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Late Pleistocene Lowstand Wedges on the Southeastern Continental Shelf of Korea (Korea Strait)

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ABSTRACT

Sparker profiles and sediment cores collected from the Korea Strait show a distinct pattern of stacked prograding wedges consisting of three distinct units. These wedges are interpreted as the lowstand deposits formed during glacioeustatic sea-level lowstands. Repeated sea-level falls during late Pleistocene with high sediment discharge from the paleo-Nakdong River system resulted in the formation of thick lowstand wedges.

INTRODUCTION

Posamentier et al. (1988) demonstrated the presence of the deposits associated with low sea-level conditions on the shelf, i.e. "shelf-perched lowstand wedges", which reflects regressive wedges of coastal-deltaic sediments prograding seaward over the outer shelf and slope. These sedimentary packages commonly show seaward prograding reflection patterns mainly characterized by complex sigmoid-oblique clinoforms on seismic profiles. The occurrence of lowstand shoreline and regressive facies associated with relative sea level fall on the outer shelf has been documented by a number of workers (Aksu and Piper, 1983; Suter and Berryhill, 1985; Kindinger, 1988; Tesson et al., 1990; Field and Trincardi, 1991; Ercilla et al., 1994).

The study area (Korea Strait) is located on the southeastern part of the Korean Peninsula and Tsushima Island (Fig. 1). The sedimentary packages characterized by seaward prograding reflection patterns exist on the outer shelf of the Korea Strait. In this study, we discuss the distribution pattern and acoustic characters of the stacked complex of the late Pleistocene lowstand wedges on the shelf margin.

