# *Repeating and triggered slow slip events in the near-trench region of the Nankai Trough detected by borehole observatories*

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Slow slip events (SSE), non-volcanic tremor, and very low-frequency earthquakes (VLFE) are well documented down-dip of the seismogenic zone of major faults, yet similar observations for the shallowest reaches of subduction megathrusts are rare. Here, we document a family of repeating strain transients in the outermost Nankai subduction zone, updip of the region that ruptures in great (M8-class) earthquakes. We report on data from two borehole observatories: IODP Site C0002, which penetrates the accretionary prism and monitors a zone 931-980 m below seafloor (mbsf) at a location 36 km landward of the trench; and Site C0010, 25 km landward, which penetrates the prism and monitors a zone spanning 389-407 mbsf. We focus on a time window from Dec. 2010 - Apr. 2016, for which we recovered records of formation pore pressure at both sites.

After filtering oceanographic noise using a local hydrostatic reference at each site, the pressure records reveal seven transient signals that are synchronous at the two holes. Of these, five arise spontaneously, and occur at ~1 yr intervals with durations of ~7-21 days. All are positive in sign at C0010, with consistent magnitudes of ~0.3-0.9 kPa; at Site C0002 three are negative in sign and two are positive, with magnitudes of ~0.3-0.7 kPa. The remaining two events are larger (1.7-2.7 kPa), exhibit a negative sign at both sites, and occur immediately following: (1) the Mar. 2011 M9 Tohoku earthquake; and (2) a sequence including an Apr. 1 M6 thrust event on the plate interface nearby and the Apr. 16 M7 Kumamoto event. In most cases, the pressure transients are accompanied by swarms of VLFE on the shallow plate interface. We interpret the pressure signals to reflect volumetric strain in response to SSEs. Simple dislocation models illustrate that the data at both sites are well fit by slip of ~1-2 cm on a patch at the plate interface that extends 20-40 km in the down-dip direction, and is centered beneath Site C0002 (spontaneous events) or slightly updip (triggered events). This coincides with a region of the megathrust characterized in previous studies by anomalously low $V_p$, and elevated pore fluid pressure. The repeating nature of the events, taken together with apparent triggering by regional earthquakes, indicates that the outermost reaches of the subduction megathrust are highly sensitive to perturbation and are perched near a state of failure.

 