Final Report
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Seismic-Sites: a Web-based Field Guide to the Faults of Southern California

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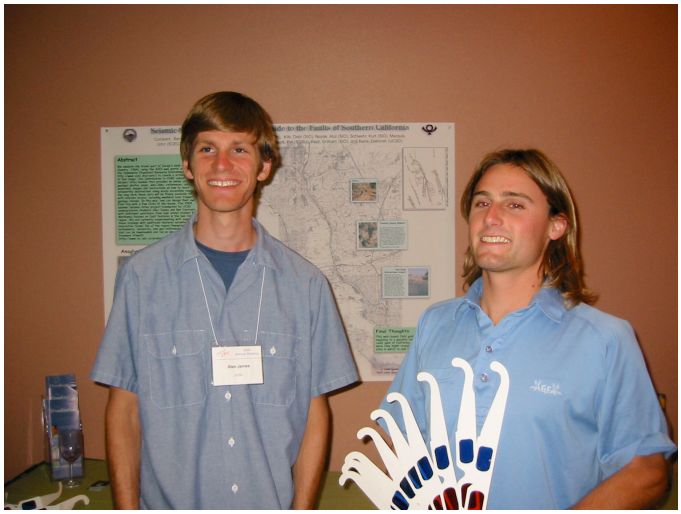
Project Summary

SCEC funding, in addition to matching funds from SIO, allowed us to hire two undergraduate students (our original plan was to hire only one student) to help create a Web-based field guide to the faults of southern California (http://siovizcenter.ucsd.edu/projects/seismicsites/index.htm). This project entailed compiling documentation such as photos, driving directions, geologic information, and accompanying descriptive text that could subsequently be developed into a web-base field guide. The long-term goal of this Southern California Earthquake Center (SCEC) project is to have various different regional 'Virtual Field Trip' materials compiled in a database that will be freely accessible through the SCEC website as an educational resource (http://www.scec.org/education/) and, when appropriate, the images also placed in the Electronic Encyclopedia of Earthquakes database (http://www.scec.org/e3/index.shtml). In this way, anyone with WWW access, including weekend road trippers and geology classes can easily gather the information.

We hired UCSD undergraduate students Ben Constant (History Major) and Alex James (Physics Major & President of the Physics Club). Ben and Alex had complimentary skills that when combined made a powerful team. Ben grew up in San Diego and knew the secret ins/outs of driving the congested San Diego roads and where the back-ally free parking was located. Alex had more computer experience and could help guide in that respect. Together Ben and Alex brainstormed trough problems, worked through technical issues and together came up with work-around solutions far beyond our expectations (see Appendix A for full documentation of their work).

The first focus for Ben & Alex was to collect data and information for the Rose Canyon fault zone in San Diego. After reading local geology books, doing some web-based searches and corresponding with local experts, Ben and Alex went '*Fault Hunting*' in Tecolote canyon and the surrounding areas. This *Fault Hunting* continued through the duration of this summer project and the two slowly amassed and cataloged geo-referenced digital images, driving directions and accompany text. The dynamic duo helped craft an abstract for the SCEC meeting, they wrote an 8 page document describing their work and they created a poster containing detailed information about their project for presentation at the SCEC meeting (Figure 1; top left). They also created an anaglyph image of the Rose Canyon fault that, when viewed with red/blue glasses (see Figure 1; bottom), becomes 3D stereo. Additionally, they teamed up with summer intern Evan Morikawa who imported their geo-referenced photographs into a 'scene file' for use with the freeware package iView3D. This scene file includes topography of the San Diego region, known fault traces, major roads and highways along with the juxtaposition of the geo-referenced photographs (Figure 1; top right). This interactive freeware is platform independent and the scene file is readily available (see http://www.siovizcenter.ucsd.edu/library/objects/index.php). All of these end products were presented at the annual SCEC meeting on September 20 and 21, 2004.



