

Index

Page numbers in *italics* refer to Figures. Page numbers in **bold** refer to Tables.

- across fault pressure differences 148
 - San Luis Pass reservoirs 260
 - Upper Rotliegende reservoirs 4, 16, 17, 21, 22–23, 24, 27, 28–32
 - uncertainty variation 33
- algorithms *see* shale gouge ratio (SGR); shale smear factor (SSF)
- Allan maps 3, 5, 32, 147, 148, 163
 - Corallina field 151, 155
 - Ling Gu 149, 152
- Ameland Field **12**
- Ameland Member 11, 14, 26
- Amphistegina chipolensis* biozone
 - San Luis Pass reservoirs 257–258, 259
 - seal 260, 263, 264, 266, 268, 270, 271, 272, 273
- Anahuac Shale 257
- anchoring/adjustment bias **128**
- anticline trap 2
- Apulia Carbonate Platform 105, 110
- Arches National Park 103, 104, 105, 107, 108
 - fault-zone architecture bias 132, 133
- Atlantic Ocean, opening 15
- Austin Chalk 87, 88
- availability bias **128**

- baffles 9, 11, 91, 242
- Barque Field **12**
- Barra Velha Formation 43
- Bartlett Fault 104–105, 106, 107
- Base Cretaceous Unconformity 186, 189
- Base Permian Unconformity 11, 14
- Bathurst Formation 151, 155
- Bergen Arc System 104, 105
- bias
 - anchoring/adjustment **128**
 - availability **128**
 - cognitive 127, **128**, 136, 137, **138–139**
 - communication 132, 134–135, 137, **138**, 139
 - confirmation 127, **128**
 - data collection 130–131, 135–136, 137, 139
 - geologists 126, 135–136, 137, **138–139**, 139
 - motivational **128**, 130–132
 - overconfidence 127, **128**
 - physical **128**, **138**
 - representative **128**
 - selection **128**, 130–131, 136, **138**
 - systematic, in fault zone architecture models 127–139
 - terminology 137
 - unconscious 137, **139**
- Big Hole Fault, cataclasite 176
- bleaching, sandstone 107, 109, 110, 111, 116
- Boquillas Formation 89
- Brazil, Pre-salt Province
 - carbonates 39–40
 - fault hydraulic behaviour 40
 - post-salt reservoirs 43, 44
- Brent rock properties 19, 32, 271
- Broad Fourteens Basin 15

- buoyancy pressure 4
 - hanging-wall 209, 215, 217, 218, 219
 - San Luis Pass reservoirs 260, 266, 268
 - Upper Rotliegende reservoirs 23
- Byerlee's Law 78

- Cache Valley normal fault 103, 104, 105
 - damage zone 107, 109, 110, 116
 - salt walls 105
- calcilutite 43
- Caledonian nappe 104
- Caledonian orogeny, Øygarden Gneiss Complex 105, 107
- Campos Basin 43
 - carbonate hydromechanical behaviour 43
- Canyon Lake Gorge, Texas
 - refracted normal faults 4, 79–83, 84–86
 - dilation tendency analysis 81, 82, 83, 86
 - dissolution 83, 85
 - slip tendency analysis 81, 82, 83, 86
- capillary seal *see* membrane seal
- capillary threshold pressure 1, 146, 166, 167, 176, 177
 - San Luis Pass reservoirs 259, 260, 266, 267, 270, 273
 - Upper Rotliegende reservoirs 4, 18, 21, 28, 31
- carbonate mud sealing layer *see* carbonates, sealing mechanisms, artificial mud sealing layer
- carbonates
 - Brazilian Pre-salt Province 39–40, 43
 - fault reactivation project 40, 43–68
 - fault zone architecture, and permeability 42–43
 - fault-sealing mechanisms 4
 - hydromechanical behaviour of faults 40, 43
 - sealing mechanisms 42
 - artificial mud sealing layer 44, 45, 46, 65
 - shear testing 46–47, 65
- Carboniferous source rock 11
 - stratigraphy 14
- cataclasis seals 2, 4
- cataclasites 200
 - clay-poor 168, 169, 170
 - Upper Rotliegende reservoirs 17–18, 19, 21, 24, 28, **34**, **35**
- cataclastic bands
 - Upper Rotliegende reservoirs 17, 21, 24, 28, 32
 - diagenesis and cementation 18, 19
- Cedar Mountain Formation 106, 107
- cementation, in carbonate fault rock 42–43
- cementation bands 18
