DEGLACIATION AND LANDSCAPE EVOLUTION OF THE HALLOWELL REGION

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1. Height of Wisconsinan Glaciation approximately 28,000 yrs BP. Ice between 1 and 2 miles thick over Hallowell area. Leading edge of the Laurentian Ice Sheet is at the continental shelf at the mouth of the Gulf of Maine.

2. Deglaciation to present coastline approximately 14,000 yrs BP. Accompanied by marine submergence as great volumes of water added to ocean from melting ice sheets and regional crust is depressed by weight of glacier.

3. Glacier front retreats further to the Hallowell area. About 13,500 to 13,200 yrs BP. Glacier face retreating at a rate of about 0.1 to 0.05 miles per year, but most likely re-advanced seasonally.

4. Stages of Ice Sheet Disintegration: Ice sheet (front of which is submerged but floating) separates along the bedrock high which defined the western edge of the ancestral Kennebec River valley (Winthrop Hill) and main ice sheet retreats westerly. Ice lobe remains in the valley between bedrock highs (defined structurally by folded Waterville Formation rocks interlayered with small injections of Hallowell Granite).

5. Ice-filled valley is dominated by a large esker (sub-ice channel partially filled with sand and gravel deposits). Axis of the esker runs north-south alternately on the west and east side of the present Kennebec River channel (Hallowell cemetary – Chelsea Butternut Park (Hallowell Water District aquifer) – Loudon Hill (Williams sand pit).

   Ice lobe dimensions at beginning of disintegration most likely >400 feet thick by 1 mile wide and fills the ancestral Kennebec River channel. Bottom of ice lobe approximately 80 feet below the present river channel bottom. Axis of esker follows ancestral river channel location which is defined and confined by bedrock at depth.

   Ice melts along east and west margins of the lobe first along a calving front where ice slices fall into the shallow ocean filling the ancestral river valley as the ice lobe retreats south to north. Fine-grained glacio-marine deposits rapidly fill these marginal areas while esker deposits begin to accumulate vertically, still confined to a sub-ice channel (as base level (sea level) rises progressively from the south and through the area, accumulating esker channel sediments force ice channel waters to erode into the ice ceiling of the glacier. Ice front retreats past Augusta and Kennebec River valley becomes a fjord. Fine-grained glacio-marine deposits continue to fill the bottom and sides of the fjord. (circa 13,000 BP).

