Supplementary Material for

Seismotectonics of the Mount St. Helens Region

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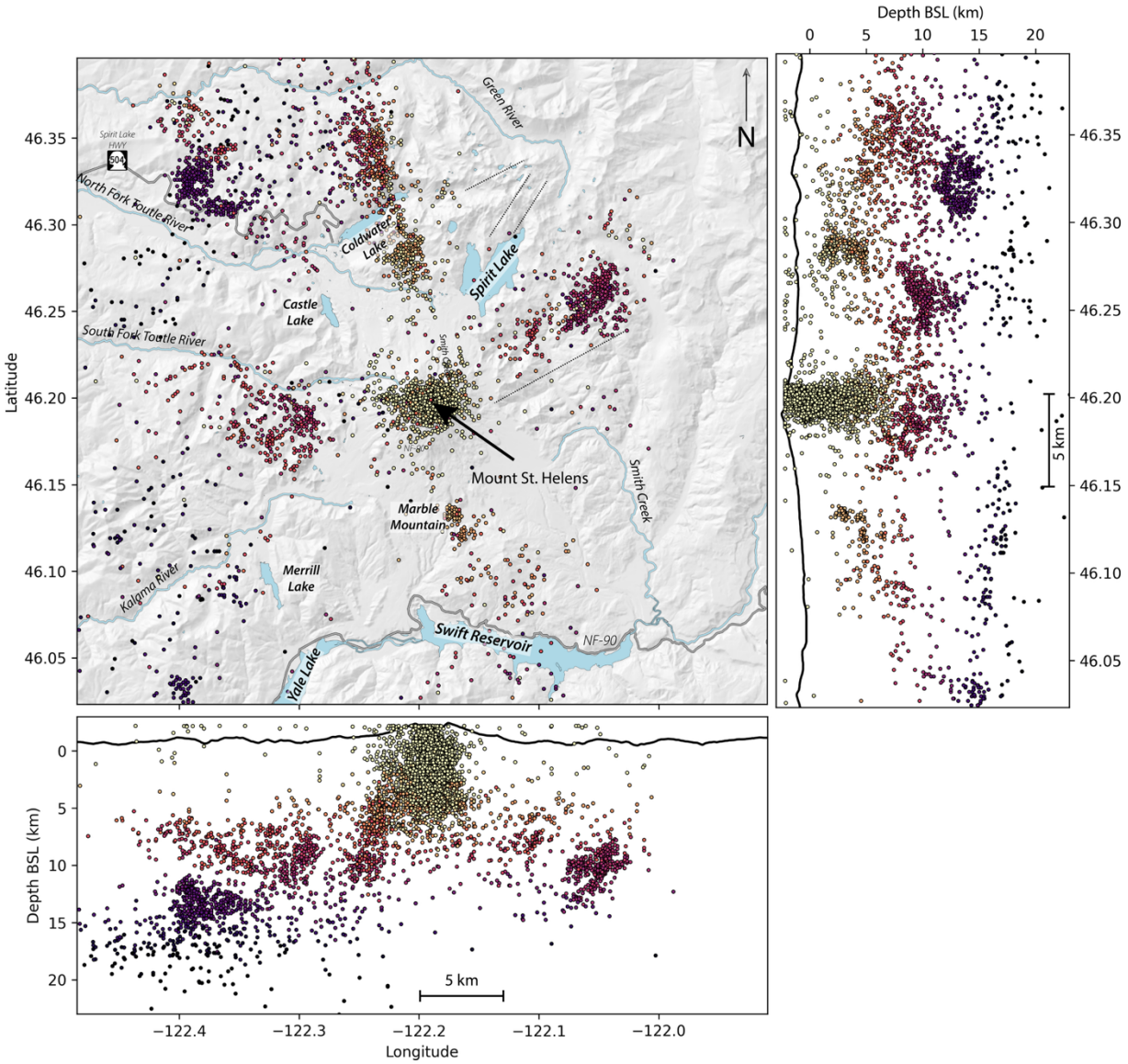
Text S1: Headers for long-term and XD/iMUSH earthquake catalog files. These files may be accessed through Hirao et al. (2026) at https://doi.org/10.5281/zenodo.18916956.

