Interaction between photochemical and microbial degradation of dissolved organic matter in the Pearl River Estuary

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The migration and fate of dissolve organic matter (DOM) in estuarine ecosystems have gained more attention, due to the important role of the estuary as the bridge of the land and ocean,. Photochemical and microbial processes have long been considered as the key routes for the transformation and mineralization of DOM in the aquatic ecosystems. However, how the above processes influencing each other is still poorly understood. In this study, the interaction between photo- and bio-degradation of DOM was investigated in surface water in the Pearl River Estuary in south China. Microbial, photochemical and microbial + photochemical experiments were carried out and monitored by direct measurements of dissolve organic carbon (DOC) and the adsorption spectra of chromophoric dissolved organic matter (CDOM). The results demonstrated both the fraction of microbial degradation of DOM and the rate of this pathway in the dark were higher in the mid estuary than those in the upper and lower estuaries . The microbial degradation of CDOM under natural light along the estuary was promoted, whereas that of DOC was inhibited. After one-month microbial consumption in the dark, the photobleaching rate of CDOM was slightly enhanced along the estuary. Differently from CDOM photobleaching, the photodegradation rate of DOC was promoted in the upper estuary, but inhibited in the lower estuary. Furthermore, two broadband shoulders at 285-310 nm and 350-360 nm, respectively, were found for the absorption spectrum of CDOM after microbial and then photochemical degradation in the upper estuary, which meant the formation of carbonyl and aromatic heterocyclic compounds. The shoulders were smaller (absent) for the mid (lower) estuarine sample. This study provides direct evidence that microbial and photochemical degradation of DOM can significantly impact on each other in the estuarine ecosystem. Further studies are needed to explore the mechanisms between the two processes in large scale areas.

Keywords: Pearl River Estuary, Dissolved organic carbon, Chromophoric dissolved organic matter, Photochemical degradation, Microbial degradation