- chirp 2D data, San Luis Pass reservoirs 258, 261, 262
- Cima delle Murelle Formation 103, 105, 120
- CIPS (Calcite *In situ* Precipitation System) artificial grainstone 44
 - petrophysical and geomechanical properties **45**
 - shear testing 45–65
- clay, fault rock 3
 - and cross-fault flow 40, 163
 - San Luis Pass reservoirs 260
- clay content, low, and fluid flow 4, 17

- clay smear modelling, Juxtaposition Table Method 202, 203, 204–205, 206
- clay smear potential (CSP) 1, 4, 17
- clay smears 2, 169
- Cleaver Bank High 16
- Clemente-Tomas Fault Zone 255, 256–257
- listric faults 261
- Clipper Field **12**
- CO₂ leakage, selection bias 131–132
- CO₂ storage prospecting 2, 6, 254, 255, 259, 273
- Cobra Field **12**
- compaction, influence on fault seal 192, 193
- compactive failure 76, 77
- dilation tendency 79, 91
- slip tendency 79, 91
- compactive shear failure 76, 77
- dilation tendency 79, 91
- Ernst Tinaja 89
- Leafcutter Fault 88, 89
- slip tendency 79, 91
- compartmentalization 2, 9
- Holstein Field 229, 246
- Upper Rotliegende reservoirs 16, 26, 27, 28, 29–31
- Copper Shale Member 11, 14
- coquina, Santos Basin 43
- Corallina Field
- fault profiles 150, 154
- fault seal analysis 149–153
- uncertainty distribution 151, **156**
- validation error 153, 157
- stratigraphy 150, **155**
- Corsair Growth Fault Zone 257
- Courthouse Fault 104
- damage zone *see* fault damage zone; wall damage zone
- data collection, bias 130–131, 135–136, 137, 139
- datasets
- ambiguous terminology 134
- bias 129, 137
- debiasing 137, **138–139**
- deformation 99, 100
- and fault-sealing potential 2, 4, 5
- deformation adjustment factor 183, 184, 185, 186, 190, 192
- deformation bands 5, 6, 17–18, 99, 100, 101, 102, 223–249
- Cache Valley 109, 110, 116
- development 18
- fault damage zone 115, 116
- Hidden Canyon 107
- Holstein Field 6, 224, 229–249
- impact on reservoir flow 240, 246
- occurrence and density 229–231
- orientation and kinematics 231–233
- permeability 236, **237**, **239**, 240, **241**, 242
- well-test 240, 242
- see also* Holstein Field, deformation bands
- Humber Flats 110, 111
- impact on reservoir fluid flow 224, 240, 246
- Moab Fault 107, 108
- outcrop studies 224
- permeability 223, 224, 236, **237**, **239**, 240, **241**
- and threshold pressure 18, 32–33
- porosity 223, **237**, 238
- prediction in reservoirs 246–248
- strain hardening 18
- Upper Rotliegende reservoirs 17
- Dekeyser faults 15, 16, 19, 32
- Dewey Bridge Member 105, 109, 110, 116
- diagenesis
- carbonate fault rock 42–43
- Upper Rotliegende reservoirs 18, 19
- dilatancy-fluid diffusion theory 41
- dilation
- fault core 165
- shear-induced 41, 52, 63–64, 65, 66
- dilation tendency 4, 77
- analysis and applications 77–78, 91–92
- Canyon Lake Gorge 81, 82, 83, 86
- Ernst Tinaja 89–90
- Leafcutter Fault 87, 88, 89
- and failure modes 79, 90–92
- and fluid flow 90
- volume gain 79, 91, 92
- volume loss 79, 91, 92
- volume neutral 79, 91, 92
- dip leakage 220
- disaggregation bands 18, 32, 200
- dissolution 75
- Canyon Lake Gorge 83, 85
- Dory Field, fault seal analysis, validation error 153, 157
- drag fold, Hidden Canyon 106, 107, 115
- Drücker-Prager elastoplastic model 49–50, 64, 65
- Dunlin Group 210, 211
- earthquakes, and fault reactivation 41
- Echuca Shoals Formation 151, 155
- elasticity, fault damage zones 115
- Ensign Field **13**
- Entrada Formation 4, 103, 105, 106, 107, 109, 110, 115, 116
- Ernst Tinaja, Big Bend National Park, minor thrust faults 89–90
- failure envelopes 75–76
- failure modes
- and deformation mechanisms 75–77
- and dilation tendency 79
