Sonoma Volcanics, their weathering products and landslide susceptibility

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Background

As the Sonoma region becomes more population dense, expansion into the more mountainous areas becomes necessary and understanding variables controlling landslides becomes a matter of public safety.

We evaluated recent landslide scars and steep slopes to determine how slope stability correlated with (1) rock type, (2) degree of alteration, and (3) degree of vegetation. Samples were collected at the Fairfield-Osborn Preserve, which is mapped as mafic Sonoma volcanics and landslide deposits. The preserve is fitting for this study due to its extreme variation in topography.

Observations to Make for Each Site

Slope (>30°)
Lithology
Systematic Weathering Patterns
Vegetation

Methods

Sample collection

Sample sites were chosen based on slope profile and within the confines of the Fairfield Osborn Preserve. Areas on the map in light blue, indication slopes of greater than 30 degrees were selected as these would be the most likely to fail during a landslide event.

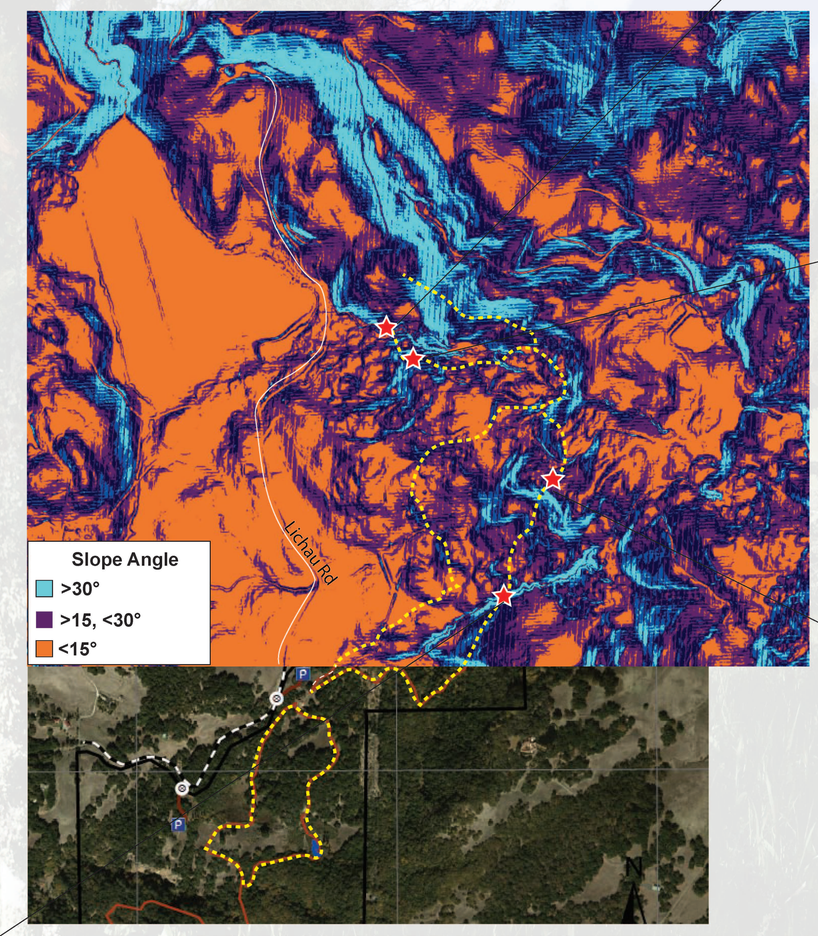
A site of a recent landslide was also selected, as this location would provide a end-member for comparison.

Preparation of thin sections

Rock samples were cut down to a billet size block on a rock saw and polished on one surface to fit onto a microscope slide. These billets were then mounted to the slide with epoxy and allowed to harden. The last step in this procedure was to cut the billet down to a standard thickness of 30 microns to allow light to pass through it.

Results

Map showing slope angles in Fairfield Osborn Preserve



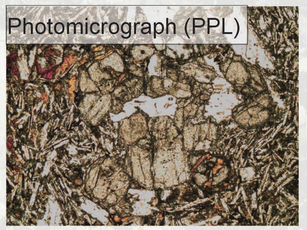
Sample 2: 18FOPZ002 (Landslide Scarp)
Weathered Tuff - Volcaniclastics

The steepest and most unstable of the sites sampled, this weathered tuff became exposed by recent landslide activity.

The whole exposed scarp consisted of lapilli ash tuff and various layers of weathered volcaniclastic material. This loose, relatively unconsolidated material offered little structural support to the hillside.

Sample 3: 18FOPZ003 (Stable Slope)
Large Blocky Lava (Basalt); (Rubble, possible landslide desposit); Grassy, Single large tree

Found on a relatively steep slope near tuff deposits, this basalt was more developed mineralogically than rock sampled at site 1. Containing phenocrysts of olivine and plagioclase this basalt lacked any flow direction indicators in its plagioclase groundmass.



Sample 1: 18FOPZ001 (Stable Slope)
Large Blocky Lava
(Rubble, possible landslide desposit)
Grassy, Tree roots

This basalt, composed of almost entirely of equigranular plagioclase feldspar showed trachyic growth, indicating past lava flow direction.

Found in a relatively stable environment with respect to slope, this basalt showed minimal weathering of mineral components.

Sample 4: 18FOPZ004 (Stable Slope)
Exposed outcrop in streambed
Large Blocky Lava (Basalt)
Lava flow showing layers
Vertical offsets and planes

This outcrop, found in a small streambed consisting of a highly weathered basalt showed significant growth of iddingsite, an alteration mineral formed from the decomposition of olivine. Groundmass consisted largely of volcanic glass along with small amounts of plagioclase. While significantly weathered, this outcrop appeared to be as stable as un-weathered basalts.

Conclusions

It was found that composition of material, rather than the weathering effects observed on minerals, played a key role in land stability of the Sonoma Volcanics.

Basalts were found to be relatively stable even when weathered into alteration products. Volcaniclastic tuff deposits however were unstable in all but the gentlest of slopes.

These results conclude that for future human development of the Sonoma Volcanics, areas with large tuff deposits should be avoided when planning building projects.