Geomorphology of the Colockum Pass Area
Kittitas County, Washington

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Geologic Setting

The Colockum Pass area lies at the southeastern end of the Wenatchee Mountain range. East and southeast of Table Mountain and Mission Ridge the mountain range consists of Columbia River Basalt arched into a broad anticline. The axis of the anticline runs approximately northwest-southeast and forms a major geographic separation of the Wenatchee and Ellensburg Valleys.

The Columbia River Basalt is Miocene in age and overlies the Cretaceous to early Tertiary Wenatchee and Swauk Formations. The Wenatchee and Swauk Formations largely consist of beds of sandstone, siltstone and carbonaceous shale. The Swauk overlies Mesozoic granitic rocks in the upper reaches of the Squilchuck River drainage.

East of Naneum Canyon, virtually all exposed rocks are varieties of basalt flows. The basalts are all chemically similar but different flows exhibit many distinctive physical characteristics. These include columnar jointing, irregular jointing, platelike jointing, flow-brecciation, pillows, and palagonite. In addition, thin sedimentary interbeds occur between some basalt flows.

Physiography

The broad anticlinal structure imparted to the rocks by tectonic forces is largely intact today as a topographic feature southeast of Mission Ridge and Naneum Ridge. That is, there exists an anticlinal ridge or arch that has not been completely breached by erosion. Only the youngest rocks, the basalt flows, are exposed, and the land surface in many places coincides with the upper surface of these flows.

The undissected surface of the basalt flows forms smooth, broad surfaces that are either flat or gently sloping. They largely reflect the dip of the basalt flows. Therefore the flatter slopes lie along the central or axial portion of the anticlinal ridge, whereas steeper but evenly sloping surfaces extend down the sides of the anticlinal ridge toward Wenatchee, the Columbia River, and Ellensburg.

Erosion has dissected the flanks of the arched basalt forming many valleys. In most cases the divides between valleys are still relatively flat, indicating that the arching is quite young. Many valleys are essentially equal in develop-

ment, but significant differences occur. For example, Naneum Canyon, Squilchuck and Stimilt drainages are more developed than others; that is, deeper and wider.

Landforms resulting from mass-wasting processes occur on valley sides. These landforms consist of talus slopes, a variety of landslide masses, and shallow, lobe-shaped features that may be indicative of soil flowage. The landslides appear to be of basically two types: slumping of basalt flows along steep valley sides, and slumps within talus and landslide debris.

Erosion

Erosion within this area has occurred through gullying (headward erosion of streams), downcutting, and mass wasting along valley sides. The basalts are prone to mass-wasting processes because of their jointed character, physical differences between flows, the differential movement of ground water within the basalts, and occasional beds of sediments between flows. Under very dry conditions, valley sides formed in basalt flows consists of talus slopes at the base, which project up to a nearly vertical basalt cliff. As the valley widens, the cliff will eventually be covered by the talus.

Under wet conditions, differential ground-water movements within the basalt flows act to generate large landslides along valley sides. Landsliding is more prevalent where sedimentary rocks are interbedded with or underlie the basalts. Valley widening through this process continues until the flat-topped divide has been completely destroyed. Of course, sliding of unstable mass-wasting debris will continue until equilibrium is achieved between the slope of the valley sides and the hydrologic conditions.

The Colockum Pass area is intermediate with respect to dry-mass wasting and wet-mass wasting. Furthermore, variation exists within the area itself.

In general, it seems that wetter conditions prevailed during some ancient time (perhaps neoglaciation, 3000 or so years ago) during which large-scale slumping occurred within basalt flows (sometimes measured in hundreds of acres). Subsequently, climate has been drier, and the development of talus slopes is more prevalent. But even today, talus debris and old landslide deposits can be unstable. There is evidence of the present occurrence of smaller scale slumping of debris slopes.

During ancient and modern times, landsliding has been more prevalent on northerly facing slopes. This is probably because of greater snowpack and therefore greater soil saturation and ground-water recharge during the spring.

Because of the coincidence of snowpack, rainfall and freeze-thaw temperature variations, mass wasting is most active but, in some places, only active during the spring.

Evidence of soil flowage exists where there is a combination of high elevations, north aspects, no trees, and relatively steep valley sides. This is in the form of shallow (approximately one meter thick) lobate masses that extend downslope a few tens of meters from a small escarpment. To determine whether this is true solifluction (flowage due to freeze-thaw of saturated ground) would require detailed study. Conversely, the flowage may be a form of earth flow; that is, flowage of saturated colluvial soils. It probably only occurs during the spring.

Conslusions Applicable to Forest Management Operability

I consider large slumping of basalt flows along valley sides to be no longer an active process in the Colockum Pass area. Precipitation does not seem to have been great enough in the recent past to generate the large slumps in basalt. However, an uncommonly wet year or series of years could reactivate large-scale, deep-seated landsliding.

Smaller scale landsliding is active today. It is restricted to slumping of talus debris slopes and old landslide deposits, especially along the toes of old landslide masses. Today, individual active landslides may cover up to a few tens of acres.

Soil flowage has occurred in the recent past and may occur every year to some extent, but is very restricted to certain high elevation, north-facing, treeless, relatively steep colluvial soils.

All of the mass-wasting processes are most active in the spring, less so in late autumn and winter and essentially nonexistent during the summer and early autumn.

Recommendations for further study

The mass-wasting features should be observed during other seasons, especially spring, in order to confirm some of the above conclusions.

The soil characteristics may provide clues to the reality of wetter conditions that possibly existed sometime in the past.

An analysis of clay mineralogy may provide insight to the potential for soil flowage under particularly wet conditions.