

Index

Figures are shown in *italics*; tables in **bold**

- accretion 307
- accretion wedge 132, 189, 286, 330
 - Apennine 421, 429, 430, *431*, 432, 433
- actinolite 290
- Adriatic (Apulian) Plate 5–36, 134, 146, 157, 403
- Adula nappe 4, *264*, 266–271
 - deformation 377–383
 - lithology and structure 369–371
 - petrology 371–377
 - Tertiary subduction 365–387
- age data 2, 8, 9, 70
 - Austroalpine basement **14–17**, 27
 - Carpathians 103–106
 - Rieserferner pluton 29
 - Tauern Window 94–97
- age of deformation
 - Dinarides 353–354
 - Monte Rosa nappe 265–266
 - Valstrona di Omega 46, 48, 54, 59–61, 62
- age of magmatic rock–suite 12–13
- age of metamorphism 424
- age, nanofossil **337–339**, 348, 350
- age, petrology and isotopic age 117–136
- age, Eocene–Miocene revised 335–359
- Ahorn shear zone 199–204, 206–216
- Ahrntal Fault 199, 214
- ALCAPA *see* Alpine–Carpathian–Pannonian unit
- Alpine Austroalpine–Penninic suture 8
- Alpine deformation phases 211
- Alpine Tethys 219
- Alpine–Carpathian–Pannonian unit 169, *170*, 282
 - convergence 317–332, *333*
- amphibolite 373, 375, 382
- amphibolite facies 23, 263, 265, 267, 397, 401
- analysis, nanofossil 340–347
- analytical data
 - white mica **107–108**, *109*, **113**
- analytical method
 - ⁴⁰Ar/³⁹Ar dating 111–113
 - fission-track 65, 172–173
 - metamorphic minerals 286–287
- anchizone 291–293, 297, 299, 301, 302, 308, 310
- andalusite 28, 288, 289, 396
- anhydrite 89
- anthracite 287, 296, 297
- Antola nappe 425
- apatite fission track
 - age 29, *31*, 32, 36
 - data 173, *175*, 177–181, *180*, *182*
- Apulian margin subduction 383–385
- Apulian Plate *see* Adriatic Plate
- ⁴⁰Ar/³⁹Ar dating 104–106
 - analytical techniques 111–113
 - Valstrona di Omega 46, 54–55, **56**, 57, 60, 61, 62
- Austroalpine basement 5–36
 - age data **14–17**, 27
 - cooling and exhumation 31–32
 - cross-section 7, 19
 - geochemistry 10–18
 - geodynamics 32–36
 - intrusive history 28–32
 - lithology 6
 - magmatic evolution 9–18
 - metamorphic age 7–9
 - metamorphism 18–28
 - age 27–28
 - Alpine 35–36
 - pre-Alpine 23–27
 - structural evolution 18–28
 - post-collision 28–32
- Avalonia 5
- backthrust 425, 430
- backthrusting 252, 253, 274, 365, 367, 368
- Barrovian metamorphism (HT metamorphism) 371, 373–377, 394, 396
- basalt, sub-greenschist facies 298–300
- biostratigraphy 335–359
- bituminite reflectance 285, 294, 295
- blueschist 118, 120, 128, 129, 134, 424, 400
 - Carpathians 101, 104, *105*, 106, 110
- boudinage 50, 52, 53
- Brenner Fault 197, 214
- Briançonnais
 - basement 400, 401
 - metamorphism 125, 129
 - subduction 132, *136*, 383
- brittle deformation 173
- Bündnerschiefer nappes 220–221, 223
- Bucovinian nappes 171–172, 181, *183*
- burial depth 187–189, *305*
- Cadomia 5, 33, 220
- Cambrian 34
- Canavese Zone 47
- Carpathian embayment *170*, 317–318, 332
- Carpathians *102*, *103*, *111*
- cata-bituminite 294, 295
- cataclastite 73
- Celtic terrane 9
- chemistry, metamorphic minerals 290–291
- chlorite 290, 291
- chlorite geothermometry 291, 306, 307
- chloritoid 288, 289, 396, 398
- chloritoid isograd 286, 298, 299–300
