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EVALUATION OF ERODED MESOZOIC FORMATIONS IN NORTHERN ALSACE (FRANCE) USING ORGANIC GEOCHEMISTRY AND BASIN THERMAL MODELLING

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Introduction

The Upper Rhine Graben (URG) is a Cenozoic intracontinental rift 300 km long and 30-40 km wide which extends partly in France, Germany and Switzerland, (Schumacher, 2002). The sedimentary basin is NNE/SW trending and its current geometry corresponds to a set of asymmetrical and antithetical halfgrabens, connected by transfer zones using structures inherited from the Paleozoic. Pre-rift sedimentary filling is composed of a serie of Permian to early Upper Jurassic formations separated from syn-rift Cenozoic deposits by a major unconformity. While the Mesozoic sediments are very similar to those encountered in the Paris Basin, the Cenozoic deposits are typical of the URG. The study area corresponds to the Pechelbronn sub-basin which holds most of the petroleum reservoirs of northern Alsace (France), in the western central part of the URG.

In the Pechelbronn sub-basin, it is noticed that the unconformity reaches the Middle Jurassic formations. Compared to the Paris Basin sedimentary successions, this questions why Upper Jurassic and Cretaceous formations are missing (Schnaebele, 1948; Ménéillet et al., 2015). Especially for the Cretaceous sediments, it remains uncertain whether their absence is related to a sedimentary hiatus or a period of erosion as discussed by Ziegler (1990) or Blaise et al. (2011, 2014). This uncertainty is problematic to rebuild the burial history of Mesozoic sedimentary formations. Indeed, vitrinite reflectance values (Ro%) in well profiles present a sharp offset in Ro% values in the Jurassic series compared to the Tertiary (Robert, 1985) suggesting that there may be two different geothermal histories to be considered.

Rock samples of Tertiary and Jurassic ages as well as petroleum samples were collected in the Pechelbronn area and analysed for their organic geochemistry. The geochemical analyses of the Jurassic outcrops show that the Mesozoic formations are immature. If we consider that the pre-tertiary sedimentary column was not sufficiently buried before the Cretaceous, we can estimate a maximum paleo-burial and thus, evaluate the thickness of the eroded series. This estimation is made using 1D thermal models (PetroMod) from wells located in the Northern Alsace for which geological and Ro% data were published (Robert, 1985).

The aim of this presentation will be to show evaluation of heat flux, oil generation and maximum paleo-burial in the Pechelbronn area by using molecular markers, vitrinite reflectance, kinetic properties of source-rocks and artificial maturation. The comparison between the values simulated by the 1D thermal basin models (PetroMod) and the measured values from the maturity markers allows calibration for these wells. Model calibration consists in estimating the thicknesses of the eroded series and heat flux values. Supplementary information are brought by comparing calculated thermal maturity of oils with geochemistry of collected oil samples. Special attention will be given to possible local heat anomalies linked to hydrothermal fluid circulations, well known in the URG (Werner and Doebel, 1974; Lampe and Person, 2002; Baillieux, 2012).

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