Research on Reservoir Conditions of Buried Hill Reservoirs

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Abstracts. With EWL Thoughts, the buried hill reservoirs are composed of a wide range of rocks, including carbonate rocks and clastic rocks, as well as igneous rocks and metamorphic rocks. The oil and gas in the buried hill reservoirs are from the hydrocarbon source rocks of the lower section of the Shahejie Formation and the Dongying Formation. Combining the various accumulation conditions to achieve favorable target optimization, the results are as follows: The Liangshan tectonic belt of Shulu West Slope has a favorable target at the higher part of the slope; the Shulu deep depression buried tectonic belt is preferably the northern part of the deep depression area with favorable target concentration, and the type of buried hill is fault block mountain. The Ningjin bulge suggests that the risk target is a raised high part; the Xinhe bulge suggests that the risk target is a fold-erosion mountain.

Keywords: Accumulation conditions; hydrocarbon source rocks; Buried Hill Reservoirs.

1. The types and distribution of ancient buried hills
The ancient buried hill is a form of paleo-geomorphic. The tectonic movement caused the formation to be weathered and denuded for a long time, resulting in uneven surface morphology. Later it was sunk again and covered by the Cenozoic sedimentary layer. The raised hills are called ancient buried hills[2]-[4]. The unconformity surface is developed on it, and the buried hill stratum belongs to the basement of the overlying basin[1-3]. The ancient topography is covered by an overlying impermeable layer to form a trap, and the oil reservoir formed by it is called the ancient buried hill reservoir.

The division of buried hill types should abide by the two basic principles of science and practicality. Scientifically classifying and researching ancient buried hills can provide guidance for finding and discovering buried hill reservoirs.

The formation of buried hills is a complex, long-term geological process. In this process, the geological functions of various internal stresses and external stresses can be used for mountain formation. Among them, fold action, fracture action, river undercut and leaching are common mountain-forming factors. Therefore, the formation of buried hills is often the result of a combination of various geological factors[4-6].

2. Paleo-geomorphic buried hills and tectonic buried hills
At present, most of the classification of ancient buried hills is based on the principle of latent mountain formation and is based on the type of buried hill structure. On this basis, combined with seismic interpretation and geological section data[5]-[6], from the geological background and main genesis of
the formation of buried hills, the buried hills are divided into two categories: paleo-geomorphic buried
hills and tectonic buried hills. According to the main factors of orogenication and considering the
tectonic features of the buried hill core, the buried hill structure is divided into the following five types,
namely, erosion buried hill, fold-erosion buried hill, fault block-erosion buried hill, fold buried hill and
block buried hill. As shown in figure 1.

![Fig.1 Classification model of buried hill](image)

From east to west, the Shulu depression is successively composed of the Xinhe uplift buried hill
tectonic belt, the central trough buried hill tectonic belt, the suiluxi slope buried hill tectonic belt and
the ningjin uplift buried hill tectonic belt[7-10]. It presents a distribution pattern of bulge - deep
depression -slope -bump. As is shown in Fig2.

![Fig. 2 Distribution pattern of buried hill belt in Shulu Depression](image)
The raising buried hill structural belt mainly develops fold-erosion mountain, and the deep depression buried hill structural belt mainly develops fold mountain and fault block mountain. The slope buried hill structural belt mainly develops eroded mountain, and also develops a small number of fault blocks - erosion mountain and fold - Eroding mountains and fault blocks[11-14].

The eroded mountain is mainly developed in the middle part of the slope and the high part of the north block. Most of them are hidden buried hills. (The gully is filled with alluvial fans, and the plane is characterized by nasal structures. The Jingu 14-1x buried hill is a typical example. ). The eroded mountain is a buried hill structure that remains after the formation of the unconformity surface. The late stage is generally sunk, and the buried hill structure is deeply buried. The later tectonic movement has no obvious transformation effect (The sedimentary layer above the buried hill structure is not affected by the buried hill structure).

3. Reservoir conditions of buried hill hydrocarbon reservoir

The buried hill reservoirs are composed of a wide range of rocks, including carbonate rocks and clastic rocks, as well as igneous rocks and metamorphic rocks[10]. The bedrock reservoirs composed of different rock types suffer from structural fracture, weathering, leaching and dissolution, and become well-sewed joints, caves and fracture systems, especially carbonate rocks, with the best reservoir conditions.

