Index

$N_g$ (gravity number), 393
$p_b$ (lithostatic pressure), 390
$p_h$ (hydrostatic pressure), 390
$p_l$ (excess lithostatic pressure), 390
$\beta$-factor (of time), 224
$\beta$-factors, 215
$b$-factor, 218
$\zeta$-coordinate, 67
$\zeta$-coordinate (horizon), 97

adiabat, 191
adiabat (linear melt fraction), 236
Airy isostasy, 194
Amonton’s law, 260
Anderson’s theory of faulting, 269
anisotropic (permeability), 23
aperture (hydrofracture), 397
arithmetic average, 27
Arrhenius kinetics, 128
asthenosphere, 105, 194
average permeability, 27
average permeability (hydrofracture), 397

backstripping, 243
bending moment, 282
Benfield’s temperature solution, 181
Betti’s reciprocal theorem, 82
Biot equations, 426
blanketing (thermal), 181
Bouguer correction, 344
Bouguer’s formula, 325
Boussinesq approximation, 477
brittle, 260
brittle–ductile transition, 273
Brun’s formula, 347
bulk modulus, 38
burial history, 94
Byerlee’s law, 261

Cauchy–Riemann relations, 75
cement (quartz), 361
characteristic time (heat conduction), 208
clay, 19, 361
coefficient of friction, 260
cohesive strength, 268
compaction (gravitational), 90
compaction computation, 102
compaction of soils, 88
confining pressure, 80
creep (solid), 377
conservation (fluid mass), 386
conservation (fluid), 420
conservation (silica), 377
conservation (solid), 417
conservation laws in 1D, 68
conservation of energy (1D), 106
conservation of energy (general), 186
conservative fields, 323
continuity equation, 215
coupled heat flow (transient), 147
coupled temperature, 221
correlation function, 6
Coulomb fracture envelope, 268
crust, 105, 194
crustal roots, 198
curvature (radius), 286
cylinder coordinates, 326

Damköhler number, 379
Darcy flux (given void ratio), 388
Darcy’s law, 12
Darcy’s law (overpressure), 387
decompression melting, 230
dehydration of clay, 473
deposition, 181
depth (horizon), 97
depth-dependent stretching, 218
deviatoric stress, 55
Index

DFT (discrete Fourier transform), 502
diagenesis, 361
differential stress, 55
diffusion (characteristic time), 379
dikes and sills (temperature), 159
dim zone, 400
Dirac delta function, 289
directional permeability, 25
discrete Fourier transform, 502
dissolution rate, 362
disturbing potential, 323
drained compressibilities, 84
ductile, 260
ductile flow, 273
Duhemel’s theorem, 179
dynamic friction, 263
E (exponential integral function), 373
earthquakes, 263
effective elastic thickness, 290
effective stress, 63, 88
Ei (exponential integral function), 373
elastic and viscous deformation, 304
ellipsoid (permeability), 25
ellipsoid (stress), 53
entropy (specific), 188
erf (error function), 154
eric (complementary error function), 154
erosion, 100
error function (erf), 154
Euler coordinates, 64
Euler’s formula, 505
eustacy, 200
eustacy (tectonic subsidence), 242
excess lithostatic pressure, 390
fast Fourier transform (FFT), 502, 510
fault (normal), 260
fault (reverse), 260
fault (thrust), 260
faulting (domino style), 219
FFT (fast Fourier transform), 502, 510
Fick’s law, 377
flexural rigidity, 286
flexure (beam), 282
flexure (broken plate), 294
flexure (degree of isostatic equilibrium), 295
flexure (lateral extent of the load), 295
flexure (lithosphere), 282
flexure (plate compression), 298
flexure (point load), 289
flexure (rectangular load), 298
flexure (viscoelastic), 302
flexure and viscous mantle, 301
fluid content (increment of), 424
flux (fluid), 12
footwall, 260
force, 38
force (from stress), 43
forced convective heat transfer, 140
Fourier series, 502
Fourier’s law, 31
fracture (brittle), 268
fracture (heat flow), 151
free-air correction, 344
friction, 260
friction (static and dynamic), 263
gas chimney, 400
Gauss’s law, 323
geroid, 344
geotherms (lithospheric mantle), 124
Gibson solution (dimensionless), 412
Gibson solution (large strain), 405
Gibson solution (overpressure), 401
gravitation, 316
gravitational acceleration, 316
gavity, 14, 316
gavity and flexure, 347
gavity in 2D, 334
gavity number, 393, 457
gavity number (chemical compaction), 468
gravity number (dehydration), 473
hanging wall, 260
harmonic average, 27
heat conductivity, 31
heat conductivity (mantle), 124
Hooke’s law, 38
Hooke’s law (general), 56
hydraulic head, 434
hydrofracturing, 271, 393, 397
hydrofracturing, 271, 393, 397
hydrostatic equilibrium, 194
hydrostatic pressure, 390
illite, 361
increment in fluid content, 424
instantaneous stretching (condition), 224
internal friction (angle), 268
internal friction (coefficient), 268
invariants, 47
isostasy (and gravity), 347
isostatic subsidence, 194
Jacobian determinant, 64
Kozeny–Carman permeability, 15, 18
Index

