Introduction

Facies recognition using well logs is a useful aid in interpreting the depositional setting of an area. A lot of information about the sediments and sedimentary processes is contained in well logs. Gamma Ray log is introduced in petrophysics for the significant identification of shale and this is the main reasoning that fluctuation of GR indicates the change in mineralogy and is used to interpret litho-curves for identification.

This paper introduces basic tool to interpret depositional facies considering the shapes of well-log curves in terms of shape of log is directly related to the grain size of rock successions.

The purpose of this paper is to find the reservoir bodies in Volodymyrska Field using five types of Gamma Ray log curves from the wells № 5, 7, 8, 11 (depth interval 1700 - 2560 m), and to identify the impact of the distribution of the facies on petrophysical properties (such as porosity).

Theory

Facies analysis is a fundamental sedimentological method of characterizing bodies of rocks with unique lithological, physical, and biological attributes relative to all adjacent deposits.

Log-shape analysis techniques have been developed in the past (Pirson, 1970), especially for the SP and GR curves, to identify depositional facies in a terrigenous depositional setting.

The shape of Gamma Ray log curves is a basic tool for the interpretation of lithofacies and depositional environments. Sharp breaks in the GR curve are an indication of rapid change in energy distribution and it is used to identify sand and shale units. Abrupt changes in the GR log response are interpreted to be related to sharp breaks associated with unconformities and sequence boundaries. Figure 1 shows five major types of log curves. Vertical profiles of grain size as specific environment have certain characteristics (Selley, 1978).

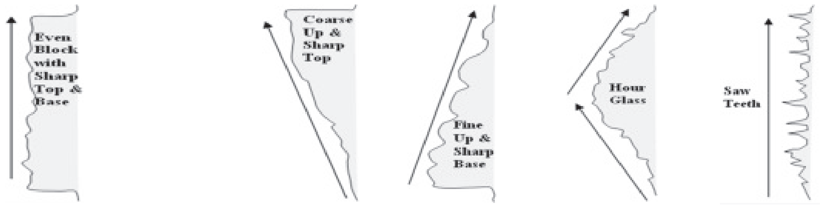
Type of log motif shape	Cylindrical/box shape	Funnel shape	Bell shape	Symmetrical shape	Serrated/saw tooth shape
Sediment supply	Aggradation	Progradation	Retrogradation	Petrograding & retrograding	Aggrading
GR trend					
Characteristic	Sharp top and base with consistent trend	Abrupt top with coarsening upward trend	Abrupt base with fining upward trend	Ideally rounded base and top	Irregular pattern/spikes of GR log

***Figure 1** The direct correlation between facies and a variety of other log shapes relative to the sedimentological relationship (Selley, 1978)*

The Gamma Ray may be smooth, serrated or complex. Zones of high GR response may correspond to a variety of depositional settings, from shelf and deeper-marine to coastal plains, backshore marshes and lacustrine environments. In fully subaqueous settings (marine or lacustrine), high GR responses correlate to periods of restricted bottom-water circulation and/or with times of reduced sediment supply (Catuneanu, 2006).

Results

Lithofacies interpretation was carried out with Schlumberger's Techlog software using well-logs obtained from four wells. The lithology identification was determined by logging curves (Gamma Ray, Deep Resistivity, Neutron Gamma Ray, Compressional Slowness, Caliper and etc.), which are sensitive to lithology change. Primary interpretation of lithology shows that the entire well interval consists of sand, shaly sand, dolomite, limestone, silt and shale. The Gamma Ray log was the main method for the identification of lithology encountered in the wells (Adeel Nazeer and Shabeer Ahmed Abbasi, 2016). The log motifs of aggradation, progradation, retrogradation, petrograding/retrograding, aggrading features were identified in the study area and used to characterize the depositional environment.

The different curve-shapes of the GR logs from the study area are shown in Figure 2. There are five types of log curves: cylindrical/boxcar shape (a), funnel shape (b), bell shape (c), bow shape (d) and irregular shape (e).

