Index

Note: page numbers in italic type refer to illustrations and tables

Alandskoe, southern Urals 168
alluvial tin mining on Dartmoor 91–101
barytes and galena 97
climate deterioration 101
documentary evidence of mining 91, 92
field site selection 93, 94
laboratory methods 94–5
palaeochannels
River Avon 98–100, 99, 100, 101
River Erme 98, 99, 100–101, 100
radiocarbon dating 93, 95, 97, 98–100, 99
Ringarooma River, Tasmania 93, 97
sediment sampling 93–4
Taw Marsh terrace site 95–6, 96
Teign valley site
middle terrace 96–8, 97, 98
upper terrace 93, 97
tin concentrations 96, 97, 97–100, 97–100
correlated to silt percentage 97–8, 97
tin slag 92
tin streaming (hydraulic mining of placer deposits) 92
downstream environmental impact 92–3, 97
alum extraction processes, geochemistry of 12, 139–45
alum industry 139–40
alum shales of North Yorkshire 139, 140
sulphur content 145
alunite 139–40
Carlton Banks Alum Works 142–3, 145
geochemical analysis 142–5
EDXRF (energy dispersive X-ray fluorescence) 143–5, 144
methodology 143
variations in fresh shale composition 143, 145
magnetic susceptibility 143, 144, 145
production process 140–2, 141
extraction 140
extraction efficiency 142, 143, 145
purification 140–2
waste tips of calcined shale 142
Spence process 140
anthropology, and archaeology 8
archaeological chemistry 7
archaeological geology 9
Archaeological Prospection 9
archaeometry 7
Ariconium Romano-British iron working site 156, 159–63
Arkaim, southern Urals 167, 169, 170, 171
Australopithecine site at Limeworks Cave, Makapansgat 10–11, 61–76
bones derived from hyena dens 71
breccias 71–2, 74, 75–6
cave deposits 65–74
Member 1 (A and B) 65–9, 65, 67, 68, 70, 72, 75–6
Member 2 69–70, 70, 71, 75–6
Member 3 70–1, 70, 75–6
Member 4 66, 71–4, 72, 73
cave stratigraphy 63–5, 65
cave topography 63–5, 64
chronology 61–2
location 62
mud-crack polygons 68, 69, 75
paleomagnetism 62, 63, 72, 73, 74, 76
palynological analysis 62
rhythmites 73–4
speleothem depositional environments 66, 67–9, 71, 74–5
standing water and water tables 75
Australopithecus africanus remains 61, 63, 70–1
Blaengwynlais ore deposit, Glamorgan iron orefield 112, 116, 117
bloomery furnace mass balance and efficiency 12, 155–64
contribution of furnace lining to slag 155, 163
mass balance of smelting components 155–63
equations 157–9
errors in best fit solution 161–3
fuel ash contribution 159, 163
graphical solutions 155–9, 161, 162, 163
major elements 159, 161
rare-earth elements 161, 162
trace elements 161, 162
major element composition of components 159, 160
brass alloys see zinc isotope fractionation
Bristol Channel Orefield 103–20, 155–64
genological background 111, 111, 156–7
Brouage see geochemistry of granite ballast
Bute ore deposit, Glamorgan iron orefield 111, 112, 117, 120
Carlton Banks Alum Works 142–3, 145
see also alum extraction processes
INDEX

cave deposits see Australopithecine site at Makapansgat

Dacre, lead smelting site 16, 18, 27–9, 28, 30, 31
Dartmoor see alluvial tin mining on Dartmoor
Darwin, Charles 8
depth to buried features see Euler deconvolution in depth estimation

environmental geochemistry 11
environmental reconstructions 10, 79–89
Euler deconvolution in depth estimation 10, 35–40, 55–7
Euler deconvolution theory 37–8, 38
fluxgate gradiometer data 35–6
GPR (ground penetrating radar) 38–40, 39

Fforest Fawr ore deposit, Glamorgan iron orefield 111–12, 115, 116, 117
fluxgate gradiometer surveys
delineation of wall footings 35–6, 36
Euler deconvolution methods applied to 37–8, 38, 40
metal working sites 16–17, 18, 19–27, 21–5, 27–8, 29, 30

Geoarchaeology 9
goarchaeology
definition 7
in the United States 8
geochemical analysis 11
geochemistry
early alum extraction processes 12
modelling of bloomery iron smelting 12, 155–64
gochemistry of granite ballast boulders 11–12, 123–36
archaeological dating 125, 126
ballast boulders
cabotage 127, 136
in dated building structures (Brouage) 125, 126, 127
evidence for direct travel 124, 127
maritime practices 123–4
in ore furnace lining (La Rochelle) 125, 126, 127
un-mixed sample types 124, 127
laboratory methods 124
muscovite-bearing granite 127–34, 135–6
Carnmenellis intrusion 133–4, 133
geochronology 133–4
geographical origin 133–4
petrography 127, 129, 129, 131, 132
rare-earth element patterns 133, 133
single magmatic series 129–32
trade between Falmouth and La Rochelle and Brouage 136
muscovite-free granite 134–6, 127
Donegal batholith 134
geochronology 135
gEOGRAPHICAL ORIGIN 134–5
petrography 127, 129, 134, 135
trade between Donegal and Brouage 134–6
site details 128
syenite boulders 127

