Index

Abakaliki, mining contamination, 306
Abidjan, 335
Acid rain, 11
Acidic deposition, 90
Adsorption process, 183–185
Aerosol concentrations in marine regions, 151
Aerosol particles, 72, 149, 151, 168
dry deposition of, 160–163
Aerosols, 45
atmospheric transport of, 107
solubility, 82
Agricultural wastes, 226
Air pollution, 336–337
Air-to-sea exchange rates, 163–165
Air-to-sea fluxes, 149, 166
Algal growth, 228
Algal products, 228
Alkali industry, 327
Alkylmercury fungicides, 60
Alloy manufacturing, 77
Alocasia odora, 223
Aminolevulinic acid dehydratase (ALA-D), 57
Anaerobic conditions, 260
Analytical data, quality control, 49
Animal manure, 227, 228
Antimony
deposition figures for, 110
in soils, 111
Aquatic biota, 205–206
mercury bioaccumulation in, 255–277
Aquatic ecosystems
Australian, 191, 202–207
management of, 206–207
Aquatic environment
heavy metals in, 239
mercury in, rehabilitation and control measures, 269–272
trace metals in, 237–240
Aquatic fauna, 205–206

Arsenic
airborne, 63
alkyl species, 183
analytical concerns, 47
anthropogenic emissions, 294–297
anthropogenic sources, xix, 76–79, 84, 281–288
atmospheric, 74–76
atmospheric fluxes, 77
atmospheric transport, 81–83
behaviour in the body, 55–56
biogeochemical and biochemical pathways of, 44–45
biological methylation of, 44
chemical speciation from high-temperature processes, 79–81
chemicals, 286, 297
compounds, 47, 55
data needs, 45
emission rates from natural sources, 47
emissions, xxii, xxiii, 43, 44, 71–74, 280
equilibrium speciation calculations, 176
exposure thresholds, 64–65
general recommendations, 47
global atmospheric burden, 290–291
global atmospheric fluxes, 280, 291
global cycling of, 279–301
global oceanic burden and flux, 291–293
global tropospheric burden, 290
group report, 43–48
health effects and populations affected, xxiii, 46–47, 61–63
human exposure, 327–329
in aerosols, 45
in aquatic environment, 193–194
in coals and crude oils, 72
in drinking water, 46, 47, 62, 65, 328
Arsenic (cont.)
in environment, 43, 317-320
in fish, 46
in foods, 63
in India, 315-333
in marine atmosphere, 162
in marine rain, 152
in medications, 63
in oxygenated waters, 178
in plants, 116
in remote marine air and rain, 148
in seafood, 226
in sediments, 46, 294
in soils, 45, 111, 289, 297, 319
in vegetables, 328
in water, 319
industrial applications, 77
ingestion, xxii, 43, 328
inhalaion, 43
inorganic, 80
long-term exposure to, 61
low temperature volatilization, 289, 297
major sources of, xix
major transport pathway, 43
metabolic factors associated with
environmental exposure, 54
microbial methylation, xx
natural emissions, 297
natural sources, 44, 78, 288-289
net atmospheric flux, 291
net oceanic flux, 294
oceanic influx, 293
organic, 80
organs affected by, 62
overt toxicity, 53
pathways to man, 45
pesticides, 77
poisoning, xxii, 54
residence times in seawater, 185
route of entry, 43
sinks for, 46
solubility, 83
sources, 43-44
speciation and cycling in natural
waters, 175-186
speciation calculations, 179
toxicity of, 63
transfer rates in ecosystems, 45
volatility of, 80

volcanic source, 44
Arsenic trioxide, 286
Arsenious oxide, 319
Aswan High Dam Reservoir
khors, 236
morphology, 236
processes affecting distribution of
trace metals in, 241
residence time partitioning
