Index

Note: page numbers in italics refer to Figures, while those in bold denote Tables.

2D data see two-dimensional seismic data
3D data see three-dimensional seismic data

abandoned meander loops 127
adjustment bounded cycles (ABCs) 62–4, 80
aggradation 212
Amazon Fan 60, 71–7, 74, 78, 234
amplitude attribute maps 225, 227
amplitude extraction 4, 5–7, 51, 53
amplitude time slices 12
anastomosing channels 207, 208–9, 209, 213, 219
Angola see offshore Angola
ANNs see artificial neural networks
anthropogenic hazards 8–10
Arabian Gulf see Persian (Arabian) Gulf
artificial neural networks (ANNs) 123–4
see also neural networks classification
automated seismic facies classification 21–2, 23
automated seismic facies mapping 105–20
avulsion 42, 211–12, 218, 224

Barents Sea
former ice stream imprints 151–69
palaeo-shelf sediments 158–9, 164–7
palaeo-slope sediments 152, 165–7
seafloor morphology 153, 155, 156–8
stratigraphy and chronology 155–6
base-level changes 212, 214
see also sea level
basement morphology, San Juan Basin 144–7
Base-Miocene unconformity (BMU) 254, 256, 257, 258, 259, 263, 264
Base-Pliocene flooding surface (BPFS) 254, 260, 261
Base-Pliocene unconformity (BPSU) 234, 261–3
bed-load channels 208, 212
biogeography 8
Bjørnøya Trough, Barents Sea 152–3, 156
Bjørnøya Trough Mouth Fan 152, 154, 158, 165–7
BMU see Base-Miocene unconformity
Borneo, Kutei Basin 86
bottom-current processes 237–52
contourites 245, 246, 248–51, 249–50
sediment waves 241–5, 247–8, 250
bounding surfaces 29–30
BPFS see Base-Pliocene flooding surface
BPSU see Base-Pliocene unconformity
braided channels 207, 208, 209, 211, 213, 215, 217
Brazos River valley, Louisiana shelf 34–5
breccias
cave collapse 193, 194, 198–9
hydrothermal 199
Brushy Canyon Formation 58–60, 72–3, 76
buried surface lineations 158–9
Caddo Limestone 189, 195, 196, 201
Calcasieu River valley, Louisiana shelf 33–4, 37, 38
canyons, Mahakam Delta 97–8
carbonates
collapse features 187–203
curvature analysis 142–3, 144
eolianites 178–9
oolites 171–2, 178–9, 182–3
ramp evaluation 171–2, 179–84
seismic facies mapping 105–20
shoreface clinoforms 171–85
caves, Ellenburger Formation 192, 193
channel fairway 240, 242
channel fills 57–8, 99–102, 250
channel form facies 68
channel–levee complexes
offshore West Africa 224
Pliocene deep-water system 142
structural features 143
see also lobe–channel–levee complexes
channels
branching network 73
classification 206–10, 207–14
deep-water turbidites 3, 8, 11–13, 142
fluvial 22–6, 32–8
geometry identification 24, 25
high-gradient, linear 225–31, 232, 232, 233
Mahakam Delta shelf 94, 95, 98
parameterization 126–8
pattern characteristics 209, 213
plan view morphology 209, 213
sediment type 207, 208
slope turbidites 93
straight 207, 232–4
tributary slope systems 238–40
see also incised channels; sinuous channels;
subaerial channels; submarine channels
chaotic reflection (CR) packages 258, 259
chronostratigraphy
OIS2 sequence boundary 38–40
sequence boundaries 30, 32
West African continental margin 51–2, 54
cliniforms
carbonate shoreface 171–85
genometry 173–9
Mahakam Delta, Indonesia 90, 91, 93, 96–7
Pliocene 262–3
toplap/downlap relationships 173–4, 175
coastal dune–interdune topography 177
coastal plain sequence 22–6
cockpit karst geomorphology 192, 193, 196
coherecence horizon extractions 202
Ellenburger Formation 190
Marble Falls Formation 195, 197
coherecence time slices 5, 12, 13
collapse features
breccia 193, 194, 198–9
chimneys 187, 191, 192–3, 199
Fort Worth Basin 187–203
Colorado River 35, 38
continental margins
Gulf of Mexico 29–46
Mauritania 237–52
West Africa 47–84
contourites 245, 246, 248–51, 249–50
correlation coefficients 112
CR see chaotic reflection
Cretaceous
reservoirs, San Juan Basin 144–7
Sarvak Formation 105–20
unconformity 3
curvature analysis
collapse features 188–90, 192
deep-water channel system 142
Devonian carbonate buildups 142–3, 144
San Juan Basin 144–7
sinuous rivers 128–31, 132, 133
uses 140
visualization 139–49
Dakota Formation 144, 145, 146
data interrogation strategies 12
deep-marine margin adjustment 77
deep-water channel systems 8, 142
deep-water crevasse splay 10
deep-water deposition
architectural elements 57–8
local v. regional controls 77–80
outcrop analogues 58–60
stratigraphic analysis 47–84
deep-water turbidite system 3, 6, 11–13
def ormation belts, continental margins 48, 49
DEM see digital elevation model
depositional sequences
seismic imaging 15–28
stratal slicing 24, 25, 27
Devonian
carbonate buildups, curvature analysis 142–3, 144
pinnacle reefs, facies mapping 9
digital elevation model (DEM) data 147, 148
dip curvature 140, 141, 142, 146
dip-oriented seismic section 71
dipping planar slices 4, 6
distributive channel complexes 232, 232
downlap
cliniforms 173–4, 175
Mahakam Delta, Indonesia 89, 90, 91
downstream controls on fluvial geomorphology 207, 210
Ellenburger Formation 190–3
horizon extractions 189–90, 194
time slices 195, 196
Eocene, South Pyrenean basin 99–102
erosional canyons 97–8
erosional channels 94
eustatic record, Gulf of Mexico 31–2
e xternal controls on deep-water systems 77–80
‘Exxonian’ sequence boundary 29, 30, 43
facies
automated classification 21–2, 23
lobe-channel–levee complexes 81
lobeform 68
paleocaves 195, 198–9
Sarvak Formation 106–7, 108
Smackover Formation 171, 173–4
facies mapping
automated 105–20
Devonian reefs 9
large-scale depositional domains 114–17
types 106–7, 108
Falher Member, Alberta 143, 145
faults
offshore Angola 224, 231
polygonal, Oligocene sediments 256, 257
first-order stratigraphic cycles 52–3
FLTs see funny looking things
fluvial channels
classification 21–2, 23
Gulf of Mexico 32–8
imaging 22–6
stratal slicing 24, 25
fluvial geomorphology 205–22
3D seismic studies 213–19
downstream controls 207, 210
river types and classification 206–10
upstream controls 207, 210
variability and change factors 210–13
fluvial to deepwater sediment transfer 85–103
folded multi-attribute display 195, 200
folded surfaces, curvature analysis 140–1
Fortho Worth Basin, USA 187–203
fourth-order stratigraphic cycles 55–6, 57, 64–5, 70
frequency control 20
frequency scan 20, 22
fringing ooid-bank margin 182
frontal lobe deposition 78–9
Fruitland Coal 144, 145, 146
funny looking things (FLTs) 2
Gaussian curvature 140, 142, 190
geo logical significance
multi-attribute classification 111
seismic attributes 113
GeoTime cube 121–37
glacio-eustatic cycles 88
gradient control, lobe–channel–levee complexes 61–4
gravity-driven slope and basin physiography 48–9, 50
gravity transport see turbidity currents
Gulf of Mexico
chronology 42–3
continental shelf 29–46
deep-water turbidite system 3, 6, 11–13
geomorphology 32–8, 42
high-resolution seismic data 32, 33
incised valleys 32–8, 42
Halimeda reefs 92, 98
high-amplitude continuous reflectors (HARPs) 58, 78, 79
high amplitude discontinuous reflectors (HARs) 58
high-amplitude seismic reflections 160
high-gradient linear channels 225–31, 232, 233, 233
high-resolution three-dimensional (3D) seismic data 121–37
high shelf-to-basin relief 49, 52
high-sinuosity river 135
INDEX

