Forgone Oil in the Los Angeles Basin: Assessment of Remaining Petroleum in Giant Fields of Southern California*

Donald L. Gautier[1], M. E. Tennyson[1], R. R. Charpentier[1], Troy A. Cook[1], and Timothy R. Klett[1]

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[1]U.S. Geological Survey, Menlo Park, CA (gautier@usgs.gov)

Abstract

Using a probabilistic methodology that considers estimated original oil in place, recovery efficiency, and extent of application of available production technologies, the U.S. Geological Survey recently assessed remaining recoverable oil in major fields of the Los Angeles Basin. The L.A. Basin provides a textbook example of the effects of competing land use and conflicting community priorities on petroleum production. During much of the twentieth century, discovery and development of the L.A. oil fields went hand in hand with rapid and unrestricted urbanization, which impacted field development from the first day of drilling. In spite of one of the world's greatest concentrations of oil per unit area and famously high local demand for refined petroleum, recovery efficiency in the major fields remains low, and basin-wide production continues to fall. Most small- to medium-size fields have already been abandoned, in many cases covered by residential or commercial development while still on primary production. Recovery of oil from major fields has also been increasingly restricted, as community standards have changed. For example, along the Wilmington Anticline and Newport-Inglewood Fault Zone, where at least six fields have estimated OOIP volumes in excess of 1 billion barrels and have been on production for about 90 years, most fields are widely viewed as nearly depleted. However, with average recovery of less than 28% of OOIP, in almost any setting other than urban southern California, recovery in such major fields could reasonably be expected to reach at least 40 to 50%. The USGS assessment suggests the most likely case, given an overriding need for oil and disregarding economic factors, is that volumes well in excess of one billion barrels of oil could be recovered from existing fields through widespread application of current best practice industry technology such as improved imaging, advanced directional drilling, and steam and carbon dioxide floods

Selected Reference

Wright, T.L., 1991, Structural geology and tectonic evolution of the Los Angeles Basin, California, *in* K.T. Biddle (ed.), Active Margin Basins: AAPG Memoir 52, p. 35-134.

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Forgone Oil in the L.A. Basin

Assessment of Remaining Petroleum in Giant Fields of Southern California

Donald L. Gautier, M. E. Tennyson

R.R. Charpentier, T.A. Cook and T.R. Klett

Long Beach 25 April 2012

U.S. Department of the Interior
U.S. Geological Survey

Topics of This Presentation

- Oil and urbanization in the Los Angeles basin
- Methodology for assessment of remaining oil
- Example from Long Beach oil field
- Assessment results
- Conclusions

