A Cartographic Ode to Chapman: A Revised Regional Depiction of Postglacial Landscape Evolution in the Champlain Valley

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BACKGROUND

In the years following Donald Chapman's seminal 1937 publication on the postglacial history of the Champlain Valley, numerous authors have developed improved age constraints and described new techniques for estimating the spatial extent of Glacial Lake Vermont and the Champlain Sea. However Chapman's maps still represent the most comprehensive and regional depiction of postglacial lake levels throughout the Champlain Valley. Existing maps lack the necessary detail to provide useful constraints on the relationship between postglacial landscape evolution and modern land use activities in the Champlain Valley.

Inspired by work depicting the extent of Pleistocene lakes in the Western Great Basin, we offer a post-Chapman cartographic synthesis of ~100 years of research within the Champlain Valley. We include reconstructions of glacial ice margins constrained by surficial landforms, locations of lacustrine and deltaic sediments, wave-cut terraces, and lidar-derived shorelines. Our compilation suggest further refinement is needed within smaller arms of each lake level depicted extending into modern stream valleys and tributaries that now drain into Lake Champlain. A combination of shoreline features identified by earlier workers, new lidar products and up-valley interpolation of fluvial-deltaic sandplains may provide further constraints on reconstructing paleo-shorelines.

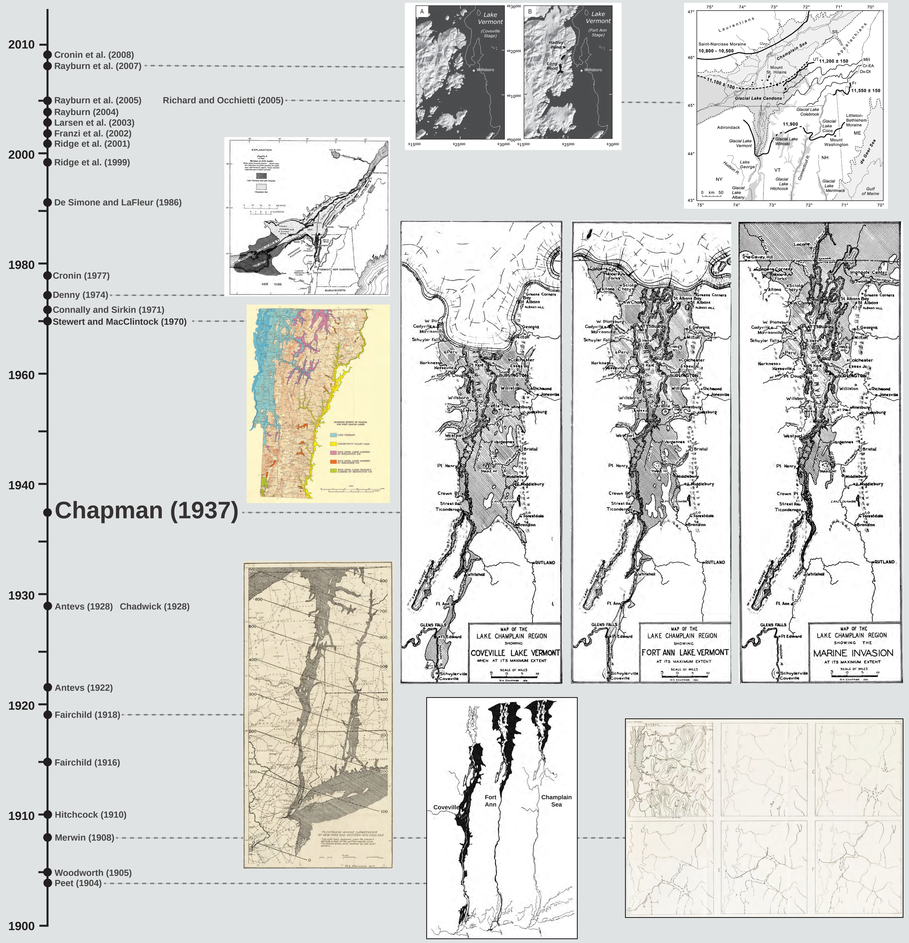
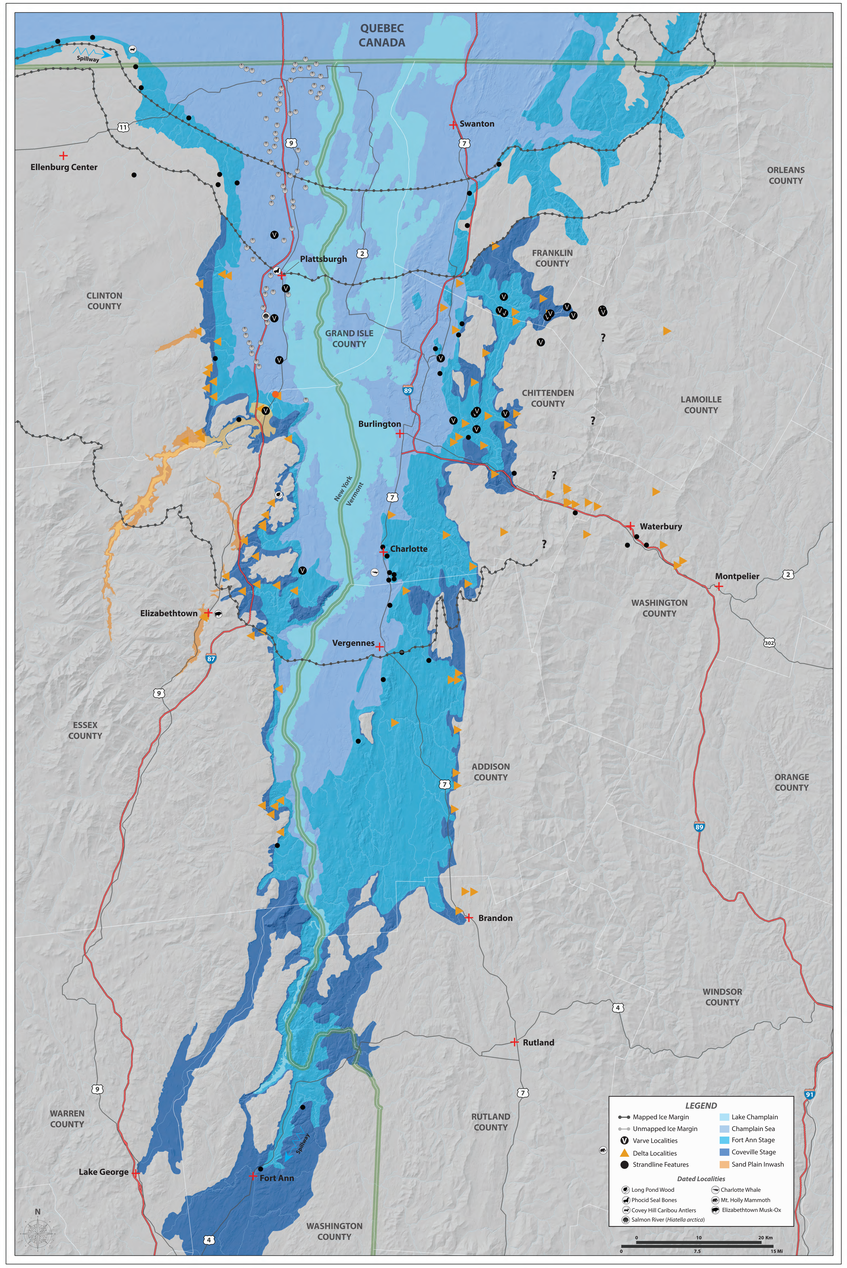