highstands
  carbonate shoreface clinoforms 177
  Mahakam Delta, Indonesia 94–5
Holocene
  river factors 210–13
  transgressive surface 89, 90–2
horizon-based attribute mapping 5, 11
horizon extractions 189
  see also coherence horizon extractions
horizon picking and illumination 2
horizon slicing 2–4, 17, 18, 26
  see also stratal slicing
hydrocarbon leakage 151
hydrothermal brecciation 199
iceberg plough marks 154
ice streams 151–69
  3D seismic data 154–5
  bed identification 152–4
  mega-scale glacial lineations 154, 156–63
  trough mouth fans 154
igneous geomorphology 10
illumination 2, 161
image logs, palaeocave facies 198–9
imaging quality 15–28
  seismic frequency control 20
  seismic phase character 17–20
  slicing techniques 15–17
incised channels
  3D seismic studies 212, 215, 216, 217
  Mahakam Delta, Indonesia 88, 95, 96, 97, 98–9
  northwestern Gulf of Mexico 32–8, 42
  submarine 225, 227–8, 228, 229, 231, 232–4, 232
  Texas continental shelf 34, 38
  tributary slope systems 238, 240
Indonesia, Mahakam Delta 85–103
  integrated stratigraphic/geomorphic analysis 50–61, 59
  internal controls on deep-water systems 77–80
  interval attribute analysis 4–5, 8
  Intra-Oligocene unconformity (IOU) 254, 256, 257, 263, 264
isochore maps
  Ellenburger Formation 191, 194
  submarine channels 230, 231
Java, offshore 8
Jurassic, Smackover Formation 171–85
karst geomorphology 187–203, 193
large-scale depositional domains 114–17
last glacial eustatic lowstand 29–46
late Pleistocene Mahakam lowstand delta 87
lateral thickness identification 25
LCLCs see lobe–channel–levee complexes
levees
  submarine channels 225, 226–7, 231, 232, 233
  tributary slope channel systems 238–9, 240, 250
  see also channel–levee complexes;
  lobe–channel–levee complexes
limestone 189, 195, 196, 201
  see also carbonates
linear high-gradient channels 225–31, 232, 232, 233
lineations, subglacial see mega-scale glacial lineations
lithofacies, Smackover Formation 171, 173–4
lithology identification 25
Little Bahama Bank 181, 184
lobe–channel–levee complexes (LCLCs) 47–84
  analogue calibration 71–7
  architectural elements 57–8
  depositional pattern 78
  dynamic genesis 58
  evolution 68, 69
  facies associations 81
  gradient control on architecture 61–4
  local v. regional controls 77–80
  stratigraphic cycle hierarchy 52–7, 64–71
  strike oriented cross-sections 75
  three-stage model 79–80
  see also channel–levee complexes
lobiform facies 68
local gradient control 61
local stratigraphic evolution 62–4
Lomre Terrace, offshore Norway 253–67
Louisiana
  Jurassic Smackover Formation 171–85
  offshore shelf 15–28
  western continental shelf 31, 33–7
lower slope environment
  contours 245, 246–7
  sinuous channels 239, 241
low shelf-to-basin relief 52
lowstands
  deposits 87, 90–4, 93
  fluvial geomorphology 32–8
  last glacial eustatic 29–46
  Mahakam Delta, Indonesia 95–8
Mahakam Delta, Indonesia 85–103
  2D and 3D methodology 88–90
  evolitional summary 98–9
  Holocene/Pleistocene stratigraphy 90–4
  late Pleistocene lowstand 87
  modern delta 86–7
  Quaternary sequences 94–8
  transgressive period 98
Marble Falls Formation 190, 191, 195, 197, 201
margin adjustment bounded cycles 62–4
margin basin adjustment 61–2, 80
marine deposits see deep-water deposition
Mauritanian continental slope 237–52
  seafloor morphology 239–40
  sediment waves 241–5
  tributary slope channel systems 238–40
maximum flooding surface 29, 173
maximum lowstand 43
mean curvature 140–1, 141, 195, 196
meander-belt elements 121–37
  characteristics 206
  meander loops 131–5, 133, 136, 241
  object extraction 123–5
  parameterization 125–35
  Recent analogues 125–6
