

超浅疏松地层气、水层识别方法 ——以大庆某地区黑帝庙层为例

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摘要 大庆某地区黑帝庙储层压实程度低、成岩作用差、物性好, 导致气、水层的电性特征相近而难以区分。在储层岩性、物性、水性和电性关系分析的基础上, 确立中子测井为气层敏感曲线。以中子测井曲线为核心, 建立中子测井与深侧向电阻率、密度、声波时差的交会图, 确定气层解释下限标准。利用电阻率与声波时差、自然电位以及中子测井与密度、声波时差在气、水层匹配关系的不同, 提出多曲线重叠与气测资料综合定性判断气层方法。为进一步扩大气层响应特征, 采用多曲线定量计算气层解释综合判断参数, 并与自然电位曲线交会区分气、水层, 取得较好效果。15口试气井解释结果与试气结论进行背对背验证, 气层解释符合率达到了84.4%。

关键词 超浅疏松地层; 气、水层; 曲线重叠; 下限标准; 气测分析

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* E F O U J G J D B U J P O . F U I P E P G (B T B O E 8 B U F S - B Z F S
6 O D P O T P M J E B U F E ' P S N B U J P O 5 B L J O H U I F) F J E J N
" S F B P G % B R J O H B T B O & Y B N Q M F

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Abstract The compaction degree of the Heidimiao reservoir in a Daqing area is very low, the diagenesis is poor, but the physical properties of the formation are good. Therefore the electrical characteristics of the gas layer are so close to those of the water layer that it is difficult to distinguish two kinds of reservoir layers. In order to solve this problem, this paper proposes to take the neutron logging as the sensitive curve of the gas layer based on the analysis of the relations between above mentioned properties. With the neutron logging curve as the central key, the cross-plots of the deep lateral resistivity, the density, the acoustic travel time are established to determine the lower limitation standard of the gas zone interpretation. According to the different matching relationships between the resistivity and the acoustic travel time or the spontaneous potential and, alternatively, between the neutron logging and the density, or the acoustic travel time in gas and water layers, a comprehensive and qualitative method is proposed to determine the gas layer by using the multi-curve overlapping combined with the gas logging data. In order to further enhance the gas response characteristics, the comprehensive judgment parameters are calculated by the multi-curve to interpret the gas layer quantitatively. Better results are achieved in distinguishing gas and water layers by using the cross-plots between these parameters and the

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spontaneous potential curve. The interpretation coincidence rate of the gas layer reaches 84.4% according to the verification by the results of 15 gas test wells' interpretation and their gas testing conclusions.

Keywords extra shallow unconsolidated formation; gas and water layers; curve overlapping; lower limitation standard; gas logging analysis

