Index

Note: Page numbers in *italics* denote figures, while those in **bold** denote tables.

- ablation 88, 263
- accumulation area ratio 88
- adfreeze 58–59, 97
- aggradation 199, 212–214
- alluvial fan, paraglacial 74
- alluvial fill 199
- alveolar weathering 19
- angle of friction 181, 191–195
- anthropogenic forcing 2

  **Basal adfreezing** 58–59
  - characteristics 65
  - debris content 57
  - debris entrainment 58–59, 62–63
  - dynamic response 58
  - facies 58
  - formation 57–59, 61–63, 63–64
  - isotopic signature 57–58
  - permafrost environment 61–63
  - shearing hypothesis 58–59, 62
  - types 64

  **Biological weathering** 14–15, 17, 18, 29, 45
  - blockfields 12, 19, 85, 91, 92
  - age estimates 91
  - interpretation 91

  **British Columbia** 199–218
  - geomorphology 201–202
  - glacier advances 211
  - lithostratigraphy 206, 207, 208, 209–211, 209, 210
  - moraines 202
  - Nostetuko River 199–200, 201, 205, 213
  - Quaternary volcanic landscapes 219–233
  - radiocarbon ages 211
  - sediments 204–209
  - study area 199–200, 200, 220–222, 221
  - terraces 203, 204
  - brunification 15
  - buried glacier ice 60–61, 64

  **Cheekye basin, paraglacial sediment**
  - budget 225–227, 226, 227
  - Cheekye fan 222–225, 223
  - glacier terminus 225
  - ice-contact sediments 226
  - radiocarbon dating 224
  - chemical erosion 43
  - rates 29, 43
  - solute runoff 34–36
  - chemical weathering 14–15, 16, 29, 44, 46
  - Clapeyron equation 63
  - climate
  - regions 6
  - Würmian bioclimatic zones 6

- climate change
  - effects 1
  - timescale of landform response 263

- climate forcing 2
  - external 258

- climate sensitivity 257–265
  - definition 257, 258
  - feedbacks 258, 260
  - and geomorphology 260–261
  - Last Glacial Maximum 259–260
  - modelling 260
  - not a constant 259–260
  - periglacial regions 260
  - regional variation 263
  - volcanic eruptions 259

- climatic geomorphology 5–28

- climatic variability
  - altitudinal 85
  - spatial 85

- cold-climate
  - geomorphology 15–19, 18, 24
  - processes 165
  - corrie widening 121
  - rock slope failure 113, 115
  - cosmogenic isotope surface exposure dating 133, 135, 139
  - cryoplanation 7, 12
  - cryosol 15
  - cryoturbation 10

- dating 19, 20
  - controls on 152
  - see also cosmogenic isotope surface exposure dating; radiocarbon dating; tree ring series

- debris flows 183

- debutressing 238

- decarbonization 15

- deglaciation 72
  - paraglacial response 261

- delta formation 159

- denudation 10, 251–252
  - measurement 33
  - total denudation rate 44
  - discrete debris accumulations 85–102, 92
  - and climate 91
  - interpretation 85–86, 98–99
  - see also landslides; rock avalanche; rock slope failure; talus slopes

- disturbance regimes 248–249, 252
  - landscapes 235–255

- dynamic geomorphology 80–82

- England, Milfield Basin 145–164

- Equilibrium Line Altitude 87–88, 238

- erosion
  - rates 40–44
  - rock slope failure 103
  - wind 19
  - see also chemical erosion; glacial erosion
Great Britain
rockfall talus slopes 133–144
see also England; Scottish Highlands
grèzes litées 5, 6
ground ice, two stage development model 65
ground penetrating radar 138

Holocene, glacier fluctuations 199–218

ice see basal ice; buried glacier ice; ground ice; intrasedimental ice; massive ice; pore ice; segregation ice
ice classification schemes 57
ice core record 81
ice dykes 60
ice extent, debris flux 90–91
ice lens formation 51–52
ice sediment classification 57, 65, 66
ice stream dynamics 63–64
water supply 64
ice volumes 86
ice wedge polygons 10, 21, 156, 160
ice-contact sediments 226
ice-dammed lake 145

