

# Index

Page numbers in *italics* refer to figures.

- Aa flow, 34  
 Aar Massif, 162, 522  
 abortive subduction, 433–34  
 absolute plate velocity, 359–60, 359  
 absolute reference frame, 359  
 abyssal plains, 342, 402, 406  
 Acadian Orogeny, 582, 589–90, 591, 594  
 Acadian Phase, 252  
 Acatlan Complex, 603  
 accelerated (tertiary) creep, 93, 93  
 acceleration, 43  
 accommodation zones, 394, 395, 494  
 accreted terranes, 440  
 accretionary complexes, 566  
 accretionary flux, 566–67, 568, 571–72  
   defined, 566  
 accretionary orogeny, 440*n*  
 accretionary wedge (accretionary prism),  
   415, 417, 420–24, 420, 421, 433,  
   567, 567, 607  
   in Alps, 521  
   backstop of, 420–21  
   bivergence in, 421–22  
   blueschist formation in, 423–24  
   in critical taper theory, 422–23, 423  
   double-sided, 567–68, 568  
   extensional collapse of, 421–22  
   as setting for fold-thrust belts, 449  
   stable, 567  
   transport direction of, 457  
 Aconcagua, Mount, 578  
 active-arc volcanoes, 566  
 active continental margins, 358  
 active faults, 199  
 active folding, 257–60, 259, 261  
 active margins, 405  
 active orogens, 347  
 active rifts, 347–48, 382  
 active strain markers, 80–81  
 adiabatic gradient, 102, 102  
 admissible sections, 468  
 Adriatic Plate, 510, 511, 514, 517,  
   522, 574  
 advection, 349, 351  
 African Plate, 358, 360, 363  
 Aleutian Trench, 428  
 Alice Springs Orogeny, 553  
 Alleghanian Orogeny, 582, 590–91, 619,  
   621, 623  
 Alleghanian phase, 252  
 allochthon, 173, 455  
 allochthonous rock, 457, 588  
 allochthonous salt sheet, 407–8  
 alluvial fan, 397  
 Alpine Fault, 188, 296, 476, 477, 488,  
   497, 498  
 Alps, 3, 33, 76, 76, 86, 347, 503, 504, 523,  
   545, 554, 567, 573, 574, 604  
   accretion wedge in, 521  
   Cascadia wedge compared with, 574  
   convergence in, 521  
   Cretaceous orogeny of, 521  
   deep structure of, 514–17, 515–16  
   earthquake foci of, 515–16, 516–17  
   evolution of, 517–22, 518–20  
   Glarner Thrust of, 434  
   major paleogeographic units of, 512–14, 513  
   major tectonic units of, 510–12  
   plate collision in, 521–22  
   recumbent folds in, 205, 244–45, 459, 459  
   rheologic behavior of, 517  
   tectonic evolution of, 510–23, 511  
   Upper Rhine Graben of, 522–23  
 Altaiids, 503, 504, 535–45, 540  
   evolution of, 539–44, 541, 543  
   geographic extent of, 535–36  
   structure of, 538–39  
   tectonic subdivisions of, 536–37  
 Altay Mountains, 542–44  
 Altiplano Plateau, 560, 577–80  
 Alvin, 405  
 Alytn Tach Fault, 476, 530  
 Amasia, 367*n*, 608*n*  
 Amazonian craton, 582  
 Amazonia-Plata craton, 609  
 Amontons, Guillaume, 132*n*  
 Amontons's laws of friction, 132  
 amphibole, 32, 282–83, 290, 328, 424  
 amplitude, 240–41, 240  
 anastomosing, as term, 167*n*  
 anastomosing cleaning domain, 276, 277  
 anatexis, 283  
 Ancestral Rockies, 439, 439, 621, 626  
 Andean Orogeny, 575–77  
 Andean-type backarc, 425, 426, 431  
 Anderson, E. M., 191*n*  
 Anderson's theory of faulting, 191–92, 191  
 andesite, 535, 550, 575  
 Andes Mountains, 347, 412, 413, 415, 425,  
   448–49, 503, 504, 560, 575–81, 576  
   crustal thickening and, 580–81  
   lithospheric thinning and, 580–81  
   oroclinal bending in, 579–80  
   paleotectonic control of, 580  
   segmentation of, 578–80  
   tectonic provinces of, 578  
   tectonics of, 577–78, 577  
 Angara craton, 612  
 Angelina sedgwicki (trilobites), 63  
 angular shear, 71  
 angular strain, 70–71  
 anhydrite, 242, 397, 517  
 anisotropy of magnetic susceptibility  
   (AMS), 292  
 annealing (static recrystallization), 226  
 anorthosite, 307, 587  
 Antarctic Plate, 358, 363  
 anticline, 241, 243, 522  
   fault-bend, 462  
   rollover, 388, 388  
   synformal, 243*n*  
 anticlinorium, 247–48  
 antiformal syncline, 243*n*  
 antiforms, 241, 243, 246, 248, 251  
 antitaxial veins, 162, 163  
 antithetic faults, 195, 388, 388, 390  
 antithetic fractures, 301  
 Antler Orogeny, 559  
 apatite fission-track dating, 571–72, 572  
 Appalachian-Caledonide Orogen, 366  
 Appalachian Mountains, 70, 90, 146,  
   157–58, 182, 219, 284, 347, 396,  
   396, 440, 441, 457, 503, 504, 554,  
   582, 593, 597, 608, 609, 615  
   conjugate joint systems in, 157–58  
   crustal accretion in, 440, 441  
   phases of, 252  
   Pike Mountain Thrust of, 452–53, 453,  
   494, 495  
   rift orientation in, 396, 396  
   Valley-and-Ridge Province of, 251, 449,  
   459, 460, 582, 590  
 Appalachian Orogen, 582–91, 605, 608, 608  
   closure of Iapetus Ocean and, 588–89  
   destruction of passive margins in,  
   587–88  
   formation of Pangea and, 590–91  
   overview of, 582–83  
   tectonic components of, 582–87, 582,  
   585, 586  
   tectonic evolution of, 588  
 apparent constriction, 78  
 apparent flattening, 78  
 Apulia, 514  
 Apulian Plate, 514  
 Arabian Plate, 477, 495  
 Arches National Park, 138, 139  
 Archimedes' law, 353–54  
 arc length, 240, 240  
 arc-trench gap, 425  
 Ardmore Basin, 490  
 area balanced cross section, 468–70, 470  
 arenite, 587, 612  
 Argand, Emile, 523, 525, 527, 529, 530  
 argille scagliose, 182  
 argillite, 551

- Armorica, 600, 604  
 arrest lines, 141, 144  
 aseismic slip, 199  
 Asgard, Mount, 610  
 ash flow, 35  
 Asia, 348, 355, 412, 428, 431, 436–38, 437, 439, 492, 492, 497, 525–30, 526, 533, 545, 615*n*, 625  
 asperities, 132, 133, 182–83  
   in earthquakes, 199  
 asthenosphere, 6, 59, 336–37, 353–54, 356, 365, 367, 414, 425, 435, 436, 506, 616  
   at mid-ocean ridges, 402, 405  
   in rifting process, 397–98, 400–401, 408  
   variations in temperature of, 623  
 asymmetric folds, 248–49, 248  
 asymmetric rift model, 385  
 Atacama fault system, 579  
 atmospheric circulation, 506  
 atomic number, 325  
 augen gneiss, 283  
 aulacogens, 384, 384, 408  
 Australia, 355, 613. *See also* Tasman orogenic belt  
 Australian Plate, 568  
 autobrecciation, 33  
 autochthon, 173, 455  
 autochthonous rock, 457–59  
 Avalonia, 600, 601, 602–3, 604  
 Avalon Terrane, 608  
 Avalon Zone, 585, 587, 597, 599–600  
 Avogadro's number, 217*n*  
 axial compression, 121–22  
 axial plane, 240, 255–57  
 axial plane cleavage, 264, 264*n*, 279  
 Axial realm, 583, 584–85, 587  
 axial stretching, 121  
 axial surface, 240, 240, 244, 255
- backarc basin, 425, 427  
 backarc region, 415, 425–28, 429, 426, 448–49, 492  
   types of, 425  
 backstop, 420–21, 422, 568  
 backthrusts, 457, 459  
 balanced cross sections, 468–70  
   quick-look technique for, 469–70, 470  
 ball-and-pillow structures (load casts), 19, 20  
 Baltica, 593, 597, 598, 599–600, 601, 601, 602, 604–5, 610, 610, 612  
 Baltica craton, 609  
 Baltic Shield, 605, 612  
 barbs, 141  
 Barringer Meteor Crater, 36, 37  
 basal conglomerate, 23  
 basal detachment, 385, 457–59  
 basal drag, 364, 365, 365  
 basalt, 31, 81, 140, 181, 314*n*, 339, 345, 399, 400, 405, 415, 417, 420, 440, 497, 535, 561, 597, 625  
   fabric of, 271  
   flood, 399  
   pillow, 34–35, 34, 342, 363*n*, 505, 535, 551, 572  
 Basel earthquake, 523  
 basement high, 390  
 basement rocks, 346, 459, 504  
   of Appalachian Orogen, 587  
   crystalline, 505  
 Basin and Range Province, U.S., 188, 196, 296, 347, 384*n*, 390, 392, 397, 399, 400, 557, 561, 563, 565, 569  
   formation of, 562, 562  
   Garlock Fault and, 495–96, 496
- basin and range topography, 399  
 basin inversion, 197, 433  
 basins, 393, 399  
   backarc, 425, 427  
   forearc, 415, 424  
   foreland, 197, 433, 433, 448, 449, 505  
   passive-margin, 406, 408, 431, 433, 450–51  
   pull-apart, 491–92, 611  
   rift, *see* rift basins  
   steerhead, 397, 399  
 bathymetric provinces, 342  
 Beatles, 362  
 Becraft limestone, 21  
 bedding (stratification), 14–23, 273  
   in balanced cross section, 469  
   bottomset, 18  
   conformable and unconformable  
     contacts in, 19–23, 20–23  
   cross, 17–19, 18  
   definitions of, 15–16  
   disrupted, 19, 20  
   fold shape and, 246  
   foreset, 18  
   graded, 17–19, 17, 18  
   homoclinal, 17  
   joint spacing and thickness of, 147–48  
   in structural analysis, 16–17  
   terminology of, 15  
   terms describing types of, 16  
   topset, 18  
   units of, 15*n*  
   welds and, 27  
 bedding-cleavage lineation, 289–90  
 bedding-parallel parting, 16  
 belemnite, 85–86, 86  
 Belt-Purcell Supergroup, 558  
 bending, folding and, 259, 259  
   oroclinal, 506, 579–80  
   resistance to, 351, 353  
 Bengal Fan, 602  
 Benioff, H., 417*n*  
 Bergell Massif, 514  
 Bergen High, 390  
 Bering Sea, 425–27, 427  
 Big Horn Mountains, 250  
 bimodal volcanic suite, 399  
 biotite, 282, 302, 318, 319, 329  
 Biot-Ramberg equation, 260–61, 262  
 bivergent orogen, 434  
 bivergent wedge (bivergent prism), 421–22, 474, 474
- black smokers, 405*n*  
 Blair dolomite, 133–34, 134  
 blastomylonite, 297–98  
 blind fault, 177, 178  
 blind thrusts, 454  
 blind rotation, 487, 488  
 blocky veins, 160–61, 161  
 Blue Mountains, Australia, 401  
 blueschist, 423–24, 512, 548, 551, 560, 589  
 body forces, 43  
 Boltzmann's constant, 217*n*  
 boninite, 550  
 bookshelf faults, 388  
 bookshelf model, 302*n*  
 bottomset beds, 18  
 boudin necks, 289  
 boudins, 288, 288, 289, 303  
 Bouma sequence, 17  
 bow-and-arrow rule, 466  
 box folds, 242, 250  
 brachiopods, 84, 85  
 branch line, 455  
 Brasiliano/Pan African orogens, 347  
 Brazilian Shield, 396, 578, 580
- breakaway fault, 385  
 break-forward sequence, 455–56, 458  
 break thrusts, 460, 461  
 breccia, 34, 189, 190, 199, 391, 392–93, 488, 492, 498  
   fault, 179–80, 180  
   impact, 36, 38  
   indurated, 181  
   random fabrics in, 179  
   vein-filled, 181  
 Bresse Graben, 512, 522  
 Brevard Zone, 584  
 Briançonnais microcontinent, 510, 512  
 brittle behavior (fracturing), 108–10, 110, 111, 205  
 brittle deformation, 6, 114–37, 295  
   atomic structure and, 117–18, 117  
   brittle faulting and, 123–24  
   crack-surface displacement and, 122–23, 122  
   defined, 115, 116  
   environmental factors in, 134–36, 135  
   formation of shear fractures and, 124–26, 125  
   frictional sliding in, 132–34, 132  
   Griffin cracks in, 118, 119–20, 121, 122, 126–27  
   nonrecoverable stress in, 117–18  
   predicting, 126–31, 128–31  
   processes of, 118, 119  
   stress concentration in, 118–21, 119–20  
   tensile cracking in, 118–23, 119–22  
   terminology of, 114–16, 115  
   types of, 119  
   *see also* faults and faulting; joints; veins  
 brittle-ductile paradox, 110, 111  
 brittle-ductile transition, 110, 111, 200*n*, 295–96  
 brittle-plastic transition, 59–60, 110, 131, 190, 200*n*, 295, 348, 492, 510, 517, 579  
 broken formations, 423  
 buckle folds, 259–61, 259, 261, 267  
 bulge nucleation, 226, 227  
 bulk modulus, 95, 95  
 buoyancy, 26–27, 349  
   Archimedes' law of, 353–54  
 Burchfiel, B. C., 496*n*  
 Burgers vector, 208–9, 208, 210, 211, 212, 216, 217, 220, 221, 221, 222, 224, 224  
 Byerlee, J., 133*n*  
 Byerlee's law, 133, 133, 348
- Cadomian Orogeny, 595, 597  
 calcite, 123, 124, 159, 162, 181, 183, 192, 210, 224, 225, 226, 227, 228, 242, 266, 275, 284, 286, 296, 318–19, 465, 517  
   in cleavage processes, 275–76  
   deformation mechanism map for, 230, 23  
   fabric of, 310–11, 310  
   twinning in, 213–16, 213, 214–15, 439*n*, 622–23, 622  
 calcite strain-gauge technique, 215–16, 215  
 Caledonide Orogen, 582  
 Caledonides, 239, 347, 503, 504, 593–605, 602, 607, 608, 608  
   breakup of Gondwana and, 599–600  
   closure of Iapetus Ocean and, 601–3  
   collision events in, 600–605  
   fragmentation of, 600–601  
   ice age in, 603  
   marginal basins of, 598–600, 598  
   orogenic belts of, 595–96  
   subduction in, 600–601

