

Bibliography

- Ekdale AA, Bromley RG, Pemberton SG (1984) Ichnology. The use of trace fossils in sedimentology and stratigraphy. SEPM Short Course 15, pp 317
- Frey RW, Voorhies MR, Howard JD (1975) Estuaries of the Georgia coast, USA: sedimentology and biology. VIII. Fossil and recent skeletal remains in Georgia estuaries. *Senckenberg Marit* 7:257–295
- Niyogi D, Mallick S (1972) Morphology of the Midnapur District, West Bengal. In: Proceeding of seminar on geomorphology, geohydrology and geotectonics of the lower Ganga Basin, Kharagpur IIT: 81–85

Subject Index

A

Areas referred

- Alabama, 33, 159, 246
- Aldabra Atoll, North Carolina, 159
- Andros Island, Bahamas, 69
- Australian coast, 33
- carbonate sandflats of Bahamas, 69
- Cretaceous of British Columbia, 159, 246
- Doboy Sound estuary, USA, 118, 120
- Fergana Bay, 33
- Florida, 33, 113, 234, 239, 254
- Georgia coast, 70, 116, 118, 121, 124, 159, 191, 234, 246, 253, 254
- German Bight, 33, 159, 191, 234, 246
- Gulf of Gaeta, 33, 113, 118, 124, 127, 159, 191, 234, 246, 253
- Long Sand Island, 83
- Miocene of Poland, 159, 246
- Mio-Pliocene of Japan, 159, 246
- North Sea, 33
- Oligocene of Egypt, 159, 237, 246
- Pleistocene of the USA and Bahamas, 159, 246
- Pliocene of England, 159
- Quaternary Miliolites of Saurashtra, India, 205
- Red Sea coast, 33
- Sapelo Island, Georgia, 33
- Scottish Shelf, 33
- Seychelles, 33, 69, 113
- Taiwan tidal flats, 33, 79, 84, 93, 104, 113, 118, 192, 253
- Usu Bay, Indonesia, 33, 113
- Virginia coast, USA, 33
- Willapa Bay, USA, 159, 246

B

Bengal Basin

- geotectonic development, 8
- accretionary wedges (prisms), 7
- Andaman-Nicobar islands, 11
- asymmetric and pericratonic basin, 4
- Barisal–Chandpur Gravity High (BCGH), 6
- basin margin fault, 6, 8
- Bay of Bengal Sea, 1, 4, 5, 9, 14, 16, 19, 33, 139, 164, 238, 239, 281
- Bengal Deep Sea Fan, 6, 9
- Bengal Delta Complex, 1, 4, 6, 11
- Burma plate, 7, 8
- central deep basin, 5, 7
- Chittagong–Tripura Fold Belt (CTFB), 6, 7
- collision stage, 8
- continental drift, 15
- Dauki Fault, 6
- drifting stage, 8
- eighty five degree (85°) East Ridge, 6
- Eurasian plate, 7
- foreland basin, 7
- frontal thrust, 6
- Ganges–Brahmaputra-Meghna (GBM) system, 6
- geotectonic evolution, 7
- geotectonic provinces, 7
- glacio-eustatic oscillations, 9
- Gondwanaland, 9
- Gravity High, 6, 8
- Hatia Trough, 9
- Himalayan orogeny, 4
- Himalayan ranges, 4, 8, 12

- Himalayan upliftment, 9
- Hinge Zone, 5, 6, 8
- hotspot activity, 6, 9
- Indian and Tibetan plates, 7
- Indian shield, 4, 6, 9
- Indo-Burma Ranges, 4, 6, 7
- Indo-Malaysian region, 4
- Jamuna Fault, 6
- Kerguelen hotspot activity, 9
- Kolkata–Mymensingh Hinge Zone (KMHZ), 6
- Malda–Kishengarh Fault, 6
- orogen, 7
- orogenic system, 6
- passive continental margin, 7
- Pleistocene glacial maximum, 9
- proto-Bengal basin, 6, 8
- remnant ocean basin, 7
- sediment depocenter, 8, 9
- sediment provenances, 8
- Shillong Plateau, 6, 8
- stable shelf, 5, 7, 8, 10
- subduction stage, 8
- submarine fan system, 6
- Sunda Arc, 7, 8
- Sundarban Mangrove deltas, 1, 9, 26, 32, 33, 70, 160
- Swatch-of-no-Ground submarine canyon, 6
- Syhet or Surma Trough, 6
- syn-rift stage, 8
- tectonic features, 6
- Tethyan Sea, 7, 15
- stratigraphic build up, 9
 - Barail Group, 9
 - Bogra Formation, 9
 - Bolpur Formation, 9
 - delta progradation stage, 8
 - delta surfaces, 18
 - depositional history, 8
 - Ghatal Formation, 9
 - Holocene-Recent depositional phase, 9
 - Jalangi Formation, 9
 - Kalna Formation, 18, 198, 207, 217, 238, 239, 256, 278
 - Kopili Shale, 9
 - Kusumgram Formation, 18
 - Neogene sediments, 6
 - Rajmahal traps, 22
 - reefal carbonate build-ups, 9
 - Surma Group, 9
 - Sylhet Limestone, 9
 - Tethyan sediments, 7
- Biophysical mechanisms and principles
 - application potential, 32, 160, 183
 - bathymetric zonation, 179, 196
 - biophysical model, 160, 180, 183
 - burrow cycle phases, 181
 - burrow infill, 178, 187
 - burrow morphology, 34, 53, 54, 77, 87, 96, 173, 178, 183
 - burrow morphotypes, 85, 165
 - burrow mouth plugging, 171, 173, 178
 - burrow orientation, 35, 72, 101, 118, 176, 185
 - capillary water, 165, 169, 179, 181, 182
 - secondary projections, 174
 - significance, 32, 139, 183
 - taxonomic identification, 35, 167, 245
- Burrow morphological parameters, 52, 53
 - actual length (AL), 52, 99
 - AL and SAL, 53
 - burrow axis, 53
 - capillary juvenile shafts, 72
 - capillary (narrow) burrow tubes, 34, 46, 49, 85
 - depth of max./min. circumference (MxD/MnD), 52
 - diameter of burrow opening, 53
 - HB and DB, 53
 - height of max./min. circumference (MxH/MnH), 52
 - max./min. circumference (MxC/MnC), 52
 - opening diameter (OD), 52, 53, 99
 - PVL and SVL, 53
 - spiral burrow, 54, 106
 - swollen nodes, 54, 104, 244
 - vertical length (VL), 52, 53, 99, 101, 106, 174, 205, 255
 - VOB, HOB and AOB, 53
- C**
 - Conceptual terminologies
 - abandoned burrow, 50
 - burrow cycle, 50, 180, 181
 - complete/incomplete burrow, 50
 - complex or composite burrow forms, 52
 - cyclic biological process, 178
 - ecospace shortage, 196
 - hydrodynamic parameters, 179
 - ichnoprofile, 35, 50, 167
 - ichnostratigraphy, 50
 - ichnotaxonomy, 183
 - juvenile/young/adult/old burrow, 50
 - male/female burrow, 50
 - network burrow system, 52, 54

