Spatial and Temporal Fault Analysis and Prospect Quality Evaluation Using Automated Interpretation and Solid Modeling Techniques

Laura Evins, Antony J. Marsh, Julio Gomez, Gladys Gonzalez, John Tyrrell, and Franco Spano

Paradigm, 820 Gessner St., Suite 400, Houston, TX 77024

ABSTRACT

Automatic fault extraction, 3-D horizon propagation, and solid model building are combined in a 3-D visualization environment to achieve early, unbiased understanding of the structural geology for an offshore Gulf of Mexico gas prospect. The process of autopicking faults presents a paradigm shift, as faults are treated as a system, rather than a set of individual faults that are generated by manual or semi-automatic fault picking methods.

Fault surface linkages and cross-cutting relationships are established early in the interpretation cycle in order to understand structural evolution of fault systems and how these may impact trap formation and hydrocarbon migration. Evaluation of fault processes are aided by using fault plane geometric attributes such as dip, azimuth, and Gaussian curvature on autopicked faults. The 3-D visualization environment provides an excellent means for collecting and integrating the spatial and temporal elements associated with autopicked faults.

Ancient and present day stress regimes are analyzed using fault azimuth, length, order of magnitude, and size to access possible sub-seismic fracturing.

3-D propagation of a top reservoir horizon and introduction of fluid contacts into a solid model allows probable fault closures to be analyzed and potential size determined, thereby allowing the interpreter to concentrate on the economically viable prospects. This approach can be applied in both quick-look reconnaissance workflows and more in-depth evaluation for field development. This could set the basis for further prospect evaluation studies incorporating fault seal analysis based on lithologic juxtaposition and fluid transmissivity properties.

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