THE STRATIGRAPHY OF SEVEN MILE CREEK PARK

By
Elliot A. Peterson

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Under the supervision of Professor Laura Triplett

ABSTRACT

Seven Mile Creek is a small tributary to the Minnesota River, located in south-central Minnesota, surrounded by 628 acres of county parkland. Although this creek has been heavily studied for water quality, the geologic history of the park remains relatively unknown. The exposures and outcrops explored within Seven Mile Creek Park show that at least three glacial advances have affected this area, including the Superior, Wadena, and Des Moines Lobes, depositing three distinct tills, the Hawk Creek, the Granite Falls and the New Ulm Tills, respectively. Also, a boulder pavement characteristic of the Wadena Lobe occurs in between the Granite Falls and New Ulm Tills. Also present are thick sequences of interglacial material between the Hawk Creek and Granite Falls Tills, indicating a period of time between the deposition of those tills during which Seven Mile Creek Park was not covered by ice. Pre-Wisconsonian "Old Gray" Till, exposed in several locations just south of the park, was not found.

ACKNOWLEDGEMENTS

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INTRODUCTION

For more than 10,000 years, since the last glaciers retreated, the rivers and streams that flow into the Minnesota River Valley have been trying to establish equilibrium with the new glacially-altered topography and recreate the balance that is always sought by nature. Seven Mile Creek is a small tributary to the Minnesota River, located in south-central Minnesota (figure 1), which has been largely affected by recent glaciations and continuing erosion. Many glaciations have impacted Seven Mile Creek, and several separate lobes during the Wisconsonian glaciation covered and uncovered the creek.

The purpose of this thesis is to outline the glacial history of southern Minnesota and the Seven Mile Creek area, and to create stratigraphic columns of the tills from several outcrops in and around Seven Mile Creek Park. I will attempt to make a correlation between some of the layers in my stratigraphic columns, and between any known, previously described, formally named tills. Making accurate correlations is important for understanding the regional geology. Also, I will describe the physical characteristics of the tills I encounter in Seven Mile Creek Park for the benefit of any future research on the tills in the park. A thorough description of each till is necessary because many tills look very similar, due to the fact that they may overrun the same underlying material, and leave similar, but not identical, tills.

Previous Work

Charles Matsch (1972) studied the stratigraphy of southwestern Minnesota near Mankato, MN. His results provide the groundwork for much of my own work. Lusardi (1998) conducted a significant amount of research only a few miles north of Henderson, MN, which is approximately 28 miles north of my sites, an almost insignificant distance when speaking of tills

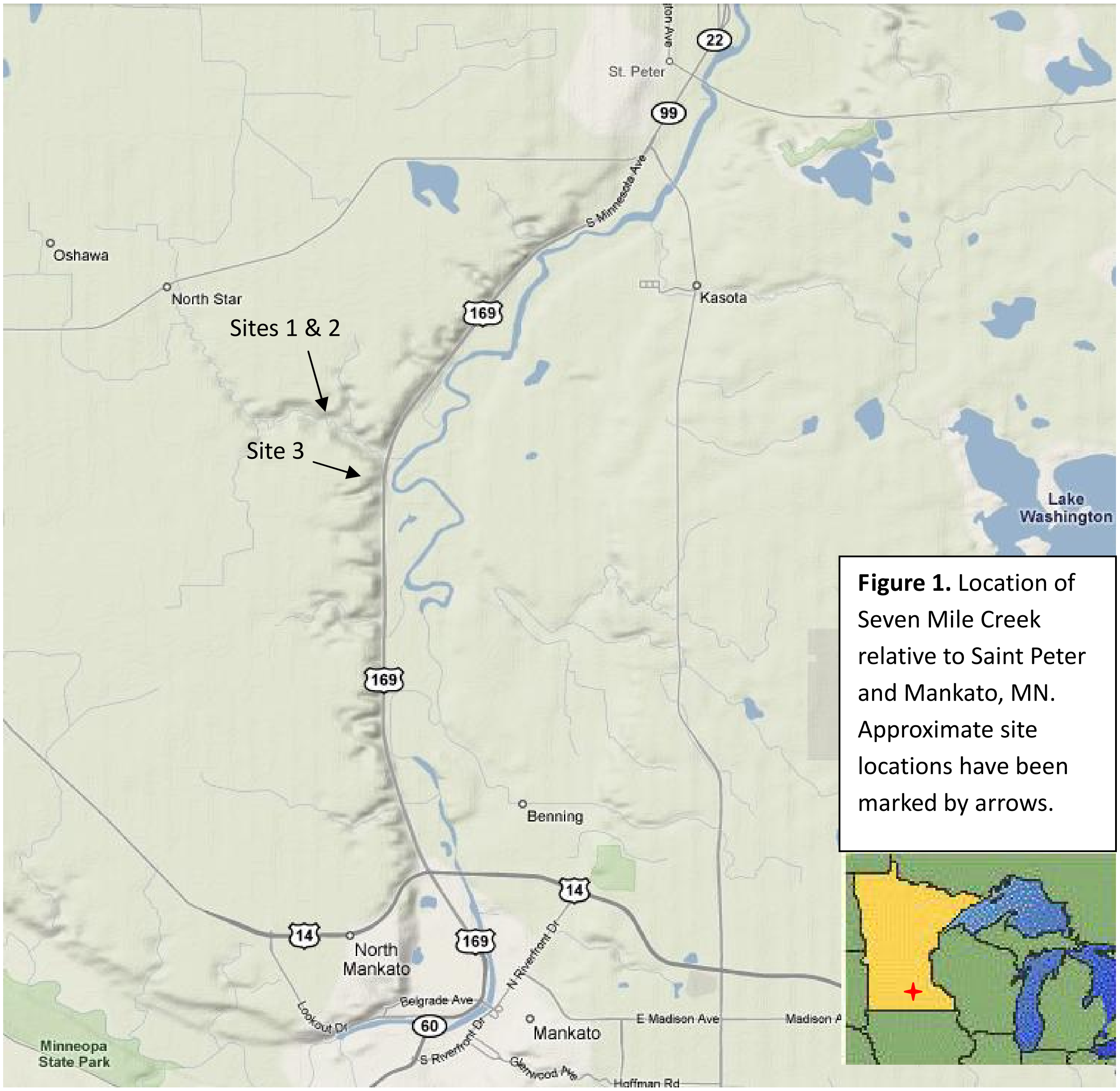

Figure 1. Location of Seven Mile Creek relative to Saint Peter and Mankato, MN. Approximate site locations have been marked by arrows.

spread across multiple states. In that work, she described five tills, all of which correlate with Matsch (1972), and all four of the tills identified by Patterson (1995) correlate as well. A previous student at Gustavus Adolphus College, Sally Gramstad, completed a thesis about pre-Wisconsonian gray tills in the Mankato, MN area in 1997. Based on suggestions from her thesis, certain lab procedures were omitted, including isothermal remnant magnetization and x-ray diffractometer measurements of clay fraction, and others were focused on, primarily grain size analysis. I am drawing my correlations with help from those works.

