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Last interglacial to Holocene sedimentation on intertidal to subtidal flats revealed by seismic and deep-core sediment analyses, southwest coast of Korea

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A B S T R A C T

Over the past two decades, tidal flats in the west coast of Korea (eastern Yellow Sea) have been extensively investigated to reveal sedimentation and stratigraphic evolution coupled with sea level changes. In spite of such efforts, their sedimentary record and evolution pattern particularly in the deeper subtidal area are relatively little documented. To expand and fulfill our knowledge on sedimentation history from last interglacial to the Holocene, three drilled cores (up to ca. 28 m in length) and Chirp seismic profiles obtained from the subtidal zones along the southwestern coast of Korea were examined, with supplementary OSL and ^{14}C-AMS age dates. Based on the sedimentary facies analysis correlated with seismic units, the subtidal deposits can be divided into four units: Unit I) basal fluvial deposit (MIS 6?), Unit II) tidal deposits (MIS 5e), Unit III) transition deposits between salt marsh and oxidized inland coastal dune (early Holocene), and Unit IV) Holocene tidal deposits, in ascending order. These units can be then grouped into two sedimentary sequences, a lower sequence S1 (Unit I and II) and an upper S2 (Unit III and IV) separated by an unconformable surface, being responded to two cycles in sea-level fluctuations. Each sequence started with non-marine deposits formed during lowstand in sea-level, and then overlain by tidal successions deposited during transgression. The feature thus indicates two tidal deposits, i.e., last interglacial and the Holocene in ages, preserved in the macrotidal west coast of Korea, possibly being major constituents of coastal successions to be survived in the records. This can be used to correlate with other marine strata in the western (Chinese) Yellow Sea since the last interglacial.

1. Introduction

Coastal-margin sedimentary successions record depositional histories with evidences both of changes in local sea-levels and regional climates, because coastal areas are sensitive to environmental changes. For example, the channel-fill sedimentary deposits of the tidal flat respond to the change of sea level and sediment supply in coastal environments. The prograding channel-flat system will produce a fining-upward sequence with thick sand successions, whereas regressive system contains scant channel-fill deposits with upward-coarsening successions (Dalrymple, 1992; Fan, 2013).

The Yellow Sea is a shallow (average water depth about 55 m), gentle sloped epicontinental sea formed during the Eocene (Chough et al., 2000), having been underwent several subaerial exposures and submergences caused by changes in sea-level and climates during the late Quaternary (Chen et al., 1985; Lee and Yoon, 1997; Jin et al., 2002). Many studies have been carried out to reveal late Quaternary (pre-Holocene to Present) stratigraphic evolution in the western coastal areas (nearshore to coastal plain) of the Yellow Sea using deep drilled cores. The resultant sedimentary deposits have evolved complicatedly in response to sea-level fluctuations and sediment supply by climate changes during the late Quaternary (Marsset et al., 1996; Zhang and Li, 1996; Saito et al., 1998; Li et al., 2000, 2001; Hori et al., 2001, 2002; Berné et al., 2002; Wellner and Bartek, 2003; Liu et al., 2004, 2007, 2010).

In the eastern part of the Yellow Sea, numerous studies have been focused largely in the Holocene deposits (Jin and Chough, 1998; Park et al., 1998; Kim et al., 1999; Chun et al., 2000; Li et al., 2000; Chang

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and Choi, 2001; Yoo et al., 2002; Lim et al., 2003, 2004a; Yang et al., 2006) and less frequently pre-Holocene deposits (Park et al., 1999; Choi et al., 2001; Lim and Park, 2003; Lim et al., 2004b; Yang et al., 2006; Chang et al., 2014). Comprehensive stratigraphic evolution of the late Quaternary including the pre-Holocene, therefore, has been less understood in the eastern coastal areas of the Yellow Sea, compared to their western counterpart.

Seismic survey supplemented with core data and age dates has been widely performed in many coastal setting since the beginning of the 2000's (Dalrymple and Zaitlin, 1994; Lobo et al., 2003; Billeaud et al., 2009; Sorrel et al., 2009; Chaumillon et al., 2010; Tessier et al., 2010, 2012). These served as basic framework for reconstructing coastal paleo-environments in time and space. The west coast tidal flats of Korea (the eastern Yellow Sea) have been extensively investigated for more than two decades, especially their Holocene sedimentary infillings using cores and age dates (Choi et al., 2001; Lim et al., 2003; Yang et al., 2006; Kwon, 2012). However, little information is available from the “white” zone between submerged lower tidal flat and deeper lower shoreface, where poor seismic data can be acquired due to shallow water depth. In spite of such an unfavorable condition, we acquired high-resolution seismic profiles and deep drilled cores (up to ca. 30 m long) in the shallow subtidal-to-intertidal flats of the southwest coast of Korea using a portable compact seismic survey system (Fig. 1). Detailed analyses of these deep-drilled core sediments and seismic profiles with ^{14}C-AMS (Accelerated Mass Spectrometry) and OSL (Optically Stimulated Luminescence) dates bridge the gap of the Quaternary stratigraphy between tidal flat and shelf, and eventually expand our knowledge on stratigraphic evolution in response to changes in local sea-levels and sediment supply rates since the Last Interglacial (MIS 5e, Marine Isotope Stage) in the “blank zone”.

