Introduction

The Cedar Creek and Belle Grove National Historical Park (CEBE) was created on December 19, 2002 and encompasses approximately 3,500 acres. Located in Warren, Shenandoah, and Frederick counties in Virginia, CEBE is situated between Strasburg and Middletown, Virginia (Figure 1). The elevations of CEBE range between 500 and 700 feet (Figures 2, 3, and 4) (Topozone 1994-1999). This report is a compilation and synthesis of natural resource information including geology, soil, water quality and quantity, wetlands, vegetation, wildlife, sensitive species, air quality, viewsheds, lightscapes, and soundscapes. Most analysis was based on a CEBE boundary digitized using ArcMap 8.3, 1997 aerial photographs, and an initial map provided by the National Park Service (NPS). A more accurate boundary is currently being developed but should result in little change to this natural resource information. Aerial photographs taken in 2002 were provided by the Virginia Base Mapping Program recently but too late to be incorporated into this report.

Recommendations are the views and opinions of the author and, in some cases, key informants who are familiar with environmental resources described herein, and by the faculty of The Pennsylvania State University, Center for Watershed Stewardship.

Figures and Appendices not developed by the author were clipped and pasted in their original format.

A list of contacts utilized in the creation of this report is located in Appendix 1. Appendix 2 contains a bibliography of acquired documentation and metadata.