- occupied/unoccupied burrow, 50
 - paraffin wax casting, 167
 - pelletal/pellet-spread design, 52
 - permanent burrow, 50
 - pre-tidal/post-tidal burrows, 50, 170
 - post-tidal sediment domes, 174
 - primary/ main shaft, 52
 - primary/Secondary aperture/opening, 52
 - secondary burrow arm, 174
 - secondary shaft/arm, 52
 - simple burrow forms, 52
 - temporary burrow, 50, 113
- E**
- Ediacaran fossil analogues
 - Cyclomedusa cf. radiata*, 136, 251
 - Cyclomedusa davidi*, 136, 251
 - Cyclomedusa* sp., 136
 - Ediacaria cf. flindersi, 136, 251
 - Medusinites sp., 136
 - Nimbia* sp., 139
 - Paliella* sp., 139
 - Environmental zonation
 - barren zone, 142, 194, 196, 247, 279
 - Charybdis* subzone, 199, 201, 279
 - coastal ichnozones/subzones, 195, 279
 - Diopatra* subzone, 198, 279
 - Dotilla-Scylla-Varuna-Alpheus* subzone, 199, 200, 279
 - Heteropilumnus-Eurycarcinus-Tagelus*-polychaete boring subzone, 198, 279
 - lower estuarine ichnozones/subzones, 191, 194, 279
 - Macoma* subzone, 198, 279
 - Ocyopode-Ilyoplax-Metaplax* subzone, 195, 196, 279
 - pellet spread subzone, 191, 198
 - Uca-Turritella-Telescopium* subzone, 191, 196, 279
- G**
- Geological significance
 - palaeoenvironmental, 233, 234, 236, 281
 - burrow orientation and
 - palaeogeomorphology, 242
 - current flow pattern, 243, 252
 - geopetals, 243, 282
 - ichnological adaptations in mangrove ecosystem, 243
 - palaeosealevel interpretations, 237
 - recognition/characterization of
 - paleoshoreline environments, 234
 - recognition of depositional events, 236, 252
 - significance of long cross-coast
 - Ocyopodid trackways, 245
 - temporal changes in ichnozones, 264
 - coastline retreat/erosion, 264
 - sea level rise, 264
 - trace fossil interpretations, 246
 - characterization of *Psilonichnus*
 - ichnofacies, 180
 - ichnotaxonomy, 277
 - modern analogues, 249–251, 277, 283, 284
 - recognition of ancient crab burrows, 247
 - Geotechnical significance
 - Uca* mud mounds, indicators of beach instability, 263
 - current annual rates of deposition and erosion, 252, 256
 - directional properties, 261
 - ichnological activities as cause of beach erosion, 258
 - decay of ancient Kalna firm and hardgrounds, 260
 - reworking of sediments by crabs—
 - Digha beach erosion, 258
 - placer exploration, 262, 263
- I**
- Ichnofabric
 - conceptual background, 211, 214, 217
 - equilibrium species, 221, 229, 281
 - Nabadwip ichnofabrics, 218
 - backshore - foreshore ichnofabric, 218
 - estuarine river bank ichnofabric, 218, 281
 - estuarine river bar ichnofabric, 218, 281
 - supratidal biomat ichnofabric, 221, 281
 - salient features, 227
 - sub-Recent Kalna ichnofabrics, 221
 - Kalna fluvial ichnofabric, 221, 238
 - Kalna superposed firmground ichnofabrics, 223
 - Kalna superposed woodground ichnofabrics, 226
 - Ichnofacies
 - Conceptual background, 211
 - Continental ichnofacies, 211, 212
 - Scoyenia* ichnofacies, 211, 212
 - Termitichnus* ichnofacies, 212
 - Coprinisphaera* ichnofacies, 212
 - Mermia* ichnofacies, 212
 - Kalna *Scoyenia* ichnofacies, 216, 280
 - Kalna *Teredolites* ichnofacies, 216
 - Marine ichnofacies, 211, 212

