Tectonophysics 677–678 (2016) 190–198

Contents lists available at ScienceDirect

Tectonophysics

journal homepage: www.elsevier.com/locate/tecto

Seismic evidence for Mesozoic strata in the northern Nansha waters, South China Sea

Yanlin Wang [a,*], Yan Qiu [b], Pin Yan [a], Hongbo Zheng [a], Hailing Liu [a], Jun Wang [b]

[a] CAS Key Laboratory of Marginal Sea Geology, South China Sea Institute of Oceanology, CAS, No. 164 West Xin'gang Rd., 510301 Guangzhou, China
[b] Guangzhou Marine Geological Survey, P.O. Box 1180, Nan'gang, 510760 Guangzhou, China

ARTICLE INFO

Article history:
Received 30 November 2015
Received in revised form 1 April 2016
Accepted 2 April 2016
Available online 8 April 2016

Keywords:
Nansha waters
Lower structural layer
Angular unconformities
Velocity leap
Mesozoic
Proto-South China Sea

ABSTRACT

According to previous studies, Mesozoic deposits have been unequivocally identified in the northeastern Nansha waters (southern margin of the South China Sea, SCS). Thick lower structural layers in the north Nansha waters have not clearly been identified as either Mesozoic or Cenozoic strata. These strata are characterized by strong top erosion, tilted layer or folded anticlines. New long-offset multi-channel seismic data show refracted phases from the top of the lower structural layer in the northern Nansha waters. A major velocity leap (approximately from 1.6 km/s to 3.8 km/s or 2.9 km/s to 5.3 km/s), calculated from the refraction wave of seismic data, is found across a prominent angular unconformity, indicating a major sedimentary hiatus. According to the stratigraphic characteristics and velocity range of the lower structural layer, velocity leap at the top of lower structural layer and ubiquitous absence of upper Cretaceous strata in the Nansha waters, the lower structural layer of the northern Nansha waters are interpreted as Mesozoic. Based on the similarities in stratigraphic characteristics of the lower structural layers between the northern and central Nansha waters, previous studies from gravity data and multi-channel seismic data, we propose that lower structural layers over central Nansha waters may also Mesozoic. This further suggests that the intensity of upper crustal extension was moderate in Nansha waters during the Cenozoic, which related to a combination of the Cenozoic slab pull of the proto-SCS and lithosphere delamination over an ancient orogenic belt between the northern and southern continental margins of the SCS, which may weaken extension of upper crust over the Nansha waters.

1. Introduction

From the Late Cretaceous into the Early Cenozoic, southern Chinese mainland experienced a transition from a convergent to a divergent margin, eventually resulting in a portion of its southern margin drifting southward (Fig. 1) (Fyhn et al., 2010; Holloway, 1982; Li and Li, 2007; Taylor and Hayes, 1983). The southern part of the SCS is thus a key region to understand the evolution of the SCS. One approach to gain a better understanding of the evolution of the SCS is to track the distribution of Mesozoic basement and sedimentary units, which propagated to the south.

Though intensive resource exploration surveys have been carried out around the Nansha waters, Mesozoic deposits have only been identified in Liyue (Reed) Bank (Fig. 2) (Hinz and Schluter, 1985; Kudrass et al., 1986; Taylor and Hayes, 1980). Due to a lack of drilling/coring in the region, the clear identification of Mesozoic strata still remains controversial in the central and northern regions of the Nansha waters (Fig. 3). It has been debated whether thick lower structural layer below the strongly eroded unconformities is Mesozoic strata (Sun et al., 2008; Yan and Liu, 2004) associated with the Mesozoic northwestward subduction of the Pacific Plate. However, others believe them to be Cenozoic strata (Ding et al., 2013; Song and Li, 2015; Yao et al., 2012) recording collision between the Nansha waters and Borneo. Therefore, some fundamental geological aspects regarding the central part of the Nansha waters remain unclear. For example, what are the characteristics of the Mesozoic strata over the Nansha Microcontinental Block? Why are these Mesozoic strata preserved during the Cenozoic?

Two geophysical surveys using a long seismic streamer have been carried out along a NNW–SSE-trending seismic line from the SW subbasin of the SCS into the Nansha waters (NH973-01 and C2B; Fig. 2). The high-resolution seismic profiles obtained in these surveys provide evidence of the existence of lower structural layer in the northern Nansha waters. Especially, seismic shot gathers show evidence of refracted phases from the top of the lower structural layer. We calculated seismic velocity from the refracted phases of seismic shot gathers and demonstrate a major velocity leap across a prominent angular unconformity. We correlated stratigraphic characteristics and seismic velocity over the Nansha waters and the Chaoshan Depression, which contains Mesozoic strata, with the aim of delineating the age of the lower structural layer.

