

# Index

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

- Alba Field  
remobilized Eocene channel complex 59, 110  
sand injection at polygonal faults 19, 21, 63, 110  
wing-like intrusions 205, 209
- Andes Fold-Thrust Belt 29, 30
- Aspromonte massif, Calabria, basement-hosted injectites 216, 218, 229
- Austral Basin, injectite scale 144
- Austral-Magallanes Basin 30  
chronostratigraphy 31  
core data sedimentary facies 32, 35, 38–39  
bioturbated siltstone/mudstone 35, 38, 39  
mud-clast breccia 35  
structureless sandstone 35, 39  
thin-bedded turbidites 38–39, 41  
deep-water depositional system 6, 41, 42, 43  
discordant intrusions 6, 35  
evolution 41  
geological setting 29–30  
hydrofracture 35, 41, 43  
overpressure 41, 43  
petroleum exploration potential 6, 29, 41, 43  
hydrocarbon migration 43  
porosity/permeability 43  
reservoir properties 43  
seal integrity 43  
traps 41, 43  
seismic anomaly data 30, 32–33, 34, 35, 36, 37, 41  
Upper Cretaceous–Paleocene SIC 3, 5, 29–43  
dykes and sills 34, 35, 36, 37, 39, 40, 41, 43  
evolution 41  
jack-up structures 34, 35, 36, 37, 39, 40  
sand injection 6, 39, 40, 41, 42  
triggering events 41
- Balder Field  
Paleogene reservoir sandstone 7, 95  
parent sand remobilization 7, 95, 98, 111–112  
diagenetic state 98  
horizontal entrainment models 108–109  
sill emplacement 104–107, 108  
well sanding 98–99, 108
- Balder Formation 51, 53, 54, 152  
pockmarks 123, 125, 130  
sand remobilization seismic reconstruction **121**, 122, 123, 125, 126, 129, 130  
tuff mounds 95, 97  
tuff seal 120, 123  
wing-like intrusions 205
- Balder-Grane-Forseti remobilization complex 96
- basement, sand injectite 8, 215–230
- Bergen High, thermal gradient 104
- Beryl Embayment 96  
hydrocarbon migration 143
- bioturbation, Austral-Magallanes Basin 35
- Bor sandstone member 50, 51, 52, 53, 54
- bowls *see* sandstone intrusions, bowl-shaped breccia
- Austral-Magallanes Basin 35  
collapse, Calabria basement-hosted injectite 220  
injection, TGIC 185, 193–197, 199–200, 209  
Volund southern wing 155, 156, 157, 159, 160–161, 164–165
- Brent Group 110
- Brimmond Field 167, 168, 171, 172  
oil 172, 178
- Brimmond Sand Fairway 7, 167–179  
AVO interpretation 172, 173  
borehole logs 168, 170  
deep-water submarine fan channel 167  
Eocene injectites 168, 169, 170, 171  
fluid prediction volume 172, 173, 174  
parent unit 172  
pressures 178  
rock physics 172  
seismic modelling 167, 168, 172, 178  
target generation 172, 173, 174, 178
- Britannia Field, sand remobilization 110
- Calabria  
basement-hosted injectites 216, 219–221, 227–230  
cataclasis 219, 221  
dykes 216, 218–220, 221, 226–227  
exhumation 219  
faults 216, 218  
geological/tectonic background 218  
joints and fractures 219, 221  
sedimentary infill 219, 220  
weathering 219, 229–230
- Calabria–Ionian convergent boundary 216, 218
- Calabria-Peloritani terrane 218, 219
- California Coast Ranges, TGIC 182, 183
- Cannonville Member 260, 261, 262
- carbon capture and storage (CCUS) 1
- Carmel Formation, sand pipes 260, 261, 262, 264, 266
- Catanzaro Graben 216, 218, 219, 226–227, 229
- Cecilie Field 110
- Cecilie segment 50, 52  
injectites 52, 53, 55
- Cenozoic, Norwegian–Danish Basin 48–64
- Central Graben 48, 49, 120, **121**
- Central North Sea  
sand remobilization 120–132  
sea-level fluctuation 120, **121**, 130
- Central Sub-basin 12
- Central Trough 72
- Chalk Formation 106, 107, 109, 110
- Chalk Group 95, 97, 108  
N-DB 48, 51, 53, 54, 56
- channel deposits, seismic anomalies, GSB 17, 20, 21
- Chestnut Field, turbidite lobe 110
- Chimney Rock Pipe 261, 264, 266
- Chondrites*, Austral-Magallanes Basin 35, 38
- CHOPS (cold heavy oil production with sand) 99, 100, 101, 108, 109
- Chorillo Chico Formation 41