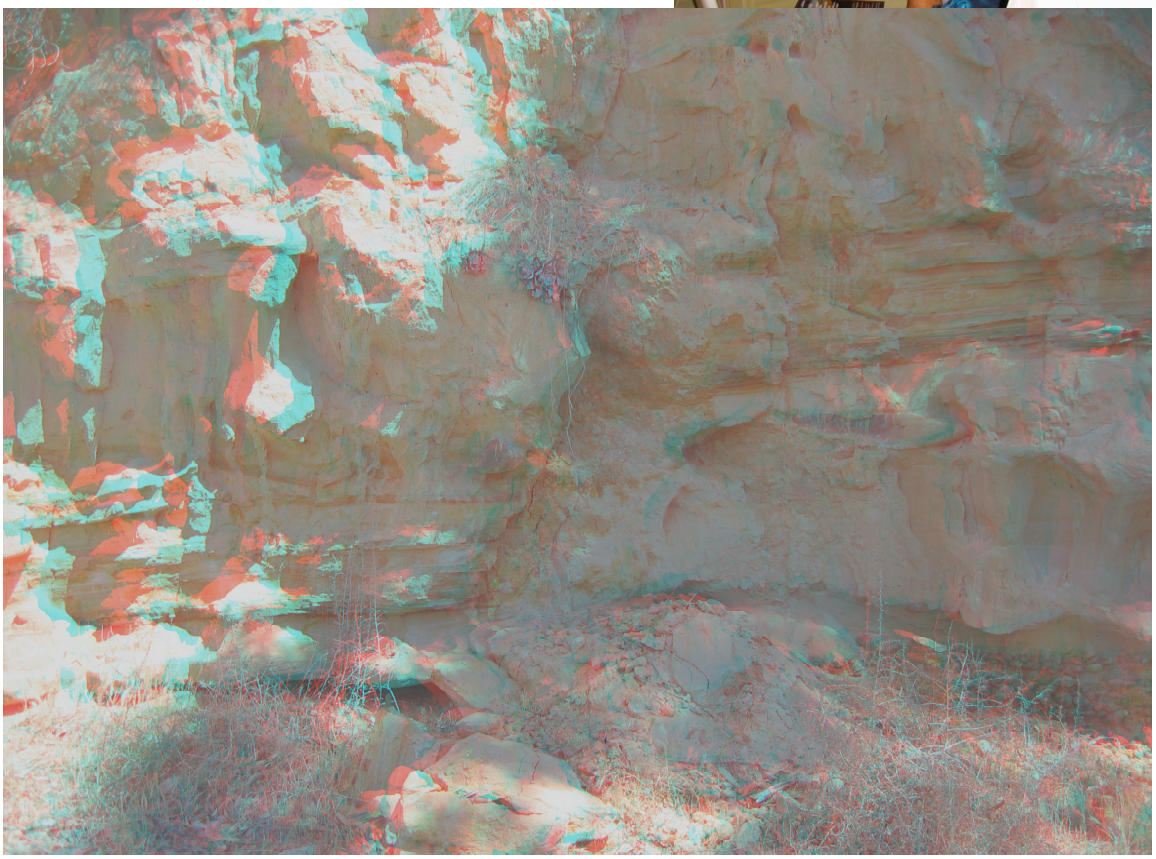


Figure 1: (top left) Undergraduate students Ben Constant and Alex James presented the results of their project at the annual SCEC meeting. Included in their presentation was an anaglyph image (bottom) that when viewed with Red/Blue glasses (as displayed by Ben) became 3D. (top right) Also displayed was a 3D interactive visualization for the visitors to explore.

If you have a color version of this page you can view the bottom image in 3D stereo using red/blue glasses.