  meandering channels 24, 25, 207, 211, 213
mega-scale glacial lineations
  buried surfaces 158–9
  formation 154
by guest
Downloaded from https://pubs.geoscienceworld.org/books/chapter-pdf/3888703/9781862395251_backmatter.pdf
Miocene
Miocene–Pliocene strata 15–28
shelf sand ridges 8
Upper (Seismic Unit 2) 254, 258–60
Mississippiian, Forth Worth Basin, USA 187–203
mixed-load channels 208, 212
Morillo Formation 99–102
most negative curvature volume 201
movie display mode 25, 27
multi-attribute classification 105–20
attribute evaluation and selection 111–13
neural networks-based 113–14
number of classes 115
Sarvak Formation 109–11
supervised/unsupervised 113–14, 115–18, 117–19
workflow 109
multi-beam bathymetry 146, 147–8
multi-slice mode 25, 27
multi-trace geometric attributes, carbonate collapse
features 187–203
natural cubic splines 126, 128, 129
Nauts Formation, Barents Sea 156
neural networks classification 21–2, 105–20
see also artificial neural networks
Nile River, sinuosity 211, 214
Nitiara River, USA 216
normal curvatures 139
North Sea Basin
soft-sediment features 253–67
stratigraphy 255–63
Norway see offshore Norway
offlapping grainstone units 172
offshore Angola 223–35
see also West African continental margin
offshore Louisiana 15–28
offshore Northwest Java 8
offshore Norway 253–67
Oligocene
Intra-Oligocene unconformity 254, 256, 257, 264
Middle to Upper 254, 258, 259
oolid depositional model 183
oolitic carbonates 171–2, 178–9, 182–3
Ondocian, Ellenburger Formation 190–3
Ouachita fold and thrust belt 188, 190–2
outcrop analogues
Amazon Fan 60
Brushy Canyon Formation 58–60
calibration 71–7
Cosewigue River, Suriname 125
Western Siberian Lowlands 125–6, 127
Zaire Fan 60–1
oxygen isotope curve 31–2
oxygen isotope stage 2 sequence boundary 40
paleo-cave facies 195, 197–9
paleoceanography 7
paleoecological 7–8
paleoecogeographic maps 50–1
INDEX
paleo-shelf sediments 158–9, 164–7
paleo-slope sediments 152, 165–7
Palaeozoic, collapse features 187–203
passive continental margin 48
Permian, Brushy Canyon Formation 58–60, 72–3
Persian (Arabian) Gulf
carbonate ramp 179, 182
dacies mapping 105–20
oolid depositional model 183
phase character 17–20
plan view geometry
channel characteristics 206
channel classification 209, 213
fluviatil systems 205–22
pattern recognition 2, 6
play fairway analysis 80–1
Pleistocene
fluviatil systems, Malay basin 215, 217
transgressive surface 89, 90–2
Pliocene
Base-Pliocene flooding surface 254, 260, 261
Base-Pliocene unconformity 254, 261–3
climaticose forms 262–3
coastal plain sequence 22–6
Miocene–Pliocene strata 15–28
Seismic Unit 2 254, 258–60
Seismic Unit 3 254, 260–1
point bars
parameterization 131–5, 134, 136
reservoirs, Java Sea 218
polygonal faults 256, 257
principal component filtering 194
principal curvatures 139
progradational beach ridges 181
proportional slicing 4, 7, 17
see also stratigraphic slicing
quality of imaging 15–28
Quaternary
eustatic record, Gulf of Mexico 31–2
Mahakam Delta, Indonesia 94–8
sequence boundaries 30
radiocarbon ages
Gulf of Mexico 40, 41, 42–3
OIS2 sequence boundary 41
ramp carbonates 171–2, 179–84
reflector curvature 188–90, 192
regional margin deformation 62–4
reservoir implications, deep-water systems 80–1
Rio Grande 38, 40
rivers see channels; fluvial channels; fluvial
geomorphology
R-mode cluster, seismic attributes 112
root-mean-square (RMS) amplitude 159–63, 162, 166
Sabine River valley, Louisiana shelf 33–4, 38
salt structures 223–4
salt-withdrawal basins 225–8, 229–30
San Juan Basin 144–7
Sarvak Formation 105–20
facies types 106–7, 108
large-scale depositional setting 107–9
multi-attribute classification 109–11
INDEX

