Consultants Corner

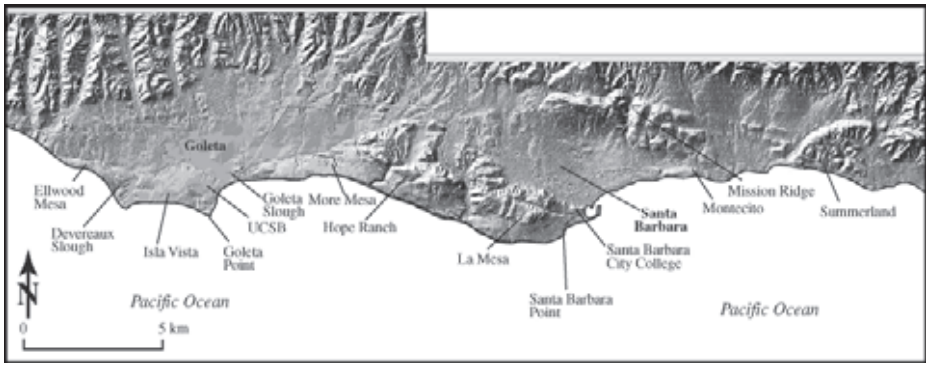
Spring 2006

Geology Of The Santa Barbara Coastal Plain

The City of Santa Barbara is located between the Santa Ynez Mountains and the Pacific Ocean, approximately 25 miles west of Ventura, California. The beautiful mountains and coastal area reveal a vast array of rock formations and landforms that depict a varied and tumultuous geological history. The oldest rocks are 50 million years old and are exposed in rocky ledge outcrops that are tilted on their side, enabling geologists to literally walk back in geologic history through the mountains. Convolutions, or breaks in the rock layers, are the result of folding, faulting and uplift. In fact, the rocks that form the Santa Ynez Mountains were initially deposited in an ocean basin that was located in the Los Angeles area. These rocks were then subsequently rotated in a clockwise direction more than 90 degrees to their present position.

In more recent geologic time, the last 500,000 years that is, the area has been uplifting by faulting, producing the Santa Ynez Mountain Range and other hills on the coastal plain. This uplift is recorded by the erosion of the mountains and accumulation of these sediments in lowland areas on the coastal plain. With continued uplift and faulting, these lowland sediments are now forming hills such as Mission Ridge. Mission Ridge is a prominent hill north of downtown Santa Barbara that is more than 800 feet high.

During this time of uplift, the Santa Barbara area was being inundated about every 20,000 years by a fluctuating sea level. When sea level reaches its highest point, a sea cliff and beach platform are notched into the land. The land, along with the sea cliff and beach platform, is eventually uplifted as the result of earthquakes and a new beach is formed at sea level.



Pictured above: The Mission Ridge anticline, which is formed on the hanging wall block of the Mission Ridge segment. The fold forms a prominent landform on the coastal piedmont. The Santa Ynez Mountain Range can be seen in the background.

One earthquake can uplift the land from a few inches to up to 20 feet. This uplift process forms a terrace or "stair-step" topography on the hills. These terraces are former beaches that have been uplifted due to the cumulative effects of faulting. Geologists call this stair-step topography marine terrace landforms. They can be evaluated to determine how fast the area is being uplifted.

The Ventura-Santa Barbara area has one of the youngest marine terraces because of the relatively high uplift rates. The Ventura-Santa Barbara area is being uplifted about 2-5 mm/year. Keep in mind that this number is a yearly average. Single events on faults in the

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Earth Systems

Santa Barbara Coastal Plain...

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Ventura-Santa Barbara area can produce earthquakes that can elevate or uplift the land up to 20 feet. The land does not uplift every year, but its average is calculated over thousands of years.

One interesting aspect of the Santa Barbara geology is the fact that numerous faults are mapped through the City of Santa Barbara. Many of these faults were not known or mapped until after many buildings were constructed. This is the reason we perform fault hazard evaluations; to prevent constructing a structure over a fault. The faults in Santa Barbara parallel the coastline and are mapped by the numerous hills that are formed along the trace of the fault.

There are many challenges in evaluating faults in urban areas due to the presence of underground utilities, thick underlying fill material, and limited areas in which to excavate trenches. The largest fault in the area is the Santa Ynez fault, located along the Santa Ynez River about seven miles north of Santa Barbara. There are numerous other large faults located offshore in the Santa Barbara Channel, such as the Pitas Point, North Channel and Oak Ridge faults. All these faults are capable of producing a magnitude 7+ earthquake. The largest onshore fault in Santa Barbara is the Mission Ridge fault system and it is capable of producing a magnitude 6.5 earthquake. Other faults in Santa Barbara are capable of producing a magnitude 6.0 earthquake.

The fault-produced hills on the Santa Barbara coastal plain are called anticlinal hills. They provide us with beautiful views of the ocean and mountains. The hills and slopes are dotted with homes and large mansions; however, these hills often have steep slopes and are underlain by shale. Shale is a weak-rock that readily weathers to clay and, as a result, is prone to landsliding. Sycamore Canyon is an example where the slopes continue to fail and slide, and where several landslides have been destroying homes and breaking underground utilities and services.

The geology of the Santa Barbara area is fascinating because, when traversing the Santa Ynez Mountains, one literally walks back tens of millions of years in geologic time. These rocks record the geologic history of how the mountains were formed and eventually shed their sediments forming a narrow coastal plain. The geology and landforms on the coastal plain depict the cumulative effects of faulting in more recent geologic time. As a result of these processes and the nature of the rocks, landslides and other hazards are actively a part of the landscape on the coastal plain of Santa Barbara, California.

—Larry D. Gurrola, Ph.D.

Sycamore Canyon home damage.

Sycamore Canyon road closure.

Seismic sources of the onshore Santa Barbara Fold Belt show south-dipping, reverse faults, some of which are blind with associated north-verging, hanging wall anticlines and footwall synclines.