

Index

a

actinide metals

- actinium
- – chemical behaviour 325
- – thermochemical data 325
- – thermodynamic parameters 326
- americium 407
- berkelium and californium 419
- curium 415
- neptunium
- – neptunium (III) 380
- – neptunium (IV) 380
- – neptunium (V) 384
- – neptunium (VI) 394
- plutonium 396
- protactinium(V) *see* protactinium(V)
- uranium
- – dioxouranium(VI) cation 336
- – uranium(III) 336
- – uranium(IV) 336
- – uranium(V) 350
- – uranium(VI) 350
- protactinium(IV) 327

actinium

- chemical behaviour 325
- thermochemical data 325
- thermodynamic parameters 326

alkali metals

- lithium *see* lithium
- hydrolytic reactions 135
- potassium
- – collation and assessment 149
- – temperature dependence 148
- – thermodynamic parameters 149
- rubidium, cesium and francium 149
- sodium
- – collation and assessment 143
- – temperature dependence 142

- – thermodynamic parameters 143

alkaline earth metals

- barium *see* barium
- beryllium *see* beryllium
- calcium *see* calcium
- magnesium *see* magnesium
- radium *see* radium
- strontium *see* strontium

aluminium

- aluminosilicate mineral phases 757
- derived interaction coefficients 768, 769
- gibbsite 768
- goethite *vs.* boehmite 767
- hydrolysis reactions 793
- ion interaction parameters 764, 766, 769, 770
- oxyhydroxide mineral phases 757
- polymeric hydrolysis species 757
- predominance diagram 796
- solubility constant
- – boehmite 780, 782
- – gibbsite 778
- stability constants 760, 762–764, 769–771, 782, 786
- temperature dependence 758, 759
- thermodynamic properties 757, 776, 795
- zero ionic strength 770, 772, 774, 775

americium (III)

- collation and assessment 410
- ionic strength dependence 407
- thermochemical data 407

americium (IV) 411

americium (V) 414

americium (VI) 415

b

barium

- stability constant 215–217

- temperature dependence 214
- thermodynamic parameters 215
- barium chloride 111
- berkelium 419
- beryllium
 - collation and assessment
 - – calorimetry 176
 - – fixed ionic strength 168
 - – Gibbs energy 168
 - – hydrothermal temperatures 177
 - – potentiometric method 175
 - – solubility constant 167
 - – speciation, predominance diagram 177, 178
 - – stability constants 168, 169, 171, 175
 - hydrolysis species 155, 156
 - ionic strength dependence
 - – ion interaction theory 162
 - – nuclear magnetic resonance studies 163
 - – sodium perchlorate 161
 - – solvent extraction measurements 161
 - – stability constant 165
 - temperature dependence
 - – monomeric hydrolysis species 158
 - – solubility data 157
 - – stability constant 159, 160
 - thermodynamic data 166
- bismuth
 - collation and assessment 882
 - ionic strength dependence 876
 - speciation 884
 - temperature dependence
 - – hydrolysis 875
 - solubility constants and temperature 874
- c**
- cadmium
 - cadmium(II) 718
 - collation and assessment 736
 - ionic strength dependence 730
 - thermodynamic parameters 733
- calcium
 - collation and assessment
 - – hydrolysis constant 205, 207, 208
 - – ion interaction theory 209
 - – portlandite, solubility constant 200, 201
 - hydrolytic reactions 195
 - ionic strength dependence 198, 199
 - solubility of portlandite 195
 - temperature dependence 195–198
 - thermodynamic data 199, 210
- californium 419
- cerium
 - Gibbs energy of formation 260
 - hydrolytic reactions 263
 - oxygen-lanthanide interatomic distance 260
 - stability constants 261–263
 - cerium(IV)
 - – hydroxide phase 312
 - – ion interaction theory 316
 - – ionic strength dependence 310, 311
 - – oxidising agent 307
 - – stability constants 312, 315, 316
 - – temperature dependence 308, 309
 - – thermodynamic data 311, 317
- chromium
 - adsorption/desorption reactions 542
 - Gibbs energy, eskolaite 542
 - high and low solubility 542
 - hydrolytic reactions 542, 550, 552
 - ionic strength dependence 544–547
 - polymeric reactions 542
 - precipitation/dissolution reactions 542
 - predominance diagram 555
 - stability constant 553, 554
 - temperature dependence 546, 547, 549
 - thermochemical data selection 543, 544
 - thermodynamic values 549, 550
 - toxicological impact 542
- cobalt
 - cobalt(II)
 - – Gibbs energy 625
 - – ionic strength dependence 624
 - – predominance speciation 626
 - – solubility constant 625, 626
 - – temperature dependence 621, 622
 - – thermochemical data selection 620
 - – thermodynamic data 625, 626
 - cobalt(III)
 - – enthalpy of reaction 630
 - – ionic strength dependence 630
 - – monomeric hydrolysis, data 631
 - – temperature dependence 628, 629
 - – thermodynamic values 630, 631
 - formation reaction 620
 - ionic radii data 620
 - oxidation states and mixed oxidation state phases 620
- copper
 - copper(I)
 - – cuprite 654
 - – temperature dependence 650–652
 - – thermodynamic data 653–655
 - copper(II)
 - – hydrolytic reactions 666
 - – ionic strength dependence 660–665

