706394 A Consistent Geostatistical Approach for Constraining Multiple Surfaces to Horizontal Wells

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The robust use of horizontal well data in 3D stratigraphic horizon modeling is an important challenge. In many reservoir models there are inconsistencies between the zone log information observed in horizontal wells, and the horizons and zones of the 3D model.

The two main reasons for these inconsistencies are that:
1) Zone log information is not used directly in the modeling of the surfaces;
2) Well picks in deviated wells do not impact the modeling of adjacent surfaces.

Inconsistencies between the 3D model and the horizontal well data are typically resolved by time consuming, iterative manual editing of the stratigraphic horizons.

A robust, geostatistical approach for ensuring the correct modelling of multiple stacked stratigraphic surfaces constrained by long horizontal wells is presented. The approach has been developed to maintain 3D consistency between the stratigraphic surfaces and horizontal well data. The stratigraphic surfaces are treated simultaneously in 3D and universal or Bayesian cokriging is used for prediction of surface location based on a variety of constraints including: well picks; zone logs; isochores and seismic interval velocities.

In contrast to standard approaches, all well markers (picks) are treated simultaneously and will have impact on surfaces above and below. This ensures consistent use of all available well marker data for all surfaces.

Zone log constraints in long horizontal wells are handled by identifying the sections of the well paths that impose soft (inequality) constraints on the surfaces. The key sections of the horizontal wells are re-sampled at approximate grid resolution and used as help points in the kriging equations. Identifying the soft constrains and assigning correct value to the help points is the cornerstone of the method.

Velocity and isochore trends are used to ensure that overall shape of the structure and thickness variations are preserved. Uncertainty trends for velocities and isochores are used to allow flexibility in the relative weights assigned to the various input constraints.

Uncertainty in the resulting surfaces can be investigated by simulation (Monte Carlo) techniques or by inspecting the calculated prediction errors. In particular we find that the depth uncertainty on surfaces delimiting thin zones becomes very small close to horizontal wells.

The method is efficient and can handle tens of surfaces and hundreds of wells within minutes.

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