THE FLOOD CHANNEL HISTORY OF GLACIAL LAKE BASCOM: A MINIATURE SCABLANDS

Demian Saffer
Department of Geology, Williams College, Williamstown, MA 01267

Edwin P. Madera
Department of Earth and Environmental Science, Wesleyan University, Middletown, CT 06459

GOALS: The goals of this investigation are:

1) To determine the origin of channeled terrain in our study area
2) To reconstruct the chronology and nature of channel use
3) To correlate history of channels to known regional models of deglaciation

INTRODUCTION AND SETTING:

Regional models for deglaciation in the Hoosic River Valley and the Vermont Valley during the Pleistocene retreat of the Wisconsinan Laurentide Ice Sheet include the formation of glacial Lake Bascom, which was bounded by bedrock formations to the south, east, and west, and by a tongue of ice in the Hoosic Valley to the north. The lake reached a maximum elevation of 1050', extending south from a southern Vermont ice margin, through the Hoosic Valley for 30 miles to Pittsfield, where it was controlled by the Berkshire spillway (Taylor 1903). Small & DeSimone (1993) have identified terraces, lake deltas, and spillways indicating several stable Lake Bascom stages. These stages include a 900' level, controlled by the Potter Hill spillway, and 700' and 665' levels, identified only by terraces and deltas.

Our study area is located northwest of Hoosick Falls, N.Y., between the Hoosic and Hudson River Valleys. It is bounded to the north by the Hoosic Valley, to the west by the Tomhannock Reservoir, to the east by Nipmoose Valley, and to the south by the Potter Hill spillway. A system of anastamosing channels, occupied by underfit modern streams is located in the Grafton and Eagle Bridge, New York, 1:24,000 quadrangles. Little is known about the surficial geology or glacial history of these channels. Our investigation employed several approaches to reconstruct the nature and timing of channel formation and use.

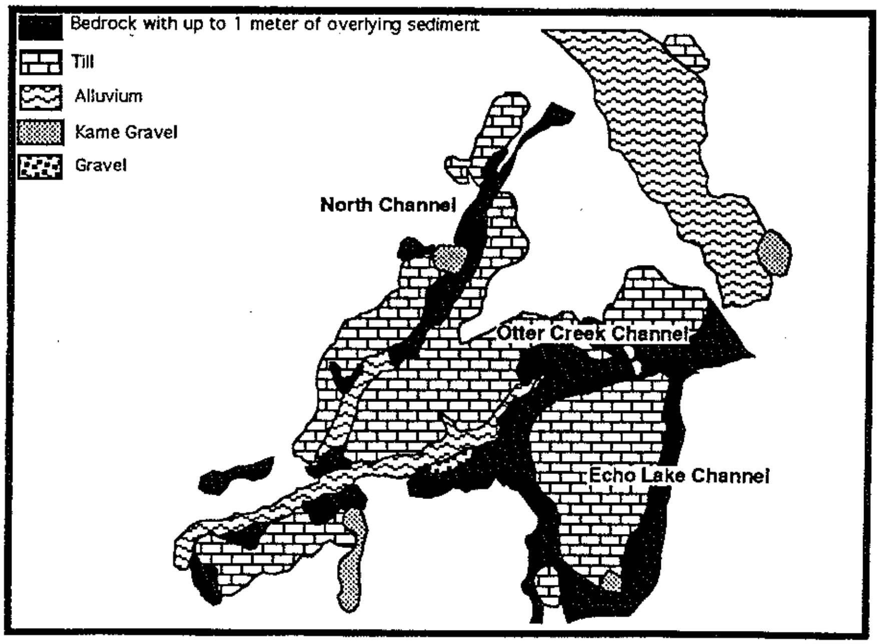


Figure 1

METHODS: Seven techniques were used to achieve the goals of this study:

1) Aerial photo examination
2) Surficial field mapping
3) Seismic profiles to determine depth to bedrock
4) Map analysis of channel gradients
5) Projection of ice margins
6) Sedimentological analysis of ice contact deposits
7) Comparison of channel geology and landforms to known flood areas

DATA & OBSERVATIONS:

We used stereoscopic aerial photograph pairs to locate major channels and gain an enhanced view of topography. This analysis was an important way to locate the channels which controlled water flow and warranted a more detailed investigation. Surficial mapping by foot allowed determination of channel wall and floor composition. We mapped till and bedrock outcrops (Figure 1), and dug pits to ascertain sediment composition. Gravel pits offered alluvium exposures, which we examined for cross bedding and imbrication directions. As an addition to field mapping, we ran a seismic line at the head of the Echo Lake channel to determine depth to bedrock.

