

Subject Index

- Acadian Orogeny, 492, 494
Accretionary complex, Japan Trench transect, 120, 343, 399–400
Accretionary wedges, island arcs, 17, 116, 393–406
After Shocks (Focal plane solutions), *see* Seismic Activity
Alps, alpine, 7, 17
 Fault zone, New Zealand, 197–210, 211–22
 age, 206–7, 214, 215–7, 218, 219
 Cenozoic evolution, 207–8
 composite section, 199–202
 dip of, 203–5
 geological history, 212
 horizontal displacements, 212–3, 217
 minor structures affecting mylonites, 206
 ratios of horizontal to vertical displacement, 206, 212, 213, 217
 stretching lineations and slip-vectors, 205–6
 thermal effects, 218–21
 uplift rates, 211–8
 vertical displacements, 213
French, Ultra-dauphinois Zone, thrust faults, 329–35
Haute-Savoie, 159–65
Helvetic Nappes, 293–309, 319–27
 calcite tectonites, 151–8
Himalayan belt, 381–91
 megasuture, 15
 thrust faulting, 371–9
Maritime (France),
 amount of displacement, 339–43
 general stratigraphy and structure, 335
 gravity sliding, 335–52
 listric normal faults, 345–6
 minor structures, 343
 nappe emplacement, relationship with massif, 348–51
 nappe fronts, 343
 possible development, 347, 350
 stratigraphy above the Trias, 335–8
 structures above the Trias, 338–9
 time relationships, 346–8
 Tinee Nappe, 339
Schists, New Zealand, 202–10
 age data, 215, 217, 218
 Haast Schists, 213–5
 uplift rates and thermal structures, 215–22
Switzerland, 293–309
 similarity with Caledonides and Appalachians, 130
Amadeus basin, crystalline basement, 24
Ampferer (A) subduction, *see* Subduction, Ampferer, (A)
Andersonian faulting, 107
Andes, shortening mechanisms, 513–28
 basement shortening, 522–4
 cover shortening, 520–2
 geotectonic setting, 514–5
 structures of fold and thrust belt, 518–20
 tectonic history, 515–8
Antalya Complex, SW Turkey, wrench related thrusting along, 359–62
Appalachians
 basement relationships, 4, 17, 506–11
 COCORP profiles, 506–11
 cross section, 231, 494
 details of large thrusts and nappes, 99
 Orogen, North American, thrusts and nappes, 491–9
 New England and Maritime, 494–6
 Southern and central, 491–4
 Pine Mountain, 56–7
 similarity with Caledonides and Alps, 130
 southern, COCORP profiling, 506–11
Aquathermal pressuring, 36
Argentera Massif, 336, 338, 340
 gravity sliding, 335–2
 relationship with nappe emplacement, 348–51
 see also Alps Maritime
Arnaboll Nappe, 244, 247, 249, 250–51, 256
Assynt, maps, 248, 255, 279
 cross section, 249
 strain field, 283–5
 structures, 254
Asturias, Western, 353
Australasia
 Huon zone, 418–23
 margin collision zone, and Banda-Arc, large scale overthrusting, 407–16
 Neogene thrust emplacement, from frontal arc in New Guinea, 417–23
Autochthon Nappe, 294–309
Auvergne, 355, 356
Axen Nappe, 295, 297, 298, 319
c-Axis preferred orientations, *see* Crystallographic preferred orientation

B Subduction, *see* Subduction
Balanced Cross Sections, 16, 17, 428, 429, 432–40, 456–9, 479
Ballachullish slide, 261, 262
Banda Arc, 407–16
 overthrusting, geometrical problems and implications, 407–16
 Australian margin collision zone, 407
 Benioff zone, 408–13
 relation of crystalline basement, 413
 root-zone, 413
 and Sunda Arc, 414
Bannock Thrust, Wyoming, 99
Basal thrust faults, 83–6
 formation, mechanism, 107–8
 weakness, importance, 102
Basement domes and diapirism, 125–34
Basement relationships, 4, 7, 23, 125–134, 293–5, 413, 501–11, 513–27
 see also Massifs
Basement shortening, 2, 4, 17, 112
 Andean foreland fold belt, 513–28

