

DIVISION OF TECTONIC BELT FROM DIFFERENT PERIODS IN RAOYANG SAG

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ABSTRACT

Secondary tectonic belt is the focus of oil and gas exploration, because it controls the conditions of oil and gas traps directly. Raoyang sag experienced several tectonic movements, and there are great differences between deep and superficial feature, so it is important to research from different periods. Divide Raoyang sag from different periods into buried hill tectonic belt and Paleogene tectonic belt based on gravity anomalies, fracture characteristics, tectonic styles, etc. There are 12 buried hill tectonic belts including fault-block type, residual hill type and fold type, and 13 Paleogene tectonic belts including fault belt and anticline belt. Buried hill tectonic belts are controlled by deep faults, and paleogene tectonic belts are controlled by different basal activity, cover slip, reverse traction etc.

KEYWORDS

Division from different periods, buried hill tectonic belts, Paleogene tectonic belts, Raoyang sag.

1. INTRODUCTION

Petroliferous basins is uneven, the division of the internal structure unit is more conducive to oil and gas exploration [1]. Secondary tectonic belt is the focus of oil and gas exploration, which controls the oil and gas traps conditions and reflects the universal law of oil and gas distribution. There are many types secondary tectonic belt, such as buried hill belt, anticline belt, slope belt, fault nose belt and faulted-stage belt [2]. A group researcher divided Raoyang sag into slope belt, sub subsag, central uplift belt, the main subsag, buried hill belt / fault belt and sub subsags from west to east as a whole [3-5]. The Raoyang sag experienced several tectonic movements, and there are big differences between shallow and deep in stratigraphic features, construction outlook, tectonic evolution characteristics and hydrocarbon accumulation characteristics. So, the early general division is difficult to accurately interpret the structural features. Division of tectonic belt from different periods is particularly important. Divide Raoyang sag from the pre-Tertiary and Paleogene into buried hill tectonic belt and Paleogene tectonic belt in order to guide the oil and gas exploration better.

2. REGIONAL OVERVIEW

Raoyang sag is located in the middle of Jizhong depression. Affected by tectonic background, Raoyang sag is a Cenozoic halfgraben-like basin with faulting in east and overlap in west. It is north to Baxian sag, south to Hengshui fault, east to Xianxian uplift and westward overlap to Goyang low uplift [6-11] (Figure 1).



Figure 1: The tectonic position of Raoyang sag.

3. BASIS FOR TECTONIC BELT DIVISION

3.1 Gravity Anomaly

Gravity anomaly is the comprehensive response potential field of the underground geologic bodies. Different wavelengths of anomalies reflect different structure features. Faults cause gravity anomaly, so there is generally gravity anomaly gradient belt in fault zone. Lithology also has a big impact on gravity anomaly, so because of the obvious density differences between the buried hill and overlying sedimentary strata, the buried hill is with the performance of the gravity anomaly. In slopes also can cause local gravity anomaly due to the change of Paleozoic strata thickness [12, 13].

3.2 Fault

Fault is the most important basis of tectonic unit's division. First-order fault separates sag from uplift second-order fault separates Secondary tectonic belt. Faults in Raoyang sag can be divided into four levels, in which Hengshui fault and Xianxian fault are first-order faults, Maxi fault, Chu'an fault and others are second-order faults (Table 1) (Figure 2).

Table 1: Faults of Raoyang sag.

Fault Name	Fault level	Fault Name	Fault level
Hengshui fault	Class I	Hejian fault	Class II
Xianxian fault	Class I	Dawangzhuang fault	Class II
Maxi fault	Class II	Liuxi fault	Class II
Chu'an fault	Class II	Liuchu-Huangfucun fault	Class II
Gaoyang-Boye fault	Class II	Liulu fault	Class II
Wuchi fault	Class II	Eastern Dwangzhuang fault	Class II
Renxi fault	Class II	Yangwuzhai fault	Class II
Renqiu fault	Class II	Hubei fault	Class II

3.3 Structural Style

Secondary tectonic belt is formed by a number of positive tectonics which are caused by the same tectonic movement and have similar form. Same tectonic belt develops same or similar structural style. Tectonic style in Raoyang sag can be divided into three categories: stretching, strike-slip and inversion structure styles, and also can be further divided into 15 categories including horst-graben structure style, forward-tilting structure styles and so on.




4. DIVISION FROM DIFFERENT PERIODS

Divide Raoyang sag from different periods into buried hill tectonic belt and Paleogene tectonic belt based on fault distribution, gravity anomaly data, structural style, and combined with the formation conditions and evolution characteristics. And analyze the formation, distribution, and deformation characteristics of belts from different periods.

4.1 Buried Hill Tectonic Belts

Before paleogene, most areas of Raoyang sag are controlled by deep faults. Crust rose first, suffered from erosion, and then subsided to be buried, forming buried hill tectonics consist of the pre-tertiary strata under the denudation plane and paleogene draping strata above the denudation plane. Pre-tertiary strata is in direct contact with the paleogene strata, and the significant density difference between them cause local gravity anomaly [14]. So analyzed the pre-tertiary stratigraphic characteristics to divide Raoyang sag into 12 buried hill tectonic belts based on gravity, fracture and other information. According to the structural characteristics, they are further divided into two fault block buried hill tectonic belts, nine monadnock buried hill tectonic belts and one-fold type buried hill tectonic belt (Table 2).

Table 2: Buried hill tectonic belts type of Raoyang sag.