- Clay Smear Potential 273  
 Coffee Soil Fault 49, 52  
 Colorado *see* Front Range, Colorado, basement-hosted injectites  
 conical intrusions *see* sandstone intrusions, conical  
 Copanello injectite outcrop 216, 218, 219, 220  
*Cosmorhaphé* 38  
 Crawford Ridge 110
- D-1 Fault 48, 49, 58, 63  
 diagenesis 98, 273  
 discordance 4, 6, 17, 20, 22, 23, 24, 35  
 Domengine Formation 182, 183–187, 205, 208, 274  
 Dosados Sandstone 204, 209  
 Draupne Formation 106, 107  
 Dufa Member 49, 50, 51  
 dykes  
   basement-hosted injectites 221–226, 223, 227, 229  
   Frimmersdorf Seam 241, 243–244, 250  
   Kodachrome State Park 260  
   sandstone 4, 118  
     Austral-Magallanes Basin 35, 39  
     detection 4  
   sandstone-filled faults 280–281  
   TGIC 185, 187, 189, 190, 191, 192–193, 194, 196, 197, 201–204  
   *see also* sand injectites, dykes; sandstone intrusions, dykes
- earthquakes  
   Lower Rhine Embayment 238  
   as trigger for sand injection 25, 71, 259, 269  
 East Carpathian Fold Zone, GSIC 5  
 East Flank Sub-basin 12  
 East Shetland Platform 72, 95, 96  
 embankments, piping failure 101, 102, 109  
 Entrada Sandstone Formation, sand pipes 260, 261, 264  
 Erft Block 236, 238  
   stratigraphy 237  
 Erft Fault 236, 238  
 European Cenozoic Rift System 236, 238, 251  
 extrudites *see* sand extrusion
- Fagano Fault Zone 30  
 fan deltas 7, 120, 121, 122, 123  
 Farallon plate subduction 182, 183, 207  
 Faroe-Shetland Basin 72  
 fault gouge 279–280  
 fault valve mechanism 278  
 faults  
   cataclasites 273, 279  
   clay smearing 251–252, 269, 273, 279–280  
   halokinetic, NDB 6, 48  
   polygonal  
     GSB 6, 14, 15, 17, 18, 19–20, 21, 25–26  
     N-DB 56, 63  
     NSB 14, 48  
     trigger for sand intrusion 11, 70–71, 75–76, 78  
   reactivated 2  
   sandstone-filled 8, 275–282  
     Central California 274–282  
     connectivity 273, 279–280, 281  
     contractional tectonics 275, 276, 281  
     emplacement conditions 276–278, 280  
     high-velocity fluid flow 276–278  
     poor consolidations 276  
     pore-fluid pressure 276  
   extensional tectonics 275, 277, 280, 281  
   hydrocarbon systems 278–280  
     reservoir compartmentalization 273, 279  
     reservoir modelling 281–282  
   improved transmissibility 280  
   orientation modelling 280–281  
   porosity/permeability 273–274, 280, 281, 282  
   seismic data 282  
   sills and dykes 280–281  
   strike-slip tectonics 275–276, 278, 281  
   sealing potential 273, 278–279, 281
- Feldbiss Fault 236, 251  
 Floki Fairway submarine channel system  
   50, 51, 58–59  
   injectites 58–59, 61, 62, 63  
   depoecentre 59  
   overpressure 59  
   salt ridge 58  
   sand remobilization 59, 62  
 Floki-1 well 58, 59  
 fluid migration 47, 95, 130, 181  
   basement-hosted injectites 227  
   Frimmersdorf Seam 249–250, 252  
   GSICs 181  
   Kodachrome Basin State Park sand pipes 8, 268, 269, 270  
   sandstone-filled faults 276–280, 279  
   TGIC 208  
   thermogenic 47, 63  
 fluidization 1, 11, 69, 70, 95, 288  
   Austral-Magallanes Basin 41  
   Kodachrome Basin State Park 8, 104, 267, 270  
   Mesozoic sandy sediments 99, 103–105, 108  
   sandstone-filled faults 276, 278  
   terminology 4  
   TGIC 192, 200, 204, 208, 209, 275  
 Fort Brown Formation, injectite scale 144  
 Forties Field 7, 167, 172, 178  
 fracture networks  
   basement rock 215  
   fluidized sand propagation 11  
 Franciscan subduction complex 182, 183, 206, 207  
 Freja Member 49, 50, 51  
 Frigg Field 103  
 Frimmersdorf Sand 237, 238, 241, 242, 243, 244, 246, 252  
 Frimmersdorf Seam  
   sand injectite 8, 235, 236, 237, 238, 239–253, 247  
   channel and flood deposits 241, 242, 243, 246  
   emplacement 247–252  
   erosive contact 248–249  