- Canadian Rockies, 444, 445, 457, 459, 466, 554, 615*n*
- Canadian Shield, 375, 385, 615, 616
- Cantabrian Mountains, 250
- Caribbean Orogen, 608
- Caribbean Plate, 498
- Carolina Slate Belt, 593, 597, 599–600
- Carolina Zone, 585, 587, 588
- Cascades chain, 350
- Cascadia subduction wedge, 566–74
  - accretionary flux in, 566–67, 568, 571–72
    - Alpine wedge compared with, 574, 576
    - erosion in, 571–73, 572
    - forearcs of, 570–72, 573
    - pro-side accretion in, 568–69
    - structural lid of, 569, 572–73, 573
    - subduction polarity in, 568–69
    - subduction zone of, 569–71, 570
- cataclasis, cataclastic flow, 116, 167, 167, 191, 205, 206–7, 228, 232, 295, 296, 517
  - bean bag experiment in, 206, 206
  - in brittle faulting, 123–24
  - ductile deformation and, 205, 206–7, 206
- cataclasite, 181, 182, 190, 296, 492
- cataclastic shear zone, 124
- Catskill Mountains, 15, 139
- C-C structure, 302, 303, 303
- C-foliation, 302–3, 303
- C'-foliation, 302–3, 303
- Challenger*, H. M. S., 402
- Chaman Fault, Pakistan, 476, 492, 497
- chemical bonds, 117, 117
- chemical weathering, 16
- chert, 245, 424, 535, 551
- chevron folds, 245, 250, 263, 550
- Chief Mountain, 174, 174
- chlorite, 159, 183, 192, 278–79, 394
- chocolate-tablet boudinage, 289
- Churchill craton, 610, 611–13
- Cincinnati Arch, 618
- classical (Newtonian) mechanics, 40, 41, 229
- classic fold-thrust belts, 452
- clastic dikes, 19, 20
- clastomylonite, 297–98, 297
- clay, 23, 180, 181, 182, 192
  - in cleavage processes, 275–76, 277, 278, 279, 281, 286
- cleavage, 273–82, 622, 625
  - axial plane, 264, 264*n*, 279
  - classification of, 276–77, 277
  - continuous, 277, 280
  - crenulation, 274, 280–82, 281, 282, 286, 288
  - cross-cutting in, 287
  - defined, 273–74
  - disjunctive, 273, 274–76, 275, 278, 286
  - field vocabulary for, 276–77, 277
  - fracture, 274
  - gneissosity and, 282–84
  - low-grade, 284–85, 286
  - migmatization and, 282–84
  - moderate, 277
  - pencil, 274, 277–78, 277, 278, 286
  - phyllitic, 278–79, 281
  - quartz and, 275–76, 277, 278, 281, 282
  - schistosity and, 278, 279–80
  - in shale, 277–78, 281, 286–87
  - slaty, 274, 278, 278, 279, 281, 286–87, 465, 554, 603, 622
  - spaced, 274, 275–76, 284
  - strain and, 284–85
  - strong, 277
  - symmetrical and asymmetrical, 281, 281
- tectonic, 465
- transecting, 287
- volume loss and, 285, 285
- weak, 276–77
- cleavage domains, 274, 286
  - spacing of, 276–77, 277
  - vocabulary of, 276–77
- cleavage refraction, 286, 287
- closing relationship, 363
- closure temperature, 327–28, 328
- coal, 182
- coaxial strain, 67–69, 68
- Coble creep (grain-boundary diffusion), 217–18, 218, 232
- COCORP (Consortium for Continental Reflection), 374
- Cocos Plate, 358
- coefficient of internal friction, 128
- cohesion, 128
- cohesive fault rocks, 179
- collisional tectonics, 429–43, 450, 505, 507
  - abortive subduction in, 433–34
  - accretionary tectonics in, 440–41, 441
  - in Alps, 521–22
  - basic stages of, 429–31
  - continental interiors in, 438–40, 439, 492
  - crustal thickening in, 435–36, 435, 436
  - deep structure of, 442
  - erosion in, 442–43
  - extensional (orogenic) collapse in, 435–36, 435, 436
  - fault-and-fold zones in, 438–40, 439
  - faulting in, 432, 433, 436–40, 437, 439
  - lateral escape in, 436, 437, 438, 438
  - modeling studies of, 442–43, 442
  - plateau lift in, 438
  - precollision configuration and, 431, 432
  - promontories and recesses in, 430, 431
  - rock and structure types in, 430–31
  - shape of colliding pieces in, 430–31
  - stress in, 438–40
  - strike-slip faulting in, 436–38, 437, 492
  - sutures in, 429–30, 432, 433, 440
  - terminology of, 430
- collision zones, 356–58, 358, 429, 431
- Colorado Plateau, 250, 562, 615, 622, 625
- Columbian Orogeny, 560
- Columbia Plateau, 399
- columnar jointing, 35, 36, 146
- combination model, 389
- compaction, 23
- compatibility problem, 310*n*
- compensation, depth of, 354
- competency, flow and, 110–11
- composite material, 111
- compositional boundary, 352
- compositional change, 340
- compressibility, 95
- compression waves (P-waves), 340, 341, 350
- concordant age, 326
- conduction, 349, 351, 506
- confining pressure, 51, 101–03, 103, 108, 193
- conformable contacts, 19–23, 20–23
- conjugate fractures, 126, 129, 129
- conjugate joint systems, 145–46, 157–58
- “conservative” plate boundaries, 356
- constitutive equations (flow laws), 93, 219–20, 232
- “consuming” plate boundaries, 356
- contact strain zone (CSZ), 262
- continental arcs, 425
- continental crust, 342–48, 343, 344, 346, 347, 414, 425, 429, 440, 497, 506
  - categories of, 617
  - collapse of, 410
- continental platform in, 346
- cratons of, 346–47, 348
- magmatic underplating of, 345
- passive margins of, 347–48
- Precambrian shields in, 345
- rifts in, 347, 348. *See also* rifts and rifting
- strength of, 348
  - beneath Tibetan Plateau, 527, 529–30, 530
  - younger orogenic belts of, 348
- continental drift theory, 4, 355, 358
- continental-interior platform, 615
- continental platforms, 346
- continental rifting. *See* rifts and rifting
- continental rise, 406
- continental shelf, 406, 408
- continental slope, 406
- continuous cleavage, 277, 280
- continuous fabric, 271, 272
- continuum mechanics, 40–41, 41
- contracting Earth hypothesis, 355*n*
- contractional backarc, 425, 427
- contractional faults, 170–72, 172
- contraction theory, 4
- convection, 349, 349, 351, 353, 365, 366, 408, 506
- convection-cell model, 364
- convergence, 6, 6
- convergence rate, 417
- convergent dip isogons, 246
- convergent plate boundaries, 356, 357, 364, 414
- convergent plate margins, 414–29, 414, 415, 450
  - accretion wedge in, 415, 420–24, 420, 421, 423
  - in Alps, 521
  - backarc region of, 415, 425–28, 426, 429
  - coupled vs. uncoupled, 428–29
  - distribution of, 414–15
  - downgoing slab of, 414, 415–18, 419
  - earthquakes in, 417–18, 419
  - forearc region of, 415, 424–25
  - foreland of, 448–49
  - oblique, 492
  - overriding slab of, 414
  - rollback movement in, 414
  - strike-slip faulting in, 426, 429
  - subduction at, 414
  - terminology of, 414–15, 416
  - Tibetan Plateau and, 528–29
  - trench in, 415, 418–20, 419, 420
  - volcanic arc in, 414, 415, 425, 426, 427, 428, 428, 429
- convergent wedge, 568
- cooling age, 328
- cooling rate, 329
- coordinate transformation, 7–8
- Cordilleran metamorphic core complexes, 390–94, 392–93
- Cordilleran Orogen, 608, 610
- core complexes, 390–94, 392–93
- core-mantle (mortar) structure, 227, 227
- core of Earth, 336, 337, 340, 350
- Cornubian Batholith, 604
- corrugations, 183
- Cottage Grove Fault, 620
- Coulomb, Charles, 127
- Coulomb material, 471–72
- Coulomb's failure criterion, 128–29, 128, 131, 132, 134, 136, 157, 191, 192
- Coulomb wedge, 472, 473–74
- country rock, 32–33
- coupled convergent margins, 428–29
- “cover” rock, 346
- cracks (tensile fractures), 116

- crack-seal process, 161, 183  
 crack-surface displacement, 122–23, 122  
 crack tip, 142, 159  
 craters, 35–36, 37  
 cratons, 197, 348, 443, 503  
   in collisions, 431  
   of continental crust, 346–47  
   defined, 615  
 creep:  
   dislocation, 212, 224, 229  
   exponential-law, 225  
   low-temperature, 216  
   power-law, 220, 228, 230  
   steady-state (secondary), 93, 93  
   superplastic, 222, 228–29, 229  
   tertiary (accelerated), 93, 93  
   transient (primary), 93, 93  
 creep curve, 92–93, 93, 98  
 creep parameters, 100  
 crenulation cleavage, 274, 280–82, 281,  
   282, 286, 288  
 crenulation lineation, 288–89  
 crescent terrane, 572, 573  
 crest, of fold, 240, 247*n*  
 Cretaceous-Tertiary “Laramide” phase, 252  
 critical remote tensile stress, 127  
 critical resolved shear stress (CRSS), 210,  
   213, 220  
 critical stress intensity factor, 127  
 critical stress state, 128  
 critical taper angle, 422, 423, 443  
   of Coulomb wedge, 472–73  
 critical taper theory, 442–43, 473, 473,  
   accretionary wedge in, 422–23, 423  
 cross beds, 17–19, 18  
 cross joints, 145  
 cross-slip and climb, 210–12, 212, 220  
 cross-strike joints, 146, 465  
 Crow’s Nest Mountain Klippe, 455, 458  
 crust, 336–37, 340, 343, 353  
   in collisional tectonics, 435–36, 435, 436  
   continental, *see* continental crust  
   oceanic, 342, 344, 402, 403, 414  
   ratio of mantle’s thickness to, 623–25  
   subsidence of, 397  
 cryptovolcanic structures, 36  
 crystal deformation, *see* dislocation  
 crystalline basement, 505  
 crystallographic-preferred fabric, 222,  
   296, 307–8, 311  
   defined, 307  
   measurement of, 311  
   Symmetry Principle and, 310  
 crystal plastic deformation, 167  
 crystal plasticity, 205, 210–16, 261,  
   296, 517  
   cross-slip and climb and, 210–12,  
     212, 216  
   dislocation glide and, 210  
   mechanical twinning and, 210, 213–16,  
     213, 214–15  
   terms and concepts related to, 223  
 crystal systems, 308–9, 309  
 C-S structure, 302, 303, 303  
 C-surface, 310  
 culmination, of hinge line, 251  
 Cumberland Batholith, 610  
 cumulate layer, 402  
 cumulate rock, 342, 402  
 cumulative displacement, 176  
 Curie, Pierre, 309*n*  
 Curie principle (symmetry principle),  
   308–10, 309  
 current direction, 17  
 cutoff, in faulting, 173, 453  
 cutoff line, 173  
 cylindrical folds, 239–40, 240  
 Dalradian Supergroup, 597  
 Darien Basin, 485  
 Darwin, Charles, 292  
 daughter isotope, 325–26  
 Davis, G. A., 496*n*  
 Dead Sea, 476, 477, 492  
 debris flow, 24–25  
 decay constant (half-life), 325  
 decoration technique, 209, 221  
 deformation, 6–8, 62, 63, 316–33  
   in accretionary orogens, 554  
   brittle. *See* brittle deformation  
   in cataclastic flow, 205, 206–7, 206  
   components of, 63–64, 64  
   dating of, 328–29  
   D-P-P-t paths and, 329–31, 333, 333  
   ductile. *See* ductile deformation  
   foliation and, 322–23, 323  
   frame of reference and, 64  
   geothermal gradient and, 331–32, 332  
   metamorphism and, 322–25, 323–325  
   mineral zonation and, 321  
   plate-interior, 356  
   polyphase nature of, 505  
   pressure-temperature analysis of,  
     319–21, 319, 320  
   pressure-temperature (P-T) history  
     and, 331  
   pressure-time (P-t) history and, 331  
   P-T-t path and, 321, 33, 333  
   regional, 155–56, 156  
   sample field observations for study of,  
     316–19  
   strain and, 67–65, 64  
   in strike-slip zones, 482–84  
   temperature-time (T-t) history and, 331  
   terms and concepts related to, 317  
 deformation apparatus experiment,  
   101–2, 102  
 deformation mechanism maps, 229–33,  
   230–31  
   constructing, 232–33  
   limitations of, 233  
 deformation microstructures, 222–29  
   recovery in, 222–25  
   recrystallization in. *See*  
     recrystallization  
   superplastic creep in, 222, 228–29, 229  
 deformed-state cross section, 468, 469–70  
 Delamerian Orogen, 548–49, 549  
 delamination model, 389, 389, 506  
 Delaware Basin, 242  
 density inversion, 26  
 depositional contacts, 19  
 depositional environment, 17  
 depression of hinge line, 251  
 depth of compensation, 354  
 “destructive” plate boundaries, 356  
 detachment fault (décollement), 422,  
   455, 590  
 detachment fold (décollement), 186,  
   462–64, 464  
 detachment horizon, 241  
 detachment zone (décollement), 505  
 Devil’s Postpile, 35, 146  
 Devil’s Tower, 35, 146  
 Spielbergian Platform of, 146  
 dextral (right-lateral), 170, 170  
 dextral shear, 287  
 diamictites, 612  
 Dietz, Robert S., 355  
 differential compaction, 23  
 differential loading, 26  
 differential weathering, 16  
 differentiation process, 219  
 diffuse plate boundaries, 355–56  
 diffusion, 207, 220, 283  
   fluid-assisted, 217–18, 324  
   grain-boundary, 217–18, 218  
   volume, 217, 218, 218, 232  
 diffusional mass transfer, 205, 217–19,  
   218, 219  
 dihedral angle, in joint system, 145  
 dikes, 399, 402, 505, 603, 611  
   clastic, 19, 20  
   columnar jointing in, 146  
   defined, 116  
   radial, 31  
   ring, 31  
   sheeted, 342  
 dike swarms, 31, 399, 597, 603, 611, 613  
 dilatancy, 124  
 dilation, 64  
 dimensional analysis, 42  
 dimensional-preferred fabric, 307  
 diorite, 31  
 dip-isogon analysis, 246, 247  
 dip-slip component, 169, 169  
 dip-slip fault, 169, 170, 490*n*  
 disconformities, 22–23  
 discordant age, 326  
 disharmonic folds, 240–41, 242  
 disjunctive cleavage, 273, 274–76, 275,  
   278, 286  
 dislocation, 207–10  
   edge, 207–10, 208–9, 212, 212–13, 220,  
     221, 221, 224  
   imaging, 221, 222  
   mixed, 209, 221  
   movement of, 210  
   partial, 210, 213  
   perfect, 210  
   screw, 207–10, 208, 212, 221  
   sources of, 216, 217  
   temperature and, 211–12  
 dislocation annihilation, 212  
 dislocation creep, 212, 224, 229  
 dislocation density, 216  
 dislocation glide (exponential creep),  
   213–14, 220, 230, 232, 307, 308, 351  
 dislocation wall (tilt boundary), 224, 224  
 displacement, sense of, 298  
 displacement field, 63  
 disrupted bedding, 19, 20  
 dissociation process, 210  
 distortion, 40, 63  
 distortion loops, 221  
 divergence, 6, 6  
 divergent dip isogons, 246  
 divergent plate boundaries, 356, 357  
 docking event, 440  
 dolomite, 148, 149, 206, 212, 213, 318–19,  
   453, 549  
 dome-and-basin (type 1) interference  
   pattern, 254–55, 254, 258, 313  
 domino model, 301–2, 301  
 doubly plunging folds, 251–52  
 Dover-Hermitage Bay Fault, 587  
 downbuilding, 29  
 downgoing plate (downgoing slab), 414,  
   415–18, 418, 419  
 down-to-Gulf faults, 30, 30, 176  
 downward-facing antiform, 243  
 downward-facing folds, 243  
 downward-facing synform, 243  
 downwelling, 364, 365, 366–67  
 drag fold, 187