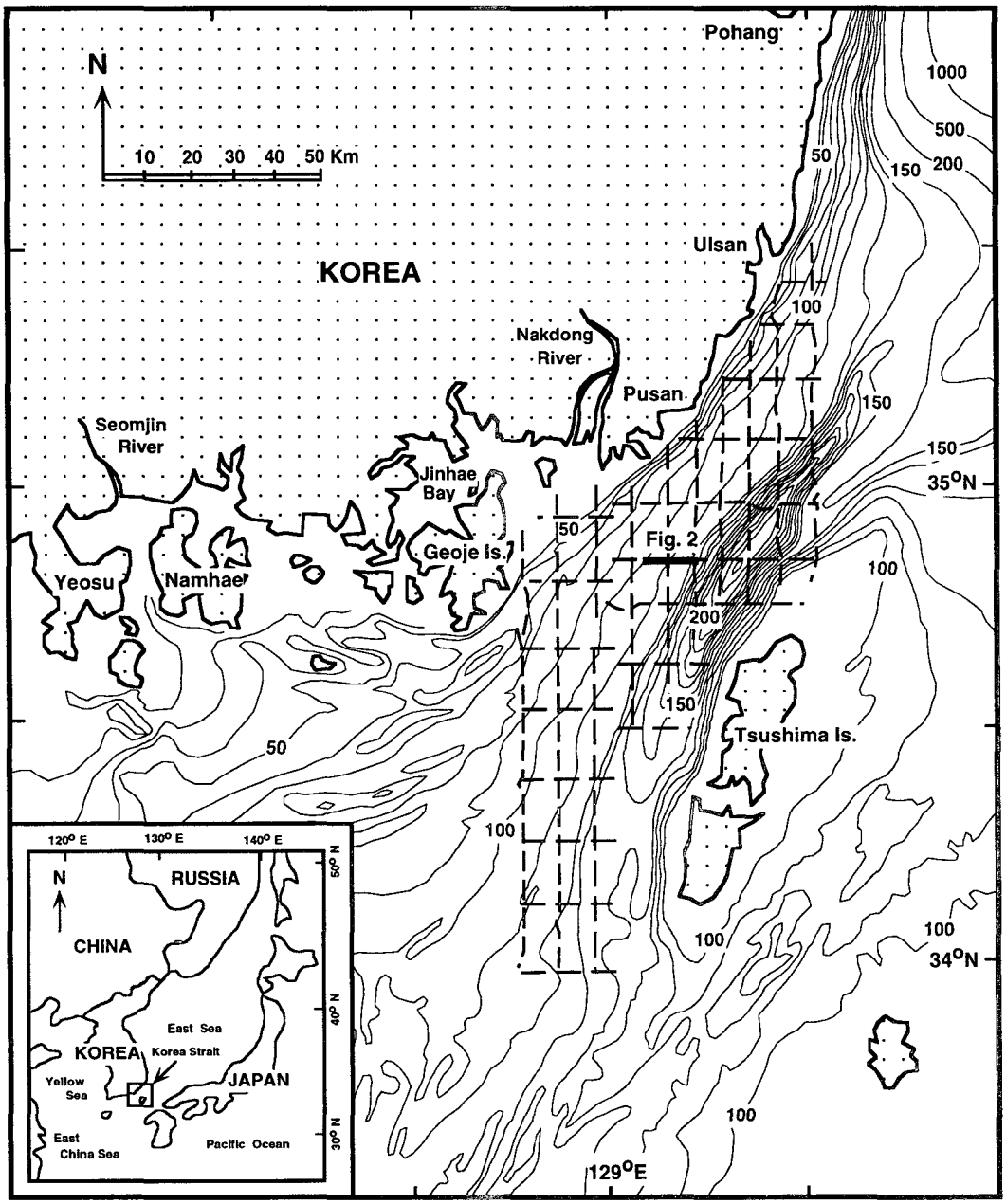

Fig. 1. Bathymetry (solid lines; contour interval 10 m) and tracks (broken lines) of sparker seismic profiles of the study area. Heavy lines denote the selected profile shown in Fig. 2.

ACOUSTIC CHARACTERS OF SEDIMENTARY WEDGES

Most of the seismic sections across the shelf margin of the Korea Strait exhibit vertical stacks of thick, laterally extensive sedimentary deposits. The sedimentary package overlying the older sedimentary sequence is characterized by a series of superimposed wedge-shaped units that thicken seaward. Three wedge-shaped units (A, B and C in ascending order) are separated by continuous, high amplitude reflectors on the sparker profiles (Fig. 2). Each unit shows seaward dipping clinoforms characterized by sigmoidoblique or shingled reflections. Some chaotic or hummocky reflectors are also observed in these units. The lower unit (A) above the older sedimentary strata occupies the shelf margin and trough region. This unit is characterized by subparallel to progradational reflection configurations (mainly complex sigmoid-oblique type) with some hummocky reflectors. Unit A becomes thinner and pinches out at water depths of about 90-110 m.

The middle unit (B) can be traced over a wide area of the shelf margin and trough regions. It is characterized by gently seaward-dipping reflectors. Some show chaotic or hummocky reflection patterns. Unit B in turn onlaps the upper surface of unit A and pinches out at water depths of about 100-110 m.

The upper unit (C) occurs on the shelf margin and in the trough region and generally onlaps onto the top surface of unit B. This unit, as in the case of unit A, shows seaward-dipping reflectors featured by parallel to oblique prograding reflection patterns. On the steep northern slope of the trough with a gradient of about 1.2-1.5°, the upper surface of unit C shows erosional scarps caused by sediment failure due to sliding and slumping. The slumped blocks in the trough region show acoustically chaotic or hummocky reflection patterns, whereas sediments due to sliding are relatively well-stratified. The area distribution of the sediments is limited to the base of slope in the central and northern part of trough. Unit C, onlapping onto the top surface of unit B, pinches out at water depths of about 110-120 m, and is as thick as 45 m on the southwestern margin of the trough.

EVOLUTION OF SEDIMENTARY WEDGES

The development of the sedimentary sequence on the Korea Strait shelf was controlled by the Quaternary fluctuations of sea level coupled with high sediment discharge from the Nakdong River (Park and Choi, 1986; Park and Yoo, 1988, 1992; Min, 1994). The most characteristic reflection configuration of the shelf margin deposits is seaward progradational clinoforms with complex sigmoid-oblique or shingled reflections. This reflection pattern, in general, represents deltaic progradation or depositional outbuliding seaward. The landward limit of unit C, which onlaps the underlying surface at 110-120 m water depth, indicates that this unit may have been deposited when relative sea level was lower than the present level. Units A and B, onlapping the mid-shelf between 90 and 110 m water depth, may also repre-

