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Textures, provenances and structures of sediment in the inner shelf south of Shandong Peninsula, western South Yellow Sea

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ABSTRACT

Although many studies have been performed on the mud wedge in the distal part of the Yellow River subaqueous delta, little is known about the southwestern terminus of the Yellow River mud wedge in the inner shelf of the Southern Yellow Sea (SYS). We use ~3000 km of high-resolution subbottom seismic profiles, 147 surficial sediment samples, as well as 30 fluvial sediment samples to study sediment textures, provenance and structures in the inner shelf in western SYS. Our results show that sediment in the inner shelf south of Shandong Peninsula can be categorized into multiple types, including sand, silt, sandy silt, muddy sand, mud, gravel mud and others. About 60% of the study area is covered by silt and sandy silt. Assuming a finer texture of sediment from Yellow River and a relatively coarser one for sediment from local small rivers, our results reveal at least two contrasting sediment sources. East of the Laoshantou Headland, on the southern coast of the peninsula, the sediment is mainly from the Yellow River. Holocene sediment deposition reaches about 15 m thickness in water depths of ~10 m. The homogeneous surficial sediment pattern is mainly controlled by the Yellow Sea Coastal Current, the Yellow Sea Warm Current, as well as local currents. However, west of Laoshantou Headland, sediment from local small rivers draining the peninsula plays a more important role. Over there the Holocene mud wedge is no more than 5-m thick, and is re-worked by strong tides and longshore currents. The seaward extension of Laoshantou Headland the southern peninsula seems to act as an effective sediment trap, aiding the accumulation of sediment carried by longshore currents. This new study delineates the western boundary of Yellow River subaqueous delta and helps better quantify sediment budget in the Yellow Sea. It also shed light on the sedimentation interplay of large rivers with local small rivers on many epicontinental shelves and passive margins around the world.

1. Introduction

The distribution of marine sediments is generally controlled by the source and depositional environment. Sediment grain sizes and types are important for the understanding of sediment transport and depositional mechanisms in the modern environment, as well as for explaining depositional processes and sediment dynamics over geological time scales (Gao and Collins, 2014). In this study we investigate the terrigenous sediment that forms a depositional system in the Southern Yellow Sea (SYS) under the influence of complex current systems. Previous studies were conducted on the mud depositional system in the Northern Yellow Sea (NYS) and central SYS regions, focusing on the sediment origin, paleoclimate, and transport mechanisms (Milliman et al., 1987; Cheng and Gao, 2000; Shi et al., 2002; Liu et al., 2002, 2007, 2004; Yang and Liu, 2007; Wang, 2009). Yang and Liu (2007), for instance, reported a large and elongated mud belt in the distal part of the Yellow River subaqueous delta, wrapping along the coast of Shandong Peninsula (Fig. 1). Line spacings of seismic profiles used by Yang and Liu (2007), however, were on the scale of 10 s km which makes it challenging to delineate the exact boundary of the Yellow River subaqueous delta and its detailed structure. Little research has been carried out concerning mud deposition on the inner shelf south of the Shandong Peninsula (Zhao et al., 1991). The Yellow River is the second largest river of the world in terms of sediment loads. Over the last several

