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Continuous Logging Response Mode of Complex Lithology

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Abstract: The lithology profile of Baer Depression in Hailar Basin is complex, which not only exists in the volcanic lava and sedimentary rock, but also has the transition lithology of volcanic rock. Conventional logging curve of obvious characteristics, better reflect the ability of large sedimentary thickness of lithology, but for the deposition of thin thickness, complex composition of transition rocks, often need to on the basis of the lithologic variation for the judgment. Based on the analysis of the relationship between the main lithology and well logging response of the Baer depression in Hailar basin, this paper presents and establishes 4 kinds of logging response patterns of the lithologic profile, and gives the corresponding well examples. The application of the logging response model of continuous lithologic profile will greatly improve the identification accuracy of the thin and complex composition of the transitional lithology.
Keywords: Baer Depression; Complex lithologic section; transitional lithology; Logging response.

INTRODUCTION

The formation of Nantun group in Hailar basin and the widely developed volcano clastic rocks [1, 2]. Its lithology includes volcanic clastic rock, general sedimentary rock, volcanic lava and transition lithology [3]. The accurate identification of this complex lithology directly affects the evaluation of reservoir in Hailar basin [4]. In recent years, the use of acoustic electric imaging, ECS and other new technologies to carry out igneous lithology identification work, has made great progress. The lithology identification work mostly according to the lithologic analysis samples of logging response data using cross plot, cluster analysis and other means establishment of lithology identification standard, without taking into account the logging response of continuous change trend and lithologic section deposition rules and its relationship [5]. Therefore, it is necessary to establish a continuous variation pattern between the logging response and lithologic profile, in order to realize the rational identification of complex lithologic section in Baer depression of Hailar basin.

THE BASIC TREND OF LOGGING RESPONSE WITH LITHOLOGY

Resistivity, bulk density, interval transit time, photoelectric cross section index, natural gamma ray and its energy spectrum are the response functions of some physical properties of rock strata. Among them, the mineral composition, the arrangement structure and the size of the rock particles are the important factors which lead to the change of well logging curve.

In the case of fluid properties, the rock particles are made from fine to coarse, and the arrangement structure is loose to tight, and the resistivity amplitude will be changed from low to high. If in the process of reservoir sedimentation, while the volcano eruption and other activities, so that the reservoir lithology contains a certain amount of volcanic debris and other components, then the reservoir resistivity value will show an increasing trend.

The density logging (DEN) curve is mainly influenced by the mineral composition of the rock particles in the reservoir. Rock particles arranged more compact; the volume density value is high and pyroclastic rocks mainly consisting of after the action of the high temperature and high pressure of pyroclastic material. Therefore, relative to the average sedimentary rock, showing increased density.

The value of sonic logging (AC) is mainly affected by the mineral composition, the density and the structure of the rock. In the normal sedimentary rocks, the thicker the rock particles, the acoustic time difference is generally increased with the increase of the. In the igneous rock formation, sonic in dense basalt minimum, acidic rhyolite is slightly higher. In the same rock, the sonic time of the volcanic clastic rock is higher than that of the lava. Similarly, in the case of rock alteration, the acoustic time difference is also slightly increased.

Photoelectric cross section index logging (PEF) curve is a gamma gamma logging method which is

mainly used to measure the photoelectric effect. PEF value mainly depends on the rock mineral composition and content [J]. It can not only mark identification of sedimentary rock containing calcium or calcium strata as curve, and as a result of mudstone, volcanic rock often rich in various minerals, showing than common sedimentary sandstone slightly higher values. At the same time, from basic to acidic PEF value decreased gradually.

Natural gamma ray and energy spectrum logging curve. Almost all the rocks show some kind of natural radioactivity. The radioactivity intensity of the rock layer is mainly determined by the radioactive intensity of various minerals and the content of the mineral. In general, common in igneous lava formation, basalt rhyolite Ayama Iina, the highest radioactive minimum. For sedimentary rocks, gamma measurements are generally based on increased shale content (or particles). The content of uranium in magmatite, ultrabasic rocks from acidic, neutral and basic to gradually reduce.

