

Copyright is owned by the Author of the thesis. Permission is given for a copy to be downloaded by an individual for the purpose of research and private study only. The thesis may not be reproduced elsewhere without the permission of the Author.

A TEXTURAL AND MINERALOGICAL STUDY OF THE  
BEACH SANDS, ALONG THE SOUTHWEST  
COAST OF THE NORTH ISLAND.

A thesis presented in partial fulfilment  
of the requirement for the Degree of  
Master of Science in Soil Science  
at Massey University.

by

NEIL ALEXANDER LITHGOW

1986

### ABSTRACT

A sediment survey of the beaches from Patea to Manawatu River on the southwest coast of the North Island has been undertaken. The survey objectives are to establish the beach sediment provenance, the net longshore drift and the extent of the contributing rivers to the longshore drift system. Sediments derived from the Taranaki Volcanics predominate, particularly in the northern part of the study area. However, sediment contributions from other sources (Pliocene to Pleistocene and Recent sediments, Taupo Volcanic Zone volcanics) become increasingly important in the southern part of the study area.

A gradual decrease in heavy mineral abundance indicates a net southeastward longshore drift. This is further supported by the distribution pattern of the grain size parameters and local heavy mineral distribution patterns about the river mouths within the study area.

The high abundance of heavy minerals and coarser sediment 1-3 km south of Whangaehu, Rangitikei and Turakina River mouths, suggests that the discharging river sediment is being deposited onto the beach at some distance south of the river mouths rather than immediately adjacent to them. Grain size parameters indicate that the Whangaehu and Rangitikei Rivers are contributing coarse sediment to the longshore drift system, while the Turakina River is supplying lesser amounts of, but finer and better sorted, sediment to the adjacent beaches at the river mouth.

### ACKNOWLEDGEMENTS.

I wish to thank the many people who gave assistance in the course of my research. In particular I wish to acknowledge:

Dr. R.B. Stewart for his valued supervision, his encouragement and assistance in the field and laboratory, and for his constructive criticism which is appreciated in the preparation of this thesis;

Mr R.M.S. Johnston, Rangitikei-Wanganui Catchment Board, who provided transport, valued advice and assistance in the field, and whose suggestions and constructive criticism pertaining to this study were invaluable;

Mr R.C. Wallace, Dr. A.S. Palmer and Mr B.V. Alloway who provided suggestions and encouragement during laboratory work and Mrs H. Murphy for helping with computing problems.

Thanks to; Miss A. Loughnan for helping with some of the diagrams; to Mrs L. Te Anini for typing the charts; to fellow students M. Pierrard, M. Smith, R. Sykes and S. Phimsarn and many others.

TABLE OF CONTENTS.

	<u>PAGE</u>
ABSTRACT	ii
ACKNOWLEDGEMENTS	iii
TABLE OF CONTENTS	iv
LIST OF TABLES	vii
LIST OF PLATES	viii
LIST OF FIGURES	ix
CHAPTER	
1 <u>INTRODUCTION</u>	1
1.1 Background	2
1.2 Objectives	2
2 <u>THE TERRESTRIAL ENVIRONMENT</u>	4
2.1 Introduction	5
2.2 Geological and Geomorphic History	6
2.3 Coastal Geology and Geomorphology	9
2.3.1 Coastal Geomorphology	9
2.3.2 Coastal Cliff Exposures	12
2.4 The Drainage System	17
2.5 Meteorological Conditions	20
2.6 Summary	23
3 <u>THE MARINE ENVIRONMENT</u>	24
3.1 Introduction	25
3.2 Bathymetric Features	26
3.3 Currents on the North West Cook Strait Shelf	28

	<u>PAGE</u>
3.4 Wave Climate	32
3.4.1 General	32
3.4.2 Sea Fetch	32
3.4.3 Wave Period	34
3.4.4 Wave Direction	34
3.4.5 Wave Heights	35
3.5 Offshore Sediments	36
3.6 Summary	40
4 <u>TEXTURAL CHARACTERISTICS OF THE FORESHORE ALONG</u>	
<u>THE SOUTHWEST COAST OF THE NORTH ISLAND</u>	42
4.1 Literature Review	43
4.2 Materials and Methods	46
4.2.1 Sediment Sampling	46
4.2.2 Carbonate Analysis	48
4.2.3 Textural Analysis	51
4.3 Results From Textural Analyses	52
4.3.1 Mean Grain Size	52
4.3.2 Inclusive Graphic Standard Deviation	58
4.3.3 Inclusive Graphic Skewness	63
4.3.4 Textural Parameters For Gravel Free Sediment	66
	<u>PAGE</u>
5 <u>MINERALOGICAL CHARACTERISTICS OF THE BEACH SANDS ALONG</u>	
<u>THE SOUTHWEST COAST OF THE NORTH ISLAND</u>	74
5.1 Literature Review	75
5.2 Materials and Methods	77

