



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Characteristics of South African peats and their potential exploitation

by

Willem Jacobus Smuts

**Submitted in partial fulfilment of the requirements for the
degree of Doctor of Philosophy
in the
Faculty of Science
University of Pretoria
October 1997**



CONTENTS

List of Text Figures	v
List of Tables	ix
Acknowledgements	xi
ABSTRACT	xii
SAMEVATTING	xiv
1 INTRODUCTION	1
1.1 OBJECTIVES AND SCOPE	1
2 PEAT AND MIRES	2
2.1 PEAT FORMATION AND TEMPLATES OF MIRE DEVELOPMENT	5
2.1.1 <i>Peat Formation</i>	5
2.1.1.1 Nutrient cycling and hydrology	5
2.1.1.2 Climate	7
2.1.1.3 Energetics	7
2.1.2 <i>Templates of Mire Development</i>	9
2.1.2.1 Hydrological Template	9
2.1.2.2 Climatic Template	10
3 METHODS	12
3.1 FIELD METHODS	12
3.2 LABORATORY METHODS	16
3.3 MACERAL DESCRIPTION	18
3.3.1 <i>Huminite (Vitrinite precursor)</i>	22
3.3.2 <i>Liptinite (exinite)</i>	22
3.3.3 <i>Inertinite</i>	22
3.3.4 <i>Matrix</i>	25
3.4 PALYNOLOGICAL COMPOSITION	25
4 SOUTH AFRICAN MIRE TYPES	25
4.1 VEGETATION	25
4.1.1 <i>Sedge/reed (grass)</i>	26
4.1.2 <i>Hardwood mires (Swamp forests)</i>	26
4.1.3 <i>Raphia palm</i>	26
4.1.4 <i>Mangrove mires</i>	27
4.2 MIRE CLASSIFICATION BASED ON GEOMORPHOLOGY	27
4.2.1 <i>Extensive mires</i>	27
4.2.1.1 Extensive coastal mires	27
4.2.1.2 Inland mires	32
4.2.2 <i>Bound mires</i>	36
4.2.2.1 Valley mires	36
4.2.2.2 Upland mires	40
4.2.2.3 Interdune mires	40
4.2.2.4 Pan mires	40
4.2.2.5 Spring mires	41
5 CHARACTERISATION OF MIRES	44
5.1 THE NATAL MIRE COMPLEX (NMC)	44
5.1.1 <i>Geomorphological setting</i>	44
5.1.2 <i>Vegetation</i>	51
5.1.3 <i>Field characteristics of the peat</i>	51
5.1.4 <i>Peat petrography</i>	53
5.1.4.1 Botanical composition	54
5.1.4.2 Maceral description	56
5.1.4.2.1 Huminite (Vitrinite precursor) (Fig. 5.6 and 5.7)	56



	iii
5.1.4.2.2 Liptinite (exinite) (Fig. 5.8)	62
5.1.4.2.3 Inertinite (Fig. 5.9 and 5.10)	62
5.1.4.2.4 Matrix	70
5.1.4.3 Palynological composition	70
5.1.5 Physical-chemical properties of the peat	72
5.1.5.1 Proximate analysis	72
5.1.5.1.1 Ash contents	72
5.1.5.1.2 Fixed carbon and Volatile matter	77
5.1.5.2 Elemental analyses (Table 5.4)	83
5.1.5.3 Calorific Value	85
5.1.5.4 Fischer Assay	87
5.1.5.5 Bulk density and water holding capacity (absorbency)	89
5.1.5.6 Fibre content	89
5.1.6 Mineral matter	90
5.1.6.1 Mineralogical composition	90
5.1.6.2 SULPHUR CONTENT	91
5.1.6.3 Ash analyses	94
FIG 5.24	98
fig 5.24a & b	99
5.1.7 Conditions of peat formation	100
5.2 INLAND VALLEY MIRES	103
5.2.1 Geomorphological setting	104
5.2.2 Vegetation	104
5.2.3 Field characteristics of the peat	104
5.2.4 Peat petrography	112
5.2.5 Physical-chemical properties of the peat	114
5.2.5.1 Proximate analysis	114
5.2.5.1.1 Ash	114
5.2.5.1.2 Fixed carbon	114
5.2.5.2 Elemental analyses	118
fig 5.35	119
5.2.5.3 Calorific Value	120
5.2.6 Mineral matter	123
5.2.6.1 Mineralogical composition	123
5.2.6.2 Sulphur content	123
5.2.6.3 Ash Analyses	124
fig5.38	127
fig5.39	128
Fig. 5.40 Trace element relationships observed in peat ash analyses	129
5.2.7 Conditions of peat formation	130
5.3 INLAND EXTENSIVE MIRES	131
5.3.1 Geomorphological setting	131
5.3.2 Vegetation	132
5.3.3 Field Characteristics of the peat	132
5.3.4 Physical-chemical properties and mineral matter	133
6 PROPERTY INTERRELATIONSHIPS OF SOUTH AFRICAN PEATS	139
6.1 CARBON - HYDROGEN	139
6.2 H/C - O/C (ATOMIC PROPORTIONS)	140
6.3 FIXED CARBON / VOLATILE MATTER VERSUS CALORIFIC VALUE	143
6.4 COMPOSITION OF VOLATILE MATTER	147
6.5 FISCHER ASSAY	147
7 A COMPARISON WITH OTHER PEATS IN AFRICA	149
7.1 PROXIMATE ANALYSIS	149
7.2 FIXED CARBON/VOLATILE MATTER VERSUS CALORIFIC VALUE	149
7.3 PETROGRAPHY	149
7.4 INORGANIC FRACTION	150
7.5 ACCUMULATION AND GROWTH RATES	155