- polynuclear species 667
- predominance speciation 669, 675
- stability constant 660, 667–669
- temperature dependence 656, 657, 659
- thermodynamic values 665, 669
- fossil fuel fired power plants 650
- hydrolytic reactions 650
- ionic radii 650
- toxic properties 650
- curium
 - ionic strength dependence 416
 - thermochemical data 415, 418

d

- Debye–Hückel equation 187
- Debye–Hückel theory
 - activity coefficient 12
 - Boltzmann distribution law 10
 - charge density 11
 - parameters 17
 - Poisson equation 10
- dysprosium 290–292

e

- enthalpy and entropy 24
- erbium 295–297
- europium 279, 280, 283

g

- gadolinium 284–286, 288
- gallium
 - hydrolysis reactions 797
 - ion interaction theory 804
 - ionic strength dependence 803, 804
 - predominance region 812
 - solubility constant 798, 800, 802, 806
 - stability constants 798, 800, 802, 803, 807, 809, 810
 - stable phase 797
 - temperature range 798
 - thermodynamic data 798, 806, 812
 - zero ionic strength 799
- gibbsite 2
- gold metal 718
 - gold(I) 740
 - gold(III) 740

h

- hafnium 460
 - thermochemical data 461
- holmium 293–295
- hydrolysis 2

i

- indium
 - calorimetric technique 816
 - ionic strength dependence 813–815
 - stable phase 812
 - thermodynamic parameters 816, 817
- ion interaction theory 14
- ionic strength dependence 836
- iridium 736
- iron
 - aqueous chemistry 574
 - dehydration and crystallisation 574
 - hydrolytic reactions 573, 574
 - iron (II)
 - ionic strength dependence 579
 - predominance speciation 585
 - solubility constant of magnetite 580, 584
 - temperature dependence 575–577, 579
 - thermochemical data selection 575
 - thermodynamic data 579, 580, 585
 - iron (III)
 - ionic strength dependence 594–596, 598
 - ion interaction theory 593
 - maghemite 600, 601
 - magnetite solubility 590
 - polymeric hydrolysis species 615
 - predominance speciation 618, 619
 - solubility constant data 602, 605, 611, 615
 - stability constant data 592
 - temperature dependence 587–591
 - thermochemical data selection 585–587
 - zero ionic strength 593
 - white rust 575

j

- Jahn–Teller effect 650

l

- lanthanum
 - Gibbs energy of formation 256
 - ion interaction theory 259
 - monomeric stability constants 259
 - solubility constant 256
 - stability constant 256, 259
 - zero ionic strength 260
- lead(II) 835
 - collation and assessment 855
 - ionic strength dependence 846
 - speciation 862
 - thermochemical data 843
 - thermodynamic parameters 855
 - temperature dependence 843

