# The Origins of Reservoir Overpressure in Kelasu Tectonic Zone

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**Abstract**. There exists controversy about the origins of reservoir overpressure in kelasu tectonic zone of kuqa depression . Based on it, the distribution and the evolution characteristics of reservoir pressure were analysed, the contribution of the tectonic compression stress to residual pressure was evaluated, and the overpressured causes of reservoir were discussed. The research results indicated that the tectonic compression stress is important factor for the overpressure of reservoir, and the contribution of the tectonic compression stress to residual pressure is different in different area of kelasu tectonic zone, and the contribution is increasing from west area to east area. Hydrocarbon injection also play an imorant part in overpressure of reservoir. The hydrocarbon injection can lead to the increasing of porefluid pressure. Along with the hydrocarbon injection, the ratio of tectonic compression transforming to porefluid pressure is increasing. In all, tectonic compression stress and the hydrocarbon injection are the main causes of reservoir overpressure, and in different area the main cause may be different.

## Introduction

Kelasu tectonic zone develop a number of overpressure gas field ,such as the Dabei 1 (the pressure coefficient is 1.62), the Keshen 2(the pressure coefficient is 1.73) and the Kela 2 (pressure coefficient is 1.95 ~ 2.20). Many scholars[1-3]paid attention to the phenomenon. simulated experiment[4]and the theoretical calculation[5-6]were used to explain the cause of the overpressured reservoir. At present ,the main viewpoints were as follows: tectonic compression[7] ,gas filling[8] , tectonic uplift and disequilibrium compaction[9-10]. Although there existed many viewpoints, they can not explain all phenomenon. Based on this, the proportion of tectonic pressure changing into reservoir pressure was calculated, and the importance of gas filling was analysed.

## General Situation of Study Region

As shown in the figure. 1, Kuqa Depression is located in the northern part of the Tarim Basin and adjacent South Tianshan Mountain in the north, close to the North Tarim Uplift in the south. The trend of depression to northeast by east distribution, with 42700 $km^2$, the length from east to west is 550 km, the width of north-south is 50-90 km, from west to east gradually narrowed, as a Cenozoic to Mesozoic developed depression. Kuqa depression can be further divided into 7 secondary tectonic units, as the northern monoclinic zone, Crassus-Izzy Crick tectonic belt, Wushen sag, Baicheng sag, Yangxia sag, Qiulitage structural belt and the southern slope zone. The large gas field of Kela 2, Dabei 1, Yinan2 and Keshen2 were found in the depression .

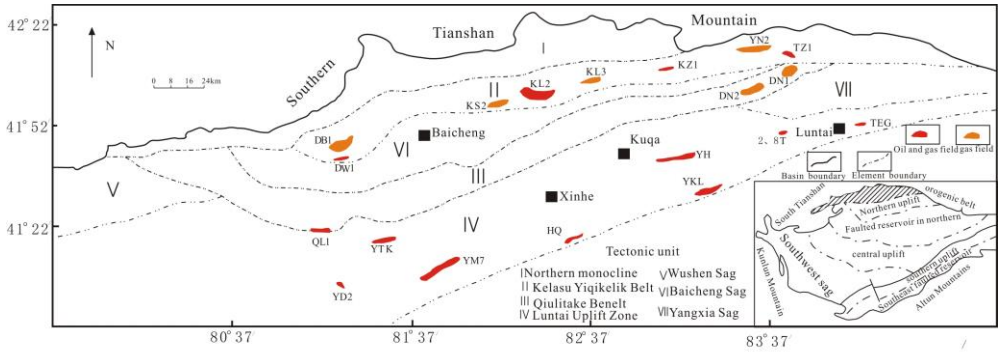


Fig. 1 Oil and gas field distribution in Kuqa depression.

## Distribution Characteristics of Reservoir Fluid Pressure

According to the measured pressure data of Zhang Likuan, Zhao Jingzhou, etc., pressure coefficient was calculated, and the distribution diagram was shown in Fig. 2 . According to the distribution diagram, Analysis can be drawn as follows: 1)The pressure coefficient decreased from north to south. The pressure coefficient of northern part of kelasu tectonic belt is higher than 1.5, belonging to the overpressured belt. 2) The pressure coefficient has the increasing trend from Dabei region to kelasu region, and the pressure coefficient of Kela 2 reachs 2.0; 3) There are more large gas field in the area of higher coefficient;4) There are more large gas field in the area of gypsum salt rock and gypsum mudstone; 5) The decline rate of north belt is obviously larger than the South Zone, which may be the results of faults releasing pressure.

