

Life on an Active Margin: Swimming Pools and Movie Stars

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Welcome to Anaheim! The Geological Society of America is back in Southern California, and it's been quite a while. The last time GSA's annual meeting came to California was in 1991—33 years ago—down San Diego way. I remember that conference well, as I was a third-year Ph.D. student presenting my first talk at what we now call GSA Connects.

I recall that there were a lot of dudes presenting in that session. Fortunately, much has changed for the better in the past three decades. This year's Connects features a greater diversity of presenters and participants than ever before.

Speaking of dudes, I'm honored to have *the Dude* here today. Dude, welcome to GSA!

*(The Dude stands up and does a Hollywood wave,
"Hey, what's up man?")*

The Dude is also known as Jeffrey Lebowski from *The Big Lebowski*. The film was set in these parts and the Dude is reputedly the laziest man in all of greater Los Angeles. Nonetheless, I'm stoked he's here in the house at GSA.

In 1991, the same year *The Big Lebowski* was set, we used slide carousels—two of them at the same time! It was double-barreled projection, and in my mind that was state of the art. Here's a slide pair from my talk on mylonites formed in different tectonic environments. I have plenty more slides about mylonites, but unfortunately for me—and perhaps lucky for you—I've been advised to say no more about them during this talk.

I'd like to thank our members who step up as volunteers to make a meeting like this come together—it's a labor of love, and the process to get us here is years in the making. Over the past year, I've been to many GSA meetings across various time zones, and it's been awesome to see how the GSA staff and the local committees make field trips, short courses, and meetings a reality. For me, a high point of serving as President has been collaborating with the GSA staff to make the Society better.

During your time here at Connects, you'll notice that we've shaken things up a bit and made a few changes. For those who've never attended a GSA awards ceremony or a presidential address, thanks for taking the time to be here—my hope is you find this celebration affirming, joyful, and fun.

Today, I am highlighting my connection to this dynamic and wondrous corner of America—to Southern California and to life on this active margin. GSA Connects 2024 has two themes: *Life along an Active Margin* and *Water in a Changing World*. Both are timely and relevant.

FAMILY MATTERS

My connection to California is rooted in geology, yet over the past two decades, it's become intertwined with family.

That personal perspective provides a broader relevance as to why studying the Earth is important.

No doubt some of you are wondering, "Why is he here again?" since I'm the dude (that's in lower case) who gave the address last year at Connects in Pittsburgh. I'm here for a second time because of a family tragedy that beset President-Elect Carmie Garzzone earlier this year. Carmie is my colleague and friend—her counsel is always on the mark, and she's the academic leader that I aspire to be. This address is dedicated to Carmie and her family. It is wrapped around family and that's done with intention, as family is precious, fragile, and something we should always cherish.

After that 1991 GSA meeting in San Diego, I'd planned to head east to further study the mylonites exposed in the canyons of the Anza-Borrego region. But I was too young to rent a car—I was stuck in San Diego. Stuck until my Ph.D. advisor, Carol Simpson, accompanied me to the rental car counter, adroitly managing to get me on my way in that fly red Geo Storm!

It was humbling, but through the lens of time, I now see that Carol, in her brilliantly understated British manner, was doing what so many of you have done for decades—training the next generation of geoscientists through thick and thin, through all the hard bits. It's work like that which creates intergenerational community, and that's one of the hallmarks of GSA.

I'll also note that after my talk in San Diego, Carol remarked that "I'd not mucked it up too badly." I'm hoping for a similar result today.

In 1994, I finished my Ph.D. and left California's mylonites in the rearview mirror for new research endeavors. But in the twenty-first century, I returned to California for a wholly different set of reasons.

I'm from a small family; for years, it was pretty much just my mother and my brother. Here's a 2009 image of us by a sea loch in the northwest of Scotland, at the home village of my mom's grandfather. Across the loch, you can see the glacially sculpted Applecross Mountains undergirded by those problematic Torridonian strata—plus, not far away there's some fabulous mylonite exposed along the Moine Fault! But I digress.

My younger brother is a chef and an actor, and in the early 2000s he moved to Los Angeles. He is, in the parlance of our time, a raging a**hole, but I love him nonetheless.

