UCSB

EARTH SCIENCE

SPEAKERS CLUB

WEBB 1100 • THURSDAY MAY 11th. • 2:00 PM

Testing for physical constraints on large Intermediate-depth earthquake fault geometry via finite-fault inversions

Adam Arce

Department of Earth Science

UCSB

Intermediate-depth earthquakes (IDEs) refer to those with a 70 – 300 km focal depth (Gutenberg and Richter, 1949). Brittle-behavior (i.e. earthquakes) within this depth range is only permissible within wet, relatively-cold subducted lithosphere. IDEs are the brittle response to the geodynamic/petrologic processes undergone during subduction and carry crucial information related to thermal, petrological, and stress stages of the subducted slab. With the consideration that rupture lengths (L) of IDEs generally scale with seismic moment (M_0) as $M_0 \propto L^3$, increasing with earthquake magnitude; we study the slip distributions of two large earthquakes in the northern Mariana subduction zone: the Sep. 28th, 2007 M_w 7.5 event with a hypocentral depth of 112 km and the Mar. 28th, 2000 M_w 7.6 event at 246 km depth. We aim to address the following questions:

(I) It is still debated whether large IDE rupture occurs along pre-existing outer-rise faults. Given that the focal depths of outer-rise earthquakes are found to be bounded within material at temperatures below 600^{o}C, can large earthquakes break through the corresponding width in slab-normal direction at depth?

(II) In most subduction zones, IDEs are distributed along two distinct, down-dipping planes separated by a 10 – 40 km thick aseismic region; collectively known as a double Wadati-Benioff zone (DWBZ). The locations of DWBZ are found to be correlated with the pressure-temperature condition of serpentine dehydration. Do large earthquakes rupture across the aseismic region separating the DWBZ? Do large earthquakes rupture outside the DWBZ?

(III) In most subduction zones, the upper- and lower-layers of the DWBZ predominately exhibit downdip compression (DC) or downdip extension (DE), respectively. It has been interpreted as the result of plate unbending, possibly in combination with dehydration embrittlement. Do rupture length of these two large IDEs, both with normal fault focal mechanisms, fit into the predicted DE zone?