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A new drilling performance benchmarking: ROP indexing methodology

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ABSTRACT

The performance efficiency in drilling oil, gas wells is eventually measured by means of comparing the time versus depth curve. However this is now being questioned, is a well drilled relatively in a shorter time period the most efficient well? Large data are now being acquired while drilling, however not all of the data available is utilized appropriately to get the big picture of the well being drilled. This research study is aiming to introduce a performance comparison methodology based on Rate of Penetration (ROP). All other operational steps other than drilling activity is routine unless there are hole problems and not dependent on formation. Drilling ROP on the other hand is a parameter that can be used to benchmark the efficiency of the drilling performances. In this research study the data of 40 wells drilled in Middle East Geomarket is used. This document describes ROP Indexing Methodology for drilling performance, and gives examples of its application from actual data. The study showed that previously used drillability performance comparisons by the industry are not feasible for benchmarking. It is obvious that he drilling industry needs a new methodology to benchmark drilling performance of the wells using advanced computers and available data being acquired from the rigs.

1. Introduction

Most of the formations in Middle East Geomarket are relatively flat beneath the surface. Drilling performance is desired to be improved with the learnings from the offset wells. The formations to be penetrated while drilling to the pay zone are relatively similar, and in similar thicknesses for all of the wells to be drilled for development. Fig. 1 gives the Stratigraphic column for Rumaila and Zubair Oilfields, Al-Ameri et al. (2011). Subsurface formation top layouts for 12 wells drilled in Middle East is as given in Fig. 2. The succession of the formations reveal that the thicknesses of the formations are very close to each other from one well to another. This means that the wells to be drilled in the same area are going to be very similar to one another.

Drilling performance of a well is the time taken to construct the wellbore. The benchmarking is based on overall expenditure spent to construct the well. Rig day rate charges and services charges vary from one field to another. There is no need to mention that rig rates vary from one country to another. Nowadays with advanced technological innovations, the wellbore sections are drilled from shoe to shoe with PDC bits. The learning curve of drilling activities shall be captured so that the future wells could be drilled efficiently.

Field developments in giant fields requires drilling of massive number of wells. In a press release in 2009 Eni has declared that more than 200 wells are included for drilling to develop an oil field in the Middle East Geomarket. The operator companies are looking for the ways to optimize the expenditures, which is a function of drilling the wells faster. Devereux (1998) stated that there are two keys to drilling a cost-effective well. The first is avoiding problems, and the second is maximizing progress, which is mainly based on good drilling practices. The objective of this research is to identify which well is with the best progress, once it the drilling is completed. Alternatively with this methodology the progress of an ongoing drilling campaign can be monitored fairly easily.

At present one of the most common performance benchmarking for drilling performance is the time versus depth charts. Rushmore (2011) stated that the relative steepness of the data charts indicates the “speeds” of drilling rate of penetrations of the wells. However it is not easy to differentiate the data charts if in one of the well's non productive time occurrence had taken place.

The proposed benchmarking methodology in this research however is concentrating on the Rate of Penetration (ROP) occurrences. The possible variations in flat time periods are not taken into account. Flat time periods in a time versus depth curve is the span of time spent on operations during which the depth of the well is not increasing. Fig. 3 gives an example flat time comparisons for 12 wells similar in profile. Under

