043056N	73.694093W	81	9	6	1		56	38	6	sandy loam
10	Purchase Loop 2	10/6/15	41.054520N	73.699388W	86	7	8	2		41	47	12	loam
11	liberty park off trail	10/20/15	41.0450N	73.7498W	61	6	5	4	pebbles, 2cm angular	40	33	27	clay loam
12	border of white plains and w. harrison at fork. across from Horton's Mill	10/20/15	41.0417N	73.753W	58	8	7	0		53	47	0	sandy loam
13	byram shore road	10/20/15	40.9992N	73.6515W	12	5	6.5	3.5		33	43	23	loam
14	playland pky	10/20/15	40.9701N	73.6924W	11	4	9.5	1.5		27	63	10	silt loam
15	edith read sanctuary	10/20/15	40.9651N	73.6657W	14	7	7	1		47	47	7	sandy loam*
16	Baker Lane (Hastings)	10/22/15	40.9951N	73.8782W	41	9	4	2	*hard to dig	60	27	13	sandy loam
17	farragut ave (Hastings)	10/22/15	40.9912N	73.8747W	69	7.5	7.5	0		50	50	0	silt loam
18	Dan Rile Memorial Park (Hastings)	10/22/15	40.9875	73.8711W	46	10	5	0		67	33	0	sandy loam
19	Sprain Ridge Park (Hastings)	10/22/15	40.9865	73.8489	53	7.5	7	0.5		50	47	3	sandy loam
20	333 North Street	11/1/15	41.0268N	73.7445W	67	6	9	1		38	56	6	silt loam

	site	date	latitude	longitude	Elev.m	sand (mL)	silt (mL)	clay (mL)	comments	% sand	% silt	% clay	soil texture class
21	Underhill Ave	11/1/15	41.0353N	73.7515W	53	9	7	0	1 cm angular	56	44	0	sandy loam
22	Locust Rd. Greenwich	11/1/15	41.0909N	73.7072W	135	7.5	10	1		41	54	5	silt loam
23	Bedford Rd. Greenwich	11/1/15	41.0936N	73.7045W	114	7.5	10	1		41	54	5	silt loam
24	Cutler Rd	11/1/15	41.0963N	73.7050W	114	7.5	5	1.5	no pebbles	54	36	11	sandy loam
25	Rte 433N NY/CT	11/1/15	41.1150N	73.6956W	165	5	20	1		19	77	4	silt loam
26	Snyders Hill Rd	11/1/15	41.1967N	73.6911W	235	6.5	8	1		42	52	6	silt loam
27	Chestnut Ridge Racquet Club	11/1/15	41.1979N	73.6895W	235	10	10	0		50	50	0	silt loam
28	Darlington Rd	11/1/15	41.2031N	73.6952W	135	7.5	6.5	0.5		52	45	3	sandy loam
29	West Patent Elementary School	11/1/15	41.2185N	73.7002W	154	7.5	5	1		56	37	7	sandy loam
30	Katonah Service Station	11/1/15	41.2531N	73.6835W	70	7.5	6.5	0		54	46	0	sandy loam
31	Mustato Rd, Katonah	11/1/15	41.2563N	73.6681W	108	12.5	1	0		93	7	0	sand
32	Beaver Dam Rd., Katonah	11/1/15	41.2487N	73.6659W	98	10	5	0.25		66	33	2	sandy loam
33	John Jay Historic Site	11/1/15	41.2486N	73.6602W	135	7.5	8.5	1		44	50	6	silt loam
34	Maple Ave	11/1/15	41.2584N	73.6518W	121	8	7	0		53	47	0	sandy loam
35	cross river reservoir	11/1/15	41.2626N	73.6643W	114	10	7.5	0		57	43	0	sandy loam
36	reservoir rd	11/1/15	41.2635N	73.6742W	80	13	4.5	0.25		73	25	1	loamy sand
37	Rte 35W near woodsbridge rd	11/1/15	41.2665N	73.6892W	65	10	4	0		71	29	0	loamy sand
38	Pepsi Cola, Somers	11/1/15	41.2754N	73.7087W	84	15	2.5	0		86	14	0	sand
39	Bronx River Pky- Dept of Public Safety	11/1/15	40.9748N	73.8160W	34	9	6.5	0		58	42	0	sandy loam
40	Bronx River Pky- near crestwood station	11/1/15	40.9672N	73.8186W	33	10	8	0.5		54	43	3	sandy loam
41	Across Malcolm Wilson Park	11/1/15	40.9539N	73.8303W	39	10	7.5	0.25		56	42	1	sandy loam
42	Parkway Oval Park Trail	11/1/15	40.9552N	73.8275W	111	7.5	6.5	1		50	43	7	sandy loam
43	Bronx River Trail #1	11/1/15	40.9566N	73.8267W	96	12.5	3	1		76	18	6	sandy loam

