Post-seismic to Co-seismic Moment Ratio: a Case Study of the 2016 Moderate Earthquakes along Chaman Fault Inferred from Sentinel-1 InSAR Time-Series

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Postseismic-to-co-seismic moment ratios for large earthquakes greater than M7 are roughly around 0.3 or less, but those for moderate to even smaller earthquakes could be greater than 1 or more (Chen and Lapsta, 2009; Alwahedi and Hawthorne, 2018). However, there have been limited estimates on those ratios for moderate earthquakes. Of those limited estimates on postseismic-to-co-seismic moment ratio, the one reported by Furuya and Satyabala (2008) is exceptionally large, reaching nearly 6, in which a long-lasting afterslip due to an M5.0 earthquake in 2005 along Chaman Fault was detected. Chaman Fault is the western transform plate boundary between Indian and Eurasian plates and is well known for its low seismicity, which was interpreted as either a long-recurrent interval of large earthquakes or steady creep. Meanwhile, on May 13 and July 10, 2016, moderate earthquakes occurred along the Chaman fault, and are the largest earthquakes since the 2005 M5.0 event but located ~150 km further to the south. The USGS reports that the 1st event on May 13 consists of the triplet at almost the same hypocenter with Mw 5.2, 4.7, and 5.5 and that the 2nd event ~20 km to the north-east was mb 4.7 (body-wave magnitude). Our goals are to check if the Chaman Fault is anomalous in terms of its frictional properties and/or if the post-seismic to co-seismic moment ratio for moderate earthquakes will always get larger, compared to those for larger earthquakes. To estimate the post- to co-seismic moment ratios for these events, we examine the surface deformation associated with these moderate earthquakes, using 75 Sentinel-1A SAR images from October 2014 to August 2018 to generate 428 interferograms. We perform InSAR time-series analysis, using the LiCSBAS package by Morishita et al (2020). Below are our findings so far:

- The post-seismic to co-seismic moment ratio for the smaller mb 4.7 earthquake was ~10, whereas that for the larger Mw5-class events to the south was ~2.

- Slips on the fault for the mb4.7 earthquake reached the surface, whereas those for the Mw5 events did not.

-The apparent seasonality for the post-seismic moment release for the larger Mw5 earthquakes is probably caused because the areas are ~20 km distant from the reference area.

- No clear secular creep signals were detected before the earthquakes. Although we could notice possible triggered slip signals before the mb4.7 earthquake, their LOS changes are at most 5 mm and the estimated slip-patches for the mb4.7 earthquake were clearly distant from those for the possible triggered slip.

- Significant gap in the slip patches between the M5-class events and the mb4.7 event is located in the fault-bending zone that also coincides with the ruptured area by the 1892 M6.6 earthquake.

- Slip velocities and stress drops estimated for the mb4.7 event are smaller than those of the M5-class events.

Keywords: Chaman Fault, Afterslip, moderate earthquake, InSAR