   fluid migration 249–250, 252  
   host unit 244–246  
   humic acid remobilization 248–249  
   intrusive complex 243–244, 248  
   jack-ups 249  
   parent units 241–243, 246  
   sealing unit 247, 251, 252  
   sills and dykes 241, 243–244, 250  
   source 246–247  
   trigger mechanisms 250–251

- Front Range, Colorado  
 basement-hosted injectites 8, 217, 221–225, 227–230, 229  
 dykes 221–226, 223, 227, 229  
 faults 218  
 geological/tectonic background 218–219  
 granite weathering 224–226, 229–230  
 Tavakaiv Quartzite 217, 218, 222, 224–225, 229  
 Ute Pass Fault 217, 218, 221, 222, 225, 229
- Garzweiler open-cast mine  
 lignite/sand succession, Ville Formation 238  
 sand injectites 8, 235–253  
 emplacement 247–252  
 faults 245–246, 250–251  
 source 246–247  
*see also* Frimmersdorf Seam
- Garzweiler Seam 237, 238
- gas hydrates 63
- gas seep features 118
- Goldeneye Field 110
- granitoids, sand injectites 215–230  
 Calabria 218, 219–221  
 weathering 219, 229–230  
 Front Range, Colorado 218–219, 221–225  
 porosity/permeability 225–226  
 weathering 224–226
- Great South Basin (GSB)  
 Paleocene sand injection complex 6, 12–26, 12  
 depositional setting 14, 17, 19  
 discordant intrusions 6, 17, 22, 23, 24  
 faults, polygonal 6, 14, 15, 17–20, 21, 25–26  
 fluids 20–21  
 geological setting 13–14  
 injection 20  
 and polygonal faults 17, 21, 25–26  
 triggers 20–21  
 jack-up structures 22, 23, 24, 25  
 overpressure 20, 21  
 parent units 6  
 seismic anomalies 12, 14, 17, 18, 19, 20, 25  
 dataset 14, 15  
 seismicity 25  
 stratigraphy 13, 14, 16  
 submarine channelized package 6, 17, 20, 21  
 tectonic evolution 16
- Great Valley Group 182, 202, 207
- Grid Formation 73, 75, 87
- Gulf of Mexico, overpressured sands 71
- Gunsight Butte Member, sand pipes 260, 261, 262, 264
- Half Dome outcrop, TGIC 186, 192, 195, 196, 204, 209
- halokinesis, Zechstein evaporites 6, 48
- Hambach open-cast mine 236, 252
- Harding-Gryphon remobilization complex 96
- Hareelv Formation, GSIC 5
- Hefring Member 50, 51, 58–59  
 remobilization 59
- Heimdal sandstone 97, 107, 153
- Hermod sandstone 153, 154, 158, 164
- Hessian Graben 238
- Hoiho Group 13, 16
- Horda Formation 50, 51, 53, 54, 60, 62, 120  
 polygonal faults 48  
 sand remobilization seismic reconstruction 121, 122, 123, 126
- Horda Platform 96
- Horda Shale seal, Brimmond Field 167, 169, 170, 172
- Hordaland Group 7  
 remobilized sands trigger mechanisms 73–81  
 mounds  
 distribution 81–82, 83  
 sand content 83
- Horn Graben 49
- humic acid remobilization 248–249
- hydrocarbon migration  
 Beryl Embayment 143  
 sandstone intrusions 1  
 sandstone-filled faults 278–280
- hydrocarbon reservoirs  
 appraisal and development 1  
 basement-hosted 8, 215, 230  
 analogues 215, 216  
 compartmentalization 273, 279  
 connectivity 1, 7, 11, 273, 279–280, 281  
 GSICs 181, 182, 208  
 injectite networks 146  
 sealing faults 273, 278–279
- hydrofracturing 47  
 Calabria basement-hosted injectite 220  
 Frimmersdorf Seam 236  
 lignite injectites 248–249, 250, 252  
 pore fluid pressure 181–182  
 sandstone intrusions 2, 3, 104, 106, 107–108, 181–182, 288  
 Austral-Magallanes Basin 35, 41, 43  
 erosion during emplacement 2, 35  
 TGIC 193, 195–196, 197, 200, 207, 208  
 Volund Field 155, 157
- hydrothermal fluids 70
- Ibenholt Valley 48, 49, 56
- Idun sandstone member 50, 51, 52, 53
- illite, Statfjord Group 98, 99
- incised channel  
 North Sea Basin 142  
 seismic data 120, 122, 123, 124, 127
- Inden open-cast mine 236, 252
- Ionian subduction zone 218
- jack-up structures 3, 7, 72, 110–111, 249  
 Austral-Magallanes Basin 34, 35, 36, 37, 39, 40  
 GSB 22, 23, 24, 25  
 TGIC 192, 196  
 Utsira High 7, 75, 77
- Jackerath Horst 236, 238, 244, 246, 250–251