Lagrange coordinate (ζ), 386
Lagrange coordinates, 64
Laplace equation, 327
Laplace transform, 402
latent heat of fusion, 167
line mass (gravity), 330
linear stability analysis, 482
liquids, 230
lithosphere, 105, 194
lithosphere (oceanic), 238
lithospheric strength, 273
lithostatic pressure, 390
mantle, 105
mantle density, 224
mantle flow, 215
mass conservation, 215
mass conservation in 1D, 69
material derivative, 64
McKenzie model (initial subsidence), 202
McKenzie model (surface heat flow), 211
McKenzie model (temperature solution), 209
McKenzie model (thermal transient), 207
McKenzie model (thermal uplift), 202
mechanical compaction, 407
melt, 230
melt fraction, 230, 238
melt fraction (McKenzie and Bickle), 234
meteoric fluid flow, 442
meteoric fluid flow (and temperature), 140
mGal, 325
mineral reaction, 473
Moho, 194
Mohr’s circle, 51
mole, 377
momentum balance, 70

net rock, 67
neutral surface, 282
Newton’s law, 316
Newton’s second law, 70
non-Rayleigh convection, 477
normal fault, 260

oceanic lithosphere, 238
oil generation and expulsion, 476
overpressure, 434
overpressure (dehydration), 473
overpressure (equation), 387
overpressure (exact solution), 393
overpressure (Gibson solution), 401
overpressure (Gibson solution, large strain), 405
overpressure (given the void ratio), 392
overpressure (layer), 470

overpressure (thermal), 459
overpressure build-up in clay, 454
overpressure decay, 446
overpressure decay in clay, 452

partial melting, 230
particle path, 74
Peclet number, 224
penetrable grain model, 9
percolation threshold, 364
periodic heating of the surface, 173
permeability, 12, 18
permeability (directional), 25
permeability (empirical), 18
permeability (Kozeny–Carman), 15
permeability (parallel tubes), 15
permeability ellipsoidal, 25
permeability function (linear), 405
phase change, 224
planar surface, 440
point mass, 316
Poisson’s equation, 327
Poisson’s ratio, 38
porosity, 3
porosity (as a function ζ), 95
porosity (as a function of ζ), 99
porosity (thermal expansibility), 431
porosity (time-rate of change), 431
porosity function (linear), 401
porosity-free rock, 67
potential (fluid flow), 14, 434
potential (gravitational), 321
potential energy, 321
power law creep, 273
Pratt isostasy, 194
pre-calibration of burial histories, 97
precipitation (characteristic time), 379
precipitation rate, 362
pressure (confining), 80
pressure release melting, 230
pressure-solution, 361
principal directions, 23
principal stress, 47
principal system (stress), 47
principle of detailed balancing, 362
pseudo-potential, 434
quartz cement, 361
quartz grains, 361
radioactive heat generation, 112
radius of curvature, 286
Rayleigh convection, 482
reaction–diffusion equation, 377
Index