$B^{2/3}r^{1/4} \ll A o h > \backslash 4 \theta \# < \gg 800 m \pm A o ! T^3 \dot{y}$
 $] g S p J \text{Æ} r F ! A o \pm x \hat{A} ! \textcircled{R} ; \# F ! A o , \% ! T : , \% 9 U'$
 $h > \textcircled{R} \# 6 8 ! \textcircled{R} U \ddot{Y} F \ddot{O} o \pm \ddot{O} T g " B U 1 \text{f} / \ddot{O} U' , \ddot{E} / 8$
 $\ddot{O} \{ U = \ddot{O} \% * U U \} ? ! \ddot{O} o - T D^{\circ} a U' t \cdot K \text{Æ} \ddot{O} 25 \%$
 $U' t \# D E < (216 \times 10^{-3} \mu m^2 ! A 1 \ddot{O} o C \ddot{O} T U' : 9 o z ! A$
 $o \pm * b T ! \textcircled{R} E / ! \{ K h ! A o p 5 \beta U' : 7 Y \# \ddot{O} > * b K h i D \ddot{e}]$
 $10 U \ddot{a} 2 \Omega \cdot m \# U A o \wedge 6 * g ! A o !] o ! a - , C \ddot{O} \{ U \text{€}]$
 $o \theta \# < \gg 500 m \# U \text{€}] o ! a - , C \ddot{O} - 7 Y \{ \gg 5000 \text{ mg/LU}$
 $\text{€}] o \theta \# T \gg 700 m \# U \text{€}] o ! a - , C \ddot{O} - 7 Y U 6000 \sim$
 $10000 \text{ mg/LU} \} ? ! r F ! a o * b K h (t P U' ; \{ K h ! A o \pm * b T !$
 $\textcircled{R} \ddot{O} D \text{U} \} ? ! A ! a o x K ! : @ g 3 U^{\wedge} \gg - A / \text{€} g^2 A ! A B q \text{Æ}$
 $D^{\circ} > U W c \text{€} ! A o * b " x ? F \div 4 \ddot{O} ! ' U (\ll \& ! A o | L \pm$
 $" x \hat{A} 3 i U' / \theta ! A ! a o \pm * b T @ \ddot{O} X 8 K \} 4 \ddot{O} \div ! A o @ \ddot{O} X +$
 $' u U \& @ \ddot{n} \$ A g S p J \text{Æ} ! A o p 5 \beta \ddot{O} \hat{a} \div - p \$ \% \ddot{E} \# 6 F \ddot{U} > \textcircled{R} <$
 $v U Y ' \& ' , - - A / \text{€} !$
 $\& \gg ! A ! a o \pm @ \ddot{O} X 6 \mu G - A / \text{€} \text{æ} " U^{\neg} M . i j 0 v^{[1]} V$
 $* U " \# ; Z] j O^{\text{TM}} 3 i F \ddot{U} " = ' \neg Z \} - = ' \neg \ddot{O}$
 $3 i F \ddot{U} " \& ! A ! a o E = y @ \ddot{O} X U' f^3 @ \hat{a} G J F A \pm ? F \div 4 @ \text{€} U'$
 $\hat{A} * U u \ddot{E} 7 \text{æ} a U O^{\text{TM}} \cdot \{ 0 v^{[2,3]} E G D \hat{O} Q \acute{U} ! A o \pm ! \ddot{n} , ^1 a \# \& \ddot{O}$
 $\hat{a} U \& 5 . \hat{A} E = y Z \} j O^{\text{TM}} F \ddot{U} : " x \hat{A} U 3 E G D \hat{O} \# K ! \ddot{O} / (" x \hat{A}$
 $\hat{A} \pm \dot{Y} 3 i E = y \& ! U Q \acute{U} \ddot{O} * U ! A o \pm X ! A / 8 \ddot{O} U \text{€} E$
 $E 6 ' \# : \ddot{O} \$ i \pm ! A o U 9 \# p (\dot{Y}^3 \mu G l \hat{e} \hat{A} \ddot{Z} 59 E , \$ <$
 $\pm ! A o ! U j K^3 ! \text{æ} * j " r o ! A \pm \times \hat{e} C \$ \% = \hat{I} (D \ddot{e}] 80 \%$
 $7 U \text{€} p' i 0 v^{[4]} U C \hat{A} u \hat{A} ; k \# U 3 Z \} " x \hat{A} \cdot K \text{Æ} \ddot{O} ; \text{€}$
 $Q W \cdot K \text{Æ} \ddot{O} " x \hat{A} 3 i U ! a \hat{a} F \ddot{U} 5 U E G D \hat{O} 3 i i Q \acute{U} ! A$
 $o U U C \hat{A} u \hat{A} ; k \# U V * U \# \ddot{O} > \ddot{O} * b K h (3 X ; \ddot{O} \ddot{O}$
 $^1 , \hat{A} ! A " x ! i E = y \ddot{n} G @ \ddot{O} X ! A o U \& \gg X C O_2 \pm \{ * b K h ($
 $! A o U E G D \hat{O} e - \hat{I} \dot{Z} \backslash \div 3 \hat{a} W " ! i " 0 v " x \hat{A} \dot{Y} - \backslash @ \ddot{O} X U'$
 $3 \ddot{u} A ! A O \hat{I} @ \hat{I} O S 5 (D \ddot{e}] 88 \% 7 ! \text{€} e * U \pm ! A o 3 \frac{1}{2} \text{æ}$
 $" E 6 , \hat{A} 3 \frac{1}{2}^{[5]} G p 4 @ \hat{I} Q X " ^{[6,7]} \& \hat{A} 3 \frac{1}{2} " ^{[8]} \text{€} <$
 $3 \ddot{u} 4 \sim 4 " ^{[9,10]} \backslash . > F \ddot{U} g " ^{[11]} ! A " x , \hat{A} 0 - @ \hat{I} " ^{[12]} t /$
 $i 3 ? " ^{[13-20]} 0 v ! Y - A / \text{€} \dot{y} ' G 3 i F \ddot{U} 5 \cdot 5 ! A " x B q \text{Æ} 4) 5$
 $\text{€} T Q \acute{U} B^{2/3} r^{1/4} \ll ! A o \pm @ \ddot{O} X \text{æ} " !$

1 识别思路

$G_i \gg B^{2/3} r^{1/4} \ll ! A o \ddot{O} T ' - T ! a T ^1 * b T ! \textcircled{R} \pm \pm : o$
 $T U ; - \pm \pm - \dot{u} \text{æ} " ^1 , - \pm \pm 8 K \} 4 \ddot{O} : B \hat{a} 3 ! A ! a o \ddot{O}$
 $\rightarrow @ \ddot{O} X ' ' ! ' U Y - A / \text{€} N \hat{A} u E G D \hat{O} \& T F \ddot{U} A ! \text{æ} A ! A \hat{a} \pm$
 $* b " x 3 i E = y 4) 5 3 \frac{1}{2} ; \& ! U \ll ' \& ! A o - g | L \pm " x \hat{A}$
 $3 i U' \text{€} g e \ddot{d} 3 X \pm ' : 9 \pm * b T ? F \div \ddot{n} G + ' u U \div /$
 $! A o @ \ddot{O} X \pm 8 K \} 4 \ddot{O} ! \text{€} N U J A * U G \ddot{Z} * b " x 3 i x K ! f F z$
 $2 (U ! A ! a o m = (\dot{Y} ' ' \pm ! \textcircled{R} \pm \pm : 9 U F \ddot{O} * U G 3 i F \ddot{U} U'$

