Abstract

Under the Sumatran plate boundary the Australian-Indian plate is subducting at about 60 mm/yr in the direction $N11^0E$. The oblique convergence is partitioned into trench-parallel slip—accommodated largely by the Sumatran fault zone and trench-perpendicular slip—accommodated by the subduction zone. Our detailed map of the Sumatran fault zone (SFZ) shows that the Sumatran fault is highly segmented. The influence of these fault segmentations on historical seismic source dimensions suggests that the dimensions of future events will also be influenced by fault geometry. The largest geomorphic offsets along the Sumatran fault zone are about 20 km, and may represent the total offset across the fault. The shape and location of the Sumatran fault and the active volcanic arc are highly correlated with the shape and character of the underlying subducting oceanic lithosphere

We utilize coral *microatolls* in west Sumatra to document evidence for deformation of the underlying subduction interface. Microatolls are very sensitive to fluctuations in sea level, and thus act as natural tide gauges. They record not only the magnitude of vertical deformation associated with earthquakes (*paleoseismic* data), but also continuously track long-term *aseismic* deformation that occurs during intervals between earthquakes (*paleogeodetic* data). Numerous microatolls from the region around the equator record a simple pattern of tilt away from the trench axis in 1935 related to an $M_w7.7$ earthquake. About 115 km from the trench axis, uplift was nil. Nearer to the trench, uplift progressively increased trench-ward to at least 90 cm. Farther than 115 km from the trench, submergence of up to 35 cm occurred. We model these paleogeodetic data by a 2.3 m slip event on the interface between 88 and 125 km from the trench axis. A large aseismic event or "silent earthquake" in 1962 is among the most interesting phenomena discovered in the coral record, and is the second largest short-lived event recorded throughout the equatorial region. Furthermore, paleogeodetic data reveal that the *interseismic* deformation rates have varied both temporally and spatially.