Regional Glacial History

There are several tills present in the area, a result of the many previous glacial advances which covered the region. Some of these tills have been formally named and associated with the advances of particular glaciers, although others have not (figure 2). There may be other tills present dating prior to the Wisconsonian (Gramstad, 1997), so both those lobes and phases that occur immediately before and during the Wisconsonian Glacial Period will be mentioned.

Youngest
Modern interglaciation (~10,000 years ago)
Lake Agassiz, River Warren
Des Moines lobe - New Ulm Till
New Ulm Phase (~14,000 years ago)
Wadena Lobe – Granite Falls
Granite Falls Phase (~34,000 years ago)
Superior Lobe – Hawk Creek Till
Hawk Creek Phase (~35,000 years ago)
Wisconsonian Glacial Period (~110 kya)
Sangamonan interglaciation (~130 kya)
Illinoian Glacial Period (~190 kya)
Pre-Illinoian (~2,500 kya)
Oldest

Figure 2: A generalized Pleistocene timeline of the glacial and interglacial ages and the phases within the Wisconsonian, with approximate starting dates in parentheses. The Pre-Illinoian is a period of 11 distinct Glacial and Interglacial cycles.

There have been four till units identified within the Minnesota River Valley according to Matsch (1972), all corresponding to separate lobes that passed during the Wisconsonian. The oldest unit is an unnamed gray, calcareous, shale-free till underlying the Hawk Creek Till (Matsch, 1972, Lusardi, 1998). It was deposited sometime between the Hawk Creek Phase and the approximate starting date for the Wisconsonian, 100,000 years ago, and is unofficially named the Old Gray till.

Overlying the Old Gray Till is the Hawk Creek Till, described as a “pink to reddish-brown, sandy clay loam till” (Matsch, 1972). This till was laid down by the Superior Lobe, which moved in from the northeast to as far southwest as South Dakota. The Hawk Creek Till has been dated at about 35,000 years old (Matsch, 1972). The next phase is called the Granite Falls phase, during which the Wadena Lobe which advanced from the north-central part of Minnesota, laid down a till named the Granite Falls Till (Wright, 1973). This phase may have begun as soon as 1,000 years after the Hawk Creek phase. This glacier remained primarily in the western half of the state; however, it may have reached the Seven Mile Creek area. This till is described as a “middle, yellow to yellowish brown, calcareous loamy till, containing mostly limestone, dolomite and granitic pebbles” (Matsch, 1972). An important characteristic of this till is that is lies underneath a boulder pavement which formed when the glacier retreated.

The most recent glacial advance in this region was from the Des Moines Lobe, which laid down the New Ulm Till, one of the few officially named tills in the St. Peter/Mankato area. This is a “light olive-brown, calcareous clay loam till, containing pebbles predominantly of siliceous shale, limestone, dolomite and granitic rocks” (Matsch, 1972). This till was deposited by the Des Moines Lobe, which expanded as far south as Des Moines, Iowa. When this glacier advanced, it moved across the recently deposited boulder pavement. This glacier did not destroy the boulder pavement in all locations, but merely faceted and striated individual stones (Matsch, 1972), providing an even more unique layer to assist in correlation.

The Des Moines Lobe began to retreat and melt back about 12,000 years ago, which led to the creation of pro-glacial lakes, including Lakes Minnesota, Grantsburg, Upham, Aitkin and

Lake Agassiz, which was by far the largest, covering an area of more than 200,000 square miles (Matsch, 1972). Lake Agassiz began to drain from only one source, the River Warren, which carved a path southeastward across the state, turning sharply northeastward at what is now Mankato, MN, and creating the Minnesota River Valley. The great River Warren cut a trench into Minnesota 250 feet deep, which created a significant topographic change (Matsch, 1972). Streams and other tributaries to the River Warren began to downcut through the newly formed glacial sediments in an attempt to bring themselves into equilibrium with the new topography. Seven Mile Creek is one of these tributaries, which has, over the course of the last 10,000 years, cut headward 2-3 miles away from the Minnesota River. Seven Mile Creek has a gradient of approximately 34 feet per mile, and is still eroding and working its way toward equilibrium.

Holocene History of Seven Mile Creek

Seven Mile Creek is a small tributary to the Minnesota River, located in southern central Minnesota, in between Saint Peter and Mankato. There are two hypotheses as to the origins of Seven Mile Creek. One hypothesis is that Seven Mile Creek began down-cutting to its current level only after the Lake Agassiz was dammed up and glacial River Warren began to cut its path through Minnesota, into what is now the Minnesota River Valley. If that is true, then prior to the River Warren cutting out the Minnesota River Valley, Seven Mile Creek would not have existed, because there was no downward slope on which to flow. The other hypothesis is that the river existed before the glaciers advanced, and the glaciers simply filled up the creek. The river restarted once the glaciers retreated and began to cut through the glacial till to its present level.

METHODS

Field Work

Before entering the field, detailed one and three meter resolution sets of LIDAR data covering Seven mile Creek Park were received from the Brown-Nicollet County Water Board and were analyzed. The field sites used for this thesis were ultimately located by walking and biking through Seven Mile Creek Park and driving around in the surrounding areas.

