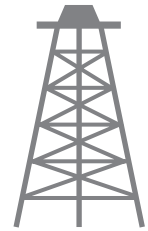




Pacific Petroleum Geology



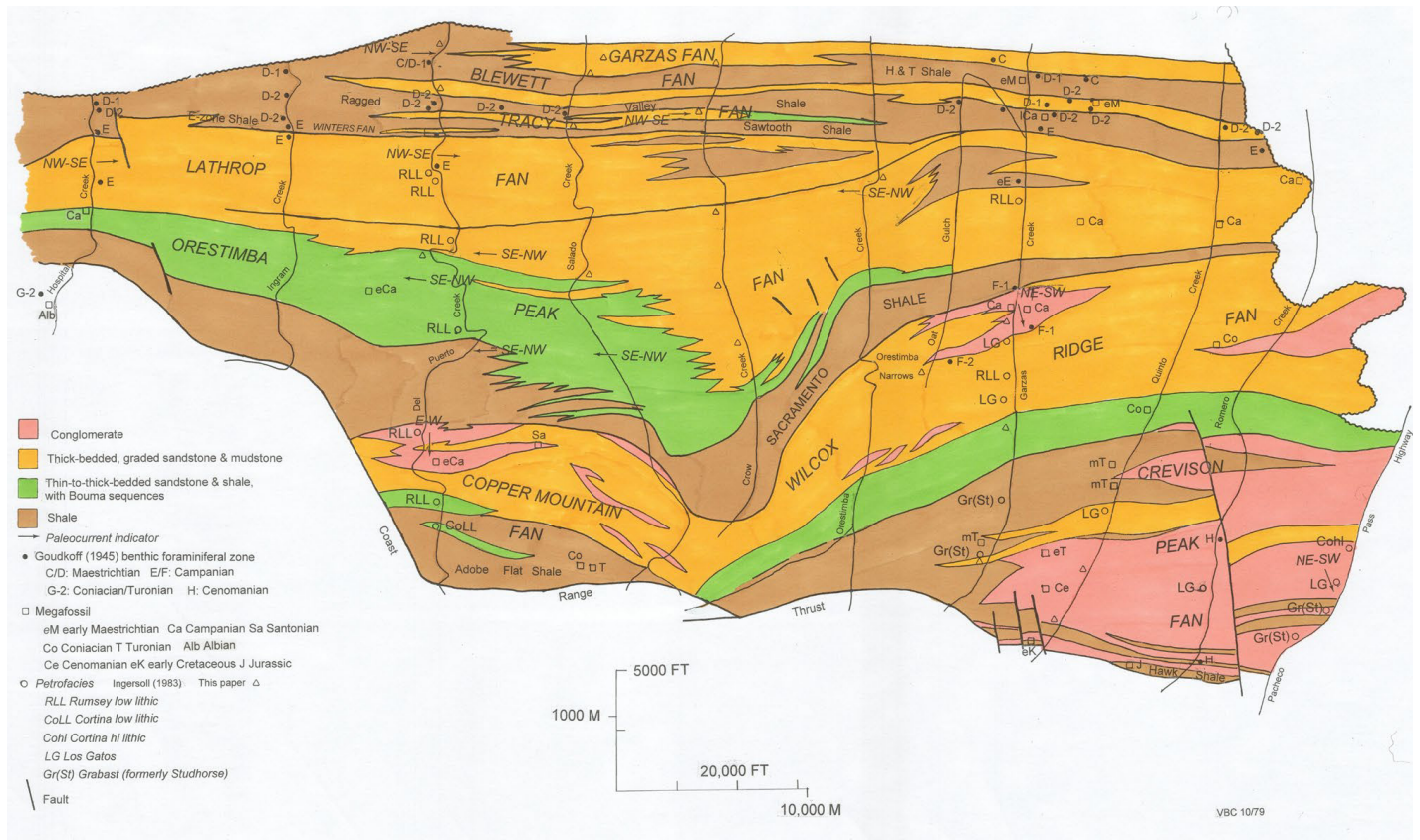
NEWSLETTER

Pacific Section • American Association of Petroleum Geologists

January-March 2021

New Pacific Section AAPG Publication!

Advances in the Geology of the Sacramento and Northern San Joaquin Basins since PSAAPG Miscellaneous Publications 41 and 43, Volume 1



Stratigraphic cross section parallel to structural strike from Hospital Creek to Pacheco Pass, main area of northern Diablo Range. From Cherven, 2020, Genetic stratigraphy of Upper Cretaceous strata in the northern Diablo Range and northern San Joaquin Valley, California.

See page 5 for more information on the new volume.

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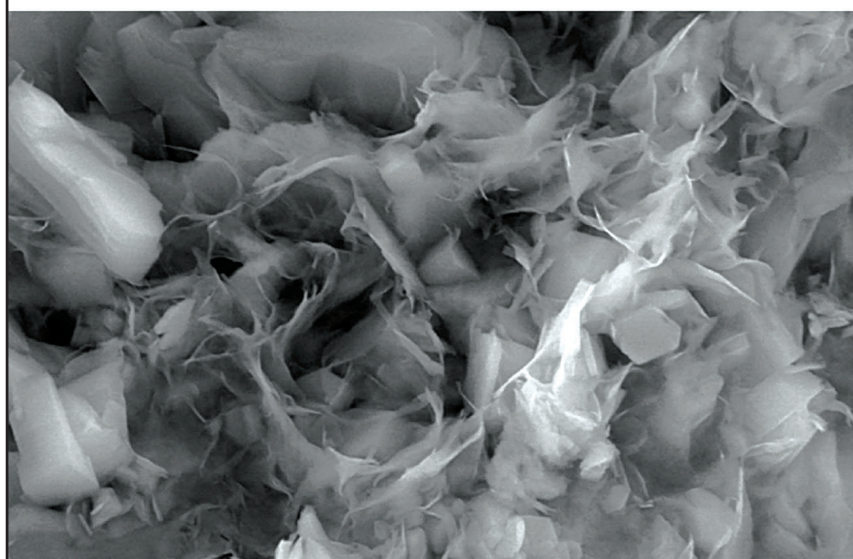
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Cover: Figure 4 in Vic Cherven's article on genetic Upper Cretaceous stratigraphy of the northern Diablo Range, one of the articles in the new PSAAPG publication. The article is based on Vic's thesis research at Stanford University.

Submit an Article to the Pacific Petroleum Newsletter!

- CONTACT THE EDITOR at editor@PSAAPG.org
- Images (graphics, photos, and scans) must be at least 300 dpi resolution. Text should be at least 600 dpi.
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Hello Pacific Section Geoscientists,

When I was sent home from work in March 2020, I did not expect to have a year anniversary of working from home. But now as we pass the one-year mark for the Pandemic, I'd like to look to the future. Without a doubt this last year has brought many challenges to our lives. We've lost loved ones; we've missed opportunities and celebrations, but we've also gained many things as well. I am hopeful for the future.