Appendix A

A Field guide to Seismic Sites in the San Diego Region
Written by SCEC interns Alex James (UCSD) and Benjamin Constant (UCSD)
Accompany photos can be found on line at:
http://siovizcenter.ucsd.edu/projects/seismicsites/index.htm

Abstract

Seismologists who grew up in California in the 1960's can probably trace their interest in the subject to the book Earthquake Country by Robert Iacopi (1964), which explains "why California has earthquakes and how to live with them." This book also includes a driving guide to the major faults, giving readers directions for driving along, for example, the San Andreas fault, with accompanying descriptive text. We emulate the travel part of Iacopi's book, using the SCEC web portal interface titled the Community Organized Resource Environment (CORE; http://www.scec.org/core/) to help create a virtual field guide of the San Diego region. Our contribution to CORE consists of a Seismic-Sites module that provides an online catalog of geologic photos, maps, web-links, references, anaglyph and panoramic images and instructions on how to reach noteworthy destinations along easily accessible roads. In the long term these data will be freely available to anyone with internet access, including weekend road trippers and geology classes. In this way, one can design their own field trip with a few clicks of the mouse. Our 2004 summer Seismic-Sites project (conducted by UCSD undergraduate students Alex James and Benjamin Constant, with additional assistance from High-tech High student Evan Morikawa) focuses on fault features in the San Diego region. We are currently experimenting with augmenting these catalogs with additional features including a 3D interactive 'scene' file of the region (topography, bathymetry, seismicity, and geo-referenced photographs) that can be downloaded and run on any platform using the freeware *iView3D* (http://www.siovizcenter.ucsd.edu/library/objects/index.php).

Introduction

This field guide to the faults of San Diego (Rose Canyon) starts North in La Jolla and will continue south to the sites in Coronado. A great place to begin this tour is at the top of Mt. Soledad in La Jolla on a clear day. Mt. Soledad is located at N32°50.376' / W117°14.664' about 789 feet above sea level. To get here (from the North) exit from the I-5 South at La Jolla Village Dr., and take a right. Take a left at Torrey Pines Rd. and continue straight for about one mile. At the bottom of the hill merge left/straight across La Jolla Parkway and up Hidden Valley Rd. Continue up the hill and take a right at Via Capri. Drive up to the apex of the hill. Turn left into Mt. Soledad Park, and park your vehicle next to the cross. From here, there is an excellent view of the trace of the Rose Canyon fault. The fault comes into contact with the shore in the most Northwestern of the view. From there it travels along the base of Mt. Soledad to the I-5 south, where it continues past the sites of Costco's parking lot, Tecolote Park, Downtown San Diego, and Coronado. To the South one can view the sites at Point Loma Nazarene University and Sunset Cliffs.

Stop 1: The La Jolla Cove and Boomer Beach

Located at N32° 51' / W117° 16'. Parking here can be time consuming, but it can accommodate any sized group. Here are some access tips. This site requires a low tide in order to observe findings. Minimal cliff climbing is also necessary. Please proceed with caution; these rocks are slippery when wet. This is where the Rose Canyon Fault begins. It then travels toward and around the North and Eastern sides of Mt. Soledad, towards I-5. Although there were not large shifts here, it is important to note that this site is rocky, which is a distinct change from the miles of sandstone cliffs and long beaches. The rock shore continues down to Pacific Beach Point, it then submerges, and reappears at Sunset Cliffs at Point Loma.

Here are driving directions. Driving I-5 north, exit at La Jolla Parkway, and continue straight onto Torrey Pines Rd for approximately 1 mile. Or, Driving I-5 South, exit and take a right onto La Jolla Village Dr. Turn left onto Torrey Pines Rd and proceed approximately 2.5 miles. Turn right at the Prospect St. stop light. Go right down a small hill that branches off and becomes Coast Blvd. Continue straight along the ocean until you reach a stop sign. Park near by, and proceed past the public restrooms to the green gazeebo. Start tour below the gazeebo and continue to walk North to the point of La Jolla where there is stratification and tide-pools running through a fissure in the rocks.

Stop 2: Dolphin Street Cliffs

This site is located at N32° 48.9' / W117° 16.4'. The Dolphin St. cliffs do require above-average climbing skills. It is also important that a visit to this site would only be fruitful at low tide, because most of the site is underwater. Parking is readily available, but the site is unsafe when the visiting group is larger than five people. There are views of small breakages in the stratification at this site.

