

High Resolution Logs of TOC: Statistics Serving Geosciences

Frank Haeseler¹, Fatima Mahdaoui², Rouven Elias², Francois Gelin³

¹TRC-Q, Total EP Qatar, Doha, QATAR

²Total EP/FGO, Pau, FRANCE

³Total EP/SCR, Pau, FRANCE

ABSTRACT

The LIPS “Laser Induced Pyrolysis System” is a cutting edge instrument developed by Total. It is based on a pyrolysis of the organic material present in rocks by a laser shot. The two main applications are tarmats in carbonate reservoirs and unconventional plays.

Vertical and lateral distribution of organic carbon in sedimentary formations present variations at centimetric or even millimetric scales. These variations were overlooked by classical analysis techniques. With the typical sedimentation rate of carbonates, conventional, low resolution measurements (1 sample / 2m) may represent up to 100 ky whereas LIPS measurements at 0.5mm interval will represent 250 years. The LIPS can perform fast acquisition of thousands of data since it needs no sample preparation prior to the analysis. This new technique has a set of unique features:

- it is poorly destructive: laser impacts only 1 mm³ of material,
- it generates big data (typically 10 000 data points and more for 100 meters of core). Statistical treatments on such data sets provide more significant and more representative description than discrete and low resolution sampling. This opens completely new perspectives to understand organic matter deposition and distribution.

Descriptive and inductive statistics may be used to infer laws and to detect:

- trends, behaviors and dependencies,

- relationships with lithology, rock type, Milankowitch cycles...

- it provides high resolution data allowing more accurate location and better quantitative evaluation of the organic carbon. This type of data reveals the occurrence of barriers and the loss of reserves due to the presence of tarmat in reservoir.

The paper will present LIPS data from all around the globe including unconventional shales and specific applications to carbonate reservoirs and resources from the gulf. These data will be compared to conventional methods and discussed accordingly.

The statistical interpretation of high resolution TOC data provided by this technology opens new horizons in Geosciences. A very exciting application is the identification of “Milanković-type” cyclic sedimentation by rhythmic variations in organic carbon. This interpretation of organic matter distribution has huge operational impacts: it allows identifying relationships between minerals and organic carbon (discriminating between source and reservoirs rocks) and applied at larger scales allows forecasting permeability barriers in carbonate reservoirs or hotspots in shale formation.