Over the past two weeks I have taken all three portions of the PG exam. If I failed to reply to an email or still owe you something – apologies, it is coming your way soon! Last spring, I was unable to take the first two portions the FG and PG due to the world's shuttering. In an earlier column I wrote about some of the fun surprises I've found while getting back to the fundamentals of geology and the processes that shaped the Earth over its billions of years. Geologic time has always fascinated me, so when I think about how long the past year has seemed, I'm reminded of how brief our stay here on Earth is. That said, another takeaway from my exams is the gift of community. I sat with friends, colleagues (both past and present) and other budding and seasoned geologists all hoping to begin, preserve, and extend their careers as geoscientists. It was both nice and a little scary to be in the company of others. We were carefully spaced for the testing and everyone was masked, there were bottles of hand sanitizer aplenty, but it still felt odd to be around so many people! Best of luck to my comrades who took their exams.

One aspect of the past year that I hope we can continue is the virtual meeting. I know we are all itching to get back into our respective meeting places, so that we can shake hands, embrace and toast one another, but it has been wonderful tuning in to my local SJGS meeting and seeing familiar faces and names of friends that have moved beyond the San Joaquin Valley. The past year has been a social experiment like no other. While we adopted social distancing, we also expanded our social reaches. About a year ago we made the challenging decision to cancel our 2020 meeting in Oxnard. Anyone that has been involved in planning a meeting knows what a difficult choice this was to make. So much time and effort are put in to planning a meeting, and while there's always last-minute things to do, the lion's share of work had already been completed. We are tentatively planning for Pacific Section's annual meeting to be virtually in June 2021. We have a team of interested and excited people who are busily at work planning. This meeting will look differently than prior meetings, but one thing we have realized over the last year is that we can regroup and learn how to do new things well.

Thank you for all your support and patience through this last year. Tony Reid has done a masterful job with our newsletter, creating thoughtful, geologically interesting, and technical articles. I personally enjoyed reading all about Cynthia and Dan's amazing trip to Africa, and the geological overviews taken from Aquifer Exemptions. I'd like to send a shoutout to San Diego State University, as they represent our Section and compete in this year's Imperial Barrel Competition. We are also proud to continue our scholarship program to our local societies. The last year has been most difficult for many non-profits and our organization is no different. We rely on our annual meetings to fund our accounts, not being able to have our traditional in-person convention has challenged that depended-on revenue. We are looking forward to getting back to an in-person convention in 2022.

Hang in there friends, good things are ahead. Until next time!

Becca Schempp

President – Pacific Section AAPG

Announcing a New Pacific Section AAPG Publication
Advances in the Geology of the Sacramento and Northern San Joaquin Basins
since PSAAPG Miscellaneous Publications 41 and 43, Volume 1

Edited by S. A. Reid and Scott T. Hector

The Pacific Section AAPG is pleased to announce a new publication, *Advances in the Geology of the Sacramento and Northern San Joaquin Basins since PSAAPG Miscellaneous Publications 41 and 43, Volume 1*, is available for purchase. The collection of articles is the first Pacific Section publication in the area in 24 years. All articles are written by Vic Cherven, with one article having Peter Fischer and Scott Hector as co-authors. Articles reflect three decades of Vic's work in the Sacramento and northern San Joaquin Basins and include studies of outcrops in the northern Diablo Range from his dissertation at Stanford, and proprietary studies while working with Pete Fischer at Mesa Verde. Articles were written by Vic between 2008 and 2014 and are published here for the first time.

Articles include thorough studies of the Late Cretaceous through Paleogene section of the basin's stratigraphic fill. Vic relies on extensive analysis of electric log character, combined with core descriptions and paleontological data, to build correlations, facies interpretations and sequence stratigraphic frameworks. He uses the detailed stratigraphic frameworks to construct accurate timing of structural events, including episodes of faulting on the Midland, Kirby Hills and other fault systems. Geologists will find Vic's methods to characterize facies and build and use stratigraphic frameworks very useful, whether working in California's Gas Country, or in other regions of the world.

In their preface to their 1997 volume, editors Frank Cressy and Michael Simmons expressed their hope that MP-43 would encourage others to publish additional studies of the Great Valley. This publication, labeled as Volume 1, is the initial response to Frank and Mike's plea, and represents articles ready for publication as of early 2021. A second volume is planned, and several articles are being completed that will form the foundation of the new volume. But just like Frank and Mike, it is hoped that Volume 1 will stimulate further interest from those working the Sacramento and northern San Joaquin Basins, and to submit their articles for publication.

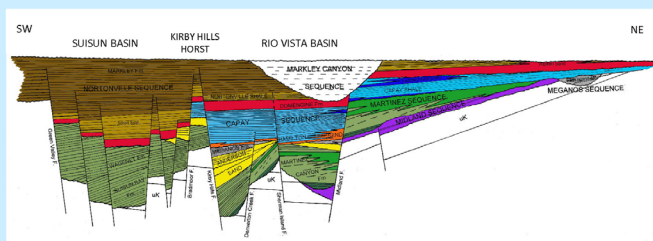
The volume is Digital Publication CD 7 and is available by direct download from the PS AAPG web site, or in CD form. In either form, the price is \$45.

To purchase, contact the PS AAPG Publisher at Pacific Section AAPG, Publications Chair, P.O. Box 1072, Bakersfield, CA, 93302, or contact Larry Knauer at laknauer@aol.com.

**Advances in the Geology
of the Sacramento and
Northern San Joaquin Basins**

since PSAAPG Miscellaneous Publications 41 and 43

Volume 1



Pacific Section AAPG • Digital Publication CD 7

Published by the Pacific Section American Association of Petroleum Geologists
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December 2020

From Renee Richards at CGS

Congratulations Joan Barminski on Your Retirement!

The Coast Geological Society and Pacific Section AAPG congratulate Joan Barminski on her recent retirement and thank her for her long-term contributions to the community and societies.

Joan's 43-year career spanned many job locations and agencies. Joan received her undergraduate degree in geology from Smith College in Massachusetts in 1975 and continued her work in geology and marine sciences at the University of North Carolina at Chapel Hill. Following her master's work, her career with the government started with the U.S. Geological Survey in Washington, DC as an oceanographer.

In 1984, Joan's west coast adventure began when she transferred to the Pacific OCS Region office of the Minerals Management Service in Santa Maria working in Exploration and Development. In 1991, she moved to the Camarillo MMS office and was appointed Chief of the Production and Development Section for OCS leases and units. Since then, Joan has held many leadership positions with MMS and BOEM, and she is retiring after serving for five years as the Pacific Regional Director for the Bureau of Ocean Energy Management.

Few have done more for the Coast Geological Society than Joan. She has held officer positions as President, Treasurer, and Education Chairman. She represented CGS in Pacific Section AAPG as Treasurer and President and was also a member of the National AAPG House of Delegates. Joan has contributed countless hours organizing PSAAPG annual conventions serving in many roles and most notably as Convention Chair of the highly successful 2015 meeting in Oxnard.

Comments from her Pacific Section colleagues testify to her many contributions. Mike Nelson, former CGS and Pacific Section president, commented "Joan has been an outstanding leader to work with in CGS and PSAAPG. She is a practical problem solver who accomplishes the task at hand and plans for future endeavors. Her confident leadership motivated teams of industry professionals in CGS and PSAAPG to hold society meetings and conventions. It is a privilege to know her personally and I appreciate her integrity, vision, and collaborative spirit."

"Joan's efforts on behalf of CGS have been extraordinary," said Jon Schwalbach. "This really surprised me, since I'm a Blue Devil and haven't met many competent folks who have come out of Chapel Hill! Joan is really the exception. But all kidding and rivalry aside, I first worked with Joan (and Mike) when they were registration chairs for the 1997 PSAAPG Ventura Convention. They did a fantastic job, and the contributions have continued through the years."