between particles and water, 241
shape, 236
siltation, 237, 247
suspended matter transportation
and movement patterns, 241
thermal stratification, 242-243
trace metals in, 235-254
Atmospheric concentrations in
Hawaii, 153-154
Atmospheric emissions, xx
Atmospheric transport, 81-83,
107-117
Australia, heavy metal pollution,
188-216
Background concentrations in air,
rain and dry deposition, 149-152
Backwaters, 326
Bangalore, 326
Biogeochemical cycling, 169, 170
Biomass combustion, 13
Blackfoot disease, 62, 63
Blood samples, lead in, 224
Bombay, 326, 327
Brassica albolabula, 223
Brassica chinensis, 222, 227
Brassica parachinensis, 222, 223, 224,
227, 228
Bubble Interfacial Microlayer
Sampler, 164

Cadmium
airborne, 40
and cigarette smoking, 55
and zinc production, 38
anthropogenic sources, 37-39,
76-79, 84
atmospheric, 74-76
in Samoa, 155
atmospheric deposition, 128
atmospheric fluxes, 77
atmospheric transport, 81-83
average daily intakes, 40
behaviour in the body, 55-56
biogeochemical cycling, 41
body burden of, 40
chemical forms, 80
chemical speciation from high-temperature processes, 79-81
contamination, 38, 61
in elderly females, 61
daily intake of, 328
deposition in Norway, 108
dietary intake, xxii, 39
DTPA-extractable, 321
emission control, 127
emissions, 36, 37, 38, 71-74
environmental dissipation, 40
equilibrium speciation calculations, 176
exposure of elderly females to, xix
exposure thresholds, 64-65
extraction of, 38
from natural sources, 78
gastrointestinal absorption, 55
GEMS programme, 49
geochemical behaviour of, 309
geochemical dispersion, 304
global cycling, 35
group report, 35-42
health effects and populations affected, xxii, 35, 60-61
human exposure, 327-329
human exposure pathways, 39-40
in Abakaliki area, 306
in agricultural soils in taxonomic order, 124
in air, 128, 323
in aquatic environment, 193-194
in Aswan High Dam Reservoir, 243
in cigarette smoke, 40
in coals and crude oils, 72
in commercial crops, 127
in common rocks, 122
in crops, 41, 119-146, 128-140
from locations throughout US, 136-138
from major producing regions in US, 139
in domestic water supplies, 121
in environment, 320-324
in food chain, 120
in foodstuffs, 328
in India, 315-333
in kidney, 60
in lithosphere, 121
in marine atmosphere, 162
in marine sediments, 122
in natural surface soils, 114
in oxygenated waters, 178
in plants, 116
in remote marine air and rain, 148
in river waters, 246-247
in seafood, 226
in sediments, 122, 303-313
in sewage sludges, 127
in soils, 41, 111, 119-146, 303-313, 321
in surface soils, 123
in tropical soils, 307, 311
in vegetable crops, 132-134
in vegetative and reproductive tissues, 139
in water, 320
inadvertent sources, 37
industrial applications, 77
information needs, 40-41
ingestion of, 339
inhalation, 121
inventories, xxii
levels near mining and smelting operations, 126-127
metabolic factors, associated with environmental exposure, 54
morality studies, 61
natural levels in soils, 122-126
natural sources, 37, 121-122
overt toxicity, 53
persistence, 120
poisoning, xxii, 54, 120
potential environmental hazards, 141
principal uses, 39
range of mean concentration by crop class, 140
redistribution in soils, 311
residence times in seawater, 185
sensitivity to freshwater animals, 199
solubility, 83
Cadmium (cont.)