- Ernst Member 89–90
- fault reactivation 79
- and slip tendency 79
- fault bends, in fault damage zones 115
- fault core 18, 99, 100, 101
- description bias 134, 135
- fault rock distributions 168
- and seal potential 166
- fault rock properties 168–170
- geocellular model 168, 179
- rock properties 168–170
- lenses 100, 101, 106, 168, 169, 170
- Moab Fault 106
- permeability 164–165, 173, 183
- sealing potential 176, 177, 178, 179
- structure and composition 164–167
- thickness 101, 172–173, 175, 179
- V_{shale} 173
- fault damage zone 2, 5, 17, 66, 99, 100, 101, 165, 166
- Cache Valley normal fault 107, 109, 110

- cross-fault 101
 - data, and fault modelling 112, 115
 - deformation frequency plots 102, 106, 107, 108, 109, 110, 111, 112, 113, 116–117
 - description bias 134, 135
 - displacement 100, 101, 116, 117–118
 - effect of lithology and rock properties 115–116
 - and fluid flow properties 115, 116
 - Hidden Canyon 106, 107
 - inner 101, 107, 110, 111, 115
 - Moab Fault 107, 108
 - outer 101, 107, 110, 111, 115
 - Øygarden Gneiss Complex 112, 114
 - permeability 41
 - scanlines 101–102, 106, 107, 110, 113
 - tip 100, 101
 - wall 100, 101
 - width 100, 101, 102, 115, 116–118
 - Hidden Canyon 107
 - Majella Mountain 111
 - fault displacement, and damage zone width 100, 101, 116–118
 - fault drag 2, 5
 - fault exposures, bias 130, 131
 - fault gouge zones
 - Moab Fault 166, 167
 - stochastic modelling 163–194
 - application to fault seal analysis 183–186
 - fault facies hierarchy 168, 169, 172, 173
 - fault rock
 - dimensions 170–171
 - permeability 171–172, 173–177, 181, 183–186
 - properties 169–170
 - cataclasites 169, 170, 176, 181, 182, 184
 - fault-bound lenses 169, 170, 179, 181, 182
 - shale smears 169, 181, 182, 183
 - shaly gouge 169–170, 176, 181–184
 - thickness 172–173, 175, 176
 - V_{shale} ranges 173, 174, 175, 176, 181–186
 - random v. structured gouge models 180, 181, 183
 - results 173–181
 - fault facies proportions 166, 167, 177–181, 182
 - fault seal capacity 176, 177, 178, 180, 181, 183
 - harmonic permeability model 176–181, 182
 - hydrocarbon column 176–177, 179, 180, 183
 - leak point depth 173, 177–183, 190
 - model output 173–179
 - thickness trends 173, 175, 176, 179, 181
 - variogram analysis 173, 175, 176, 179, 181
- fault height 101
- fault hydraulic behaviour
 - carbonate reservoirs 40–42
 - previous research 41–42
 - siliciclastic reservoirs 40
- fault length 101
- fault lenses *see* fault core, lenses
- fault modelling, damage zone data 112, 115
- fault models, mental 126–127
- fault movement, as cause of leakage, San Luis Pass reservoirs 272–273
- fault property modelling
 - Juxtaposition Table Method 200, 201–206
 - Monte Carlo simulation 201, 202, 205
 - traditional methods 200
- uncertainty 201, 202
- fault reactivation, failure modes 79, 91
- Fault Reactivation in Carbonates project 40–41, 43–68
 - geological context 43–44
 - implications for hydrocarbon industry 66–67
 - reservoir rocks 44–45
 - seal 44, 45
 - shear testing 46–53, 63–65
 - triaxial testing 48, 50–51, 53–61, 65
- fault rock
 - carbonate 40
 - classification, ambiguous terminology 134, 135
 - fluid flow 17
 - permeability 1, 17–21, 22, 32, 34, 35, 164–165
 - shale/clay content 1, 3, 4, 16, 40, 168–169
 - thickness, Juxtaposition Table Method 201–202, 203, 205, 206
 - Upper Rotliegende reservoirs 17–21
- fault seal 2, 4, 9, 11, 145–159, 163, 164
 - analysis 3, 6, 146–159, 254, 258–268
 - back-testing technique 147
 - Corallina Field 149–153
 - fault gouge zone stochastic modelling 183–186
