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Supporting Information for

In-situ observation of pre-, co- and post-seismic shear slip at 1.5 km depth

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Detection of Seismic Events

The sensors were grouted in place in six monitoring boreholes, surrounding the experimental volume in 3-D. Most events that occurred during the fracture initiation are too weak to determine reliable phase arrivals and locate the hypocenters. Hence, for this study we focus on event detection rather than location. We use detected events as a proxy for fracturing activity. The results of the passive seismic monitoring of a larger series of hydraulic stimulations are described in detail in Schoenball et al. (2020). For event detection we use an STA/LTA detector and require a detection on all three components of the accelerometer OT16. The selected sensor is the second closest accelerometer to the stimulated interval (d = 11.2 m) and has a very good coupling to the host rock. It is much more sensitive to the early seismic activity than any other sensor. In fact, most events are only visible on the channels of this sensor. For quality control we manually confirmed a random sample of detected events to be indeed seismic events.

Hydraulic fracture initiation and propagation

Concomitant with the departure from the linear pressure regime, we begin to see seismic activity and significant displacements accumulating in the pressurized interval (Figure S1). Displacements started out to be in shear before we observed borehole-axial deformation. The recorded axial displacements are negative, indicating that an opening

mode fracture was located in the pressurized interval but outside of the SIMFIP sensor clamps. Indeed, the negative displacements correspond to the compression of the rock between the SIMFIP clamping points as the hydraulic fracture opened in the adjacent rock between one clamping point and a packer element.

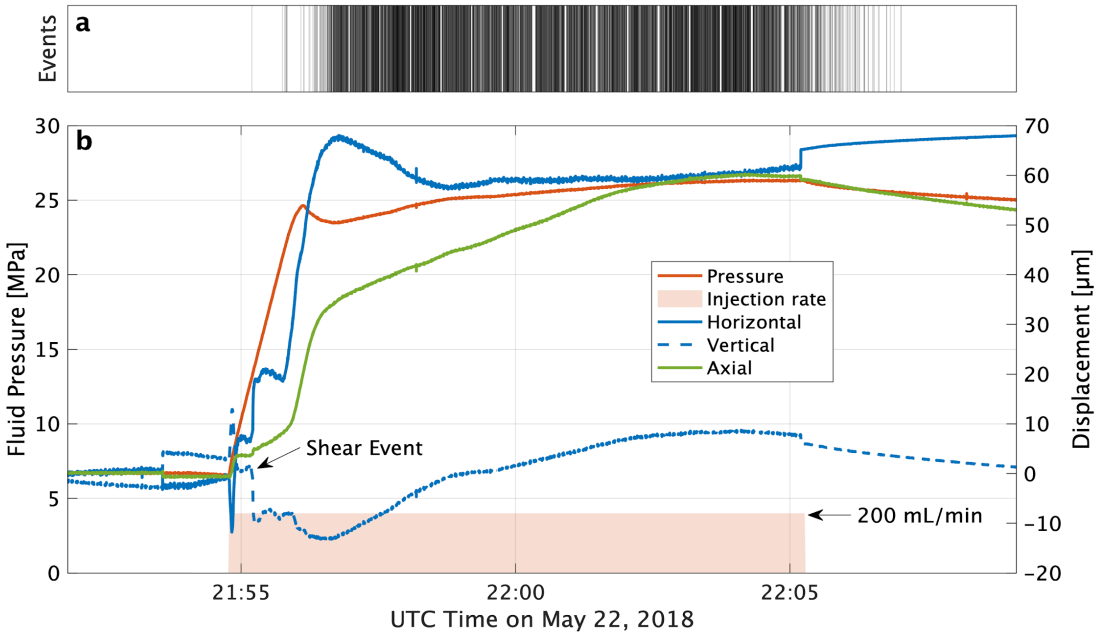

Figure S1. (a) Occurrence times of seismic events detected on accelerometer OT16. (b) Injection rate and pressure (orange) and the displacements recorded by the SIMFIP probe in the two radial directions (blue) and axial (green).