- jamming, remobilization systems 104–105, 107, 108
- Johan Sverdrup oil field 72, 73, 74, 75, 76, 77
- Kalkin ZG-1 well 3, 30, 32, 33, 34, 39  
 core data 35, 38, 42  
 gamma-ray log 35, 38  
 resistivity 38  
 sedimentary facies 35, 38–39
- Kaolinitization 98
- Karoo Basin, SIC 5
- Kawau Formation 14
- Kawau Sub-basin 12

- Kimmeridge Clay Formation, oil 172  
 Kobra Field 152, 158  
 Kodachrome Basin State Park  
   sand pipe formation 8, 104, 259–270, 260, 261  
   Chimney Rock Pipe 261, 264, 266  
   clay smears 269  
   faults 265, 266, 267, 268, 269  
   fluid migration 8, 104, 268, 269, 270  
   fluidization 8, 104, 267, 270  
   host rock stratigraphy 260, 262  
   pipe cementation 259, 263, 265, 269, 270  
   pipe composition and structure 263, 264–265  
   pipe distribution 261, 263–264  
   pipe geometry 260, 263  
   sub-horizontal layering 264–265, 267, 268, 270  
   triggering events 259, 268–269  
     earthquake 269  
     fluid flow and liquefaction 268–269, 270  
     withdrawal syncline 260, 265–266, 267, 270  
 Kolga sandstone member 50, 51, 52, 53, 54  
 Köln Block 236, 238  
 Krefeld Block 236, 238  
 Kreyenhagen Shale  
   fluidization velocity 276  
   sandstone-filled fault 275, 276  
   TGIC 182–184, 185, 186, 187, 198, 205, 208, 274  
 Kupferschiefer Formation 57  
  
 Lark Formation 50, 51, 56, 121  
   polygonal faults 48  
 lignite  
   formation 247–248  
   sand injectite 8, 235, 239–253  
 liquefaction 4, 69, 268, 269, 270  
   seismicity 11, 25, 71  
   slab sliding 85–86  
 Lista Formation 7, 50, 51, 53, 54, 56, 97  
   injectites 136, 137, 138, 142, 143, 146  
 loading  
   glacial 70  
   and overpressure formation 47, 57, 62, 63  
 Lodo Formation 182, 183–186, 187, 205, 208, 274  
 Lomre Terrace, mounds 110  
 Lower Rhine Basin 235, 236  
   fault planes, clay smears 251–252  
   sand injectites 235–253  
   stratigraphy 237, 238  
 Lower Rhine Embayment 235, 236, 238  
   earthquakes 238, 251  
   extension and subsidence 238  
   geological background 236–238  
   injectites 235, 251, 252–253  
   stratigraphy 237, 238  
   stress fields 251  
   tectonic activity 251  
 Luna Graben 57  
 Luna Valley 48, 49, 50, 51  
   overpressure 57, 62  
   sand remobilization and injectites 56–57, 61, 63  
   seal failure 57  
 Luna-1 well 56–57  
  
 Måløy slope, sand injection 19, 40, 59, 63, 72, 88  
 Marinella, basement-hosted injectite 216, 219–220  
  
 Marshall Paraconformity 16, 18  
 Maule Field, Eocene sandstone 167, 168, 171, 172, 174, 175, 177, 178–179  
 Maureen Formation  
   as parent sand 7, 136–142, 139  
   sand weld 142  
 Messinian limestone, Calabria 218, 219, 220, 228  
 Messinian Salinity Crisis 63  
 meteorite impact, sand injection triggering mechanism 71, 259  
 Mid North Sea High 72  
 mineralogy *see* sandstone intrusions, petrography and mineralogy  
 Monocline Ridge 274  
   sandstone-filled fault 275, 276  
 Moray Group 121, 122, 126  
 Moreno Formation 182, 183, 209, 274  
   sandstone-filled fault 275, 277  
   fluidization velocity 276  
 Morken lignite Seam 237, 238  
 mounds  
   Siri Canyon 52, 53, 61  
   Utsira High 7, 75, 76–77, 79–80, 80–83, 84, 86, 109  
 mud volcanoes 11  
 mudstone  
   Austral-Magallanes Basin 32–35, 39, 41, 43  
   breccia 3  
   Central North Sea 120, 121, 127, 130  
   GSB 17, 19, 21, 25  
   Lark Formation 56  
   Lista Formation 53, 136, 142  
   TGIC 182, 183, 184, 185, 190, 191, 193–194, 195, 196, 198, 199, 209  
   Utsira High 76, 78, 80  
   Volund southern wing 151–152, 155, 156, 157, 159, 160–161, 164–165  
  
 Nanaimo Basin, SIC 5  
 Nanco ZG-1 well 30, 32, 33, 34, 39  
   core data 35, 38  
   gamma-ray log 35, 38  
   resistivity 38  
   sedimentary facies 35, 38–39  
 Nauchlan Member 110, 205  
 Navajo Sandstone 264, 267  