We plotted longitudinal channel floor and kame deposit gradients to determine the order of deposition and erosion. The Otter Creek channel falls on a lower gradient than its kame deposits, suggesting that formation was the result of two separate events (Figure 2). The first of these events must have deposited the kamic sands and gravels, while the second eroded through them to scour the current channel. This is consistent with the location of remnant kame deposits at points where the channels join and bifurcate, and flow velocities are subsequently low enough to prevent erosion. The erosion and deposition are unlikely to be contemporaneous because the kame gradient is shallower than that of the valley floor. The large elevation gap (30 ft) between the kame gradient and the valley floor also suggests two separate events.

Outwash gravel found where Otter Creek empties into the Tomhannock reservoir lies at a lower elevation than Otter Creek kame deposits, and fits on a gradient described by the eroded channel floor. The lithologic composition of the outwash matches upstream kames that sit on a higher and shallower gradient; the outwash clast sizes follow a typical fining-downstream pattern from upstream kames as well. This is evidence for a second, erosional event, in which gravels from pre-existing upstream deposits were redeposited where the valley widens significantly, at a point of low flow velocity. A two stage event is also evidenced by preserved terraces in the North Channel. Like Otter Creek, because the identified kamic deposit sits above the channel gradient (Figure 3), it is probably a depositional feature from early channel use that was later spared by erosion. Till and bedrock remnants are present at several places within the channels. Morphologically, these features appear as streamlined longitudinal ridges.