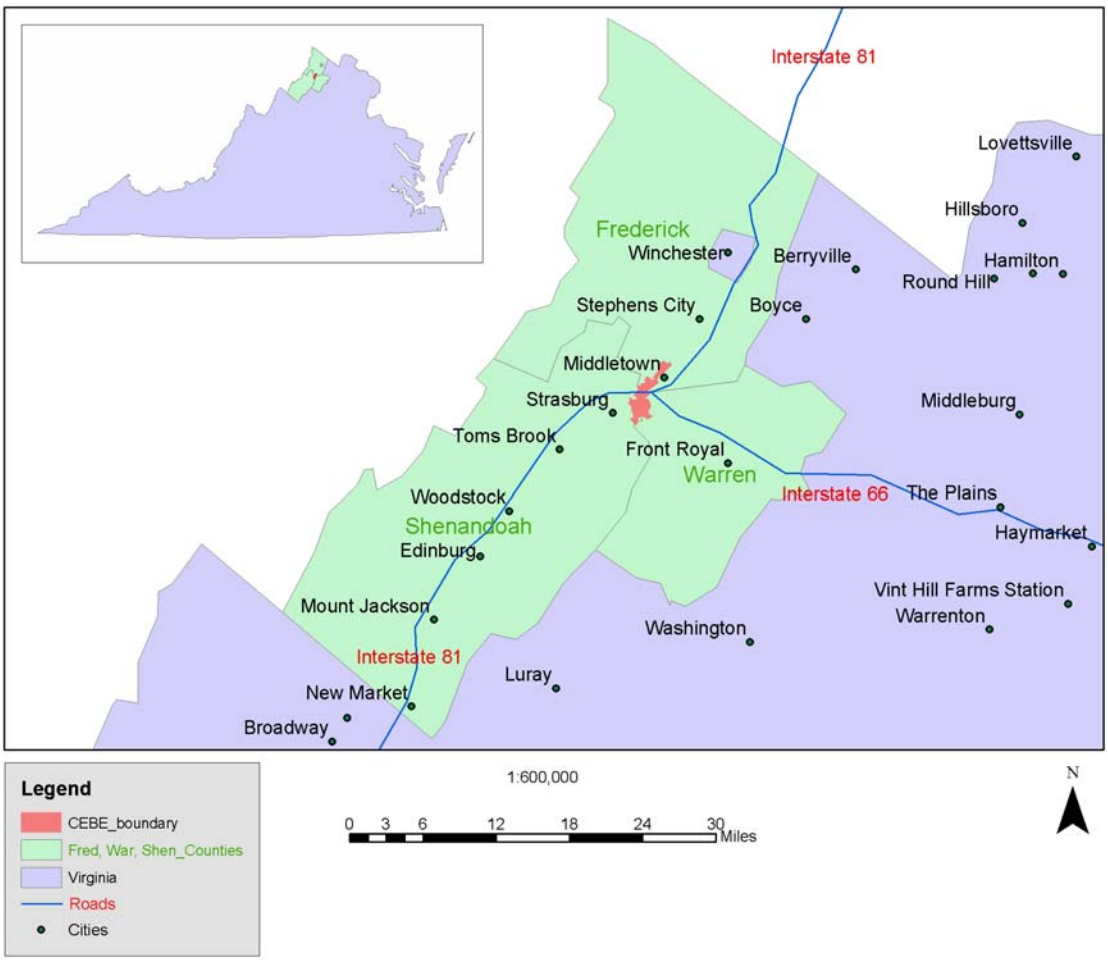

Figure 1. Location map for the Cedar Creek and Belle Grove National Historical Park (CEBE).