- Cruziana* ichnofacies, 212
Glossifungites ichnofacies, 212
Nereites ichnofacies, 212
Psilonichnus ichnofacies, 180, 215, 234, 237, 239, 249, 250, 283
Skolithos ichnofacies, 184, 214–216, 234, 235, 280, 283
Teredolites ichnofacies, 214, 216, 235, 239, 280, 283, 286
Trypanites ichnofacies, 212
Zoophycos ichnofacies, 212
 Nabadwip mixed *Psilonichnus**Skolithos* ichnofacies, 214
- Ichnology**
Paleodictyon sp., 3
 Age of Fucoids, 3
 Age of Naturalists, 3
 Age of Reaction, 3
 archetypal ichnofacies, 3
 bioturbation, 3, 217, 218, 220, 252, 281
 bioturbation index, 3, 217
 bottom up predators, 122
 descriptive ichnology, 49
 dinosaurian footprints, 2
 dubiofossils, 32, 139, 143, 251, 277, 284
 ecosystem services, 4, 11
 ecotone, 70
 Entradichnus Ichnofacies, 142
 ethological Revolution, 3
 experimental ichnology, 16
 faunal zones, 43
 freshwater zone, 19, 32, 124
 Fucoid Hypothesis, 3
 Golden Age, 3
 ground water exploration, 2
 historical background, 1
 hydrocarbon exploration, 2, 234
 ichnocoenoses, 3, 211, 213–215, 234
 ichnofabric overprinting, 31, 216, 217, 238, 285, 286
 ichnofabrics, 3, 32, 217, 226, 229, 238, 251, 277, 280
 ichnofacies, 32, 238, 251, 277, 280, 285
 ichnological features, 16, 35, 49, 50, 142, 198, 233, 236, 282
 ichnological tools, 31, 32, 69, 283, 286
 ichnozonation, 16, 264
 ichnozones/subzones, 191, 240, 264, 279
 invertebrate ichnology, 3
 lower estuarine faunal zone, 43
 mangrove ecosystem, 4, 11, 16, 24, 31, 85, 233, 235, 243, 244, 250, 255, 277, 283, 284
 mangrove ichnology, 1, 4, 32, 277
 Modern Approach, 3
 Modern Era, 3
 modern mangroves, 2, 4
 morphological series, 72
 morphological transformation of burrow, 61
 Neoichnology, 1, 3, 31, 45
 Palaeoichnology, 1
 Paleodictyon sp, 3
 preservation of traces, 203
 deep tier preservation, 203
 full relief preservation, 205
 shallow tier preservation, 205
 pseudofossils, 139, 143, 251
 Renaissance, 3
 reservoir characterization, 2
 Senckenberg Laboratory, 3
 top down predators, 122
 trace fossils, 1, 3, 31–34, 135, 142, 159, 203, 211, 212, 221, 234, 248, 249, 251, 277, 282–284
 turtle trackways, 1
 upper estuarine and freshwater faunal zones, 43
Zoophytes, 3
- L**
 Literature survey, 1, 32
- M**
 Materials and methods
 burrow casting, 16, 32, 34, 167
 burrow density, 35
 casting medium, 34
 paraffin wax, 32, 34
 plaster of Paris and washing soda, 34
 Portland cement, 34
- O**
 Organo-sedimentary structures
 algal borings, 2
 bilobed network trails of gastropods, 148
 bilobed trails, 127, 147
 biogenic faecal pellet mounds, 90
 bioglyph, 131, 223
 biomat-associated traces, 54, 133
 bird foot prints/trackways, 141
 boring structures, 54, 104, 111, 129, 226, 248
 bulbous structure for brooding, 109, 244
 burrow collapse, 79, 143, 179, 180, 182, 260

burrow mouth chimneys, 31
 burrow population, 54, 61, 72, 87, 120,
 184, 198, 216, 236, 260, 281
 burrows, 2, 29–35, 45–47, 49, 50, 53, 54,
 61, 66, 70, 72, 77, 84, 85, 87, 90, 92, 95,
 96, 99, 101, 102, 104, 106, 109, 111,
 113, 115, 119, 124, 140, 150, 167, 169,
 176, 178, 179, 182–184, 196, 205, 207,
 210, 212–216, 218, 221, 223, 233, 234,
 237, 243, 244, 246–248, 251, 259, 264,
 279, 281–283
 calcified tube, 129, 131, 207, 226
 Chondrites sp, 3
 compound igloos, 90
 dimorphic burrows, 102, 200
 Dotilla sand igloos, 84, 85
 fecal pyramids, 69
 feeding and fecal pellets, 2, 31
 foot prints, 31, 135, 141, 216
 grazing marks, 29, 31, 46, 113, 203, 218,
 249
 guided pathways, 29, 79, 89, 278
 Hydromedusae impressions, 138, 139, 251,
 284
 lebensspuren, 31, 32, 41, 46, 49, 54, 113,
 150, 191, 195, 200, 233, 240, 242, 249,
 250, 277, 279, 280, 286
 meandering trails of bivalves, 147
 Molluscan trails, 149
 mud mounds, 69, 84, 263, 278, 280
 pelletal designs, 79, 87, 90, 102, 104, 174,
 198, 201, 214, 221, 243, 244, 278, 279,
 282
 asteroid, 79, 90
 concentric, 79, 85, 87, 89
 concentric radiating, 79
 mossy, 79, 90
 pellet-mat designs, 79
 petalloid, 79, 87, 90
 radial, 69, 79, 85, 87, 89, 102, 154
 simple fan, 87
 plant root penetration structures, 2
 resting marks, 31
 reticulate burrow system, 125, 141
 reticulate trail system, 125
 sand ball galaxies, 90
 scratch marks, 31, 46, 49, 65, 81, 87, 92,
 99, 101, 131, 135, 154, 198, 203, 216,
 218, 240, 247, 249
 sea anemone traces, 136
 sediment domes, 31, 79, 137, 174, 242, 282
 starfish trackways and resting traces, 145
 Telescopium trails, 69

trackways, 1, 29, 31, 33, 46, 47, 85, 138,
 140–142, 150, 244, 245, 247, 249
 trails, 2, 31, 32, 49, 124, 125, 127, 135,
 142, 148, 196, 201, 203, 205, 215, 216,
 218, 244, 247, 249, 264, 265
 triangular anchor marks, 113
 xenoglyph, 131

P

Physical evidences

of coastal erosion, 269, 270
 of shoreline retreat, 269, 270

Preserved traces

Kalna preserved traces, 205
 continental mayfly burrows, 205, 223
 Planolites, 205, 280
 Scoyenia, 205, 216, 280
 Tagelus plebeius burrows, 238
 Tonganoxichnus, 280
 Nabadwip preserved traces, 207
 Arenicolites, 207
 Diopatrachus, 210
 Gyrolithes, 207
 Macanopsis, 207
 Ophiomorpha, 207
 Psilonichnus, 207
 Skolithos, 207
 Thalassinoides, 207

S

Scopes and objectives, 1, 31

Study areas

Banas River Basin, 35, 141, 185, 239, 240,
 243, 245, 263
 Basanti, 16
 Bhagirathi riverbeds, 32, 124
 Chunakhali, 16, 102, 106
 coastal sectors, 16
 Bakkhali, 16
 Digha, 16
 Frazergunj, 16
 Gopalpur, 33
 Junput, 16
 Shankarpur, 16
 estuarine river banks, 16, 46, 47, 66, 160,
 215, 217, 235, 236, 242, 243, 248, 261
 floodplains, 16, 19, 22, 200, 261, 282
 Gosaba, 16
 Sagar Island, 16
 Sajnekhali creek, 28, 33
 Sundarban Mangrove deltas
 adaptations of mangrove faunas, 28
 amphibious life, 30