- Basement shortening (*contd*)
 gravity spreading, 522
 folds produced by, 299
 mobilization 23, 27
- Basins
 Amadeus, 24
 associated with megasutures, 15
 back-arc, 467
 fore-arc, 518
 Pannion, 23
- Batholiths, 120
 Patagonian, 517
 Canadian Rocky Mountains, 441
 Mt Stuart, 485
 volumes of batholiths, 120
- Bearpaw Mountains, gravity gliding, 20
- Belt-Purcell Supergroup, 430
- Ben More Nappe, 247
- Bending resistance, 56, 57
- Benioff zone, collision tectonics, 408–13
see also Subduction
- Berinag Nappe, 383–6
- Birtavarre area (N Norway), 185–95
- Blind thrusts, *see* Thrusts, blind
- Blue Ridge, Appalachians
 crystalline basement, 23
 thrusts, 493
- Borrolan Complex, 246, 258, 275
- Bouguer gravity anomalies, 421, 433–5
- Boundary Conditions,
 stresses, 81–3, 89–90, 94, 100
see also Stress fields
- Brevard Zone, 493
- Bronson Hill, Gneiss domes, 131
 cross section, 132
- Calcite deformation mechanisms, 151–8
 dynamic analysis of twinning, 146–8
e-twinning, 157–8
 experimental deformation, 157–8
f-glide, 157–8
 graphical representation of texture, 153–5
 microstructure, 155–7
r-glide, 157–8
 x-ray texture goniometry, 151–3
- Caledonides, British Isles, map 268
 collision geometry, 269–72
 estimation of shortening, 267–74
 summary of features, 269
- Caledonides, E Greenland, estimation of shortening, 267–74
 summary of features, 269
- Caledonides, Scandinavia, 17
 basement cover relationships, 126
 buoyancy of sialic basement, 130–1
 dynamic effect, numerical test, 133
 Central Scandinavia, internal geometry of nappes, 225–34
 cross section, 232
 estimation of shortening, 267–74
 distribution of Nordland granites, 129
 Northern Norway, crystallographic preferred orientations, 185–95
 role of gravity, 125–40, 225–8
 similarity with Appalachians and Alps, 130
 spreading mechanisms, 134–9, 228
 mathematical equations, 135–9
 models, 134–9
 strain profile of major thrust fault, 235–9
 thrust faulting involving crystalline basement, 23
- Caledonides, Scotland,
 Moine Thrust, 241–60, 267–74, 275–92
see also Moine Thrust
- tectonic slides, 261–5
 features, 261–3
 formation, 264
 terminology, 263
- Caledonides, *see also* Appalachians
- Caledonian volcanism, ending of, 270–1
- Canadian Rocky Mts, 1, 427–48, 449–62, 475–82
 Foreland belt, 228–9, 427–448
 cross section, 229
 Front Ranges, 143–49, 449–62
 listric normal faults, 20, 143, 441, 443
 tectonic thickening, 113
 thrust progression, 33, 143, 228
- Canadian Rocky Mts, Northern, large ‘blind’ thrusts, 449–62
 blind thrusts, 452–6
 comparison with Southern Rocky Mountains, 460–1
 geological framework, 450–2
 palinspastic restorations, 459–60
 two representative structure cross-sections, 456–9
 Laurier section, 456–8
 Tuchodi section, 458–9
- Canadian Rocky Mts, Southern, structure, 428–30
 balanced structure sections, 432–40
 palinspastic restorations, 440
 tectonic models, 441–4
 tectonostratigraphic framework, 430–2
 times of deformation, 440–1
- Canadian Rocky Mts, South-east, metamorphic complex, and relationship to foreland thrusting, 463–73
see Foothills, Rocky Mountain
- Cantabrian Mountains, 353
- Cataclasites, *see* Deformation mechanisms: Fault rocks, cataclasites
- Central Crystalline Nappe (Himalaya), 387
- Cenozoic evolution of the Alpine fault zone, model, 207–8
- Cevennes-Rouergne, 354
- Chail nappe, 382, 386
- Chaman transform zone, tectonic setting, 363–4
- China megasuture boundaries, 14
- Clastic wedge sequence, west central Alberta, 475–6
- Clays, and décollement, 3, 50–1
- Cleavage variations through nappe pile, 301
- COCORP (seismic reflection profiling), 4, 501–11
 Central Appalachians, 17
 Southern Appalachians, 501–11
 Wind River Uplift, 501–6
- Cohesion, 34, 92
- Cohesive strength, 92, 101
- Collision tectonics,
 Andes, 513–5
 Australia and Banda Arc, 407–16
 Caledonides, 267–74

- Collision tectonics (*contd*)
 Canadian Cordillera, 428
 Chaman transform, Pakistan 363–9
 Geometric rules, 271–2
 Himalaya–Makran, 375–8
 Huon Zone, New Guinea, 417–23
 India–Central Asia, 25, 390
 Variscan Arc, 353–8
- Columbia, offshore seismic section, 16
 Columbia river fault, 44, 466, 468
 Contraction fault, definition, 8
see also, Faults, contraction
- Consortium for Continental Reflection Profiling, *see* COCORP
- Convergence zones
 Chaman, 363–9
- Cordillera
 Andes, basement shortening, 513–28
 N American, 15, 111–6, 427–48, 463–73, 480–90
 fluid push model, 116
 megasuture, 15
 orogenic belt, 111–2
 Canada, metamorphic complex, 463–73
 Southern Rocky Mountains, 427–48
 U.S.A., listric normal faults, 20–30
 West Washington, 483–90
- Coulomb, Navier–Coulomb failure criterion, 47, 51–3, 100
 Coulomb–plasticity, 86
 Crack–seal deformation, 3, 297–300
 Crete, W, 375, 376
 Crystalline basement, thrust faulting involving, 23–6
 Crystalline nappes
 Outer Banda Arc, 413
 Western Himalayas, 381–91
 central, 387
 outer, 386–7
- Crystallinity, Illite, *see* Illite crystallinity
- Crystallographic preferred orientations
 Lochseiten mylonites, 151–8
 obliquity of textures, 157, 188–93
 pole figures, 152, 153–57, 189, 190
 quartz strain and shear sense, Caledonides, N. Norway, 185–95
- Culminations, Scandinavian Caledonides 127–9
 Cumberland Thrust, 99
 Curly schist mylonites, New Zealand, 200
- Dalradian, tectonic slides, 261
 Damara Orogen, Namibia/SW Africa, saline horizons, 167–72
 Dasht-e-Byaz, thrusting associated with strike-slip fault, 371–3
 after-shock sequence, 372–3
see also seismic activity.
- Décollement, 3, 23–4, 337
 Java, 99
 3D propagation, 311–8
see also thrusts, rock mechanics
- Deformation mechanisms *see also* Faults and Thrusts
 cataclasis, 3, 107, 108, 193; New Zealand, 197–210, 215
 and rock mechanics, 108
 crack–seal 3, 297–300
 diffusion, 3, 108, 178, 253
 dislocation creep, 3, 253
 dynamic recrystallization, 3, 155, 157, 167, 168, 175, 178, 252
 grain boundary migration, 151–8
 grain boundary sliding, 3, 151–8, 175–9, 193, 253
 intra-crystalline gliding, 107, 155, 192
 mesoscopic, 185–8
 in miogeoclinal wedge, 113
 mylonites, 3, 107, 155, 167, 188, 193, 197, 202, 206–9, 215, 217, 251–4, 288–90, 505
 pressure solution, 134, 146, 178, 193, 253, 300, 301, 311, 316, 331
 in salt glaciers 173–83
 secondary faulting, 65–77
 thrust sheet, at ramp, 55–63
 in a trench 111
 twinning, calcite and dolomite, 146–8, 157–8
- Deformation paths, 157
 Dehydration reactions, 3, 264
 serpentinites, 107, 264
 Delémont basin, 311–15
 Deltas, deformation, 2
 gravity gliding, 19, 41–54
 model, 42–6
 processes, 46–51
see also Gravity gliding
- Denver earthquakes, 34
 Dévériculation, 226, 227
 Devonian–Mississippian shale succession, 452–4, 469
 Diabaig formation, 246, 255
 Diablerets Nappe, 295, 296, 301, 306
 Diapirism, 2, 125, 173–83
 basement, in orogens, 125–34
see also Caledonides, Scandinavia
 salt and shale, 19
 salt glaciers, and sliding, 173–83
- Dips, subduction zone, and trench deposits, 112
 fault-zone, New Zealand, 203–5
 of thrust belts, and associated subduction zones, 121
 of thrust planes, 85–6
- Discontinuities, low angle, and high pore pressures, 34–5
 and overthrusts, calculations, 35–6
 Dislocation fault model, elastic, 65–7
 clay and secondary faulting, 68–75
 photoelastic, 67–8
- Displacement Appalachians, 490, 509
 Canadian Rocky Mountains, 440, 459–60, 980
 Helvetic Nappes, 305–6
 Moine Thrust, 241, 258
 sequence, 61–2
 of thrusts, discussion, 5, 7
 vertical, 68–75
- Doldenhorn Nappe, 295, 297
 Dolomite, twinning, dynamic analysis, 146–8
 Dolomites, unconformity
see Unconformity Dolomites
- Domes
 Alps, Helvetic, 293, 294, 295
 de Barrot, France, 336, 337, 349

