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The influence of tectonics, climate and lithology on the landscape evolution of the northern Transantarctic Mountains

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The northern segment of the Transantarctic Mountains is comprised by northern Victoria Land, located between the Pacific passive continental margin of Antarctica and the western shore of the Ross Sea. Regional basement is composed by a succession of terranes that were accreted onto the East Antarctic Craton during the Paleozoic, and is overlain by a sequence of Mesozoic sedimentary rocks, and Jurassic flood basalts. A distinctive crustal pattern developed with the initiation of the Gondwana breakup in the Jurassic, comprising the tectonic depression of the Rennick Graben, and Outback Shoulder and Admiralty Block forming its western and eastern flank, respectively. The morphology of both shoulders of the Rennick Graben differs considerably.

The Outback Shoulder represents a typical landscape associated with unconfined ice flow and periglacial activity, consisting of summit plateaus, glacial erosion terraces, and circues basins. The well-developed and generally strongly weathered summit plateaus reach topographic altitudes up to ∼2800 m in the USARP Mountains (western Outback Shoulder). Despite of the high topographic altitudes, Cenozoic denudation hardly exceeded 2000 m as indicated by existing and new apatite fission track data ([1], [2]). Moreover, cosmogenic isotope ages up to 11.2 Ma suggest that these glacial erosion surfaces belong to the oldest known exposure-dated surfaces on Earth [3]. The landscape pattern changes towards the Rennick Graben further east where the morphology of the Morozumi Range is dominated by up to ∼2000 m high, moder-

ately weathered glacial erosion terraces and striated ridges. These remnants of early phases of valley downcutting occur a few hundred metres below the summit plateaus and above the present day ice surface. They have experienced denudation of up to $\sim$4000 m since the Oligocene ([1], [2], new fission track data), and have been exposed since the Messinian [3].

In contrast to the Outback Shoulder, the morphology of the Admiralty Block is much more controlled by channelled ice flow. The major part of the Admiralty Block shows a high-Alpine topography characterised by arêtes, horns and glacial troughs. The highest peaks reach elevations in excess of 4000 m, and the maximum relief between summits and glacier valley bottoms may be in the same order. The rates and amounts of Cenozoic denudation vary considerably within the Admiralty Block, but commonly exceed 80 m/My, and 5000 m, respectively [1]. Cosmogenic isotope data indicate surface exposition since the Late Pliocene [3].

The evolution of such diverse morphology across northern Victoria Land cannot be explained by means of a singular mechanism. Instead, the landscape is shaped by multiple effects of tectonic, climatic, and lithological factors. These factors incorporate the episodic tectonism of the Cenozoic West Antarctic Rift System triggering the uplift of the Transantarctic Mountains; the isostatic response of the hinterland to this uplift; the permanent glaciation of Antarctica since the Olicocene, including the production of protective ice sheets in the west (Outback Shoulder) and erosive glacial drainage systems in the east (Admiralty Block); glacial isostasy; and rheological and lithological differences of the upper crust.

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