WASTING AWAY: MASS MOVEMENT IN THE ALBION RANGE, IDAHO

ALICE JOSEPHINE LETCHER
Whitman College, Walla Walla
Sponsor: Robert Carson

INTRODUCTION

Approximately 24 km^2 of the sides of Mount Harrison and adjacent Connor Ridge are scarred by ten ancient landslides. The slides are characterized by steep concave scarps, hummocky ground, springs, local block fields, and, on Mount Harrison, sag ponds. Headwall scarps exist mainly between elevations of 2350 and 2550 m, with debris toes extending as far as 2 km downslope. Most of the landslides have southerly aspects. There are minor areas of reactivated mass wasting on three of the large landslides.

Nine of the ten landslides included in this study occur on Connor Ridge, which is the topographic expression of the Big Bertha mantled gneiss dome. These landslides occur along dipslopes of approximately 25º within an unnamed bed of schist which forms the boundary between the Archean metasedimentary Green Creek Complex and the overlying Proterozoic Elba Quartzite. The landslides are primarily found on southerly slopes but are also present to a lesser degree on north-facing slopes. The landslides on Big Bertha Dome have similar morphologies: based on hummock height, the deposits have a minimum thickness of between 7 and 40 m; the scarp areas are generally small compared to deposit areas, and the deposits do not reach far beyond the foot of the dome. Their thickness and limited extent suggests that movement was slow and viscous. The slide deposits are tentatively divided into three relative ages, based on surface morphology.

The landslide complex on the south side of Mount Harrison differs greatly from the slides found on Big Bertha Dome. This complex has headwall scarps originating near the probable lower limit of Pinedale glaciation. Slides initiated on slopes of approximately 22º. Part of the mass wasting debris is likely Bull Lake and/or Pinedale drift. Multiple landslide lobes extend far down drainages. The deposits are estimated to be several to a few tens of meters thick. Their extent and apparent thickness suggest a more fluid regime than on Big Bertha Dome.

GEOLOGIC SETTING

The Albion Mountains of Idaho are a steep block-faulted range lying within the hinterland of the Sevier orogenic belt (Miller, 1980). The range is the northern continuation of the metamorphic core complex exposed in the Raft River and Grouse Creek Mountains of Utah. Within the Albion Range are four mantled gneiss domes: Independence Lakes Dome, City of Rocks Dome, Moulton Dome, and Big Bertha Dome. The last of these comprises the primary study area of this investigation. Armstrong (1968) found that the domes are cored by Archean granites and granitic gneisses, and mantled with Proterozoic and Paleozoic metasediments.

Regional deformation took place throughout the Mesozoic and Cenozoic, locally metamorphosing strata to the amphibolite facies (Miller, 1980). Miller (1978) suggests that doming occurred in the Pliocene, although there is some evidence that it was coeval with the 28 Ma emplacement of the Almo Pluton.

