GLACIOTECTONIC ORIGIN OF TERRAIN, HITHER HILLS, LONG ISLAND: A PRELIMINARY STUDY

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The primary goal of this project is to develop an accurate understanding of the origin of the terrain in Hither Hills, Long Island and thereby to comprehend better the glaciotectonics of Long Island in general. Aber et al. (1989) state that glaciotectonic deformation produces locally severe disruption of the normal geology and terrain, and therefore it can have an important effect on many human activities. Recognition of glacially thrust terrain on Long Island is especially important for the development of accurate models of ground water flow. For example, thrusting and tilting of a glacial sediment column that includes aquitards (such as clays) could drastically redirect the flow of groundwater. We are now in a preliminary survey stage of a project that is eventually to involve the use of geophysical techniques to elucidate the nature of glaciotectonic structures in the study area. Our main data sources for the initial survey are aerial photographs of the region (Figure 1), USGS topographic mapping (Figure 2), and published well data (Prince, 1986) from a variety of boreholes in the area.

Because they were formed so recently, structural features in glaciotectonic areas typically correspond closely to topography. Therefore, we believe that an understanding of the geometries of the ridges in Hither Hills, Long Island will provide some indication of the structural features that are present there. The study region is located on the south fork of Long Island, and covers an area of approximately 5 km by 2 km. The hills are generally slightly arcuate in shape and display very continuous geometries within smaller areas or 'patches' of the study region. The overall geometries of the entire study region tend to exhibit a somewhat less consistent trend than that which is observed in the smaller areas. Our early results indicate the following geometries: Hills (folds) display a typical wavelength of 100 m. Ridges are discernible along length scales ranging from 450 m to 1400 m along axis with bearings between 035° and 095°. The study area is divided into separated regions or domains ranging in size from 0.17 sq. km to 1.9 sq. km, within which the hills are quite similar. Within any one of these domains, bearings are consistent within 10°, the amplitudes of the hills are consistent within about 15%, and the wavelengths of hills are consistent within about 20%.

Our preliminary conclusion is that the highly organized hill terrain of Hither Hills is the result of glacial push tectonics. Each hill probably represents an anticline that is cored by a thrust fault or shear zone that acts as a forward verging ramp along which shear is transferred upward from a local zone of detachment. This idea is supported by the fact that fold axes trending roughly normal to the local direction of glacial advance, with amplitudes up to several tens of meters, have been reported in this and other areas of eastern Long Island. The detachment may be localized in a weak or overpressured sedimentary layer. However, substantiating this will require further investigation using more involved geophysical methods. If the detachment is controlled by the lithology, then we predict that the nature and depth of the detachment layer should be the primary control on the size and spacing

