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## THE LORRAINE CARBONIFEROUS BASIN (FRANCE) AS A NEW TARGET OF REGIONAL GAS RESOURCE FOR THE ENERGY TRANSITION STRATEGY?

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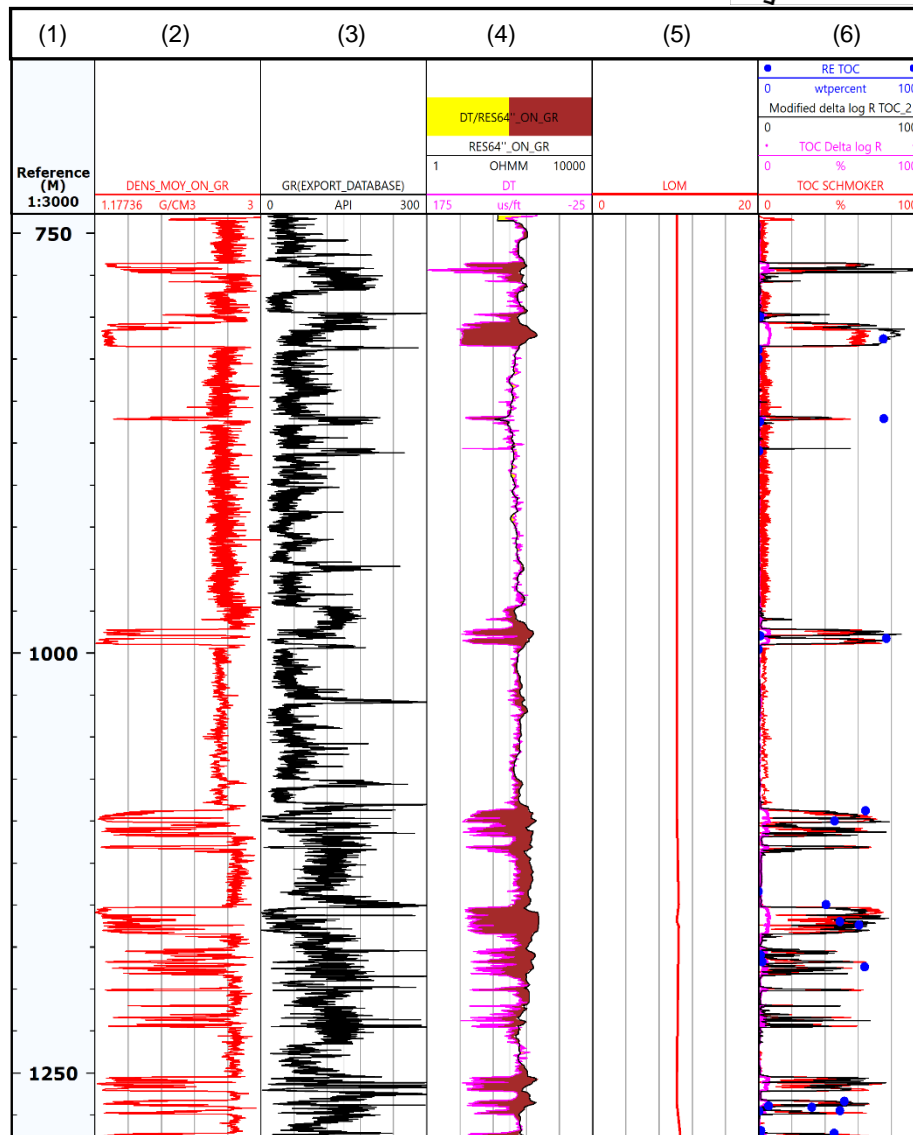
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Knowledge of the nature of the deep-seated geological structures of Europe is a strategic aspect of the energy transition. Indeed, the existence of underground resources as well as geological features able to serve as energy storage sites becomes increasingly important. Natural gas has been classified by the European Union as sustainable investment and current dramatic events underline how energy transition efforts can be jeopardized without secured supply. In such background, the identification of local/regional gas resources is important.

In Lorraine (North-East France), the Carboniferous basin play an important resource of coal bed methane (CBM). Currently, new exploration campaigns are being carried out through the research program REGALOR (2018-2023) and new accurate data are offered by La Française de l'Énergie. Therefore, new research contributes to a better understanding of the sedimentary pattern and thermal history of the basin. The Lorraine Carboniferous Basin is about 200 km long, 80 km wide. The sedimentary infilling is made up of 8 km of fluvio-lacustrine deposits. The Westphalian strata (315-308 Ma) which host most of the coal deposits are overlain by fluvio-lacustrine series of Stephanian (307-302 Ma) in which coal is far lesser abundant. Carboniferous-Permian strata are buried under a 500 to 1800 m thick Mesozoic cover of 500m to 1800m (Donsimoni, 1981; Izart et al., 2016).

The ultimate CBM resource evaluation of the basin requires the description of sedimentary features and their burial history. In this objective, a new approach of the application of well log for the evaluation of kerogen distribution assessment in coal seams as well as clay to silt facies has been developed. Schmoker et al. (1979), Passey et al. (1990), and Carpentier et al. (1991) developed schemes that applied to marine clay deposits. The aim of this study is to apply these methods to continental deposits. Environmental deposition conditions of sediments were determined as to decipher the highly heterogeneous continental fluvio-lacustrine deposits. Continuous well log data records calibrated with Rock Eval data available from drilling cores were used to estimate systematic total organic carbon contents in wells (figure 1). Organic geochemistry provided information on coal preservation as a function of depositional conditions as well as thermal maturity level and hydrocarbons generation potential. Artificial maturation of the various coaly facies by confined pyrolysis allowed to determine the geochemical characteristics of gas as well as the methane generation potential from entrance of oil to end of gas windows. Sedimentological and geochemical data were integrated into 1D burial models to reconstruct methane generation through time in the basin for several key localities.

The overall dataset therefore aims to set a background methodology as to calculate the ultimate methane resources generation through space and time in the Lorraine Carboniferous basin.



**Figure 1.** Example of Total Organic Carbon Evaluation for Folschviller well (Lorraine Carboniferous Basin, France) using well log data. 1: Depth (m), 2: Bulk Density Log (g/cc), 3: Gamma-Ray Log (API), 4: Delta log R separation (Sonic slowness ( $\mu\text{s}/\text{ft}$ ) and Deep Resistivity Log (Ohm), 5 : Level of organic maturity (LOM), 6 : Total Organic carbon (wt%) as determined by Delta Log R method (purple), Modified Delta log R method (black), Schmoker's method (red) and Rock-Eval Analysis (blue dots).

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#### References:

- Passey, Q. R., Creaney, S., Kulla, J. B., Moretti, F. J., & Stroud, J. D. (1990). A practical model for organic richness from porosity and resistivity logs. *AAPG bulletin*, 74(12), 1777-1794.
- Schmoker, J. W. (1979). Determination of organic content of Appalachian Devonian shales from formation-density logs: *Geologic notes*. *AAPG Bulletin*, 63(9), 1504-1509.
- Carpentier, B., Bessereau, G., & Huc, A. Y. (1989). Diagraphies et roches-mères. Estimation des teneurs en carbone organique par la méthode CARBOLOG. *Revue de l'Institut français du pétrole*, 44(6), 699-719.