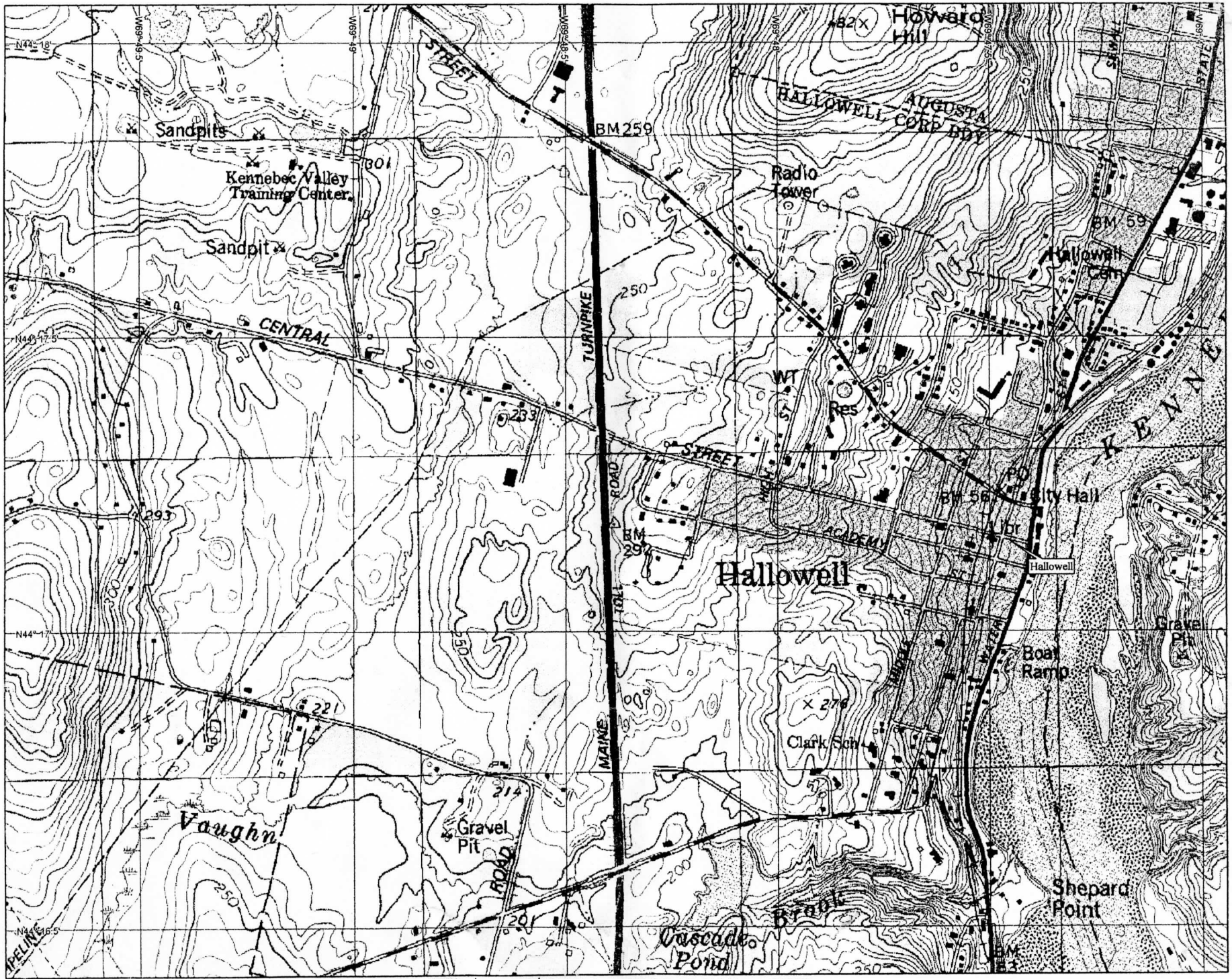
   Sea level drops at a rate of about 10 feet per year. Kennebec River begins to down cut into valley-fill glacio-marine deposits (circa 11,500 BP).

6. Ice sheet west of Winthrop Hill ridge and disintegrating at rate of about 500 to 600 feet per year. Ice face orientation now controlled by underlying bedrock-structure. Glacier