sea floor morphology
Barents Sea 153, 155
gulf to-basin relief 49, 52
Mauritanian continental slope 239–40
mega-scale glacial lineations 156–8
West African continental margin 48, 51
sea level
fall, fluvial channels 36
placement 10–12
proxy curve 31–2
see also highstands; lowstands
second-order stratigraphic cycles 53–6, 55–6, 72
see also adjustment bounded cycles
sedimentation, Gulf of Mexico 30–2
sediment blocks
high-amplitude seismic reflections 160
mega-scale glacial lineations 159–63, 165–7
top-block surface 163, 164
sediment type, channel classification 207, 208
sediment waves 241–5, 247–8, 250
seismic analytical techniques 2–5
seismic attributes 105–20
applications 114
geological significance 111, 113
maps 110
meander-belt deposits 124
seismic data see three-dimensional seismic data;
two-dimensional seismic data
seismic facies mapping see facies mapping
seismic frequency control 20
seismic phase character 17–20
seismic phase unwrapping 17
sequence boundaries
oxygen isotope stage 2 29–46
Smackover Formation 173, 178
south Texas shelf 40
sequence stratigraphy 29–46
shelf margin system 172
shelf to slope transition, Mahakam Delta, Indonesia 92–4
sinuosity
degree of 207–8, 209
parameterization 128–31
River Nile 211, 214
subaerial channels 234
submarine channels 233
shelves
channel fills 99–102, 100
sinuous channels
3D seismic studies 215, 219
Mahakam Delta 85–103
parameterization 126–7
planform characteristics 206
submarine 231–4, 232, 239, 241, 247, 250
see also straight channels
Skade Formation 263
sliding techniques 15–17
slope failures, tributary channels 239–40, 242, 246, 250
slope turbidite channels 93
Smackover Formation 171–85
carbonate ramp evaluation 171–2, 179–84
clinoform geometry 173–9
depositional model 171, 174
lithofacies 171–2, 173–4
stacking pattern 176
wave/wind-dominated shoreline 179
Sobrarbe Delta Formation 99–102
soft-sediment features
deformation phases 255
North Sea Basin 253–67
stratigraphic framework 255–63
Sogn Graben 254, 255
South Atlantic continental margin see West African continental margin
South Pyrenean Eocene basin 99–102
spontaneous potential (SP) logs 19
stacking patterns
seismic facies mapping 106, 108
Smackover Formation 176
straight channels 207, 232–4
see also sinuous channels
stratal geometries 106, 108
straal slicing
developmental processes 24, 25, 27
four frequency band panel 22
nonlinear slicing tool 19
Pliocene meandering fluvial system 24, 25
technique 2–4, 17, 18
see also horizon slicing; proportional slicing
stratigraphic analysis
deep-water deposition 47–84
integrated geomorphic analysis 50–61
stratigraphic cycle hierarchy
Brushy Canyon Formation 58–60
deep-water deposition 52–7, 54
evolving patterns 66–7
recognition criteria and characterization 55–6
West African continental margin 64–71
stratigraphy of sequences 29–46
subaerial channels 234
see also submarine channels
subglacial deformation 156–7
subglacial lineations see mega-scale glacial lineations
submarine channels 223–35
characteristics 225–31, 226–30
evolution 232–4
general slope model 231–2, 232
high-gradient linear 225–31
see also subaerial channels
surfaces
bounding surfaces 29–30
folded 140–1
imaging strategies 18
surveys 205–22
transgressive 89, 90–2
visualization 2
Surinam, Tambaredjo oil field 122–3
suspended-load channels 208, 212
Tambaredjo oil field, Surinam 122–3
techniques 2–5, 15–17
tectonic geomorphology 10
Texas continental shelf 31, 34–8, 38–9
texture classification 21
third-order stratigraphic cycles 55–6, 56–7, 59, 63
three-dimensional (3D) seismic data 1–2
fluvial geomorphology 205–22
ice streams 154–5
Mahakam Delta 85–103
meander belt elements 121–37