sorption of, 322
source inventories, 36-37
sources and extent of contamination of soils, 126-128
speciation and cycling in natural waters, 175-186
toxicity, 120
vapour phase, 166
volatility of, 80
volcanic action, 37
wastes, 39
Calcutta, 326
Cancer, 62
Carbonate, 180
Cement production, 77
Chalcopyrite, 306
Chandigarh, 320, 327
Chembur, 326
Chemical industries, 316-317
Chicken manure, 226, 227, 229, 230
Chloralkali industry, 327
Chloralkali wastes, 93-97
Chlorella pyrenoidosa, 228
Chlorella salina, 228
Chromium
deposition patterns in Norway, 111
in Lake Nubia sediments, 245
in river sediments, 248
in soils, 111
Churchill River, 266, 267, 269
Cigarette smoking, 40, 55, 121, 328
Cladophora glomerata, 10
Coal combustion, 70-74, 80, 81, 91-93, 284-285, 295, 297, 319
Coal fired power plants, 127
Coal production, 316-317
Coastal waters, 319
Cobalt
in Aswan High Dam Reservoir, 243
in Lake Nubia sediments, 245
in river sediments, 248
in soils, 111
Coke production, 76
Combustion temperature, xx
Cookson Reservoir, 266
Copper
deposition patterns in Norway, 111
dry deposition of, 165
in Aswan High Dam Reservoir, 243
in brown earth profiles, 113
in dust, 223
in fish, 230
in natural surface soils, 114
in river sediments, 248
in river waters, 246-247
in soils, 111
mining, 201
primary production of, 38-39
refining, 281
sensitivity to freshwater animals, 199
smelting, 281, 294, 295, 296, 319
Cows milk, 323
Crassostrea gigas, 226
Crisis spp., 10
Cynodon dactylon, 223, 225
Cyprinus carpio, 229
Daphnia magna, 10
Desiccants, 286
Developing countries, 13-14, 335-341
cadmium contamination, 141
mercury in, 21
monitoring heavy metals, 343-347
Developing countries, xix
Drinking water, 46, 47, 63, 319, 328
arsenic in, 62, 65
Dry deposition
measurement of, 160-163
model calculations of, 160
Ecosystem studies, 199-202
Egypt, see Aswan High Dam Reservoir
Electroplating wastes, 188
Electrostatic precipitators, 296
Eleusine indica, 223, 225
Energy production, 296
Environmental compartments, xxi
Environmental contamination, 15
Environmental cycling, 15
Environmental degradation, 15
Environmental fluxes, xxiii
Environmental sinks, xxi
Equilibrium speciation calculations, 176
Equilibrium speciation models, 176
Equisetum, 10
Erie, Lake, 326
Erythrocyte protoporphyrin fluorescence, 13
Estuarine waters, 319, 326
Fertilizers, 127-128, 318, 321, 338
Finniss River, 197, 201
Fish arsenic in, 46
heavy metals in, 250-251
lead in, 230
mercury in, 25-26, 49, 59, 90, 257-268, 326
methylmercury in, 25, 268
production and contamination, 229-230
zinc in, 230
Fish studies, Nile River, 248-252
Flow variability, 202-203
Fly ash, 320, 323
Fontinalis sp., 10
Food additives, 286
Food chain, xix, 3, 17, 18, 120, 121, 128
Food contamination, 63
Foodstuffs, 39, 319, 320, 323, 328
Forest fires, 289
Fossil fuels, xx, 79, 80, 337
Fowler’s solution, 62, 63
Free erythrocyte protoporphyrin (FEP), 57
Freshwater flora, 206
Freshwater invertebrates, 205
Fulvic acids, 180
Fungicides, 60, 319, 327
Galena, 306, 339
Gangrene, 62
Gasoline combustion, 79, 81, 219-224, 336
GEMS programme, 49
Geothermal power, 296
Ghana, 339
Glass manufacture, 288
Global mass balance, 148
Goa, 319
Grain, mercury in, 326
Groundwaters, 338
Haemangioendothelioma of the liver, 62
Hard and soft acid and base (HSAB) concept, 180
Harmattan season, 339
Hawaii, atmospheric concentrations in, 153-154
Hearing loss, 63
Heavy metals
air pollution, 336-337
analytical methods, 197
anthropogenic sources, 165, 188, 336
