

## National Assessment of Oil and Gas Fact Sheet

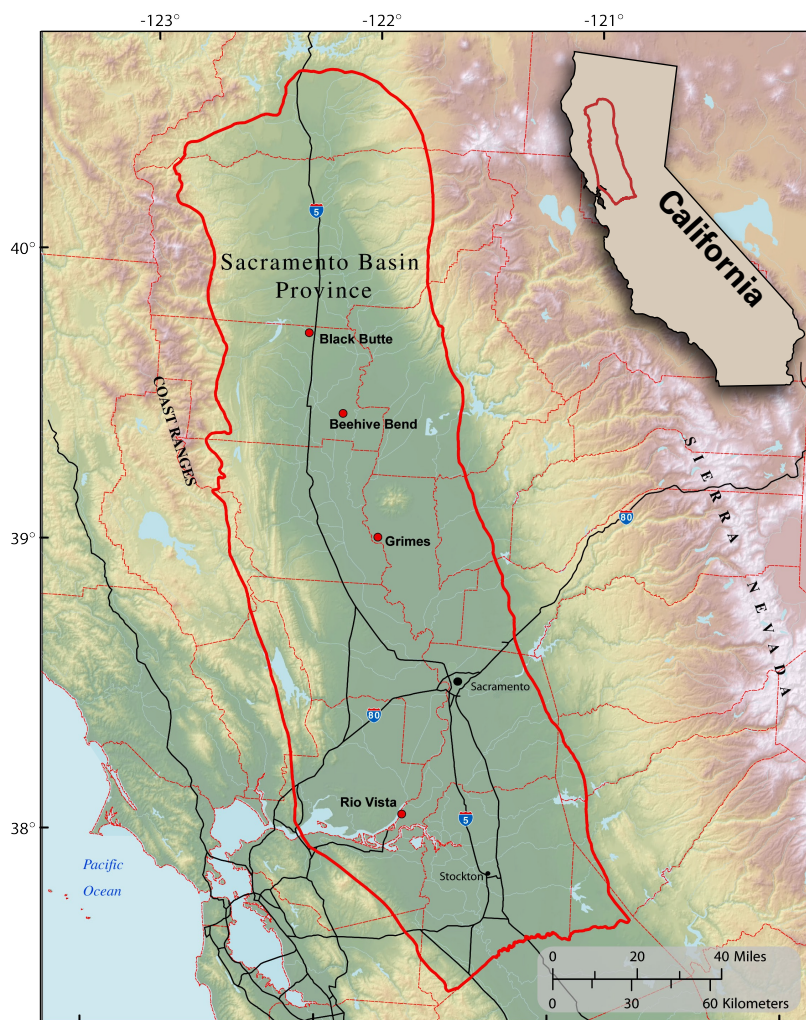
# Assessment of Undiscovered Natural Gas Resources of the Sacramento Basin Province of California, 2006

**T**he U.S. Geological Survey (USGS) recently completed a new assessment of undiscovered natural gas resources of the Sacramento Basin Province of California. Using a geology-based assessment methodology, the USGS mean estimates of undiscovered, technically recoverable resources are 534 billion cubic feet of natural gas and 323 thousand barrels of natural gas liquids in the Sacramento Basin Province. Additional undiscovered oil accumulations larger than 0.5 million barrels are considered unlikely.

### Introduction

The Sacramento Basin forms the northern half of California's Central Valley. It is an elongate, northwest-trending structural trough filled with more than 20,000 feet of Early Cretaceous (~145 to 100 million years old) and younger marine and nonmarine sedimentary rocks. The Sacramento Basin oil and gas province has been extensively explored for petroleum resources, and more than 9 trillion cubic feet of natural gas have so far been produced.