$\text{€} \hat{I} 50 ! A " x , \hat{A} \% \ddot{d} 3 \ddot{n} 3 - T X F \ddot{U} ! ! i 4) 5 Q \text{€} ! A o ! U$
 $' ' - m 7 U V * U G 3 i @ \hat{I} 0 \hat{A} 4) 5 ? F \div \text{€} F \ddot{U} Q \text{€} \hat{I} \cdot U - T ! A$
 $o \pm \dot{u} \hat{A} ! \textcircled{R} U \ddot{U} G 3 i G > \ddot{y} \ddot{O} G B q \text{Æ} G \text{æ} " 4) 5 Q \text{€}$
 $! A ! a o U L \ddot{E} \hat{I} B^{2/3} r^{1/4} \ll] o ! A o ? F \div \pm \pm \ddot{O} \rightarrow / 8 \ddot{O} !$

2 气层敏感性曲线分析

$* \wedge \gg B^{2/3} r^{1/4} \ll] o , \ddot{E} / 8 \ddot{O} \{ U \ddot{U} \cdot K \text{Æ} p 5 \text{U} \cdot K \text{Æ} E G$
 $T a U] o ! a - , C \ddot{O} , \% \& D^{\circ} \{ U \} ? ! A o ; ! a o \pm * b K h ($
 $3 i " \# 3 i ^1 \ddot{O} \ddot{O} 3 i X : T U V * U E \ddot{E} 3 i g 3$
 $! A ! a o \pm u \ddot{E} - 7 Y :) 3 ! s^{\wedge} \gg V \& c ! A \pm X ! O 4 \cdot ! a$
 $< \hat{A} G U' C C \hat{A} u \hat{A} \pm \dot{Z} \dot{u} \text{€} \ddot{E} g^3 E . \dot{u} u \ddot{E} U' ' Z \}$
 $" x \hat{A} \& \ddot{O} o X ! A F \ddot{U} \pm G > ! D^{\circ} | L ! ' U Y ' 3 = ' \neg Z \}$
 $3 i \rightarrow \text{€} g " r ! A o \pm | L 3 i !$

$E G D \hat{O} T^3 \dot{y}] g \text{€} , \pm \pm ! A o ! A o ! A ! a 9 o \div ! a o$
 $\pm \pm " x \hat{A} \dot{u} \hat{A} ! \textcircled{R} \& ! 3 \frac{1}{2} - U \ddot{Y} 7 Y \& \gg ! A o \div ! A o U \text{€}$
 $= ' \neg Z \} " x \hat{A} i - 7 Y < \gg 28 \% \text{U} \cdot + U \cdot \text{U} \ddot{Z} \cdot \text{U} \ddot{Z} \ddot{Z} 9 \& \gg ! A ! a 9$
 $o \div ! a o U \text{€} = ' \neg Z \} " x \hat{A} i - 7 Y T \gg 35 \% \text{U} \cdot + U \cdot \text{U} \ddot{Z} \cdot \text{U} \ddot{Z}$
 $* \wedge ' > \hat{I} = ' \neg Z \} \rightarrow \ddot{E} \& \ddot{O} o \pm X ! A F \ddot{U} C D^{\circ} | L !$

3 多曲线交会确定气层解释下限标准

$\ddot{n} G " \backslash - \dot{u} , ! > \hat{I} @ \ddot{O} X ! A o \pm \text{æ} " U^{\circ} h > \textcircled{R} \backslash V * U ! A o$
 $; L < ! A o U " x \hat{A} 3 i 7 r i T < \pm \pm : 9 E = y \ddot{n} G U \ll ' ! A o$
 $\pm \pm " x \hat{A} \dot{u} \hat{A} 80 ! U \text{€} 59 D \ddot{e}] @ \ddot{O} X ! A o \pm , \pm \pm ! E G D \hat{O} 7 E 3$
 $\frac{1}{2} U p (\dot{Y} Z \} " x \hat{A} 3 i \& ! A o n 3 | L U' ' Z \} " x \hat{A}$
 $3 i g e \ddot{d} U E E 6 " * b K h (3 i " \# 3 i \ddot{O} \ddot{O} 3 i \% g$
 $! A o ? 3 \pm D^2 \ddot{O} 3 i U' ; Z \} " x \hat{A} 3 i / \theta \ddot{n} G + U L \rightarrow$
 $\text{€} ! A o * b " x ? F \div 8 K \} 4 \ddot{O} !$

3.1 中子-密度交会

$V * U T^3 \dot{y}] g A ! A B q \text{Æ} U A (A ! A o z \& \hat{A} \pm \ddot{O} \ddot{O}$
 $U \cdot D E N U \ddot{Z} \} U C N I U \ddot{Z} i U' / \theta \ddot{O} \ddot{O} - Z \} \ddot{n} G + U \cdot + U \ddot{Z} \text{Æ} 59$
 $\rightarrow \text{€} S p J \text{Æ} ! A ! a o ? F \div \pm \pm 8 K \} 4 \ddot{O} U \text{€} C N L U \text{€} 3 \% A D E N U \text{€}$
 $2.02 \text{ g/cm}^3 \# g ! a o U \text{€} C N L U j 33 \% C D E N U j 2.02 \text{ g/cm}^3 \# g ! A$
 $o ! \ddot{n} G + \ddot{Z} F \hat{O} * U 17 A ! A \hat{A} U A ! A o z 33 o U A Q \% \text{æ} A$
 $o Z ! a \% \text{æ} ^1 ! a o Z ! A \% \text{æ} \text{U} \ddot{Z} W U ' + u 1 \ddot{e} \ddot{O} g 87.9 \% !$

