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Supporting Information for

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## Introduction

The supplement provides additional information that clarifies the results described in the main text. Visualization of the dataset is shown in Figure S1. This plot shows data availability and gaps in the data for all the stations used in this study. Examples of spectra fitting used to estimate the stress drops are shown in Figure S2. Figure S3 shows the temporal variation in the magnitude of completeness along the study area. This plot was used to estimate a minimum magnitude of completeness for the RE discussed in the main text. Figure S4 shows the map view of all detected RE families with no magnitude of completeness restriction. Figure S5 shows a more complete version of Figure 7 which includes all detected RE pairs, regardless of their magnitude; for this plot, we also consider stations PEIG and YOIG. Likewise, Figure S6 presents an extended version of Figure 11, including all detected RE. In addition, we provide two datasets: (1) Dataset S1 provides a summary of each of the RE sequences found including the average location, magnitude, recurrence time and date and time of the events within each sequence; (2) Dataset S2 provides the stress drop estimates used in the calculation of the asperity size.

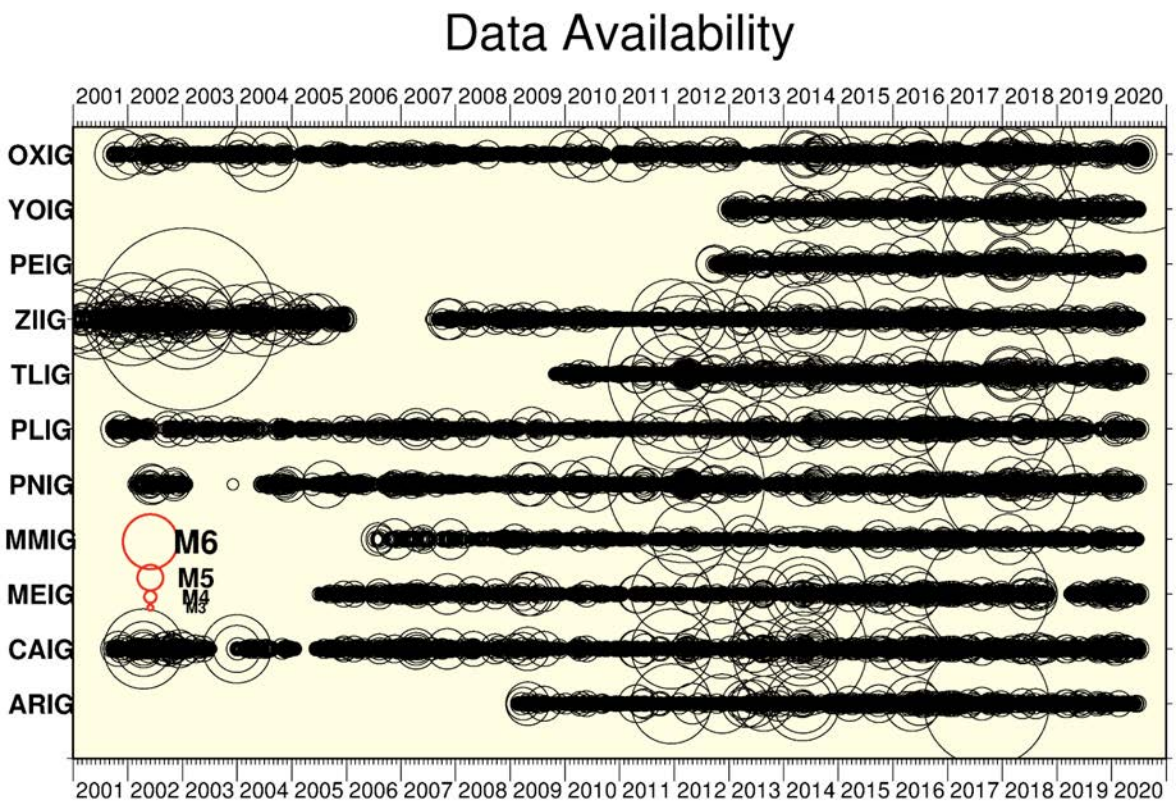


**Figure S1.** Data distribution per station. Circles indicate that the station recorded an event reported in the local catalog. The radius of each circle is proportional to the size of the event.

