Rapid soil accumulation in a frozen landscape

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The only place on Earth where climate conditions and sedimentation processes are remotely comparable to those on Mars are the high elevation regions of the McMurdo Dry Valleys, Antarctica [1]. In particular, central Beacon Valley preserves a pristine landscape where potentially little has changed over the last few million of years. The most prominent feature found in Beacon Valley are large polygon structures, which are roughly 15 m in diameter and have a relief of 1-3 m. A highly cited model for the development of the polygon structures argues that in central Beacon Valley the underlying ice controls their shape and the locations where new cracks between polygons form and deactivate over time [2]. However, in lower Beacon Valley, Sletten et al., (2003) [3] reported polygon crack growth of 1 mm yr-1 over the past 40 years indicating that even in a single valley, the formation and deactivation of polygons is poorly understood. Here we report a detailed cross section of a polygon, make several depth-profiles of meteoric ^{10}Be along this cross section and use optically stimulated luminescence (OSL) to date a few key samples at the center of this polygon. While confirming conclusions of previous studies that the polygon shoulders are stable on a 100 kyr timescale and experience little vertical sediment mixing, our results also give clear evidence of eolian transport to the polygon center leading to a sediment accumulation rate of 3 cm kyr-1 over the last 15 kyr. Moreover, the data suggest that the accumulated material is locally derived and, hence, surface erosion of the polygon shoulders must exist that cannot be recorded by meteoric ^{10}Be. We conclude that polygon modification and soil accumulation under the apparent frozen conditions of Beacon Valley is an active and on-going process.

[1] D. R. Marchant *et al* (2010) in *Life in Antarctic Deserts and Other Cold Dry Environments: Astrobiological Analogs*, 9–77. [2] D. R. Marchant et al. (2002) *GSA Bulletin* **114**, 718–730. [3] R. Sletten *et al* (2003) *J. Geophys. Res.* **108**, 8044.