Examples of Petroleum Exploration

14.1 Ordovician Petroleum Reservoir in the Tarim Basin

The geological location of the Ordovician buried hill is on the Lunnan low bulge at the Tabei uplift in the Tarim basin (Fig. 9.9). The Lunnan Ordovician buried hill is next to the Caohu depression on the eastern side; it is adjacent to the Halahatang depression on the western side; it utilizes the Luntai fault as its northern boundary and it is next to the Manjiaer depression on the southern side (Liang, 2008; Yang et al., 2008).

The Lunnan Ordovician buried hill occupies a major portion of the Lunnan paleo-uplift, which contains a favorable exploration area of 2,450 km$^2$. After more than 20 years of drilling exploration in the Ordovician buried hill type of oil reservoirs, the discovered geological oil reserve is more than $1 \times 10^8$ t. At the same time, apart from isolated enriched oil reservoirs, the entire buried hill contains oil. Therefore, this area not only has great potential for petroleum exploration and development, but it is also an important domain for in-depth exploration in the Tarim basin.

14.1.1 History of Petroleum Exploration

The exploration history of the Lunnan Ordovician buried hill type reservoir included three phases.

During the early 1990s, the first exploration phase set out to investigate the higher position of the Lunnan buried hill. In 1990, a borehole test for the Ordovician system at large intervals was carried out at the Lunnan 15 well. The well test obtained 1.5 m$^3$ of oil that could be converted into a daily production rate of 30 m$^3$/d. After the well was completed, the results of the well test for individual layers indicated a dry well. At same time, the New Star Co. completed the Sha 23 well on the eastern wing of the Tahe #3 structure. The well test also showed a dry well. During 15 – 18 September 1990, a borehole, wall mounted, well completion
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test was carried out at an interval of 5,224 – 5,478 m in the Sha 23 well; the drawdown pressure was 19.613 MPa and the quantity of obtained fluids (natural gas and a small amount of crude oil) from the test was 0.56 m$^3$. The report of the well test indicated that “the oil and gas were unevenly distributed in the lithosome of the tested interval that had unsaturated oil content and limited storage capacity.”

During the middle of the 1990s, the second exploration phase explored the southern slope of the uplift. The Tahe oil field was discovered. This oil field was a large scale oil and gas field with more than a hundred million tonnes of petroleum reserves, which was discovered on the northern side of the Tarim basin by the New Star Co. during the “Ninth Five-Year Plan”. The major portion of this petroleum field consisted of the Ordovician oil and gas reservoirs. In the exploration blocks #3, #4 and #6, the total proven petroleum reserve was 12,950.8×10$^4$ t of oil equivalent.

The third exploration phase has been in progress from the end of the 1990s to the present; the exploration target is the southwestern slope (the Lungu area). Recently, a 3D seismic survey has been carried out. In addition, based on the structural interpretation, the forecast of reservoir sequences and an estimation of fractures are in progress (Fig. 14.1).

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Fig. 14.1. Evaluation map of the Ordovician buried hill type reservoirs in the Lunnan area

14.1.2 Condition of the Hydrocarbon Source Rock

In the Lunnan area, oil and gas in the Ordovician system originated in the marine environment; the petroleum mainly came from the Cambrian–Ordovician systems. In addition, this region was next to the largest hydrocarbon generating center (the