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6. DEBRIS SLIDES AND DEBRIS FLOWS ON ANAKEESTA RIDGE, GREAT SMOKY MOUNTAINS NATIONAL PARK, TENNESSEE

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Five major and four minor avalanche chutes (Ryan and Clark, 1986) are located on Anakeesta Ridge in the Great Smoky Mountains National Park, Tennessee (fig. 6.1). Anakeesta Ridge is an east-west-trending mountain, 4.5 km² in map area. Summit elevation range is 1,200 to 1,800 m. The ridge is bounded to the north by the second-order, dendritically patterned Alum Cave Creek. To the south is the third-order Walker Camp Prong, closely paralleled by heavily traveled U.S. Highway 441. The underlying Anakeesta Formation includes a variety of rock types (Hadley and Goldsmith, 1963): arkosic pebble conglomerate, graywacke, feldspathic sandstone, chloritoid slate and argillite, carbonaceous slate, and phyllite. Iron sulfide occurs throughout the rock along bedding and cleavage in the form of pyrite. Along joints, bedding, and cleavage, iron sulfide occurs as limonite and goethite.

In August 1984, a debris slide temporarily closed U.S. Highway 441. There is widespread concern that slides will occur in the future, so there is a need for locational and temporal predictors (Clark, 1984a, b). Useful indicators include morphology, drainage, vegetation, tension cracks in vegetation mat, root throw sites, and geologic structure. Present slide scars are useful in providing failure geometry and sites for estimation of debris volume.

Debris slide analysis involves the application of rock and soil mechanics. Abundant bedding, joint, and

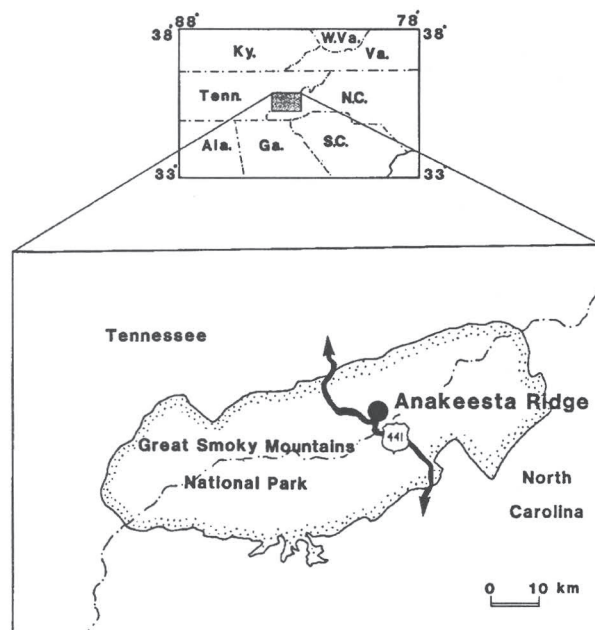


Figure 6.1. Location map showing the Great Smoky Mountains National Park and Anakeesta Ridge.

cleavage discontinuities are available as failure planes and release surfaces along Anakeesta Ridge. Chute morphology along Anakeesta Ridge is characterized by wedge failure planes along the flow track and a combination of circular, planar, and wedge failure planes in the upper slide scar area. Unstable hanging blocks are located in the slide scar. This geometry indicates that limiting-equilibrium analyses may be utilized to assess slope stability. Factors of safety can be determined with

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planar and wedge geometries using the methods of limiting equilibrium outlined by Hoek and Bray (1981). Data required include slope and plane/wedge geometry, internal material friction angle(s), and discontinuity cohesion values. The factor of safety is not greatly influenced over the expected range of internal friction angle (Kane and Drumm, 1986), so determination of discontinuity cohesion is necessary. These values can be computed from the results of direct shear tests involving joint, cleavage, and bedding planes. Use of the STABL slope stability PC program as outlined by Lovell and Thomaz (1986) will enable a variety of failure surfaces to be evaluated.

As the area annually receives 200 to 240 cm of precipitation (McMaster and Hubbard, 1970), the prime triggering mechanism for debris mobilization may be pore pressure increases following high precipitation (Ryan and Clark, 1986). Such moisture may result from a season of above-normal precipitation or from a single major precipitation event, such as an intense low-pressure cell, a thunderstorm, or a hurricane. Bogucki (1970) noted that intense summer rainstorms are the major cause of debris slides in the Appalachian Highlands. As rain gages in the area are not continuously recording, specific temporal information is lacking.

Scar head and scar flank wastage stations are positioned on the ridge to monitor soil and vegetational mat stability. Backwasting of soil and vegetational mats continues at the scar heads; as of October 1986, the single largest loss has been 12.5 cm for a 4.3-cm 2-day rainfall. Some scar heads have breached the ridge crest; this situation is generally found in association with tree throw. As opposed to continuing scar head wastage, the chute flanks are more stable, as indicated by undisturbed vegetation growth.

In the park, areal extent of the Anakeesta Formation along the Tennessee/North Carolina border is approximately 155 km². On a regional scale in the Blue Ridge province, the following groups and formations have been mapped on a scale of 1:500,000 as 'sulfidic' slate (North Carolina Geological Survey, 1985): the Great Smoky Group, the Boyd Gap Formation, and the Wehuty Formation. These mapping units represent a large package of pyritiferous rock. If instability on Anakeesta Ridge is related to lithology, then mass movements in as-yet unmonitored areas may be occurring elsewhere within the park, and possibly, also on the regional scale.

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