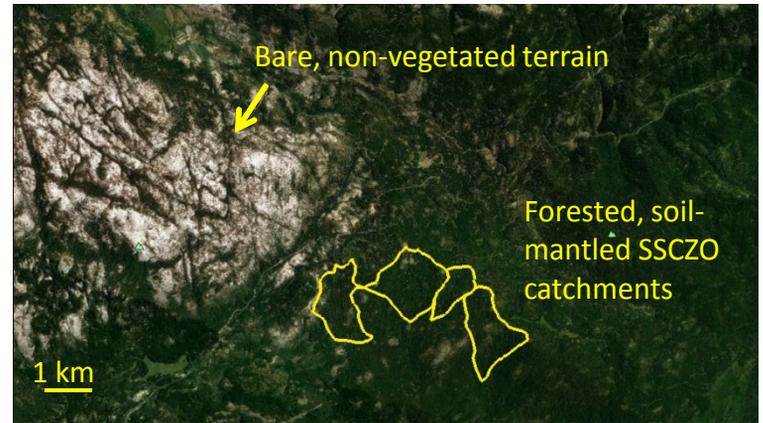


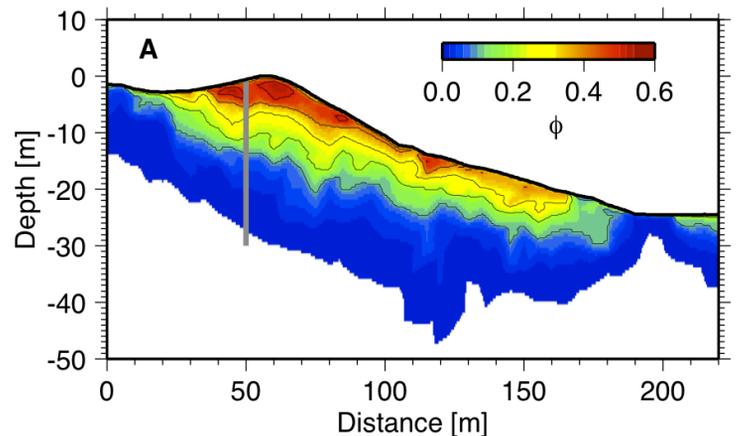
**Research question.** One research theme at the Southern Sierra Critical Zone Observatory (SSCZO) addressed how topographic variability, moisture, weathering and soil formation control the thickness and development of regolith. The landscape is starkly dichotomous, with densely canopied forests immediately next to vast patches of exposed bedrock with little or no soil or forest cover. What drives such sharp contrasts in weathering and thus soil formation?

**Landscape evolution.** Cosmogenic nuclides show that this question matters, because bare areas are eroding much slower than soil-covered areas. Thus landscape evolution is strongly influenced by the presence/absence of soil; when soil is absent, erosion is apparently limited by the rate of bedrock weathering, which is slow, because bedrock tends to stay dry. This data adds fresh quantitative insight into the still-vigorous century-old debate about landscape evolution in the Sierra Nevada. However it leaves open the fundamental question of why the bare areas are bare.

**Vegetation and regolith.** Differences in bedrock geochemistry provide the most plausible answer, based on our analysis. Specifically, the plant-essential nutrient phosphorus (P) varies markedly in concentration in bedrock. It changes abruptly at contacts between different rock types, where forests often give way to expanses of exposed bedrock. This suggests that bedrock P may provoke an intrinsic nutrient limitation on ecosystems. By influencing soil cover, bedrock P may also provoke an intrinsic weathering limitation on landscape evolution.



**Cross-disciplinary perspectives.** One of the more exciting areas of cross-disciplinary research at the SSCZO lies in our efforts to understand regolith formation. There are some potentially strong, biotically mediated feedbacks, which have exciting implications for understanding a wide range of surface processes. Regolith formation both depends on and influences the amounts and types of vegetation that become established on the landscape. For example, climate and hydrology exert direct controls on regolith formation and thus on vegetation type, density and activity. Meanwhile, vegetation distribution, density and physiology influence regolith development, and water and element balances. Recognizing and studying these feedbacks was enabled through a sustained team effort, through the coupling of diverse perspectives from geophysics, hydrology, biogeochemistry, ecology and geomorphology.



On slopes where soil is present, geophysical surveys show evidence of weathering and thus water storage potential (shown here) 10-30 m below the surface at the SSCZO. Together with erosion rates from cosmogenic nuclides, this indicates regolith residence times of  $10^5$ - $10^6$  years. This time frame implies that we will ultimately need to consider the influence of Pleistocene climate variability to fully understand the current depth and development of regolith.