The Hayward Fault at U.C. Berkeley – A Field Trip

April 2003

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On this field trip we will view some of the most dramatic expressions of the Hayward Fault in the Berkeley area. Most of the subtle geomorphic (geo=earth, morphic = shape) expressions of the fault have been removed by development, and by the natural processes of landsliding and erosion. Some clear expressions of the fault remain, and these are important for mapping the main trace through the intervening sections. The field trip stops are shown on the map in Figure 1. Begin at Founders Rock.

STOP 1: FOUNDERS ROCK

In 1866, several men met at Founders Rock, at the corner of Gayley and Hearst, probably to enjoy the view and the sunset. During their discussion, the name "Berkeley" was given to the site of the College of California. The College, which was mainly an institution where agriculture and mining were to be taught, was to move out of the city into a more rural environment. Later, in 1868, the University was also inaugurated at Founders Rock.

This site was chosen for the College because it provided an important resource: a year round water supply from Strawberry Creek. During the dry part of the year water continues to flow from Strawberry Creek. On the one hand, this is due to the fog that regularly enters the bay from the cold current off the coast. If there were no Berkeley Hills, however, the fog would rapidly dissipate. As it is, the fog hangs on the ridges, where the water condenses on the trees and shrubs, drips to the ground and eventually percolates to Strawberry Creek. Without the Hayward Fault, there would be no Berkeley Hills.

Just as the hills are a geomorphic expression of the fault, there are other smaller landforms along the Hayward fault which help us to recognize its exact location. In the area around UCB, we can easily find offset stream channels and shutter ridges. Figure 2 shows a topographic map of the area around UCB with the fault drawn in (heavy line). Note the difference in topography between the NE (hilly and steep) and the SW (relatively flat and sloping) sides of the fault. In addition to the shutter ridges we will see during the field trip, there are clear example of shutter ridges at E (Blackberry Creek) and F (Claremont Hotel) in Figure 2.

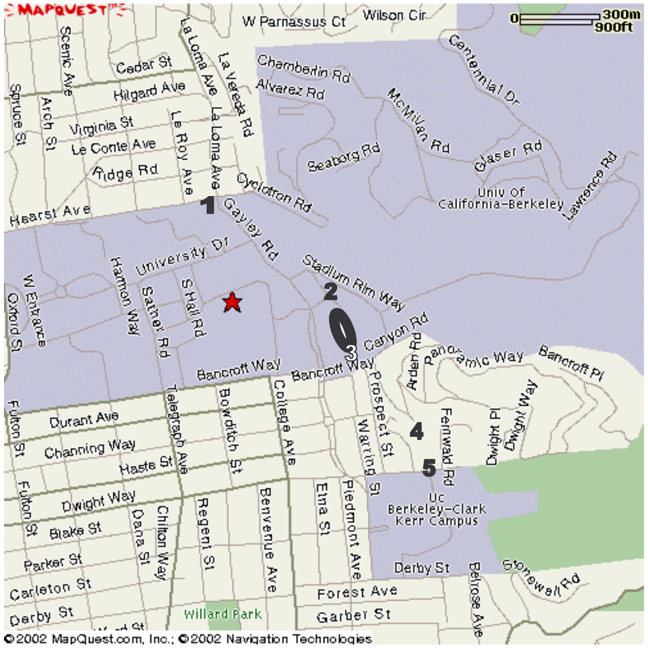

Figure 1: Field trip route and stops

1) Founders Rock
2) Kleeberger Field, Memorial Stadium (northwest)
3) Memorial Stadium (southeast)
4) Hamilton Creek Shutter ridge and displaced stream channel
5) Dwight Way scarp and offset; Fernwald Housing Complex

Up the hill from Founders Rock is Foothill Housing. When it was built, the plan was to connect the buildings N and S of Cyclotron Road with a second story walkway. That plan was scuttled during the construction due to the fear that the walkway would collapse in the case of an earthquake. The fault exits the Foothill Housing complex at the gate across from Highland road.

