[PS]Characteristics of the Neogene Faults Activities and Hydrocarbon Migration Modes in the Jizhong Sag, Bohai Bay Basin, China*

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Abstract

As important vertical migration pathways, faults are important for the formation and distribution of outward-sourced reservoirs, especially for the hydrocarbon accumulation in Neogene reservoirs. According to the study of distribution of Neogene reservoirs, characters of fault activity and fault sealing property, two kinds of hydrocarbon migration modes with faults are recognized in Jizhong Depression, Bohai Bay Basin, which included far-source ladder-type lateral migration pattern in slope zone and near-source zone vertical migration pattern in fault terrace belts.

Vertical migration pattern in fault terrace belts mainly exists in eastern step-fault zones in Raoyang Depression. Enrichment degree and enrichment layers are determined by fault activity during main hydrocarbon accumulation periods. As a result of weak activity and short duration of fault activity in the Liuxi fault belt, the reservoir is mainly distributed in the third member of the Guantao Formation. On the other hand, owing to strong activity (more than 1.2 activity index) and long duration of fault activity in the Liubei fault belt and western of step-fault zone, the reservoir has a high degree of hydrocarbon enrichment and multi-layer department together, including the upper Guantao Formation, the lower Guantao Formation, and the Minghuazhen Formation.

Far source ladder-type migration pattern is the major modes for hydrocarbon accumulates of Neogene in the Baxian Depression. The ability of hydrocarbon vertical migration was not strong for its weak tectonic movement, so the hydrocarbon migration pattern and directions of hydrocarbon accumulation in Neogene is determined by lateral sealing ability of faults. It is suggested that, with the fault opening position in the Guantao Formation and Dongying Formation, oil and gas will go through the opening position of faults and enter into the Dongying Formation on the lateral migration, then accumulated in sealing layers by fault Wen11 and fault Wen46.

Characteristics of the Faults Activities and Neogene Hydrocarbon Migration Modes in the Jizhong depression, Bohai Bay Basin, China

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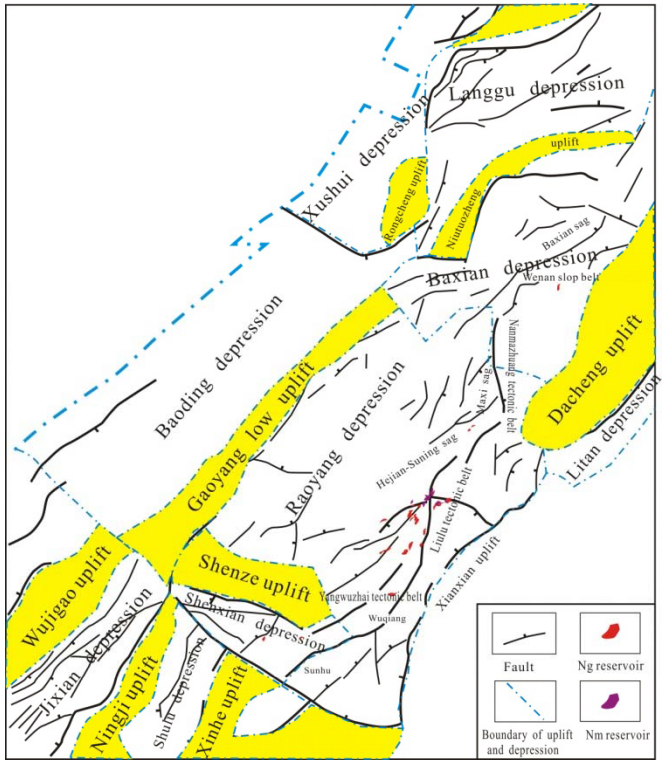
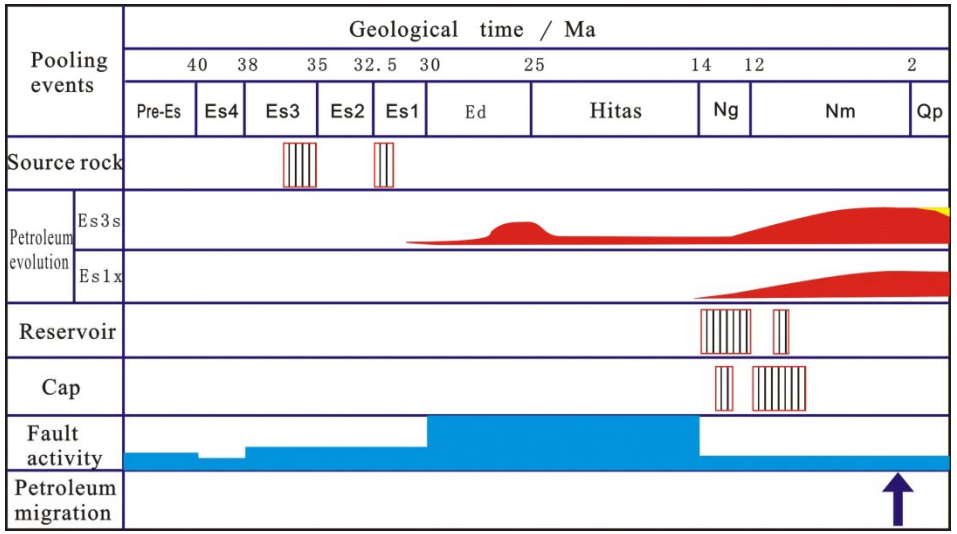
1. GEOLOGICAL SETTING



