

TABLE OF CONTENTS

DECLARATION	i
DEDICATION	ii
ACKNOWLEDGEMENT	iii
ABSTRACT	iv
SARI.....	v
TABLE OF CONTENTS	vi
LIST OF FIGURES.....	ix
LIST OF TABLES.....	xii
CHAPTER I: INTRODUCTION.....	1
I.1 Background	1
I.2 Location of Study	2
I.3 Problem Formulation	4
I.4 Objectives of Research.....	4
I.5 Scope of Work.....	4
I.6 Research outcome	5
CHAPTER II: LITERATURE REVIEW	6
II.1. Regional geology	6
II. 1.1. Physiography	6
II.1.2 Regional geology and Tectonic Setting	7
II.1.3 Stratigraphy.....	8
II.2 Previous research	11
II. 3. Basic theory	13
II.3.1 Volcanic Sedimentary Deposits	13
II.3.2. Characteristics of reservoir rock	21
II.3.3 Depositional Environment	29
II.3.4 Turbidite Currents	32
II.3.5 Volcanic Source Material, Sandstone	33
CHAPTER III: HYPOTHESIS AND RESEARCH METHODS	37
III. 1. Hypothesis	37
III. 2 Methodology.....	37
III.2.1 Research data.....	37
III.3 Research material	45



III.4 Research framework	45
III.4.1 Research Phase	46
III.4.2 Flow chart of research	48
III.4.3 Time management	49
CHAPTER IV: LITHOFACIES AND RESERVOIR PROPERTIES	50
IV.1 Lithofacies	50
IV.1.1 Tegalrejo Section.....	50
IV.1.2 Piyungan Sections	61
IV.2 Laboratory Result	65
IV.2.1 Petrography Result	65
IV.2.2 Petrophysic Result.....	68
IV.2.3 Scanning Electron Macroscopic (SEM) Result.....	68
IV.2.4 X-Ray Diffraction (XRD) Result	74
IV.3 Facies Association and Depositional Processes	77
CHAPTER V: RESERVOIR CHARACTERISTICS OF PRIMARY AND RESEDIMENTED VOLCANICLASTIC SANDSTONES	81
V. 1 Primary and Resedimented Volcaniclastic Sandstones	81
V.2 Porosity	82
V.1.1 The correlation of porosity from Petrographic, Petrophysic, SEM analysis and the type of clay mineral from XRD analysis.....	82
V.2 Permeability.....	88
V.3 Porosity and Permeability.....	89
V.4 Reservoir Characteristics of Primary and Resedimented Volcaniclastic Sandstones	91
CHAPTER VI: CONCLUSIONS AND RECOMMENDATIONS	94
VI.1 Conclusions	94
VI.2 Recommendations	95
REFERENCES	96
Appendix I: Petrographic Analysis.....	99
Appendix II: Result from X-Ray Diffraction Analysis	117
Appendix III: Petrophysic Result	123
Appendix III.1. Porosity Result.....	124
Appendix III.2. Permeability Result.....	125
<i>Sample CE-11</i>	<i>127</i>
<i>Sample CE-23</i>	<i>130</i>



Sample CEW-3	131
Sample CEW-7	132
Sample TPA-6	134
Appendix IV: SEM Result	135
Appendix V: Stratigraphic Measurement	148

LIST OF FIGURES

Figure 1: Location of Study Area	3
Figure 2: Physiography of Eastern Java	6
Figure 3: Indonesia Plate Tectonic	7
Figure 4: Stratigraphic succession of Southern Mountain Range in East Java Area	11
Figure 5: Volcanic glass; a) Un distorted bubble-wall glass shards, b) versus distorted and flattened	14
Figure 6: Genetic classification of volcanic deposits	15
Figure 7: Principal ways that pyroclastic flows are generated.	18
Figure 8: Ideal sections through non-welded pyroclastic flow deposits.	19
Figure 9: Geometry of subaerial deposits generated by fallout from eruption clouds.	20
Figure 10: Zoned plagioclase	21
Figure 11: Sand grains showing the difference between shape and sphericity	25
Figure 12: Permeability variation for (A) downward-fining and (B) downward-coarsening avalanche cross-beds	25
Figure 13: Graph of porosity against permeability showing their relationship with grain size and sorting for uncemented sands	26
Figure 14: The loosest and tightest theoretical packing for spheres of uniform diameter ...	26
Figure 15: Block diagram of sand showing layered fabric with grains oriented parallel to current, generally $K_x > K_y > K_z$	27
Figure 16: Various depositional environments: Terrestrial, Shallow Marine, and Deep Marine	29
Figure 17: Various textural properties of clastic sediment and sediment rocks	31
Figure 18: Classification of sandstones based on three mineral components	32
Figure 19: Principal facies variation in volcanic rocks	34
Figure 20: Sources for subaqueous volcanic debris, and transport processes	35
Figure 21: Means by which subaqueous	36
Figure 22: a) Saturating sample with kerosen in vacuum, b) measure mass saturated	38
Figure 23: Mass saturated measure in air	39
Figure 24: Gas permeameter	40
Figure 25: a) Gas permeameter, b) Sample in pynometer	41
Figure 26: a) Thin section sample; b) Microscope	42
Figure 27: Scanning Electron Microscope and Energy Dispersive X-Ray Spectrometer ...	43



