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Sources tracking of Ni contaminated seawaters using Ni/Cu ratio and Gd anomaly in Gyeonggi Bay, Korea

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The Incheon Special Management Area(ISMA) is adjacent to a metropolitan city and is part of Gyeonggi Bay located on the western coast of Korea. ISMA was designated as a SMA in 2000, and various policies for environmental management was being implemented. Despite these efforts, dissolved Ni in ISMA is still exceeded long-term guidelines(1.8 μg/L). In order to investigate the sources of Ni contamination in seawater, we collected surface seawaters in spring(40 locations) and summer 2021(25 locations) from ISMA, Gyeonggi Bay(G), Ganghwa(GH), and Shihwa-Lake(SH). Dissolved trace metals and REEs were measured by ICP-MS after the preconcentration of metals using Nobias-PA1 resin.

Since the spatial distribution of dissolved metals indicated the input of metals from freshwaters, it might be suggested that metal distribution was controlled by the mixing of offshore water and freshwaters from land. The freshwater sources are the Han River connecting to GH, and the inner part of SH affecting the center of Shihwa-Lake. Ni and Cu in Gyeonggi Bay (excluding ISMA) have a strong positive relationship (r=0.93), so the behavior of Ni can be estimated using the Ni/Cu ratio. Additionally, Gd can be used as a tracer for pollutants due to its stable properties in the environment. In particular, in this study area, Ni/Cu ratio and $Gd_{anomaly}$ have conservative behavior with respect to salinity, it is suitable for tracking pollutants flowing in from various rivers. $Gd_{anomaly}$ and Ni/Cu values differed from region to region: for Gdanomaly, GH>SH>ISMA>G; for Ni/Cu, SH>ISMA>G>GH. The values of ISMA were included in the GH, SH and G ranges. For tracking the sources, we selected three end-members based on Ni/Cu ratio and Gd_{excess}. In spring, E1) GH: Ni/Cu, 0.51±0.07; Gd_{excess}, 3.69±2.39. E2) The innermost area of SH(4 stations): Adjacent to the national industrial complexes. Ni/Cu, 2.65±0.95; Gd_{excess}, 0.45±0.12. E3) Outside of G(6 stations): Ni/Cu, 1.02±0.15; Gd_{excess}, 0.13±0.02. Using End Member Mixing Analysis, the contribution of each endmember to ISMA was G 81%, SH 15% and GH 5%. This means that ISMA is mainly formed by mixing the seawater of Gyeonggi Bay and Shihwa-Lake, and most pollutants flowing into ISMA originate from Shihwa-lake.