	<u>PAGE</u>
5.2.1 Heavy Mineral Separation	77
5.2.2 Grain Counts	78
5.3 Sediment Source Areas	79
5.4 Sand Mineralogy Identification	82
5.5 Mineralogical Trends	87
5.5.1 Total Heavy Mineral Content	87
5.5.2 Opaque Minerals	90
5.5.3 Hypersthene	94
5.5.4 Clinopyroxene	97
5.5.5 Amphibole	100
5.5.6 Light Minerals	104
5.5.6.1 Quartz and Feldspar	104
5.5.6.2 Feldspar:Quartz Ratio	107
6 DISCUSSION	110
7 CONCLUSIONS	117
APPENDICES	121
APPENDIX A Grain size parameters employed.	122
APPENDIX B Textural and mineralogical data for beach sediments, sand dunes, coastal cliffs and rivers along the southwest coast of the North Island.	124
REFERENCES	137

LIST OF TABLES.

<u>TABLE</u>		<u>PAGE</u>
1	Sediment inputs to the southwest coast of the North Island from discharging rivers.	17
2	Summary of the main water movements on the North West Cook Strait Shelf, outlining their dominant direction of travel and speeds at particular depths.	31
3	Sample station locations and data. (Appendix B).	125
4	Textural data for sample stations along the southwest coast of the North Island. (Appendix B).	128
5	Mineral percentages from grain counts in 2-4 phi magnetic fraction, for sample stations along the southwest coast of the North Island. (Appendix B).	132
6	Mineral percentages from grain counts in 2-4 phi non magnetic fraction, for sample stations along the southwest coast of the North Island. (Appendix B).	135



LIST OF PLATES.

<u>PLATE</u>		<u>PAGE</u>
1	North of Castlecliff Beach, with fordunes at the toe of the Pleistocene cliffs backing the beach. The photograph also shows the prograded Castlecliff Beach on the north mole at Wanganui River.	57
2	Bluff Trig Beach with Pleistocene cliffs backing the beach and a tidal platform exposed at the mid tide mark.	62
3	Photograph along Kai-Iwi Beach showing Kai-Iwi and Mowhanau Streams and the eroding Castlecliffian cliffs south of Mowhanau.	93

LIST OF FIGURES.

<u>FIGURE</u>	<u>PAGE</u>
1 A location diagram of the study area.	3
2.1 Coastal change (m/yr) for the Rangitikei-Wanganui Coastline, for a survey period of approximately one century prior to 1982.	11
2.2 Nukumaruan coastal section, Waitotara to Wainui Beach. Lithostratigraphy, thickness and depth of deposition are indicated.	15
2.3 Castlecliffian coastal section, Wainui Beach southeast to Wanganui, showing the lithostratigraphy and thickness, depth of deposition and apparent sea-level change.	16
2.4 A map illustrating the drainage pattern for the study area and the geology of the source areas for beach sediments.	18
2.5 Mean annual wind frequency (%) of surface wind direction at Wanganui Airport, 1977-1981.	22
3.1 Offshore bathymetry for the North West Cook Strait Shelf area.	27
3.2 Coastal currents	29
3.3 Linear fetch lengths for various directions of wave approach, along the southwest coast of the North Island.	33
3.4 Sediment distribution on the North West Cook Strait Shelf area.	37
3.5 Distribution of ironsand in sediments finer than 2mm diameter.	39
4.1 Sediment sampling of sand and gravel beaches for the investigation of longshore variations in sediment properties.	47

PAGE

4.2	An index for textural and mineralogical plots, to compare the locations of the sample stations with repeat samples, sand dunes and coastal cliff sample stations, along the southwest coast of the North Island.	49
4.3	Plot of graphic mean with distance along the foreshore.	53
4.4	Plot of inclusive graphic standard deviation with distance along the foreshore.	60
4.5	Plot of inclusive graphic skewness with distance along the foreshore.	64
4.6	Plot of the gravel free graphic mean with distance along the foreshore.	68
4.7	Plot of gravel free inclusive graphic standard deviation with distance along the foreshore.	70
4.8	Plot of gravel free inclusive graphic skewness with distance along the foreshore.	72
5.1	Plot of percent magnetic weight with distance along the foreshore.	88
5.2	Plot of opaque mineral percent abundance with distance along the foreshore.	91
5.3	Plot of hypersthene percent abundance with distance along the foreshore.	95
5.4	Plot of clinopyroxene percent abundance with distance along the foreshore.	98
5.5	Plot of amphibole percent abundance with distance along the foreshore.	101
5.6	Ninety-five percent confidence level graph for mineral point counting.	103
5.7	Plot of feldspar and quartz percent abundance with	

PAGE

distance along the foreshore.	105
5.8 Plot of feldspar:quartz ratio with distance along the foreshore.	108

CHAPTER 1  
INTRODUCTON.