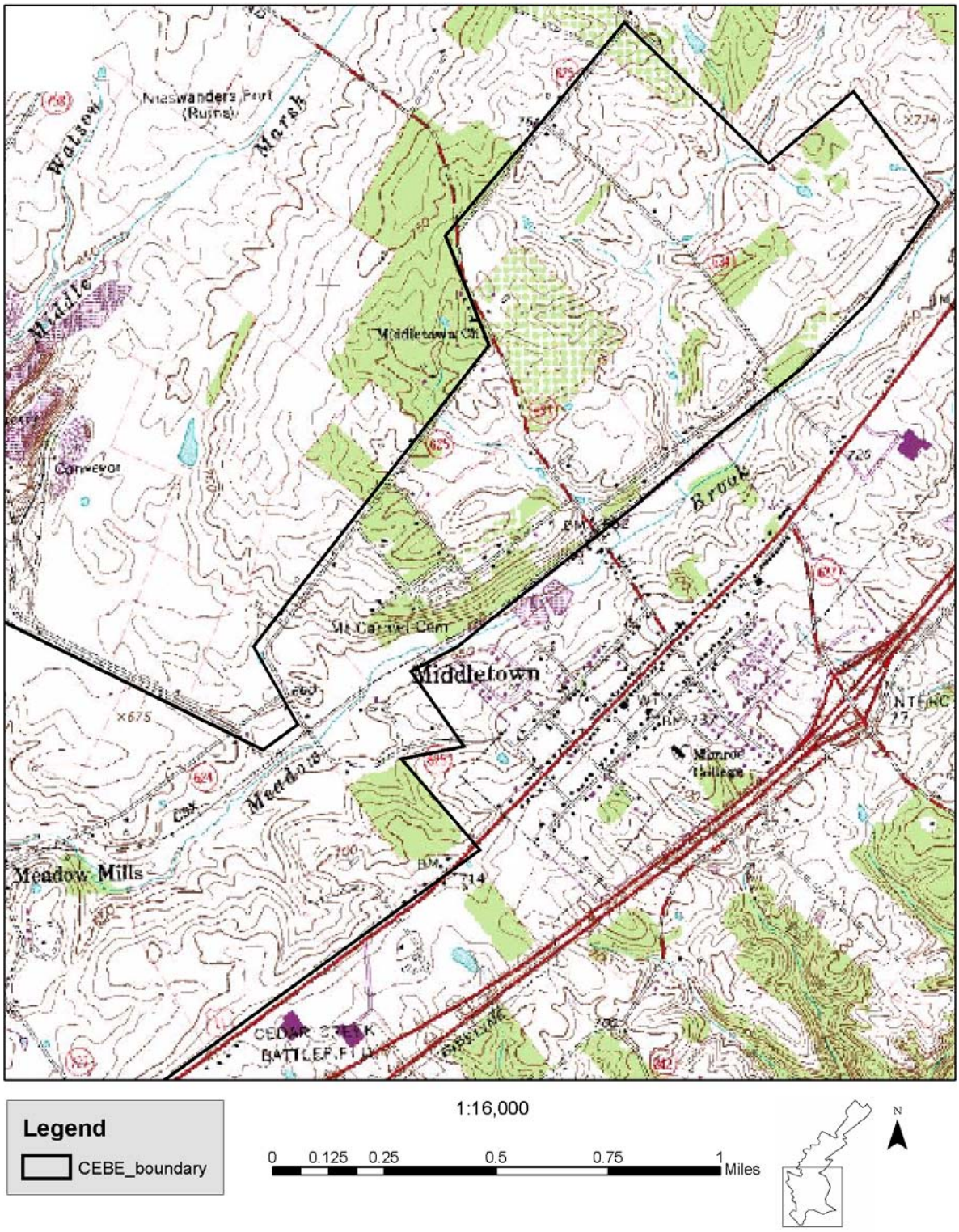

Figure 2. Topographic map of the Cedar Creek and Belle Grove National Historical Park (CEBE) – northern section. Data provided by Topozone www.topozone.com 1994, 1999.

