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# RESERVOIR ROCK GENETIC TYPES OF ABU-MADI FORMATION, BALTIM FIELD, OFFSHORE NILE DELTA, EGYPT

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**الأنواع الأصلية لصخور خزان أبو ماضي , حقل بلطيم , دلتا النيل البحرية,مصر**

**الخلاصة:** تم تحديد الأنواع الأصلية للصخور تم باستخدام منحنيات تسجيلات أشعة جاما كما تم تقسيم الأنواع الأصلية لصخور خزان أبو ماضي بناءاً علي سحن رواسب الدلتا والامتدادات الجيولوجية لهذه الصخور وبيئة الترسيب.

**ABSTRACT:** *Abu-Madi Formation in Baltim Field, offshore Nile Delta deposited as fluviomarine environment which exhibits complex lithofacies. It is composed mainly of sandstone intercalated with siltstone and shale interbeds. Facies analysis and reconstruction of facies patterns for Abu-Madi Formation were performed using Log curve shapes techniques. Vertical profiles of borehole log data against sand intervals of Abu-Madi Formation define the history of deposition and the different genetic rock types. Three rock genetic types were identified indicating deltaic sedimentation. They are: 1. Braided stream, 2. Mouth bar deposits and 3. Meandering channels. These rock genetic types are considered as the main gas producing zones in the Baltim Field.*

## INTRODUCTION

The present study deals with Baltim Concession which is a large exploration and exploitation license located in the offshore Nile Delta, Egypt. The concession covers an area of 430 Km² of the central portion of the present day Nile Delta cone.

Baltim area lies to the north of the Nile Delta between latitudes 31°37′25″ and 31°56′19″N and longitudes 31°1′12″ and 31°26′7″E, about 250 km off the Mediterranean sea shoreline. It covers an area of about 5000 km2, with a length of 250 km and a width of 18.75 km. Baltim area is considered as the northwest extension of Abu Madi, El-Qar'a main channel or paleo valley. The study area is a part of Nile Delta offshore area (Fig.1), which is characterized by the presence of large number of gas fields that have a big amount of reserves from the hydrocarbon point of view.

## METHODOLOGY

Log curve shapes of Abu-Madi Formation are directly related to reservoir rock genetic types, its asscoiated primary structures and history of deposition by observing both gamma ray and deep resistivity curves against Abu-Madi reservoir intervals used to recognizig different reservoir rock genetic types in both vertical and areal distrubition. Already these techinques have been already invesitgated by (Galloway, 1968; Fisher, 1969; Pirson,1981 and Selley, 1982), and