Three sites were located in and around Seven Mile Creek Park that have good exposures of till and were easily accessible. Without easy access it would be much more difficult to trench the sites and collect samples and without an existing exposure there might not be any stratigraphy to map in the first place (i.e. a slump). All sites had multiple beds visible, and were well above the level of the bedrock or extended down to the bedrock. Contacts with the bedrock are useful for correlation, since the elevation of the bedrock is much less variable than the elevation of the till layers often are.

Two sites were found along the creek in Seven Mile Creek Park, and are approximately 1.4 miles upstream from the Minnesota River, and the third site is at the southeastern boundary of the park, along Highway 169, a half mile south of the entrance to the park. After the sites had been located, slope calculations were made in GIS, and the sites were verified to have a very high slope.

Once the sites were identified to be the best sites available, the slope faces were trenched to get fresh exposures for better identification, description, and clear contacts between the beds. Trenching was conducted in the fall of 2008 with the assistance of Professor Alan Gishlick and some students. Detailed descriptions of the stratigraphy were made at each site including the size, color, and texture of each potential unit. Elevations were approximated from the LIDAR data, as well as from GPS points that were taken during initial investigation of the exposures.

Samples were collected from the freshly trenched sites at every contact, and for larger layers, at intervals of approximately 50cm. Sterile specimen cups and lids were used to keep each sample isolated until it could be processed in the lab.

Lab Methods

Based on Gramstad's success in her 1997 thesis, I chose to focus on grain size analysis, primarily because it was the method that she found most successful. Another method that she used and found successful was the sand-fraction analysis, and this data would be helpful, however, due to time constraints, I could not to calculate the sand-fraction analysis. I chose not to attempt x-ray diffractometer measurements or isothermal remnant magnetization, both because Gramstad had no success with them, and also, in the case of the isothermal remnant magnetization, because it was not relevant to my work. Although she had success with pebble counts, due to time constraints I found it unlikely that I would be able to identify which layers, if any, were Pre-Wisconsonian Tills, collect gallon size samples and properly analyze them, so I did not use this method. She also had some success plotting till fabrics, but I found it unnecessary to use this lab method since no Pre-Wisconsonian Tills were found to analyze.

Individual tills are distinguished by the grain size and the composition of the materials within the till. Grain size analysis and sand-fraction analysis are the two primary methods of identifying individual tills. In grain size analysis, the size of the grains in a sample of till is estimated using a method of sieving, and grouped into three categories: sand (0.079in- 0.0025in), silt (0.0025in-0.00015in) and clay (< 0.00015in). These are then calculated as a percentage, and a ternary pair (xx-yy-zz) is assigned to be characteristic of the till.

Future researchers should consider allowing for enough time to conduct sand-fraction analysis, and consider whether plotting till fabrics and pebble counts would enhance their research or not.

Grain Size Analysis

Grain size distributions were determined following the method of Kettler (2001). His method, while meant for soil analysis, works very well for tills, and is much faster than the standard method. Using a 12g sample and 36mL of 3% Hexametaphosphate (HMP) solution for a 3-1 ratio, these were added to a vial and shaken for 2 hours. After shaking, the samples were wet sieved through a .053mm (.0025in) sieve, and were rinsed thoroughly with de-ionized water. The particles that made it through the sieve were collected in a 600mL beaker. This beaker contained both the silt and clay material and they needed be separated to calculate the individual percentages. After filling the beaker and stirring vigorously to suspend all the particles, they were allowed to go through a sedimentation period of at least 90 minutes but less than 6 hours. After sedimentation, all but 50-100mL of liquid were siphoned off. The particles that remained on the sieve were collected into a 250mL beaker, and along with the 600mL beakers were placed into an oven at 100º C overnight. The Sand% and Silt% were calculated based on their fraction of the original sample mass:

Sand% = (oven dry sand mass/original sample mass) x 100%

Silt% = (oven dry silt mass/original sample mass) x 100%

The Clay% was determined by subtracting the sum of the Sand% and Silt% from 100%,

Clay% = 100 – (Sand% + Silt%).

The results of my grain size analysis will be correlated with those in Lusardi's (1998) and Matsch's (1972) work.

RESULTS

Cut Bank Site

This site (figure 3) is located in the NE ¼ of the NW ¼ of section 11, T109N R27W, and is labeled the Cut Bank because it is located along a cut bank of Seven Mile Creek, where erosion and slumping created the exposure. The exposure is on the north side of the creek, and contains till units that are approximately 8.5 meters thick (figure 4), with the top of the exposure is at 263m above sea level. The site is very active, and has slumped at least once from the time it was discovered until the submission of this report.

Figure 4 shows the stratigraphic column at the Cut Bank site. The description will be in reverse order, starting at the top of the column with the youngest bed and working downward to the older beds, because the top of the exposure is much clearer than the bottom. Lines have been drawn in at the two major contacts, beneath the boulder layer and above the “white quartz sand.”

At the top lies a “tan/buff colored, layered” loam till. A sample could not be obtained from this layer because of its height above the slump. The next two layers in the column are nearly identical yet visibly separate boulder to cobble layers, approximately 55cm thick each. The sizes of the rocks in these layers were estimated to be up to one foot in diameter, although larger boulders were visible at the bottom of the bank. These boulder and cobble layers appeared to be contained in a medium of medium to fine grained gravel.

Underlying the boulder and cobble layers is a similar yet quite distinct till to the one above the boulder layer. Although the color is similar, this layer contains micaceous, incompetent granites and was visibly rich in pebble sized rocks, which the other till appeared to be lacking.

The following layer is a perfectly white quartz sand layer, which coarsened upwards. Following this quartz sand are nearly three meters of clay-rich layers alternating with sand-rich layers. Also included in these layers are several strongly cemented iron-rich layers, containing iron concretions and iron spherules.

Underneath these layers lies one last till before the bedrock. This is labeled on the figure as "buff/tan till," however it also has some hues of red, which were originally dismissed as iron leaching, but are now understood to be characteristic of some tills.

Kirby Pass Site

This site, Kirby Pass (figure 5), is located very close to the previously described Cut Bank site, approximately 400 feet south and on the other side of the creek, and can be found in the exact same area of the quadrangle. This site was created when the pass was carved out during the installation of the Kirby Pass trail. The exposure is approximately 2.5 meters thick (figure 6), with the top of the exposure at 258 meters above sea level. Although this site is small, it is steep and it is still actively slumping, as can be seen by the buildup of sand at the bottom of the pass.