- drape (forced) folds, 187  
 dry diffusion, 219  
 ductile behavior, 108–10, 110, 111. *See also* flow  
 ductile deformation, 6, 204–36  
   cataclastic flow and, 205, 206–7, 206  
   crystal defects and, 207–10, 207  
   crystal plasticity and, *see* crystal plasticity  
   deformation mechanism maps for, 229–33, 229–33  
   deformation microstructures in. *See* deformation microstructures  
   diffusional mass transfer and, 205, 217–19, 218, 219  
   flow laws of, 219–20  
   imaging dislocations and, 221, 222  
   mechanisms and processes of, 234–35  
   microstructure of, 220–21, 221  
   temperature and, 205, 211–212  
   twinning and. *See* mechanical twinning  
 ductile shear zones, 294–315, 295  
   defined, 294–95  
   deflected foliations in, 305–7, 306  
   fold transposition and, 311–13, 311, 312  
   mylonites and. *See* mylonite  
   rotated grains in, 304–5  
   shear sense indicators for, 298–304, 300, 301–2  
   sheath folds and, 313, 314  
   strain in, 304–7  
   Symmetry Principle and, 308–10  
   textures and, 307–8, 310–11, 310  
 Duncan Lake, 164  
 dunite, 339  
 Dunnage Zone, 584, 585–87, 588  
 duplexes, 197, 197, 455–56, 458, 472  
   extensional, 388  
   strike-slip, 492, 492  
 dynamic friction, 132  
 dynamic recrystallization, 225–26, 228, 296
- Earth, 503–4**  
   bathymetric provinces of, 342  
   core of, 336, 337, 340, 350  
   heat transport in, 349, 349, 353  
   internal layering of, 336–40, 338–39, 340  
   isostasy principle and, 353–54, 354  
   major and minor plates of, 358, 358  
   rheologic behavior of, 350–54  
   rheologic layers of, 336–37, 352  
   seismic profile of, 340, 341  
   shape of, 359  
   thermal conditions in early history of, 506–7  
 earthquakes, 19, 56, 92, 93, 108, 117, 118, 136, 167, 176, 181, 295, 337, 340, 355, 368, 397, 427, 429, 476, 532, 578  
   Alps foci of, 515–16, 516–17  
   Basel, 523  
   in Cascadia subduction zone, 569–70  
   in continental interiors, 503  
   convergent-margin, 200  
   at convergent plate boundaries, 417–18, 419  
   in coupled and uncoupled margins, 429  
   deep-focus, 200, 417–18  
   epicenters of, 200, 356  
   faulting and, 198, 199–201, 199  
   fluid pressure and, 192  
   focus of, 200  
   “Good Friday,” 417  
   Kobe, Japan, 1995, 198  
   mid-ocean ridge, 497  
   New Madrid, 503  
   in North American Cordillera, 564  
   stress drop and, 194  
   Wadati-Benioff Zone and, 417–18, 418, 566  
 East African Rift, 347, 382, 383, 396, 408, 503  
 East Anatolian Fault, 438, 438, 476, 492, 495  
 East Pacific Rise, 404  
 eclogite, 365, 372, 417, 584  
 edge dislocation, 207–10, 208–9, 212, 212–13, 220, 221, 221, 224  
 effective normal stress, 471  
 effective pressure, 101  
 effective stress, 136, 471  
 effective viscosity, 99  
 Einstein, Albert, 43, 217  
 elastic behavior, 93–96, 94, 95–96  
 elastico-viscous behavior, 94, 97–98  
 elastic-plastic behavior, 99, 99  
 elongation, 70–71, 71, 91  
   quadratic, 71–73  
 El Tigre Fault, 579  
 emergent fault, 177, 178, 188–89  
 emergent thrusts, 454  
 Emperor Seamount Chain, 428  
*en echelon* faults, 184, 484–85, 485  
*en echelon* folds, 251, 252  
*en echelon* vein arrays, 160, 160  
 ensialic arcs, 542  
 ensimatic arcs, 542  
 entropy, 319–20  
 enveloping surface, 247–48, 312  
 epeirogenic structures, 616, 617–19  
 epeirogeny, 440, 618  
   causes of, 623–25, 624  
 epicenter of earthquake, 200, 356  
 equal-angle net (Wulff net), 628, 630  
 equal-area net (Schmidt net), 628, 629  
 equilibrium conditions, 319  
 erosion, 16, 152, 188–89, 201, 442–43, 472, 506, 507, 521, 569, 576  
   of accretion wedge, 567  
   of Cascadian subduction zone, 571–73, 572  
   in collisional tectonics, 442–43  
   windows and, 454  
 escape structures, 596  
 escarpments, oceanic, 498  
 eugeosyncline, 406*n*  
 Euler pole, 361–63, 362, 363, 497  
 Eurasian Plate, 358  
 European Plate, 517  
 evaporite, 397, 453, 549  
 Everest, Mount, 412, 413, 419, 528, 532  
 exaggerated grain growth, 226*n*  
 exfoliation domes, 146  
 exfoliation (sheeting) joints, 146, 146  
 exhumation, 433–34, 442–43  
 exhumation rate, 331  
 exhumed fault, 177, 188–89  
 exotic terranes, 440*n*, 441, 492, 597  
 exponential creep (dislocation glide), 213–14, 220, 230, 232, 307, 308, 351  
 exponential-law creep, 225  
 extensional backarc region, 425, 429  
 extensional (orogenic) collapse, 410, 421, 435–36, 435, 436, 472  
 extensional crenulations, *see* C'-foliation  
 extensional duplex, 388  
 extensional fault, 170, 172, 172, 412, 472  
 external foliation, 323  
 extra half-plane, 207, 208  
 extrusive rocks, 30
- fabric elements, 270, 290, 292  
 fabrics:  
   continuous, 271, 272  
   magnetic properties in, 292, 292  
   microscopy and, 292–93  
   penetrative, 271–72  
   planar, 272–73  
   preferred (nonrandom), 271, 272  
   primary, 270  
   random, 270–71, 272  
   seismic properties in, 292  
   spaced, 271, 272  
   tectonic, 270, 271, 273, 292  
   terminology of, 270–72  
   wave splitting in, 292  
   *see also* cleavage; foliations; lineations  
 failed arm, 408  
 failure criterion for frictional sliding, 132–33  
 failure envelope, 127, 129–30  
   composite, 131  
 failure strength for shear rupture, 125–26  
 failure stress, 93  
 Famantinian Orogeny, 595, 599  
 Farallon-Pacific Ridge, 364  
 Farallon Plate, 364, 560, 561  
 far-field stresses, 439  
 fast ridges, 403, 403, 404, 405  
 fault arrays, 195–98, 195, 196  
 fault-bend anticline, 462  
 fault-bend folding, 186, 252, 460–62, 461, 462  
 fault bends, 176–77, 176, 177, 490*n*  
 fault block, 169  
 fault contacts, 19  
 fault creep, 199  
 fault dip, 169, 169  
 fault gouge, 180–83, 180, 189, 190, 201  
   indurated, 181  
 fault-inception folds, 185*n*  
 fault inversion, 197  
 fault-line scarp, 189  
 fault-parallel ridges, 188, 189, 488  
 fault-parallel veins, 123  
 fault-propagation folds, 185–86, 252, 462, 463  
 fault-related folds, 184–87, 185–86  
 fault rocks, 189, 296  
   brittle, 179–82  
   classification of, 180  
   cohesive, 179  
   field terminology of, 297  
   noncohesive, 179  
 faults and faulting, 108, 110, 111, 111, 166–201, 167, 168  
   in accretionary prism, 422–23  
   active, 199  
   in Alps, 511–12, 516–17  
   in Altaids, 535, 544  
   Anderson's theory of, 191–92, 191  
   in Andean Orogeny, 576, 579  
   antithetic, 195, 388, 388, 390  
   in Appalachian Orogen, 584, 587, 590–91  
   bends in, 176–77, 176, 177  
   blind, 177, 178  
   bookshelf, 388  
   breakaway, 385  
   break-forward sequence in, 455–56  
   brittle, 123–24  
   in Caledonides, 603, 605  
   characteristics of, 179–87  
   in collisional tectonics, 432, 433, 436–40, 437, 439  
   contractional, 170–72, 172

- faults and faulting, (*continued*)  
 cross-section representation of, 172–73, 173  
 cutoff in, 173, 453  
 defined, 166  
 depth and changes in, 190–91  
 dextral (right-lateral), 170, 170  
 dip-slip, 169, 170, 490*n*  
 displacement and, 178–79, 179  
 down-to-Gulf, 30, 30, 176  
 earthquakes and, 198, 199–201, 199  
 emergent, 177, 178, 188–89  
*en echelon*, 184, 484–85, 485  
 exhumed, 177, 188–89  
 extensional, 170, 172, 172, 412, 472  
 fluids and, 192–93  
 folding and, 184–87, 185–86  
 growth (syndepositional), 199, 389, 407  
 inversion of, 197  
 joints related to, 155–56, 156  
 length of, 177–79, 179  
 listric, 29, 169, 176, 192, 192, 387–88, 388  
 major, 176  
 map representation of, 172–73, 173  
 in Midcontinent U.S., 620–21, 620, 625–26  
 minor, 176  
 net slip in, 174–76, 175  
 normal, *see* normal faults  
 in North American Cordillera, 557, 560, 563, 564–65  
 oblique-slip, 169–70, 170, 191, 621  
 oceanic transform, 497–98  
 out-of-sequence, 456, 472  
 out-of-syncline, 457, 459  
 paleostress and, 197–98  
 recognition and interpretation of, 187–91, 188, 189, 190  
 resources and, 199  
 reverse, 170, 172, 196–97, 197, 433, 561, 564  
 in rifting process, 385–92, 387–89, 394, 396, 401, 407–8, 410  
 rollover, 29  
 in salt structures, 29–30, 29–30  
 seismic, 199  
 seismic imaging and, 370  
 sinistral (left-lateral), 170, 170  
 slickensides and, 182–84, 182, 183  
 slip lineations and, 182–84, 183  
 society and, 198–99  
 stress in relation to, 191–94  
 strike-slip, *see* strike-slip faults  
 subsidiary geometries of, 184, 184  
 subsurface, 189–90, 190  
 synthetic, 195, 388, 388, 390  
 tear, 454, 493–94, 495  
 terminations in, 177–78, 178, 179  
 terminology of, 169–72, 170  
 throughgoing, 126  
 thrust, *see* thrust fault  
 in Tibetan Plateau, 528, 529, 530–33, 531, 532  
 tip line of, 177, 455, 462  
 transcurrent, 481–82, 483  
 transfer, 394, 495  
 transform, *see* transform faults  
 transtensional, 408  
 types of, 169–72, 170–71  
 wall of, 169  
 fault scarp, 188, 188  
 fault splays, 167, 190, 191  
 fault-surface veins, 123, 183–84  
 fault valving (seismic pumping), 192
- fault zones, 116, 548, 554, 620  
 breccia in, 179–80  
 characteristics of, 179–87  
 defined, 166  
 displacement in, 166–67, 167  
 fault creep and, 199  
 fluids and, 192–93  
 folding in, 186  
 foliations in, 285–88, 288  
 in Midcontinent U.S., 617, 619–21, 625–26  
 recognition and interpretation of, 187–91, 188, 190  
 shear-sense indications in, 187, 187  
 subsidiary geometries of, 184, 184  
 feldspar, 32, 168, 181, 212, 213, 225, 226, 227, 278, 282, 283, 284, 296, 298, 300, 301, 302, 318, 319, 510, 517  
 fenster (window), 173, 173, 454, 455  
 fiber lineations, 290  
 fibrous veins, 160–64, 161–63  
 field study:  
 graphic representation in, 151–52, 151  
 inventory method of, 150–51, 151  
 of joints, 149–52  
 questions to ask in, 149–50  
 selection method of, 151, 151  
 of subsurface data, 189–90  
 finite Euler pole, 361  
 finite strain, 66  
 firmo-viscous behavior, 97*n*  
 first law of motion, 43  
 first-order folds, 464  
 “fish flash,” 302  
 fissility, 16  
 “fixist” view, 355*n*  
 flats:  
 in balanced cross section, 469–70  
 in fault arrays, 196  
 in fault bends, 176–77, 176, 460–62  
 hanging-wall, 453–54  
 in normal faults, 388  
 in thrust faults, 453–54, 454  
 flexural folding, 259  
 flexural loading, 156, 623, 624  
 flexural rigidity, 351, 353  
 flexural slip, 262–63, 263, 286  
 flexure-related rifting, 408–9  
 Flinn diagram, 76–77, 77, 78, 81–82  
 flood basalt, 399  
 floor thrust, 197, 455  
 flow, 90, 204  
 competency and, 110–11  
 steady-state, 220, 233  
 temperature and, 103–4  
 flower structure, 495, 620  
 in continental strike-slip faults, 488, 490, 491  
 of fault arrays, 197, 197, 408  
 inactive, 497  
 flow folding, 262–63, 263  
 flow foliation, 34  
 flow laws (constitutive equations), 93, 219–20, 232  
 flow lines, 68  
 flow stresses, 99  
 fluid-assisted diffusion, *see* pressure solution  
 fluid/rock ratio, 285  
 flysch, 17, 505, 551, 602  
 foam structure, 225  
 focus, of earthquake, 200  
 fold axis, 240  
 fold hinge lineation, 288
- fold nappes, 459, 459  
 fold profile plane, 240  
 folds and folding, 111, 111, 201, 238–68, 277, 422  
 active vs. passive, 257–60, 259, 261  
 anatomy of, 239–43, 239, 241  
 asymmetric, 248–49, 248  
 box, 242, 250  
 buckle folds and, 259, 259, 260–61, 261, 267  
 chevron, 245, 250, 263, 550  
 classification of, 243–46, 246, 247  
 in collisional tectonics, 433, 438–39  
 crest of, 240, 247*n*  
 cylindrical, 239–40, 240  
 defined, 238  
 dip-isogon analysis of, 246, 247  
 disharmonic, 240–41, 242  
 doubly plunging, 251–52  
 downward facing, 243  
 drag, 187  
 drape (forced), 187  
*en echelon*, 251, 251  
 envelope surface of, 247–48, 248  
 fault-bend, 186, 252, 460–62, 461, 462  
 fault-inception, 185*n*  
 faulting and, 184–87, 185–86  
 fault-propagation, 185–86, 252, 462, 463  
 fault related, 184–87, 185–86  
 first-order, 464  
 flexural slip and flow, 262–63, 263, 265–66, 266, 267  
 fold facing and, 241–43, 243  
 fold orientation and, 244–45, 244, 245  
 fold shape and, 243, 245–46, 265  
 fold style and, 255–57, 257  
 fold systems and, 246–49, 248, 248  
 fold vergence and, 248–49, 249  
 foliations in, 285–88, 287, 288  
 generations in, 252, 256  
 harmonic, 240–41  
 interference patterns in, 253, 254–55, 254, 258, 313  
 interpretive sequence of, 266–68, 267  
 isoclinal, 313, 433  
 joints and, 156  
 kinematic models of, 262–66, 263, 264, 265, 266  
 kink, 250, 250, 263  
 limb of, 239  
 lineations and, 288–89  
 mechanics of, 257–62, 259, 261  
 mesoscopic, 465  
 in Midcontinent U.S., 621, 625–26  
 monoclinical, 439  
 multilayers in, 262, 266  
 neutral-surface folding and, 263–64, 263, 265–66, 265  
 noncylindrical, 240, 240  
 in North American Cordillera, 557, 564–65  
 parallel, 246, 247, 264, 265–66  
 parasitic, 248–49, 249  
 passive, 257–60, 259, 261  
 penecontemporaneous, 422  
 plunging, 244  
 pygmatic, 250–51, 251  
 reclined, 245  
 recumbent, 239, 244–45, 268, 505  
 rollover, 388, 390, 407  
 in salt structures, 29–30, 29–30  
 second-order, 464  
 shallow, 244  
 sheath. *See* sheath folds

