

Oil and Gas Investor

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Oil is king as producers and investors seek liquid gold.

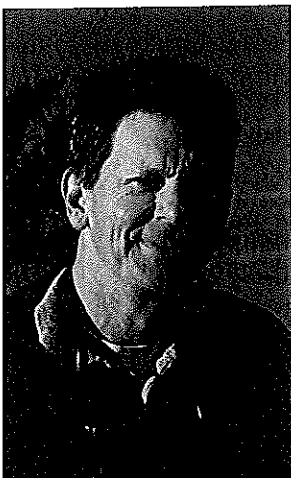
KING OIL

The disconnect in commodity prices has prompted gas devotees to seek oil exposure and long-time crude prospectors to bear down on their oily assets. Here are some paths being taken.

ARTICLE BY
LOUISE S. DURHAM

PHOTOGRAPHY BY
LOWELL GEORGIA

Venoco Inc. is focused on California's Monterey shale. Mike Wracher, vice president, Sacramento Basin & Exploration, says, "There's a lot of oil still trapped in that shale, and that's what we're going after."



Right, surface casing awaits use as Black Creek Drilling Rig #1 drills an injector well for Denbury Resources Inc. at its enhanced oil recovery operations in the West Hastings Unit, Texas. Facing page: Production tech Juan Buitron pulls a well file at Denbury's Hastings office.

Flexibility is key to surviving and prospering in the oil and gas industry. It used to be about supply and demand. Today, speculators and geopolitical events add a new layer of uncertainty. For anyone playing in this high-stakes business, staying on top of the game is essential.

Ironically, operators' success in drilling and producing shale gas is a major culprit in the current oversupply of natural gas, which has tamped down prices to a paltry \$3 to \$4-plus per thousand cubic feet, while crude oil prices keep rising. And as commodity prices diverged, operators began scrambling to stake claims in oil-rich deposits, either forsaking gas entirely or assembling a buffer for their gas programs.

In large part, shale remains uppermost in the minds of these operators—oil shale, that is, in plays like the Eagle Ford, Bakken and Niobrara, which apparently hold a treasure trove of oil. But operators are just as focused on opportunities elsewhere: California, the Permian Basin, enhanced oil recovery in older fields, and North Louisiana and Mississippi, to name just a few.

Monterey revisited

Environmentally correct California is rich in oil, with a long history of exploration and production that began in Los Angeles, of all places. According to Stephen Testa, executive officer of the State Mining and Geology Board of California, "Los Angeles was built on oil."

Surface oil seeps, such as the famous La Brea tar pit, are not unusual in this region. The Los Angeles City oilfield was discovered in 1892 by two prospectors visiting downtown Los Angeles who noticed a tar coating on the wheels of a cart. Upon being told where the tar originated, they rushed to evaluate the nearby area, ultimately drilling a 450-foot well using the sharpened end of a eucalyptus tree. Today, with crude prices soaring, excitement is swirling around the state's oil potential.

Almost all of the oil in California has been sourced by the Miocene-age Monterey shale, according to Mike Wracher, vice president of the Sacramento Basin & Exploration, with Denver-based Venoco Inc. To put this in perspective, the Monterey has sourced producing giants Kern River, Elk Hills, and Midway-Sun-

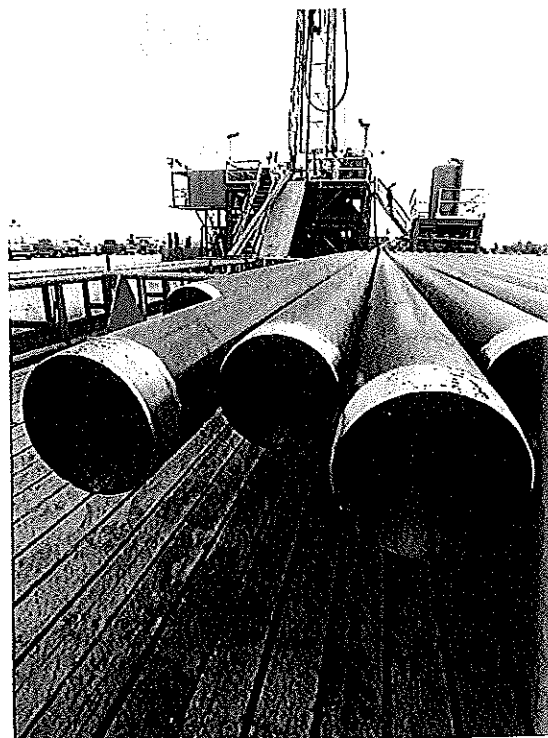
set fields, to name a few.

