Strain and Structure of a Temperate, Maritime Glacier: *Te Moeka o Tuawe* / Fox Glacier, South Westland, New Zealand

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"Raki, the Sky Father, wedded Papa-tui-nuku, the Earth Mother. After the marriage, the four sons of Raki who were named Ao-raki, Raki-ora, Raki-rua, and Raraki-roa came down to greet their father's new wife in the canoe of the eldest brother Ao-raki, known as Te Waka o Aoraki. They cruised around Papa-tui-nuku, then, keen to explore, the voyagers set out to sea, but no matter how far they travelled, they could not find land. They decided to return to their celestial home, but the karakia which should have lifted the waka back to the heavens failed and the canoe fell back into the sea and turned over onto its side, and settled with the west side much higher out of the water than the east, thus the whole waka formed Te Waka o Aoraki, the South Island. Ao-raki and his brothers clambered on to the high side and were turned to stone, where they remain today, Aoraki being the highest peak, surrounded by his younger brothers. The permanent snows of these peaks were known as whenuahuka and the great snow fields hukapapa. The glaciers that flowed out of them were called huhapo. Nearby in the darkened valleys was kopakanui or ice and in places cut off from the sun was thick ice of waiuka meaning solid water"

-Maori Mythology

Abstract

The study of glaciers has an immense significance for understanding and predicting global environmental change. The Earth is a dynamic system, consisting of individual units such as the cryosphere, an understanding of which may provide the basis for predicting future environmental change on a global scale. The dynamics of a glacier, a major indicator of the climatic and environmental situation is often presented as supraglacial structures, which reflect glacier formation, deformation and flow. Although structural attributes such as folds, faults, crevasse traces and foliation are commonly described in glaciers, the origin and significance of many of these structures remains unclear.

This research project mapped the surface structures of Fox Glacier, using remote sensing in the form of aerial photographs and field observations, to produce a structural glaciological interpretation of the glacier surface, structural field maps of individual structures, and a schematic structural evolution of Fox Glacier. In addition, cumulative strain, and strain rates were calculated for three different areas of the lower Fox Glacier. The relationship between the observed structures and the measured strain rates has also been considered.

Fox Glacier is located in the South Westland region of the South Island of New Zealand. From the Main Divide of the Southern Alps up to 3000m altitude, Fox Glacier flows for 13 km, terminating at an altitude of 270 metres in temperate rainforest, 17 km from the present coastline. The steep gradient allows for relatively rapid ice flow. Despite being a very dynamic glacier, very little research has been carried out on Fox Glacier in recent years with most research in the area being concentrated on its neighbour the Franz Josef, and even more so on the glaciers of the Eastern side of the Main Divide (e.g. the Tasman and Mueller glaciers).

There is a high level of spatial variability in structural types observed, and the cumulative strain and strain rates measured on the surface of the Fox Glacier, with the variations being linked to valley topography including long-profile gradient and valley width. Strain rates of

208.78 y^{-1} and -162.06 y^{-1} were recorded on Fox Glacier. A relationship can be determined between observed glaciological structural features and measured strain rates, suggesting strain rate has an influence on the type, magnitude, location and frequency of these features, however, the study is only a 'snap-shot' of the strain conditions experienced in the most dynamically active time, during the summer ablation season.

Developing predictive models of the structural evolution of glaciers may help further understanding of how glaciers respond to a change in climatic input, especially climatic warming. This is particularly important for larger ice sheet outlet glaciers whose structure and flow appear to reflect and control dynamics of the ice sheet behind

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