### 1.1 BACKGROUND.

The Rangitikei-Wanganui Catchment Board administers the coastal region extending 85 km from the Waitotara River in the north to Himitangi Beach in the south. The Catchment Board is currently undertaking a Coastal Hazard Zone survey, which is a five year project funded by NWASCA. A survey of the beach sediments commencing in May, 1984, along the coast from Patea River in the north to Manawatu River in the south (Fig.1) was subsequently undertaken in order to determine both longshore drift directions and provenance of beach sediments.

### 1.2 OBJECTIVES.

This thesis has four major objectives to be determined from textural and mineralogical data,

(1) To determine the provenance of the beach sediments along the coast from Patea to Manawatu River.

(2) To verify the net longshore drift direction in the study area.

(3) To determine which rivers in the Rangitikei-Wanganui Catchment Board area (Wanganui, Whangaehu, Turakina and Rangitikei Rivers) are contributing sediment to the longshore drift system.

(4) To assess other coastal processes that have some bearing on the mineralogy and texture of the beach sands in the study area.

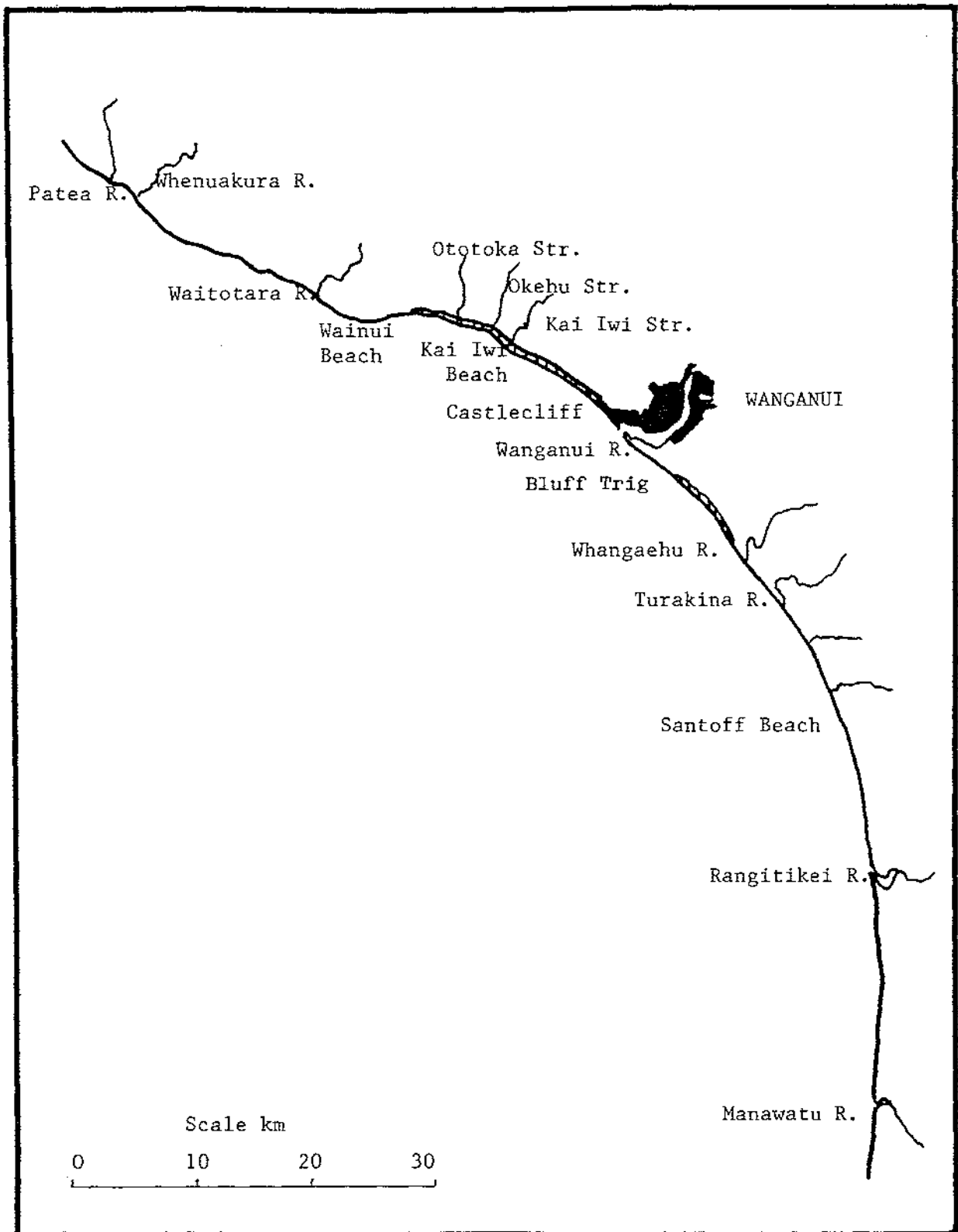


FIG. 1.

LOCATION DIAGRAM OF THE STUDY AREA