Optical properties of chromophoric and fluorescent dissolved organic matter in the coastal Jeju Island: Impact of the anthropogenic sources

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The hydrological properties (temperature, salinity, pH, and dissolved oxygen), dissolved organic carbon (DOC) and nitrogen (DON), and optical absorption and fluorescence signals were measured in Jeju Island, Korea, during 2016–2018, especially in potential point-sources (e.g. coastal aquafarms, a sewage treatment facility, and coastal artesian springs). The water samples were filtered through 0.2 μm polycarbonate syringe filters. The optical analysis was conducted using a spectrophotometer (Aqualog, Horiba, USA). Absorbance spectra were converted into the absorption coefficient, and fluorescence intensities were conducted by the parallel factor analysis (PARAFAC) model. The fluorescent components were compared with previous studies through the web-based OpenFluor database.

The absorption coefficient at 350 nm ranged from 0.05 to 7.63 m⁻¹, and it was up to 150 times higher near the point-sources than in the normal coastal ocean. In addition, a₃₅₀ was observed to be exponentially increased as the reduced distance from the aquafarm outlet. Similarly, the concentration of DOC was 89 ± 29 μM near the point-sources and 78 ± 13 μM in the normal coastal area. They were also observed to be high fluorescence near the point-sources. Principal component analysis (PCA) was applied to illustrate the relationship among the five PARAFAC components, DOC, DON, a₃₅₀, and fluorescence indexes (HIX, BIX, FI, TC ratio, and RI). The PCA results separated allochthonous, terrestrial components from autochthonous, microbial components, as explained 71.3% of the variance in the data. Based on the HIX (1.26 – 55.70) and BIX (0.52 – 2.87) values in this study, the organic matter around the coastal Jeju Island seem to be highly affected by the coastal groundwater. Here, we used multiple optical properties of organic matter near the coastal area to identify the key factor contributing its distribution and water qualities and to determine the significant influence of the point-sources.

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