3.2 中子-电阻率交会

$\# \ddot{O} > * b K h (U \cdot L L D U \ddot{Z} \hat{A} \hat{I} " x \# \ddot{O} D^{\circ} \# U^{\neg} h > \textcircled{R} \dot{u} M \hat{I}$
 $' \ddot{a}] o * b K h (\pm C U Z \} " x \hat{A} A (i h > \textcircled{R} \dot{u} M \cdot K \text{Æ} " n \text{€} Z$
 $X ! O F \ddot{U} \pm C ! ! a o * b K h (D^{\circ} \{ U Z \} " x \hat{A} i D^{\circ} P U A o * b$
 $K h (D^{\circ} P U Z \} " x \hat{A} i D^{\circ} \{ U E G D \hat{O} ^1 52 \pm \ddot{n} G \cdot + 3 U \ddot{Z} ' \mu$
 $a] g 3 ! A ! a o U \text{€} L L D U j 15 \Omega \cdot m A C N L U \text{€} 3 \% \# g ! a o U$
 $\text{€} L L D U \text{€} 5 \Omega \cdot m C C N L U j 33 \% \# g ! A o ! \ddot{n} G + \ddot{Z} F \hat{O} * U 17$
 $A ! A \hat{A} U A ! A o z 33 o U A Q \% \text{æ} W U ' + u 1 \ddot{e} \ddot{O} g 93.9 \% !$

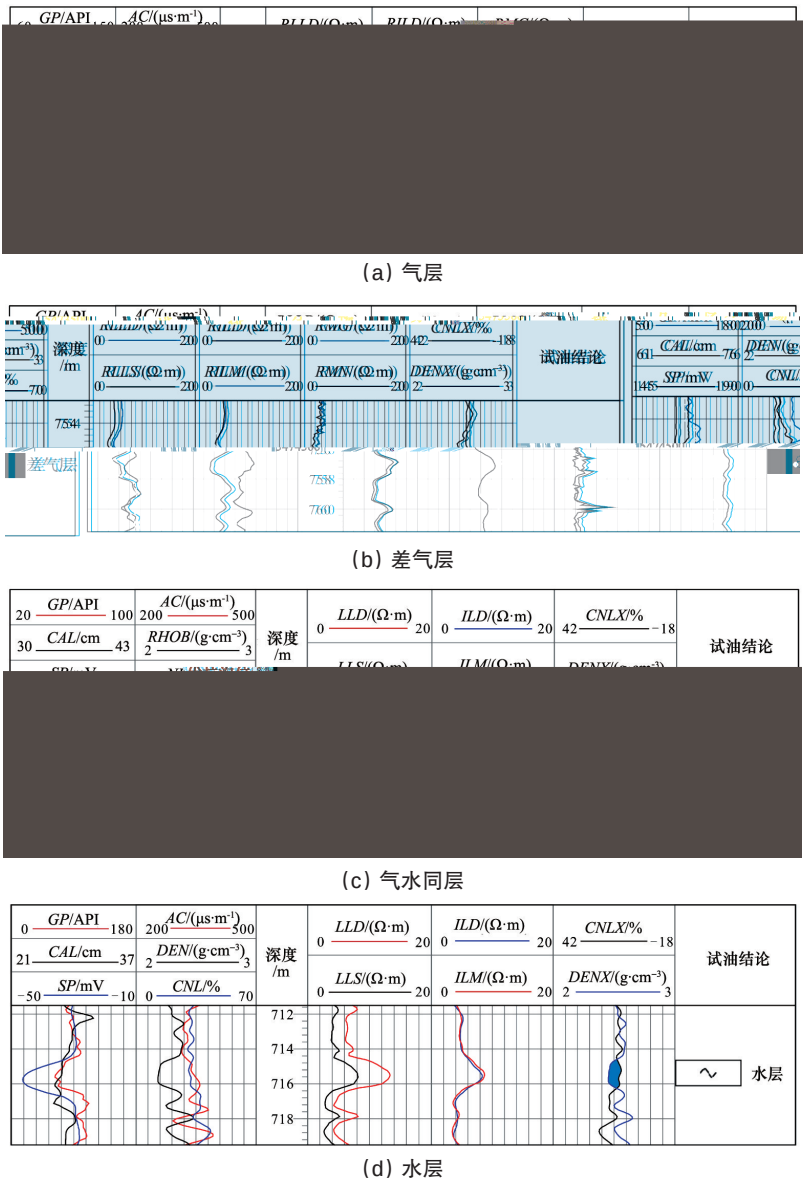


图 1 大庆某地区横向测井响应特征

Fig. 1 Lateral logging response characteristic diagram in an area of Daqing

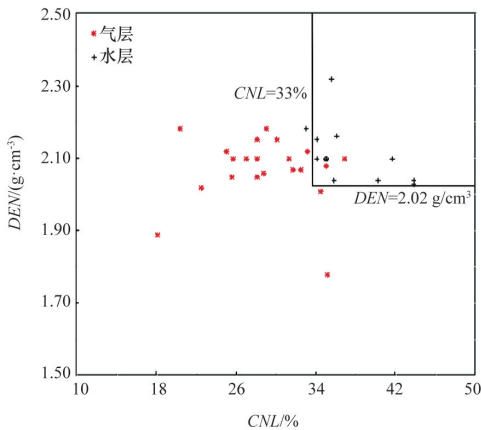


图 2 大庆某地区黑帝庙油层中子-密度交会图

Fig. 2 Cross-plot diagram between neutron logging and density in Heidimiao reservoir in an area of Daqing

