Supporting Material for Paper 2014GLXXXXXX

# The 23 June 2014 Rat Islands archipelago, Alaska Mw 7.9 intermediate depth earthquake

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## Introduction

Auxiliary materials comprise 6 figures and one QuickTime animation.

Figure S1. Locations of stations (circles) recording P waves used in backprojections for four different networks in (a) Japan (Hi-net), (b) Europe, (c) Australia and South Pacific, and (d) North America. The average correlation coefficients from multi-station correlations are shown by the color scale.

Figure S2. Comparison of observed (black) and synthetic (red) P and SH ground motions for the preferred rupture model shown in Figure 3. For each station, the azimuth from the source (φ) and epicentral distance (Δ) are indicated, along with the peak-to-peak ground motion in microns (blue numbers). The observed signal (black traces) amplitudes are normalized. The red curves are true relative amplitude synthetic waveforms. For each station the first trace is ground displacement and the second trace is ground velocity.

Figure S3. Rupture model for the steeply dipping plane for the 23 June 2014 Mw 7.9 Rat Island archipelago earthquake obtained by linear waveform inversion of teleseismic P and SH ground displacements and ground velocities for the period band 1.1-200 s. Corresponding waveform fits are shown in Figure S4. (a) The moment rate function with the body wave inversion estimates of seismic moment, $M_0$, rupture centroid time $T_c$, and average rupture expansion velocity $V_r$. (b) The average fault geometry focal mechanism, with strike, φ, dip, δ, and rake, λ for the preferred fault plane. (c) Slip distribution on the model fault plane, which has 7.5 km grid spacing. The average slip for each subfault is color-coded and the vectors indicate the slip magnitude and direction of the hanging-wall plane relative to the foot-wall. The dashed circles are isochrones for the expanding rupture front in 10 s increments. The subfault source durations are indicated by the polygons in each subfault, with the total rupture duration of each being 9 s. The star indicates the position of the hypocenter, and corresponds to the star in Figure 1.

Figure S4. Comparison of observed (black) and synthetic (red) P and SH ground motions for the steeply-dipping fault plane rupture model shown in Figure S3. For each station, the azimuth from the source (φ) and epicentral distance (Δ) is indicated, along with the peak-to-peak ground motion in microns (blue numbers). The observed signal (black traces) amplitudes are normalized. The red curves are true relative amplitude synthetic waveforms. For each station the first trace is ground displacement and the second trace is ground velocity.

Figure S5. All aftershock locations from the USGS-NEIC are viewed in (a) map view with bathymetry and Aleutian trench (barbed line) shown, (b) vertical cross-section A-A’ along an azimuth of 17° through the mainshock hypocenter, which is perpendicular to the local strike of the Aleutian trench with the red triangle indicating the trench position and the dashed cyan lines indicating the possible slab dipping angles, (c) vertical cross-section

B-B’ along an azimuth of 295.7° in the plunge direction of the shallow-dipping nodal plane, and (d) vertical cross-section C-C’ along an azimuths of 84.4° in the plunge direction of the steeply-dipping nodal plane. Earthquake hypocenters are shown by circles, color-coded with source depth and radius-scaled proportional to magnitude, as in Figure 1. The spread of aftershock locations does not allow unambiguous preference for a fault-plane, but in either case the source region appears to be spatially concentrated over a 50 km x 50 km extent.

Figure S6. Details about the seismograms shown for recent large intermediate depth earthquakes from 1993 to 2014 in Figure 5. For each event, a representative teleseismic P wave ground displacement recording from 64° to 79° is shown with a 20 s leader and 150 s of motion. Data are filtered in the passband 0.005 to 4.0 Hz. The waveforms are aligned on the P arrival, with the predicted arrival time of pP indicated by green tick marks and the sP arrival time indicated by blue tick marks. The amplitudes are normalized by the peak amplitude of each recording. The event location, year, Julian day, and station name are indicated, with the station azimuth (φ) and epicentral distance (Δ) and the PAGER-cat source depth (h) indicated.

Animation S1. QuickTime MOV file with H264 compression of back-projections for the 0.5-2.0 Hz P waves signals recorded at European (EU), North American (NA), Japanese (Hi-net), and Australia/South Pacific (AU) networks. The signal power at each time instant is plotted over the source region grid, with purple indicating maximum coherent power.