

Research Advances

The Age of the Old Transgression Sequence in the Pearl River Delta, China

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1 Introduction

The Pearl River Delta (PRD) is located in the north coast area of the South China Sea (SCS). As one of the largest delta in China, only the two latest events among the several tens of eustatic fluctuations occurring in the Quaternary were recorded in almost whole area of the PRD. There has been consensus on the age of the younger transgression sequence, which was dated to the Holocene and resulted from a postglacial sea level rise, while there has long been debated on the age of the older transgression sequence of the delta with the altitude between -15 m and -35 m, which was previously dated to MIS3 to early MIS2 using ^{14}C and TL (Thermoluminescence) techniques. This is really a controversial topic because during this period the global sea level was falling into at least -50 m, which does not match the altitudes of the older transgression sequence and only MIS5 global sea level could lead to transgression in the delta. The wide disparity on the time and sea level of MIS3 and MIS5 results in various explanations. The upper limit of ^{14}C dating (~ 43 ka) may restrict the ability to obtain an old age. It has been verified that the TL dating is problematic applying on sediments. By exploiting multiple techniques of the OSL (Optically Stimulated Luminescence) dating and sequence stratigraphy connecting the present PRD and north continental shelf of the SCS, we have obtained a new and more reliable age to the old transgression sequence of the PRD.

2 Method

2.1 Multiple OSL datings

Samples were collected at the Meishan terrace and boreholes in the PRD plain. Coarse-grained ($180\text{--}212\text{ }\mu\text{m}$), fine-grained ($4\text{--}11\text{ }\mu\text{m}$) quartz and coarse-grained ($180\text{--}212\text{ }\mu\text{m}$) feldspar were extracted from the samples and their luminescence signals were measured on Risø TL/OSL-DA-20 readers at Luminescence Research Labs both of Sun Yat-sen (China) University and Aberystwyth (UK) University (the most distinguished OSL Lab. in the

world). The SAR (single aliquot regenerative dose) protocol was used for De measurements. The analyses of De distribution, saturation characters and other parameters ensure the quality of OSL ages. It is the first time of systemic OSL dating of coarse-grain quartz and feldspar in the PRD. All of the results approximately cluster to a narrow range.

2.2 Sequence stratigraphy

In order to reveal the relationship between depositional sequences and marine isotope stages (MIS) in the late Quaternary, for the first time we integrated the borehole transects in the PRD and seismic stratigraphic profiles on the north continental shelf of the SCS using the sequence stratigraphy method. The stratigraphy evolution model of the coastal area of the north SCS during the past 200kyr is recognized and compared to OSL ages from modern PRD.

3 Results

3.1 Multiple OSL datings

The bottom sandy layer of the Meishan terrace is dated to 74.3 ± 2.7 ka using coarse-grained quartz OSL dating. In the boreholes adjacent to the Meishan terrace, the coarse-grained quartz OSL dating suggests the oldest age of 88.5 ± 6.1 ka and the coarse-grained feldspar pIR-IRSL dating reaches 98.2 ± 8.3 ka, which can be correlated to the Meishan terrace. In the borehole in the south delta plain, coarse-grained quartz OSL dating gives the oldest age of 113.6 ± 13.8 ka in the bottom deposit (Fig.1). All of them approximately match MIS5.

3.2 Sequence stratigraphy

Six sets of sequence stratigraphy and system tracts of each sequence on the north continental shelf of the SCS, are identified (Fig. 1). The HST of sequence D, which indicates the high sea level during MIS5, can be correlated with the old transgression sequence in the PRD. While sequence C which indicates the transgression during MIS3, did not extend northward to the modern delta area, where only fluvial sediments and weathered deposits were found during the MIS4-MIS3 transgression and the MIS3-

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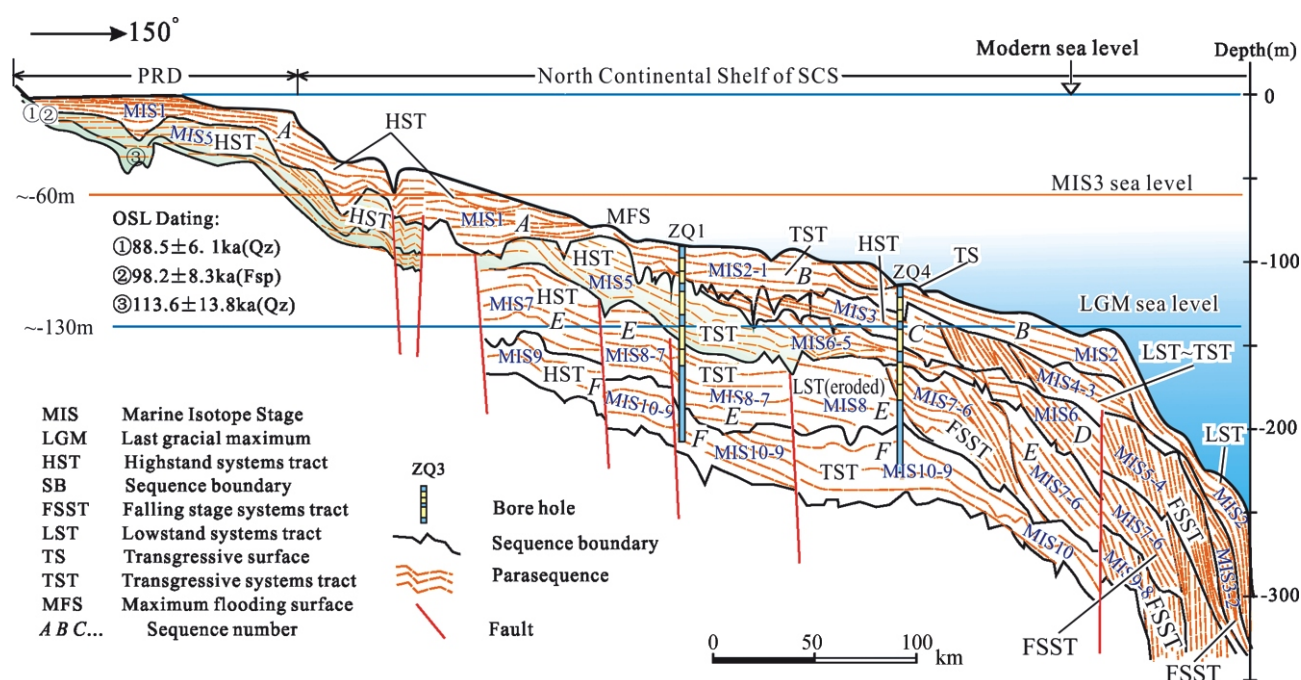


Fig. 1. Sequence stratigraphic profiles from the PRD to the north continental shelf of the SCS.

MIS2 regression. The upper transgression cycle, represented by sequence B (LST-TST), A (HST), and the upper sequence of the PRD, indicates the rapid sea level rise after the Last Glacial Maximum to the Holocene. The sequence stratigraphy interpretation supports our OSL ages.

4 Conclusions

(1) The old transgression sequence of the PRD formed during MIS5. The transgression during MIS3 on the north continental shelf of the SCS did not extend northward to the modern delta area.

(2) The sea level changes reflected by the transgression-regression cycles in the north SCS are consistent with global eustatic fluctuation. It is unnecessary to explain higher sea level along the north SCS than that of other places around the world in MIS3.

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