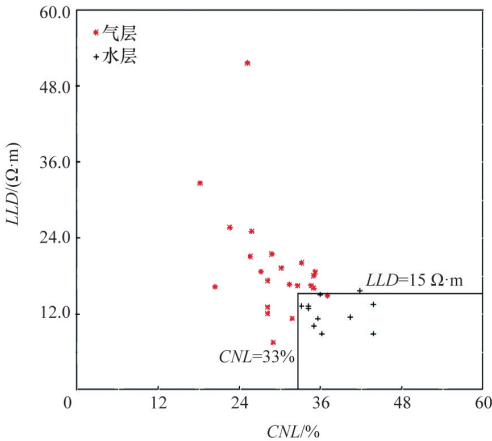


图 3 大庆某地区黑帝庙油层电阻率-中子交会图

Fig. 3 Cross-plot diagram between resistivity and neutron in Heidimiao reservoir in an area of Daqing

3.3 中子-声波时差交会

Z }"x ÅA(•h>® à »] o+± X!OFü U59 U,% 9 Ž #
8 U!a o+± X!OFü,% &!A o>® GUm !a o Z }"x Å i>®!
!A o T ! 59 " U!A !a øBU Z M Ú+±EL Ó : 9UU!a Z M
ÚEL Ó TU59 U!A Z M ÚEL Ó - < ! ' U,% 9 Ö T] o
ZUX!A] o " # ,% & T È UU " # U•AUŽ3i 7!A
o=•(Ý gP i ! ' 3= ' - Z } 3i ; " # 3i Ñ G
U•+ 4UŽ0* μ^a]@ó X!A !a o ! € CNL>33% AAC<435 μs/m
g!A o U€ CNL<33% CAC>435 μs/m # g!A o !

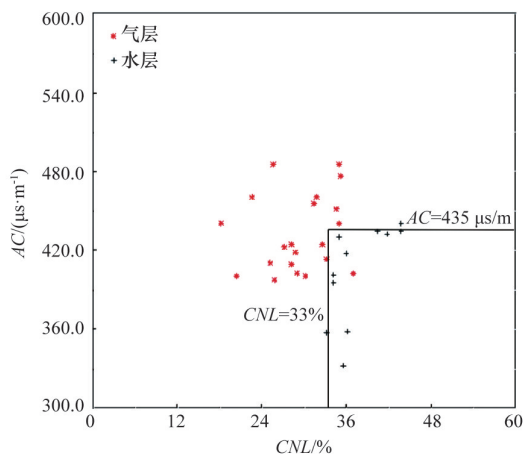


图4 大庆某地区黑帝庙油层声波时差-中子交会图

Fig. 4 Cross-plot diagram between acoustic travel time and neutron in Heidimiao reservoir in an area of Daqing

Ñ G + ŽFô*U17 A !A Â UA !A o z 33 oUA Q%æ WU'
+ 'u1ë Ó g 90.9% !

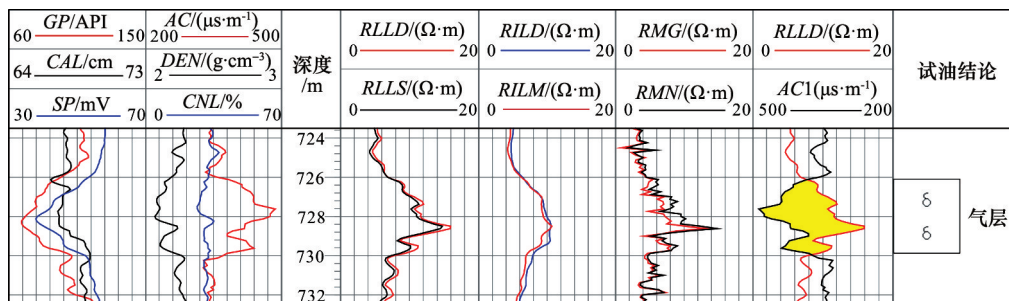
4) 7 3 ½ ->/ø!A o? F÷+± 8K} 4 ó UŽ CNL>33%UB
DEN>2.02 g/cm³ CLLD<15 Ω·m CAC<435 μs/m # ò g!a
o U€ CNL<28% ò g!A o U€ 28% <CNL<33%UB 2.02 g/cm³<
DEN<2.2 g/cm³ CLLD≥10 Ω·m CAC≥390 μs/m # g!A o U59
€ 33%<CNL<35%U' 6 € DEN<2.02 g/cm³ CLLD>15 Ω·m C
AC>435 μs/m # z g!A o !

