

# Evidence for faulting and fluid-driven earthquake processes from seismic attenuation variations beneath Los Angeles

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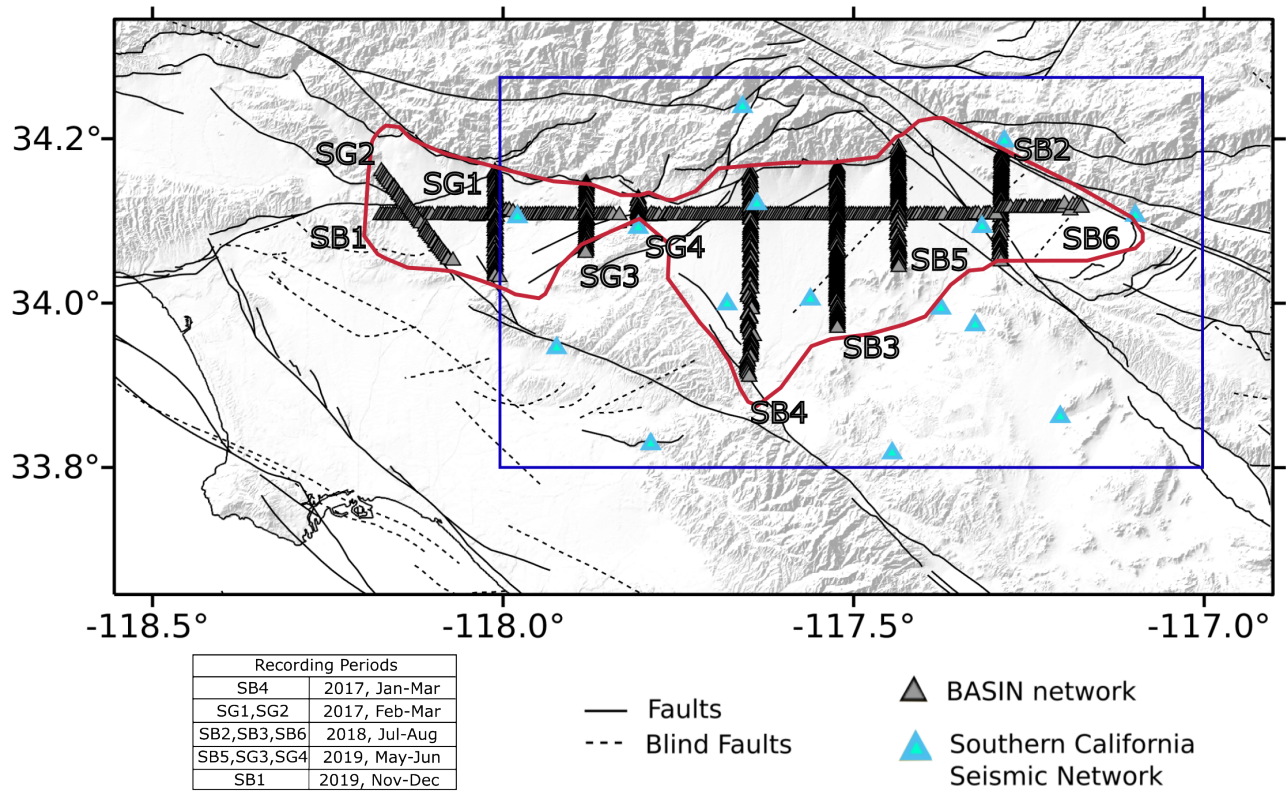
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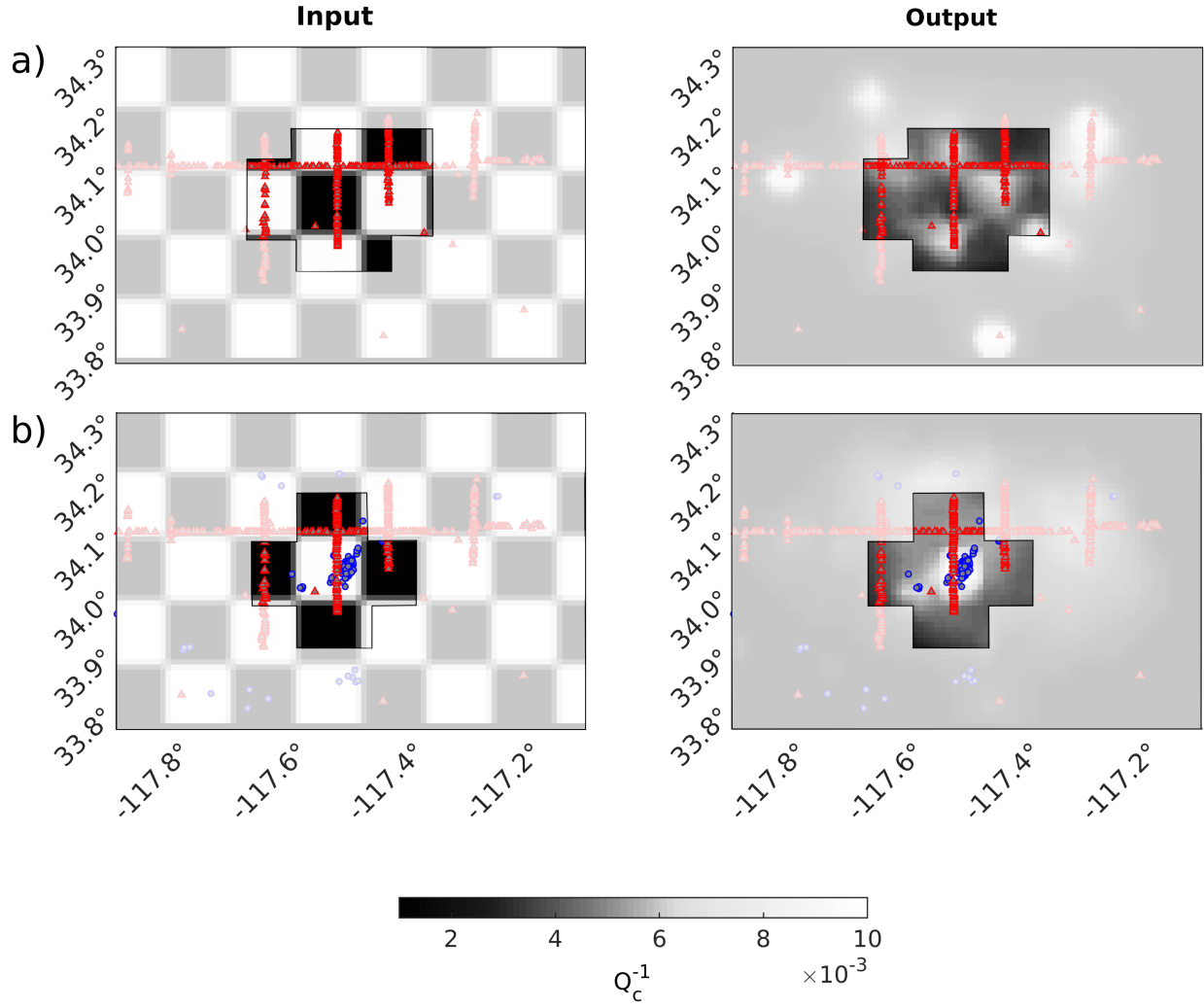
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## Supplementary Materials

