



Morphological structures relate to the location and extent of the seismogenic zone – bathymetric studies of the Sunda margin, Indonesia

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Earthquake history shows that the Sunda subduction zone of the Indonesian margin produces great earthquakes offshore Sumatra, whereas earthquakes of comparable magnitude are lacking offshore Java and the Lesser Sunda islands. Morphological structures from multibeam bathymetric data across the forearc relate with the extent of the seismogenic zone (SZ).

Off Java and the Lesser Sunda islands the Indo-Australian plate subducts almost normal underneath the oceanic plate of the Indonesian archipelago. Landward of the trench, the outer wedge of the slope break is ~50 km uniformly wide with uniform bathymetric gradients. The slope of the outer wedge is locally cut by one/two steeper ridges of ~5 km extent. The sharp slope break corresponds to the updip limit of the SZ, which is also associated with the seawardmost part of the outer arc high. Landward of the slope break we find narrow, uniform outer arc ridges. The landward termination of these ridges coincides with the downdip limit of the SZ. The intersection of the shallow upper plate mantle with the subduction thrust fault marks the downdip limit of the SZ beneath the forearc.

Off Sumatra the Indo-Australian plate subducts obliquely underneath the continental part of the Indonesian Sunda margin. Landward of the trench, the outer wedge varies, being mostly ~70 km wide, in some areas narrowing to 50 km width. The lower slope bathymetric gradients are steep. The outer wedge slope is made up of several steeper ridges of ~5 km extent. The slope break is only locally sharp, and corresponds to the updip limit of the SZ. The outer arc ridges off Sumatra are, in comparison with the forearc structures off Java and the Lesser Sunda islands, wider and partly elevated above sea level forming the Mentawai forearc islands. The downdip limit of the SZ coincides with the intersection of a deeper upper plate mantle with the subduction thrust fault beneath the forearc. Sunda Strait marks a transition zone between the Sumatra and Java margins.

Seafloor morphology enables the identification of the seismogenic zone (SZ) across the entire Sunda margin. The SZ is uniformly wide for the Sumatra margin and narrows off Sunda Strait. Sunda Strait is the transition between the Sumatra margin and the uniformly narrow extent of the SZ of the Java/Lesser Sunda margin. Comparing the Java and Lesser Sunda islands with the Sumatra margin we find the differences along the Sunda margin, especially the wider extent of the SZ off Sumatra, producing larger earthquakes, to result from the combination of various causes: The sediment income on the oceanic incoming plate and the subduction direction; we attribute a major role to the continental/oceanic upper plate nature of Sumatra/Java influencing the composition and deformation style along the forearc and subduction fault. Off Sumatra the SZ is up to more than twice as wide as off Java/Lesser Sunda islands, enlarging the unstable regime off Sumatra and thus the risk of sudden stress release in a great earthquake.