Figure 6 is the stratigraphic column detailing the layers found at this site, and will be described from the top down. Based on the height of the top of the exposure, the column should begin somewhere just under the boulder and cobble layers seen in the Cut Bank stratigraphic column. Lines have been drawn in to emphasize contacts, the first is at the base of the sand layer, and the second between the tills.

The uppermost layer is 100cm of tan sand. The soil above this sand layer contained some cobbles. The base of the sand layer contains a small redder section of sand. Two layers of till follow underneath the thick sand layer. The first is a smaller, 40cm section with many pebbles and micaceous granites. The second till is a thicker 100+ cm layer that continued deeper than could be trenched, and which looked very similar to the smaller 40cm section.

Timber Lane Site

The Timber Lane site figure 7 is located at the southern extent of the park along Timber Lane, the first road south of the entrance to Seven Mile Creek Park (SW ¼, SW ¼, section 12, T109N, R27W). This site was created when the road was installed, and because of the erosion and slumping, requires its own drainage ditch. The exposure is 6 meters thick (figure 8), with the top of the exposure at 260 meters above sea level. This site has a wider exposure which allows for a better overall view of the site, and can be accurately described as a road cut.

Figure 8 is the stratigraphic column for the layers discovered at the Timber Lane site. The column will be described from the top down. Lines have been drawn in to emphasize certain contacts. The uppermost two lines surround the till unit under the boulder layer, the third line is above the 40cm “white sand with soft iron banding,” and the lowest line lies above the contact with the Jordan Sandstone.

The top of the column shows two till layers separated by a boulder layer. The till layer above the boulder and cobble layer was too high to properly sample, but was visually described as “tan till,” and some pebbles from the till were tested with acid in the lab and reacted vigorously, indicating that they were carbonate. The boulder and cobble layer contained some very large boulders, with sizes visually estimated to be as large as 3 feet in diameter. Some of the rocks from this layer were visibly faceted and striated. This layer was contained in a medium of medium to fine grained tan/brown gravel. Underneath the boulder layer lies a tan till, 115cm thick, containing various pebbles and micaceous granites.

Following the lower till are two 20cm layers of clay, one white and one gray. Following the two clay layers is white quartz sand. In an attempt to learn more than just what layer is above which, I took a broader view of the layers underneath the lower till unit, and there appeared to be four connected sequences. The three layers directly under the till are a white sandy clay loam, a tan sandy loam and a white sandier loam, totaling 55cm. This appears to be a fining upwards sequence with these three layers and underneath them appears a hard, iron and concretion filled barrier.

Underneath this iron barrier lie three more layers, this time with layers of white sand, white sandy clay loam and a white silty clay, which together are a fining downwards sequence, over 125cm. There is also an iron barrier layer beneath them. The next sequence of layers is 90cm thick, and contains a layer of white sand and a gray loam. This is another fining downward sequence, bordered by another iron barrier. The final sequence will be a little more difficult to associate because the top third (50cm) of the potential sequence could not be sampled; however it is described as clay (>20% clay). If it is indeed clay, then the following layers of silty clay loam, clay loam and sandy clay loam represent a fining upwards sequence, bordered yet again by a dense iron barrier. This appears to be the end of the sequences, as directly beneath this layer is the Jordan Sandstone.

DISCUSSION

Figure 9 shows the correlation between the three sites in Seven Mile Creek Park.

Cut Bank Site

The uppermost "tan/buff layered" loam till which lies directly on top of two distinct cobble and boulder layers appears to be characteristic of the New Ulm Till, as described by Matsch (1972). The predominant factor in this correlation is its location relative to the boulder layer. The layers beneath the New Ulm Till in the stratigraphic column are boulder layers. These provided an excellent point of reference when comparing the different sites, and also helped to identify which tills were present, since it is known that the New Ulm Till lies above and the Granite Falls Till lies beneath a boulder layer (Filby, 1998).

According to Matsch (1972), the Granite Falls Till lies beneath a boulder layer, and is yellow and rich in pebble-sized clasts. The following layer was described as a "tan/buff till with pebbles and micaceous granites." My findings and the grain size analysis of this till suggest that it is the Granite Falls Till.

It is at this point in the analysis that things begin to get a little less certain. Although the three uppermost layers correlate well with the known units described above, the layers beneath them become more confusing. The subsequent layer is white quartz sand, followed by nearly three meters of alternating clay-rich layers and sand-rich layers, which include several iron-rich layers. Matsch described an interglacial period from which these layers are most likely derived, which occurred after the advance of the Superior Lobe, but before the advance of the Wadena Lobe (Matsch, p. 555, 1972). This means that the interglacial sediments should be found above the Hawk Creek Till and under the Granite Falls Till, and they are. While few samples were collected from these layers, the majority of them are clayey or clay-rich, and they would be of a similar texture to the "Clay, white with reddish bands" and the "white/gray pure clay," which would be described texturally as silty clay or silty clay loam. Layers described as sand are also present, which may indicate fining sequences. These layers seem to have been subject to more iron-leeching than others, as is visible by the frequent red (iron) banding and iron concretions.

Beneath these interglacial period layers lies one last till before the bedrock. This is labeled on figure 4 as "buff/tan till," but also has some red hues. Described as a sandy loam or sandy clay loam till, it is the Hawk Creek Till, and this assessment agrees with Matsch's description of the till.

Gowan (1998, p.164), citing Matsch (1972) and others, shows in a diagram (figure 10) the different extents of certain glacial tills as they are present in three locations in Minnesota. The study Matsch conducted is located relatively close to my sites, and so I would believe his results to be similar to mine, and so far they have been. Although only the tills were specifically listed in the diagram, his written work describes many similar finding to my own.

