



Respiration of allochthonous organic carbon in unproductive forest lakes determined by the Keeling plot method

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ABSTRACT: We carried out short-term (2 d) experiments in nine unproductive lakes in northern Sweden in order to investigate organic carbon sources supporting lake water respiration. Surface water was incubated in gas-tight bottles in the dark, and the concentration and isotopic composition ($\delta^{13}\text{C}$) of dissolved inorganic carbon (DIC) were measured at the start and end of the incubations. Keeling plot analyses revealed that the $\delta^{13}\text{C}$ of the respired carbon was between -28.4‰ and -30.6‰ in the lakes and that the respired carbon was mainly of allochthonous organic carbon (AlloOC) origin. The respiration of AlloOC corresponded well with metabolic imbalances indicated by negative net ecosystem production (NEP) values in the lake waters. Keeling plot analysis of DIC accumulating in the hypolimnion of two lakes during summer stratification showed $\delta^{13}\text{C}$ values of around -26.6‰ for excess DIC, implying that the accumulation of DIC was mainly derived from respiration of AlloOC. Our data provide direct evidence that net heterotrophy of these lakes is caused by input and respiration of AlloOC. We conclude that the Keeling plot method is a powerful technique that enables characterization and quantification of the organic carbon sources contributing to respiration in aquatic systems.

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