Naturally Fractured Carbonate Reservoir Characterization: A Case Study of a Mature High Pour Point Oil Field in Hungary

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Abstract:

An integrated technical study was conducted for a field development project in West-Hungary. This study offers a better solution for estimating petrophysical properties and fracture facies vertically along the well and laterally for 3D static and dynamic models of naturally fractured reservoirs in carbonate rocks. More than 30 wells with 40 years of production history were used to build reliable static and dynamic models. The fracture class/facies play an essential role in spatial distribution of petrophysical properties during 3D reservoir modeling. It was defined by integrating the conventional logs, image logs, drilling parameters, and production or well test data. Three fracture facies are defined as macro-fracture (including permeable sub-seismic fault), micro-fracture, and host rock. Subsequently the fracture-class's spatial distribution is guided by seismic attributes of fault likelihood combined with geological concept of fault and damage zone. As a result, the established fracture classes along the wells are validated by static and dynamic subsurface data. Spherical self-organizing map (SOM) was also implemented for predicting the fracture location in wells having limited subsurface data. Moreover, fracture lateral distribution follows the distribution of the fault zone of fault core, high-damage zone, low-damage zone, and host-rock. The higher the fault displacement the wider the damage zone and fault core formed. Macro-fractures and micro-fractures frequently appear around fault core and high damage zone. While only microfractures are dominantly present in the low damaged zones. In contrast, the unfractured class is dominantly distributed in host rock area. Also, the lithologies considered in distributing the fracture class because the rock mechanic properties and number of fractures are strongly controlled by rock compositions. Once the fracture class is distributed, porosity, permeability, and water saturation are modelled in the 3D geocellular model. Finally, this fracture class also plays a role as a rock typing for reservoir simulation. The saturation height model is built using the fracture class distribution resulting the initialization, history matching process, and production forecast from 20 wells are showing excellent quality. As a novelty, this study offers a better understanding of fracture distribution and accelerates the history matching process with a more confident result of production forecast. In the absence of advanced technologies like image logs and production logging (PLT) measurements, this study still effectively assists us to recognize the fracture presence and its quality in both well-depth interval and 3D spatial space, and successfully guided us in proposing a new infill drilling with strong confidence and delivering on the high-end of expected results.

Bio:

Muhammad Nur Ali Akbar is an integrated Reservoir Engineer and Petrophysicist with 7+ years broad international experience in oil and gas field development, exploration, and CCUS (carbon capture, utilization and storage) projects in Hungary, Croatia, Norway, and Indonesia. Currently, He works at MOL Hungary under West-Hungarian Field Development Subsurface Team. Previously in Indonesia, He started his career in 2014 as a reservoir engineer consultant at Indonesia R&D Centre of Oil and Gas - LEMIGAS and LAPI ITB for serving various exploration and field development plan projects for Pertamina, Petronas, Repsol, and Ophir. He holds a BSc in Petroleum Engineering at Bandung Institute of Technology & Science and MSc in Petroleum Geo-Engineering at the University of Miskolc. He has published and presented more than 20 technical papers, won numerous technical awards from various professional societies, and contributing as the technical reviewer as well in respectful scientific and engineering journals. His research

interests include in the integrated field of naturally fractured basement reservoir characterization, fracture and rock typing, rock physics, and advanced geostatistical methods. He is a member of SPWLA, SPE, and EAGE. Formerly, he was a president of SPWLA Indonesia chapter 2017-2019 and led the 2nd SPWLA Asia Pacific Technical Symposium 2018 in Bogor, Indonesia.