

High Concentration of Phosphate and its Mechanism in "Gomi-kui" and "Gata-do"

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[Introduction]

River and creeks (waterways) network is developed in Saga plain, which has water and water storage functions. Silt from the upper stream and suspension clay carried by tidal effect are accumulated in creeks and rivers. Mud sediment in creeks has been used as a fertilizer until the spread of chemical fertilizer (Kato 1997). This work is called "Gomi-kui". On the other hand, the mud sediment deposited in the flow passage of the river tidal area such as the Rokkaku River is called "Gata-do". This has been considered to be a nutrient supply source to the Ariake Sea by solutes of nutrient (Mishima 2017). The present study hypothesized "Gomi-kui" and "Gata-do" is abundant in nutrients through a phosphate release by reduction of iron oxide in reductive sediments. We investigated to clarify this hypothesis.

[Results and Discussion]

Concentration of PO_4^{3-} in pore water of "Gata-do" increased along the flowing-down the river. The highest concentration of $73.5 \mu\text{mol L}^{-1}$ was observed at the point of 5.5 km from the river mouth (Fig. 1). This increase in PO_4^{3-} concentration was associated with the increase in clay content and the decrease in DO (Fig. 2). That is, the development of reductional environment apparently influenced the increase of PO_4^{3-} concentration. From the upstream to the 19.6 km point, the concentration of Fe^{2+} and S^{2-} in the pore water also increased. From the downstream side of 19.6 km point, however, Fe^{2+} and S^{2-} concentration decreased, while the PO_4^{3-} concentration continued to increase. A positive correlation was found between the increase in EC and the increase in PO_4^{3-} concentration ($p < 0.05$). It is likely from this result that the formation of iron sulfide (FeS) is involved in increasing the concentration of PO_4^{3-} . In the reductive sediment, PO_4^{3-} would be released in association with Fe reduction. In addition, as an effect of seawater intrusion, the reduction of SO_4^{2-} would produce abundant S^{2-} to remove Fe^{2+} as FeS. PO_4^{3-} would remain in dissolved state without being affected by Fe^{2+} (Hartzell and Jordan 2012). This mechanism is expected to contribute to high PO_4^{3-} concentration.

Similar results were observed for "Gomi-kui" mud: high PO_4^{3-} concentration, tendency of increase and decrease in Fe^{2+} and S^{2-} concentration, decrease in DO, and increase in clay content. Results suggest that phosphate concentration is remarkably increased due to the mechanism associated with Fe reduction in "Gomi-kui" and "Gata-do". Phosphate released from lowlying areas could be a source to coastal areas.

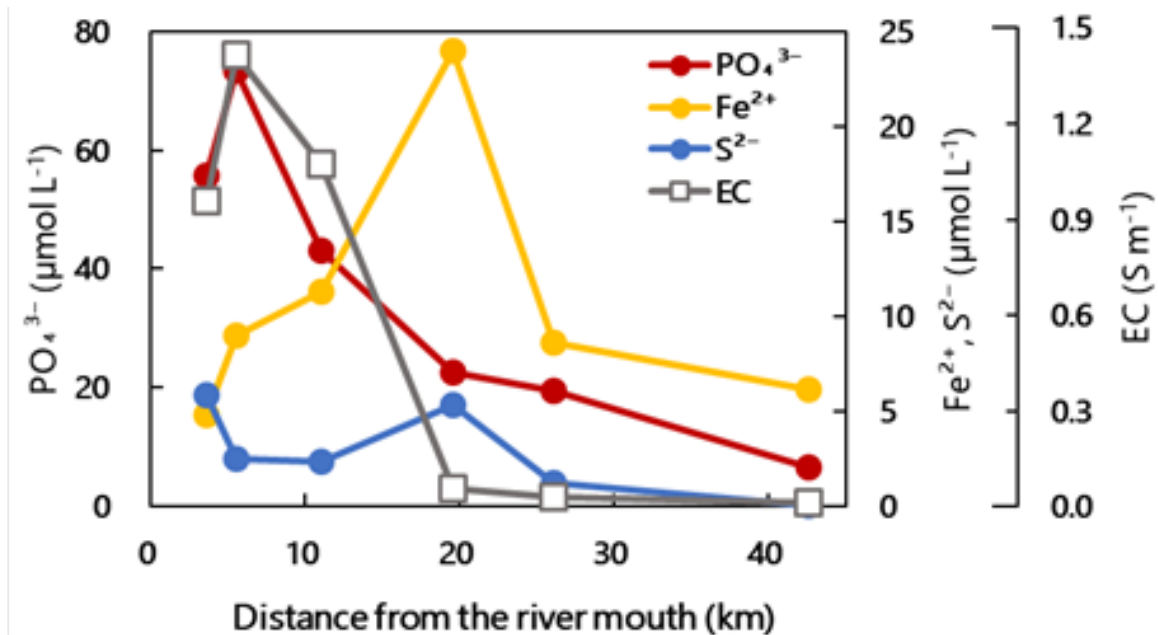


Fig.1 PO₄³⁻, Fe²⁺, S²⁻ concentration in pore water and EC in surface water along the flowing-down the Rokka River

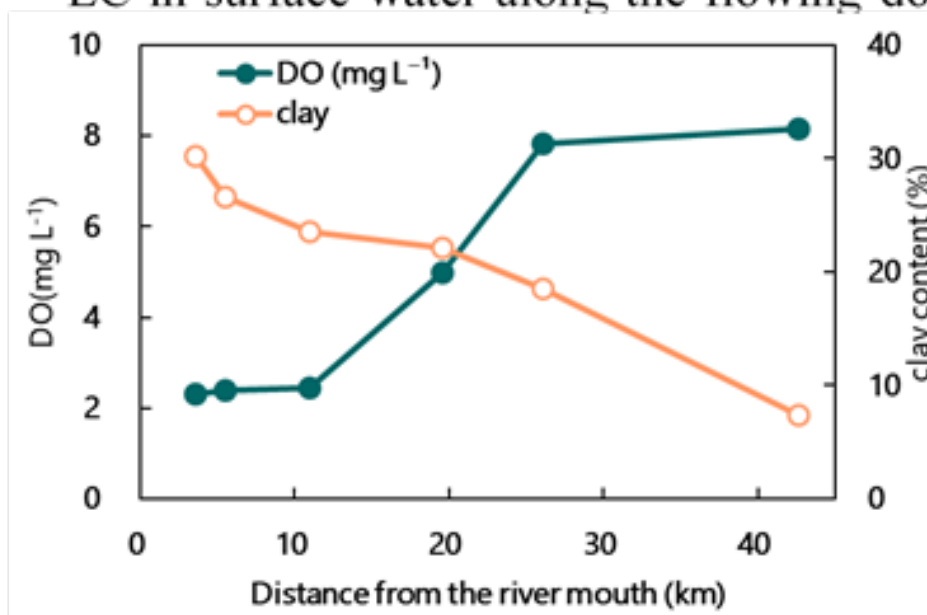


Fig.2 EC, DO in surface water and clay content of sediment along the flowing-down the Rokka River