- anatomical specializations, 29
- behavioral specializations, 30
- biorythms, 30
- breeding migration, 30
- burrowing habit, 30
- feeding pellets, 29
- globular pellets, 29, 66, 85, 87
- grazing marks, 29
- long trackways, 29, 49, 245
- maxilliped, 29
- mud mound building life habit, 33
- osmoregulation, 30
- pelletal designs, 29
- Periophthalmus* sp., 29, 41, 44, 47
- predators, 29, 30, 46, 79, 87, 89
- quasiterrestrial (amphibious) mode of life, 29, 70, 278, 280
- salt-secreting glands, 30
- sexual dimorphism, 279
- suctorial function, 29
- visibility problem, 29
- biodiversity, 13
 - adjutant stork, 14
 - Algae, 22, 116, 133, 138, 258, 285
 - Annelida, 13
 - Arthropoda, 13
 - barking deer, 14
 - Bengal fox, 14
 - brahmini kite, 14
 - brown alga *Fucus*, 3
 - bulbul, 14
 - cattle egret, 14
 - civet cat, 14
 - crabs, 13
 - crow pheasant, 14
 - demersal fish, 13
 - dicotyledon, 13
 - fern, 13
 - fishing cat, 14
 - halophytic mangroves, 13
 - honeybees, 14
 - Invertebrates, 13
 - jackal, 14
 - jungle cats, 14
 - jungle myna, 14
 - little egret, 14
 - lobster, 13
 - magpie robin, 14
 - Mollusca, 13
 - monitor lizard, 14
 - monkey, 14
 - monocotyledon, 13
 - open billed stork, 14
 - orchids, 13
 - pelagic fish, 13
 - plants, 1, 2, 13, 25, 28, 34, 66, 87, 113, 215, 221, 254, 278
 - pond heron, 14
 - prawns, 14, 30
 - Purple heron, 14
 - Rhesus monkey, 30
 - rose ringed parakeet, 14
 - Royal Bengal Tiger, 14
 - shrimp, 13
 - snakes, 14
 - sparrow, 14
 - spotted deer, 14
 - spotted dove, 14
 - Sundarban's bio-spectrum, 14
 - tailor bird, 14
 - vertebrates, 13
 - water monitor, 14
 - wild boars, 14
 - wood pecker, 14
- endangered species, 14
 - barking deer, 14
 - Batagur baska*, 14
 - Chelonia mydas*, 14
 - Heritiera fomes*, 14
 - hog deer, 14
 - Javan rhino, 14
 - Nypa fruticans*, 14
 - Panthera tigris*, 14
 - Pelochelys bibroni*, 14
 - Phoenix paludosa*, 14
 - Wild buffalo, 14
- evolution of mangroves, 15
 - Center-of-origin hypothesis, 15
 - continental drift, 15
 - Gondwanaland, 15
 - Tethyan Sea, 15
 - Vicariance hypothesis, 15
- mangrove distribution, 11
 - Andaman and Nicobar Islands, 11
 - Bangladesh, 11
 - Cauvery-Krishna-Godavari-Mahanadi river deltas, 11
 - Goa, 11
 - Gujarat, 11
 - Gulfs of Kutch and Cambay, 34
 - Ratnagiri, 11
 - River Baleshwar, 11
 - River Harinbhanga, 11
 - River Hooghly, 11
- mangrove ecosystem, 12
 - algal bloom, 22, 91, 250
 - algal mat, 2
 - anaerobic bacteria, 13

- Avicennia germinans*, 13
- biomats or microbial mats, 22
- carbon density, 11
- deforestation, 16, 26
- diverse gene pool, 12
- ecospace, 268
- ecosystem, 12
- environmental parameters, 13
- geotropic roots, 13
- knee roots, 13
- mangroves, 13
- parenchyma, 13
- physiological adaptations, 13
- pneumatophores, 13
- propagules, 13
- Red mangroves, 13
- rising sea level, 13
- Rhizophora mangal*, 13
- salt-secreting glands, 13
- stilt roots, 13
- stomata, 13
- supratidal marshy environment, 13
- viviparous germination, 13
- white (or grey) mangroves, 13
- xerophyllous leaves, 13
- mangrove faunas and floras, 16, 24
 - alpheid prawns, 30
 - amphibians, 14, 24
 - arthropods, 24
 - Avicenniaceae, 28
 - Bandicoota indica*, 30
 - birds, 14, 24
 - Boleophthalmus* sp., 29
 - Combretaceae, 28
 - crustaceans, 14, 24, 30, 31
 - Diopatra cupria*, 31, 41, 43, 44, 47, 116
 - endobenthic invertebrates, 26, 30, 32
 - Excoecaria agallocha*, 28
 - fishes, 14, 24, 30
 - grapsid crabs, 29
 - grass *Oxyza* sp., 122
 - grass *Proterecia coarctata*, 122
 - Heritiera fomes*, 14, 28
 - Heritiera minor*, 28
 - Ilyoplax* sp., 29
 - insects, 24, 141
 - Macoma birmanica*, 33, 41, 43, 44, 47, 122
 - Macrophthalmus* sp., 29, 43, 47, 92, 96
 - mammals, 14, 24
 - Meliaceae, 28
 - microorganisms, 24
 - mollusks, 24, 30, 122, 127
 - morpho-physiological features, 28
 - mudskipper fish, 29, 44
 - Myrsinaceae, 28
 - Nypa fruticans*, 14, 28
 - ocypodid crabs, 29
 - Palmae/Arecaceae, 28
 - Phoenix paludosa*, 14, 28
 - Plumbaginaceae, 28
 - pneumatophore, 13, 28, 66
 - polychaetes, 24, 31, 33, 34, 41, 47, 122, 129
 - Pteridophytes, 13
 - reptiles, 1, 14, 24
 - Rhizophoraceae, 13, 28
 - root buttress, 28
 - Sesarma* sp., 29
 - Sonneratia apetala*, 28, 30
 - Sonneratiaceae, 28
 - Sterculiaceae, 28
 - Thalassinid prawns, 30
 - trace-making invertebrates, 3, 24, 43
 - worms, 3, 24, 34, 116
- physiography and geomorphology, 19
 - abandoned channel, 19, 22
 - backswamps, 19, 22, 23, 32
 - bars, 11, 19, 22, 24
 - beach-dune ridges, 19
 - beaches, 11, 18, 19, 23, 33
 - Brahmaputra River, 6
 - braided drainage, 19
 - coastal dunes, 11, 22, 23
 - coastal landforms, 19
 - coastal wetland, 11
 - coastal zone, 14, 18, 19, 22, 24, 43
 - creeks, 11, 19, 44
 - dune ridges, 19
 - estuaries, 4, 10, 11, 19, 30
 - estuarine zone, 19, 22, 28
 - floodplains, 16, 19, 22
 - foreshore beaches, 19
 - geomorphic features, 16
 - geomorphic profile (section), 19
 - Hooghly River, 19, 22
 - intertidal beaches, 11, 18, 19
 - islands, 11, 16, 19, 28
 - meandering rivers, 11
 - mobile dunes, 19
 - mudflats, 19, 22–24
 - mudground, 19
 - natural levees, 19, 22
 - palaeochannels, 18
 - palaeoshorelines, 18
 - salt marshes, 11
 - sand sheets, 19
 - tidal flats, 11, 19, 22