8 UTILISATION POTENTIAL OF PEAT	162
8.1 ENERGY.....	162
8.2 HORTICULTURAL/ AGRICULTURAL POTENTIAL	164
8.3 CHEMICAL FEEDSTOCK AND INSULATION POTENTIAL	167
8.4 CULTIVATION OF PEATLANDS.....	167
8.5 NEW TECHNOLOGIES	169
8.6 OTHER POTENTIAL	169
9 CLASSIFICATION, SUMMARY AND CONCLUSION	170
9.1 CLASSIFICATION.....	170
9.2 CONCLUSIONS	174
9.3 RESOURCE ESTIMATION	176
9.4 MIRE USE IN SOUTH AFRICA:.....	177
9.5 ENVIRONMENTAL CONSIDERATIONS	178
REFERENCES	181
APPENDIX ONE.....	196
APPENDIX TWO.....	200
APPENDIX THREE.....	206
APPENDIX FOUR.....	208
APPENDIX FIVE	214
APPENDIX SIX.....	215

LIST OF TEXT FIGURES

Figure 2.1	Nutrient flow patterns in a mire (after Moore, 1987)	6
Figure 2.2	Relative influence of rainwater and groundwater on hydrologic input of mires (after Moore, 1987)	6
Figure 3.1	Russian peat drill	13
Figure 3.2	An example of the log sheets used in the field to describe peat cores	14
Figure 3.3	Von Post's Humification Scale for describing peat samples in the field	15
Figure 3.4	Calorific value versus inherent moisture	19
Figure 4.1	Distribution of major mire types in southern Africa	28
Figure 4.2	Mangrove communities of southern Africa	29
Figure 4.3	The Mhlatuze mire system that surrounds the port city of Richards Bay in northern KwaZulu/Natal	30
Figure 4.4	The Mfolozi swamp south of St. Lucia with mire types ranging from pure mangrove forest through to sedge/reed meadows	31
Figure 4.5	A) The Mkuze swamp immediately north of Lake St. Lucia	33
	B) The Muzi swamp just south of the South Africa / Mozambique border. Note that the swamp does extend into Mozambique	34
Figure 4.6	The Okavango Swamp Complex in northern Botswana. Diagram after McCarthy and Ellery (1993)	35
Figure 4.7	Part of the Klip River, an example of mire formation along geological contacts due to differential weathering	37
Figure 4.8	Two examples, Wakkerstroom and Ntsikeni, where mire formation resulted from Karoo dolerites impeding drainage	38
Figure 4.9	The Lakenvlei mire north-east of the town of Belfast, eastern Transvaal highveld. The knick point is indicated by an arrow	39
Figure 4.10	Typical interdune mires (black). Note also numerous areas (white) of wind erosion activated by human intervention	42