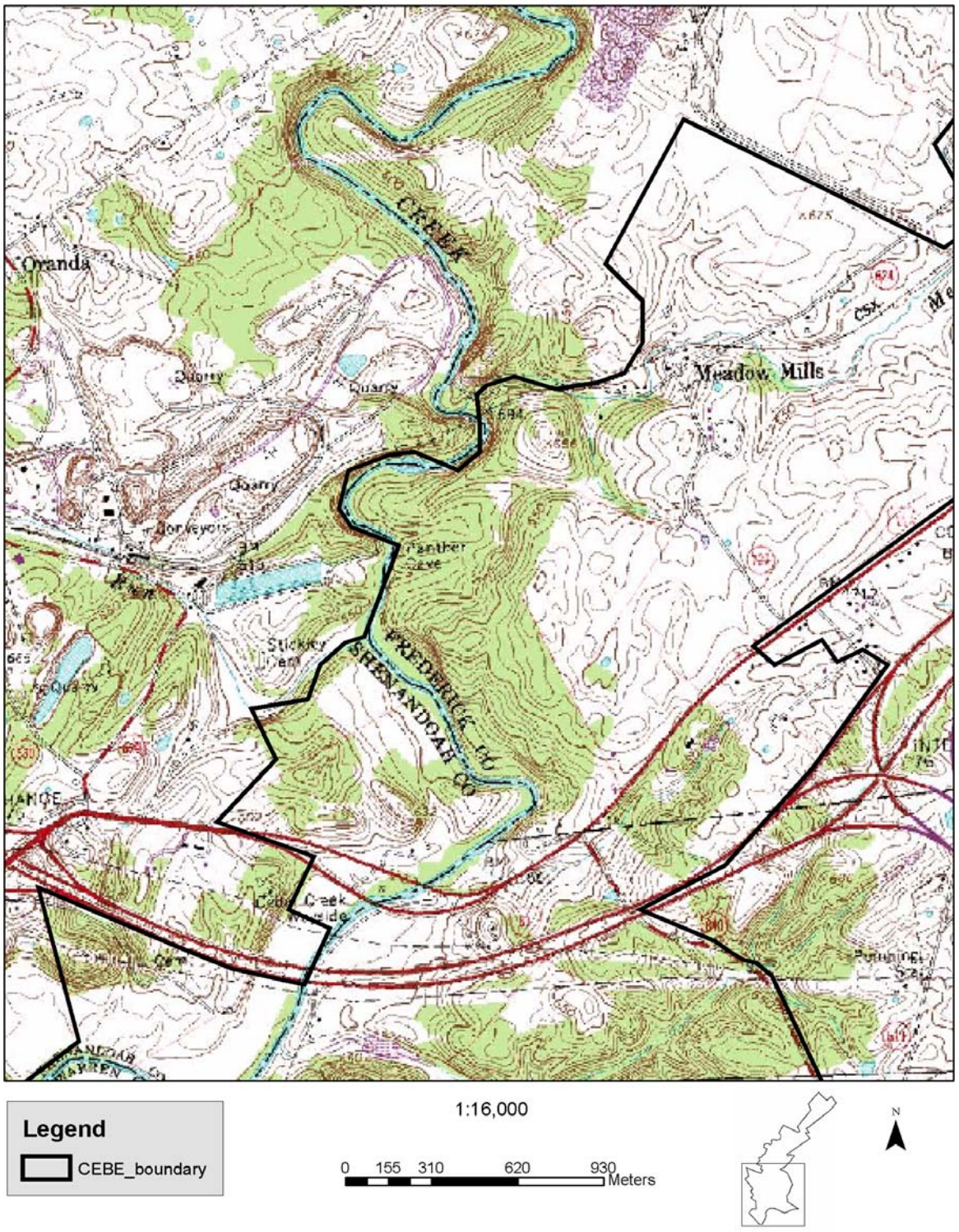

Figure 3. Topographic map of the Cedar Creek and Belle Grove National Historical Park (CEBE) – middle section. Data provided by Topozone www.topozone.com 1994, 1999.