trade routes 123, 136, 136
geochronology 11–12, 61–2, 133–4, 135
The Geological Evidences of the Antiquity of Man (Lyell) 8
goology 7
and archaeology 9
gomorphology 7, 9
geophysics in urban areas see microgravity in industrial archaeology
goradar (GPR; ground penetrating radar) 9, 10, 36–40, 39, 45
Glamorgan orefield 103, 104, 111
evidence of exploitation 117–18
goology of 111–12, 111
historical context of exploitation 119–20, 119
ore characteristics 112–18, 113, 114
trace element data 115–17
see also iron ore
Grinton lead smelting site 18, 26–7, 27, 31
historical relics of the south Urals 12, 165–76
Alandskeoe 168
Arkaime 167, 169, 170, 171
burial mounds 173, 175–6
composition of artefacts
copper and bronze 171–3
lead and gold 174, 175–6, 175
conservation of artefacts 167
corrosion products of copper and bronze artefacts 173
goological–mineralogical data bank 167
Kuisak 167, 168, 172–3
locations of settlements 166
material sources for lithic industry 166, 167–8
mining and metal working 167, 169–70
Bronze Age copper mines 169–70, 170
ore assemblages 169–71
Sintashta 172
Vorovskaya Yama, Bronze Age mine 169, 170, 171

ICP-MS (Inductively Coupled Plasma-Mass Spectrometry) 107, 109, 115–17, 149, 150–1, 152, 155, 156
iron ore, provenancing in Bristol Channel
Orefield 11, 103–20, 156
de Clare family, Lords of Glamorgan 119–20
Trelech industrial centre 119–20
exploitation evidence 117–18
Glamorgan iron orefield 111, 111
goology 111–12, 111
ore characteristics 112–18
orebodies worked out 111–12
Pb/Ba data 116–17, 116
under control of de Clare family 119, 119
historical context 119–20
location 104
Magor Pill boat 103
date of foundering 119
iron ore cargo 103, 108, 109, 110, 116, 118
grade 107
lump ore facies 104, 106–7
ore genesis 118
powder ore 107, 107
INDEX

provenancing within Glamorgan ore field 111–18, 120
major element analysis (XRF) 108, 113, 114, 116
rare earth element analysis 110
trace element analysis (ICP-MS) 107, 109, 115–17
iron smelting technology
blast furnace (indirect process) 16, 19, 29, 117
bloomery process (direct process) 16, 18–19, 18, 29, 1178
finery/chafery 16, 18, 19
see also bloomery furnace mass balance; medieval iron and lead smelting; metal working sites
Kuisak, southern Urals 167, 168, 172–3
Kyloe Cow Beck, iron bloomery 16, 22–4, 23, 24, 31