- Domes (*contd*)
 Frenchman Cap, Canadian Cordillera, 465
 Tso Moriri, Himalaya, 387–8
 Donegal, structures, 263
 Drusberg-Santis Nappe, 295, 297, 298
 Duplex, 320
 definition, 8
- Earthquakes, 34, 371–9, aftershock sequences,
 Iran, 371–3
 Denver, 34
see also Seismic activity
- Elastic dislocation theory, 65
 Elastico-brittle, 2
 Erosional surface, effect of, 58–63, 105
 Evaporites, 3, 35, 167–72, 311, 330, 335, 338, 346
 Expanding Earth, 14
 Extension fault, 8
 Externides, thrust sheets, 38
 Extrusion flow, 138
- Failure criteria
 Coulomb, 47, 51–3, 100
- Faults, *see also* Thrusts
 antithetic, 51, 74–5, 111
 contraction, definition, 8
 displacement along, Helvetic Nappes, 324–6
 displacement ratios, Alpine Fault, New Zealand,
 206
 extension, definition, 8
 growth in deltaic gravity slide, 19, 41–2, 52–53
 listric, normal, 20, 21, 48, 143, 441, 443
 Alps maritime, 339, 342, 345–6, 350–1
 definition, 7
 listric, reverse, 7, 228, 249–50, 339, 343, 344, 347,
 definition, 7
 Zagros, 373–6
 master, stress, causing secondary faulting, 68–73
 normal, 28, 50, 306, 309, 514–27
 reverse, 373–4, *see also* Listric reverse
 and rock mechanics, 99–109
 secondary, and deformation, 65–77
 and basal thrust faults, 83–6
 calculated vertical displacements, 67–8
 and maximum shear stress, 68–73
 photoelastic model, 67
 predicted displacements, 68–73
 trajectories, 72–3
 strike-slip, and overthrusting, 26–7, 79, 80, 267–
 74, 312–4, 316, 324, 325, 371–3
 and thrust interaction; Chaman transform zone
 363–70; Zagros, 371–9,
 Zagros fold belt, 371–3
 synthetic, 73, 74, 111
 tear
 lesser Himalayan, 386–7
 transform, 197–210, 363–70
 transverse (tear) Helvetic Nappes, 325–6
 wrench, 312, 316, 317, Antalya Complex Turkey,
 359–62
- Fault Rocks, 1, 108, 197–210
 Cataclasites, 108
 Alpine fault, New Zealand, 197–210
 structure and distribution, 197–210
 Loch Eriboll Scotland, 252
 Pseudotachylyte, 200, 201, 202
 strain profile, N Norway, 235–9
see also Mylonites: Deformation mechanisms
- Finisterre Range, thrusts and geological develop-
 ment, 418–23
 Finnmark, strain profile, major thrust fault, 235–9
 Fixists, discussion, 14
 Flathead area B.C., section, 25, 44
 Flats, 8, 55, 57, 114, 181, 298
 definition, 8
 Floor thrust, 8
see also thrusts
- Fluid
 inclusions, 168
 homogenisation temperatures, 168
 pressure, pore, 2, 3, 34–7, 41–54, 86–8, 100, 101,
 107, 115, 118, 254, 332, 351, 402, 405,
 482, 496
see also Pore pressure
 push model, 116–20
 applications, 119
 contrast with other models, 118–9
 driving stresses, 118
 examples, 119–20
- Focal Plane Solutions, 371–9
- Fold nappes, 1, 4, 228, 230, 298–9
 definition, 7, 8
 emplacement, Central Scandinavian Caledonides,
 225–34
- Foldbelts
 Andes, 513–528
 Appalachians, 491–9, 506–11
 Canadian Rocky Mountains, 427–48, 449–62,
 475–82
 tectonics, 13–32
 crystalline basement, 23–6
 external zones, compression and subduction,
 16–8
 Zagros, 371–9
- Foothills, Rocky Mountains, thrust nappes, 437–8,
 475–82
see also Canadian Rocky Mountains
 stratigraphy, 475–6
 structure, 476–9
- Foothills, Rocky Mountains, Dahlstrom's family of
 structures, 143, 145
- Force, buttressing, 50, 79
- Fore deep, 37, 228
 Andes, 518, 520
 Banda Arc, 412
 generation of, 37
- Foreland tectonics, 24–5, 228–9, 241–60, 427–48,
 449–62,
 Appalachians, 491–9
 and fold belts, Andes, 513–28
 and metamorphic complex SE Canadian Cordill-
 era, 463–73
 Moine Thrust zone, 241–60
- Northern Canadian Rocky Mountains, 449–62
 Southern Canadian Rocky Mountains, 449–62
 thrust belts, N America, 111–2, 427–48, 491–9