Recently, U.S. Geological Survey (USGS) scientists finished an assessment of the undiscovered natural gas potential of the Sacramento Basin Province. (The southern half of the Central Valley, the San Joaquin Basin, a prolific oil province, was assessed in 2003.) Their assessment of the Sacramento Basin indicates the probable existence of some still undiscovered, technically recoverable natural gas resources—in other words, those resources that can be discovered, developed, and produced by using current technology. The assessment is based on the geologic elements used to define a Total Petroleum System (TPS), including hydrocar-

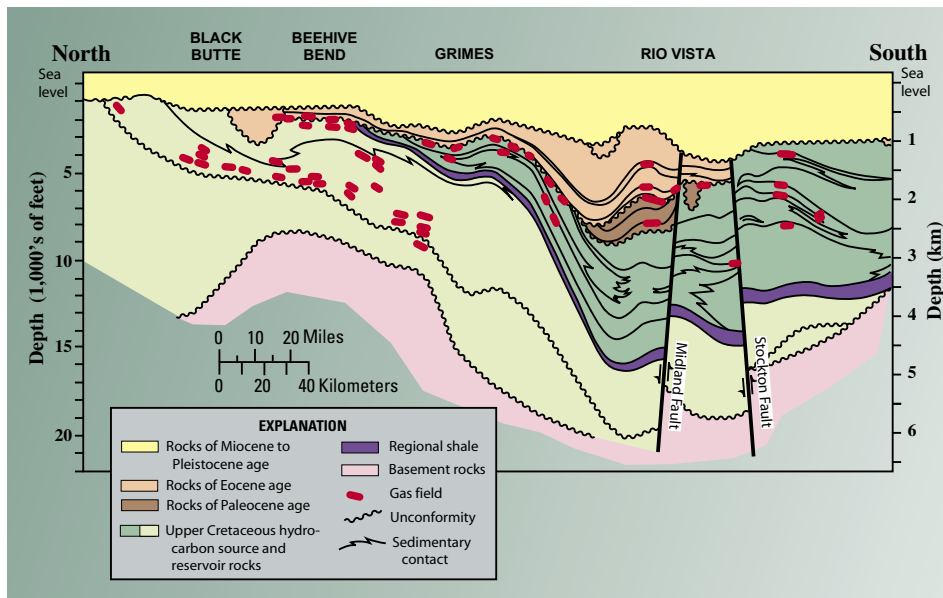


*The Sacramento Basin oil and gas province (heavy red line) covers an area of nearly 12,000 square miles and forms the northern part of California's Central Valley. The province is bordered on the west by the Coast Ranges, on the north by the Klamath Mountains, on the east by the Sierra Nevada, and arbitrarily on the south by the Stanislaus-San Joaquin County line (thin red lines show county boundaries).*

bon source rocks (source-rock type and maturation and hydrocarbon generation and migration), reservoir rocks (sequence stratigraphy and petrophysical properties), and hydrocarbon traps (trap formation and timing). In the Sacramento Basin Province, the USGS defined two TPSs—the Dobbins-Forbes TPS and the Winters-Domengine TPS—and four assessment units, two in each petroleum system.

### Resource Summary

The USGS assessment strategy provides estimates of the volumes of undiscovered petroleum (mainly oil, natural gas, and natural gas liquids) that are technically recoverable. For the Sacramento Basin Province, the USGS estimates that total undiscovered natural gas resources range between 139 and 1,067 billion cubic feet (BCF; 95% and



*Schematic geologic cross section illustrating distribution of hydrocarbon source and reservoir rocks with depth in the Sacramento Basin. The mean estimate of undiscovered, technically recoverable natural gas resources in the basin is 534 billion cubic feet, and more than 80% of this is contained in Upper Cretaceous rocks. The regional shale (purple shading) separates the two total petroleum systems (TPS)—the Dobbins-Forbes TPS is below the shale and the Winters-Domengine TPS is above. Labeled localities appear on the map on page 1. Locations and depths of known gas fields in the Sacramento Basin are shown schematically. Stratigraphy is modified from a figure originally published in an article by Morrison and others in American Association of Petroleum Geologists Memoir 15 (1971).*

