Pet.Sci.(2013)10:292-302
DOI 10.1007/s12182-013-0278-1

Characteristics of the turbidite fan in the Wenchang Formation of the Enping Sag, Pearl River Mouth Basin, China and its hydrocarbon significance

Chen Guojun[1], Li Chao[1, 2*], Du Guichao[2], Zhang Gongcheng[3], Lü Chengfu[1] and Wang Qi[1]

[1] Key Laboratory of Petroleum Resources Research, Institute of Geology and Geophysics, Chinese Academy of Sciences, Lanzhou, Gansu 730000, China

[2] University of Chinese Academy of Sciences, Beijing 100049, China

[3] Research Institute of China National Offshore Oil Corporation, Beijing 100027, China

Abstract: A turbidite fan in the Eocene upper Wenchang Formation in the Enping Sag, Pearl River Mouth Basin (PRMB) has been studied using seismic, logging and borehole data. The fan is characterized by parallel progradation on the dip seismic profile and is mound-shaped or lenticular-shaped on the strike seismic profile. The study of the core and logging data from well EP17-3-1, which is located in the front side of the turbidite fan, shows that this fan is a set of normal grading sand beds, interbedded within thick dark grey mudstones of semi-deep to deep lake deposits in the Wenchang Formation. The fan is interpreted as a sand/mud-rich turbidite fan that has an area of over 140 km^2 and a maximum thickness of over 340 m. Combined with a study of the regional geological background and previous provenance analysis of the Eocene Wenchang Formation, the main potential provenances for the turbidite fan are considered to be the Panyu low-uplift and northern fault terrace zone. The Enping Sag is considered to be a half graben-like basin whose north side is faulted and whose south side is overlapped. Basement subsidence in the Eocene was mainly controlled by boundary faults which dip relatively steeply on the north side, causing the subsidence center of the Enping Sag in this stage to be close to the north boundary faults. Sustained faults developed in the Enping Sag during the Eocene caused an increase of the relative height difference between the north and the south uplift zone in the Enping Sag. Affected by the second episode of the Zhuqiong movement (39-36 Ma) in late Eocene, sediments which had accumulated on the Panyu low-uplift zone were triggered and moved toward the subsidence center of the Enping Sag and formed the turbidite fan. The second episode of the Zhuqiong movement is the most important triggering factor for the formation of the turbidite fan in the Wenchang Formation. Seismic attribute characterization shows that the low frequency energy is enhanced and high frequency energy is weakened when seismic waves propagate through the oil-bearing zone in this fan. Amplitude versus offset (AVO) anomalies are observed in the seismic data and abnormally high pressure is encountered. The turbidite fan in the Wenchang Formation has provided important information for sedimentary evolution in deep layers of the Enping Sag and pointed to a new direction for the hydrocarbon exploration in the study area.

Key words: Pearl River Mouth Basin, Enping Sag, Wenchang Formation, turbidite fan, hydrocarbon exploration

1 Introduction

Hydrocarbon exploration in deep-water basins has become an important and active field for the global oil and gas industry, since turbidite sandbodies were found to be important oil and gas reservoirs in the 1950s (Wu, 1986; Pang et al, 2006; 2007). Deep-water turbidite fans are not only one of the main focuses in global hydrocarbon exploration, but also a frontier in sedimentological studies in recent years (Zhu et al, 2004; Chen et al, 2007; Wang et al, 2011). An estimated 1,200 to 1,300 oil and gas fields, including producing fields, are known from deep-water turbidites and related systems (Stow and Mayall, 2000). Pettingill (1998) documented 925 of these fields (excluding carbonate plays) from 54 basins, of which 43 fields could be classified as giants (>500 million barrels oil equivalent). Turbidite reservoirs are also widely discussed in China (Lai and Gu, 1984; Gao and Wu,

*Corresponding author. email: lichaomails@163.com
Received May 11, 2012