Moosylvania: Survey of a Micro-Environment

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Environmental Science 102

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Introduction:

During the topography lab of February 1995, I found a particularly interesting spring in an area within the Rocky and Bullwinkle plot of Hopkins Forest. I named the area Moosylvania, (out of an obscure reference to the cartoon), and conducted observations into its geology, biology, and chemistry. Many factors are affected by the presence of springs on the site, especially vegetation type and quantity. Since a system of seeps seems to run along the entire South shore of the brook, and there are six springs in the R&B plot alone, data collected from an intensive survey of one site may be extrapolated to the larger ecosystem of Hopkins forest.

Note: Photos should be used in conjunction with topographic map and the overlay to see where and in what direction they were taken. In general photos are numbered east to west. Photos should be numbered in their order of appearance in the text!

Site Description:

Moosylvania is an area south of the Birch Brook in the Rocky and Bullwinkle plot as seen in Map 1. A steep ridge system on the NW side of Moosylvania makes the site visible even on the 1:15,000 scale of Map 1. The two flowing springs at the base of a tree and a snag 13m apart(photos #3 and #6) have carved a "U" shaped area out of the plateau to the South as seen in photo #7. The topography and corresponding vegetation are unlike the surrounding area. The system was spotted during the topographic survey of the plot by a spot on the hillside barren of snow because the warmer spring water had melted it. The marsh environment that is partially fed by the spring at the base of the hill was revealed by the fern fiddleheads as seen in the sketch, which are seen only in waterlogged areas of the plot, poking through the snow. The entire project is an in depth site analysis so site description will continue throughout the paper.

Methods and Materials:

A large portion of the time spent in the field was devoted to construction of the topographic map. Since the scale is so small, I discarded the usual technique of transect construction and used a freehand method for the most part. Quantitative elevations were calculated by using the data points of transect 6 from the February topographic survey of the R&B plot which intersected Moosylvania, in conjunction with new measurements. At four prominent features, such as where the slope tapers off in the area of the southern most solucification site, I plotted elevations using the Brunton Pocket Trans~~ect~~it. Thus, a reasonably accurate map was constructed without relying entirely on the Brunton, which would be inaccurate for such a small scale survey. While drawing the sketches, special attention was given to any notable features; thus, the map is more accurate around the spring sites and less so on the southern side which had fewer prominent features.

Water samples were obtained from S1, S2, and W1,(see topographic map overlay). I conducted biological tests for total and fecal coliform by filtering water samples with the membrane filter technique. All other biological observations I did through species identification using keys. Total number of trees taller than 6 feet were counted as well to see dominant species in moist environments. I used this method rather than the point-sample method in order to obtain a broader and more accurate sample. Aquatic invertebrates were counted at the site of W1 in order to obtain a water quality rating.

I used a portable Hach-1 thermometer to determine temperature of the two springs, the marsh and the brook in the field. Water samples from the springs and the marsh were taken for analysis in the laboratory for comparison with samples of the brook already analyzed during the water chemistry laboratory experiment. In lab, I determined pH and ANC using a portable pH meter and a Hach titrater.

Results:

