Assisted Chronostratigraphic Multi-Well Correlation Using Facies, Distality and Depositional Slopes

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Abstract

Well-log interpretation and chronostratigraphic well correlation are essential steps in the basin and reservoir modeling, as they provide clues for the quantification of depositional history and flow units. At the sub-seismic scale (1 to 100 meters), correlations affect the layer geometry and the geobodies connectivity but are subject to many uncertainties because of lack of data at the relevant scale. To reduce these uncertainties, several interpretation and correlation steps may be necessary to obtain a model agreed upon by experts, but this process does not assess correlation uncertainties. To reduce correlation bias due to the interpreter and to help assessing stratigraphic uncertainties in a reproducible way, we propose a computer-assisted method which automatically generates possible well correlations based on facies interpretations and formal interpretation concepts.This method uses facies interpretations translated into a paleo-geographic variable infered from depositional environments (e.g. the position along a proximal-to-distal transect). Assuming that wells have a global distality due to their position with respect to the overall basin geometry during the considered stratigraphic interval, we can interpolate a three-dimensional surface constrained by well-markers and the local stratigraphic dip measurement acquired along wells. These surfaces represent relative paleo-topographic surfaces at a given depositional time. In first approximation, a large paleo-depth gradient should be observed along the sediment transport direction, and a smaller slope should exist along the depositional strike. Well correlations are computed using a correlation cost between all possible marker combinations aggregated by the Dynamic Time Warping algorithm. These correlation costs are based on

the shape of the relative paleo-topography. Additionally, proximal facies interpreted in a distal well cannot be associated with distal facies interpreted in a proximal well, and conversely distal facies interpreted in a distal well may be likely associated with a proximal facies interpreted in a proximal well. Along the depositional strike, the method tries to associate identical or close facies with respect to the distality. We apply the developed method to correlate North Sea Jurassic well cores where lagoon, wave-dominated deltaic and fluvial deposits have been identified. Results highlight well-sections where manual biostratigraphic correlations and generated consistent stratigraphic scenarios differ providing interpreters with a map of the most uncertain well sections.