Walk south along Gayley Road from Founder's Rock toward the stadium. Just north of the Greek Theater on the left, there is a relatively flat area (at location B on figure 4). This area has been used for constructing University buildings. It is the former bed of a "beheaded" stream channel of the Strawberry Creek. On Figure 3, you can clearly see the bend in the elevation contours, just left of the Greek Theater, indicating this beheaded valley, with no continuation farther east in the hills. One of the easiest ways to map a strike-slip fault is by the lining-up of deflected drainages along its length. Many drainages are offset by the Hayward Fault, and some of these provide primary evidence of the fault's location. We will see two on this field trip: Hamilton Creek and Strawberry Creek.

George Louderback was a long time professor of geology at UC Berkeley. When the University wanted to build the Womens dormitory here in 1939, he was employed to make a fault investigation. He mapped the surface features, probably including the beheaded channel of Strawberry Creek that forms the driveway to the original portion of what is now "Foothill dormitories". Compare what you see here to the features on your maps. The map contours are lines of equal elevation. Louderback extended the Lawson adit through the Hayward Fault zone, to where stream gravels were truncated against sheared bedrock. He suggested the building should be placed 10 feet to the west from this point to allow leeway for fault movements "in the not too distant future".

Note where Strawberry Creek comes out from under Gaylor Dr. at Stadium Rim Way. This is 1100 feet NW of where it enters the stadium area.

STOP 2. KLEEBERGER FIELD PARKING LOT

In the stairs leading up hill around the stadium, note that the second step from the top of the first group of steps is cracked. The fault exits the stadium here and runs NW toward Bowles Hall. Just north of the Stadium fence, you can see the small walled enclosure containing the top of the Berkeley Seismological Laboratory Hayward Fault Network borehole station (CMSB). This seismometer, at the bottom of a 100 m (300 ft, about the length of the football field) hole is part of a system for studying the Hayward Fault.

North of the seismometer, you can see a shallow ditch in the hillside. This was dug several years ago to study the history of the Hayward fault using the sediments.

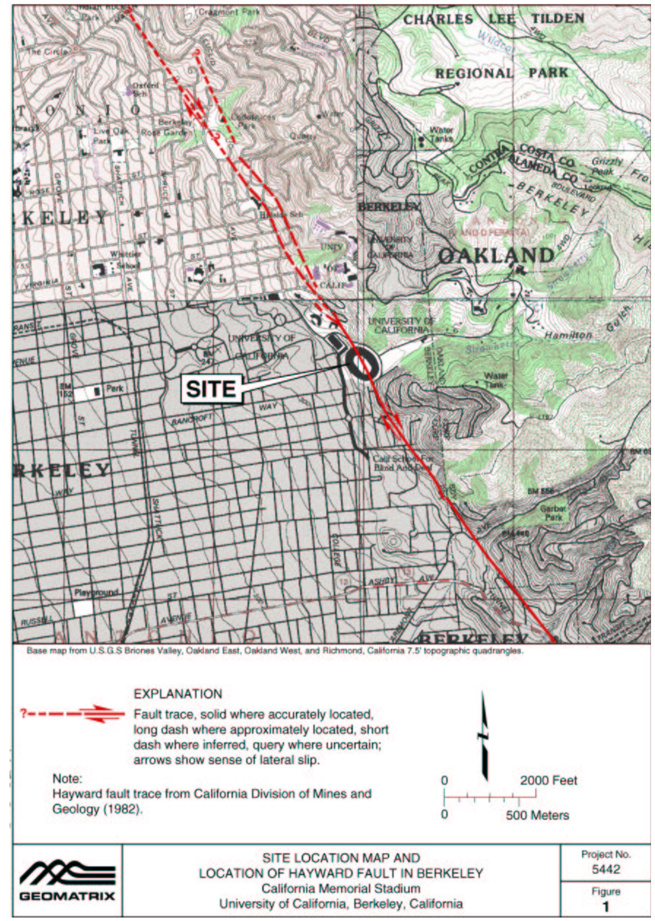

Figure 2: Topography of the Hayward Fault in southeast Berkeley, CA. Note the abrupt increase in the slope (number of contour lines per inch) and offset streams associated with the Hayward fault. The mouths of the Claremont, Strawberry and Blackberry Creeks are tectonically offset.

