Geophysical Insights into 'The Wall', a Prominent Glacial Feature on the SBU Campus

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The geology of Long Island is dominated by glacial processes, and Stony Brook University (SBU) sits atop one of its most prominent features: the Harbor Hill Moraine. Evidence for the existence of the moraine can be seen throughout the Stony Brook campus, but perhaps most visibly in the plateau on which Tabler Quad now sits. The flanks of Tabler are notorious amongst students for the dramatic ~10 meter rise in elevation that must be hiked to reach the dormitories. The results of this study suggests that this change in elevation results from a glaciotectonic structure created as the advancing glacier was interacting with a mass of glacially-derived sediments built up at its terminus.

During the Wisconsin glaciation, a glacier pushed through the area where SBU now stands. As the glacier progressed forward, it occasionally became mechanically advantageous to build a ramp within the sediments that were being shoved along, allowing the glacier to ride over the sediments. What occurred at Tabler, however, appears a bit more complex. Our working model suggests the development of a lateral ramp in addition to a frontal ramp. A frontal ramp occurs where a mass of moving rock, or in this case, a glacier and accompanying sediments, step up over some of the sediment that is preceding it in a thrust fault. The thrust fault will leave sediments both below the ramp, as well as in front of it, undeformed, and sitting below the overriding mass. A lateral ramp is constructed when lateral differences at the level of the bottom of the overthrust require a component of strike-slip motion along the basal thrust in a segment trending perpendicularly to the thrust fault of a frontal ramp.

Such a model for the formation of the structure allows itemization of a list of testable predictions. For example, it predicts that if 'The Wall' was formed in this manner, it would be draped by a near-surface glacial till deposited at the base of the overriding glacier. The model also predicts that the sedimentary layers within The Wall will remain nearly undisturbed from the positions that they were originally deposited in; the deposition of the sediments probably occurred as outwash deposited by streams originating from the terminus of the glacier when it was located a short distance to the north. Fluvial stratigraphic sequences may be seen within the sediments, with the glacier's movement causing both progradational and retrogradational environments. In the area where the thrust fault occurred, deformation of the layering is expected as a result. Furthermore, the sediments just beneath the base of The Wall should be similar to those found on nearby, lower altitude parts of campus.

The primary method of investigation used in this research was ground penetrating radar (GPR). To provide a clear picture of The Wall, the GPR was run over four distinct areas. Two lines were laid out to separately image the proposed frontal and lateral ramps, one line was run along the top of The Wall, and a final line was placed approximately 150 meters to the northeast. From these four lines, the history of the wall can begin to be told. Over the study area, a multitude of layers were imaged down to a depth of 25 meters. Starting with the line that ran along the top of the wall, strong reflectors were noted near the surface, indicating a capping diamict, with layering which runs approximately horizontal. This initial information fits the model for sediments deposited in a pro-glacial outwash, which have been subsequently overridden by the glacier. The next two lines focused on the areas where the ramps are predicted to have formed. In both cases, deformation was seen in the near surface layers, but deeper layers were seen to run undisturbed and approximately horizontal underneath The Wall. The deformation seen is consistent with the gentle folding expected in the case of a fault bend fold associated with the thrust fault theory of formation. The final line was selected so as to provide insights into the geological settings that lay beneath The Wall. Located to the northeast of The Wall, and laying at a lower elevation, this area should correspond to the layering seen underneath. Given the relative short length of these lines, it remains hard to make a definitive statement, but the layers are very roughly horizontal, with deformation seen on scale of a few meters. The layers in this area have an approximate strike of 150 degrees, and a 10 degree dip towards the southwest. These planes correspond to those generated by the layers seen running underneath The Wall some 150 meters away. The observations made during this survey correspond to our theory of formation for The Wall, and fit within the model of a terrain shaped by pro-glacial outwash, which was then overridden by the advancing glacier.

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