- clastic wedge, Pienides 329–331
- clay minerals 287
- closure, Ligurian Tethys 432, 433
- coal 285, 309
- coalification map 294
- coesite 1, 393, 394
- Collio Formation 70–73
- collision 396, 397, 404
 - Apennine *414*, 425, 430
 - Variscan 5, 6–7, 33, 35

- collisional orogens 101–110
 collision-related minerals 401–402
 composite fault 234, 242, 244
 continental convergence, Alpine 35
 continental units
 isotope and petrological data 121, 134
 convergence
 Carpathian embayment 317, 332
 cooling age, Adula nappe 382
 cooling history, Getic detachment 310
 cooling history, Maramures 169–195
 cooling path, Rieserferner pluton 32
 cooling 302–311
 Corsica, orogenic system 413–433
 Cosustea mélange 286, 287, 290, 293, 298
 Cosustea nappe 284, 302
 Cosustea unit 291, 293, 301, 306
 crust, lower, deformation of 45–65
 crust, lower, faulting in 215–216
 crustal extension, southern Alps 80
 crustal stacking 35
 crustal thinning 48
 crystallographic-preferred orientation (CPO) 256, 259–263
- Danubian window, metamorphism 281–311
 Deferegggen Group 8, 9, 11, 14–17, 18, 20, 21, 26, 33
 Deferegggen–Antholz–Vals line 8–9, 21, 30, 31, 33, 36
 deformation phases 211
 Adula nappe 377–383
 Dinarides 149–155
 Monte Rosa nappe 256–258, 270–271
 Tauern Window 204–205
 deformation
 brittle 9, 49, 53, 54, 73, 78, 79
 ductile 49, 51, 53, 54, 73, 78
 pre-Alpine ductile 18–28
 deformation, Stellihorn shear zone 263–275
 Dent Blanche nappe 118–120
 depositional environment 71, 79, 91–94
 Dinarides 336, 340, 350, 352–353
 Pienides 321–324, 328
 detrital mineral associations 287
 diagenesis 287–291, 293, 296–298, 302
 syn-kinematic 309, 310
 Dinarides 145–164
 deformation 149–155
 depositional environment 335–359
 palaeomagnetism 149, 155–157
 tectonic zones 147
 thrusts 154
 topography 147
 diopside 290
 dolomite 87, 93
 duplex structure 90, 224–226
 Durreck Muscoviteschist Group 8, 9, 14–17, 26
- earthquakes, Switzerland 232, 234, 242, 244, 246
 focal mechanism 245
 eclogite 118, 120, 129, 373
 eclogite facies 2, 4, 23, 28, 263, 264, 267
 electron-microprobe analysis 285, 286
 enriched mid ocean ridge basalt (N-MORB) 7, 10, 13, 32, 33
 Eo-Alpine (Cretaceous) metamorphic event 9, 27, 35–36
 Eo-Alpine thrusting 33
 epizone 291–293, 296–299, 301, 306
 evaporite, Triassic 71
 exhumation
 Adula nappe 383, 385
 Apennine 425, 426, 430
 central Alps 272, 273–275
 Ivrea Zone 45–65
 Rodna horst 187
 Maramures 169–195
 Tauern Window 197–216
 extension 50, 70
 Monte Rosa nappe 251–276
 External Dinarides 146
 extrusion tectonics 3
- fabric in mylonite 49–54
 fabric in plutons 30–31
 facies analysis 321–324, 329
 fault orientation 243, 244
 faults, surface expression 234–244
 morphology 235, 237, 238, 239
 faults, post-glacial displacement 236, 237, 238, 239
 fission track age 29, 31, 32, 34, 36
 Valstrona di Omega 46, 55, 59, 60–62, 63
 fission track analysis 65, 172–173, 194, 195
 fission track data 174–177
 flysch 417, 420, 425
 in foreland basin 336
 folding and shear 203–213
 folds, Dinarides 153
 folds, recumbent 207–208
 foliation 204, 209, 210
 mylonitic 256–259, 268
 pre-Alpine 21
