## Harvard University, Solid Earth Physics Seminar

Tuesday 26 January 2016, 1:00 pm
4th Floor Faculty Lounge, Hoffman Laboratory, 20 Oxford St.

# *Okhotsk 2013 and Bonin 2015: Surprises from recent large deep earthquakes*


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***Abstract:*** We study the spectral amplitudes of the first two Earth radial modes, ${}_0S_0$ and ${}_1S_0$, excited by the Sea of Okhotsk earthquake of 24 May 2013, the largest deep event ever recorded, in the search for an isotropic component to its source. In contrast to the case of the 1994 Bolivian earthquake, we detect an implosive component $M_I = -6.9 \times 10^{26}$ dyn*cm, equivalent to 2% of the full scalar moment, but 9% of the lone deviatoric component exciting the Earth's radial modes. This implosive component would be expected in the model of transformational faulting in which deep earthquake rupture nucleates and grows upon transformation of metastable olivine to ringwoodite in the cold subducting slab. This interpretation is confirmed by quantitative estimates (55 to 80 cm) of the thick- ness of the transformed shear zone, which scale favorably, relative to earthquake fault length, with the upper end of the range of laboratory results reported for ices, germanates and silicates. The resulting extent of the transformation in the metastable wedge is consis- tent with the local geometry of the deep slab, as recently determined by rupture modeling and aftershock distribution. Our results are in contrast to those for the two runner-up largest deep earthquakes, the 1994 Bolivian and 1970 Colombian shocks, for which a similar isotropic component could not be detected. We attribute this difference to variabil- ity in the ratio of isotropic to deviatoric components, which combined with the smaller size of the 1970 and 1994 events, would make any putative implosive component fall below detection levels, especially in the case of the 1970 Colombian earthquake for which only analog narrow-band records were available.

Preliminary results are presented in the case of the deep 2015 Bonin earthquake, which occurred 100 km deeper than any prior known seismicity in the area, and outside the direct continuation of the local Wadati-Benioff Zone; that event may be too small for radial mode investigation.