by guest
Downloaded from https://pubs.geoscienceworld.org/books/chapter-pdf/3888703/9781862395251_backmatter.pdf
three-dimensional (3D) seismic data (Continued)
soft-sediment features 253–67
submarine channels offshore Angola 223–35
time isochore maps 191, 194
time slices 4, 5
Ellenburger Formation 195, 196
underfit streams 218
toplap, clinoforms 173–4, 175, 178
total curvature 140
tributary slope channel systems 238–40, 242
Trinity River valley, Louisiana shelf 34, 37, 38, 42
trough mouth fans 154
turbidites
channel fills, Mahakam Delta 85–103
classification 48
deep-water system, Gulf of Mexico 3, 6, 11–13
turbidity currents 237–52
processes and deposits 246–51, 250
surging 233–4
tributary slope channel systems 238–40
two-dimensional (2D) seismic data 1
curvature attributes 139–49
Mahakam Delta 85–103
unconformities 3, 4
Barents Sea 157
Base-Miocene 254, 256, 257, 263, 264
Base-Pliocene 254, 261–3
Intra-Oligocene 254, 256, 257, 263, 264
OIS2 sequence boundary 38–9
underfit streams 216, 218, 219
upstream controls on fluvial geomorphology 207, 210
Utsira Formation 260, 263
valleys see channels
variance attribute maps 225, 226–7