Her dedication and willingness to contribute her knowledge and interest in geology has been shared with Coast Geological Society and PSAAPG for many years. We all appreciate the amount of time she and her husband Mike have put into their contributions to the societies.

Our best wishes to Joan and her family, including her two wonderful children Michael and Lizzie, for happiness in the years ahead!



Early days as District Geologist, 1980-1984, in Hyannis, MA during exploratory drilling on Georges Bank in the North Atlantic District, USGS.

Photo courtesy of Bud Danenberger



In 2015, Joan became the Regional Director of the Pacific Outer Continental Shelf (OCS) Region.

Photo courtesy of John Romero.

**New Publication from the
Pacific Section AAPG**

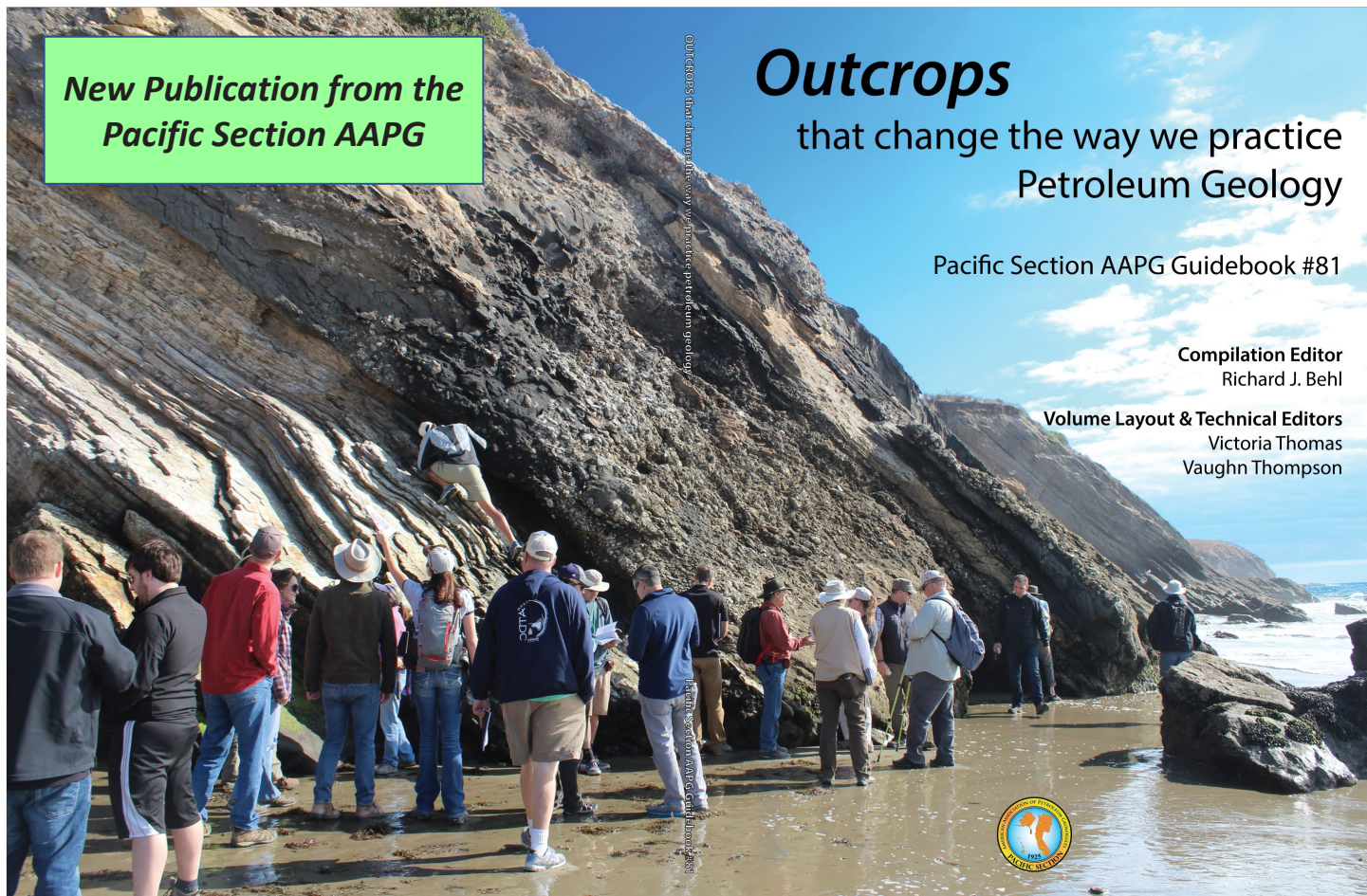
Outcrops

that change the way we practice
Petroleum Geology

Pacific Section AAPG Guidebook #81

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SANDE OIL FIELD GEOLOGY

50 Years Ago: Reflections on the February 9, 1971, San Fernando Earthquake

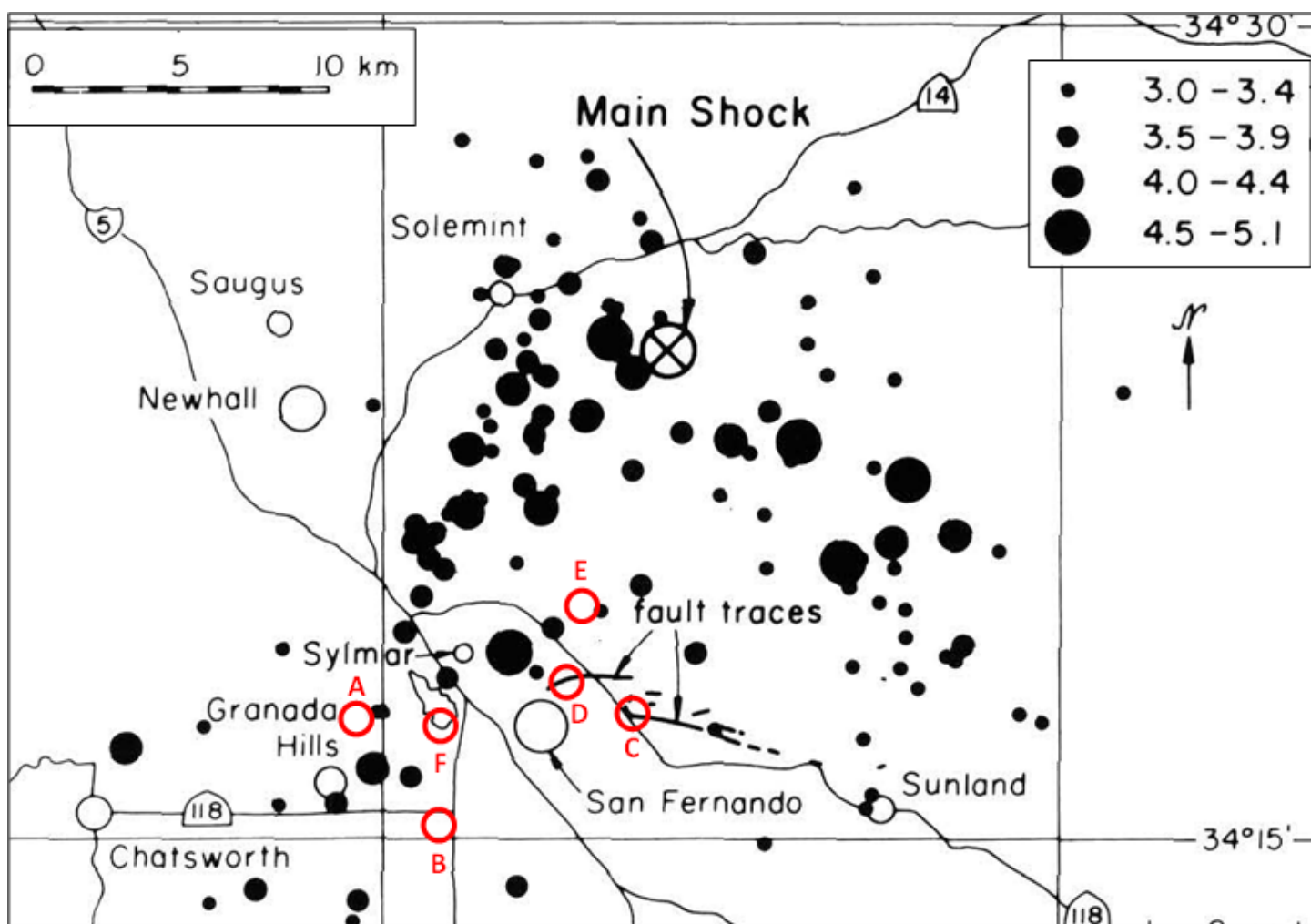
Tony Reid
Editor-in-Chief

Last month, on February 9, was the 50th anniversary of the San Fernando Earthquake. The earthquake devastated a large area of the northern San Fernando Valley and caused many deaths and billions of dollars in damage. Frightening damage from fault ruptures led to the passage of the Alquist-Priolo Geologic Hazard Zones Act. Failures of buildings, highways, and other infrastructure led to engineering updates that undoubtedly helped reduce losses in the Northridge Earthquake 23 years later.

My experiences the morning of the earthquake were not unique as I shared the event with millions of other Southern Californians. In my case, however, the quake sparked a fascination in geologic processes that ultimately resulted in my studying and practicing geology. I recall the morning of the quake with vivid clarity.

I had gotten up that morning unusually early, at 5:30, to study for a physics test. I was 17 and in my senior year at Granada Hills High School. I made myself comfortable in the family room, sitting in a recliner chair and spread out my notes on my lap. After about half an hour, I got hungry and broke into the lunch my mom had made the night before. I was eating some sort of a Hostess baked thing and was thinking how bad it tasted, when suddenly all my mom's collectable ceramics on the hutch to my right proceeded to march to the edge and plunge to their death. At about the same time, the floor lamp to my left rapidly slammed to the floor and I was in the dark.

I had felt earthquakes before, but nothing like this. I knew about the San Andreas Fault and believed this was the 'big one'. At this point I had my first irrational thought: I was going to be buried



Location of main shock, initial aftershocks, and fault ruptures from the San Fernando Earthquake (from Allen et al., in USGS Professional Paper 733, 1971). On the map in red are (A), my home, (B) Susan's home, (C) fault scarp on Foothill Blvd, Photos 1 and 2, (D) damage due to faulting in San Fernando, Photo 3, (E) Olive View Hospital, Photo 4, and (F) Lower Van Norman Dam, Photo 5.

alive in debris if I didn't get out of the house. I jumped out of the recliner, ran to the front door, and fumbled with the locks. My dad has installed a few impressive latches because (1) this was LA, and (2) periodic Santa Ana winds hit with such force as to blow open the front door. The disgusting Hostess pastry was still in my hand, and although I do not recall dropping it, bits would emerge from underneath the door's threshold for months afterwards.