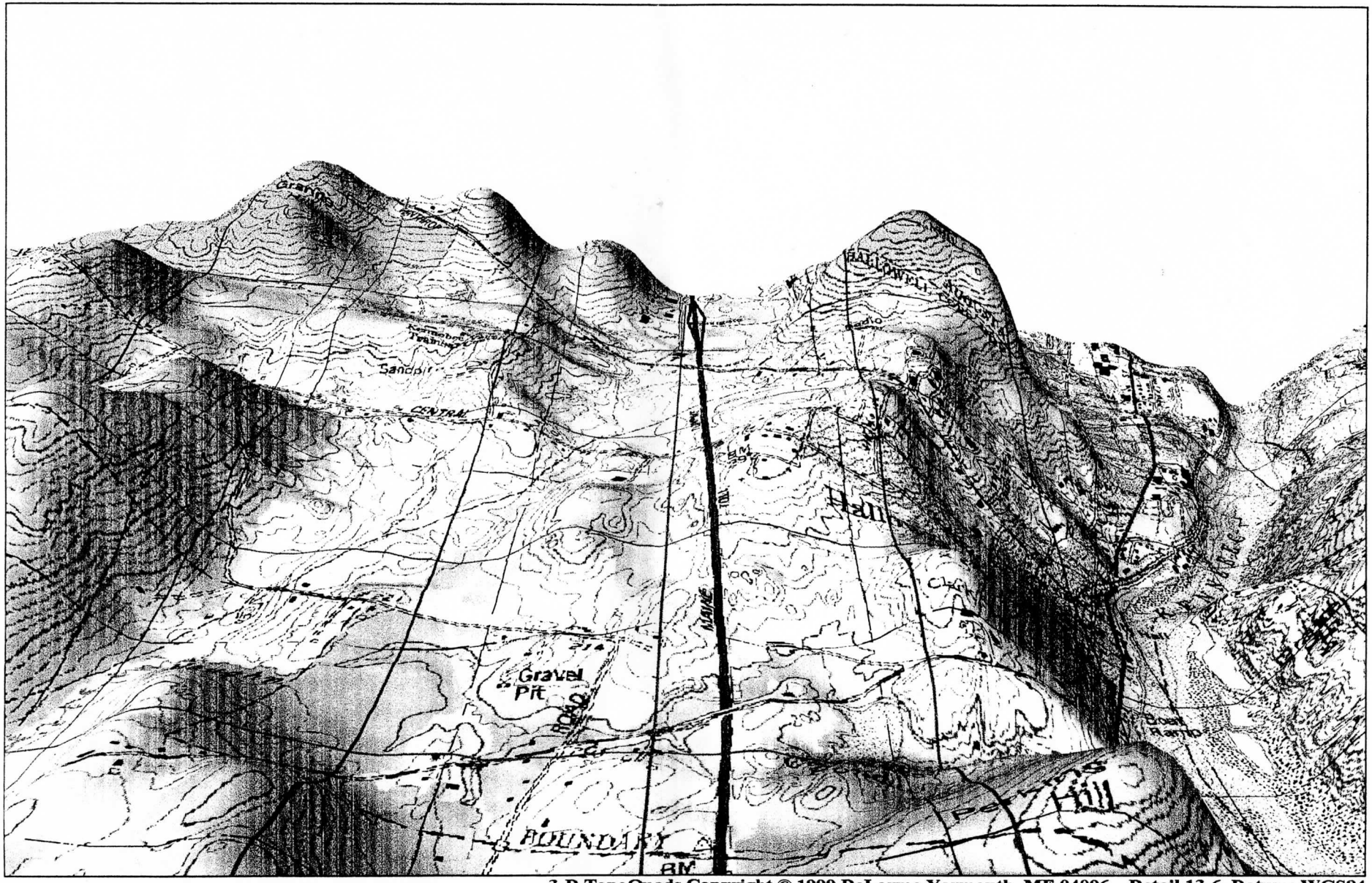
front is aligned north-south. Front of glacier is submerged and floating. Ice front advances seasonally and deposits an end moraine and 3 DeGeer moraines between Granite Hill ridge and Winthrop Hill ridge.

Area between ridges now a semi-restricted circulation estuarine lagoon with an outlet below Cascade Pond and shallow lagoons to the north and south. Ice sheet grounded on Granite Hill ridge. Very little glacio-marine sediments infilling lagoon. Finally, ice sheet front recedes past Granite Hill. Sea level now at 338 feet (circa 13,000 BP). Rapid formation of Gilbert-type sand delta just south of Granite Hill.

Ice front and sea level withdraw simultaneously from Hallowell. Lagoon becomes isolated from coastal waters to the south (Farmingdale) circa 12,800 BP and north Augusta in just a few more years. Only communication with receding ocean now is through inlet below Cascade Pond (not in existence). Sea level finally drops below this point around 12,600 BP and the backlands of Hallowell become a terrestrial upland subject to sub-aerial weathering processes. Vaughn Brook begins to down-cut into the glacio-marine deposits infilling the Kennebec River valley and continues to down-cut until the ocean completely withdraws from Hallowell (circa 11,500 BP) and the underlying bedrock is exposed.



