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Chemical weathering in glacial catchments of the Tibetan Plateau may be an important carbon source

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Chemical weathering affects the carbon cycle profoundly by removing carbon dioxide from the atmosphere and storing it in weathering products. The Tibetan Plateau (TP) is a focus of chemical weathering research worldwide due to the famous "uplift-weathering hypothesis". Dissolved inorganic carbon (DIC) fluxes account for the majority of total carbon transportation in most rivers. The DIC budget for glacial meltwater of the Tibetan Plateau (TP), however, is still poorly understood, even though here has the largest glacier distribution outside of the Poles. In this study, the Niyaqu and Qugaqie catchments in the central TP were selected to examine the influence of glaciation on the DIC budget in lateral transport (sources and fluxes) from 2016 to 2018. Significant seasonal variation in DIC concentration was found in the glaciated Qugaqie catchment, but not in the not-glaciated Niyaqu catchment. $\delta^{13}C_{DIC}$ show seasonal changes for both catchments, with depleted signatures in the monsoon season. DIC sources were quantified via the MixSIAR model using $\delta^{13}C_{DIC}$ and ionic ratios. The contributions from carbonate/silicate weathering driven by atmospheric CO_2 was 13–15% lower, while biogenic CO_2 involved in chemical weathering was 9–15% higher during the monsoon season. Carbonate dissolution driven by H_2SO_4 is the most important contribution to DIC in both catchments (40.7±2.2% for Niyaqu and 48.5±3.1% for Qugaqie). The net CO_2 consumption rates of chemical weathering in Niyaqu and Qugaqie were $-0.07\pm0.04\times10^5$ mol/km^2/y and $-0.28\pm0.05\times10^5$ mol/km^2/y, respectively. CO_2 consumption flux is insignificant in the non-glaciated Niyaqu catchment. Extrapolating the data to glaciated regions of the whole TP, its CO_2 release flux may be two times than the total carbon sink flux caused by silicate weathering in the Yarlung Tsangpo basin which is the largest river in this plateau (-3.11×10^{10} mol/y versus 1.91×10^{10} mol/y). This study highlights that chemical weathering in glaciated regions may release substantial CO_2 even though the total CO_2 release flux estimated here may have significant uncertainties.