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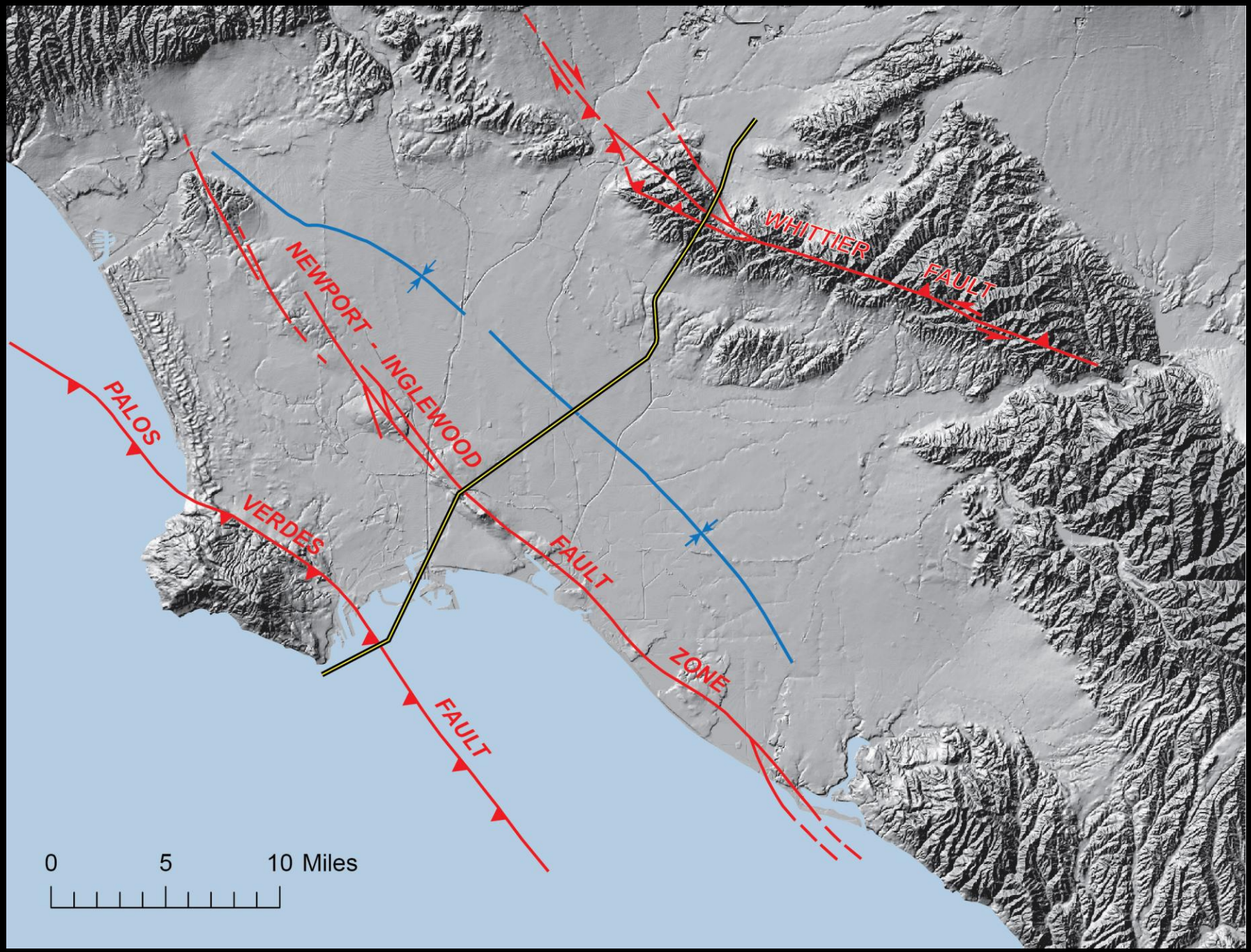
WHITTIER
FAULT
NEWPORT - INGLEWOOD
