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Research Advances

# Three source rocks discovered in the Mid-Lower Jurassic, Dunhuang Basin in China

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## 1. Objective

Dunhuang Basin is the largest area and the third hydrocarbon resources potential basin among the basins of Hexi Corridor, and also a low exploration degree basin. The source rock position, characteristics and hydrocarbon generating potential of residual Mid-Lower Jurassic are still unknown. The project is to ascertain the source rock development and hydrocarbon generating capacity of Mid-Lower Jurassic, to find out the resource potential, to delineate the resource prospect area and to optimize the favorable areas. It may direct the petroleum exploration in Dunhuang Basin.

## 2. Methods

By the surveys over Dunhuang Basin and its peripheral areas in Lower Jurassic, and by the comparison and comprehensive study of the data from Well XC1, 2D seismic, gravity, magnetics and electrics, Mid-Lower Jurassic was correlated and subdivided. And Zhongjiangou Formation in Middle Jurassic and Dashankou Formation in Lower Jurassic were confirmed the main source rock intervals. The carboniferous shale and dark mudstone samples taken from the outcrops and core were made geochemical test and analysis. The hydrocarbon generating potential was evaluated by the abundance, type and maturity of organic matter. Morever, the hydrocarbon resources potential is integratedly assessed by the source thickness, buried depth and extension.

## 3.Results

The outcrops indicate the dark mudstone and carboniferous shale in Dashankou Formation of Lower Jurassic in Dunhuang Basin ( Jiang P and Fan XL, 2005), which are medium-poor source rocks and up to mature totally (Fig. 1). The samples taken from Heidaban section, mainly dark mudstone, are mature, medium source rocks with the mean TOC 1.39% and the organic matter type $II_1$ or III. The samples taken from Lucaogou section, mainly carboniferous shale, are maturated or highly maturated, medium source rocks with the organic matter type $II_2$. The organic matter type of Daba and Hongliugou sections is III. And no source rock has been identified in Duobagou and Qingtainan sections. It is noteworthy that these samples are generally taken from the basin margin facies and subjected to long-term weathering, which may result in lower soluble organic matter content and lower transformational ratio of the organics.

Well XC1 located on the margins of Wudun Sag was drilled three sets of source rocks (Liu ZQ et al., 2016), added up to 101.5 m and up to premium-good source rocks (Table 1)(Zhang XC et al., 2017). Respectively, the upper part of Zhongjiangou Formation of Middle Jurassic, mainly dark mudstone, is integratedly assessed premium to good source rock, of which the kerogen type is I and $II_1$, TOC is from 0.17% to 5.69% and 3.03% averagely, the mean of $S_1$+$S_2$, $R_o$ and $T_{max}$ is 12.07 mg/g, 0.67 and 447 °C respectively. The lower part of Zhongjiangou Formation of Middle Jurassic, mainly sand and mudstone thin interbeds, is good source rock, of which the kerogen type is $II_2$-III, and the mean of TOC, $S_1$+$S_2$, $R_o$ and $T_{max}$ is 3.81%, 9.34 mg/g, 0.70 and 449 °C respectively. Dashankou Formation of Lower Jurassic, mainly sand and shale interbeds, is totally assessed medium source rock, of which the karogen type is $II_2$-III, and TOC, $S_1$+$S_2$, and $T_{max}$ is averagely 1.62%, 2.19 mg/g and 461 °C.

It is integratedly assessed three most exploration potential areas totally 2230 $km^2$, respectively the eastern subsag of Qingtai Sag, Southern subsag of Wudun Sag and north-western part of Hongliugou Sag, based on the source rock test and analysis, residual thickness of Mid-Lower Jurassic and buried depth for secondary hydrocarbon generation.

## 4. Conclusion

The dark mudstone and carboniferous shale in Zhongji-

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**Table 1. Source rock parameters of samples taken from Well XC1, Dunhuang Basin**