	site	date	latitude	longitude	Elev.m	sand (mL)	silt (mL)	clay (mL)	comments	% sand	% silt	% clay	soil texture class
44	Bronx River Trail #2	11/1/15	40.9564N	73.8302W	36	7.5	6.5	0.5		52	45	3	sandy loam
45	Bronx River Trail #3	11/1/15	40.9541N	73.8311W	35	7	5.5			56	44	0	sandy loam
46	lake and old lake	11/3/15	41.0596N	73.7302W	80	7.5	5	1		56	37	7	sandy loam
47	rye lake	11/3/15	41.0666N	73.7228W	115	7.5	4.5	1		58	35	8	sandy loam
48	Rte 120	11/3/15	41.0721N	73.7168W	118	7.5	3	2.5		58	23	19	sandy loam
49	New King St	11/3/15	41.0820N	73.7141W	122	10	2	0		83	17	0	loamy sand
50	120A	11/3/15	41.0774N	73.7048W	139	9	5	1		60	33	7	sandy loam
51	King Street	11/3/15	41.0589N	73.6940W	97	8.5	4.5	1		61	32	7	sandy loam
52	15N	11/3/15	41.0421N	73.6715W	69	7.5	6.5	1		50	43	7	sandy loam
53	lower cross road	11/3/15	41.1105N	73.6514W	87	8	3	2		62	23	15	sandy loam
54	Babcock Preserve #1	11/3/15	41.1029N	73.6314W	110	7.5	3	1.5		63	25	13	sandy loam
55	Babcock Preserve #2	11/3/15	41.1029N	73.6325W	92	8	5	1		57	36	7	sandy loam
56	Babcock Preserve #3	11/3/15	41.1033N	73.6328W	110	5	7	0.125	1/2 cm pebbles, subangular	41	58	1	silt loam
57	Babcock Preserve #4	11/3/15	41.1031N	73.6332W	74	7.5	7.5	0.5		48	48	3	sandy loam
58	Graham Hills Park #1	11/7/15	41.1215N	73.8046W	120	7	7.5	1	2,5 cm, sub rounded	45	48	6	sandy loam
59	Graham Hills Park #2	11/7/15	41.1232N	73.8044W	116	7.5	5	0	.25 CM ANGULAR	60	40	0	sandy loam
60	Choate Ln.	11/7/15	41.1286N	73.8025W	96	6	6.5	0.125	NP	48	51	1	silt loam
61	Hardscrabble Wilderness Area #1	11/7/15	41.1468N	73.8018W	130	7.5	7.5	0.5	NO PEBBLES	48	48	3	sandy loam
62	Hardscrabble Wilderness Area #2	11/7/15	41.1466N	73.7998W	171	10	2.5	0.125	1/2 CM PEBBLES SA	79	20	1	loamy sand
63	Hardscrabble Wilderness Area #3	11/7/15	41.1453N	73.7983W	146	7	7	0.5	NO PEBBLES	48	48	3	sandy loam