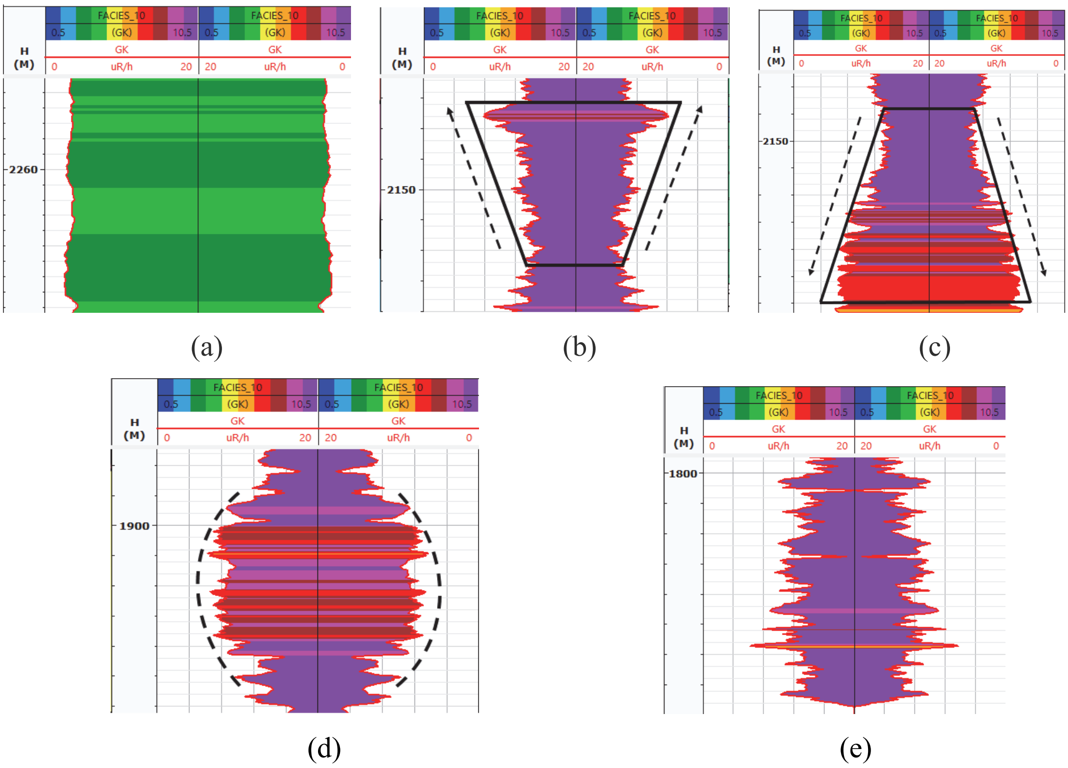


***Figure 2** Gamma Ray log curves observed in the wells 5, 7, 11, 8 of Volodymyrivska Field*

The identified log motifs were used to describe the parasequence as either aggradation, progradation, retrogradation, petrograding/retrograding or aggrading. Study area is filled by stratigraphic succession from Lower Cretaceous to recent sediments. But exploring horizons of Lower Cretaceous was the main subject of researches.

Four wells Volodymyrivska-5, Volodymyrivska-7, Volodymyrivska-11, Volodymyrivska-8 were selected. After identification of facies, simple correlation of four wells of Volodymyrivska Field was carried out (as shown in Figure 3).

Cylindrical-shaped successions in the wells, where found, have thickness less than 10 m. This trend is dominant in the dense carbonaceous units and some of the sands bodies of this type have a high reservoir quality.

Funnel-shaped successions are also supported by the small thickness value of 2-10 m. This shape characterizes the GR logs of the sand bodies of the wells 5, 7, 11 of Volodymyrivska Field.

Bell-shaped successions are less prominent than the other GR trends. The thickness values here ranged between 3-10 m.