woodground, 18, 19
 Quaternary geology, 18
 delta surfaces, 18
 eustatic sea level, 18
 floodplain deposits, 19
 fluvio-delta complexes, 6
 Kalna Formation, 18
 Kalna mudground, 19
 Kalna woodground, 19
 Kusumgram Formation, 18
 Nabadwip Formation, 18
 palaeomangrove forest, 18
 terraces, 18
 Worgram Fomation, 18
 recognitions, 15
 Bio-geographic Region, 15
 biosphere reserve, 15
 Man Biosphere (MAB) Programme, 15
 Project Tiger, 15
 Ramsar Site, 15
 Sundarban Tiger Reserve (STR), 15
 Sundarbans National Park, 15
 Wildlife Sanctuary, 15
 World Natural Heritage Sites, 15
 Sedimentology-hydrodynamics-climate, 22
 aeolian current lineation, 22
 breaker zones, 22, 23
 cross-beddings, 22
 depositional environments, 3, 24
 desiccation cracks, 22
 dissolved oxygen content, 24
 flaser-convolute-wavy beddings, 22
 glacio-eustatic oscillations, 9
 herringbone cross beds, 22
 high angle cross beds, 22
 hummocky beddings, 22
 hydraulic energy, 22
 Kalbaishakhi, 11, 24
 marine transgression, 9
 mud balls, 22
 oligohaline, 12
 Pleistocene glacial maximum, 9
 polyhaline, 12
 rill marks, 22
 ripple-drift laminations, 22
 ripples, 22
 salinity gradients, 12
 scour marks, 22
 slump structures, 22
 storm, 11, 12, 14, 22, 24
 tidal influence, 12
 tidal rhythmic beddings, 22
 tides and waves, 22
 tropical cyclones, 24

wrinkle marks, 22

T

Trace fossils referred

Alpertia santacruzensis, 136
Ancorichnus foronus, 212
Arenicolites *isp.*, 66, 183, 186, 207, 212,
 213, 215, 216, 218, 234, 246, 282, 283
Asteriacites *isp.*, 147
Beltanelliformis brunsae, 136
Chomatichnus wegberensis, 205
Cosmorhapha *isp.*, 3
Cruziana *isp.*, 3
Digitichnus *isp.*, 142
Diopatrachus *isp.*, 215, 218, 234, 248,
 249, 281, 283
Entradichnus *isp.*, 142
fossilized sand spherules, 90, 210
Gyrolithes *isp.*, 34, 142, 159, 207, 215,
 246, 248, 282
Helminthoida *isp.*, 135
Helminthoidichnites *isp.*, 135
Helminthopsis *isp.*, 135
Macanopsis *isp.*, 34, 159, 184, 207, 215,
 234, 246, 248, 282
Manchuriophycus, 143
Oniscus *isp.*, 85, 248
Ophiomorpha *isp.*, 66, 90, 150, 207, 210,
 213, 215, 218, 237, 244, 246, 248, 278,
 282
Palaeophycus *isp.*, 142
Planolites *isp.*, 135, 142, 215, 216, 221,
 234, 248, 249
Polynices duplicatus, 148
Protichnites *isp.*, 142
Pylonichnus *isp.*, 159, 183, 234, 235, 282
rhizomorphs, 142
Rhyzonetron *isp.*, 143, 251, 284
Rusophycus *isp.*, 3, 148
Scolicia *isp.*, 124
Scoyenia gracilis, 212
Skolithos *isp.*, 34, 142, 159, 183, 184, 205,
 215, 218, 226, 246, 280, 282
Spongiomorpha *isp.*, 34, 159, 234, 246,
 248, 282
Taenidium *isp.*, 142
Taphrhelminthopsis *isp.*, 234, 249, 283
Teredolites clavatus, 134, 226
Thalassinoides *isp.*, 34, 113, 159, 212, 215,
 216, 218, 234, 237, 246, 248, 282
 Trace making organisms and associates
 Annelida, 13
 Diopatra bicristimanus, 113

