

A NOVEL PALEO SEA SURFACE NUTRIENT PROXY BASED ON LONG CHAIN ALKYL DIOLS: NUTRIENT DIOL INDEX (NDI)

Jong-Ku Gal^{1,2}, Jung-Hyun Kim¹, Kyung-Hoon Shin²

¹Korea Polar Research Institute (KOPRI), South Korea

²Hanyang University, South Korea

Abstract

During recent years, several diol-based indices have been introduced to provide information on past climatic and environmental conditions. Here, we investigated the distribution of long chain diols (LCDs) using suspended particulate matter (SPM) collected along a south-north transect ranging from the East Sea of Korea to the Bering Sea in the northwestern Pacific region. Our results shed light on the spatial distribution pattern of LCDs in the Pacific Ocean, showing that both saturated and unsaturated C₂₈ and C₃₀ 1,14-diols were dominant in most SPM samples. The principal component analysis (PCA) results indicated that the C_{28:1} and C_{30:1} 1,14-diols were positively associated with nutrient concentrations. However, only the C_{28:1} 1,14-diol in addition to the C₂₈ 1,14-diol was positively associated with nutrient concentrations in the global surface sediment data set previously published, while the C_{30:1} 1,14-diol was related to sea surface temperature (SST). Based on these observations, we developed the nutrient diol index (NDI) as follows:

Nutrient diol index (NDI)

$$= \frac{[C_{28} \ 1,14] + [C_{28:1} \ 1,14]}{[C_{28} \ 1,14] + [C_{28:1} \ 1,14] + [C_{30} \ 1,14] + [C_{30:1} \ 1,14] + [C_{28} \ 1,13] + [C_{30} \ 1,13] + [C_{30} \ 1,15]}$$

The NDI was positively associated with the ocean atlas values of surface water phosphate and nitrate concentrations for the SPM and surface sediment data sets (Fig. 1). Accordingly, the results of our study showed that the NDI has potential as a quantitative nutrient proxy for estimating sea surface phosphate (or nitrate) changes. Definitely, more works are needed to assess the NDI applicability for reconstructing surface water nutrient variations in the past, by analysing more SPM and sediment cores collected from various oceanic settings.

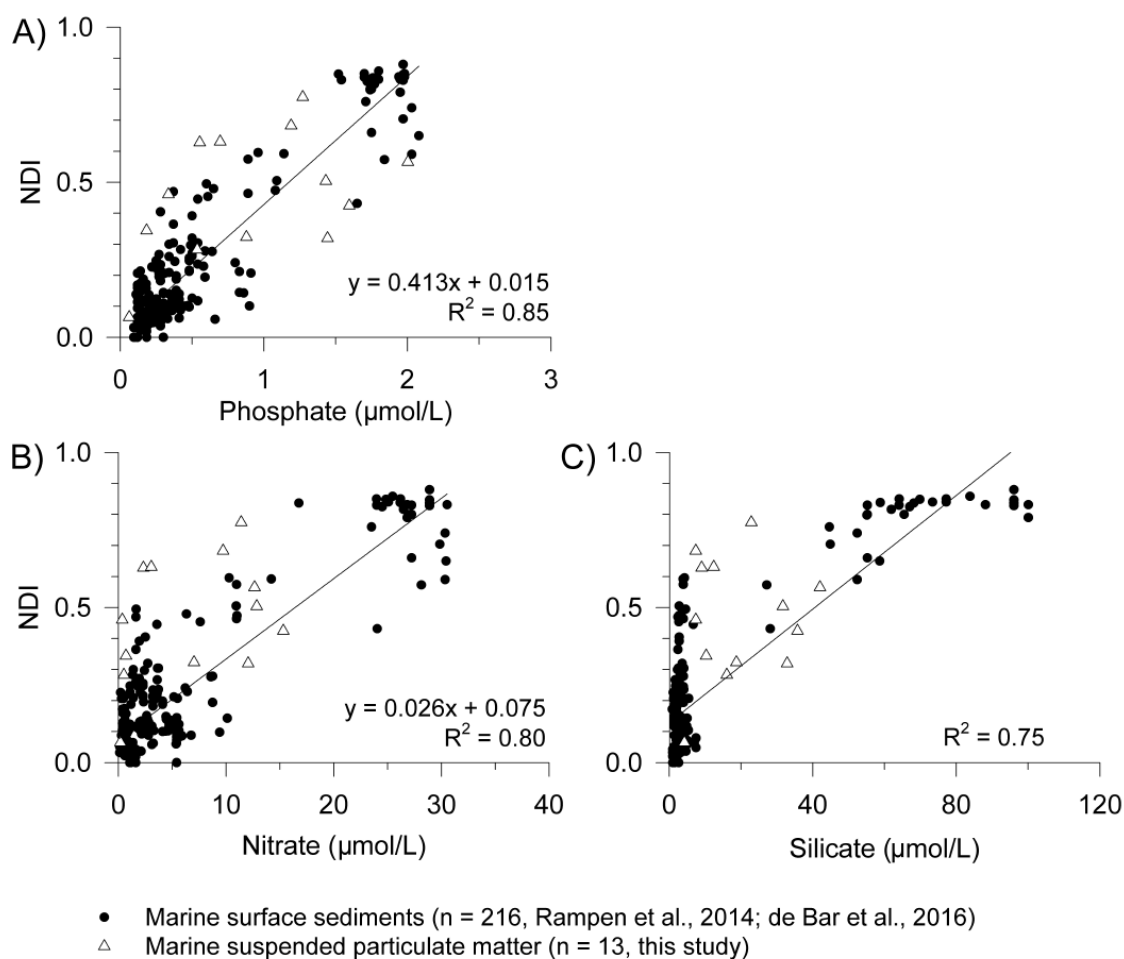


Figure 1 Scatter plots of nutrient concentrations (phosphate, nitrate, and silicate) with (A–C) the NDI. Closed circles indicate the compiled surface sediment data (n = 216) from Rampen et al. (2014) and de Bar et al. (2016) with the annual mean nutrient concentrations (WOA13). The open triangles indicate the SPM data (n = 13) in this study with the summer nutrient concentrations (WOA13). It should be noted that we only used the global surface sediment data set for calculating the linear correlation.

References

- [1] Rampen S W, Willmott V, Kim J H, Rodrigo-Gámiz M, Uliana E, Mollenhauer G, Schefuß E, Sinninghe Damsté J S and Schouten S 2014 Evaluation of long chain 1,14-alkyl diols in marine sediments as indicators for upwelling and temperature *Org. Geochem.* 76 39–47
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