Advanced Structural and Stratigraphic Modeling Techniques in Shale and Tight Oil Basin Reservoir Studies

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ABSTRACT

The validity of the distribution of reservoir-quality facies in regional and basin-wide geomodels of unconventional and tight-oil plays depends on the accuracy and precision of the available structural and stratigraphic frameworks. Integrated reservoir models, combining seismic, log, core, and production data, are critical tools necessary for capturing the basin fill history and for predicting the 3D facies architecture.

For university researchers, the lack of publicly available 3D seismic surveys is an impediment to creating accurate models of faults and stratigraphic zones. Three approaches were used to overcome this deficit: (1) well log correlation of detailed stratigraphic zones for densely sampled vertical wells; (2) calculation of trend surfaces from thousands of geosteered 3D horizontal well position logs (used to correct local stratigraphic dip and strike characteristics); and (3) residual analysis of regional and local horizontal well trend surfaces to identify faults.

Independent data and identification methods were used to confirm the validity of these new surfaces and faults, including 3D seismic interpretations (where available), well log-based fault correlations, and analysis of seismicity. The resulting horizons were used to define the more accurate structure and stratigraphy used in the 3D geocellular models.

Examples of the approaches to refining geomodels are illustrated for the main North American unconventional reservoir and tight oil plays, including the Eagle Ford, Bakken, Barnett, Haynesville, Fayetteville, Marcellus, and the Midland and Delaware basins.

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