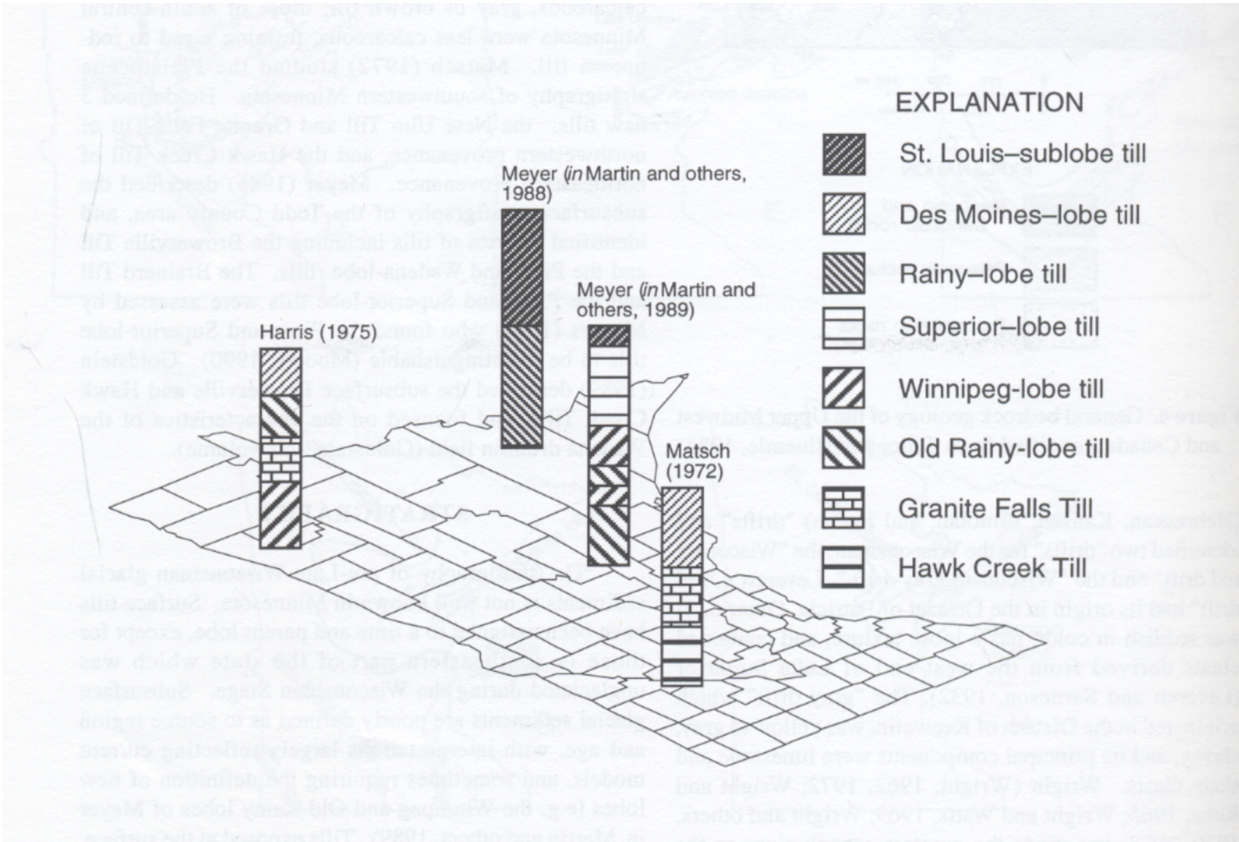

Figure 5. Glacial stratigraphy at four localities in Minnesota, showing lateral and vertical range in till type distribution. Stratigraphic columns are schematic; they are not drawn to scale and are not an accurate portrayal of the relative thickness of glacial sediments. The names used for the till units are those designated by the authors.Column (A) from Harris (1975).Column (B) from Meyer (in Martin and others, 1988).Column (C) from Meyer (in Martin and others, 1988).Column (D) from Matsch (1972).

Figure 10. Gowan's diagram of generalized stratigraphic columns across Minnesota.

Kirby Pass Site

This site's stratigraphic column appears to begin somewhere just under the boulder and cobble layers. Some cobbles were found in the soil layer, which could indicate that the boulder and cobble layers were present not too far above the top of the exposure. Because this site is so much smaller, and there are only two or three true layers within it, its correlation will be a little more speculative.

I believe that the 100cm sand layer just under the "gray clay" layer is actually the boulder and cobble layer visible in the other sites. In between and amongst the boulder layers at the other sites a tan/brown sand was visible, however no sample was taken to compare the sands since the layer was being described as the boulder layer, and the matrix that existed between the boulders and cobbles seemed insignificant. This idea works well with the rest of the column, because the subsequent layer in the Kirby Pass site contains the micaceous granites that are found as part of the Granite Falls Till under the boulder layer at the other sites. The sand layer was also already exposed and needed little trenching, and so what little was done did not dig deep enough to find any cobbles that may have been there. Had the trenching dug deeper into the sand layer, or the soil been checked, I think that many more cobbles would have been found and a stronger correlation could be made.

The two layers of till underneath the sand (boulder) layer are likely the same till, except that at this site the iron has leached out of the upper portion, leaving a more clay-rich upper layer and the iron-rich lower layer. This till would then correlate very well to the Granite Falls Till, since it is known to be under a boulder layer, and has at both of my other sites contained micaceous granites. The grain size and texture analysis also agree with this being the Granite Falls Till.

Timber Lane Site

This column appears very similar to the Cut Bank site, which is immensely helpful in correlating, and also shows that there does not appear to be much change in the stratigraphy in the mile in between this site and the other sites. The top of the column shows two till layers separated by a boulder layer. The topmost layer, called "tan till with carbonate pebbles," was again too high up to get a good sample, but because of its relation to the boulder layer is likely the New Ulm Till. If the till underneath the boulders is Granite Falls Till, then the till above the boulder layer can be indirectly correlated to be the New Ulm Till.

The boulder layer at the Timber Lane site appeared very similar to the one at the Cut Bank site, except that there were a few larger boulders visible than those at the Cut Bank site. The medium to fine grained tan gravel medium was also present. The grain size, texture and color of the till, along with the presence of micaceous granites underneath the boulder layer, leads me to believe that it is indeed the Granite Falls Till, and so the till above the boulder layer is likely to be the New Ulm Till.

