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OSL chronology and accumulation rate of the Nakdong deltaic sediments, southeastern Korean Peninsula

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ABSTRACT

Optically stimulated luminescence (OSL) dating was performed on Late Quaternary deltaic sequences from a 55-m-long core sampled from the Nakdong River estuary, Korea. OSL ages obtained from chemically separated fine (4–11 μm) and coarse (90–212 μm) quartz grains ranged from 29.4 ± 2.6 to 0.4 ± 0.04 ka, revealing clear consistency between the grain-size fractions. The D_e values from the standardized growth curve (SGC) are consistent with those from the single-aliquot regenerative-dose (SAR) procedure, which suggests that the SGC is valid for the Nakdong deltaic sediments. The ^{14}C ages of shells and wood fragments ranged from 11 to 2.9 ka, demonstrating reasonable agreement with the OSL ages, within the error range. However, the limited number and random sampling interval of the ^{14}C age data (10 ages) result in a simple linear and exponential trend in the depth–age curve. In contrast, OSL ages obtained by high-resolution sampling show down-section variations in the depth–age curve, indicating the occurrence of rapid changes in sedimentation rate. It is suggested that the high-sampling-resolution OSL ages provide a more realistic and detailed depth–age curve and sedimentation rate. The Nakdong deltaic sediments were divided into five units based on sedimentation rate. The lowest (unit 5) shows a break in sedimentation between the last glacial maximum (LGM) and the Holocene. The sedimentation rate increased in units 4 and 3, presumably corresponding to the early to middle Holocene sea level rise and high stand. Unit 2 shows a gradually decreasing sedimentation rate following the regression of the shoreline, until about 2 ka. The progradation of the Nakdong River delta resulted in the rapid accumulation of unit 1 during the last 2000 years.

1. Introduction

Abundant sediment supply and ample accommodation space have led to thick sediment accumulations and the development of the major Late Quaternary Nakdong deltaic sequence in the southeastern coastal area of the Korean Peninsula. This deltaic area is important for reconstructing sea level changes during the late Quaternary. Although several recent studies have examined the Holocene evolution of the Nakdong River delta (Lee and Chung, 2000; Park et al., 2000; Yoo and Park, 2000; Yoo et al., 2011, 2014), little is known about the timing of the major sedimentological changes. A general chronology has been developed for the Nakdong deltaic sediments based on ^{14}C dating. However, 'old carbon' effects associated with bulk samples and reservoir effects from marine biological products make it difficult to obtain proper samples and a consistent sampling interval throughout the sequence for ^{14}C dating (Kim et al., 2012). However, a high-resolution chronological framework and the reconstruction of coastal environments can be achieved when the collection of dating samples is closely spaced (López and Thompson, 2012). Optically stimulated luminescence (OSL) dating can provide highly detailed sample data at regular intervals, and it is applicable over a longer time range than ^{14}C dating. OSL has been successfully used for dating the world's major delta sequences (Sanderson et al., 2003, 2007; Zhao et al., 2008; Tamura et al., 2012). However, OSL dating has yet to be successfully applied to deltaic sediments in the Korean Peninsula. In this study, we test the applicability of quartz OSL dating for the Late Quaternary deltaic sequences in the Nakdong River estuary. The OSL results were systematically compared with ^{14}C dating results. This study provides a new precise chronology and more a detailed accumulation record for the Nakdong deltaic sequences.

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2. Study area and sample preparation

The southeastern coastal area of the Korean Peninsula is primarily influenced by the Nakdong River, the second largest fluvial system in Korea, which has produced a thick accumulation of deltaic sediments. The Nakdong River drains an area of 23,817 km^2, and the main stream is over 525 km long (Park and Lee, 2002). The study area preserves a record of sea level changes. It was completely exposed during the last glacial maximum (LGM), resulting in subaerial erosion. In contrast, postglacial transgression formed different sedimentary units derived from coastal and estuarine systems. Previous investigations (Park and Yoo, 1988; Suk, 1989; Min, 1994) have shown that glacio-eustatic sea level fluctuations coupled with the sediment discharge from the Nakdong River were significant factors controlling the sedimentary processes in this area during the Late Quaternary.