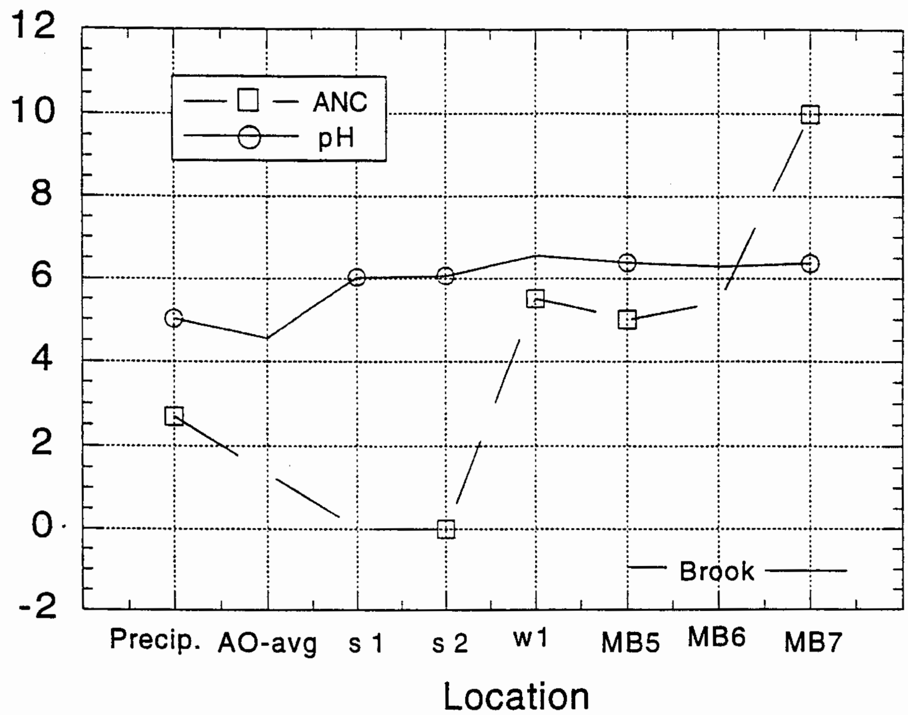
I observed morphologic features and later identified according to Skinner & Porter (1992). Solucification sites, areas of rockfall and a steep landslide area were visible and classified. I obtained information on mapping techniques from Cooke and Doornkamp (1990) and conducted further geologic research in order to obtain Figure 1, a cross section, and Figure 2 a general history of the site. I dug a series of trenches as well, in order to determine the parent material, which was found to be till. The cross section was conducted by correlating many observations about geology with reference material. Section 3 summary table describing surficial geology conditions by LaFleur and DeSimone(1992) describes "Very slow percolation rates in areas of thick till; bedrock near the surface in some areas. *Groundwater seepage on slopes; mass wasting on slopes*." The last part of this statement corresponds exactly with Moosylvania, thus revealing the deep layer of till. The conclusion that the bedrock ~~is~~ phyllite was made because the soils on the plain above and south of the site are phyllite rich till.

Did you make this term up? You're referring to SOLIFLUCTION?

I used many sources to determine the formation of the area as shown in Figure 2 , but the resource that proved most useful came from a description of a similar watershed in Vermont by Jerris (1991).

Chemical tests conducted to compare pH and ANC traveling through the water cycle are shown in Figure 3. I also tested water to compare ion content with precipitation, however since the data on soils has been deleted in the database not all comparisons could be conducted.

Figure 3: pH and ANC Increase
as Water Travels through Cycle



Error for pH is +-0.2 and +-0.5 mg/L $CaCO_3$ for ANC is calculated from other experiments

Results for biological tests including total and fecal coliform, survey of aquatic insects, and tree and fern identification reveal the unique micro-environment of a spring. No fecal coliform were present and Table 1 illustrates the total coliform which is significant because of the 0 reading on the marsh is unusual.

Table 1: Total Coliform in and around Moosylvania

Spring 1:	19
Spring 2:	9
Marsh 1:	0
Middle Branch 5:	40
Middle Branch 6:	20
Middle Branch 7:	100

I classified aquatic insects only to order. A thorough survey was not the intention since the goal was only to analyze water quality. Some observations of diversity were obtainable as seen in table 2. Since I was the only person looking for insects these results are by no means comprehensive. Also of interest, within the sample bucket of the insects were two salamanders, one was 10 cm long adult and the other 2 cm juvenile with gills still visible.

Table 2: Number of Aquatic insects by Order

Ephermeroptera	2
Coleoptera	2
Diptera	2
Trichoptera	1(case present)

Vegetation was crucial in identifying the site and was strongly influenced by topography and morphology which will be seen in discussion. At least 4 different species of ferns were noted including Onoclea sensibilis, Osmunda cinammonea, Poystichean acrostichoids, and one unidentified. Trees common throughout the plot were found in this area as well, but distribution revealed a strong tendency of division by species. At the actual sites of the springs, both trees were yellow ~~paper~~ birch with branching trunks(photos #4 & #8). Below the springs were 4 paper birch and 2 red oak, while above the spring were 9 red maples and 1 red oak and paper birch. Sapling populations were dominated by hemlock with a significant number of beech as well.

