The Slip Behavior of the Shallow Megathrust from Seafloor Observations

Susan Y. Schwartz - UC Santa Cruz
Domain A
Large Slip
Very weak shaking
Strong tsunami

Domain B
Large slip
Low frequency shaking

Domain C
Moderate slip
High frequency shaking

Domain D
Slow slip/Seismic tremor

Lay et al., JGR (2012).
Is the Shallow Megathrust Locked?

Peru Trench
Gagnon et al. (2005)
Fig. 3. Global distribution of slow earthquakes.

Obara & Kato, 2016
CRSEIZE: Costa Rica Subduction Zone Experiment - Instrumenting the Plate Boundary with a Seismic, GPS and Fluid Flow Network


Technical/Instrumental Assistance: Dan Sampson, IRIS, UNA VCO
2000 Slow Slip Events—Postulated from Fluid Flow

Brown et al., 2005
LaBonte et al., 2009
2003 Slow Slip Event—Observed Geodetically
Dixon et al., 2014
Slow slip occurs both up- and down-dip of the seismogenic zone.

Up-dip slow slip may extend to very close to the trench. Not well resolved

If the present rate of shallow slow slip exists, all interseismic strain accumulation is released in slow slip.
Slow slip initiates offshore and propagates to the trench
Hikurangi Ocean Bottom Investigation of Tremor and Slow Slip (HOBITSS)
Seafloor moves up ~2-5 cm

Wallace et al., 2016
Seafloor pressure gauge captures slow slip event (Wallace et al., 2016)
Ocean Bottom Seismometer (OBS)
Absolute Pressure Gauge (APG)
GeoNet Seismometer
2014 Gisborne SSE (mm slip)
Subducting Seamount
Seamount Templates (+/- 5 km PI): Time vs. Magnitude

Seamount Detections (3-5 OBS stations): Time vs. Magnitude

Seamount Templates (+/- 5 km PI): Time vs. Magnitude

Seamount Detections (3-5 OBS stations): Time vs. Magnitude

Repeating Earthquake Families in Seamount area (12 total)
The image illustrates a geological cross-section with various labeled features. The top portion of the image is a high-angle view, showing the Fracture Zone and Accretionary Wedge. The bottom portion is a depth profile with labels for the Plate Interface and Low-amplitude reflectivity. The inset on the right indicates the Gisborne Knolls and the Subducting Seamount.

The diagram also includes the 2014 Gisborne SSE and 2014 SSE Tremor, with arrows indicating the SSE Duration and Tremor Duration. The depth (km) is marked on the vertical axis, and the Distance (km) from -38.64/178.41 (S60E) is shown on the horizontal axis. The Julian Day 2014 is also indicated on the horizontal axis, ranging from 260 to 332.

Key features include:
- **High Reflectivity Zone**
- **Fracture Zone**
- **Accretionary Wedge**
- **Plate Interface**
- **Low-amplitude reflectivity**
- **Subducting Seamount**
- **Gisborne Knolls**

The diagram provides a visual representation of seismic and geological features, aiding in the understanding of the area's geological and tectonic dynamics.
Template Matching with Seismic Data
CONTINUING WORK:

1. Pick P and S arrivals and locate new events.
2. Determine faulting geometry of earthquakes to establish which events are on the plate interface.
3. Perform template matching to identify repeating sequences.
4. Correlate our postulated shallow slow slip events with geodetic data (CI-APGs, borehole strain, GPS) and seismic tremor.