

Organic Carbon Storage and Dynamics in the Nakdong Estuary, South Korea: Insights from a Tidal Flat Sediment Core

YUNJI KIM, JEONGWON KANG, SEONYOUNG PARK,
KYEONGYOON KWAK AND BYUNGCHEOL KUM

Korea Institute of Ocean Science & Technology

Estuaries act as significant carbon reservoirs, where large amounts of carbon are stored and sequestered from the atmosphere. Vegetation and phytoplankton are major contributors of carbon sequestration, known as blue carbon storage. In the Nakdong Estuary, diverse vegetation, including reeds and *Scirpus planiculmis*, has inhabited the tidal marshes; however, vegetation coverage of the estuary has declined over the past decades. This study investigates the organic matter (OM) behavior in the estuary, using OM and biogenic silica (BSi) parameters of a sediment core collected from a tidal flat in Nakdong River Estuary, Korea. Total organic carbon (TOC), total nitrogen (TN), $\delta^{13}\text{C}$, and $\delta^{15}\text{N}$ were analyzed as OM parameters, and BSi was estimated using a sequential digestion method for diatom-derived BSi ($\text{BSi}_{\text{diatom}}$), residual BSi ($\text{BSi}_{\text{residual}}$), and total BSi ($\text{BSi}_{\text{total}}$) estimation. The C/N ratio showed a strong correlation with $\delta^{13}\text{C}$, indicating that OM is well-preserved in the tidal flat sediments. Marine and terrestrial TOC ($\text{TOC}_{\text{marine}}$ and $\text{TOC}_{\text{terrestrial}}$) were calculated using C/N ratio and OM contents. $\text{TOC}_{\text{terrestrial}}$ was consistently higher than $\text{TOC}_{\text{marine}}$ throughout the sediment core, suggesting that terrestrial OM input dominates OM deposition regardless of anthropogenic and natural environmental changes. Additionally, $\text{BSi}_{\text{total}}$ exhibited a strong correlation with all TOC fractions, indicating that siliceous organisms play a crucial role in carbon storage of the estuary. However, $\text{BSi}_{\text{diatom}}$ and $\text{BSi}_{\text{residual}}$ showed different relationships with TOC fractions. $\text{BSi}_{\text{diatom}}$ tended to be diluted by $\text{TOC}_{\text{terrestrial}}$ suggesting that diatom production is not a major contributor to the marine production in the estuary. Conversely, $\text{BSi}_{\text{residual}}$ increased with higher TOC fractions, indicating that non-diatom siliceous organisms, such as salt marsh plants, contribute more significantly to OM accumulation. The correlations of carbon stock (the capacity of organic carbon storage), OM provenance, and BSi parameters suggest that vegetation-derived OM is better preserved than diatom-derived OM. Therefore, vegetation, such as salt marsh plants, likely play a more dominant role in long-term carbon sequestration than diatoms within the estuary.