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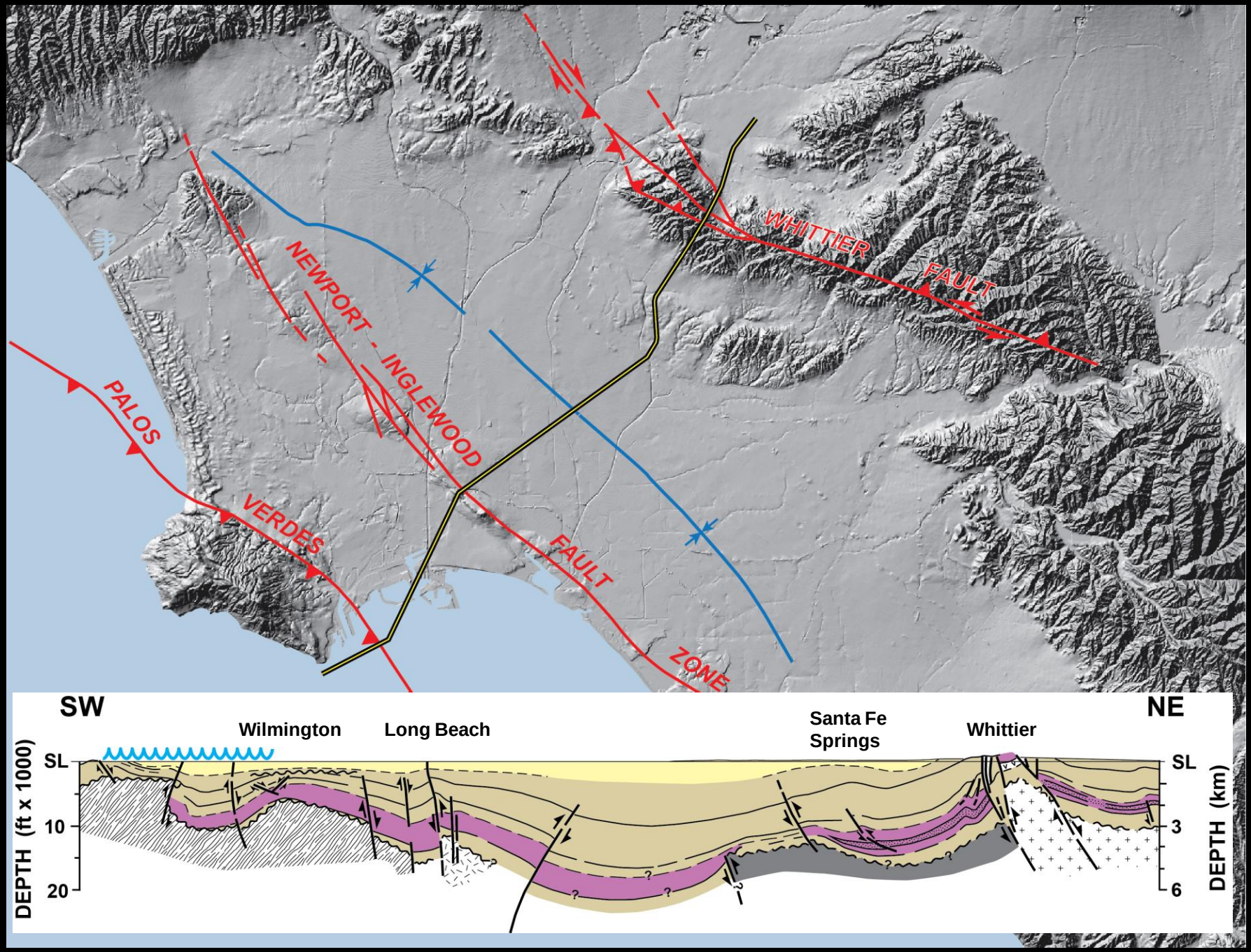
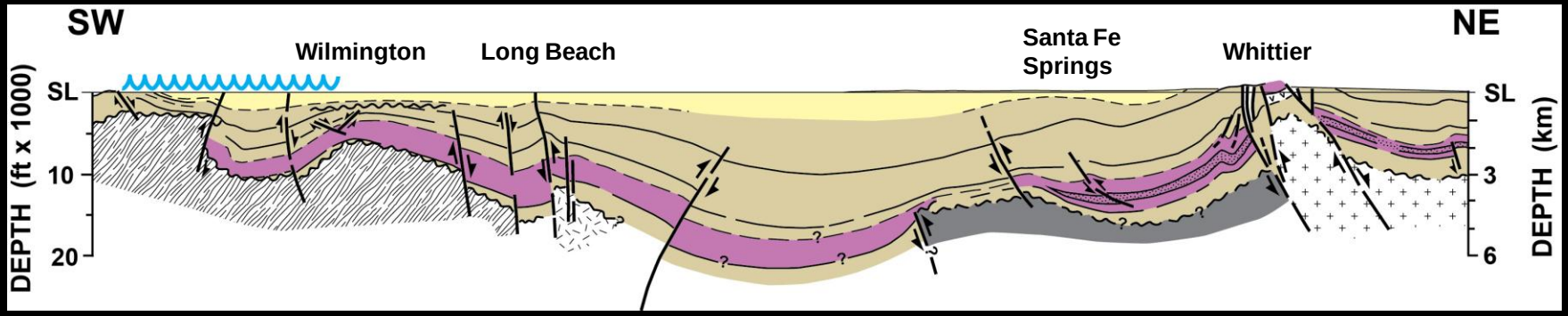
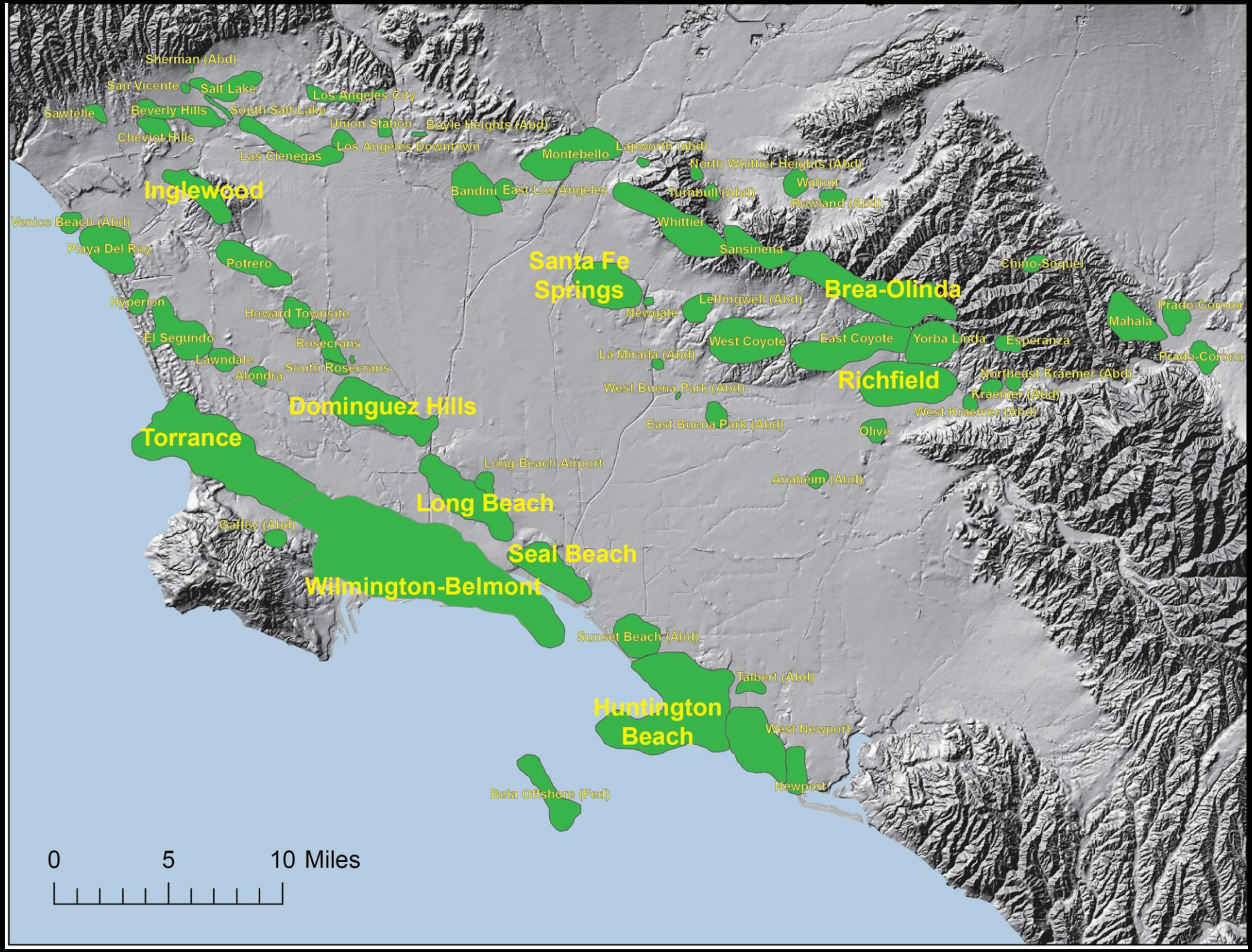