| Position | Depth/m | Lithology | Organic matter abundance | | | Organic matter type | Organic matter thermal evolution degree | | | Source rock grade |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | TOC /% | $S_1+S_2$ /(mg/g) | Chloroform bitumen "*A*" /% | | tmax /°C | *Ro* /% | Evolution degree | |
| $J_2z$ | 2264-2289 | Dark mudstone | 0.17−5.69<br>3.03(10) | 0.17−28.16<br>12.07(10) | 0.08−0.55<br>0.32(4) | I − $II_1$ | 430−457<br>447(10) | 0.48−0.82<br>0.67(4) | mature | Premium-Good |
| $J_2z$ | 2360-2380 | Mainly sand and shale thin interbeds | 0.67−36.20<br>3.81(8) | 1.14−45.02<br>9.79(8) | 0.03−0.29<br>0.16(4) | $II_2$-III | 444−453<br>449(8) | 0.55−0.86<br>0.70(5) | mature | Good |
| $J_1d$ | 2511-2614 | Mainly sand and shale interbeds | 1.36−1.86<br>1.62(4) | 1.63−3.04<br>2.19(4) | / | $II_2$-III | 459−463<br>461(4) | 0.63−0.68<br>0.65(4) | mature | Medium |

*Note*: $\frac{0.08-0.15}{0.11(2)}$ means $\frac{\text{minimum}-\text{maximum}}{average(number\ of\ sample)}$

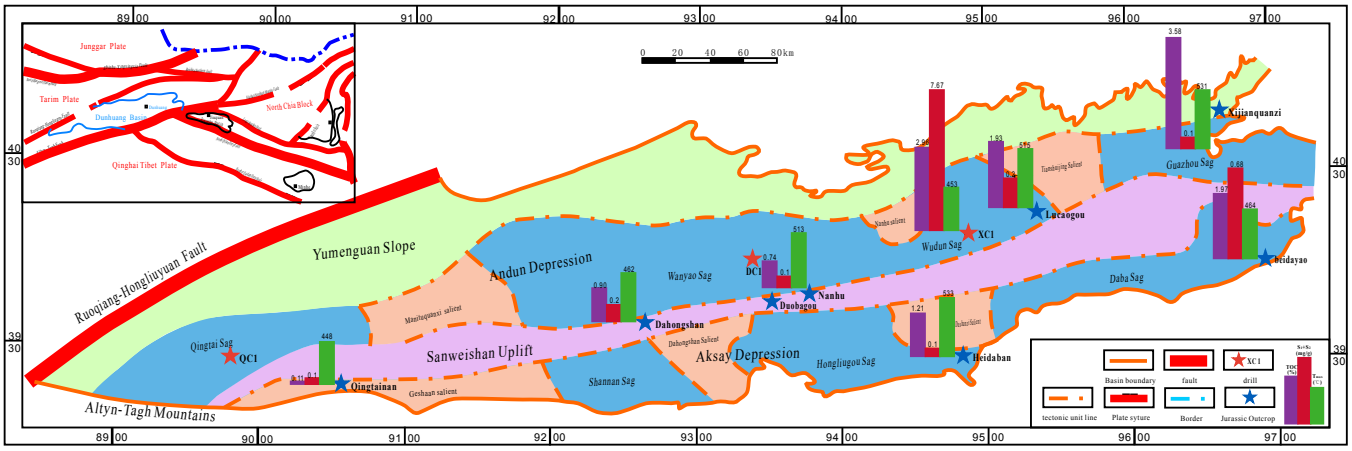


**Fig. 1.** Histogram of geo-chemical indicates of outcrop samples in Dunhuang Basin and its peripheral areas.

angou Formation of Middle Jurassic and Dashankou Formation of Lower Jurassic are the source rocks in Dunhuang Basin. The source rock of Dashankou Formation is totally mature and medium-poor based on the outcrop samples. However, three sets of source rock are drilled. Two sets of source rock developed in Zhongjiangou Formation are mature, premium-good source rocks, of which the organic matter type is I-$II_1$ and the mean of $R_o$ is 0.8. The source rock of Dashankou Formation is medium and the organic matter type is $II_2$-III. It is integratedly assessed that the most exploration potential areas of Dunhuang Basin are the eastern subsag of Qingtai Sag, southern subsag of Wudun Sag and north-western part of Hongliugou Sag.

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## References

Jiang P, Fan XL. 2005. Analysis of middle-lower Jurassic petroleum system in Dunhuang Basin. Earth Science, Journal of China University of Geosciences, 30(2), 211-214, 254(in Chinese with English abstract)).

Liu ZQ, Liu JM, Li ZK. 2016. Identification and geological significance of effective source rocks in Dunhuang Basin. Gansu Geology, 25(4), 50-55(in Chinese with English abstract).

Zhang XC, Li JG, Liu WQ. 2017. Geological conditions of tight oil reservoirs in Wudun Sag of Dunhuang Basin, Gansu, China. Journal of Earth Sciences and Environment, 39(2), 248-254(in Chinese with English abstract).