Geochemical Study on the Origin of Organic Matter and Depositional Environment of Late Quaternary Sediments in the Ulleung Basin of the East Sea*

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Abstract

According to radiocarbon dating of planktonic foraminifera samples from the Ulleung Basin of the East Sea, the cores cover the time interval from the middle stage of marine isotope stage (MIS) III through the last glacial maximum (LGM) to the Holocene. In the cores, hemipelagic muds (bioturbated and slightly laminated mud facies) were mainly deposited during interglacial periods (MIS I/III), whereas non-hemipelagic muds (laminated and homogenous mud facies) were formed during glacial period (MIS II). During the cold time, sedimentation rates clearly increased more than the other times. Such characteristic changes in sedimentary facies and sedimentation rate evidently reflect paleo-environmental variations on the Ulleung Basin during the Late Quaternary. Also, the cores contain several lapilli tephra layers, rhyolitic ash layers, and dark laminated muds. Among these, previously well-known tephra layers (Ulleung-Oki, Aira-Tanzawa, and Ulleung-Yamato) were identified and used to stratigraphically correlate the cores. Particularly, our sedimentary geochemical studies (Rock-Eval pyrolysis, elemental, and stable isotope analyses) allow us to discuss the origin of organic matter and the depositional environment of sediments. Down-core profiles of TOC (Total Organic Carbon), TN (Total Nitrogen) and δ¹³Corg show the lowest values during MIS II and the highest during MIS I. The relationship between TOC/TN and δ¹³Corg suggests that the organic matter was predominantly produced by a marine source rather than by a terrestrial source. However, redox-sensitive trace elements have not significantly varied during MIS II as well as during MIS I/III. The ratios of these trace elements also indicate a predominant oxic or suboxic environment, indicating that the Late Quaternary depositional condition of the Ulleung Basin was less dynamically changed than we expected before.

References Cited


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\textbf{Abstract}

According to radiocarbon dating of planktonic foraminifera samples from the Ulleung Basin of the East Sea, the cores cover the time interval from the middle stage of marine isotope stage (MIS) 3 through last glacial maximum (LGM) to Holocene. In the cores, hemipelagic muds (bioturbated and slightly laminated mud facies) were mainly deposited during interglacial periods (MIS 1/3), whereas non-hemipelagic muds (laminated and homogenous mud facies) were formed during glacial period (MIS 2). During the cold time, sedimentation rates clearly increased more than the other times. Such characteristic changes in sedimentary facies and sedimentation rate evidently reflect paleo-environmental variations on the Ulleung Basin during Late Quaternary. Also, the cores contain several tephras layers, rhyolitic ash layers and dark laminated muds. Among these, previously well-known tephras layers (Ulleung-Oki, Aira-Tanzawa and Ulleung-Yamato) were identified and used to stratigraphically correlate the cores.

In the cores, TOC/TN, C/N, K/Al, and Mg/Ca ratios were used to infer paleo-ecological and geochemical environments. Abundances of redox-sensitive elements (e.g., Fe, Mn, V, Cr, Cu, Co, Ni, Zn, and Mo) were used to determine the depositional environment. Radiocarbon age dating of planktonic foraminifera samples from the Ulleung Basin of the East Sea, the cores cover the time interval from the middle stage of marine isotope stage (MIS) 3 through last glacial maximum (LGM) to Holocene. In the cores, hemipelagic muds (bioturbated and slightly laminated mud facies) were mainly deposited during interglacial periods (MIS 1/3), whereas non-hemipelagic muds (laminated and homogenous mud facies) were formed during glacial period (MIS 2). During the cold time, sedimentation rates clearly increased more than the other times. Such characteristic changes in sedimentary facies and sedimentation rate evidently reflect paleo-environmental variations on the Ulleung Basin during Late Quaternary. Also, the cores contain several tephras layers, rhyolitic ash layers and dark laminated muds. Among these, previously well-known tephras layers (Ulleung-Oki, Aira-Tanzawa and Ulleung-Yamato) were identified and used to stratigraphically correlate the cores.

\textbf{Age Dating and Model}

- Selected samples were \(^{14}C\)-dated at AMS at the lab. of Univ. Kiel, Germany
- After tephrasтратigraphic studies, DLM, U-Oki, AT, and U-Ym represent 15.4, 10.1, 23.0 and 30.9 ka BP, respectively (e.g., Park et al., 2006; Kim et al., 2007). They are useful tie points for the chronostatigraphic correlation, and were here used to construct the age model of the sediment cores

- According to this method, the U-Oki layer is roughly designated as the boundary between MIS 1/2 and the AT layer is between MIS 2/3

\textbf{Depositional Condition: Inflnence of Tephra and Bioditritus}

- Ratios of redox-sensitive trace elements indicate a predominately oxic or suboxic environment during times of sediment deposition since the Late Quaternary

- Tephra and foraminiferal shell fragments display abnormal elemental ratios: Bioditritus and tephra obviously affect the variation of sedimentary facies and the geochemistry in the Ulleung Basin

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