High-resolution seismic reflection images crossing the Sumatran seismogenic zone: "Sumatra Earthquake And Tsunami Offshore Survey" (SEATOS), 2005

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As part of SEATOS ("Sumatra Earthquake and Tsunami Offshore Survey"), conducted in May 2005 from *M/V The Performer*, high- resolution seismic reflection profiles were collected over parts of the Sunda accretionary wedge southwest of Sumatra. Most of these single-channel, GI-air gun profiles were sited to investigate subsurface geology associated with seafloor features identified using *HMS Scott* multibeam data. These features were hypothesized to have resulted from the devastating, tsunami-producing earthquake of 26 December 2004. The seismic images underscore the complex geology of the accretionary wedge, representing the long-term geologic record of subduction of the Indian plate beneath the Burma-Sunda plates.

In the forearc basin, reflections are flat-lying and coherent over tens of kilometers. The profiles image at least six zones that may represent periodic debris flows associated with discrete seismic events. There are also examples of possible liquefaction pockmarks at the seafloor. Evidence of faulting or slumping from the 2004 earthquake is not apparent in seismic data from the fore arc basin or the adjacent high. The high is characterized by steep-sided thrust ridges and folds. Sediments within inter-ridge basins show a history of fault-related folding and growth sedimentation related to the ongoing regional convergence that characterizes this region.

Along the front of the accretionary wedge, a number of landward-vergent folds are observed within thrust blocks bounded by steep faults at their leading and trailing sides. These structures suggest that uppermost sediments within the trench form a passive roof delaminated from seaward vergent deeper sediments. One feature of particular interest lies along the seaward boundary of one of the blocks; the "ditch" is ~15-20 m deep and ~200 m wide at the seafloor, resembling an extensional graben but in a compressional regime. There is seismic evidence of significant (i.e., meters) of seafloor displacement along imaged faults flanking the "ditch". It is concluded from these data that the most significant surface displacement resulting from the Great Sumatra-Andaman earthquake occurred at the toe thrust/leading edge of the accretionary prism, in ~4500 m water depth. This area of localized deformation is basinward of predicted patterns from current co-seismic displacement models derived from the earthquake seismic records.