Figure 4.11	Pan mires of the Eastern Transvaal (Chrissiesmeer area) during the dry season with low water levels	43
Figure 5.1	The northern part of the Natal Mire Complex (NMC)	45
Figure 5.2	A) Interdune sedge/reed mire near Black Rock	47
	B) Transition between <i>Raphia</i> and swamp forest vegetation of the Siyadla region	
	C) A view of the peat surface inside a swamp forest	48
	D) A view into the <i>Raphia australis</i> mire	
Figure 5.3	A) Mangrove / Swamp forest transition	49
	B) An oblique aerial view of part of the 45 000 ha Mkuze swamp	
	C) A view of the dense understorey of a typical freshwater swamp forest	50
	D) A near-vertical view of the hydrosereal zonation in a NMC sedge/reed mire	
Figure 5.4	Cross-section through eastern edge of mangrove/forest mire at Mapelane	52
Figure 5.5	Cross-section through a swamp forest mire (Mgobozeleni)	52
Figure 5.6	Peat macerals described from polished and thin sections	58
Figure 5.7	Peat macerals described from polished and thin sections	60
Figure 5.8	Peat macerals described from polished and thin sections	63
Figure 5.9	Peat macerals described from polished and thin sections	65
Figure 5.10	Peat macerals described from polished and thin sections	67
Figure 5.11	Maceral composition of NMC peat types	69
Figure 5.12	Pollen count versus ash content for Mgobozeleni mire	73
Figure 5.13	Pollen diagram for Mgobozeleni	74
Figure 5.14	Ash (wt %, dry) for major NMC peats	75
Figure 5.15	A) Ash/depth profiles from a forest mire	78
	B) Ash/depth profiles from a sedge/reed mire	79
	C) Locality maps for forest mire DA2 and sedge/reed mire BA58	80
Figure 5.16	Fixed carbon (daf) versus depth for dominant NMC peat types	81
Figure 5.17	Fixed carbon (daf) for the dominant NMC peat types	82
Figure 5.18	Fixed carbon versus depth	86

	vii
Figure 5.19	Fixed carbon (daf) versus ash (dry)86
Figure 5.20	Calorific value (MJ/kg, dry) for the dominant peat types 88
Figure 5.21	CV versus FC for the NMC 93
Figure 5.22	Average composition of the mineral matter in the NMC 93
Figure 5.23	Correlation between major elements and trace elements in peat ash 95
Figure 5.24	Sulphur versus depth in a <i>Raphia</i> mire 98
Figure 5.24A	% Deviation from the mean for major elements in the NMC 99
Figure 5.24B	% Deviation from the mean for trace elements in the NMC 99
Figure 5.25	Locality map of the larger Klip River mire south of Johannesburg 105
Figure 5.26	Locality map for Gerhard Minnebron (GMB) 106
Figure 5.27	Valley mire vegetation types107
Figure 5.28	Cross-section through parts of the Klip River mire109
Figure 5.29	East/west section through Gerhard Minnebron sedge/reed mire110
Figure 5.30	Thalweg section through part of Rikarusus mire111
Figure 5.31	Maceral composition for valley mire sedge/reed peats113
Figure 5.32	Ash / depth profiles115
Figure 5.33	Fixed carbon versus depth116
Figure 3.34	Fixed carbon (daf) distribution117
Figure 5.35	Fischer assay / ultimate analysis relationships119
Figure 5.36	Calorific value (daf) versus depth121
Figure 5.37	Calorific value versus fixed carbon122
Figure 5.38	Deviation from the mean for major elements in Valley Mire peats 127
Figure 5.39	Deviation from the mean for trace elements in Valley Mire peats 128
Figure 5.40	Trace element relationships observed in peat ash analyses129
Figure 5.41	Significant major element relationships: Okavango Swamp peats134
Figure 6.1	Seyler diagram for some South African peats141
Figure 6.2	South African peats in relation to the coal band142
Figure 6.3	FC versus CV with respect to the coal band144
Figure 6.4	Major peat fields with relation to the coal band145
Figure 6.5	Valley mire and NMC sedge/reed in relation to the coal band146
Figure 6.6	Composition of the volatile matter in south African peats147
Figure 7.1	Proximate analysis of South African and other African peats151

Figure 7.2	South African and other African peats with respect to the coal band	152
Figure 7.3	Maceral compositions from South - West- and Central Africa	153
Figure 7.4	Age of South African and other African peats with depth	158
Figure 7.5	Function of compaction	159