His bachelor party in 2013 was epic, and as you can see, we were all tricked out to be in LA. From what I can



remember, we ate BBQ, then played paintball in the desert. Here you can see my brother exulting in his Scottish heritage. That's me as *Star Trek*'s Captain Kirk. Curiously, and for reasons that I still find hard to fathom, the rest of that crew continues to refer to me as Captain Jerk.

My brother Jonathan found his place in Southern California. These days, he's got a marvelous family and he's an amazing father. It's wonderful to see his peeps grow, and I'm fortunate that they are here today.

But I have another family connection here in La La Land. Straight out of high school, my stepson moved to LA to learn digital music and video production. On a hot day in mid-August, we delivered William to an unsavory mid-rise apartment complex in Hollywood to commence his studies in this City of Angels. It was a difficult trip—parents don't just drop their 18-year-old kid off on Hollywood Boulevard and feel good about it.

But later that same day, while buying groceries at the nearby Trader Joe's, I encountered Neil Young in the frozen food aisle. Neil was, of course, searching for a heart of gold. That's part of the magic that is Southern California—rock stars, movie stars, you never know who you'll run into. Today, William is thriving here in Southern California, doing production work for the likes of Bad Bunny and Sabrina Carpenter. If you know those artists, I'm glad you're here today—GSA needs you.

With both my brother's family and my son living here, we've gone on many adventures in Southern California, and invariably geology slips right in. I hope you've seen this map, either when you registered for the meeting or arrived here at Connects. It's a map of Southern California geo-sites, and it's fabulous. Chelsea McRaven Feeney at Mountain Press crafted it and, from my perspective, it's art worthy of being framed and hung in a place of honor. And as the Dude once noted, a piece like this can really hold a room together. I'm looking forward to the GSA Connects map becoming a yearly tradition as the Society ventures across North America at our annual meetings.

GSA recently became the sponsor for geoheritage in the United States. We've stepped up to host the U.S. Advisory Board on Geoheritage and Geoparks, and I'm excited to work together collectively. For me, geoheritage includes conserving geologically special places, but it's more. It's the world that's all around us. As I said last year, we need to bring our science to the public. Geoheritage provides a framework to wrap the past, the present, and the future of both spectacular and everyday places into a compelling narrative that is relevant to a broad audience.

LIFE ALONG AN ACTIVE MARGIN

Speaking of geoheritage, 80 km northwest of Anaheim there is a particularly cool geo-site—Vasquez Rocks, featured on the Connects Geo-Sites map. I've wan-

dered this rocky ground with my family; for them it's a fine hike in the high desert, but for me, it's a place that brings together time and tectonics.

Chunky conglomerates and sandstones underlie Vasquez Rocks. These Oligocene to Miocene strata dip to the southwest, forming spectacular landforms, highlighting everything one needs to know about dip- and anti-dip slopes. These sediments, deposited in a terrestrial basin, were soon tilted and rotated as strain was partitioned across the San Andreas and its compatriot faults.

Yet, there's something more to Vasquez Rocks. Space, the final frontier. For it was upon these rocks in 1967—or was it Stardate 3045.6—that Captain James T. Kirk of the Starship *Enterprise* found himself engaged in mortal combat with a Gorn.

(The Gorn enters from stage right, and menacingly picks up a large rock.)

It seems there's a Gorn in our midst today. You see, the Gorn are a tad misunderstood.

That *Star Trek* scene from Vasquez Rocks ended peacefully. I know that we can achieve a similar result today, so let's graciously welcome the Gorn to GSA Connects 2024.

(Impressed by the welcome, the Gorn puts down the large rock and whimsically tosses a beachball to the crowd.)

My brother and his family live at the northern edge of the San Fernando Valley, where the terrain starts to rise into the Santa Susana Mountains. In these parts, the San Fernando Valley is known simply as the Valley. It's the provenance of Valley Girls—if you're of a certain vintage, that has cultural significance for you. Their house isn't far from the epicenter of the 1971 San Fernando earthquake. That magnitude 6.6 temblor, caused by slip along a thrust fault beneath the San Gabriel Mountains, jarred Southern California awake and destroyed a wide swath of significant

infrastructure. Sixty-five people perished, and the damage totaled more than half a billion dollars.

However, it could have been much worse, as the Van Norman Dams barely escaped destruction. These reservoirs, at the lower end of the Los Angeles aqueduct, stockpiled gobs of water that Los Angeles has siphoned out of the Sierra Nevada and Owens Valley.