2. Geological setting

The subtidal-to-intertidal flats in the southwestern coast of Korea (Fig. 1), i.e., Baeksu and Duuri tidal flats, are under a macrotidal regime, but, at the same time, are exposed to strong high waves particularly during winter. Subsequently, modern depositional patterns are characterized by alternation of mud-dominated facies in summer and sand-dominated facies in winter (Yang et al., 2005; Baek et al., 2009; Baek, 2010). In summer, thickness of deposited mud reaches about 30 cm over the whole tidal flat. This is because the summer muddy sediments on tidal flats in the southwestern coast of Korea are essentially derived from thick mud belts in the neighboring offshore area rather than river systems (Baek and Chun, 2010). Almost half of tidal flats have been reclaimed for agricultural purposes over the last millennium, thereby initially indented coastal lines became artificial and straight today (Fig. 1).

The Baeksu tidal flat of the study area is located along the southwestern coast of Korea (Fig. 1). Its rocky substrate comprises Precambrian gneiss complex with extrusive Cretaceous volcanic rocks. The tidal flat is 4–6 km wide and 8–10 km long at low tide. Distribution pattern of surface sediments show seaward-fining in grain size trend in winter and seaward-coarsening in summer. Topographic slopes are very gentle with 0.05–0.07° in intertidal flat and 0.07–0.12° in subtidal area on average. Slope gradients are gentler in summer than winter, and at intertidal flat than subtidal flat (Yang, 2006; Baek, 2010). In the subtidal area, sand ridges show ca. 3 m in height and ca. 500 m in width, posing a NE-SW elongation

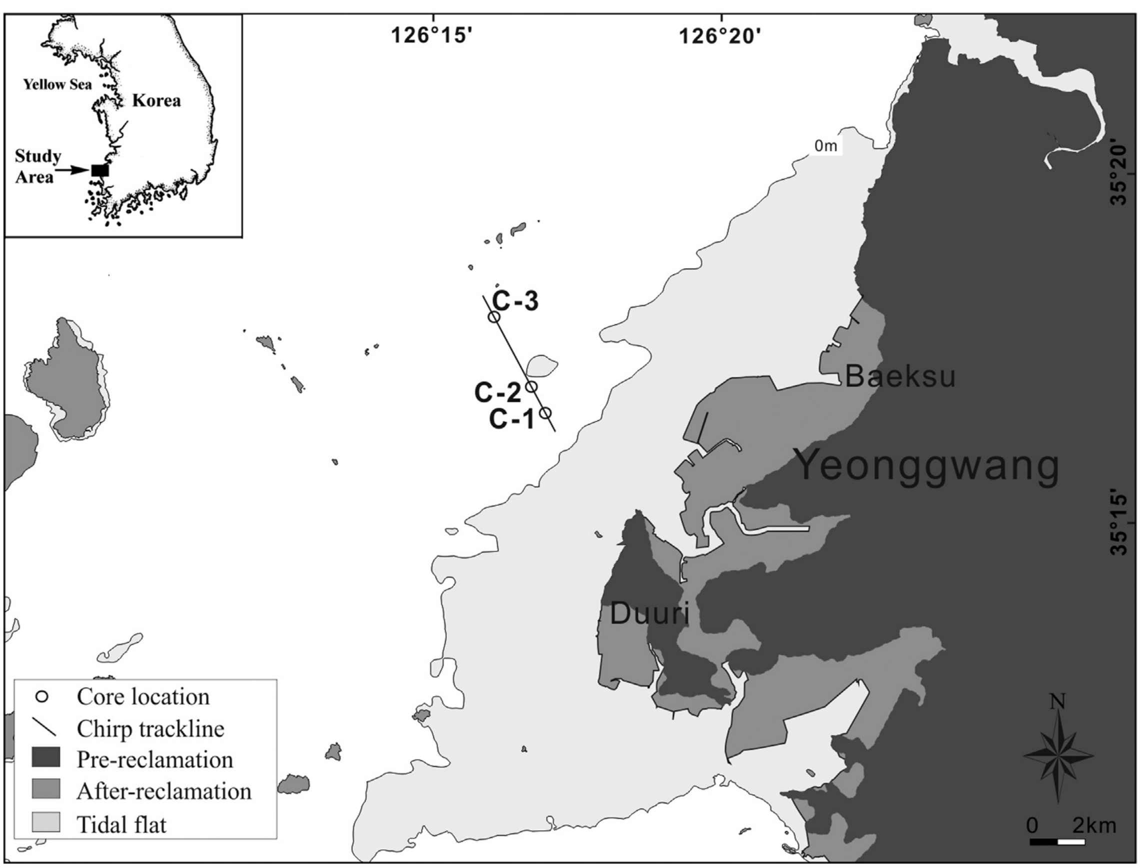

Fig. 1. Location map of Younggwang tidal flat, southwestern coast of Korea, with seismic tracklines and core locations. Seismic lines and core logs are illustrated in Figs. 2 and 3, respectively.