 650 ft Scale: 1 : 16,000 Detail: 13-6 Datum: WGS84



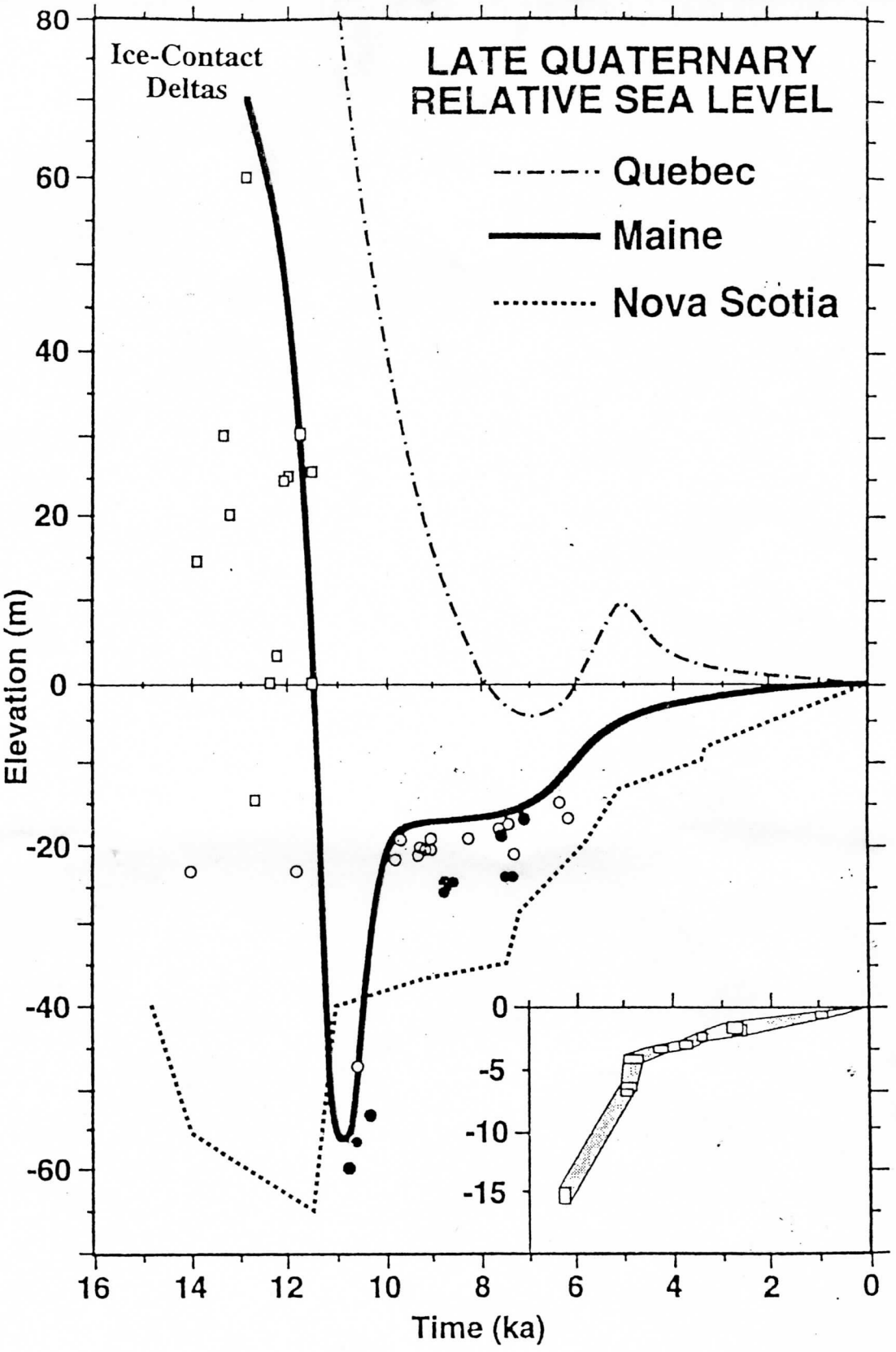
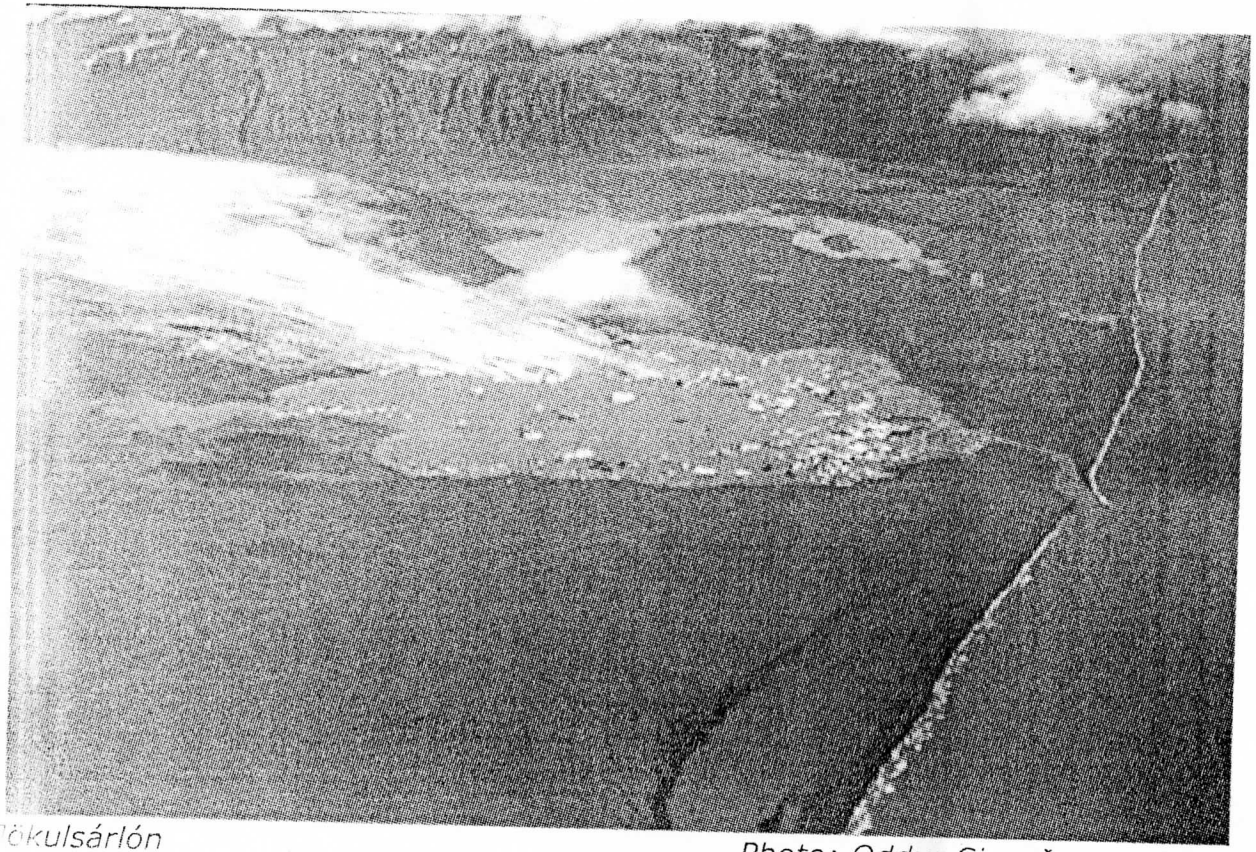


