A Seismic Investigation into the earthquake that caused the Boxing day 2004 Tsunami

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On December 26, 2004, off the coast of Northern Sumatra, a massive offshore earthquake triggered the deadliest Tsunami in recorded history. The earthquake occurred at 10 km depth, measuring to 9.3 on the open ended Richter scale. The earthquake was the second largest earthquake in recorded history, and broke 1300 km of plate boundary over a 150 km wide area. The initial shock lasted for 500 seconds, with multiple and widespread aftershocks until the second earthquake occurred some months later.

The sudden vertical rise of the seabed, approximately 3 m, during the earthquake displaced massive volumes of water and resulted in a Tsunami that struck the coastlines of the Indian Ocean.

The wave height at the shore line has been estimated to vary between 3 and 30m depending on location and extended as far as 1 kilometer in-land. The Tsunami traveled as far as 5000km, to the east coast of Africa, arriving with enough force to kill people and destroy property.

By the end of the day more than 150,000 people were dead or missing and millions more were homeless in 11 countries. Hardest hit were Sumatra (death toll greater than 170,000), Sri Lanka (death toll greater than 31,000), Thailand, and India.

Following this disaster Schlumberger contributed the M/V Geco Searcher and data processing resources to create 2D seismic images in the vicinity of the earth quake epicentre. (see map) as part of an International research effort, in conjunction with IPGP and BPPT. This deep seismic survey is a part of a larger effort to map the region, since the Tsunami, including high resolution sea bottom bathymetry mapping and an OBS refraction survey.

The data was Acquired over 5 days in July 2006 and processed in WesternGeco Jakarta Data Centre during August to December 2006.

The data was recorded with deep towed sources & cables, up to 12 Kilometre offsets and twenty second recording time. Final processed images will be shown indicating the subduction zone at 30-40 kilometres depth.

The paper will describe:

- The geologic background to the area
- The survey design process, with a focus on deep/low frequency signal penetration
- The reconfiguration of the Q-Marine equipment to a deep crustal imaging system
- The raw data
- The data processing applied
- The final migrated images
- Review of what has been discovered
- Potential further work