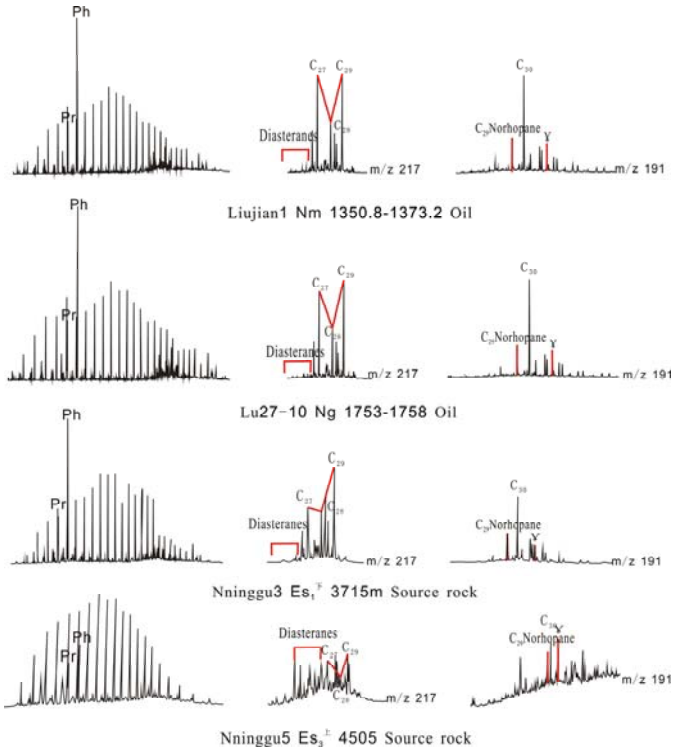
Tectonic division and distribution of Neogene reservoirs in Jizhong depression

The Neogene reservoirs of Jizhong depression are occurred in the fault belt of RaoYang sag and Wenan slope belt of BaXian sag. The Neogene petroleum accumulation condition is well, and mainly depend on the fault activity.



