GLACIAL GEOMORPHOLOGY AND APPLIED HYDROGEOLOGY, MA-NY-VT TRI-STATE REGION

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Introduction

Our Keck/NSF project examined varied aspects of the glacial geomorphology, glacial geologic history, and hydrogeology among the hills and valleys of the Taconic Highlands generally north and west of our base camp in Wood House on the Williams College campus. The students' observational powers, mapping skills, analytical techniques, and interpretive abilities were areas we addressed during four weeks from mid-June to mid-July.

Geologic Setting

The regional physiography is typical of western New England (Figure 1). The Taconic Highlands are composed predominantly of Cambro-Ordovician schist and phyllite to the south with phyllite and slate to the north. Structural trends are north-south, and the summit ridge approximates the New York-Vermont and New York-Massachusetts borders. The Green Mountains are composed predominantly of pre-Cambrian granitic gneiss with the Cambrian Cheshire quartzite along the western flank. Structural trends are also north-south.

The Vermont Valley represents the major lowland of southwestern Vermont and is underlain by Cambrian through Ordovician marble, dolomitic marble, quartzite, and slate. The lowland is broad and widens to the south from Manchester to Bennington, then narrows south from Bennington. The Batten Kill and Paran Creek are the major surface streams and both are underfit.

The Hoosic River flows northwest from Williamstown to Hoosick Falls and is underlain by marble. Thence, the river flows west out of the study area through Taconic lithologies.

The Champlain-Hudson ice lobe of the Laurentide ice sheet expanded southeastward over the region prior to 22 Ka during the waxing phase of the late Wisconsinan glaciation. During the waning phase, both the Vermont and Hoosic valleys contained active ice tongues protruding from the lobate margin of the receding ice sheet. The region was deglaciated by 13 Ka, and both valleys received copious amounts of ice-contact and glaciolacustrine sediment. Details of this deglaciation formed the focus of three projects. The hydrogeologic and geochemical properties of these glacigenic sediments and the underlying bedrock were the focus of two projects. Three projects covered various sections of the Vermont Valley, one was nestled in a tributary valley to the Hoosic River in Massachusetts and one was sited in the Taconic Highlands of New York.

Student Research Projects

Edwin "Swamp Thing" Madera and Demian "Damo" Saffer tackled the problem of outlets for lower levels of glacial Lake Bascom. During deglaciation, the retreating Hoosic ice tongue dammed the north-draining Hoosic Valley and impounded a large proglacial lake first identified by Frank Bursley Taylor (1903). At its highest level, Lake Bascom overflowed a col at the southernmost reach of the drainage basin, but as the melting ice uncovered the Taconic Highlands, lower cols must have been used as temporary spillways. Taylor (1903) identified the Potter Hill spillway for the second highest level of the lake and recognized several still lower lake levels. Yet, the controlling spillways for these levels have remained a mystery. DeSimone and LaFleur (1985) and DeSimone and Dethier (1992) proposed that the geomorphology of Nipmoose Hill in the Taconics might warrant detailed study. Madera and Saffer's mapping of the channels they discovered and their interpretation

