

Index

- 1923 Kanto earthquake, 209, 210, 220, 221
 1945 Mikawa earthquake, 226, 227
 1966 Tashkent earthquake, 241
 1973 Nemuro-Hanto-Oki earthquake, 235
 1978 Izu Oshima Kinkai earthquake, 228, 229
 1986 Chalfant earthquake, 230
 1986 Mount Lewis earthquake, 230
 1986 Stone Canyon earthquake, 231
 1989 Loma Prieta earthquake, 214, 224, 238
 1990 Upland earthquake, 231
 1992 Joshua Tree earthquake, 231
 1992 Landers earthquake, 231
 1995 Kobe earthquake, 98, 152, 185, 196
 2000 Tottori earthquake, 185
 2009 L'Aquila earthquake, 247
- activated seismicity
 during the process leading up to a great or major earthquake, 212
 activation of seismicity, 145, 208
 adhesion, 11
 aftershock activity, 208
 apparent area of contact, 11
 apparent shear rupture energy, 179, 196
 asperities, 2, 3, 11, 13, 33, 72, 91, 99, 100, 106, 143, 144, 147, 156, 175, 183, 184, 185, 198, 206
 asperity area, 185
 average recurrence time interval
 for large earthquakes on a fault, 201
- background seismicity, 145
 barriers, 2, 3, 72, 91, 106, 107, 143, 144, 251
 Benioff strain release, 214, 237, 238
 biaxial testing apparatus, 39
 breakdown displacement, 24, 36, 52, 57, 59, 69, 88, 92, 100, 142, 148, 151, 153, 161, 165, 181, 183, 198
 breakdown (or slip-weakening) phase, 50
 breakdown process, 19, 161
 breakdown stress drop, 3, 26, 36, 52, 83, 84, 85, 87, 148, 153, 161
 breakdown time, 168, 170
 breakdown zone, 19, 20, 22, 39, 69, 161, 174
 breakdown zone length (or size), 69, 70, 142, 170
 breakdown zone model, 20, 24
 brittle fracture, 9
 brittle regime, 72
 brittle–plastic transition regime (or semi-brittle regime), 72, 79
b-value, 180, 198, 247
- cataclasis, 7
 causal factors for recurrence time interval fluctuation, 202
 change in Coulomb failure stress, 239
 characteristic length, 37, 44, 62
 representing fault surface irregularity, 123, 139, 140, 182, 185, 193
 representing the geometric irregularity of shear-fractured (or shear-rupture) surfaces, 36, 50, 88
 chemical effect of (pore) water (molecules), 73, 81
 cohesive force, 19
 cohesive strength, 9, 10, 11
 cohesive zone, 18, 19
 cohesive zone model, 19
 concept of effective stress, 73
 constitutive equation, 8
 constitutive law, 6
 for earthquake ruptures, 1, 3, 19
 for plastic flow, 8
 for (real) earthquake ruptures, 4, 91, 103
 for shear failure, 32
 for shear failure (or fracture) of intact rock, 28
 for shear failure (or fracture or rupture), 33, 34
 for shear rupture, 4
 constitutive law displacement parameters, 112
 constitutive law formulation
 for earthquake ruptures, 93
 constitutive law parameters, 46, 56, 71, 104
 constitutive properties
 of the shear failure of intact rock, 72
 constitutive relation, 6, 8, 19, 67, 68
 for bond breaking process, 9
 for fracture, 9
 for frictional slip failure, 9, 50
 for rock fracture, 9
 for the shear failure of intact rock, 35, 50, 72
 constitutive relation parameters, 26
 constitutive scaling law, 4, 63, 185
 constitutive scaling relation, 184
 crack driving force (or crack extension force), 16