- Diopatra cupria*, 31, 41, 43, 198, 255, 256
Diopatra neapolitana, 118, 253
Diopatra pusillator, 113
Diopatra sugokai, 253
Echiurus echiurus, 191
Lanice conchilega, 191, 236
Loimia medusa, 122
Notomastus sp., 106
 beetles, 141, 142
 Decapod Crustaceans, 41, 136, 183, 236, 251
 Alpheus armillatus, 113
 Alpheus crassimanus, 113
 Alpheus floridanus, 113
 Alpheus heterochaelis, 113
 Alpheus normanni, 113
 Alpheus rapax, 113
 Callinassa biformis, 191
 Callinassa kraussi, 99
 Callinassa major, 191
 Charybdis rostrata, 43, 46, 102, 103, 105, 165, 238, 248, 282
 Diogenes costatus, 113
 Diogenes spp. (hermit crabs), 32, 43, 113
 Dotilla brevitarsis, 43
 Dotilla fenestrata, 90
 Dotilla myctiroides, 90
 Dotilla wichmani, 90
 Eurycarcinus grandidieri, 43, 47, 108, 111, 129, 260
 Heteropilumnus ciliates, 129
 Ilyoplax pusillus, 43, 44, 85, 165, 174
 Limulus polyphemus, 116
 Limulus spp. (horseshoe crab), 41, 115
 Macrophthalmus depressus, 47, 93
 Macrophthalmus tomentosus, 43, 92, 93, 96
 Metaplax crenulata, 42, 99
 Metaplax distincta, 42, 98, 99, 248
 Metaplax indica, 42, 96, 97
 Ocypode cardimana, 42, 163, 173
 Ocypode ceratophthalmus, 42
 Ocypode kuhli, 82
 Ocypode macrocera, 42, 163, 173, 176
 Ocypode stimpsoni, 42, 163, 171, 176
 Scopimera longidactyla, 104
 Scopimera spp., 90
 Scylla serrata, 43, 44, 46, 106, 244
 Uca borealis, 69, 70
 Uca formosensis, 69
 Uca lactea, 69, 70
 Uca marionis, 32, 42, 61, 62, 65, 66, 69, 72, 165, 236, 263, 264
 Uca marionis var nitidus, 66, 69
 Uca minax, 69, 70
 Uca pugilator, 70
 Uca pugnax, 69, 70
 Upogebia affinis, 46, 99
 Varuna literata, 42–44, 46, 99, 100
 heart urchin *Moira atropos*, 192
 Mollusca, 13
 Donax variabilis, 203
 Macoma balthica, 122, 124
 Macoma birmanica, 122, 124
 Macoma constricta, 124
 Macoma depressus, 93
 Macoma dilatatus, 93
 Macoma exigua, 124
 Macoma tenta, 124
 Pholodidea wiffenae, 214
 Tagelus divisus, 120, 121
 Tagelus plebeius, 41, 119–121
 Telescopium telescopium, 41
 Turritella attenuata, 128–130
 Turritella communis, 124
 Turritella spp., 41
 mud skipper fish
 Pisces Periophthalmus koelreuteri, 41
Trace making organisms and associates
 heart urchin *Echinocardium cordatum*, 191
Trace-making habits and habitats
 behavioral patterns, 45, 46
 brood chamber, 46
 burrowing, feeding and locomotion, 46
 camouflaging crabs, 45
 dimorphic burrows, 46, 50
 egg incubation, 46
 feeding and excavation pellets, 46
 fiddler (or calling) crabs, 46, 61
 habitat adaptations, 45, 85
 juvenile recruitment, 46
 larval and juvenile development, 46
 life-style categories, 45
 running crabs, 45, 82
 sand-bubbler crabs, 46
 side burrowers, 46
 swimmer crabs, 46
 tube dweller crabs, 47

Photographic Index

B

Bakkhali—Frazergunj coast

erosion and deposition of (Fig. 8.5c, p.),
258

temporal shifting of (Fig. 8.11, p.), 266

Beach erosion

causes of

anthropological (Fig. 8.15c–e, p.), 271

biological (Fig. 8.7, p.), 261

physical (Fig. 8.15a–b, p.), 271

Bengal basin

geological units of (Fig. 1.5, p. ; Fig. 8.4,
p.), 17, 253

geomorphic units of (Fig. 1.5b–c, p.), 17

geotectonic evolution of (Fig. 1.3a–d; p.), 8

geotectonic features and provinces of
(Fig. 1.2, p. ; Fig. 1.3d, p.), 5, 8

studied beach sectors of (Fig. 1.4, p. ;
Fig. 8.6a, p.), 16, 259

Biophysical modeling

intertidal crab burrowing (Fig. 4.8, p.), 180

experimental burrow mouth plugging
(Fig. 4.4, p.), 171

Burrow parameters

(Fig. 3.1, p.), 51

analyses of (Fig. 4.3, p.), 169

C

Common organic assemblage

(Fig. 1.10, p.), 26

Common trace producers

(Fig. 2.2, p.), 45

Alpheus sp. (Fig. 3.32f, p.), 112

bird, insect and mammalian trackways
(Fig. 1.10, p. ; Fig. 3.59a–g, p.), 26, 152

Charybdis rostrata (Fig. 3.28a, p.), 105

Dotilla brevitarsis (Fig. 3.18m, p. ;

Fig. 3.19c, e, p.), 88, 89

Eurycarcinus grandidieri (Fig. 3.30c, d,
p.), 108

Heteropilumnus ciliatus (Fig. 3.31g, p.),
110

Hydro-medusa (Fig. 3.49a–c, p.), 138

Ilyoplax pusillus (Fig. 3.17g, p.), 86

Limulus sp. (king crabs) (Fig. 3.34a, p.),
115

Macoma birmanica (Fig. 3.39a–d, p.), 123

Macrophthalmus tomentosus (Fig. 3.21f, g,
p.), 93

Metaplex distincta (Fig. 3.25i, p.), 98

Metaplex indica (Fig. 3.24b, p.), 97

Metaplex spp. (Fig. 3.23c, p.), 95

Ocypode spp. (Fig. 3.8, p.), 71

Polychaete *Diopatra cupria* (Fig. 3.36k,
p.), 119

Sea anemones (Fig. 3.48d, p.), 137

Tagelus plebius (Fig. 3.38, p.), 121

Telescopium spp. (Fig. 3.41a, p.), 128

Turritella attenuata (Fig. 3.40b1, p.), 127

Uca marionis (Fig. 3.2e, p.), 62

Uca marionis var *nitidus* (Fig. 3.5i, j, p.),
65

Varuna literata (Fig. 3.26i, p.), 100

Cyclone Aila

destruction of (Fig. 8.12, p.), 267

D

Digha beach

bio-erosion of (Fig. 8.7, p.), 261

geomorphic profile of (Fig. 8.6b, p.), 259

Ocypode crabs of

- analysis of burrow length (Fig. 8.6d, p.), 259
- burrow concentration (Fig. 8.6c, p.), 259
- burrow profile (Fig. 8.6b, p.), 259

G

Ganges delta complex

- Holocene woodgrounds of (Fig. 4.1, p.), 164
- regional geological map of (Fig. 4.1, p.), 164

Geological features

- Kalna mudground (Fig. 1.6b, h, p.), 20
- Kalna woodground/palaeoforest (Fig. 1.6f, p.), 20

