Geology of the Great Falls Park Area

Fairfax County, Virginia

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November 1956

Open-file report

Not reviewed for conformance with standards and nomenclature of the Geological Survey.

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The Great Falls of the Potomac River are about 9 miles above the District of Columbia line, in the Piedmont physiographic province. The river flows through a wooded valley and drops about 100 feet over rapids and falls in the 5 miles between Walkers Island and Vaso Island. Above the falls the river gorge is nearly half a mile wide at the bottom; below the falls the river is confined to a narrow channel not more than 150 feet wide in places.

The course of the river as well as that of the tributary streams is largely controlled by the structure of the underlying bedrock. A former channel of the Potomac, having a bottom altitude of 150 feet, some 80 feet above that of the present riverbed, bypasses the falls on the Virginia side of the river. This old channel, which is about 500 feet wide leaves the gorge just above the falls and reenters it about 1 1/2 miles farther downstream. An elongate ridge, trending southeastward, separates the river from the high abandoned channel. The ridge, which has an altitude of 200 feet, is capped by a terrace deposit made up of large rounded boulders as much as 6 to 8

feet in diameter. These boulders are derived from the Triassic rock units that crop out 6 miles upstream, near the Loudon County line and beyond.

Bedrock in the Great Falls area is shown on the Geologic map of Virginia (1928) as the Wissahickon and for many years it was presumed to be precambrian. However, later investigations seem to indicate that the rocks in the Great Falls area should be assigned to the Peters Creek quartzite and that at least some of the rocks in the Piedmont are younger than Precambrian, possibly Ordovician. Although many of the rocks appear to be of sedimentary origin they have been so thoroughly altered that any fossils that might have existed have been destroyed; thus their exact age cannot be determined from available data.

The geologic history of the area begins with the deposition of the sedimentary rocks. Basaltic rocks either alternated with the sedimentary rocks as lava flows or were intruded into the sedimentary rocks after they became consolidated. Probably most of the basic rocks in the series are intrusives, although some may be altered flows. Coarse-grained, light-colored granitic rocks were intruded at about the same time or perhaps somewhat later. Then followed a period of mountain-building activity which compressed the rocks into closed folds. Shearing, crushing, and faulting accompanied these movements, and the rocks were strongly altered. Still later another cycle of intrusion took place, this time of acidic magmas which produced the younger granites and the associated aplite dikes (light-colored, fine-grained rock) and quartz

veins. Renewed earth movements, less intense than the preceding ones, caused some shearing in the younger granites and quartz veins as well as in the older rocks.

During the many millions of years since the earliest sedimentary rocks were laid down, but principally during the periods of earth movement, all the rocks have been altered--the sandstones to quartzites, gneisses, and schists, the shales to slates and schists, and the basic rocks to metabasalt, chlorite schist, talc schist, and amphibolite. Gneiss, schist, and slate are strongly banded rocks which show the effects of the extreme pressures to which they have been subjected.

Most of these rock types are represented in the immediate vicinity of Great Falls. Exposed along the river bluff are mica and quartz schist and prominent interbedded quartzite, mostly rather dark in color. Intrusive into these metamorphic rocks are small bodies of medium- to coarse-grained light-colored granitic acidic rocks and contrasting dark-gray to black fine-grained basic rocks. These intrusives are in the form of small dikes, sills, and irregular masses.

Generally the quartzite and schist strike (trend) between true north and N. 18° E. and dip steeply to the southeast. As a rule the bedding and the schistosity, or banding, of the rocks appear to be parallel, although locally the schists are highly contorted.

A prominent set of joints--tension fractures--cuts the rocks in the vicinity of the falls nearly at right angles to the schistosity. These joints trend N. 70° to 80° W. and have steep to vertical dips.

The boulders forming the terrace on the top of the elongate ridge are clearly derived from formations of Triassic age and were

carried downstream by the ancestral Potomac River. These rocks are mainly sandstones and conglomerates, some of which show signs of baking by intrusive diabase, boulders of which also are present in the terrace deposits.

The river gorge and bordering bluffs have been scoured by the action of the water with its load of sediment, and the rock exposed is rather fresh and unweathered. Farther back, away from the river, weathering products have been accumulating for many thousands of years and the fresh rock is concealed under great thicknesses of soil and weathered rock, in some places as much as 150 feet deep. Deep weathering is characteristic of the Piedmont, and it is difficult to recognize the different rock types by the soils derived from them. For this reason the valleys of the major streams are the best places to study the rocks of the Piedmont.

Bibliography

1. Cloos, Ernst, 1950, Geology of Bear Island: Johns Hopkins Univ., Studies in Geology, v. 16, no. 2.

2. Darton, N. H., and Keith, Arthur, 1901, Description of the Washington area: U. S. Geol. Survey Geologic Atlas of the United States, folio 70.

3. Fenneman, N. M., 1938, Physiography of eastern United States: New York, McGraw-Hill Book Co., Inc.

4. Virginia Geological Survey, 1928, Geologic map of Virginia, scale 1:500,000.