REMINERALIZATION OF SEDIMENTARY ORGANIC CARBON IN THE CHANGJIANG ESTUARY AND THE EAST CHINA SEA INNER SHELF

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Introduction

Large-river delta-front estuaries (LDEs) are important sinks of organic carbon (OC) in marine environment and play a significant role in global carbon cycling (Bianchi and Allison, 2009). Despite large sedimentary OC (SOC) inputs, extensive losses of SOC were observed in LDEs compared to other marine deposits of similar net accumulation rate, and recent studies demonstrated that mobile-muds in LDEs play an important role to the remineralization of SOC (Aller et al., 1998; Blair and Aller, 2012; Yao et al., 2014). Although a few studies have examined the diagenetic processes and preservation status of SOC in the Changjiang LDE (e.g., Aller et al., 1985; Song et al., 2015; Yao et al., 2014), the rates, processes, controlling mechanisms, and impacts of SOC remineralization in this region are still poorly understood.

In this study, remineralization of SOC in 9 sites of the Changjiang LDE was investigated using time-sequence sediment incubation method. We determined pore-water dissolved inorganic carbon (DIC), dissolved inorganic nitrogen (DIN) nutrients (NH_4^+, NO_3^-, and NO_2^-), redox sensitive elements (Fe^{2+} and Mn^{2+}), and major anions (K^+, Ca^{2+}, Mg^{2+}, SO_4^{2-} and Cl^-), coupled with specific surface area (SSA), total OC (TOC) contents and stable carbon isotope abundance ($\delta^{13}C$) in surface sediments. The primary objectives of this work were to constrain early diagenetic cycling and controlling mechanisms of remineralization, and build a SOC budget that includes remineralization process for the Changjiang LDE.

Results

Vertical profiles of pore-water DIC and NH_4^+ had similar trends during the sediment incubation, showing a significant increase in the upper 10 cm sediments in offshore sites, indicated that active remineralization of SOC occurred in these sediments. Higher DIC production flux was mainly observed in offshore sites with relatively enriched ^{13}C of SOC, indicating preferentially degradation of marine SOC. However, lower TOC/SSA loadings (<0.4 m^2/g) were mainly observed in nearshore sits indicated that physical activities enhanced remineralization process in the surface sediments, and this decomposition way of physical dominance is different from the anoxic decomposition way in offshore sites. Obvious increase of Fe^{2+} in pore-water with incubation time were mainly found in the Changjiang Estuary, indicating that high concentrations of highly reactive Fe in the Changjiang Estuary resulted in intense Fe reduction. Evident depletion of SO_4^{2-} during the sediment incubation and higher SO_4^{2-} consumption rates indicated that SO_4^{2-} is the dominant electron acceptor in the study area. Pore-water Ca^{2+} concentrations decreased with incubation time coupled with increase of DIC and NH_4^+ indicating the formation of authigenic carbonates. The decrease of pore-water K^+ and Mg^{2+} concentrations with incubation time were likely attributed to reverse weathering. Based on the SOC budget, about 19% of both terrestrial and marine inputs decomposed in sediments, and about 9% of SOC buried in the Changjiang LDE (4.64×10^4 t OC/yr), indicated that the Changjiang LDE is an important OC sink.

Conclusions

1. Higher marine SOC in offshore sites resulted in higher DIC production flux. However, under *in-situ* conditions, more SOC was likely to be decomposed in nearshore sites due to intense physical activities.
2. SO_4^{2-} is likely to be the dominant electron acceptor in the Changjiang LDE.
3. The rapid formation of authigenic minerals was occurred along with strong remineralization of SOC in the Changjiang LDE.
4. About 30% of both terrestrial and marine source SOC decomposed and/or buried in the Changjiang LDE, indicated that the Changjiang LDE is an important SOC sink in the ECS shelf.

References

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