 Nelson Field 167, 168  
 Neurath Sand 237, 238, 241, 242, 243, 244, 246, 249–250, 252  
 Nevadan orogeny 182  
 New Idria mass-transport deposit 208  
 Nini segment 50, 52  
   injectites 52, 53, 54, 55  
 nonconformity, basement, Calabria 218  
 Nordland Group 50, 51, 121, 122  
 North Sea, transgression/regression LRE 238  
 North Sea Basin  
   deep-water fan systems 48, 95, 136  
   deep-water sand injection triggering mechanisms 72–73  
   injectites 12, 48  
   overpressure 142  
   source 141–142  
   timing 143  
   Paleocene sediments 136, 137  
   bowl structures, seismic mapping 136–146

- polygonal faults 48
  - stratigraphy 137
  - submarine fan deposits 136
  - as subsurface analogue 39, 40, 41
- North Viking Graben 22
  - diagenetic stages 98
  - gravity sliding 86
  - hydrocarbon generation 97
- Northern Area, Norwegian–Danish Basin 50, 51, 58, 60
  - overpressure 60
  - salt ridges 60
  - sediment slump remobilization/injectites 60, 61, 62
- Northern North Sea, stratigraphy 73
- Norwegian–Danish Basin
  - differential loading and depocentres 59, 62, 63
  - sand injection complex 6–7, 48
  - sand injectites 48, 50–60
    - data 50
    - see also Floki Fairway submarine channel system; Luna Valley; Siri Canyon
  - sand remobilization controlling factors 60–64
    - halokinetic faulting 6, 48
    - injection geometry 6, 61–62
    - overpressure mechanisms 6, 62–63
    - parent sand 6, 60–62
    - polygonal faulting 56, 63
    - timing 63
    - trigger mechanisms 6, 63–64
  - sedimentation 48–50, 51
  - stratigraphy 48–50, 51
  - tectonics and structure 48
- Numidian Flysch, SIC 5
- outcrop analogues 2, 40, 41, 215
- outcrop data 7–8, 182
- Outer Moray Firth 72, 109
- overpressure
  - Floki Fairway submarine channel system 59
  - N-DB 55, 56, 57, 60, 62–63
  - sand injection 11, 47, 71–73, 288
    - Austral-Magallanes Basin 41, 43
    - GSB 20, 21
    - North Sea Basin 142
  - TGIC 208, 209
- Pakaha Group 13, 14, 16
- Pakaha Horst 12
- Pakaha-1 well 12, 14
- palaeoseafloor, sand extrusion 4, 53, 55–56, 275, 288
- Paleogene, Balder Field reservoir sandstone 95
- Panoche Giant Injection Complex (PGIC) 5, 182, 183, 187, 274, 287–288
  - comparison with TGIC 199, 202, 204, 205, 207, 208–209
  - extrudites 275
  - as outcrop analogue 40, 41
  - petrology and mineralogy 288–299
  - turbidite remobilization 274–275
- Panoche Hills 274
- parent body 4, 69, 95, 118
  - Balder Field sand injection complex 95
  - North Sea Basin injectites 141–142
  - overpressure 71
  - sand depletion 135
- parent sandstone 4, 47
  - Norwegian–Danish Basin 55, 56, 57, 60–62
- parent units 4
  - NDB 6
- Paria River Member 260, 262
- Parihaka-1 well 16
- Peel Fault 236
- Penrod Group 13, 14, 16
- petrography see sandstone intrusions, petrography and mineralogy
- petroleum exploration, Austral-Magallanes Basin 6, 29, 41, 43
- petroleum resources
  - GSICs 181, 182
  - see also hydrocarbon reservoirs
- Phycosiphon* 38
- Pietragrande injectite outcrop 216, 218, 219, 221
- Pikes Peak Granite 217, 225, 229
- Planolites* 38
- pockmarks 63, 122, 123, 124
- Porcupine Basin, slab sliding 85
- proppants, sand 215
- pseudotachylite, Marinella injectite 219
- Pukaki Sub-basin 12
- quartzite, basement-hosted injectite, Front Range, Colorado 217, 218
- radioactive waste disposal 1
- Rakiura Group 13, 14, 16
- Rakiura Trough 12
- remobilization
  - terminology 4
  - triggers 47
- Rhenish Massif 235, 236
- Rhine Rift System 237–238
- Rind sandstone member 50, 51, 52, 53
- Ringhorne Field 95
- Ringkøbing-Fyn High 48, 49
- Rio Chico-Dungeness High 29, 30, 32, 41
- Rocas Verdes tectonostratigraphic sequence 29–30, 31
- Rodinia Supercontinent, breakup 218
- Roer Valley Graben 235, 236, 238
- Roermond 1992 earthquake 238
- Rogaland Group 48–49, 51, 62