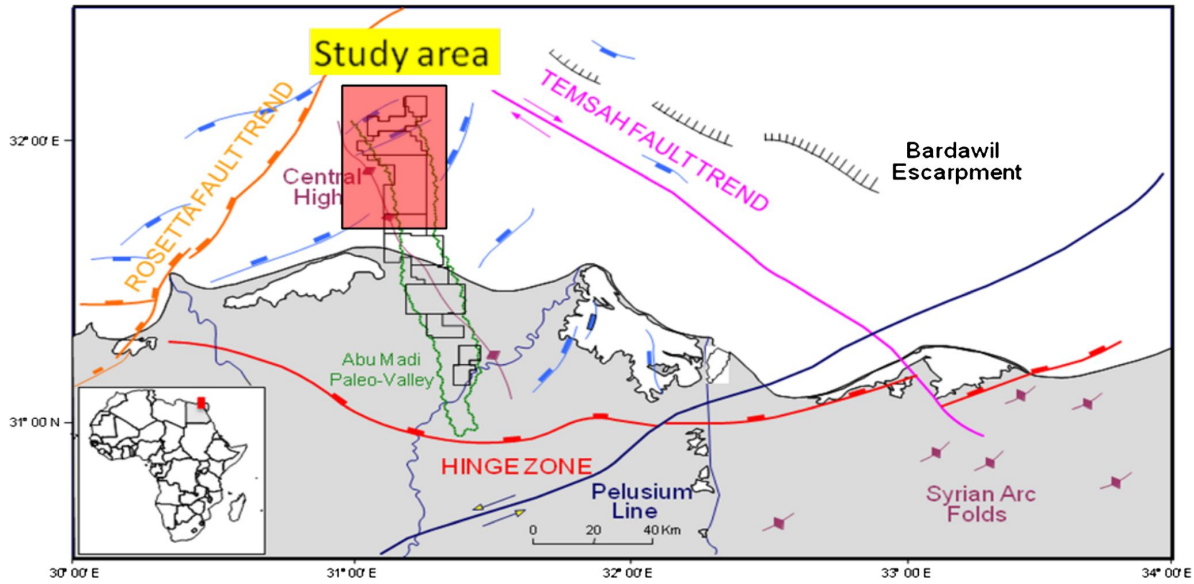


**Fig. 1: Nile Delta location map with main structure elements (Barsoum et al. 2004).**

applied in oil industry (Sneider and et .al., 1977;berg, 1979; and El Sayed; 1981). (El Sayed; 1986) published a paper on the Algyo-2 sandstone reservoir of hungary based on the different forms of log curve shapes. It was found that sanstone intervals are characteristically distinguishable by gamma ray Curves in which different genetic sand bodies could be depicted (Fig. 2).

There are three general trends or curve shapes that can be recognized when looking at well log curves, for instance the gamma log tracks the upward change in clay-mineral content (Fig.3).

