Interactions between the intraslab earthquakes and episodic slow slips beneath Kii Peninsula controlled by fluid migration

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Slow slips are thought to be related to geofluids and sometimes occur near the times of intraslab earthquakes. Studies have examined the interaction of slow slip with intraslab earthquakes, showing that even slow deformation on the plate interface has the potential to change the stress field (Warren-Smith et al. 2019) and seismicity (Han et al. 2014) within the subducting slab. However, detailed processes and relationships between intraslab earthquakes, slow slip phenomena and geofluids are not known. In the present study, we found changes in seismicity rates, b-values, and stresses in the Philippine sea slab before and after the times of slow slip episodes beneath Kii peninsula, southwestern Japan. At 1 month before the slow slip times, seismic rate and b-value of intraslab earthquakes become high, which is consistent with the effects of fluid-induced seismicity (Bachmann et al. 2012) and “geofluid injection” seismicity beneath northeastern Japan (Yoshida et al. 2017; 2018). Stress orientations in the upper-plane earthquakes suggest that the plate boundary just beneath the slow slip zone is weakly locked before slow slip times, becoming unlocked afterwards, whereas updip of the zone, it becomes more locked after slow slip. These interpretations of the degree of locking on plate boundary are consistent with results from Cascadia based on LFE recurrence patterns (Sweet et al. 2019) in that the locking on the plate boundary there appears to increase as one goes updip through the ETS zone. Our results suggest that monitoring of intraslab earthquakes may provide a means to evaluate not only slow slip activity but also plate boundary conditions.