biogeochemical cycling of, 188, 191-197
chemical analysis, 196-197
chemical forms, 239
ecological effects, 199
effects on Australian ecosystems, 188
effects on biota, 198-202
fate on entering the ocean, 167-169
in animals, 115-116
in aquatic environment, 239
in fish, 250-251
in marine atmosphere, 166-167
in marine biota, 192
in marine organisms, 226
in ombrotrophic bogs, 115
in plants, 115-116
in sediments and waters, 192
in soils, 111-115, 308-309
in surface waters, 337
in terrestrial environment, 192
levels of, 191-192
long-range atmospheric transport, 107-117
monitoring, 335-341
natural sources, 336, 338-339
pollution in Australia, 188-216
pollution sources, 336-339
sources of, 188-190
speciation studies, 196-197
toxicity studies, 198-199
transfer across air-sea interface, 147-173
transfer process, 195, 197-198
Herbicides, 286
High alkalinity river water (HARW), 177, 180
High temperature processes on power generation and industry, 69-87
Hong Kong
general background, 218-219
lead contamination, 217-233
traffic density, 219
Human hair, lead in, 224
Humic acids, 180
Hydroelectric power plant, 266
Hydroelectric reservoirs, 255-277
Hydrolysis constants, 184
Hydrolysis sequence, 180, 184
Hylocomium splendens, 10, 111
Hyperkeratosis, 61
Hyperpigmentation, 61
Hypertension, 328
Hypnum cupressiforme, 10
Ibadan, 337
India
arsenic in environment, 317-320
cadmium in environment, 320-324
chemical industries, 316-317
cycling of arsenic, cadmium, lead and mercury in, 315-333
human exposure to arsenic, cadmium, lead and mercury, 327-329
lead in environment, 324-325
mercury in environment, 325-327
mineral processing, 316-317
perspectives, 329-340
Indra Prastha power station, 319, 320
Industrial development, 329
Industrial emissions, 337
Industrial processes, 69-87
Industrial production, 317
Industrial sources, 190, 225
Industrial wastes, 7, 188, 190
Industrialization, 335
Iron
in sediments, 307-308
manufacturing, 76, 77, 80
Iron ore processing, 295
Iron ore tailings, 226
Itai-itai disease, 61
Ivory Coast, 335

La Grande Reservoir, 265
Lagos, 335, 336
Lakes, 204-205
acidiﬁcation, 90
quantitative effect of sediment, 243
trophic status, 27
Land clearance, 286
Lead
accumulation, xxi
adverse effects in children, 14
alkyl species, 183
and urban microenvironment, 12-13
anthropogenic, xix, xxi, 14, 76-79, 84
as function of particle size, 162
at open ocean sites, 167
atmospheric, 74-76, 167
in Samoa, 155
atmospheric ﬂuxes, 77
atmospheric transport, 81-83
behaviour in the body, 55-56
biogeochemical cycle, 3, 4
biomagniﬁcation, 7
biomethylated, 9
biopurification 7
biotransformation of inorganic environmental, 4
blood levels, 13, 224
brain damage, xxi
cycling, 5
factors aﬀecting, 10-11
daily intakes, 329
deposition in Norway, 108
dry deposition, 165
dust vector, 13
emission controls, 11
emissions, xxi, 8, 9, 13, 71-74, 189, 219-220, 336
environmental hazard, 3
environmental pathways, 5
equilibrium speciation calculations, 176
exposure thresholds, 64-65
fishing weights, 7
from gasoline combustion, 219-224
from industrial activities, 225
<table>
<thead>
<tr>
<th>From natural sources, 78</th>
<th>In vegetation, 223</th>
</tr>
</thead>
<tbody>
<tr>
<td>from sediments, 7</td>
<td>in water, 325</td>
</tr>
<tr>
<td>from water pipes, xix</td>
<td>indicator organisms, 10</td>
</tr>
<tr>
<td>gasoline additives, 8</td>
<td>industrial applications, 77</td>
</tr>
<tr>
<td>GEMS programme, 49</td>
<td>ingestion of, 339</td>