- Foreland tectonics (*contd*)
 emplaced by sliding, spreading or pushing, 114–5, 228
 tectonic thickening, 113–4
- Franciscan terranes, balanced section techniques, 17
- French Massif central, nappe and thrust tectonics, 354–8
- Friction, angles, 43, 86–7
 coefficient, 86–7
- Frictional heating, 3, 163–5, 170, 218–21
see also Shear heating
 sliding and thrust mechanics, 115
- Frictional plastic behaviour, 86–7
- Front ranges, Canadian Rocky Mountains, dynamic analysis, 143–9
 Northern Canadian Rocky Mountains, 449–62
- Gaissa Nappe, 235, 236
- Galicia, eastern, 353–4
 western, 354
- Gellihorn Nappe, 295, 297
- Glacier
 flow analogy, 100, 105, 114, 115, 134, 138, 289
see also Gravitational spreading
 salt, S.Iran, sliding and deformation mechanisms, 173–83
- Glarner Nappe, 297, 301
- Glarus, Nappe, 3, 4, 319–21
 thrust, 35, 85, 86, 99, 102, 107, 151–8, 319–20, 324
 microfabric of calcite tectonites, 151–8
- Glencoul Nappe, 247, 248, 254, 255, 280–3, 286–90
 differential movement of imbricate faults beneath, 285–86
- Gneiss domes, 130, 131, 132, 463, 464–5
 granitoid, domes within, Bronson Hill Antichlorium, 131
- Gneissic salt, 174–83
see also Lewisian Gneiss
- Goshute Valley Nevada, Seismic section, 25
- Graben faults, 51, *see also* Rhinegraben
- Grain boundary migration, 151–8
 cleavage slip, 178
 diffusion, 178
 mechanisms, 175–9
 pressure solution, 178
 recrystallization, 178
 tensional failure, 178
- Granites, Nordland, 126, 271
 age determinations, 126
 buoyant layer, model, 133
 distribution, 129, 133
 spreading models, 134–9
- Granulation, 107, 108, 175, 176, *see also* Deformation mechanisms
- Gravitational spreading, 2, 18, 114, 115, 117, 119, 134–9, 175, 181, 228, 231, 289, 443–4, 522
 Canadian Rocky Mountains, 443
 model calculations, 135–139
 Scandinavian Caledonides, 228, 231
 S Andean Cordillera, 522
- Gravity anomalies, 421, 433–5
- Gravity gliding, 1, 2, 18, 41–54, 103–4, 126, 135, 225–8, 335–52, 493, 496, 522
 in deltas, 41–54
 model, 42–6
 development of diverticulation phenomenon by, 227
- foreland thrusts, 114
 and imbrication, 94–5
 role in orogenic belt, 125–40
see also Caledonides
- Maritime Alps, 335–52
see also Alps Maritime
- process, 46–51
 calculations, 47–9
 limit states, 46–7
 rate, 51
 slope pressure, 50
 syndimentary, 50, 53
 and rock mechanics, 103–4
 up-slope movement, 102–3
- of sedimentary sequences phenomenology, 18–23
- S Andes, 522
- structures produced, 50–1
- tectonics three types
 collapse and spreading, 126
 diapirism, 126
 gliding, 126
see also Gravitational spreading
- Grenville Orogen, 245, 246
- Growth faults, *see* Faults
- Gulf coast, U.S.A., 19–23
- Gulf of Mexico, gravity gliding, 19
- Haast Schist Group NZ, 199, 211–22
- Haute Provence, 337, 338–9
- Haute-Savoie, France
 metamorphic transformations, 159–65
- Heart Mountains, gravity gliding, 20
- Heart Mt. thrust, 1, 20, 102
- Hercynian
 high-level structures, 1
- Hellenic trench, 378
- Helvetic Nappes, 3, 151–8, 293–309
 calcite tectonites, 151–8
 tectonics, 293–309
 distribution of major nappe units, 294–7
 map, 295
 cleavage, 301
 faults, 306, 309
 finite strain, 300
 fold and thrust tectonics, E. Switzerland, 319–27
 movement direction of thrust sheets, 324–5
 principal stratigraphic features, 297–8
 small scale structures, 299–309
 tectonic vein features, 303–6
 transverse faults, 325–6
 variations, control of tectonic features of, 298–9
- Himalaya, Himalayan, 381–91
 Alpine-Himalayan active thrusting, 371–9
 Western, thrusts and nappes, 381–91
 lithostructural zones, 384–5
 structural history, 386
- Hormuz salt, *see* Salt