"About 38 billion barrels have been sourced to conventional fields, and the source rock itself can probably source 10 times that amount," Wracher says. "More than 17,000 wells have penetrated the Monterey, which is thought to contain as much as 300 billion barrels of oil in place."

The Monterey formation is a complex lithology—it's a shale, but not a shale, in the minds of some industry folks. It's a mix of rock types and is basically a large deposit of diatomaceous material. At one stage it's low-permeability, unaltered diatomite—the Opal A phase—and must be stimulated to recover oil.

As pressure and temperature increase with depth, the Monterey becomes more brittle and fractured as it alters into cristobalite tridymite, known as the Opal CT phase. It evolves into a quartz phase as lithification progresses. The formation produces from all three phases, and results can vary significantly among wells. The Monterey may contain sandstones, depending on the locale.

In a striking difference compared with other



shale plays under way that are typically associated with structures about 300 million years old, the Monterey is 5- to 17 million years old. There are large areas in the peak oil-generation window, so it's generating oil now. Some of the larger Monterey fields have been in geological existence for less than a million years. The region's subsurface has been highly twisted and broken from the huge amount of physically disturbing activity in this tectonically active part of the world. The good news: this tends to create a variety of hydrocarbon traps.

No matter the differing views regarding whether the Monterey is a shale or not, conventional or not, Venoco has sufficient experience to support its opinion. In addition to its onshore California Monterey shale activity, which kicked off in 2006 focusing on the Salinas Valley, San Joaquin and Santa Maria basins, the company has amassed considerable successes in this shale offshore.

"This is not a conventional play by any stretch of the imagination," Wracher emphasizes. "There's a lot of oil still trapped in that shale, and that's what we're going after."

"There are some conventional aspects like structural components, and that helps because those areas are more heavily fractured; but a lot of shale plays have structure," he says. "We're going after the deeper, more brittle, naturally fractured Opal CT and quartz phases, and most of our acreage is in the quartz phase, which is the most brittle and most naturally fractured."

"We picked our acreage in all the basins we're working based on our understanding of the natural fractures, and we're definitely focused on structural trends where the rock is more broken up."

Venoco has latched onto a lot of land in the process: more than 200,000 net acres total in the play and 46,000 acres held by production, with more leasing under way.

Wracher does note that there is production from sands within the Monterey, with distinct channel sands bounded by the shale. "In the old days, companies wouldn't venture outside the channels, but now they realize they can produce right out of the shale. These sands likely will provide conventional opportunities, adding to the upside for the play." Venoco expects to have additional geologic control to better place wells as a result of its ongoing 500-square-mile joint 3-D seismic shoot with Occidental Petroleum Corp., covering 320,000 acres in the San Joaquin Basin.

Venoco has drilled a number of vertical wells in the Monterey shale, but they are mainly "science" wells to cut cores for evaluation of rock properties of differing zones. Very little core has been cut through the formation away from the older established fields.

Horizontals are the order of the day for drilling the expected producers. The initial horizontal well in the San Joaquin Basin was a duster, but the company thinks there may be potential in the target zone in a different direc-

tion from the lateral leg, along with deeper potential on the acreage. In the Santa Maria Basin, the second horizontal well apparently drilled into a gas cap. Venoco plans to redrill the well, only deeper. The vertical section of the third well, in the same basin, reached total depth at 8,000 feet, and the 4,000-foot lateral was to be multifraced.

In the Salinas Valley, Venoco's fourth horizontal with a 2,100-foot lateral was "looking good" at total depth; management's longer-term expectation for an unstimulated lateral of this length, in this area, is for an initial potential of 154 barrels of oil equivalent per day. The company had spudded its fifth and sixth horizontals as of mid-March and had three rigs running in the play, with a fourth to be added.

Initially, Venoco anticipated large acid jobs would be the completion MO, but now plans to implement frac jobs in a number of wells, with the specific mix yet to be nailed down.

