

Geologic Controls for Landslides in the Central American Highlands in Northern El Salvador

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El Salvador is subject to many natural hazards such as volcanic eruptions, earthquakes, and hurricanes. One of the results from hurricanes and earthquakes are landslides. Most of the destructive landslides in El Salvador are located near the ocean along the chain of volcanoes and occur in younger deposits. Due to their experiences with earthquakes and landslides, the people of El Salvador are aware of the risks of landslides. Consequently, the government has established an organization named the Servicio Nacional de Estudios Territoriales (SNET) to monitor seismic events and to investigate landslides and the risk they pose for the residents. The majority of their work, though, is concentrated in the region of volcanic activity; mostly in the coastal regions of the country. The northern more mountainous regions of the country have not been investigated to any great extent although it contains some of the country's largest landslides. SNET has requested that a study in the northern mountains be conducted to better understand the potential for large scale landslides that might affect population centers.

The surface geology consists of volcanic ash deposits both welded and non-welded underlain by volcanic rock mostly of acidic composition. Due to the large lateral extent of the ash deposits, however, the bedrock geology is not well understood. Being in a tropical environment the surface layers have weathered into residual soils. What is striking about the residual soils is that they remain at very steep angles. Slope angles, drainage morphology, and regional geomorphology of the mountains are controlled by the tectonic stresses from the plate movements between the Cocos, North American, and Caribbean Plates. A key factor in the stability of the residual soils is that they possess higher strength than traditional weathered soils. This strength has been attributed to the presence of allophane, imogolite, and halloysite, weathering products from the volcanic ash. An infinite slope model was performed for residual soils overlaying bedrock indicating that, while the increased strength is important, an additional factor in their stability is the buttressing effect of the blanketing ash deposits. In many terrains where the infinite slope model is used, the slopes have been formed by erosion or the cutting down of the valleys and through many of the geologic layers. Once erosion occurs, leaving exposed surface layers, such as residual soils, shallow landslides occur.

Therefore in order to have deeper translational landslides, the blanketing of a younger ash deposit, which eventually weathers to a residual soil, over a paleo-rock surfaces must support the ash deposits and act as a support mechanism until erosion cuts through the soil. In general, it was found that the potential for large landslides in northern El Salvador that could affect population centers is relatively low. What is apparent, though, is that due to its steep topography and high rainfall the area is susceptible to smaller landslides, especially roads and highways that have altered the slopes and drainages.