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METEOROLOGICAL CONTROLS ON AEOLIAN PROCESSES AND DUNE MORPHOLOGY IN A POLAR DESERT: VICTORIA VALLEY, ANTARCTICA

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Aeolian sand transport studies in cold climates are few and largely qualitative. While desert dunes and aeolian processes in warm climates are well documented, little attention has been given to their cold climate counterparts. The hyper-arid, polar desert of Victoria Valley, McMurdo Dry Valleys contains an abundance of aeolian deposits, the largest in Antarctica, providing a unique setting in which to study cold climate aeolian processes and dune morphology. The Victoria Valley dune field, at the confluence of the Packard and Victoria Valleys has been the focus of several studies during the 1960's and 70's which provided detailed observations of the morphology and structure of the niveo-aeolian deposits, but the connections between aeolian processes and dune morphology remain unclear.

This research presents results from a detailed field study of a polar barchan dune made during summer conditions of contrasting thermally-driven easterly airflow and topographically modified foehn southwesterly airflow. Aeolian sand transport monitored by sand traps and a Sensit™ was shown to be supply-limited, responding to surficial and atmospheric variables specific to cold climates. Despite 24-hour solar insolation at this latitude during summer, sand flux in the dune field displayed a diurnal pattern under the thermally-driven easterly wind regime. This can be attributed to, 1) inter-particle cohesion (ice bonding) at low surface temperatures during the early morning when the valley floor was shaded, and 2) reduced frequency and intensity of transport capacity winds by 'night' due to weakening of the along valley thermally induced pressure gradient. A period of warm, dry and gusty foehn southwesterly winds promoted aeolian processes by destabilising additional surface sediments, with dune morphology responding rapidly to atmospheric conditions. However due to subsequent wind direction reversal, net dune movement was minimal. A conceptual model is presented which links synoptic and local scale atmospheric processes to observed aeolian transport and dune geomorphology in the Victoria Valley dune field.