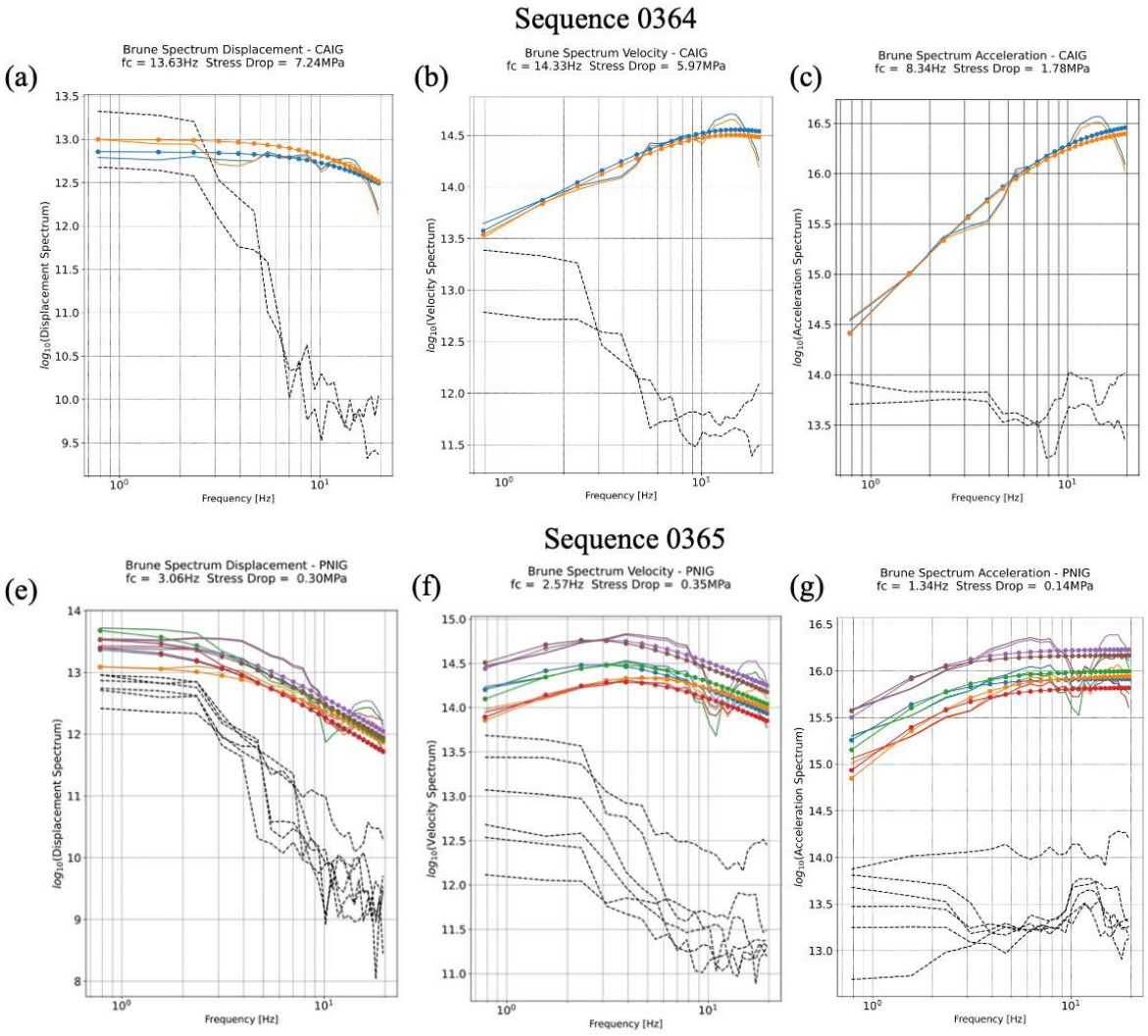


**Figure S2.** Examples of spectrum fittings for sequences 0364 (high stress drop) and 0365 (low stress drop): (a,e) displacement, (b,f) velocity and (c,g) acceleration spectra. Colored irregular lines show the spectrum after correcting for the instrument response and path effects. Colored dot-dash lines show the best fitting curve and dotted black line shows the spectrum for a time window of 128 samples before the arrival of the *P* wave.

