FAULT SEAL ANALYSIS – PRICIPLES AND PRACTICE

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Abstract

Fault Seal Analysis (FSA) is a multidisciplinary methodology that integrates principles of structural geology, seismic interpretation, and geomechanics to assess the capacity of faults to act as barriers to subsurface fluid migration. Faults play a critical role in trapping hydrocarbons, governing fluid exchange, and influencing pressure distribution within reservoirs, thereby impacting well placement, drilling risks, and production strategies. FSA examines various fault sealing mechanisms, including membrane (capillary) seals, juxtaposition seals, and fault rock seals such as cataclasites and clay smears. The analysis relies on constructing consistent 3D fault-framework models, accurate mapping of fault geometries, and defining hanging wall and footwall cutoffs using tools like Allan diagrams.

A key parameter in fault seal prediction is the Shale Gouge Ratio (SGR), which estimates the clay content within fault zones based on lithology and fault displacement. SGR values are empirically linked to fault sealing capacity, capillary pressure, and maximum hydrocarbon column height, with thresholds distinguishing between sealing and non-sealing behavior. Laboratory measurements and field calibration further refine estimates of fault permeability and capillary entry pressure. The FSA workflow incorporates diverse data sources, including seismic surveys, well logs, core analyses, and production data, to generate qualitative and quantitative assessments of fault seal integrity. Ultimately, FSA supports risk assessment for subsurface projects by predicting fluid migration across fault zones, aiding in exploration, production planning, and reservoir management.

About speaker

Dr. Volker Schuller is a senior geologist with over 25 years of experience, including 20 years in the oil and gas industry. He specializes in structural geology, tectonics, fault-seal analysis, and geomechanics, with extensive expertise in exploration, field development, and operations across international projects. Dr. Schuller has led multidisciplinary teams, managed R&D initiatives, and contributed to M&A activities. He is proficient in seismic interpretation, prospect evaluation, and basin analysis, and has published widely in international journals.
Volker holds a PhD earned at University of Tübingen/Germany, focusing on the geodynamics of the Apuseni/Transilvanian Basin/ Carpathian interfaces.