



Block-field sandstone retaining wall on Passage Creek.

Cover photograph: A block field on the west side of Passage Creek.

For more information:

Visit the USGS Home Page at:
<http://www.usgs.gov>

Visit the Forest Service Home Page at:
<http://www.fs.fed.us/gwjnf>

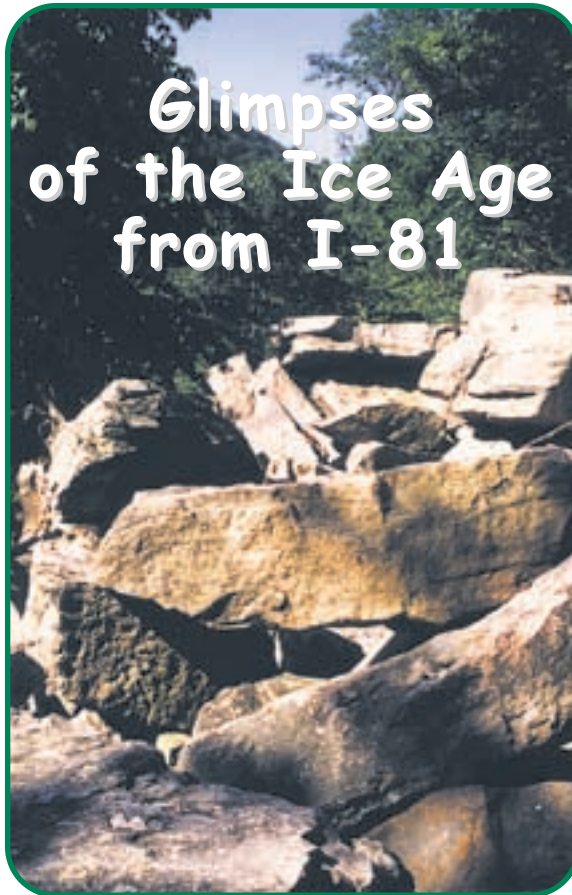
The United States Department of Agriculture (USDA) and Department of Interior (DOI) prohibit discrimination in their programs on the basis of race, color, national origin, sex, religion, age, disability, political beliefs, and marital or familial status. (Not all prohibited bases apply to all programs.)

Persons with disabilities who require alternative means of communication of program information (braille, large print, audiotape, etc.) should contact the USDA's TARGET CENTER at 1-202-720-2600.

To file a complaint, write the Secretary of Agriculture, U.S. Department of Agriculture, Washington, DC 20250, or call:

1-800-245-6340 (voice) or 1-202-720-1127 (TDD).

USDA and DOI are equal employment opportunity employers.



Geologic Wonders of the George Washington and Jefferson National Forests

No. 1 in a series
Lee Ranger District



**U.S. Department of Interior
U.S. Geological Survey**

in cooperation with



**U.S. Department of Agriculture
Forest Service, Southern Region**

Introduction

Travelers on Interstate Highway 81 can see remnants of the Ice Age on the mountains between Strasburg and Harrison-burg, Virginia. Scattered along the miles of green, forested mountains are many gray patches without any forests. These treeless patches, or openings, in the steep mountain forests are block fields -- geo- logic features that owe their origin to the Ice Age.

Block fields-What are they?

Rocks that fall from a cliff and cover the slope below are known as talus. How-ever, in some areas boulders cover a patch of ground high on a mountain without an obvious source of rocks, such as a cliff directly above. These boulder-strewn slopes are known as block fields. Many block fields occur in the Appalachian Mountains. The block fields are usually some distance below outcrops of the hard sandstone that forms the tops of moun-tains. Typically there is a stand of timber between the outcrops and block fields. Some excellent examples can be seen on the slopes of Massanutten Mountain from Interstate Highway 81, between Strasburg and Harrisonburg (fig. 1).

How did block fields get in the middle of a mountain forest?

A clue comes from the fact that block fields are common above tree line on high mountain slopes and in polar regions. Repeated freezing and thawing of water in bedrock fractures gradually wedge rocks apart. Cold climates favor the formation of block fields. The last Ice Age, in the Pleistocene Epoch, began about 2 million years ago and ended about 10,000 years ago. Great sheets of ice, more than a mile thick in some places, moved south from the polar regions to the Ohio River area. Although the ice sheets did not reach Virginia, the resulting change in climate did.



Figure 1. View of block fields from near Interstate 81. (Photographed from Route 646 northeast of Round Hill near Toms Brook.)

During the Ice Age the climate in Virginia was much colder than at the present time, and the tree line was lower on the mountains. The cold, wind-swept upper slopes of mountains had many bare bed-rock slopes. The repeated freezing and thawing split open the bedrock and pried loose a jumble of angular rocks. Some of these rocks from cliffs and steep slopes tumbled down the treeless upper slopes of the mountains to accumulate as talus.

After the Ice Age a warmer climate returned to Virginia. The freezing and thawing action on the mountains was greatly reduced. The tree line raised. With only a small amount of new rock broken off the mountaintop, trees began to grow on the talus. Gradually, over thousands of years, the forest cover was established over most of the talus. As the mountains eroded, block fields moved downs-lope. Trees grew between block fields and the outcrops that were the source of the rocks.