- Rona Ridge, fractured basement reservoir 216
- Rur Block 236, 238
- Rur Fault 236
- salt
  - faulting, remobilization trigger mechanism 63
  - Norwegian–Danish Basin 48, 49, 52, 58, 60
- San Andreas Fault System 183, 274, 276
- San Joaquin Basin 274
  - TGIC 182, 183, 206, 207
- San Nicola Formation 218, 219, 220
- sand
  - aeolian, Kodachrome pipes 259
  - sequence stratigraphy 111
- sand depletion, parent body 135, 142, 143
- sand entrainment 99–103
  - analogues 101, 108–109
  - CHOPS 99, 100, 101, 108, 109
  - sequence stratigraphy 111

- sand extrusion  
 palaeoseafloor 4, 288  
 Siri Canyon 53, 55–56
- sand injection  
 origin of sand 4  
 overpressure 11, 20, 21, 47, 288  
 process 4, 11  
 scale invariance 1–2, 11, 143–146  
 terminology 2, 4  
 timing 4, 6  
 triggering mechanism 11, 20–21, 25, 47, 63–64, 70–88  
 downslope slab sliding 85–88  
 earthquakes 11, 25, 71  
 lateral fluid transfer 70, 142  
 meteorite impact 71  
 overpressure 70, 71–73, 142  
 polygonal faults 70–71
- sand injection complexes  
 giant (GSICs) 1, 2, 3, 5, 181–182  
*see also* Panoche Giant Injection Complex; Tumey  
 Giant Injection Complex
- sand injectites 117, 118, 235, 238–239  
 Austral-Magallanes Basin GSIC 6, 41, 42, 43  
 basement-hosted 8, 215–230  
 Calabria 216, 218–221  
 emplacement depth 227, 228  
 exhumation 218, 219, 230  
 fluid migration 227  
 Front Range, Colorado 217, 218–219, 221–225  
 overpressure 228  
 proppants 215  
 sealing medium 228–229  
 Central North Sea 120–132  
 conical 171  
 depositional or intruded structures 110–111  
 dykes 118, 124, 127, 128, 129, 130, 131, 132  
 basement-hosted 215, 218–225  
 lignite seams 239  
 Eocene, Brimmond Sand Fairway 168, 170, 171  
 fan deltas 126, 127, 128, 129, 130, 131  
 Central North Sea 120–123  
 Floki Fairway 58–59  
 formation 47  
 Garzweiler open-cast mine 235–253  
 Frimmersdorf Seam 239–241  
 incised channels 120, 122, 123, 124, 127, 128, 129, 130  
 North Sea Basin 142  
 Luna Valley 56–57  
 Norwegian–Danish Basin 50–64  
 parent body 118, 129, 130, 132  
 North Sea Basin 141–142  
 sand depletion 135, 142, 143  
 pockmarks 122, 123, 124, 127, 128, 129, 130, 132  
 sand sheets 118, 122, 129, 131, 132  
 saucer-shaped 122, 124, 127, 128, 129, 130, 131, 132  
 seismic 3D mapping 135–146  
 seismic identification 117  
 sequence stratigraphy and structural context 111, 117  
 sheet-shaped 122, 124, 127, 130  
 shelf break 123, 125, 127, 128, 129, 130, 131  
 sills 118, 124, 130, 131, 132  
 basement-hosted 215  
 lignite seams 239  
 Siri Canyon 52–55  
 terminology 2, 4  
 timing, North Sea Basin 143
- sand pipes 8, 104, 259–270  
*see also* Kodachrome Basin State Park, sand pipe  
 formation
- sand remobilization 117  
 Brimmond Sand Fairway 167–179  
 broadband omnidirectional seismic reconstruction  
 117–132  
 Central North Sea 120–132  
 depositional/structural mapping 125–129, 131  
 method and workflow 118–120  
 in deep marine deposits, triggers 69–88  
 entrainment and emplacement 99–112  
 Floki Fairway 59, 62  
 processes 117, 131
- sand volcanoes, palaeoseafloor 4, 6  
 sand welds 7, 142, 143
- sandstone intrusions 2, 3  
 bowl-shaped 4, 7, 20  
 complex internal reflections, GSB 17, 19, 24, 25  
 conical 4, 11, 47, 72, 118  
 discordance to bedding 4  
 Austral-Magallanes Basin 6, 35  
 GSB 6, 17, 20, 22, 23, 24  
 dykes 4, 11, 69  
 Austral-Magallanes Basin 34, 35, 36, 37  
 grain modification 288, 294–298  
 hydraulic fractures 2, 181–182  
 hydrocarbon migration 1  
 jack-up structures 72, 77, 111, 192  
 mineralogy *see* sandstone intrusions,  
 petrography and mineralogy
- outcrop data 182  
 petrography and mineralogy 8, 287–299  
 abrasion 288, 295, 296–297, 299  
 corrosion 297, 299  
 heavy minerals 291–292  