LIST OF TABLES

TABLE 3.1 MACERAL CLASSIFICATION OF BROWN COALS AND LIGNITES (INTERNATIONAL HANDBOOK OF COAL PETROGRAPHY 1971, 1975).....	20
TABLE 3.2 ORIGIN OF VITRINITES AND INERTINITES (AFTER STACH ET AL., 1982).	21
AMANZAMNYAMA/SIYADLA.	45
TABLE 5.1 THE MOST COMMON PEAT FORMING PLANTS FROM THE DOMINANT PEATLAND TYPES IN THE NATAL MIRE COMPLEX.....	46
TABLE 5.2 PEATLAND TYPES AND SUB-TYPES RECOGNISED	55
IN THE NATAL MIRE COMPLEX (NMC).....	55
TABLE 5.3 CHARACTERISTICS OF ALL NMC PEATS (ASH < 50%) IRRESPECTIVE OF TYPE (MOISTURE-FREE BASIS).....	72
TABLE 5.4 ELEMENTAL CHARACTERISTICS OF NMC PEAT SAMPLES (DAF)	83
TABLE 5.5 RECALCULATED CV (MJ/KG).....	85
TABLE 5.6 PHYSICAL CHARACTERISTICS OF THE MAJOR PEAT TYPES	90
TABLE 5.7 AVERAGE COMPOSITION (%) OF THE MINERAL MATTER IN FOUR PEAT TYPES. (X-RAY DIFFRACTION ANALYSIS OF INORGANIC FRACTION ONLY).....	91
TABLE 5.8 SULPHUR CONTENTS AND CALCULATED PYRITE CONTENTS FOR NMC PEATS (ONLY WHOLE PEATS WITH ASH CONTENTS <50 % WERE ANALYSED).	94
TABLE 5.9 AVERAGE TRACE ELEMENTS FOR NMC PEATS. TRANSVAAL AND CAPE REED/SEDGE PEAT VALUES INCLUDED FOR COMPARISON (ALL VALUES IN PPM FROM PRESSED ASH PELLETS).....	96
TABLE 5.10 AVERAGE MAJOR ELEMENT ANALYSES OF PEAT ASH	97
AND THE STANDARD DEVIATIONS.....	97
TABLE 5.11 RADIOCARBON DATES FOR SOME SOUTH AFRICAN PEATS (DETERMINED BY EMATECH, CSIR).	101
TABLE 5.12 RATES OF PEAT ACCUMULATION IN THE NATAL MIRE COMPLEX (MM.YR ⁻¹). No CORRECTION MADE FOR COMPACTION.....	102
TABLE 5.13 RATES OF PEAT ACCUMULATION IN THE NATAL MIRE COMPLEX (MM.YR ⁻¹). CORRECTED FOR COMPACTION.	102
TABLE 5.14 ADJUSTED ELEMENTAL ANALYSES OF SOME INLAND VALLEY MIRE PEATS.....	118
TABLE 5.15 FISCHER ASSAYS (DAF) AND ELEMENTAL CHARACTERISTICS	121
(DAF) OF SOME SELECTED PEATS	121
TABLE 5.16 AVERAGE COMPOSITION (%) OF THE MINERAL MATTER IN INLAND VALLEY MIRE PEATS. (X-RAY DIFFRACTION ANALYSIS).....	123
TABLE 5.17 AVERAGE SULPHUR CONTENTS FOR VALLEY MIRE PEATS	124
TABLE 5.18 SELECTED TRACE ELEMENTS FROM VALLEY MIRE PEATS. ANOMALOUS VALUES IN KL (KLIP RIVER MIRE) WITH RESPECT TO TRANSVAAL PEAT ARE INDICATED BY SHADING.)	126
TABLE 5.19 MAJOR ELEMENT ANALYSES FOR VALLEY MIRE PEATS.....	126
TABLE 5.20 RADIOCARBON DATES FOR SOME VALLEY MIRE PEATS (DETERMINED BY EMATECH, CSIR).....	130
TABLE 5.21 RATES OF PEAT ACCUMULATION IN TRANSVAAL REED/SEDGE MIRES (MM.YR ⁻¹).	131
TABLE 5.22 ANALYSIS OF PLANT MATERIAL (DRY BASIS) (AFTER MCCARTHY ET AL., 1989, TABLE 1).....	135
TABLE 5.23 CHEMICAL ANALYSIS OF PEAT SAMPLES (FROM MCCARTHY ET AL., 1989, TABLE 3).....	136
TABLE 5.24 INTER-OXIDE TRENDS: PEAT ASH OKAVANGO SWAMP (BASED ON DATA FROM MCCARTHY ET AL., 1989).	138
TABLE 7.1 MEAN ASH ANALYSIS (CALCULATED TO 100 %) AND CLAY MINERAL COMPOSITION OF THE INORGANIC FRACTION	150
TABLE 7.2 CALCULATED AGES COMPARED WITH MEASURED AGES FOR BURUNDI PEATS.....	155
TABLE 7.3 PERCENTAGE CHANGE IN THICKNESS WITH DEPTH CALCULATED FROM EQUATION (1): $D = 1.6218 \cdot A^{0.79}$, D_1 = THICKNESS AFTER FIRST YEAR AND D_{10} = THICKNESS AFTER TENTH YEAR OF A TEN YEAR PERIOD.	156
TABLE 7.4 GROWTH RATE OF PEAT FROM BURUNDI.....	157
TABLE 7.4 CALCULATED AGES COMPARED WITH MEASURED AGES FOR NMC PEATS.....	160
TABLE 7.5 CALCULATED AGES COMPARED WITH MEASURED AGES FOR VALLEY MIRE PEATS	161
TABLE 7.6 PERCENTAGE CHANGE IN THICKNESS WITH DEPTH AS A FUNCTION OF PEAT COMPACTION IN SOUTH AFRICAN VALLEY MIRE PEATS, BASED ON EQUATION (5).....	161
TABLE 8.1 WORLD PEAT PRODUCTION 1980 (10 ³ T/A, 40% MOISTURE CONTENT) (WORLD BANK/BORD NA MONA, 1984).	163
TABLE 8.2 WORLD HORTICULTURAL PRODUCTION, RESERVES AND RESERVE BASE: 1992 (10 ³ TONS) (CANTRELL, 1993).....	164