The earthquake catalogs analyzed in this study are uploaded here as CSV dataframe files. The headers are as follows:

- 'evid' : unique event identifier
- 'utc' : event origin time in UTC
- 'lat', 'lon' : event location latitude and longitude in decimal degrees
- 'depth' : event location depth in km below sea level
- 'rmsP', 'rmsS' : root mean squared misfit for P and S phases
- 'eh', 'ez' : location uncertainty for horizontal and vertical directions
- 'et' : event origin time misfit
- 'type' : whether an event is 'pnsn' or 'new' detection
- 'mag' : event magnitude from extended local magnitude scale M_L

For information regarding focal mechanism catalog headers, please refer to the Hardebeck and Shearer (2002) manual.

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34 **Figure S1.** Absolute starting locations from NonLinLoc (Lomax et al., 2000; Lomax et al.,
35 2009) of all templates of nonvolcanic events used in this study as well as volcanic events
36 beneath Mount St. Helens. Event depths are presented in kilometers below sea level (BSL).
37 The volcanic events beneath Mount St. Helens are analyzed in Hirao et al. (2025). Note the
38 distinct gap between events beneath the edifice and surrounding faults.

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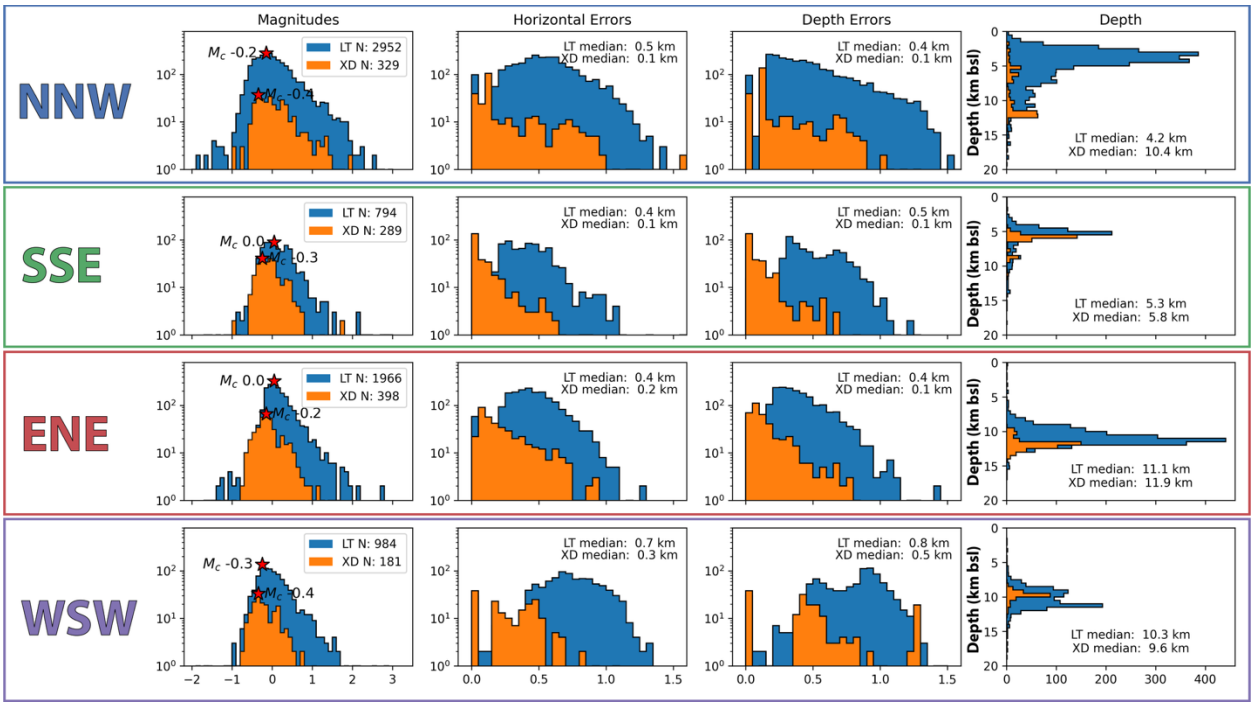


Figure S2. Location statistics for all four seismicity groups (see Fig. 3), including magnitude of completeness (M_c), magnitude distributions, horizontal and depth uncertainties, and depth distributions for both long-term (LT) 2008–2024 catalog and 2014–2016 catalog created with the Imaging Under Mount St. Helens (iMUSH or XD) dense array experiment (Creager, 2014; Kiser et al., 2016).