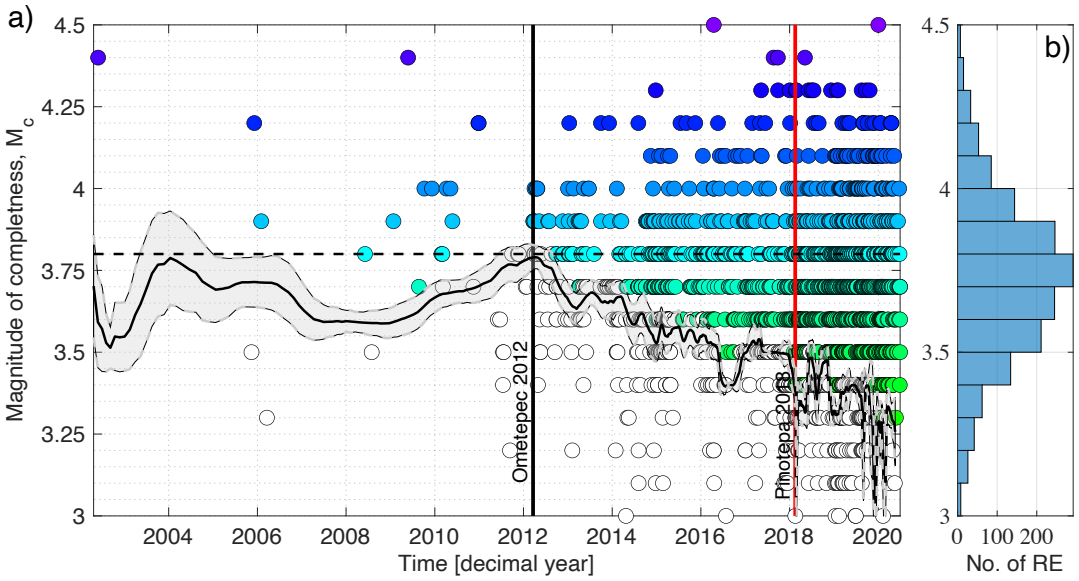


**Figure S3**. (a) Magnitude of completeness as a function of time and magnitude distribution of the repeating events. The continuous black line indicates the estimated magnitude of completeness estimated using ZMap software, gray shaded area shows the 95% confidence interval. Circles indicate the magnitude and occurrence time of all RE color-coded by magnitude. Vertical lines indicate the time of the Ometepec and Pinotepa Nacional; the horizontal dotted line shows indicate the limit where the magnitude of completeness is above the temporal variation. Panel (b) shows the magnitude distribution of the all the RE.