	site	date	latitude	longitude	Elev.m	sand (mL)	silt (mL)	clay (mL)	comments	% sand	% silt	% clay	soil texture class
64	Hardscrabble Lake Dr	11/7/15	41.1489N	73.8003W	129	7.5	7.5	0.25	1 cm SA-SR	49	49	2	sandy loam
65	Roaring Brook Rd	11/7/15	41.1786N	73.7571W	99					#DIV/0!	#DIV/0!	#DIV/0!	
66	Whipoorwill Park #1	11/7/15	41.1689N	73.7433W	159	99	66	0.1125	no pebbles	60	40	1	sandy loam
65	Roaring Brook Rd	11/7/15	41.1786N	73.7571W	99	9	6	1	1 cm pebbles, sub angular	56	38	6	sandy loam
67	Whipoorwill Park #2	11/7/15	41.1695N	73.7425W	127	8	5	0	big pebbles in soil horizon- 3-4cm, rounded	62	38	0	sandy loam
68	Whipoorwill Park #3	11/7/15	41.1695N	73.7429W	131	7.5	8	0.25	1 cm sub rounded	48	51	2	sandy loam
69	Borden Preserve #1	11/7/15	41.1765N	73.7267W	75	5.5	3.5	2.5	PEBBLES 3 CM SR	48	30	22	loam
70	Borden Preserve #2	11/7/15	41.1767N	73.7269W	120	7.5	7	0.125	NP	51	48	1	sandy loam
71	Haas Audobon #1	11/7/15	41.1654N	73.7211W	194	7	8	1	1 1/2 CM ub angular	44	50	6	silt loam
72	Haas Audobon #2	11/7/15	41.1662N	73.7212W	164	10	2.5	0.5	no pebbles	77	19	4	loamy sand
73	Marsh Memorial Sanctuary #1	11/7/15	41.1931N	73.7163W	137	5	9	0.25	3CM SA	35	63	2	silt loam
74	Marsh Memorial Sanctuary #2	11/7/15	41.1924N	73.7159W	135	8	6	0.125	NO PEBBLES	57	42	1	sandy loam
75	Marsh Memorial Sanctuary #3	11/7/15	41.1968N	73.7169W	100	7.5	5.5	1	NO PEBBLES	54	39	7	sandy loam
76	Hissarlik Way #1	11/8/15	41.1522N	73.6573W	130	7.5	5	0.25		59	39	2	sandy loam
77	Hissarlik Way #2	11/8/15	41.1520N	73.6572W	153	10	6	0.125	pebbles 3cm subrounded	62	37	1	sandy loam
78	St. Mary's Rd	11/8/15	41.1742N	73.6266W	125	4	10	0.5	no pebbles	28	69	3	silt loam
79	Mianus River Rd	11/8/15	41.1812N	73.6229W	112	7.5	6.5	0.5		52	45	3	sandy loam
80	Mianus River Gorge #1	11/8/15	41.1845N	73.6216W	115	10	4.5	0.125		68	31	1	sandy loam
81	Mianus River Gorge #2	11/8/15	41.1885N	73.6213W	110	11	3	0	big pebbles! 4cm sub angular	79	21	0	loamy sand
82	Ward Pound Ridge Preserve #1	11/8/15	41.2596N	73.6069W	109	10	4	0	pebbles 1 cm angular	71	29	0	loamy sand

	site	date	latitude	longitude	Elev.m	sand (mL)	silt (mL)	clay (mL)	comments	% sand	% silt	% clay	soil texture class
83	Ward Pound Ridge Preserve #2	11/8/15	41.2606N	73.6132W	74	11	3	0	pebbles 1 cm subangular	79	21	0	loamy sand
84	Ward Pound Ridge Preserve #3	11/8/15	41.2613N	73.6144W	96	10	4	0.125	pebbles, 0.5cm angular	71	28	1	sandy loam
85	Bouton Rd	11/8/15	41.2761N	73.5770W	128	10	8	0		56	44	0	sandy loam
86	Oscoleta Rd	11/8/15	41.2950N	73.5700W	146	9	3.5	0.5		69	27	4	sandy loam
87	Sal J Prezioso Mountain Lakes Park #1	11/8/15	41.3085N	73.5674W	200	10	5	0.125	pebbles, 1.5 cm angular	66	33	1	sandy loam
88	Sal J Prezioso Mountain Lakes Park #2	11/8/15	41.3088N	73.5657W	218	7.5	5	0.5	pebbles, 1-3 cm sub rounded	58	38	4	sandy loam
89	Sal J Prezioso Mountain Lakes Park #3	11/8/15	41.3063N	73.5706W	183	8	6	0.125	pebbles, 1cm angular	57	42	1	sandy loam
90	Hawley Rd	11/8/15	41.3144N	73.5828W	140	12.5	2.5		1-2 SR	83	17	0	loamy sand
91	Waccabuc Rd	11/8/15	41.3032N	73.6152W	106	10	5	0		67	33	0	sandy loam
92	Marx Preserve	11/8/15	41.3011N	73.6287W	118	12	6	0.125		66	33	1	sandy loam
93	Goldens Bridge Rd	11/8/15	41.2996N	73.6851W	66	15	0	0.5	1 cm pebbles, subangular-subrounded	97	0	3	sand
94	Somers Tpk	11/8/15	41.3037N	73.6988W	63	10	5	0	1/2 cm pebbles angular	67	33	0	sandy loam