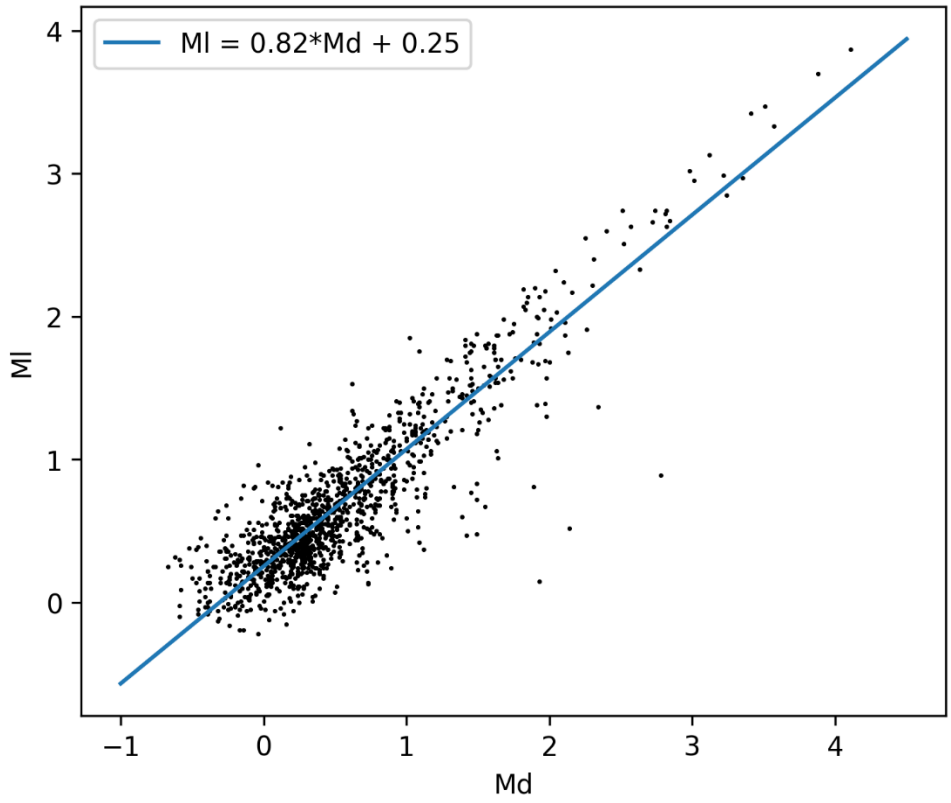


Figure S3. Linear scaling between duration magnitude (Md) and local Richter magnitude (Ml) for templates. These magnitudes are sourced from the Pacific Northwest Seismic Network (University of Washington, 1963) earthquake catalog.