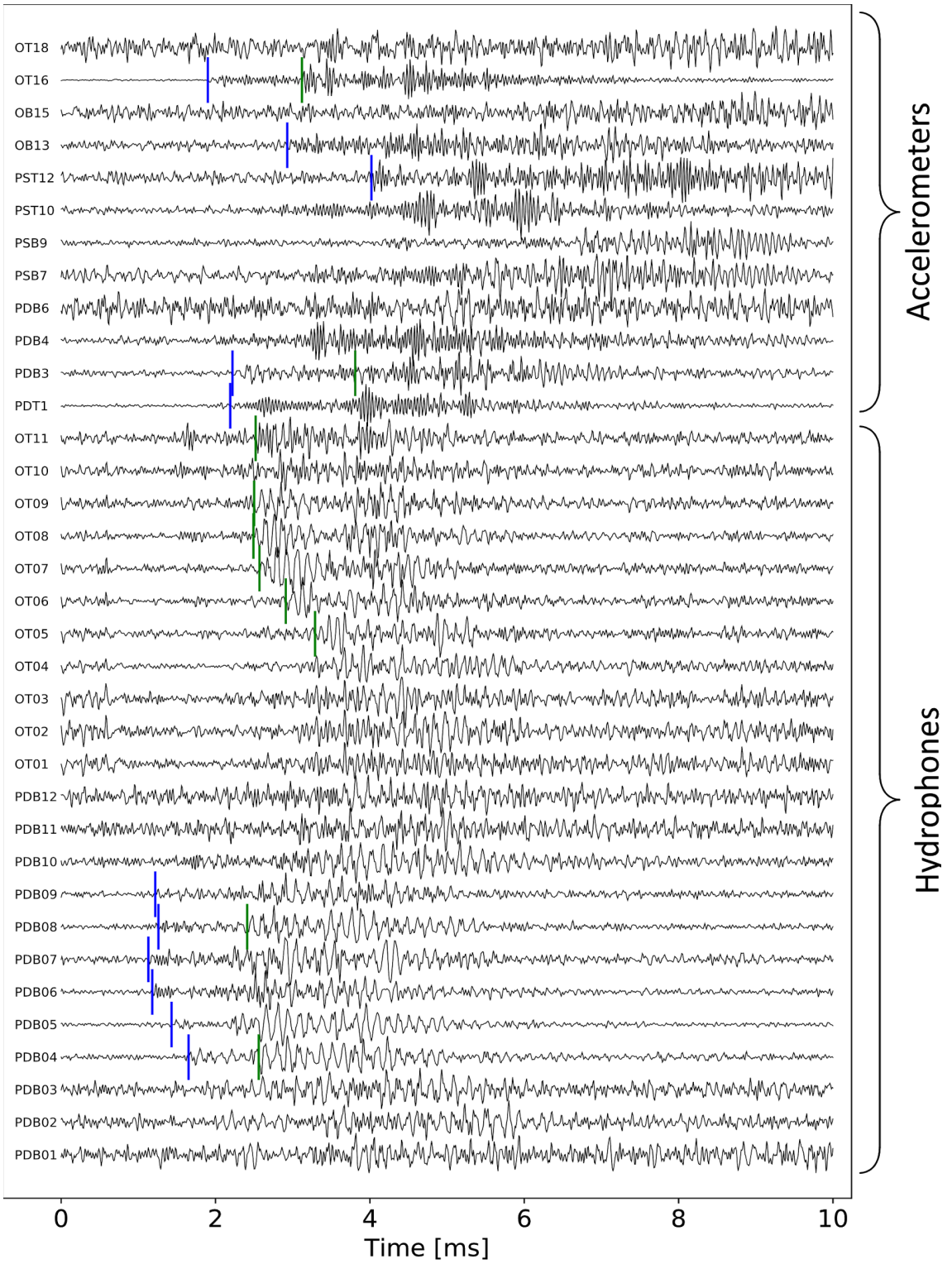

Figure S2. Waveforms of the shear event recorded on accelerometers (only x-components shown) and hydrophones. Manually picked P and S-wave arrivals are marked by blue and green dashes, respectively.