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Recognition of a pronival ("protalus") rampart in the Tararua Range, North Island, New Zealand

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A pronival (protalus) rampart is a ridge of predominantly coarse detritus, usually located at or near the foot of a talus slope, that has formed through the accumulation of debris along the down-slope margins of a perennial firn-field following supranival gravitational transport. We present evidence for a relict pronival rampart on the southeast-facing side of Dundas Ridge in the eastern Tararua Range, North Island, New Zealand. Our interpretation is based on geomorphic similarities with actively forming landforms in alpine environments, and on the congruence with criteria widely believed to be diagnostic of relict pronival ramparts elsewhere. The rampart is located at 1200 m at the base of a talus slope on a steep backwall, and comprises a broad low ridge, c. 250 m long and c. 25 m wide, that traverses the slope in a northeast/southwest direction, approximately parallel to the surface contours. The ridge is asymmetric in cross-profile, with a steep (max. 40º) distal slope and a low gradient (<20º) proximal slope, and is semi-arcuate in plan-form. Throughout its length, the landform is composed of open-work debris with variable amounts of interstitial fines. Component clasts are very angular (63%) or angular (31%), and their maximum b-axis length is 1.5 m, indicating the rampart material has undergone passive transport. The rampart crest is 60-70 m from the base of the talus slope, and this has two implications: (1) reconstructing the upper surface of the firn-field from the rampart crest to the base of the upslope rockwall, a firn-field gradient of 28º to 35º can be estimated, greater than the minimum value (20º) proposed in previous studies; (2) a firn-field of this size may be expected to alter the form of the rampart due to increased basal shear stress, encouraging creep of firn and possibly basal sliding. In New Zealand, high precision dating techniques such as cosmogenic radionuclides have been applied to unconsolidated ridge deposits in the central Southern Alps, on the basis that the ridges mark periods of Holocene climate-forced glacier advance. Given the often fragmentary nature of last glacial maximum and Holocene moraine records in New Zealand mountains, due to high precipitation and erosion rates, we suggest that it is important that a range of process-origins for depositional ridges in high mountain zones are considered before glacier expansion is invoked, and climate extrapolations are made.