La Rochelle
historical development 124–5
see also geochemistry of granite ballast
lead smelting sites 10, 16, 26–9, 31, 32
see also iron and lead smelting works
Lesser Garth ore deposit, Glamorgan iron orefield 111, 112, 115, 116, 117
Limeworks Cave, Makapansgat see Australopithecine site at Makapansgat
Llanharry ore deposit, Glamorgan iron orefield 111, 115, 116, 117, 157
Lock Farm, reburied iron bloomery furnace 16, 19–21, 20, 21, 22, 24, 31
Lyell, Sir Charles 7–8
magnetic gradiometry (magnetostratigraphy) 10
Magor Pill boat, iron ore cargo see iron ore, provenancing
medieval iron and lead smelting works 15–32
charcoal storage areas 29
Dacre lead smelting site 16, 18, 27–9, 28, 30, 31
furnace area calculations 24
geophysical techniques and methodology 16–18
earth resistance 17, 29
fluxgate gradiometer surveys 16–17, 18, 19–27, 27–3, 27–8, 29, 30
magnetic susceptibility determinations 16–17, 19, 26, 27, 29, 31, 32
pulse induction surveys 17
Grinton lead smelting site 16, 26–7, 27, 31
Hendy-isaf bloomery 117
Kyloe Cow Beck 16, 22–4, 23, 24, 31
Lock Farm experimental site 16, 18, 19–21, 20, 21, 22, 24, 31
Mwyndy bloomery 117
previous work 15–16
site locations 17–18, 17
technology
iron smelting 18–19, 29–30
lead smelting 26, 29–30
Timberholme High Bloomery 25–6, 25, 31
tin processing sites 16
metal working sites
Ariconium Romano-British iron smelting site 156, 159–63
Fforest Fawr 117
Glamorgan orefield 112–15, 117
Hendy-isaf 117
Mwyndy 117
remote sensing techniques
earth resistance 15, 16, 29
fluxgate gradiometer surveys 16–17, 18, 19–27, 27–3, 27–8, 29, 30
gamma-ray spectroscopy 16
magnetic susceptibility surveys 15, 16–17, 19, 26, 27, 29, 31, 32, 146, 145
magnetometer surveys 15–17
pulsed induction 16
southern Urals 167, 169–71, 170
Trellech, iron-making centre (Gwent) 119
see also medieval iron and lead smelting works
microgravity in industrial archaeology 10, 41–58
Bouguer anomaly maps 48, 49, 51, 53
regional anomaly removal 50, 53, 57
second horizontal derivative 49, 51, 52, 54–5, 54, 55, 57
terrain correction 49–50, 50, 53, 57
data
acquisition 48–9
enhancement 49–51, 57
interpretation 53–5, 54
reduction 49
sources of noise 52–3
Euler deconvolution method 55–57, 56
geology of site 52, 53
gravimeter resolution 47
gravity modelling in 3D 55–7, 56
previous microgravity surveys 46
previous site investigations 43–4
principles of microgravity 45–6
site reconnaissance 44, 48
survey design 46–8
techniques for void detection 44–6
Williamson tunnels, history and redevelopment 41–4, 43, 44, 53
Miskin ore deposit, Glamorgan iron orefield 111, 115–16
Mwyndy ore deposit, Glamorgan iron orefield 111, 112, 115, 117
On the Origin of Species (Darwin) 8
palaeoindian sites, ephemeral nature 9
palynology 10, 62
see also soil-stratigraphic palynology in podsols
pedology 7
Principles of Geology (Lyell) 8
radiocarbon dating 8, 88
remote sensing (archaeological prospection) 7, 9–10
aerial photography 9
earth resistance 15, 16, 29
gearadar 9, 10, 36, 38–40, 39, 45
ground based techniques 9
remote sensing (archaeological prospection) (cont.)
  high-resolution microgravity 10, 45–58
  magnetic (fluxgate) gradiometry see fluxgate gradiometer surveys
  magnetic susceptibility 15, 16–17, 19, 26, 27, 29, 31, 32, 143, 144, 145
  multispectral data (airborne and satellite) 9
  resistivity 9
  shallow seismic techniques 9
  in urban areas 10, 41–58
salt trade, Brouage 125
sedimentology 7, 9
Sintashta, southern Urals 172
slag deposits 30
  assimilation of furnace lining 155
  chemical analysis 10, 12, 25–6, 28
  iron content 19
  low anomaly values of lead slag 27, 29, 30, 31
  magnetic susceptibility surveys 15, 16, 26, 27, 29, 31, 32
  in mass balance equations 157–9
soil-stratigraphic palynology in podsoils 79–89
  14C dating 88
  biological activity 80
field site (Lour 7; ferric podsol) 80–3, 81
  dated inputs to podsol 137Cs 82, 84–5, 86
  depth and rate of mixing 86–7, 88
  non-native pollen 81, 84, 86
  spheroidal carbonaceous particles (SCPs) 82, 84–5, 86
  stratigraphic locations 84, 85
earthworms absent 85, 87, 88
enchytraeids 85–6, 87
faunal excrement 85–6, 87
location of tetrad pollen grains 84, 85–6
methodology 82
  physical and soil-faunal data 83, 84
  soil profile description 82
  Lour Peat Profile 81, 82, 87
mor horizons, formation of 80
pollen assemblages 79–80
  trapped within organic horizons 86, 87, 88
  unreliable for interpreting vegetation histories 87, 88–9
pollen mixing processes 80, 86–7, 88
  near-surface feeding invertebrates 86, 88
previous work 80
soil-micromorphological analysis 80, 82, 83, 85
vegetation histories 79–80
stratigraphy 7
  in cave deposits 10–11, 61–76
  in soil profiles 79–89
Timberholme, high bloomery site 25–6, 25, 31, 31
tin mining see alluvial tin mining on Dartmoor trade patterns see geochemistry of granitic ballast boulders; historical relics of the south Urals; iron ore Trecastell ore deposit, Glamorgan iron orefield 111, 115, 117
Trelech, iron-making centre 119–20
tunnels see microgravity in industrial archaeology Urals see historical relics of the south Urals
void detection see microgravity in industrial archaeology Vorovskaya Yama, Bronze Age copper mine 169, 170, 171
Williamson, Joseph 42
Williamson tunnels, Edge Hill, Liverpool see microgravity in industrial archaeology Wroxeter Hinterland project 35–40, 36
X-ray fluorescence (XRF) 94, 108, 143–5, 144, 156
zinc isotope fractionation in liquid brass alloys 12, 147–53
  brass-making 147–8
  cementation process 147–8
  direct process 148, 152
fractionation factor estimates 149, 151–2, 151
  ICP-MS (inductively coupled plasma-mass spectrometry) 149, 150–1, 152
isotopic zinc fractionation during evaporation 147, 148, 152
  experimental methodology 149–51
  mathematical modelling 148–9, 152
zinc isotope analyses (ICP-MS) 150–1, 150, 151, 152
Rayleigh fractionation 148–9, 152