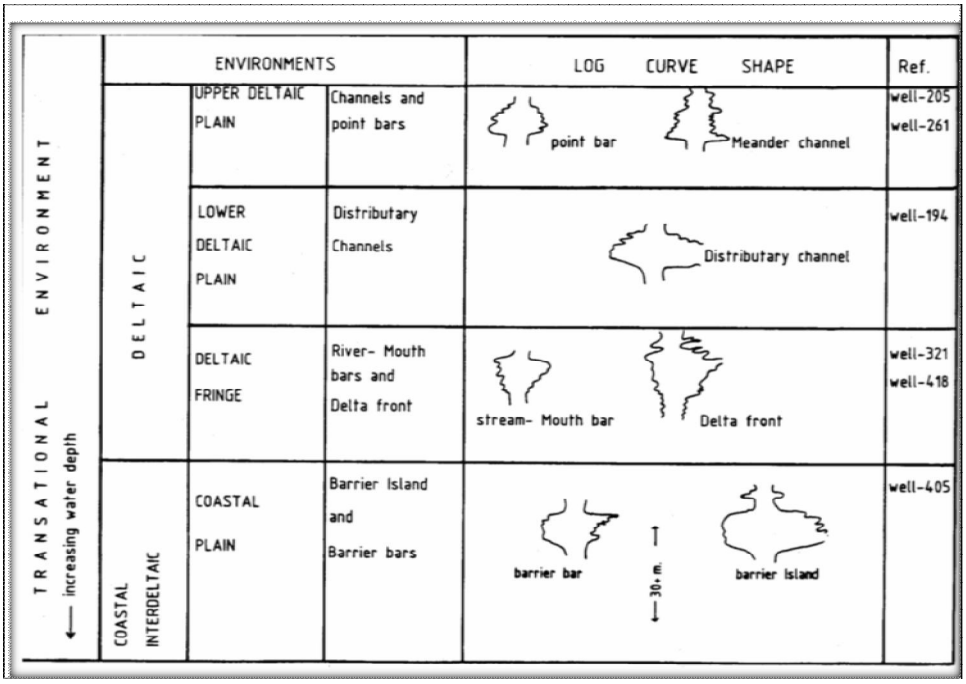


**Fig. 2: Log curve shapes of Algyo-2 rock sequence (after El Sayed, 1987).**

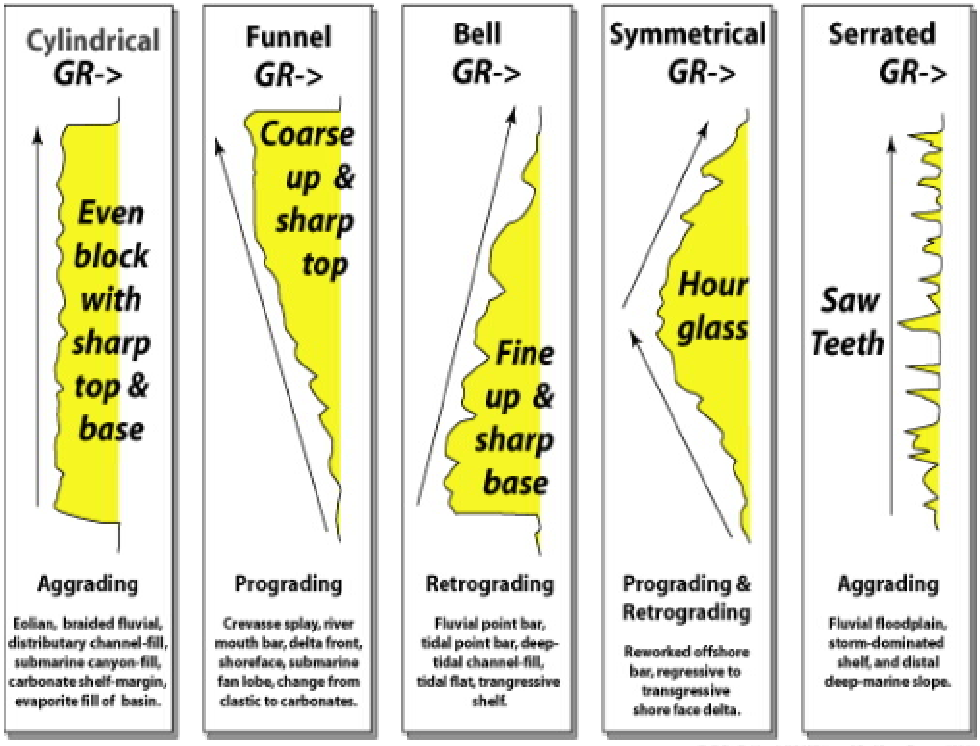


**Fig. 3: Classification of gamma ray log curve shapes in terms of sedimentary facies pattern. (Emreys 1997).**

The target of the present research work is to delineate the different rock genetic types presented in the Abu-Madi Formation using gamma ray log curve shape technique .

## RESULTS AND DISSCUSSION

The Gamma ray log vertical profiles of the Abu-Madi Formation are used to investigate and catorgized the rock genetic types according to log curve shapes introduced by many authors (El Sayed 1981,. Ban and El Sayed,1987 and Emerys 1997).The main log curve shapes have been found in the Abu-Madi formation are:

1. **Coarsening upward sequence** (funnel shape and cylinderical shape): a gradual upward decrease in gamma ray curve response. In shallow marine settings, this trend reflects a change from shale-rich into sand-rich lithology and upward increase in depositional energy with shallowing-upward and coarsening. In deep marine settings, this trend reflects an increase in the sand content of turbidite bodies. This trend also may indicate gradual change from clastic to carbonate deposition. The depositing material is relatively coarse grained and moderately well sorted. Normally more coarse material will be found at the base and there will be a general fining upward. The cylindrical shaped gamma ray curve indicates massive, featureless, non-graded sand normally associated with channel fills as meandering fluvial and delta distributaries channels genetic rock types (Fig.4).