- critical length (or size) L_c (of nucleation zone), 141, 142, 180
 critical length (or size) L_{sc} (of nucleation zone), 131, 134, 140
 critical size of seismic nucleation zone, 146
 cumulative Benioff strain release, 214, 238
 cutoff frequency f_{max} , 167
 cutoff frequency f_{max}^s (at seismic source), 168, 169, 174
 cycle process for a typical, large earthquake, 206
- deformation, 6
 ductile, 7, 8
 elastic, 6
 non-elastic, 7
 permanent, 7
 plastic, 7
 delayed fracture, 217
 depth profiles of constitutive law parameters, 106
 displacement-hardening (or slip-strengthening), 59
 displacement-related constitutive law parameters, 62
 ductile fracture, 9
 duration (time), 189
 of shear rupture nucleation, 179, 190, 193
 dynamic high-speed rupture (or earthquake), 145
 dynamic rupture growth at accelerating speeds, 135
 dynamically propagating stick-slip rupture, 51, 53, 54
- earthquake nucleation process, 242
 earthquake rupture, 121, 145, 146, 223
 process, 4
 earthquake (rupture) nucleation, 224
 process, 122
 effect of (effective) normal stress
 on shear failure strength, 74, 75
 effect of effective normal stress
 on the shear failure strength of wet Tsukuba granite, 77
 effect of normal stress
 on the shear failure strength of dry Westerly granite, 75
 effect of strain rate
 on shear failure strength, 74, 81
 effect of temperature
 on shear failure strength, 74
 on the shear failure strength of dry Westerly granite, 76
 on the shear failure strength of wet Tsukuba granite, 79
 effective breakdown displacement, 103
 effective breakdown stress drop, 103
 effective normal stress, 73
 effective stress law, 73
- elastic brittle fracture, 17
 elastic constants
 Lame's constants, Young's modulus, Poisson's ratio, modulus of rigidity, bulk modulus of elasticity, 6
 elastic crack model, 18
 elastic deformation of rock, 34
 elastic rebound model, 149
 elastic strain energy, 72, 143, 144, 145, 148, 201, 207, 234
 energy release rate, 16, 23
- fault zone, 33, 231
 fault zone heterogeneity, 231
 fault zone thickness, 34
 effective, 33, 180
 Fichtelbirge granite, 86
 forecast scientific scenario (or predictive model), 233, 241
 fracture energy, 16, 19
 of inhomogeneous (or heterogeneous) materials, 17
 fracture modes, 9
 fracture strength, 11
 fracture surface
 of a heterogeneous body, 16
 frequency characteristics (of strain gauge sensor), 41
 frictional coefficient, 12
 frictional sliding, 14
 frictional slip failure, 4
 frictional slip failure energy, 65
 frictional slip failure (or frictional stick-slip failure), 39
 frictional stick-slip failure, 14, 39
 frictional strength, 13, 72
 frictional strength (or resistance), 12, 14
- Gamma function, 201
 generation of short-period strong motion (at the source), 175
 geometric irregularities, 2
 geometric irregularity, 2
 of a nonplanar fracture surface, 16
 of fault surfaces, 123, 136, 138, 182
 of shear-fracturing surfaces, 19
 of shear rupturing surfaces, 36
 of shear-rupturing (or shear-fractured) surfaces, 88, 123
 with band-limited self-similarity, 2
 geometric property of rupture surfaces, 62
 Gutenberg–Richter frequency–magnitude relation, 197, 198
- Hawking, Stephen, 92
 heterogeneities
 of seismogenic layer and preexisting faults therein, 2

- heterogeneity, 2
 high-pressure testing apparatus, 28
 Hooke's law, 6
- immediate foreshocks, 157, 160, 223, 225, 226, 227, 229, 231
 inhomogeneous (or heterogeneous) fault, 3, 4, 72, 91, 121, 122, 142
 interlocking asperities, 3
 intermediate-term forecasting models, 237
 interstitial pore water, 73
 interstitial pore water pressure, 73
- J* integral, 22, 23
- laboratory-derived constitutive relation for shear failure, 20, 34, 63
 laboratory-derived rupture nucleation model, 145
 law of effective stress, 73
 linear slip-weakening model, 101
 load-unload response ratio (LURR), 239
 model, 238, 239
- macroscopic (shear) fracture surfaces, 7, 33, 34
 mainshock nucleation zone size, 229, 231
 mainshock rupture, 208
 master fault, 144, 145, 206, 208, 240
 mechanical effect of pore water pressure, 73
 modal analysis and physical parameters for Tsukuba granite, 30
 model of the cycle process for a typical, large earthquake, 209
- non-elastic (or ductile) deformation, 34
 nucleation
 earthquake, 4
 earthquake rupture, 4
 nucleation process, 92, 127, 128, 136, 145, 189, 192, 208, 209, 225, 226, 243, 244
 nucleation phase (shear rupture), 127, 128, 129
 nucleation process of frictional stick-slip failure, 46
 nucleation zone, 46, 136, 226, 229, 242
 nucleation zone length (or size), 142, 147, 242
- peak shear strength, 34, 36, 83, 100, 127
 peak slip acceleration, 52, 54, 163, 164, 165, 174
 peak slip velocity, 52, 54, 163, 164, 165, 174
 physical model of shear rupture nucleation process, 141
 physical model of the nucleation process for typical earthquakes, 223
 plastic flow law parameters, 8
 plastic regime, 72
 plate-boundary subduction zone, 214, 219
 precursory phenomena, 221, 233, 241, 247
 precursory seismic activity, 221
- prerequisites for rational constitutive formulation for real earthquake ruptures, 92
 principal stresses (maximum, intermediate, and minimum), 28
 probabilistic forecast, 236
 probability density function, 200
 probability (of a future earthquake occurrence), 200, 201, 236
 pulse width of slip acceleration, 168
- quantification of seismic activity (or seismicity quantification), 237
 quantitative effects of effective normal stress and temperature
 on the shear failure strength of wet Tsukuba granite, 80
 quantitative effects of normal stress and temperature
 on the shear failure strength of dry Westerly granite, 77
 quiescent period of seismicity, 207
 quiescent seismicity (or background seismicity), 207
- rate- and state-dependent constitutive formulations, 94
 rate- and state-dependent constitutive law, 94, 96
 rate- and state-dependent constitutive law parameters, 96, 97
 real area of contact, 11, 14
 real area of fracture surface, 16
 recurrence time interval, 201, 236
 recurrence time interval fluctuation, 203
 release of elastic strain energy, 68, 69
 residual friction stress, 36, 84, 100
 resistance to rupture growth, 2, 3, 16, 25, 27, 63, 72, 92, 121, 127, 134, 141, 143, 145, 148, 151, 176, 183, 195, 197, 208, 225, 226, 228, 229
 resistance to (shear) rupture growth, 179
 resolved normal stress across fault plane, 32, 82
 resolved shear stress along fault plane, 32, 82
 roughness of sliding surfaces, 14
 rupture growth length, 131, 139, 146, 147, 189, 191, 193, 244
 rupture growth rate (or rupture velocity), 129, 131, 136, 139, 189
- San Marcos gabbro, 86
 scale-dependence, 3, 165, 180
 scale-dependent earthquake rupture, 1, 4
 scale-dependent earthquake rupture generation process, 4
 scale-dependent physical quantities, 3, 92, 100, 179, 180, 181
 scale-dependent shear rupture generation process
 physical nature of, 4
 scale-dependent shear rupture process
 physical nature of, 4