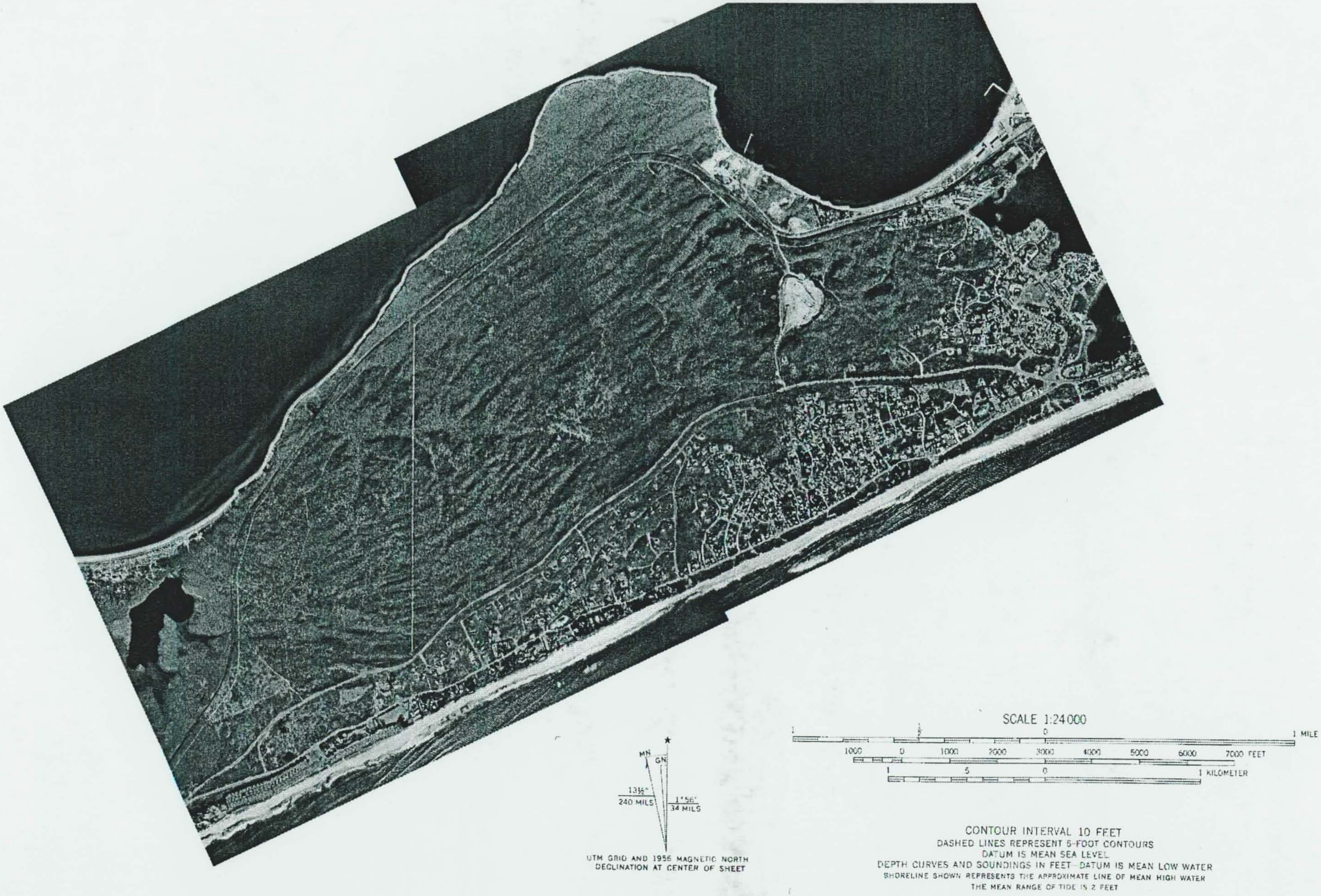

Figure 1. Aerial photograph of the Hither Hills region on the south fork of Long Island. Note that the hills are trending in an overall northeast direction which is relatively consistent throughout the region.