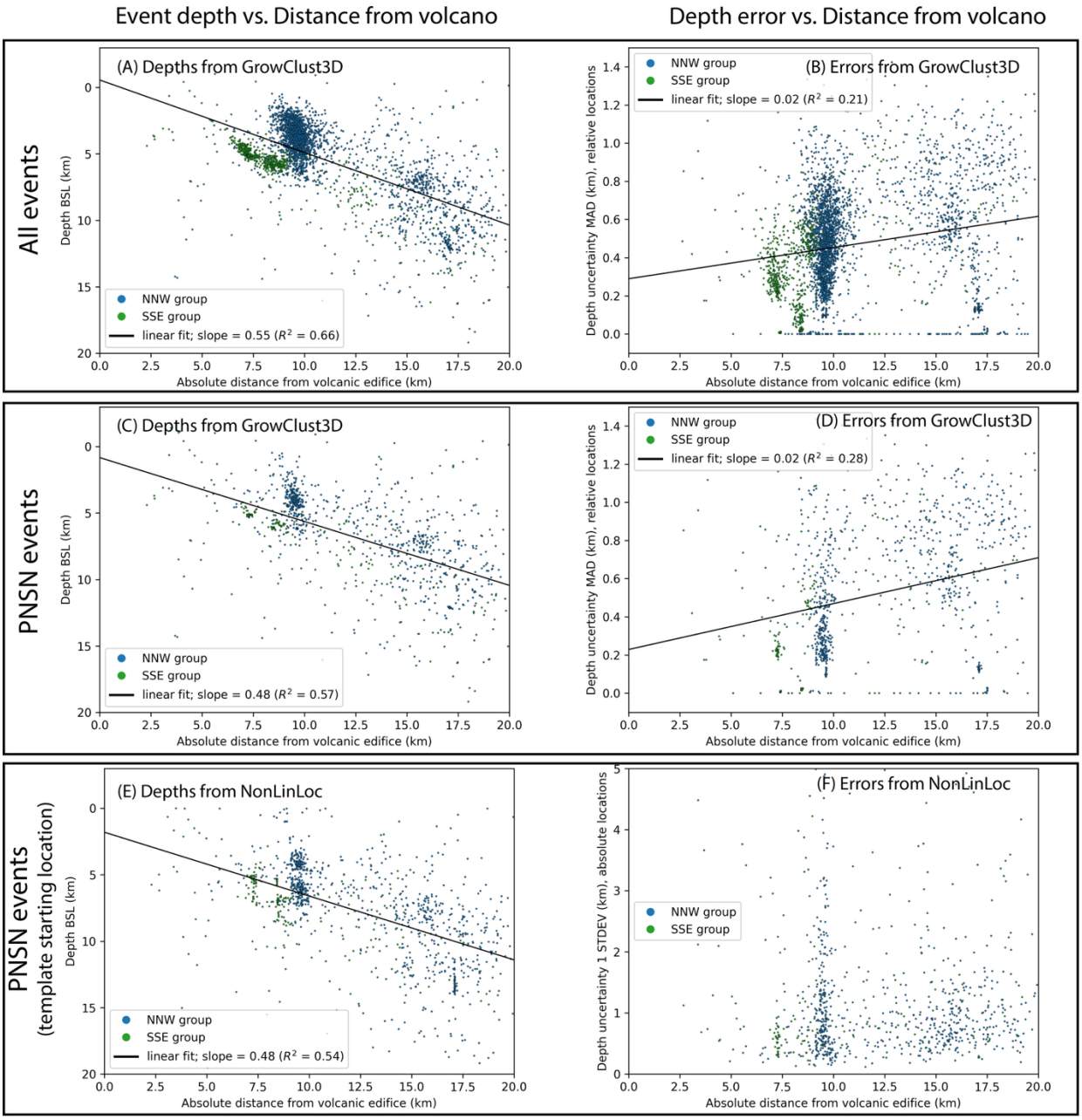


Figure S4: Event depths and depth uncertainties of events contained in the NNW and SSE nonvolcanic groups. Event depths in km below sea level (BSL) and uncertainties km median absolute deviation (MAD) are plotted agains their absolute distances from Mount St. Helens. Panels (A), (C), and (E) respectively show event depths from the enhanced catalog located with GrowClust3D (Trugman et al, 2023), Pacific Northwest Seismic Network catalogued events located with GrowClust3D, and template starting locations from NonLinLoc (Lomax et al, 2001; Lomax et al, 2009) . Depth uncertainty and distance from Mount St. Helens are shown accordingly in (B), (D), and (F).

