

The 2004 Sumatra Earthquake and Tsunami: Understanding a Unique Geohazard

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The destructive Indian Ocean tsunamis of December 26, 2004 were produced by a huge magnitude 9.3 earthquake offshore northern Sumatra. This megathrust earthquake was located in the collision zone where Indian oceanic crust is subducting beneath Asia. Several aspects of this earthquake make it unique. The magnitude, 9.3, was the largest recorded since 1964 and in terms of seismic energy release represents almost ten years worth of normal global seismicity. It generated destructive tsunamis that appear to be unique in recorded history of countries bordering the Indian Ocean.

In addition, examination of the tectonic setting of this earthquake suggests that it was in a unique tectonic position. Initial rupture was close to the northern end of Simeulue Island. From here, rupture propagated rapidly northward, ultimately traveling nearly 1500 km to the plate boundary offshore Myanmar. This represents rupture of almost the entire boundary of a small plate, the Burma plate, that is accommodating some of the rapid plate motion between India and Asia. Aftershocks of the main event show faulting within Asia, in the Burma plate and also within the subducting India plate. Some seismicity indicates that the boundary between the Indian and Australian plates may run through this area as well. This would mean that the epicenter is at a very unusual location, at the junction between four plates. This location may have implications for recurrence time of such an event.

In addition to its unique tectonic character, this earthquake revealed faults in how scientific knowledge is communicated to the general public. Although seismic risk was well-known locally, contributing to the low casualty rate on, for example, Simeulue Island, tsunami risk was underappreciated in other locations such as mainland Thailand. This event presents a challenge for the future in how we disseminate complex information.