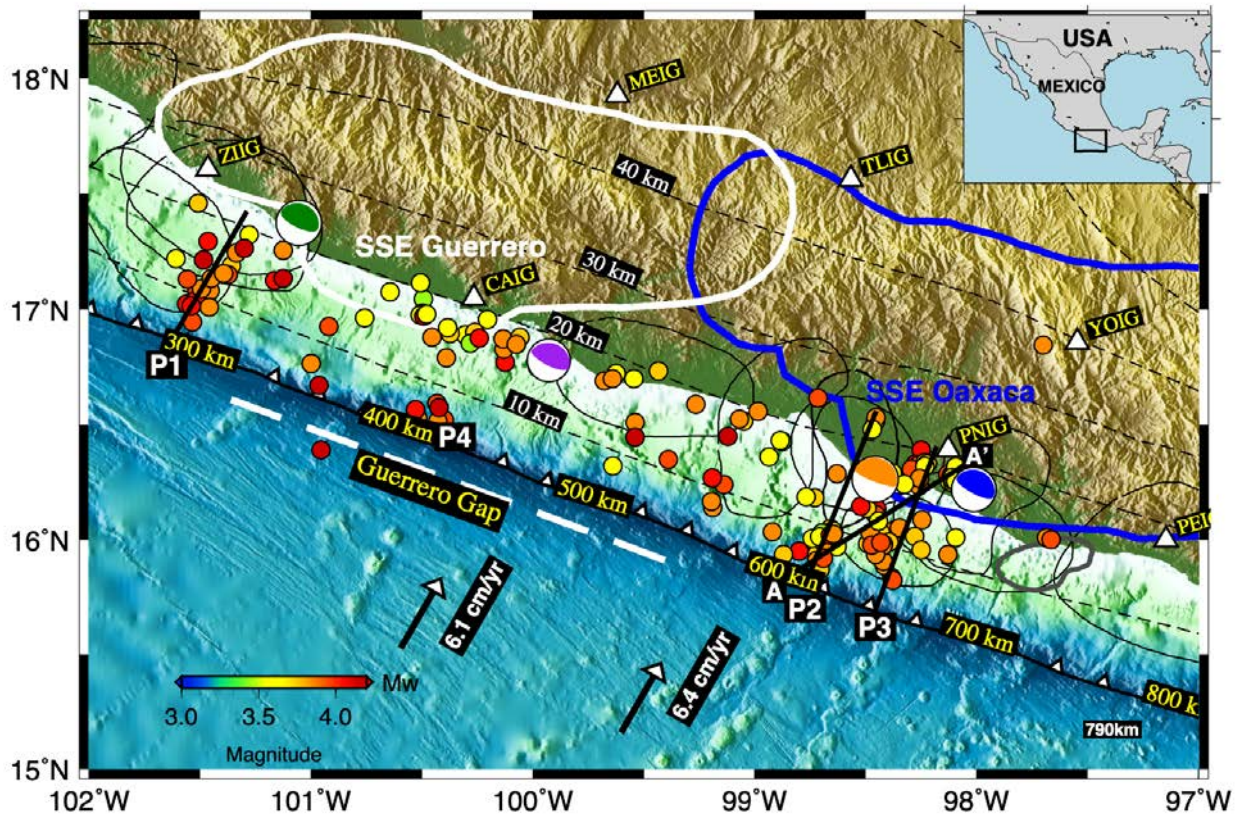


**Figure S4.** All detected RE sequences along the Guerrero and Oaxaca megathrust. Triangles indicate the location of the permanent seismic stations used in this study. The white dotted line shows the extension of the Guerrero Gap. Black lines indicate the location of the three profiles examined in this study. Focal mechanisms correspond to the recent $M_w$ > 7.0 earthquakes: 2014 Papanoa earthquake (green), 2012 Ometepec earthquake (orange), 2018 Pinotepa earthquake (blue) and 2021 Acapulco earthquake (purple). RE clusters are indicated by circles color-coded by magnitude. Black dotted lines show the slab iso-depth as shown by Cruz-Atienza et al., 2021. Black closed contours represent rupture areas of large earthquakes (Kostoglodov & Pacheco, 1999). Thick contours approximate areas of SSE rupture areas in Guerrero (white) and Oaxaca (blue) (Graham et al., 2014).

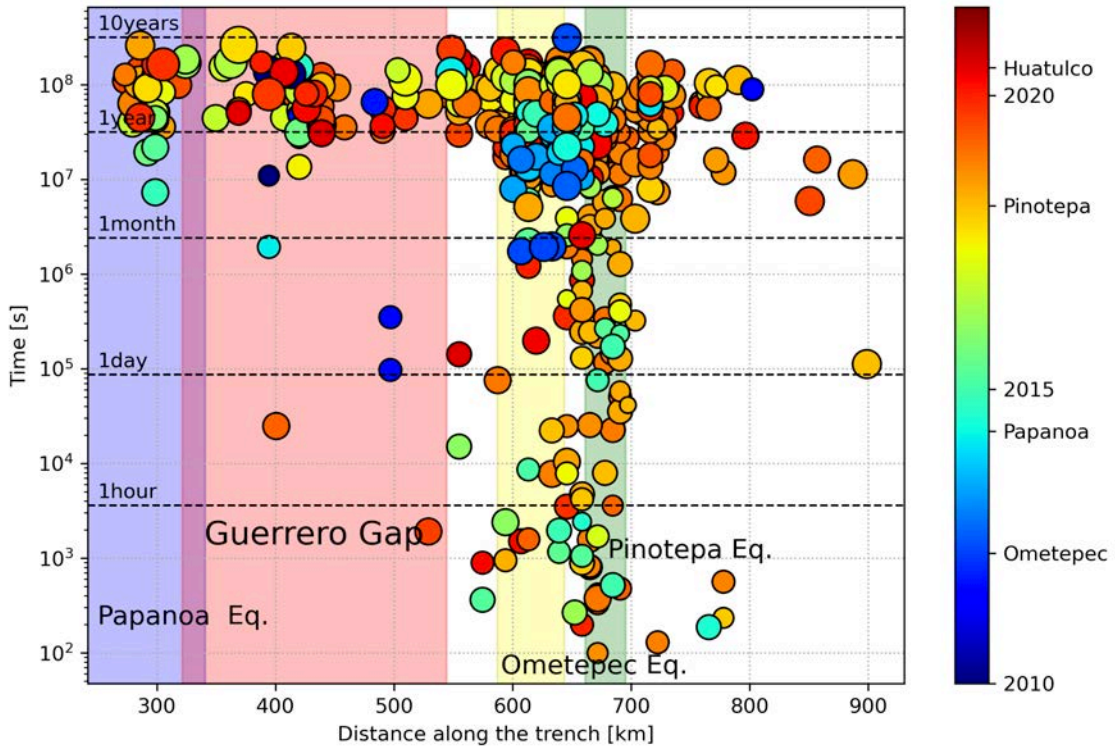


**Figure S5.** Recurrence times for all reported RE pairs color-coded by the average occurrence time. The size of the circles is proportional to the magnitude of the events. Shaded areas show the projected rupture areas of the 2014 Papanoa earthquake (blue), the Guerrero Gap (red), the 2012 Ometepec earthquake (yellow) and the 2018 Pinotepa earthquake (green).