Finally getting through the front door, I was met by our car, which had the same idea as me – get out of the garage fast. The massive Chrysler pushed open the garage door and was about half out and still rolling. In the early morning dawn light, I avoided the car and ran for the street. You would think in middle of the street I would feel safe, but I had irrational thought #2: remembering the old Clark Gable movie *San Francisco*, in the earthquake scenes big cracks opening in the streets and swallowed the panicked crowd. So instead, I moved to our front lawn, where of course cracks would not open. On the lawn, I actually had a rational thought: A big tree was shaking violently and I had heard or read somewhere that tree trunks can snap in the earthquakes. Between the hazards of the rolling car, cracks in the street and falling trees, I was starting to feel like I was running out of options when the shaking stopped as abruptly as it had started.

The neighborhood was eerie quiet, and I was the only one on our street to make it outside. Massive destruction had not occurred, although I'm sure each household had its own drama that morning. In the growing light I could see the San Gabriel Mountains to the east. They seemed odd and looking more closely, it was as if there was a 'double exposure' of the skyline, with the sharp outline against the clear sky, and slightly above this, another dim and transparent skyline. Whether this was dust rising from the crest of the mountains, or something else, I don't know, and I haven't heard of a phenomenon like this.

Irrational thought #3 was completely forgetting about my mom, who was temporarily trapped in her bedroom by tons of stuff that had poured out of the hallway closets. Upon returning to the house, hearing her pleas for help, and realizing an 'oh crap I forgot mom' moment, I worked for a few minutes to clear her a path to the front of the house.

Aftershocks had started. For the first day or two, the ground didn't stop moving. Some were as violent as the main but thankfully short. For a few, we ran for the front door and onto the driveway. Electricity, phones, water and gas were out. We found a transistor radio, and could not find a radio station, which meant that power was out to a large area of Los Angeles. We found a few distant stations such as San Diego, and DJs were commenting about the quake, but didn't know where it was located. As the morning wore on, more stations came back on, and we realized there was a no-information circle and we seemed to be near the center of it.

My dad arrived home by mid-morning – he worked at the wholesale produce market in downtown LA, and had to seek shelter because the old building he was in started to crumble. It

took him a while to figure out the earthquake was in the Valley, but once he did, he headed back home. I remember him saying there was no traffic, which is unheard of in LA at 8 am. Traveling north of the San Diego Freeway, he had to exit at Devonshire because the freeway was damaged north of there. By afternoon our electricity was back on, and we saw on TV the full extent of damage to buildings, highways and the Van Norman Dam. A huge area of the Valley was being evacuated because the upstream face of the dam had failed, and only a few feet of earth prevented a wall of water from inundating the neighborhoods below. Initially we wondered if we were in the evacuation zone, but it turned out we were about a half mile west of the evacuate area.

About a week after the main quake, my brother Chris and I went on a self-lead field trip to the San Fernando and Sylmar areas. Chris was on the staff of the *Daily Bruin*, UCLA's student newspaper, and had a press pass that assisted our access to closed areas. Our first stop was on Foothill Blvd, where a new three-foot-high scarp ran parallel to the curb for a few hundred feet (Photo 1). A convalescent hospital, located on the hanging wall block, was in terrible shape (Photo 2), and I felt bad for the patients and staff that were inside on the morning of the earthquake. We followed the fault ruptures into the city of San Fernando, where foundations of many buildings were damaged (Photo 3). It is easy to understand why building on an active fault is not a good idea, and it was this area that gave inspiration for the Alquist-Pliolo Act.