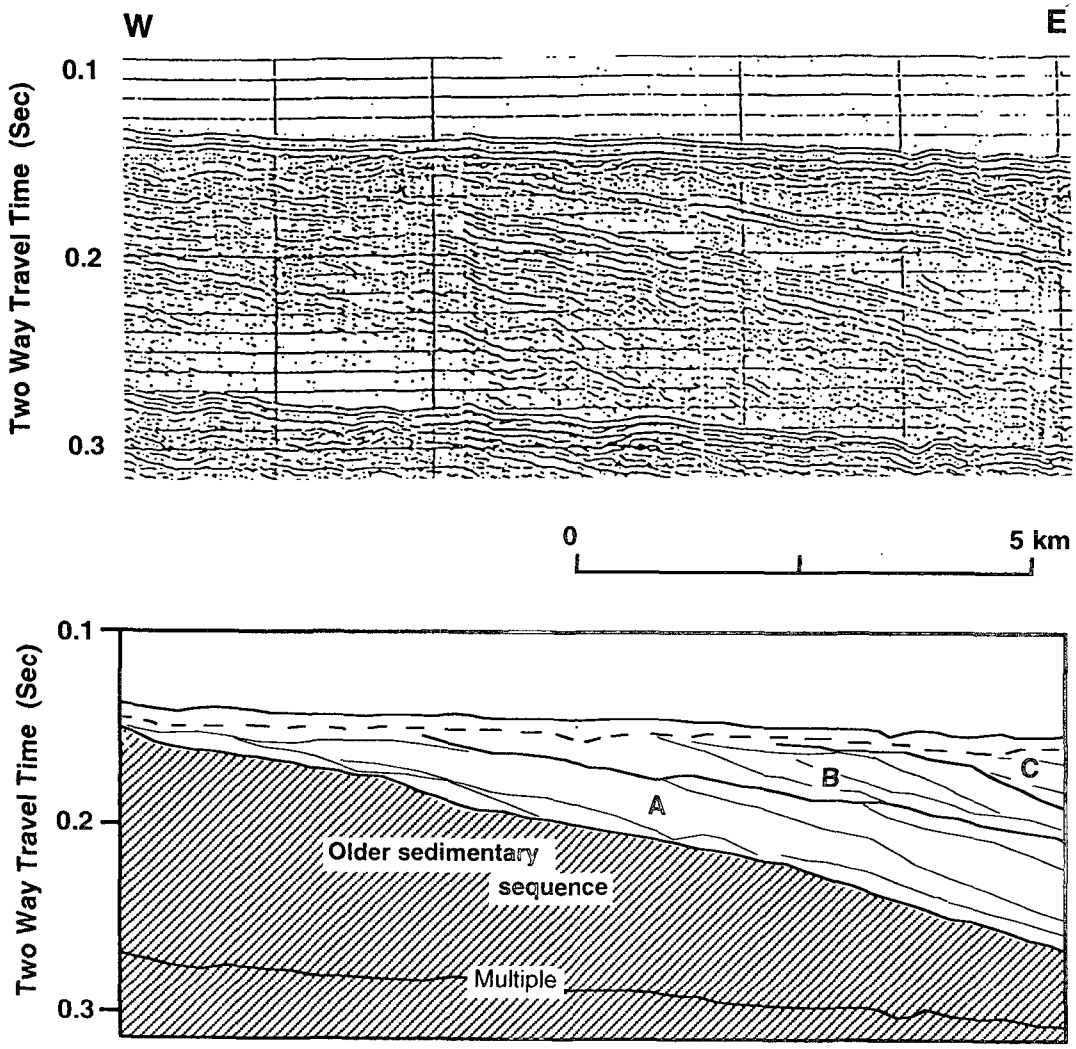

Fig. 2. Sparker seismic profile and interpretation from the shelf margin (for location, see Fig. 1), showing three sedimentary wedges (A-lower, B-middle, C-upper) and thin basal layer directly overlying these deposits.