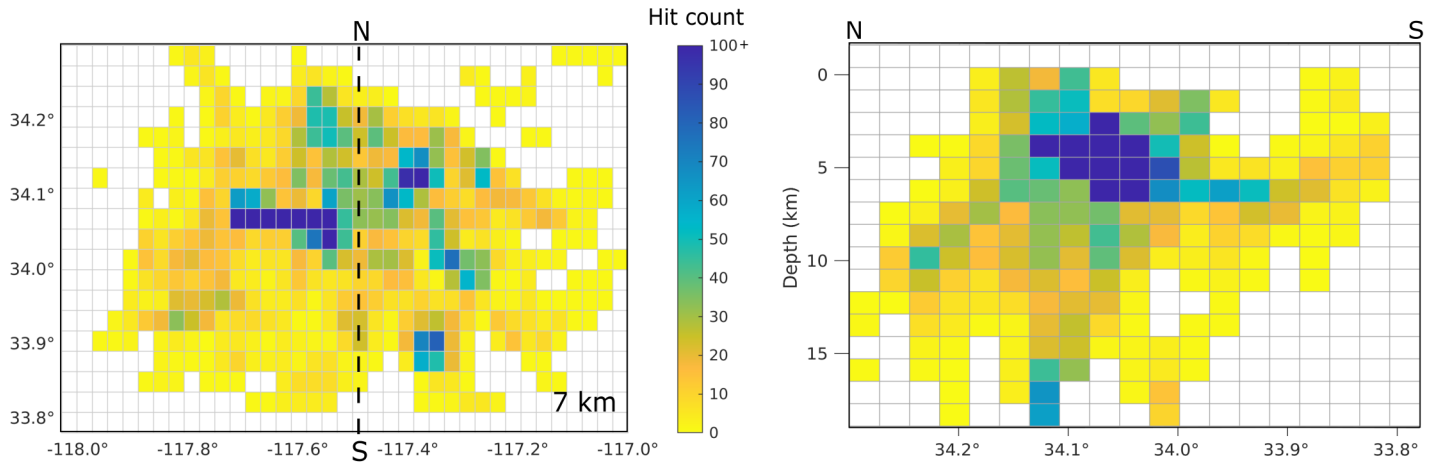
The earthquake catalogs used in this study and the seismic attenuation models are included as separate files in the Supplementary Materials.