There's plenty of oil awaiting the drillbit, but getting there can be pricey.

"We estimate the average estimated ultimate recovery (EUR) for a Monterey shale well to be 400,000 barrels of oil equivalent, and we anticipate the average cost for a horizontal going forward could increase to the \$6-million-plus range," says Tim Ficker, chief financial officer.

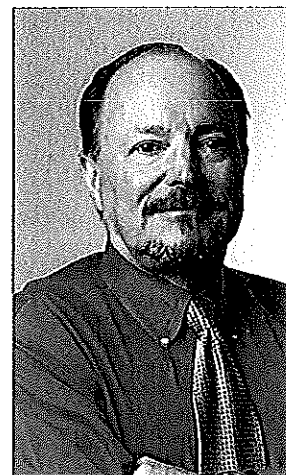
The company plans to drill 30 gross wells in the Monterey shale in 2011, including 22 horizontals. The capital budget dedicated to the play for 2011 currently stands at \$100 million, but that could increase to cover higher drilling and completion costs, according to Mike Edwards, vice president of corporate and investor relations.

Oxy often remains mum on its activities, but the company can't avoid a high-profile status in the California oil patch, where it's an industry leader with impressive fields to its credit. One of the best known is Elk Hills Field, where it's thought that the Monterey producing gross column is hundreds of feet thick. The company reportedly will drill 107 shale wells outside of Elk Hills Field during 2011. Other companies reported to have Monterey-prospective acreage include Zodiac Exploration, Gasco Energy, Plains Exploration & Production, Berry Petroleum and National Fuel Gas.

Long Beach

There's a whole other kind of oily play taking place in California's urban Long Beach area, where residents generally coexist peacefully with oil production. It's the old Long Beach Oilfield, dubbed Long Beach/Signal Hill Field by some of the locals. It qualifies as one of the giant fields in the U.S., having produced more than 1 billion barrels of oil to date from Pliocene and Miocene-age sandstones.

And it boasts the highest recovery per surface square foot of productive area of any field in the world, according to Dave Slater, executive vice



Dave Slater, executive vice president and chief operating officer of Signal Hill Petroleum Inc., notes that Long Beach Field is highly complex, "and in that complexity we know there's a lot of opportunity."

Facing page: Denbury's Gulf Coast manager Abel Salazar and Hastings production superintendent Tommy Browning check an injector well at the West Hastings Unit, where CO₂ enhanced oil recovery is under way. The company estimates some 60- to 90 million barrels of oil are recoverable at the field.

Signal Hill Petroleum Inc. is rejuvenating Long Beach Field. Here, a rig drills a 9,400-foot step-out in the densely populated area. The company has allocated \$25 million in spending for the field in 2011. Overleaf: Denbury's 24-inch, \$884-million Green Pipeline is delivering CO₂ to Hastings Field for injection.



PHOTO COURTESY SIGNAL HILL PETROLEUM

president and chief operating officer of Signal Hill, California-based Signal Hill Petroleum Inc. (SHPI). The company operates the majority of the field, where it currently produces 2,800 barrels of oil per day from 200 producing wells. There have been 2,800 wells drilled in the field, most of them abandoned. But Signal Hill is at work rejuvenating this field. The company has

allocated \$25 million for the field for 2011, including a current 3-D program.

Twenty percent of the field occurs in Long Beach, and 80% in Signal Hill, which is a two-square-mile community of 10,000 residents, surrounded by the 50-square-mile city of Long Beach and its half-million residents.

"In the 1920s, after the discovery of oil in

Long Beach Field, the city proposed an onerous oil tax," explains Slater. "The oil men got together and basically created their own city of Signal Hill and voted not to have an oil tax on themselves. Today, both cities have an oil tax."

The company estimates there are up to 3 billion barrels of original oil in place in the field, which bull's-eyes on Signal Hill, but modern seismic technology hasn't been applied there or to the Los Angeles Basin overall. Dense urban environments are not conducive to seismic surveys with their array of crew members, sprawling cables, noise and myriad other issues.