</tr>
<tr>
<td>geochemical behaviour, 309</td>
<td>inhalation, 54</td>
</tr>
<tr>
<td>geochemical dispersion, 304</td>
<td>inorganic form, 4</td>
</tr>
<tr>
<td>group report, 3–16</td>
<td>major sources of, xix</td>
</tr>
<tr>
<td>haematological effects, 56</td>
<td>mass-size function, 162</td>
</tr>
<tr>
<td>health effects and populations affected, xix, 3, 56–59</td>
<td>monitoring, 12</td>
</tr>
<tr>
<td>human exposure, 327–329</td>
<td>national level data, 11</td>
</tr>
<tr>
<td>in Abakaliki area, 306</td>
<td>on land, 5</td>
</tr>
<tr>
<td>in air, 5, 219–220, 323</td>
<td>organometallic compounds, 4</td>
</tr>
<tr>
<td>in aquatic environment, 193–194</td>
<td>overt toxicity, 53</td>
</tr>
<tr>
<td>in brown earth profiles, 113</td>
<td>oxide, 80</td>
</tr>
<tr>
<td>in central nervous system, 57</td>
<td>pathways and accumulating compartments, 9</td>
</tr>
<tr>
<td>in children, 3, 12, 54, 339</td>
<td>poisoning, xxi, 55</td>
</tr>
<tr>
<td>in coals and crude oils, 72</td>
<td>primary production, 38–39</td>
</tr>
<tr>
<td>in consumer goods, 14</td>
<td>regional information, 7–8</td>
</tr>
<tr>
<td>in developing countries, 13–14</td>
<td>regional inventories, 15</td>
</tr>
<tr>
<td>in domestic animals, 327</td>
<td>reservoirs of, 9</td>
</tr>
<tr>
<td>in dust, 220–223</td>
<td>residence times in seawater, 185</td>
</tr>
<tr>
<td>in environment, 324–325</td>
<td>responses of biota, 10</td>
</tr>
<tr>
<td>in fish, 230</td>
<td>riverborne, 7</td>
</tr>
<tr>
<td>in freshwater, 5, 10</td>
<td>routes of human exposure, 5</td>
</tr>
<tr>
<td>in gasoline, 11, 14</td>
<td>shot ingestion, 7</td>
</tr>
<tr>
<td>in haematological system, 56</td>
<td>smelting, 283–284</td>
</tr>
<tr>
<td>in Hong Kong, 217–233</td>
<td>sources, xix, 8</td>
</tr>
<tr>
<td>in human hair, 224</td>
<td>speciation and cycling in natural waters, 4, 175–186</td>
</tr>
<tr>
<td>in India, 315–333</td>
<td>susceptibility of children to, 58</td>
</tr>
<tr>
<td>in marine atmosphere, 162</td>
<td>susceptibility of humans to, xxii, 14</td>
</tr>
<tr>
<td>in natural surface soils, 112, 114</td>
<td>technologies shift, xxii</td>
</tr>
<tr>
<td>in nervous system, 56</td>
<td>terrestrial food chains, 3</td>
</tr>
<tr>
<td>in ocean water, 7, 185</td>
<td>transplacental transfer, 55</td>
</tr>
<tr>
<td>in oxygenated waters, 178</td>
<td>via wet, dry or cloud deposition, 5</td>
</tr>
<tr>
<td>in paints, 225</td>
<td>volatility of, 80</td>
</tr>
<tr>
<td>in plants, 116, 223–224</td>
<td>water pipes, 13</td>
</tr>
<tr>
<td>in rain, 150</td>
<td>Lead chloride, 80</td>
</tr>
<tr>
<td>in remote marine air and rain, 148</td>
<td>Lignite deposits, 316</td>
</tr>
<tr>
<td>in renal system, 56</td>
<td>Limnocorals, 269</td>
</tr>
<tr>
<td>in river sediments, 248</td>
<td>Litter</td>
</tr>
<tr>
<td>in river waters, 246–247</td>
<td>accumulation, 338</td>
</tr>
<tr>
<td>in salt water ecosystems, 6</td>
<td>decomposition, 10</td>
</tr>
<tr>
<td>in sediments, 225, 303–313</td>
<td>London, 336</td>
</tr>
<tr>
<td>in soils, 220–222, 303–313, 321, 324</td>
<td>Low alkalinity river water (LARW), 177, 180</td>
</tr>
<tr>
<td>in surface peat, 114</td>
<td>Lung cancer, 62, 63</td>
</tr>
<tr>
<td>in tropical soils, 307, 312</td>
<td></td>
</tr>
<tr>
<td>in vegetables, 227</td>
<td></td>
</tr>
</tbody>
</table>
Magela Creek, 197
Manganese
  in Aswan High Dam Reservoir, 241, 243
  in Lake Nubia sediments, 245
  in river sediments, 248
  in sediments, 307-308