- similar, 246  
 strain in, 265, 265, 266, 268  
 superposed. *See* superposed folding  
 symmetry in, 248–49, 248, 257  
 in Tasman orogenic belt, 550  
 thrust-related, *see* thrust-related folding  
 in Tibetan Plateau, 532  
 transposition, 311–13, 311, 312  
 upright, 244  
 upward-facing, 243
- fold-thrust belts, 196, 444–74, 449, 450  
 in Altaiids, 535  
 balanced cross section and, 468–70, 469, 470  
 classic, 452  
 critical taper theory and, 472–73  
 in European Alps, 510, 522–23  
 map view of, 465–68, 466, 467  
 mechanical stratigraphy and, 452  
 mechanics of, 470–74  
 overall architecture of, 457–59, 458, 459  
 regional context of, 448–52  
 stress in, 470–72, 471  
 strike-slip faulting in, 493, 493  
 tectonic settings of, 448–52, 449, 450, 451  
 terminology of, 446–48  
 thrust-related folding and, 459–64, 461, 462, 464  
 thrust systems and, *see* thrust systems
- foliations, 255, 272–84, 272, 505  
 classification scheme for, 274  
 cleavage and, *see* cleavage  
 defined, 271, 272  
 deflected, 305–7, 306  
 deformation and, 322–23, 323  
 in ductile shear zones, 305–7, 306  
 external, 323  
 flow, 35  
 in folds and fault zones, 285–88, 287, 288  
 internal, 323  
 intrusive, 32–34  
 metamorphism and, 322–323, 323  
 schistosity and, 279–80  
 as shear-sense indicator, 302–3, 302, 303  
 temporal sequence of, 273  
 transposed, 283
- footwall block, 169  
 footwall cutoff, 173, 173  
 footwall flat, 453–54  
 footwall ramp, 453–54  
 force, 43–44  
 terminology and symbols of, 42  
 units and quantities of, 42–43, 43  
*see also* stress
- forced (drape) folds, 187  
 forearc basin, 415, 424  
 forearc region, 415  
 foreland, 431, 443, 448  
 of Andean-type margins, 448–49  
 as setting for fold-thrust belts, 448–50  
 foreland basin, 197, 448, 449  
 foreland direction, 448  
 foreland sedimentary basin, 433, 433, 505  
 foreset beds, 18  
 forethrusts, 457  
 forewedge, 421, 474  
 form lineations, 288–89, 288  
 Fort Simpson Basin, 376, 376, 378, 380  
 fossils, 84, 85  
 fracture cleavage, 274  
 fracture front, 117, 117
- fractures, 98, 273  
 antithetic, 301  
 conjugate, 126, 129, 129  
 cooling, 35  
 defined, 116  
 effect of fluids on, 134–35  
 of grains, 299–302, 301  
 hybrid shear, 131  
 hydraulic, *see* hydraulic fracturing  
 intermediate principle stress and, 136  
 shear, 116, 124–26, 125  
 subsidiary faults and, 184  
 synthetic, 301  
 tensile, 116  
 transitional-tensile, 131, 157  
 in vein arrays, 160  
*see also* faults and faulting
- fracture tip, 117, 117  
 fracture toughness, 127  
 fracture trace, 116–17, 117  
 fracture zones, 497–98  
 frame of reference, 64  
 Franciscan Complex, 560  
 Franklin Orogeny, 607, 608, 608  
 Frank-Read sources, 216, 217  
 free surfaces, 144, 158, 191, 192  
 frequency diagram, 151  
 frictional coefficient, 133  
 frictional-plastic transition, 295, 296  
 frictional regime, 295, 296  
 frictional sliding, 193–94, 206  
 in brittle deformation, 132–34, 132  
 criteria for, 132–33  
 heat generated by, 181–82  
 pressure and, 206–7
- frontal collisions, 430  
 frontal ramp, 454  
 fusion age (gas age), 327
- gabbro, 31, 342, 348, 372, 402, 405, 505, 535  
 Gander Zone, 585–87, 593  
 Ganga Basin, 528  
 Garlock Fault, 483, 495–96, 496  
 garnet, 304–5, 304, 318, 319, 320, 331  
 dating of, 328–29  
 formation of, 320  
 growth of, 322  
 snowball, 304–5, 304, 323–24, 324, 325  
 zoned, 322
- gas age (fusion age), 327  
 GASP (Garnet + Silica + plagioclase), 320–21  
 general linear behavior, 98  
 general shear, 68  
 generation, fold, 252, 256  
 genetic labels, 545  
 geodes, 322  
 geologic structures, 4–6, 14  
 classification of, 5–6  
 defined, 4, 6–8, 7  
*see also* structural analysis
- geologic timescale, 632  
 geophones (miniseismometers), 369  
 geophysical imaging, 368–81  
 crust-mantle transition and, 372–74, 372–73, 378  
 gravity anomalies and, 379–81, 380  
 importance of seismic profiles in, 374  
 interpreting data of, 370, 371  
 of northwest Canada, 375–80, 375–77, 379  
 with seismic reflection, 368–70, 369
- geosyncline hypothesis, 4, 355*n*  
 geosynclines, 406*n*, 582
- geotectonic theory, 355  
 geothermal gradient, 32, 102, 331–32, 332, 333, 443  
 geothermobarometry, 319–21, 320  
 geothermometers, 320–21, 320  
 Giant's Causeway, 35, 146  
 Glacier Park, 174  
 glaciers, 204, 258, 264, 351, 603  
 Glarner Thrust, 434  
 Glarus Thrust, 521  
 glass, 181, 182  
 behavior of, 111  
 glaucophane, 424  
 glide (slip) planes, 210, 307  
*Glomar Explorer*, 339  
 gneiss, 283, 299, 300, 312, 312, 314, 318–19, 318, 321, 329, 374, 390, 401, 433, 507, 551  
 layering in, 282–84, 282, 283  
 migmatitic, 146  
 gneissosity, 273, 282–83  
 Golconda Thrust, 559  
 Gondwana, 526, 547, 549, 551, 554, 583, 593, 594–95, 597, 603, 604  
 breakup of, 599–600, 605  
 North American tectonic genealogy and, 607–8, 609, 613  
 Gondwanan realm, 583, 585–87, 588, 589, 590–91  
 Goochland zone, 585, 587  
 “Good Friday” earthquake, 417  
 Gothian Orogen, 612  
 Gotthard Massif, 291  
 gouge, 180–83, 180, 189, 190, 201, 488, 492  
 grabens, 196, 196, 385, 387, 397, 401, 405, 407, 409, 417  
 in Tibetan Plateau, 532  
 graded beds, 17–19, 17, 18  
 grain-boundary diffusion (Coble creep), 217–218, 218, 232  
 grain-boundary sliding superplasticity (GBSS), *see* creep, superplastic
- grains:  
 fractured, 299–302, 301  
 rotated, 304–5, 304, 305  
 structural, 465*n*  
 as term, 299
- grain-size-sensitive creep, 229  
 grain-tail complexes, 299  
 Grampian Orogeny, 595, 599  
 Grand Canyon, 15, 22, 149  
 Grand Unified Theory, 43  
 granite, 31, 111, 146, 146, 153, 165, 199, 296, 303, 329, 337, 344–45, 399, 401, 436, 505, 560, 587, 603, 605, 611  
 fabric of, 271  
 postorogenic, 436  
 in Tasman orogenic belt, 548, 551  
 of Tibetan Plateau, 532–33
- granodiorite, 344–45, 535  
 granulite, 372  
 graphite, 318, 319  
 gravitational collapse, 410, 517, 532  
 gravity, 62  
 anomalies, 354, 379–81, 380, 419*n*  
 sliding, 471, 472  
 spreading, 27, 471, 472
- Great Dike of Zimbabwe, 31  
 Great Glen Fault, 605  
 Great Salt Lake, 397  
 Great Valley Basin, 560  
 Green River Basin, 370, 371  
 green-schist facies, 252, 550, 552  
 greenstone, 424, 587

- Gregory Rift, 383  
 Grenville Front, 181  
 Grenville Orogen, 282, 295, 297, 300, 307, 312, 314, 322, 582, 591, 607, 608, 609, 610, 612  
 greywackes, 250, 611  
 grid pattern, in joints, 156–57, 157  
 Griffith, A. W., 119, 126–27  
 Griffith cracks, 118, 119–20, 121, 122, 126–27, 136, 152  
 Griffith criterion, 128  
 Griffith energy balance, 126  
 groove lineations, 183, 290  
 groundwater, 199, 219  
 growth (syndepositional) faults, 199, 389, 407  
 growth twins, 213  
 Gulf of Suez, 389–90, 391  
 guyots, 342  
 gypsum, 397
- hackle fringe, 144  
 hackle zones, 141, 142–44  
 Haiyuan Fault, 530–31, 532, 533  
 Half Dome, 146  
 half-graben system, 196, 196, 397, 399, 407  
 half-life (delay constant), 325  
 halite, 227, 397  
 Hall, James, 4  
 halokinesis, 26  
 inversion and, 29  
 hanging-wall block, 169, 387–88, 390, 399, 405  
 hanging-wall cutoff, 173, 173  
 hanging-wall down movement, 170  
 hanging-wall flat, 453–54  
 hanging-wall ramp, 453–54  
 hanging-wall up movement, 170  
 Hanson slip-line method, 186, 313*n*  
 harmonic folds, 240–41  
 Harz Mountains, 275  
 Hawaiian-Emperor hot spot track, 360, 360  
 Hearne Province, 613  
 Heart Mountain, 25, 25  
 heave, 174, 176  
 Henry Mountains, 31  
 Hercynides, 545  
 Hess, Harry, 4, 355, 402  
 heterogeneous strain, 7, 65, 65  
 heterogeneous stress fields, 55  
 hiatus, in unconformity, 21  
 high-angle grain boundaries, 225  
 high-temperature creep, 216  
 Himalayan Mountains, 57, 347, 412, 413, 436, 449, 503, 504, 507, 545, 558, 567, 602  
 evolution of, 525–28, 526, 527  
 extension of, 532  
 hinge area, 239  
 hinge line, 239, 240, 255  
 culmination of, 251  
 depression of, 251  
 kink-style, 462  
 hinterland, 431, 433–34, 448, 449, 505  
 hinterland direction, 448  
 histogram, 152  
 Holmes, Arthur, 4  
 homoclinal bedding, 17  
 homogeneous strain, 7, 65–66, 65, 82  
 homogeneous stress fields, 55  
 homologous temperature, 229, 258  
 defined, 205  
 Hooke, Robert, 94*n*  
 Hooke's Law, 94, 148  
 hooking, in joints, 147  
 horizontal boundary load, 472
- hornblende, 291, 318, 319, 327, 328, 329, 517, 600  
 hornfels, 32  
 horses, 422, 455  
 horsetail fractures, 177  
 horsetails, 481–82, 482, 483  
 horsts, 196, 196, 385, 387, 390, 397, 399, 417  
 hot spots, 350, 359–60, 360, 361, 440, 560, 560, 562  
 hot-spot tracks, 360, 360  
 Hubbert, M. King, 193*n*, 470*n*  
 Hubbert-Rubey hypothesis, 193  
 Hutton, James, 2, 22  
 hybrid model, 389  
 hybrid shear fractures, 131  
 hydraulic fracturing, 122, 135  
 in joints, 154–55, 155  
 hydrolytic weakening, 106*n*, 135  
 hydrostatic pressure (isotropic stress), 47, 52–53, 52–53, 55, 102, 134, 135, 470–71, 471  
 hydrothermal fluids, 405  
 hypothesis, theory vs., 355*n*  
 hypsometric curve, 342
- Iapetus Ocean, 584, 585, 591, 600, 601  
 closure of, 588–89, 598  
 East, 593, 594–95, 599–600, 601–3, 604, 605  
 major tectothermal events of, 596  
 West, 593, 597, 599, 600, 605
- Ibero-Armorica-Moldanubian Plate, 604  
 ice, 204  
 Ice Age, 98  
 ideal plastic behavior, 99  
 igneous structures, 30–38  
 cooling fractures in, 35  
 extrusion and, 33–34  
 impact structures and, 35–38, 37  
 magma flows and, 30–31, 31  
 plutons and, 32–34  
 sheet intrusions and, 31–32, 32  
 terminology of, 31  
 ignimbrites, 34, 399, 400  
 Illinois Basin, 618–19, 620, 620  
 illite, 278–79  
 ilmenite, 319  
 imbricate array of normal faults, 388  
 imbricate fan, 197, 455–56, 457  
 imbrication, 16  
 impurities, 207, 207  
 inactive faults, 199  
 inactive rifts, 347, 382–84  
 inactive transform, 497*n*  
 Incaic Orogeny, 576  
 incision rate, 571, 572  
 incremental strains, 66  
 India, 348, 355, 412, 431, 436–38, 437, 439, 492, 492, 497, 525–30, 526, 533, 615*n*, 625  
 Indian Ocean Ridge, 408  
 Indo-Australian Plate, 358  
 inequant crystals, 32–34  
 Inertia, Law of, 43  
 infinitesimal strain, 72  
 inflection point, 239  
 initial daughter, 325–26  
 inner core, 340  
 instantaneous Euler pole, 361  
 interference patterns fold, 253, 254–55, 254, 258, 313  
 interior drainage, 397  
 interlimb angle, 240, 240  
 fold orientation by, 245–46, 246  
 internal foliation, 323  
 internal reference frame, 298–99
- internal strain energy, 95, 222–24  
 internal vorticity, 68  
 intersection lineation, 289, 290  
 intersections, “x” and “+,” 146  
 interstitials, 207, 207  
 intracratonic, 617  
 intraformational internal, 25  
 intraplate seismicity, 200  
 intrusive contacts, 19  
 intrusive foliation, 32–34  
 intrusive rocks, 30  
 inventory method field study, 150–51, 151  
 inversion, 29, 449–50, 451  
 invisibility criterion, 222  
 ironstone, 611  
 island arcs, 425, 440  
 isochron equation, 325–27  
 isoclinal folding, 313, 433  
 isostasy, principle of, 353–54, 354, 623  
 isostatic gravity, 380  
 isostatic uplift, 92, 497  
 isotherms, 35, 351, 507  
 isotopes, 325  
 isotopic closure temperature, 327–28, 328  
 isotopic dating, 325–27, 326–27  
 isotopic (mass) number, 325  
 isotropic stress (hydrostatic pressure), 47, 52–53, 52–53, 55, 102, 134, 135, 470–71, 471
- Izu-Bonin Arc, 542
- Jacksboro Fault, 495  
 Japan, 440  
 Japan Sea, 427–28  
 Japan-type volcanic arc, 426  
 J intersections, 149  
 J junction, 147  
 jog (offset), 220, 221  
 joint arrays, 144–49, 145, 274  
 cross-cutting relations in, 146–47  
 graphic representation of, 151–52, 151  
 joint sets and systems in, 145–46, 146  
 spacing in sedimentary rocks of, 147–49, 147, 150  
 systematic vs. nonsystematic joints in, 144, 144
- joint origin, 140  
 joints (fractures), 35, 138–59  
 arrays of. *See* joint arrays  
 columnar, 35, 36, 146  
 conjugate systems of, 145–46, 157–58  
 cross, 145  
 cross-strike, 146, 465  
 defined, 115, 116, 138, 165  
 exfoliation. *See* sheeting joints  
 field study of, 149–52  
 in fold-thrust belts, 465  
 grid patterns and, 156–57, 157  
 hooking in, 147  
 hydraulic fracturing of, 154–55, 155  
 ladder pattern in, 156–57, 157  
 limits on growth of, 158–59, 159  
 master, 145  
 in Midcontinent U.S., 622–23  
 nonsystematic, 144, 144, 149  
 origin and interpretation of, 152–58, 152  
 orthogonal systems of, 145–46, 156–57, 157  
 outer-arc extension, 157  
 paleostress trajectories and, 158  
 pinnate, 156  
 plumose structure of, 140–44, 142, 143  
 regional deformation and, 155–56, 156  
 release, 156  
 sheeting formation in, 153–54, 153  
 strike-parallel, 146, 465