 - Ling Gu 149, 150, 151, 152, 153
 - Monte Carlo method 146–159
 - procedure and methods 147–149
 - San Luis Pass reservoirs 259–261, 263, 268
 - combined with HR3D seismic data 6, 268–274
 - techniques 16–17
 - uncertainties and sensitivities 32–34
 - workflow 31–32
 - capacity 1, 3–4
 - hanging-wall traps 2, 209–221
 - influence of compaction 192, 193
 - lateral 145, 146, 158
 - prediction 3, 254
 - Upper Rotliegende reservoirs 4, 19, 21–23, 31
 - processes 2, 3–4
 - top 2, 145, 146, 259, 263, 269, 270
 - types 2, 9, 11
 - see also* juxtaposition seal; Local Deformation Line Model; membrane seal
- fault zone architecture 2, 4–5, 165
 - and permeability
 - carbonates 42–43
 - shear testing 51, 61–63, 65–66
 - XCT 45–46, 51
 - and scaling laws 99–120
 - systematic biases 127–139, 135
- fault-bound lenses 169, 170
- fault-valve model 64, 66
- faults, normal, bias 129
- field studies
 - motivational bias 130–132
 - selection bias 130–131, 138
 - systematic bias 139
- fill-to-spill capacity
 - Ling Gu 153
 - San Luis Pass reservoirs 261, 263, 264, 268, 269, 270–271
- fluid flow 3, 17, 32, 41
 - along-fault 18, 165, 177
 - cross-fault 18, 145, 164, 165, 176, 177
 - and clay minerals 40, 163

- fluid flow (*Continued*)
 and dilation tendency 90, 91
 fault damage zone data 115, 116, 165
 and *in situ* stress 42, 75
 shear testing experiments 47–48, 52, 63
 and slip tendency 78, 83, 86, 90, 91
see also permeability
- footwall 101
 Cache Valley 105, 109, 110
 Hidden Canyon 106, 107
 Hidden Valley fault zone 80, 84
 Marnock Field 189, 190
 Moab Fault damage zone 107, 108
 Øygarden Gneiss Complex damage zone 112
- footwall traps 2, 6, 215, 218, 219, 220, **220**
- fractures, cemented 18
- free water level, Upper Rotliegende reservoirs **12–13**, 16, 21–23, 24, 26, 27, 28, 33
- Frio Formation 257
- gas chimneys 254
 San Luis Pass reservoirs 261, 262, 266, 271–272, 273
- gas column *see* hydrocarbon column
- gas–water contact *see* hydrocarbon–water contact
- gas/oil ratio development, Juxtaposition Table
 Method 205
- geologists, bias 135–136, 137, **138–139**, 139
- Glen Rose Limestone 79, 81, 84–85
- graben, Southern Permian Basin 15, 16
- grainstone
 Campos Basin 43, 44
 synthetic *see* CIPS (Calcite *In situ* Precipitation System)
- Green Canyon 224, 225
- Griffin Field, fault seal analysis, validation error 153, 157
- Grijpskerk Field **12**
- Grimsel Test Site, fault exposure 130, 131
- Groningen gas field 9
- Guarujá Formation 43, 44
- Gulf of Mexico
 hydrocarbon source rocks 257
 San Luis Pass 255–274
- hanging-wall 101
 Cache Valley 105, 109, 110, 116
 Hidden Canyon 107, 115
 Hidden Valley fault zone 80
 Marnock Field 189, 190
- hanging-wall traps 2, 6, 209
 dip leakage 220
 failure 220–221
 North Sea 209
 data analysis 215–219
 knowledge database 212–215
 literature search 212, **213**, **214**
 Oseberg Syd 210, 211
 SGR v. buoyancy pressure 215, 217, 218, 219
 three-way 209, 210
- Heather Sandstone 210, 211
- Hibernia Formation 151, 155
- Hidden Canyon, fault damage zone 103, 104–105, 106, 107, 115
- Hidden Valley fault zone 79–83, 84–86
- Holstein Field
 compartmentalization 229, 246
 deformation bands 6, 224, 229–249
 fault rock 236, **237**, 238
 formation 246–248
 impact on reservoir flow 240
 occurrence and density 229–231, 246
 orientation and kinematics 231–233
 permeability 236, **237**, **239**, 240, **241**, 242
 compared with PTA 242–244
 well-test 240, 242
 discovery and development 228–229
 monocline 224, 225, 226, 227, 228, 246
 petrophysics 233–240
 regional setting and kinematics 224–228
 reservoir permeability