Manures, 318
Marine aerosols, 169
Marine atmosphere, heavy metals in, 166-167
Marine environment, microorganisms in, 166
Mean oceanic residence time, 184
Mercury
  adsorption, 92
  airborne, 99
  analytical sampling, 22
  and environmental health, 19
  and selenium relationship, 28-29
  anthropogenic fluxes, 20
  anthropogenic sources, 76-79, 84
  aquatic environment, 17
  aquatic food chain, 19
  as fungicide, 60
  atmospheric, 74-76, 83
  atmospheric deposition rates, 97
  atmospheric fluxes, 77
  atmospheric load, 18
  atmospheric transport, 81-83
  bacterial methylation, 26
  behaviour in the body, 55-56
  bioaccumulation, 18
     by aquatic biota, 255-277
  bioamplification, 259
  biogeochemical cycle, 20-21, 90
  biological impacts, 19
  biomagnification, 17, 19
  bulk deposition, 95
  chemical speciation from high-temperature processes, 79-81
  concentrations in various atmospheres, 96
  condensation, 92
  current trends in use, 21
  demethylation, 24, 25
  deposition, 22, 26-27, 90-91
  early toxic effects, 17
  emissions, xx, 18, 20, 27-28, 71-74, 90-91
     from coal-fired power plants, 93
  from waste deposits, 96
  equilibrium concentration in pure water, 102
  equilibrium speciation calculations, 176
  from natural sources, 78
  from solid wastes, 93
gaseous, 81, 163, 167
general atmospheric cycle, 100
global atmospheric pool, 17
global cycling, 90, 99-102
global dispersion, 17
global wet deposition, 102
group report, 17-33
hair analysis, 19
health effects and populations affected, 18, 59-60
human exposure, 327-329
in air, 95, 100
in aquatic environment, 193-194
rehabilitation and control measures, 269-272
in atmosphere, 21, 22
in coals and crude oils, 72
in developing countries, 21
in domestic animals, 327
in environment, 23, 325-327
in fish, 25-26, 49, 59, 90, 257-268, 326
in grain, 326
in India, 315-333
in muscle, 25
in oxygenated waters, 178
in plants, 99
in sediments, 326
in soils, 97-99
in stored solid wastes, 27-28
in surface soils, 113
in water, 325
industrial applications, 77
inorganic compounds, 99
lake budget, 27
long range transport, 17
major pathway to man, 17
major sources of, xix
marine biological sources, 152
marine pollution, 21
metabolic factors, associated with environmental exposure, 54
methylation, xx, 17, 24, 25, 27
microbial demethylation, 24
Index

monitoring, 21
natural emission rates from solid materials, 95
organic compounds, 99
overt toxicity, 53
particulate, 95, 166
plant uptake studies, 98-99
poisoning, xx, 60, 339
puzzles regarding, xxii
removal from atmosphere, 101
residence times in seawater, 185
sampling, 99
solubilities of, 102
speciation and cycling in natural waters, 175-186
technologies shift, xxii
total annual surface emission, 96
toxic effects, 19
toxicity modification, 29
vapour phase, xx, 22, 80, 89-106, 166
volatility of, 80, 93
see also Methylmercury
Mercury cycle, 21
Mercury slimicides, 21
Metabolic factors, 54-56
Metal alkyls, 180
Metal–organic complexes, 196, 308
Metal–organic interactions in natural waters, 181
Metals Cycling Workshop, xx
Metastable oxidation states, 180
Meteorological factors, 148
Methylmercury
anoxic systems, 183
exposure thresholds, 64-65
in fish, 25, 268
in surface water, 24
intoxication, 59
poisoning, 18, 29, 54
toxicity, 29
transplacental transfer, 55
uptake efficiency from water, 257
Microbial redox processes, 181
Micrococcus luteus, 10
Mineral deposits, 304
Mineral processing, 316-317
Mineral production, 318