TABLE 8.3 WATER CONTENT AND MINIMUM WATERHOLDING CAPACITY OF SATURATED PEATS (LUCAS ET AL., 1971)	165
TABLE 9.1 FLOW DIAGRAM FOR BOG CLASSIFICATION	171
TABLE 9.2 FLOW DIAGRAM FOR FEN CLASSIFICATION	172
TABLE 9.3 FURTHER SUBDIVISIONS FOR FOREST AND SEDGE / REED MIRES	173
TABLE 9.4 GENERALISED RESERVE CHARACTERISTICS (AS PRESENTED BY THE DEPARTMENT OF MINERALS & ENERGY TO THE AFRICAN ENERGY PROGRAMME, 1993)	176

ACKNOWLEDGEMENTS

The Lord for granting me the patience and perseverance to see this exercise through.
My wife Ria and all the children who over the last six years had to put up with my many absences from home and hearth.

The following people also assisted me at various times and places with field work, laboratory work or otherwise during this period:

Edouard Akiaoue, Louis Kirstein, Petra Labuschagne, Charles Mabuella, Bennie Mashele, Hanna Mazus, Peter Msiza, Cobus Smuts, Gert van der Linde, the Geological Survey Laboratory (in particular Steph Labuschagne, Deon De Bruin, Koos Elsenbroek and Riaan Botes) and Library staff and Anonymous et al.. Mr P-L Grundling and Ms A Latsky are thanked for their diligence while employed as undergraduate student assistants by the Survey. A special word of thanks must go to Dr Stefan Kotlicki of the Polish Institute of Geology in Sosnowiec, who managed to get me a copy of the out of print Peat Bogs of Polesie by Stanislaw Kulczynski.

I am also indebted to the directors of the Natal Parks Board, the KwaZulu Bureau of Natural Resources and Mr Steve van der Linde (KwaZulu Forestry - Mbazwana) for permission to work in their respective areas, for assistance from their staff (especially Dr D.J. Alletson, Dick Nash, Bill Howell, Dr Scotty Kyle, Harold Thornhill, Harry Ostrosky and Wayne Matthews) and for accommodation from time-to-time.

I must also recognise the role of the Chief Director, Dr Nok Frick and the management of the Geological Survey in the promotion of this project throughout my term of employment with the Survey, especially Drs Jan Bredell, who started me off on the peat project, and Erik Hammerbeck who looked after me and the project until I left at the end of April 1994. The Geological Survey of South Africa allowed me the opportunity to become expert in my field through my work and exposure both in this and other parts of Africa, Russia and Europe - for this I will always be indebted to the organisation.