Irish
Ballintra West 171, 171, 172
Ballycroe Strand 168–171, 170
Cnoc na nAccraí 172–174, 173
Knockadoon Head 168, 169
Quaternary lithostratigraphy 165–180, 167
regional stratigraphic framework 166–168
stratigraphic interpretation 175–177, 176
study sites 167
talus slopes 133–144
White Strand 174–175, 174

lacustrine deposits 246
interpretation 247–248
landslide dams 244–247, 246, 247
sediment delivery 249
landslide–interruption complexes 244–247, 246
landslides 227–229
controls on 235
frequency–magnitude model 229, 230
glacially conditioned 229–230, 231, 235–255
interpretation 247–251
paraglacial adjustment 237–239
post glacial denudation 251–252
temporal distribution 238
trigger event 238
see also discrete debris accumulations; rock avalanche; rock slope failure

Light Detection and Ranging (LiDAR) 151
lithalsas see palsas
lithosol 15
lithostratigraphy
interpretation 165, 175–177, 176
limitations 177–178
relative age tool 166
transition count matrix 177

marine isotope stage 165
Markov chain analysis 178

mass movement, magnitude–frequency 235
massive ice 57–69, 60, 61
origin 60–61, 64–65
mean surface temperature 257–258
mechanical weathering 29
microweathering
data 37
moisture 29
processes 29–49
rates 29–49, 47