lead(IV) 835, 866

lithium

- collation and assessment 138
- ionic strength dependence 137
- temperature dependence 136
- thermodynamic parameters 138

lithium chloride 107

lithium perchlorate 115

lutetium 303–307

m

magnesium

- collation and assessment
 - activity coefficients 184
 - chloride self-medium 191
 - equilibration time 187
 - literature thermodynamic data 194
 - polymeric species formation 194
 - precipitation reactions 187, 194
 - saturation pressure 192
 - solubility constant, brucite 185
 - x-ray diffraction 187
 - ionic strength dependence 182, 183
 - speciation, predominance diagram 194, 195
 - temperature dependence
 - brucite solubility 180
 - solubility constant 179
 - stability constant 181
 - uncertainties 179, 181
 - thermodynamic parameters 183, 184
- manganese 3
- ionic radii 556
 - manganese(II)
 - ionic strength dependence 561, 562
 - predominance speciation diagram 568
 - stability constant data 561–563, 567
 - temperature dependence 557, 558, 560
 - thermochemical data 556
 - thermodynamic values 562
 - manganese(III)
 - bixbyite 569
 - Gibbs energy data 568
 - hydrolysis data 571, 573
 - ionic strength dependence 570, 571
 - temperature dependence 569, 570
 - thermochemical data selection 569
 - thermodynamic values 571, 573
 - manganese(IV) 573
 - oxidation states 556
 - photosynthesis process 556
 - pyrolusite 556
- mercury 718
- mercury(I) 741

– mercury(II)

- collation and assessment 745
 - ionic strength dependence 742
 - thermochemical data 742
 - thermodynamic parameters 745
- metal ion 1
- molybdenum 719

n

neodymium

- re-evaluated solubility measurements 273
 - solubility constant 268, 269
 - stability constants 271, 273–275
- neptunium
- neptunium (III) 380
 - neptunium (IV)
 - collation and assessment 383
 - ionic strength dependence 381
 - thermochemical data 380
 - thermodynamic parameters 383
 - neptunium (V)
 - collation and assessment 388
 - ionic strength dependence 385
 - thermochemical data 384
 - thermodynamic parameters 387
 - neptunium (VI) 394
 - thermodynamic parameters 395

nickel

- battery systems 649
- electrochemical cells 632
- hydrolytic reactions 633
- ionic radius 633
- mass transfer 632
- nickel II
 - bunsenite, solubility constant 642, 643
 - Gibbs energy 642
 - ionic strength dependence 638–640
 - speciation predominance 647
 - stability constant 637, 647, 648
 - temperature dependence 633, 634, 636, 637
 - theophrastite, β -Ni(OH)₂(s) 642, 643
 - thermochemical data selection 633
 - thermodynamic parameters, 641nickel III 647
- reactor construction 633

nickel hydride battery 3

Nuclear Energy Agency of the Organisation for Economic Cooperation and Development 4

o

osmotic coefficient 12

p

- palladium 723
- palladium(II) 717
- platinum 739
- plutonium
 - plutonium(III) 396
 - plutonium(IV)
 - collation and assessment 399
 - ionic strength dependence 398
 - thermochemical data 397
 - plutonium(V) 401
 - plutonium(VI) 403
- polonium(II) 884
- polonium(IV)
 - monomeric hydrolysis constants 889
 - solubility constants 888
 - stability constants 888
 - thermodynamic parameters 889
- potassium chloride 102
- potassium iodide 118
- potassium nitrate 118
- praseodymium 264, 265
- promethium 276
- protactinium(IV) 327
- protactinium(V)
 - collation and assessment 332
 - ionic strength dependence 329
 - temperature dependence 328
 - thermochemical data 328
 - thermodynamic parameters 331

r

- radium
 - stability constant 218
 - thermodynamic data 218, 219
- rhodium
 - collation and assessment 723
 - ionic strength dependence 721
 - temperature dependence 721

s

- samarium 276–278, 280
- scandium
 - amphoteric nature 225
 - hydroxide and oxide phases 225
 - ionic strength dependence 227–229
 - polymeric hydrolysis species 226
 - potentiometric data 226
 - predominance speciation 235
 - solubility constant 231–233, 235
 - thermochemical data 226, 227
 - thermodynamic parameters 230
- silver
 - collation and assessment 728

