Coseismic, Postseismic, and Interseismic Deformation in the Boundary Zone between the 2004 and 2005 Sunda Megathrust Ruptures: Insights from Coral Microatolls

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Simeulue Island, off the west coast of northern Sumatra, straddles the boundary of the 2004 and 2005 Sunda megathrust ruptures. The 2004 and 2005 earthquakes nucleated northwest and southeast of Simeulue, respectively, and each ruptured bilaterally toward the 100-km-long island. Cumulative uplift was 1.5 m at both the northwest and southeast tips of the island but diminished toward the island's center, where uplift reached only 0.5 m or less. Hence, although the 2004 and 2005 uplifts overlap, there is an uplift deficit, or saddle, on central Simeulue.

In addition to enabling observations of coseismic uplift, *Porites* coral microatolls enable measurements of postseismic and interseismic elevation changes. Whereas uplift in the year after May 2005 was negligible (< 10 cm) at the northwest and southeast ends of Simeulue, 30 cm of postseismic uplift occurred during that period in central Simeulue. Moreover, analysis of microatoll morphology indicates that, averaged over decades and longer, interseismic strain accumulation rates are lower in central Simeulue than at the island's ends. Additionally, we find evidence for uplift during the Nov 2002 earthquake and during at least one aseismic uplift event (tectonic uplift that cannot be attributed to a catalogued earthquake), in late 2003, in central Simeulue.

Historical intensity data imply that prior to 2005 the last great earthquake caused by rupture of the megathrust under Nias island, to the south, occurred in 1861; initial U-Th dates from uplifted fossil microatolls suggest that, like the 2005 rupture, the 1861 rupture extended north to southern Simeulue, but that uplift did not extend to northern Simeulue. Thus it appears that the 1861 and 2005 ruptures were similar in that they extended into but not through the Simeulue Saddle. Altogether, these observations suggest that the Simeulue Saddle is a poorly coupled segment of the megathrust that serves as a persistent barrier to rupture.

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