

CONTENTS

Abstract	i-iv
Declaration	v
Certificate of the Supervisors	vi
Acknowledgements	vii-ix
Table of content	x-xiv
List of tables	xv-xvii
List of figures	xviii-xxii
List of Abbreviations	xxiii-xxiv
 CHAPTER 1: Introduction	
1.1. General background	1-3
1.2. Problem statement	3-4
1.3. Research question	4-7
1.4. Aims and objective	7
1.5. Research design	7-8
1.6. Thesis integration	9-10
1.7. Highlights of this work	10-11
References	11-16
 CHAPTER 2: Literature Review	
2.1. The problem and its background	17
2.2. Groundwater arsenic across the world and India	17-18
2.3. Health hazards associated with consumption of arsenic contaminated water	19
2.4. Sources and pathways of arsenic in groundwater	19-23
2.5. Groundwater fluoride around the world and in India	24-25
2.6. Fluoride hydrogeochemistry	25-26
2.7. Dangers associated with drinking fluoride contaminated water	26-27

Contents

2.8.	The problem of co-contamination and its study	27-31
	References	31-48
CHAPTER 3: Materials and methods		
3.1.	Study area	49-55
3.1.1.	The Brahmaputra Flood Plains (BFP)	49-53
3.1.1.1.	Geomorphology and climatic conditions	50-52
3.1.1.2.	Hydrogeology	52-53
3.1.2.	Jorhat district	54-55
3.2.	Analytical section	55-69
3.2.1.	Groundwater	55-61
3.2.1.1.	Sampling	55-57
3.2.1.2.	<i>In situ</i> analysis	57
3.2.1.3.	Cation analysis	58
3.2.1.4.	Anion analysis	58-61
3.2.1.5.	Trace metal analysis	61
3.2.1.6.	Dissolved Organic Carbon	61
3.2.2.	Sediment	62-67
3.2.2.1.	Sampling	62
3.2.2.2.	pH and EC	62
3.2.2.3.	Total Organic Carbon	62
3.2.2.4.	Mineralogy and elemental analysis	62-63
3.2.2.5.	Grain size analysis	63
3.2.2.6.	Cation Exchange Capacity	64
3.2.2.7.	Sequential extraction of As	64-66
3.2.2.8.	Calculation of partition coefficient (K _d)	66
3.2.2.9.	Batch desorption experiment	67
3.2.3.	Computational analysis	68-69

Contents

3.2.3.1.	Graphical interpretation of data	68
3.2.3.2.	Statistical analysis	68-69
3.2.3.3.	Speciation modelling	69
3.2.3.4.	Preparation of maps	69
References		69-72
 CHAPTER 4: Occurrence of arsenic and fluoride; and the associated hydrochemical processes: A comparative spatial and temporal distribution		
4.1.	Introduction	73-76
4.2.	Materials and methods	77
4.3.	Results and discussion	77-139
4.3.1.	Spatial and seasonal distribution of arsenic and fluoride in the Brahmaputra Flood Plains	77-112
4.3.1.1.	Groundwater chemistry	77-80
4.3.1.2.	Mineralogy	80-83
4.3.1.3.	Hydrochemical facies	84-85
4.3.1.4.	Hydrogeochemical evaluation	86-93
4.3.1.5.	Distribution of arsenic and fluoride	94-98
4.3.1.6.	Statistical analysis	99-109
4.3.1.6.1.	Correlation analysis	99-105
4.3.1.6.2.	Multivariate statistical analysis	105-109
4.3.1.7.	Speciation study	110-112
4.3.2.	Impact of river proximity on arsenic and fluoride distribution in the BFP	112-118
4.3.3.	Arsenic hydrogeochemistry in the Jorhat district	118-139
4.3.3.1.	Summary of chemical parameters in the study area	118-120

Contents

4.3.3.2.	Graphical representation of hydrochemical data	120-123
4.3.3.3.	Hydrochemistry of the study area	123-126
4.3.3.4.	Distribution of arsenic	126-129
4.3.3.5.	Statistical analysis	129-137
4.3.3.5.1.	Correlation analysis	129-133
4.3.3.5.2.	Multivariate statistical analysis	133-137
4.3.3.6.	Saturation indices	137-139
4.4.	Conclusion and recommendation	139-141
	References	141-148
 CHAPTER 5: Assessment of arsenic and fluoride co-contamination perspectives in the natural settings		
5.1.	Introduction	149-150
5.2.	Materials and method	151
5.3.	Results and discussion	151-167
5.3.1.	General hydrogeochemistry and water type	151-153
5.3.2.	Characterization of Arsenic and Fluoride	154-160
5.3.3.	Statistical analysis	160-163
5.3.3.1.	Principal components analysis	160-161
5.3.3.2.	Hierarchical cluster analysis	161-163
5.3.4.	Mineralogical evidence	163-164
5.3.5.	Speciation modelling	164-167
5.4.	Conclusion and recommendation	167-168

Contents

References	168-174
CHAPTER 6: Phase distribution and mobility assessment using desorption and sequential extraction procedures	
6.1. Introduction	175-177
6.2. Materials and methods	177-178
6.3. Results and discussion	179-194
6.3.1. Physico-chemical characterization of the soil and sediment samples and its implication	179-184
6.3.2. Arsenic fractionation	185-187
6.3.3. Evaluation of leaching potential of As through partitioning coefficient	187-190
6.3.4. Understanding As and F ⁻ co-occurrence through batch desorption	190-194
6.4. Conclusion and recommendation	195-196
References	196-201
CHAPTER 7 Conclusion and recommendation	202-206
List of publications	207