STOP 3: MEMORIAL STADIUM/STRAWBERRY CREEK

The Stadium was built in 1923 as a tribute to UC Berkeley alumni who fell in World War I. It involved bringing in 250,000 cubic yards of fill. It sits directly astride the Hayward Fault, on a **shutter ridge** that blocked the stream and deflected the flow of Strawberry Creek to the North. In fact, an 1100-foot-offset-length of Strawberry Creek was buried in a culvert beneath the site. The course of the creek emerges from Strawberry Canyon above, then it jogs 1100 feet northwestward and emerges from a culvert behind the Women's Faculty Club near the intersection of Stadium Rim Road and Galey Road. The channel that is now Hearst Avenue (C in figure 3) is probably an even older channel of Strawberry Creek, as was the Mining Circle channel. By analyzing the morphology and ages of these channels, we have been able to determine both the total vertical and total lateral rates of motion of the Hayward Fault at Berkeley. If we assume that the Mining channel was abandoned when Strawberry Creek started flowing down its current channel, dating the beheaded channel at Mining Circle indicates that the fault moved 1,100 feet in 32,000 years. This gives an average slip rate of about 10 mm/yr. Compare this value with the current creep rate along this portion of the fault, about 5 mm/year. The Hearst avenue channel is offset 2400 feet from Strawberry Creek. Because the Mining Circle Channel has been offset about 1900 feet since it captured flow from the Hearst Avenue channel, we infer that the Hearst Avenue channel was abandoned approximately 60,000 years ago.

The stadium structure has been offset by slow creep of the Hayward fault (Figure 5A). More than 14 inches (355 mm) of offset have accumulated across the stadium since it was built. This can be seen as the distress of interior and exterior walls and joints. It is particularly apparent in the offset of an expansion joint along the stadium's south rim. (the Stadium was originally built in two halves, to allow motion on the Hayward Fault during a large earthquake – it was thought that in such an event, the stadium structure would just gently separate along the junction).

Walk to the top of the stadium, on the south side. Follow the rim until you find an offset expansion joint covered with a piece of metal. There is another one on the opposite side of the Stadium, somewhat less displaced. The offset of the expansion joint is larger than expected from fault creep, because of amplification of motion at the top of the structure, which is more constrained at its bottom.

STOP 4: HAMILTON CREEK

Walk down Prospect St to the first intersection on the left , turn onto Hillside and walk to the bridge over Hamilton Creek. On the left of the bridge, there is an iron gate leading to a public footpath which goes uphill along the creek. About 30 yards from the gate, the creek turns sharply to the right. Walk down into the creek bed and follow it (with a property wall on your right, a Tibetan temple) another 30 yards or so until the creek turns sharply to the left and up hill. You have just walked through an offset stream channel.

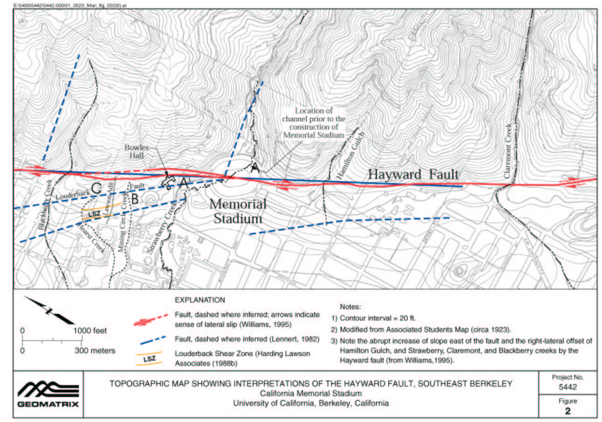

Figure 3: Landforms and culture in the area of the Hayward fault zone, UC Berkeley. Major fault related landforms are: A – A' = Strawberry Creek channel offset; B = abandoned Mining Circle Channel; C = abandoned Hearst Avenue Channel.