WHITTIER
FAULT
NEWPORT - INGLEWOOD
PALOS
VERDES
FAULT
ZONE
SW
NE
Wilmington
Long Beach
Santa Fe
Springs
Whittier
SL
10
20
DEPTH (ft x 1000)
SL
3
6
DEPTH (km)

Los Angeles Basin Petroleum System

- Prolific Miocene source rock
- Active petroleum system; ideal timing
- Submarine fan and slope channel reservoirs
- Largest traps are faulted anticlines
- World's highest known oil/sediment ratio



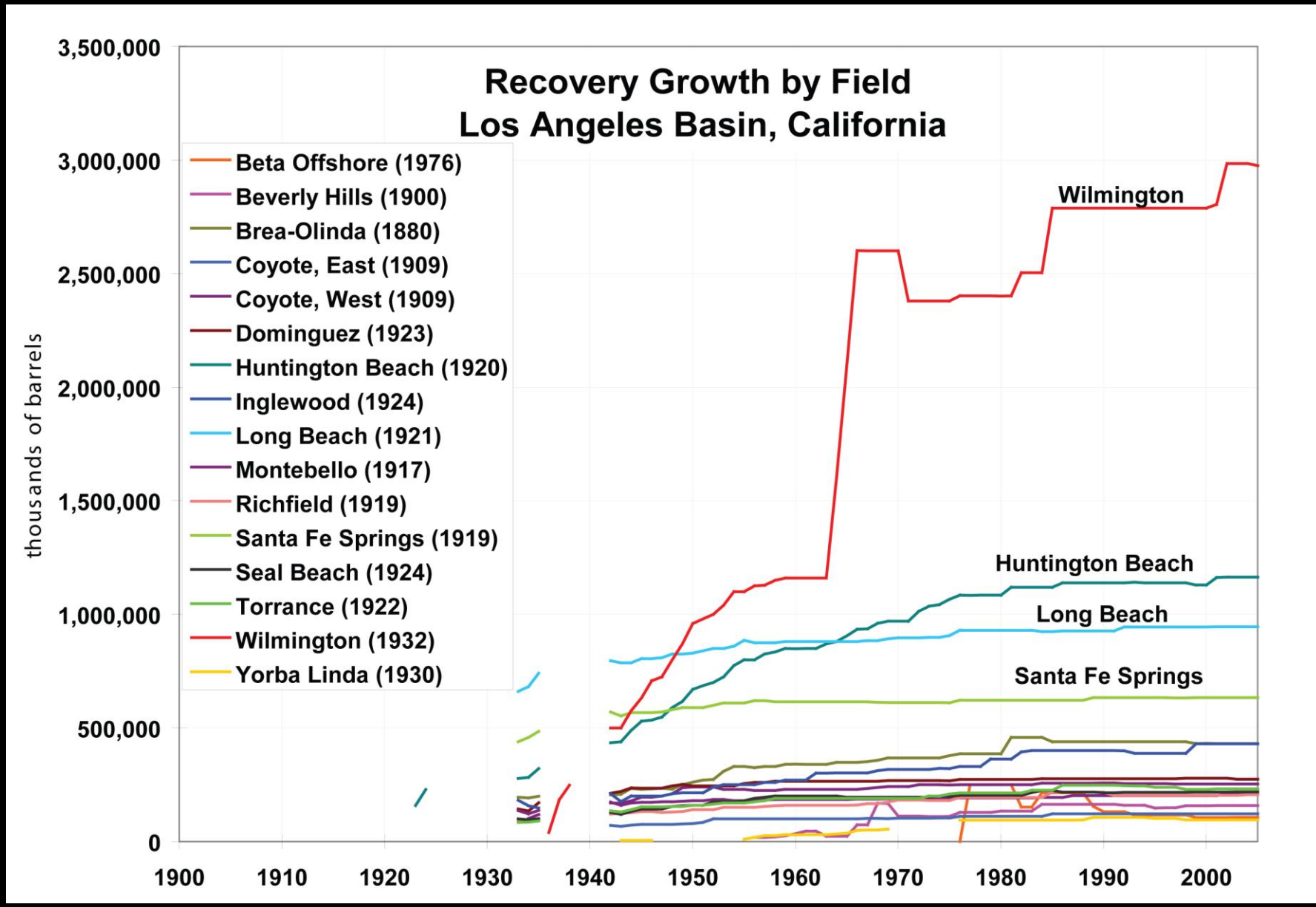

Sherman (Abd)
San Vicente
Salt Lake
Los Angeles City
Sawtelle
Beverly Hills
South Salt Lake
Union Station
Boyle Heights (Abd)
Cheviot Hills
Las Cienegas
Los Angeles Downtown
Montebello
Lapworth (Abd)
North Whittier Heights (Abd)
Walnut
Inglewood
Bandini
East Los Angeles
Turnbull (Abd)
Rowland (Abd)
Venice Beach (Abd)
Whittier
Playa Del Rey
Sansinena
Potrero
Santa Fe Springs
Chino-Soquel
Brea-Olinda
Hyperion
Howard Townsite
Leffingwell (Abd)
Newgate
Prado-Corona
Mahala
El Segundo
Rosecrans
West Coyote
East Coyote
Yorba Linda
Esperanza
Lawndale
La Mirada (Abd)
Alondra
South Rosecrans
Northeast Kraemer (Abd)
Richfield
West Buena Park (Abd)
Kraemer (Abd)
Dominguez Hills
West Kraemer (Abd)
Torrance
East Buena Park (Abd)
Olive
Long Beach Airport
Anaheim (Abd)
Long Beach
Gaffey (Abd)
Seal Beach
Wilmington-Belmont
Sunset Beach (Abd)
Talbert (Abd)
Huntington Beach
West Newport
Newport
Beta Offshore (Fed)
0
5
10 Miles

Oil and Urbanization

- The fields and the city developed together
- Conflicts from day one
- Now ~ 18 million people live in the L.A. basin
- Many smaller fields have been abandoned; production continues to fall
- Estimated recovery efficiency 21% – 34%

Long Beach Historical Society

USGS



Tennyson 2006

How Much Recoverable Oil Remains in the Los Angeles Basin?