Symmetrical shape successions occur between depths of 2420 and 2550 m and has a good GR log correlation and lithology of Volodymyrivska Field.

Serrated-shaped successions are very prevalent in Volodymyrivska Field and usually indicative of silts and shale with the periodically appearance of sands according to well log interpretation. The thickness of the irregular GR log shapes in the wells range from 2 to 60 m.

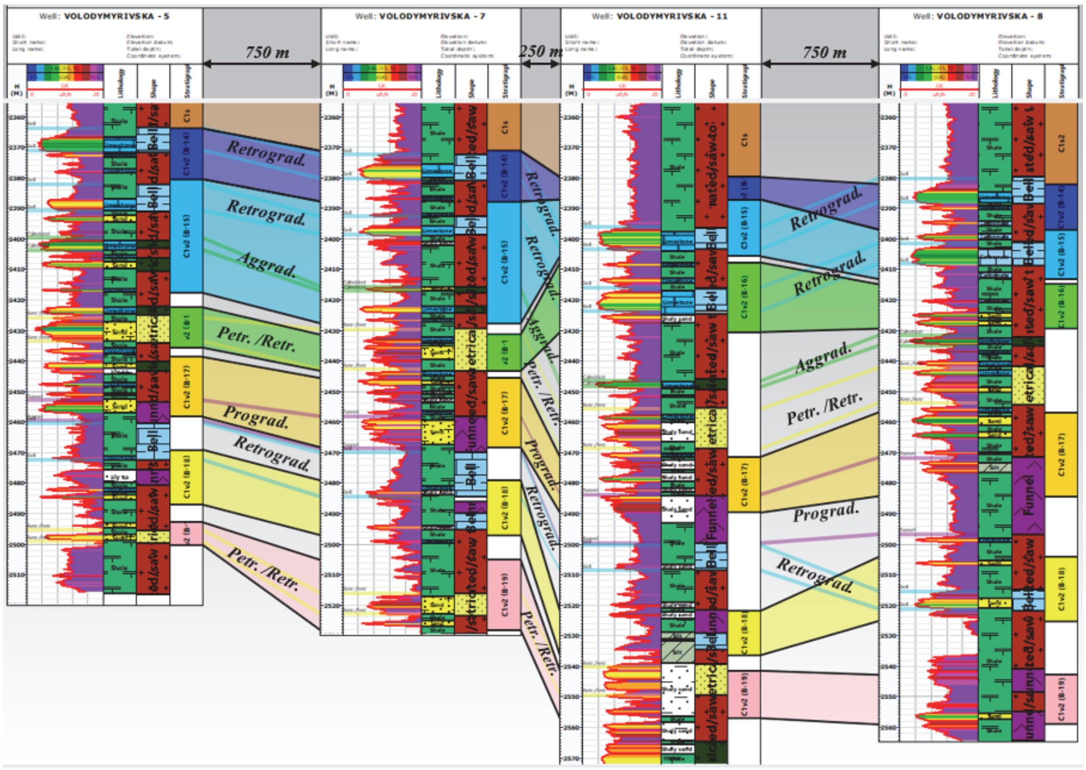


Figure 3 *Facies interpretation of Lower Cretaceous of Volodymyrivska Field; showing correlation between GR Lithofacies*

The log signature (coarsening upward) allows to identify the sandstones bars of shoreface. The Gamma Ray log trend of Volodymyrivska-5, which occurs between depths of 2453 and 2460 m, is funnel-shaped with a thickness of about 7 m. The sand body in the upper part of this trend has high reservoir quality (15 % of total porosity) and low Gamma Ray value according to the well log methods. The same log motif shape was identified and correlated in wells № 7, 11, 8 of Volodymyrivska Field. The thickness of the sand body in Volodymyrivska-7 (7 m) and Volodymyrivska-11 (8 m) is greater than that one in Volodymyrivska-5 (4 m). The shale volume is gradually increasing in the direction of Volodymyrivska-8. There is also a slight decrease in porosity in the direction of Volodymyrivska-8. One of the main differences between Volodymyrivska-8 and the other three wells is the depositional scale. The prograding zone of Volodymyrivska-8 is comparatively large (25 m). The funnel-shaped successions in wells № 5, 7 are less than 10 m. In the stratigraphy of the Dnipro-Donetsk Depression, this zone falls within the Upper Visean Productive Horizon V-17.

