

GEOMORPHIC PROCESSES
AND
ENVIRONMENTAL CHANGE
ON
SUBANTARCTIC MACQUARIE ISLAND

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B.Sc. (Hons)

A thesis submitted in fulfilment of the regulations of Doctor of Philosophy,
Graduate School of the Environment, Division of Environmental
and Life Sciences, Macquarie University, July 2000.



Frontispiece. Peat slide on southern slopes above Stony Creek, Macquarie Island.

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ABSTRACT

The major terrestrial geomorphic processes presently active in the cool, moist, windy subantarctic climate of Macquarie Island are tectonic activity, mass movement, and aeolian, fluvial and frost processes. Tectonic activity associated with the island's uplift has been fundamental to the development of the contemporary landscape, creating lake basins, channeling streams and producing numerous fault scarps. Contemporary tectonic activity also occurs. Mass movement is frequent, but as the most frequent types of failure are peat slides, little overall alteration of the underlying hillslope results. Loading of slopes by water and wind-blown mineral material is a more important trigger for mass movement than tectonic activity. Aeolian erosion and deposition are important island-wide in a variety of substrates. The continuous strong winds erode both sand and peat, producing blowouts and bowl-like features. The impact of strong winds on fieldmark vegetation is important in maintaining the vegetation-banked terrace form. Fluvial erosion and deposition processes occur as slope wash, rill erosion, stream incision and gullyng. Contemporary frost processes are not restricted to surfaces of mineral material, but also affect exposed peat, although this is less common. Primarily, these processes produce small-scale sorted ground; however, the patterning of ground associated with the vegetation-banked terraces and the contribution of frost processes and wind-blown ice and snow in maintaining the terrace form are the most widespread examples of frost processes on the island.

Current rates of geomorphic processes are site-dependent. On the plateau and its seaward slopes, mass failure of peat is likely to occur when precipitation exceeds 25 mm d^{-1} . Slopes vegetated by *Poa foliosa* will fail within 5000 y. Rates of movement of surficial gravels by fluvial and frost processes on vegetation-banked terraces average between 30 and 138 mm

y^{-1} . The combination of aeolian and fluvial processes on exposed peat and sand give rates of erosion of $43 \text{ mm } y^{-1}$ and rates of accretion of $28 \text{ mm } y^{-1}$.

Wind, water and tectonics, often in combination with each other, are integral to the geomorphology of the Macquarie Island plateau and environmental change, in terms of landscape evolution within the Quaternary, is related to changes in these factors.

CERTIFICATE OF ORIGINALITY

The work presented in this thesis has not been submitted for the award of any degree or diploma at any other university or institution. This thesis contains no material written by another person except where due reference is made in the text.

The following outlines my contribution to the co-authored papers presented in this thesis:

Chapter 6:

Selkirk, J. M. and Saffigna, L. J. 1999, Wind and water erosion of a peat and sand area on subantarctic Macquarie Island. *Arctic, Antarctic and Alpine Research* 31 (4): 412-420, 1999.

90 % conception, 90 % fieldwork, 100 % analysis and writing

Appendix 1:

Adamson, D. A., **Selkirk, J. M.** and Seppelt, R. D. 1993, Serpentinite, harzburgite and vegetation on subantarctic Macquarie Island. *Arctic and Alpine Research* 25 (3): 216-219.

50 % Fieldwork, 40 % analysis and 50 % writing

Adamson, D. A., Selkirk, P. M., Price, D. M., Ward, N., and **Selkirk, J. M.** 1996, Pleistocene uplift and palaeoenvironments on Macquarie Island. In Banks, M. R. and Brown, M. J. (eds.): Climatic succession and glacial history of the Southern Hemisphere over the last five million years. *Papers and Proceedings of the Royal Society of Tasmania* 130 (2): 25-32

Contributed section on lacustrine deposit in north Bauer Creek valley and its implications

Pickard, J. and **Selkirk, J.M.** 1997, An improved hand core sampler for peat. *Palynology* 21: 209-211.

Field testing of corer

McBride, T.P. and **Selkirk, J.M.** *in press*, Palaeolake diatoms on subantarctic Macquarie Island: possible markers of climate change. In Johns, J. (ed.) *Proceedings of the 15th Diatom Symposium, Perth 1999*.

Contributed section on morphology of lacustrine deposit in north Bauer Creek valley and its implications

A handwritten signature in black ink, reading "J Selkirk Bell". The signature is written in a cursive, flowing style.

Jennifer Selkirk-Bell

July 2000

ACKNOWLEDGEMENTS

The work undertaken for this study would not have been possible without the assistance and support of many. Firstly I would like to thank my supervisors, John Pickard, Don Adamson and Trish Fanning for interesting discussions, encouragement and support during the time of this study. Their encouragement of completion despite my being in the Falkland Islands for family reasons is greatly appreciated. Trish Fanning is thanked for her support and supervision after John left the Graduate School of the Environment.

Study on Macquarie Island is not possible without the logistical support provided by the Australian Antarctic Division, and permission to work on the island was given by the Tasmanian Parks and Wildlife Service, Department of Primary Industry, Water and Environment. Scholarship funds for this study were provided by the Antarctic Advisory Committee Grant Scheme.

Special thanks go to Geof Copson and Jennie Whinam (Tasmanian Parks and Wildlife Service) who gave freely of their time, both in Hobart and on Macquarie Island, and increased my knowledge of the island immensely. Jennie also provided a sounding board and much needed encouragement and support on many occasions while I was living in Hobart.

Fieldwork on Macquarie Island would not be possible but for assistance in the field given by many people. Robert Gibson, Patrick McBride and Luke Saffigna are thanked for their collaborations and discussions in the field and afterwards. Field assistance was provided by Don Adamson, Chris Arthur, Rob Barclay, Ken Barrett, Cameron Bell, Tom Cheblowski, Herbert Dartnall, Andy Cox, Trudy Disney, Zudhan Fathoni, Dave Glackin, Roger Handsworth, Ian Jackson, Trang Luu, Dale Main, Ian McLean, Charles Mohring, Greg Pancoke, John Rich, Joan Russell, Patricia Selkirk, Keith Shadbolt, Christine Spry, and Dave Stewart – many thanks to you all. I would also like to acknowledge all the other members of the Australian National Antarctic Research Expeditions to Macquarie Island in 1989, 1990, 1992, 1993, 1994 for general assistance.

I would like to thank Vladimir Kronratiev, Commonwealth Bureau of Meteorology, for computing assistance with the wind data collection program and Dominique Guinet and Gabi Schmidt-Adam for abstract translations into French and German respectively.

Lucinda Coates, Michelle Leishman, Rob Ferguson, Rob Harcourt, Jo Hess, Cindy Hull, Iffat Qamar, and Joy Monckton have provided general support, encouragement and friendship. I am grateful to you all. Special thanks also go Rob F. for so much help with the figure production and to Luc for the proof reading.

While I have been living in the Falklands Islands, Nikki Buxton, Derek Clelland, Mo and Gary Fuller, Pippa McHaffie, Rachel Middleton and Chelsea Parsons have provided wonderful friendships, been hugely supportive and given me the encouragement that has kept me going. Nikki is also to be thanked for her computing skills and assistance, and Chelsea for her help with some diagrams.

I thank my immediate and extended families for unwavering support and encouragement. I thank Fergus Selkirk-Bell for the enjoyments a two and a half year old can bring to his mother during the final stages of thesis writing, while his father was in a different country. Lastly, I thank my husband Cameron Bell for his unending support and the belief that, despite us having a child in the middle of it all, his getting a job on the other side of the world and us moving to the Falkland Islands, that one day it would all be done.