Geomorphic features

- backswamps (Fig. 1.7 m, p. ; Fig. 1.8e, f, p.), 21, 23
- beaches
 - intertidal (Fig. 1.6a, b, f, h, p. ; Fig. 1.7a–j, l, p.), 20, 21
 - supratidal (Fig. 1.6c–d, p. ; Fig. 1.7k, p. ; Fig. 1.8d, p.), 20, 21, 23
- creeks (Fig. 1.8f, p. ; Fig. 1.9a, d, h, p.)
 - Start from here, 23, 25
- creek bank slumping (Fig. 1.9b, e, f, p.), 25
- dunes
 - domal (Fig. 1.7c, p.), 21
 - Low amplitude (Fig. 1.7d, p.), 21
 - parabolic (Fig. 1.8a, l, p.), 23
 - recent mobile (Fig. 1.6c, p.), 20
 - transverse (Fig. 1.8b, p.), 23
- islands (Fig. 1.9c, p.), 25
- mangrove forested coast (Fig. 1.6a, g, p. ; Fig. 1.8a–f; Fig. 1.9a–h; p.), 20, 23, 25

I

Ichnoprofiles

- across beach sectors (Fig. 4.2, p.), 168

M

Mangroves

- distribution
 - global (Fig. 1.1a, p.), 2
 - Indian coast (Fig. 1.1b, p.), 2
 - Sundarban Delta Complex (Fig. 1.1c, p.), 2
- features
 - destruction of plants (Fig. 1.9g, p. ; Fig. 1.11h, p.), 25, 27
 - development of forest (Fig. 1.11e–h, p.), 27

- pneumatophores (Fig. 1.9f, p. ; Fig. 1.11d, p.), 25, 27
- snake roots (Fig. 1.11c, p.), 27
- stilt roots (Fig. 1.9a, p. ; Fig. 1.11b, p.), 25, 27
- tilting of plants (Fig. 1.9d, p.), 25

Modern biomats (Fig. 3.45, p.), 133

N

Neoichnology

- barren ichnozone (Fig. 5.3, p.), 197
- beach sand burrowing (Fig. 5.3, p.), 197
- crab burrows
 - bathymetric zonation of (Fig. 4.9, p.), 181
 - bathymetric control on morphology of (Fig. 4.10, p.), 185
 - preferred burrow orientation (Fig. 8.8, p.), 262
- ichnofabrics (Fig. 7.2, p.), 219
- Kalna clayground *Tagelus* (Fig. 7.6a, p.), 225
- Kalna woodground polychaete (Fig. 7.7, p.), 227
- Nabadwip (Fig. 7.6b, p.), 225
- overprinting (Fig. 7.5, p.), 224
- superposition (Fig. 7.8a, p.), 228
- ichnofacies
 - gradients and environments of (Fig. 7.1, p.), 213
 - superposition of (Fig. 8.1, p.), 239
- ichnoforms
 - in estuarine river banks (Fig. 7.3, p.), 220
 - in Kalna clayground (Fig. 7.4, p.), 222
- ichnological subzones
 - in coastal zone (Fig. 5.2, p.), 193
 - in estuarine zone (Fig. 5.5, p.), 200
 - temporal transformation of (Fig. 8.10, p.), 265
- ichnostratigraphic models (Fig. 8.2, p.), 241
- location map of sampled lebensspuren (Fig. 5.1, p.), 192
- pre-tidal versus post-tidal burrows
 - of *Ocypride cardimana* (Fig. 4.5e, p.), 172
 - of *Ocypride stimpsoni* (Fig. 4.6a, p.), 175
 - of *Ilyoplax pusilus* (Fig. 4.5f, p. ; Fig. 4.6b, p.), 172, 175
 - of *Ocypride ceratophthalma* (Fig. 4.5g, p.), 172
- regional ichnozones and subzones (Fig. 2.1, p.), 44

O**Organo-sedimentary structures**

- Algal microborings on ooids (Fig. 8.3, p.), 242
- Alpheus* sp. burrow system (Fig. 3.32, p.), 112
- biomat traces
- beak marks (Fig. 3.47l2, p.), 135
 - bird foot prints (Fig. 3.47l1, p.), 135
 - bivalve and gastropod trails (Fig. 3.46a–b, p. ; Fig. 3.47k, p.), 134, 135
 - scribbling worm burrow system (Fig. 3.60, p.), 153
 - worm burrows (Fig. 3.46c–g, p. ; Fig. 3.47a–j, p.), 134, 135
- Bivalve trails, burrows and resting traces (Fig. 3.55, p.), 147
- Charybdis rostrata* burrowing and boring (Fig. 3.28, p.), 105
- Charybdis rostrata* pellet-making (Fig. 3.27, p.), 103
- crab burrow-mouth star patterns (Fig. 3.58a–f, p.), 151
- crab chimneys (*Ophiomorpha*) (Fig. 3.58g–l, p.), 151
- Crustacean trackways (Fig. 3.57, p.), 150
- Decapod pellets, pellet trails and scratch marks (Fig. 3.59h–n, r, v, p.), 152
- Diogenes* spp. (hermit crabs) anchor and grazing marks (Fig. 3.33, p.), 114
- Dotilla brevitarsis*
- burrows (Fig. 3.18a–l, p.), 88
 - pelletal designs (Fig. 3.19, p.), 89
 - concentric (Fig. 3.19b, p.), 89
 - concentric radial (Fig. 3.19c, p.), 89
 - pellet mat (Fig. 3.19f, p. ; Fig. 5.4, p.), 89, 199
 - petaloid (Fig. 3.19e, p.), 89
 - radial (Fig. 3.19d, p.), 89
 - simple fan (Fig. 3.19a, p.), 89
- Dotilla* spp. sand igloos (Fig. 3.20, p.), 91
- dune sand traces
- ant burrows (Fig. 3.51b–c, p.), 141
 - beetle trackways (Fig. 3.50e–f, p.), 140
 - bird trackways (Fig. 3.50m–n, p.), 140
 - Decapod trackways (Fig. 3.50a, b1, j, l, p. ; Fig. 3.51i, k, l, p.), 140, 141
 - insect burrows (Fig. 3.50c, g–i, p. ; Fig. 3.51h, p.), 140, 141
 - long crab trackways (Fig. 3.51d, e, p.), 141
 - vertebrate foot prints (Fig. 3.51f, g, m, p.), 141
 - worm burrows (Fig. 3.50k, p. ; Fig. 3.51j, p.), 140, 141
- Eurycarcinus grandidieri* borings (Fig. 3.30a–b, p.), 108
- Gastropod and decapod trails (Fig. 3.59o–q, t, p.), 152
- Hermit crab trackways (Fig. 3.56 Ja, p.), 149
- Heteropilumnus ciliatus*
- burrows and pellets (Fig. 3.31, p.), 110
- Hydro-medusa imprints versus Proterozoic fossil *Grypania* (Fig. 3.49, p.), 138
- Ilyoplax pusillus*
- capillary burrows (Fig. 3.17a, p.), 86
 - pelletal designs (Fig. 3.17b–f, p.), 86
- Kalna traces
- mayfly burrows (Fig. 6.2h, p. ; Fig. 7.4, p.), 206, 222
 - Planolites* (Fig. 6.2c, d, e, f, g, i, p. ; Fig. 7.4, p.), 206, 222
 - Scoyenia* (Fig. 6.2c, p. ; Fig. 7.4, p.), 206, 222
 - Skolithos* (Fig. 6.2c, d, e, g, p. ; Fig. 7.4, p.), 206, 222
 - Tonganoxichnus* (Fig. 6.2c, e, p. ; Fig. 7.4, p.), 206, 222
- Limulus* sp. (king crabs)
- resting traces (Fig. 3.34, p.), 115
- Macoma birmanica*
- siphonal tubes (Fig. 3.39, p.), 123
- Macrophthalmus tomentosus* burrows (Fig. 3.21, p. ; Fig. 3.22, p.), 93, 94
- Metaplex distincta* burrows (Fig. 3.25, p.), 98
- Metaplex indica* burrows (Fig. 3.23, p. ; Fig. 3.24, p.), 95, 97
- Molluscan trails (Fig. 3.56a–m, p.), 149
- Nabadwip preserved traces (Fig. 6.1, 6.3, 6.4, p.), 204, 206, 208
- Gyrolithes* (Fig. 6.3h, p.), 208
 - Macanopsis* (Fig. 6.4b, c, p.), 209
 - Psilonichnus* (Fig. 6.3a–f, i–k, p. ; Fig. 6.4g–i, p.), 208, 209
 - Skolithos* (Fig. 6.4a, g, e, f, h, p.), 209
 - Thalassinoides* (Fig. 6.3g, p.), 208
 - unknown trails (Fig. 6.3m, p.), 208
 - vertebrate foot prints (Fig. 6.3l, p.), 208
- Ocypode* spp.
- burrows (Fig. 3.9, p. ; Fig. 3.10, p. ; Fig. 4.7, p.), 75, 76, 178