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Methodology

- Select fields for analysis
- Review geology and engineering literature
- Compile development history
- Estimate distributions of OOIP and RE_{max}
- Run Monte Carlo simulation
  - Sample OOIP and RE distributions
  - Calculate remaining recoverable oil
  - Repeat 20,000 times

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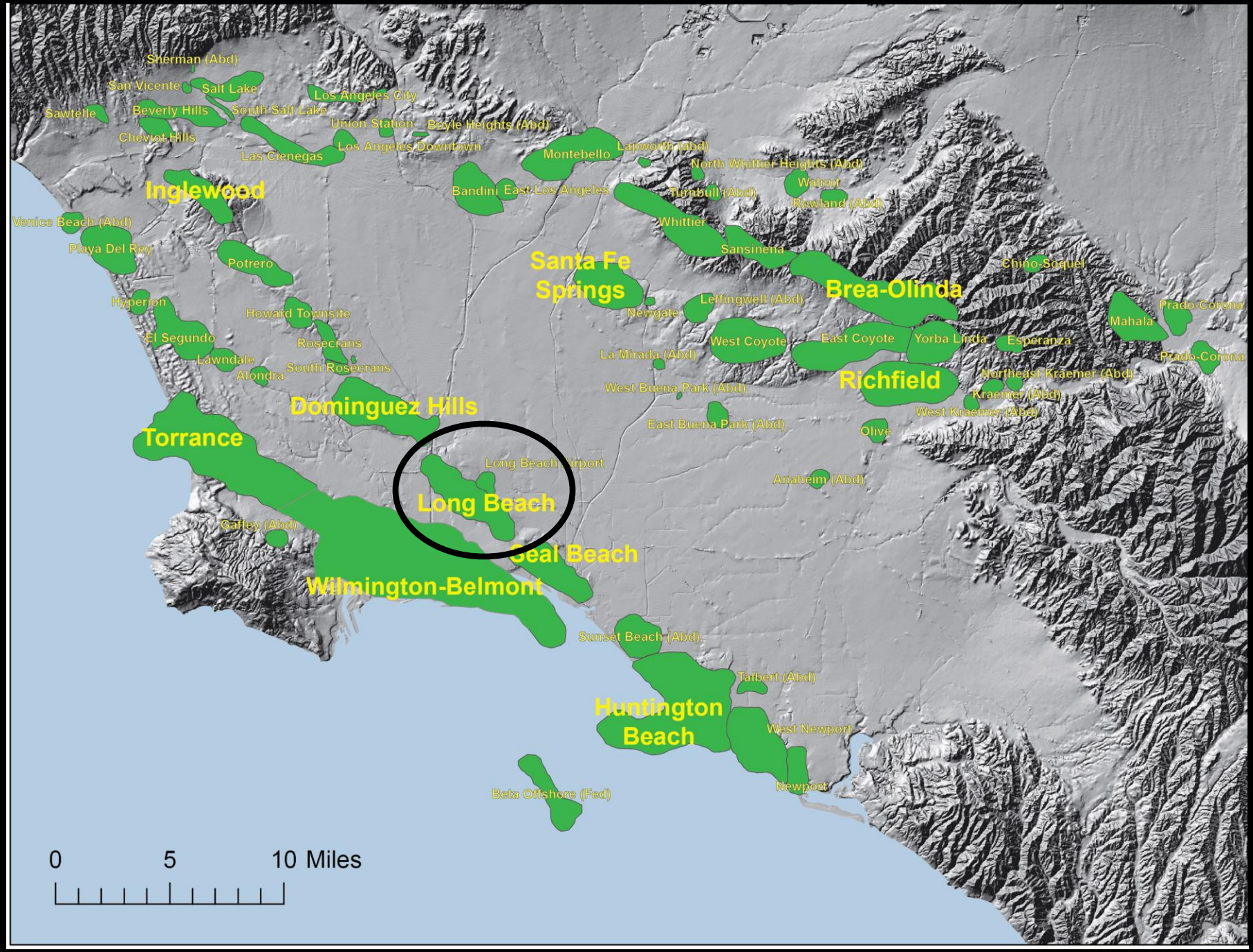
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Rowland (Abd)
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Potrero
Santa Fe Springs
Chino-Soquel
Brea-Olinda
Hyperion
Howard Townsite