While there was no clay layer found at the Cut Bank site underneath the Granite Falls Till, as there is at this site, according to Matsch (1972) the layers that follow were deposited during an interglacial period, and these interglacial layers are less consistent across the Seven Mile Creek area than the till layers. The interglacial environment that existed while the sand and clay layers were being deposited is much more small-scale when compared to the glaciers. Very different depositional environments may have existed in close proximity, and the 2 meters of associated deposition at the Timber Lane site may be very different than the other sites, but when the bigger picture is seen, they are indeed similar. These layers are perfect examples of this. The clay layer and the following layers of white sand create a fining upward sequence in the first half meter of sediment underneath the Granite Falls Till.

Because the layers have correlated very well so far, and we have moved into alternating clay and sand layers, just as before in the Cut Bank site, it appears that this location received a similar sequence of deposition from the interglacial period described by Matsch (1972). The following two meters are also sequences, though they are both fining downward and each is nearly a full meter thick. The processing of the samples from the 100cm layer near the bottom of the column labeled "clay, fining upward, iron rich, color alternating red/gray" were so rich in iron, that they would not fully dissolve during the lab processing, which resulted in Sand% that is too high. Because all of the samples in this layer were affected similarly, the fining downward claim is still valid.

Directly beneath this layer is the Jordan Sandstone, which indicates the end of the interglacial sediment, however no Hawk Creek Till was located. Because Hawk Creek Till was located at the Cut Bank site, it would have been a safe assumption to expect to find it here as well. A reasonable explanation for the missing till is that it may have simply thinned out too much and become mixed in with the above sediment. An extreme possibility is that the Superior Lobe, which deposited the Hawk Creek Till, stopped in between the two sites, which explains the lack of the till. This theory, however, is a little more farfetched than I would believe, and I feel the thinning explanation is much more likely.

CONCLUSION

Pre-Wisconsonian "Old Gray" Till was not found at all in Seven Mile Creek Park. The other three tills at all three sites correlated well with each other. They all showed that the New Ulm Till, Granite Falls Till and the boulder layer in between them are present within Seven Mile Creek Park. They also showed that there was a period of interglaciation after the Hawk Creek Till and before the Granite Falls Till which led to the creation of many thin, indistinct layers of clay and sand. These interglacial layers seemed to be laid down in sequences, either fining upwards or fining downwards, and each of these sequences had a dense iron layer at its lower contacts. The Hawk Creek Till is present, and while it was not perfectly correlated, I believe that its existence is not a misinterpretation or a fluke. Compared to other sites explored by other researchers, these exposures and the tills within them were thinner than what were expected, averaging only a meter thick.

It is likely that the glacier that deposited the "Old Gray" Till passed through Seven Mile Creek Park. The complete absence of Pre-Wisconsonian "Old Gray" Till was unexpected, since others found such thick exposures nearby. An explanation for this is that there must be an unknown factor leading to the small thickness of the tills found within the park. Because of these thin layers, any glaciers that came after the deposition of the "Old Gray" Till would have had an easier time removing all traces of the till than in other areas where the till is thicker.

Neither of the hypotheses of the creation of Seven Mile Creek was given solid proof, but since there was no Pre-Wisconsonian till found, it is more likely that the creek was created only after the Wisconsonian Glacial Period began.

There is potential for this work and future work like it to provide helpful data in the study of ravine growth and expansion. Since the factors for ravine growth are unknown, it is important to gather any information we can so that once a growth factor is established,

Any future work done concerning the Pre-Wisconsonian "Old Gray" Till in Seven Mile Creek Park should be sure to include an even more thorough search for exposures, and include the pebble count and sand-fraction analysis methods, both to further corroborate my correlations, and to provide more accuracy in any claim of having found the "Old Gray" Till.

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Figure 3. The Cut Bank exposure. The boulder layers, reddish oxidized till, and white sand layer are visible at the top.