- surface morphology and, 140–44  
 systematic, 144, 144, 149  
 terminology of, 140–41  
 uplift and unroofing of, 152–53, 153  
 joint set, 145  
 joint spacing, 147–49, 147  
   bed thickness and, 147–48  
   lithology and, 148, 149  
   magnitude of strain and, 149  
   tensile strength and, 148–49  
 joint stress shadow, 147–48, 148  
 joint system, 145  
 joint tip, 158  
 joint trajectories, 151  
*Journey to the Center of the Earth*  
   (Verne), 337  
 Juan de Fuca Plate, 569–70, 569  
 Juan de Fuca Trench, 419  
 Juan Fernandez oceanic ridge, 578–79  
 jump frequency, 217  
 Jura fold-thrust belt, 494  
 Jura Mountains, 250, 449, 464, 464, 511,  
   512, 522–23  
  
 Kaapvaal craton, 613  
 Kangaroo Island, 144  
 Karakoram mountain range, 41  
 Karelia craton, 612  
 karst, 432  
 keirogen, 544  
 Kelvinian behavior, 97*n*  
 Kenorland, 612–13  
 Ketilidian Orogen, 612  
 Khangai-Khantey Ocean, 542, 544  
 Khanty-Mansy Ocean, 542  
 Kidd, Mount, 445  
 Kilimanjaro, Mount, 398  
 kinematic indicators, 298*n*  
 kinematic vorticity number, 68  
 King, P. B., 582  
 kink folds, 250, 250, 263  
 Kipchak arc, 541, 541, 542, 544  
 klippe, 173–74, 173, 174, 454, 455  
 Kobe, Japan, 198  
 Kodiak Island, 449  
 Kohistan arc, 527  
 Koli Nappe, 600–601  
 Kula Plate, 560, 561  
 Kuril Trench, 428  
 kyanite, 290, 318, 319, 319  
  
 Labrador Orogen, 611, 612  
 laccoliths, 37  
 Lachlan Orogen, 160, 548, 548–51, 549, 550  
   timing of deformation in, 551–53, 552,  
   553, 554  
 ladder pattern, in joints, 156–57, 157  
 landslides, 25  
 Lapworth, Charles, 225, 294, 296  
 Laramide Orogeny, 622, 623  
 La Salle fault-and-fold zone, 619–20  
 lateral escape process, 410, 492, 495  
 lateral ramps, 454, 493–94, 495  
 lateral slip, 6, 6  
 Laurasia, 525–26, 604, 605  
 Laurentia, 593, 594–95, 597, 598, 599,  
   600, 601, 601, 602–5, 607, 609  
 Laurentian realm, 583–84, 587–91, 589  
 lava, 337, 399  
 lava flows, 34, 81  
 law, 11  
 Law of Superposition, 241, 243, 252  
 layer-parallel shortening (lps), 267, 286  
 layer thickening, 260–61  
 left-lateral (sinistral) fault, 170, 170  
 Leonardo da Vinci, 3, 132*n*  
  
 Lepontine dome, 511–12, 514, 516, 523  
 Lewis Thrust, 174, 180, 445, 468, 469  
 Liesegang banding, 24  
 Ligerian Orogeny, 595, 604  
 limb, of fold, 239  
 limestone, 81, 100, 103, 103, 104, 105,  
   106, 139, 162, 215, 219, 232, 265,  
   266, 278, 286, 294, 452, 453, 465,  
   522, 535, 549, 622  
 lineaments, 163, 164  
 linear elastic fracture mechanics, 120  
 linear velocity, 361, 362–63, 362  
 lineated slickenside, 183  
 lineations, 255, 272, 264, 275, 288–91, 298  
   bedding-cleavage, 289–90  
   crenulation, 288–89  
   defined, 271, 288  
   fiber, 290  
   fold hinge, 288  
   form, 288–89, 288  
   grove, 183, 290  
   intersection, 289, 290  
   mineral, 290, 291, 295  
   shear-direction, 290  
   stretching, 290, 295  
   surface, 289–90, 290  
   tectonic interpretation of, 290  
 Liqueiñe-Ofqui Fault, 579  
 listric faults, 29, 169, 176, 192, 192,  
   387–88, 288  
   formation of, 192, 192  
 listric normal faults, 387–88, 388  
 lithology, 150  
   joint spacing and, 148, 149  
   in plate collisions, 429, 442  
 LITHOPROBE program, 374  
 lithosphere, 6, 59, 336–37, 351–54, 356,  
   365–67, 414, 415, 497, 506, 532,  
   557, 563  
   boundaries of, 352  
   at convergent plate margins, 424  
   in formation of Alps, 510, 512  
   imaging of, *see* geophysical imaging  
   isostatic equilibrium of, 354  
   mid-ocean ridges and, 402–5  
   oceanic, 402, 557  
   peripheral bulge in, 415, 417  
   in rifting process, 384, 397–98, 399,  
   400–402, 402, 405, 408  
   uncompensated, 354  
 lithosphere delamination, 435, 436, 438, 442  
 lithosphere plates, 355  
 lithostatic pressure, 52–53, 102, 152, 193,  
   337, 470  
 lit-par-lit intrusion, 283  
 load casts (ball-and-pillow structures),  
   19, 20  
 local stress, 118  
 log-log plot, 260, 260  
 Loma Prieta earthquake, 564  
 longitudinal splitting, 121, 121  
 longitudinal strain, 70–71  
 long-lived rift-margin uplifts, 401, 402  
 Lost River Range, 463  
 lower mantle, 340, 349, 418  
 lower plate, 389  
 lower-plate margins, 408  
 low-grade cleavage, 284–85, 286  
 low-temperature creep, 216  
 low-velocity zone, 349, 353  
 LS-tectonite, 271–72, 272  
 L-tectonite, 271–72, 272  
 Luning dolomite, 206  
  
 M'Clintock Orogeny, 595  
 McConnell Thrust, 461, 466  
  
 Mackenzie Mountains, 380  
 MacQuerie Trench, 477  
 macro, as term, 9  
 macrofold, 246  
 mafic xenoliths, 33  
 magma, 30–31, 348, 350, 405, 425, 429,  
   435–36, 442  
 magma chamber, 31, 405  
   at mid-ocean ridges, 402  
 magmatic underplating, 345, 398  
 magnetic anisotropy, 87  
 magnitude of displacement, 298  
 magnitude-orientation diagrams, 79  
 major faults, 176  
 Makran fold-thrust belt, 494, 496  
 Makran subduction zone, 566–67  
 Malaspina Glacier, 92  
 mantle, 336–37, 340, 351, 364–65, 418, 506  
   heat transport in, 349, 349  
   internal structure of, 348–50, 350  
   layers of, 349  
   ratio of crust's thickness to, 623–25  
 mantle plumes, 350, 359–60, 398, 399,  
   408, 409  
 marble, 111, 206, 213, 225, 232, 233, 296,  
   298, 302, 303, 318–19, 587  
 Mariana Trench, 342, 417, 419, 566  
 Mariana-type backarc, 425, 426  
 marine magnetic anomalies, 363*n*  
 marker horizon, 174  
 marl, 286  
 Massif Central, 35  
 massive-gabbro layer, 402  
 mass (isotopic) number, 325  
 master joints, 145  
 material lines, 65–66, 65  
 Maxwell, James C., 97*n*, 98  
 Maxwell relaxation time, 97–98, 98  
 mechanical stratigraphy, 452  
 mechanical twinning, 210, 213–16,  
   222, 439*n*  
   in calcite, 213–16, 213, 214–15, 439*n*,  
   622–23, 622  
   crystal plasticity and, 210, 213–16, 213,  
   214–15  
   in Midcontinent U.S., 622, 622  
   rate-controlling mechanisms in, 216  
   strain-producing mechanisms in, 216  
 mechanics, principles of, 40–41  
 mega, as term, 9  
 Meguma Zone, 585, 587, 590  
 mélange rock formation, 423, 424, 528, 548  
 Meliata-Hallstatt Ocean, 514  
 membrane effect, 152, 153  
 membrane stresses, 409  
 meso, as term, 9  
 mesofold, 246  
 mesoscopic folds, 465  
 mesoscopic strain, 465  
 metamorphic core complexes, 390–94,  
   392–93  
 metamorphic differentiation, 283  
 metamorphic field gradient, 331  
 metamorphic underplating, 333  
 metamorphism, 294, 316–33, 412  
   in collisional tectonics, 433  
   deformation and, 322–25, 323–25  
   D-P-T-t paths and, 329–31, 333, 333  
   foliation and, 322–23, 323  
   geothermal gradient and, 331–32, 332  
   in Lachlan Orogeny, 550–51  
   mineral zonation and, 321  
   pressure-temperature analysis of,  
   319–21, 319, 320  
   pressure-temperature (P-T) history  
   and, 331

- metamorphism, (*continued*)  
 pressure-time (P-t) history and, 331  
 prograde and retrograde, 321  
 P-T-t path and, 321, 333, 333  
 retrograde, 321, 394  
 sample field observations for study of, 316–19  
 shock, 37  
 temperature-time (T-t) history and, 331  
 terms and concepts related to, 317  
 meteors, 35, 36–37  
 mica, 16, 80, 219, 273, 280, 281, 284, 286, 302, 554  
   timing of cleavage formation in, 551–52  
   white, 278–79  
 mica fish, 299  
 Michigan Basin, 503, 618–19  
 micrite, 424  
 micro, as term, 8–9  
 microcracks, 206, 374  
 microfabric, 222  
 microfolds, 246, 277, 280, 288–89  
 microfractures, 206  
 microlithons, 274, 276, 278, 280  
 microplates, 358  
 microstructures, 270, 307, 314  
 Mid-Atlantic Ridge, 363, 404, 480  
 Midcontinental Rift, 384*n*, 503  
 Midcontinent fault-and-fold zones, 439  
 Midcontinent of U.S., tectonics of, 615–27, 616  
   classes of structures in, 616–19  
   epeirogenic structures of, 616, 617–19  
   fault-and-fold zones of, 617, 619–20, 619, 620  
   fault zones in, 625–26  
   intragranular strain in, 617, 622–23  
   joint systems of, 617, 622–23  
   unsuccessful rifts in, 623  
 mid-crustal detachment, 442  
 mid-ocean ridges, 196, 342, 355, 356, 357, 358, 367, 384, 394, 395, 396, 414, 425, 440, 476, 480, 481  
   slow and fast, 403, 405  
   tectonics of, 402–4, 403, 404  
   transform faults and, 497–98  
 Midway Island, 360  
 migmatite, 32, 33, 258, 283–84, 551, 604  
 migration, data processing technique, 12  
 migration recrystallization, 226, 227–28  
 mineral lineations, 290, 291, 295  
 minerals:  
   closure temperature of, 327–28  
   growth of, 322–24, 324  
   inclusions in, 322–23  
   isotopic dating of, 325–27, 326–27  
   refractory, 283  
   time of growth, 327–28, 328  
   zonation of, 321  
 miniseismometers (geophones), 369  
 Minnesota River Valley (MRV)  
   Terrane, 612  
 minor faults, 176  
 miogeosyncline, 406*n*  
 mirror planes, 308–9, 309  
 mirror zones, 140, 142, 144  
 mist zones, 140, 142, 144  
 mixed dislocation, 209, 221  
 Moab, Utah, 158  
 Mode I displacement, 122–23, 122, 123, 127, 138, 141, 147, 150, 157  
 Mode II displacement, 122–23, 122, 123, 127  
 Mode III displacement, 122–23, 122, 127  
 model, as term, 11  
 moderate cleavage, 277  
 Moho discontinuity, 32, 59–60, 342, 344, 345, 348, 370, 372–73, 373–74, 375, 377, 378, 379, 514, 516, 563  
 Mohorovičić, Andrija, 342*n*  
 Mohr, Otto, 129  
 Mohr-Coulomb criterion, 129–30, 471  
 Mohr diagram, 134, 134, 135, 135, 136, 157  
   constructing, 50–51, 50–51  
   Coulomb criterion in, 128–31, 128, 129, 130–31, 132  
   for strain, 73–75, 74  
   for stress, 49–51, 49–51, 52, 102–3  
 Moine Series, 294, 296  
 Moine Supergroup, 598–99  
 molasse, 505, 605  
 Molasse Basin, 511, 512, 522, 523  
 monazite, 319, 322, 328, 603  
 monoclinial folds, 439  
 monoclines, 250, 250, 425, 459  
 monoclinic planes, 308–9, 309, 310  
 Monterey Salient, 460, 467  
 Morcles thrust, 205  
 mortar (core-mantle) structure, 227, 227  
 mountains, 2–4, 4, 155, 146, 188, 191, 355*n*, 488, 503, 504, 505–7, 505, 564, 575, 576  
 mudstone, 277, 292, 535, 549  
 Mugodzhur arc, 542, 544  
 mullions, 288, 289  
 muscovite, 225, 279*n*, 283, 318, 329, 560  
 mushroom (type 2) interference pattern, 254–55, 254, 258  
 mylonite, 190–91, 25–26, 225, 234, 272, 289, 294, 296–98, 301, 302, 318, 328, 433, 492, 601  
   in core complexes, 390–94  
   grains of, 299  
   types of, 297–98, 298  
   see also shear-sense indicators  
 mylonitic foliation, 264, 284, 295, 298, 302–3, 305, 307, 310, 310, 311, 391  
 mylonitization, 370  
 Nabarro-Herring creep (volume diffusion), 217, 218, 218, 232  
 Nagelhorn, 268  
 Nain craton, 610, 611–13  
 nappes, 244–45, 268, 433, 434, 505, 505, 611  
   in Alps, 512, 516, 521  
   fold, 459, 459  
 natural strain, 72  
 Nazca oceanic ridge, 578  
 Nazca Plate, 358, 448, 575, 577, 578  
 negative buoyancy, 26, 349, 414, 442  
 negative flower structure, 488, 490, 491  
 neocrystallization, 299  
 neomineralization, 272  
 Neotethys Ocean, 523, 526–27, 526  
 net slip, 169  
   determination of, 174–76, 175, 176  
 net-slip vector, 169  
 neutral buoyancy, 27, 31  
 New England Orogen, 548, 548, 551, 553  
 Newfoundland, 280  
 New Madrid earthquakes, 503  
 New Madrid Fault System, 356  
 New Scotland Formation, 21  
 Newtonian (linear viscous) behavior, 96, 230, 260, 261  
 Newtonian (classical) mechanics, 40, 41, 229  
 New World Island, 465  
 New Zealand Alps, 188  
 non-coaxial strain, 67–69, 68, 305, 306, 307–8, 307, 310  
 noncohesive fault rocks, 179  
 noncylindrical folds, 240, 240  
 no net torque calculation, 360*n*  
 nonrandom (preferred) fabric, 271  
 non-recoverable (permanent) strain, 96, 98, 117  
 nonrotational normal faults, 388  
 nonsutured domain, 276  
 nonsystematic joints, 144, 144, 149  
 nontectonic structures, 14–38  
   igneous, 30–38  
   salt, 26–30  
   sedimentary, 14–30  
 normal faults, 170, 172, 191, 196, 196, 385–89, 387–89, 407, 421, 433, 435, 484, 486, 491, 511, 517, 528, 532, 535, 544, 563, 576, 579, 620  
   listric, 387–88, 388  
   nonrotational, 388  
   planar, 387–88  
   rotational, 388, 391–92  
 normalized center-to-center analysis, 83  
 normal stress, 44–45, 46, 48, 48, 54, 133, 133, 471  
 North America, tectonic genealogy of, 607–13, 608  
   Gondwana in, 607–8, 609, 613  
   Kenorland in, 612–13  
   Nuna in, 608, 610–12, 610, 612, 613  
   Pangea in, 607–8, 613  
   Rodinia in, 609, 609, 612, 613  
 North American Cordillera, 252, 390, 392, 503, 504, 554, 557–65, 608, 615  
   Altaids compared with, 535, 536  
   crustal accretion in, 440, 441  
   monoclinial folds in, 439  
   regional analysis of, 557–65, 558, 560, 561  
   Sevier/Laramide fold-thrust belt of, 449  
 North American Plate, 358, 360, 363, 363, 476, 477, 496, 497, 557, 563, 564, 569, 572  
 North Anatolian Fault, 438, 438, 476, 492, 495  
 North Caspian Basin, 544  
 Northridge earthquake, 564  
 North Sea Rift, 389, 391  
 Nuna, 608, 610–12, 610, 612  
 Nurol Basin, 544  
 oblique collisions, 430  
 oblique convergence, 356, 440  
 oblique ramp, 454  
 oblique rifting, 382, 396, 396  
 oblique-slip fault, 169–70, 170, 191, 621  
 observation:  
   interpretation and, 10, 11  
   scale of, 8–10  
 Occidentalia, 599  
 oceanic crust, 342, 344, 402, 403, 414  
 oceanic transform faults, 497–98  
 oceanic trenches, 342  
 offscraping process, 422, 472  
 offset, 220, 221  
 oil, 199, 368, 408, 445, 471  
 olenellid trilobites, 597, 599  
 olistostromes, 422  
 olivine, 100, 181, 200, 207, 209, 209, 212, 221, 227, 228, 234, 283, 311, 339, 348–49, 351, 402, 405, 497, 517  
   deformation mechanism map for, 232, 232  
   dislocation decoration of, 237  
 Olympic Mountains, 570, 571–73  
   uplift of, 572–73  
 Olympic subduction complex, 572–73  
 ooids, 81, 81