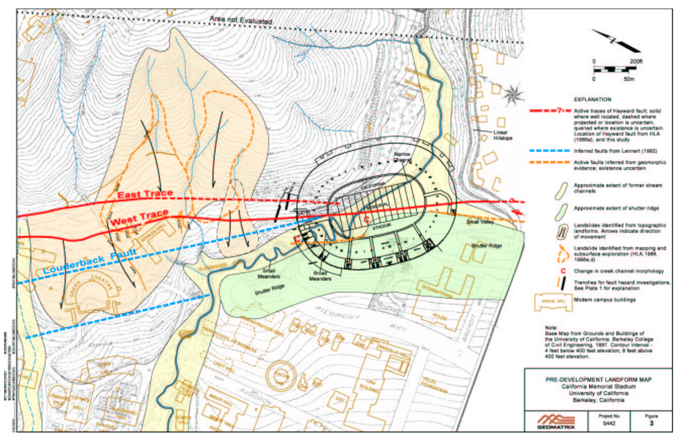

Figure 4: Strawberry Creek, Memorial Stadium and the Hayward fault.This map shows the shutter ridge on which the stadium was built. Note the active trace of the fault goes through the stadium and past the corner of Bowles Hall. The creek bed was filled to build the stadium and create the playing field. In the event of an earthquake liquefaction might occur.

The portion between the two sharp bends lies right on the Hayward Fault. You can observe the offset of the creek bed due to a topographic high (a small shutter ridge, the property within the wall) that blocked it from flowing straight downhill to the Bay.

Observe the topography along the fault: it rises sharply, delineating the fault scarp. Do not follow the creek up hill but continue along the Hayward Fault. To do this, you have to walk upwards along the wooden fence. When you pass the gate, you will find yourself in a recently re-done parking lot which is astride the Hayward fault. A couple of years ago, a trench was dug across this parking lot to observe displacements in the fault zone caused by ancient earthquakes. The trench has unfortunately been covered up. Continue in the same direction through a field onto Dwight Way. This field is the former site of the Fernwald Housing complex. The structures were built right on top of the fault, an interesting site for our field trip because of the very strong deformation caused by creep on the fault. The housing complex was abandoned about 15 years ago and, unfortunately for our field trip, demolished in 1999.

STOP 5: DWIGHT WAY FAULT SCARP

Once on Dwight Way, walk left up the hill to the corner near the top of the street. As you walk up the steep slope, you are walking on the Hayward Fault scarp. As you get to the flatter area at the top, turn around and stand facing towards the Bay. On either side of the street, look at the curbs. Note the distinct displacement of the curb towards the right (at the level of the wooden electricity pole if you are standing on the left side of the street, facing towards the Bay). The curb has recently been repaired on both sides of the street, but the offset is still visible.

This is the end of the field trip. As you walk back, look for evidence of the Hayward fault.

A. Right-lateral displacement of stadium parapet at expansion joint between Sections K-KK (south end of stadium).

B. Cracking at corner of entryway to stadium in Section A (north side of stadium).

Figure 5: Damage to Memorial Stadium due to the Hayward fault. A. At the south end of the stadium, the expansion joint at section KK has opened more than 20 cm at the top. Underneath the stadium in this section, you can also see tilted support columns and cracks in a wall recently built into the stadium. B. There are 3 types of cracks present in the stadium walls, horizontal cracks, vertical cracks and diagonal cracks. Typically, the horizontal cracks are due to construction related problems while the vertical cracks are the result of differential setting. The diagonal cracks are usually caused by fault related movement.