

## **Understanding the bore hole destabilizing factors from well logs- A case study from the wells of North Assam Shelf of India**

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### **Abstract**

Drilling a smooth and stabilized well is the prime objective of a drilling. Smooth and stabilized well is not only the requirement of Drilling, but also important for Logging and Production. A good bore hole has nothing to do with the trajectory it can be an extended reach, Horizontal or any other high tech. well. Borehole rugosity increases the stand off length offered to the measuring devices. Under gauged wells bring concern for drill string and logging, be it wire line or LWD. The technological advancement aims in ensuring a near to complete solution but in actual practice it may not be able to deliver the desired results. It requires a re-look of the geological subsurface conditions and other inputs. Despite drilling so many wells, complications do arise. It is seen that drilling a fresh well in the same field can sometime be a new experience when the well depth is 4000+meters. Available subsurface data which acquired in subsequent years can be analyzed and utilized for refinement. It does not require a very complicated analysis; but basic inputs before hand to a drilling Engineer as he goes to drill.

One of the most destabilizing factor for bore hole integrity is the various clay types and their distribution. These clays react differently to drilling fluids and are detrimental not only to drilling but in production completions also. The reactive shales swell and less drilling fluid exposure is recommended for foliated clays so as not to choke the pore throats. The knowledge of clay type and their behaviour can lead to better mud designing.

The wells of North Assam Shelf have producing horizons from Tipams to Tura. The well depths are 3800+meters. The complications start from very beginning. Present paper is an attempt to understand the distributions of clays in the various strata of sub surface formations. The study can be an input to define a direction for further R&D and will be beneficial to designing the drilling fluids.

### **Introduction**

Subsurface clay minerals are mainly from Smectite, chlorite, kaolinite and illite family. Glauconite is the clay which is a very good indicator of depositional environment.

Illite family is some of the most common types of clay mineral which is found more in consolidated and older sediments. This mineral is formed from the natural weathering of potassium feldspars and transformation of other clays. When mixed with swelling shales destroys the permeability and reduces the effective porosity.

Smectite is a group of soft swelling clays and having high degree of affinity towards water. Dominance of this clay not only makes the dissension of drilling string problematic but overexposure to drilling mud effects the logging data acquisition.

Chlorite is characterized with low water absorbing clay but extremely sensitive to acids and oxygenated water. Acid treatment of such formations should be done carefully.

Kaolinite is associated with low degree of compaction. A completion in such type clay needs clay stabilization substances.

### **Methodology**

Well composite of various litho units were made and lithology cross plots for clay typing were generated. Lithology crossplots were generated from spectral gamma ray logs. Cross plots were evaluated as per standardized values of radio elements concentration. Log Correlation of litho units with cross plots was also assured.

### **Case study**

Drilling a Brails section is always be problematic in Laipling gaon are of Assam. A well is selected for understanding the behaviour of clays in brails units. Present studied well of Laiplinggaon was planned to be drilled to a depth of 3755M with objective in pay sands in Lower Brails -1(LBS-1) and Lower Brails 5(LBS-5).The complications were observed in almost every job like held ups of drilling string and held ups during logging. Density log could not be recorded as it is a padded device and was getting tight pulls during the logging. Clay typing is done to understand the behaviour of LBS units in this well are as follows:

### **LBS-1**

Dominant clay in LBS-1 is smectite the log characteristics and clay typing is shown in fig-1. drilling fluid exposure for longer period makes Smectite family clays swell. The drilling complications in this lithounit can be attributed due to this.

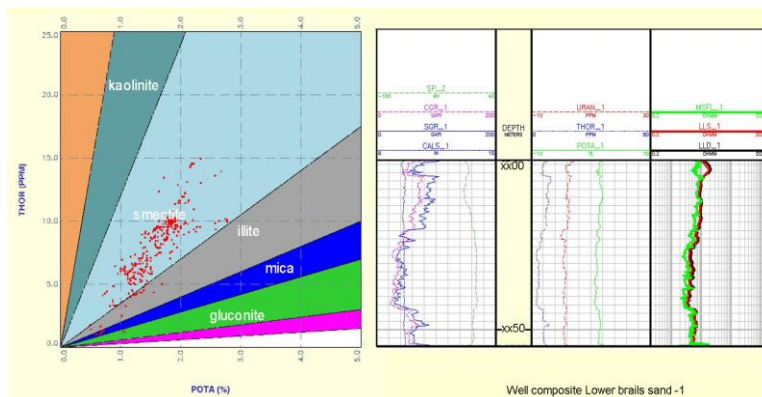


fig-1.

## LBS-2

Study of LBS-2 has noticed the clay is Smectite with chloritic input the mixed layer clay has no bias ref fig-2 below

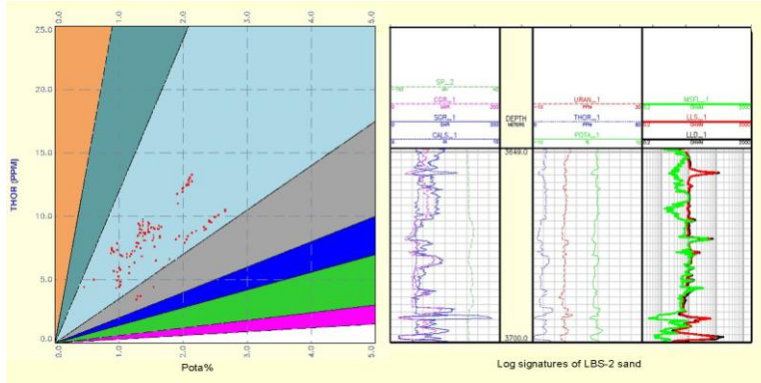


fig-2

## LBS-3

The characteristics of LBS-3 and LBS-2 are almost same well condition also gets deteriorated is evident from the caliper logs shown in the first log track.