 pressure transient analysis 242–244
 relative permeability 244–246
 salt withdrawal 224
 sand K2 reservoir 224, 227, 228, 229, 230
 properties 234–236, **237**, 238, 240, 242, **243**
 MICP testing 244, 245
 sediment deposition 224
 stress 246–248
- Holstein Terrace 224, 226, 227
- Honaker Trail Formation, footwall damage zone 107, 108
- host rock, clay-content, Upper Rotliegende reservoirs 4, 17, 19, 20, 32, **34**, **35**
- HR3D seismic reflection data
 combined with traditional fault seal and trap analyses 6, 268–272, 274
 overburden imaging 254–255, 258–268
- Humbog Flats 103, 104, 105
 fault damage zone 110, 111, 119
- hybrid failure 76, 77
 dilation tendency 78, 79, 91
 Ernst Tinaja 89
 Leafcutter Fault 87, 88
 slip tendency 79, 91
- hydraulic seals 218
- hydrocarbon buoyancy pressure 176
- hydrocarbon column 5, 17, 164, 176–177, 179, 180, 183
 hanging-wall trap 210, 215–216, 218–221, 220
 Marnock Field 191
 San Luis Pass reservoirs 261, 263, 264, 266, 268, 270
 Upper Rotliegende reservoirs 22, 24, 28
- hydrocarbon migration 41, 254–255, 263–266, 269, 271, 272–273
- hydrocarbon prospectivity 6, 253–255, 268–274
- hydrocarbon system 145
- hydrocarbon–water contact 145, 148, 190, 191
 hanging-wall traps 210, 211, 218
 independent (IHW) 147, 149, 159
 Corallina Field 150, 153
 Ling Gu 149, 150, 153
 Marnock Field 186, 187, 188, 190
 modelled (MHW) 149
 Corallina field 151, 153, 156
 Ling Gu 149, 153
 Upper Rotliegende reservoirs 24, 28
- hydrothermal deposits, and fault reactivation 41
- Imbetiba Formation 43
- Indefatigable Field **13**
- Itapema Formation 43

- Jalan Mukah Fault
 fault architecture bias 129
 fault facies 169
 shaly-gouge fault core 183
- Jucurutu River, fault exposure 130
- Jupiter fields **13**
- juxtaposition fault model, San Luis Pass reservoirs
 263–266, **268**, 270–271, 272
- juxtaposition seal 1, 2, 3, 11, 145, 148, 158, 159, 163
 Corallina Field 151, 153, 155, 156, 157
 hanging-wall traps 209, 210, 215–216, 219
 Oseberg Syd 211
 Ling Gu 149, 152, 153, 157
 Marnock Field 189, 190
 Upper Rotliegende reservoirs 24, 26, 27, 28,
 29, 31, 32
- Juxtaposition Table Method 200, 201–206, 201
 in producing fields 205
 V_{phyt} -permeability relationship 201–202
 workflow 200, 201–205
- K4/K5 Field **12**
- K12-A Field **12**
- K12-E Field **12**
- K15-FG Field **12**
- karst 42, 110, 112, 116
- Klinkenberg correction 33, 236
- L10-4 well **12**
- L11-Gillian Field **12**
- L12b-C Field 11, **12**, 15, 23–29
- L13-FE Field **12**
- L15b-A Field **12**
- Laminaria Formation 150, 151, 153
- Late-Cimmerian event 15, 16
- Leafcutter Fault, Pinto Creek, Texas
 dilation tendency analysis 87, 88, 89
 slip tendency analysis 87, 88, 89
- leak point 3, 148–149, 153, 164, 166, 167, 173, 177
 San Luis Pass reservoirs 263, 265, 266
see also fault gouge zones, stochastic modelling, leak
 point depth
- leakage
 hanging-wall traps 220
 San Luis Pass reservoirs 272–273
 water drive 190
- Leman Field **13**
- Limburg Group 14, 25, 29, 30
- Ling Gu, fault seal analysis 149, 150, 151, 152, 153
 displacement profiles 151
 uncertainty distribution **152**
 validation error 153, 157
- lithology, effect on fault damage zone 115–116
- Local Deformation Line (LDL) model 184, 185,
 186, 194
 fault permeability 190, 192
 Marnock gas condensate field 186–190, 187, 194
 Monte Carlo model 190, 191
- Louann Salt 257
- Lower Slochteren Member 11, 14, 24, 25, 29, 30
- lowest closing contour 148, 151, 152, 153, 154
- Macabu Formation 43
- McKinleyville Thrust, deformation bands 246
- Majella Mountain
 faulted carbonate 101, 102, 103, 105