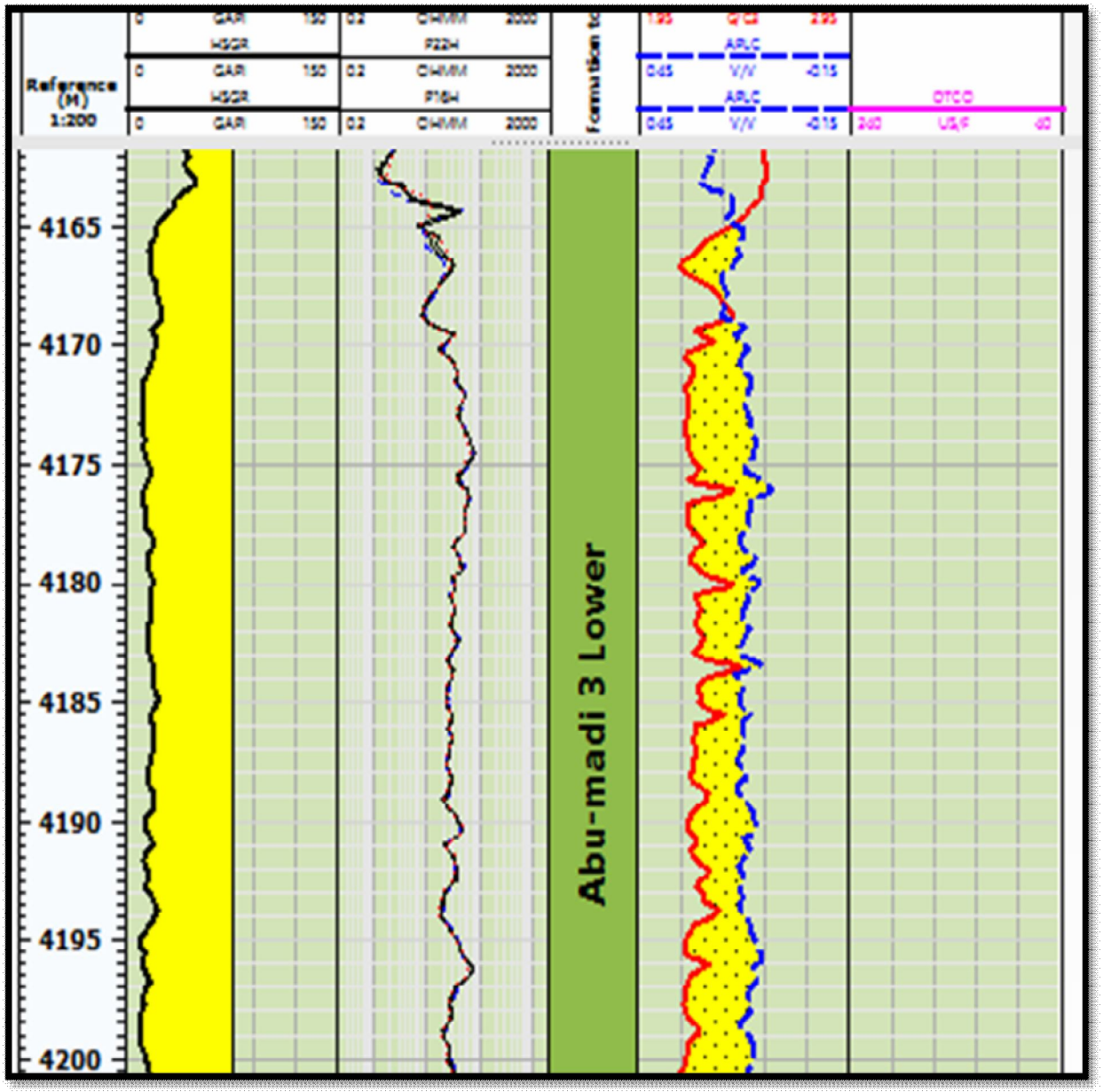


**Fig. 4: Abu-Madi formation log curve shapes (cylinderical) indicating meandring fluvial deposits.**

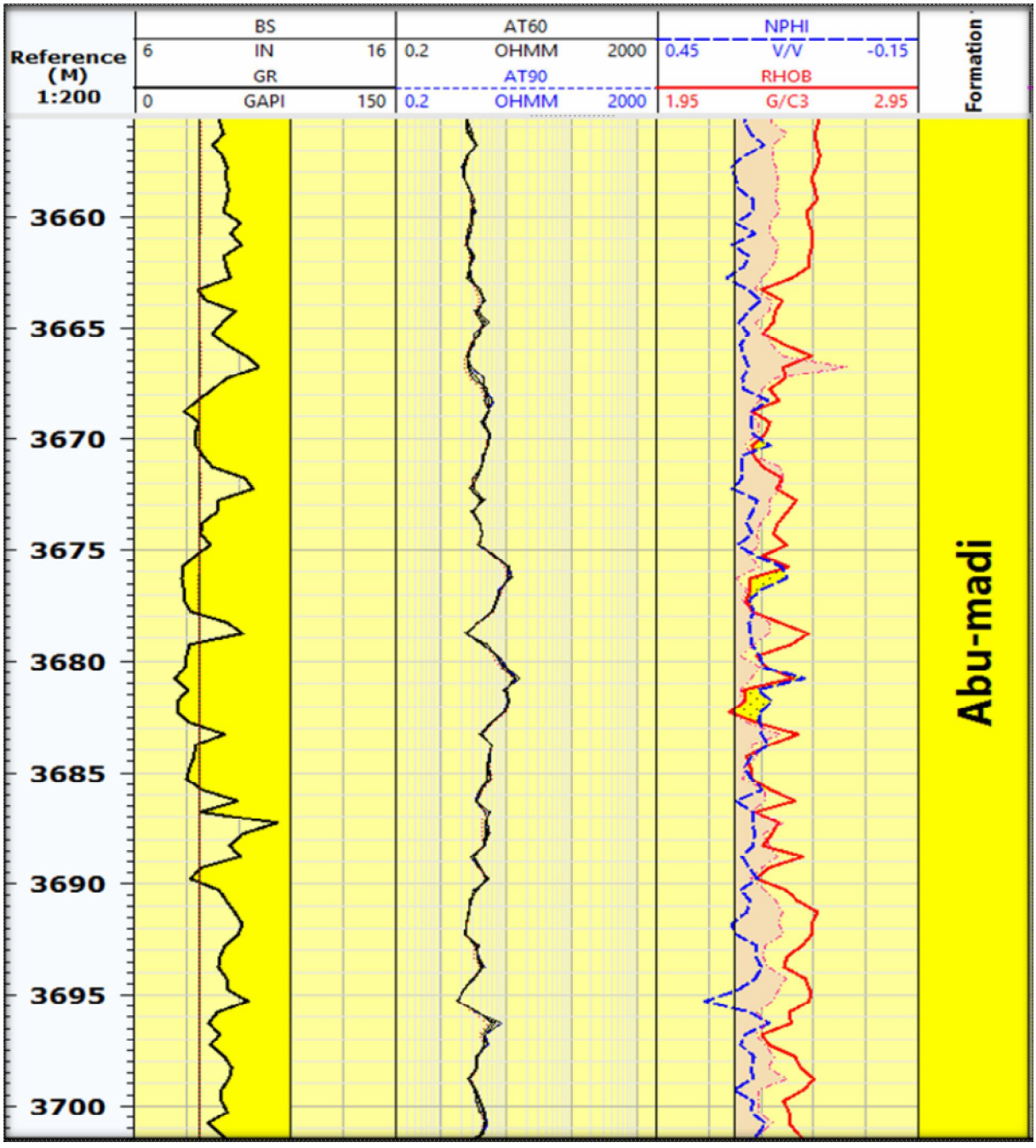


**Fig. 5: Abu-Madi Formation log curve shapes (Funnel shape) indicating mouth bars deposits.**

Distributaries mouth bar sands are relatively fine grained and moderately sorted. However, curve shapes reflect a general coarsening upward in a highly serrated funnel type configuration. The serrations probably arise from irregular downward movements due to growth faulting, common in a highly constructive delta (Fig.5).

2. **Cleaning upward trend (bell shape)**: a gradual upward increase in gamma ray response: This trend may reflect upward fining (eg: a lithology change from sand to shale) or upward fining of sand beds in a thinly interbedded sand-shale unit. This trend usually implies a decrease in depositional energy. In a non-marine setting, fining upward is predominant within meandering or tidal channel deposits with an upward decrease in fluid velocity within a channel (coarser sediments at base of channel). In a shallow-marine setting, this trend usually reflects an upward deepening and a decrease in depositional energy which refelcts bradied stream enviornment (Fig.6).

