



CONTENTS

List of Figures

i

List of Tables

vi

Chapter 1	Introduction	1-24
1.1	Modern Geodynamics	1
1.2	Subduction Zone	7
1.2.1	The structure of subduction zone	8
1.2.2	Accretionary prism	11
	<i>Ophiolites</i>	11
	<i>Sediments</i>	13
	<i>Mud volcanoes and fluid activity</i>	13
1.2.3	Island arc	14
1.3	Chemistry of subduction related ophiolites, slab and mantle wedge	14
1.3.1	Supra subduction related ophiolite	14
1.3.2	Chemistry of mantle wedge and slab	15
1.4	The Andaman subduction zone	20
1.5	Objectives and significance	22
Chapter 2	Geology and Earlier work	25-47
2.1	Geology of Andaman and Nicobar Islands	26
2.1.1	The Ophiolite Group	27
	<i>Mantle tectonite</i>	30
	<i>Layered ultramafic-mafic sequence</i>	30

	<i>Intrusive units</i>	31
	<i>Extrusive units</i>	31
	<i>Sedimentary cover</i>	32
2.1.2	The Mithakhari Group	34
2.1.3	The Andaman Flysch Group	35
2.1.4	The Archipelago Group	36
2.1.5	Island Arc Group	36
	<i>Narcondam Volcano</i>	37
	<i>Barren Island volcano</i>	38
2.2	Structure of the Andaman and Nicobar Islands	40
2.3	Mud Volcanoes of the Andaman Islands	42
Chapter 3	Volcanological studies of Barren Island	48-78
3.1	Introduction	48
3.2	Geology	50
3.3	Prehistoric eruptions	54
3.3.1	Pre-caldera tuff breccias: deposits left by lahars and debris flows	54
3.3.2	Ash beds: pyroclastic surge and fall deposits	58
3.3.3	The prehistoric aa flows	61
3.3.4	Possible syn-caldera deposits	61
3.4	Historic eruptions	62
3.5	Recent eruptions	64
3.5.1	The 1991 eruption	65
3.5.2	The 1994–95 eruption	67
3.5.3	The 2005–06 eruption	69
3.5.4	The 2008 -09 eruption	70

3.5.5	The 2010 -11 eruption	72
3.6	The nature of the caldera-filling aa flows	72
3.7	The cinder cone and recent ash cover	77
Chapter 4	Materials and Methods	79-111
4.1	Sampling protocol	79
4.2	Analytical methods	81
4.2.1	Petrography	91
4.2.2	Geochemical characterization	92
	<i>Major element content</i>	92
	<i>Loss on ignition</i>	93
	<i>Trace element contents</i>	98
	<i>Radiogenic isotopic ratio</i>	103
	<i>Stable oxygen and hydrogen isotopic ratios</i>	109
	<i>Total carbon(C) and nitrogen (N) contents in mud breccia</i>	110
Chapter 5	Results	112-140
5.1	Petrological description	112
5.1.1	Thin section studies	112
	<i>Andaman ophiolite</i>	113
	<i>Barren Island lavas</i>	114
5.1.2	X-ray diffractometry	117
5.2	Geochemical data	118
5.2.1	Chemistry of mud breccias and rock clasts	119
5.2.2	$\delta^{18}\text{O}$ and δD of water from mud volcano, Andaman Islands	124
5.2.3	Chemistry of rocks from Andaman	

	Ophiolite Group	126
5.2.4	Chemistry of lavas and ash beds of Barren Island volcano	130
Chapter 6	Discussion	141- 190
6.1	Origin of Andaman ophiolites	142
6.1.1	Interferences from field relationship and petrography	142
6.1.2	Interferences from geochemistry	144
6.2	Origin of Andaman mud volcanoes	150
6.2.1	Morphology	150
6.2.2	Clay mineralogy of mud breccias	152
6.2.3	Stable isotopic compositions of mud water	152
6.2.4	Origin of mud breccias	158
	<i>Clues from Major oxides and trace elements</i>	158
	<i>Clues from radiogenic isotopes</i>	164
6.2.5	<i>Origin of clasts</i>	166
6.3	Origin & evolution of Barren Island Volcano	167
6.3.1	Inferences from field studies	167
6.3.2	Inferences from petrography	168
6.3.3	Geochemistry of lavas and ash beds	168
	<i>Clues from major oxide and trace elements</i>	
	<i>Concentrations</i>	168
	Clues from radiogenic isotopic ratios: Mantle source characteristics	177
	<i>a) Slab fluids versus slab sediments</i>	179
	<i>b) Slab materials versus mantle wedge</i>	180
	Mantle melting and magma generation	184

	<i>a) Degree of melting</i>	184
	<i>b) Depth of melting</i>	188
Chapter 7	Summary and Conclusions	191
	<i>Scope for future work</i>	195
References		197-216
List of publications		217