Environmental impacts on artificial lake by tidal power plant: Application of $\delta^{13}C$, $\delta^{15}N$ and $\delta^{34}S$ values

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Artificial Lake Shihwa (surface area 43.8 km2, drainage basin 476.5 km2) in South Korea, a salt water lake was created by entrapment of the Yellow Sea through the construction of a dike (12.7km in length) in 1994. However, the dike construction has led to a serious deterioration of water quality in the region due to the insufficient circulation of the enclosed lake water and the continuous input of anthropogenic organic matter from nearby industrial complexes. To cope with the problem, the South Korean government designated and opened a water gate in a middle of the dike in 2001 to allow water exchange with the adjacent sea, moreover a tidal power plant constructed to promote seawater circulation and to supply electric power to the nearby industrial complex in 2011. The vertical distribution of C/N ratio and stable isotope ratios (δ13C, δ15N and δ34S) in sediment cores was investigated to evaluate environmental change after establishment of tidal power plant and the historical record of origin for organic matter over 30 years in the lake. Since 1994, core samples showed higher C/N ratio(14~16) and lighter δ13C values ranging from -25~-26‰. It could indicate that large influxes of land-derived organic sources including rural, urban, and industrial regions effects environmental conditions in Shihwa lake. Also, higher sulfide contents and lighter δ34S values ranging from -20~-11‰ was observed core samples, indicate that Shihwa lake gradually changed from oxic to anoxic condition due to inflow large amount of anthropogenic organic matter. Enhancing water exchange through the periodic opening of the watergate and establishment tidal power plant in 2011, δ13C values of core samples has more heavier values ranging from -21~-22‰ compared to 1994 indicating that marine organic matter may be transported to Shihwa lake due to sufficient water circulation through watergate and tidal power plant. Also, it was supported by C/N ratio which showed ranging from 7 to 9. Moreover δ34S values ranging from -0~8‰ was observed core samples, indicate that Shihwa lake gradually became oxic condition.

Consequently, the vertical profiles of isotope values in the sediments tracked the sources of the organic matter and inferred environmental conditions.