On the conditioning of
process-based channelized meandering reservoir models on well data

by Anna Bubnova

Abstract

Process-based reservoir models are generated by the simulation of the main sedimentation processes in time. In particular, three-dimensional models of meandering channelized systems can be constructed from three main processes: migration of the channel, aggradation of the system and avulsions, as it is performed in Flumy software for fluvial environments. For an operational use, for instance flow simulation, these simulations need to be conditioned to available exploration data (well logging, seismic, …). The work presented here, largely based on previous developments, focuses on the conditioning of the Flumy model to well data.

Two main questions have been considered during this thesis. The major one concerns the reproduction of known data at well locations. This is currently done by a "dynamic conditioning" procedure which consists in adapting the model processes while the simulation is running. For instance, the deposition of sand at well locations is favored, when desired, by an adaptation of migration or avulsion processes. However, the way the processes are adapted may generate undesirable effects and could reduce the model realism. A thorough study has been conducted in order to identify and analyze undesirable impacts of the dynamic conditioning. Such impacts were observed to be present both at the location of wells and throughout the block model. Developments have been made in order to improve the existing algorithms.

The second question is related to the determination of the input model parameters, which should be consistent with the well data. A special tool is integrated in Flumy – the Non Expert User calculator (Nexus) – which permits to define the simulation parameters set from three key parameters: the sand proportion, the channel maximum depth and the sandbodies lateral extension. However, natural reservoirs often consist in several stratigraphic units with their own geological characteristics. The identification of such units within the studied domain is of prime importance before running a conditional simulation, with consistent parameters for each unit. A new method for determining optimal stratigraphic units from well data is proposed. It is based on the Hierarchical Geostatistical Clustering applied to the well global Vertical Proportion Curve (VPC). Stratigraphic units could be detected from synthetic and field data cases, even when the global well VPC was not visually representative.

Thesis key words:

Hierarchical Clustering, Geostatistics, Process-based models, reservoirs, conditional simulations