Mineral reserves, 318
Mining operations, 126, 189, 197, 200, 201, 306, 337
Molonglo River, 200
Monitoring
comprehensive, 340
coordinating body, 346
environmental, 13, 339-340
funding limitations, 12
handbooks of agreed techniques, 345
heavy metals, 335-341, 343-347
historical record, 12
international collaboration and financial aid, 344
international compatibility, 344
international funding, 346
planning, 12
programme proposals, 344
specialist training for, 346
three-tier system, 344-345
Mugil dunes unierie, 326
Murray River, 203
Mytulus edulis, 10
Nasal septum lesions, 61
Nasser, Lake, 242-245
Natural gas flaring, 337
Natural sources, unknown, 165
Natural waters, metal–organic interactions in, 181
Nelson River, 266
New York, 336
Nickel
deposition patterns in Norway, 111
in soils, 111
Nigeria, 335. 337, 339
dispersion of cadmium, lead and zinc in soils and sediments, 303-313
Nile River
ecosystems, 235-254
fish studies, 248-252
monitoring sites, 240
pollution assessment, 248-252
trace metals in, 245-246, 248, 249
watershed areas, 237
Nitrogen fertilizers, 127
Non-equilibrium behaviour, 180
Non-ferrous metal production, 74-76, 79, 80, 126, 140, 294, 296-297
Norway
  deposition of heavy metals, 107–117
  heavy metals in soils, 111–115
  sampling stations, 109
  trace element deposition patterns, 109–111
Nubia, Lake, 242, 243, 245
Nutritional deficiencies, 14
Nutritional factors, 19

Oat grain, 130
Ocean cycles, 148
Oceans
  arsenic influx and outflux, 293–294
  heavy metals in, 167–169
  Oil combustion, 70–74, 80
  Ombrotrophic bogs, heavy metals in, 115
Opinacca reservoir, 265
Opium, 328
Organic complex formation, 180
Organomercurial compounds, 19, 327
Oxygen redoxcline in stratified lakes, 243
Paints, lead-containing, 225
Peat profiles, 115
Petroleum products, 325
Phosphorus fertilizers, 127–128
Pig manure, 227, 229, 230
Pinna bicolor, 200
Plants, lead in, 116, 223–224
Pleurozium schreberi, 10
Port Harcourt, 337
Power generation, 69–87
Power plants, 337
Precipitation scavenging, 101, 102
Precipitation systems, 152
Proteinuria, 60
Punjab, 320, 323
Quebec reservoirs, 265

R-mode factor analysis, 308, 312
Radionuclides, 168
Rain collection, for metal analysis, 152
Rain concentrations, 149–150
  collected from islands and ships, 150

marine, 150
Rain fluxes, and washout factors, 156–159
Rain samples
  collection from ships, 155
  collection system, 154
  contamination of, 154–156
  ocean surface, 154
  representativeness of, 152
Raphanus sativus, 227
Recycled components for dry deposition measurements, 165
Recycled metals in marine rains, 164
Redox speciation, 180–183
Reference standards, 50
Refuse compost, 227
Refuse incineration, 76, 77, 80
Reservoirs, mercury in fish from, 258–268
Residence times, 183–185
River sediments, trace metals in, 248, 249
River waters, trace metals in, 246–247
Rivers, 202, 203, 206, 207
Saccostrea glomerata, 226
Saharan dust, 339
Samoa, lead and cadmium in rain samples, 155
Sarotherodon mossambicus, 230
Scavenging ratios, see Washout factors
Scavenging residence times, 184
Scrubbing agents, 239
Sea salt particle deposition, 161
Sea salt spray, 288, 294
Sea spray recycling, 163
Seawater, 167, 177, 179, 180, 325
  residence times in, 185
  speciation models, 178
Selenium
  and mercury relationship, 28–29
  in plants, 116
  in surface soils, 113
Sewage dumping, 225–226
Sewage effluents, 190
Sewage irrigation, 321, 322
Sewage sludge, 41, 127, 133, 134, 139, 190, 226–230, 323, 338
