UPLIFT AND SUBSIDENCE DURING THE SEPTEMBER 2007 MENTAWAI EARTHQUAKES FROM FIELD OBSERVATIONS

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ABSTRACT

Seismic rupture of the Sunda megathrust offshore southern Sumatra in September 2007 resulted in uplift of part of the Mentawai Islands. The 700-km-long Mentawai patch last ruptured in 1797 and 1833. Measurements of vertical deformation using GPS and coral microatolls indicate that 2007 uplift is entirely within the region of uplift of the 1833 earthquake but does not extend northwestern into a region that last slipped in 1797; moreover, uplift in 2007 is less than in 1797 or 1833. The limited spatial extent and the modest amounts of slip in 2007 indicate only a fraction of potential accumulated slip was relieved by the 2007 earthquakes. This suggests the 2007 earthquakes are only the beginning of a new sequence of large ruptures of the Mentawai patch.

CONCLUSIONS

- the 2007 Mentawai EQs ruptured portions of the megathrust that have not ruptured since 1797 & 1833
- 2007 uplift is almost entirely within the 1833 uplift region; the NW limit of uplift in 2007 approximates that in 1833, just north of Sipora Island
- the Siberut section of the megathrust has not ruptured since 1797
- the largest observed uplift associated with the 2007 earthquakes is 1.5 m, documented on Mega Island at 4° S
- north of 3° S, 2007 uplift is generally less than those in 1797 & 1833
- a small net subsidence trough occurs in the central part of the Pagai Islands; the pivot line for the M 8.4 event must lie west of this trough
- the close timing & partial overlap of 1797 & 1833 indicate that a single megathrust rupture need not relieve all accumulated strain
- a comparison of strain accumulated in the past half-century with strain relieved shows that, even where slip occurred in 2007, strain relief was only partial
- multiple lines of evidence suggest the 2007 earthquakes mark only the beginning of a new sequence of large Mentawai patch ruptures