* Corresponding author at: CAS Key Laboratory of Marginal Sea Geology, South China Sea Institute of Oceanology, CAS, No. 164 West Xin'gang Rd., Guangzhou 510301, China.
E-mail address: wenhuiwen@163.com (Y. Wang).

http://dx.doi.org/10.1016/j.tecto.2016.04.003
0040-1951/

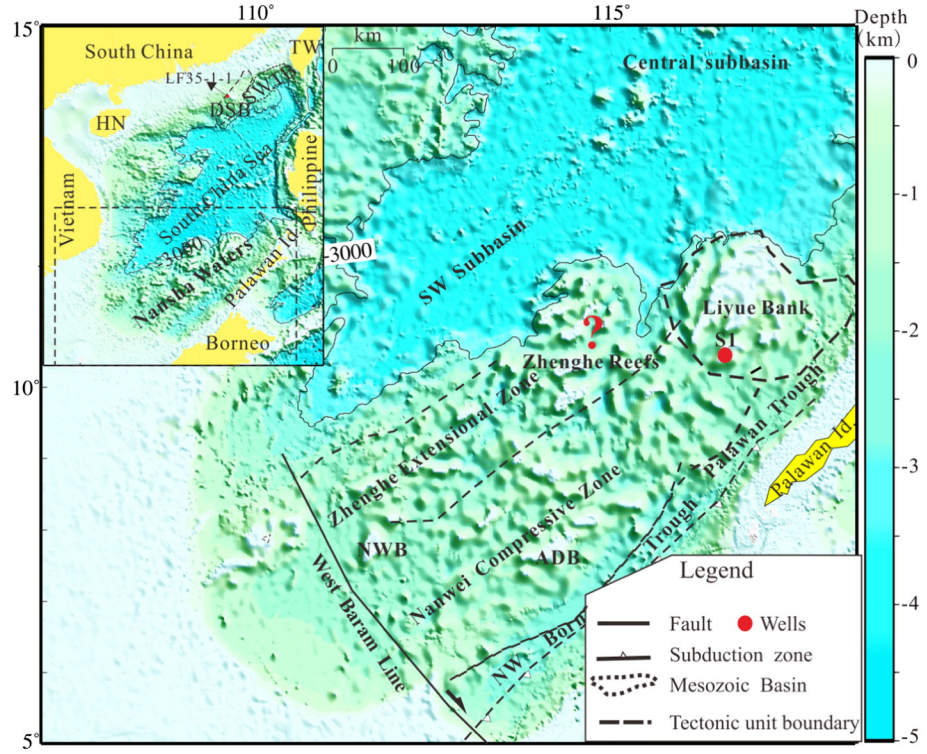

Fig. 1. Bathymetry map of the South China Sea and the location of the confirmed Mesozoic basin. SWTB: SW Taiwan Basin; DSB: Dongsha Basin; TW: Taiwan; HN: Hainan; NWB: Nanwei Bank; ADB: Andu Bank; S1: Sampagutita-1.

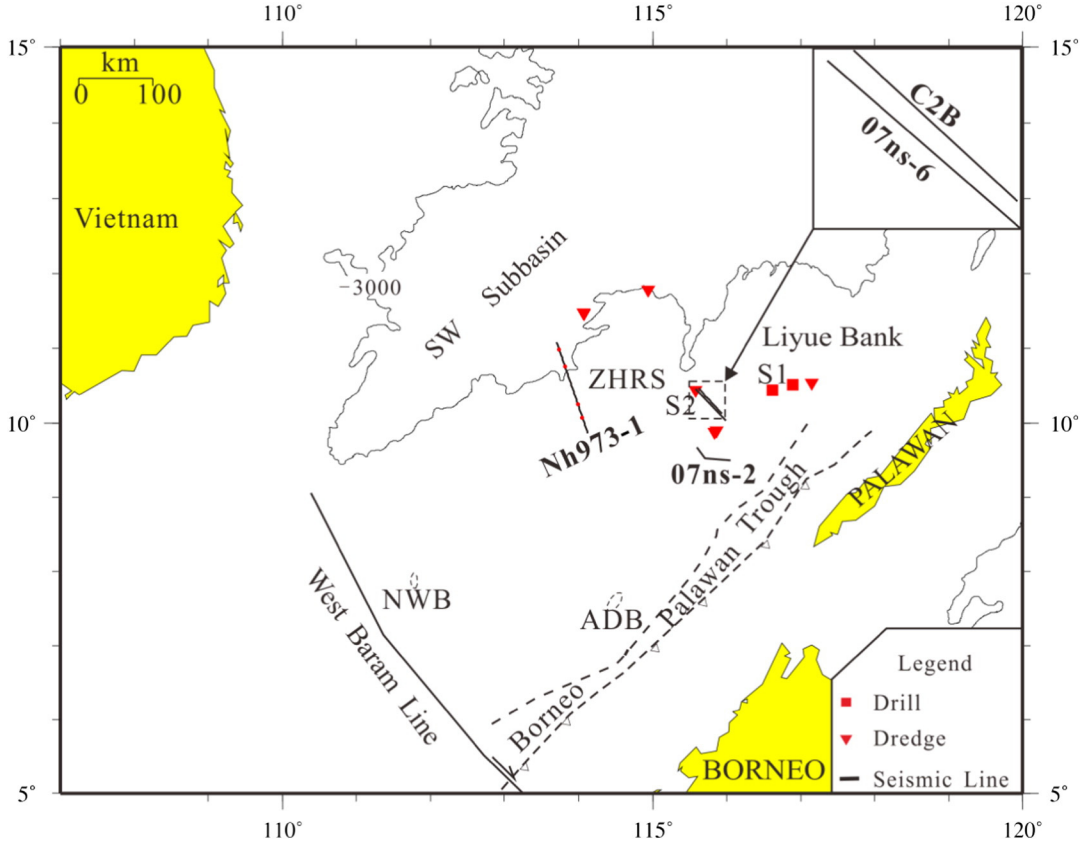

Fig. 2. Location map of the seismic profiles and Mesozoic samples position in the Nansha waters (Kudrass et al., 1986; Taylor and Hayes, 1980). Line NH973-01, 07NS-2, 07NS-6, as well as line C2B are discussed in the text. ZHRS: Zhenghe Reefs; S2: SO27-21.