 foraminifera, planktonic 335, 337–339, 340
 foreland basin, sedimentation 317–332
- garnet 20, 21, 22, 23, 24, 25, 27, 374
 geochemistry, Austroalpine basement 10–12
 geochronology *see* age
 geodynamic evolution
 Adriatic–Austroalpine plate 32–36
 Tertiary 393–404
 geophysics
 Apennine–Corsica 415, 417
 Penninic nappes 234
 Salzach–Ennstal–Mariazell–Puchberg Fault (SEMP) 215–216
 Tauern Window 219–222, 224–226
 geothermal gradient 186, 188
 geothermobarometry 23–27
 Getic detachment 4
 metamorphism 307–310
 Getic-Supragetic units 282, 286, 301
 Gondwana 5, 6, 33, 220
 passive margin 34–35
 goniometry 259–263
 granite, Hercynian 219
 granulite facies 48

- graphite 88, 92, 220, 225, 296
 Grassi Detachment Fault 69–80
 age 70
 map 72
 reconstruction 78–80
 gravitational faults 234, 235–239
 greenschist 152, 298, 301, 373, 424
 greenschist facies 189, 251, 265, 267, 401
 Danubian Window 281, 310–311
 Greiner basin 225
 Greiner shear zone 199, 214
 gypsum 222, 293
- Helminthoid Flysch 417, 420, 425
 Helvetic nappes 244
 Hercynian magmatic suite 219
 high-pressure wedges 101–110
 history of research
 Alps 1–4, 393–394
 Apennine–Corsica 413–415
 Hochstegen marble 222
 hornblende data **56**, 57
 horst and graben 224
- illite Kübler index 291–298, 307
 imbricated crust 404
 index minerals 394, 395
 inertinite 294
 inselberg, Croatia 146, 148, 162
 Insubric Fault 3, 251–253, 256, 258, 266, 275
 Insubric mylonite 365, 367
 Insubric Zone 47, 48
 intermontane basin 83, 84, 283
 Internal Dinarides 145–164
 intrusive history
 Austroalpine basement 28–32
 isoclinal fold 18, 20
 isostatic rebound 242
 isotope age data **122–124**
 Ivrea Zone 1, 45–65
- kaolinite 287, 298, 299, 302
 K–Ar, Valstrona di Omega 55, **58**, 59, 60, 61, 62, 63
 Kaserer Basin 87, 95–97
 Katschberg Fault 197
 Kübler index 285, 286–287
 illite 291–298, 307
 kyanite 25, 26, 27, 396, 397
 Adula nappe 373, 374, 375, 382
- landscape and neofaulting 234–235
 landslide *see* mass movement
 Laurussia 5, 33
 Lepontine dome 3, 366, 368, 403
 deformation 253–254, 263–275,
 lignite 309
 Ligurian Knot 414, 432
 lineament detection 234–235
 liptinite 293
 lithofacies, Pienides 321–324, 329
 lithostratigraphy
 Adula nappe 369–371
 Austroalpine basement 6
 Danubian window 284–286
 Northern Apennine 420, 419–421
 Riffler–Schönach Basin **90**, 91–94
 Tauern Window 98
 loess 241
- Mafic Complex 48
 magmatic rock suite, pre-Variscan *11*
 zircon age 12–13
 magnetic susceptibility 30–31
 Malenco–Platta 134–136
 mantle wedge 34
 mantle-derived material 10, 13, 17, 18, 48
 Maramures 3, 169–195
 burial 188–189
 exhumation 181–186
 fission track analysis 172–173, *194*, *195*
 apatite data **178**
 zircon data **176**
 geology 170–171
 thermal modelling 177–181, *181*, *182*
 thermochronological analysis 173–177
 marble 92–94, *105*, 222
 mass movement 235–239
 Matreier Zone, cross-section *19*
 maturation 297
 Medvednica Mountains, tectonics 145–164
 palaeomagnetism 155–157
 reconstruction 157–162
 transport direction 149–155
 mélange 286, 383, 429
 Meliata Ocean 35, 131, 134
 Meliata suture 101–110