reduction of gravity data, 344
reverse fault, 260
Reynolds transport theorem, 70
rheology, 260
rift axis, 215
rift phases, 215
rock compressibility, 80
rotation matrices, 20
salt structures, 138
salt tectonics, 138
sandstone, 18, 361
sea floor spreading, 238
seal (fluid flow), 449
sediment maturity, 127
separation of variables (McKenzie), 209
shale, 19, 361
shear (pure), 59
shear (simple), 59
shear modulus, 39
silica, 362
sills and dikes (solidification), 170
sills and dikes (temperature), 159
simple shear extension, 220
soils (compaction), 88
solidification, 167
solidus, 230
specific surface, 6
specific surface (simple), 364
specific volume, 188
sphere (gravity), 329
spherical coordinates, 319
spheroid, 344
static friction, 263
stationary temperature (sphere), 132
stationary temperature solution (heat generation), 115
stationary temperature solutions, 109
Stefan problem, 167
stick–slip faulting, 263
storage (unconstrained), 451
storage coefficient (constrained), 422
storage coefficient (definition), 422
storage coefficient (unconstrained), 421, 422
strain (1D), 38
strain (general), 40
strain (shear), 39
strain (tensile), 40
strain (volume), 38
strain rate, 215
stream function, 75
streamline, 74
streamlines (2D), 75
streamlines (in 2D), 75
streamlines (wells), 491
streamtube, 75
stress, 43
stress (tensor), 43
stress (thermal), 60
stress ellipsoid, 53
stress–strain relations, 56
stylolites, 361
subsidence (cristal thinning), 200
subsidence (density change), 224
subsidence (initial), 206
subsidence (isostatic), 194
subsidence (maximum thermal), 206, 213
subsidence (maximum), 206
subsidence (tectonic), 242
subsidence (thermal), 213, 238
subsidence (total), 242
Talwani’s formula, 334
tectonics (plate), 194
temperature (and heat convection), 140
temperature (fracture), 151
temperature (semi-infinite half-space), 154
temperature (sills and dikes), 159
temperature and salt domes, 138
tension cutoff, 270
thermal convection, 482
thermal convection (weak), 477
thermal expansibility porosity, 431
thermal transient, 181
thermal uplift (McKenzie model), 202
thermodynamics, 188
thrust fault, 260
time constant (viscoelastic), 303
torque, 282
tortuosity, 377
total subsidence, 242
transformation ratio, 128
transient temperature (sphere), 134
transmissibility, 25
TTI (time–temperature index), 127
uniaxial compressive strength, 270
unit depth, 393
unit pressure, 393
unjacketed compressibilities, 84
uplift (density change), 224
variable surface temperature, 177
velocity (fluid), 12
velocity (solid), 12
viscoelastic (time constant), 303
viscoelastic plate, 307
viscoelasticity, 302

526Index

reduction of gravity data, 344
reverse fault, 260
Reynolds transport theorem, 70
rheology, 260
rift axis, 215
rift phases, 215
rock compressibility, 80
rotation matrices, 20
salt structures, 138
salt tectonics, 138
sandstone, 18, 361
sea floor spreading, 238
seal (fluid flow), 449
sediment maturity, 127
separation of variables (McKenzie), 209
shale, 19, 361
shear (pure), 59
shear (simple), 59
shear modulus, 39
silica, 362
sills and dikes (solidification), 170
sills and dikes (temperature), 159
simple shear extension, 220
soils (compaction), 88
solidification, 167
solidus, 230
specific surface, 6
specific surface (simple), 364
specific volume, 188
sphere (gravity), 329
spherical coordinates, 319
spheroid, 344
static friction, 263
stationary temperature (sphere), 132
stationary temperature solution (heat generation), 115
stationary temperature solutions, 109
Stefan problem, 167
stick–slip faulting, 263
storage (unconstrained), 451
storage coefficient (constrained), 422
storage coefficient (definition), 422
storage coefficient (unconstrained), 421, 422
strain (1D), 38
strain (general), 40
strain (shear), 39
strain (tensile), 40
strain (volume), 38
strain rate, 215
stream function, 75
streamline, 74
streamlines (2D), 75
streamlines (in 2D), 75
streamlines (wells), 491
streamtube, 75
stress, 43
stress (tensor), 43
stress (thermal), 60
stress ellipsoid, 53
stress–strain relations, 56
stylolites, 361
subsidence (cristal thinning), 200
subsidence (density change), 224
subsidence (initial), 206
subsidence (isostatic), 194
subsidence (maximum thermal), 206, 213
subsidence (maximum), 206
subsidence (tectonic), 242
subsidence (thermal), 213, 238
subsidence (total), 242
Talwani’s formula, 334
tectonics (plate), 194
temperature (and heat convection), 140
temperature (fracture), 151
temperature (semi-infinite half-space), 154
temperature (sills and dikes), 159
temperature and salt domes, 138
tension cutoff, 270
thermal convection, 482
thermal convection (weak), 477
thermal expansibility porosity, 431
thermal transient, 181
thermal uplift (McKenzie model), 202
thermodynamics, 188
thrust fault, 260
time constant (viscoelastic), 303
torque, 282
tortuosity, 377
total subsidence, 242
transformation ratio, 128
transient temperature (sphere), 134
transmissibility, 25
TTI (time–temperature index), 127
uniaxial compressive strength, 270
unit depth, 393
unit pressure, 393
unjacketed compressibilities, 84
uplift (density change), 224
variable surface temperature, 177
velocity (fluid), 12
velocity (solid), 12
viscoelastic (time constant), 303
viscoelastic plate, 307
viscoelasticity, 302
Index

viscosity, 12
viscous and elastic deformation, 304
viscous plate, 310
vitrinite reflectance, 127
vitrinite reflectance, easy-ro, 128
void ratio, 3
void ratio function (linear), 405
water table, 440

weak thermal convection, 477
work (and displacement), 82
yield strength envelope, 273
Young's modulus, 38
YSE, 273
zeta-coordinate, 67
zeta-depth (horizon), 97