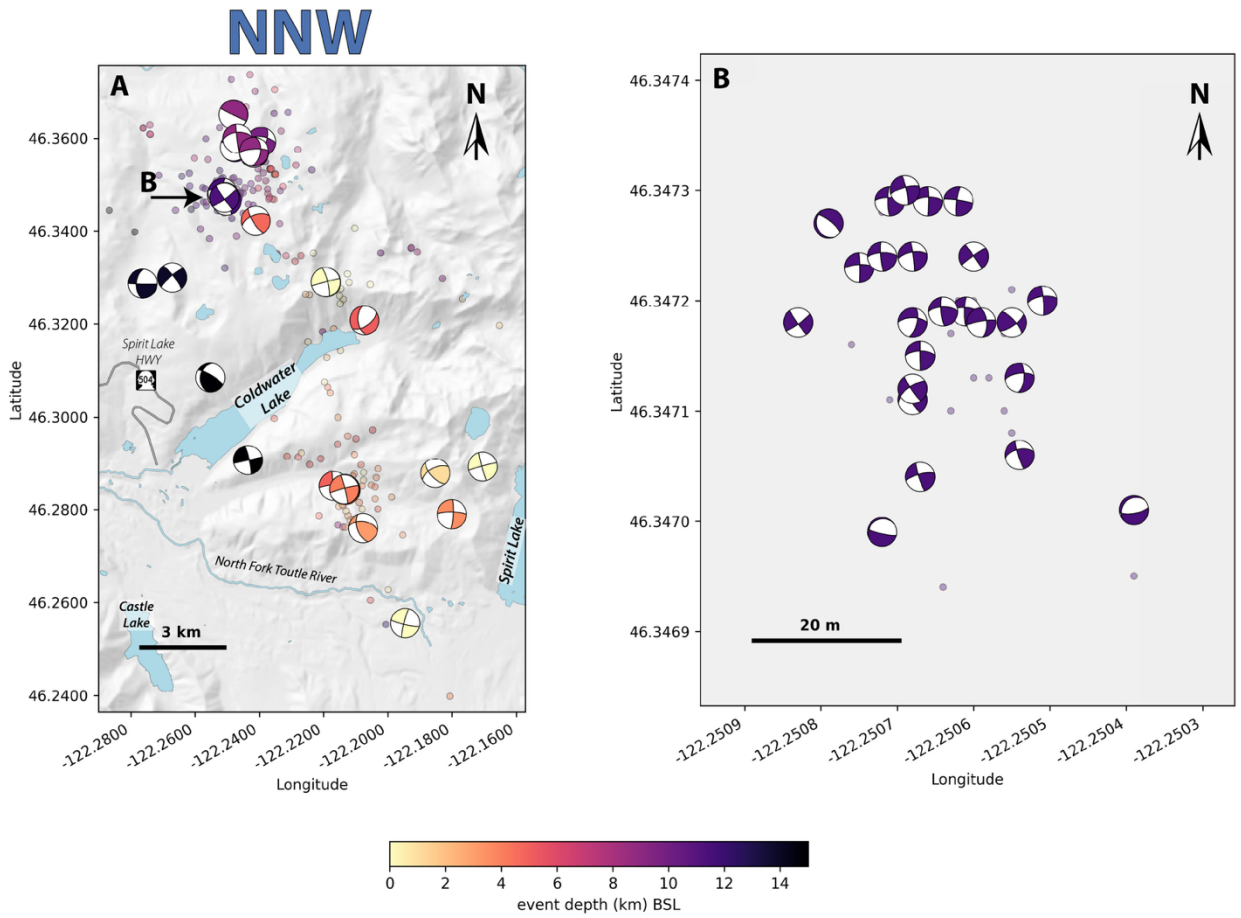


Figure S5. Zoomed view for the focal mechanisms in the NNW group in (A). (B) shows a tightly clustered group of solutions indicated by the arrow in A. Transparent dots are events from the 2014—2016 Imaging Under Mount St. Helens catalog without focal mechanism solutions.

