PATTERNS OF WEATHERING IN SEDIMENTARY BEDROCK ACROSS A SEQUENCE OF REPEATING RIDGES AND VALLEYS

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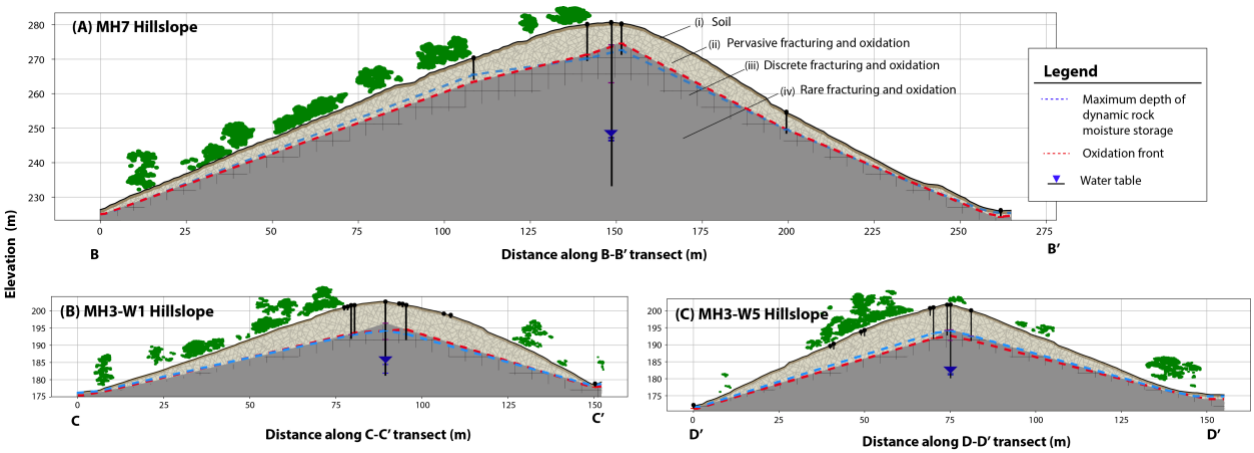
ABSTRACT

Bedrock weathering plays a fundamental role in solubilizing nutrients and converting bedrock to soil, and thus altering the capacity of a landscape to store water for ecosystems. Compared to the mobile soil layer, little is known about the structure of bedrock weathering profiles across hillslopes and the extent to which observations from one hillslope can be scaled to represent other hillslopes of similar topographic form. Here, we compare patterns of bedrock weathering and water storage across a sequence of repeating ridges and valleys in the upturned sedimentary Great Valley Sequence of the eastern Northern California Coast Range. Deep drilling, downhole logging, and analysis of recovered samples reveal an upslope thickening weathering profile. Within channels that bound hillslopes, bedrock cores are relatively unweathered within centimeters of the ground surface, while at the ridges, evidence of weathering extends to 10 m below the surface for the two hillslopes with 25 m relief, and 18 m for the 50 m relief hillslope. Relative to fresh bedrock, matrix chips near the top of the weathered profile at the ridges has experienced a porosity gain of roughly 10% and a chemical denudation mass loss of 5 - 10 %. Our observations reveal a pervasively weathered and fractured layer, which coincides with the mineral weathering front and is accompanied by unsaturated dynamic water storage. Hillslopes sharing the same lithology, vegetation, climate, and tectonic history seem to also share similar patterns of bedrock weathering at the hillslope scale. Our data provide constraints on the mechanisms that couple the evolution of the land surface and the propagation of weathering fronts.



This figure is a summary of patterns of weathering and water storage across study hillslopes, namely MH7 (A), MH3-W1 (B) and MH3-W5 (C). The dashed lines are interpolated depths between direct observations made at boreholes. Four layers are identified based on the extent of fracturing and oxidation.

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