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Geology of the National Capital Region—Field Trip Guidebook

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Front Cover: Great Falls of the Potomac River, looking north on the Virginia side. The Potomac falls 80 feet across resistant metagraywacke and schist of Neoproterozoic to Early Cambrian age. Downcutting of the Potomac from the bedrock terrace to the current river channel occurred in the last 30,000 years. See field trips 5 and 6.
Photograph by Gary Fleming, Virginia Department of Conservation and Recreation.

Geology of the National Capital Region—Field Trip Guidebook

Joint Meeting of Northeast and Southeast Sections
Geological Society of America
Tysons Corner, Virginia
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Edited by Scott Southworth and William Burton

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U.S. Department of the Interior
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U.S. Geological Survey
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Preface

The 2004 Joint Northeast-Southeast Section Meeting of the Geological Society of America is the fourth such meeting and the third to be held in or near Washington, D.C. This guidebook and the field trips presented herein are intended to provide meeting participants, as well as other interested readers, a means to understand and enjoy the rich geological and historical legacy of the National Capital Region.

The field trips cover all of the major physiographic and geologic provinces of the central Appalachians in the Mid-Atlantic region. Trip 1 outlines the tectonic history of northern Virginia along an east-to-west transect from the Coastal Plain province to the Blue Ridge province, whereas the other field trips each focus on a specific province. From west to east, these excursions investigate the paleoclimate controls on the stratigraphy of the Paleozoic rocks of the Allegheny Plateau and Valley and Ridge province in West Virginia, Pennsylvania, and Maryland (Trip 3); Eocene volcanic rocks that intrude Paleozoic rocks in the westernmost Valley and Ridge province in Virginia and West Virginia (Trip 4); age, petrology, and structure of Mesoproterozoic gneisses and granitoids located in the Blue Ridge province within and near Shenandoah National Park, Virginia (Trip 2); the use of argon data to unravel the complex structural and thermal history of the metamorphic rocks of the eastern Piedmont province in Maryland and Virginia (Trip 5); the use of cosmogenic isotopes to understand the timing of bedrock incision and formation of terraces along the Potomac River in the eastern Piedmont province near Great Falls, Virginia and Maryland (Trip 6); the nature of the boundary between rocks of the Goochland and Chopawamsic terranes in the eastern Piedmont of Virginia (Trip 7); the role of bluffs and fluvial terraces of the Coastal Plain in the Civil War Battle of Fredericksburg, Virginia (Trip 8); and the Tertiary lithology and paleontology of Coastal Plain strata around the Chesapeake Bay of Virginia and Maryland (Trip 9).

Some of the field trips present new geochronological research that uses isotopic techniques to unravel Earth history and processes, including U-Pb dating to determine the timing of metamorphism and igneous activity associated with the Mesoproterozoic Grenville orogeny (Trip 2); argon ($^{40}Ar/^{39}Ar$) analysis to understand the complex Paleozoic history of deformation and metamorphism in the Piedmont (Trip 5); and cosmogenic beryllium-10 data to derive exposure ages of landforms and deposits of the Potomac River valley (Trip 6).

Several trips shed insight on significant or enigmatic geologic features of the region. Trip 3 presents evidence for global paleoclimate controls on the Paleozoic stratigraphy of the Appalachian basin, including evidence for Late Devonian glacial deposits. Trip 4 investigates unusual Eocene igneous rocks in the Eastern United States, and Trip 2 visits several local ductile high-strain zones, offering geologists opportunities to consider the importance of such structures relative to the poorly understood Rockfish Valley fault zone in the Blue Ridge province. In the Piedmont province, Trip 7 focuses on a controversial terrane boundary, whereas Trip 5 crosses several lithologic belts with distinct thermotectonic histories that suggest terrane boundaries. Trip 6 sheds new light on the erosional history of a major river gorge cut into crystalline rocks in the Fall Zone.

Four trips are recommended for Earth science teachers and are cosponsored by the National Association of Geologic Teachers (NAGT). These trips focus on the tectonic history of northern Virginia (Trip 1), terraces of the Potomac River at Great Falls and cosmogenic isotope analysis to date the terraces and the incision history (Trip 6), and Tertiary lithology and paleontology of the Chesapeake Bay region (Trip 9). Trip 8 takes advantage of the rich Civil War history of this region to look at the role that geology played in the strategies and outcome of the Battle of Fredericksburg.

This guidebook is the result of much hard work by many individuals. The editors wish to thank the field trip leaders and authors, the technical reviewers, and Nancy Stamm of the USGS Geologic Names Committee. We also owe a very special thanks to Linda Gundersen, Chief Scientist, Geologic Discipline, USGS, who provided funding for the guidebook.

Contents

Conversion Factors

Multiply	By	To obtain
	Length	
inch (in.)	2.54	centimeter (cm)
inch (in.)	25.4	millimeter (mm)
foot (ft)	0.3048	meter (m)
mile (mi)	1.609	kilometer (km)
yard (yd)	0.9144	meter (m)
	Area	
square mile (mi^2)	2.590	square kilometer (km^2)
	Volume	
cubic foot (ft^3)	0.02832	cubic meter (m^3)
cubic mile (mi^3)	4.168	cubic kilometer (km^3)
	Flow rate	
cubic foot per second (ft^3/s)	0.02832	cubic meter per second (m^3/s)
mile per hour (mi/h)	1.609	kilometer per hour (km/h)
	Length	
centimeter (cm)	0.3937	inch (in.)
millimeter (mm)	0.03937	inch (in.)
meter (m)	3.281	foot (ft)
kilometer (km)	0.6214	mile (mi)
meter (m)	1.094	yard (yd)
	Area	
square kilometer (km^2)	0.3861	square mile (mi^2)
	Volume	
cubic meter (m^3)	35.31	cubic foot (ft^3)
cubic kilometer (km^3)	0.2399	cubic mile (mi^3)
	Flow rate	
cubic meter per second (m^3/s)	35.31	cubic foot per second (ft^3/s)
kilometer per hour (km/h)	0.6214	mile per hour (mi/h)

Temperature in degrees Celsius (°C) may be converted to degrees Fahrenheit (°F) as follows:

$$°F=(1.8\times C)+32$$

Temperature in degrees Fahrenheit (°F) may be converted to degrees Celsius (°C) as follows:

$$°C=(°F-32)/1.8$$

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