

## **Earthquake Recurrence and Long-Term Segmentation near the Boundary of the 2004 and 2005 Sunda Megathrust Ruptures**

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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 was 0.5 m or less. Hence, although the 2004 and 2005 uplifts overlapped, there was an uplift deficit, or saddle, on central Simeulue.

Postseismic and long-term interseismic behavior, as revealed by coral microatolls, suggests that the Simeulue Saddle is more than a transient feature. The Saddle was partially, but far from completely, filled in by postseismic slip through 2007. As much as ~20 cm of uplift occurred in the Saddle region during both the Nov 2002 and Feb 2008  $M \sim 7.3$  earthquakes, although even those contributions fail to erase the deficit. Microatoll morphologies indicate that, averaged over decades and longer, interseismic strain accumulation rates are lower in central Simeulue than at the island's ends.

U-Th dates of fossil coral microatolls suggest that northern Simeulue, which was uplifted in 2004, experienced an earthquake couplet or triplet in the 14th-15th centuries. Sites there experienced modest uplifts in ~AD 1393 and substantially larger uplifts in ~AD 1454. Some evidence exists for a third event, earlier in the 14th century, that uplifted northern Simeulue, but there is no evidence for prehistorical events after ~1454. The apparent lack of coral living on any of the reefs of northern Simeulue between ~AD 1454 and the early 20th century suggests that the reefs were above sea level during that entire period.

South of the Saddle, prior uplifts occurred in AD 1907, 1861, 1843, and around 1799. The 1861 earthquake appears to have been the closest analog to 2005 in size and extent, with 1843 and ~1799 being smaller, and with 1907 apparently occurring updip.

The spatiotemporal distribution of coral diedowns around Simeulue indicates that earthquakes have repeatedly propagated into the Saddle from both the north and the south, but there is no evidence of any rupture that has ever propagated through the Saddle. Altogether, observations of the behavior of central Simeulue during the recent and older earthquakes, and during postseismic and interseismic periods, suggest that the Simeulue Saddle is a poorly coupled segment of the megathrust that serves as a persistent barrier to rupture.