 Meliata unit 104, *105*, *106*, *111*
 Meliata zone 2
 metaconglomerate 86, 87
 metamorphic facies *396*, **397**, **399**
 metamorphic grade 288
 metamorphic map, Alps *119*
 metamorphic mineral associations 287–290
 metamorphic petrology,
 metasediments 393–404
 metamorphism 4
 Adula nappe 381–382
 Apennine–Corsica 423–425
 Austroalpine basement 18–28
 Stellihorn shear zone 263–265
 metamorphism, low-grade 281–311
 metamorphism, subduction-related 117–136
 meta-porphyrroid 8, *11*, 12
 metasediments, petrology 393–404
 mid ocean ridge basalt 7, *11*, 18, 33
 mineralogy, metasediments 394–397
 Moho 36, 428
 mollusc **337**
 monazite age 27, 29, 35
 Valstrona di Omega 46, 48, 54, 59–62
 Monte Rosa nappe 3, 251–276
 deformation 263–275
 goniometry 259–263
 metamorphism 263–265
 structure 256–259
 moraine, faulted 239–242
 MORB (mid ocean ridge basalt) 7, *11*, 18, 33

- Morbegno Gneiss 70, 71–78
 Mount Medvednica 3
 mylonite 208, 214, 251, 256–263, 266, 275
 Morbegno Gneiss 71–73
 microstructure 73–78
 mylonite belt 47, 49–54
 mylonite zone 366, 367, 382
- nannoflora 47–348
 nannofossil 335–359
 age **337–339**, 348, 350
 distribution **342–344**
 nannoplankton 4, **349, 351**
 nappe stack 219–228, 282, 425
 Monte Rosa 253–254, 273
 nappe stacking 149, 305, 307, 308, 317, 319
 central Alps 365, 368, 369
 Cretaceous 170, 172, 179, 183, 187, 189
 and metamorphism 310
 Neotectonic faulting 231–246
 N-MORB (enriched mid ocean ridge basalt) 7, 10,
 13, 32, 33
 Noric Composite terrane 9
 Northern Apennine, orogenic system 413–433
 Northern–Deferegggen–Petzeck Group 7, 18, 21, 26,
 33, 34, 35
 age data 9, **14–17**
 magmatism 9, 10, 11
 thermobarometry 24, 25
- ocean floor metamorphism 283, 298, 302–306, 310
 oceanic spreading 421
 oceanic units
 isotope and petrological data 121
 olistolith 222
 ophiolite 9, 117, 120, 134
 Apennine–Corsica 417, 425, 426, 429
 Dinaridic 146, 149, 152, 153, 162
 ophiolitic mélange 254
 optical microscopy 285, 286
 organic matter reflectance 287, 293–298
 organic maturation 297, 309
 Orobic anticline 1, 70
 cross-section 73
 orogeny analyses 1–4
 orthogneiss 8, 12
- palaeocurrents, Pienides 324–325, 330
 palaeodepth 186, 188
 palaeogeographic reconstruction
 western Mediterranean 131, 131, 133
 palaeogeography 132–135, 136
 Dinaride 353
 palaeomagnetic direction **157, 159, 160**
 palaeomagnetism
 Dinarides 149, 155–157
 Medvednica Mountains 157–162, 163
 palaeontology, micro-, Pienides 327, **328**, 329
 palaeotectonic reconstruction 429
 Palaeotethys 35
 palynomorphs **337–339, 349, 351**
 Pangea break-up 84, 219
 paragonite 291
- pegmatite, Permian 8, 21, 28, 33, 35
 Penninic nappe stack 253–254, 273
 Penninic nappes 226, 244, 368
 cross-section 223, 366
 lithology 221–222
 seismicity 234
 Penninic Ocean Basin 220
 Periadriatic fault 157, 161, 162, 163, 251
 see also Insubric Fault
 Permian thermal event 28, 35
 petrography, Pienides 326–327
 petrological data and subduction 121, 128
 petrology and isotopic age 117–136
 petrology, Adula nappe 371–377
 Petrosani basin 283, 288, 309
 Pfitsch–Mörchner Basin 85–87, 94–95, 97
 phengite 396
 photomicrographs