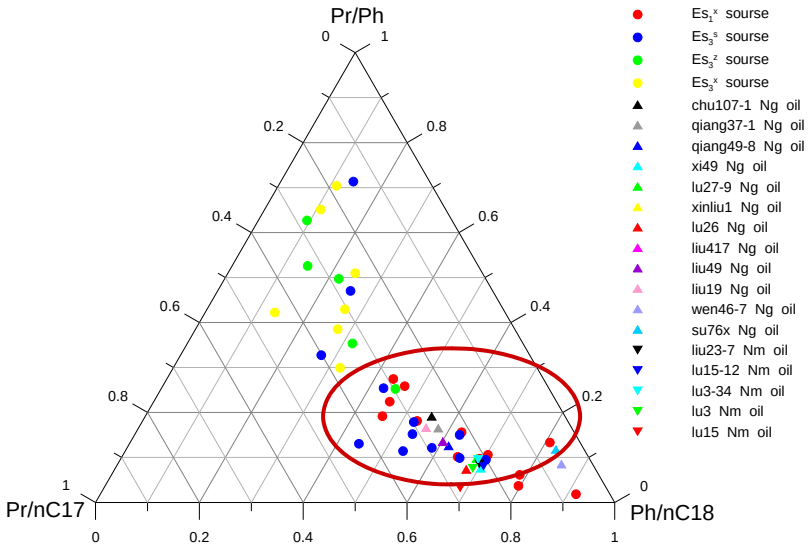
Reservoiring elements of Neogene reservoirs in Jizhong sag

2.FAULT ACTIVITY AND PETROLEUM ACCUMULATION



Spectrogram of Neogene Crude oil and Paleogene source rocks in Raoyang sag

Based on saturated hydrocarbons chromatography and chromatography - mass spectrometry analysis of crude oil and source rocks, research has shown that Neogene oil in Raoyang Sag is mainly come from Es1 lower source rocks, with the character of nearest transportation.



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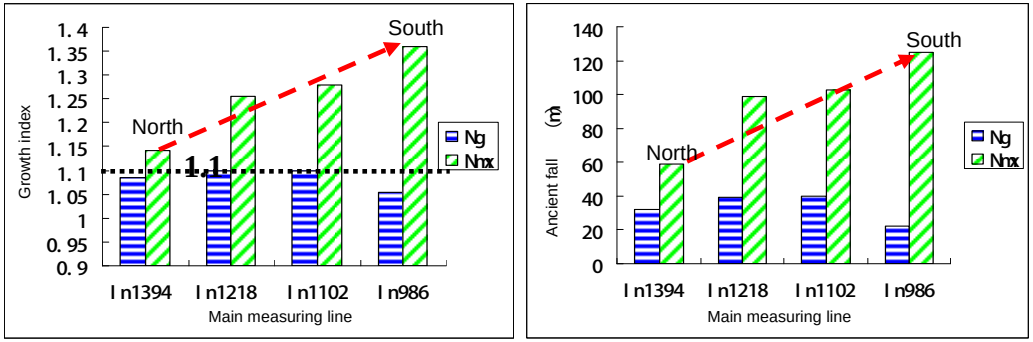
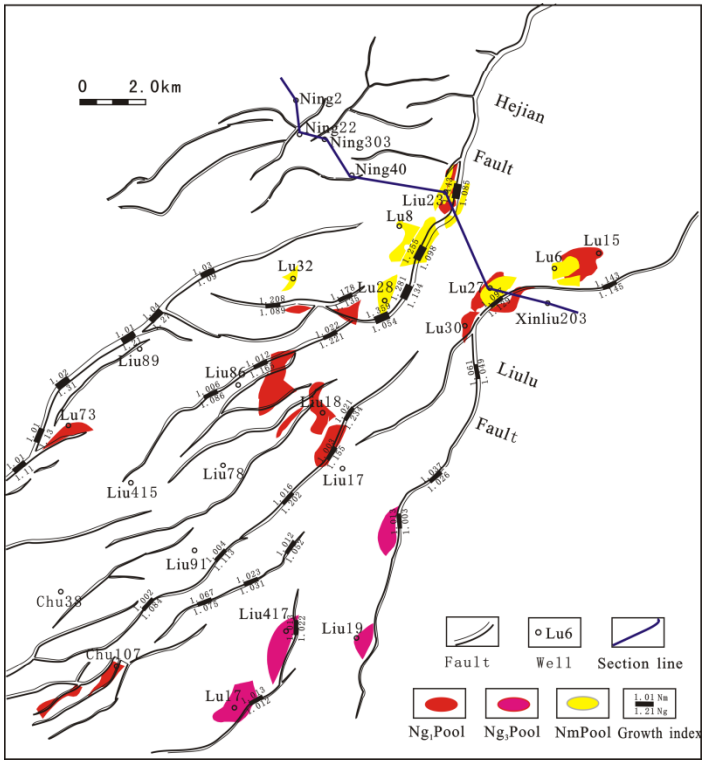


