Contribution ID: **127** Contribution code: **ACI-8** Type: **Oral Presentation**

Constraining erosion rates and landscape evolution with in-situ 10Be and 26Al cosmogenic nuclides at Table Mountain, Antarctica

Wednesday, 23 October 2024 13:30 (20 minutes)

Surface weathering and permafrost exhumation rates in the Transantarctic Mountains are important for understanding landscape evolution, determining onset of persistent polar climate conditions, and refining East Antarctic Ice Sheet response to past climate perturbations. We report cosmogenic 10Be and 26Al in bedrock, erratics, a 3m permafrost depth-profile and cobbles embedded within Sirius Group sediments at Table Mountain, McMurdo Dry Valleys, to quantify apparent erosion rates at high elevation, hyper-arid polar landscapes. Including recalculated 10Be and 26Al concentrations from Table Mountain (Ivy-Ochs et al., 1995), Beacon sandstone bedrock, adjacent to Sirius Group sediments, give apparent erosion rates ranging from 0.04 –0.39 m/Myr (average=0.17±0.12; n=11) that on average are ˜5 times lower than 10Be-based cobble erosion rates, 0.16 –2.7 m/Myr (average=0.85±0.82; n=7), embedded within the Sirius Group surface. 26Al/10Be ratios show a negligible bedrock or cobble burial history. Assuming secular equilibrium conditions for exposed bedrock, the larger cobble erosion rate and spread suggests that emergence of Sirius Group cobbles has been an ongoing process for at least the past few millions years –after exhumation they experience increased production allowing a larger 10Be inventory until steady state commensurate with surface production. Equivalent minimum (zero-erosion) exposure ages are much younger than their inferred Miocene depositional age derived from stratigraphic correlations and noble gas exposure ages, leading to data interpretation as maximum erosion rate. 10Be and 26Al depth profiles show distinct exponential attenuation, suggesting no vertical mixing or post-depositional disturbance of Sirius Group permafrost. Depth profile modelling, interpreted within erosional steady state conditions, results in a best fit surface exhumation rate of 0.53±0.13 m/Myr, and zero inheritance. In contrast, Sirius Group denudation at Table Mountain based on geochemical profiling meteoric 10Be diffusion (Dickinson et al., 2012) is an order of magnitude lower than results from our in-situ 10Be permafrost profile.

Student Submission

No

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Session Classification: Applications of Cosmogenic Isotopes

Track Classification: Applications of Cosmogenic Isotopes