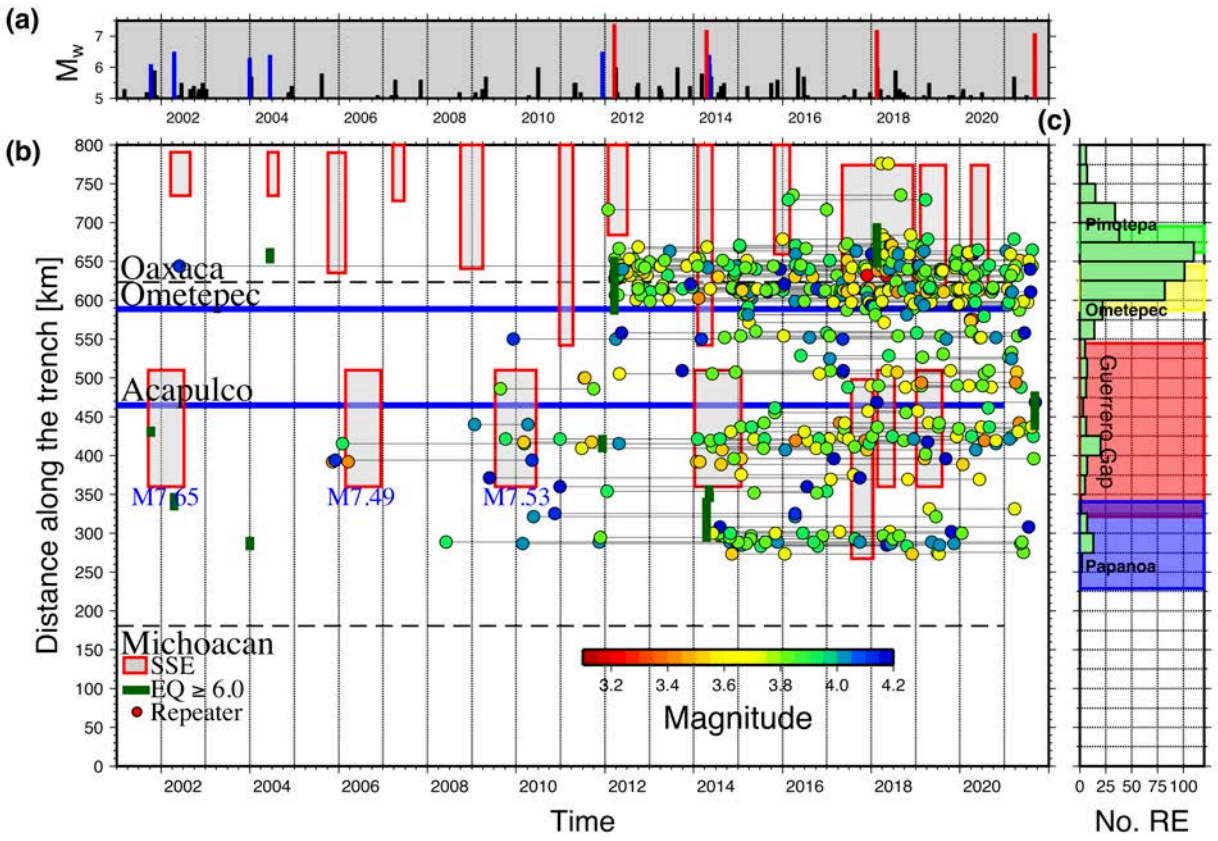


**Figure S6.** Temporal variations of the repeating earthquakes in Mexico for all detected REs. (a) Timeline for events with magnitude $5.0 \leq M < 6.0$ (black bars), $6.0 \leq M < 7.0$ (blue bars) and $M \geq 7.0$ (red bars). (b) The *y* axis indicates the distance along the trench as indicated in Figure 4. Shaded areas show the approximate duration and along the trench projected areas. REs are color-coded by magnitude. Green bars indicate the earthquakes' occurrence and estimated length of earthquakes with a magnitude larger than 6.0. (c) Distribution of REs along the trench.

**Dataset S1.** Spreadsheet containing the estimated stress drops for each sequence.

**Dataset S2.** Spreadsheet containing the mean location of RE sequences, its recurrence times and data and time of each event within each sequence.