Here are directions to the Dolphin St. site. Driving I-5 north, exit at La Jolla Parkway and continue straight onto Torrey Pines Rd. Or, Driving I-5 South, exit and take a right onto La Jolla Village Dr. Turn left onto Trorrey Pines Rd. Turn left onto Girard Ave. Turn right onto Pearl St. Turn left onto La Jolla Blvd. and drive approximately 2 miles. Turn right onto Camino de la Costa. Take an immediate left onto Chelsea Ave. Take an immediate right onto Dolphin Pl. Park in front of house address 5730 Dolphin. Walk between houses 5730 and 5734 to the ocean cliff. *Carefully* go around the railing and proceed down the cliff. Once down to the first level proceed with caution down to the second and lowest level of rock.

Stop 3: Costco Parking Lot

This site is located at N32° 42.836' / W117° 8.925'. The elevation at this location is 174 feet. Costco's lot can accommodate a large group safely and easily. In the

Southeast corner of the lot, behind a chain-link fence is evidence of a fault movement (about eight inches offset). We were able to document this shift in an anaglyph and normal photographs. Thanks to Costco for cutting out the hillside for their parking lot, with out it this site would not viewable.

To get here from I-5 north, exit at Balboa Ave. Stay right, the road curves around to Morena Blvd. north. Or, from I-5 south, exit at Grand, Garnet St. ("Beaches"), and take a left onto Balboa Ave. Stay right, the road curves around to Morena Blvd. north. Continue driving for approximately 2 miles. On the right is Costco. Enter the lot and drive to the Southeast corner, next to the gas station. Park your vehicle, and then walk to the tall chain-link fence. The site is about 25-30 feet north from where the fence starts. In order to get closer to the fault zone, one should wear rubber rain boots, because it is necessary to walk through a stagnant drainage ditch.

Stop 4: Tecolote Canyon Ball-field

This site is located at N°3 2 46' /W117° 12', about 150 feet in altitude. This site is easily accessible for a large group of visitors. This site is one of the most obvious in the San Diego region. This site is located behind the left-center field fence at the Bronco baseball field. Behind the fence is a description of the site. On the right is a dark conglomerate (Pleistocene) that is half a million years old. On the left is light colored sandstone (Eocene) from the Scripps Formation that is about 50 million years old.

To get here exit off the I-5 and go east, past the only stop light. Proceed approximately 200 meters. At the cul-de-sac, drive into the parking lot entrance to the right. Get out of your vehicle and walk south, up a sloped walkway and onto the Bronco field. Proceed to the site, which is behind left-center field.

Stop 5: Point Loma Nazarene University's Cliffs

This site is located at N32°42.908' / W117°15.388', from 0 to 25 feet in elevation. Low tide is the only time to view this seismic site. This site requires moderate climbing skills. Proceed with caution because the cliff-face may give, due to your weight. Once down the cliff, you will be able to see many shifts that range from one inch to 6 feet long. These were the largest shifts we encountered in this region and are suspected to be strands of a fault other than Rose Canyon.

To get here, follow these directions. Driving I-5 south, take Rosecrans exit (Highway 209 South). Proceed South on Rosecrans. Turn right on Canon. Follow Canon to Catalina Blvd. Turn left onto Catalina, and then turn right onto Lomaland Dr. The University entrance is at the top of the hill. Or, when driving north on the I-5 take the airport exit. Follow the signs to the airport which will lead you to Harbor Drive until you come to Rosecrans, turn south (left), continuing on to Canon Street and turn right. Follow Canon to Catalina Boulevard. Turn left onto Catalina, then right onto Lomaland Drive. The University entrance is at the top of the hill. At the guard booth, obtain a parking permit and directions to bottom lot located next to the cliffs and the City Athletic Field. Walk down to the cliffs and then South along the cliff face. Just before the chain-link fence walk down the undisclosed path. Proceed down the hazardous cliffs with caution.

Stop 6: Airport Cell-phone Parking Lot

This site is located at N32°43.788' / W117°11.337' at approximately 10 feet above sea level. This site is easy to get to and can easily accommodate a large amount of people. At this site, there are stress fractures running from North (the runway) to South (the San Diego Harbor). This is in the same direction in which the fault travels. A dip in the asphalt runs with the fault and looks like it is for drainage, but there is no drain hole. We conjecture that this could be a possible sag-line?