According to the above analysis, it can be seen that the reservoir lithology is different, and the logging response is also different. But because each logging tool has its limitation in the vertical resolution, the logging value is the visual value. In the view of a geological sedimentary unit, the change of well logging curve often reflects the evolution of the geological sedimentary environment. Therefore, for certain sedimentary environment of regional geology, in a lot of practical data analysis based on can establish lithologic gradient within the sedimentary geological unit of logging response continuous mode and use these patterns to carry on the lithological discrimination, can effectively reduce logging lithological identification of multiple solutions.

CONTINUOUS MODE OF EXPRESSION

Continuous mode of volcanic clastic sedimentary rocks

The typical lithologic change patterns are: the calcareous mudstone, calcareous siltstone, the calcareous coagulation. This kind of lithology logging response varies substantially changes consistent with general sedimentary rocks, namely with rock granularity by thick to fine, well logging curve also occurred in a series of changes: the resistivity increases neutron value decreases, the photoelectric absorption cross section increases (Figure 1),thorium value gradually decreased. But due to the conglomerate composition in the study area is often rhyolite, granite, causing radioactive curve value uplift, thorium and gamma value and Figure 1 in different change trend (Figure 2) and other curves of Figure 1 consistent presentation.

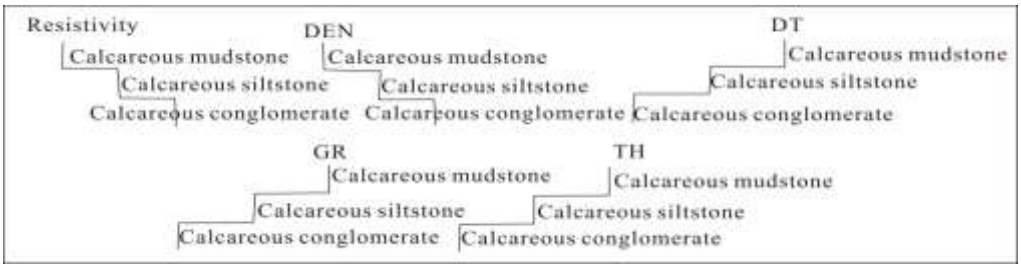

Fig-1: The first one of the variation law of the logging response of the continuous mode pattern of pyroclastic sedimentary rock

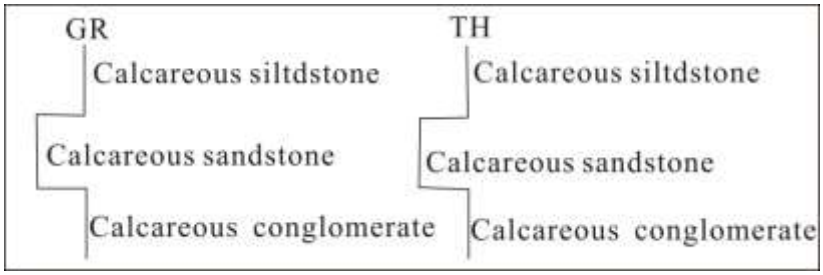

Fig-2: The second one of the variation law of the logging response of the continuous mode pattern of pyroclastic sedimentary rock

Figure 3 is the figure 1 display mode of comprehensive curve and lithologic section as an example, 1442.5m~1448.5m segment from the first lithologic calcareous mudstone, calcareous siltstone and calcareous sandstone continuum model, graph and trend curves are correspondent with Figure 1.

