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The Indian Ocean tsunami of December 26^{th} 2004: results from the marine surveys of HMS Scott and the Sumatra Earthquake and Tsunami Offshore Survey (SEATOS), 2005

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To investigate the southern part of the rupture zone of the December 26^{th} Indian Ocean earthquake several marine scientific expeditions took place in 2005. The first expedition to visit the area after the earthquake was aboard HMS Scott in January-February during which high resolution 12 kHz swath bathymetry was acquired. The survey was the first of its kind carried out so soon after a Great Earthquake and data were acquired over 40,000 square kilometres of seabed located in the southern part of the rupture zone offshore Sumatra. A second expedition, termed the Sumatra Earthquake and Tsunami Offshore Survey (SEATOS) and based on the results of the Scott survey took place in May. During SEATOS high-resolution single channel seismic was acquired together with seabed video and still photographic images of the seabed acquired by Remotely Operated Vehicle (ROV).

The area investigated by the surveys includes the Indian/Asian plate boundary and lower accretionary prism, parts of the Aceh forearc basin and outer arc high including the southern termination of the earthquake rupture and probable segment boundary. The results from the two expeditions provide new insight into the structure of the region over the earthquake epicentre that informs on the tsunami potential of the Andaman-Sumatra subduction zone and may be summarised as follows.

The swath bathymetry and high-resolution seismic image an accretionary prism comprising an outer, actively deforming, toe region made up of discrete asymmetric thrust folds up to 1000m high (Henstock et al., in press). These pass inboard across a steep seabed gradient into the older accretionary region that forms a heavily dissected submarine plateau where erosion is the dominant process. Within the forearc basin there is a $\sim$1 kilometre thick sedimentary sequence which contains numerous submarine mass flow deposits. The basin is bordered in the west by a strike slip fault. Together with the ROV video and still photographs the dataset provides very little evidence for large-scale seabed movement attributable to the December 2004 earthquake. The movement identified is mainly confined to the toe of the accretionary prism along the deformation front and is very localised. A linear trough, the 'ditch', located on the deformation front (Henstock et al., in press) is a very young feature as shown by the video and still photographic images, but its origin is still problematic. Vertical displacement measured from ROV investigations is comparable to maximum vertical displacements as calculated from earthquake magnitude (Lay et al., 2005).

There is a great deal of evidence for submarine landslides on the plate boundary and inboard within the Aceh forearc basin. However, there seem to be none that contributed significantly to the December 2004 tsunami. A large landslide identified on the Scott data is most likely older than December 2004. Even if formed in December its location deep on the accretionary toe together with its small size prevents it from being a significant local tsunami source. Within the forearc basin, there is significant evidence for submarine sediment failure, but again the debris flows are old and predate December 2004.