Sewage system, 7, 39
Skin tumours, 61
Smelting operations, 126, 281, 283-284, 294-296, 319, 337
Soils
arsenic in, 45, 111, 289, 297, 319
cadmium in, 41, 111, 119-146, 303-313, 321
chromium in, 111
cobalt in, 111
copper in, 111
ferralitic, 309
heavy metals in, 111-115, 308-309
lead in, 220-222, 307, 312, 321, 324
mercury in, 97-99, 113
mercuriferous, 97-99
nickel in, 111
oxidation–reduction potential of, 133
pH effects, 128-134, 322
pollution of, 338
roadside, 336
sewage-irrigated, 321, 322
trace elements in, 306
tubewell-irrigated, 322, 324
waste water-irrigated, 324
zinc in, 111, 303-313
South Esk River, 200-201
Speciation studies, 196-197
Spencer’s Gulf, 200
*Sphagnum* moss, 269
Sphalerite, 306
Stability constants, 176-177
Standard reference material, 49-50
Steel manufacturing, 76, 77, 80, 284
Stormwater quality, 190
Stream sediments, 304, 307, 311, 312
Streams, 202, 203, 206, 207
Sulphate complexation, 179
Sulphide forming elements, 71
Sulphide ores, 74
Sulphur compounds, 260
Surface complexation constants, 184
Surface complexation model, 183
Swiss chard, 130
Synfuel technology, 296
*Tilapia* mozambique, 326
*Tillandsia usneoides*, 10
Tin mining, 200
Tobacco, 39

Total dissolved solids (TDS), 203, 204
Toxicity studies, 198-199
Trace metals, 71, 73, 77, 81, 82
adsorbability and relative residence time, 239
and suspended solids, 247-248
atmospheric concentrations of, 148
biochemical role, 239
biogeochemical cycle, 239
deposition patterns in Norway, 109-111
dry deposition of, 160
in aquatic environment, 237-240
in Aswan High Dam Reservoir, 235-254
in Aswan High Dam Reservoir sediments, 245-246
in Nile River, 245-246, 248, 249
in river sediments, 248, 249
in river waters, 246-247
in rock–soil–plant systems, 304
in sediments, 309-312
in surface waters, 169
in tropical soils, 309-312
ingestion, 239
mass median diameter of, 82
mass-size distribution of, 160
non-biodegradable, 239
point and non-point sources, 189
regional distribution of, 304
removal from atmosphere, 82
sampling of precipitation for, 108
suspended solids as scavengers for, 247
Transfer processes, 197-198
Tropical ecosystems, 303-313
Tropical rain forests, 338
Tropical rivers, 203
Tropical weathering, 338
*Ulva lactuca*, 226, 228
United States, cadmium levels in soils and crops, 119-146
Uranium mining, 197, 201
Urbanization, 335
Vanadium in seawater, 167
Vegetables
arsenic in, 328
Vegetables (cont.)
  cadmium in, 132-134
  lead in, 223, 227
Volcanoes, 289

Washout factors, 166
  and mass median diameter
    (MMD), 157
  and rain fluxes, 156-159
  defined, 156
  to calculate metal deposition rates, 156
Waste disposal, 39
Waste incineration, 165, 288, 337
Waste materials, 93-97
  recycling of, 226-230
Water pollution, 325, 337-338
Water quality, 203-204
Water supplies, cadmium in, 121
West Africa, 335-341
Willard Bay reservoir, 258
Wind blown dust, 189, 339
Wind erosion, 288
Wind flow patterns, 151

Zinc
  dry deposition, 165
  geochemical behaviour, 309
  geochemical dispersion, 304
  in Abakaliki area, 306
  in Aswan High Dam Reservoir, 243
  in dust, 223
  in fish, 230
  in Lake Nubia sediments, 245
  in natural surface soils, 114
  in plants, 116
  in river sediments, 248
  in river waters, 246-247
  in sediments, 303-313
  in soils, 111, 303-313
  in tropical soils, 307
  sensitivity to freshwater animals, 199
Zinc pollution, 200
Zinc production, 74-75, 284

Wolfram mining, 200
Wood fuel consumption, 286
Wood preservatives, 287, 297