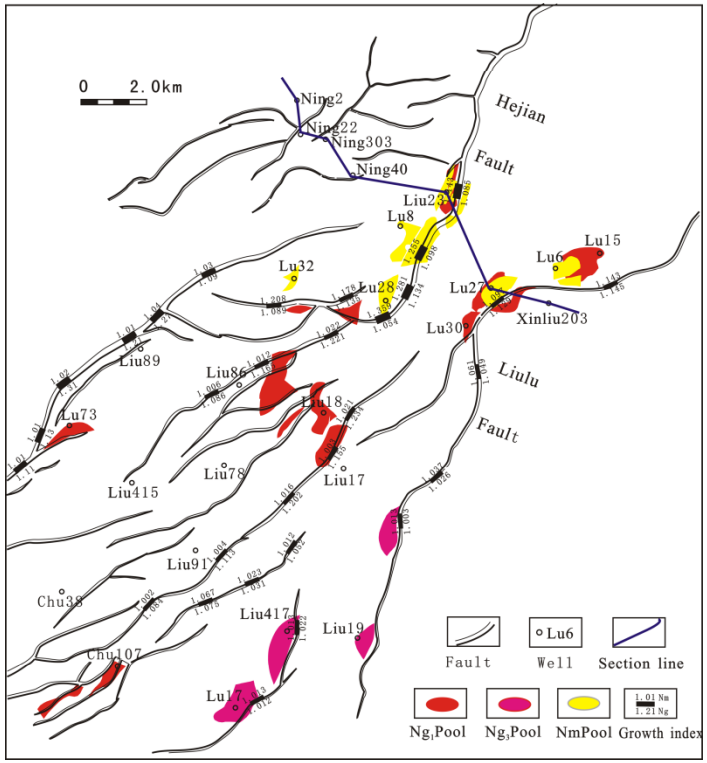
Growth index and ancient fall of Hejian fault

The position of Neogene reservoir is near to the late active strong oil-source faults. According to the analysis of the fault growth index and ancient fall during the main accumulation stages, the activity of main source faults is very strong in Liulu tectonic belt. The fault activity in the intensity and duration of Liulu Fault and Hejian Fault is the first one in the tectonic belt. Enrichment degree and enrichment layers are determined by fault activity during main hydrocarbon accumulation periods. .



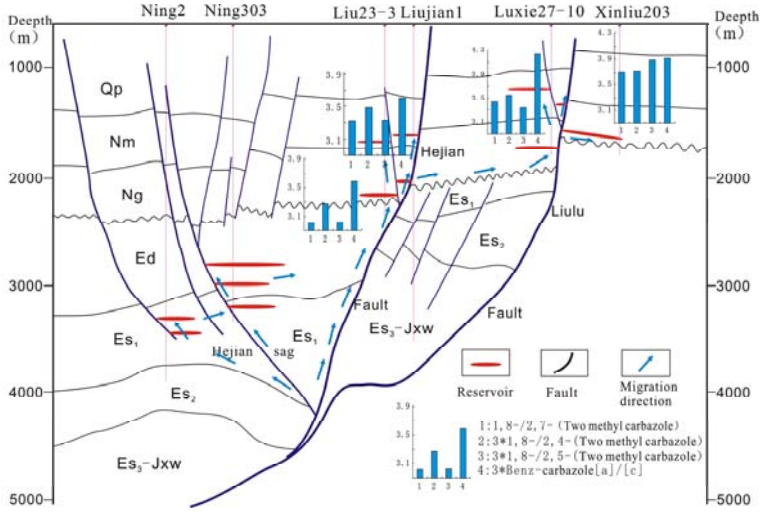
Relationship of late fault activity and Neogene reservoirs distribution in Raoyang sag