 fault damage zone 110–111, 112, 113,
 116, 120
- Marginulina ascensionensis* biozone
 San Luis Pass reservoirs 257–258, 259
 as seal 260, 266
- Marnock gas condensate field
 LDL model 186–190, 187, 194
 deformation adjustment 190, 192
 Monte Carlo model 190, 191
 Red Fault 187, 188, 189
 SGR 189, 190
- Marsh Island, hanging-wall buoyancy pressure **214**,
 217, 218
- Mattinata Fault 42
- mélange, terminology 132
- membrane seal 2, 11, 145, 146, 153, 158, 159, 163
 hanging-wall traps 209, 210, 215–216, 218–219
 Oseberg Syd 211
 Southern North Sea fields 10, 11
 Rotliegend level 16, 24, 28, 29, 31–32, 33
 terminology 134
- metamorphism, Øygarden Gneiss Complex 105, 107
- microbialites, Campos Basin 43
- Mid North Sea High 15
- Mid-Basin High salt tongue 224–225, 228
- Mid-Cimmerian event 15
- Mid-North Sea High 11
- mineralization 75
 and dilation tendency 78
 and fluid transmissivity 78
- Minerva Field, fault seal analysis, validation error
 153, 157
- Moab Fault 2, 101, 103, 104–105, 106, 107
 architecture bias 132, 133
 deformation bands 107, 108, 115
 fault-core gouge zone 166, 167
 footwall damage zone 107, 108
- Moab Tongue Member 106, 107, 115
- Moab Valley salt wall 104
- models
 conceptual, ambiguous terminology 134
 mental 125–126
 geosciences 126–127, **138–139**
 systematic bias 127, 135–136, **138–139**
 modelling approaches 5
- Monterey Formation, fluid migration 41
- Morrone di Pacentro Formation 103, 105, 120
 fault damage zone 110
- motivational bias **128**
 field studies 130–132
- mudstone
 microbial *see* calcilitite
 synthetic 44, 45
- mylonite
 Øygarden Gneiss Complex 105, 107
 terminology 132, 134
- Navajo Formation 4, 103, 105, 107, 109, 110, 116
- North Sea
 fault block traps 209
 hanging-wall knowledge database 212–215
 hanging-wall literature search 212, **213, 214**

- observations, ambiguous terminology 132, 134–135
- Øygarden Gneiss Complex
 faults 101, *104*, 105, 107
 damage zone 112, *114*
- open fractures 18
- Oseberg Syd, hanging-wall trap 210, *211*
- outcrops
 deformation band studies 224
 fault zone architecture 4–5
 scale v. human scale 129–130
 selection bias 130, 137, **138**
- Outeiro formation 43
- overburden imaging
 HR3D seismic reflection data 254–255
 as indication of hydrocarbons and fault seal potential
 254, 261
- Pangaea supercontinent, break-up 15
- Paradox Basin 102, 104–105
- permeability
 along fault 165
 deformation adjustment factor 183
 deformation bands 18, 32–33, 223, 224, 234, 236, **237**,
239, 240, **241**, 242
 fault core 164, *165*
 fault damage zone 41, 115–116
 and fault gouge clay content 163, 168
 fault rock 1
 dilatancy–fluid diffusion theory 41
 Upper Rotliegende reservoirs 18–21, 22, 32
 and fault zone architecture, carbonates 42–43, 65
 measurement uncertainty and sensitivity 32–33
 relative 244–246
 reservoir, pressure transient analysis 242
 and slip tendency 79, 91
 stochastic fault facies model 171–172, 173, *174*,
175, 183
- permeability–phylosilicate content (V_{phyl}) relationship 199
 Juxtaposition Table Method 201–202, 203, 205
- Permian, Upper Rotliegende reservoirs
 fault seal behaviour 4, 9–35
 stratigraphy *14*
- phylosilicate bands 18, 32
- phylosilicate content (V_{phyl})-permeability
 relationship 199
 Juxtaposition Table Method 201–202, 203
- phylosilicate framework faults 18, 169–170
- Picaroon Field 257
- Pinto Creek, dilation and slip tendency 87–89
- porosity
 deformation bands 223, 234, 236, **237**, 238
 fault damage zone 115–116
- pressure solution, in carbonate fault rock 42
- pressure transient analysis (PTA) 242–244