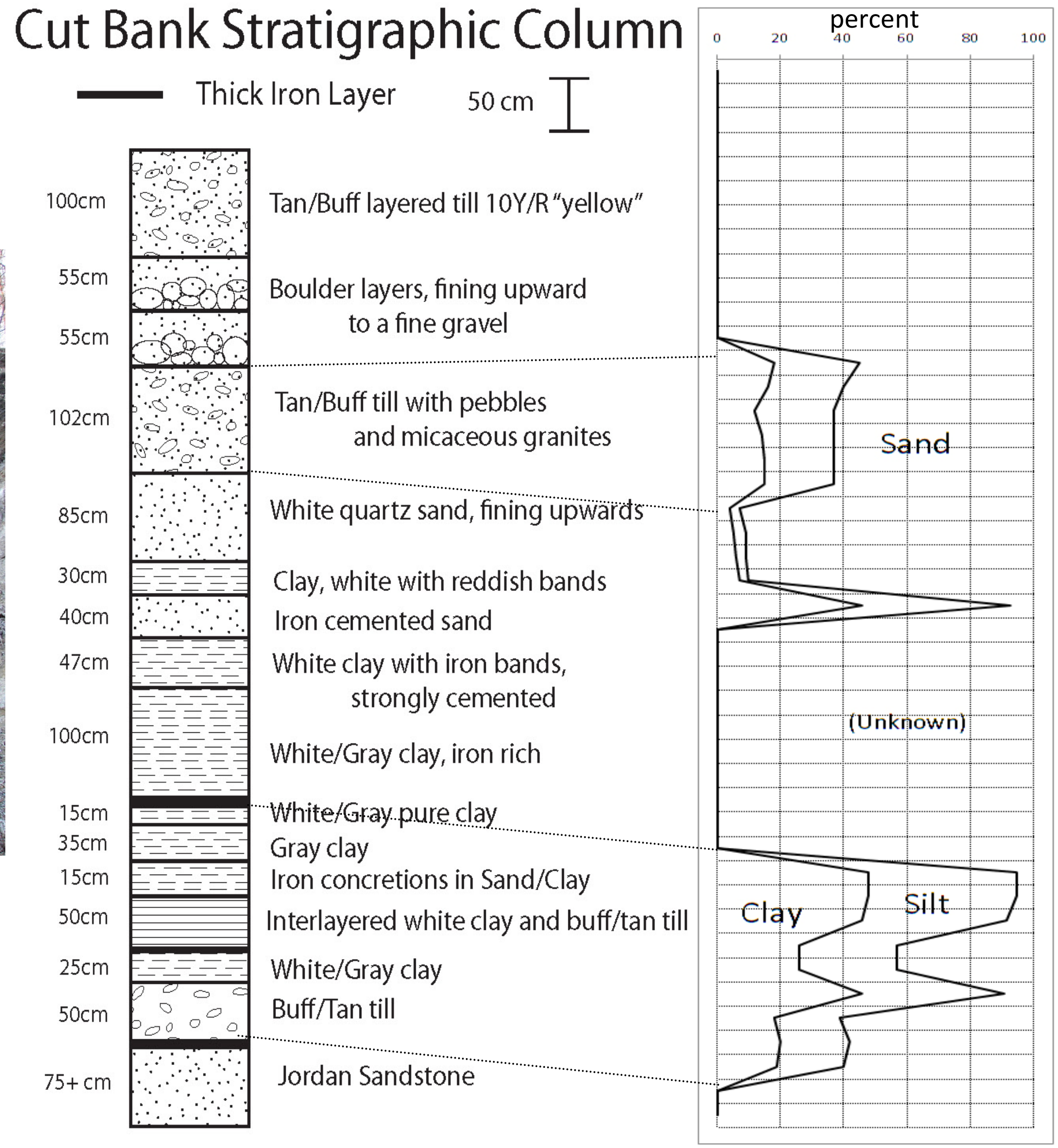

Figure 4. The Cut Bank Stratigraphic Column and Grain Size Analysis. Lines drawn to connect areas of equal elevation.

Figure 5. The Kirby Pass Site exposure. Distinct contacts can be seen at the iron rich sand and the clayey till at the center of the trench.

Kirby Pass Stratigraphic Column

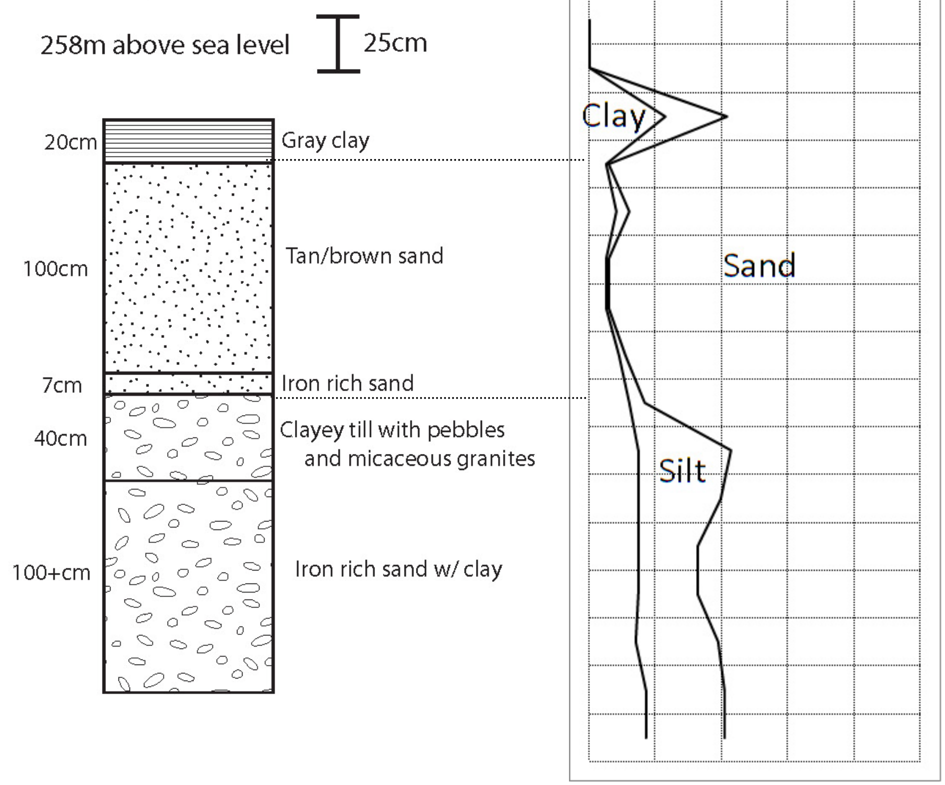

Figure 6. The Kirby Pass Stratigraphic Column and Grain Size Analysis. Lines connect areas of equal elevation.

Figure 7. The Timber Lane Road Cut. The boulder layer is visible at the top left, and the bedrock contact is seen at bottom.

