

# 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) 254, 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  
channelform 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  
clinoforms  
carbonate shoreface 171–85  
geometry 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  
coherence horizon extractions 202  
Ellenburger Formation 190  
Marble Falls Formation 195, 197  
coherence 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
- co-rendered images 5, 13
- Coriolis Deviation 249, 250
- 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
- deformation 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
  - clinoforms 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
- external controls on deep-water systems 77–80
- 'Exxonian' sequence boundary 29, 30, 43
- facies
  - automated classification 21–2, 23
  - lobe–channel–levee complexes 81
  - lobiform 68
  - palaeocaves 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
- Forth 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 (FLT)s 2
- Gaussian curvature 140, 142, 190
- geological 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, 232, 233
- high-resolution three-dimensional (3D) seismic data 121–37
- high shelf-to-basin relief 49, 52
- high-sinuosity river 135

- 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
- lobeform 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  
 contourites 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  
 evolutionary 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

- mega-scale glacial lineations (*Continued*)
  - seafloor morphology 156–8
  - underlying sediment blocks 159–63
- middle slope environment
  - contourites 245, 248–9
  - sediment waves 242–5, 243–4
- Miocene
  - Miocene–Pliocene strata 15–28
  - shelf sand ridges 8
  - Upper (Seismic Unit 2) 254, 258–60
- Mississippian, 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 113
  - Sarvak Formation 109–11
  - supervised/unsupervised 113–14, 115–18, 117–19
  - workflow 109
- multibeam bathymetry 146, 147–8
- multi-slice mode 25, 27
- multi-trace geometric attributes, carbonate collapse features 187–203
- natural cubic splines 126, 128, 129
- Naust Formation, Barents Sea 156
- neural networks classification 21–2, 105–20
  - see also* artificial neural networks
- Nile River, sinuosity 211, 214
- Niobrara 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
- ooid depositional model 183
- oolitic carbonates 171–2, 178–9, 182–3
- Ordovician, 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
  - Cosewijne 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
- palaeocave facies 195, 197–9
- palaeoceanography 7
- palaeoclimatology 7–8
- palaeogeographic maps 50–1
- palaeo-shelf sediments 158–9, 164–7
- palaeo-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
  - facies mapping 105–20
  - ooid depositional model 183
- phase character 17–20
- plan view geometry
  - channel characteristics 206
  - channel classification 209, 213
  - fluvial systems 205–22
  - pattern recognition 2, 6
- play fairway analysis 80–1
- Pleistocene
  - fluvial systems, Malay basin 215, 217
  - transgressive surface 89, 90–2
- Pliocene
  - Base-Pliocene flooding surface 254, 260, 261
  - Base-Pliocene unconformity 254, 261–3
  - clinoforms 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* stratal 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

- seafloor morphology
  - Barents Sea 153, 155
  - high shelf-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
  - turbidite channel fills 99–102, 100
- sinuous channels
  - 3D seismic studies 215, 219
  - Mahakam Delta 85–103
  - parameterization 126–7
  - platform characteristics 206
  - submarine 231–4, 232, 239, 241, 247, 250
  - see also* straight channels
- Skade Formation 263
- slicing 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
- stratal slicing
  - depositional 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

- three-dimensional (3D) seismic data (*Continued*)  
 soft-sediment features 253–67  
 submarine channels offshore Angola 223–35  
 three-dimensional growing algorithm tool 124  
 time isochore maps 191, 194  
 time slices 4, 5  
   Ellenburger Formation 195, 196  
   underfit streams 218  
 tolap, clinofolds 173–4, 175, 178  
 total curvature 140  
 transgressive surface 29  
 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