Figure 3. Late Quaternary relative sea-level curve for coastal Maine, modified from Kelley et al. (1992) (open circles), with new offshore dates (solid circles). Inset depicts salt-marsh data after 7 ka within envelope enclosing error boxes (vertical exaggeration is 1.5× relative to complete curve). Published dates (squares; Belknap et al., 1987; Anderson et al., 1990) determine regressive side of curve. Quebec (Dionne, 1988) and Nova Scotia (Stea et al., 1994) are shown for comparison.



Jökulsárlón

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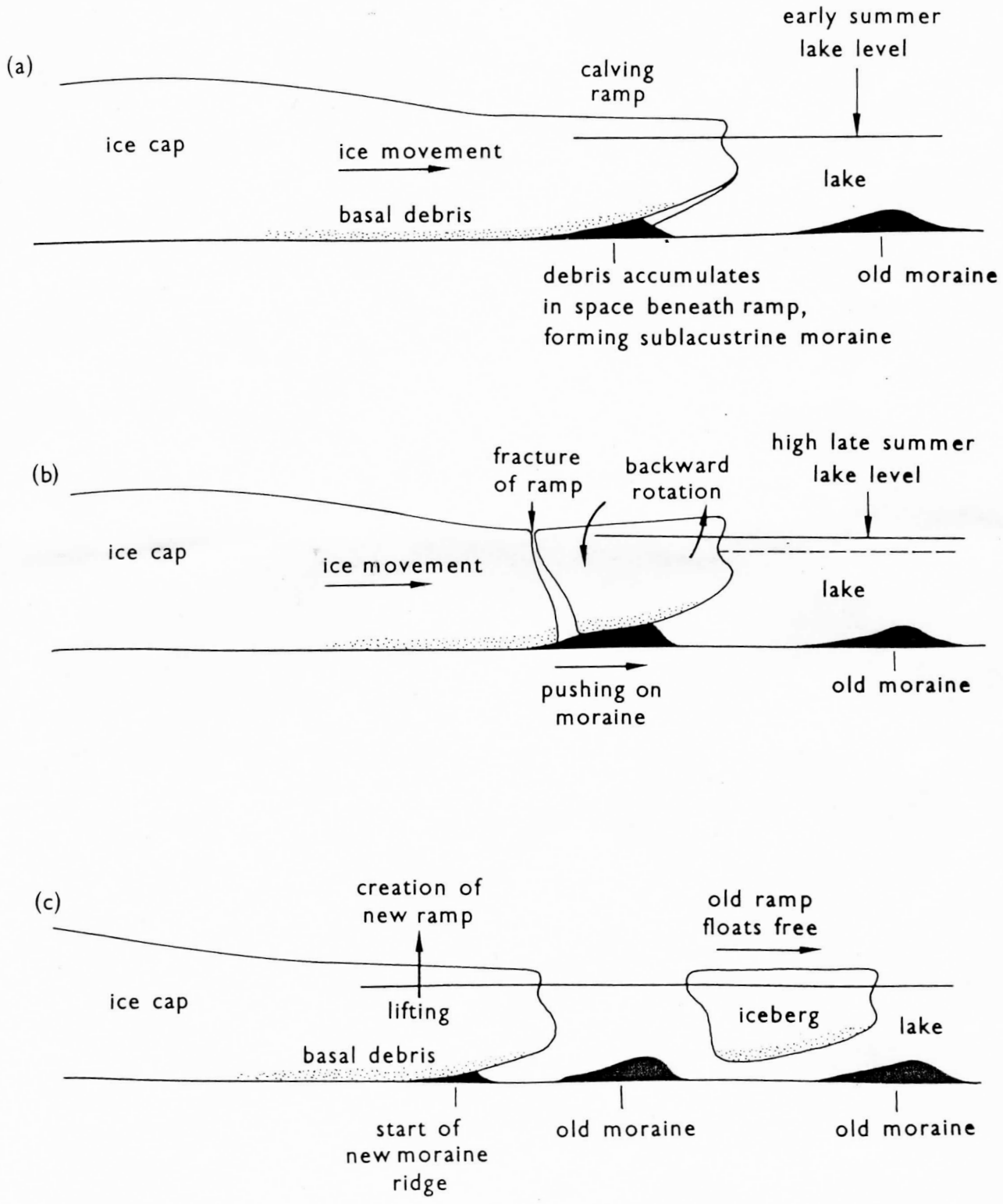
(a)
early summer
lake level
calving
ramp
ice cap
ice movement
lake
basal debris
debris accumulates
in space beneath ramp,
forming sublacustrine moraine
old moraine
(b)
fracture
of ramp
backward
rotation
high late summer
lake level
ice cap
ice movement
lake
pushing on
moraine
old moraine
(c)
creation of
new ramp
old ramp
floats free
ice cap
lifting
iceberg
lake
basal debris
start of
new moraine
ridge
old moraine
old moraine