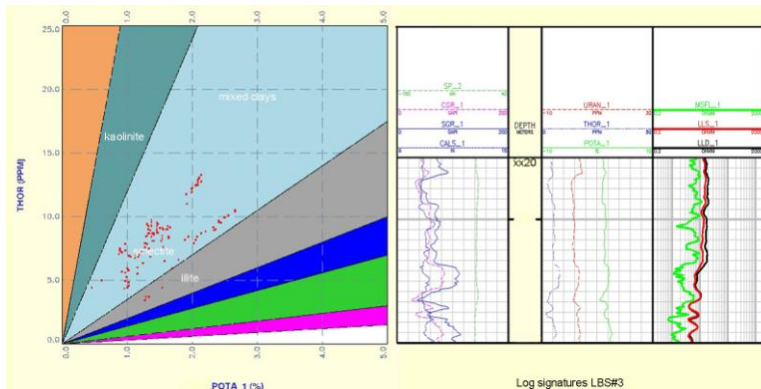


fig-3

### **LBS-5**

LBS-5 sand is showing the clay trend analysis dominantly and Kaolinitic in nature. The sand is dirty as compares to the 1, 2&3. Caliper in the top of the sand is showing bad borehole.

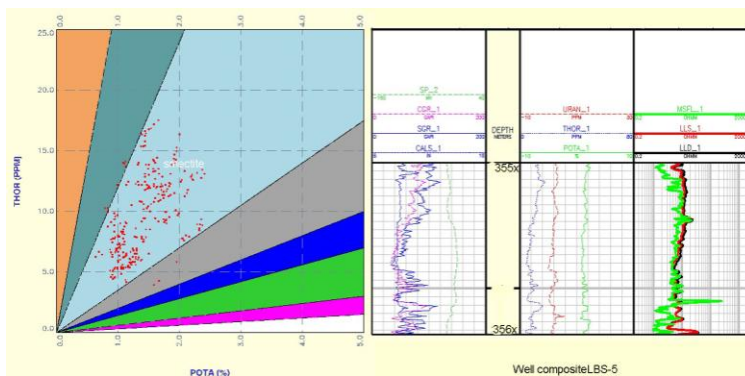


fig-4

### **LBS-6**

There is a clear distinction between LBS5 and LBS6 unit. Dominant clay is illite as compared to very less no. of points falling in Smectite region. The mixture of illite followed by smectite is the clay pattern in this unit. Such type of clay typing reduces the permeability and effective porosity

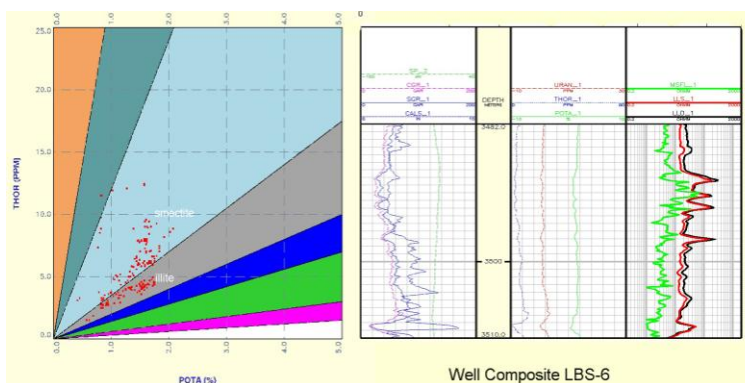


fig-5

### **Tura formation**

Dominant clay in Tura formation in the Disangmukh area was evaluated as Smectite. Kaolinic input is also noticed it may be due to the vicinity of source of sediment nearby.

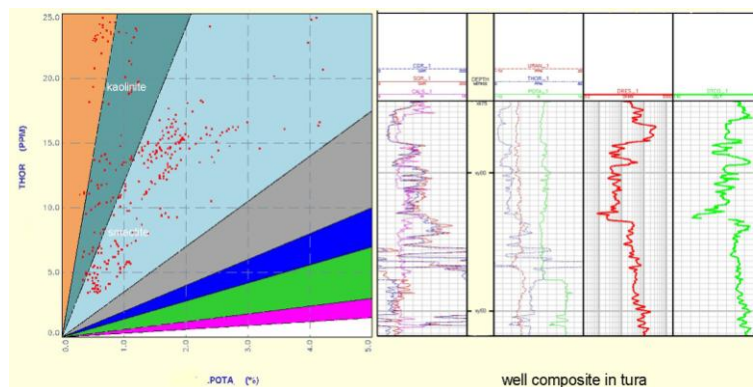


fig-6

### **Conclusions**

Clay pattern in Brails have shown the presence of Smectite in abundance. Presences of Smectite family clays are giving problems in drilling such sections. Each litho unit is mapped and variation in clay nature is from illite to kaolinite. Presence of chlorite with illite is creating production related complications in Laipling-Gaon field.

Tura formation has also shown the dominant clay as smectite with heavy thorium bearing minerals.

Hence the knowledge of clay in each litho-unit is an important input while planning for drilling and designing the drilling fluid and also during production.

### **Acknowledgements**

Authors are very thankful to ONGC Management for giving permission and providing infrastructure and opportunity to write this paper. Acknowledgements are due to my colleagues of KDMIPE for their valuable suggestions

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