Mapping Carbonate Karsts Using Morphological Filter

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Abstract

Carbonate rocks, such as limestone and dolomite, are great hydrocarbon source rocks and make half of the world's oil reserves. Moreover, these rocks are susceptible to dissolution by water or acidic fluid resulting in karst features. Such geological features are important due to their ability to introduce porosity and large-scale voids. Although the former can be hydrocarbon-bearing, the latter can introduce drilling hazards if not accounted for. However, characterization of these features from conventional seismic data is difficult. Therefore, detecting and segmenting karst features from seismic data is a challenging endeavor and crucial for any hydrocarbon play in carbonate reservoirs.

To address the challenge of detecting karst features from seismic surveys, a workflow combining coherence attribute and mathematical morphology is proposed. The workflow takes advantage of the geological properties of karst features such as the rapid change in lithology relative to the surrounding rocks in both the vertical and horizontal directions. This characteristic property renders karst features highly incoherent relative to other geological features which makes the aforementioned easily detectable by the coherence seismic attribute. Also, by utilizing mathematical morphological filtering, further segmentation for the karst features can be achieved to separate them from other incoherent features. The karst features are later directly overlaid on seismic data for visualization and evaluation.

The karst detection workflow helps geoscientists in accurately mapping carbonate dissolution karsts for hydrocarbon prospect generation and drilling risk assessment. This optimized workflow was applied on field data containing carbonate karst features. It was effective in highlighting these features. Furthermore, the optimization takes advantage of high performance computing in order to reduce runtime, which helps in the overall turnaround time for instantaneous 3D seismic interactive interpretation.