My promoter, Prof CP Snyman for sharing his enthusiasm, years of experience, joining me for a field visit in Natal during the floods of '93, for financial assistance to attend the International Peat Society Symposium in Warsaw and Biebrza, Poland during June 1994 and the IPS Congress in Bremen, Germany in 1996 and for helping me to keep the nose to the grindstone and retaining a clear vision of my objectives at all times.

ABSTRACT

Peat has been exploited for some time by man for use in various technological processes, power generation, agriculture and the chemical industries. In Africa this potentially important resource has remained virtually untapped and as a result also unmanaged. Currently little diversity exists in peat usage in South Africa. However, it does represent an increasingly important commodity in the daily lives of many South Africans, notably in the agricultural and horticultural fields.

This investigation of selected "type" peat deposits in South Africa had as its objectives: (1) to determine the extent and nature of peats and peatlands in South Africa; (2) to study peat sedimentology and palaeoecology; (3) to provide a basis for characterisation of peat types; (4) to classify peatlands; (5) to delineate management constraints. For these purposes in this treatise South African peats are investigated in terms of morphological, botanical, physical, chemical and petrologic attributes. Previous to these investigations, no detailed study of the characteristics of South African peats had been done.

The following are a few of the more important conclusions resulting from this study:

(1) Under favourable conditions peatlands (mires) occur in South Africa in widely different climatic systems. However, those of socio-economic consequence tend to be located in certain broad geomorphological settings in the higher rainfall, eastern half of the country. Extensive primary mires in drier sub-tropic and tropic areas are restricted to deltaic and estuarine positions, merging with coastal mangrove swamps. Where rainfall is higher, mires extend further up-river and inland into lake, interdune and other low lying enclosed areas.

(2) Cooler, more humid regions facilitate peat formation in a wider range of basin types, following the order, estuarine/deltaic, river flood plains, open lake basins, closed lake basins, valley heads and springs.

(3) The geomorphological expression of the geology of an area is extremely important to peat accumulation as it provides the primary template required for mire development.

(4) As far as vegetation is concerned, four main mire types can be distinguished, viz. sedge/reed, hardwood forest, *Raphia* palm and mangrove mires.

(5) South African peats are true peat in rank, ashy in grade and hemic to sapric in type with a decomposition range of 20 - 60 %. South African peats have on average an ash content of 23%; fixed carbon content of 21.8%; volatile matter of 43.7%; moisture content of 10.9% and calorific value of 14.7 MJ/kg. Sedge/reed peats tend to be perhydrous (rich in combustible hydrocarbons). It would also appear that South African peats are in most respects no different from other African peats.

(6) Peatland area is currently estimated at approximately one million ha, representing 0.8 % of the total land surface. Roughly 30 % is regarded as harvestable peatland, representing $\pm 5\,580 \times 10^6 \text{ m}^3$ of peat.

(7) In mires some of the excess energy produced in the ecosystem is retained and accumulated as peat. Thus the entire system is gradually increasing its energy content as peat builds up. Given adequately high rainfall and/or permanent water levels, mires (notably reed/sedge mires) in southern Africa generate large volumes of plant matter annually with the potential to accrue much of this primary production in the peat layer, leading to significant recent accumulation rates of between 5 and 10 cm per year. By way of ^{14}C age calculations this translates to accumulation rates of between 0.75 mm and 108 mm per year for African peats.

(8) It is suggested that under a prudent and appropriate management schedule, South African sedge/reed peats represent a valuable renewable resource with wide application in agronomy and for rural small-scale energy supply. Sensitive utilisation of this resource may in fact alleviate the pressure on other finite natural resources in certain densely populated rural areas of southern Africa.

SAMEVATTING

Veen word reeds lank benut in verskeie tegnologiese prosesse, energie opwekking, landbou en chemiese toepassings. In Afrika het hierdie potensiëel belangrike hulpbron feitlik onaangeraak gebly. Op die oomblik is daar nie 'n groot verskeidenheid van veengebruike in Suid Afrika nie. Dit word egter 'n toenemend belangrike kommoditeit in die daaglikse lewens van baie Suid-Afrikaners, veral in die landbou- en tuinbousektore.

