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Fluxes, Sources and Control Mechanisms of CO_2 Exchange across Water-Air Interface in Summer in a Subtropical River, south China

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CO_2 exchange across the water-air interface in a river system plays an important role in the global carbon cycle of inland water, but there are still lots of disputes and controversy on sources, fluxes and control mechanisms of carbon in CO_2 gas. This study researched variations, sources ,and control mechanism on intensity and direction of CO_2 exchange across the water-air interface in two typical transections in a subtropical river, Guijiang River, south China, based on high-resolution monitoring of atmospheric environmental parameters, CO_2 exchange, hydrochemical parameters and carbon isotopes (Δ14C and δ13C). The results showed that the intensity of CO_2 exchange across the water-air interface displayed similar diurnal pattern at the two transections in the mainstream of the Guijiang River because it was controlled by metabolism process of the sub-aquatic community. However, there is a significant spatial change in the direction of CO_2 exchange (CO_2 evasion and uptake), which may be influenced by the different CO_2 sources in the two transections. The calculations using C isotopes (Δ14C and δ13C) end-member methods showed that DIC was mainly derived from atmospheric CO_2 at the non-karst transaction (upstream) and the contribution rate was 57.5%. In contrast, at karst transaction (downstream), the CO_2 evasion was mainly derived from carbonate rocks and the contribution rate was 44.3%. The direction of CO_2 exchange showed an opposite trend in the two transections because different carbon sources, which drove different pCO_2 balances status between water and atmosphere, and the influence of the metabolic process of metabolism process of the sub-aquatic community. Therefore, the variations of CO_2 exchange intensity and direction were jointly controlled by the internal process of metabolism of sub-aquatic community and the external carbon sources, and the changes of carbon sources were controlled by geological feature. In conclusion, due to the strong photosynthetic absorption of DIC under different geological feature in the mainstream of Guijiang River, the research transections did not only directly absorb atmospheric CO_2 at some time, but also further limit CO_2 degassing, which resulted in a considerable carbon sink flux of 251.01t /d, about 0.09Tg C/yr.