Supplemental Information for Geodetic Evidence for Distributed Shear Below the Brittle Crust of the Walker Lane, Western United States

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1 The Impact of Postseismic Transients

We examine the impact of postseismic transients on the conclusions presented in the main paper by repeating the Shear Zone Model analysis on the corrected velocities. We correct the GPS time-series for expected postseismic displacement using the method of Wang et al. (2006). For this we use the seismic sources presented by Kreemer and Young (2022) and Young et al. (2023) and, as in those studies, we consider the viscosity profile presented by Guns and Bennett (2020) and Broermann et al. (2021). All the earthquakes considered are M≥6, are located outside the shear zone, and occurred before the GPS observation period (any postseismic deformation following earthquakes during the observation period is omitted by excluding the post-seismic time-series).

Figure S1 shows the comparison between corrected and uncorrected velocities, along with the corresponding corrections. The correction in the northern Walker Lane (WL) is notably influenced by 1700 Cascadia earthquakes, whereas corrections in the east-central WL result from historical seismicity in the Central Nevada Seismic Belt (Caskey et al., 2000; Hammond et al., 2009). There is little difference in the velocities in the western WL.

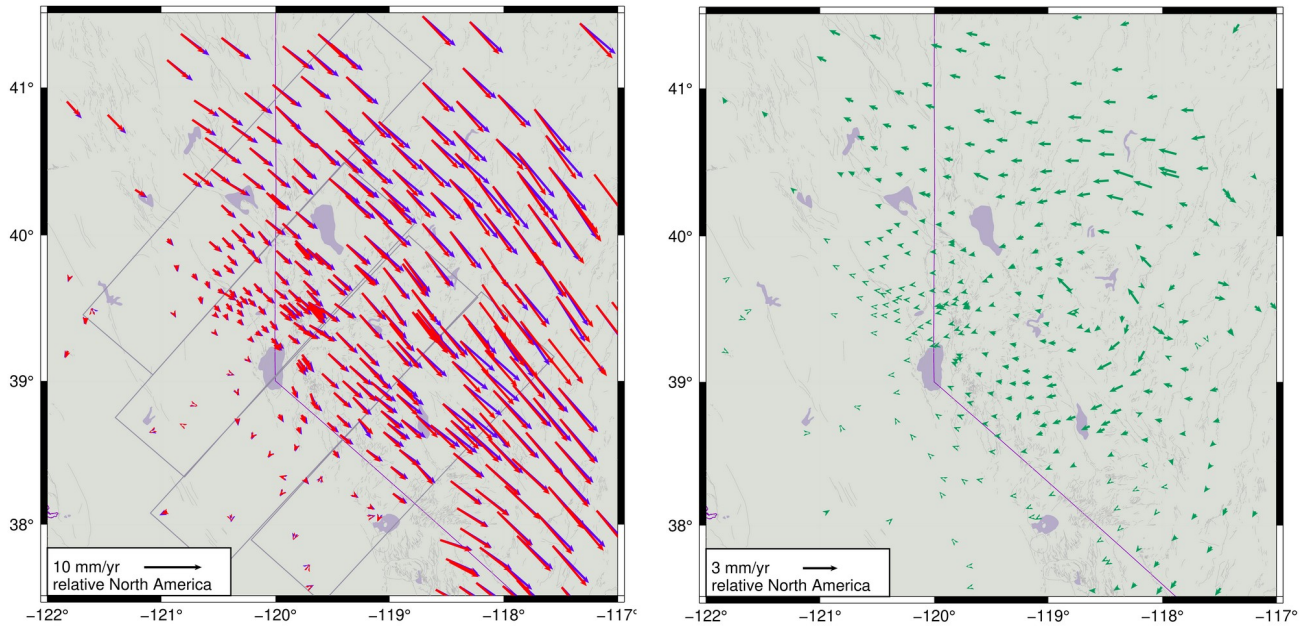

Figure S1: Left – the corrected (blue) velocities are plotted on top of the original (red). The profile outlines (gray) have the same shape as in the Figure 1d of the main paper, but with azimuths adjusted. Right – the postseismic correction, defined as the corrected velocities subtracted from the uncorrected.

We use the same profiles as in the main paper, but with the orientations adjusted to account for the slightly different velocity azimuths. The resulting profiles (Figure S2) are similar to those in the main paper, although with more scatter. The fit results of the SZM are slightly different from the fit to the uncorrected velocities. The predicted width for P1 increased from 130±4 km to 156±6 km, but the width for P2 decreased from 138±6 km to 122±6 km. The slip budget for P2 and P4 has changed by about 1 mm/yr.

Despite the differences, the predicted shear zone width is still in agreement with the seismicity in the region (Figure S3). The western edge of the zone also corresponds to the crest of the Sierra Nevada, albeit slightly shifted westward in P1. Our conclusion is that the correction does not substantially alter the findings presented in the main paper.

