Interaction between South China Sea deep circulation and the northwestern Pearl River Mouth Basin

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Abstract: *Since Late Miocene the supply of the South China Sea deep water by the Pacific and Indian Ocean waters decreased in the course of tectonic sea basin closing with only shallow waterways remaining as outside connections. A sequence stratigraphic analysis has been applied in the NW Pearl River Mouth Basin (PRMB) using multichannel seismic data collected during R/V SONNE Cruise SO-221 in May 2012. The data show that in the Yitong Ansha (YA) rifted continental block a sedimentary environmental change occurred in Late Miocene when a leeward carbonate reef oriented toward NE is replaced by open shelf conditions influenced by a SW bottom water current interpreted as the SCS-Western Boundary Current. The interaction between the SCS-Western Boundary Current and the basin topography subsiding into different water masses generated a giant elongated detached drift, the YA Drift, fed by a mixed turbidite-contourite depositional system.*

Key words: *South China Sea Western Boundary Current, Yitong Ansha Drift.*

INTRODUCTION

After spreading of the South China Sea (SCS) ceased in the middle Miocene, benthic foraminifer stable isotope records from ODP Leg 184 on the northern slope margin, at 13.87 Ma, suggest a reorganization of regional ocean circulation of the deep Pacific Ocean into the SCS (Wang et al., 2000). The restriction of the Indonesian Gateway and subduction of the Luzon arc beneath the SCS margin maintained exchange of surface water but deep water inflow to the SCS today occurs only through the Luzon Strait originating the SCS Western Boundary Current flowing alongslope toward SW (Fig. 1) The main objective of this study is to associate the sedimentary succession in the NW Pearl River Mouth Basin (PRMB) to the evidences of the Late Miocene current reorganization by establishing a sequence stratigraphic framework including the interaction between current related alongslope transport with gravity driven downslope transport (Brackenridge et al., 2011).

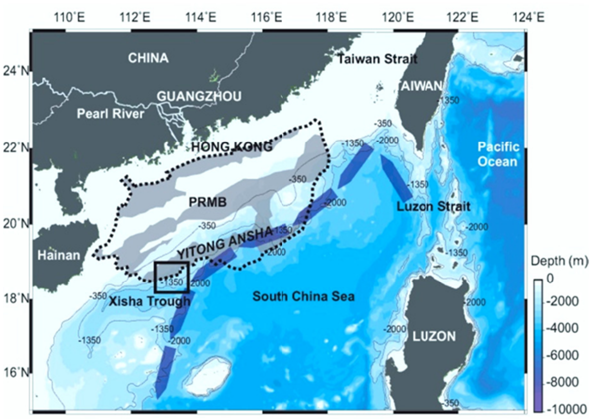

FIGURE 1. Location of the study area in the NW Pearl River Mouth Basin (PRMB) and main direction of the South China Sea Western Boundary Current (blue arrows).

DATA AND METHODS

High-resolution multichannel seismic and bathymetric data were collected during Cruise SO-221 in May 2012 in the Yitong Ansha (YA) rifted continental block in the NW PRMB (Fig. 1). After data processing, the seismic profiles have been interpreted based on seismic facies recognition in the common PRMB lithostratigraphy (Lüdmann and Wong 1999), on sequences distribution and on accumulation rate (Clift et al., 2014).

SEISMOSTRATIGRAPHIC INTERPRETATION

Strong hyperbolic reflections are interpreted as volcanic material injected through the YA continental basement in the middle Miocene during early post-rift phase (Fig. 2). Two satellite basins formed while syn-rift deposits (U6, U5 and U4) were deformed and displaced. A regressive-transgressive clinoform set within U3 on the NE flanks of the volcanic intrusions is interpreted as a leeward carbonatic reef developed from middle toward late Miocene influenced by a surface current directed toward NE. Following the late Miocene reef drowning unconformity, the progradation direction turned toward SW. Mounded onlap terminations at the morphological highs, well defined convex upward onlapping sequences at the low relief together with downlap terminations toward SW at the base of slope of the volcanic intrusions are observed within U2-U1. Such a stacking pattern clearly shows the influence of a bottom current interpreted as the SCS-Western Boundary Current according to similarity of the present day condition with respect to the strata continuity.