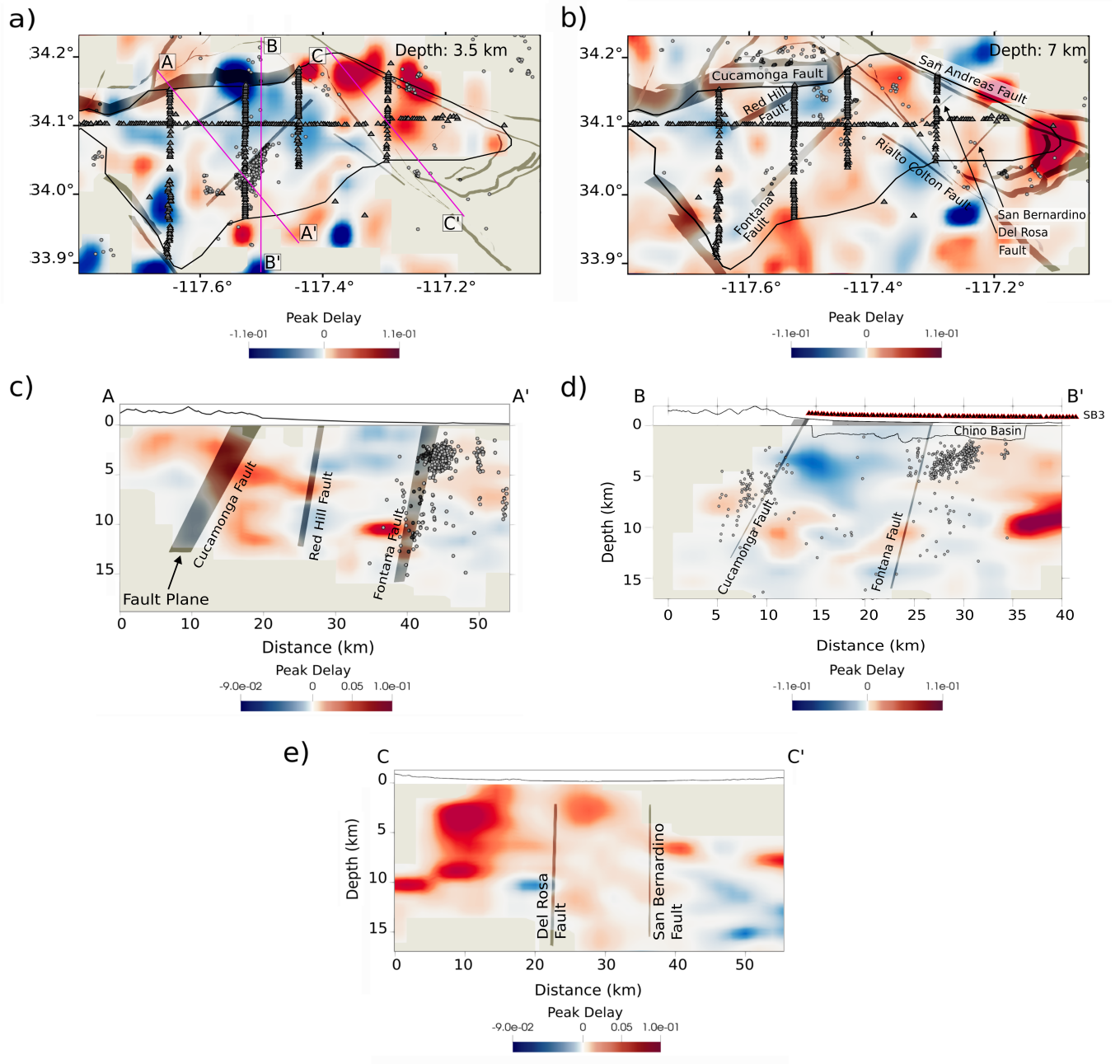
**Figure 1.** Map showing the locations of the seismic nodes (gray triangles) that were installed along 10 dense linear arrays labelled in the map during the BASIN experiment. The blue polygon indicates the study area. Eight BASIN arrays (SG3, SG4, part of SB1, SB2, SB3, SB4, SB5, and SB6) were used in this study. The light blue triangles indicate the 15 broadband stations from the Southern California Seismic Network that were included in our dataset. The red line indicates the shape of the sedimentary basin.