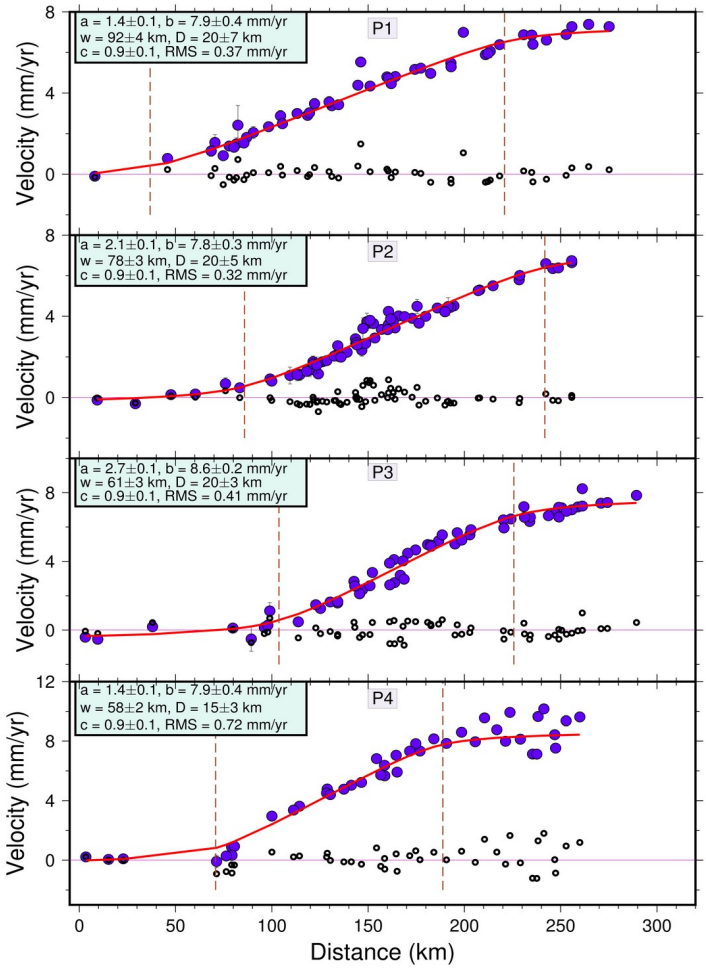

Figure S2: The results of the Shear Zone Model fit. This figure is same as Figure 6 in the main paper, but for velocities that have been corrected for postseismic relaxation. The outlines of the profiles are shown in Figure S1. The residuals are plotted as black circles.

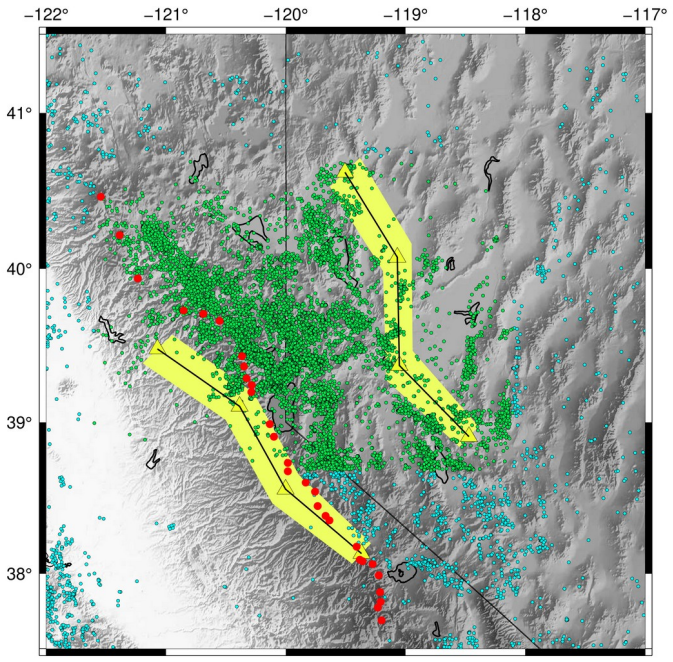

Figure S3: Same as Figure 10 in the main paper, showing the outline of the Shear Zone Model – predicted outline of the shear zone with uncertainty (yellow areas). Seismicity is same as in Figure 10. The red dots are the highest peaks, plotted as a proxy for the Sierra Nevada crest.

2. Data Set S1

The datafile ds01 contains the following columns:

1. Station name
2. Station longitude
3. Station latitude
4. East velocity (mm/yr) in the North America reference frame
5. North velocity (mm/yr) in the North America reference frame
6. East velocity (mm/yr) in the Sierra Nevada reference frame
7. North velocity (mm/yr) in the Sierra Nevada reference frame
8. Letter signifying the reference station set used in the transformation (N-northern, C-central Sierra Nevada)
9. Uncertainty in the east velocity (mm/yr)
10. Uncertainty in the north velocity (mm/yr)

11. The network the station belongs to

References

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