2-D to 3-D Fracture Network Detection and Forecasting in a Carbonate Reservoir Analogue Using Multiple Point Statistics (MPS)

Bruna, Pierre-Olivier; Hardebol, Nico; Bisdom, Kevin; Straubhaar, Julien; Mariéthoz, Grégoire; Bertotti, Giovanni

Publication date
2017

Document Version
Final published version

Citation (APA)
Bruna, P.-O., Hardebol, N., Bisdom, K., Straubhaar, J., Mariéthoz, G., & Bertotti, G. (2017). *2-D to 3-D Fracture Network Detection and Forecasting in a Carbonate Reservoir Analogue Using Multiple Point Statistics (MPS)*. Abstract from AAPG International Conference & Exhibition 2017, London, United Kingdom.

AAPG Datapages/Search and Discovery Article #90310 ©2017 AAPG/SEG International Conference and Exhibition, London, England, October 15-18, 2017

2-D to 3-D Fracture Network Detection and Forecasting in a Carbonate Reservoir Analogue Using Multiple Point Statistics (MPS)

Pierre-Olivier Bruna[1], Nico Hardebol[1], Kevin Bisdom[2], Julien Straubhaar[3], Grégoire Mariethoz[4], and Giovanni Bertotti[1]

[1]Department of Geoscience and Engineering, Applied Geology section, TU Delft , 2628 CN, Delft, Netherlands.
[2]Shell Global Solutions International, 2288 GS Rijswijk, Netherlands.
[3]Centre d'hydrogéologie et de géothermie (CHYN) , Université de Neuchâtel , CH-2000 Neuchâtel, Switzerland.
[4]Institute of Earth Surface Dynamics (IDYST) UNIL-Mouline, Geopolis, University of Lausanne, 1015 Lausanne, Switzerland.

ABSTRACT

Natural fractures have a strong impact on flow in carbonate reservoirs. Their subsurface distribution is often unknown due to their sub-seismic size and to the scarcity of available well data. Therefore, the one of the way used to constrain the 3D architecture of fracture networks is to resort to outcrop analogues. Outcrops represent a local close-up of the present-day multiscale state of deformation. Outcrop data can be used to calibrate mechanical and fluid flow models to predict the impact of fractures on storage and flow. However, the geological complexity of outcrops requires simplifications to make reservoir-scale fracture modelling possible. A common approach is to use outcrop fracture data to populate subsurface reservoirs through stochastic discrete fracture network models. These models are generally based on limited amount of parameters implying a randomisation of the obtained realisations. Alternatively, we used Multiple Point Statistics (MPS) method. We create series of theoretical training images (TI) with varying fracture spacing, orientation, length and typology. The TIs were used in MPS process to build synthetic outcrop-scale models to demonstrate and quantify how key features of the fracture network can be reproduced by the MPS method. We applied our method to the Jandaíra carbonate Formation in the Potiguar basin (NE Brazil), which is analogue for some offshore Brazil reservoirs. A structural analysis (type, orientation, abutment) of exposed fractures was conducted both at the station scale (10 × 10 m) using a classical characterisation approach and at the outcrop scale (> 200 × 200 m) using photogrammetry models acquired from a drone. Four separate pavements interpreted this way, were used as input data to predict the geometry of the fracture network at reservoir scale (area > 10 km A planar 50 × 50 m synthetic TI representative of the complexity of the outcrop fracture pattern was used to generate series of MPS models. These MPS fracture models were compared to the outcrop fracture interpretation to quantify the degree of consistency. Ultimately, at the reservoir scale, one or more representative TIs per outcrop was created and simultaneously used during MPS runs. The obtained models forecast the fracture distribution at the reservoir scale considering the local fracture variability in the Jandaíra Formation. Our new approach can be applied to obtain more realistic reservoir scale fracture network models.