Geophysical Ambiguity of Fault Interpretations on 3D Seismic Datasets

John Solum[1], Onyekachi Onyeagoro[2]
[1]Shell International E&P; [2]Shell E & P Inc.

9.29.2020 - 10.1.2020 – AAPG Annual Convention and Exhibition 2020, Online/Virtual

Abstract

The primary input for accurate prediction of the effects of faults on subsurface fluid flow is a seismically validated, geologically permissible fault interpretation. For example, if seismically-mappable fault relays are not included in an interpretation, then the results of any fault seal analyses derived from that interpretation will not be useful for either exploration or production activities. Ambiguity of fault interpretations can be caused by both an inherent “lack of clarity” in fault interpretation associated with limitations in seismic imaging (e.g., subsalt, steep dips), as well as interpretation errors (e.g., overcorrelation, picking non-structural features as faults). We quantified this ambiguity by evaluating the seismic expression of 5,391 faults interpreted on 39 3D seismic datasets from a variety of geological settings around the globe. Each fault was evaluated by generating a seismic cross section parallel to the dip direction of the fault and panning that section back and forth along the entire length of the fault in a 3D seismic interpretation package. Each fault was assigned a kinematic type (normal, reverse, strike-slip, transtensional, transpressional, or undefined/unclear) and an ambiguity ranking from 1 (very low ambiguity) to 5 (very high ambiguity), based on consistency of reflector offsets or deflections along each fault. One third of the interpretations contained a majority of faults ranked ambiguous to highly ambiguous, and almost two thirds of interpretations contained a significant number of ambiguous faults. Ambiguity due to interpretation error can be reduced through use of structural QA/QC techniques or even deep learning, but it is important to realize that business decisions are routinely made based on inherently ambiguous interpretations. The fault ranking methodology used in this study has three main uses: 1) to identify ambiguous fault interpretations that require extra validation to

ensure that they are geologically permissible; 2) is that traps defined by ambiguous faults should almost certainly have multiple structural scenarios to account for the existence of multiple geologically realistic fault interpretations; 3) is that fault ranking can help to decide which faults need to be explicitly included in a geocellular model, and which can be handled either as simulation faults or as modifications to a permeability property grid.