- ophiolites, 342, 430, 505, 506, 521, 527, 528, 551, 585–87, 588, 596, 598–99, 604, 611
- Oregon-Washington Trench, 419–20
- ore minerals, 199
- Original Horizontality, Law of, 2, 16–17
- oroclinal bending, 506
- in Andes, 579–80
- orocline, 468
- orogenic architecture, 505
- orogenic (extensional) collapse, 410, 421, 435–36, 435, 436, 472
- orogenic phase, 252
- orogens:
- bivergent, 434
- collisional, 607
- inactive, 347
- as term, 502
- turkic-type. *See* Altaiids
- orogeny, as term, 502
- orthogneiss, 283, 505, 587
- orthogonal joint systems, 145–46, 156–57, 157
- orthorhombic planes, 308–9, 309, 310
- Ouachita Orogen, 582, 607–8, 608
- outer-arc extension joints, 157
- outer core, 340
- outer swell (peripheral bulge), 415, 417, 417
- out-of-sequence faults, 456, 472
- out-of-syncline faults, 457, 459
- overburden, 435
- overriding plate (overriding slab), 414
- Ozark Dome, 618
- Pacific Plate, 355, 368, 360, 363, 427, 477, 496, 497, 557, 560, 563, 564, 568
- Pahoehoe flow, 33
- Painted Desert, 15
- paleocurrent direction, 16
- paleopiezometer, 227–28
- paleosol, 23
- paleostress, 57, 227
- fault systems and, 197–98
- paleostress trajectories, 157
- Paleotethys Ocean, 526, 526
- Palisades Sill, 399*n*
- palm structure, 488*n*
- Pangea, 355, 366, 396, 525, 582, 590–91, 596, 605
- North American tectonic genealogy and, 607–8, 613
- Panotia, 366
- paragneiss, 283, 318, 321, 505, 587
- parallel dip isogons, 246
- parallel dislocations, 221
- parallel folds, 246, 247, 264, 265–66
- Parana Basin, 399
- parasitic folds, 248–49, 249
- parent isotope, 325
- partial dislocation, 210, 213
- partial melting, 397–98, 398*n*, 399
- of magma, 31
- passive continental margins, 358
- passive folding, 257–60, 259, 261
- passive-margin basins, 26, 406, 408, 431, 433
- as setting for fold-thrust belts, 450–51
- passive margins, 196, 347, 431, 505
- in rifts and rifting, 384–85, 405–8, 406, 407
- passive-margin sedimentary wedge, 406–7, 407
- passive markers, 67, 80
- pegmatites, 299, 328
- pelagic sediment, 342, 402
- Pele, Mount, 35
- pelite, 587
- pencil cleavage, 274, 277–78, 277, 278, 286
- penecontemporaneous folding, 422
- penecontemporaneous structures, 24–25, 25
- penetrative fabric, 271–72
- Penninic Valais Ocean, 510
- Penobscot Orogeny, 588
- Penokean Orogen, 611
- perfect dislocation, 210
- peridotite (ultramafic rock), 31, 181, 339, 348, 349, 350, 351, 353, 372, 397, 425
- periodic table, 325
- peripheral bulge (outer swell), 415, 417, 417
- permanent (non-recoverable) strain, 96, 98, 117
- permeability, 134, 165
- Permian Castle Formation, 242
- Peru-Chile Trench, 577
- petrographic microscope, 221
- petroleum industry, 368, 375
- phase change, 340
- Philippine Sea, 425
- Philippines Fault, 542
- phlogopite, 302
- phyllite, 279, 280, 281, 289
- phyllitic cleavage, 278–79, 281
- phyllosilicates, 225, 278–79, 281, 302
- Piedmont Terrane, 593, 597, 599–600
- Piedmont Zone, 584–85, 589
- Piemont-Liguria Basin, 512–14
- Piemont-Liguria Ocean, 510, 512–14, 521, 523
- piercing points, 174
- pile-ups, 211
- pillow basalt, 34–35, 34, 342, 363*n*, 505, 535, 551, 572
- pillow-basalt layer, 402–3
- pinch-and-swell structure, 23
- Pine Mountain Thrust, 452–53, 453, 494, 495
- pinnate joints, 156
- pitted pebbles, 24, 24
- plagioclase, 100, 213, 300, 319, 320
- plagiogranite, 588
- planar domain, 276, 277
- planar fabric, 272–73
- planar normal faults, 387–88
- planar systemic arrays, 160, 160
- plastic regime, 295, 296
- plateau uplift, 438
- plate-boundary seismicity, 200
- plate-interior deformation, 356
- plates, 337, 355
- boundaries of, 355–58, 356, 357, 358
- convergence of. *See* convergent plate margins
- interior of, 355–56
- major and minor, 358, 358
- motion of, 359–64, 359, 361, 362
- subduction of, 356
- triple junctions of, 364, 364
- plate tectonic theory, 4, 6, 58, 200, 337, 557–58, 582
- convection-cell model of, 364
- driving forces of, 364–65
- global view of, 502–8
- plate boundaries and, 355–58, 356, 357, 358
- plate kinematics and, 353–64, 359, 362, 363
- principle features of, 6
- supercontinent cycle and, 366–67, 366
- tenets of, 355–58
- plume axis, 141
- plumose structure, 140–44, 142, 150, 154
- formation of, 141–42
- types of, 143
- plunging fold, 244
- plutons, 31, 370, 399, 535, 549
- igneous structures and, 32–34
- postorogenic, 436
- residual stress and, 154
- Point Sal Ophiolite, 34
- Poiseuille, Jean-Louis, 96*n*
- Poisson, Simeon-Denis, 95*n*
- Poisson effect, 125–26
- uplift and, 152–53
- Poisson's ratio, 95, 95, 126
- polar-wander paths, 440
- polygonized microstructure, 225
- pore-fluid pressure, 101, 105–6, 106, 122, 134–35, 135, 154, 155, 192
- in fold-thrust belts, 470–71
- frictional sliding and, 136
- shear failure and, 136
- poroelastic effect, 155*n*
- porphyroblastesis, 322
- porphyroblasts, 280, 322–23, 323, 328
- porphyroclasts, 280
- positive buoyancy, 26, 349
- positive flower structure, 488, 490
- postkinematic growth, 322–23, 323, 324, 328
- postorogenic extension, 506
- postorogenic granite, 436
- power-law creep, 220, 228, 230
- Precambrian shields, 345
- preferred (nonrandom) fabric, 271, 272
- prekinematic growth, 322, 323, 324
- pressure, 333
- confining, 51, 101–3, 103, 108, 193
- in deformation experiment, 101–2, 102
- frictional sliding and, 206–7
- lithostatic, 52–53, 102, 152, 193, 337, 470
- metamorphism and, 319–22, 319, 320
- quantification of, 319–22, 319, 320
- pressure ridges, 487–88, 489
- pressure shadows, 274
- pressure solution, 23–24, 217, 218–19, 219, 274–75, 277, 281, 286
- pressure-solution cleavage, *see* disjunctive cleavage
- pressure-temperature (P-T) history, 331
- pressure-time (P-t) history, 331
- primary (transient) creep, 93, 93
- primary fabrics, 270
- primary weld, 27
- principle strain axes, 66
- process zone, 120, 121
- profile plane, 245–46
- prograde metamorphism, 321
- prograde path, 331
- promontories, 430, 431
- protocataclasite, 181
- protomylonite, 297
- pseudotachylyte, 37, 181, 181, 190, 200, 201
- P-shears, 184, 184, 484
- P-T-t path, 321, 333, 333
- ptygmatic folds, 250–51, 251
- pull-apart basins, 491–92, 611
- pumice, 289
- Pumpelly, Raphael, 248*n*
- Pumpelly's Rule, 248*n*
- Puna Plateau, 578–80
- pure shear, 68
- pure-shear model, 389, 389
- P-waves (compression waves), 340, 341, 350
- Pyrenees Mountains, 450
- pyroxene, 32, 224, 282, 402, 517

- quadratic elongation, 71–73  
 quantum mechanics, 40  
 quartz, 32, 37, 80, 100, 104, 123, 162, 162, 181, 183, 192, 219, 221, 224, 225, 226, 227, 228, 266, 282, 283, 284, 285*n*, 286, 289, 290, 295, 302, 318, 319, 348, 410, 465, 510, 549, 612  
   in cleavage processes, 275–76, 277, 278, 281, 282  
   deformation mechanism map for, 231–32, 231  
   deformation of, 106, 106, 517  
   fabric of, 310–11, 310  
 quartzite, 103, 289, 294, 296, 303, 587  
 Quechua Orogeny, 576–77  
 Queen Charlotte Fault, 476, 557  
 quick-look technique, 469–70, 470
- Racklan Orogen, 608  
 radial dike, 31  
 Rainier, Mount, 570  
 ramps:  
   in balanced cross sections, 469–70  
   in fault arrays, 196  
   in fault-bend folding, 460–62  
   in fault bends, 176–77, 176  
   frontal, 454  
   hanging-wall, 453–54  
   lateral, 454, 493–94, 495  
   in normal faults, 388  
   oblique, 454  
   in thrust faults, 453–54, 454  
 Ramsay diagram, 77–78, 81–82, 88, 88  
 random fabric, 270–71, 272  
 random-walk process, 217  
 range, 397, 399  
 rate-controlling mechanism, 216  
 real area of contact, 132, 133  
 recently active orogens, 347  
 recesses, 430, 431, 466  
 reclined fold, 245  
 recoverable strain, 95, 117  
 recrystallization, 222, 225–28, 225–28  
   dynamic, 225–26  
   mechanisms of, 226–27  
   rotation, 226–27  
 recumbent folds, 239, 244–45, 268, 505  
 recurrence interval, 201  
 Red River Fault, 476  
 Red Sea Rift, 390, 399, 400, 401  
 reduction spots, 284, 284  
 reference frame, 7–8  
 refolded fold (type 3) interference pattern, 253, 254–55, 254  
 refractory minerals, 283  
 regional shortening, 286  
 regional tectonics:  
   of Andes Mountains, 575–81  
   of Appalachian Orogen, 582–91  
   of Caledonides, 593–605  
   of Cascadia subduction wedge, 566–74  
   environmental conditions and, 506–7  
   global deformation patterns and, 503–4  
   learning from, 504–6  
   of Midcontinent U.S., 615–27  
   of North America, 607–13  
   of North American Cordillera, 557–65  
   of northwestern Canada, 375–80, 375–77, 379  
   overview of, 502–8  
   of southwestern Canada, 370  
 regional transport direction, 456–57  
 Reidel shears, 184, 184, 484, 485, 486, 486  
 relative displacement, 8  
 relative plate velocity, 360–64, 361, 362  
   using vectors to describe, 361–64, 362, 363  
 relative reference frame, 359  
 relay zone, 466, 466  
 release joints, 156  
 releasing bends, 177, 177, 410, 490, 491, 492  
 releasing stepover, 484  
 remnant arc, 425, 426  
 remote stress, 118, 119–20, 122, 127  
 residual stress, 154  
 restored cross section, 468  
 restraining bends, 177, 177  
   along strike-slip fault, 452, 452, 490–92, 491  
 restraining stepover, 484  
 retrocharriage, 574  
 retrograde metamorphism, 321, 394  
 retrograde path, 331  
 retrowedge, 421, 474  
 reverse faults, 170, 172, 196–97, 197, 433, 561, 564  
 Rheic Ocean, 593, 604  
 Rheinische Schiefergebirge, 280  
 rheolitic relationships:  
   confining pressure and, 102–3, 103, 108  
   creep curve and, 92–93  
   elastic behavior and, 93–96, 94  
   elastoviscous behavior and, 94, 97–98, 98  
   linear behavior and, 93, 94, 96, 98, 98  
   nonlinear behavior and, 93, 98–100, 98  
   pore-fluid pressure and, 101, 105–6, 106  
   strain rate and, 91–92, 96, 104–5  
   temperature and, 103–4, 104  
   viscoelastic behavior and, 94, 97, 98  
   viscous behavior and, 93, 94, 96–97, 99  
 rheologic layering, 351  
 rheology, 90–111  
   definition of, 90  
   deformation experiment in, 101–2, 102, 110  
   in natural rocks, 100–108, 101  
   significance of natural conditions and, 107–8, 108  
   terminology and concepts of, 91, 108–11, 109  
 Rhine Graben, 512  
   Upper, 522–23  
 rhombochasm, 611  
 rhyolite, 31, 399, 535, 551, 611  
 rhyolitic lava, 34  
 ridge-push force, 365–66, 365, 409  
 Riedal shears, 484, 485, 486  
 rift basins, 397, 399  
   inversion of, 449–50, 451  
 rift-drift transition, 384, 395, 396, 399, 597  
 rift-margin uplifts, 399–402  
 rift relict, 405  
 rifts and rifting, 26, 196, 347, 358, 366, 366, 382–410, 383, 384, 385, 395, 398, 502  
   active, 347–48, 382  
   in Alps, 522  
   in Altids, 542  
   in Andean Orogeny, 576  
   in Appalachian Orogen, 582, 584, 591  
   asthenosphere in, 397–98, 400–401, 408  
   in backarc basins, 425, 427  
   causes of, 408–10, 409  
   in collisional tectonics, 443  
   defined, 382–83  
   depositional sequence of, 397  
   faulting and, 385–92, 387–89, 394, 396, 401, 407–8, 410  
   flexure-related, 408–9  
   heating in, 400–401  
   igneous-rock assemblages in, 397–99  
   inactive, 347, 382–84  
   lithosphere in, 384, 387–98, 399, 400–402, 402, 405, 408  
   lower plate in, 389, 390  
   metamorphic core complexes in, 390–94, 392–93  
   in Midcontinent U.S., 620, 623, 624, 625  
   mylonitization in, 390–93  
   in North American Cordillera, 557, 559, 564  
   oblique, 382, 396, 396  
   orientation of, 396  
   passive margins of, 384–85, 405–8, 406, 407  
   preexisting structures and, 396  
   pure-shear model of, 389, 389  
   rift-margin uplifts in, 399–402, 400, 402  
   seafloor spreading in, 384, 395, 396, 402–5, 410  
   sedimentary-rock assemblages in, 397  
   segments in, 394  
   simple-shear model of, 389, 389  
   in strike-slip faults, 495–96, 496  
   structure of, 385–90, 387  
   subsidence and, 397, 399, 401  
   successful, 358, 384  
   and tectonics of mid-ocean ridges, 402–4, 403, 404  
   terminology of, 386  
   thermally activated, 408  
   topographic features of, 397–402, 400  
   transform faults and, 480, 481  
   unsuccessful, 358, 384, 623  
   uplift in, 399–402, 400  
   upper plate in, 389, 390, 394  
   volcanism in, 399  
 rift sub-basin, 390  
 rift system, 382  
   formation of, 394–96  
 rift volcanoes, 398  
 right-lateral (dextral) fault, 170, 170  
 rigid-body rotation (RBR), 63–64  
 rigid-body translation (RBT), 63–64  
 rigidity (shear modulus), 95, 95  
 ring dike, 31  
 Rio Grande Rift, 392, 562  
 Roberts Mountains Thrust, 558  
 rocks, competency scale for, 110–11  
 rock salt, 99–100  
 rock-water interactions, 284  
 Rocky Mountain Arsenal, 192–93  
 Rocky Mountains, 15, 425, 439, 561, 615, 621–23, 625, 626, 627  
 Rocky Mountain Trench, 370, 371  
 Rodinia, 366, 558, 582, 583–84, 591, 609, 609, 612, 613  
 rods, 289  
 rollback, 414  
 rollover anticline, 388, 388  
 rollover fault, 29  
 rollover folds, 388, 390, 407  
 rollover syncline, 388  
 Romanche Fracture Zone, 396  
 roof thrust, 197, 455, 458  
 rose diagram, 151, 152  
 rotation, 63, 277, 362, 496  
   block, 487, 488  
   defined, 7, 8  
   of grains, 304–5, 304, 305  
   by indentation, 506