Viking Graben 254, 255
visualization
curvature attributes 139–49
surfaces 2
volume-based attribute mapping 5, 12, 112, 167
volume co-rendering 5, 13
volume sculpting 17
voxel-growing tool 124, 125
voxels extraction 5, 10, 126–7

Wabamun Formation, Alberta 143, 145
waveform classification 21
wave/wind-dominated shoreline 179
weakly confined channel complexes 231, 232
West African continental margin 47–84
Amazon Fan comparison 78
architectural elements 57–8
basinward fold-belt phase 62–3
Brushy Canyon Formation comparison 76
deep-water deposition 47–9
evolution 79
initial extension and compression phase 62
integrated stratigraphic/geomorphic analysis 50–61
outer fold-belt phase 64
stratigraphic cycle hierarchy 52–7, 64–71
study area and interpretation methods 49–51
see also offshore Angola
West Caicos Island 178
western Louisiana continental shelf 31, 33–4
fluvial channel system 35, 37
sequence boundary 37
Winnipegosis Formation, Saskatchewan 142–3, 144
workflow 2–5, 109

Zaire Fan 60–1, 71–7, 78
zero-phase data 17–20, 26
Seismic Geomorphology
Applications to Hydrocarbon Exploration and Production

Edited by
R. J. Davies, H. W. Posamentier, L. J. Wood and J. A. Cartwright

We are poised to embark on a new era of discovery in the study of geomorphology. The discipline has a long and illustrious history, but in recent years an entirely new way of studying landscapes and seascapes has been developed. It involves the use of 3D seismic data. Just as CAT scans allow medical staff to view our anatomy in 3D, seismic data now allows Earth scientists to do what the early geomorphologists could only dream of – view tens and hundreds of square kilometres of the Earth’s subsurface in 3D and therefore see for the first time how landscapes have evolved through time. This volume demonstrates how Earth scientists are starting to use this relatively new tool to study the dynamic evolution of a range of sedimentary environments.

Visit our online bookshop: http://www.geolsoc.org.uk/bookshop
Geological Society website: http://www.geolsoc.org.uk

Cover illustration:
Miocene carbonate platforms offshore northeast Madura, Indonesia. The colors indicate time structure, with blues indicating topographic lows and reds indicating topographic highs. The area is cut by two left lateral trans-tensional faults. The buildups shown range in size from 3 km (in the foreground) to 7 km in diameter (in the left background). The platform tops lie approximately 240 m above the surrounding basin floor. Note the polygonal fracturing in the left-side middle ground, a feature characteristic of mud-rich basin deposits (seismic data courtesy of MIGAS and PGS).