## **CONTENTS**

PREFACE			
ACŁ	(NOV	VLEDGMENTS	χV
COI	NTRIE	BUTORS	xvii
1	OVERVIEW OF MERCURY IN THE ENVIRONMENT Guangliang Liu, Yong Cai, Nelson O'Driscoll, Xinbin Feng, and Guibin Jiang		1
	1.1	Introduction / 1	
	1.2	Toxicity and Health Risks of Mercury Exposure / 2	
	1.3	Sources of Mercury / 2	
	1.4	Overview of Mercury Biogeochemical Cycling / 7	
	1.5	Structure of the Book / 8	
	1.6	Concluding Remarks / 9	
		References / 9	
PA	RTI	ANALYTICAL DEVELOPMENTS	13
2	OF I	ANCES IN SPECIATION ANALYSIS MERCURY IN THE ENVIRONMENT in Li, Yongguang Yin, Guangliang Liu, and Yong Cai	15
	2.1	Introduction / 15	

	2.2	Sample Preparation for Hg Speciation in Environmental Samples / 16	
	2.3	Application of GC Technique in Hg Speciation Analysis / 32	!
	2.4	Application of HPLC Technique in Hg Speciation Analysis / 36	
	2.5	Application of Capillary Electrophoresis Techniques in Hg Speciation Analysis / 39	
	2.6	Application of X-Ray Absorption Spectroscopy in Probing Chemical Microenvironment of Hg / 40	
	2.7	Application of Stable Isotope Dilution Technique in Mercury Speciation Analysis / 41	
	2.8	Summary / 43	
		References / 44	
3		URING GAS PHASE MERCURY EMISSIONS INDUSTRIAL EFFLUENTS	59
	Samuel	J. Ippolito, Ylias M. Sabri, and Suresh K. Bhargava	
	3.1	Introduction / 59	
	3.2	Standardized Methods for Measuring Mercury / 72	
	3.3	Mercury Continuous Emission Monitors (CEMs) / 81	
	3.4	Future Outlook / 95	
		References / 96	
PAI	RT II	SPECIATION AND TRANSFORMATION	111
4		SPHERIC CHEMISTRY OF MERCURY n Lin, Pattaraporn Singhasuk, and Simo O. Pehkonen	113
	4.1	Introduction / 113	
	4.2	The Overall Picture / 114	
	4.3	Chemical Transformations in the Gas Phase / 118	
	4.4	Chemical Transformations in the Aqueous Phase / 131	
	4.5	Redox Chemistry at the Interface Between the Atmosphere and Earth's Surfaces / 136	
	4.6	Atmospheric Implications of the Identified Redox Pathways / 139	
	4.7	Future Research Needs / 143	
		References / 144	

5		OBIAL TRANSFORMATIONS IN THE CURY CYCLE	155
	Chu-Ching Lin, Nathan Yee, and Tamar Barkay		•
	5.1	Introduction / 155	
	5.2	Mercury Methylation / 158	
	5.3	Methylmercury Degradation / 168	
	5.4	Redox Cycling of Inorganic Hg / 169	
	5.5	Conclusions / 179	
		References / 180	
6	PHOTOREACTIONS OF MERCURY IN AQUATIC SYSTEMS		193
	Emma	E. Vost, Marc Amyot, and Nelson J. O'Driscoll	
	6.1	Significance of Mercury Photoreactions / 193	
	6.2	Concepts in Mercury Photoreactions / 194	
	6.3	Current Methods in Mercury Photochemistry / 209	
	6.4	Summary / 211	
		References / 212	
7	7 CHEMICAL SPECIATION OF MERCURY IN SOIL AND SEDIMENT		219
	Ulf Skyllberg		
	7.1	Introduction / 219	
	7.2	Physicochemical Properties, Oxidation States, Chemical	
		Forms, Structures, and Concentrations of Mercury in the Environment / 220	
	7.3	Aqueous Phase: Major Ligands and Their Affinities for Mercury(II) / 222	
	7.4	Liquid and Solid Phases of Mercury in Soils and Sediments / 229	
	7.5	Reactions of Mercury(II) with Soil and Sediment Particle Surfaces / 231	
	7.6	Stabilization of Nanoparticulate Mercury(II) Sulfides by Natural Organic Matter / 237	
	7.7	Solubility and Chemical Speciation of Mercury(II) in Soils and Sediments / 237	
	7.8	Methods for Studying the Chemistry of Mercury(II) in Soils and Sediments / 248	

Future Research Needs / 249

7.9

		References / 252	
8	ON ME	FFECTS OF DISSOLVED ORGANIC MATTER ERCURY BIOGEOCHEMISTRY  A. Gerbig, Joseph N. Ryan, and George R. Aiken	259
	8.1	Introduction / 259	
	8.2	Dissolved Organic Matter / 260	
	8.3	Field Observations / 263	
	8.4	Effects of DOM on Mercury Distributions Between Solution and Particles / 265	
	8.5	Mercury Binding Strength / 268	
	8.6	Mercury Binding Environment / 271	
	8.7	Methylmercury Binding Strength and Environment / 274	
	8.8	DOM and Mercury Mineral Dissolution / 276	
	8.9	DOM and Mercury Mineral Precipitation / 280	
		References / 284	
9	AND T	KING GEOCHEMICAL TRANSFORMATIONS RANSPORT OF MERCURY THROUGH PE FRACTIONATION  Hintelmann and Wang Zheng  Introduction / 293 Fractionation of Mercury Isotopes in Environmental Processes / 300  Hg Isotope Variations in Nature / 315  Summary / 319  References / 320	293
PART III		TRANSPORT AND FATE	329
10	<b>ATMO</b> Oleg Tr	SPHERIC TRANSPORT OF MERCURY avnikov	331
	10.1 10.2	Introduction / 331 General Concepts of Mercury Cycling in the Atmosphere / 331	
	10.3	Methods for Studying Atmospheric Mercury Transport / 336	

