



Splay faults imaged by fluid-driven aftershocks of the 2004 Mw 9.2 Sumatra-Andaman earthquake

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High-precision teleseismic double-difference locations and focal mechanisms of aftershocks of the 2004 Mw 9.2 Sumatra-Andaman earthquake illuminate an active imbricate fault system in the accretionary prism offshore northern Sumatra. They reveal repeated failure of a shallow northeast-dipping thrust fault above the megathrust, which we interpret to be the reactivation of a splay fault that rises from the megathrust at ~ 55 km depth and cuts through the overriding Sunda plate. The projected intersection of the splay fault with the seafloor correlates with a recently active thrust fault seen in postseismic bathymetry data west of the Aceh basin. The general pattern of the aftershock distribution shows northeast oriented streaks as much as 80 km long and only a few kilometers wide, separated by sparsely seismic zones. A spatiotemporal analysis of the aftershock distribution indicates that ascending fluids released from the subducting oceanic crust along inherited seafloor fabric may control brittle fracture in the overriding plate. We speculate that if the splay fault was active coseismically, it may have led to amplified vertical uplift of the forearc ridge and contributed to generating the cataclysmic near-field tsunami that struck the northwest Sumatra coast following the 2004 rupture.