- Hubbert and Rubey theory, 34, 35, 37, 100, 102
- Huon Zone
 geological development, 418–23
 continent-island arc collision, 418–20
 Finisterre Thrust, 420
- Iapetus
 Ocean, 271, 496
 Suture, 268, 270, 272
- Ibero-Armorican Arc, plate tectonic interpretation, 353–8
- Idaho-Wyoming thrust belt, 148, 170
- Illite crystallinity(ies), 159–63, 167, 168, 170
- Imbricates
 accretionary model, 393, 399
 Antalya complex, 359–62
 Glencoul Nappe, differential movement, 285–6
 Loch Eriboll (Moine Thrust Zone), 249–50, 276–9
 lower, 249
 upper, 249–50
 Moine Thrust Zone, 249–51, 254–5, 276–9, 285–6
 thrusts and fold in lower Glarus Nappe complex, 319–21
 and thrust sheet gliding, 80, 94–5
 Trench, Japan, 393
- Indus-Tsangpo suture, thrusts and nappes, 384, 388, 390
- Infrahelvetic complex, 297, 301, 319
- Ingalls complex and Navaho Divide fault zone, 483–6
- Intercutaneous structures, 335–52
- Inverse pole figures, calcite tectonites, 153
- Ionian sea, active faulting, 373
- Iran
 earthquakes, 371–3
 evolution of Zagros fold belt, 371–9
 salt glaciers, 173–83
- Isostatic adjustment, 2, 37, 441
- Japan trench transect, seismic data, 393–406
- Java Trench, seismic section, 16
- Jotun Nappe, 14, 126
 displacement, 17
- Jungbwa, ophiolite melange and ultrabasic nappes, 388–90
- Jura
 fold belt, 35, 99, 311–8
 3D propagation of décollement, 311–8
 regional generalization, 316–7
 Rheintal Jura, Delémont basin, 311–6
- Jutogh Nappe, 386
- Kalak Nappe, crystallographic preferred orientation of quartz, 185–95
- Kashmir-Chamba Parautochthon, 387
- Khurgu earthquake, 377
- Kiakoura Orogeny, 199, 212
- Kinlochewe Nappe, 247–8, 254
 map and cross section, 250
- Kiogar, ophiolitic melange and ultrabasic nappes, 388–90
- Kishorn Nappe, 247–8
- Klippe, 494
 definition, 8
- Kootenay Arc, 433–6, 441–3, 464–5
- Krol-Berinag Nappes, 383–6
- Kuh-e-Nanak (Dashti) Iran, sliding and deformation mechanisms in salt, 173–83,
- Lac des Arcs Thrust, dynamic analysis, 143–9
- Laccoliths, comparison with fold nappes, 4
- Ladakh, ophiolitic melange and ophiolite nappe, 388
- Lags, 181, 261
- Laksefjord Nappe, crystallographic preferred orientation, 185–95
 strain profile, 235–9
- Laramide, decoupling zone, 24
 Orogeny, 501
- Lateral shortening—rate, 280–3
- Laubscher theory, 35
- Lesser Himalaya, 382, 383, 384, 386
- Lewis Thrust (Canadian Rocky Mountains), 99, 429, 441
- Lewisian thrusts, 248
 gneiss, 241, 242–5, 280
 mylonite, 252–3
see also Mylonites
- Listric
 normal faults, 8, 20, 41–2, 143, 279, 339, 342, 441
 Alps Maritime, 339, 342, 345–6, 347, 350–1
 shear zones, 179, 182, 277, 279
 reverse faults, 7, 249–50, 343
 Andes, 520
 definition, 8
see also Faults, listric
- Loch Eriboll, Moine Thrust, 244, 248–54, 276, 277, 278
 variations in shear strain, 276–80
- Lochalsh, structures, 254–5
- Lochseitenkalk, 3, 35, 297
 mylonites, 151–8
- Longitudinal strains, 280–3
- Lopez fault zone, 486–8
 structural setting and displacement history, 487–8
- Louisiana, onshore seismic section, 22
- Low-angle discontinuities and high pore pressures, 34–5
- McConnell Thrust, 99, 105, 119, 143–9, 441, 476–82
 dynamic analysis, 143–9
 geological setting, 143–6
- Macroscopic ductility, 2
- Makran, 363–9
- Markansu Valley earthquake, aftershock sequences, 371–3
- Massifs, 130, 159–65, 293, 294, 295, 298, 320, 329, 335–52, 353–5
See also Plate: Argentera: French Massif Central
- Mathematical models
 deformation at a ramp, 55–63
 fault, based on elastic dislocation theory, 65

- Mathematical models (*contd*)
 fluid welt model, driving force, 116–9
 gravitational gliding in deltas, 43–51
 gravitational spreading, 133–9
 nappe deformation, 236–8
 stress in thrust sheet gliding, 81–3
 thrust blocks, 99–109
- Megasuture
 Mesozoic Cenozoic, 14, 15, 27
 associated basins, 14–5
 foreland thrust belts, N America, 111
 distributions, 113
 types of boundaries, 14–5
see also Sutures
- Melange
 Kiogar and Jungbwa, 388–90
 Ladakh, 388
- Mesozoic-Cenozoic megasutures, *see* Megasutures
- Mesozoic-Cenozoic continental margin, wrench related thrusting along, 359–62
- Mesozoic fault zones, W. Washington, 483–90
- Mesozoic foreland thrust belts, N. America, 111
 distribution, 113
- Metamorphic complex of SE Canadian Cordillera, 463–73
- Metamorphism
 inverse gradients, 126, 163–5
 Platé Massif, Haute Savoie, 159–65
see also Shuswap Metamorphic complex
- Mississippi, off-shore seismic sections, 20, 21
- Mohave Desert Thrust, 113, 114, 119
- Mohr circle analysis, 34, 45–8, 50, 87, 88, 97, 100
- Mohr circle, pole to, 46, 97
- Moines, 245
- Moine Thrust, zone, 4, 241–60, 275–92
 Cambro-Ordovician sediments, 246
 differential movements and transport direction, 257
 evolution, 256
 fold axes in thrust zones, 287–9
 Lewisian Gneiss, 242–5, 252–3
 lithological characteristics, 245
 mylonites, 251–4, 288–90
 nappe, 4, 248, 249, 251–2
 post-Cambrian intrusives, 246
 regional structure and orogenesis, 246–7
 strains, shear, causes, 280–3
 Assynt area, 283–5
 differential movements of imbricate faults, 285–6
 stratigraphy and structure, 241–60
 structures, 247–55
 thrust stacking sequence, 256
 Torridonian, 245–6
 variations in shape of finite strain ellipsoid, 286–7
 variations in shear strain, 276–80
- Monashee Mountains, 464, 465
- Montagne Noire, 354
- Morcles Nappe, 151–8, 294, 295, 296, 300, 301, 302, 305
 calcite tectonites, 151–8
- Mountain Park, Alberta, 475–82
- Mt. Fable, thrusts, 147
- Muddy Mt. Thrust, 99
- Mürtschen Nappe, 295, 297, 319, 320, 321–4
- Muskwa Anticlinorium, 450, 451
- Mylonites, 3, 107, 151, 155, 167, 188, 193, 197, 202, 215, 217, 251–4, 288–90, 505
 fault rocks, New Zealand, 197–210, 214
 age, 206, 215–7, 219
 curly schist, 200, 202
 interpretative model, 207–8
 minor structures affecting, 206
- Helvetic Nappes, 151, 297
- Lewisian, 243
- Lochseiten, 151–8
- Moine Thrust Zone, 244, 248, 252–4
 deformation mechanisms, 253–4
 folding, 252
 Lewisian, 252–3
 Moine, 253
 origin, 257
 quartzite, 252
- Unconformity Dolomite, Damara Orogen, 167
- Nappe, definition, 7–9
- Navier-Coulomb failure criterion, *see* Coulomb
- Navaho Divide fault zone, 483–6
 displacement, 486
 serpentinite matrix, 484–6
- Naukluft nappes, saline horizons, 167–72
- New Guinea, Papua
 Neogene thrust emplacement from frontal arc, 417–23
- New Zealand, Alpine Fault Zone, 197–210
- Newtonian viscous, models, 2, 55–63
- Niger Delta gravity gliding, 19, 41
- Nordland granites, Scandinavian Caledonides, 127–8
- Numerical dynamic analysis, 143–8
- Obduction, 358
- Oblique slip element, Chaman transform zone, 366
- O.D.F. calcite tectonites, 154
- Off-scraping, Japan Trench transect, 393
- Ophiolites, 13, 99, 483, 494
 fault complexes Washington USA, 483–93
 melange and nappe, Ladakh, 388
 Kiogar and Jungbwa, 388–9
- Orientation distribution function, ODF, 153–4
see also Crystallographic preferred orientation
- Orogen
 Caledonide, 246–7, 267–74, 275
 diachronism and oblique collision, 269–70
 estimation of shortening, 267–74
see also Caledonides
 Damara, *see* Damara Orogen
 Laramide, 501
 New Zealand, 197, 199, 211–22
 North American Appalachian, 491–9
 S Andes, 515
- Orogenic belt
 idealized, 111
 weak zones, 116