Milankovich forcing 2

Millfield Basin 145–164, 146
age-elevation of active channel 160
delta formation 159
fluvial sequences 153–159, 158
geomorphological map 154
landform assemblages 148, 149
landform interpretation 159–162
model of lake drainage 159–161
paraglacial systems 159
Quaternary history 147–150
river long profile 150, 153
sediment core logs 155, 157
sediment dating 152
study area 147–150
Till–Tweed Geoarchaeology Project 147
valley floor cross profile 157, 158
valley floor incision phases 159–160
moraines 85
bulk density 185
dating 88
dry densities 188, 188
formation 182, 195
frozen sediment 62, 63
technological properties 182, 195
glacier mass balance 86
interpretation 86, 90, 93
morphology 184
oversteepening 181
particle shape 189, 191, 192–194
particle size 184, 188, 189, 194
proxy records 215
record sensitivity 215
sediment storage 195
slope angles 184
slope gradient dispersal diagrams 187
slope profile 186, 187, 188
surface lowering rates 194–195
see also steep lateral moraines
morphodynamics 12
Mount Garibaldi 222–225, 223
deglaciation 222–225, 227
glacier terminus 225
post glacial phase 225
sediment deposits 222–225, 227
volcano growth 222
Mount Meager
landforms 228
landslide frequency–magnitude model 229, 230
landslides 227–229
sediment pulsing 227–229
sediment yield curve 229
nivation 12–14
northern hemisphere temperature anomaly 260–261, 262, 263
Norway
annual temperature 31
erosion rates 40–44, 43
glimorphic environment 30–33
landscape 31
lithology 31
microweathering 29–49, 37
precipitation 31
rock slope failure 108–114, 110, 116–117
soil development 31
study locations 30, 31–33, 32
vegetation 31
weathering rates 34–36, 40–44
Nostetuko River 199–200
aggradation history 200
radiocarbon ages 205
sediment chronology 213
stratigraphic logs 200
topographic maps 200
oxidation 15
Pakistan
Upper Indus Basin 235–255, 236
see also Gilgit–Hunza basin
glaeological reconstruction 5
glaic relief 129
gla formation 55
buoyancy 51–56
model 51–52, 53
phases 54
palsas 21, 21
environmental indicators 55
force balance 53
internal structure 52
paraglacial 71–84
alluvial fan 74
definition 71, 73, 134
environments 1–3
fluvial response 162
mass movement 195
models 80, 145
processes 23, 24, 76, 181, 183, 235
and glacial 76
rock slope failure 103–131, 133, 139, 140
scree 95
slope adjustment 181–197
transitional landscapes 79–82
valley fill 74
see also zone of paraglacial relaxation
paraglacial cycle 161, 219, 220
rock slope failure 126
paraglacial geomorphology 19, 24
definition 219
publications 73
Quaternary volcanic landscapes 219–233
paraglacial landforms 23, 76
classification 159
paraglacial sediment exhaustion model 2, 23, 24, 77–79, 78, 219, 220, 227, 230, 238
paraglacial sediment wave model 76–78, 78
paraglacial sediments 1, 73–75, 219
extrinsic perturbation 231–232
pulses 214
release 79, 80
yield 76, 78, 78, 145, 214
paraglacial systems
evolution 73–76
global warming 261
interpretation 159–162
origin 73–76
secondary 159
partitioned landscapes 249–251, 250, 252
peat
deposit age 206, 212–214
deposition of 199, 212–214
physical properties 51, 53, 55
periglacial 1–3, 71–84, 238
definition 71
equilibrium 72, 73
erosion cycle 7
sediments 1
periglacial geomorphology 5–28
development of 5, 7–12
periglacial landforms 1, 72, 133
evolution 73
periglacial processes 7, 72, 243
monitoring 22
slope dynamics 8–9
periglacial regions, climate sensitivity 260, 261
periglacial–glacial system 72, 73
periglacial–paraglacial indicators 134–141
permafrost 51, 57, 71, 72, 133, 243
active layer 22, 238
CO₂ degassing 3
distribution 3
rock glaciers 97
spatial changes 21–22
subaerial aggradation 60
temporal changes 21–22
thaw 19–21
thickness 3
physical weathering 46
pingos 10, 11
plateau glaciers 85, 88–90, 89, 92
centre of mass 90
Pleistocene
deglaciation 145–164
Europe 5–7
podolization 15
polygonal ice wedge casts see ice wedge polygons
pore ice 65
porewater pressure 60
porosity 44–45
precipitation 1
trends 263
proglacial 71–84
definition 71
equilibrium 73
INDEX