- ionic strength dependence 727
- speciation 730
- temperature dependence 725
- thermodynamic parameters 728
- silver(I) 718
- sodium nitrate 119
- sodium perchlorate 113
- sodium triflate 122
- spectrophotometry
 - Beer-Lambert–Bouguer Law 46
 - considerations and limitations 48
 - electronic transitions 46
 - hydrated copper(II) atom 46
 - uranium(VI) 48
- stability and solubility constants
 - d³ and d⁸ transition metal ions 894
 - d⁴ and d⁹ transition metal ions 894
 - experimental uncertainties 49
 - four cerium(IV) concentrations 36
 - hydrolysis
 - aluminium(III) 896
 - constants 44
 - ionic radii data 894
 - M(OH)₂^(z-2) species 896
 - M₃(OH)₄ species 902
 - M₃(OH)₄^(3z-4) 899
 - Zn(OH)₂ (aq) 895
 - hydrolysis species 893
 - liquid-liquid extraction
 - considerations and limitations 41
 - extraction process 38
 - graphical methodologies 37
 - hydrophilic/hydrophobic property 38
 - regression analysis 40
 - metal ions 58
 - monomeric species, higher stoichiometry 904
 - oxide and hydroxide phases 901
 - potentiometry
 - considerations and limitations 37
 - formation function 32
 - free hydrogen ion concentration 34
 - hydrogen ion activity 32, 33
 - metal ion concentration 35
 - stoichiometric and thermodynamic properties 32
 - solid-liquid extraction 42
 - spectrophotometry *see* spectrophotometry
 - three thallium(III) concentrations 35
 - temperature dependence 57
 - temperatures other than 25°C 905
 - thermodynamic calculations 59
 - UTMIC 906
- statistical analysis and selection criteria

- uncertainty assessment
- data availability 55
- stability and solubility constants 57
- propagation 56
- strontium
- stability constant 212, 213
- temperature dependence 210, 211
- thermodynamic parameters 211, 213

t

- technetium 719
- terbium 287, 290
- thallium
- oxide phase 817
- thallium(I) 817, 820–822
- thallium(II) 822, 825, 826
- theory
- activity of water 23
- Debye–Hückel theory *see* Debye–Hückel theory
- hydrolysis reactions 7
- ion interaction parameters
- KOH and NaOH solutions 18, 22
- ion interaction theory 14
- osmotic coefficient 12
- stability and solubility constants 9, 26
- stoichiometric stability constant 7, 8
- temperature dependent parameters 17
- thermodynamic parameters 882
- thorium
- hydrolysis species 463
- ionic strength 470, 479
- isotopes 462
- microcrystalline 465
- properties 463
- solubility behaviour 464, 465
- solubility constant 466, 482
- speciation 487, 488, 493, 494
- stability constants 466, 481, 483, 484, 486–489
- temperature 467–469
- thermodynamic values 478, 480
- thulium 297–299
- tin(II) 835
- collation and assessment 838
- speciation 840
- thermochemical data 836
- thermodynamic parameters 838
- tin(IV) 835, 840
- titanium
- collation and assessment 439
- existence 433
- hydrolysis 501
- ionic strength dependence 500

