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SEQUENCE STRATIGRAPHY AND HYDROCARBON POTENTIAL OF THE XIHU TROUGH, EAST CHINA SEA

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ABSTRACT

The Xihu Trough is a back-arc basin situated on the continental shelf of the East China Sea. It comprises a NE-SW trending half-graben bounded on the eastern side by a normal listric fault. It probably originated in the Late Palaeocene or Early Eocene in response to the westward subduction of the Pacific plate beneath the Eurasian continent. Crustal extension and rapid subsidence took place until Early Oligocene. Volcanic activity was widespread at times, and a thick succession of sediments was deposited. Less pronounced extension and more moderate subsidence continued until the Late Miocene. At this point extension ceased and the Okinawa Trough started to form further to the east. The basin axis continued to sag, however, and gentle subsidence continued until the present day. Extension was interspersed by short episodes of compression, particularly in the Early Oligocene, Late Oligocene and Late Miocene, when normal fault movement was partially reversed and gentle anticlines formed as a result of localized inversion. The latter was accompanied each time by widespread uplift and erosion along the eastern margin of the basin, and substantial erosion also took place on the crests of the Late Oligocene and Late Miocene folds.

At least 7, or possibly 10, depositional sequences can be recognised in the Xihu Trough. These sequences are the Oujiang/Wenzhou (Palaeocene-Eocene), Pinghu (Eocene?-Early Oligocene), Lower Huagang (Early Oligocene), Upper Huagang (Late Oligocene), Longjing/Yuquan (Early-Middle Miocene), Liulang (Late Miocene), Santan (Pliocene) and Donghai (Quaternary). Each sequence rests unconformably upon the previous one, particularly at the eastern edge of the basin where angular and onlapping relationships can be discerned on seismic. In the basin centre, the sequence boundaries are represented merely by strong reflections. The boundaries between the sequences appear to have resulted from local fluctuations in sea-level superimposed on eustatic fluctuations. The local fluctuations are thought to have been caused by the alternations between extensional and compressional tectonics within the basin.

Each sequence can be divided into a lower, sand-dominated section that formed on an alluvial plain or lower coastal plain during a lowstand in sea level, and an upper, mud-dominated section representing lower coastal plain and shoreface conditions during a highstand. The lowstand sections are composed mainly of thick units of stacked fluvial channel sands, interbedded with overbank mudstones and coals deposited on flood plains and in coastal swamps. The highstand sections, in contrast, comprise largely mudstones and coals deposited together with relatively thin distributary channel, mouth bar, and crevasse splay sands.

Reservoir potential is best in the lower sand-dominated parts of the sequences, whereas potential seals are more likely to be present in the highstand units. The reservoir quality of the channel sandstones

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is excellent, particularly in the shallower parts of the basin, although it starts to decline below a depth of 3000 m and is generally very poor below 3600 m. Regional seals are generally lacking in the Xihu Trough because the shales are relatively thin and interbedded with crevasse splay sands. Rich sources for gas, condensate, and oil have been identified within the upper Pinghu Sequence. These sources are principally coals and associated carbonaceous claystones. Oil generation probably started in the Later Miocene (5-10 Ma) in the southern part of the basin, at a time when most of the younger anticlines were being formed. Peak maturity for light oil and condensate was reached slightly later, in Early Pliocene (2.5-5 Ma), and it was followed by the onset gas generation. Peak generation of light oil and condensate had already passed in the northern part of the basin by the end of the Middle Miocene (10 Ma), and gas generation was well underway before any traps had been formed.