Provenance of sediments in the western Sea of Japan over the last 30 ka: Implications for paleoenvironmental changes

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The Sea of Japan is a unique marginal sea in the northwest Pacific Ocean, which is known as "miniature ocean". Constrained by four shallow straits communicating with surroundings seas, it is very sensitive to glacio-eustatic sea level changes. Also, it is located beneath the East Asia Monsoon, which affects the hydrography of surface waters, deep circulations and accumulation of terrigenous materials. The presence of seasonal ice also plays a role in controlling the local distributions of terrigenous materials and deep ventilation in the Sea of Japan. An increasing body of studies revealed pronounced changes in past ocean environment in the Sea of Japan since the late Quaternary. However, it remains elusive for past environment changes in the western Sea of Japan. In this study, we investigate the lithology, rare earth elements and radiogenic isotopes of sediment core LV53-18 retrieved from the western Sea of Japan since the last glaciation.

The contents of coarse fraction of sediment grain size suggest an advance in sea ice cover during the last deglaciation and the early Holocene (15-8 ka) and potential perennial sea ice cover during Heinrich Stadial (HS) 1 and HS2. The variation in sea ice cover is explained by changing strength of East Asian Winter Monsoon (EAWM). On millennial timescales (HS2, HS1 and Younger Dryas), our grain size data shows a reverse correlation between the EAWM and the East Asian Summer Monsoon (EASM), indicating by Chinese stalagmite $\delta^{18}$O record, and it is ascribed to the slowdown of Atlantic Meridional Overturning Circulation (AMOC). The brine rejection related to sea-ice generation enhances local deep ventilation.

Both the concentration of $\Sigma$REEs and positive Eu anomaly (1.2~1.4) reveal a sustained contribution of calcium-rich volcanic materials after 8 ka, which coincides with the onset and intensity of Liman Cold Current during the sea-level highstand. Furthermore, the $^{87}$Sr/$^{86}$Sr values (0.706347 to 0.711713) decrease after 8 ka while $\varepsilon$Nd (-5.09 to -2.45) are more radiogenic, which further corroborate the presence of volcanic materials. On the basis of a binary mixture of volcanic material and upper crust, we estimated qualitatively the relative contributions of these two end-members. In summary, our study underlines the importance of EAWM in controlling the environment in the western Sea of Japan and reveals increasing volcanic contribution since 8 ka,
which is related to the intensity of Liman Cold Current.

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