Interseismic and post-South Napa earthquake deformation in the Northern San Francisco Bay Region from survey GPS observations

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1. Recent GNSS surveys

A major task for our project is to continue to survey geodetic marks. This contributes to two significant scientific objectives: (1) density the relatively sparse continuous network in the region (e.g. NOTAX, USGS and BARD); and (2) maintain fundamental observations relative to which we may measure coseismic displacements and postseismic deformation in the event of a future earthquake on the coastal San Andreas Fault, Rodgers Creek and/or southern Maacama Faults, or Green Valley Fault.

2. Latest GNSS velocity solution and geodetic fault slip rate estimates

![Velocity map](image)

- 20 mm/yr
- UCR-MIT
- USGS
- Continuous GPS
- PBO/BARD/USGS

![Velocity profile](image)

- North (mm)
- East (mm)
- Up (mm)

![Profile perpendicular](image)

- Profile-perpendicular (i.e. approximately strike-parallel) GNSS velocities along the Point Reyes profile, as shown in Figure 5.

The Point Reyes profile shows a velocity gradient of about 35 mm/yr over 100 km, with only a small residual motion relative to the Pacific at the toe of Point Reyes (< 2 mm/yr), indicating that there is nearly statistically insignificant remaining motion accommodated offshore.

Our analyses using one million Monte Carlo Markov Chain models approximately agrees with the current UCERF 3 slip rate for the San Andreas Fault, but we predict higher slip rates for the Rodgers Creek and Green Valley Faults, summing to approximately the total velocity gradient along the profile.

The West Napa Fault is not included in the analyses, its location between and close to the Rodgers Creek and Green Valley Fault will likely result in highly correlated slip rates, even more so than shown in Figure 7b.

3. Continuation of post-South Napa earthquake observations

A second task for our project is to continue to measure post-earthquake deformation following the 2014-08-24 South Napa event, to build on the work of Floyd et al. (2016), and many others. Several studies at the time detected significant afterslip on the fault plane and, given the fact that many faults in the region creep, we wish to know if the earthquake induced any change in characteristics of the West Napa Fault, including generating creep.

Data has been processed using the latest IGS orbit products and expressed in the latest reference frame ITRF2014 (IGS14). Here we present these latest time series for sites around the epicentral region. They reveal that rapid afterslip mostly dissipated by the beginning of 2015, six months after the earthquake, with very little further motion after 2015. Even the closest PBO site, P261, show no residual motion relative to pre-earthquake velocities from the beginning of 2017 onwards, 2.5 years after the earthquake.

![Time series](image)

![Fault segment comparison](image)

Table 1 Comparison to UCERF 3.1 fault slip rates

<table>
<thead>
<tr>
<th>Fault segment</th>
<th>UCERF 3.1</th>
<th>Our MCMC</th>
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</thead>
<tbody>
<tr>
<td>Mean (min-max) mm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>San Andreas (North)</td>
<td>18.0 (13.2-22.8)</td>
<td>18.5-19.5</td>
</tr>
<tr>
<td>Rodgers Creek</td>
<td>5.7 (5.1-7.5)</td>
<td>5.5-11</td>
</tr>
<tr>
<td>Green Valley</td>
<td>3.8 (1.8-5.5)</td>
<td>9-10</td>
</tr>
</tbody>
</table>

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