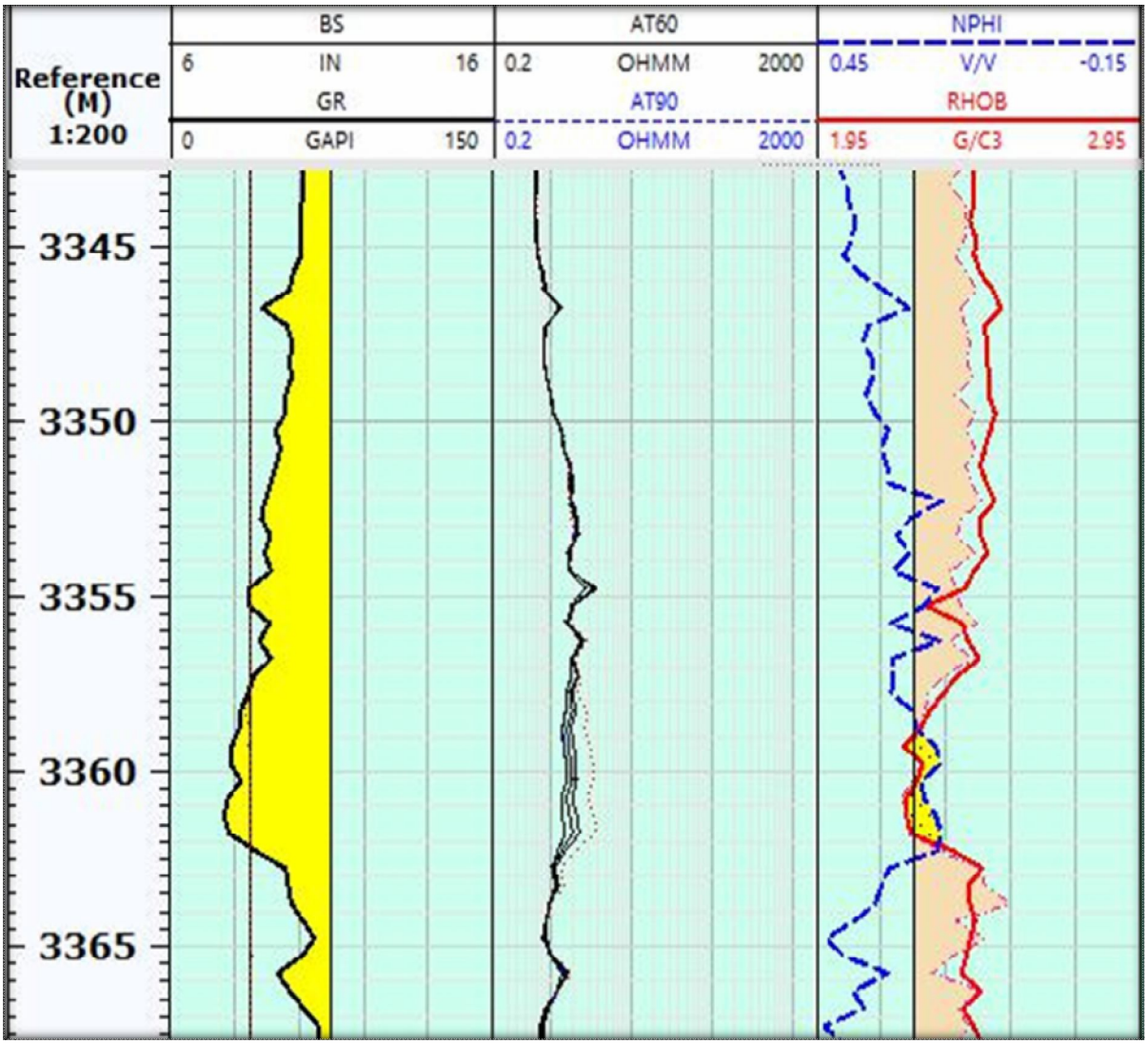


**Fig. 6: Abu-Madi formation log curve shapes (Bell shape) indicating braided stream deposits.**

## CONCLUSIONS

1. Log curve shape technique is a direct indicator for rock genetic types and depositonal enivornment especially in deltaic enivronments.
2. Abu-Madi sandstone Formation is genetically sub-divided into three deltaic facies.
3. Future prospectivity is probably greatest in the central parts of the Baltim East and Baltim North fields, especially in Abu-Madi Formation which considered as the main reservoir.
4. Abu-Madi Formation is characterized by high effective porosity, permeability, thick sandstone, low shale content and high gas saturation.

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