THE CONTROL OF HYDROLOGICAL INORGANIC CARBON INPUT ON PALEO-CO_2 RELEASE FROM GLACIAL LAKES

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The climate-carbon feedbacks in lake systems generally links the paleo-atmospheric CO_2 variations with biogenic (organic carbon oxidation) and geogenic (chemical weathering) sources of carbon. However, the relative contributions of biogenic and geogenic processes in Himalayan glacial lakes and its feedback to paleo-atmospheric CO_2 variations is poorly constrained. Here, we studied the carbon isotope compositions of carbonates ($\delta^{13}C_{carb}$, $\delta^{18}O$) and organic matters ($\delta^{13}C_{org}$), total organic carbon (TOC), and elemental compositions of sediments preserved in an exposed stratigraphy of Chorabari peri-glacial lake (lat: $30^0$44'51" N; long: $79^0$03'40"; 3960 m a.m.s.l) in the central Himalaya, India. The depositional age of the studied sequence was about 2 ka. We observed a sudden depletion in $\delta^{13}C_{carb}$ values between ~1.8-1.7 ka that continued till ~0.7 ka, followed by a gradual rise to the present. Whereas, an initial enrichment in $\delta^{13}C_{org}$ between 1.8-1.7 ka followed a gradual decline in the $\delta^{13}C_{org}$ and TOC values until ~0.7 ka and subsequent increase till present. We find that during deglacial conditions of the catchment (before and after 1.7-0.7 ka), the lake-water was CO_2(aq) supersaturated with concentration up to ~1500 µmol L^{-1}. We surmise that CO_2(aq) supersaturation was dominantly controlled by enhanced input of organic matter and carbonate weathering derived DIC fluxes. Again, these controls compromised during glacial conditions (between 1.7-0.7 ka), when the lake acted as a closed system, as opposed to an open system during deglacial conditions. During glacial periods the dissolved CO_2 concentrations range between 200-400 µmol L^{-1} due to limited biogenic inputs as evident from depleted $\delta^{13}C_{DIC}$ values. We, therefore, conclude that during deglaciated conditions the glacial lakes would act as a source of atmospheric CO_2, whereas during glacial conditions, the glacial lakes will act as a sink of atmospheric CO_2.