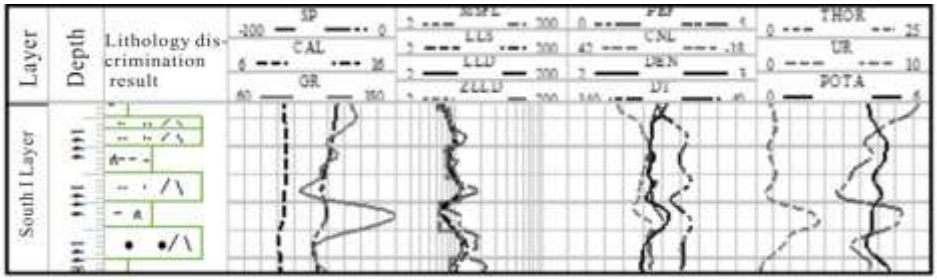

Fig-3: Examples of the continuous pattern of Calcareous mudstone, Lime powder sandstone and tuff sandstone

GENERAL SEDIMENTARY ROCKS AND PYROCLASTIC SEDIMENTARY ROCK

In the logging curve is difficult to find the kind of lithologic continuous mode. The reason is that both in the sedimentary environment appears tuffaceous rocks or in volcanic clastic sedimentary rocks are generally sedimentary rocks, related to the sedimentary environment, for example deposition process, took place near a volcano eruption of geologic activity. Well logging curve resolution is limited; it is difficult to reflect the information. The purpose of this model is to put forward this model, which is to be found in the same oil layer, if it is found to be a common sedimentary rock or volcanic clastic sedimentary rock, the well logging curve will have a relative change trend.

Figure 4 is the trend of the relative change of well logging curves (in the case of siltstone and volcanic rock composition) for general sedimentary rocks and volcanic clastic sedimentary rocks. Figure in minor changes in the resistivity curve is given. The reason is that tuffaceous lithology of volcanic rock composition can be tuff, lava particles. These substances impact on the power curve to reference it and general sedimentary rock particles size relative to set.

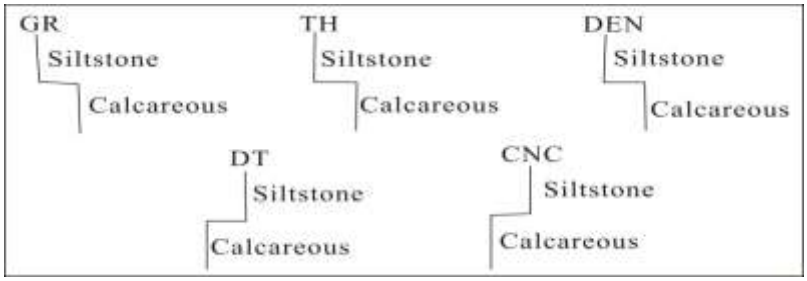

Fig-4: The relative variation trend of the logging curves of the general sedimentary rocks and volcanic clastic sedimentary rocks

PYROCLASTIC SEDIMENTARY ROCK, SEDIMENTARY VOLCANIC CLASTIC ROCK, PYROCLASTIC ROCK

This type of model for the volcanic rock containing material for fine particles, coarse particles and so on are given. In the application, the relative size of the rock particles and the volcanic rock particles should be fully considered, and it should be noted that the lithology of the coarse particles in the study area often contains a certain degree of radioactive material. Basic principles for coarse grained sedimentary rock mixed with respect to its fine ash particles, resistivity curve will decline, radioactive curve will increase, slightly decreased density curve; and fine-grained sedimentary rocks, mixed with respect to the coarse particles of volcanic material, resistivity curve will rise, radioactive curve increased (acidic volcanic rocks) or decreased (volcanic rock), rising density curve. Figure 5 shows the tuff, psephitic tuff, calcareous conglomerate logging curve examples.