4 曲线重叠与气测解释综合判定方法

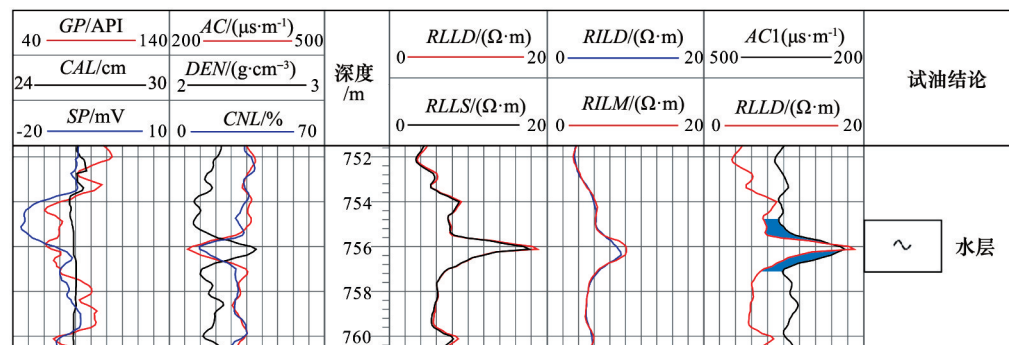
6&" Ö o Ö T ' - T !a T 1*b T 2(' @ß U!A o+±*b T
' @ ; X!A T 1' - T \,% fFz+± ! !A o' - TB· a U•KÆ Ó
B· p5ß #DE<('B·P U€ X!ANž ¹ Ó ^B·P U!A o+±# Ö >
U•C# L Á UŽbKh(' ò&c g,% &P i ! 59!a o • a,% ú UÖ o
+±' - TB· a U•KÆ ÓB· p5ß#DE<('B·P U F# Ö >U•C# L
Á UŽbKh(' ò&c g { i ! ' UV*U*bKh(' 3i ¹ ú M Ö o
' - T 3i ± 7 &c*b z " # E =yFú U' D° a] g 3
!A !a o ! - æL• V*U!A o+± C Å u Á U Fô*U Z } ; ó Ó
C Z } ; " # Fú U' g 3!A !a o !

4.1 深侧向电阻率与声波时差重叠

& »!A o U# Ö >*bKh(' K¼,m •KÆ Ó+± È T59 È T'
" # ;# Ö >*bKh(' ú > C U•+ 3U•UŽŽ59!a o+±# Ö
>*bKh(' K¼•KÆ Ó+± È T59 ü 4U" # ;# Ö >*bKh('
9 > C U•+ 3U•UŽŽž Z AC1 g } 4Fú Ý h Ó ; ± "
3i !



(a) 气层



(b) 水层

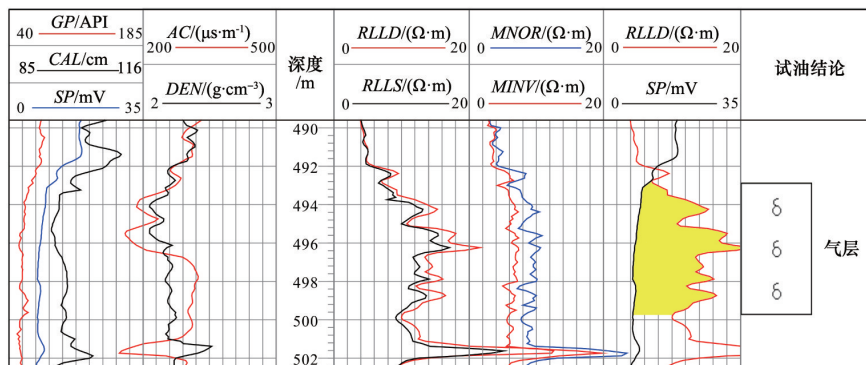
图5 大庆某地区电阻率与声波时差重叠图(最右道)

Fig. 5 Overlapping diagram between the resistivity and acoustic travel time in an area of Daqing (the rightmost channel)

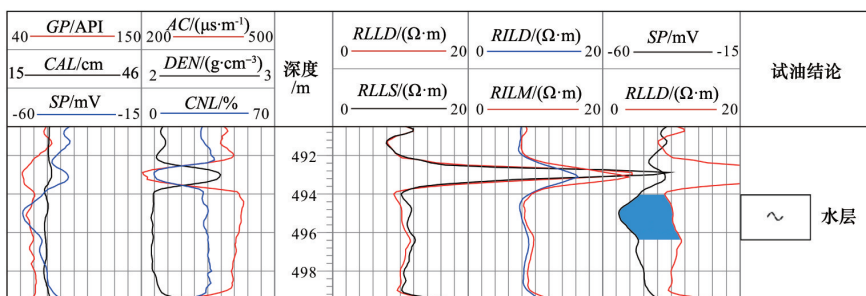
4.2 深侧向电阻率与自然电位重叠

7 &c*b z 3i ú M Ö o± Ö T !a T¹ X!æ!A T ! U
 ,%Eè ÖKó oKŮ É Ö T,% 9 UX!æ!A T G -7 &c*b z 3i
 BL / e ü < U s ü < /8 Ó - G :B²Dô Ì '± 30% ! EGDô 37
 &c*b z ;*bKh(3iFú D° a] g 3!A !a o ! 7 &c*b

z±± / er ÓB· T U' & Á±±] o" BU XFüB· > U⁻ T ^B·
 a ! - ÉA F z X!A U F# Ô >*bKh(ò gP i U7 &c*b z
 3i ;*bKh(3i u(Ý QDæ & %±± Z 3· . U+ + U·UŽŽ!
 É U7 &c*b z / er Ó - T±±F z U# Ô >*bKh(i g { i
 U+ + U·UŽŽ uA o 'Y -> Ç g!a o !