Figure 1: Timeline of cartographic representations of Lake Vermont and Champlain Sea, including maps from Chapman's seminal 1937 publication "Late-glacial and postglacial history of the Champlain Valley."



METHODOLOGY

This map integrates information from a variety of primary and secondary data sources related to the postglacial landscape of the Champlain Valley with specific emphasis on the spatial extent of Lake Vermont and the Champlain Sea. These data include:

1. **Strandline features** constraining the extent of lake margins extracted from existing historical literature, surficial mapping efforts, and interpretation of recent LIDAR products (Kemp and Alling, 1925; Chapman, 1937; Connally, 1970; Prest, 1970; Denny, 1972; Wagner, 1972; Larsen, 1987; Diemer, 1988; Franzi et al. 2002; Larsen et al. 2003; Donahue et al. 2004; Rayburn, 2004; De Simone, 2006; Franzi et al. 2007; Lomonaco, 2007; Wright, 2011; Springston et al. 2015 and Wright et al. 2015).
2. The spatial extent of the **Coveville** and **Fort Ann Stages** of **Lake Vermont** and the extent of the later **Champlain Sea** were reconstructed using these strandline features to interpolate a trend surface covering the entire region of interest. These surfaces were then subtracted from a 10-meter DEM representing modern topography and the difference between the two were clipped to glacial margins. The resulting layer represents the inferred extent of each former lake level and follows a similar approach as Leverington et al. (2002), Baedke et al. (2004), Clark et al. (2008) and Brecken ridge (2013).
3. **Varve** sampling sites and **marine fossil** localities were obtained from Antevs, 1928; Rayburn et al. 2011; and Denny (1967, 1970).
4. Relevant **radiocarbon** dates and **Pleistocene** fauna sites were obtained from Boulanger and Lyman, 2007; Franzi et al. 2007; Rayburn et al. 2011; Ferenac et al. 2014; and Franzi et al. 2015.
5. **Glacial ice margins** were reconstructed based on surficial mapping and interpretation of aerial photography and LIDAR derivatives using Denny, 1974; Franzi, 1992; and Kranitz et al. 2014.
6. The extent of inferred **sandplain inwash** was reconstructed by Kranitz et al. (2014) using a trend surface - corrected

FUTURE WORK

Although Chapman's work was incredibly detailed and accurate (even compared to modern mapping techniques), there remains a lot of work left in producing an accurate representation of the spatial extent of glacial and post-glacial lakes in the Champlain Valley. This synthesis highlights the need to: (1) improve our understanding of glacial margins extending across Vermont, (2) further refine the extent of each lake level within adjacent valleys to account for post-glacial fluvial down-cutting, (3) produce equivalent sand plain in-wash estimates along lake margins within Vermont, (4) develop an equivalent database for marine fossils within Vermont, (5) further discriminate between deltas associated with specific lake levels, and (6) continue to add strandline features to the existing database as new lidar products become available in both New York and Vermont.

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