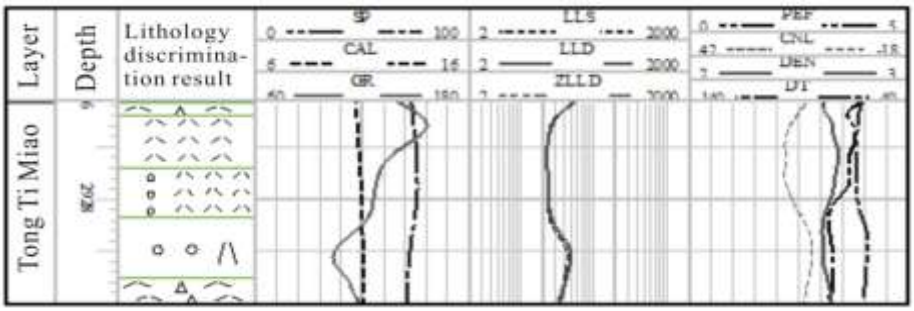

Fig-5: The tuff-psephitic tuff-calcareous conglomerate logging curves example

PYROCLASTIC ROCK-VOLCANIC LAVA

This type often appears in the bottom of Tongtimiao and Budate reservoir group. Two types of lithology are often associated. Specific performance is lava tend to exhibit high resistivity, low porosity and logging response characteristics and erosion of volcanic lava becomes broken, then mixed with some fine pyroclastic debris, often showing the resistivity decreased and porosity increased (i.e. neutron curves increased, decreased density, acoustic slowness rise), radioactive curve a slight increase trend. Figure 6 shows logging response trend of a well andesitic tuff, altered andesite and andesite.

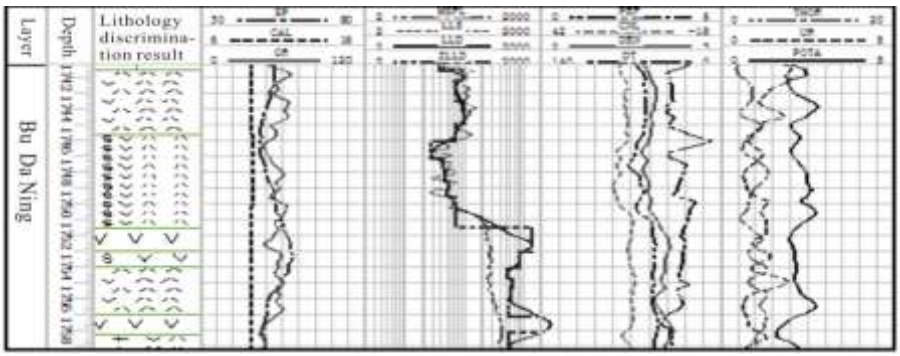

Fig-6: The trend of pyroclastic rock and volcanic lava logging curves example

CONCLUSION

Owing to characteristics of lithology and diverse, complex in depression of Baer Depression in Hailar Basin, established lithological response of continuous deposition pattern, effectively overcome the lithology interpretation of the multiple solutions and improve the accuracy of transitional lithology identification. It is pointed out that this four continuous deposition mode changes mainly involves the change of lithology granularity and containing volcanic component change. Therefore, in order to adapt to the variability of actual lithology. On the basis of these patterns, the background value of a kind of lithology, and the logging curve amplitude change rate of the evolution of other continuous mode.

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REFERENCES

1. Hai-yan, W. A. N. G., Li, L. I. U., & Yu-qiao, G. A. O. (2005). Discussion of diageneses of volcaniclastic rocks of Nantun Formation in Beier sags, Hailar Basin. *Global Geology*, *24*(3), 219-224.
2. Jian-wen, C., Bin, W., & Chang-shan, L. (2000). Logging Identification of Volcanic Rocks. *ESF: Earth Science Frontiers*, *7*(4), 458.
3. CHEN, J., & FAN, X. M. (2007). MO Xiu-wen College of GeoExploration Science and Technology, Jilin University, Changchun 130026, China; The Resrarch of Volcaniclastic Rock Lithologic Identification Based Logging. *Journal of Jilin University (Earth Science Edition) S*, *1*.
4. Schmid, R. (1981). Descriptive nomenclature and classification of pyroclastic deposits and fragments: Recommendations of the IUGS Subcommission on the Systematics of Igneous Rocks. *Geology*, *9*(1), 41-43.
5. Meiling, Z., Yang, S., Boyuan, G., & Lili, L. (2009). 1. Daqing Petroleum Institute of Earth Sciences, Daqing City, Heilongjiang Province 163318; 2. College of Geo-Resources and Information, China University of Petroleum, Dongying City, Shandong Province 257061; Major Lithological Distribution and Log Response Analysis of Volcanic Rock Bearing Strata in Hailar Basin. *China Petroleum Exploration*, *2*.