Fault block buried hill structural belt		Changyangdian, Huangfucun
Monadnock buried hill structural belt		Yanling, Nanmazhuang, Renqiu, Xuezhuang-Balizhuang, Hejian, Zhao Huangzhuang, Dawangzhuang-Suning, Liulu, Sunhu
Fold type buried hill structure belt		Goyang-Tongkou

Crust uplift and being erosion, rock weathering resistance, crust decline and burial, and the transformation after paleotopography burial are all controlled by tectonic movement. Thus, the formation of buried hill tectonic belt mainly depends on the tectonic movement. Rather the formation of buried hill in this area mainly depends on fault activity especially the deep faults. So, most of the buried hill tectonic belts distribute near the deep fault (Figure 2).

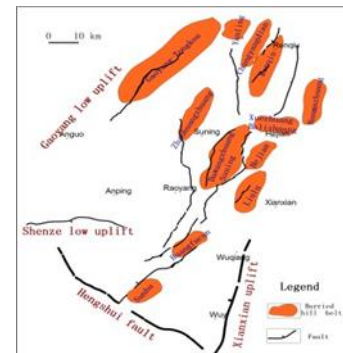


Figure 2: Distribution of buried hill tectonic belts of Raoyang sag.

Buried hill tectonic belt mainly distribute in the north-central of Raoyang sag. The western Goyang-Tongkou buried hill tectonic belt is the biggest one. The rest are small, such as northern Yanling, Changyangdian, Renqiu, Nanmazhuang and south-central Zhao Huangzhuang, Dawangzhuang-Suning, Hejian, Liulu buried hill tectonic belts. Goyang-Tongkou buried hill belt is mainly controlled by Goyang-Boye fault, located in the northern part of Lixian slope; Nanmazhuang buried hill belt is located in upthrow of Renxi fault [15]. Nanmazhuang buried hill belt is controlled by Maxi fault, located in the northeast corner of Raoyang sag.

4.1 Paleogene Tectonic Belt

Affected by Himalayan movement and due to different basal activity, cover slip and reverse traction, Raoyang sag developed a series of paleogene fault and anticline tectonics above early tectonic foundation in paleogene period. According to fault characteristics, structural style and others, divide Raoyang sag into twelve fault belts, one anticline belt and the mosaic-distribution of sub sags and slopes, etc., (Table 3).

Table 3: Paleogene tectonic belts type of Raoyang sag.

Anticline belt	Liuchu-Huangfucun
Fault belt	Yanling, Nanmazhuang, Renqiu, Balizhuang, Xuezhuang, Suning, Hejian, Zhao Huangzhuang, Dawangzhuang, Gaoyang-Boye, Yangwuzhai, Sunhu

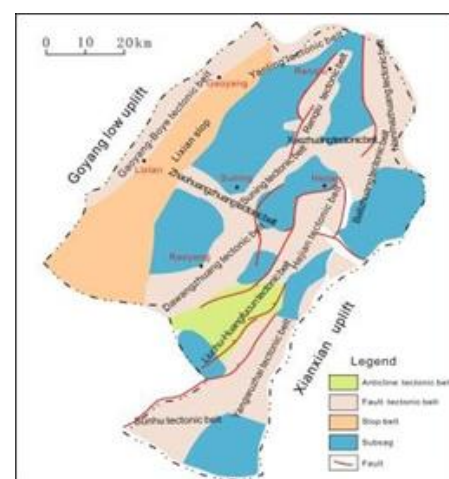


Figure 3: Paleogene tectonic belts distribution of Raoyang sag.

Raoyang sag has mosaic-distribution of bits and subsags in paleogene period. In south-central sag, the basal spacing of Liulu fault, Huangfucun fault, and dipping Dawangzhuang east fault becomes smaller with the increasing depth. Formations slid to the settlement center along the fault plane, and the center bottom formations derive arch tension, leading to central arch and surrounding subsidence, and forming Liuchu-Huangfucun anticline belt with down-extrusion, up-tension and top-subsidence. Affected by the activities of Dawangzhuang fault, Yangwuzhai fault and so on, it usually develops a series of fault terrace style, forming Dawangzhuang, Yangwuzhai, Hejian fault tectonic belts. In subsags, such as Hejian subsag controlled by Hejian fault, down dropped block formation of Hejian fault fall down sharply to deep sag forming gap with rising dish. The down dropped block clastic fill the gap, developing reverse compensation fault which pinch in Hejian fault and form graben anticline style with Hejian fault. Slope with weak activity, such as Lixian slope, mainly developed graben-horst, warped fault blocks structural styles (Figure 3).

Raoyang sag mainly develops fault tectonic belt in paleogene period. Affected by the strong fault activity, fault tectonic belt mainly develops warped fault blocks, fault bench, graben-horst structural styles; anticline tectonic belt mainly develops a series of anticline tectonic styles, such as basement uplift anticline, inverse traction anticline, gravity sliding anticline, formation compensation anticline and so on.

5. CONCLUSIONS

Divide Raoyang sag from different periods into pre-tertiary buried hill tectonic belt and Paleogene tectonic belt based on gravity anomalies, fracture characteristics, tectonic styles, etc. Controlled by first-order and second-order fault, pre-tertiary formation develops twelve buried hill tectonic belts consist of fault block, monadnock and fold type buried hill tectonic belts, which usually distribute near the deep fault. Due to different basal activity, cover slip and reverse traction, Raoyang sag develops thirteen paleogene tectonic belts, consist of fault and anticline tectonic belts, in which fault tectonic belt is the principal one. Fault tectonic belt mainly develops warped fault blocks, fault bench, graben-horst structural styles etc.; anticline tectonic belt usually develops a series of anticline tectonic styles.

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