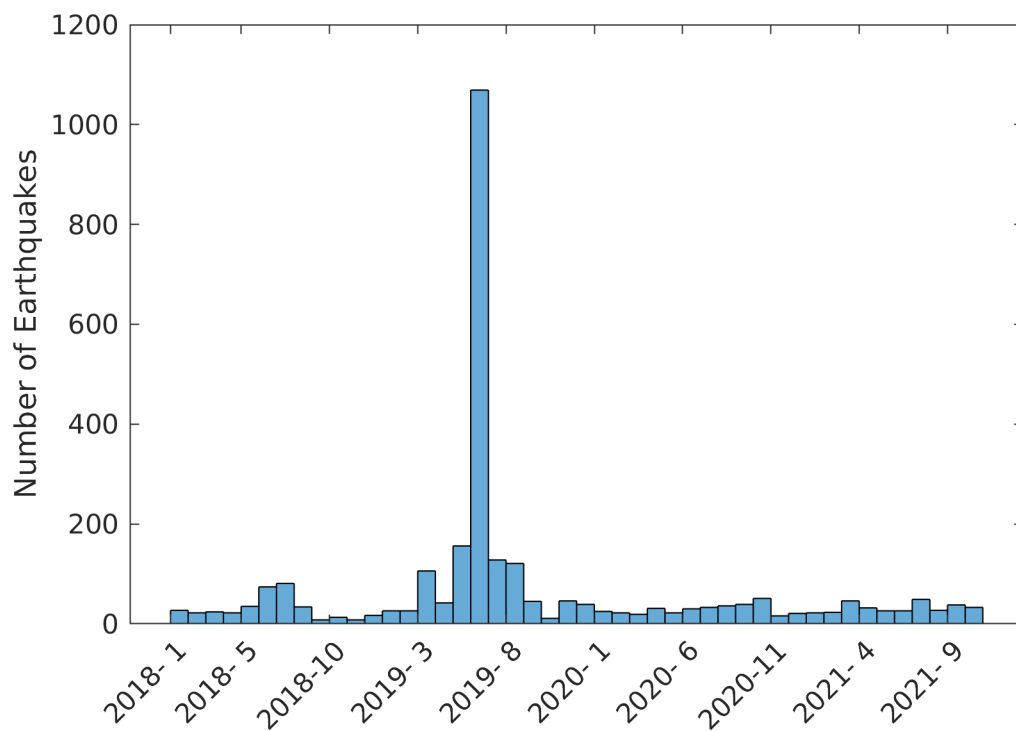
**Figure 2.** (a)-(b): Checkerboard tests (input in the left panels and output in the right panels) for  $Q_c^{-1}$  anomalies at 1.5 and 4.5 km depth at 18 Hz.



**Figure 3.** Hit count showing the well-resolved areas for peak delay maps. Blocks crossed by less than 3 rays are shown in white. The horizontal and vertical slices are taken at 7 km depth, and -117.5° longitude, respectively.