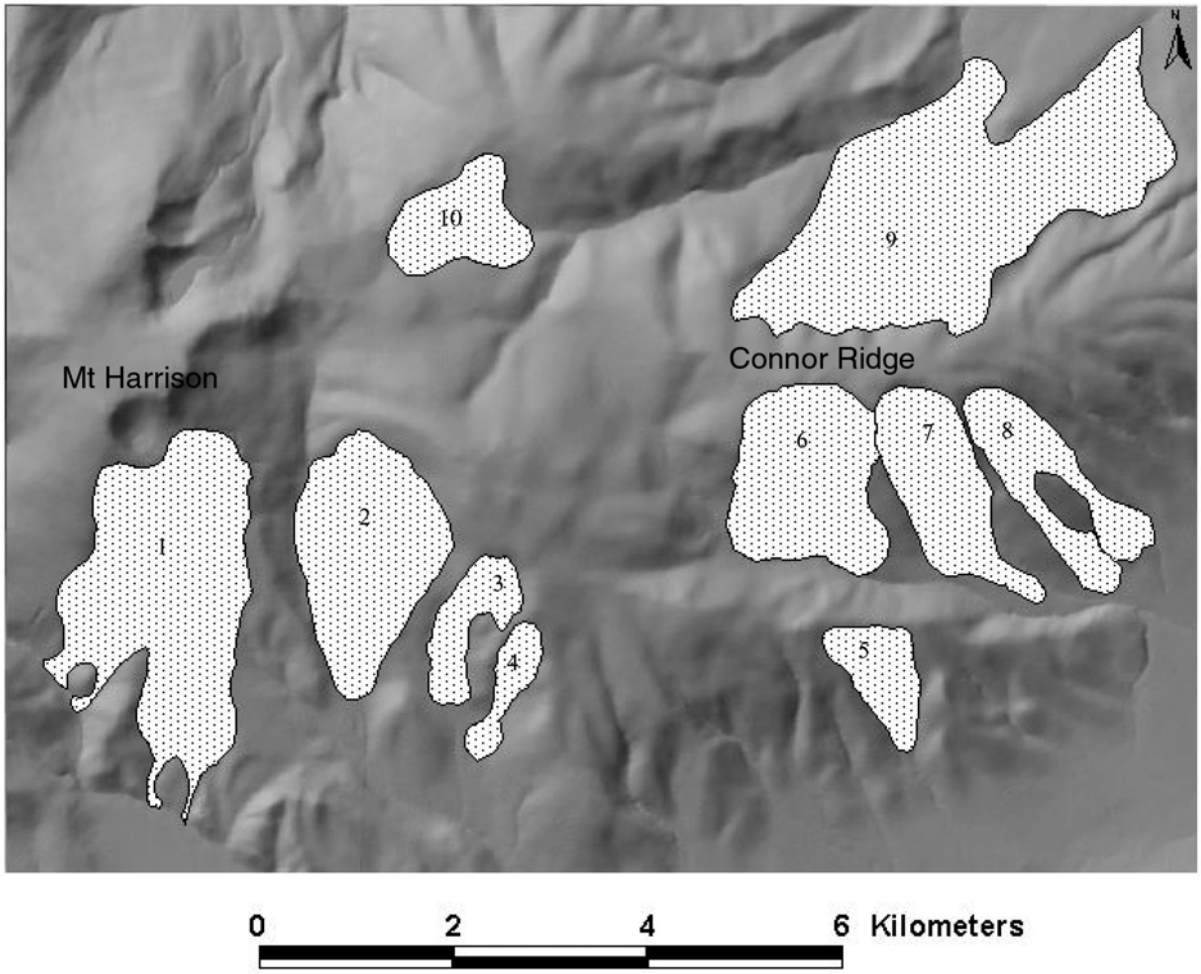

Figure 1. Distribution and extent of landslides on Mount Harrison and Connor Ridge. The landslides are 1. Mount Harrison, 2. Pomerelle, 3. Granite, 4. Packrat, 5. Kemp Hollow, 6 West, 7. Middle, and 8. East Connor Ridge, 9. North, 10. Thomas Flat.

STRATIGRAPHY

The study area is divided into three stratigraphic units (Miller, 1987): the Precambrian metamorphic-igneous basement rock, the Archean Green Creek Complex (GCC), and a thick sequence of Proterozoic and Paleozoic metasediments. The last of these units consists mainly of the Elba Quartzite, with minor amounts of schists and carbonates. Above it are several thousand meters of interlayered Cambrian or Ordovician quartzites, schists, and marbles (Miller, 1980).

The top unit in the GCC, immediately below the Elba Quartzite, is a distinctly foliated unnamed biotite-muscovite schist. Miller (1980) found it to be unconformable with the underlying gneiss. The schist is much younger than is the gneiss (Armstrong and Hills, 1967), and may represent a paleosol which formed on the eroded surface of the GCC. The thickness of schist outcrops in the study area is a few to tens of meters.

Only preliminary studies have been made of Mount Harrison (Anderson, 1931; Armstrong, 1968). Its known stratigraphy consists of Paleozoic metasediments, including the Connor Creek Formation and the Harrison Summit Quartzite. The latter exists only on Mount Harrison (Armstrong, 1968). The strata have a uniformly shallow northward dip.

DISCUSSION

The nine landslides on or near Big Bertha Dome moved slowly. Deposits are a few to tens of meters thick, consisting of numerous well-defined hummocks. All the slides but North Slide took place on southerly slopes, indicating that aspect may play a role in slide distribution. Major fractures in Big Bertha Dome may have influenced where specific landslides occurred. Fractures and benches

parallel to headwall scarps hint at continued movement.

The Big Bertha Dome slides are tentatively divided into three relative ages: Packrat, West Connor Ridge, and North Slide are believed to be the oldest slides. This conclusion is based on the subdued topography of the slides, as well as deep (5 cm) weathering pits found in exposures of the Precambrian basement complex in Packrat and West Connor Slide. Granite, Pomerelle, Kemp Hollow, Thomas Flat, and part of Middle Connor Slide are assigned an intermediate age. Hummocks in these slide deposits are more distinct than in the older deposits, and stream incision along the deposit edges is shallower than on Packrat, West Conner Ridge, and North Slide. East Connor Ridge and part of Middle Connor Ridge Slides are interpreted to be the youngest. These slide deposits have the most well defined hummocks of all, and the least stream incision along deposit edges. In addition, the younger portion of Middle Connor Ridge slide overlaps older deposits.

There is evidence for recent reactivation of the slides on Packrat, East and Middle Connor Ridge Slides. At each of these sites, the reactivation is minor compared with the extent of the original slides. On East and Middle Connor Slides, reactivation consists of small slumps and earth flows with fresh, bare scarps, indicating movement took place within the last several years. Reactivation on Packrat slide took place as a series of small slumps and debris flows near the top of the old slide deposit. Vegetation growth on the scarps and deposits suggests an age of 10-20 years. Additionally, local landowners report that about 10 years ago, a debris flow blocked Cottonwood Creek Road. The debris flow was preceded by a heavy rainstorm.

