

# A systematic study of very low frequency earthquakes (VLFs) in Cascadia

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Very low frequency earthquakes (VLFs) are rich in 0.02-0.05 Hz energy and depleted in higher frequencies compared to local earthquakes of similar magnitudes. They are thought to represent a mode of fault slip that is typically associated with slow earthquakes. So far, VLFs are found in a handful of subduction zones worldwide including Japan and Ryukyu trench [Ando et al., 2012; Ito et al., 2010]. They are typically located downdip of the seismogenic zone and near the subduction trench as well, making them a critically important event to study the interaction between different frictional/stress regime and near-trench tsunamigenic earthquakes.

VLFs are recently found in Cascadia during an episodic tremor and slip (ETS) event [Ghosh et al., 2015]. A grid-search moment tensor method is used to obtain the best locations and source parameters. They are located downdip of the seismogenic zone, and migrate alongstrike with tremor activity (see figure). Their focal mechanisms indicate double-couple sources, and are consistent with shallow subduction thrust geometry in the study area. The  $M_w$  ranged between 3.3 and 3.7. VLFs releases more moment than the total cumulative moment released by tremor activity during an entire ETS event. They are providing a unique way to investigate fault heterogeneity, the wide spectrum of fault slip and energy partitioning across the frequency spectrum of seismic radiation during faulting.

## References

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Tremor (orange dots), VLFs (yellow stars), and their focal mechanisms during August 2011. The date of occurrences and moment of magnitudes ( $M_w$ ) of VLFs are noted. Black triangles are the seismic stations used to obtain source parameters of the VLFs. The tremor catalog is obtained from <http://pnsn.org/tremor>. Tremor detected between 31 July and 2 September 2011 is used to show the tremor distribution during the episodic tremor and slip event. Fig. is modified from Ghosh et al., 2015.