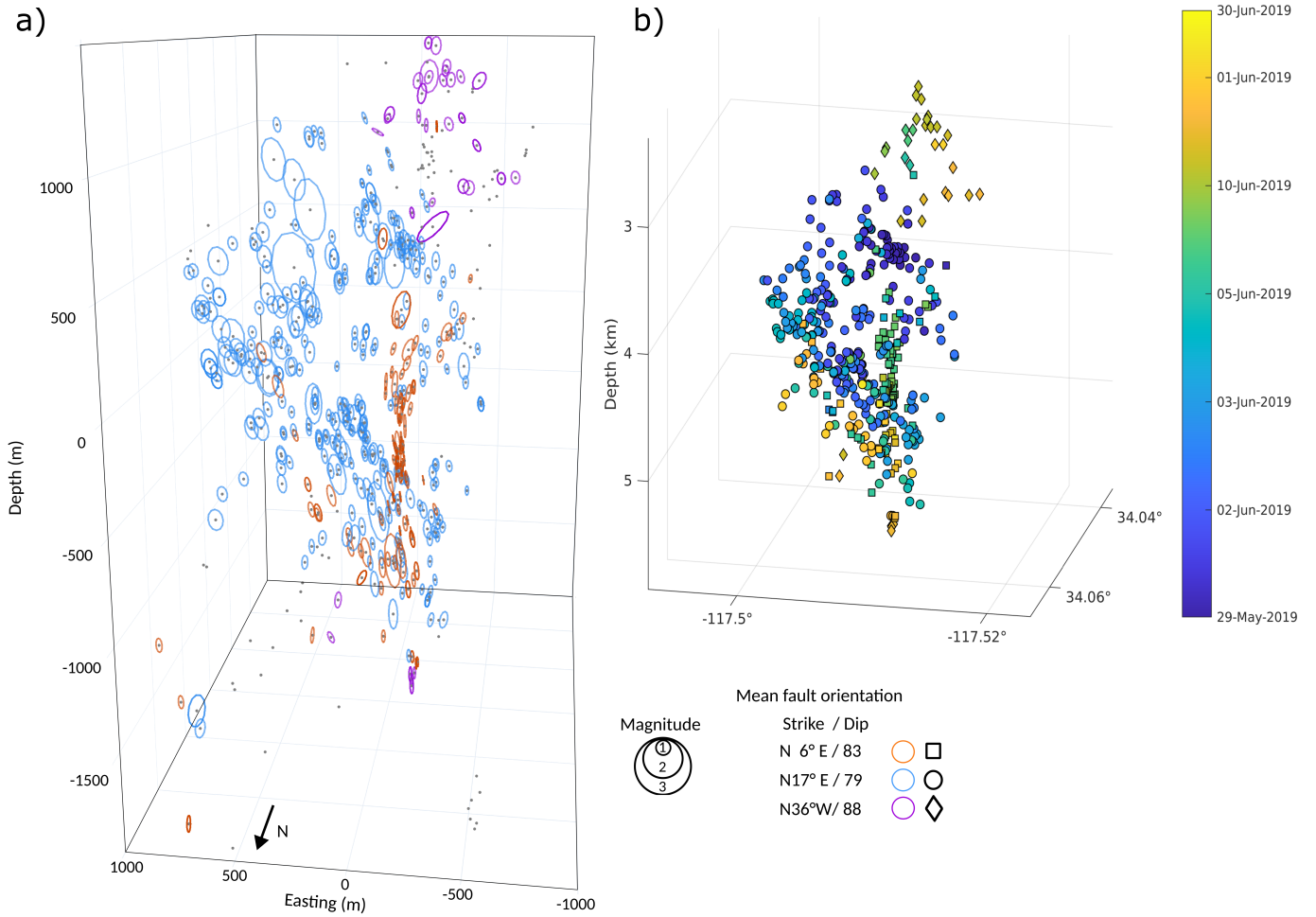


**Figure 4.** (a)-(b): Horizontal slices showing scattering anomalies at 3.5 and 7 km depth. (c)-(d)-(e): north-south and diagonal cross-sections as shown in panel (a). The results are for the 6-12 Hz frequency band.