- scaling parameter
 for the physical scaling of scale-dependent physical quantities, 181
- scaling property
 inherent in shear-rupture breakdown, 3, 4
- scaling relation
 between breakdown displacement and breakdown zone size, 179, 188
 between breakdown displacement and nucleation zone size, 179, 188
 between critical region size and final event magnitude, 240
 between seismic moment and breakdown displacement, 151, 153
 between seismic moment and nucleation zone size, 154
 between the duration time of shear rupture nucleation and characteristic length, 190
- seismic activity, 208, 209, 210, 217
 model, 207, 215, 222
- seismic gap, 207, 235
- seismic moment, 149, 150, 151, 153, 244
- seismic nucleation phase, 146
- seismic nucleation zone, 141
- seismogenic fault zone properties, 1
- seismogenic layer, 1, 70, 71, 224, 225, 226, 227, 228, 229
- Senatorski's fault model, 203
- shallow earthquake source, 91
- shallow focus earthquakes, 1, 121
- shear failure (or fracture) strength, 72, 73
- shear failure (or rupture), 1
- shear fracture, 4, 9
- shear fracture energy, 25, 36, 65
- shear fracture strength
 of intact rock, 3
- shear rupture nucleation (process), 121, 122, 131, 135, 141, 145, 146, 148, 208, 242
- short-term forecasting model, 243, 244
- single-degree-of-freedom rigid-block spring model, 67
- sliding mode or in-plane shear mode (mode II), 9
- slip acceleration, 50, 161, 181
- slip failure, 46
- slip rupture nucleation, 129
- slip velocity, 50, 128, 136, 161
- slip-dependent constitutive formulation, 56, 100, 101
- slip-dependent constitutive law, 55, 56, 99, 100, 101, 102, 106
- slip-dependent constitutive relation, 101
 for shear failure of intact granite, 34
- slip-rate effects on friction, 95
- slip-strengthening, 46
- slip-strengthening mechanism
 for frictional slip failure, 46
- slip-strengthening phase, 46, 101
- slip-weakening, 59, 128
- slip-weakening displacement, 36
- slip-weakening mechanism
 for frictional slip failure, 46
- slip-weakening phase, 101
- slip-weakening process, 46
- slow and quasi-static rupture growth, 135
- spherical triaxial pressure cell, 28
- stability or instability of shear failure process, 32
- stability/instability of slip failure (or shear rupture) process, 69
- steady-state creep flow, 8
- stepover zones, 2
- stick-slip, 14
- stick-slip (shear) rupture nucleation, 127, 131, 138, 141
- stick-slip rupture, 50
- stiffness of loading system (elastic), 14, 39, 67
- stress corrosion (or stress-aided corrosion), 73, 82, 217, 219
- stress drop, 149
- stress transfer, 203
- strong areas highly resistant to rupture growth on a fault, 3, 71, 72, 144
- strong areas of high resistance to rupture growth, 3
- strong (local) areas highly resistant to rupture growth on a fault, 2
- strong motion, 4
- seismic waves, 3
- strong motion seismic waves, 160, 161
- structural heterogeneities, 2
- tearing mode or anti-plane shear mode (mode III), 9
- tensile fracture (mode I), 9
- theoretical strength, 11
- time-dependence of static frictional coefficient, 13, 14
- time-to-failure function model, 213, 237
- transition process
 from the phase of stable, slow rupture growth to the subsequent accelerating phase of rupture growth, 135
- Tsukuba granite, 30, 39, 73, 80, 85, 87, 122
- underlying physical fault model
 of earthquake sources, 168
- unification of constitutive relations
 for the shear failure of intact rock and for frictional slip failure, 56
- unified comprehension
 of shear fracture and frictional stick-slip failure, 59
- unifying (constitutive) law, 4, 32, 100
- Weibull distribution, 200
- Westerly granite, 73, 75, 76, 77, 80, 258, 264, 265
- zone of dynamic rupture propagation, 46