Diel variations of dissolved inorganic carbon in the Pearl River plume and the northern South China Sea shelf upwelling during summer

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Strong river-to-sea mixing, stratification, and coastal eutrophication are usually observed on a plume dominated-continental shelf, but the effects of diel variations and upwelling on the carbonate system are still unclear on the northern South China Sea continental shelf. The Pearl River plume and upwelling at the northern South China Sea were surveyed at the near-field (1 day), the mid-field (6 days), and the far-field sites (1day) along the plume trajectory. We sampled total alkalinity (TA) and dissolved inorganic carbon (DIC) and calculated buffer capacity at the near-surface and near-bottom waters. We also estimated primary productivity (PP, based on $d^{13}C$) at the near-field site and calculated net community productivity (NCP) in the mid-field site after removing the mixing effect. At this plume-upwelling hybrid system, lower salinity, TA, and DIC value and higher buffer capacity and NCP were observed in the near-surface water than the values in the near-bottom water. A good correlation between the common logarithm of light intensity and PP was observed; suggesting that the diel variation of PP was dominated by day-night light cycle. Moreover, the changes of net biological uptake (36% to 76%) were higher than the changes of salinities (3% to 8%) during the subsurface upwelling (from development, maxima, and decline stages at the middle-field site). We suggest that respiration-associated biological activities in addition to PP and physical mixing dominated the near-surface water during subsurface upwelling. Finally, at this coupled plume and upwelling system, the diel variation of carbonate system can be dominated by PP induced by periodic sunlight cycle and further affected by respiration strengthened by intensive upwelling.

Keywords: Pearl River plume, inorganic carbon, upwelling, CO2

