Supplementary Table I

1 MPa, high-velocity friction results

Exp. #	μ_p	μ_r*	μ_{ss}	D_w (m)	Final displacement (m)
Room-humidity					
512	1.1358	0.6224			7.53
513	1.1263	0.5416			13.46
514	1.2848		0.3996	19.2	26.68
532	1.2348		0.3784	21.3	36.77
Brine-saturated					
516	0.9423				16.72
517	0.7243		0.3155	16.7	30.02
535	0.8511		0.2174	16.5	33.35

* μr = the residual friction value, reported for experiments terminated before steady-state sliding was fully established

9 MPa, high-velocity friction results

Exp. #	μ_p	μ_{ss}	D_w (m)	Final displacement (m)
Room-humidity				
523	0.8079	0.2322	0.56	1.005
624	0.7865	0.2035	1.67	4.579
Brine-saturated				
525	0.2966	0.0963	0.013	1.732
626	0.3534	0.1117	0.053	1.214
627	0.3575	0.1048	0.057	1.066

18 MPa, high-velocity friction results

Exp. #	μ_p	μ_{ss}	D_w (m)	Final displacement (m)
Room-humidity				
519	0.753	0.1579	0.29	0.7193
Brine-saturated				
521	0.2886	0.0783	0.033	2.248

Supplementary Table I. *Summary of high velocity friction experiment results. μ_p = Peak friction; μ_{ss} = Steady-state friction; D_W = Slip weakening distance (See main text and Supplementary Information III for details).*

Supplementary Table II

LIF 1.1 - Hanging-wall damage zone - Hybrid shear fractures					
Distance (cm)	*Width (mm)*	*Length (cm)*	*Orientation*	*Displacement (mm)*	*Fracture energy (MJ m^-2)*
0	10	120	001/72	30	0.11655
60	1	80	328/71	1	0.005135
130	5	300	342/70	20	0.0857
165	10	350	110/68	1	0.005135
175	5	150	340/70	1	0.005135
255	2	320	124/88	3	0.015105
286	1	25	345/75	3	0.015105
333	1	140	130/83	2	0.01017
366	1	160	330/65	2	0.01017
590	1	220	145/87	1	0.005135
675	1	300	140/65	2	0.01017
1493	10	550	328/86	20	0.0857
LIF 1.1 - Hanging-wall damage zone - Disaggregation shear bands					
Distance (cm)	*Width (mm)*	*Length (cm)*	*Orientation*	*Displacement (mm)*	*Fracture energy (MJ m^-2)*
0	1	20	116/61	30	0.11655
30	1	50	253/39	20	0.0857
35	1	40	254/38	10	0.04735
50	1	15	104/60	10	0.04735
60	1	100	240/40	45	0.145575
60	1	30	265/32	8	0.03868
60	1	10	250/32	30	0.11655
60	1	10	090/45	18	0.07893
272	2	50	330/52	10	0.04735
290	10	50	320/50	70	0.1551
LIF 1.1 - Foot-wall damage zone - Hybrid shear fractures					
Distance (cm)	*Width (mm)*	*Length (cm)*	*Orientation*	*Displacement (mm)*	*Fracture energy (MJ m^-2)*
0	3	120	335/84	3	0.015105
155	20	250	046/84	65	0.1551
180	2	400	036/85	70	0.1551
205	1	30	265/90	2	0.01017
220	3	350	002/80	6	0.02961
270	1	50	023/39	1	0.005135
290	2	40	328/72	2	0.01017
330	1	40	335/79	1	0.005135
360	1	15	026/86	1	0.005135
395	10	160	286/90	2	0.01017
413	8	350	010/86	3	0.015105
535	15	220	096/82	10	0.04735
535	15	100	096/82	10	0.04735
535	15	120	078/88	10	0.04735
535	15	70	078/88	10	0.04735
540	1	25	274/70	3	0.015105
LIF 1.1 - Foot-wall damage zone - Disaggregation shear bands					
Distance (cm)	*Width (mm)*	*Length (cm)*	*Orientation*	*Displacement (mm)*	*Fracture energy (MJ m^-2)*
0	1	30	043/80	65	0.1551
0	1	40	209/10	65	0.1551
25	20	25	194/35	25	0.102125
25	1	6	204/42	14	0.06419
45	1	10	236/70	6	0.02961
50	1	4	235/60	1	0.005135
55	2	50	186/40	90	0.1551
90	20	40	239/45	70	0.1551
145	1	30	257/30	80	0.1551
145	1	30	277/20	10	0.04735
155	1	50	240/44	80	0.1551
205	1	70	204/42	25	0.102125
265	1	15	075/36	9	0.043065
290	1	20	060/45	15	0.068025
300	1	20	082/49	20	0.0857
305	1	20	080/50	15	0.068025
305	1	20	054/55	14	0.06419

305	1	20	054/55	14	0.06419
310	1	25	088/44	10	0.04735
315	1	15	084/43	32	0.12112
343	1	15	216/66	3	0.015105
375	10	15	220/22	120	0.1551
380	2	40	199/09	180	0.1551
385	1	10	213/22	25	0.102125
385	1	10	208/17	40	0.1374
385	1	15	205/35	1	0.005135
385	1	40	195/12	1	0.005135
395	1	15	208/37	15	0.068025
445	1	15	060/60	40	0.1374
425	1	30	052/60	240	0.1551

Supplementary Table II. *Structural data collected along a transect in the 16 m wide damage zone of fault LIF1.1, which are used to calculate the off-fault fracture energy ($E_G^{Off\text{-}fault}$) required to create hybrid shear fractures and disaggregation bands in the damage zone (See the main text and (Supplementary Information IV for details).*