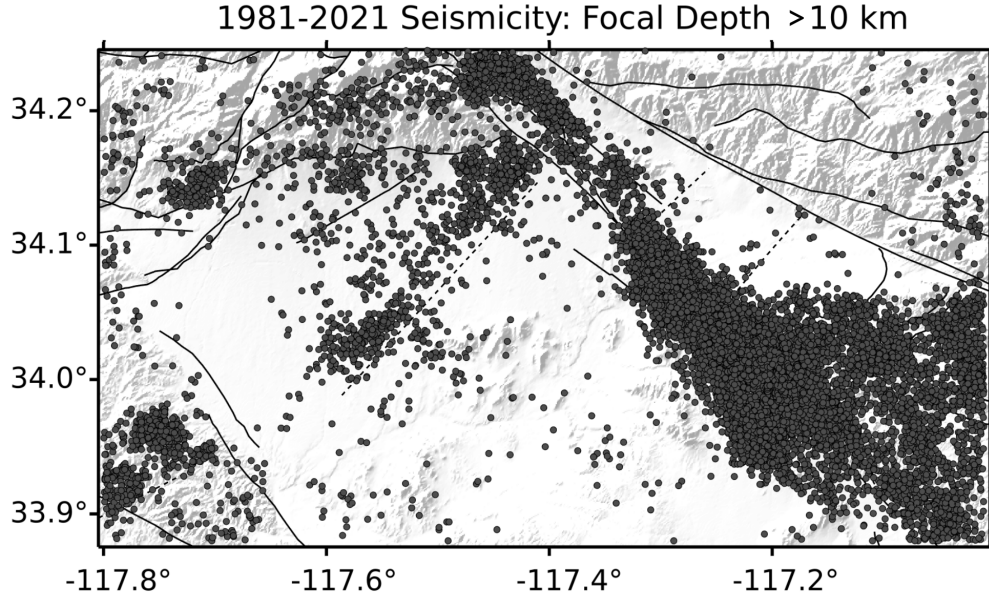


**Figure 5.** Seismicity in the area of the 2019 Fontana sequence between 2018 and 2021.

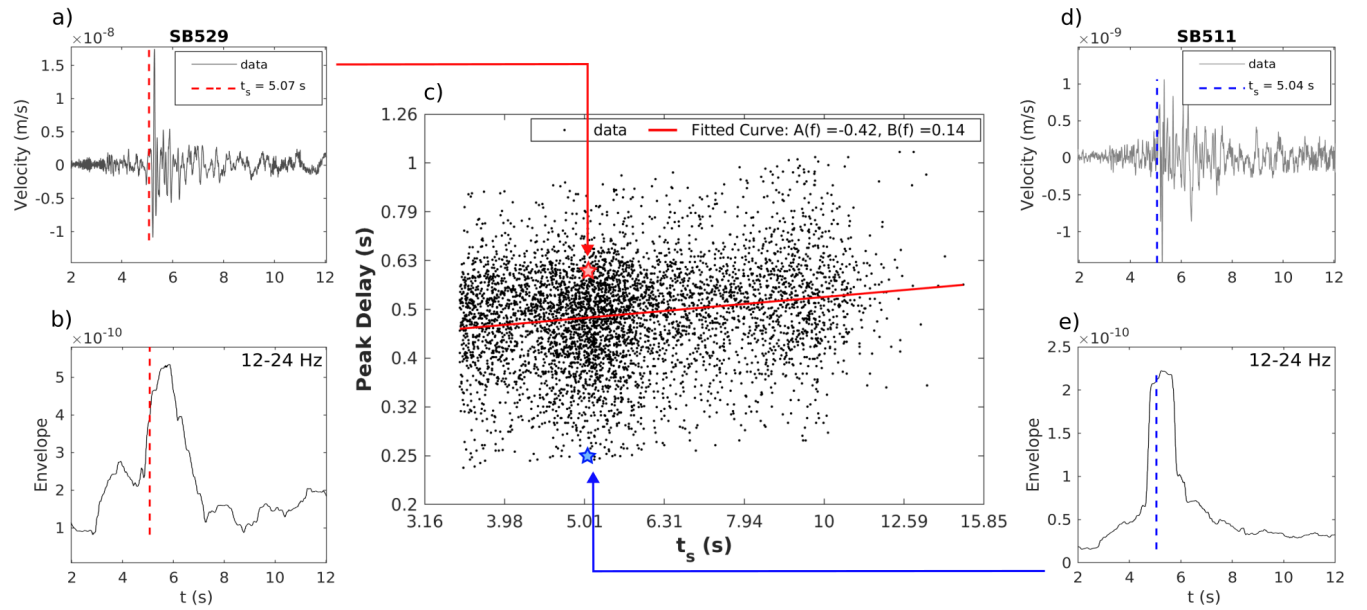




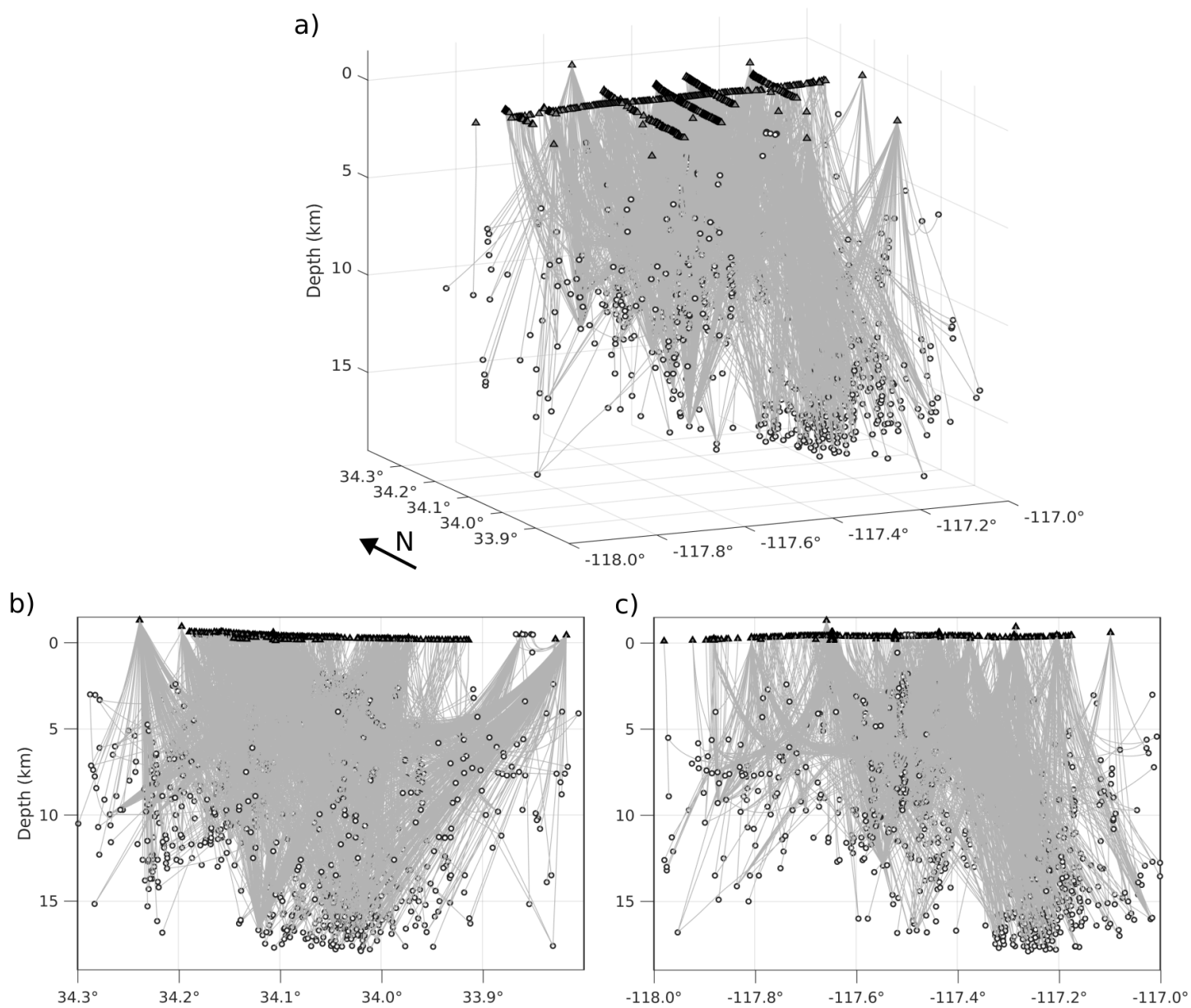
**Figure 6.** 3D view (a) from the northwest of the modelled fault networks corresponding to the 2019 Fontana seismic sequence. We used the seismicity presented in Fig. 7. The circles indicate the preferred fault orientations and are colour-coded based on the cluster classification resulting from the analysis. 3D view (b) from the northwest of the earthquakes, which are shown with different symbols based on the cluster classification resulting from the 3D fault plane imaging. The dots are also colour-coded based on the time.



