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A tale of two plutons: Compositional control on weathering, erosion, and landscape morphology

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While lithological differences are well known to affect the morphology of landscapes, less is understood about how subtle differences in the composition of granitoid bedrock may affect weathering, erosion, and landscape evolution. Here, we investigate a landscape in the semi-arid Coastal Cordillera of Central Chile, whose bedrock is made up of two plutons of differing composition; a monzogranite and a diorite/gabbro. The landscape underlain by the diorite/gabbro appears to consist of taller hills and a lower drainage density compared to the landscape underlain by the monzogranite, which appears to be characterized by smaller hills and a higher drainage density. We hypothesize that the contrast in landscape morphology is related to differential weathering rates, due to the mineralogical compositions of the underlying bedrock. Most importantly, differences in feldspar composition can affect dissolution rates as potassium-rich feldspars are less weatherable than calcium- and sodium-rich feldspars. To test our hypothesis, we obtained the major oxide composition of the bedrock using X-Ray Fluorescence and measured in situ cosmogenic ¹⁰Be to obtain denudation rates of bedrock and soils. We also measured surficial sediment grain sizes, and conducted topographic analysis of the landscape using a 1-m resolution digital elevation model (DEM). Preliminary results suggest that the surface sediments of the monzogranite have – on average – a smaller grain size, and the chemical composition of the bedrock shows higher levels of SiO₂ and K₂O, and lower levels of Na₂O and CaO, compared to the gabbro/diorite. DEM analysis supports our field impression and indicates significant differences in drainage density between the two plutons. In addition, ¹⁰Be results so far suggest similar erosion rates between the two plutons. We plan to further investigate the mineralogy using thin sections obtained from bedrock outcrops and obtain more field measurements.