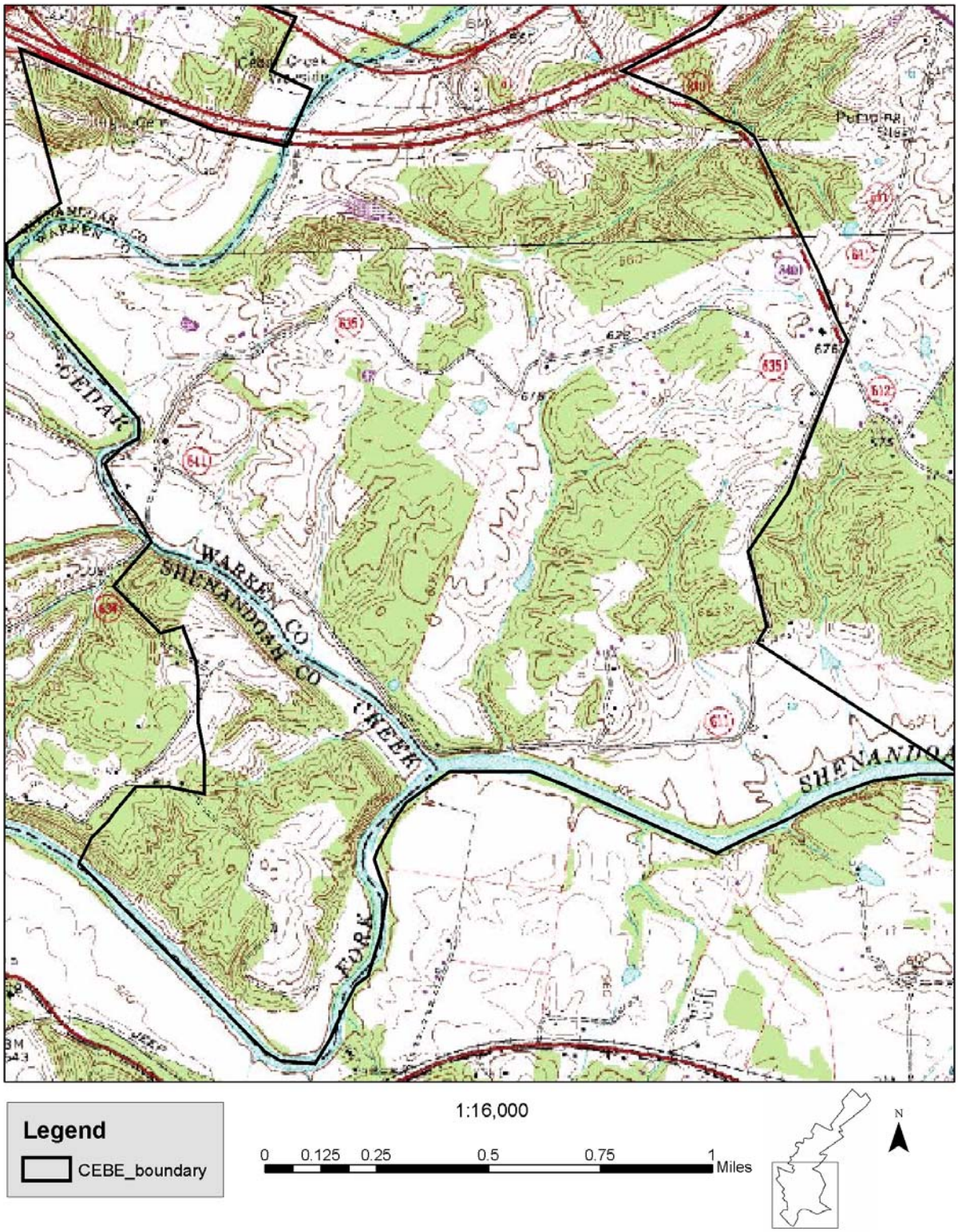

Figure 4. Topographic map of the Cedar Creek and Belle Grove National Historical Park (CEBE) – southern section. Data provided by Topozone www.topozone.com 1994, 1999.

Geology

Description

Please refer to Appendix 3 for geologic term definitions. The Cedar Creek and Belle Grove National Historical Park is located within the Ridge and Valley physiographic province (Figures 5 and 6). This province is characterized by folded beds of sedimentary rock that were deposited in the Iapetus Ocean (Scotese 2003) during the Paleozoic Era (Figures 7, 8, and 9) and form long, narrow, parallel ridges and valleys. Generally, sandstones compose the ridge tops and carbonate rocks such as limestone form the valleys. The Ridge and Valley province is divided into two subregions, the Valley of Virginia, which CEBE is contained in, and the Allegheny Mountains. The Valley of Virginia is a regional name for the larger Great Valley, which stretches from New York to Alabama (Woodward 1997). The rocks that underlie the Great Valley in and around CEBE form the Massanutten synclinorium, a regional fold resulting from the late Paleozoic Alleghanian orogeny (Figures 7 and 8). The core of the synclinorium is mostly clastic rocks of the Middle and Upper Ordovician Martinsburg Formation (Southworth 2002). The dissolving of the carbonate rocks that primarily underlie the Valley of Virginia results in karst topography (Woodward 1997).

CEBE includes six main geologic formations, which will be discussed according to age from youngest to oldest. All of the formations, except the Martinsburg Formation, alluvial deposits, and terrace deposits, were deposited in the shallow, tropical, Iapetus ocean that existed for at least 70 million years (Roberts 2003). The Pinesburg Station Dolomite and Rockdale Run Formation, undivided, is within the Beekmantown Group and is from the Ordovician Period. This formation lies directly below the Edinburg Formation, Lincolnshire Limestone, and New Market Limestone, undivided, in geologic time and there is an unconformity between them. The Pinesburg Station section consists of medium to light gray, fine-grained dolostone that is medium to thick bedded and has sparse fossils. The weathered surface exhibits a “butcher block” structure. Medium gray, fine-grained limestone is located near the base of the section. Irregular bedded, brecciated dolomite, that indicates paleokarst, is located near the top of the section. This section reflects a restricted shallow marine environment that was subarial at times (Southworth 2002). The thickness ranges from 0 to 875 feet. The Rockdale Run Formation section consists of medium gray, fine-grained, fossiliferous limestone with intraformational conglomerates, algal bioherms, bioclastic zones, burrow mottling, and chert nodules. The dolostone is laminated with mudcracks. The section reflects an alteration from subtidal to peritidal environments (Southworth 2002). It also contains light to medium gray, fine-grained, laminated, dolomitic limestone and dolostone with mottled beds. Thin lenses of calcareous sandstone occur in Warren County; while thin lenses of gray chert are common near the base of the section. The formation’s upper contact with the New Market formation is unconformable. The lower contact of the formation is located where the oldest, thick bedded dolomite overlies the dark gray limestone of the Stonehenge Limestone. Thickness ranges from 1500 feet to 2400 feet (Rader et. al 1996).