 micro-fractured sand grains 3, 289–296, 299  
 mineral fractionation 288, 292, 298, 299  
 mudstone clasts 290–291, 297–298, 299  
 saucer-shaped 4, 11, 47, 69, 72, 75  
 Austral-Magallanes Basin 35, 40  
 GSB 17, 22, 25
- seismic imaging 11
- sills 4, 11, 69  
 Austral-Magallanes Basin 34, 35, 36, 37  
 Viking Graben 104–107
- terminology 2, 4
- wing-like  
 GSB 17, 20, 23, 25  
 TGIC *see* Tumey Giant Injection Complex  
 Volund Field 3, 151–165, 205
- wings and saucers 4  
 Volund Field 151, 163  
*see also* sand injectites
- Santa Cruz Mudstone 5, 288, 290, 293, 294  
 saucers *see* sandstone intrusions, saucer-shaped
- scale invariance, clastic injectites 143–146
- sea-level change, sand remobilization and injectites 63
- seal breach 11, 21, 25, 117, 181  
 N-DB 55, 56, 57  
 sand remobilization, Utsira High 104, 106,  
 107–108, 109

- seals, hydrocarbon systems 1, 11, 43, 117
- seismicity  
 and gravitational collapse 208  
 and liquefaction 11, 25  
 sand injection trigger mechanism 259
- Sele Formation 50, 51, 53, 54, 57  
 sand remobilization seismic reconstruction 120, **121**,  
 122, 123, 124, **125**, 126, 128, 129, 130
- Serre Massif, Calabria, basement-hosted injectites 8, 216,  
 218, 229
- Shale Gouge Ratio (SGR) 273
- Shale Smear Factor 273
- shearing  
 earthquakes 71  
 meteorite impact 71  
 water liberation 70
- Shephard Point, sand pipes 260, 261, 266  
 faults 268–269  
 withdrawal syncline 260, 265–266, 267, 270
- Sierra Nevada magmatic arc 182, 206, 208
- Sila Massif, Calabria, basement-hosted injectites 216, 218
- silicification 98
- sills 4, 118  
 Austral-Magallanes Basin 35, 39  
 Frimmersdorf Seam 241, 243–244, 250  
 sandstone-filled faults 280–281  
 TGIC 185–187, 189, 191, 192–197, 201–204  
 Viking Graben 7, 40  
 Volund Formation 40, 153, 154–155, 156, 163  
*see also* sand injectites, sills; sandstone intrusions, sills
- Silver Creek 274  
 sandstone-filled fault 276, 278
- Siri Canyon 48, 49, 50, 52–55  
 overburden 51, 55–56, 61  
 sand extrusion 53, 55–56  
 overpressure 55, 56  
 sandstone members 50, 51, 52–55  
 acoustic character 52, 53  
 dykes and sills 53, 61  
 hydrocarbon potential 55, 63  
 mounds 52, 53, 61  
 remobilization and injectites 52–55, 61, 62  
 seal failure 53, 55, 56
- Siri wells 52
- Skade Formation 73, 74, 75, 76, 80–81, 87
- slab sliding, sand injection trigger mechanism 85–88
- South Viking Graben 72
- Statfjord Formation 95, 96, 97, 99
- Statfjord Group 106, 107, 111
- Stavanger Platform 72
- Stine segment, injectites 52, 53, 54
- Stord Basin 72, 96  
 fault reactivation 98
- Stronsay Group 49, 51, 120, **121**, 122, 126
- Takapu Sub-basin 12
- Taratu Formation 14
- Tartan mudstone Formation 13, 14, 16, 17
- Tavakaiv Quartzite 217, 218, 222, 224–225, 229
- Tay Sandstone Member 120, **121**, 129, 130
- Tegelen Fault 236
- Thalassinoides* 38
- tidal pumping 70
- Tierra del Fuego, SIC 5
- tonalite, Calabria basement-hosted injectites 219–220,  
 221, 227, 229
- Tonto Field, Eocene sandstone 167, 168, 172, 176, 177,  
 178, 179
- traps  
 Austral-Magallanes Basin 41, 43  
 GSICs 181
- Tulare Formation 184, 185, 187
- Tumey Giant Injection Complex (TGIC) 5, 7–8, 182–210,  
 274, 275, 287–288  
 architecture 185, 187–193  
 geometry and framework 204, 205, 206, 207  
 lower interval 185, 187, 188, **189**, 191, 192, 197  
 upper interval 185, 187, **189**, 192, 195–197, 201  
 breccia 185, 193–197, 199–200, 209  
 comparison with PGIC 199, 202, 204, 205,  
 207, 208–209  
 conceptual model 206  
 dykes 185, 187, 189, 190, 191, 192–193, 194,  
 196, 197, 201–204  
 fluidization 192, 200, 204, 208, 209, 275  
 geological controls 207–208  
 geological setting 182–184  
 Half Dome outcrop 186, 192, 195, 196, 204, 209  
 hydrofracturing 193, 195–196, 197, 200, 207, 208  