Photo 1. I'm standing on Foothill Blvd in Sylmar, holding a yard stick, in front of the fault scarp about a week after the earthquake. The curb and sidewalk behind me are uplifted about 3 feet. Photo by Chris Reid.



Photo 2. The scarp is just to the right of the photo and you can see the deformed sidewalk. Photo by Chris Reid. This close to the fault scarp, the hanging wall block was severely broken, with the convalescent hospital trashed and subsequently torn down. This exact location is now home to the I210-CA118 freeway interchange.



Photo 3. Damage to an apartment building in the area of fault rupture in San Fernando. Photo by Chris Reid.



Photo 4. The recently completed Olive View hospital, located in an area of intense shaking on the hanging wall block. Note the collapsed stairwell structure and the damage to the second-floor columns. The structure was demolished and replaced with a new hospital. Photo by Chris Reid.

Next, we visited areas where shaking was intense, including the new LA County Olive View Hospital. Shaking was so strong here that the stairwells detached from the main structure and fell on to the one-story structures below (Photo 4). Vertical acceleration here measured during the earthquake was the highest ever recorded, which led to numerous design changes for new structures.

Our final stop was in the parking lot of the Odyssey Restaurant, which was a perfect viewpoint to see the Lower Van Norman Dam. By this time, the reservoir had been drained, and the failed upstream face of the dam was clearly visible (Photo 5). My wife Susan grew up in a house located immediately below the dam and was evacuated for a week as the reservoir was slowly drained (Larry Knauer lived near Victory Blvd and was also evacuated). I later heard, at a SJGS monthly talk, I believe, that modeling indicated that if the dam had failed there would have been 12 feet of water moving 60 mph at her house.



Photo 5. The Lower Van Norman Dam, looking west from the Odyssey Restaurant parking lot after the reservoir had been drained. The upstream face of the dam slid into the reservoir, taking out one of the two intake towers. The lake drained slowly, and at one point fire trucks were used to pump water out of the reservoir. Photo by Chris Reid. A smaller reservoir was rebuilt upstream a half mile upstream.

Buena Vista Museum Survives Three Alarm Fire

Last December, Bakersfield's Buena Vista Museum dodged two nearby fires. Tim Elam, retired Chevron Geologist, Park Ranger and member of the museum's Board of Directors, provides the following comments on the condition of the museum on the day after the fires:

The Museum survived thanks to the terrific work of firefighters. Four other buildings on the east side of Chester Avenue between 20th and 21st streets did not survive, including Tina Marie's café. These were the four buildings immediately south of the Museum. I have linked two things...the 5:00 news clip from KGET TV and The Bakersfield Californian newspaper article. This is dramatic footage, and there are many fire clips on YouTube. In general, the Museum is the tall, bright-colored building to the left in views that look east across Chester Ave.

The Museum has water damage in the lowest floor, which is below ground. Water was being pumped out from that floor last night. There may be water damage to the roof above the top floor. But there doesn't appear to be any fire/heat damage right now. Our sprinklers were not activated. Still too early to assess all the damage issues. It does appear there were two separate fires, the second started within minutes after firefighters completed fighting the first one. I don't want to get into speculation as to how the fires started, though there isn't much doubt.

<https://www.youtube.com/watch?v=kQ4aGMmUK7M>

https://www.google.com/amp/s/www.bakersfield.com/news/fire-guts-2-downtown-businesses-including-renowned-tina-marie-s-restaurant/article_d2825194-3ca0-11eb-8552-cb703941511d.amp.html

A few days later, Tim had an update:

Smoke entered the building through crevices in the bricks on the southwest corner of the top floor. Firefighters inside the building did not allow flames to also enter through that crevice. It was close to doing so! There is a thin layer of soot blanketing every surface in the building. So, there will be much smoke/soot/smell removal to do as well. That will be a challenge to achieve with things like our taxidermy animals and gift shop items. First indications suggest our new roof likely held up well, but it must be reviewed by a qualified expert. Restoration and insurance-related work will be ongoing for some time.

To help with the cleanup and to assist with the hopefully soon reopening of the museum, the Pacific Section AAPG Foundation is pleased to provide a \$1,000 donation.

Donations to the museum from our members are encouraged, so please visit their website at:
www.buenavistamuseum.org

Did You Know?

Tim has produced 9 earth science videos for the Buena Vista Museum. Topics include the geology of the San Joaquin Basin, geologic features of the San Andreas Fault in the Frazier Park area, and gold mining districts of Kern County. Tim describes his most recent video as "a historic video about gold mining in the Randsburg, California (Mojave Desert) area. I was fortunate to gain access to some digitally enhanced photos from +/- 1900. The video has surprising back stories having to do with golf, Hollywood, and chicanery, as well as references to whiskey, geology, and gold mining."

View all the videos at the Buena Vista Museum website.

Three Pacific Section Geologists to Receive 2021 AAPG Awards

This year's crop of AAPG award winners includes three from the Pacific Section. Congratulations to Leslie Magoon, Daniel Schwartz and Stephen Testa.

The following is from the January 2021 AAPG Explorer:

AAPG Honorary Member Leslie Magoon is the recipient of the Association's highest honor, the **AAPG Sidney Powers Memorial Award**.

Magoon is a retired professor in the Department of Geological and Environmental Sciences at Stanford University. He worked eight years for Shell Oil Company in exploration and 30 years with the U.S. Geological Survey and is presently an emeritus scientist with the USGS. Since 1981, he has made a name for himself for his investigation and popularization of the petroleum system through talks, courses and AAPG Memoir 60: "The Petroleum System: From Source to Trap," for which he received the Robert H. Dott. Sr. Award in 1996.

Honorary Member Award, presented to Members who have distinguished themselves by their accomplishments and through their service to the profession of petroleum geology and to AAPG.

- Daniel "Dan" Schwartz of Daniel E. Schwartz LLC in Bakersfield, Calif.

Public Service Award, presented to recognize contributions of AAPG Members to public affairs – and intended to encourage such activities.

- Stephen Testa of TEC in Mokelumne Hill, Calif.

NOW AVAILABLE

Anomalies

† **Pioneering Women in Petroleum Geology: 1917-2017**

To be released April 1, 2017, *Anomalies* represents a deep foraging into the unrealized and near lost history of women that began in 1917 their 100 year journey as petroleum geologists.

“Robbie Gries and her contributors have created a remarkable account of early women in petroleum geology. The book represents a “deep dive” into the lives, accomplishments, triumphs, and, even, terrors, of early women professionals. It displays impressive scholarship, and reflects four years’ efforts to source histories of these largely forgotten women professionals.

An astounding network of women professionals, formed by need, strengthened by time, constituting an amazing support system. Robbie has done an amazing, multi-year research effort in uncovering hundreds of early petroleum geologists, active in many countries, whose early efforts are now recorded for our belated appreciation.

A delightful, hopeful, sense of progress is conveyed by the book, as the intense survival stories of early women geologists, give way to a prideful modern acknowledgement of the importance of women petroleum geoscientists in our modern petroleum industry.

The book should be read by every petroleum geologist, geophysicist, and petroleum engineer; partly for the pleasure of the sprightly told adventures, partly for a sense of history, and, significantly, because it engenders a proper respect towards all women professionals, forging their unique way in a “man’s world”.

