

# Contents

## Part I The Basic Theory and Methodology

<b>1 The Basic Theory of P-process at Sediment/Water Interface (SWI) in Lake</b> . . . . .	3
1.1 “Internal P-loading” and P-release Mechanisms in Lake Sediments. . . . .	3
1.2 Diffusive Gradients in Thin Films (DGT) Technique and the Development Trend for the Application at SWI or Rhizosphere. . . . .	5
1.3 The Uptake and Accumulation Mechanisms for Elements at the Rhizosphere of Aquatic Plant in Lake . . . . .	15
1.4 Summary . . . . .	19
References . . . . .	20
<b>2 Problem Introduction, Research Idea, and Studying Zone</b> . . . . .	27
2.1 Problem Introduction . . . . .	28
2.2 The Research Idea and the General Design for DGT Research . . .	30
2.3 Studying Zones in Dianchi and Erhai Lakes . . . . .	32
2.4 Summary . . . . .	34
References . . . . .	35
<b>3 The Research Methodology</b> . . . . .	39
3.1 The Design for DGT Probe and Piston. . . . .	40
3.2 The Test Method for DGT Piston and Probe in Sediments of Dianchi Lake and the Subsequent Procedures . . . . .	40
3.3 The DGT Method (in Situ or in Rhizobox) for the P-Uptake Process by Roots of Aquatic Plants in Erhai Lake . . . . .	43
3.3.1 The in situ DGT Test . . . . .	43
3.3.2 The DGT Test in Rhizobox . . . . .	46
3.4 The Computer Programs for DGT (DIFS, Visual MINTEQ, and Image J.1.38 E Softwares) and the Operation/Experiment Methodology . . . . .	49

3.5	The Computer Imaging Densitometry (CID) Technique for the Analysis of Sulfide-Microniches and DGT-S(-II) Profile . . . . .	54
3.6	Laser Ablation Inductively Coupled Plasma Mass Spectrometry (LA-ICP-MS) Technique for Gel Analysis . . . . .	56
3.7	The Analysis Methods for Physicochemical Properties of Lake Sediments . . . . .	61
3.8	The Main Scientific Problem and Technological Difficulty to Be Solved . . . . .	64
3.9	Summary . . . . .	69
	References . . . . .	69

## **Part II “Internal P-Loading” at SWI of Dianchi Lake**

<b>4</b>	<b>The “Internal P-Loading” at SWI Assessed by DGT Technique . . . . .</b>	<b>75</b>
4.1	Fe-Remobilization and the Solubility Assessment for Fe-Sulfide Mineral . . . . .	76
4.2	P-Remobilization and “Internal P-Loading” . . . . .	80
4.3	P-DIFS Simulation and Sediment-P Reactivity . . . . .	86
4.4	Summary . . . . .	90
	References . . . . .	90
<b>5</b>	<b>The Coupled Fe–S–P Biogeochemical Mechanism for P-Release and Sulfide Microniche in Sediments Assessed by DGT–CID Technique (Dianchi Lake) . . . . .</b>	<b>93</b>
5.1	The Distribution Character of Sulfide Microniche and Biogeochemical Mechanism in Sediments Based on DGT–CID Technique . . . . .	94
5.2	The Coupled Fe–S–P Process for P-Release Mechanism in Sediment Microzone . . . . .	101
5.3	Summary . . . . .	104
	References . . . . .	104
<b>6</b>	<b>The P-release Risk Predicted by Chemical Image of Fe in Sediment Porewater Measured by DGT/LA-ICP-MS and Fe-Microniches . . . . .</b>	<b>107</b>
6.1	The Measurement Method for Fe at SWI Using SPR-IDA DGT and LA-ICP-MS with High Spatial Resolutions . . . . .	107
6.2	DGT-Fe Distribution Character of Chemical Images . . . . .	111
6.3	The Proportion of DGT Flux Related to Fe-Microniche in “Hot Spots” of the Total DGT Flux in Microzone and the Implication . . . . .	116
6.4	The Release of P and Trace Metals Predicted by Fe-Microniches . . . . .	119
6.5	Summary . . . . .	120
	References . . . . .	121

### Part III The P-behavior at the Interface of Sediment/Root of Aquatic Plants (Erhai Lake)

<b>7 The Uptake and Accumulation Mechanisms of P-Predicted by In Situ DGT Test at the Rhizosphere of Aquatic Plant . . . . .</b>	<b>125</b>
7.1 P-Concentrations in Sediment–Porewater–Plant Samples and the DGT Measurement Results . . . . .	126
7.2 The Linear Relationship Between DGT Measurement and P-Content in Plant Tissues for the Prediction of P-Uptake . . .	128
7.3 The Quantification for P-Uptake by Root of Aquatic Plant Using DGT Flux . . . . .	140
7.4 Summary . . . . .	143
References . . . . .	143
<b>8 The Uptake and Accumulation of P Assessed by DGT/Rhizobox Method . . . . .</b>	<b>145</b>
8.1 P-Concentration in Sediment–Porewater–Plant Samples and the Derivation of $C_E$ and $R_{diff}$ . . . . .	146
8.2 The Linear Regression of DGT Measurement Against P-Content in Plant Tissues for the Predictor of Bioavailability . . . . .	150
8.3 The Significance of DGT as the Surrogate of Root for P-Uptake and the Implication for Ecological Restoration of Eutrophic Lake . . . . .	159
8.4 Summary . . . . .	160
References . . . . .	161
<b>9 Conclusion and Prospect . . . . .</b>	<b>163</b>
9.1 The DGT and Related Techniques for Lake Research . . . . .	163
9.2 The Environmental Process of P and Related Elements in Sediment or Rhizosphere Revealed by DGT Technique and the Significance. . . . .	165
9.2.1 The Mechanism and Release Intensity of “Internal P-Loading” and Kinetic Exchange of P at DGT/Porewater/Sediment Interface . . . . .	165
9.2.2 Sulfide Microniche for the Coupled Fe–S–P Biogeochemical Process and the Chemical Image of Labile Fe for the Prediction of P-Release . . . . .	165
9.2.3 DGT as a Prediction Tool for P-Bioavailability and Transfer at the Sediment/Root Interface . . . . .	166
9.2.4 The Significance for DGT Technique as the Ecological Indicator for P-Process at Sediment or Rhizosphere in Lakes. . . . .	167
9.3 Further Work—the New Technique Coupled with DGT for Sediment Microzone or Rhizosphere. . . . .	168
9.4 Summary . . . . .	169

DGT-based Measurement of Phosphorus in Sediment  
Microzones and Rhizospheres

Wang, S.; Wu, Z.

2016, XXVII, 170 p. 70 illus., 40 illus. in color., Hardcover

ISBN: 978-981-10-0720-0