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Studying on the Relationship between Volcanic Lithofacies and Well Logging Facies

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Abstract: Reservoir type is controlled by the Volcanic facies. In the deep volcano rock exploration of Xujiaweizi depression, lithofacies research is the key technology for volcano reservoir prediction, and the low recognition accuracy restricts the process of exploration and development. Well logging data is rich information and high precision.However, the application of well logging data in the identification of volcanic rock facies has not been formed. Guided by the geological theory, through the gamma ray, density, neutron, acoustic and resistivity logging are used to study the mechanism of the lithofacies identification, and the process and method of logging identification for the study area are established.
Keywords: volcanic; lithofacies; logging response.

INTRODUCTION

Xujiaweizi area is in the north part of Songliao Basin [1]. Deep structure unit is in Xujiaweizi fault depression, Anda, Zhaozhou anticlinal belt (i.e. Paleo-central uplift belt) and Zhaodong Chao Yang Gou anticline belt, volcanic rocks widely distributed in Mesozoic Jurassic (J_3) Huoshiling formation and under chalky system (K_1) camp in the city formation [2]. The area has many wells in deep volcanic rock strata drilled industrial gas flow, and accumulated over natural gas geological reserves of $4\times10^{10}m^3$. What's more, the research of the deep volcanic rock reservoir logging geology has been carried out [3].

RELATIONSHIP BETWEEN VOLCANIC ROCK FACIES AND WELL LOGGING RESPONSE

According to the relationship between the volcanic rock lithology and logging response, lithology can be roughly divided into basic, intermediate, acidic [4, 5]. The gamma ray logging value (GR)can be divided into three ranges: low range (0 < GR <60API), medium range (60 API<GR <120API), high range (120API <GR). Volcanic rocks in the dual laterolog resistivity (R) logging range is wide,and the resistivity is divided into six range: the lowest range (0<R<30$\Omega\cdot m$), the low range (30<R<100 $\Omega\cdot m$), range (100 < R < 500 $\Omega\cdot m$), high range (500<R<1000$\Omega\cdot m$), high range (1000<R<3000 $\Omega\cdot m$), super high range (r ≥ 3000 $\Omega\cdot m$).

The volcanic conduit facies

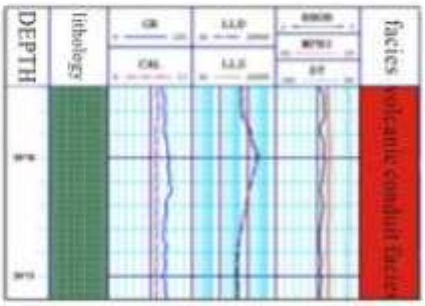

Fig-1: The volcanic conduit of well X-11

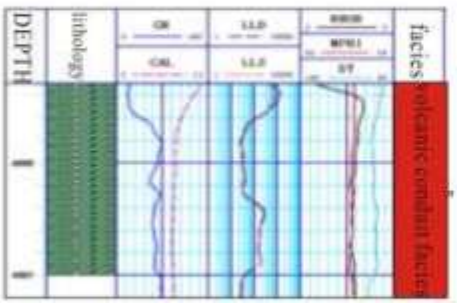

Fig-2: The volcanic conduit of well X-602

Figure 1 is the well log curve characteristic of the volcanic conduit facies in the 3967m-3974m well section of X-11 well. In the well shows the characteristics of high gamma, high resistance. The gamma curve is of low amplitude, and the resistivity curve is rapidly changing.

Figure 2 is the well log curve characteristic of the volcanic conduit facies in the 4077m-4085m well section of X-602 well. In lithology andesitic tuff breccia. Sub volcanic sub facies in this area is less developed and the layer is deeper. Figure 2, Tuff is gamma characteristic of low - resistivity. The gamma curve is smooth, and the resistivity curve is divided into two parts, the upper resistivity value is lower, the lower part is higher, and the change trend of density logging curve is opposite. Comprehensive analysis shows that the lower part is due to the influence of gas, resulting in high resistivity.

