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Effects of invasive Spartina anglica on rates and pathways of organic carbon oxidation in the intertidal sediment inhabited by native Suaeda japonica in the Han River estuary, Yellow Sea

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Coastal wetland ecosystems including salt marshes and tidal flats play a significant role as a biogeochmeical hot spot where rapid turnover of organic material and inorganic nutrients occurs. The Ganghwa intertidal wetland with an area of 244 km2 represents one of the largest wetlands in the area, and the area has been extensively inhabited by the native marsh plant Suaeda japonica. However, the invasive Spartina anglica has rapidly substituted the native S. japonica in the area since it was reported first in 2015, expanding their coverage by 70 times from approximately 400 m2 in 2015 to 31,181 m2 in 2018. Despite the ecological and environmental issues associated with the S. anglica in intertidal sediments, little is known about the impact of this invading salt marsh plant on the biogeochemical processes in the Ganghwa intertidal sediment. A combination of geochemical analysis and microbial metabolic rate measurements including anaerobic organic carbon (Corg) oxidation, sulfate reduction (SR) and iron reduction (FeR) was conducted in the sediments inhabited by the invasive Spartina anglica (SA) and indigenous salt marsh plant Suaeda japonica (SJ) and unvegetated mudflat (UMF). One of the most prominent geochemical features associated with the Spartina anglica invasion was that sediment at SA showed more oxidized condition with low levels of NH4+, Fe2+ and H2S in the pore water than at the SJ site. The rates of anaerobic Corg oxidation, FeR and SR were highest at SA, intermediate at SJ and lowest at UMF site. FeR and SR the two most significant Corg oxidation pathways at the vegetated sites, comprising 49% and 65% of Corg oxidation at SA and 39% and 56% of Corg oxidation at SJ, respectively. Especially, Microbial FeR at the rhizosphere of the SA accounted for 61–78% of Corg oxidation. In contrast, both FeR and SR accounted for 75% of Corg at the UMF site. Overall, our results suggested that the invasion of Spartina anglica induces profound impacts on the biogeochemical C-Fe-S cycles, which ultimately generates variations in the ecological and biogeochemical processes of the Ganghwa wetlands in the future.