Hierdie ondersoek van gesellekteerde "tipe" veenafsettings in Suid-Afrika het as oogmerk gehad: (1) om die omvang en voorkoms te bepaal van veen en veenlande in Suid-Afrika; (2) om die sedimentologie en palaeo-ekologie van veen te bestudeer; (3) om 'n basis te skep vir die karakterisering van veen tipes; (4) om veenlande te klassifiseer; (5) om sekere bestuursaspekte te bepaal. Vir hierdie doeleindes word gepoog in hierdie dissertasie om veen in Suid-Afrika te ondersoek en te karakteriseer in terme van geomorfologiese, botaniese, fisiese, chemiese en petrologiese eienskappe. Voor hierdie ondersoek is geen diepte studie van Suid-Afrikaanse veen nog onderneem nie.

Die volgende is enkele van die meer belangrike resultate wat gevloei het uit hierdie studie:

(1) Onder gunstige omstandighede kom veenlande in Suid-Afrika in 'n wye verskeidenheid van klimaattipes voor. Veenlande van sosio-ekonomiese belang neig egter om in sekere breë geomorfologiese omgewings in die oostelike hoër reënvalstreke van die land voor te kom. Uitgestrekte laagland, primêre veenlande in droër sub-tropiese en tropiese gebiede is beperk tot deltaïese en estuariene posisies wat vermeng met manglietmoerasse naby die kus. Waar reënval hoër is reik veenlande verder stroom-op en binnelands in mere, tussen duine en ander laagliggende komme.

(2) Koeler, vogtiger streke bevorder veenvorming in 'n wyer reeks van komtipes, in die volgorde, estuarien/deltaïes, rivier vloedvlakte, oop mere, geslote mere, valeihoofde en fonteine.

(3) Die geomorfologiese uiting van die geologie van 'n omgewing is uiters belangrik vir veenakumulاسie aangesien dit primêr verantwoordelik is vir die ontstaan van veenlande.

(4) In terme van tipiese plantegroei word vier hoof-groepe onderskei, naamlik riet/biesie, moeras-bos, *Raphia* palm en manglietmoeras.

(5) Suid-Afrikaanse veen is in rang egte veen, asryk in graad en humies tot sapries in tipe met 'n ontbindingsgraad van 20 - 60 %. Suid-Afrikaanse veen het 'n gemiddelde asinhoud van 23%; vastekoolstofinhoud van 21.8%; flugstofinhoud van 43.7%; voginhoud van 10.9% en hittewaarde van 14.7 MJ/kg. Riet/biesieveen neig om perhydries (ryk aan ontbrandbare koolwaterstowwe) te wees. Dit blyk dat Suid-Afrikaanse veen in meeste aspekte nie verskil van dié elders in Afrika nie.

(6) Veenland oppervlakte word tans geskat op ongeveer een miljoen hektaar, wat 0.8 % van die totale landsoppervlakte verteenwoordig. Hiervan word 30 % ($\pm 5\,580 \times 10^6 \text{ m}^3$ veen) gereken as oesbare veenland.

(7) In veenlande word 'n gedeelte van die oortollige energie wat in die ekosisteem geproduseer word geakumuleer as veen. Die hele sisteem verhoog dus gaandeweg sy energie-inhoud soos wat veen opbou. Gegewe genoegsame hoë reënval en/of permanente watervlakke, sal veenlande (veral riet/biesie vleilande) in suidelike Afrika jaarliks groot volumes plantmateriaal genereer met die potensiaal om 'n groot hoeveelheid van hierdie primêre produksie in die veenlaag te versamel, wat lei tot 'n beduidende resente akumulاسie tempo wat wissel tussen 5 en 10 cm per jaar. Deur middel van ^{14}C ouderdom berekeninge lewer dit akumulاسie tempos van tussen 0.75 mm and 108 mm per jaar vir Afrika veen.

(8) Dit word voorgestel dat onder 'n oordeelkundige en toepaslike bestuurstelsel Suid-Afrikaanse riet/biesie-veen 'n waardevolle hernieubare hulpbron verteenwoordig met wye toepassing in agronomie en vir landelike klein-skaal energiebehoefte. Sensitiewe benutting van hierdie hulpbron kan inderwaarheid die druk op ander beperkte natuurlike hulpbronne in sekere digbevolkte landelike gebiede van suidelike Afrika help verlig.