Leffingwell (Abd)
Newgate
Prado-Corona
Mahala
El Segundo
Rosecrans
West Coyote
East Coyote
Yorba Linda
Esperanza
La Mirada (Abd)
Lawndale
Alondra
South Rosecrans
Prado-Corona
Northeast Kraemer (Abd)
Richfield
West Buena Park (Abd)
Kraemer (Abd)
Dominguez Hills
West Kraemer (Abd)
East Buena Park (Abd)
Olive
Torrance
Long Beach Airport
Anaheim (Abd)
Long Beach
Gaffey (Abd)
Seal Beach
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Huntington Beach
West Newport
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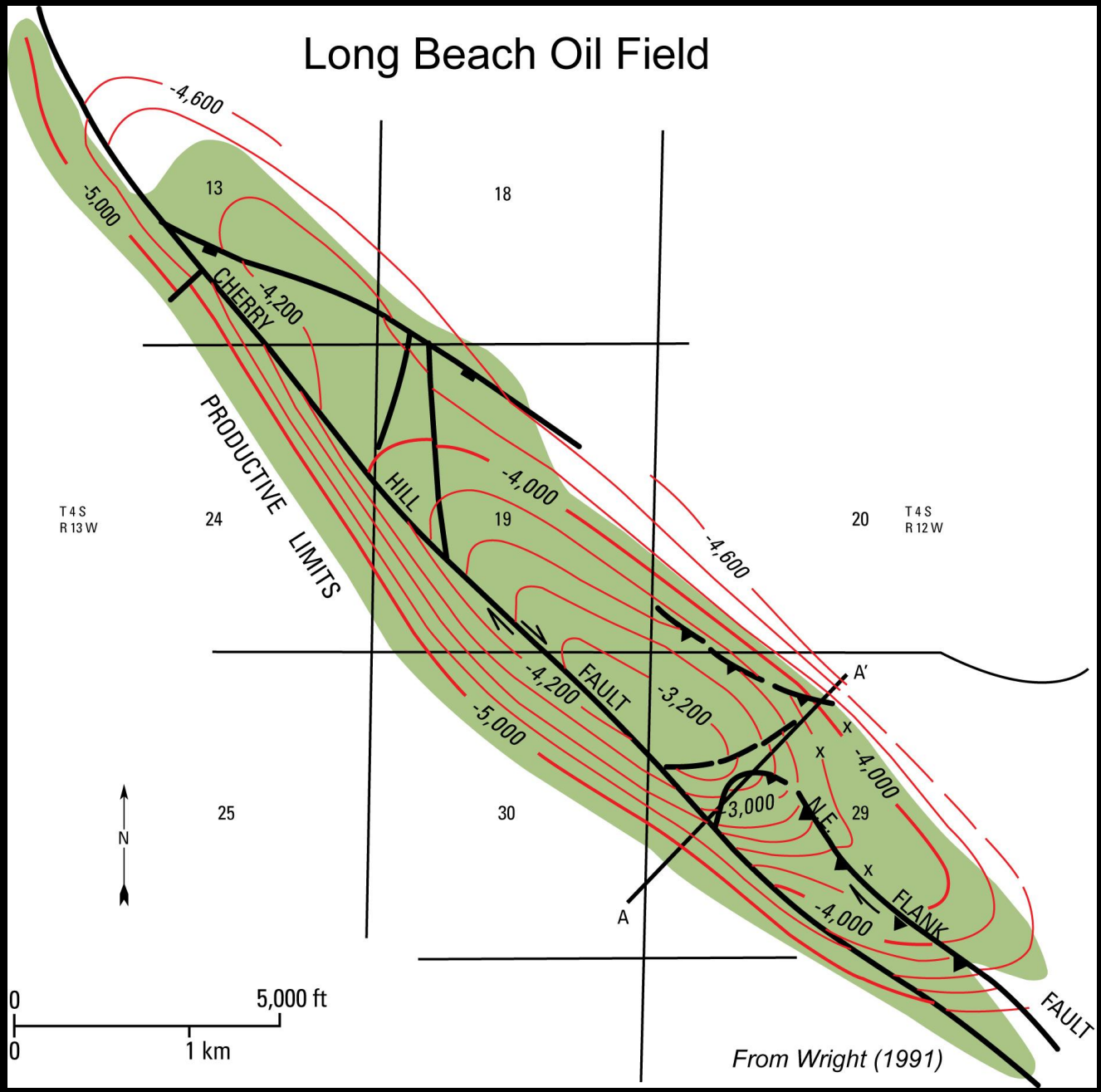
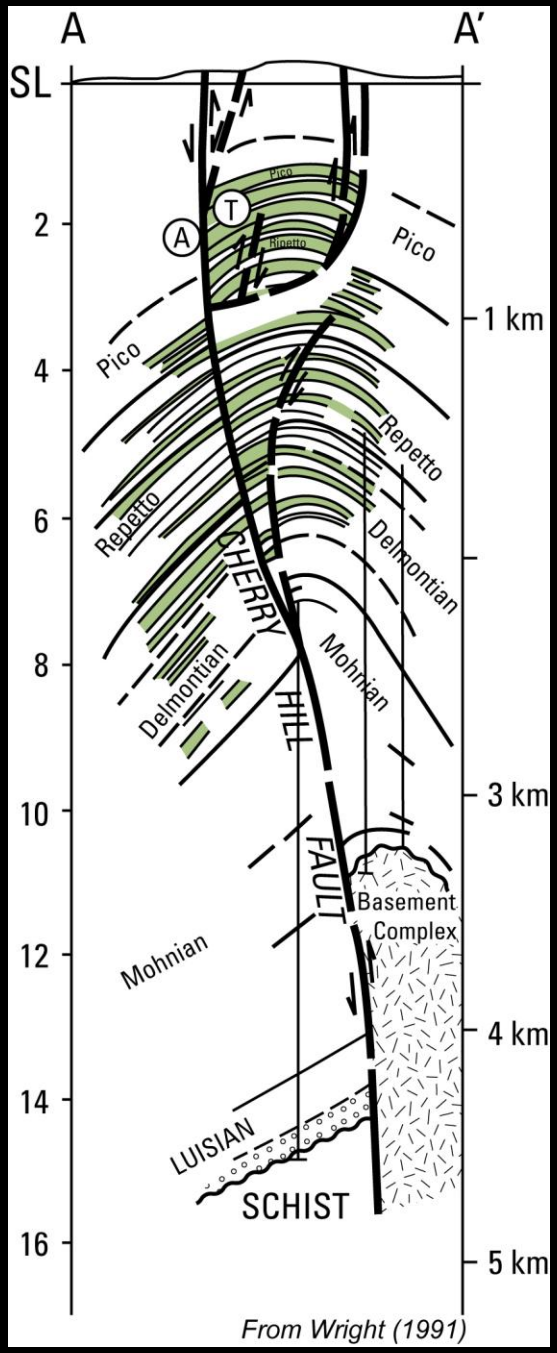
Beta Offshore (Fed)
0
5
10 Miles


