New ~14 000-year ostracod record from Lake Simcoe (Canada) tracks inputs of glacial meltwater, relative temperature changes, and sources of inorganic carbon

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1. When did glacial meltwater flow through the Lake Simcoe Basin?

-Studies of lacustrine sediments deposited near the Pleistocene-Holocene transition (~11 500 cal yr BP) are useful for clarifying the timing and location of meltwater flows from North America towards the North Atlantic Ocean.

-Oxygen-isotope compositions of ostracod valves ($\delta^{18}O_{valve}$) were used to reconstruct the oxygen isotope composition of lake water ($\delta^{18}O_{lake\ water}$) in Lake Simcoe, Canada (Fig. 1).

-Stable carbon-isotope compositions of ostracod valves ($\delta^{13}C_{valve}$) were used to reconstruct the carbon isotope composition of dissolved inorganic carbon ($\delta^{13}C_{DIC}$). Ostracod assemblage data completemented interpretations of these isotope data.

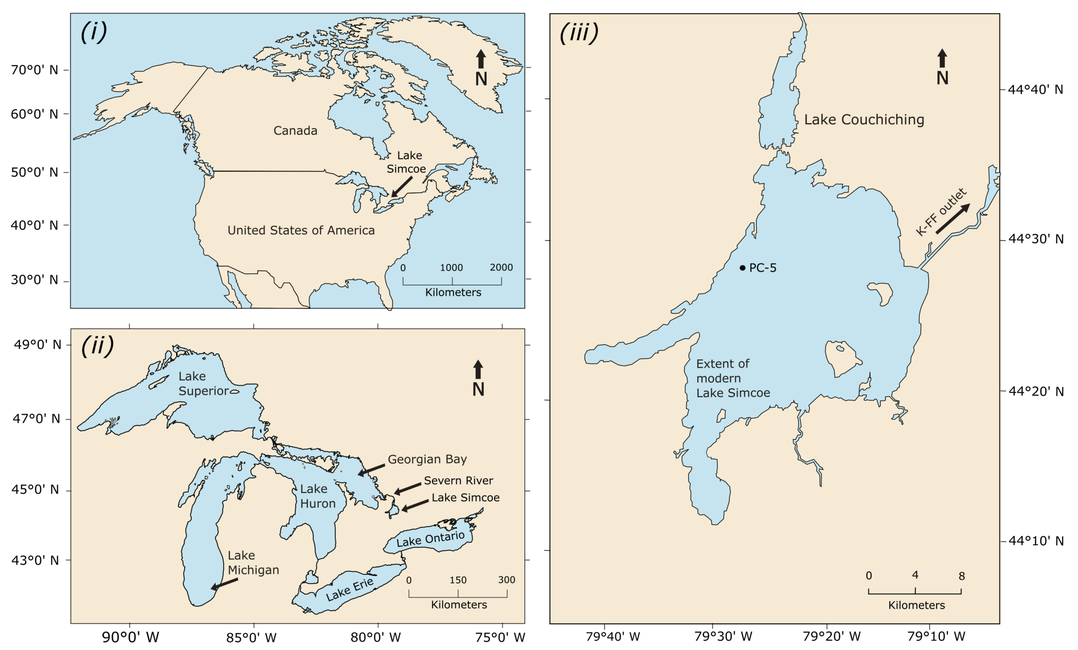

Figure 1. Maps depicting (i) the location of Lake Simcoe within Canada; (ii) the location of Lake Simcoe, and the outflowing Severn River, relative to the Laurentian Great Lakes; and (iii) Lake Couchiching and the Kirkfield-Fenelon Falls (K-FF) outlet relative to Lake Simcoe.

