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The Role of Mass Wasting in the Post-LGM Evolution of Milford Sound, Fiordland, New Zealand

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The geomorphic and sedimentary evolution of New Zealand's fiords have been influenced by their unique setting. Fiordland lies in a temperate marine climate zone, and is bounded to the west by an active transform plate boundary, where the Indo-Australian Plate collides with the Pacific Plate. The seismicity of Fiordland is dominated by the plate-boundary Alpine Fault, which runs immediately offshore of the popular tourist destination of Milford Sound; it has ruptured at least four times in the past 1000 years (the last time around 1717 A.D.), producing earthquakes of about magnitude 8. The probability of an earthquake of similar magnitude occurring along the Alpine Fault within the next 50 years is estimated at $65\pm15\%$.

Fordland's active tectonic setting also gives rise to a very wet climate. The extreme topography of the Fiordland mountains forces up the prevailing westerly winds, resulting in mean annual precipitation of nearly 7 m at Milford Sound. During the Last Glacial Maximum (LGM), these unique climatic and tectonic conditions were favourable for the advance of tidewater glaciers, which deposited material in large fans at the edge of the narrow continental shelf.

During the LGM, New Zealand was modestly glaciated, consequently the signature of global eustatic sea level change overrides any isostatic signature. Fiordland glaciers likely retreated very quickly (starting approximately 17,000 years ago), while global sea levels were still much lower than present day. Freshwater proglacial lakes would have occupied the basins during the early stages of glacial retreat, as marine transgression was blocked by entrance sills. Rapid retreat, and ultimately disappearance of valley glaciers would have resulted in a drastic reduction in sediment production and transport. Finally, eustatic sea level rise resulted in marine transgression, with freshwater lakes becoming estuaries.

This proposed model for fiord evolution in south-western New Zealand is well supported by recent seismic reflection and high-resolution sonar data. In fiords south of Milford Sound, laminated post-glacial lacustrine and marine sediments overly massive deposits of glacial till and landslide debris. However, our interpretation of the data for Milford Sound suggests that the majority of post-glacial sediment infill has been contributed by mass wasting. High-resolution multi-beam sonar data from Milford Sound clearly shows the presence of large rock avalanche deposits, which blanket much of the fiord bottom. Early interpretation of seismic data suggests that post-glacial sediment infill is likely dominated by massive deposits of rock avalanche debris.

The apparent paucity of laminated post-glacial lacustrine or marine sediments at Milford Sound is in marked contrast to the proposed evolutionary model for New Zealand fiords. Our presentation will cover the unique evolutionary history of Milford Sound, and suggest implications for natural hazards and risk management.