Long Beach Oil Field
-4,600
-5,000
13
18
CHERRY
-4,200
PRODUCTIVE LIMITS
HILL
-4,000
T 4 S
R 13 W
24
19
20
T 4 S
R 12 W
-4,600
-4,200
FAULT
-3,200
-5,000
A'
X
X
-4,000
N
25
30
3,000
N.E.
29
X
FLANK
A
-4,000
FAULT
0
5,000 ft
0
1 km
From Wright (1991)

Signal Hill ca. 1923
Long Beach Oil Field



Long Beach Oil Field

- Miocene-sourced ° API 21-32 oil
- U. Miocene/Pliocene sandstones
- 28 reservoirs; net pay ~ 3000’
- OOIP: 3 to 3.6 BB
- Area: 1725 acres ~ 1.8 MMB/acre
- Solution gas/pressure depletion
- Peak production: 1923 (68MMB)
- EUR: 946 MMB; RE 26-32 %
- Water floods in main reservoirs

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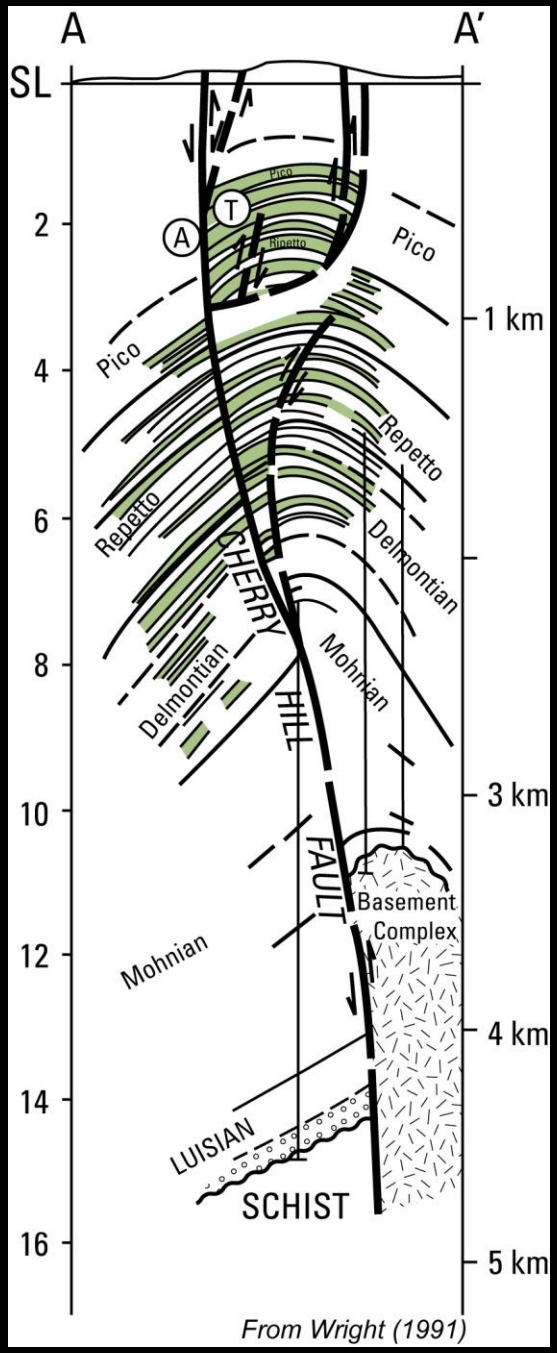