2. Establishing a sediment chronology

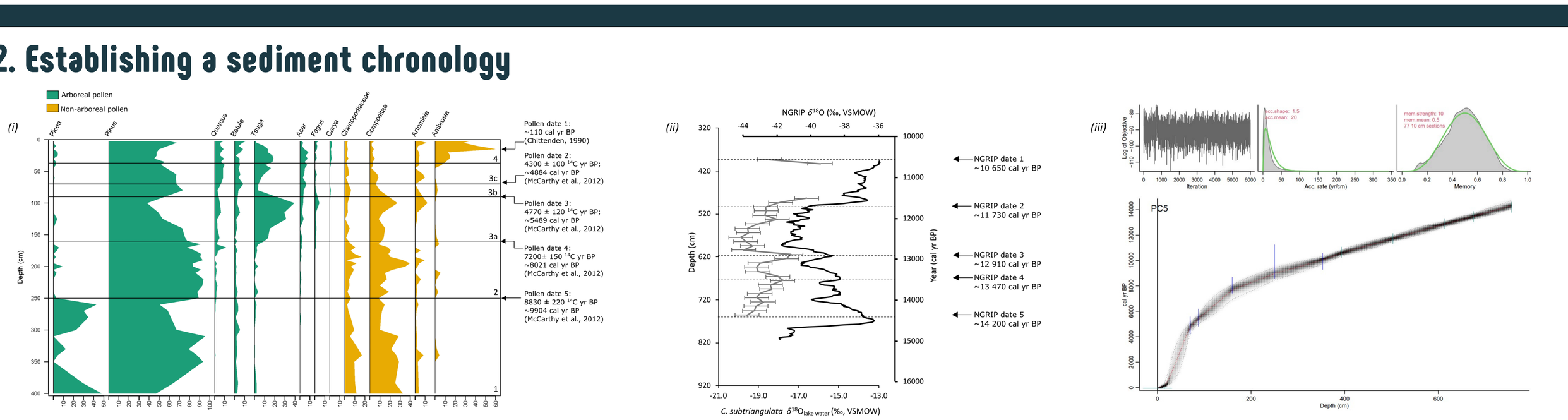

Figure 2. Inputs to the "Bacon" age-depth model (R Core Development Team, Blaauw and Christen, 2011). Panel (i) shows where ages were assigned to pollen horizons in the top-half of PC-5. This plot was made with the R packages "Vegan" and "Rioja" (Oksanen et al., 2022; Juggins et al., 2020). Pollen assemblages were first reported in Volik et al. (2016). Ages of pollen horizons come from dated cores in Chittenden (1990) and McCarthy et al. (2012). Panel (ii) demonstrates how wiggle-matching was used to assign ages to the bottom half of PC-5. The NGCRIP ice core data was provided by Vinther et al. (2006), Anderson et al. (2006) and Svensson et al. (2006). Panel (iii) shows the final Bacon age-depth model, which also includes the date of core collection, and one radiocarbon date (Lab ID: K16933, Sample ID: AA90326).

3. A ~14 000-year reconstruction of environmental change from Lake Simcoe

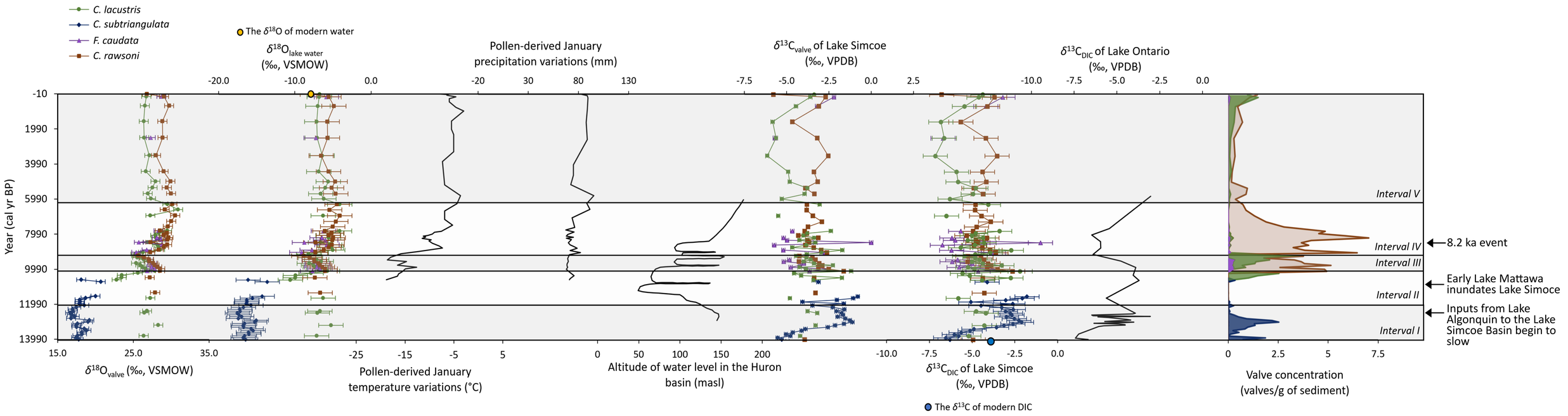

Figure 3. Proxies derived from ostracods in core PC-5 from Lake Simcoe compared with previously published records. January temperature and precipitation reconstructions are derived from pollen assemblages in PC-5 (Volik et al., 2016). The altitude of water level in the Huron Basin was first reported in Lewis et al. (2005, 2012). The $\delta^{13}C_{DIC}$ from Lake Ontario was first reported in Hladyniuk and Longstaffe (2015).

4. Constraining the timing of meltwater pulses through the Lake Simcoe Basin

-Glacial meltwater input to Lake Simcoe began to slow at ~12 050 cal yr BP.
-Early Lake Mattawa may have inundated Lake Simcoe at ~10 600 cal yr BP.
-Lake Simcoe was sensitive to regional climatic events such as the early Holocene warming.
-The carbon isotope systematics of Lake Simcoe were primarily controlled by carbon source.

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