	10.4	Knowledge Gaps / 354 References / 356	
11	AQUA	DRPTION OF MERCURY ON SOLIDS IN THE ATIC ENVIRONMENT Iliang Liu, Yanbin Li, and Yong Cai	367
	11.1 11.2 11.3 11.4	Introduction / 367 Adsorption of Mercury on Solids / 369 Role of Colloids in Mercury Adsorption / 374 Concluding Remarks / 380 References / 381	
12	THE (	IANGE OF ELEMENTAL MERCURY BETWEEN OCEANS AND THE ATMOSPHERE ureshi, Matthew Macleod, Elsie Sunderland, onrad Hungerbühler	389
	12.1 12.2 12.3 12.4	Introduction / 389  Models of Gas Exchange of Elemental Mercury at the Air–Sea Interface / 390  Field Studies of Ocean-To-Air Fluxes of Mercury / 398  Rate Constants for Reduction and Oxidation of Mercury Species in Ocean Waters / 400	
	12.5	Modeling Studies Estimating Oceanic Air—Sea Exchange / 411 Conclusions and Future Directions / 415	
	12.0	References / 416	
13	EXCHANGE OF MERCURY BETWEEN THE ATMOSPHERE AND TERRESTRIAL ECOSYSTEMS  Mae Sexauer Gustin		423
	13.1 13.2	General Overview / 423 Methods and Tools Applied for Measurement and Understanding of Air-Terrestrial Surface Exchange / 425	
	13.3 13.4	Measured Fluxes / 433 Conclusions / 442 References / 444	

PAI	RT IV	BIOACCUMULATION, TOXICITY, AND METALLOMICS	453
14	MERC	CCUMULATION AND BIOMAGNIFICATION OF CURY THROUGH FOOD WEBS Kidd, Meredith Clayden, and Tim Jardine	458
	14.1 14.2 14.3 14.4 14.5 14.6 14.7	Introduction / 455 Mercury in Aquatic and Terrestrial Organisms / 457 Mercury within Organisms / 464 Factors Affecting Mercury in Biota / 465 Biomagnification of Mercury Through Food Webs / 474 Mercury Stable Isotopes in Bioaccumulation Studies / 481 Case Study—Kejimkujik National Park and Historic Site, Nova Scotia, Canada / 482 Conclusions / 484 References / 485	
15	REFE Mines	VIEW OF MERCURY TOXICITY WITH SPECIAL RENCE TO METHYLMERCURY hi Sakamoto, Katsuyuki Murata, Akiyoshi Kakita, and hori Sasaki	<b>50</b> 1
	15.1 15.2 15.3 15.4 15.5 15.6 15.7	Introduction / 501 Global Mercury Emission into the Atmosphere / 502 Metabolism and Toxicity of Chemical Forms of Mercury / 503 Risk Assessment of Prenatal Exposure to Methylmercury / 509 Risks and Benefits of Fish Consumption for Brain Development / 510 Exceptional Methylmercury Exposure Through Rice / 510 Summary / 511 References / 511	
16	AND	ALLOMICS OF MERCURY: ROLE OF THIOL-SELENOL-CONTAINING BIOMOLECULES  Wang, Marcos Lemes, and Mohammad A.K. Khan  Introduction / 517  Metallomics of Mercury / 517  Mercury and Methylmercury Complexes with Thiol-Containing Biomolecules / 519	517

	16.4	Mercury and Methylmercury Binding to Selenol-Containing Biomolecules / 522	
	16.5	Lability of Mercury or Methylmercury Complexes with Thiols or Selenols / 524	3
	16.6	Thiol-Containing Biomolecules in the Uptake and Metabolism of Mercury / 526	
	16.7	Selenium Aided Biomineralization of Mercury and Methylmercury / 529	
	16.8	Analytical and Modeling Approaches / 531	
	16.9	Conclusion / 538	
		References / 538	
17	EXPO	N HEALTH SIGNIFICANCE OF DIETARY SURES TO METHYLMERCURY  Choi and Philippe Grandjean	545
	17.1	Introduction / 545	
	17.2	Methylmercury Exposure / 546	
	17.3	Nutrients in Fish and Seafood / 548	
	17.4	Major Prospective Cohort Studies / 549	
	17.5	Health Effects / 552	
	17.6	Cardiovascular Outcomes / 555	
	17.7	Nutrient and Methylmercury Exposure as Predictors of Developmental Outcomes / 556	
	17.8	Confounding Variables / 557	
	17.9	Risk Assessment and Exposure Imprecision / 558	
	17.10	Conclusions / 559	
		References / 561	
IND	EX		569