 injectites 185, 200, 201  
 outcrop data 182  
 overpressure 208, 209  
 palaeostress analysis 185, 187, 202, 203  
 parent units 185, 187, **188**, 204  
 lower 188–189, 190  
 upper **189**, 192, 193, 194  
 sandstone intrusions 187, **188**, 194–195, 196, 199,  
 200, 201–202, 207–208  
 geometry 204, 205  
 lower 189, 192  
 petrology and mineralogy 288–299  
 as subsurface analogue 208–209  
 upper 192–193, 195  
 saucer-shaped intrusions 204, 209  
 sedimentary logs 184–185  
 sills 185–187, 189, 191, 192–197, 201–204  
 stratigraphy 183, 185, 187  
 structural analysis 185, 187, 201–202  
 trigger mechanisms 208  
 turbidites 182, 185, 187, 190, 192, 193, 195, 206, 208  
 wing intrusion 3, 8, 184, 185, 186, 192, 193, 195, 196,  
 203, 204, 205, 209
- Tumey Gulch 274  
 sandstone-filled fault 275, 277
- Tumey Hills 274  
 geological setting 182–184, 186
- Tumey Sandstone Lentil 184, 185, 186, 187, 198, 205
- turbidites  
 Austral-Magallanes Basin 38, 39, 41  
 TGIC 182, 185, 187, 190, 192, 193, 195, 206, 208
- Ty sandstone 107, 137
- Tyr sandstone member 50, 51, 52, 53, 54, 55
- unconformities  
 Base Cretaceous 103, 104  
 early Eocene 185  
 late Eocene 185, 187, 198, 210  
 Lower Triassic 106, 107

- unconformities (*Continued*)
  - Mid-Cimmerian 106, 107
  - Mid-Miocene 50, 51, 55, 57
  - near-Top Oligocene 50, 51
  - Oligocene-Miocene 185
- Upper Rhine Graben 238
- Ute Pass Fault (UPF) 217, 218, 221, 222, 225, 229
- Utsira Formation 73, 74, 75, 76
  - sand extrusion 80–81
- Utsira High 72, 95, 96
  - earthquakes 109
  - fractured basement reservoir 216
  - inversion 98, 109
  - prior to remobilization 106, 107
  - sand remobilization 98
    - depositional or intruded structures 110–111
    - extent 109
    - fluid flow and temperature gradients 103–104
    - fluid nature and volume 103
    - fluid source 103
    - jack-up structures 7, 75
    - overpressure 103, 104
    - parent bed 75, 95, 98, 103–104
    - quiet periods 78, 80
    - sand extrusion 80–81
    - seismic data 7, 73–81
    - sill emplacement 104–107, 109
    - trigger mechanisms
      - downslope slab sliding 85–88
      - lack of rim synclines 75, 85
      - liquefaction 75
      - mounds 7, 75, 76–77, 79, 80–83, 84, 86, 109
      - polygonal faults 75–76, 78
    - uplift 77
- Våle Formation 50, 51, 53, 54, 137
- Venlo Block 235, 236, 238
- Viersen Fault 236
- Viking Graben 7, 96
  - fluid migration 7, 103–104
  - hydrocarbon generation 97
  - inversion 98
  - sand deposition 97
- sand remobilization 103–104, 109
  - fluids 103
  - overpressure 103, 104
  - seismic data 82
  - sills 7, 40
  - subsidence and uplift 97–98
- Ville Formation 237
  - lignite 235, 238
- Viper Field 152, 158
- Vocontian Basin, SIC 5, 207
- Volund Field 152
  - geological setting 152
  - oil wells 151, 152, 154, 155, 158–159
  - seismic data 152, 153
  - southern wing 3, 7, 151–165
    - attic oil 158
    - borehole logs 155, 157, 161–162
    - gas cap 155, 158
    - Hermod sandstone parent unit 153, 154, 158, 164
    - mudstone 155, 156, 157, 159, 160–161, 164–165
    - reservoir architecture 154–162, 157
    - sandstone intrusions 40, 153, 154–165
      - porosity variation 158–162, 163, 164
    - sills 40, 153, 154–155, 156, 163
    - wing geometry 164, 205, 209
- Volund injection complex 96, 110, 153, 155, 156, 157
- weathering, basement-hosted injectites 216, 218, 219, 224–226, 229–230
- Westray Group 49, 51, 121, 122
- Wickliffe Formation 14, 16, 17
  - seismic anomalies 13, 14, 17
- Wiggler Wash Member 260, 261, 262
- wings *see* sandstone intrusions, wing-like
- Winsor Member, sand pipes 260, 261, 262, 264
- Zechstein evaporites 106, 107
  - halokinesis 48
- zircon/tourmaline ratio 292, 298, 299
- Zona Glauconitica Formation 41
- Zoophycos* 38