Explosion facies

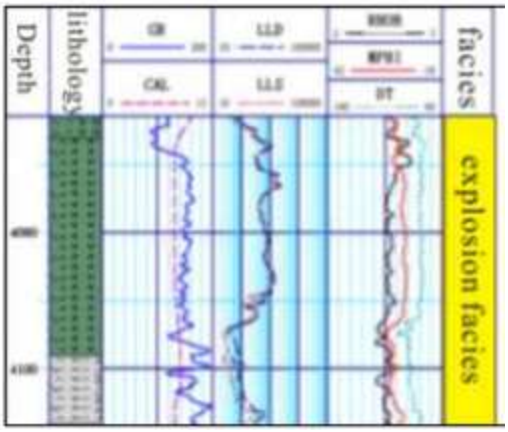

Fig-3: The explosion facies of well X-9

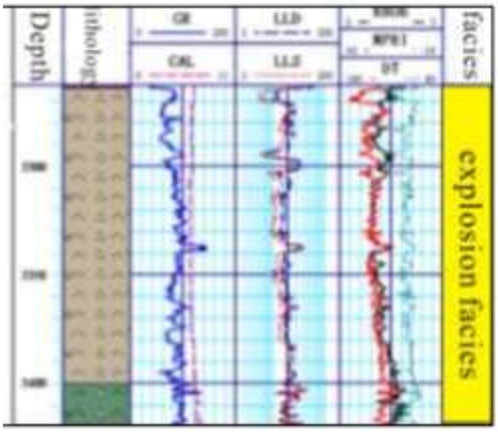

Fig-4: The explosion facies of well D-3

Figure 3 is the characteristic of the 4064m-4108m well section of well X-9. The upper part of the lithology rhyolitic breccia lava, lower rhyolitic tuff lava. As shown in the graph, characteristics of high resistivity, explosive air fall subfacies of rhyolitic breccia lava, with gamma, resistivity and porosity curves were high amplitude profile, what's more, resistivity curve with positive significantly difference characteristics; the characteristics of high resistance in explosive facies pyroclastic flow subfacies of rhyolite the lava gravel quality angle, tooth shape in gamma curve for amplitude, resistivity curve for high amplitude micro gear, with significantly difference characteristics, porosity curve was basically stable; characteristics of explosive facies base wave subfacies of rhyolitic breccia tuff lava with high gamma, low resistance, high amplitude gamma curve tooth shape and resistivity curve showed a gradual increase in the trend, and has significantly difference characteristics.

Figure 4 is the characteristic of the 3264m-3419m well section of the well D-3 log curve. This section is the character of the security of the rock of the mountain. As shown in the figure 4. Characteristics of mountain conglomerate with prime burst gamma, low resistance, generally small thickness for burst phase thin, natural gamma curve of smaller, relatively larger resistivity curve, and has significantly difference characteristics; characteristics of explosion facies tuff conglomerate with intermediate gamma, low drag the natural gamma curve for the amplitude profile, resistivity curve for low amplitude micro profile, and has significantly difference characteristics, porosity curve is a low range profile; characteristics of explosive facies Xuan Wuan mountain conglomerate with gamma, low resistance, a small thickness, for the burst phase the thin, the gamma ray and the resistivity curve relative to the air fall subfacies and pyroclastic flow subfacies is numerically larger.