- relative, 8  
rigid-body (RBR), 63  
rotational normal faults, 388, 391–92  
rotation recrystallization, 226–27  
R' shears, 184, 184, 484, 485, 486, 486  
Rubey, William, 193*n*, 470*n*  
rubidium, 325  
Rundle Thrust, 445  
Russell Fork Fault, 495  
rutile, 319
- sag ponds, 188, 487  
salient, 466  
Salinic Orogeny, 589, 589  
salt intrusions, 26  
salt structures, 26–30, 27–30  
  faulting and folding of, 29–30, 29–30  
  fault movements and, 407–8  
  geometry of, 27–29  
  halokinesis and, 26–27, 28  
  importance of, 30  
  rifting and, 397  
  stages in formation of, 28  
  terminology of, 28  
San Andreas Fault, 90, 91, 137, 168, 177, 194, 452, 491, 557  
  displacement across, 188, 189, 564  
  earthquakes along, 564  
  fault bends in, 491, 496  
  magnitude of velocity on, 363–64  
  net slip on, 176  
  strike-slip along, 564–65  
  subsidiary faults in, 184  
  subsidiary structures and, 482, 483  
  trace of, 487, 489, 497  
Sander, Bruno, 311*n*  
sandstone, 103, 105, 148, 154, 162, 186, 219, 260, 260, 262, 265, 266, 274, 275, 278, 281, 283, 286, 289, 337, 374, 397, 424, 452, 453, 549, 622  
  Cambrian, 144  
  cleavage refraction in, 287  
  Entrada, 158, 158  
  fabric of, 271  
sand volcanoes, 19  
Saudi Arabian Plate, 438  
sawtooth model, 332–333  
Sayan Mountains, 542  
Scandian Orogeny, 601, 602  
schist, 272, 279–80, 289, 433, 492  
schistosity, 273, 278, 279–80  
Scotia Plate, 358, 428, 498  
screw dislocation, 207–10, 208, 212, 221  
Scrope, G. P., 4  
seafloor spreading, 4, 355, 356, 358, 359, 366, 384, 395, 396, 401–5, 410, 425, 497, 512  
seal, clay, 181  
seamounts, 342, 428, 428, 440  
secondary (steady-state) creep, 93, 93  
secondary grain growth, 226*n*  
Second Law of Motion, 43  
second-order folds, 464  
second-rank tensor, 48, 53, 66  
sectional strain ellipses, 76, 76  
sedimentary basin, 26, 433, 433, 505  
sedimentary structures, 14–30  
  stratification in, *see* bedding  
  *see also* structural analysis  
seismic discontinuities, 340, 342  
seismic fault, 199  
seismic imaging, 368–70  
  interpreting data of, 370, 371  
  method of, 369–70, 369  
seismicity, 199–200  
seismic profiles, 374  
seismic pumping (fault valving), 192  
seismic tomography, 339–50, 350, 418  
seismic velocity, 292, 337, 369–70  
  depth profile vs., 337, 369–70  
seismic waves, 93, 98, 337, 349  
  P—(compression), 340  
  S—(shear), 340  
seismites, 201  
seismology, 93  
selection method of field study, 150, 151  
selvage, 276  
sense of displacement, 298  
sense of slip, 169  
serpentine, 181, 182, 405, 497–98, 551  
Serra do Mar, 401, 401  
Seve Nappe, 600–1  
Sevier/Laramide fold-thrust belt, 449, 560  
Sevier Orogeny, 623  
S-foliation, 302–3, 303, 305, 310  
shale, 16, 23, 81, 103, 105, 140, 158, 186, 199, 250, 262, 265, 266, 280, 283, 289, 397, 452, 453, 549, 605, 611  
  cleavage in, 277–78, 281, 286–87  
shallow fold, 244  
shatter cones, 37, 37  
shear, 307  
  angular, 71  
  failure strength for, 125–26  
  general, 68  
  intermediate principle stress and, 136  
  pure, 68  
  R and R', 184, 184, 484, 485, 486, 486  
  simple, 68, 68  
  sinistral, 287  
shear bands, 303  
shear-direction lineations, 290  
shear-fracture criteria, 127–32, 128–31  
shear fractures, 116, 124–26, 125  
shear heating, 194  
shear modulus (rigidity), 95, 95, 229  
shear reaction, 123  
shear rupturing, 123  
shear sense, 169–70  
shear-sense indicators, 176, 187, 298–304  
  domino model for, 301–2, 301  
  foliations as, 302–3, 302, 303  
  fractured grains as, 299–302, 301  
  grain-tail complexes as, 299, 301  
  mica fish as, 299, 301–2, 302  
  plane of observation and, 298–99  
  textures as, 310–11, 310  
shear strain, 71  
shear strain rate, 91, 96, 98, 99  
shear stress, 44–45, 48, 48, 54, 133, 133, 192–93  
shear zones, 111, 116, 166, 167  
  defined, 167  
  ductile, *see* ductile shear zones  
  strain in, 304–7, 305  
sheath folds, 251–52, 254, 264, 264, 265, 266  
  in ductile shear zones, 313, 314  
Sheep Mountain Anticline, 244  
sheeted-dike layer, 402  
sheeted dikes, 342  
sheeting (exfoliation) joints, 146, 146  
  formation of, 153–54, 153  
sheet intrusion, 31–32, 32  
Sherwin-Chapple equation, 261*n*  
shield, defined, 615  
shock metamorphism, 37  
Sibson-Scholz fault model, 296  
Siccar Point, 23  
Sierra Nevada Mountains, 146, 146  
Sierras Pampeanas, 578–79, 627  
sign convention, 47  
Sigsbee Escarpment, 406  
sills, 32, 370, 399  
  columnar jointing in, 146  
siltstone, 140, 142, 397  
Siluro-Devonian “Acadian” phase, 252  
similar fold, 246  
simple shear, 68, 68  
simple-shear model, 389, 389  
sinistral (left-lateral) fault, 170, 170  
sinistral shear, 287  
SI units, 42  
“slab graveyards,” 418, 419  
slab-pull force, 365–66, 365, 409, 414, 417  
slate, 103, 219, 250, 272, 280, 293, 424, 584  
  pencil cleavage in, 277–78  
  reduction spots in, 284, 284  
slaty cleavage, 274, 278, 278, 279, 281, 286–87, 465, 554, 603, 622  
Slave craton, 610, 611–13  
Slave Province, 375, 376, 379  
slickenlines, 183, 183  
slickensides, 182–84, 182, 189  
  anisotropy on, 183  
slickolites, 183–84, 183  
slip (shear displacement), 166  
  sense of, 168  
slip bands, 210  
slip fibers, 183–84, 183  
slip lineations, 150, 176, 182, 182, 189, 290, 290  
slip-line field, 436–38, 437  
slip (glide) planes, 210  
slow ridges, 403, 404, 405  
slump blocks, 422  
slumping, 24  
  intraformational intervals and, 25  
smectite, 278  
“Snake outcrop,” 312  
snowball garnet, 304–5, 304, 323–24, 324, 325  
solid-state diffusion, *see* Coble creep;  
  Nabarro-Herring creep  
solution cleavage, *see* disjunctive  
  cleavage  
Sonoma Orogeny, 559  
Sorby, Henry C., 292  
source layer, 27  
South American Plate, 358, 360, 448, 575, 577  
South American Shear Zone (SASZ), 604  
South Atlantic Ridge, 408  
Southern Alps, 488, 568  
spaced cleavage, 274, 275–76, 284  
spaced fabric, 271, 272  
spherical geometry, 359  
spherical projections, 628–630, 629–30  
spinel, 200  
stable backarc, 425–27, 427  
stable stress state, 130  
stable triple junction, 364  
stable wedge, 567  
stacking, 12  
stair-step thrust, 462  
Stanovoy Fault, 541  
Stanovoy Mountains, 541  
static friction, 132  
static recrystallization (annealing), 226  
staurolite, 324  
steady-state (secondary) creep, 93, 93  
steady-state flow, 220, 233

- S-tectonite, 271–72, 272  
 steerhead basins, 397, 399  
 Steno, Nicholas, 2, 241  
 stepover, 482–84, 484  
 stepped fault array, 184  
 stick-slip behavior, 199  
 stishovite, 37  
 stockwork vein arrays, 160, 160  
 stored strain energy, 224  
 straight dislocations, 221  
 strain, 6–8, 7, 62–89  
   angular, 70–71  
   cleavage and, 284–85  
   coaxial accumulation and, 67–69, 68  
   defined, 7, 12, 90  
   deformation and, 63–65, 64  
   in ductile shear zone, 304–7  
   elastic behavior and, 95–96  
   finite, 66  
   Flinn diagram for, 76–77, 77, 78  
   in folding, 265, 265, 266, 268  
   frame of reference and, 64  
   grain-scale, 465  
   heterogeneous, 7, 65, 65  
   homogeneous, 7, 65–66, 65, 82  
   incremental, 66  
   infinitesimal, 72  
   intragranular, 617, 622–23  
   joint spacing and magnitude of, 149  
   longitudinal, 70–71  
   measurement of, *see* strain measurement  
   mesoscopic, 465  
   Mohr circle for, 73–75, 74  
   natural, 72  
   non-coaxial, 67–69, 68, 305–8, 307, 310  
   non-recoverable (permanent), 96, 117  
   path of, 66–67, 66  
   quantities of, 70–72, 71  
   Ramsay diagram for, 77–78  
   recoverable, 95, 117  
   regional, 123  
   representation of, 75–78  
   shape and intensity of, 76–78  
   in shear zones, 304–7, 305  
   states of, 74–75, 75  
   superimposed, 69–70, 69, 265, 265  
   in superplastic creep, 228–29  
   tangential longitudinal, 264  
   tectonic, 266*n*  
   in thrust sheets, 465  
   types of, 69  
   volumetric, 70–71  
   *see also* rheologic relationships;  
   rheology  
 strain curves, 103–5, 107  
 strain-dependent viscosity, 99  
 strain ellipsoid, 65–66, 66, 79, 81  
   orientation of, 75–76  
   in pencil cleavage, 277  
 strain measurement, 78–89  
   active markers and, 80–81  
   of angular changes, 84–85, 85, 86  
   center-to-center method of, 83  
   information learned from, 87–89, 88  
   of initially non-spherical objects, 82–84, 83–84  
   of initially spherical objects, 81–82, 82, 83–84  
   of length changes, 85–86, 86  
   passive markers and, 80  
   questions to consider, 79–80  
    $R/\Phi$  method of, 83–84  
   rock textures and other gauges for, 86–87  
 strain-producing mechanism, 216  
 strain rate, 6, 89, 91–92, 104–5, 108, 185  
   in buckling experiment, 260  
   pressure solution and, 219  
 stratification, *see* bedding  
 stratigraphic facing (younging direction), 17  
 strength, strength curves, 59, 60, 110  
   tensile, 130–31, 136  
 strength paradox, 118–19  
 stress, 6–8, 40–60  
   anisotropic, 47, 53, 55  
   at a point, 46, 46, 54  
   biaxial, 52, 52  
   in collisional tectonics, 438–40  
   components of, 46–47, 47  
   compressive, 47  
   defined, 31  
   deviatic, 52–53, 53, 54  
   differential, 50, 53, 56, 59, 60  
   in Earth, 57–58  
   effective, 136, 471  
   elastic behavior and, 95–96  
   epeirogeny and, 623  
   experiment for, 47–48, 47  
   failure, 93  
   far-field, 439  
   faulting in relation to, 191–94  
   in fold-thrust belts, 470–72, 471  
   isotropic, 47, 52–53, 52–53, 55, 102, 134, 135, 470–71, 471  
   local, 118  
   mean, 52–53, 53, 54  
   measuring, 56–60, 56, 57  
   membrane, 409  
   Mohr diagram for, 49–51, 49–51, 52, 102–3  
   nonrecoverable, 117–18  
   normal, 44–45, 46, 48, 48, 54, 133, 133, 471  
   present-day, 56–57  
   principal, 45–46, 47, 55  
   principal axes of, 47, 54, 55  
   principal planes of, 45–46, 47, 55  
   remote, 118, 119–20, 122, 127  
   residual, 154  
   shear, 44–45, 48, 48, 54, 133, 133, 192–93  
   states of, 47–48, 51–52, 52  
   strength and, 110  
   summarized, 54–55  
   tensile, 47, 127  
   terminology and symbols of, 42  
   three-dimensional, 45–46  
   triaxial, 52, 52  
   two-dimensional, 44–45, 44–45  
   units and quantities of, 42–43, 43  
   yield, 99  
   *see also* rheologic relationships;  
   rheology  
 stress concentration, 118–21, 119  
 stress curves, 103–5, 107  
 stress-dependent viscosity, 99  
 stress drop, 194  
 stress ellipse, 46, 53–55, 73  
 stress fields, 55–56, 146  
   around dislocation, 209, 209  
 stress intensity factor, 127  
 stress provinces, 58  
 stress shadow, 158  
 stress tensor, 44, 53–55  
   reduced, 57  
 stress trajectories, 55–56, 55, 191–92, 197, 198  
 stretching lineation, 290, 295  
 strike-parallel joints, 146, 465  
 strike-slip component, 169, 169  
 strike-slip faults, 169, 170, 172, 173, 188, 191, 197, 394, 410, 4126, 427–28, 440, 603, 605  
   in Alps, 511, 516  
   in Altaiids, 535, 544  
   in Andes, 579  
   block rotation in, 487, 488  
   causes of complexity in, 484–87  
   collisional margins and, 492, 493  
   in collisional tectonics, 436–38, 437, 492  
   continental tectonic setting of, 493–97  
   continental transform faults and, 496  
   in convergent plate margins, 426, 492  
   deep-crustal geometry of, 492  
   defined, 476  
   distributed deformation in, 482–84  
   distribution of, 476  
   duplexes, 492, 492  
   earthquakes along, 476, 477  
   fault bends in, 490–92, 491  
   in fold-thrust belts, 493, 493  
   fracture zones and, 497–98  
   in Midcontinent U.S., 620–21, 620  
   in North American Cordillera, 560, 560–64  
   oblique-convergent plates and, 493  
   oceanic transform faults and, 497–98  
   restraining bends along, 452, 452, 490–92, 491  
   in rifts, 495–96, 496  
   structural features of, 482–92  
   subsidiary structures and, 482, 483, 484–86, 485, 486  
   terminology of, 478  
   in Tibetan Plateau, 528, 530–33, 531, 532  
   transcurrent faults and, 481–82  
   transform faults and, 478–81, 479–81  
   transpression in, 487–88, 489  
   transtension in, 487–88, 489  
 strike-slip fault systems, 197, 197  
 strong cleavage, 277  
 strontium, 533  
 structural analysis, 8–12  
   categories of, 9  
   compaction and, 23–24  
   of diagenetic structures, 23–24  
   guidelines for, 10–12, 11  
   of penecontemporaneous structures, 24–25, 25  
   of salt structures, 26–30, 27–30  
   scale of observation and, 8–9  
   stratification in, *see* bedding  
   surface markings and, 18, 19, 19  
   terminology of, 10  
 structural grain, 465*n*  
 stylolites, 24, 24, 219, 219, 276, 480  
   tectonic, 276–77  
 stylolitic cleavage, *see* disjunctive cleavage  
 stylolitic pitting, 150  
 subcritical crack growth, 135  
 subduction, 356, 414, 429, 431, 449, 554  
   abortive, 433–34  
   in Alps, 510, 514, 521  
   in Altaiids, 536, 542, 544  
   in Andean Orogeny, 575–78, 579, 581  
   in Caledonides, 600–601  
   in Cascadia subduction wedge, 569–71, 570  
   epeirogenic movement and, 625  
   global rate of, 566  
   in India-Asia collision, 526–27  
   in North American Cordillera, 558–61, 564  
 subduction wedge, 568