Discussion:

Figure 3 shows how the acidic precipitation is neutralized when passing through the water cycle. The presence of a spring shows how groundwater leaches cations from the AO-layer of the soil, making the water less acidic. pH of spring water is between that of precipitation and the brook since chemicals in the bedrock aren't working on it like the brook. The ANC of the springwater is 0, less than both precipitation and the brook. This is caused by the low pH of soil taking any of the acid neutralizing capacity from the throughflow. The presence of this spring shows how throughflow sites can act as filters in a similar manner to marshes.

Since the fact that the spring is a result of throughflow makes this area chemically significant, an explanation of that process is in order. The system of trenches I dug revealed that the C soil horizon of the area is composed of a rocky green-gray poorly sorted clay identified as glacial till. Thick till is the least hydraulically conductive soil type possible in this area according to Jerris(1991). The material above this aquitard need not have very high hydraulic conductivity because the water will congregate to and carve a channel or network through the material in an efficient manner. Steep topography in conjunction with the presence of trees as seen in and their root system collaborate to turn what would normally be seep into a spring as seen in Figure 1. The large root networks encourage the water to congregate at one spot rather than to form a broad line of seepage such as in photo #2 or a narrow area of seepage as seen in photo #1 and the sketch, (due to a saplings smaller root system playing a similar, but less significant role.) These factors also made the area visible during the winter months when other areas were covered with snow.

(you need to use the adjective .... not to confuse with electrical conductivity!

Groundwater affects soil temperature since an "...aquifer will act as a heat sink or source depending on the season," and an entire network of throughflow can be mapped by soil temperature (Back & Freeze 1983). However the temperature difference is not great, so areas like a seep with low flow will not melt snow whereas the springs in Moosylvania were sufficient to melt snow and keep green moss growing throughout the winter of 1995. Currently the water is * 1-2°C cooler than the surface temperature of 8.4°C observed in the marsh and brook. The corresponding marsh environment was identified with snow on the ground because of the ferns in the area.

The fiddleheads of Onoclea sensibilis or sensitive fern, which turn brown but remain upright throughout the winter, revealed this site. I observed the sensitive fern in trail side ditches and other areas that receive standing water throughout the plot, but the other two varieties I observed only in the area of the seeps and springs. Poystichean acrostichoids, or Christmas fern, and Osmunda cinammonea, common name: cinnamon fern, are particularly abundant in Moosylvania. These ferns act as bio-indicators of a marsh or spring environment. A species of grass plays a similar role for seeps and makes the line of seepage observable, as seen in photo #2 despite the thick layer of organic material that normally makes it invisible. The aspect of the slope is also important for thirsty ferns as well as trees since NE facing slopes receive more moisture than slopes with other aspects (Whittaker 1956). This environment is not hospitable to all ferns; the clubmoss Lycopodium flabelliforne, or running cedar, which blankets the R&B plot in the north is absent here because of its preference for dry open woods.

The red oaks observed in the plot have similar tastes and it is rare for them to grow on a NE aspect (Staterson 1977). All of the oaks I observed in Moosylvania were on the higher and drier western ridge line which also receives more sunlight than the hollow next to it. With the oaks accounted for, the only other trees are segregated by being above or below the springs. The red maple are a later successional species than paper birch, which implies that the area above the spring is less geologically active(Art). Saplings were not so sharply divided. The larger percentage of Hemlock is due to the fact that they are a shade tolerant and grow well in moist areas(Staterson 1977). Beech also prefer the north aspect and grow well also; both species are late succesional(Art).

The implication that the area above the spring is less geologically active is confirmed by both logic and the morphology of the plot. Since water is the active ingredient in mass-wasting the area below the spring is naturally more active. Further confirmation of this can be seen by consulting the topographic map. The convoluted lines caused by the two springs channels as well as ~~solucification~~ mean less stability for tree roots. The smaller number of trees, (6 as opposed to 10), below the seep is a result of this.