 boudinage 52–53
 garnet 20
 greenschist 152
 index minerals 289
 Meliata unit 105
 metapelite 374
 mylonite 52, 53, 75–78, 258, 263
 Piemonte–Liguria Ocean 120–125, 132, 135
 Pienide nappe emplacement 317–332
 Pienides 171, 174, 179, 181, 189
 plate tectonics 394
 Austroalpine 5–6
 playa-lake deposits 94
 Pogallo Line 47–48, 49, 61, 62
 Ponteranica Conglomerate 71, 79
 post-glacial faulting 236–242
 post-Variscan basins 84–85
 prehnite 290, 298, 302
 Preluca massif 173, 179, 188–189, 194, 195
 pressure-temperature conditions 48, 394–404, 432
 Adula nappe 369, 371–377
 Austroalpine basement 23–27, 35
 Danubian window 302–303
 pressure-temperature and subduction 118–130
 data for subduction metamorphism **126–127**
 projection of lineations, calculations used
 275–276
 Proto-Tethys 33
 pumpellyite 290, 298
 pyrophyllite 298, 299, 396, 397
- quartz fibres in faults 236
 quartz recrystallisation 213, 214
 quartz texture in mylonite 76–78
 quartz-c-textures 21–23
 quartzite 92–94
- radiolaria 93
 radiolarite 105
 rate of convergence 226, 231
 rate of exhumation 186, 186, 188–189
 rate of opening 80
 rate of uplift 226–227, 232, 233, 234
 reflectance 285
 reflector, mylonite 215–216
 reflectors, Tauern Window 224

- ridge-top depressions 235, 236
 riebeckite 301
 Rieserferner pluton 28, 29, 30, 31, 36
 Riffler Schonach Basin 85, 89–94, 97, 222
 cross-sections 223, 225
 Rodna horst 170, 172, 174, 181–190
 exhumation 187
 fission track analysis, results 194, 195
 Rosarolo shear zone 49–54
- Salzach–Ennstal–Mariazell–Puchberg Fault
 (SEMP) 197–216
 folding and shearing 203–211
 Sava zone 146
 sedimentary basin, Tauern Window 83–98
 sedimentary sequence 149
 foreland basin 4, 317–332
 post-Variscan basins 84–94
 thickness 189
 seismic data 224
 seismicity, Swiss Alps 231–246
 SEMP (Salzach–Ennstal–Mariazell–Puchberg Fault)
 197–216
 sensitive high resolution ion microprobe (SHRIMP)
 13, 14
 age 265–266
 U–Pb data 48, 60, 63
 zircon age 120, 129, 130
 serpentinite 86
 Sesia Zone 47, 48, 118–120
 Severin nappe 283, 284, 286, 293, 298, 302
 Severin Ocean 282
 Severin unit 285–287, 290–291, 301, 306, 310
 shear bands 18, 19, 35
 shear zone 49, 54, 424
 fabric 51, 52, 53
 Tauern Window 197, 199–216
 Stellihorn 253, 255–266, 271
 shearing, Adula nappe 385–387
 sheath fold 18, 20, 23, 54
 SHRIMP *see* sensitive high resolution ion microprobe
 sillimanite 26, 28, 375
 Simplon fault 254, 266, 273, 274
 slab break-off 28, 430, 431, 432, 433
 slab retreat 317–318
 slab roll back 35
 slickenfibres 236
 slope stability 234–239
 southern Alps 46
 subsidence history 62
 Southern Steep Belt 251–276, 366
 staurolite 25, 26, 27, 28, 29, 396
 Adula nappe 373, 374, 375, 382
 Stellihorn shear zone 253, 255–266, 271
 stretching lineation 73, 152, 258, 259, 426, 427
 stretching, Adula nappe 385–387
 Strona–Ceneri Zone 47–49, 61
 structural cross-sections
 Adula nappe 371
 Alps 227
 Alps, central 366, 367, 384
 Alps, eastern 198
 Alps, metamorphic structure 403
 Austroalpine basement 7, 19, 33, 223
 Bucovinian nappe 183
 Carpathians, Inner 111
 Corsica–Northern Apennine 418, 431