5% probabilities of greater than these amounts, respectively), with a mean estimate of 534 BCF. Of this mean natural gas estimate, 40%, or 211 BCF, is expected in the Dobbins-Forbes TPS. Nearly all of that amount (176 BCF) is anticipated to come from Upper Cretaceous (~100 to 65 million years old) submarine-fan and deltaic-sand reservoirs of the Forbes-Kione and Older Assessment Unit (AU); a minor amount (35 BCF) is estimated to exist in Cenozoic (~65 million years old to present) reservoirs of the Lower Princeton Canyon Fill and Northern Nonmarine Rocks AU. Nearly two-thirds of the estimated undiscovered natural gas resources in the province (323 BCF) is expected in the Winters-Domengine TPS. This TPS is subdivided into the Late Cretaceous Deltaic and Submarine Fan AU, with an estimated undiscovered

261 BCF of natural gas, and the Shallow Marine Sands and Canyon Fill AU, with an estimated undiscovered 62 BCF of gas in Cenozoic reservoirs.

In addition to the natural gas resources already discussed, the discovery of further petroleum resources of significant size in the Sacramento Basin Province is improbable. Natural gas liquids account for just 323 thousand barrels (mean estimate). Few minor oil accumulations have been found in the Sacramento Basin, and additional undiscovered accumulations larger than 0.5 million barrels are considered unlikely. The possible presence of a continuous, basin-centered gas accumulation in the Dobbins-Forbes TPS was considered, because of its numerous overpressured reservoirs. These reservoirs, however, exhibit few of the characteristics of a basin-centered

accumulation, and therefore such an accumulation is very unlikely, at least at currently drilled depths.

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**For Further Information**

Supporting documentation of the total petroleum systems, assessment unit descriptions, and the methodology used in the Sacramento Basin Province assessment is in preparation. Assessment results are available at the USGS Energy Resources Program Web site,  
<http://energy.cr.usgs.gov/oilgas/noga/>  
or contact

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This Fact Sheet and any updates to it are available online at  
<http://pubs.usgs.gov/fs/2007/3014/>

**Sacramento Basin Province assessment results.**

[MMBO, million barrels of oil; BCFG, billion cubic feet of gas; MBNGL, thousand barrels of natural gas liquids. Results shown are fully risked estimates. For gas fields, all liquids are included under the NGL (natural gas liquids) category. F95 denotes a 95-percent chance of at least the amount tabulated. Other fractiles are defined similarly. Fractiles are additive, assuming perfect positive correlation. TPS, Total Petroleum System; AU, Assessment Unit. Gray shading indicates not applicable]

Total Petroleum Systems (TPS) and Assessment Units (AU)	Field type	Total undiscovered resources											
		Oil (MMBO)				Gas (BCFG)				NGL (MBNGL)			
		F95	F50	F5	Mean	F95	F50	F5	Mean	F95	F50	F5	Mean
<b>Dobbins-Forbes TPS</b>													
Forbes-Kione and Older AU	Oil	0	0	0	0	0	0	0	0	0	0	0	0
	Gas					46	161	353	176	0	0	0	0
Lower Princeton Canyon Fill and Northern Nonmarine Rocks AU	Oil	0	0	0	0	0	0	0	0	0	0	0	0
	Gas					11	32	67	35	0	0	0	0
<b>Winters-Domengine TPS</b>													
Late Cretaceous Deltaic and Submarine Fan AU	Oil	0	0	0	0	0	0	0	0	0	0	0	0
	Gas					68	242	509	261	43	221	611	261
Shallow Marine Sands and Canyon Fill AU	Oil	0	0	0	0	0	0	0	0	0	0	0	0
	Gas					14	53	138	62	9	48	159	62
<b>Total Undiscovered Oil and Gas Resources</b>		<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>139</b>	<b>488</b>	<b>1,067</b>	<b>534</b>	<b>52</b>	<b>269</b>	<b>770</b>	<b>323</b>