I think probably the term earthflow will creep best describe the process. True solifluction is an arctic saturation process!

Creep/earthflow

~~Solucification~~ is the slow downslope movement of soil and regolith saturated with water. I have attributed most of the mass-wasting in the plot to solucification and confirmed this by examining the northern most since it was a former channel for spring 1. I am able to tell the regolith moved slowly because the current channel cut a path which moves around the creep/earth. ~~solucification~~ flow well above the current mass. If the wasting had occurred rapidly the channel would be more direct. Good!

Various channels for the spring also provide evidence that the level of the spring changes in relation to amounts of water. A very prominent channel is cut above spring 2 and it appears the water level was a the site of photo #5 for quite some time because of the steep cut there. Above spring 1 a distinct channel could be seen to the west, (marked in pink), as well as a less distinct channel to the south which appeared weathered.

These channels lead to a marsh environment that flows slowly parallel to the brook all along the middle branch. A cut in the western ridge line allows water in from the NW. Aquatic insects were studied in order to determine the oxygen levels at this site. The presence of coleoptera indicates that water quality is good to excellent. This implies that the water is flowing through most of the year to keep it oxygenated. I attributed the lack of coliform to error as a result of this study and lack of other explaination.

The origin of this wetland within the flood plain is a direct result of the seeps and springs along the southern ridge, not erosional effects of the stream.

Because of the cut through the ridge and the terrace system that also contains cuts, it is unlikely that the system is a small oxbow lake caused by the brook. Since the terrace is located only near the marsh and is not a system of terraces between the brook and the hill this also discounts the possibility of a point bar system. Figure 1 shows this as well, since the water that cuts the terrace in the NE portion of the map forms a channel that runs to the brook, it is most likely underlain by an impermeable till layer rather than hydraulically conductive sand that would be in a point bar.

The wetland and the springs that feed it as well as the environment of the slope that is altered by the spring is a scene repeated throughout Hopkins Forest. Understanding this portion is crucial to understanding the ecology of the forest as a whole. The presence of ferns in the moist environment and the effects of mass-wasting in tree selection clearly show the impact such a slope has on biota. The throughflow and spring also shows the chemical impact OA layers have on water chemistry more clearly than any other source.

References: Acknowledgements

[illegible]tal [illegible] is customarily presented as [illegible] DeSimone

I would like to thank the instructors of the course for providing information in lectures that was not directly referenced. Dave DeSimone provided much direct help as did Gretchen Meyer and Sandy Brown. I used the map of soil orogony handed out in class as well as the laboratory manual from the snow and water lab for reference. I thank the TA's for collecting Birch Brook samples and (personal communication) the other students of ES102 for analyzing those samples.

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Jeremy, You've completed a very satisfying and truly interdisciplinary study of a site. Your text is very well organized and fairly clear (see inline comments)

You might have pulled into subheadings your separate CHEMISTRY BIOLOGY & GEOHYDROLOGY Results .. also these same subheadings for DISCUSSION. Otherwise, a great job

I'd also have included the data graphs in the paper .. not just the poster!

With figures which are photos you should mount them onto a page with a caption .. not loose in a folder!

~~PAPER~~

PAPER $B^+ \rightarrow 88$

POSTER – (3 scores only)