- Orogenic belt (*contd*)
 Moine Thrust Zone, 246–7
 role of gravity, 125–40
- Outer crystalline nappes, Himalaya, 385, 386
- Overthrust,
 Banda Arc, 407–16
 definition, 7–9
 mechanics, 2
 Haute-Savoie, 159–65
see also Thrust
- Pakistan, Chaman transform zone, tectonic setting, 363–4
- Palinostic restorations, 440–2, 459–61, 520, 521
- Palwan trench, seismic section, 16
- Papua-Ophiolite thrust, 99
- Pelvoux massif, 329, 330
- Penninic Nappes, 293
- Perfect plastic, model, 2
see also frictional plastic
- Photoelastic model, thrust faulting, 67–8
- Physical models,
 clay, 3, 68–75
 and secondary faulting, 68–75
 silicone putty, 136
 photoelastic, 67–8
 wax, 114
- Piedmont, 493–4
- Pine Mountain
 thrust sheet deformation, 55–63
 results, numerical consequences, 56–7
- Plasticity, models, 79–80, 86–88
- Plastico-viscous theory, 35
- Plate tectonics, 27–8, 199, 267–74, 358, 363, 365–9, 390, 393–406, 483, 514–5
 Canadian Cordillera, 427–8, 441–4, 469–471
 convergence, 270
 Japan Trench transect data, 393–406
 movements, Caledonides, 267–74
 tectonic reconstructions, 27–8
 Variscan Arc, W. Europe, 358
- Platé Massif, 159–65
- Poisson's ratio, 66, 117
- Pole figures, calcite tectonites, 152
 discussion of, 153–7
 quartz, 189, 190
- Pore pressure, 2, 3, 34–7, 41–54, 86, 87, 88, 100, 101, 107, 115, 118, 254, 332, 351, 402, 405, 482
 and basal layer weakness, 102
 control of step-bedded plane thrusts, 87–8
 discontinuities and overthrusts, calculations, 35–7
 high fluid, subduction zones, 115
 high and low angle discontinuities, 34–5
 hydrostatic, 43
- Post-Cambrian intrusives, Moine Thrust Zone, 246
- Prandtl's solution, 82
- Precambrian plate remnants, preserved, 28, 29
- Pressure, fluid *see* Fluid Pressures
 pore, *see* Pore pressures
- Pressure solution, *see* Deformation mechanisms
- Pseudotachylyte, 200, 201
 age data, 218
 distribution, New Zealand, 202–3
 fault/injection vein complex, 200
 friction melt, 200
 flow banding and spherulite devitrification texture, 200–1
 localities (N.Z.), 198
 Purcell anticlinorium, 430–1, 436, 440–4
 Push from rear (behind), 2, 101
 fluid welt model, 111–124
- Ramps, 8, 55–63, 106–7, 114, 179–81, 298, 316, 320, 324, 325, 339, 343
 Alps Maritime, 350
 definition, 8
 generation zones in salt glacier, 179–81
 rock mechanics, toe affects, 106–7
 thrust sheet formation, 55–63
 mathematical model, 55–6
 Pine Mountain block, 56–7
 principal stresses, 57–63
 Rangitata Orogeny, 197, 202, 212, 214–7
 Recrystallization, salt, 178
see also Deformation mechanisms
- Reversed metamorphic gradient, 126, 159–65
- Rheintal Jura, 311–317
- Rhinegraben, 311, 312, 313, 316
- Roberts Thrust, 99
- Rock mechanics of thrust and nappe formation, 3, 4, 99–109
see also Thrusts
 basal thrust fault, formation, mechanics, 107–8
 crustal thickening, 106–7
 deformation of thrust block, 105
 degree of rigidity, 100
 details of large thrusts, 99
 forces causing movement, 99
 forces resisting movement, 99
 gravity gliding, 103–4
 moving up-slope, 102–3
 propulsion of block from rear, 101–3
 ramping, 106–7
 stability of thrust block calculations, 100–1
 toe-effect, 49–50, 57–58, 106–7
 wedge-shaped block, 104, 114–9
- Rocky Mt. Trench, 433, 437
 strike-slip faulting, 26
see also Canadian Rocky Mountains
- 'Roll-over' Anticlines, 51, 52
- Roof thrust, 8, 244, 249, 250, 320
- Rossherg-Goldau slide, 99
- Roya Nappe, 339, 341, 343–6
 amounts of displacement, 339–43
 listric normal fault, 339
- Saline horizons, Damara orogen, 167–72
 Naukluff Nappes, 167–72
- Salt diapirs
 Hormuz formation, S. Iran, 173–83, 377
- Santis Nappe, 297, 319, 320
- Scandinavian Caledonides—Central
see Caledonides, Central Scandinavia
- Scotland, NW Highlands
 Moine Thrust Zone, 241–60

