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New Methodology for 3-D Permeability Distribution: Diffusing Dynamics into Static Modeling

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ABSTRACT

Current geo-modeling practice requires the use of core data such as porosity and permeability as well as log data such as sonic, density, and neutron. In the process, the geo-model is built to honor measured data at well control points, while the properties away from the control points are predicted based on stochastic or co-kriging algorithms. The proposed methodology for distributing permeability in 3D extends the current workflow by using time-lapse static pressure data as a sort of spatial variability indicator of well core data. It is based on the assumption that the time-lapse static pressure trend of each of a group of wells within the same reservoir is an indicator of the degree of reservoir connectivity between these wells. The technique entails clustering of all time-lapse static pressure data from all the wells in the reservoir into groups of similar trend. Each group of wells with similar time-lapse pressure trend is termed a connected reservoir region (CRR). There are two possible causes of multiple CRR within a reservoir; (i) faults and (ii) permeability discontinuity. In cases where the identified CRR are not related to any interpreted faults, then those regions are incorporated into the geo-modeling workflow to serve as a guide in determining the boundaries of influence of the core and log data obtained from wells within each region. Permeability is distributed in such a way that, the occurrence of any large scale low permeability areas within a CRR is avoided during geo-modeling. The proposed methodology has the advantage of not creating artificial low permeability barriers between wells where none should exist. In a pilot test of a reservoir with notable dynamic heterogeneities, this new methodology of pressure conditioned geo-modeling contributed in building a geo-model that already captured most of the significant reservoir heterogeneities and hence saved up to 30% in history matching time.