Abstract

Offshore seismic surveys (now in the public domain) led to the discovery of several potential oil fields in the western-most Santa Barbara Channel. The surveys and wells also help to better understand this tectonically and stratigraphically complex area. It is at the western edge of the Transverse Ranges tectonic block, where the overall rotation may have created compressional structures, and it includes a portion of the transition zone from the Santa Barbara Channel to the Santa Maria Basin to the northwest. Offshore wells and seismic lines extend the control provided by onshore data, with unconformities, volcanics, and local depocenters documenting the opening of the Santa Maria Basin (from the Upper Oligocene). The exploratory wells in the area also discovered ten accumulations of heavy oil in the Miocene Monterey Formation. Only one of the two largest structural highs was developed, Point Arguello Field (200 MMBO), with much political opposition. The second large (undeveloped) structure is known as Sword. These structures illustrate aspects of the inter-basin transition zone, with very different structural orientations and ages. Sword is part of a persistent pre-Monterey structural high, whereas Point Arguello is a post-Monterey inversion structure typical of the Santa Maria Basin. Both Sword wells encountered oil in quartz-phase chert and dolomite in the Monterey. These zones have high matrix porosities, but fractures provide most of the permeability. Both wells tested 8 to 10 degree API oil at potentially economic rates (2000 to 3000 BOPD) on artificial lift. Conservative estimates for the undeveloped fields (226 MMBO) indicate a very large resource technically within reach of facilities at Point Arguello, but low oil prices and politics suggest they will be waiting many more years.

References Cited


Dibblee, T.W., 1950, Geology of Southwestern Santa Barbara County, California, Point Arguello, Lompoc, Point Conception, Los Olivos, and Gaviota Quadrangles: California Division of Mines Bulletin 150, 95 p.


Undeveloped Petroleum Potential of the Westernmost Santa Barbara Channel, Offshore California

AAPG Pacific and Rocky Mountain Sections
October 3, 2016
Las Vegas, Nevada
E-W trending SBC – Ventura basin and Transverse Ranges, near the “Big Bend” of the San Andreas fault.

As the SBC- Ventura basin is moving NW around the Big Bend, it is acting as a coherent crustal block.

Transpressive stress is also pushing it towards the San Andres (Sh max normal to SA, Zoback and others).
The crustal block can be outlined based on pre-SA, Early Tertiary and Cretaceous formations (after Crouch and Suppe), part of a linear forearc basin.

Previous to 5 mya, the stress regime was transtensional, more freedom of movement. The SBC-V basin rotated 100 degrees (Luyendyk and others), extension opening the Santa Maria basin. The westernmost SBC would have been the southern margin of the block before rotation (undo the “Z”).

Point Conception, location of next slide...
E-W trending surface anticlines reveal Early Tertiary Great Valley deposits (yellow), the northern limit of these will be the margin between the SBC-Ventura and Santa Maria basins. Extensive Monterey outcrops.

Four units of interest in the stratigraphic column; Franciscan, Great Valley, Miocene Monterey and volcanics.
Early or Pre-Miocene unconformity (truncating the Great Valley), local rhyolite/tuff, Monterey thickening to the north (transtension creating space) and late uplifts (transpression).

Jurassic under-plating probably extends farther south.
Offshore we have wells and 2D seismic data (also block outlines and bathymetry). All these well locations were based on the 2D seismic grid (late 70’s to 80’s), they are all oil discoveries or step-outs in the Monterey (offshore such wells are P&A’d).

Data available from the USGS National Archive of Marine Seismic Surveys, walrus.wr.usgs.gov

There is limited 3D seismic data (over Pt Arguello field and another over Sword), with some published results.
Generalized Monterey Structure from the seismic and well data (highs are green), two large anticlines Pt Arguello field and Sword. Orientation of Pt Arguello is consistent with current Sh max. Sword is a NE-SW trending uplift, it is much older and went through the 100 deg rotation, restores to WNW-ESE.

Note locations of C-C’ and D-D’.

Offshore, the structural trends shift from E-W to NW-SE, State Waters very structurally complex (see Fischer), Sword is the oddball.

Only dark green areas producing oil and gas.
Constructed from the 2D seismic data and wells. Truncation of Great Valley as on A and B by Early or Pre-Miocene unconformity. Sword is part of SBC-V basin margin (pre-Monterey structure). Miocene depocenter to NW, Pt Arguello is a late inversion structure, (timing and orientation as in Santa Maria Basin).
Is the area normal faulted (extensional break-up)? Farther “East” relatively unstructured. Or a compressional feature, left-lateral wrenching overriding Franciscan block during rotation?
Truncation of Great Valley again. Thin Monterey section, strike view of the Sword/Amberjack paleo-high (Crain, Mero), delineated by Monterey Thickness on this map. Limit of Great Valley truncation shown as yellow line, connects to onshore limit as margin of SBC-V Basin.

A Monterey Thick is shown at Pt Arguello field.
TD 9343’ WD 1544’
6600’ Top Monterey Transition Zone
laminated siliceous siltstone
6800’ to 7388’ Oil Shows
6850’ to 7130’ Chert Zone
quartz-phase chert
clastic-rich interval at base (little phosphate in this well)
7200’ to 7388’ Carbonate Zone
mostly dolomite in this well
7388’ Bottom Monterey
All above Oil/Water Contact

Four DST Intervals Shown;
relatively short duration (hours)
nitrogen lift, coiled tubing
total rate 2100 BOPD
oil gravity 8.5 to 10.5 API

Unfortunately low gravity oil...
The main reservoir is the glassy and porcelaneous bioclastic chert. Chert and Carbonate Zone matrix porosities can be very good (30%). Matrix permeability is low (.1 md); the high oil flow rates depend on fractures.

The low oil gravity is due to the thermal maturation of the Monterey source rock (and sulfur). The map above shows the oil gravity distribution; higher gravity in the area of thick Miocene sediments.

Low matrix permeability and low oil gravity result in low Recovery Factors, probably just a few percent of Oil in Place (onshore recovery would be much higher). Uncertainty in recovery factors and economics result in uncertain reserves.
Pacific OCS Region 2008 “Reserves” (boem.gov)

1 Bonito 49 MMBO
2 Electra 10 MMBO
3 Pt Arguello 213 MMBO
4 Rocky Pt 88 MMBO
5 Jalama 10 MMBO
6 Sword 29 MMBO
7 Castle Rock MMBO
8 Castle Rock 16 MMBO
9 Unnamed 2 MMBO
10 Government Pt 23 MMBO

Only Pt Arguello and Rocky Pt have production (EUR).

Other reserves very conservative, must be economic (politically feasible), must be leased.

Some “Contingent Resources” listed up to 2012.
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