The Edinburg Formation, Lincolnshire Limestone, and New Market Limestone, undivided, was deposited during the Ordovician Period. This formation lies directly below the Martinsburg Formation in geologic time. The Edinburg Formation consists of black, fine-grained to aphanic limestone with black shale partings. In addition, it contains pyrite and medium to light gray, fine-to coarse-grained nodular limestone with thin black shale partings. Potassium-bentonites are common near the base and top of the formation which is fossiliferous. Thickness ranges between 425 and 500 feet. The Lincolnshire Limestone consists of limestone that is light to very dark gray, fine to coarse-grained, and medium to very thick-bedded. The dark limestone contains chert nodules and the light colored limestone is fossiliferous. Thickness ranges from 25 to 250 feet. An unconformity exists directly between the Lincolnshire Limestone and the New Market Limestone. The lower unit of the New Market Limestone contains medium to dark-gray, fine-grained, thin-bedded, argillaceous, partly dolomitic, bioturbated limestone and carbonate pebble conglomerate. The upper unit is composed of medium-gray, aphanic, thick-bedded limestone with scattered, rhomboid-shaped, sparry calcite crystals. High calcium limestone is quarried in the area. Thickness ranges from 0 to 200 feet (Rader et. al 1996).

The Martinsburg Formation was deposited during the Ordovician Period and constitutes a broad belt that forms a horseshoe shape around the north end of the Massanutten synclinorium (Rader, Biggs 1976). This fossiliferous formation is approximately 3,200 feet thick. The lower section is made up of black, calcareous shale and argillaceous limestone (Rader, Biggs 1976). It is in this lower section that trilobites, gastropods, and graptolites may be found (Rader, Biggs 1976). The middle section is made up of silty shale, dark-gray calcareous siltstone, and sandstone. The upper section of the formation is made up of brown, medium to coarse grained sandstone. This formation was created over 445 million years ago during the Taconic Orogeny (Roberts 2003). During this orogeny, a volcanic island arc collided with Laurentia, or what is now North America. The carbonate deposits of North America were subducted and a deeper water foreland basin was created where clastic sediments accumulated from the eroding Taconic Mountains (Scotese 2003). Turbidites associated with the foreland basin can be found in the Martinsburg Formation (Southworth 2002). The transition from a calmer, carbonate depositional time period to a more active, clastic sediment depostional time period can be seen in this formation.

Alluvium deposits, which are the youngest formations in CEBE, exist along Cedar Creek and the Shenandoah River. These consist of flood plain deposits of sand, silt, and clay with minor amounts of rounded gravel. Near the southern tip of CEBE, terrace deposits exist that consist of sand, silt, clay, and rounded pebbles and cobbles. Both the alluvium and terrace deposits are from the Cenozoic Era and Quaternary Period (Rader, Biggs 1976).

Having over 4,000 known caves, Virginia is rich is karst resources (DCR 2004). Karst landscapes are characterized by considerable dissolution of bedrock and are commonly underlain by limestone and dolomite bedrock. Features associated with karst landscapes include sinkholes, sinking and losing streams, caves, and large flow springs. These

features allow for underground drainage networks that bypass surface drainage divides. Rare animal and plant species rely on karst landscapes, such as bats, invertebrates, plants growing near springs and seeps, and fish and mussels that reside in waters fed by karst springs.

