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Oscillations of levels and cool phases of the Laurentian Great Lakes caused by inflows from glacial Lakes Agassiz and Barlow-Ojibway†*

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Abstract

Two distinct episodes of increased water flux imposed on the Great Lakes system by discharge from upstream proglacial lakes during the period from about 11.5 to 8 ka resulted in expanded outflows, raised lake levels and associated climate changes. The interpretation of these major hydrological and climatic effects, previously unrecognized, is mainly based on the evidence of former shorelines, radiocarbon-dated shallow-water sediment sequences, paleohydraulic estimates of discharge, and pollen diagrams of vegetation change within the basins of the present Lakes Superior, Michigan, Huron, Erie and Nipissing. The concept of inflow from glacial Lake Agassiz adjacent to the retreating Laurentide Ice Sheet about 11–10 and 9.5–8.5 ka is generally supported, with inflow possibly augmented during the second period by backflooding of discharge from glacial Lake Barlow-Ojibway.

Although greater dating control is needed, six distinct phases can be recognized which characterize the hydrological history of the Upper Great Lakes from about 12 to 5 ka; 1) an early ice-dammed Kirkfield phase until 11.0 ka which drained directly to Ontario basin; 2) an ice-dammed Main Algonquin phase (11.0–10.5 ka) of relatively colder surface temperature with an associated climate reversal caused by greater water flux from glacial Lake Agassiz; 3) a short Post Algonquin phase (about 10.5–10.1 ka) encompassing ice retreat and drawdown of Lake Algonquin; 4) an Ottawa-Marquette low phase (about 10.1-9.6 ka) characterized by drainage via the then isostatically depressed Mattawa-Ottawa Valley and by reduction in Agassiz inflow by the Marquette glacial advance in Superior basin; 5) a Mattawa phase of high and variable levels (about 9.6–8.3 ka) which induced a second climatic cooling in the Upper Great Lakes area. Lakes of the Mattawa phase were supported by large inflows from both Lakes Agassiz and Barlow-Ojibway and were controlled by hydraulic resistance at a common outlet – the Rankin Constriction in Ottawa Valley – with an estimated base-flow discharge in the order of 200 000 m^3s^{-1}. 6) Lakes of the Nipissing phase (about 8.3–4.7 ka) existed below the base elevation of the previous Lake Mattawa, were nourished by local precipitation and runoff only, and drained by the classic North Bay outlet to Ottawa Valley.

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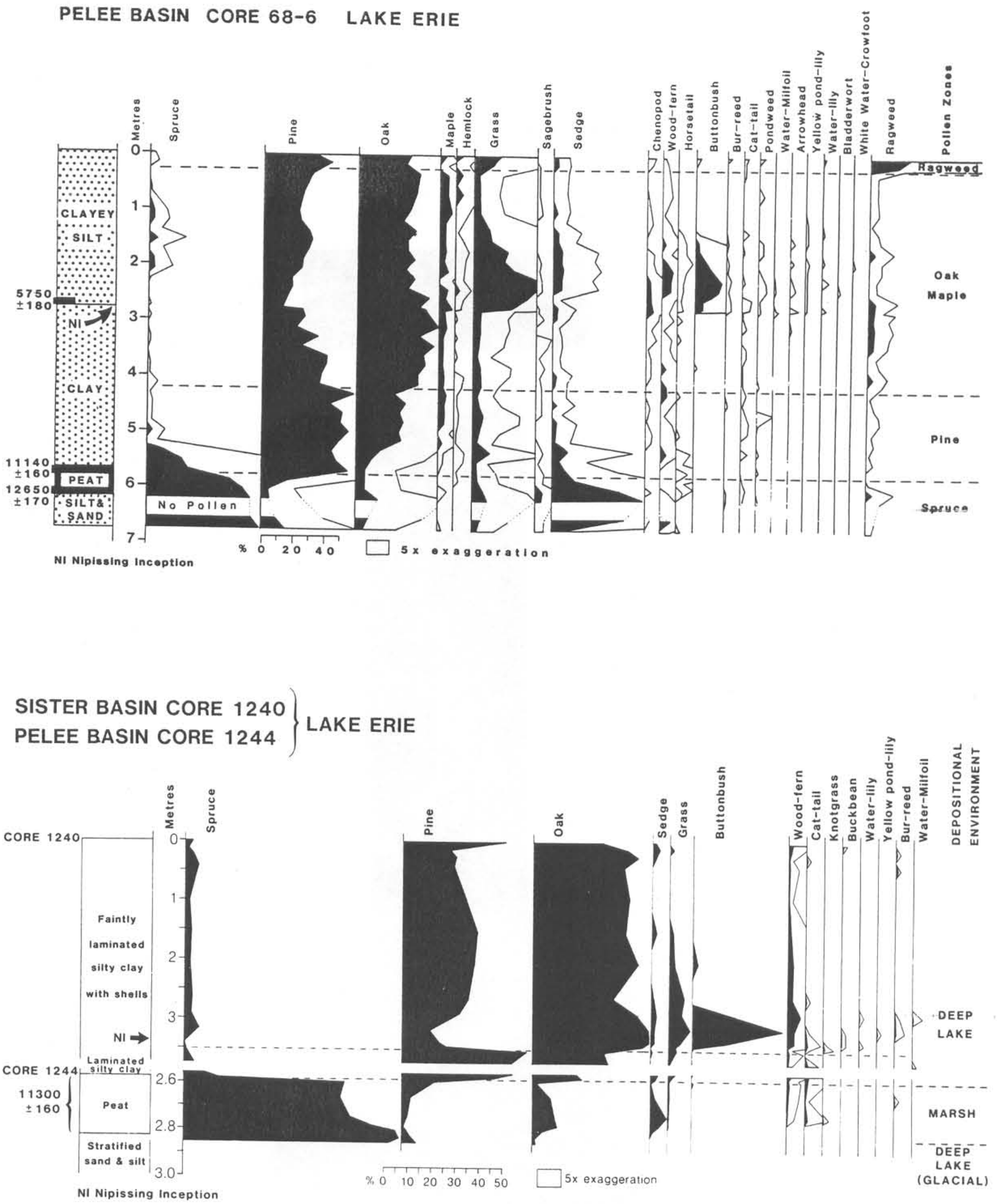

Fig. 3b. Summary lithology and palynological diagrams of piston cores from western Lake Erie showing evidence of marsh (peat) deposition: upper – core 68–6 at site 14 on Fig. 1a (provided courtesy of J. H. McAndrews), and lower – cores 1240 and 1244 located at sites 16 and 15 respectively on Fig. 1a (adapted from Lewis *et al.*, 1966). For peat section, radiocarbon age applies to core 1240 and pollen data to core 1244. In core 1244, the basal part of the peat (plant detritus) dates 12 500 ± 310 and the upper part of the peat dates 11 140 ± 160 (Table 1: 15). In both diagrams, NI refers to the inception of Nipissing phase overflow via Port Huron into Erie basin.