



## Carbon dioxide partial pressure and $\delta^{13}\text{C}$ content of north temperate and boreal lakes at spring ice melt

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**ABSTRACT:** Carbon dioxide ( $\text{CO}_2$ ) accumulates under lake ice in winter and degasses to the atmosphere after ice melt. This large springtime  $\text{CO}_2$  pulse is not typically considered in surface-atmosphere flux estimates, because most field studies have not sampled through ice during late winter. Measured  $\text{CO}_2$  partial pressure ( $p\text{CO}_2$ ) of lake surface water ranged from 8.6 to 4,290 Pa (85-4,230  $\mu\text{atm}$ ) in 234 north temperate and boreal lakes prior to ice melt during 1998 and 1999. Only four lakes had surface  $p\text{CO}_2$  less than or equal to atmospheric  $p\text{CO}_2$ , whereas 75% had  $p\text{CO}_2$  >5 times atmospheric. The  $\delta^{13}\text{C}_{\text{DIC}}$  ( $\text{DIC} = \text{SCO}_2$ ) of 142 of the lakes ranged from  $-26.28\text{‰}$  to  $+0.95\text{‰}$ . Lakes with the greatest  $p\text{CO}_2$  also had the lightest  $\delta^{13}\text{C}_{\text{DIC}}$ , which indicates respiration as their primary  $\text{CO}_2$  source. Finnish lakes that received large amounts of dissolved organic carbon from surrounding peatlands had the greatest  $p\text{CO}_2$ . Lakes set in noncarbonate till and bedrock in Minnesota and Wisconsin had the smallest  $p\text{CO}_2$  and the heaviest  $\delta^{13}\text{C}_{\text{DIC}}$ , which indicates atmospheric and/or mineral sources of C for those lakes. Potential emissions for the period after ice melt were  $2.36 \pm 1.44 \text{ mol CO}_2 \text{ m}^{-2}$  for lakes with average  $p\text{CO}_2$  values and were as large as  $13.7 \pm 8.4 \text{ mol CO}_2 \text{ m}^{-2}$  for lakes with high  $p\text{CO}_2$  values.

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