- Proto-Tethys Ocean 14
- pseudotachylites, selection bias 132
- Quissamã Formation 43, 44
- recrystallization, in carbonate fault rock 42
- Red Fault, Marnock gas condensate field *187*, 188,
189, *191*
- relay ramps 2, 5
 in fault damage zones 115
- relay zones 1, 2
 breached 2
 singly-breached 2
 unbreached 2
- remigration 254
- representative bias **128**
- Richter Sub-basin 224, 226
- Ringkøbing-Fyn High 11
- Rio Piranhas valley, fault exposure 130
- risk, mental models 127
- Rotliegend gas play 9
 stratigraphy and palaeogeography 11
 structural setting and burial history 11, 14–16
- Rotliegende *see* Upper Rotliegende reservoirs
- salt nappe, Holstein Field 224, 225, 226
- San Luis Pass reservoirs 255
 containment failure 271, 272–273
 fault juxtaposition model 263–266, **268**
 fault movement, as cause of gas migration 272–273
 fault seal and trap analyses 259–261, 263, **268**, 269–272
 fault zones 255, 256
 fill-to-spill capacity 263, 264, **268**, 269, 270, 271
 gas chimneys 261, 262, 266, 271–272, 273
 geology 255–258
 HR3D seismic data 255, 258–268
 combined with fault seal/trap analyses 268–274
 prospect risk 268–269, 271–272
 salt dome 256, 257, 264, 271–272
 stratigraphy 256, 257–258
 top seal quality 263, 269, 271–272
- San Rafael Monocline 105
- San Rafael Swell 101, 102, *103*, 104, 105, 110, 246
- sandstone
 low clay-content 4
see also Upper Rotliegende reservoirs
- Santos Basin 41, 43
- scale, outcrop v. human 129–130
- Schneverdingen Graben **13**
- Scott Field, hanging-wall trap **214**, 216, 218
- seismic data
 3D 253–254
 overburden 254
 HR3D overburden imaging 254–255, 258–268
 combined with seal/trap analyses 268–272
- selection bias **128**, 130–131, 136, **138**
 field studies 130
- shale gouge ratio (SRG) 1, 3–4, 5, 17, 146, 148, 157–158,
 159, *189*, 190
 hanging-wall traps 215, *217*, 218, 219
 Juxtaposition Table Method 202
- Ling Gu 149
- Marnock Field *189*, 190
 as proxy for V_{phyl} 199–200
- San Luis Pass reservoirs 259–260, 266–268, 269, 270,
 271, 272, 273
 Upper Rotliegende reservoirs **12–13**, 16, 19, 21, 22, 23,
 24, 31, 32
- shale smear factor (SSF) 3, 146, 170
 Juxtaposition Table Method 202, 204
- shale smears 18, *167*, 168, 169
- shale/clay content *see* fault rock, shale/clay content
- shale/clay smear seal 2
- shaly gouge *167*, 168, 169

- shear failure 76, 77
 - dilation tendency 79, 91, 92
 - slip tendency 79, 91, 92
- shear testing, fault reactivation project 46–53, 63–65
 - SPH method 48–50, 53, 64–65
 - triaxial testing 48, 50–51, 53–61, 65
- Sibson paradigm 41, 64, 66
- Sigsbee escarpment 225
- Silverpit Formation 25, 29
- Silverpit Lake 11
- Skagerrak Formation, Marnock gas condensate field
 - 186, 188
- Slick Rock Member 105–107, 109, 110, 115, 116
- slickenlines 76
 - Canyon Lake Gorge 80, 81, 82–83
- slickensides, Ernst Member 89–90
- slickolites 90
- slip lineations 76
- slip surfaces 2, 18, 164–165
- slip tendency 4, 78
 - analysis and applications 78–79, 91–92
 - Canyon Lake Gorge 81, 82, 83, 86
 - Ernst Tinaja 89–90
 - Leafcutter Fault 87, 88, 89
 - and failure modes 79, 90–92
 - and fluid flow 90
- Slochteren Sandstone reservoir 11, 24, 25, 29, 30
 - Alpha 29, 30
- SNS-A Field 11, 23, 29–31
- Soho Sub-basin 224, 225, 226, 228
- solution bands 18
- Sotra Island *see* Øygarden Gneiss Complex
- South Brae Field, hanging-wall trap **214**, 216
- Southern North Sea
 - Upper Rotliegende reservoirs 10
 - fault seal behaviour 4, 9–35
- Southern Permian Basin
 - formation and configuration 15–16
 - graben 15, 16
 - stratigraphy 11
