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Glacial lake deltas in New England record continuous, not delayed, postglacial rebound

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ABSTRACT

Deltas formed in Lake Hitchcock, a glacial lake that developed in the Connecticut River Valley, New England, between ~18.3 and 12.5 ka. The heights of topset/foreset contacts of these deltas presently increase northward, linearly, at rate of ~0.9 m/km. Others have interpreted this as indicating that isostatic rebound did not begin until after the lake drained, several kiloyears after glacial retreat began. However, (non-elastic) adjustment of Earth's lithosphere to changing loads is known to occur on time scales of years. Late-glacial shoreline features elsewhere in New England also increase in elevation with distance from the LGM margin at ~0.9 m/km, suggesting that this is a result of fundamental properties of the crust and mantle, and independent of the history of glacier retreat. On the basis of a numerical model of flexure of the lithosphere beneath a circular load, we suggest that deflection of the lithosphere is remarkably linear in a zone 50–200 km wide between the retreating ice margin and a forebulge, and that initial rebound of this zone is spatially quite uniform for some kiloyears before differential rebound starts. Thus, lake shorelines, formed over a period of some centuries during deglaciation would, today, rise linearly northward.

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Introduction

Koteff and Larsen (1989) suggested that postglacial isostatic rebound in central and western New England did not begin until several thousand years after the Laurentide Ice Sheet began to retreat from its last glacial maxiumum (LGM) position at the Ronkonkoma Moraine on Long Island, about 23,000 yr ago. Their argument is based on measurements of the elevations of topset/foreset contacts of 60 deltas built into Lake Hitchcock, a glacial lake that occupied the Connecticut River Valley in New England (Fig. 1). Although these deltas formed over a period of several millennia during deglaciation, their elevations rise remarkably linearly with distance from the LGM ice margin (Fig. 2).

The earliest segment of Lake Hitchcock formed as a result of a dam of glacial drift blocking the valley at Rocky Hill, Connecticut, ~50 km from the present coast (Flint, 1933). As the ice margin retreated from this drift dam, a spillway developed at New Britain, Connecticut, ~7 km west of Rocky Hill. The oldest recorded varve in the lake is from its southern end, just north of the Rocky Hill dam (AM 2868; Antevs, 1928), and dates to 17.9 ka (Ridge et al., 2012). It must have been deposited shortly after the development of the drift dam and the New Britain spillway. As the ice retreated, the lake expanded northward. The northern part of it persisted until at least 12.5 ka (Ridge et al., 2012).

The spillway floor is now ~25 m above sea level. When it formed, however, the crust was depressed, global sea level was >100 m lower, and the spillway was much closer to sea level (Stone et al., 2015).

Of the 60 deltas surveyed by Koteff and Larsen (1989), 23 were believed to have been active ice-contact deltas formed at the ice margin while the lake was stabilized at the level of the New Britain spillway. The most northerly of these 23 is in northern New Hampshire. Five additional deltas were believed to have been formed by meteoric water after the ice retreated from their locations. Along a profile normal to the ice sheet margin, bearing 341°, the elevations of surfaces which Koteff and Larsen identified as contacts between topset and foreset beds in these 28 "highstand" deltas rise 0.86 m/km (Fig. 2a). Of the remaining 32 deltas, field relations and topset/foreset contact elevations suggest that many were formed in a later, lower lake, and topset/foreset contacts could not be found on others.

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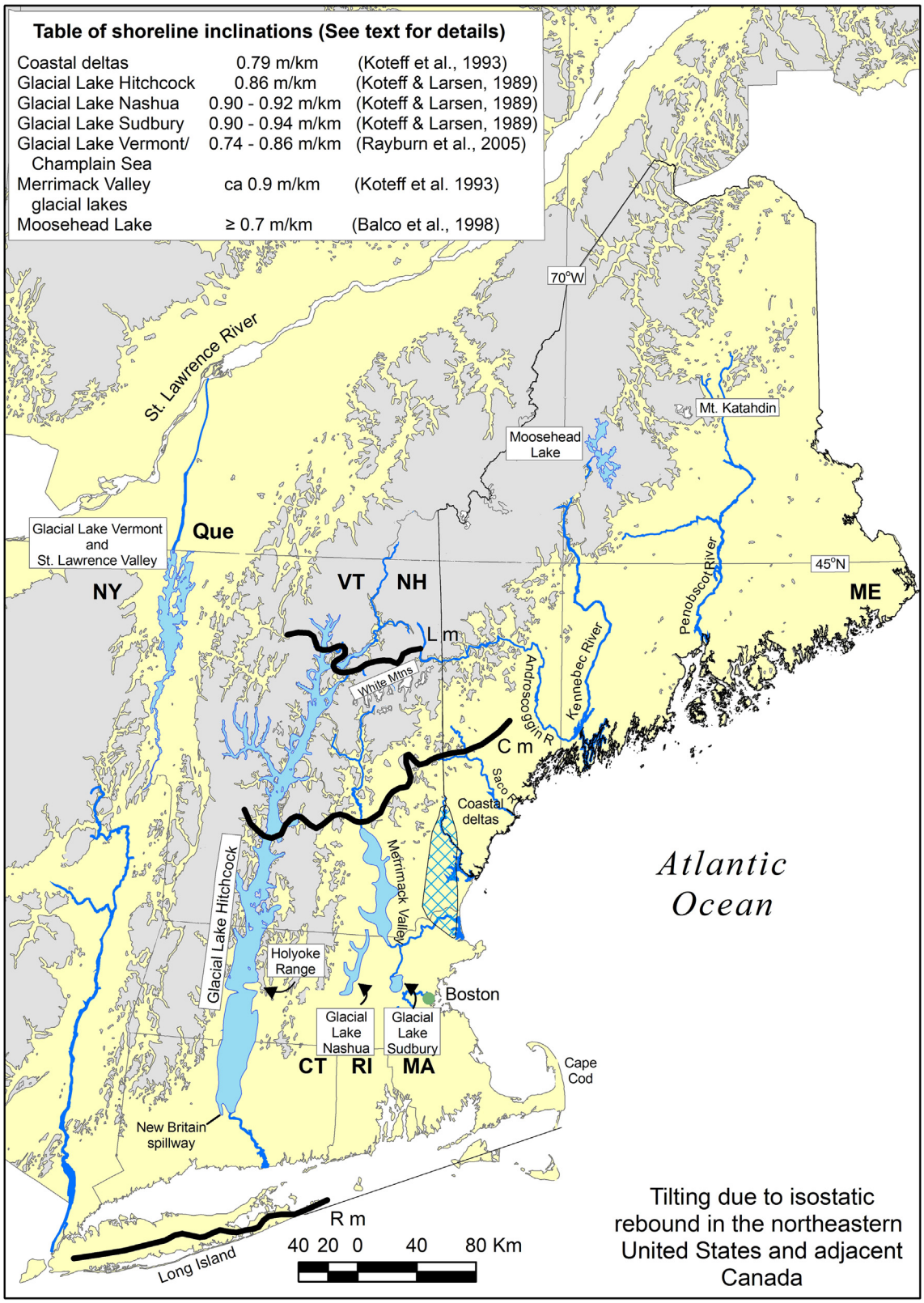

Figure 1. Map of New England and parts of adjacent New York and Quebec showing locations of sites where tilt due to postglacial rebound has been determined. Light gray areas are above ~300 m and white areas are above ~900 m. Inclinations in Table for Coastal and Lake Hitchcock deltas are those calculated herein (Fig. 2). Heavy black lines are moraines. Lm, Cm, Rm = Littleton, North Charlestown, and Ronkonkoma moraines.

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