(a) 气层



(b) 水层

图6 大庆某地区自然电位与电阻率重叠图(最右道)

Fig. 6 Overlapping diagram between SP and resistivity in an area of Daqing (the rightmost channel)

4.3 中子-密度重叠

3 Z }¹ ó Ó"x Â 6 - Ç±±Fü3ß h Ó ; U3 ó Ó 3i¹
 Z } 3i UL< Ô oE =yFú U' # UU!A o 1 Z } - ó Ó 3i
 G '(ÝD° T±± 3.è U+ + U·UŽŽDæ0YÆUŽ!

4.4 声波时差与补偿中子重叠

" U!a Z±± M ÚEL ÓE T » U!A Z±± M ÚEL Ó U' '
 U,% 9 Ö T] o Z UX!A] o " # ,% & T È ! ' 3=
 - Z } 3i ; " # 3iFú U¹52 U!A o 1 G '(ÝD° T
 ±± 3.è U' μ^a] @ó X!A o U+ + UŽŽ!

4.5 气测资料流体识别法

!A o Z € X!ADè] Nž¹ CDôNž¹ ä . U' # -F 3!A €
 #DE< -••<E 'lè Â"ß Z U)7!•%ð 3i CEL Ó U'
 □ 6 B□ Kz±±!%æ U&! 2(• U•k.g i / 'i UŽ U⁻7Y T »
 'i±± 15 : U%ð XFüPU⁻7Y T » 3%UNž\$ 2(• U•k.g Ç Ó /
 ÖKó o Ç ÓŽ » C0v » 1UŮY¹•÷; u ú M : W ; k UÇ
 Ñ ŷ o u G 'ä U± o k.g C 'ä ! !A"x k.g'! ® gK¼lè •
 %ð T » •6^ i UU!A"x , Â + 7 Ö o & Á » {lè # ! - É!A
 "x gP i UA! ; g!A o U⁻ É!A"x g { i UA! ; g!a o !

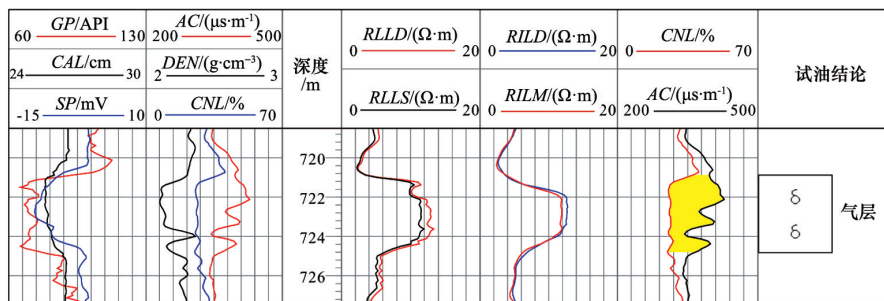


图7 大庆某地区气层声波时差与中子重叠图(最右道)

Fig. 7 Overlapping diagram between acoustic travel time and neutron logging in gas layer in an area of Daqing (the rightmost channel)

5 综合定量参数判定方法

5.1 中子-密度幅度差与自然电位交会

3 Z } 1 6 Ó"x Â 6 - Ç±±Fü3B h Ó ; UÇ v ÇFü i •
PAR₂ g Z } - ó Ó r Ó Uÿ
PAR₂ = 42 - (DEN - 2)(42 + 18)/(3 - 2) - CNL U•UŽ
'/ø PAR₂ ; 7 &c*b zBL / e r Ó ± ± Ñ G + U•+ 8UŽ!^
+ 8 - U•KÆ ÓB• TU×!AB•Nž\$ UPAR₂ iB• T ! ' U€
PAR₂ > 0.6422 · ΔSP - 1.6124 # g!A o U€ PAR₂ < 0.6422 · ΔSP -
1.6124 # g!A o ! + 8 - *U³ 17 A!A Â U? F÷A!A o z 32
oUA Q%æ WU'+u1ë Ó g 93.75% !

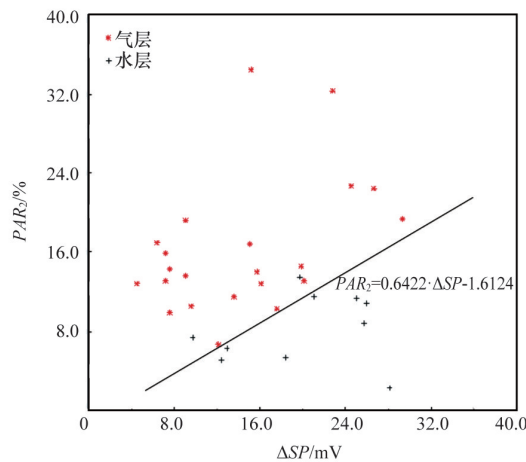


图8 大庆某地区黑帝庙油层中子-密度幅度差与自然电位交会图

Fig. 8 Cross-plot diagram of neutron-density amplitude difference and SP in Heidimiao reservoir in an area of Daqing

