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Supplement of

Fault reactivation by gas injection at an underground gas storage off the east coast of Spain

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Effect of the frequency band in depth resolution of regional moment tensors

Here we illustrate the effect of widening the frequency band used for moment tensor determination. In the manuscript we have shown results for the largest earthquake of the sequence when using the frequency band from 0.03-0.06 Hz (17-33 s), which is suitable for most of the events analyzed, particularly for the smaller ones. Using this frequency band has the advantage that the data fit is relatively good (high fit values in Figure S1a and good waveform comparisons in Figure S1c), but the shape of the fit curve has a broad maximum, and therefore the uncertainty in depth is large.

If we increase the frequency band to 0.02-0.1 Hz (10-50 s), the goodness of fit is slightly reduced, but the source depth peaked more sharply at the slightly deeper depth of 9 km (Figure S1b).

We repeated this exercise for the three largest events, and found that in all cases the higher frequency band led to a source depth of about 2 km deeper with a sharper indication of depth.

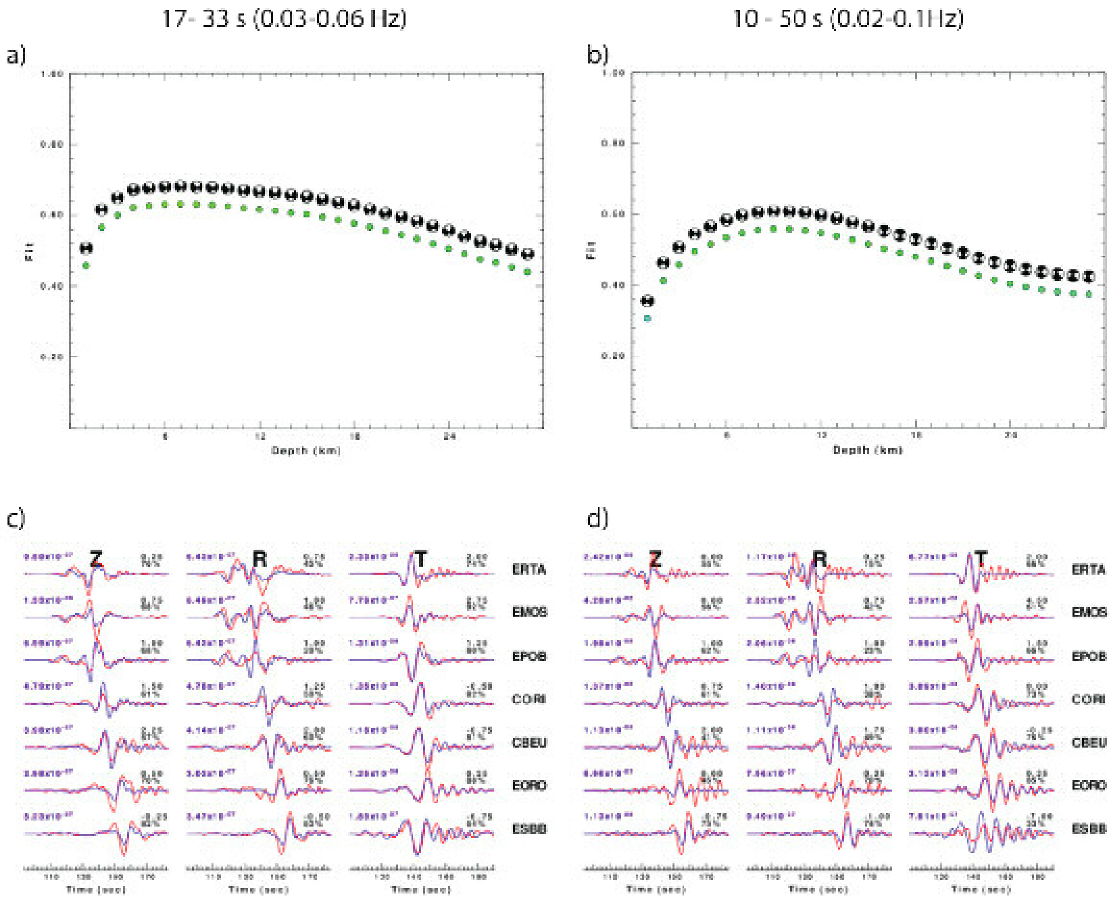

Figure S1. a) Normalized goodness of fit versus focal depth using a frequency band of 0.03-0.06 Hz. Perfect fit corresponds to a value of 1. For each depth, the best-fitting focal mechanism is shown. b) Same as a) but for the frequency band of 0.02 to 0.1 Hz. c) Waveform fits for the optimum solution of the moment tensor for this earthquake in the frequency band of 0.03-0.06 Hz. Z indicates vertical component, R radial, and T transverse. Observed (red) and predicted (blue) ground velocities for the optimum solution are shown for 7 selected stations. Units are m/s. d) same as c) but for the frequency band of 0.02 to 0.1 Hz

Sensitivity of short period SH wave reverberations to focal depth

Short period SH reverberations are clearly observed at station ALCN. The amplitude and separation of these reverberations are very sensitive to focal depth. In Figure S2, for the largest earthquake in the seismic sequence (2013-10-10 at 03:32 UTC, Mw=4.08, #9 in Table 3), and considering the focal mechanism obtained in this study (strike=40, dip=55, rake=-5) we show SH synthetic seismograms calculated for different focal depths. From this comparison it is clear that shallow focal depths (less than 3 km) are incompatible with the observed data (red line). The synthetic seismogram most similar to the observed one (with maximum value of the cross correlation coefficient) corresponds to a depth of 6 km, very close to the value of 7 km obtained in the regional moment tensor inversion (Table 3).