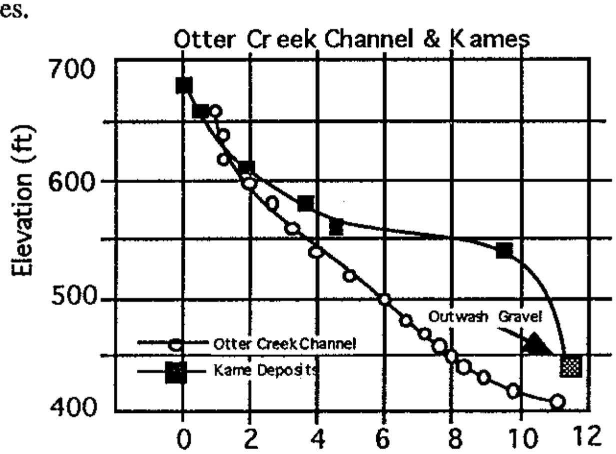


Figure 2

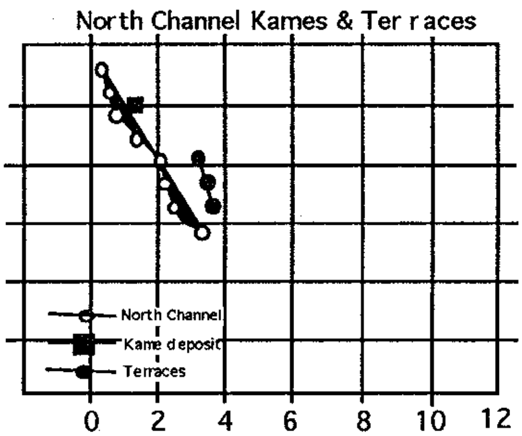


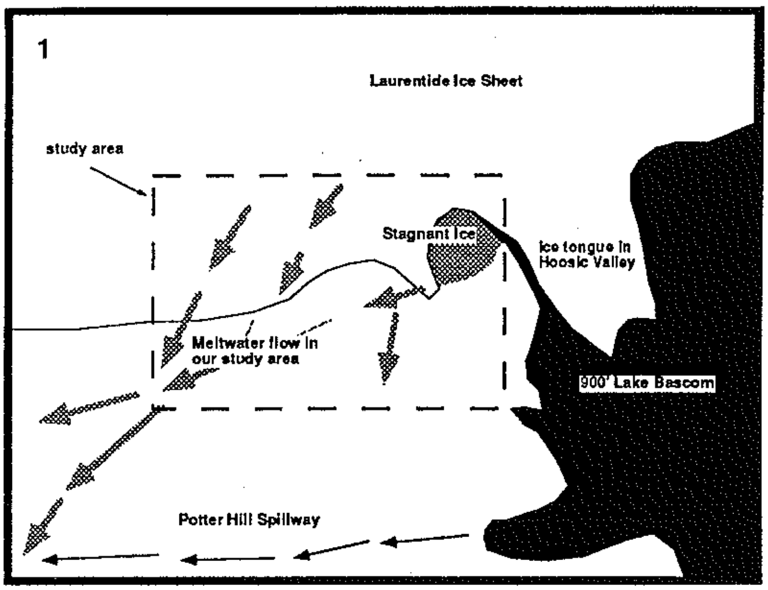
Figure 3

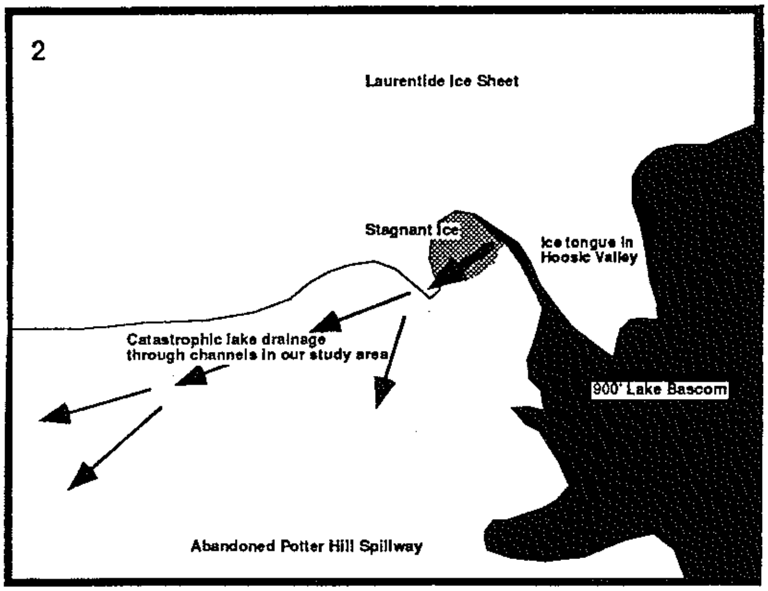
Identification of ice contact features and stereonet analysis of cross beds and imbrications in ice contact sands and gravels provide evidence for water flow directions and a for subsequent reconstruction of channel use. This data reinforces gradient evidence of two separate channel flow regimes; in several locations, imbrication directions reveal uphill flow, implying both that the water depositing the sediment flowed under hydrostatic pressure, and that accordingly, it was meltwater flowing under or through ice. This further suggests that deposition and erosion in these channels ocurred in entirely different environments. Ice contact deposits also help in generating ice margin profiles.

Ice margins constrain models for channel use by confining standing water, and blocking or revealing potential routes of water escape. Our projection of ice margins was based on both field and map work. Kame deposits identified in the field provide a set of points to which an ice margin was close. Bedrock striations and drumlin orientation within 2-3 miles of the postulated margin indicate ice flow directions. Because ice flow vectors are generally orthogonal to active margins, the orientation of these features suggests a trend line of ice flow. The active margin will follow this trend line in a general sense, as closely as the local topography allows.