Fieldwork indicates that structure plays a key role in the distribution and occurrence of landslides on Big Bertha Dome. In all cases movement occurred in strata dipping parallel to topography. Field evidence further suggests that failure occurred within the unnamed schist layer below the Elba Quartzite: in many instances, schist outcrops form dipslopes along which movement occurred.

All of the slides on Big Bertha Dome are interpreted to be post-Pinedale glaciation. Streams have incised well-defined paths along the edges of deposits, but there still exist a few closed depressions on the slide deposits. This combination indicates that the slides occurred too recently for well-integrated drainages to have formed.

The slide complex on Mount Harrison differs distinctly from the slides on Big Bertha Dome. There is no evidence of structural control on Mount Harrison. However, the mountain has been glaciated: Mount Harrison has two prominent cirques, one of which lies directly above the slide complex. Unlike the hummocky, thick deposits on Big Bertha Dome, the Mount Harrison slide resulted in long, apparently thin, tongue-like deposits. In several places, the slide flowed through narrow channels between hills, indicating a more fluid regime than was found on Big Bertha Dome.

A distinctive feature of the Mount Harrison slide complex is the presence of sag and/or beaver ponds on the slide deposits. The ponds exist in lush, marshy areas with numerous small streams and pools. They are or have previously been inhabited by beavers. It is impossible to tell whether the ponds are the result of beaver activity in a naturally wet area, or whether beavers where attracted to pre-existing ponds. Either way, the ponds indicate significant water in the slide deposits. The presence of so much water may suggest an impermeable substrate such as glacial till. In general, the Mount Harrison slide deposits are marked by thick, fairly young growth of alders, willow, and aspen, indicating moist conditions throughout the deposits.

The timing of movement on Mount Harrison may be tentatively determined. The landslide complex exists below a cirque, and has obliterated the Bull Lake and Pinedale moraines which would be associated with that glacier. This suggests that movement occurred after the Pinedale glaciation. However, limited incision by streams and partial filling of depressions on the slide deposits indicates that

mass wasting has not occurred within the past few thousand years.

CONCLUSIONS

Landsliding on Big Bertha Dome took place within an unnamed layer of schist at the top of the Archean Green Creek Complex. Structure is clearly important in the distribution and occurrence of the slides. In all cases, movement occurred on strata dipping parallel to topography. Aspect may also be important: seven of the nine slides took place on southerly slopes. All the slides were found to be slow moving and fairly deep-seated. They can be divided into three relative ages, based on surface features. Exact ages cannot be conclusively determined, but the absence of a well-integrated drainage system suggests the slides are probably post- Pinedale glaciation. Although the specific cause of movement is undetermined, land sliding was probably initiated by rain on snow events following particularly wet winters.

The timing and causes of the Mount Harrison slide complex are more difficult to determine. There are evidently no structural controls on the location of the slide complex. This slide, like most of those on Big Bertha Dome, occurred on a southerly slope, indicating aspect may have had some influence on its movement. The slide complex appears to have formed in loose, Bull Lake and Pinedale morainal material which was saturated by excessive precipitation and flowed down existing drainages. The mass wasting apparently destroyed any Bull Lake and Pinedale moraines that were in its path. This, along with the presence of chaotic drainages suggests that movement post-dates the Pinedale glaciation.

Field data from both Mount Harrison and Big Bertha Dome suggests that the landslides may be tentatively assigned an age of between a few ka to 20 ka. Additionally, it can be assumed that movement took place after the peak of glaciation (20-15 ka), but before the hypsithermal (5-6 ka). This, combined with the evidence cited above, allows the age of the mass wasting to be confined to a period between 5 and 15 ka, with a few areas of more recent, minor reactivation.

REFERENCES CITED

Anderson, A. L., 1931, Geology and mineral resources of eastern Cassia County, Idaho: Idaho Bureau of Mines and Geology Bulletin no. 14, 169 p.

Armstrong, R. L., 1968, Mantled gneiss domes in the Albion Range, southern Idaho: Geological Society of America Bulletin vol. 79, p. 1295-1311.

Armstrong, R. L., and F. A. Hills, 1967, Rb-Sr and K-Ar geochronologic studies of mantled gneiss domes, Albion Range, southern Idaho, USA: Earth and Planetary Science Letters vol. 3, p. 114-124.

Miller, D. M., 1978, Deformation associated with Big Bertha Dome, Albion Mountains, Idaho: PhD Dissertation, University of California Los Angeles, 323 p.

Miller, D. M., 1980, Structural geology of the northern Albion Mountains, south-central Idaho, *in* M. D. Crittenden, P. J. Coney, and G. H. Davis, eds., Cordilleran metamorphic core complexes: Geologic Society of America Memoir 153, p. 399-427.