- speciation 441, 442
- stability constant 502
- temperature 436
- thermochemical data 433, 438, 501
- trivalent oxide phase 499
- transition series metals
- cobalt *see* cobalt
- iron *see* iron
- manganese *see* manganese
- nickel *see* nickel
- titanium *see* titanium
- vanadium *see* vanadium
- zinc *see* zinc
- trivalent lanthanide metals
- geochemical behaviour 244
- glasses 244
- ionic radii 245
- ionic strength dependence 248–252
- lanthanum *see* lanthanum
- linear free energy relationship 252
- semiconductors 244
- solid state lasers and catalysts 244
- temperature dependence 245, 246, 248
- thermodynamic values 252

u

- unified theory of metal ion complexation (UTMIC) 893
- uranium
- dioxouranium(VI) cation 336
- uranium(III) 336
- uranium(V) 350
- uranium(IV)
- collation and assessment 342
- ionic strength dependence 340
- thermochemical data 336
- thermodynamic parameters 340
- temperature dependence 339
- uranium(V) 350
- uranium(VI)
- collation and assessment 364
- ionic strength dependence 354
- speciation 379
- temperature dependence 351
- thermochemical data 350, 362

v

- vanadium 3
- hydrogen gas production 503
- hydrolysis species 503
- oxidising agent 504
- phases 504
- vanadium(II) species 504, 505
- vanadium(III)

- – hydrolysis species 508
- – ionic strength dependence 506–508
- – stability constants 509, 511, 512
- – thermochemical data selection 506
- – thermodynamic values 508, 512
- – zero ionic strength stability constant 507
- vanadium(IV)
 - – hydrolytic reactions 515
 - – ion interaction theory 513, 514
 - – ionic strength dependence 512
 - – thermodynamic data 512, 514, 515
- vanadium(V)
 - – ion interaction theory 523, 524, 526, 527
 - – ionic strength dependence 517, 519, 521, 523
 - – monomeric hydrolysis species 532, 534
 - – potentiometry 539
 - – predominance speciation 539–541
 - – spectrophotometry 539
 - – stability constants 517, 529, 530
 - – thermochemical data selection 517
 - – thermodynamic parameters 529, 531, 539
 - – zero ionic strength 519, 523

W

water

- activity of 23
- ionic strength dependence
 - – barium chloride 111
 - – cesium chloride 86
 - – lithium chloride 107
 - – lithium perchlorate 115
 - – potassium chloride 102
 - – potassium iodide 118
 - – potassium nitrate 118
 - – sodium chloride 89
 - – sodium nitrate 119
 - – sodium perchlorate 113
 - – sodium sulfate 126
 - – sodium triflate 122
 - – tetramethylammonium chloride 89
- physical properties
 - – boiling points 61
 - – critical point 63
 - – density of water 62
 - – dielectric constant values 63

- – hydrogen bonding 61
- – phase diagram 63
- – Pourbaix diagram 64, 65
- – protolysis constant 128
- – entropy, enthalpy and heat capacity values 73
- – fixed ionic strength at other temperatures 25, 68, 72
- – zero ionic strength 65, 77
- zero ionic strength data, high pressure 128

Y

- ytterbium 300, 301, 303
- yttrium
 - energy efficient fluorescent lamps and tubes 236
 - hydrolysis and complexation reactions 236
 - inorganic complexing agents 236
 - ionic strength dependence 239
 - mineral solubility 236
 - solubility constants 240, 242, 243
 - stability constants 238
 - thermodynamic parameters 240, 243

Z

zinc

- hydrolytic reactions 676, 687, 689
- ionic strength dependence 682, 683, 685
- oxidation state 675
- predominance speciation 699
- stability constant 690, 691, 699
- temperature dependence 676, 678–681
- thermodynamic values 687, 699
- zero ionic strength stability constant 685

zirconium

- formation of $\text{Zr}(\text{OH})_5^-$ 445
- formation of $\text{Zr}_4(\text{OH})_8^{8+}$ 445
- Gibbs energy 443
- hydrolytic reactions 444
- ionic strength 446
- solubility constant 454, 455, 459
- solubility of amorphous phases 443
- speciation 458, 460
- stability constant 444
- thermodynamic data 452, 453
- uncertainty 443
- $\text{Zr}_3(\text{OH})_9^{3+}$ 445
- $\text{Zr}_4(\text{OH})_{15}^+$ 446
- zirconium dioxide 442