Timber Lane Stratigraphic Column

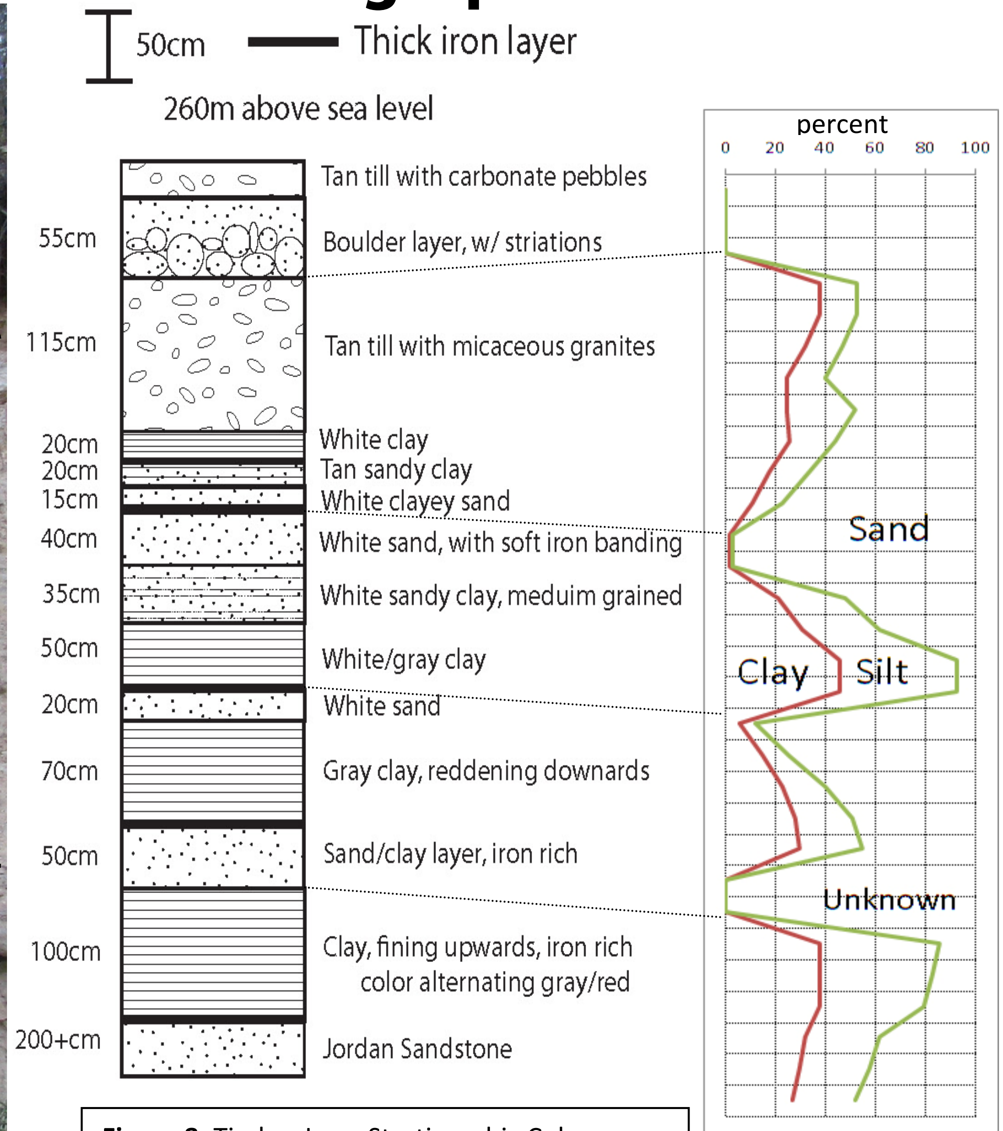

Figure 8. Timber Lane Stratigraphic Column and Grain Size Analysis. Lines drawn to connect areas of equal elevation.

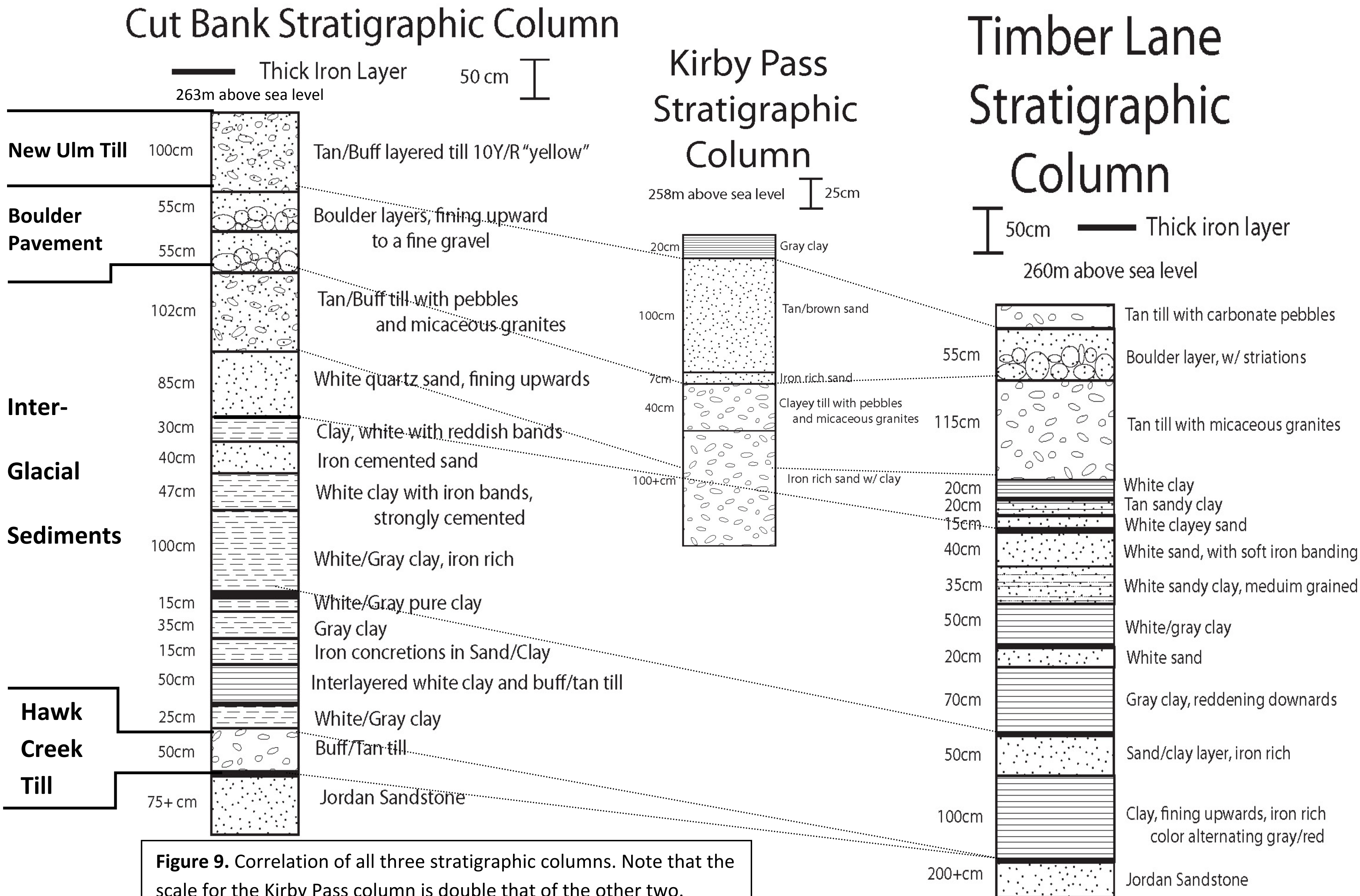

Figure 9. Correlation of all three stratigraphic columns. Note that the scale for the Kirby Pass column is double that of the other two.