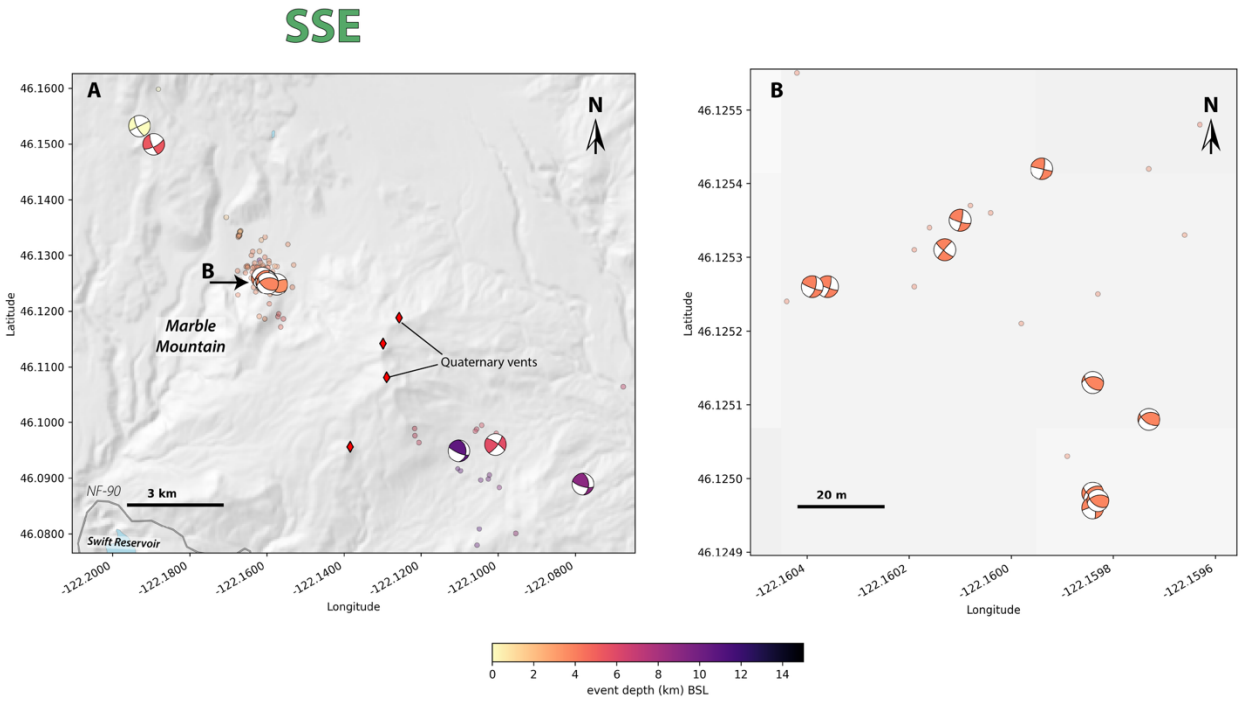


Figure S6. Zoomed view for the focal mechanisms in the SSE group in (A). (B) shows a tightly clustered group of solutions indicated by the arrow in A. Transparent dots are events from the 2014—2016 Imaging Under Mount St. Helens catalog without focal mechanism solutions.