Scotland, NW Highlands (*contd*)

see also Moine Thrust Zone

Seismic activity, 371-9

aftershock sequences predicted, 75-6

Dasht-e-Byaz, 371-3

Ghir, 376

Khurgu, 377

Markanzu Valley, 371-3

Seismic reflection studies (*see also* COCORP)

ambiguity in data interpretation, Japan Trench, 309-406

Seismic Sections

Canadian Rockies, 431

Goshute Valley Nevada, 25

Offshore Mississippi, 20, 21

Offshore Texas, 22, 23

Onshore Louisiana, 22

Selkirk Mountains, 464, 465

Seram collision tectonics, 408-13

see also Banda Arc

Seve Nappe, 126, 135

Sevier belt, Utah, 112, 120

Shali-Deoban Parautochthon, 382-3

Shear

formation, 107

friction resistance, 3

heating, mylonite rocks, New Zealand, 208, 218-21

reverse, Alpine Fault, New Zealand, 205-6

simple stress, 61, 136, 185, 190-1, 236-8, 249, 255, 300, 329, 331

Caledonides, N Norway, 185-95

Strain Profile, 235-9

strains, *see* Strain

strength, 43, 56, 61, 84, 101-3

stress distribution and secondary faulting, 68-73

stresses, and rock mechanics, 3, 35, 81-9, 99-109

model, 230

Sheath folds, 288

Shortening in thrust belts, 17

Shortening layer parallel, strains due to, 249, 280

differential movement of thrusts, 280-3

see also Basement shortening

Shuswap metamorphic complex, 230, 435, 443, 444, 463-73

basement, 464-5

structural elements, 464

tectonic history, 467-9

Skye, structures, 254-5

Slides

see also Tectonic slides

Frank, 34

Grand Bank, 119

land, 34, 108, 261-5

in salt glacier, S Iran, 173-83

flats, 181-2

listric normal shear zones, 179

ramp generation zones, 179

sole thrust, 179

Ranger, 119

Sgurr Beag, 242, 246

submarine, 42

tectonic, Caledonides, 261-5

viscous, and subduction, 115

Slip

lines, 83-4, 96-7

rates, of faults, 51

vectors, 198, 205

Soft-sediment deformation, 2, 18-23, 41-54

Solomon Sea, geology, 422, 423

Southern alps, New Zealand, 211-22

see also Alps, New Zealand

Southern Canadian Rockies, 7, 428-41

gravity gliding, 20

see also Canadian Rocky Mountains

Spain, Northern, cross-section, 353-7

Stacking, sequence, 61, 63

Moine Thrust, 241, 256-7, 275

Strain, 42, 136-9, 157, 185-95, 249, 255, 264, 275-92, 281-4, 300, 321, 331

ellipsoid, 188, 264, 281-4, 286, 287, 321

finite, 236-9, 264, 300, 301, 321

Flinn Plot, 238, 288

in glacier salt, 178

longitudinal, 280-3, 289

model calculations, 136-9

paths, deformation paths, 157

plane, 42, 276

release by faulting, 371-9

shear, associated with, 135, 185-95, 249, 276, 280-5, 287-8, 289

Caledonides, N. Norway, 185-95

profile, 235-9

Moine Thrust, variations, 249, 255, 276-9

Assynt area, 276-90

due to layer parallel shortening, 249, 255, 280-3, 287-8

due to differential movement of thrusts, 280-1, 288

softening, 107

Stress

compressive, 88-94

applied in subduction zones, 114-5

differential, 103, 144

effective, 43-4, 46, 86-94

solution for high buttressing stress, 94

fields, 66, 81, 82

in incompetent substrata, 83-88

normal, 43-4, 46, 81

overburden, 46

principal, 57-8, 81

shear, 44, 46, 55-61, 119

distribution and secondary faulting, 68-73

horizontal, 85-92

tensile, 101

trajectories, 68, 71, 90, 92, 93

within thrust sheet, 57-60, 230

yield, 117, 119

see also Coulomb

Strike slip faults

and thrust interaction, 80

Chaman transform zone, 363-70

thrusting associated with, 371-3

Stylolites, 134, 146, 300, 311

Subduction,

Ampferer, (A), 14, 15-8, 28-9, 444, 513-4

Benioff, (B), 14-8, 28-9, 357, 358, 361, 390, 393, 407-16, 418-23, 444, 463

Subduction (*contd*)