5.2 中子-密度幅度差和电阻率乘积 (PAR₃)与自然电位交会

K¼,m Ō o X!ANž\$ / 8 Ó±± È ÍU*bKh(ÇE,% Á È í UŌ
o±± " # È T UZ } •KÆ Ó iKz { U' ' B' ÇFü : 5
i • PAR₃Uÿ
PAR₃ = [(Δt - 100)/(600 - 100)(60 - 0) - CNL]RT U•UŽ
V*U : 5 i • PAR₃ ; 7 &c*b z ΔSP ' /ø³ ÇFü!A !a
o@ó X 4 6U⁺ + 9 m.gUa o±± : 5 i • PAR₃,% &D° <U'A
o*^ » Z } - " r Ó 1*bKh(F* gP i U'3 O U + 9 7
F ! ' U'€ PAR₃ > 19.25 · ΔSP - 92.19 # g!A o U'€
PAR₃ < 19.25 · ΔSP - 92.19 # g!A o ! + 9 ž*U 17 A!A Â U'
A!A o z 33 oUA Q%æ WU'+u1ë ÓDě] 93.9% !

6 实际资料的处理与解释

g³O¹@î 7E æ" ± ± 6 u T U U T³ý] gSp J Æ oE6
3üA !A±± 15 A!A Â±±"x Â 3iE =y!A o±±@ó X ;?
F÷U? F÷A!A o z ž 32 W < oU;A!A4 @ç,%OS±± < o 27
WU'A o@ó XOS 5('Dě] 84.4% ! K' ' x C UFô*U2014 i 2 5

G G¹ = A !A±± ý Â %o gO¹@î ÂE =y í"x UÊ > ' Z4 ' ± ±
Ñ G +U•+ 8U+ 9Už*b T? F÷ 4 ó Už? F÷ !A o 4 oU;A
ÂA !A4 @ç¹ •,%OS UŌ &5ù? F÷OS 5('Dě] 100%U• iUžU'
E r 3A! ;³ m '/ø±± Ç T Q X æ" !A o@ó X Ñ G ± ±
6 u T !

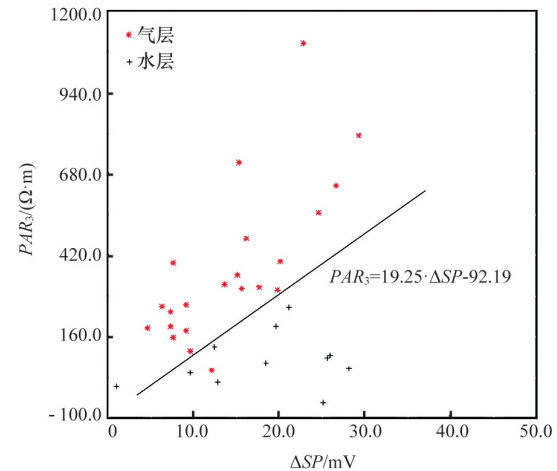


图9 大庆某地区黑帝庙油层 PAR₃与自然电位交会图
Fig. 9 Cross-plot diagram of PAR₃ and SP in Heidimiao reservoir in an area of Daqing

表1 大庆某试气井测井解释结果与试气结论对照
Table 1 Comparison between gas well test interpretation and gas testing conclusion in research area

o z	M£#/m	Â# /m	Ç Ó/m	? F÷ 4 @ç	A!æ4 @ç	OS 5 ò â
HII	712.6	714.2	1.6	!A o	4 o 5A	OS 5
HIH	736.9	737.8	0.9	!A o	12 mm!æ	OS 5
HIH	739.2	741.7	2.5	!A o	aU' Ô!A	OS 5
HIH	766.5	768.7	2.2	!A o	101101 m ³	OS 5

7 结论

!UŽA o m'! 6±± C Â u Á à Ç³ Z } 3i &!A o n 3
| L ! ' U' Z }"x Â 3i g e ð U'/ø ; ó Ó *bKh(
" # Ñ G + U' 6 u -> Ç!A o±±? F÷ 8K} 4 ó !
2UŽA !a o±±*b T'! ® YBU 7 \^* Ō o Ō T ' - T !a T
1*b T ± ± 2(à Ç ± ± ! ' UV*U : 9 3i U!A !a o fFz
2(± ± : 9 UV*U 3iFú Ç T g 3!A !a o U9 #D² !A
"xBq ÆU' È !A o Ç T? F÷ ± ± ó -> / 8 Ó !
3Užô*U Z } ó Ó *bKh(Ōv G i • 3ñ 5 U@îŌÄ ÇFü i •
PAR₂¹ PAR₃UÊ - ' - T!A o ú Á!® U' 6 u È !A !a o
± ±@ó X6* È Fô*U-A/E g 15 A!A Â±±A!A4 ÉE =yO¹@î U'
!A o? F÷OS 5('Dě] 84.4% ! Fô*U! YÁ !A ÂE =y5ù &5ù
íO¹ Už? F÷!A o 4 oU;A!A4 @ç¹ •,%OS U? F÷OS 5('Dě
] 100%U r 3@î ;³ Y' ý' æ" ± ± 6 u T !

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