- subduction zone, 358, 364, 414, 480, 498  
 accretion flux in, 566  
 wedge theory and, 567–68, 568  
*see also* Cascadia subduction wedge;  
 convergent plate margins
- subgrains, 224–25, 225, 226
- Submarine Plateau, 342
- subsidence, 476  
 in pull-apart basin, 492  
 in rifting, 397, 399, 401  
 thermal, 406
- substitutionals, 207, 207
- subsurface faulting, 189–90, 190
- successful rift, 358, 384
- Sudbury complex, 37
- Suess, Eduard, 535
- Supercontinent Cycle, 365, 366–67
- supercontinents, 355, 358, 358, 607
- superimposed strain, 69–70, 69, 265, 265
- Superior craton, 610–13, 612
- superposed folding, 252–57, 253  
 fold style and, 255–57, 257  
 interference patterns in, 253, 254–55, 254, 258  
 principle of, 252–54
- Suppe, John, 462*n*
- surface forces, 43
- surface lineations, 289–90, 290
- surface markings, 18, 19, 19
- surface rupture, 188
- suspect terrane, 440*n*, 558
- sutured domain, 276, 277
- sutures, 358, 506  
 in collision tectonics, 429–30, 432, 433, 440
- Svecofennian Orogen, 612
- S-vergence, 311
- S-waves (shear waves), 340, 341, 348, 350
- Syke, Lyle, 480*n*
- symmetrical folds, 248–49, 248, 257
- symmetric rift model, 385
- symmetry principle (Curie principle), 308–10, 309
- syncline, 241, 243, 243, 279  
 rollover, 388
- synclorium, 247–48
- syndepositional (growth) faults, 199, 389, 407
- synformal anticline, 243*n*
- synforms, 241, 243, 246, 248, 251
- synkinematic growth, 322, 323–24, 323, 324, 328
- synorogenic extension, 506
- syntaxial veins, 162, 163
- syntectonic strata, 389
- synthetic faults, 195, 388, 388, 390
- synthetic fractures, 301
- systematic joints, 144, 144, 149
- Taconic Orogeny, 582, 587–88, 591, 595, 599
- Taconic phase, 252
- tangential longitudinal strain, 264
- Tapponier, P., 531
- Tarim Basin, 529
- Tasmanides mountains, 503, 504, 553
- Tasman orogenic belt, 547–54  
 crustal structure of, 548–51  
 deformation timing in, 551–53, 552, 553, 554  
 Delamerian Orogen of, 548–49, 549  
 features of, 547–48, 547  
 Lachlan Orogen of, 548, 549–51, 549, 550  
 New England Orogen of, 548, 549, 551, 553
- tear faults, 454, 494–94, 494
- tectonic cleavage, 465
- tectonic collage, 440
- tectonic fabrics, 270, 271, 273, 292
- tectonics, 318  
 accretionary, 440–41, 441  
 collision, *see* collisional tectonics  
 defined, 336  
 intracratonic, 626  
 of mid-ocean ridges, 402–4, 403, 404  
 strike-slip, *see* strike-slip faults  
 terminology of, 386  
 thin-skinned, 459
- tectonic strain, 266*n*
- tectonic structures, 14
- tectonic underplating, 422
- “Tectonique de l’Asie, La” (Argand), 525
- teconites, 271–72, 272
- teconostratigraphic terranes, 566
- tectosphere, 351*n*
- temperature, 333  
 closure, 327–28, 328  
 of continental crust, 348  
 dislocation and, 211–12  
 ductile deformation and, 205, 211–12  
 flow and, 103–4  
 homologous, 205, 229, 258  
 metamorphism and, 319–22, 319, 320  
 quantification of, 315–22, 319, 320  
 temperature-time (T-t) history, 331
- tensile cracking criteria, 126–27
- tensile strength, 130–31, 136, 159  
 joint spacing and, 148–49
- tensile stress, 47, 127
- Tepla-Barremian Plate, 604
- terminal velocity, 142
- terrane, 506
- tertiary (accelerated) creep, 93, 93
- testable working hypothesis, 11
- Tethys Ocean, 525–27
- texture, 296, 307–8, 308  
 as shear-stress indicator, 310–11, 310
- texture goniometry, 293
- Thelon Orogen, 612
- “Theory of the Earth with Proofs and Illustrations” (Hutton), 2
- thermal boundary, 352
- thermally activated rifts, 408
- thermal subsidence, 406
- thermochronology, 329
- thick-skinned deformation, 459, 522
- thick-skinned system, 195
- thin-skinned system, 195
- thin-skinned tectonics, 459, 582
- Third Law of Motion, 46
- tholeiite, 550
- throw, 174, 176
- thrust fault, 173, 191, 197, 286, 294, 444, 484, 486, 528, 531, 532, 587  
 cross section image of, 452–54  
 inversion of, 449
- thrust-related folding, 445, 459–64  
 break thrusts and, 460, 461  
 detachment folding and, 462–64, 464  
 fault-bend folding and, 460–62, 461, 462  
 fault-propagation folding and, 462, 463
- thrusts, geometry of, 452–54
- thrust sheet paradox, 193, 193
- thrust sheets (thrust slices), 444
- thrust systems, 455–59  
 break-forward sequence in, 455–56  
 fold-thrust belt architecture and, 457–59  
 regional transport direction and, 456–57
- Tibetan Plateau, 400, 436, 438, 507, 525–33, 560  
 convergent plate margins and, 528–29  
 extension of, 532–33  
 global circulation patterns and, 533  
 postcollision deformation of, 527–30, 529  
 precollision history of, 525–27, 526  
 strike-slip faulting in, 528, 530–33, 531, 532
- Tien Shan Mountains, 438, 529, 544, 627
- tilt boundary (dislocation wall), 224, 224
- time:  
 and deformation dating, 328–29  
 D-P-P-t paths and, 329–31, 333, 333  
 growth gradient and, 331–32, 332  
 isochron equation and, 325–26  
 isotopic closure temperature and, 327–28  
 isotopic dating and, 325–27, 326–27  
 of mineral growth, 327–28, 328  
 terms and concepts related to, 317
- Tintina Fault, 380
- tipline, of fault, 177, 455, 462
- titanite, 319, 328
- Tonga-Kermadec Trench, 477
- Tonga Trench, 566
- topset beds, 18
- Tornquist Ocean, 593, 600, 604
- traction, 44, 54
- Transantarctic Mountains, 401, 401
- transcrustal extensional shear zone, 389
- transcurrent faults, 481–82, 483
- transecting cleavage, 287
- transfer faults, 394, 494
- transfer zone, 466
- transform faults, 357, 428, 431  
 in Altai, 542  
 continental, 497  
 at mid-ocean ridges, 497–98  
 oceanic, 402, 497–98  
 rifting and, 480, 481  
 strike-slip tectonics and, 479–81, 479–81
- transform plate boundaries, 356, 363–64
- Trans-Hudson Orogen, 371, 611
- transient (primary) creep, 93, 93
- transitional-tensile fractures, 131, 157
- transition zone, 340, 349
- translation, 8  
 defined, 7  
 rigid-body (RBT), 63
- translithosphere extensional shear zone, 389
- transmission electron microscopy (TEM), 221, 222, 276, 293, 293
- transposition, 281, 283, 505  
 criteria for recognizing, 312–13  
 fold, 311–13, 311, 312
- transpression, 177, 188, 306, 476, 487–88, 489, 495, 497, 542, 603, 604, 621, 625
- transpressional boundaries, 356
- transpressive duplexes, 492
- transtensive duplexes, 492
- transtension, 177, 188, 306, 476, 487–88, 489, 495, 497, 621, 625
- transtensional boundaries, 356
- transtensional faulting, 408
- transverse mountain range, 491
- Transverse Ranges, 452, 491, 496
- trenches, oceanic, 342, 356, 357, 415, 418–20, 420, 457, 535
- trench fill, 420
- trench-slope break, 424
- trend lines, 465*n*

- triangle zone, 457, 459  
 triaxial testing apparatus, 101–2, 102  
 triclinic planes, 308–9, 309  
 trilobites, 62, 63, 84  
   *olenellid*, 597, 599  
 triple junctions, 364, 364  
 trishear zone, 462, 464  
 trough, of fold, 240, 247*n*  
 turbidites, 17, 25, 70, 262, 397, 420, 420,  
   424, 432, 433, 535, 549, 587, 602, 611  
 turbidity flow, 17  
 Turkey, 438, 438, 492, 495  
 Tuross Point, 116  
 Tuva-Mongol Arc, 541–42  
 twin boundary, 213  
 twinning, *see* mechanical twinning  
 twist hackles, 144  
 Type 0 interference pattern, 254–55, 254  
 Type 1 (dome-and-basin) interference  
   pattern, 254–55, 254, 258, 313  
 Type 2 (mushroom) interference pattern,  
   254–55, 254, 258  
 Type 3 (refolded fold) interference  
   pattern, 253, 254–55, 254
- ultracataclaste, 181  
 ultramafic rock (peridotite), 31, 181, 339,  
   348, 349, 350, 351, 353, 372, 397, 425  
 ultramylonite, 297  
 unbalanced cross section, 468  
 unconformities, 2, 21–22, 21, 23  
   types of, 22  
 uncoupled convergent margins, 429  
 underplating, 472, 625  
   magmatic, 345, 398  
   metamorphic, 333  
   tectonic, 422
- uniaxial tension, 52  
 uniformitarianism, 2  
 United Plates of America, 610, 610  
 unroofing, 154  
   joints related to, 152–53, 152  
 unstable stress state, 130  
 unstable triple junction, 364  
 unsuccessful rift, 358, 384, 623  
 upbuilding, 29  
 uplift, 331*n*, 438, 442, 476  
   of Alps, 422  
   of Andes, 578–79  
   in inactive orogens, 347  
   isostatic, 92, 497  
   joints related to, 152–53, 152  
   long-lived rift-margin, 401, 402  
   in Midcontinent U.S., 618, 622  
   in North American Cordillera, 558–59,  
     561, 564  
   of Olympic Mountains, 572–73  
   plateau, 438  
   Poisson effect and, 152–53  
   in rifting process, 399–402, 400  
   of Tibetan Plateau, 529, 532, 533
- upper mantle, 340, 344, 349  
 upper plate, 389, 394  
 upper-plate margins, 408  
 Upper Silurian Rondout Formation, 21  
 upright fold, 244  
 upward-facing folds, 243  
 upwelling, 364, 365, 366, 367
- vacancies, 207, 207, 218, 220  
 Valais Ocean, 512, 521  
 Valley-and-Ridge Province, 251, 443, 459,  
   460, 582, 590  
 Variscan (Hercynian) Orogeny, 604  
 vector circuit, 363, 364  
 vectors:  
   defined, 53–54  
   for describing relative plate velocity,  
     361–64, 362, 363
- vein arrays, 159–64, 159–60  
 definition of, 159  
   *en echelon*, 160, 160  
   formation of, 160  
 vein-filled breccia, 181  
 veins, 116, 139, 139, 159–64, 219, 480  
   antitaxial, 162, 163  
   arrays of, *see* vein arrays  
   blocky, 160–61, 161  
 defined, 159  
   fault-parallel, 123  
   fault-surface, 123, 183–84  
   fibrous, 160–64, 162–63
- lineaments and, 163  
   syntaxial, 162, 163  
   terminology of, 159  
   vein fill, nature of, 160–62, 161–62
- vergence, 249, 249, 299, 311, 312, 315,  
   456*n*, 457
- Verne, Jules, 337  
 Victoria, Lake, 397  
 Viking Graben, 389, 391  
 viscoelastic behavior, 94, 97, 98  
 viscosity, 96, 204  
   buckling and, 260–61, 261, 262, 267  
   effective, 99  
   stress (strain)-dependent, 99  
 viscous behavior, 93, 94, 96–97
- volcanic arcs, 356, 414, 425, 426, 427–28,  
   428, 429, 433, 449, 492, 505, 527
- volcanoes and volcanism, 31, 35, 201,  
   356, 414, 425, 503, 527, 557, 570,  
   572, 575, 578  
   active-arc, 566  
   hot-spot, 359–60, 360  
   in North American Cordillera, 559–62  
   in North American genealogy, 610–11  
   rift, 398  
   in rifting, 399  
   sand, 19
- volume diffusion (Nabarro-Herring  
 creep), 217, 218, 218, 232
- volumetric strain, 70–71  
 Von Mises criterion, 130–31, 130
- Wadati, K., 417*n*  
 Wadati-Benioff zone, 200, 417–18, 418  
 Wales, 293  
 wall, of fault, 169  
 Wasatch Formation, 15  
 wavelength, 240–41, 240  
 wave splitting, 292  
 wavy cleavage domain, 276, 277  
 weak cleavage, 276–77  
 weak-fault hypothesis, 194  
 weathering, 16  
 wedge thrusts, 465, 465  
 Wegener, Alfred, 4, 355, 358, 364, 366,  
   428, 607
- welds, 27  
 well logs, 618, 619  
 Welsh Basin, 603  
 Western Canada Sedimentary Basin, 375,  
   375, 380, 380
- West Mariana Basin, 542  
 wet diffusion, 219  
 white mica, 278–79  
 whole Earth structure, 336  
 Wilson, J. Tuzo, 366, 478, 480  
 Wilson cycle, 366  
 Windmere Supergroup, 558  
 window (fenster), 173, 173, 454, 455  
 Wind River Fault, 370, 371  
 Wind River Thrust, 370  
 wing cracks, 123, 123, 127  
 Wopmay Orogen, 375, 376, 378, 611  
 work hardening, 106–7, 220–21  
 work softening, 106–7, 221, 227, 228  
 World Stress Map, 57–60, 58–59  
 Wrangelia, 440, 492  
 Wyoming craton, 610, 612–13
- xenoliths, 34, 234  
 Xianshuhe Fault, 530  
 X-ray goniometry, 86–87, 87
- Yellowstone National Park, 562  
 yield strength, 104, 124  
 yield stress, 99  
 Yilgarn craton, 613  
 Yosemite National Park, 146  
 younging direction (stratigraphic  
 facing), 17  
 Young's modulus, 94, 118, 127, 148, 149  
 Yule marble, 105
- zeolites, 159  
 zero-strain surface, 263  
 Zimbabwe craton, 613  
 zircon, 322, 327, 328, 603  
 Z-vergence, 311