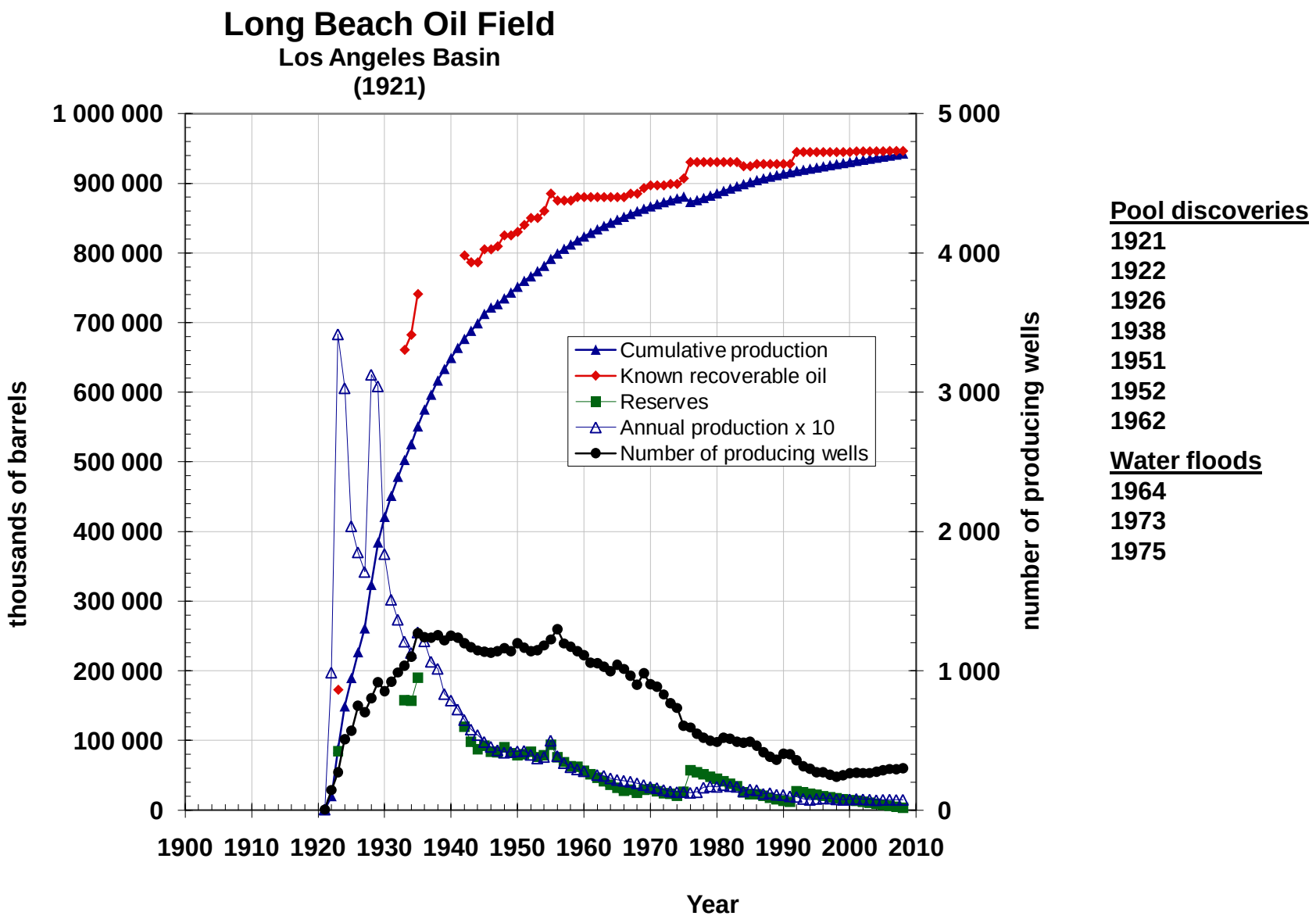
Long Beach Oil Field
Los Angeles Basin
(1921)
thousands of barrels
number of producing wells
Year
1 000 000
900 000
800 000
700 000
600 000
500 000
400 000
300 000
200 000
100 000
0
5 000
4 000
3 000
2 000
1 000
0
1900 1910 1920 1930 1940 1950 1960 1970 1980 1990 2000 2010
Cumulative production
Known recoverable oil
Reserves
Annual production x 10
Number of producing wells
Pool discoveries
1921
1922
1926
1938
1951
1952
1962
Water floods
1964
1973
1975

Assessment of Recoverable Oil in Long Beach Field

▪ OOIP (MMBO)	3000	3100	3600

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Assessment of Recoverable Oil in Long Beach Field

OOIP (MMBO)	3000	3100	3600
Estimated RE_{max}	.35	.40	.55

USGS

Assessment of Recoverable Oil in Long Beach Field

OOIP (MMBO)	3000	3100	3600
Estimated RE_{max}	.35	.40	.55
	F95	F50	F05
Recoverable oil	208	392	664

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Assessed Oil Fields

- Brea–Olinda (1880)
- Dominguez Hills (1923)
- Huntington Beach (1920)
- Inglewood (1924)
- Long Beach (1921)
- Richfield (1919)
- Santa Fe Springs (1919)
- Seal Beach (1924)
- Torrance (1922)
- Wilmington – Belmont (1932)

USGS

Assessment of Ten Oil Fields

	OOIP BB	EUR BB	% RE	% RE_{max}	Remaining BB
Brea-Olinda	1.2 – 2.4	0.431	18 - 36	35 - 45	.081 - .407
Dominguez Hills	1.0 – 1.45	0.274	19 - 27	35 - 50	.146 - .321
Huntington Beach	3.25 – 6.0	1.164	19 - 36	35 - 55	.117 - .866
Inglewood	1.0 – 2.5	0.430	17 - 43	40 - 55	.067 - .520
Long Beach	3.0 – 3.6	0.946	26 - 32	35 - 55	.208 - .664
Richfield	0.8 – 2.4	0.206	09 - 26	26 - 45	.048 - .357
Santa Fe Springs	2.1 – 2.7	0.634	23 - 30	30 - 40	.097 - .308
Seal Beach	0.85 – 1.0	0.221	22 - 26	35 - 50	.110 - .210
Torrance	0.9 – 2.0	0.232	12 - 26	35 - 55	.128 - .394
Wilmington-Belmont	7.6 – 12.0	2.984	25 - 39	35 - 55	.200 - 1.948

More Than Three (1.4 – 5.6) Billion Barrels of Recoverable Oil Remain in Ten Fields of the Los Angeles Basin

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The End

Don Gautier

gautier@usgs.gov

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