fluvial archive 199
sediment 72–73
proglacial lakes 162
proglacial landforms 72–73
classification 77
proglacial rivers, hydrology 72
protalus lobes 97
protalus ramps 95–96, 96, 133–134, 140–141
origin 140–141
protalus rock glaciers 138–140
interpretation 138
protalus rock glaciers 138–140
interpretation 138
pseudokarren 29, 39, 42
Quaternary lithostratigraphy 165–180
Quaternary volcanic landscapes
paraglacial geomorphology 219–233
study area 220–222, 221
radiative forcing 257–258
radiocarbon dating 150, 152, 199, 201, 205, 211, 212–214, 224
regulation 8, 58–59, 64
Richter slopes 12
rim retreats 117
river planform 199
rock avalanche 235, 236, 240–246
as barriers 244–247, 248
detachment zone 237, 242
emplacement morphologies 237
exhaustion model 238
lithology 237
mechanics 235–236
misclassification 237
origin 237
rock glaciers 85, 133–134, 138–140, 139
debris proportion 97
debris supply 91–95, 94, 95
interpretation 93–95
origin 93
permafrost 97
ages 104–105
breadth 103, 105, 105, 110
catastrophic 235
corrie widening 115, 119
cumulative impact 126, 127
debris 103–104, 106
distribution 251
erosion 103
grootechnics 104–105
glacial trough widening 103–131
glacially conditioned 229–230, 231, 235–255
glacier exploitation 126
incidence 118, 120
incipient trough widening 119–124
interpretation 105, 236–237
long section 104
magnitude 106, 241
map based measures 106–108, 107
paraglacial 103–131, 139, 140
paraglacial cycle 126
trough widening 117–124, 117, 125, 128, 129
types 104–105
whole valley impact 117–119
see also discrete debris accumulations; landslides;
rock avalanche; talus slopes
rock surface weakening 34, 36–38, 37, 38
rockfall talus slopes see talus slopes
rockwall retreat, rates 124–125, 134, 139–140
sackung features 235, 238, 241–243, 245
salinization 15
salt weathering 12
sand wedges 5, 6
sandur 75
Scottish Highlands
study area 108–111, 109
scree fans 95
sediment supply 1
changes 199
controls on 165
sediment yield 81, 219
diffusivity constant 219
landslides 219
paraglacial 76, 78, 78, 145, 214
sediments
cold climate 165
core logs 155, 157
deposition processes 178
diffusion rate 229
entrainment 78
facies 182
interpretation 248
see also glacigenic sediments; paraglacial sediments
segregation ice 52, 64, 65
shear box tests 181, 185–188, 188, 190–191, 191, 195
shear stress 97
slope angle 185
measurement 184
particle shape 189, 191, 192–194
particle size 184, 188, 189, 194
stabilizing 194
slope denudation 10
slope dynamics 7, 8–9
slope processes, controls on 238
slope stability, post glacial 238
small glaciers, debris supply 91–95, 94
snowline 88
regional 87
solifluction 3, 39
solute flux 30, 35, 36
sorted circles 10, 11
spalling 29, 38, 39, 40, 47
stable isotope analyses 57
steep lateral moraines 183
grootechnical controls 181–197
paraglacial slope adjustment 181–197
section 193
shear surface 193
type of failure 191–195
stone run pavement formation 20
stress release processes 135
sturzstrom see rock avalanche
sublimation 263
surface hardness
and surface lowering 44, 44
and weathering rind 44–45, 44
surface lowering 36, 37
and fracture enlargement 46
post glacial rate 29, 30
rates 43, 43, 194–195
and surface hardness 44, 44
Switzerland
climate 182
Feegletscher Nord glacier 181, 182–184
g geomorphology 183
moraines 181–197
study area 182
tafoni 29, 39, 41, 45
talus
accumulation rates 134
age determination 135
composition 138
modification 133
origin 134
periglacial development hypothesis 134
structure 137–138
talus foot landforms 133–144, 138–140, 139
debris ramps 140
evolution models 133
formation 133
interpretation 133
origin 141
periglacial–paraglacial indicators 134–141
talus slopes 133–144, 135–138, 136
evolution models 133
formation 133
interpretation 133
origin 141
particle size 135–136, 137, 138
periglacial–paraglacial indicators 134–141
scarp edge 137, 138, 140
thaw ponds 21

INDEX
thermal weathering 12, 14, 19
thermokarst 55
transitional landscapes 249–251, 250
tree ring series 201, 212–214
trough widening
asymmetric profile 119
feedback 128–129
incipient 119–124, 124
paraglacial 120
rate 130
rock slope failure 117–124, 117, 125, 128, 129
valley floor
development 157, 158, 161–162
incision phases 159–160
paraglacial fill 74
weathering 12, 14–15, 16, 17, 46
alveolar 19
controls on 29, 44–45
differential 45
fractures 45–46
indices 33–34, 36–38, 46
morphology 38–40
processes 5, 18–19, 44–45, 44
rates 15, 17, 30, 33, 34, 40–44
rock type 17, 18, 29
signatures 18
and water chemistry 33, 34
see also biological weathering; chemical weathering;
mechanical weathering; microweathering;
physical weathering; thermal weathering
weathering pits 39–40, 41, 45
weathering rind 44, 47
development 30
and fractures 46
and surface hardness 44–45, 44
thickness 29, 33–34, 36, 37, 38
Würm glaciation 6
Würmian bioclimatic zones 6
zone of paraglacial relaxation 103, 126–128, 128, 129,
161–162