2.FAULT ACTIVITY AND PETROLEUM ACCUMULATION



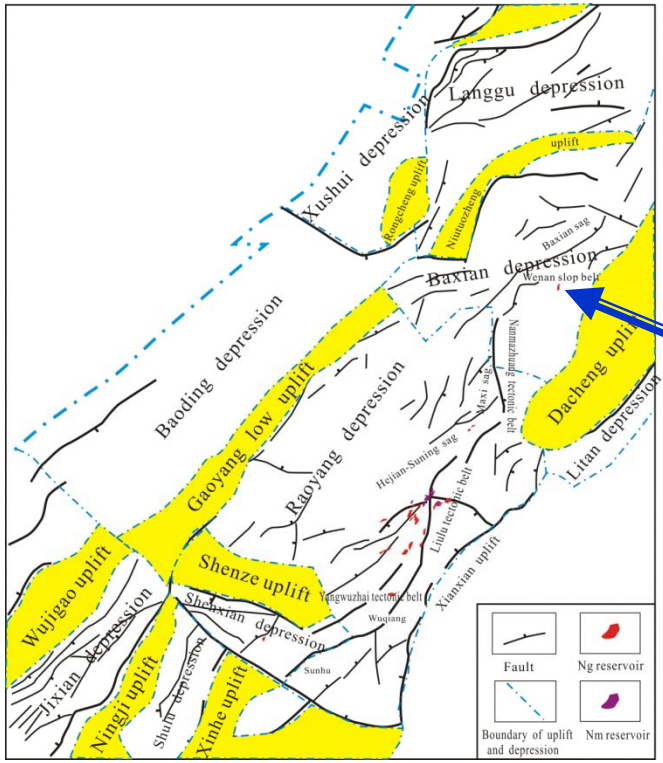
Relationship of late fault activity and Neogene reservoirs distribution in Raoyang sag

The four nitrogen compounds indicators is increasing from the Hejian subsag to Liu23-3 well to Liujian 1 well, reflect the petroleum migration trend along the Hejian fault. In general, fault activities to which horizon petroleum can migration to which horizon. .



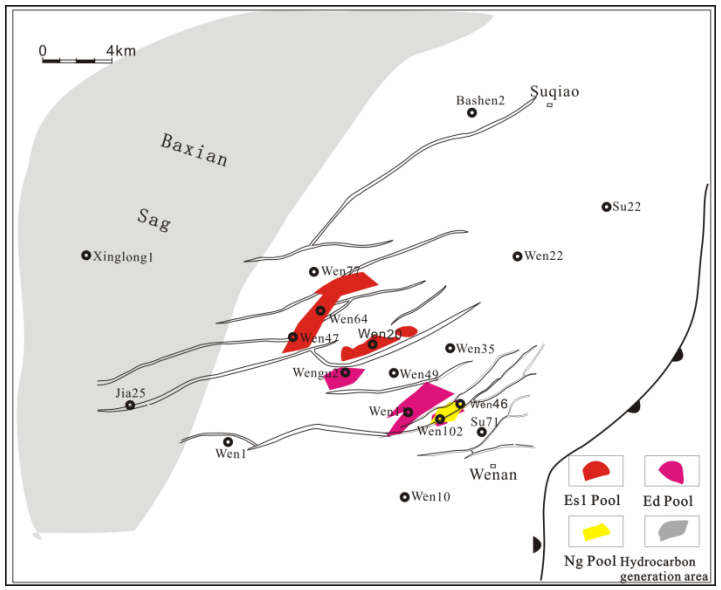
Migration section indicated by nitrogen compounds of Liulu tectonic belt，Raoyang sag