That shaking, with horizontal accelerations greater than 0.6 g, caused parts of the lower dam to collapse. These dams were constructed of fill, some of which liquefied during that shaking. It was fortunate that in the late 1960s there'd been recognition that these dams weren't sound, and consequently their water levels had been lowered a few years prior to the quake. After the partial dam collapse, it was touch and go; the lower reservoir came within 5 feet of overtopping and breaching.

Even at half capacity, the reservoir stored 3.5 billion gallons of water. Had the lower Van Norman dam breached, that water would have catastrophically inundated a significant part of the north Valley; more than 80,000 people downstream were in harm's way and evacuated after the quake. After 1971, changes were made, but it's a striking example of the connected hazards here—active tectonics thrash the municipal water storage.

In the wee hours of 17 January 1994, another major earthquake ripped off beneath Northridge in the Valley. By any measure the Northridge earthquake was significant; the Valley was pummeled, and even 30 years later it ranks as one of America's costliest disasters. The magnitude 6.7 rupture occurred along an unrecognized thrust fault, a blind thrust that tips out kilometers below Earth's surface. How could one know the fault and its consequent hazards were lurking beneath the Valley? Yet, for the better, that quake brought together different geoscience communities—seismologists, structural geologists, and petroleum geologists who, working in their own siloes, did not have the full picture. It was a real first step toward community science.

Southern California lies astride both the North American and Pacific tectonic plates. Geodetic data indicate that relative to North America, the Pacific plate is scampering to the northwest at a rate of ~45 mm/year. However, both the 1971 and 1994 quakes were firmly rooted in the Pacific Plate, not at the plate boundary. The San Andreas Fault, as it arcs across the “big bend,” is well distant from Los Angeles. Plus, it's been ominously quiet in these parts for decades.

California is a kinematic circus with its active faults and growing structures—there's transpression and transtension, plus classic wrench faults. This broad region of active deformation extends well beyond the plate boundary and brings with it a plethora of geohazards to millions of people. But, hey that's life on an active margin.

In the past two weeks, more than 100,000 acres of Southern California highlands have burned. To the southeast of Anaheim, the Airport Fire is still cooking. What's still yet to come this year? The blistering downslope Santa Ana winds have yet to kick up. And next winter, when an atmospheric river from the North Pacific deluges those burned slopes, gravity may have its moment, with mudslides becoming the hazard du jour.

In 2012, one of my geologic heroes, George Davis, challenged GSA during his presidential address to make public-facing science readily available in the form of “Response Conferences” that would spring forth after a particular geologic event wrangles up trouble—say, mudslides in Vermont, floods in Houston, or perhaps an earthquake on say the Palos Verdes fault, not so distant from Anaheim. For me, George's idea is on the mark, but how can we expand upon this? How can GSA—whose mission is science, service to society, and stewardship—take it further as society needs geoscience understanding? I'd be delighted to chat more about this topic, so find me while you're here at Connects.

WATER IN A CHANGING WORLD

Southern California has its share of both swimming pools and movie stars. When I come to LA, I look forward to being in a pool. Playing in the pool is fun—although the last time I uttered those words, the Dude (in a very non-Dude way) nearly tore my rotator cuff while roughhousing in his pool.

There are approximately 250,000 swimming pools in greater Los Angeles. From Google Earth, I've discerned that the surface area of my brother's pool is 30 m², so let's take that to be an average LA swimming pool. Multiply up yields a whopping 7.5 km² of pools in this crazy tinseltown.

On a day like today, with a sun-filled sky, warm breeze, and a low dewpoint, lots of evaporation is occurring in these pools. I can dutifully report that on days like today, my brother's pool loses about half a cm off the top, invisibly evaporating away to join the atmosphere. That's ~10 million gallons of water per day going skyward from LA's pools in the summer. Is this sustainable in a changing world?

And let's not forget, the water that fills these pools is not so local. For more than 100 years, Los Angeles has reached far beyond Southern California to effectively snatch water from the Sierra Nevada. This water turned Los Angeles into a place of beauty, excitement, and excess. The California water wars ultimately robbed the Owens Valley and its native communities of their water—that legacy of environmental damage is still with us. In a few minutes, we'll learn more about this from Kathy Jefferson Bancroft, our President's medalist.