To get here, drive I-5 south, and exit at Sassafras and turn right on Laurel. Turn right on Harbor Drive. Turn right into an empty cell phone parking lot, just South of the Airport terminal, and park next to the Northwest fence.

Stop 7: 17th and F (Downtown San Diego)

This site is located at N32°42.836' / W117°8.925', just west of the I-5. This site is at the top of possible scarp. From this location (above downtown at the bridge), look west towards a white and blue building (Police headquarters). From there, the fault's direction moves in a Southeast direction. Walk to the Southern most end of the lot. The fault then bisects 17th and Market, and meets the I-5. From there the fault runs south towards the Coronado Bay Bridge (which is visible in the background), where we found three seismic sites.

To get here from the I-5 south, take the CA 94 East exit. Take the G street exit. Turn right onto 21st street. Turn right onto Market St. Turn right onto 15th street. Turn right onto Broadway. Take an immediate right up the hill at 17th street. At the apex of the scarp/hill proceed over the bridge. Finally, park at the apartment complex's outside lot. If you do not leave your vehicle there for hours, they will not tow it.

Stop 8: Tidelands Park, Coronado

This site is located at N32°4.154' / W117°9.841', about ten feet in elevation. This site is easy to get to and can accommodate a large group. This park contains a grassy-ridge coming out of level grass, which might be possible scarp. This park might be considered to be under the Allquist Priolo laws.

From the I-5, merge onto CA-75 north, over the Coronado Bridge. Once you get off the bridge, take the first right at Glorieta Blvd. Park on the street next to the park. Walk in a Southeast direction (towards the water). About 30 meters before the water is a ridge that could be scarp. This park might be considered to be under the Allquist Priolo laws. These laws state that there shall be no new construction on land identified as having a hazardous fault within its bounds. This could explain why there are no buildings on the lot, in an area composed of million dollar condominiums.

Stop 9: Coronado Ferry Landing

This site is located at N32°41.996' / W117°10.334' at 5-10 feet in elevation. This site is easy to get to and can accommodate a large amount of people. This site has signs of a possible scarp. From this point, the fault line travels under the fenced swimming pool, towards the street intersection. The Allquist Priolo laws could be a possible reason why there is a pool and a grass park, and not more high-price condominiums.

From the I-5, merge onto CA-75 north, over the Coronado Bridge. Turn a slight right onto Pomona Ave. (CA 282 W) and continue. Turn right onto Orange Ave and park at the meters just after the intersection with 1st. Walk east (toward San Diego harbor), past the ticket booth from the intersection of 1st and Orange. Turn left (North) on the cement walkway past the fenced swimming pool for about 20 meters. On the bayside of the walkway is the possible scarp.

Stop 10: Coronado Yacht Club Scarp

This site is located at N32°40.945' / W117°10.495' at about 10 to 30 feet in elevation. This site is easily accessible and can accommodate a large amount of people. Across from the yacht club is the possible scarp. The scarp is diagonal, from lower right to upper left. The fault goes under the yacht club, but there are no visible signs of faulting. If the main gate to the club is open feel free to look around. Once you enter the club, walk North towards the water and docks. The fault travels from the Southeast (by the golf course) to the West (under the Chart House restaurant).

From the I-5, merge onto CA-75 north, over Coronado Bridge. Turn slight right onto Pamona Ave. (CA 282 W). Turn left onto A Ave. Turn left onto 10th. 10th becomes Pamona Ave. Turn left onto Strand Way. End at 1631 Strand Way (Coronado Yacht Club) and park on the street. Across (North) from your vehicle is a possible scarp.

Conclusion

This project, *Seismic Sites: a Web-based Field Guide to the Faults of Southern California*, was a successful pilot program even though urban environments, such as San Diego, are covering many undocumented sites. This an excellent start to a worthwhile, long term project. Due to the vast amount of land in which faults cover, not all the sites (in San Diego) that might be visible were documented.