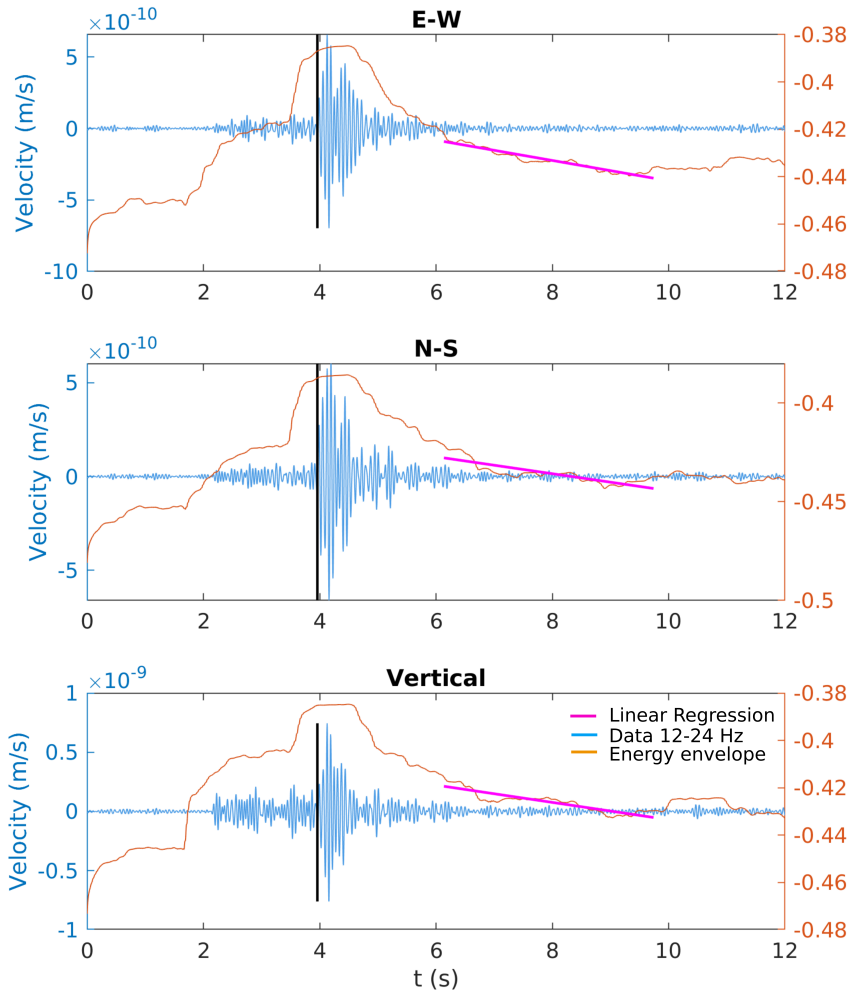
**Figure 7.** Seismicity (focal depth > 10 km) in the study area from the SCSN catalog for the time period 1981 to 2021.



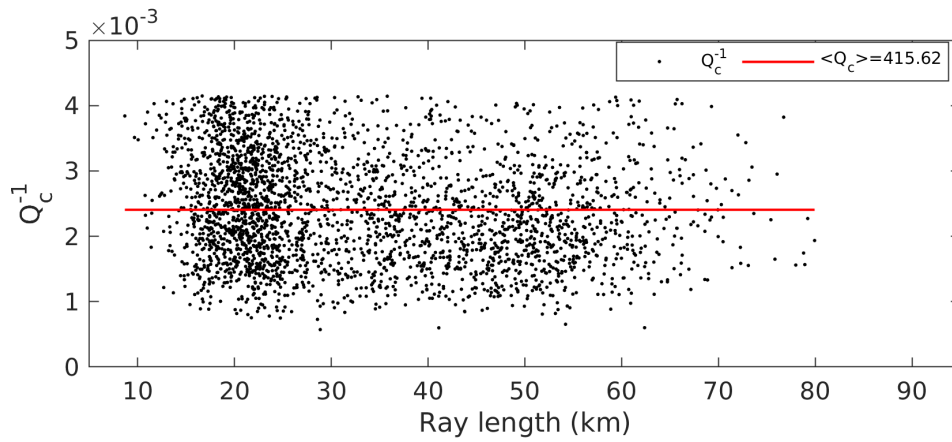
**Figure 8.** (a)-(d) Example of low and high peak delay values for two vertical component velocity seismograms recorded at two different seismic stations and characterized by the same S-wave arrival time. (b)-(e): smoothing root-mean-square envelopes in the 12-24 Hz frequency band. The vertical blue and red dashed lines indicate the S-wave onset in the case of low and high peak delay values, respectively. Panel (c): Peak Delay values as a function of the S-wave arrival time. The red line is the result of the linear regression described in the Data and Methods section. The red and blue stars indicate the position of the low and high peak delay values with respect to the best fit line.



**Figure 9.** Three-dimensional views of ray path coverage. (a) 3D view from the south-west. (b)-(c) views from the west and south, respectively.



**Figure 10.** Three component seismograms filtered in the 12-18 Hz frequency band (blue lines) and the energy envelopes (red lines). Best fit line (magenta lines) in the coda time window of length 4 s.



**Figure 11.**  $Q_c^{-1}$  as a function of the  $t_S$  arrival time.