Southern California's climate and its precipitation are highly varied. Here's another one of Cheslea's brilliant maps. It's from the “B-side” of the California Geo-Sites poster, and it illustrates the wide range of average annual precipitation across Southern California. The Salton Trough typically receives a scant ~80 mm/year, yet the Imperial Valley has been a major agricultural supplier for generations—of course, that's made possible by highjacking the waters from the Colorado River. Is this sustainable in a changing world?

With all these swimming pools and the built environment all around us here in Southern California, it's clear that we are living in an “Age of Humans.” Last spring, when the formal elevation of the Anthropocene to an epoch went down in flames, the debate garnered significant media attention for a hot second.

I'm fine with the Anthropocene. Does it rise to the level of a formal epoch? You tell me. Yet we must engage the public,



GEOLOGISTS STUDY THE PAST, THE PRESENT, AND THE FUTURE, BUT I'M TELLING YOU WE'D BETTER UP OUR GAME AND EMPHASIZE THE PRESENT AND THE FUTURE.

because humans are playing the star role in creating the drama that is modern change on Earth. At this meeting, we've got multiple sessions focused on the Anthropocene—go check them out. But let's face it, geologists got a hefty dose of bad press over the Anthropocene decision and that's a bummer, man. However, as the Dude once said, "This aggression won't stand."

In that vein, I've personally embraced the headline from the *Washington Post*; these days, when my family asks me to take out the trash or a dean asks that I sit on another university committee, I glibly respond, "The geologist says no."

ON TO THE FUTURE: GEOSCIENCE CHALLENGES, OPPORTUNITIES, AND RESPONSIBILITIES

So, geoscience has an image problem. But there are other disconnects. These days when an earthquake strikes, respected media outlets are likely to report the news as climate-related—that's a disconnect. For obvious reasons, climate science seems to take up an ever-larger slice of the media pie. But so much of climate-related science is geoscience, let's pitch those linkages at every opportunity. GSA needs to be a leader by highlighting the connections between the lithosphere, hydrosphere, biosphere, and atmosphere: this is the essence of geoscience. Geologists study the past, the present, and the future, but I'm telling you we'd better up our game and emphasize the present and the future.

There's also a disconnect between university enrollment, interest in the geosciences, and society's need for the geosciences. For some, this graph demonstrates that geoscience departments are in an existential crisis. To make things worse, many note that we're approaching a "demographic cliff" and with it a decline in overall university enrollments. I take issue with calling it a cliff; perhaps it's more of a knickpoint. We know the world needs geoscientists, but it's the messaging that's the challenge. To engage the next generation, let's make the link between the geosciences and sustainability front and center in what we do.

I may be old, but I'm optimistic as my lived experience tells me that if we expose students to the geosciences, then we have ample opportunity to bring them into the fold. Despite the broader national trend, my department at William & Mary is thriving and we're growing. I think that's in large part because we work hard to create

community; our academic department is a place of opportunity for students. Yeah, it's a significant investment of time and resources plus it's work that never stops.

Last weekend, on our departmental community field trip, we took more than 30 students to the Blue Ridge in Shenandoah National Park. This trip is not tied to a class, but students choose to be there nonetheless. It was the first field trip for many; some students had never seen mountains before. Community grows on these trips and science happens—as do broken vans, but that's another matter.

Look more closely at this group photo. Sure, there's some unruly hair after a night of camping, but notice that cloud deck covering the Shenandoah Valley—it developed as a temperature inversion settled in overnight. See the block fields—are they relict features from the Pleistocene or hazardous active landforms? These forested slopes have endured moderate to severe acid rain for decades, but it's the underlying bedrock that either exacerbates or buffers this pollution. Geology and the Earth are engaging and trips such as this will garner another cohort of students who've found a home in the geosciences. In our program, they'll learn the old ways of geology, but they're also learning to code, do community science, consider environmental justice, and tackle applied problems. That's why I'm optimistic about the future of geoscience.

Well that about does it, wraps it all up. I hope it was a pretty good story. Take it easy dudes—I know the Dude will. Enjoy GSA Connects!

Thank you to Chuck for serving as Acting President in fall 2024. Please look for a welcome letter from Incoming President Nathan A. Niemi in the February issue of GSA Today.

Scan the QR code to watch a recording of Chuck Bailey's presidential address at GSA Connects 2024.

