

Improvements in Structural and Reservoir Modeling for Future Optimal Utilization of the Honor Rancho Gas Storage Field, California, USA

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The Honor Rancho gas storage field is located in the eastern portion of the Ventura basin, a highly deformed Tertiary-age marine basin within the Transverse Ranges of southern California. Formerly an oil field, the Southeast Area of the Honor Ranch field was converted to gas storage in the mid-1970s. Gas is stored mostly in upper Miocene sands of the lower Towsley Formation, a sequence of deep-water deposited turbidite sand and shale. Several hundred exploratory and development wells have been drilled in the Honor Rancho field, adjacent oil fields, and the surrounding area. These wells provide much of the subsurface data for structural mapping and three-dimensional (3-D) structural imaging of the field presented here. Surface mapping of the southwest-dipping Quaternary strata of the Saugus Formation also provides useful data for structural interpretation; however, the steep dips and other factors (such as surface noise) have prevented the acquisition of useful seismic reflection data. In lieu of useful seismic imaging, we have constructed a 3-D structural model of the gas storage field using Seismic MicroTechnology's Kingdom Suite for well log correlation and basic subsurface mapping.

The gas storage reservoir is trapped in the footwall of the Honor Rancho thrust that merges east with the San Gabriel fault. Migrating and stored hydrocarbons are sealed updip by a shale section juxtaposed by a normal fault, but the cause and exact location of lateral seal remains problematic. Southwest of the field is the synclinally deformed basin trough, where organic-rich shale of the Modelo Formation (upper Monterey Formation equivalent) provides a mature source for oil in the basin.

The Southeast Area of the Honor Rancho field was an initially undersaturated oil reservoir (no gas cap) that operated under solution-gas expansion with gravity drainage and a weak water drive. The proven area of the reservoir was 310 acres and the initial oil/water contact was at -9700 ft TVD. Cumulative oil production at Honor Rancho is now 19.6 MMB. A total of 108 MBO and 281MBW were produced in 2002 from the 7 oil wells completed in the storage zone, and the average GOR and water cut were 217 MCF/BBL and 72%, respectively. The original oil in place (OOIP) was estimated at 39 MMB. Data from the first 13 years of primary production was re-evaluated using the material balance and the parameter estimation features of Maraco's Ogmatt program to give an estimated OOIP of 60.5 MMB. The two estimates of OOIP give oil recovery factors of 50% (39.3 MMB) and 32% (60.5 MMB).

To understand the discrepancies between estimates of OOIP, a comprehensive reservoir study has been initiated using the new structural model and petrophysical data to generate a more detailed reservoir model. Data from more than 43 wells are being used: well logs, drilling histories, lithologic descriptions, micropaleontology reports, drill stem tests, pressure and production statistics, and core and sidewall samples. A geostatistical methodology is being utilized in a static reservoir model to integrate geological and petrophysical parameters. Integration of the reservoir and structural models will assist in evaluating any additional development potential. The results will be the input for a subsequent simulation model developed to evaluate and compare alternative operating policies in formulating an optimized depletion strategy.