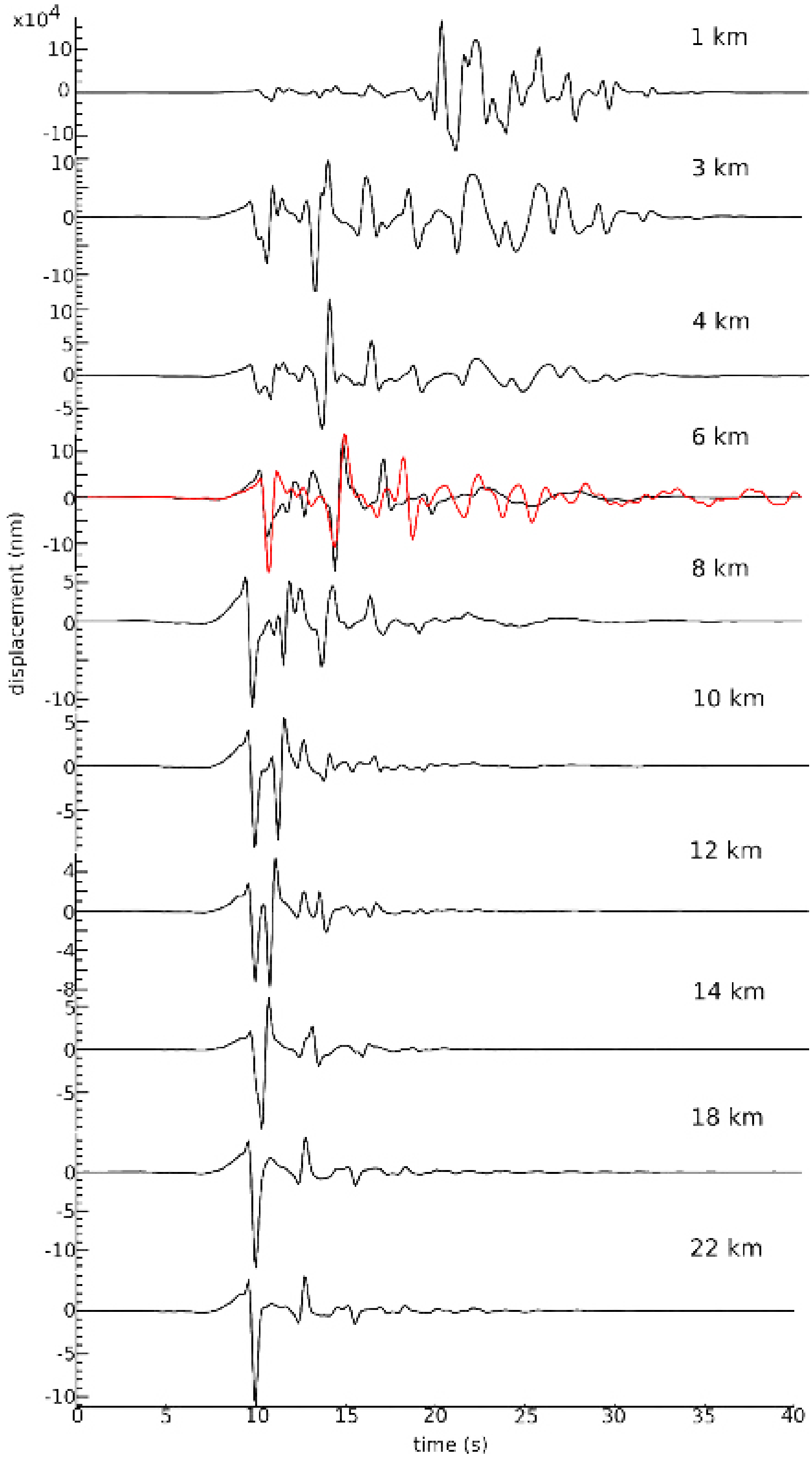

Figure S2. Synthetic waveforms (black lines) for the largest earthquake in the sequence (#9 in Table 3) computed for different hypocenter depths as would be recorded at station ALCN. Waveforms are bandpass filtered between 0.2 and 2 Hz. The observed seimogram (red line) is plotted on top of the synthetic with the largest cross-correlation coefficient (0.57), corresponding to a focal depth of 6 km.