Appendix B

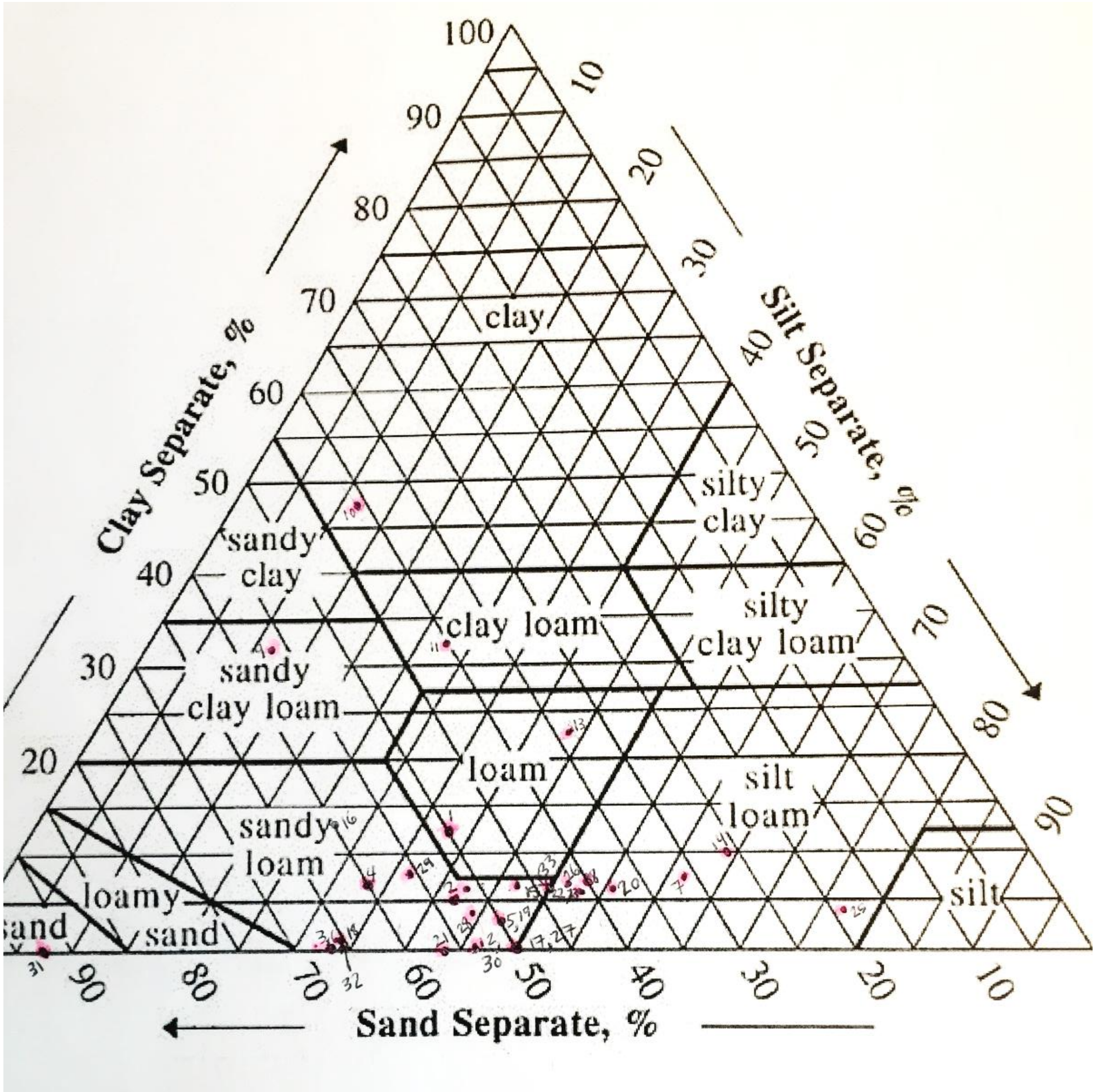

Figure 12: Ternary Plot #1, samples 1-33

