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Effects of tectonism on glacial and paraglacial processes- a New Zealand case study

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The mountains of South Island, New Zealand, are the product of plate interactions between the Indo-Australian and Pacific Plates. The Southern Alps of New Zealand are aligned along the oblique strike-slip Alpine Fault and connect the opposite facing subduction zones of the Puysegur Trough to the South and the Hikurangi Margin to the North. These mountains are characterised by rapid uplift and equally rapid erosion due to a combination of plentiful orographic precipitation and highly fractured bedrock. Consequently, landslides are the dominant erosional process in these landscapes, rather than soil diffusion.
The combination of high erosion and high precipitation rates provide exceptional sediment supply to New Zealand mountain glacier valleys mostly in the form of mass movement deposits provided from the valley slopes. Unlike most glaciated mountainous regions, a significant percentage of the precipitation falls as rain and even in winter there is substantial water flow in the lower reaches of the modern glaciers. Similar conditions would have prevailed during full glacial times.

The exceptional sediment supply generated by the rapid uplift and erosion modifies the bahaviour of the glaciers as follows;

1. New Zealand glaciers advance behind substantial ice contact fans. These fans are built by rivers that emerge from the front of the glacier. Despite substantial sediment supply from screes and shallow landslides, most material rapidly reaches the glacier base and is transported and reworked in sub-glacial drainages. The ice contact fans and their distal braid plains are the main product of glacial sedimentation. Terminal moraines are a very minor component of the system as they have low preservation potential on ice margins dominated by year round fluvial reworking.

Lateral moraines are usually largely stratified. These moraines are much more substantial than terminal moraines because they aggrade as the glacier advances and are abandoned when the glacier begins to thin. They can be very substantial in and close to mountain areas.

2. Unlike shallow landslides and other slope processes (screes, debris flows), large deep seated rock avalanches provide substantial volumes of supra-glacial material to glaciers. These play a significant but as yet poorly defined role in controlling individual glacial advances and moraine formation.

3. Once an advance ceases the downwasting glacier is trapped behind its own fan head and a proglacial lake will be formed. Terminal moraines are preserved when the glacial river drops below the fan surface and incises a permanent channel. Glacial retreat is modulated by ice calving process into the proglacial lake and glacial limits may become partly decoupled from direct climate forcing.