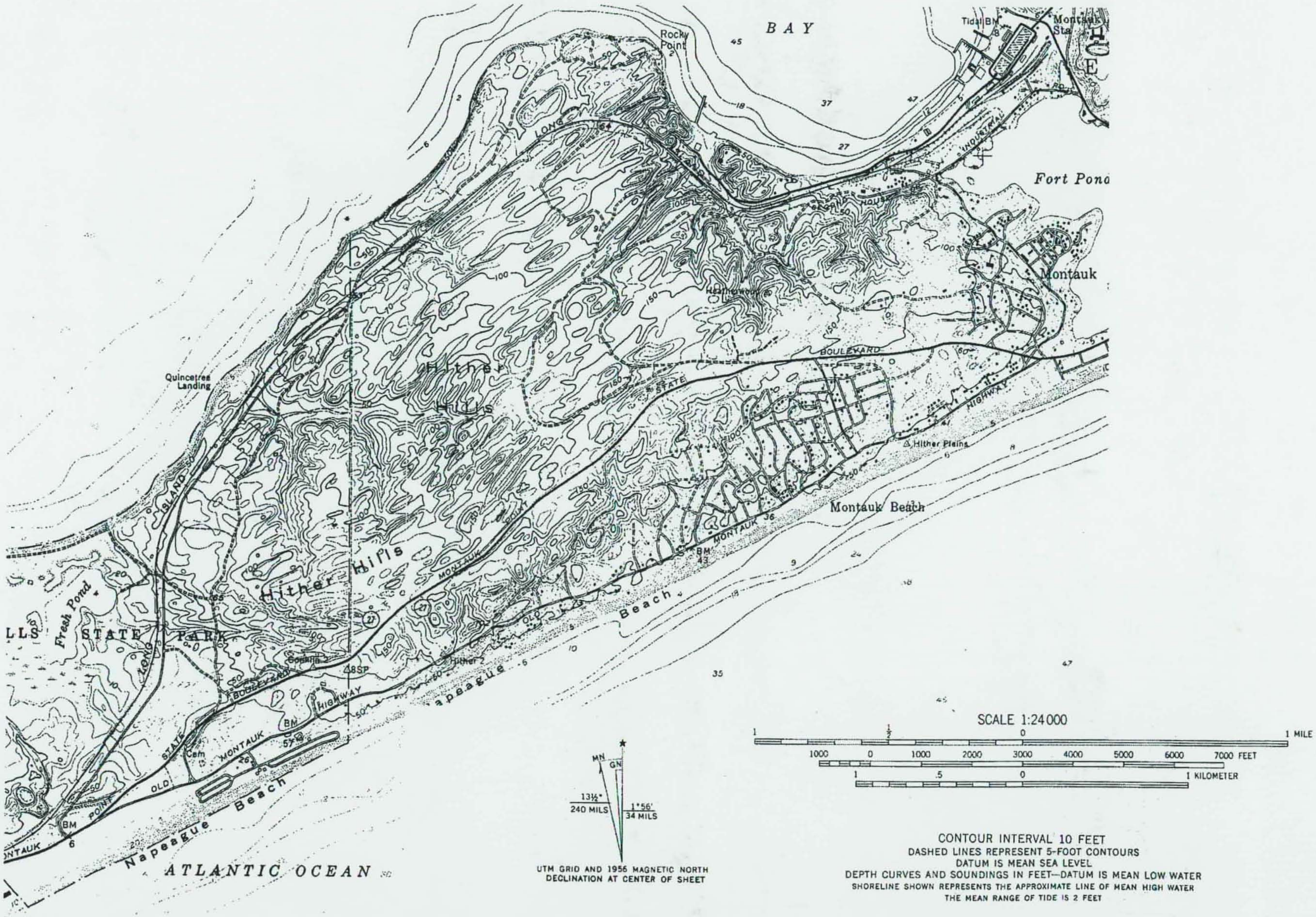

Figure 2. USGS topographic map of the study region, Hither Hills, Long Island. Note that the amplitude of the hills ranges from about 70 feet (~20 m) to about 190 feet (~60 m). This range of amplitude suggests that the detachment is probably located above the level of the water table (Prince, 1986) and is certainly located well above the fresh water/salt water interface (Prince, 1986). This will prevent problems that might occur in the collection of electromagnetic data which is dependent upon the conductivity of the medium.

of the hills. However, it is also possible that the layer of detachment was simply the base of what at the time was the relatively strong permafrost layer. In that case, the mean annual temperature at the time of thrusting would be the primary control on anticline hill geometry. The hill geometries and morphologies fit the definition of a small composite-ridge system, a glaciotectonic landform described by Aber et al. (1989), with hill heights of 20 - <100 m, areas of 1 - >100 sq. km, and a subparallel ridge and valley system arcuate in plan. Also, Aber et al. (1989) indicate that islands, such as that of Long Island upon which Hither Hills resides, are a typical topographic setting for composite-ridge systems. One possible reason for this is the subaerial exposure of sediments due to the low stand of sealevel in such settings. This provides the sedimentary material that is to be incorporated into such glaciotectonic hills. We believe that the hill terrain in the Hither Hills region of Long Island is very likely such a small composite-ridge system.

Aber, J. S., D. G. Croot, and M. M. Fenton, *Glaciotectonic Landforms and Structures*, 201 pp., Kluwer Academic Publishers, Netherlands, 1989.

Prince, K. R., *Ground-Water Assessment of the Montauk Area, Long Island, New York: U.S. Geological Survey, Water-Resources Investigations Report 85-4013*, 103 pp., United States Geological Survey, New York, 1986.