Using the trend line in conjunction with calculated ice profile gradients of ≈200' ft/mile (Mathews, 1974 & Taylor, 1903), we projected ice margins along topographic contours from known ice contact deposits. The margins are controlled primarily by topography; the surface gradient and trend line simply adjust the effect of topography as the ice is forced to deviate north or south from a general flow direction.

Otter Creek's anastamosing channel pattern is strikingly similar to the Channeled Scablands of glacial Lake Missoula, MT (Bretz, 1923). The open network of water flow is indicative of enormous discharge that can not be carried by the pre-existing channel system. Small scale features in Otter Creek closely mimic landforms associated with the Lake Missoula flood. Both channel systems are erosional, bedrock floored, and contain few sedimentary deposits. Like their larger counterparts, channels in our study area expose large regions of scoured, humpy bedrock, indicating a high discharge and flow velocity. Finally, the Channeled Scablands derive their name from hydrodynamically shaped "scabs" of bedrock oriented longitudinally in the channels. These erosional remnants are formed during inundation of the landscape with floodwater. Like the scablands of Lake Missoula, our study area was marked with scabs of bedrock, with cleavage striking parallel to flow. The similarities between the drainage channels of glacial Lake Missoula and glacial Lake Bascom offer evidence for catastrophic drainage of glacial Lake Bascom. This model is further supported by local topography and projected ice margins.

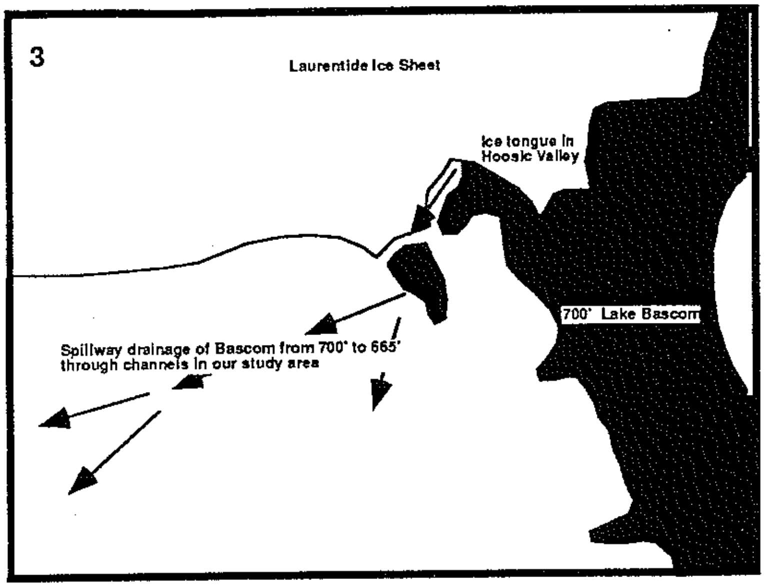




CONCLUSIONS:

1) There were at least two episodes of channel use. The Otter Creek channels were first used by meltwater, which deposited sediment along the ice margin and between blocks of stagnant ice in the hilly areas to the south of the Hoosic Valley. Based on our projected ice margins, as Lake Bascom reached a stable 700' level, topography and ice contained the water, allowing it to fill Nipmoose Valley. The valley acted as a temporary catch basin for Lake Bascom, while the Otter Creek spillway heading at Nipmoose Valley controlled drainage to about 660'-670'. This second use of the channels as a lake spillway system explains the erosional geomorphology of the current channels.

2) Lake Bascom drained catastrophically from 900', controlled by the Potter Hill spillway, to 700'. This is suggested by the anastamosing nature of the channels, as well as by marked similarities between the Otter Creek channels and the Channeled Scablands of eastern Washington state. The rugged topography east of Nipmoose Valley was a likely zone for stagnation; the presence of stagnant ice in the highlands surrounding Nipmoose Valley provides the setting for a catastrophic flood, as hydrostatic pressure of 900' glacial Lake Bascom water would burst through unnourished stagnant ice, draining the lake to a new low at 700'. This also implies a third stage of channel use, occurring after a depositional meltwater regime, but before a gradually eroding spillway controlling a 660'-670' Lake Bascom.



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