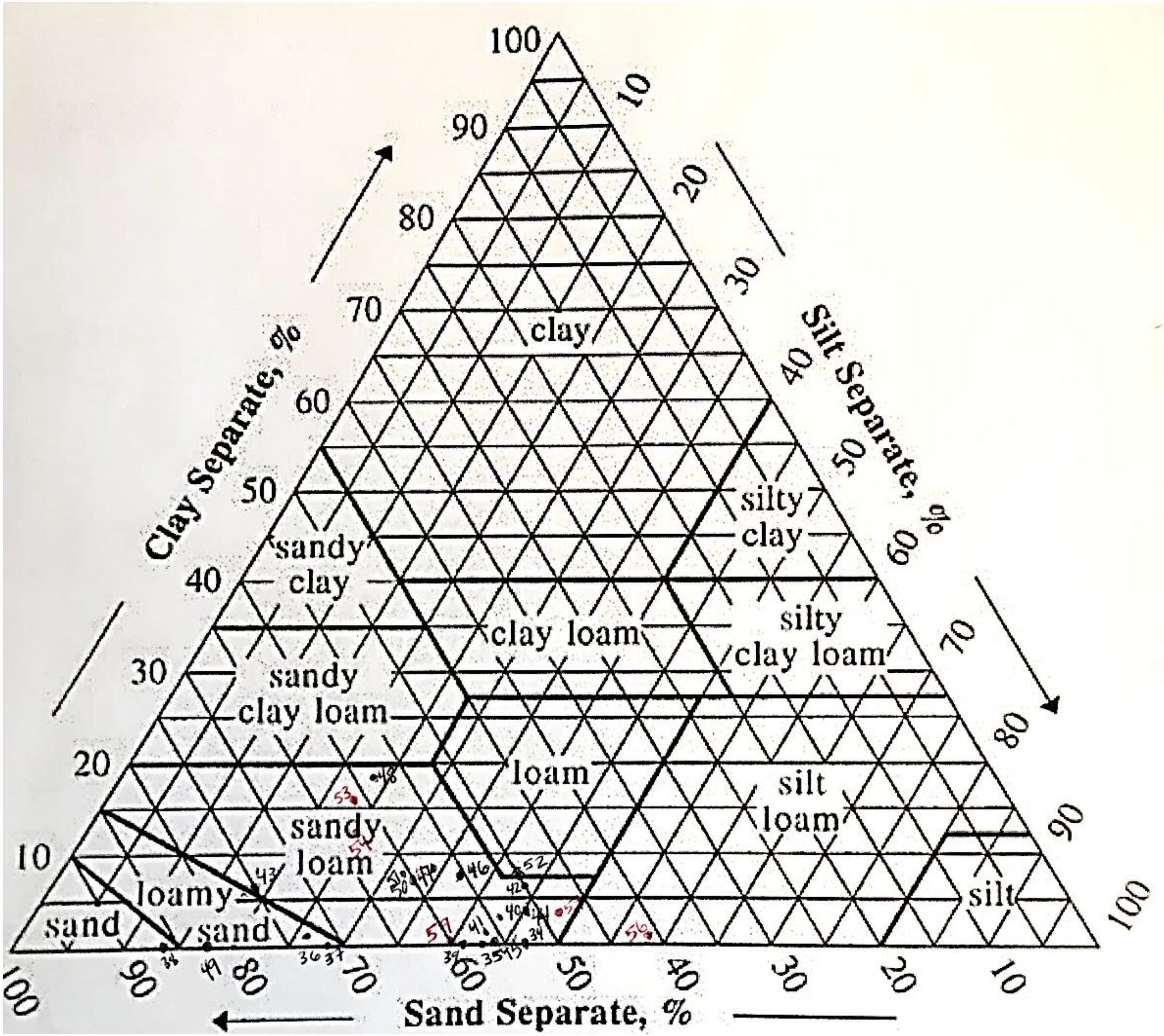

Figure 13: Ternary Plot #2, samples 34-60

