# Multi-scale folds/faults/fractures network characterization in the Saar-Lorraine coal basin.

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In an energy transition context where hydraulic fracture is prohibited, the success of unconventional resources exploration has to rely on the understanding of natural faults/fractures system. The Saar-Lorraine coal basin is a 300 km x 70 km size basin, trending NE, which developped south of the Metz-Hunsruck Boundary Fault zone (a ancient collision limit) during the late stage of the veriscan belt. It has been exploited for its coal seams and nowadays it is a target for a green coal bed methane exploration through a large european project named Regalor hereafter. The rich gas coal seam bearing levels are involved in anticlines and are part of the Westphalian sediments interval. To capture fracture network of these structural objects, a multi-scale analysis of folds geometry and their faults/fractures system was conducted from low resolution scale (seismic) to high resolution (well imagery, cores) and the use of outcrop (analogue) and surface data (geological map, digital terrain model) with an emphasis on the Saarbrucken-Merlebach anticline. First results have highlighted six main points : (1) folds display geometric characteristics of fault-propagation fold; (2) the persistence of NE-SW and NW-SE discontinuities at 1-100 km size range, (3) the presence of two generation of NW-SE faults; (4) a dextral offsetting, abutting and crosscutting relationships between folds and NW-SE faults which can lead to reservoirs compartimentalization; (5) the appearance of NS and EW fractures sets at borehole size which may correspond to the cleat system discribed on unoriented cores, (6) the complex faults/fractures geometry of the Saarbrucken-Merlebach anticline which serves as analogue for the other anticlines in the basin. Furthermore, field observations on outcrops analogues (Cevennes basin and Graissessac basin) have shown that there is a strong lithological control on fracture orientation and density in such coal bearing systems and that the synsedimentary/tectonic deformation can be very complex due to coal creeping. Structural restoration of folds will help understand the fold growth mechanism in the Saar-Lorraine coal basin.

**Mots-Clés:** Saar-Lorraine coal basin, inverted structure, fault propagated-fold, structural inheritance, dip-slip reactivation, fault-related fold, background fracture, coal creeping.

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