Some bare patches remained. These bare patches are block fields and are the most resistant to natural reforestation. Block fields are composed of huge, often unstable, jagged rocks, some as big as cars. Block fields, such as those seen from Interstate 81, give a glimpse of the Ice Age landscape in the mountains of western Virginia.

How can you tell if the boulders are moving downslope?

Under the modern climate some block fields move downslope in sudden landslides or mass movement triggered by large rainstorms. Other block fields are stable.

How can you tell if the boulders have moved downslope recently? Lichen, a primitive plant, grows very slowly on the surface of boulders. If a boulder is tilted or turned over by movement of the block field, lichens may not grow on its new, upper surface for several decades.

In contrast, if a boulder is completely covered with lichens, the boulder may not have moved for a century or more. Studies show that some block fields on steep slopes have moved within the past century, but that block fields on gentle slopes are generally stable.

Trees may also give evidence of the downslope movement of block fields. Trees growing along side and downslope from block fields can become tilted or scarred as the block field moves downslope. Tree ring analysis of sprouts that grew after tilting, or rings that formed after the tree was scarred, can tell what year a block movement occurred.

Have people used block fields?

Block fields have provided building stone for local residents for centuries. A good example is a retaining wall on Passage Creek, just downstream from the block field (back cover). Another is the Warren County Courthouse, which is made from block-field sandstone (fig. 2).



Figure 2. Block-field sandstone in the Warren County Courthouse, Front Royal, Virginia.

For additional reading:

Hupp, C.R., 1983, *Geo-botanical evidence of Late Quaternary mass wasting in block-field areas of Virginia: Earth Surface Processes and Landforms*, v. 8, John Wiley & Sons, Ltd., p. 439-450.

How to get there.

A series of block fields can be seen from Interstate Highway 81 on Massanutten Mountain to the east and on Great North Mountain to the west. For a closer look, block fields can be seen on both sides of Passage Creek and on the road to Woodstock Tower. Maps and directions follow.

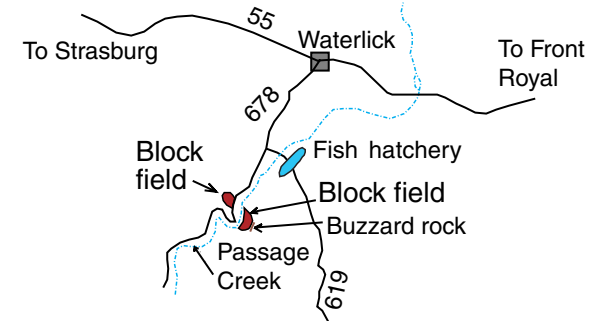
Directions to Passage Creek:

From Strasburg, take Route 55 east from its junction with Route 11 for 5 miles to Waterlick. If you begin in Front Royal, take Route 55 west from its junction with Route 340 for 5.1 miles to Waterlick. At Waterlick, turn onto Route 678 (Fort Valley Road) and go 1.9 miles to a parking area on the right side of the road. Block fields can be seen on the slopes above the parking area and upstream across the creek below Buzzard Rock. Can you distinguish the block-field boulders from those that are talus below the cliffs? Do you see evidence of movement? A retaining wall constructed of block-field sandstone can be seen downstream between the road and Passage Creek.

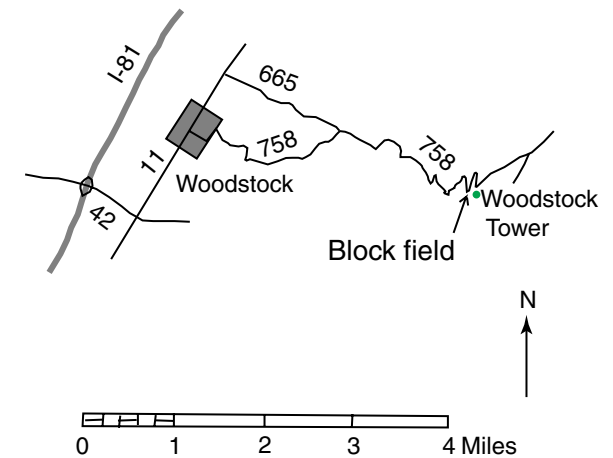
Directions to Woodstock Tower:

From I-81, take the Woodstock exit. Go east on Route 42 for 0.7 mile. Turn left on Route 11. Go 1.7 miles to the intersection with Route 665 (Mill Street). Turn right and go 1.5 miles to a stop sign at the intersection of Route 665 with 758. Turn left onto Route 758 and drive carefully for about 2 miles on the steep road winding up the mountain. Block fields can be seen on the slopes above and below the road. Continue to the Woodstock Tower parking area to turn around. Sandstone forms the resistant ridge beneath the Woodstock Tower and is the material of the block fields.

Passage Creek



Woodstock Tower



Block-field localities on Passage Creek and near Woodstock. From U.S. Geological Survey Front Royal 30x60 minute quadrangle map.