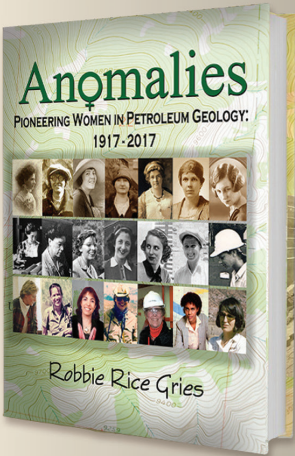
Buy this book! It will renew your pride in being a petroleum geologist, and it will enlighten you on the struggles of our wonderful women associates as they followed their professional dreams.”

– Marlan Downey, Past President of AAPG, CEO Roxanna Petroleum

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DOMAIN NAMES

Scott Hector
Vice-President, Sacramento Petroleum Association

OK, folks, do you know about “Go Daddy”? That is a company on the internet where you can go and buy a name for a website that you will own as long as you want it! That is, if your bright idea for attracting attention for a business on the internet has not already been taken by someone else. I have one for “Hobby Energy” and have thought about some others but not applied for them as of yet. One is “Base of Fresh Water” and another is any way I can start a consulting website that has the initials “GEM-CAL”. Then if anyone Googles “CalGEM” to get to what was the DOGGR, they will likely see my website pop up as an option to explore! Another one, but too long to really consider is “INVEST IN MY OIL AND GAS PROSPECT _YOUR TAX WRITE-OFF IS GUARANTEED!”

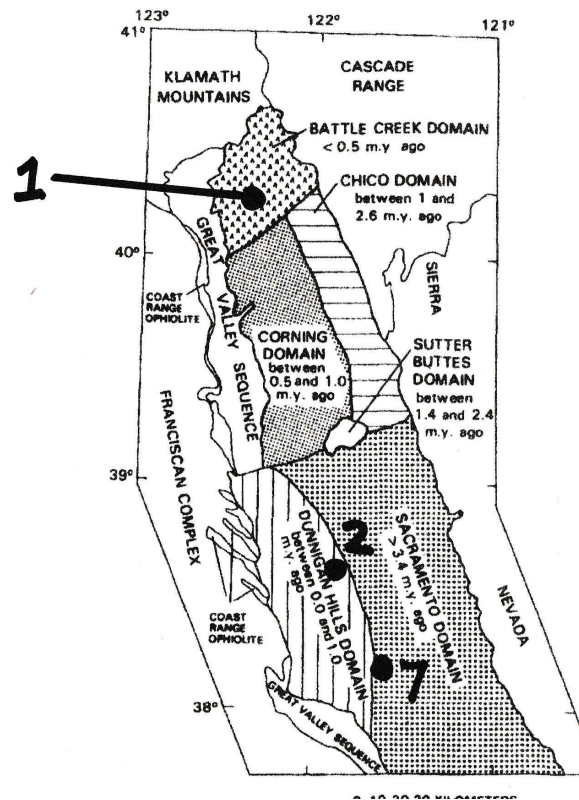
But today my remote, covid 19-necessary class will learn a bit about a different type of domain names: structural domains. You see, I am trying to put together a paper for publication on the deepest wells ever drilled in the Sacramento Basin. I could just list them, but if you don’t understand where they are in the basin, you miss out on at least half of the story. I have found out there are roughly 30 wells drilled to 13,000’ or deeper in the Sacramento Basin. If you include the Stockton Arch area and the northern San Joaquin, the number goes up by a few more clicks.

So, I have appended a map to this story. It is a map that shows the various ‘Structural Domains’ from a paper by Harwood and Helley for the United States Geological Survey back in the 1980’s. Not shown but as important is their map that shows how the San Andreas Fault started out small but then worked its way north to a present spot almost as far north as Eureka.

As the San Andreas Fault expanded to its present extend of hundreds of miles, it caused rocks on each side of it to buckle. They (Harwood and Helley) list the following domain names for what they considered different structural trends in the Sacramento Basin. They also gave an idea of when the structures formed. They are, from north to south:

1. Battle Creek Domain. This is in the far northern part of the basin. It has a very deep basin center, but the structure there has only been active for less than half a million years. The Battle Creek fault that crosses the basin from west to east (or east to west, take your pick) is active. Shell Oil drilled the deepest well ever drilled in the basin in the domain (see more on that well below).

2. Chico Domain. This is the part of the basin and valley



Structural domains (from Harwood and Helley, 1987). Annotated numbers refer to wells discussed in the text.

that is close to the Sierra Nevada in the northern basin. It extends as far south as the Sutter Buttes volcanic center. This area has little natural gas production. The beds dip off of the Sierra in a homocline. There are no deep wells here because the domain is so close to the Sierras and basement is not that deep. There is some structural activity here, however, which Harwood and Helley (aka H&H) put at between 1 and 2.5 mya.

3. Corning Domain. This is another youthful area, having been active only for 0.5 to 1.0 million years ago. However, this is also where some large structural features extend out from the Coast Range. These anticlines have been the locations for a few deep wells, including the “Alvares” well.

4. Sutter Buttes Domain. This is a small area around the Sutter Buttes volcanic center that is located between the towns of Colusa and Yuba City. It is given an age of between 1.4 and 2.4 million years ago by H&H.

5. Dunnigan Hills Domain. A stunning anticline in the vicinity of Dunnigan has formed the Dunnigan Hills.

If you travel north along freeway 505 and then I-5 near Arbuckle, the hills to the west are formed by this “recent” uplift. The study by H&H shows this uplift to be 0.0 to 1.0 million years old. For those of you that are confounded by this statement, I think the 0.0 mya means that it is actively uplifting today. You may want to spend your weekends there if you need an uplifting experience.

6. Sacramento Domain. The domain with the most gas fields is this one. It is given an age of more than 3.5 million years ago. Trying to place the largest gas field, Rio Vista, onto their map gave me some trouble. However, at least part of the field is in the Sacramento Domain, if not all of it. I think the Dunnigan Hills domain might also contain part of this field as they mapped it.

The effects of the movement of the San Andreas fault helped to form some of these domains. I have marked the locations of a few of the deepest wells on the attached map. Here is how some of the deepest wells ever drilled in the basin stack up and what their story is:

1. Shell Oil ‘Vilche’. TD 19,670’. This well was a farmout from Cities Service Oil and Gas Co to Shell, and the play concept was for Lower Cretaceous sandstone reservoirs on a low-relief anticline on the downthrown side of a major cross-valley fault. Now, please look at the map. Look for the “Battle Creek Domain”. Found it? OK, this well was drilled in this domain. Thus, even though Shell drilled deep, Shell found out that the rocks were not even marginally mature for making gas until 12,500’. The well did find Lower Cretaceous rock below 16,000’, but it was probably mostly conglomerate and not productive. It reached serpentinized ophiolitic basement rock at total depth. The well found nothing of interest in terms of oil or gas shows. Since the structure they drilled is likely very young (less than a half-million years old for this domain), it is hard to imagine how migration could have occurred from the main Sacramento Basin to its south.

2. Great Basins “Cache Creek”. TD 18,275’. This well was drilled to test a large structural feature referred to as the Dunnigan Hills Anticline on the west side of the Sacramento Basin near Woodland, California. Great Basins spud the well on August 1, 1973 and abandoned it on January 8, 1974. It reached the oldest member of the Upper Cretaceous section in this part of the basin, the Turonian Venado Sandstone. It is a thick-bedded submarine-fan deposit. The results confirmed what some geologists surmised about the anticline: that it is a young flexure that is a response to compression from the west along the San Andreas Fault.