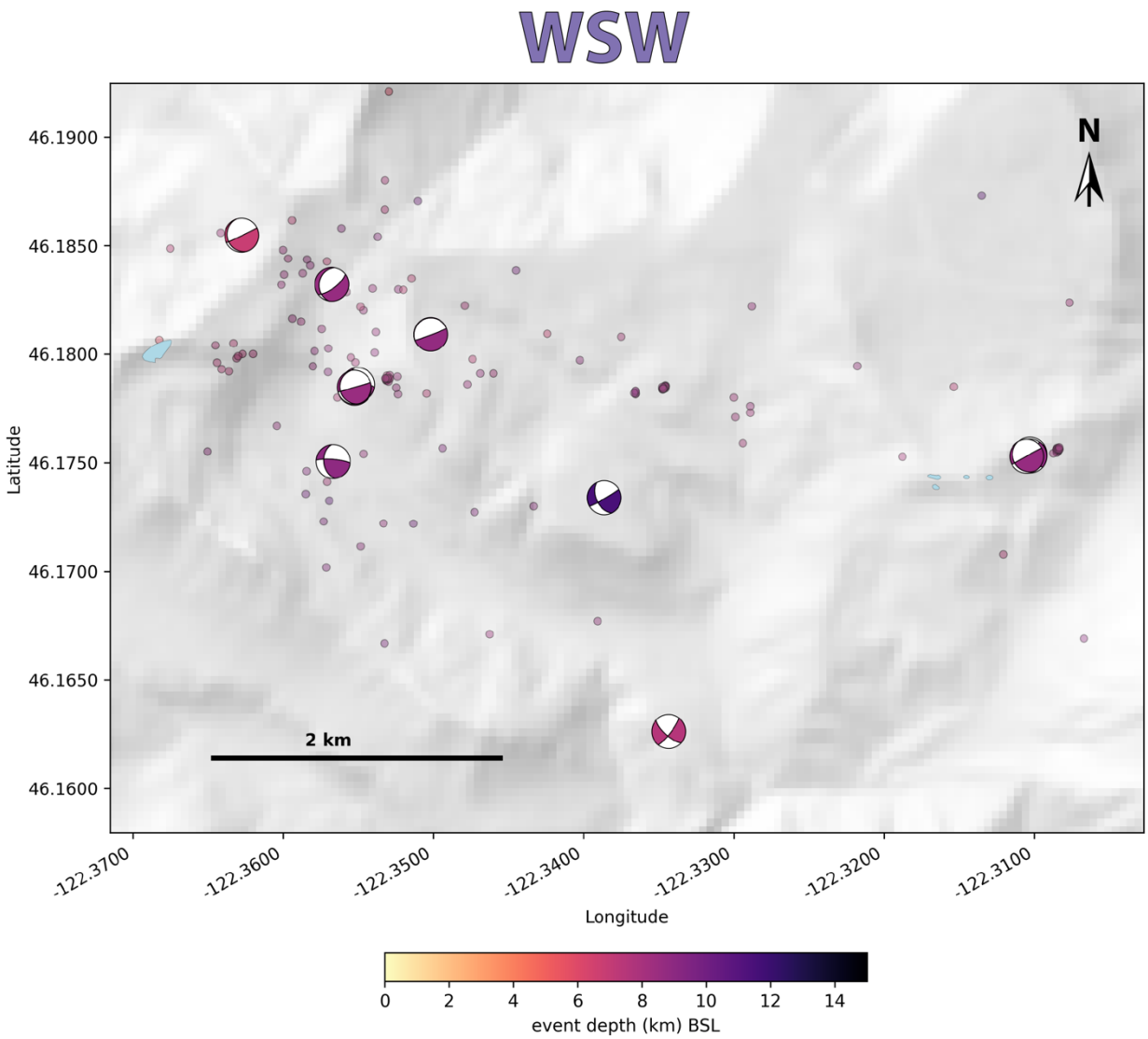
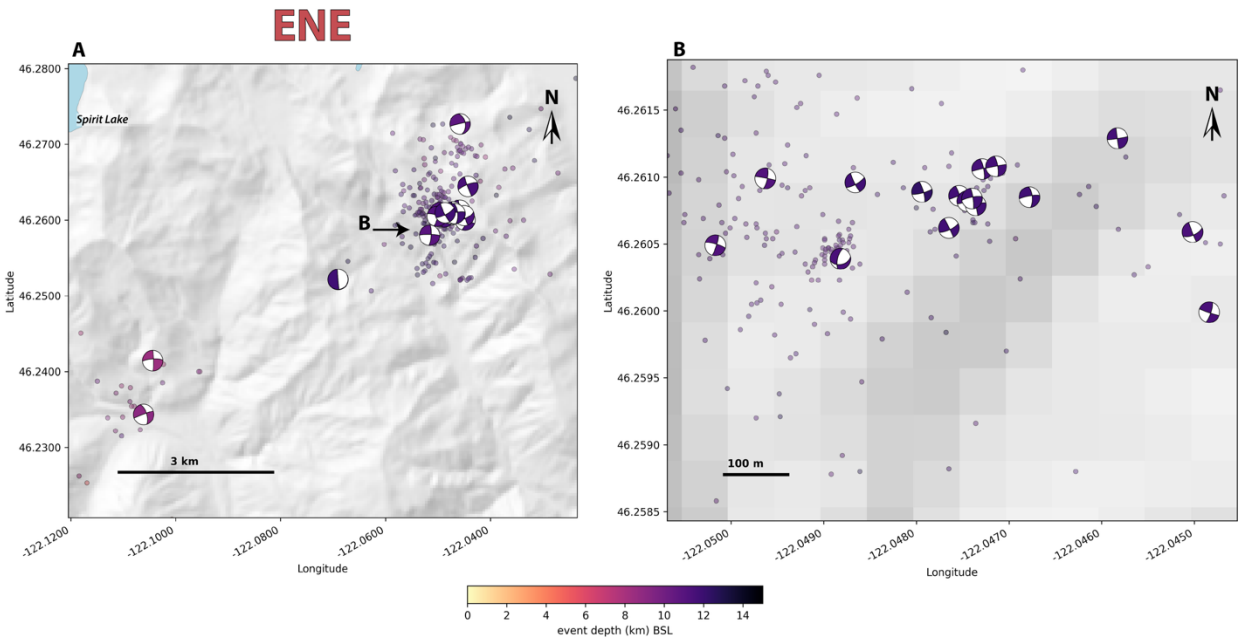


Figure S7. Zoomed view for the focal mechanisms in the WSW group. Transparent dots are events from the 2014—2016 Imaging Under Mount St. Helens catalog without focal mechanism solutions.



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87 **Figure S8.** Zoomed view for the focal mechanisms in the ENE group in (A). (B) shows a
88 tightly clustered group of solutions indicated by the arrow in A. Transparent dots are events
89 from the 2014—2016 Imaging Under Mount St. Helens catalog without focal mechanism
90 solutions.

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