3.FAULT SEALING AND PETROLEUM ACCUMULATION



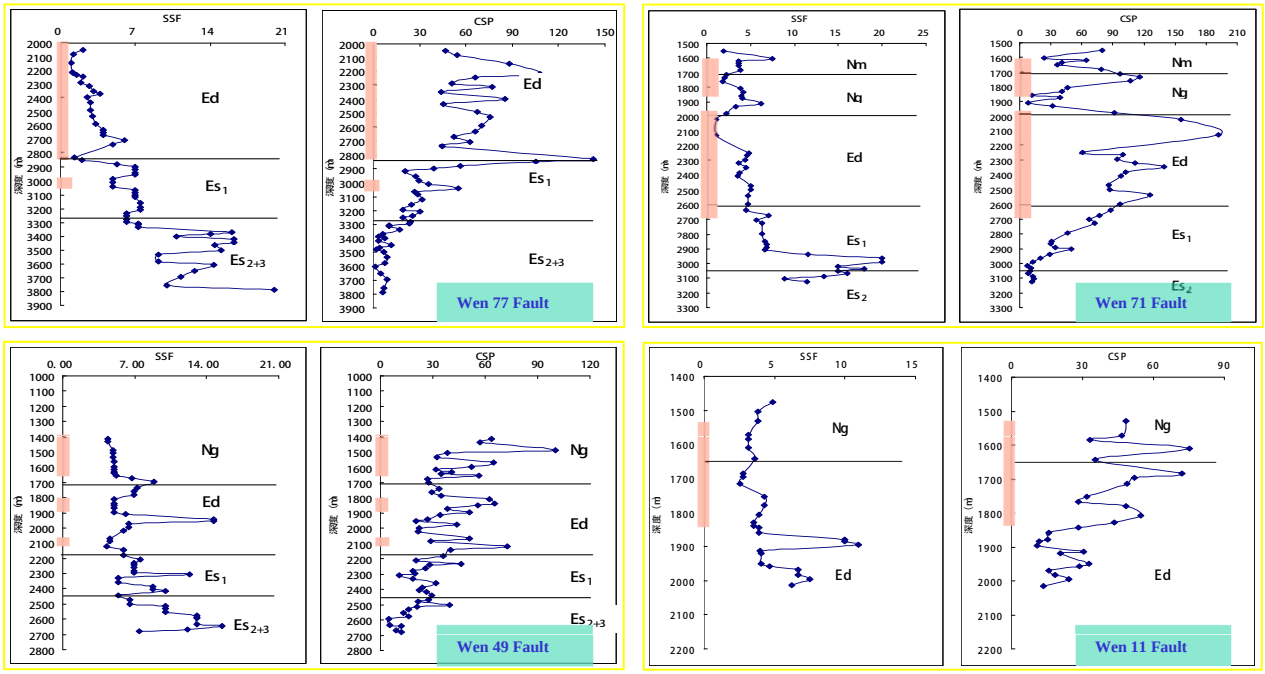
Tectonic division and distribution of Neogene reservoirs in Jizhong depression

From Baxian subsag to the Wenan slop belt, the petroleum formations becomes shallow gradually from Es1 to Ed group and to Ng group. From the distribution and the source of petroleum, the Neogene reservoir in Wenan slop belt is belongs to the typical far-source and lateral migration pattern. .