Recognizing both the need for seismic data and the challenges to its acquisition, SHPI did some serious homework on seismic equipment and zeroed in on a completely cable-free land nodal seismic-data-acquisition system developed by FairfieldNodal, of Sugar Land, Texas. Each of the small, lightweight nodes was buried in an eight-inch hole drilled into the ground, where they remained until time to be moved to a different survey area. Nodes were buried along the Long Beach Airport's taxiways and runways. In accord with California's often unique approach to challenges, a special-events permit was required and issued for the vibrator source trucks to move along the streets, like a slow parade.

The team tested an array of acquisition parameters while acquiring the 2-D seismic data. Today, they are acquiring data on a 22-mile 3-D node survey, which overlays about three-quarters of the city of Long Beach; it's scheduled for a June 2011 completion. SHPI has an economically successful well based on the 2-D data that was a re-drill to a step-out location. Since it began drilling in the field a couple of years ago, most of the wells have been re-drills at varying costs.

Long Beach Field has long been a candidate for modern 3-D interpretation. "The field sits along the Newport-Inglewood fault zone, which is one of the major fault systems cutting through the Los Angeles Basin," Slater says. "All of the folding, thrusting and faulting has created a highly complex field, and in that complexity we know there's a lot of opportunity."

"Two years ago, we started a drilling program and drilled the first new well in the field in 25 years. We've been successful in finding great oil saturations, but often in previously unmapped fault blocks. Long Beach Field is a massive reservoir with more than 10,000 vertical feet of productive section that's all chopped up. It's our conclusion there's been a tremendous amount of sourcing of the reservoirs vertically up the faults that filled everything up, and has resulted in such a high recovery per producing acre. We have wells and productive zones from 1,500 feet to 11,500 feet."

Signal Hill Petroleum is widely recognized for its neighbor-friendly approach, which has enabled it to forge ahead in this environmentally sensitive locale. The company owns and operates one drilling rig and four workover rigs

as well as most of the other equipment needed to drill and maintain its wells.

"All of the drilling we're doing is with our own rig, which runs only 12 hours a day and is shut down on Saturdays and Sundays," Slater says. "We have very compact and flexible rig-up options because we work on very tight locations, and we need to be extremely quiet and odor-free. Because of the proximity to the public, the nighttime shutdown is absolutely essential. One sure way to control noise is to turn everything off. Our unique drilling schedule is not very calendar efficient, but it's cost effective in drilling wells."

When queried about 2011 action, Devon Shay, manager of the reservoir management team at SHPI, says the company plans to re-drill 14 wells at varying depths and to bring six wells on that were previously idled. "The first part of this year, we are targeting underdeveloped and bypassed zones identified from conventional subsurface mapping," she says. "The second half of the year we plan to use 3-D data to develop drilling targets."

Permian power

When it comes to the potential to wrest more oil from older fields, no region holds quite the allure—or the mystique—of the giant Permian Basin in West Texas and southeastern New Mexico. Ninety years after the first commercial well was completed there in 1921, it is still known as the Big Daddy of crude oil reserves.

The basin encompasses a surface area that exceeds 86,000 square miles. It had produced a total of 30.4 billion barrels of oil through 2000, and it accounted for 17%, or 327 million barrels, of U.S. oil production as recently as 2002, primarily from geologic formations ranging in age from the Ordovician through Permian.

Waterfloods and CO₂ injection programs to improve recovery from the region's subsurface reservoirs have been commonplace for many years. As times change and technology advances, so does the potential recovery in most old fields. Today, the hot new targets in this gem of a basin are unconventional plays like the Bone Spring and Wolfberry—and even the Strawberry.

The Wolfberry gets its moniker from the commingling of oil from the long-producing Spraberry sandstone and the deeper packed-limestone Wolfcamp formation.

The newer, so-called Strawberry is a combo of the Spraberry and Strawn, which occurs directly above yet another deeper drilling target, the lowermost Pennsylvanian Atoka formation.

The long-productive Spraberry, often called Spraberry-Dean to include the underlying Dean sandstone, is a tight sand overall with isolated sandstone lenses that are conventional pay zones. Spraberry Trend Field was discovered in 1949, and Pioneer Natural Resources Co., Concho Resources Inc. and SM Energy Co., among

"One of the exciting things about the Spraberry is that people have been drilling deeper and deeper over the last two to five years." Scott Sheffield, Pioneer Natural Resources Co.