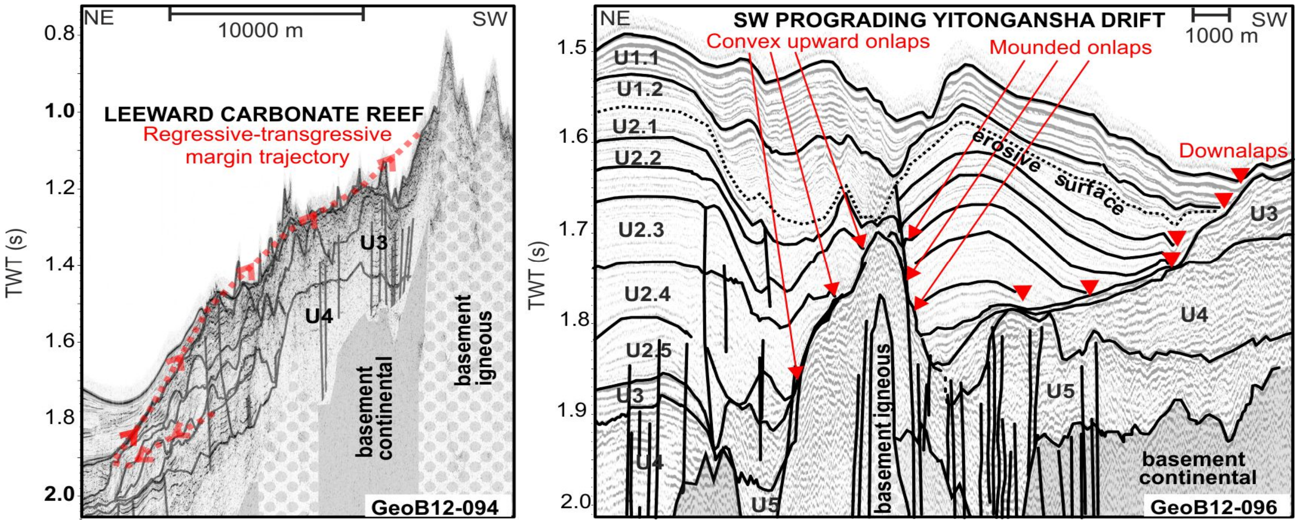

FIGURE 2. Interpreted profile GeoB12-094 on the NE flank of the volcanic intrusions showing the margin trajectory of a leeward carbonate reef formed from Middle to Late Miocene (right). The left image shows part of profile GeoB12-096 along Yitong Ansha Drift prograding SW toward the base of slope of the volcanic intrusion from late Miocene to present..

EVOLUTIONARY STAGES OF THE YA DRIFT

Several sub-units within U1-U2 can be defined, each of them constrained by a distal downlap termination and internally showing a persistent transgressive trend. In the course of the late Miocene (U2.5), a slope fan prograding seaward merged with a wavy sheet unit prograding landward, and formed a giant elongated detached drift, the YA Drift, as a niche-like trap. A debris flow channel with symmetrical levees is incised into unit U2.5. The terrigenous supply from the debris flow channel added to the hemipelagic drift components, resulting in a mixed turbidite-contourite depositional system. The incision became filled at the onset of deposition forming Unit U1.2 of early Pleistocene age when widespread erosion and scouring units occurred (Fig. 2). A dynamic equilibrium *sensu* Preu et al. (2013) between current and particle settling is restored in late Pleistocene within seafloor undulations that in cross section appear as prograding packages infilling the moat and scours in the uppermost Unit U1.1

DISCUSSION AND CONCLUSIONS

The current re-orientation from NE within U3 toward SW within U1-U2 may indicate a change in direction in the late Miocene. An intensification of bottom current activity during the early Pleistocene may be associated to U2.1. However, based on the mean slope subsidence rate (Xie et al., 2006), the igneous intrusions left the surface in late Miocene when the current reorientation is observed. They also move out of the surface circulation (>350 mbsl) during transition from Pliocene to Pleistocene, exactly when erosion, scouring and the moat incision are also observed. When margin subsidence into different water masses modifies the flow regime at the base of slope, it becomes difficult to derive considerations on global scale deep sea oceanic circulation. It can be therefore concluded that:

1) The sedimentary environment succession in the NW PRMB records the chronohistory of the SCS slope margin subsiding from the surface to the lower intermediate water.

2) The effect of subaqueous paleo-topographies which no longer exists must be taken into adequate account before drawing general conclusions on global current regimes.

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