Distribution model of petroleum in Wenan slop belt, Baxian depression

3.FAULT SEALING AND PETROLEUM ACCUMULATION



The map showing faults sealing ability in Wenan slop belt, Baxian depression

		CSP	SSF
Wen 20 Fault	Reservoir：	53-109	2.03-3.33
	Water：	19.1-33.7	11.6-13
Wen 11 Fault	Reservoir：	49-72	2.76-4.26
	Water：	13.5-15.7	6.67-7.25

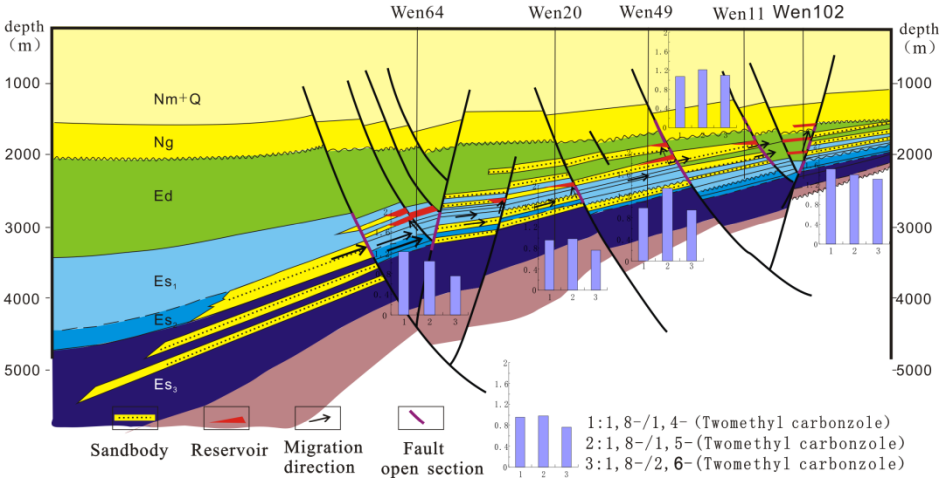
Boundary value of fault sealing：

CSP>35

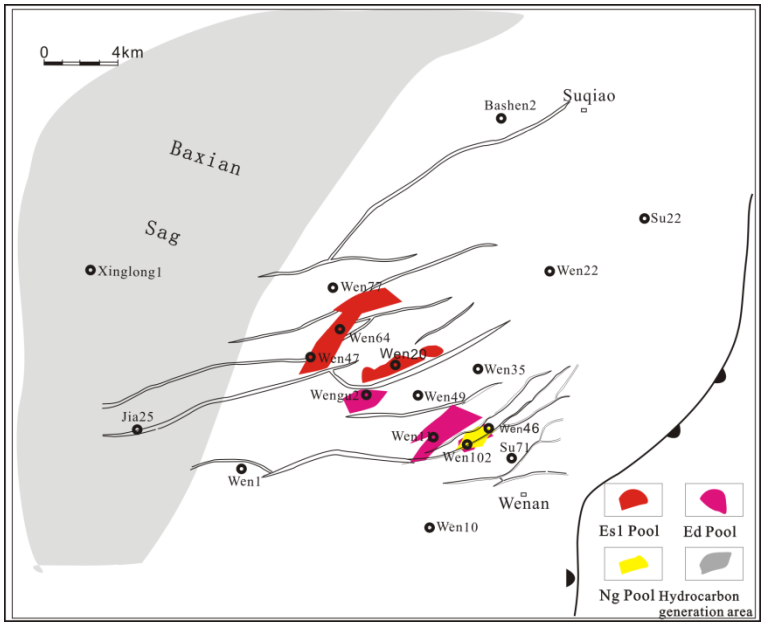
SSF <5

2.FAULT ACTIVITY AND PETROLEUM ACCUMULATION

According to the nitrogen compounds, studies have shown the passage system in the Wenan slop belt is made up of sand bodies and faults. Oil and gas is mainly from source rocks in Es1 subsection, then it migrates through sand bodies of upper Es1 subsection, Dongying formation and guantao formation and faults. With the increasing migration distance, migration horizons are getting newer, in the end it gathered in Neogene strata Wen'an slope.