ORAL A
CONTENT A–
GRAPHICS B+

POSTER OVERALL $A^- \rightarrow 90$

Figure 1: Cross section of Moosylvania

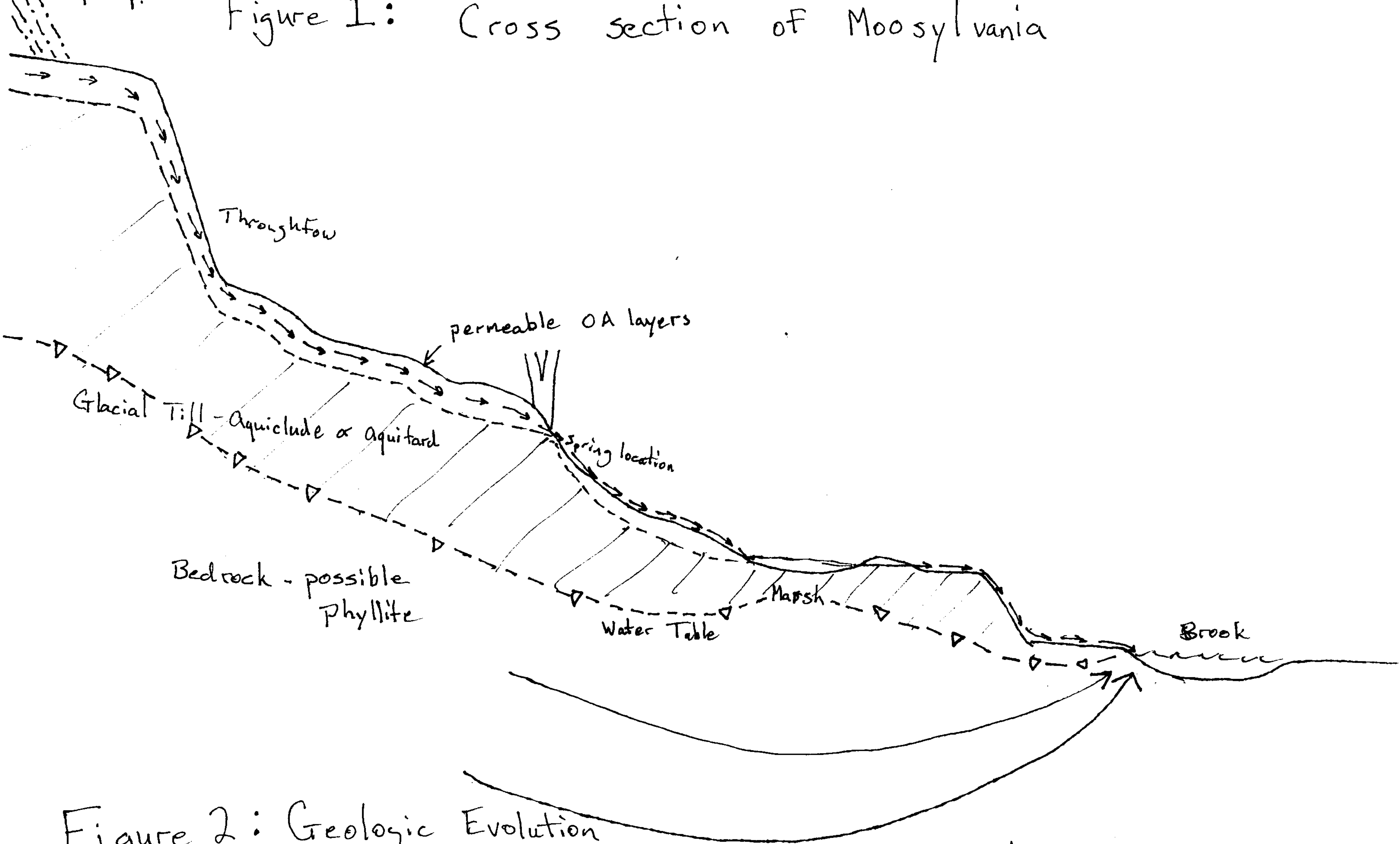
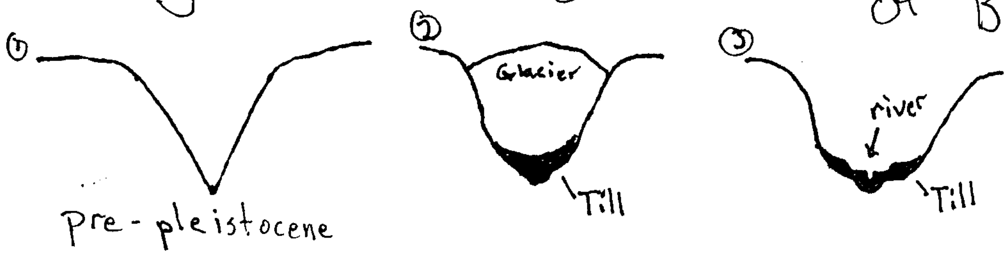
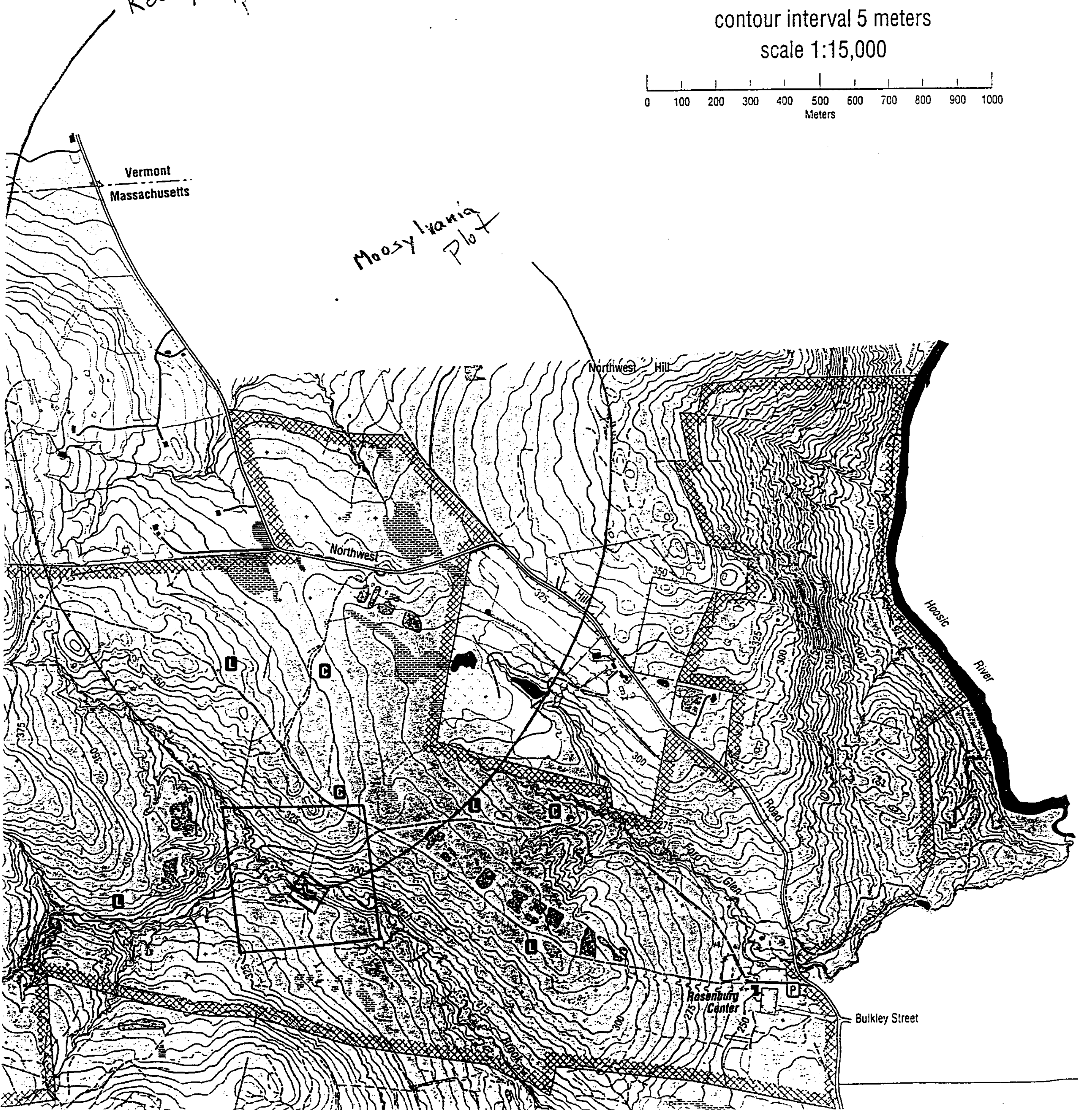


