Growth of Reserves in Large San Joaquin Basin Oil Fields During the 20th Century: Patterns, Causes, and Prospects for the Future

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Annual cumulative production and proved reserves data for 21 San Joaquin Basin giant (>100 million barrels) oil fields from 1942 to 2000, in combinationwith development histories, show that modest pre-1960s growth of reserves resulted from new pool discoveries, gas injection, and waterflooding. In the 1960s, introduction of thermal recovery caused abrupt and substantial additions to reserves in about a dozen fields with heavy oil; similar additions have continued to the present. During the 1980s, reserve additions began from fracturing of Monterey Formation diatomite on the west side of the basin. These additions have increased as production from diatomite replaces declining production from overlying steamflooded reservoirs.

Most of the nine fields in which growth has been minimal have efficient gravity drainage or water drives. Others were discovered recently enough to be developed with modern recovery techniques, so that initial evaluations of estimated ultimate recovery (EUR) were fairly accurate.

Current EURs in some reservoirs represent low recovery efficiencies, notably in low-permeability diatomites and in fields where stratigraphic complexity has hindered thermal recovery. Many fields, in contrast, have reached recoveries of 50 to 60% or more—mostly steamflooded reservoirs where very high recoveries are typical.

In the 21 fields studied, total EUR doubled between 1965 and 2000, from 7 to 14 billion barrels (BBO), almost entirely from increasing recovery efficiency as opposed to new pools or extensions. South Belridge grew by a factor of nine, and four others (Kern River, Midway-Sunset, Lost Hills, and Cymric) tripled in EUR. The average growth factor over this period was about two. Three fields (Midway-Sunset, Kern River, and South Belridge) grew by more than 1 BBO each. Although these high rates cannot be sustained indefinitely, opportunities for substantial growth remain: further exploitation of siliceous shales and diatomaceous rocks (including horizontal drilling), 3-D seismic coupled with directed drilling to target bypassed reserves, and possibly CO_2 flooding.