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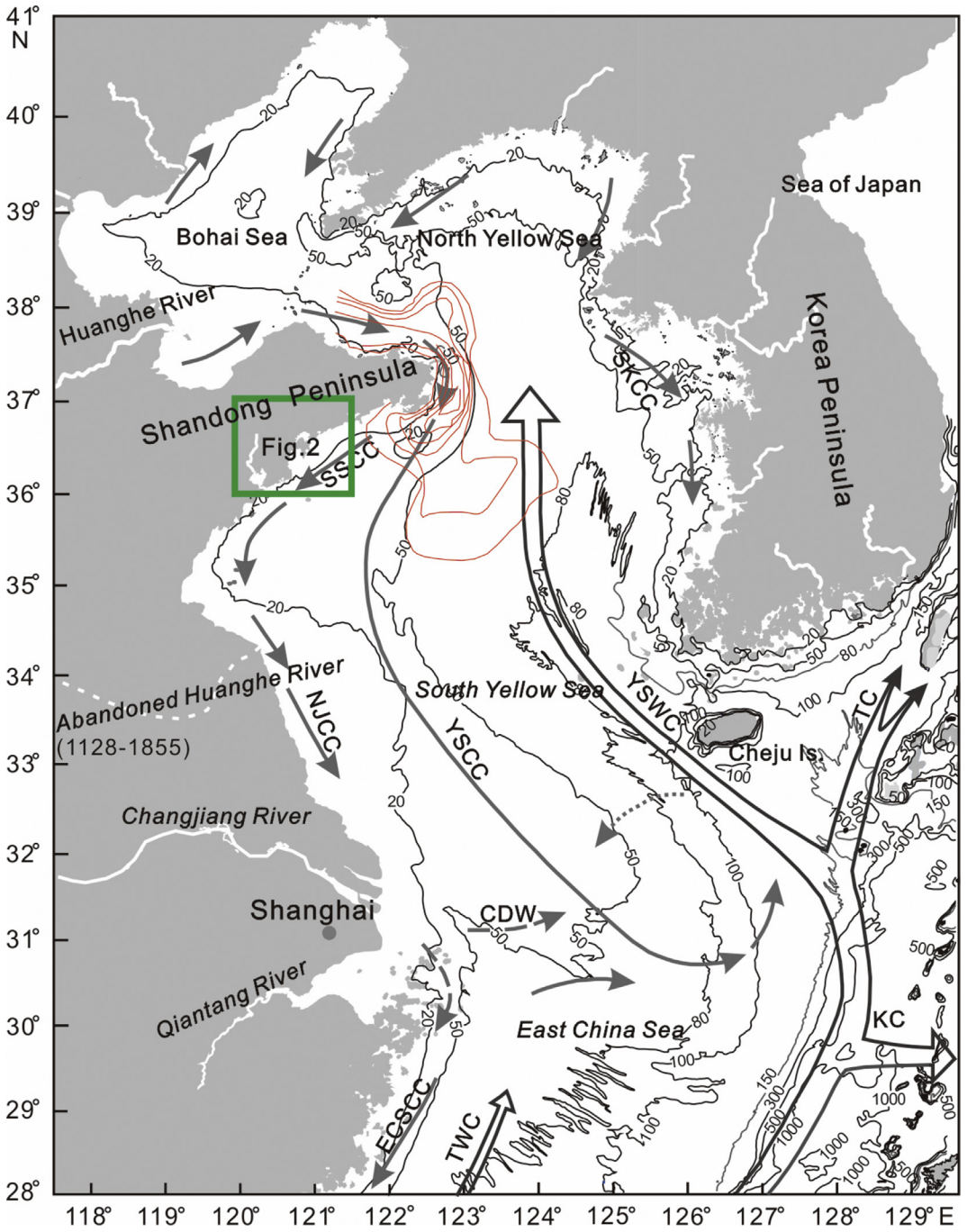

Fig. 1. Study area (green rectangle represents the area of Fig. 2) and isopach map of Yellow River-derived sediment discharged to the sea (after Yang and Liu, 2007). KC: Kuroshio Current; YSWC: Yellow Sea Warm Current; TC: Tsushima Current; YSCC: Yellow Sea Coastal Current; SKCC: South Korean Coastal Current; SSCC: South Shandong Coastal Current; NJCC: North Jiangsu Coastal Current; CDW: Changjiang Diluted Water; ECSCC: East China Sea Coastal Current; TWC: Taiwan Warm Current. (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

thousand years, it has discharged $\sim 1.08 \times 10^9$ t/yr of sediments into the Bohai Sea (Milliman and Meade, 1983). Previous studies reported that the fine sediment from the modern Yellow River is deposited along the southeast coast of Shandong Peninsula (Fig. 1) and bypasses the eastern tip of the peninsula via the Yellow Sea Coastal Current (Qin and Li, 1986).

Here we use historical and new surficial sediment samples and new high-resolution seismic profiles acquired from the inner shelf south of Shandong Peninsula to identify sediment sources and study transport mechanisms using grain size and sediment type data. Besides the Yellow River-derived sediment, sediment can also be transported to the inner shelf south of the Shandong Peninsula from several smaller local rivers such as the Rushan, Wulong and Dagu Rivers (Fig. 2). Because the Yellow Sea has a wide and gentle continental shelf with abundant sediment supply, it is an ideal place to study sediment transport processes and the interactions between an isolated large, and multiple line-sourced smaller, river systems. Findings from this study can help improve our understanding of the long-distance sediment dispersal pattern for the large river (one of the largest sediment supplies recognized globally, Milliman and Meade, 1983), as well as longshore sediment transport processes on many other sediment-rich epicontinental shelves and passive margins around the world.