 Danubian Window 284
 Grassi Detachment Fault 73, 79
 Lepontine dome 253
 Medvednica Mountains 150
 neotectonic fault 238
 Pienide nappe 330–331
 Tauern Window 88, 89, 221, 222, 223, 225
 structural evolution
 Corsica 421–425, 431
 Northern Apennine 423–433, 431
 subduction
 Adula nappe 365, 366, 368, 383–385
 Briançonnais 402–403
 Carpathians 110, 111
 continental 414, 424, 431, 432, 433
 subduction depth 128
 subduction rate 134
 subduction-related metamorphism 117–136, 306–307
 Apennine–Corsica 425, 426, 429
 lithologies 126–127
 subduction-related minerals 398–401
 subduction, age of 129–130
 sub-greenschist facies 298–300
 suture 146
 Alpine–Apennine 8, 418
 Austroalpine–Penninic 8
 Meliata 101–110
 Valaisan 254
- Tauern Window 83–98, 129, 197–216
 deformation 205, 211
 folding, age of 211
 metamorphism 205
 Salzburg–Ennstal–Mariazell–Puchberg Fault
 (SEMP) 197, 198, 214
 shear zone 199–211
 taxa cited 356–359
 tectonic sections *see* structural cross-sections
 tectonic maps
 Adula nappe 264, 268, 369, 376, 378
 Ahorn shear zone 213
 Alpine–Carpathian–Pannonian unit 102, 103, 170,
 282, 318, 333
 Alps 198, 220, 274, 368
 Apennine–Corsica 415, 416
 central Alps 368
 Corsica–Northern Apennine 415, 416, 422
 Danubian Window 283
 Dinarides 147
 Maramures area 171, 174
 Medvednica Mountains 150, 154, 156
 Monte Rosa nappe 252, 260, 261
 Pienides 320
 Stellihorn shear zone 260
 Tauern Window 221
 tectonic model, Apennine–Corsica 414
 tectonic stacking 33
 tectonics, review 1–4
 tension cracks, open 235, 236
 Tethys, palaeogeographic reconstruction 133
 thermal modelling apatite data 177–181, 181, 182

- thermobarometry 24, 25
 thermochronology, Maramures 173–177
 thin-skinned tectonics 69
 Pienides 317–318
 thrust wedge 425
 thrusts, Dinarides 154
 Thurntaler Phyllite Group 8, 11, 12, **14–17**, 18, 33
 Tisza–Dacia blocks 169–170, 172
 Tisza–Dacia unit 317–332
 topography, Alps 2
 topography, Dinarides 147
 TRANSALP seismic line 216, 219, 221, 224–226
 transcurrent shearing 275
 transport direction, Dinarides 149–155
 tschermakite 26
 Tuscan metamorphic units 419, 421, 426
 Tyrrhenian Sea 421
- ultramylonite 49, 51
 underplating 50, 61, 401
 underthrusting 424, 426, 432, 433
 uplift path 184, 185
 uplift, Neotectonic 231–246
- Val Biandino Quartz Diorite 70, 71–73, 74, 78
 Valais Ocean 129, 132, 134, 267, 403
 Valaisan suture 254
 Valle Biagio Granite 70, 71–73
- Valseisia 255
 Valstrona di Omega 45–65
 geochronology 59–61
 Variscan collision 5, 6–7, 33, 35
 vibroseis data 224, 227
 Vienna Basin 197
 vitrinite reflectance 285, 293–296, 307
 volcanic arc basalt 7, 10, 13
 volcanism in hanging wall 1
 volcanism, Permian 69
 volcanism, Tertiary 419, 421, 432
- white mica 121, 291, 374, 382
 analytical data **107–108**, 109, **113**
 whole rock isotope characteristics 13–18
 within-plate basalt 7, 10–12, 13, 17, 18, 33
- xenoliths 74
 X-ray powder diffraction 285, 286–287
- Zinsnock stock 29, 30
 zircon age 12–13
 zircon analysis 95–97
 zircon fission track age 29, 31, 34, 36
 Valstrona di Omega 46, 55,
 59, 60–62, 63
 zircon fission track data 174–177
 zoisite 290, 396