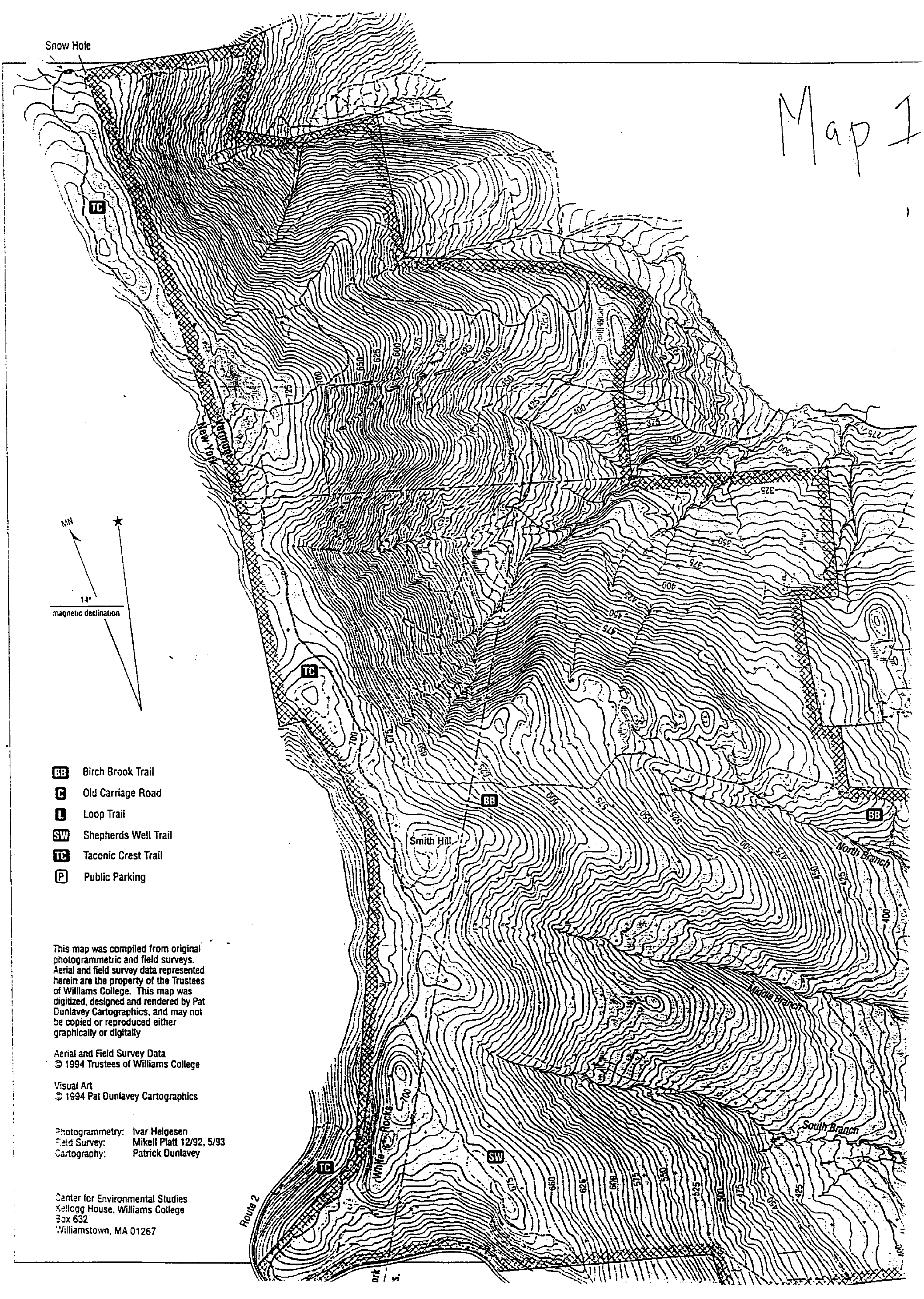
Figure 2: Geologic Evolution of Birch Brook Watershed



Hopkins Memorial Forest
Williams College



Map 1



Photogrammetry: Ivar Helgesen
Field Survey: Mikell Platt 12/92, 5/93
Cartography: Patrick Dunlavey

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