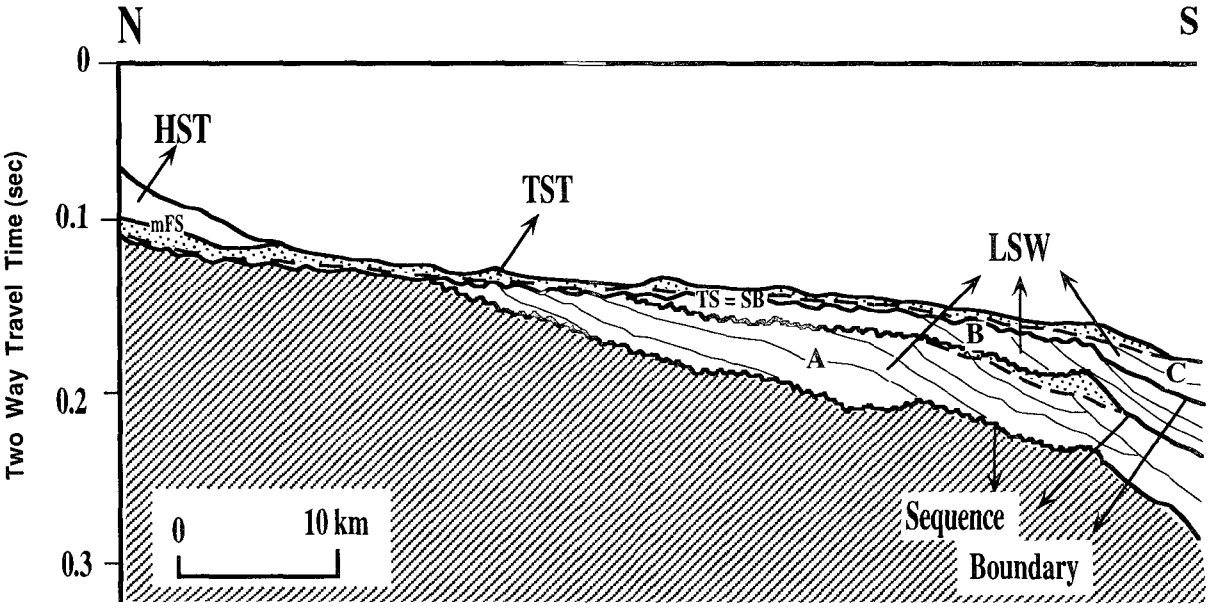

Fig. 3. A simplified stratigraphic model of the Korea Strait interpreted from seismic profiles. At least three times of sea level falls during the latest Pleistocene have resulted in the formation of widespread, thick lowstand wedges on the shelf margin and trough region. The transgressive systems tract directly overlies lowstand wedges over a wide area of the shelf, while the highstand systems tract is confined to the inner shelf. HST = highstand systems tract, TST = transgressive systems tract, LSW = lowstand wedge (A-lower, B-middle, C-upper), mFS = maximum flooding surface, TS = transgressive surface, SB = sequence boundary.

sent lowstand wedges mainly formed during relative sea-level fall. Additionally, the formation of lowstand wedges is inferred to be closely related to the extension of the paleo-Nakdong River during sea-level lowstand. Park and Yoo (1992) reported a buried paleo-fluvial system that extended onto the shelf margin during the last glacial period. This river may have supplied large amounts of clastic sediment to the shelf margin and trough region to form progradation of sedimentary wedges. Figure 3 is a stratigraphic model for the shelf sediments of the Korea Strait based on seismic profiles. Units A, B and C on the shelf margin and trough region are considered to be a lowstand wedge of the lowstand systems tract, while the inner shelf deposits are the highstand systems tract formed during the recent sea-level highstand. The thin sand layer directly overlying the lowstand wedges is interpreted to be the transgressive systems tract formed by shoreface erosion during the transgression following the sea-level lowstand.

SUMMARY

A series of superimposed, lowstand wedges on the Korea Strait shelf is comprised of three stratigraphic units (A-lower, B-middle, C-upper unit) separated by erosional unconformities. Repeated sea-level falls with high sediment discharge from the paleo-Nakdong River resulted in the deelopment of stacked, thick prograding lowstand wedges on the shelf margin and in the trough region.

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