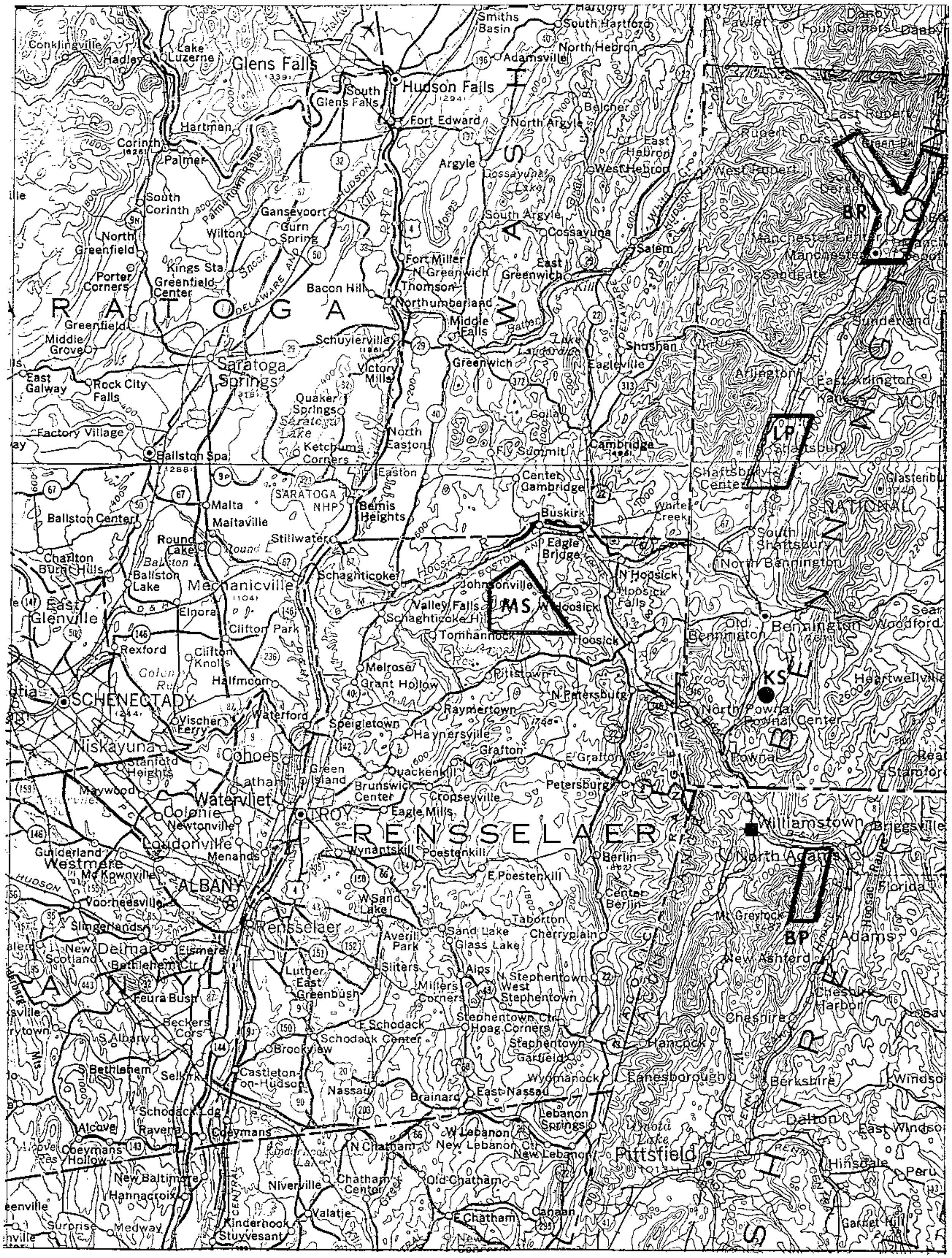

Figure 1: Location and physiography. MS = Madera and Saffer, BR = Barrera and Rosen, KS = **King and** Singh, BP = Butler and Petcovic, LP = Libbey and Pierson.

of the channel history provides surprising and delightful new insights on the story of deglaciation in the area. Additionally, sites for spillways of still lower lake levels are implicated for future study. Their analogy of the erosional morphology of the channels with the famous Channeled Scablands of eastern Washington is both timely and fitting.

John Barrera and Joy Rosen, perhaps excited by our canoe trip, studied the interrelationships between the Batten Kill's water chemistry and the composition of the underlying bedrock and cover of glacial materials in the northern Vermont Valley. They made measurements of specific conductivity and temperature at 50 preliminary sites along the Batten Kill covering approximately 300 km^2 and then narrowed their focus to 5 sites for detailed study. At these sites stream channel profiles were made and velocity measurements were taken to determine stream discharge. Velocity measurements were repeated daily to produce a time sequence related to meteorological events. Samples were obtained and ion chromatograph and atomic absorption spectrophotometer analyses were conducted in the Environmental Analysis Lab of the Williams Center for Environmental Studies. Assistance was provided by Sandra Brown, lab technician, and Jonnie Cluett (Williams '96), summer lab assistant. An unexpected result, perhaps, is the absence of a strong positive correlation between stream chemistry and drift composition.

Delano "D" King and Sheetal Singh performed a detailed analysis of a single locale, the closed Pownal Town landfill in the southern end of the Vermont Valley. Monitoring wells were in place and water samples had been analyzed according to EPA mandate since the early eighties at the landfill. Copies of these data along with landfill design/operation/closure plans and maps were obtained at cost from the Solid Waste Division of the Vermont Agency of Natural Resources. Also, DeSimone and Dethier (1987) had previously studied the surficial geology of the general area and brought environmental geology students to see the operational facility until its closure in 1991. Thus, a wealth of background data were available for "D" and Sheetal's detailed study. Daily water lever measurements were made at each monitoring well. Slug tests were performed to determine the hydrogeologic parameters of the glacial sand and gravel, and these data were compared with the sediment texture exposed in a commercial excavation adjacent to the landfill. Samples from the monitoring wells were analyzed for likely contaminants and compared to 10+ years of existing data. Much time was spent at the computer working with a groundwater flow model and in the construction of a flow net. The results of their investigation provide the kind of analysis rarely done for an ordinary, non-Superfund site.

Jessica Butler and Heather Petcovic, the "nap twins," took on the task of examining the Pleistocene through Holocene landforms and sediments in a single tributary valley to the Hoosic River east of Williamstown. Notch Valley has distinct upper and lower segments separated by The Cascade, a scenic waterfall and short gorge. The lower valley segment contains puzzling "pseudobars" of outsized proportions. The present underfit brook flows around these landforms. Unofficial visitor Eric Small (Williams '93) first recognized these forms and initiated the project idea. Numerous very large boulders, faintly to strongly imbricated, occur within and atop these pseudobars. A large, well-defined fan composed of boulders and cobbles in a poorly sorted, stratified matrix unconformably overlies eroded glaciolacustrine clay at the mouth of the valley. The elevation of the fan correlates with a Lake Bascom level. What is the origin of these landforms and sediments in this interesting little valley? These questions and others were addressed by Jessica and Heather.

Laura Libbey and Ana Pierson conducted detailed surficial geologic mapping of a fairly large area in the central Vermont Valley between two prominent moraines. Visitor Bill Shilts (1966) first mapped the area and outlined its deglacial history. Laura and Ana prepared a handsome surficial geologic map at 1:12,000 and an accompanying morphosequence map to illustrate their interpretation of the area's deglacial history. Beware of Ana as she's developed a mole-like ability to dig the deepest pasture pits in the shortest time and will win any digging contest. Laura wanted to take more photos of their field area but something mysterious happened to her camera. Their field sense rewardingly matured as the mapping progressed, and they evolved a more detailed story of deglaciation. Included is a picture of a small glacial lake, Lake Flat Top, which emerged from their analysis of the pattern and style of sedimentation and non-sedimentation in the lake basin. Map products such as these demonstrate that learning surficial mapping skills is an underappreciated expertise in this computer graphics age.

The broad scope of these five projects coupled with the enthusiasm and intelligence of our diverse group of students made this a very rewarding experience for Bob, Scott, and myself.

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