7, 8, 9, 10, 12. Chevron USA Inc. “Peter Cook”. The winner of trying to find something deep in the Sacramento

Basin definitely goes to Chevron, despite the efforts of Shell and Great Basins discussed above. In the early to mid-1960’s, Standard Oil of California drilled five deep wells in and around the Rio Vista and Lindsey Slough gas fields. I think they wanted to make sure they were not missing anything on either side of the Midland Fault. The wells were drilled to depths of 15,000’ or greater and appear to have been tests designed to drill as deep as the Forbes Formation.

OK, there are 27 wells 13,000’ or deeper in the Sacramento Basin. Almost all of them have been drilled in the Sacramento Domain. I have determined that it is likely that a half dozen of these were drilled in the Dunnigan Hills Domain, a few in the Corning Domain, one in the Battle Creek Domain, and the rest in the Sacramento Domain. What did they find in the basin after all of this expense? NOTHING NEW. There are no deeper zones found by any deep wells in the Sacramento Basin. YET.

Oh yes, one last thought. I recently decided to expand this study looking for wells 13,000’ or deeper in the natural gas prone Northern San Joaquin Province (USGS designation). I found one well of particular interest. It is the Emerald Trail “Nunes” well drilled near Los Banos in Merced County. It went to a depth of 17,813’ in 2004. I wondered if the name “Nunes” was the family of Devin Nunes, member of the House of Representatives. In the history of the well filed with the DOGGR (ahem! CalGEM) it gave some information that seemed to confirm this. As I wrote in my proposed paper: “The pages of the history filed with the State of California call the prospect a “Franciscan overthrust” play. Thus, this well, located just east of Interstate 5 and a few miles east of the San Luis Reservoir, tested an overthrust structure in the west side of the basin, penetrating some of the thickest section of sediment in the asymmetric basin. Though the well found some natural gas at great depths, the rates were very small and sub-commercial. The pre-drilling program for this well has been filed with the Division. This listed the “Eisenhower”, “Wilson”, “Roosevelt”, “Lincoln” and “Jefferson” sands as their objectives, expected to be located at depths between 13,470’ and 15,440’. The intervals tested were actually at 17,523’-17,513’, 16,956’-16,630’ and 15,223’-15,177’. Based on the names of these targets, it is expected that the well was on lands owned by the Devin Nunes family. He is former dairy farmer and now the U.S. Representative for California’s 22nd congressional district. He has served since 2003, one year before the well was drilled.”

Yes, Congressman Nunes is one thing. Congressman Hector is another. To quote LBJ, “I shall not seek, and will not accept, the nomination of my party for another term as your President”. Or anything else.

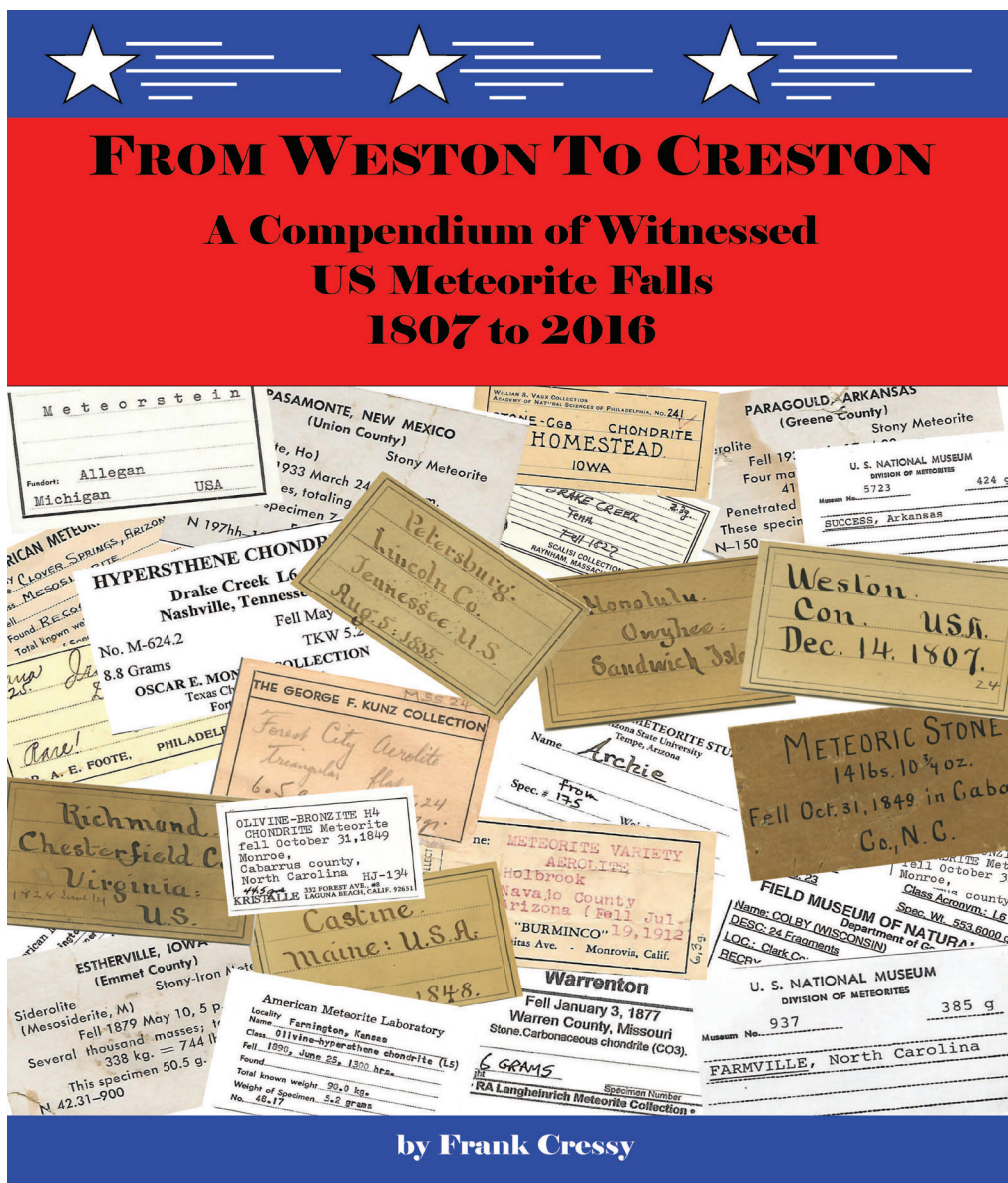
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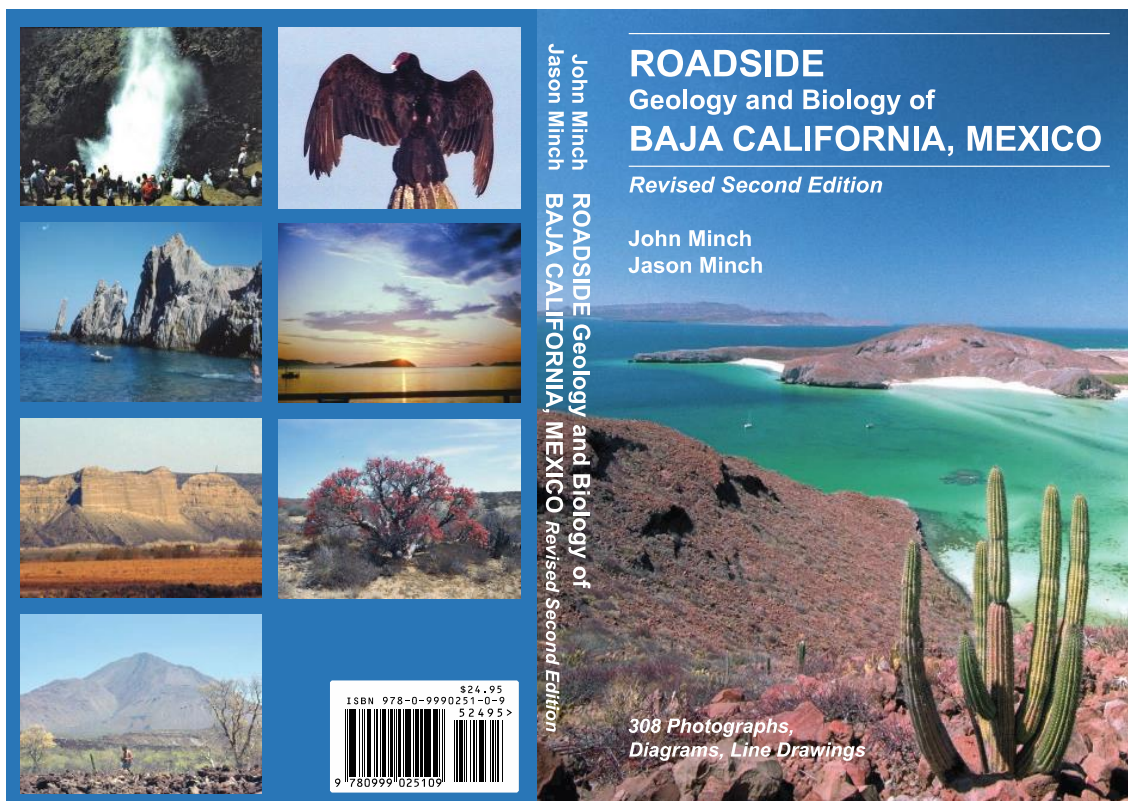
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Member Society News

