West Hackberry Salt Dome Mapping Refinement

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Abstract

The West Hackberry salt dome is a large structure located near West Hackberry, Louisiana. The dome contains storage caverns operated by three operators including the Department of Energy's Strategic Petroleum Reserve (SPR). The SPR owns 22 caverns at the West Hackberry site. To better understand the spatial relationships between the SPR storage caverns and the salt dome margin, a project to refine the structural mapping of the salt dome using available seismic data was undertaken in 2020. This refinement was concentrated on the northern margin of the dome as this is where the caverns are closest to the edge of salt. The seismic data, along with a limited amount of well control information, revealed that the northern margin of the dome has a complex geometry including multiple overhangs. Traditional two-dimensional mapping techniques are cumbersome and often fraught with error when applied to complex geometries with overhanging features. Although three-dimensional visualization provides the best method to examine these types of complex spatial relationships, it is challenging to actually interactively map features in three-dimensional space. To address this, a new workflow which closely couples two-dimensional and three-dimensional mapping was developed. This workflow provided for the real-time interaction between contour development in two-dimensional space, and the interactive inspection of the contours in three-dimensional space. This method allowed for a very robust QA/QC process, provided rapid map and model development, and was flexible enough to allow for rapid updates in the mapping data. The final contours closely adhered to the seismic interpretations and was consistent with the available well data. The contours were then used to create a full three-dimensional model of the salt dome. This model, in conjunction with cavern sonar data, was used to compute true three-dimensional distances from the salt margin to the cavern walls. This information was then used to compute the closest distance to the salt margin and to create geologic cross-sections showing this relationship. This information is required by the State of Louisiana to confirm caverns are a safe distance from the salt dome edge. The workflow developed for this project proved very successful in allowing for the rapid mapping of complex, overhanging geometries, and, provided a means to address the challenges faced when working remotely as a team.

Key words: Strategic Petroleum Reserves, Salt Domes, Seismic, Geology