3-D Modeling of Sinusoidal Fluvial Channels in the Kern River Field

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Meandering channels of the same scale and sinusoidal period as the present day Kern River have been found in a 3-D resistivity/lithology grid near the K layer of the Kern River series sands in the Kern River oil field. On a gross scale, the nine sands that make up the Kern River series can be modeled as a shallow-dipping layer cake. However, on a finer scale the modeling of a meandering-streams depositional environment is complex at best. Visualization will be used to evaluate grid sensitivities to well-log generational changes, data quality, surface control, and modeling techniques.

The 100-plus-year-old Kern River field OOIP is estimated to be 3 billion barrels, with over 2 billion barrels produced to date. The reconfiguring of field patterns controlled by geobodies versus geopolitical surface configurations to recover as much as possible of the remaining reserves is what lead to the work being discussed.

Well logs from over 10,000 wells in Kern River oil field were assembled and interpolated to generate 3-D models of resistivity. The data-assembling process involves resolving the multitude of curve aliases, correcting for temperature effects, detecting bad well curves, detecting off-depth curves, etc.

Once this huge dataset of well resistivity was QCed and assembled, various interpolation techniques were applied to generate 3-D cubes of resistivity. Various permutations of gridding scheme (stratigraphic using best-fit marker surfaces, stratigraphic using constant-dipping flat surfaces, horizontal/ gravity), areal and vertical gridding resolution, interpolation techniques (kriging, inverse-distance, nearest-neighbor), and spatial correlation models (variograms with different correlation lengths) were applied on the same data to generate different 3-D models of resistivity. While all of these highly constrained models honor the same well data, we learned that the interaction between gridding scheme and interpolation technique could lead to visually different models and interpretations. Meandering channels having the same width as the present-day Kern River could be seen in some, but not all, of these 3-D models. Faults could also be seen through cross-sectional displays.

The dense well spacing in Kern River provides us with a rich quasi-exhaustive data set, which, in turn, offers a rare opportunity to study various interpolation techniques and the interplay between the interpolation parameters and the gridding parameters. The sheer size of this dataset also provides a good "stress test" for software and hardware platforms.