- SPH (smoothed particle hydrodynamics) method 48–50,
 - 53, 64–65
- spill points 2, 148, 149
 - Corallina Field 150, 153
 - Dutch exploration prospects 9
 - hanging-wall trap 210, 211, 215
 - Ling Gu 149, 150
 - San Luis Pass reservoirs 263
- strain hardening 18
- stress
 - and fault-sealing potential, carbonates 4, 40–68
 - in faulted rock
 - and dilation tendency 77, 79, 90, 91
 - and fluid flow 42, 50, 52, 75
 - shear testing 46–53
 - and slip tendency 78, 79, 90, 91
- stromatolites, Campos Basin 43
- stylolites 90
- Suban Field, fractures 66
- supra-salt mini-basin, Holstein Field 224, 225, 226
- Telford Ridge 218
- Ten Boer Member 11, 14, 26
- tensile failure 76, 77
 - dilation tendency 79, 90–91
 - slip tendency 79
- terminology
 - ambiguous 132, 134–135, **138**
 - bias 137, 139
- Tethys Ocean
 - Apulia Carbonate Platform 105, 110
 - closure 14, 16
- Texas inner shelf *see* San Luis Pass reservoirs
- Texas Offshore OBS survey 255, 256, 258–259, 261, 262
- Thusher Fault 104
- transmissibility
 - dynamic, carbonate fault reactivation project shear testing 47, 52–53, 63–64
 - static 52–53
- transmissibility multipliers 5, 200
 - Juxtaposition Table Method 202, 204, 205, 206
 - Upper Rotliegende reservoirs 22
- transmissivity
 - and mineralization 78
 - and slip tendency 79
- trap analysis 254
 - combined with HR3D seismic data 268–272
 - San Luis Pass 259–261, 263, **268**, 269, 271
- Trap Analysis Methodology 215
- traps 145
 - geometry 2
 - North Sea 209
 - stratigraphic 145
 - see also* anticline trap; footwall traps; hanging-wall traps
- travertine
 - Italian
 - hydraulic properties 43–44
 - petrophysical and geomechanical properties **45**
 - shear testing 46–65
 - Santos Basin 41, 43
- triaxial reactivation testing 48, 50–51, 53–61, 65
- turbidites, Holstein Terrace 224, 229
- ultramafic, terminology 134
- uncertainty 1, 5–6, 137
 - fault hydraulic behaviour 40
 - fault property predictions 201, 202
 - fault seal analysis 32–34
- Uncompahgre uplift 104, 146
- Upper Rotliegend Group 14
- Upper Rotliegende reservoirs
 - across fault pressure differences 17, 21, 22–23, 24, 27, 28–32
 - uncertainty variation 33
 - cataclasis 17–18, 19, 21, 24, 28, **34**, **35**
 - deformation bands 17–18
 - exhumation 14
 - fault rock 17–21, **34**, **35**
 - fracture permeability 18–21, 22, 32, **34**, **35**
 - Hg threshold pressure **19**, 21, 22, 24, 33, **34**, **35**
 - fault seal behaviour 4, 9–35
 - case studies **12–13**, 23–31
 - L12b-C 23–29
 - SNS-A 29–31
- faulting 11, 14–15, 16, 19
- free water level **12–13**, 16, 21–23, 24, 26, 27, 28, 33
- geological setting 11, 14–17

- Upper Rotliegende reservoirs (*Continued*)
 membrane seals 16, 24, 28, 29, 31–32, 33
 N/G ratio (clay content) 17, 20, 21, 23, 24, 32, 33,
 34, 35
 oil and gas fields *14*
 sediments *14, 15*
 Upper Slochteren Member 11, *14, 24, 25*
- V-fields **13**
 Valhall Field 6
 Vallone Santo Spirito 105, 110, *120*
 Variscan Orogeny 14, *15*
 V_{clay} value 170, *171*
 Visund, hanging-wall buoyancy pressure 217, 218
 Vlieland Graben 15
 volume gain 79, 92
 volume loss 79, 92
- V_{phys} -permeability relationship 199
 Juxtaposition Table Method 201–202, 203
 V_{shale} values 4, 148, 170, 173, 179, 181–186
 Upper Ling Gu 149
 Upper Rotliegende reservoirs 24
- wall damage zone *100, 101*
 water drive leakage 190
 West Seahorse Field, fault seal analysis, validation error
 153, *157*
 West Sole fields **13**
- Young's modulus, fault damage zones 115
- Zechstein carbonate reservoir, Northern German Gas
 Basin 42
 Zechstein Group evaporites 11, *14, 15, 16, 26, 29*