- Caledonian, 268–71
- and coeval thrust belts, N. America, 111–24
- dips, and associated subduction zones, 121–2
- directions, finding, 111
- fluid push model, 116–9
 - application, 119–20
- foreland thrust belt, 112–3
 - emplacement, 114–5
 - tectonic thickening, 113–4
- Indonesia, Banda Arcs, 409–16
- Japan Trench transect, 393–406
- Makran convergence zone, 365–8
- New Guinea, Huon zone, 418–23
- North American Cordillera, 111–2, 463
- Orogenic belt, idealized, 111
- space problem, 120–1
- thrust mechanics, 115–6
- trench deposits and subduction zone dip, 112
- Variscan, 357, 358
- Sub-grain rotation, 155, 175
- Subsidence rate, 45
- Sunda Arc and Banda Arc continuity, tectonic significance, 414
- Suture, Iapetus, 268, 269
- Suture, Variscan Arc, W. Europe, 353–8
 - see also* Megasutures
- Syntectonic recrystallization, 3, 155, 157, 167, 168, 178
 - see also* Deformation mechanisms, Dynamic recrystallization
- Taconic Orogany, 492
- Taconic Thrust, 102, 493
- Taiwan, fold belt, 26, 27
- Tarskavaig Nappe, 248
- Taveyanne Sandstones, reversed metamorphic gradient, 159–65
- Tectonic Loading, 33, 35–7
- Tectonic Slides, 8, 242, 246, 261–5, 443
 - Caledonides, 242, 246, 261–5
 - definition, 8
 - features, 261–3
 - formation, 264
 - terminology, 263
- Tectonic vein systems, 303–6, 332–4, 400, 402–4
- Tensile failure, 101, 178
- Texas, off-shore, seismic sections, 22, 23
- Texture
 - see* Crystallographic preferred orientations
- Thermal effects of faulting, 3, 159–65, New Zealand, 208, 218–221
- Thin-skinned tectonics, 112–3, 143, 241, 256–7, 338–52, 427–48, 449–50, 461–2, 491–9, 506–11
- Thrust
 - Appalachians, 56–7, 99, 231, 491–9, 506–11
 - back limb, 33, 503
 - Banda Arc, 407–16
 - 'Blind' thrusts, 8, 225, 449–62, 492
 - definition, 8
 - Northern Canadian Rocky Mountains, 449–62
 - block, 2, 3, 99, 100–3, 104, 105, 106, 116, 117, 231
 - mechanics, 100–7
 - see also* Gravity gliding: gravity spreading: mathematical models: wedge
 - Caledonian, 17, 125–40, 185–95, 225–34, 235–9, 241, 257, 258, 267–74
 - Canadian Rocky Mountains, 143–9, 427–48, 449–62, 475–82
 - contraction, fault, definition, 8
 - direction of progression, 33, 113, 228, 241, 256–7
 - emplacement model, 116–20
 - Hellenic arc, 373
 - imbricates, 80, 94–5, 249–51, 254–5, 276–9, 285–6, 319–21, 359–62, 393, 399
 - internal geometry, 225–34
 - models, 43–51, 55–63, 65–75, 79–98, 99–109, 116–9, 133–9, 236–8
 - Moine Thrust Zone, 241–60, 261–272, 275
 - Pine Mountain block, 56–7,
 - Sole, 3, 179, 241–60, 261–72
 - strain profile, N. Norway, 235–9
 - stresses, 3, 57–8, 88–94, 99–107
 - subduction, relationships, 115–6
 - see also* Subduction
 - transport directions, 33, 113, 148, 185, 324–5
 - toe, 36, 49–50, 57–8, 106–7
 - velocity, 33
 - wedge, 2, 3, 104, 105, 117, 118, 231
 - Zagros, 373–7
 - see also* particular regions e.g. Helvetic Nappes, and individual names
- Tierra del Fuego, fold belt, 520
- Timor, trough, 413
 - see also* Banda Arc
- Tinée Nappe, 337, 339, 344
 - amounts of displacement, 339–43
 - gravity sliding from massif, 348–52
 - listric normal fault, 339, 342, 345–6, 350–1
 - main tectonic units, 339–43
 - minor structures, 343
 - nappe fronts, 343–5
 - possible development, 347, 350
- 'Torridonian', 245–6, 251, 255
 - Stoer group, 246
 - Torridon group, 246
- Traction, *see* Frictional Resistance
- Transform zone, Chaman, 363–70
- Transpression, 267, 269, 486
- Trench
 - deformation, 111
 - deposits, 112
 - Hellenic, 378
 - Java, 16
 - Palawan, 16
- Triassic Dolomites, 321–4
 - Alps Maritime,
 - displacement along faults, 324–6
 - Stratigraphy and structures, 335–9
- Tso Morari Dome, 387–8
- Twinning
 - Calcite, 157–8, 143–9
 - Dolomite, 143–9
 - see also* Deformation mechanisms
- Underthrusting 393, 399, 410
 - see also* Accretionary complexes

- Ultraaaphinois thrust nappe, faults, 329–35
 ductile deformation and fabrics, 331
 direction of movement of thrust sheets, 329
 inhomogeneous deformation zone development, 331–4
 relation of thrust belt to regional nappe structure, 329–31
- Ultrahelvetic nappes, 226, 227, 295, 296, 297, 299
- Unconformity Dolomites, 167–72
 fluid inclusions, 168
 petrography, 167–8
- Uplift rates, Alpine fault zone and schists, New Zealand, 211–22
- Valley and Ridge Province, Appalachians, 99, 231, 492–3
- Variscan Arc, W Europe
 sutures, thrusts, nappes, 353–8
- Veins, extension, 303
 shear, 303–6
 systems tectonic, 303–6, 332–4, 400, 402–4,
- Viscosity doubling, in thrust sheet deformation, 58
- Viscous, *see* Newtonian-viscous
- Volcanism, Caledonian diachronous ending, 270–1
- Von Mises yield criterion, 81, 83
- Washington, Western, two Mesozoic fault zones, deformational styles, 483–90
- Wedge, accretionary, 16, 114
 rates of accretion, 120
 sedimentary, and high pore pressures, 37
 shaped block, rock mechanics, 104
 foreland thrust belts, 112–3
 supracrustal, Canadian Rocky Mountains, 429–30
 see also Accretionary complex: Thrusts
- Welt, fluid, 116–20
 applications, 119
 contrast with other models, 118–9
 driving stresses, 118
 idealized model, 117
 possible examples, 119–20
- Wildhorn Nappe, 295, 296, 297, 299, 301, 302, 303, 304, 306
- Wildstrubel depression, 294, 296, 297
- Wind River Thrust, 7, 24, 26, 501–6
- Windermere Supergroup, 430–1
- Wrench related thrusting, Antalya complex, 359–62
- Wyoming Rockies *see* Wind River
- X-Ray texture goniometry, 151–3, 190
- Zagros, Southern, 99
 fold belt, active thrusting and evolution, 371–9
 evolution, 375–7
 high-angle thrust faulting, 373–5