GEOMORPHIC PROCESSES

AND

ENVIRONMENTAL CHANGE

ON

SUBANTARCTIC MACQUARIE ISLAND

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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 feldmark vegetation is important in maintaining the vegetation-banked terrace form. Fluvial erosion and deposition processes occur as slope wash, rill erosion, stream incision and gullying. 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 mm y^{-1} and rates of accretion of 28 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

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