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Anchorage, AK 99510

Virtual meetings are planned for 11:45 am to 1 pm. Check the AGS website for details on how to attend. The next meeting is:

April 15, 2021, Thursday, 11:45 Alaska Time - Anchorage

Speaker: Palma Botterell, USGS

Topic: New North Slope oil geochemistry work

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Coast Geological Society www.coastgeologicalsociety.org

P. O. Box 3055
Ventura, CA 93006

Virtual meetings continue to be planned. Meetings are the third Tuesday of the month and start at 6 pm.

April Meeting: Check the website for the April meeting title and speaker

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Los Angeles Basin Geological Society www.labgs.org

Check the LABGS website for information on upcoming virtual meetings

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(Continued on next page)

Northern California Geological Society
www.ncgeolsoc.org

803 Orion #2
Hercules, CA 94547-1938

Monthly meeting will be held via ZOOM until the county health department permits in-person meetings. Check the society website for information on attending the ZOOM meetings. Upcoming Meetings:

April 28, 2021 7:00 pm

Dr. Penelope Boston, NASA Ames Research Center

Some of the Most Challenging Questions Facing Astrobiologists Today

May 26, 2021 7:00 pm

Dr. Kathryn Stack Morgan, JPL Mars 2020 Deputy Project Scientist

The Mars 2020 Perseverance Rover: First Results from Jezero Crater

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| Program Director: | Jim O'Brient | |
| Website Editor: | Andrew Alden | geology@andrewalden.com |

Northwest Energy Association
www.nwenergy.us

P. O. Box 6679
Portland, OR 97228

Contact:
Jim Jackson or John Armentrout

No activities are planned at this time. Check the website for the latest information.

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Sacramento Petroleum Association

P. O. Box 1844
Folsom, CA 95630

Contact: Pam Ceccarelli
916-439-0400

No activities are planned at this time.

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San Joaquin Geological Society
www.sanjoaquingeologicalsociety.org

P. O. Box 1056
Bakersfield, CA 93302

Contact: Jennifer Prosser
jprosser@envirotechteam.com

Virtual meetings are held on the second Tuesday of the month. See the SJGS website for the next scheduled meeting.

Check the SJGS website for information on the April meeting.

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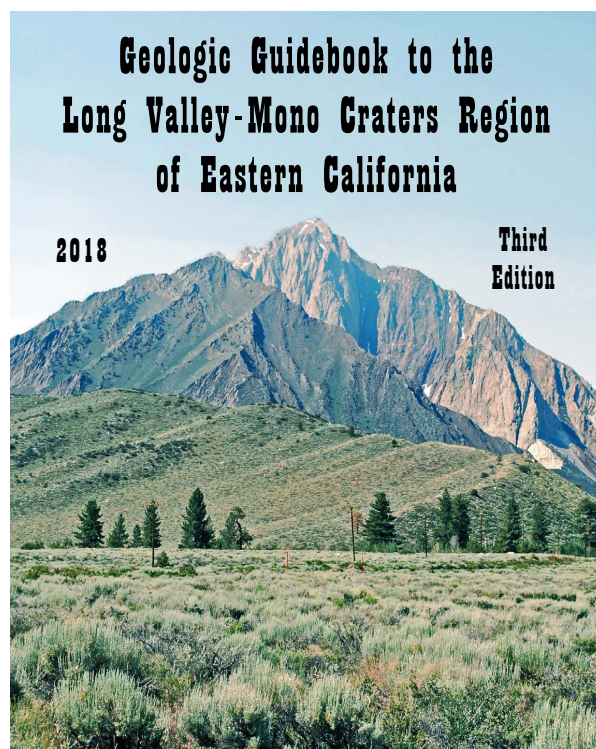
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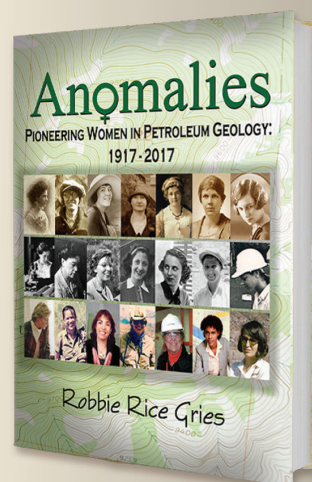
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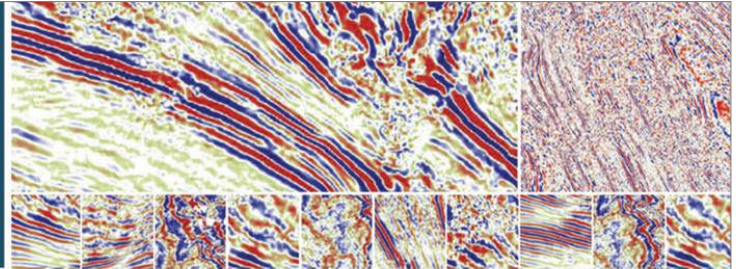


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