Integrated Chronostratigraphic Systems Applied to Conventional and Unconventional Asset Classes

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Abstract

The effectiveness of subsurface characterization depends on the accuracy in defining the time-equivalence among source, seal, and reservoir units across global basins and resource opportunities. The relative and absolute age of rock units in the subsurface are determined using chronostratigraphy, which integrates litho-, bio-, sequence-, and seismic stratigraphy. To enable a more robust and objective application of chronostratigraphy within E&P, we constructed standardized Integrated Chronostratigraphic System (ICS) workflows that utilize established tools for quantitative and probabilistic analysis of discrete, unique temporal events. We present two ICS workflows customized according to the level of resolution (regional or reservoir scale) and asset class (conventional, e.g., Gulf of Mexico Wilcox and unconventional, e.g., Permian Basin).The first technique, Ranking and Scaling (RASC), is a rapid sequencing technique that is appropriate for data rich areas in which numerous biostratigraphic and geochronologic events are shared among wells. RASC is model based and provides an average-position ordering of events with uncertainty metrics for each event. Constrained optimization (CONOP) is data driven using simulated annealing to determine the distance minimization of well tops from numerous wells through a series of correlation (optimization) trials. Thousands of simultaneous iterations are tested until an acceptable reproducible ordering of tops is established, which are then optimally repositioned within wells. Unlike RASC, CONOP is applicable in areas where there are limited sharing of events among wells. Common to both techniques is an indication of stratigraphic gaps, which can indicate sequence stratigraphically-meaningful surfaces. In our evaluation, RASC was well-

suited to the Wilcox because the dataset contained numerous wells (>20) that shared hundreds of events. CONOP performed better in the Permian Basin where there were thousands of wells, but with relatively few shared biostratigraphic events. RASC and CONOP both provide an objective test of correlation hypotheses, and guidance in modifying correlations, based on a composite of all relevant stratigraphic data. Additionally, the position and relative duration of unconformities become more readily apparent with these techniques.