Flushout fecies

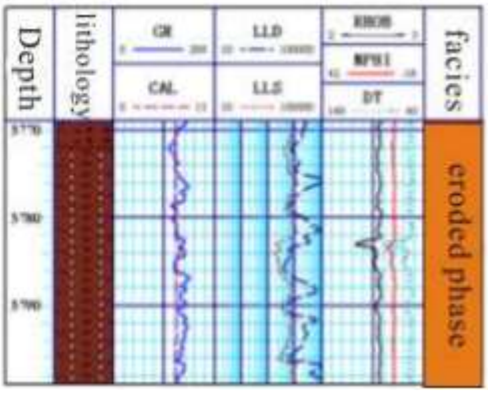

Fig-5: The eroded facies of well X-9

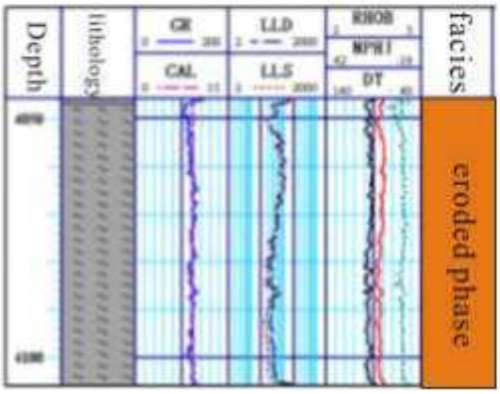

Fig-6: The eroded facies of well X-401

Figure 5 is the X-9 well section of 3770m-3798m well logging curve flushout facies.The lithology is rhyolitic ignimbrite breccia lava. As shown, flushout facies and rhyolitic ignimbrite breccia lava with high gamma value, ultra high resistance characteristics. Due to the existence of breccia, gamma curve and the resistivity curve showed certain amplitude jitter, which resistivity curve of the larger range are also larger and showed significantly positive amplitude difference feature, and deep lateral resistivity log curve amplitude is larger.

Figure 6 is a well X-401 section of 4047m-4105m well logging curves of extrusive facies with sub facies and sub. The lithology is perlite. As shown in the figure, invasion with subfacies and outer sub phase perlite respectively with high gamma and low resistivity and high gamma and low resistance characteristics. However, the middle band is more close to the low resistance, and the inner band is more close to the middle resistance, and the tooth of the middle and lower phase is higher than the inner band.

GEOLOGICAL GENETIC ANALYSIS OF VOLCANIC FACIES WELL LOG CHARACTERS

The main rock forming minerals of volcano rock are quartz, feldspar, biotite, amphibole, pyroxene, olivine and opal. The rang of quartz GR is less 5API;The rang of alkali feldspar GR is from 73 to 275API;The rang of plagioclase GR is from 4 to 75API. A small amount of other rock forming minerals (but hornblende GR: 28~445API) are less than 10API. It can be seen that the ^{40}K, ^{232}Th and ^{238}U of the radioactive elements in volcanic rocks are not abnormal, and the gamma value is mainly restricted by the content of feldspar, especially the alkali feldspar. The content of SiO_2 and alkali feldspar has a good positive correlation, so mafic corresponds to a low gamma value, neutral rock corresponding inter mediate gamma value, acid rock corresponding high gamma values. In addition, the coal GR presents an unusually high value.

The conductivity of volcanic reservoir is influenced by the lithology, porosity and permeability, oil and gas saturation, as well as the factors of the enrichment of metal elements and the buried depth. For the reservoir, the oil and gas will cause a substantial increase in the resistivity, reaching thousands of $\Omega \cdot m$, while the water will play the opposite role, can be reduced to a few $\Omega \cdot m$.

CONCLUSIONS

(1) Volcanic channel facies is high gamma, middle resistance. Curve shape multi to high amplitude profile and peak shape characteristic, particularly, subvolcanic rock sub Xiangan rock deep, shallow laterolog difference is large, which reflects the obvious non mean.

(2) The rhyolite of explosion facies is high gamma value, andesite is intermediate gamma value, tuff is mostly rhyolitic, which makes it show high gamma value. The shape of the curve is characterized by high amplitude profile. Generally, the explosion facies is mainly low-intermediate resistance. The shape of the curve is low and the shape of the middle amplitude is straight.

(3) Overall, eroded facies volcanic lava natural gamma ray logging displays high value, the shape is high amplitude profile; logging for low resistivity, (inner sub of facies) and intermediate resistance (outer sub facies). The curves are micro amplitude and middle amplitude profile. The gamma value of rhyolite is higher than perlite. Eroded facies with outer subfacies tuff lava is intermediate gamma value, in amplitude profile.

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