Figure 28: a) 5m x 5m Samples; b) Coated machine	44
Figure 29: X-Ray Diffraction Analysis (XRD)	45
Figure 30: Research flow chart.....	48
Figure 31: Interbedded Sandstone and Siltstone Facies	51
Figure 32: Sandstone Facies with Spheroidal weathered	52
Figure 33: Breccia Facies	53
Figure 34: Tuffaceous Sandstone Facies	53
Figure 35: Tuffaceous Siltstone Facies	54
Figure 36: Calcareous Tuffaceous Sandstone Facies	55
Figure 37: Calcareous Tuffaceous Siltstone.....	56
Figure 38: Gravelly Tuffaceous Sandstone Facie.....	57
Figure 39: Gravelly Tuffaceous Sandstone Facies	58
Figure 40: Polymic Breccia Facies	59
Figure 41: Andesite Facies	60
Figure 42: Tuffaceous Siltstone.....	61
Figure 43: Tuffaceous Sandstone Facies	62
Figure 44: Gravelly Tuffaceous Sandstone	63
Figure 45: Gravelly Sandstone Facies	64
Figure 46: Sandstone Facies	65
Figure 47: SEM image of sample CE-9; a) 100 x, b) 200 x, and c) 850x; showing the pore structures and cementation.....	69
Figure 48: SEM images of sample CE-13; a) 200x, b) 850 x and c) 5000x; showing the pore structures and cementation.....	70
Figure 49: SEM image of sample CE-19; a) 200x and b) 850x; showing the pore structures and cementation	71
Figure 50: SEM image of sample CE-19; c) 200x and d) 850x; showing the pore structures and cementation	71
Figure 51: SEM images of sample CE-23 with the magnification; a) 40x, b) 200x and c) 850x; showing the pore structures and cementation	72
Figure 52: SEM images of sample CE-23 of fracture pore with the magnification; d) 100x and e) 850x; showing the pore structures and cementation	72
Figure 53: SEM images of sample CEW-3 with the magnification; a) 40x and b) 200x; showing the pore structures and cementation	73



Figure 54: SEM images of sample CEW-3 with the magnification; c) 200x and d) 850x; showing the pore structures and cementation	73
Figure 55: X-ray diffraction pattern of clay minerals, Sample CE-9	74
Figure 56: X-ray diffraction pattern of clay minerals, Sample CE-13	75
Figure 57: X-ray diffraction pattern of clay minerals, Sample CE-19	76
Figure 58: X-ray diffraction pattern of clay minerals, Sample CE-23	76
Figure 59: X-ray diffraction pattern of clay minerals, Sample CEW-3	77
Figure 60: Correlation of porosity value from petrography and petrophysic.....	85
Figure 61: a) Microscope image and b) SEM image of sample CE-9 at Kebo-Butak Formation; Showing the correlation of porosity and cementation.....	86
Figure 62: Microscope image and SEM image of sample CEW-3 at Semilir Formation; Showing the correlation of porosity and cementation	86
Figure 63: Microscope and SEM images of sample CE-13 in lower part of formation; Showing the correlation of porosity and cementation	87
Figure 64: Microscope and SEM images of sample CE-19 in upper part of formation; Showing the correlation of porosity and cementation	87
Figure 65: Microscope and SEM images of sample CE-23; Showing the correlation of porosity and cementation	88
Figure 66: Porosity and Permeability Correlation.....	90
Figure 67: Correlation of Petrographic, Petrophysic, and XRD analysis.....	92

LIST OF TABLES

Table 1: Table of previous research	12
Table 2: Porosity types (North, 1985)	22
Table 3: Range of porosity classification (North, 1985)	23
Table 4: Range of permeability classification (North, 1985)	24
Table 5: Summary of zone of sandstone diagenetic process (Surdam, et al, 1989)	28
Table 6: Subdivisions of sand particles, by size (Slatt, 2006)	31
Table 7: Schedule of thesis progress	49
Table 8: Summary of Petrography Result	67
Table 9: Summary the result of porosity measurement	68
Table 10: Primary and resedimented volcanoclastic sandstones	82
Table 11: Porosity based on petrographic and petrophysic analysis	84
Table 12: Result of permeability	89
Table 13: The result of porosity and permeability	89