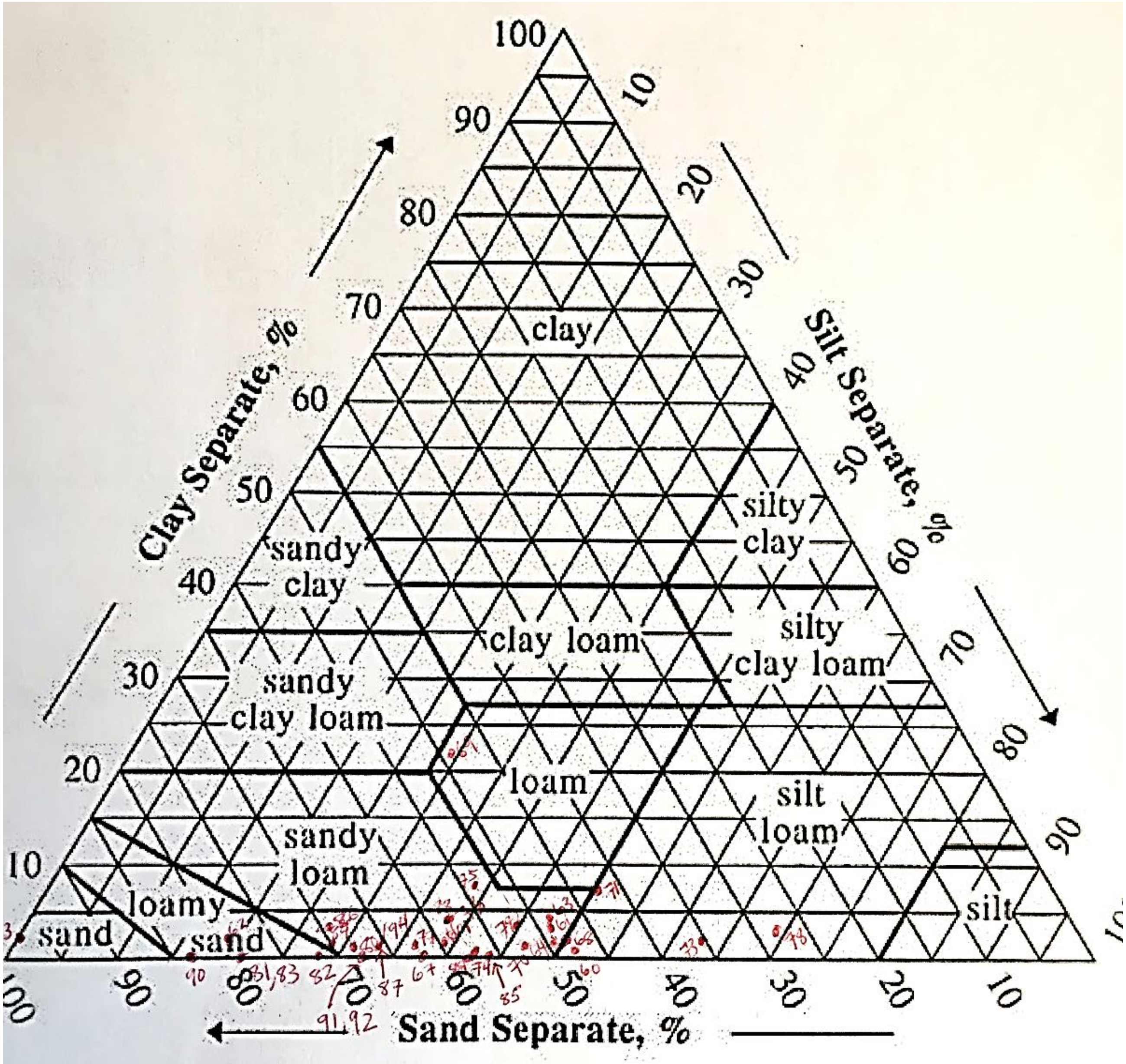

Figure 14: Zoomed in view, Ternary #2

Figure 14: Ternary Plot #3, samples 61-94

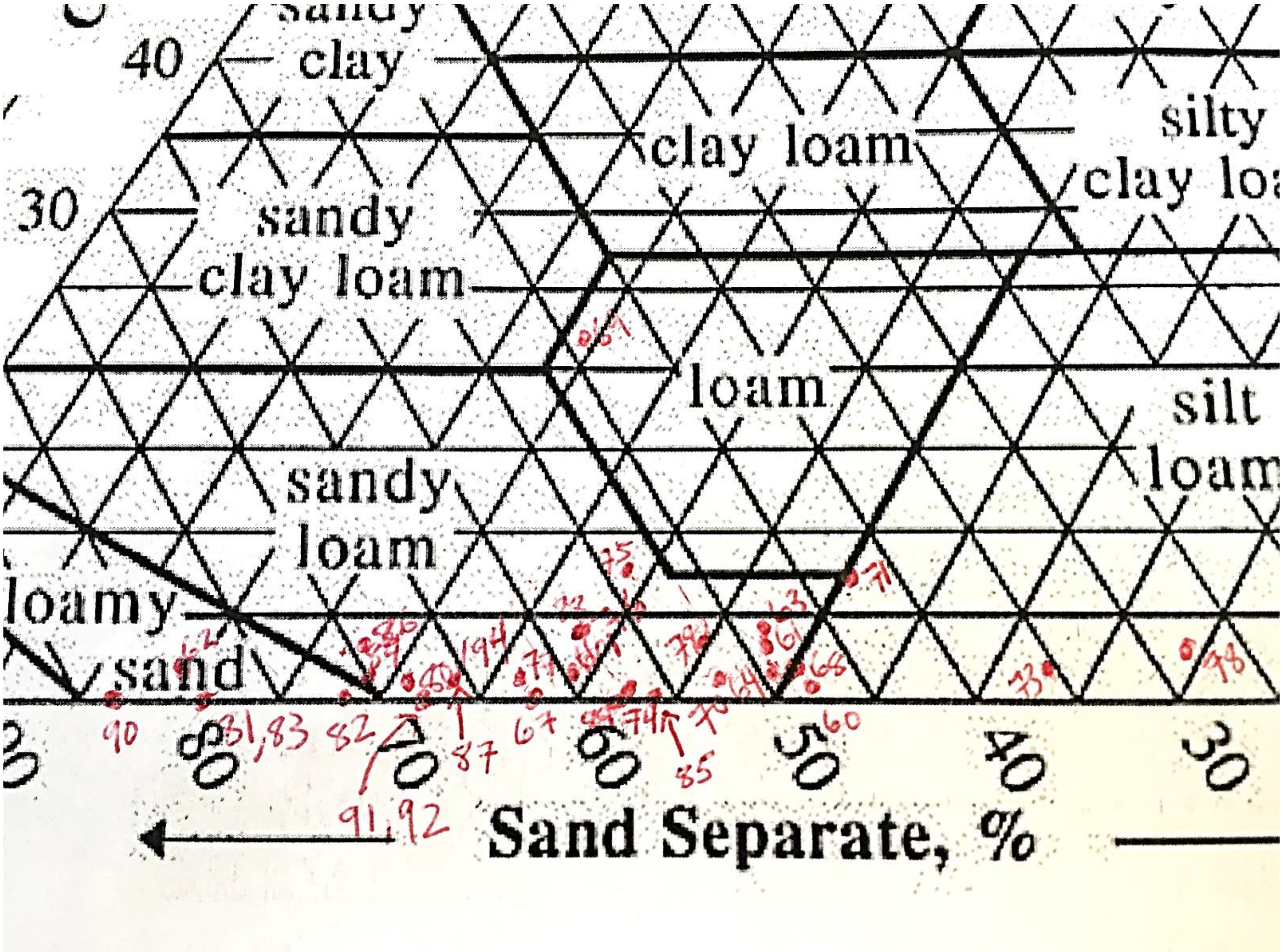

Figure 15: Zoomed in view Ternary #3