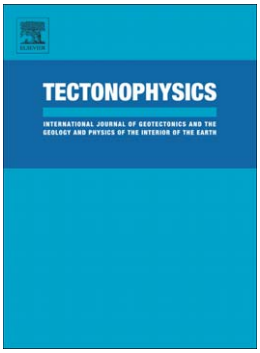

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PII: S0040-1951(18)30117-3
DOI: doi:10.1016/j.tecto.2018.03.012
Reference: TECTO 127802

To appear in: *Tectonophysics*

Received date: 19 December 2017
Revised date: 15 March 2018
Accepted date: 17 March 2018

Please cite this article as: Koulali, Achraf, McClusky, Simon, Cummins, Phil, Tregoning, Paul, Wedge geometry, frictional properties and interseismic coupling of the Java megathrust, *Tectonophysics* (2018), doi:10.1016/j.tecto.2018.03.012

Wedge geometry, frictional properties and interseismic coupling of the Java megathrust

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Abstract

The mechanical interaction between rocks at fault zones is a key element for understanding how earthquakes nucleate and propagate. Therefore, estimating frictional properties along fault planes allows us to infer the degree of elastic strain accumulation throughout the seismic cycle. The Java subduction zone is an active plate boundary where high seismic activity has long been documented. However, very little is known about the seismogenic processes of the megathrust, especially its shallowest portion where onshore geodetic networks are insensitive to recover the pattern of elastic strain. Here, we use the geometry of the offshore accretionary prism to infer frictional properties along the Java subduction zone, using Coulomb critical taper theory. We show that large portions of the inner wedge in the eastern part of the Java subduction megathrust are in a critical state, where the wedge is on the verge of failure everywhere. We identify four clusters with an internal coefficient of friction μ_{int} of ~ 0.8 and hydrostatic pore pressure within the wedge. The average effective coefficient of friction ranges between 0.3 and 0.4, reflecting a strong décollement. Our results also show that the aftershock sequence of the 1994 M_w 7.9 earthquake halted adjacent to a critical segment of the wedge, suggesting that critical taper wedge areas in the eastern Java subduction interface may behave as a permanent barrier to large earthquake rupture. In contrast, in western Java topographic slope and slab dip profiles suggest that the wedge is mechanically stable, i.e deformation is restricted to sliding along the décollement, and likely to coincide with a seismogenic portion of the megathrust. We discuss the seismic hazard implications and highlight the importance of considering the segmentation of the Java subduction zone when assessing the seismic hazard of this region.

Keywords: Critical Wedge, Java Subduction, Frictional properties, Interseismic deformation

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