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A landscape perspective of lake carbon burial in northern regions

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Carbon burial in lakes reflects both internal lake processes and the sedimentation of materials derived from the watershed. In highly populated regions, contemporary organic carbon (OC) burial has been linked to human impacts, notably urbanization and agricultural development in the watershed, and lake eutrophication. In the vast, less populated boreal and subarctic regions, however, which are dominated by oligo- mesotrophic lakes, the delivery of terrestrial organic matter is the primary pathway fueling lake sediment OC stocks. Not surprisingly, OC burial in these regions is linked to watershed characteristics, notably topography, hydrology and soil type, all related to the movement of OC within the landscape. OC burial in many lakes is therefore directly linked to terrestrial lateral export of organic matter, and thus an integral component of the watershed net C accumulation, yet is seldom accounted for in terrestrial biogeochemical models and budgets. In addition, there is evidence that OC burial in lakes is consistently increasing across the Northern hemisphere, so the importance of this landscape atmospheric C sink is expanding relative to other components of the watershed C balance. Inorganic C (IC) burial, on the other hand, is linked to the precipitation of carbonates that mostly originate from chemical weathering within the watershed. The latter process, which is strongly linked to regional geology, removes atmospheric and soil-derived respiratory CO_2, yet the ensuing calcite precipitation within lakes returns part of this CO_2 back to the water column, therefore influencing the lake C balance with the atmosphere. IC burial is strongly linked to regional geology, but there is evidence that human impacts through agriculture, increased erosion and eutrophication all tend to enhance IC burial in lakes. OC and IC burial therefore have fundamentally different impacts on the net C balance of lakes, yet both represent an extension of watershed processes that must be considered in regional C budgets, particularly in water-rich landscapes such as the boreal biome.