An Integrated Fracture Model and Characterisation Workflow

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Abstract

The building of a fractures model is a very challenging task because affected by many uncertainties and, very often, by shortage of data. To face this kind of study, the integration of all the data available at the different scales of observation can be very effective. In fact, in a fractured field, several clues and data can be collected suggesting the presence of a fracture network. Among others, the following items can be mentioned: the sub-seismic attribute lineaments (from Curvature, Continuity etc), the well data, such as the fractures observed on the Image Logs and Cores, the likely mud losses, the Well Test interpretation, the production behaviour. The fracture Model workflow takes advantage of all these recorded data at different scales of observation. The relevant fracture Model is defined integrating the larger events recognized on the Seismic Volume, i.e. Seismic Faults, and Sub-Seismic attributes-derived lineaments automatically captured using the proprietary T-Frac workflow and screened by Sibilla (Eni prop. tools) generating a large features DFN, with the smaller events recognized on Cores and Image Logs. The small fractures are modelled stochastically in the intra-wells space relying on both the Image Log fractures statistics, different orientation sets, analysed by stratigraphic interval and/or by Facies, lithology, area, and relying on a fracture intensity trend, a conceptual trend based on the different scale geological observations. The final obtained DFN needs to be characterised from petrophysical point of view. The flow capacity of the fractures network is estimated relying on the available well-test KH. This analysis allows the estimation of the fracture permeability also in the intra wells space in relation to their length, location, orientation and effective aperture. An estimation of the fracture storage capacity is very challenging, however a guesstimate can be also performed taking advantage of the storativity ratio of WT interpretation. The HM process is fundamental to assess the robustness of the Fracture Model and its related petrophysical characterization. The integration of all the available data at different scales of observation allows to build a comprehensive Fracture Model. It is composed by a deterministic large-scale population, coming from attribute analysis, and by a stochastic smaller scale population recognised on core and Image logs. The calibration with KH from wells allows to properly characterize the petrophysical properties of the fractures (effective and storage porosity, permeability). This workflow resulted to be successful in application to several Assets.