

Introduction

The distribution of oil and gas reservoirs is controlled by the pressure during the reservoir forming period.

At present, the main point is that the main cause of overpressure in Shunnan gas field is crude oil cracking, but most researches focus on crude oil cracking degree, and the amount of cracking pressurization is not clear. Meanwhile, many scholars have began to put forward many overpressure quantitative models suitable for different overpressure mechanisms(GUO Xiaowen et al., 2011; GUO Xiaowen et al., 2013;LIU Wen et al., 2018). However, there are few studies on quantitative characterization of overpressure in crude oil cracking.

We restored the paleo-pressure with PVTx simulation method (Aplin et al., 1999) and established the quantitative model for crude oil cracking pressurization of Shunnan gas reservoir and tested the the accuracy of the model with restored paleo-pressure values.



Process





Geological Setting





Fluid inclusion method (Roedder and Bodnar, 1980)

Basic principle: according to the fluid inclusion formed by the fluid trapped during the formation of minerals, it can well reflect the temperature and pressure information of fluid charging during the oil and gas accumulation period, and the P-T phase diagram of inclusion is used to restore the pressure during the oil and gas accumulation period.





Result and Discussions



Weit	Deptil/iii	HUHZUH	n stage	temperatures/°C		temperature/°C pressure/Mpa		Faleo-deptil/ill	coefficient	_
SN2	6465.8	О2уј	202 220142	150.8	P=3.71T-505.83	161.8	94.45	5437.04	1.48	
SN4	6360.1	О2уј	292-2001VId	150.4	P=6.7T+1217.15	168.4	88.87	5681.14	1.39	
SN4	6461.1	01-2y		168.9	P=2.8T-400.87	181.9	108.45	6181.48	1.58	
SN5-2	6876.5	O1p	21-11Ma	173.7	P=3.4T-532.11	189.7	112.88	6470.17	1.64	
SN6	6845.7	01-2y		170.2	P=3.47T-541.10	188.2	111.94	6414.48	1.63	
SN7	6427.2	О2уј	292-280Ma	157	P=3.9T-588.61	175	93.89	5517.24	1.42	
SN7	6429.2	01-2y	21 11142	173.2	P=4.15T-692.35	191.2	101.13	6075.86	1.61	
SN501	6572.9	01-2v	ZT-TTIAI9	164.6	P=3.5T-535.82	182.6	103.28	6207.4	1.57	



Pressurization model of crude oil cracking

According to the law of conservation of mass, Quality of Crude Oil before Cracking = Quality of Residual Oil + Quality of Cracking Gas and Pyrobitumen.





The mass of crude oil before cracking is calculated by dividing the sum of the mass of cracking gas and pyrobitumen produced by cracking by the conversion rate of crude oil cracking, or calculated by dividing the mass of residual oil by (1 - crude oil cracking conversion).



Because the density of underground can not be measured, it needs to be obtained by converting the density of surface to that depth and that pressure condition. The conversion relationship is as follows:

Density of crude oil before cracking :

$$\rho_{o1} = \frac{\rho_o}{(1 - P_h C_o)}$$

Density of cracked gas after crude oil cracking : $\rho_{g_1} = \frac{\rho_g}{[1 - (P_h + \Delta P_1)C_g]}$

Density of residual oil after crude oil cracking : $\rho_{02} = \frac{\rho_o}{[1 - (P_h + \Delta P_1)C_o]}$

Density of pyrobitumen after crude oil cracking : $\rho_{a1} = \frac{\rho_a}{[1 - (P_h + \Delta P_1)C_a]}$

$$\frac{V_t \varphi_t S_g \rho_{g1} + \rho_{a1} 17.5\%}{k} \frac{V_t \varphi_t S_g \rho_{g1} + V_t \varphi_t S_o \rho_{o2}}{\rho_{o1} - \rho_{a1} 17.5\%} = \frac{V_t \varphi_t S_o \rho_{o2}}{1 - k}$$

 ho_{o1} , Density of oil in formation before crude oil cracking, kg/m^3 ; ho_{g1} , Density of gas in formation after crude oil cracking, kg/m^3 ; ho_{o2} , Density of residual oil in formation after crude oil cracking, kg/m^3 ; ho_w , Density of water in formation after crude oil cracking, kg/m^3 ; ho_{a1} , Density of pyrobitumen in formation after crude oil cracking, kg/m^3 .



Result and Discussions



- The contribution of crude oil cracking pressurization in Shunnan area is more than 50%.
- With the increase of buried depth, the contribution rate of crude oil cracking pressurization increases.

Figure5 Pressurization range of crude oil cracking

Well	Depth/m	Horizon	Sg /%	Crude oil conversion (k) /%	Pressurization capacity of crude oil cracking/MPa	Total pressurization/M Pa	Contribution of crude oil cracking pressurization/%
SN6	6845.7	O _{1-2y}	78.5	50	27.6	46.64	59.18
SN5-2	6876.5	O_{1p}	79.2	51	29.3	48.18	60.81
SN501	6572.9	O _{1-2y}	75.8	47	24.9	47.83	54.15
SN7	6429.2	O _{1-2y}	76.1	46	20.9	40.37	51.8
SN4	6461.1	O _{1-2y}	71.9	45	21.7	41.21	52.66



Result and Discussions

>1. There are two oil and gas accumulation stages in Shunnan area of Amun transitional zone. In the early stage (292 ~ 280mA), the formation pressure is 88.87mpa ~ 94.45mpa, and the pressure coefficient is 1.39 ~ 1.48; in the late stage (21 ~ 11ma), the formation pressure is 112.88mpa, the pressure coefficient is 1.57 ~ 1.64, and the residual pressure is above 40MPa.

>2 ∿ The conversion rate of crude oil cracking is an important factor affecting the pressurization of crude oil cracking. According to the established model equation of crude oil cracking pressurization, it is calculated that the crude oil cracking pressurization in the study area is 20MPa ~ 40MPa, and the crude oil cracking pressurization rate is more than 50%.