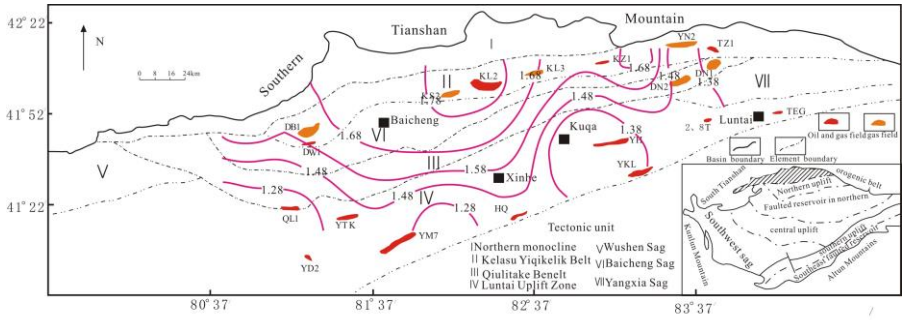


Fig. 2 Plane distribution chart of pore fluid pressure in Kuqa depression

## The Contribution of Tectonic Stress to The Reservoir of Overpressure

Previous studies have shown that tectonic stress is important source of reservoir overpressure. It is pointed that tectonic compression is the main mechanism of overpressure. Zeng Lianbo through the analysis of reservoir fluid inclusion pointed out that the formation period of abnormal high pressure is Himalaya period, and the period is the main period of tectonic deformation and tectonic frame period. Jia Chengzao through the simulation of tectonic stress field pointed out that the maximum distribution coefficient of fluid pressure region is the high stress concentration distribution area.

In the course of calculating the proportion of tectonic compression stress into the reservoir fluid pressure, The first things to clear are as follows:1)when the tectonic compression stress appears , the rock stage plays an important roles. If the rock is in the state of compaction stage, it is generally believed that the decrease of the rock volume is mainly caused rock pores. If the rock is in the state of compression stage, the decrease of the pore volume is caused by the decrease of the rock frame. The compaction coefficient of the fluid is bigger than rock frame, so the rock does not discharg fluid;2)The closed degree of research formation. The formation of closed degree is divided into three types: completely closed system, semi-closed system and completely open system. When it is in completely closed system, the tectonic stress are all converted into fluid pressure; When it is in open system, no matter how hard it is tectonic stress, the tectonic cannot be converted into fluid

pressure; When it is in half open system, the tectonic stress converted into the fluid pressure is between the two former ;3)The fluid types in the pores of the rock. If the pores are filled with water, the proportion of tectonic compression stress converted into reservoir is large. If the pores are full of gas, the proportion of tectonic compression stress converted into reservoir is small.

Calculation steps:(1)Determining the fluid sealing coefficient of the closed system. Kelasu region area closed coefficient is 0.721, and the coefficient of dabei region is 0.703;(2) Numerical simulation, experiment and empirical formula were used to obtain the present tectonic stress;(3)According to the formula, calculating fluid pressure increment caused by tectonic compression. Calculation formula is: $\Delta P=\xi(\sigma_1-S)$.

The evaluation results is showed in table1. The converting ration of dabei region is 4.75%, and the converting ration of keshen region is 23.77%. the maximum converting ration of kelasu region is 50.93% . In all, kelasu tectonic belt, the converting ration of the tectonic stress has the trend that the converting ration is increasing from west to east.

Table 1 Evaluation results of stress increment for tectonic compression of typical wellsabout overpressured large gas field in Kuqa Depression

| Well name | maximum horizontal principal stress /MPa | Excess formation pressure /MPa | sealing coefficient | Fluid compressure caused by tectonic compression /MPa | The ration of the Tectonic compression in the total pressure/% |
|---|---|---|---|---|---|
| kela2 | 112.0 | 44.7 | 0.721 | 12.33 | 27.58 |
| kela 201 | 104.8 | 31.8 | 0.721 | 10.02 | 31.52 |
| kela 201 | 105.3 | 31.0 | 0.721 | 9.50 | 30.63 |
| kela 203 | 112.0 | 40.1 | 0.721 | 11.46 | 28.59 |
| kela204 | 112.0 | 43.5 | 0.721 | 10.67 | 24.53 |
| kela 3 | 116.0 | 23.5 | 0.721 | 11.97 | 50.93 |
| keshen 2 | 131.0 | 44.9 | 0.721 | 10.67 | 23.77 |
| dabei2 | 137.0 | 47.4 | 0.703 | 2.25 | 4.75 |

## Conclusions

Tectonic compression is one of the most important causes for overpressured reservoir fluid in kelasu tectonic belt . In different blocks, the proportion of the tectonic stress to the reservoir fluid pressure is different, and its has the trend that the proportion is reducing from west to east.

Gas filling is also the important cause of overpressured reservoir fluid in kelasu tectonic belt. The gas filling can not only increase the reservoir fluid pressure, but also increase the proportion of tectonic pressure changing into reservoir fluid pressure.

Tectonic compression and gas filling are the two main cause for overpressure of kelasu tectonic belt. However, in different blocks, they play different role.

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