

March 2020



LOS ANGELES BASIN GEOLOGICAL SOCIETY

March 26th (Thursday) – 11:30 AM

Mark Legg, Legg Geophysical, Inc.

Wilmington Structure, Long Beach, CA: Strike-Slip Restraining Bend Popup or Blind Thrust Anticline?

Abstract

The Wilmington oil field occupies a large northwest-trending anticlinorium bounded to the southwest by the THUMS-Huntington Beach fault. The overall morphology of the Wilmington Structure resembles a large restraining bend uplift or “popup” along a strike-slip fault, such as the San Clemente fault offshore southern California. In contrast, a northeast-dipping Wilmington blind thrust fault beneath the structure is modeled as the uplift source (Wolfe et al. 2019). Recent high-resolution seismic profiles and shallow aquifer mapping indicate reactivation of the structure. Reactivation of faults is a major aspect of the Pacific-North America transform plate boundary evolution in southern California. Interaction between high-angle strike-slip faults and moderate to low-angle detachments and blind thrusts represents a serious earthquake threat to the region as demonstrated by recent events in New Zealand and Baja California. Comprehensive mapping of subsurface structure and stratigraphy is required to evaluate earthquake hazards. Such mapping may help predict locations of bypassed hydrocarbons in existing oil fields, and possibly enable new discoveries in adjacent regions. However, identification of strike-slip faults in the subsurface is a serious challenge. Vertical deformation is readily identified in cross-sections and at the surface, but strike-slip is manifest more subtly in subsurface imagery. Tectonic geomorphology provides one tool to help recognize strike-slip deformation. Advanced technology including 3D seismic imaging provides an important tool to use morphology for recognizing strike-slip faults in the subsurface. Numerous strike-

slip faults with local restraining geometries are available to compare with the Wilmington structure and recognize character related to strike-slip. The ultimate test for strike-slip is lateral offset of piercing points, which is very difficult to achieve in offshore and subsurface areas which are somewhat inaccessible. Mapping fault cuts at key stratigraphic horizons helps to identify potential piercing points, but resolution necessary for small offsets of low slip-rate faults is rarely achieved. Observations and interpretations of available 3D seismic volumes and recent high-resolution 2D shallow surveys provide some evidence for strike-slip along the THUMS-Huntington Beach fault (Ishutov, 2013). Accurate definition of the earthquake potential and deformation mechanisms for major geologic structures still requires thorough consideration of the tectonic history – especially along an evolving continental margin transform plate boundary.

Speaker’s Biography

Dr. Legg received a B.S. in Space Sciences & Mechanical Engineering from the Florida Institute of Technology (1973). At Florida Tech he also studied Physical Oceanography for the M.S. program. Dr. Legg continued his graduate studies in Oceanography at the Scripps Institution of Oceanography, with a National Science Foundation Graduate Fellowship, where he received his M.S. in 1980. In 1985, Dr. Legg completed his Ph.D., Geological Sciences, at the University of California, Santa Barbara. His post-graduate research focused

upon the geology and seismotectonics of the California Continental Borderland, with detailed studies of the inner borderland west of San Diego and northern Baja California. While a graduate student, Dr. Legg conducted earthquake hazard and risk analysis research for the J.H. Wiggins Company, and helped the California Division of Mines & Geology map faults and earthquakes in the borderland. After the Ph.D., Dr. Legg expanded his marine seismic exploration skills at the Amoco Tulsa Research Center. Since 1988, Dr. Legg returned to Southern California to continue his offshore faulting and earthquake hazards studies. Recent offshore faulting and earthquake research efforts have included submersible and ROV dives (Alvin, Turtle, Delta and Hercules) to study borderland faults directly, multibeam swath bathymetry mapping of seafloor structure, and acquisition, processing, and interpretation of MCS and single-channel seismic profiles throughout the borderland. He continues to educate the larger community regarding the seismic hazards of the borderland including the potential for locally-generated tsunamis through seminars and publication. As President of Legg Geophysical, a small consulting firm that specializes in Earth Sciences and Risk Analysis, Dr. Legg is involved in many diverse projects relating to both natural and man-made hazards funded by both government and commercial agencies. He is also a participating scientist with the Southern California Earthquake Center, and adjunct professor at San Diego State University, and a Visiting Assistant Research Geophysicist at UC Santa Barbara. His collaboration with scientists at Oregon State University, UC Santa Barbara, CSU Long Beach and Northridge, Caltech and Stanford to produce more accurate maps of the Borderland bathymetry for fault and tectonic studies led to the discovery of the large crater structures and active seafloor faulting. Most recently, Dr. Legg's work focuses on obtaining high-resolution multichannel seismic reflection images of coastal geology and active tectonic structures offshore in the California Continental Borderland, so that more accurate and precise understanding of the regional

tectonic evolution may be achieved. Coastal zone projects to map offshore alluvial basins for desalination plant subsurface intakes and shallow geologic hazards affecting coastal zone infrastructure are typical commercial projects completed by Legg Geophysical.

Please join the LABGS to see Mark's presentation!

Meeting Time, Place, Cost, and Reservations

When:

Thursday, March 26, 2020

Meeting Agenda

Lunch Served: 11:30 AM to 11:45PM
Announcements: 11:45 AM to 12:00 PM
Guest Speaker: 12:00 PM to 12:45 PM
Questions/Close: 12:45 PM to 1:00 PM

Place:

The Grand at Willow Street Conference Center located at 4101 East Willow Street, Long Beach, CA (562-426-0555). Take Lakewood Boulevard south from the San Diego Freeway (I-405), turn west onto Willow Street, and turn right onto Grand Avenue at the sign for the Center. Park for free in the multi-level garage structure.

Cost:

Lunch and Speaker: \$30.00 with reservations
\$40.00 without reservations
Retired: \$25.00
Student: \$10.00

PAYMENTS IN CASH OR CHECK ONLY

Meeting Reservations:

We encourage you to make your reservations using the LABGS web site, at www.labgs.net

Or, call **Joseph Landeros** at 626-497-1710 or email him at landerosjd@gmail.com

**Reservations must be made by:
10:00 AM Tuesday March 24th**

to receive reservations discount price indicated above
(this will be strictly adhered to)
But, as always, walk-ins are welcome!

**OUR WEB SITE ADDRESS:
www.labgs.org**

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ANNOUNCEMENTS:

The LABGS has expanded our meeting raffles. We would appreciate raffle prize donations! *Please bring donation items to the next meeting.*

Do you know if your PSAAPG/LABGS membership is current?

If you don't know, please check via the PSAAPG website:

<http://www.psaapg.info/cloud/miscellaneous/dues.php>

Please inform a LABGS Board member if you have a pertinent announcement.