

Table of Contents

Acknowledgements.....	v
Table of Contents.....	vii
Executive Summary.....	xi
List of Symbols and Abbreviations.....	xv
List of Figures.....	xvii
List of Tables	
CHAPTER 1 INTRODUCTION.....	1
1.1 Introduction.....	2
1.2 The Indian monsoon at a glance	3
1.3 ISM variability during the Holocene	9
1.4 Definition of the Problem	11
1.5 Objectives	12
1.6 Organization of the Thesis	13
1.7 Significance of this study.....	
CHAPTER 2 STUDY AREA AND MODERN CLIMATIC CONDITIONS..	16
2.1 Introduction.....	17
2.2 Shillong Plateau, NE Himalaya	17
2.2.1 Geology and Geomorphology.....	18
2.2.2 Modern climatic settings and vegetation	19
2.3 Tso Moriri Lake, NW Himalaya.....	22

2.3.1 Geology and Geomorphology of the Tso Moriri Lake region.....	22
2.3.2 Modern climatic conditions and vegetation.....	
CHAPTER 3 MATERIALS AND METHODS.....	27
3.1 Introduction.....	28
3.2 Field sampling.....	28
3.2.1 Field sampling for speleothems	28
3.2.2 Field sampling in the Tso Moriri Lake	30
3.3 Chronology	31
3.3.1 Chronology of stalagmite WSS-3, Wah Shikar cave.....	31
3.3.2 Chronology of stalagmite MWS-1 from the Mawmluh cave	34
3.3.3 Chronology of core TMC-1 from the Tso Moriri Lake	36
3.4 Analytical procedures	40
3.4.1 $\delta^{18}\text{O}$ and $\delta^{13}\text{C}$ ratios in speleothem calcite from NE Himalaya.....	40
3.4.2 Sediments from the Tso Moriri Lake, NW Himalaya.....	41
3.4.2.1 Grain size measurements	41
3.4.2.2 Elemental abundances.....	42
3.4.2.3 The $\delta^{18}\text{O}$ and $\delta^{13}\text{C}$ ratios in lake carbonates.....	42
3.4.2.4 The $\delta^{13}\text{C}_{\text{org}}$ ratio in organic carbon and total organic carbon (TOC) analysis.....	43
3.4.3 Spectral analysis:	44

CHAPTER 4 VARIABILITY IN INDIAN SUMMER MONSOON STRENGTH IN THE NORTHEAST HIMALAYA DURING THE LAST MILLENNIUM WITH MAJOR EMPHASIS ON EXTREME EVENTS...45

4.1 Introduction..... 46

4.2 Results..... 48

4.2.1 $\delta^{18}\text{O}$ and $\delta^{13}\text{C}$ ratios in speleothem calcite 48

4.2.2 Hendy test 50

4.2.3 Spectral analysis..... 51

4.3 Discussion..... 55

(i) AD 1,026-1,320..... 55

(ii) AD 1,320-1,710..... 57

(iii) AD 1,710 to the Present.....

CHAPTER 5 ABRUPT CHANGES IN INDIAN SUMMER MONSOON STRENGTH BETWEEN 33,800 TO 5,500 YRS BP.....63

5.1 Introduction..... 64

5.2 Results..... 65

5.2.1 $\delta^{18}\text{O}$ and $\delta^{13}\text{C}$ from speleothem calcite 65

5.2.2 Hendy Test..... 66

5.2.3 Spectral Analysis 67

5.3 Discussion.....	
CHAPTER 6 ABRUPT WEAKENING OF THE INDIAN SUMMER MONSOON ~4.3 KYR BP: COLLAPSE OF THE INDUS VALLEY CIVILIZATION.....	74
6.1 Introduction.....	75
6.2 Results.....	79
6.2.1 Grain size measurements	79
6.2.2 Elemental abundances.....	81
6.2.3 The $\delta^{18}\text{O}$ and $\delta^{13}\text{C}$ ratios in lake carbonate	83
6.2.4 The $\delta^{13}\text{C}_{\text{org}}$ and total organic carbon (TOC) in organic carbon	84
6.2.5 Spectral analysis.....	85
6.3 Discussion.....	85
6.4 Weakening of the ISM ~4.3 kyr BP and collapse of the Indus valley civilization:	
CHAPTER 7 CONCLUSIONS.....	92
CHAPTER 8 REFERENCES.....	98
APPENDIX.....	128