- burrow transformation (Fig. 3.11, p.),
 78
 clay igloos (Fig. 3.16a–g, p.), 84
 pelletal designs (Fig. 3.12, p.), 80
 –asteroid or stellar, (Fig. 3.12e, f, p.),
 80
 –concentric (Fig. 3.12a, b, p.), 80
 –concentric radiating (Fig. 3.12c, d, p.),
 80
 –isolated pellet heaps (Fig. 3.15g, i, l),
 83
 –mossy (Fig. 3.12g, p.), 80
 –pellet mat (Fig. 3.12h, p.), 80
 –pellet network (Fig. 3.15k, m, n), 83
 –pellet rows with scratch marks
 (Fig. 3.15a–d, p.), 83
 –petalloid (Fig. 3.14, p.), 82
 –radial (Fig. 3.13, p.), 81
 scratch marks (Fig. 3.15e, f), 83
 sediment domes (Fig. 3.15h, j), 83
 Polychaete *Diopatra cupria* burrows
 (Fig. 3.35, p. ; Fig. 3.36, p. ; Fig. 8.5a,
 b, p.), 117, 119, 258
 Polychaete boring tubes (Fig. 3.42, p. ;
 Fig. 3.43, p. ; Fig. 3.44, p.), 129, 130,
 132
 preserved crab burrows (Fig. 4.5a, b, p. ;
 Fig. 4.6c, d, f, p.), 172, 175
 root traces (Fig. 3.59u, p.), 152
 sea anemone traces versus Ediacaran fossils
 (Fig. 3.48, p.), 137
Scylla serrata burrows (Fig. 3.29, p.), 107
 star fish trails (Fig. 3.54, p.), 146
Tagelus plebius burrows (*Skolithos*)
 (Fig. 3.37, p. ; Fig. 3.38, p.), 120, 121
Telescopium spp. trails (Fig. 3.41, p.), 128
Turritella attenuata trails and burrows
 (Fig. 3.40, p.), 126
Uca marionis burrows (Fig. 3.2, p. ;
 Fig. 3.3, p.), 62, 63
Uca marionis var nitidus burrows
 (Fig. 3.5c–h, p.), 65
Uca spp.
 burrow-mouth chimneys (Fig. 3.6c–h,
 p.), 67
 feeding pellets (Fig. 3.6a, b, p.), 67
 mud mound (Fig. 3.7a–g, p. ; Fig. 8.9,
 p.), 68, 264
Varuna literata burrows (Fig. 3.26, p.), 100
 worm burrows
 ripple crest guided (Fig. 3.52a–c, p.),
 144
 ripple trough guided (Fig. 3.52d–g, p.),
 144
 ripple trough and crest guided
 (Fig. 3.52h, i, p.), 144
 resembling Proterozoic Rhyzonetron
 and Manchuriophycus (Fig. 3.52,
 p. ; Fig. 3.53, p.), 144, 145
 scribbling network (Fig. 3.60, p.), 153

P

Physical evidences

- of coastal erosion (Fig. 8.13, p. ; Fig 8.14,
 p.), 269, 270
 of shoreline retreat (Fig. 8.13, p. ; Fig 8.14,
 p.), 269, 270

S

Sedimentary structures

- aeolian cross beds (Fig. 1.7a, p.), 21
 aeolian current lineation (Fig. 1.7k, p.), 21
 burrow fills (Fig. 1.7i, p.), 21
 current ripples (Fig. 1.7h, p.), 21
 double crested ripples (Fig. 1.7d, p.), 21
 interference ripples (Fig. 1.7l, p.), 21
 lunate-linguoid ripples (Fig. 1.7e, p.), 21
 mud balls (Fig. 1.7f, p.), 21
 mud cracks (Fig. 1.7m, p.), 21
 parallel laminations (Fig. 1.7i, p.), 21
 rill marks (Fig. 1.7c, p.), 21
 rippled intertidal beach (Fig. 1.7j, p.), 21
 symmetrical ripples (Fig. 1.7b, p.), 21
 truncated ripples (Fig. 1.7g, p.), 21