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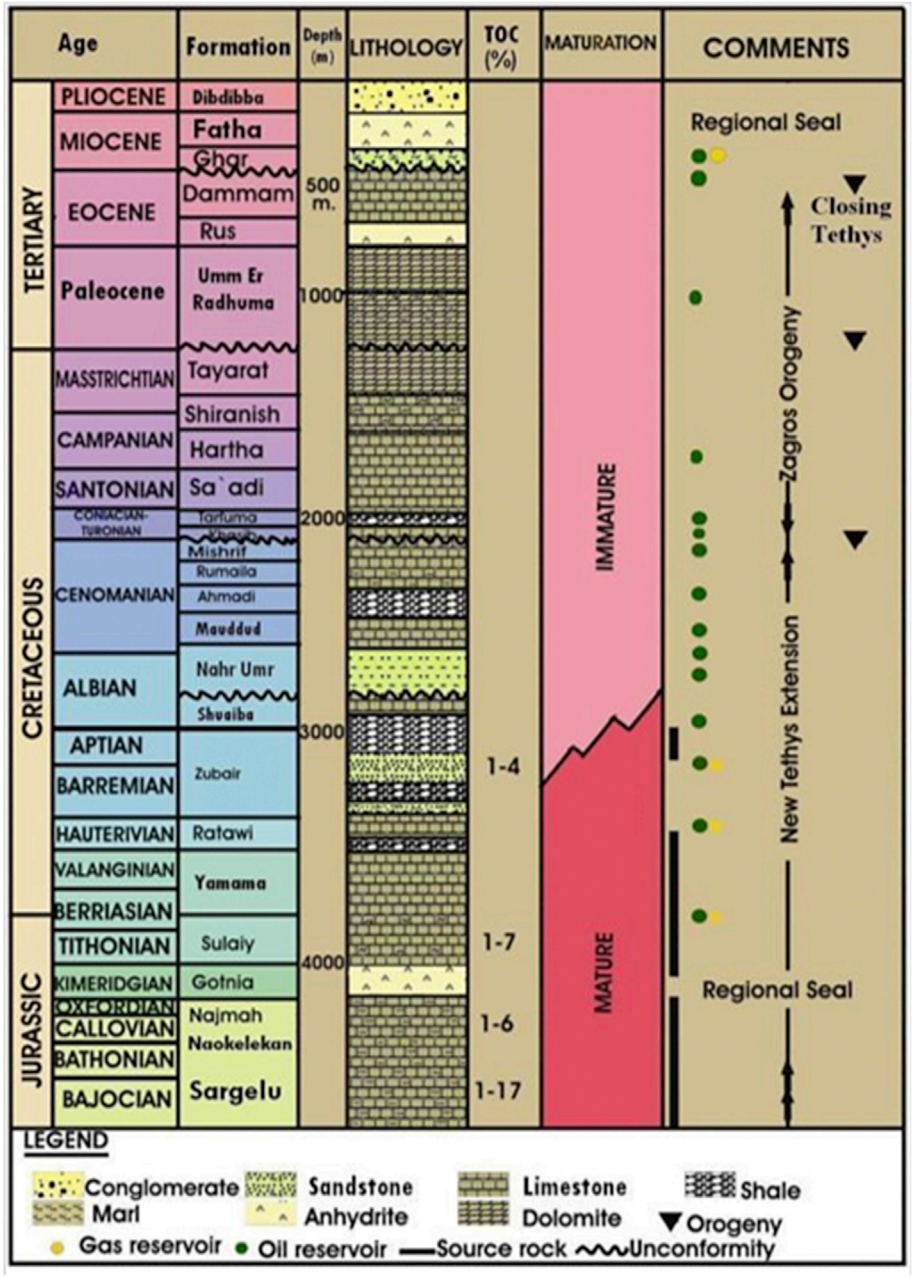

Fig. 1. Stratigraphic column of South Iraq, Basrah region (Rumaila and Zubair oil fields), Al-Ameri et al. (2011).

normal circumstances one would expect that the flat times for the sections are going to be similar to one another. However it can be observed there could be significant variations especially when one looks at the flat time of the 7" hole sections. It is important to keep in mind that the operational steps to be followed during the flat time intervals may vary from one Operator company to another. Because the steps to be conducted is going to be based on procedures and standards of the company.

NPT is time where the rig is not drilling, which pushes drilling operation behind the schedule and results in a lot of money lost, Basbar et al. (2016). Adams et al. (2010) stated however that the definition of NPT tends to vary by drilling supervisor and/or operations engineer and that the total NPT given in the end-of-well report reflects subjectivity. For instance for some operators even if the ROP is low, the operational step is not going to be categorized as an event which pushed the operation behind. In today's technology, the motto for operations in drilling is: "**Reduce flat time and increase drilling performance**". The question to be answered for benchmarking is "What should be the rate of penetration in drilling?"

2. Literature review

As stated by Kaiser (2009) drilling operations are complex and many factors influence the time and cost to drill a well. Kaiser attempted to model time and cost to drill an offshore well. The study found out that all of the relevant characteristics of drilling are not possible to be identified. This impossibility is due to the diverse and incomplete data sets. It was observed that operators maintain meticulous and detailed record of each well drilled, and crate analytical framework that incorporates the main components of drilling.

Ikoku (1978) stated in his publication that the first well drilled in a new field usually takes the most time. A progressive reduction in drilling is observed with wells to be drilled subsequently. Each new well should