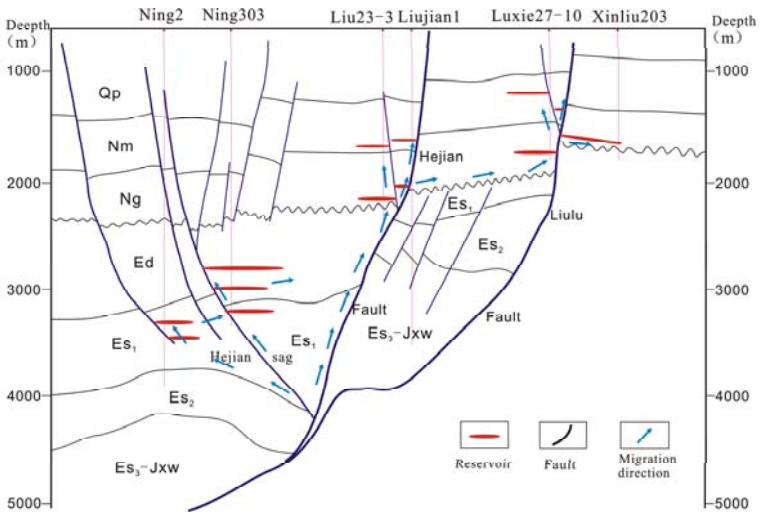
Neogene petroleum migrationshowing by nitrogen compounds and fault sealing in Wenan slop belt, Baxian sag



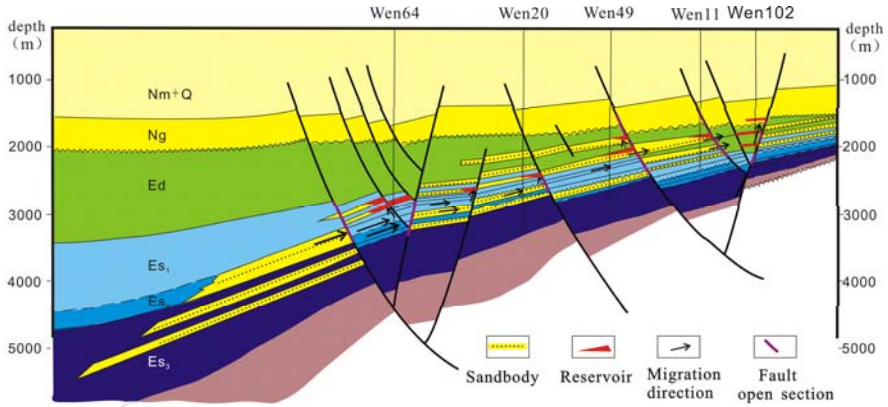
Distribution model of petroleum in Wenan slop belt, Baxian depression

4.NEOGENE PETROLEUM ACCUMULATION MODEL

According to the study of distribution of Neogene reservoirs, characters of fault activity and fault sealing property, two kinds of hydrocarbon migration modes with faults are recognized in Jizhong Depression, Bohai Bay Basin, which included far-source ladder-type lateral migration pattern in slope zone and near-source zone vertical migration pattern in fault terrace belts.



Near-source zone vertical migration pattern in fault belts



Far-source ladder-type lateral migration pattern in slope zone

CONCLUSIONS

(1) The distribution of Neogene reservoirs is nearby the strong-active oil source faults and adjacent to the subsags. Enrichment degree and enrichment layers are determined by fault activity during main hydrocarbon accumulation periods.

(2)The Neogene reservoirs is far from the sub-sag, the ability of hydrocarbon vertical migration was not strong for its weak tectonic movement,so the hydrocarbon migration pattern and directions of hydrocarbon accumulation in Neogene is determined by lateral sealing ability of faults.

(3)Two kinds of hydrocarbon migration modes with faults are recognized in Jizhong Depression, Bohai Bay Basin, which included far-source ladder-type lateral migration pattern in slope zone and near-source zone vertical migration pattern in fault terrace belts.