Figure 4 shows the porosity distribution in a reservoir section of Volodymyrivska-7. Porosity values here ranged between 2 and 18 %. This data was obtained from wireline log.

Each lithofacies represents an individual depositional event that might be related with petrophysical parameters. It must be note, that the most prevalent type of deposition is aggrading which explains fluvial flood condition almost all over the well. The slight decrease with a depth for sands with aggrading type is due to the strict change in the depositional environments. There are intervals with good porosity values between depths of 2280 m and 2530 m. These reservoir sands belong to inner fan channel (aggradation) and prograding marine shelf fans (progradation).

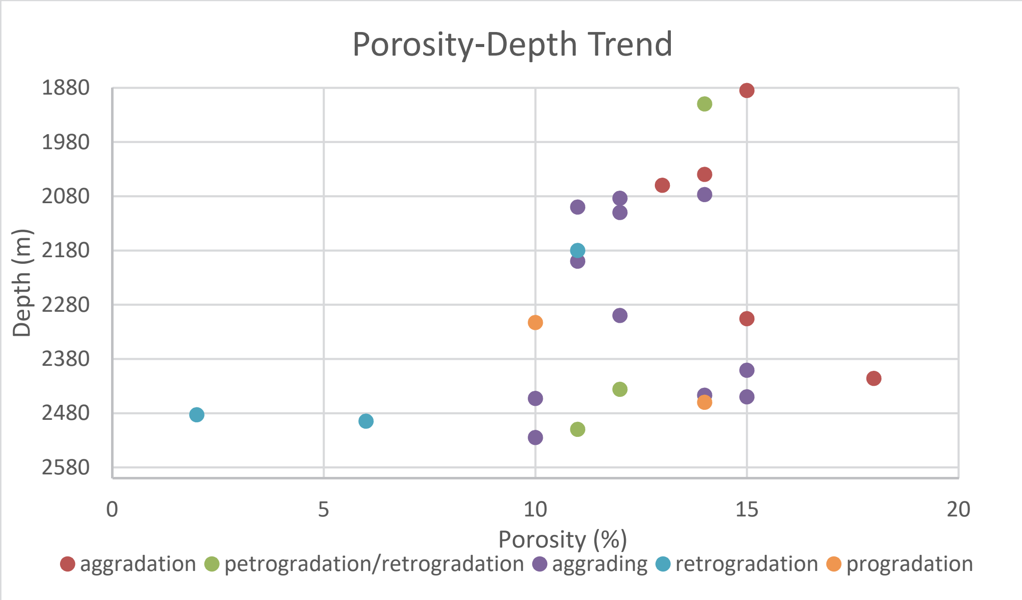


Figure 4 *Porosity vs. depth trend in sands of Volodymyrivska-7*

Conclusions

The lithofacies and environment of deposition of the Volodymyrivska field have been considered. Shapes of GR well-log curve is a basic tool to interpret depositional facies (Lower Cretaceous) because shape of log is directly related to.

Majority of the sand bodies are presented by slope channel and mixed tidal flats environment. Some of these sand bodies serve as reservoirs. The quality of the reservoirs was measured by porosity.

The authors have changed the classical approach for defining perspective reservoirs that may be used as the main technique having the full understanding of stratigraphy and the good core data.

This study has further emphasized the importance of the GR logs in lithofacies and depositional environment analysis. But in the future works, the authors plan to use other methods to predict deposition environment.

References

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