The minerals of carbonate rocks are relatively simple, but the rock structure is often complicated by the existence of structural components such as particles, grains, bio-framework, plaster and cement. The corresponding primary pore types are more, carbonate rocks the characteristics of low hardness, solubility and brittleness make the structural fissures, pores and dissolved pores develop quite well[11]-[13]. The buried hills are easily formed by the structural changes and long-term weathering and erosion. The shape of oil and gas reservoirs is obviously controlled by weathering and leaching pores, the top surface morphology of the oil and gas reservoir is consistent with the weathering crust morphology, or the layered oil and gas reservoir morphology is connected with the weathering crust. The fractures, dissolved pores and karst caves developed in carbonate reservoirs are often layered in space, forming multiple sets of dissolution and dissolution pores distributed vertically and horizontally. The four types of dissolution zones, such as weathered leaching pore zone, fractured dissolution zone, stratified dissolution pore zone and horizontal dissolution dissolved pore zone, overlap each other in the ground and interpenetrate, and the fault is penetrated locally, which makes the reservoir form high permeability with heterogeneous connected body. The original reservoir performance of the buried hill core composed of metamorphic rocks and igneous rocks is worse than that of carbonate rocks, however, in the development process of buried hills, due to long-term weathering and fracture, it is easy to form weathering crust and fissure development zone along the fault distribution, which is a good reservoir rock mass.

4. Advantageous target optimization

The favorable target is preferably based on the understanding of the oil and gas geology of the buried hill and the law of hydrocarbon accumulation. The first is the division of the buried hill structural belt. According to the distribution of the buried hill structure and the structural characteristics of the buried hill, a total of four buried hill structural belts are divided. Secondly, comprehensive analysis of the structure, faults and exploration oil and gas in different areas, combined with the accumulation model of buried hills, analyzes the main factors controlling the characteristics of hydrocarbon accumulation and controlling accumulation. Third, based on the characteristics of accumulation and the main controlling factors, the favorable drilling targets are determined. For example, the buried hill structural belt of the Shuluxi Slope is dominated by eroded hills, fault-erod hills, fold-eroded mountain reservoirs, and various types of buried hill structural traps related to erosion are the main controlling factors. The deep sloping buried hill structural belt is dominated by tectonic and fault block mountain reservoirs, and the implementation of buried hill structural traps is a key factor. The raised buried hill structural belt on both sides of the Shulu Depression is a risk drilling because it is far away from the oil-producing
area. When the buried hill structural trap is selected, factors such as the distance from the oil generating center should also be considered. Fourth, find the most favorable buried hill structural traps in different target areas, and implement the recommended well position targets on the basis of comprehensive analysis and research. Figure 3 is the map of Advantages of the buried hill and recommended well.

Fig. 3 Advantages of the buried hill and recommended well map

The Shulu West Slope Buried Hill structural belt preferably has a favorable target at the higher part of the slope. The evaluation of the well target 2, Jingu 16 North Buried Hill, the type is fault block - erosion mountain, Jin 20 East buried hill, the type is erosion mountain. The characteristics of the slope-bearing buried hill structure are small scale, the uncertainty factor is strong concealment, and whether the nose structure is a buried hill structure needs further verification.

The recommended risk target of the Ningjin Uplift is the raised high part. The buried hill structural trap is located at the high part of the bulge. It is characterized by shallow burial and good trap type, and the risk is far from the oil-producing center.

The proposed risk target for the Xinhe Projection is the fold-erosion mountain. Its characteristics are: metamorphic rock buried hill, and the other buried hills on the bulge are relatively close to the oil source area. From the plane distribution, the target distance is about 6.8km in the deepest part of the gutter, but the scale of the Xinhe fault is very large, and the maximum vertical fault distance is 6.5km, which is the linear distance from the risk target to the deepest part of the middle trough. Therefore, it is estimated that the linear distance of the risk target to the deepest part of the middle channel is about 10km, and the opening and closing capacity of the Xinhe fault is difficult to predict, so drilling is risky.

5. Conclusion
Integrate the various reservoir conditions to optimize the favorable targets. The results are as follows: The Liangshan tectonic belt of Shulu West Slope has a favorable target at the higher part of the slope; the Shulu deep depression buried tectonic belt is preferably the northern part of the deep depression area
with favorable target concentration, and the type of buried hill is fault block mountain. The Ningjin bulge suggests that the risk target is a raised high part; the Xinhe bulge suggests that the risk target is a fold-erosion mountain.

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