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High-resolution paleoenvironmental records during the late Quaternary from the marginal seas of East Asia: the intrusion of open-ocean current

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Four long mud-dominated sediment cores (35m-long YSDP 103, 32m-long SSDP 102, 72m-long SSDP103 and 52m-long SSDP 105) were recovered in the continental shelves of Korea and were examined through the analysis of AMS 14C dating, lithology, organic geochemistry and stable isotopes to reconstruct the paleoenvironmental histories during the late Quaternary. These drill cores acquired from the thick Holocene mud deposits allow us to obtain high-resolution paleoenvironmental records concerning the intrusion of open-ocean warm currents triggered by the last deglacial sea-level rise.

Various organic geochemical results (TOC, C/N, C/S, HI, δ13Corg) of core YSDP 103, taken from the southeastern Yellow Sea, showed that terrigenous organic matters were significantly dominant in the southeastern Yellow Sea between 16,600 and 4,300 cal. yr BP probably due to the influence of freshwater derived from an adjacent river and then the dominance of organic matter origin changed to marine type affected by surface primary productivity after 4,300 cal. yr BP. These results may indicate that the marine environment of the southeastern Yellow Sea changed from brackish to a modern-type shelf environment since 4,300 cal. yr BP, implying the intrusion of the open-ocean current. The δ18O values of benthic foraminifer Cibicides lobatulus, however, showed that variation changed from high-amplitude to low-amplitude fluctuations at around 3,500 cal. yr. The time discrepancy of 800 years between organic geochemical proxies and stable isotope proxies is interpreted to reflect that a modern-type shelf environment was not fully developed in the southeastern Yellow Sea until 3,500 cal. yr BP, even though the open-ocean current (Yellow Sea Warm Current) began to flow into the Yellow Sea at 4,300 cal. Yr. BP.

The results of core SSDP 102 collected in the Korean Strait reveal that the area experienced 4 stages of environmental change during the last 13,900 cal. yr BP. Occurrence of well-rounded, oxidized rock fragments at the core bottom indicates that the area was under a fluvial environment before 13,900 cal. yr BP. Between 13,900 and 7,000 cal. yr BP, the dominances of terrigenous organic matters and coarse fractions reflect that the area was changed into the estuarine (deltaic) environment which was directly affected by the Nakdong River. Between 7,000 and 6,100 cal. yr BP, the occurrence of a sand layer with remarkably high coarse fraction and low TOC contents reflects that the temporary erosion occurred in this area probably due to the deceleration of sea-level rising rate. Since 6,100 cal. yr BP, the prevailing occurrences of marine organic matters and the fine-grained sediments indicate that the study area was changed into a modern-type shelf environment under the influence of the open-ocean current (Tsushima Current).

The organic chemical result of core SSDP103 extracted in the central South Sea of Korea close to the Seomjin River mouth, indicates that the area was under a brackish coastal environment like tidal flat and estuarine at the early stage of deposition, which is supported by high occurrence of oyster shell fragments and terrigeneous organic matter. Even though there is some difficulty of age control due to older ages at depth of 33.8m, various geochemical proxies showed that the area began to change into a modern-type marine environment by far before 5.21cal. kyr, supported by increasing TOC, C/N and δ13Corg.

Based on the results of core SSDP 105 collected from the southeastern coast of Korea, the occurrence of large, well-rounded gravel at depths of 34.3 – 32 m reflects that the southeastern coast of Korea was under a shallow coastal environment before 17,500 cal. yr. During the transgressive stage of sea-level between 17,500 and 8,100 cal. yr, this area was more under a coastal environment of erosion rather than the deposition of the fine-grained sediments as indicated by the dominance of coarse fractions. Since 8,100 cal. yr when sea-level rose nearly to the present level, the southeastern coast area began to change into a modern-type shelf environment influenced by the intrusion of the Tsushima Current, which is supported by significantly high TOC contents, high $CaCO_3$ contents, and predominance of marine-type organic matters.

In summary, long mud-dominated Holocene cores provided the opportunity to elucidate the onset of inflow of the open-ocean warm current during Holocene marine transgression in the marginal seas around the Korean Peninsula. The results of four long cores suggest that the timings of intrusion of warm currents are different from each other due to the influence of brackish coastal currents and river discharge rather than increased water depth. Also, a

relative abundance of marine-type organic matter characteristic of oxygen and carbon isotopes showed differences even after establishing a modern-type marine environment, implying that properties of their environments are altered according to the changes of strength between river discharge and open-ocean current at their location.