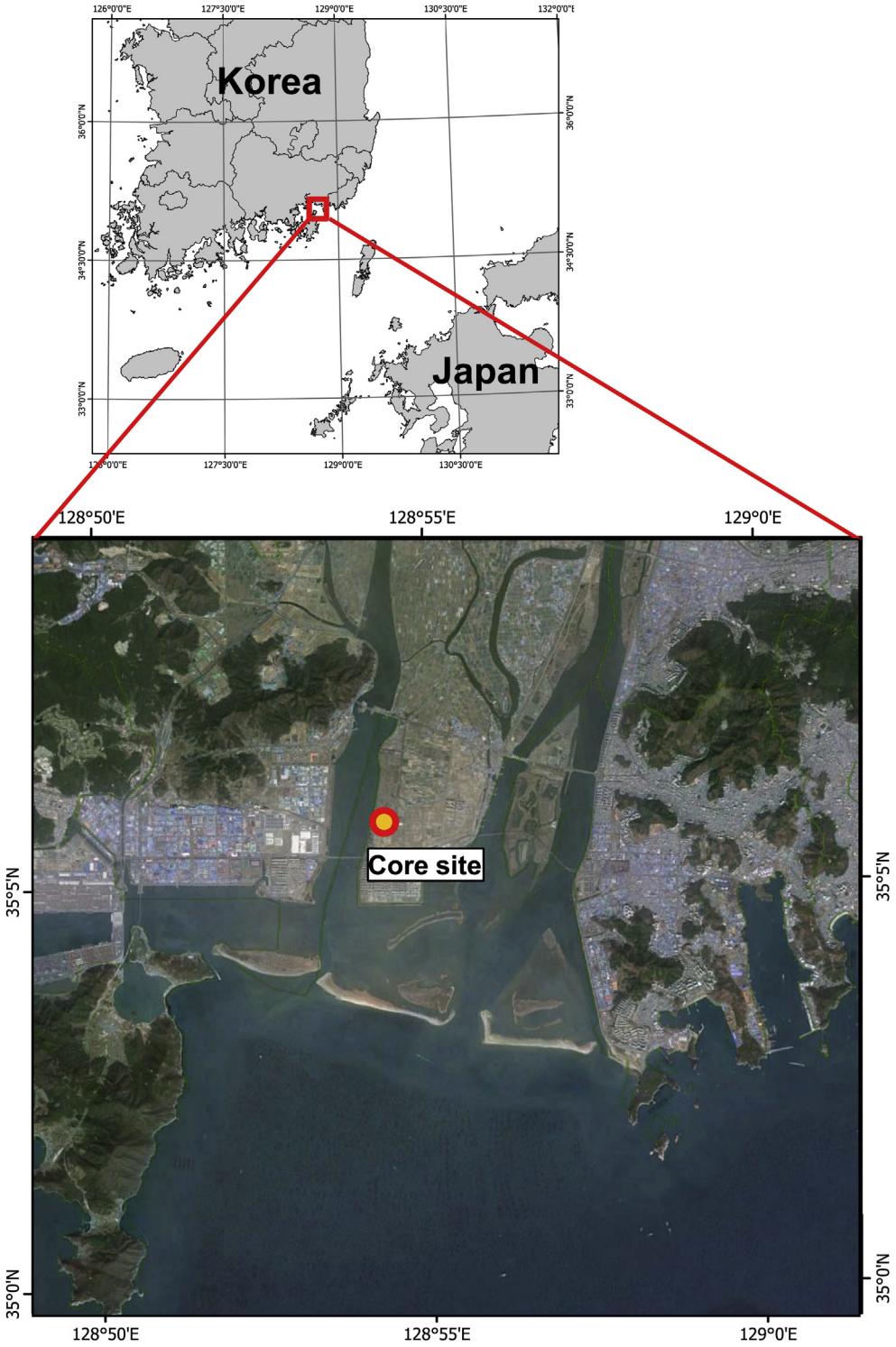

Fig. 1. The location of Nakdong deltaic area.

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