Panther Cave overlooks Cedar Creek (Figures 3 and 10) and has had graffiti problems (McCarty, 2004). Lettering engraved in the cave is believed to have been left by Civil War soldiers. An archaeological excavation was conducted in 1966 by the Northern Virginia Chapter of the Archeological Society of Virginia. Pottery, arrowheads, and woven textile objects dated to at least 10,000 to 8,000 B.C. were found (McCarty, 2004).

Recommendations

It is recommended that the karst features of the park, such as caves and sinkholes, be identified, mapped, and protected from vandalism. Sinkholes increase in size and become more abundant near incised streams. This can be seen along Cedar Creek and the Shenandoah River. The greater development of sinkholes near streams has been attributed to the steepened hydraulic gradient and increased rate of ground water flow in these areas (Orndorff 2002). According to the Karst Protection Coordinator of the Virginia Karst Program, Wil Orndorff, the caves should not be adversely impacted if the area is maintained in green space. If other activities are proposed, it has been requested by the Department of Conservation and Recreation that Mr. Orndorff be contacted at telephone number 540-831-4056. In addition, it may be helpful to identify any fossils present in road cuts or outcrops. These could be of importance to interpretive programs conducted at CEBE in the future.

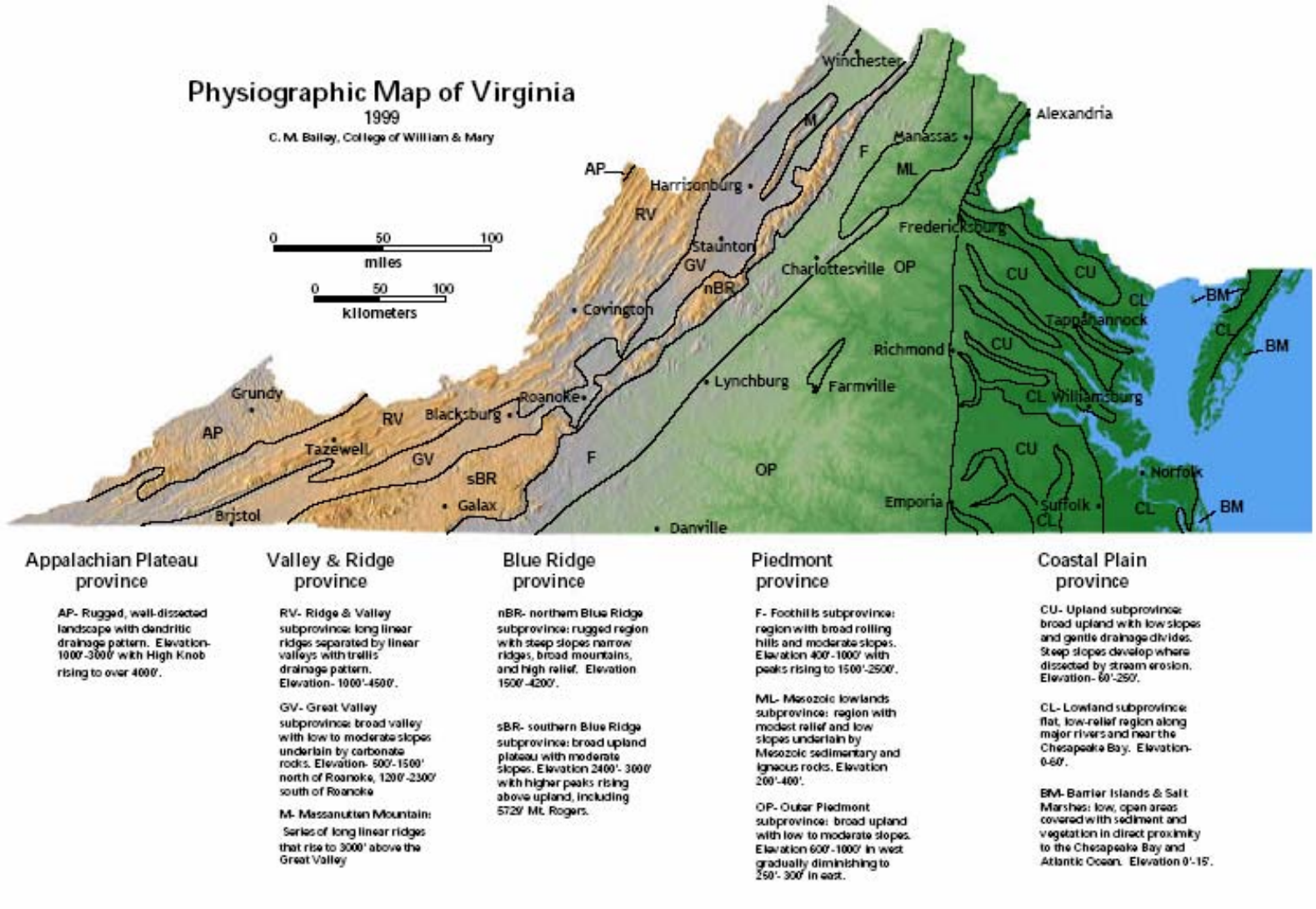

Figure 5. Physiographic map of Virginia. Provided by the College of William and Mary, 1999.

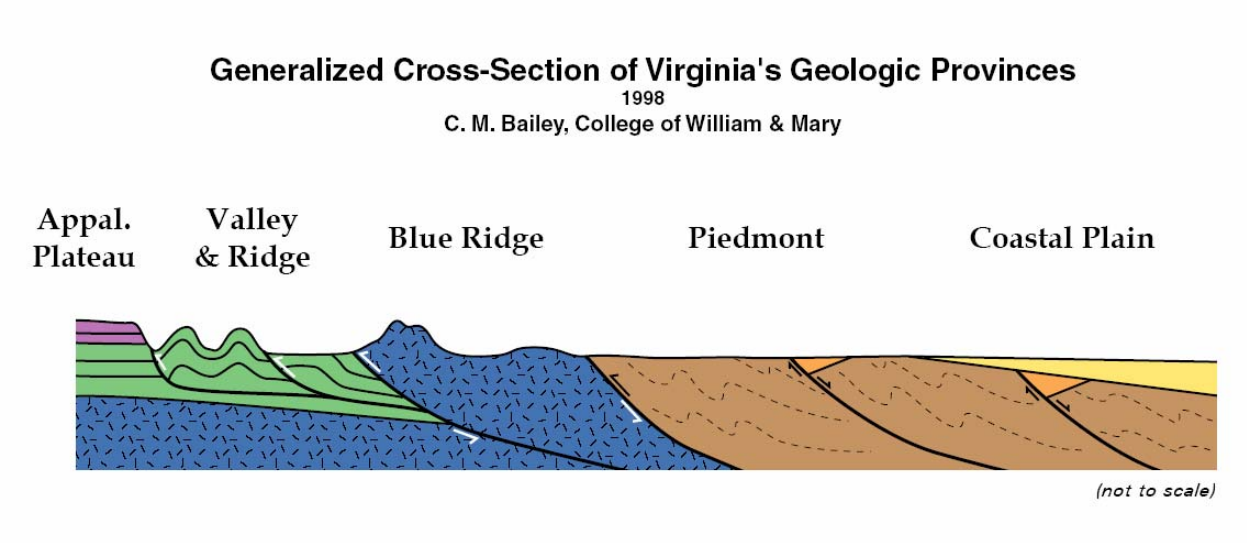

Figure 6. Cross-section of Virginia's geologic provinces. Provided by the College of William and Mary, 1998.

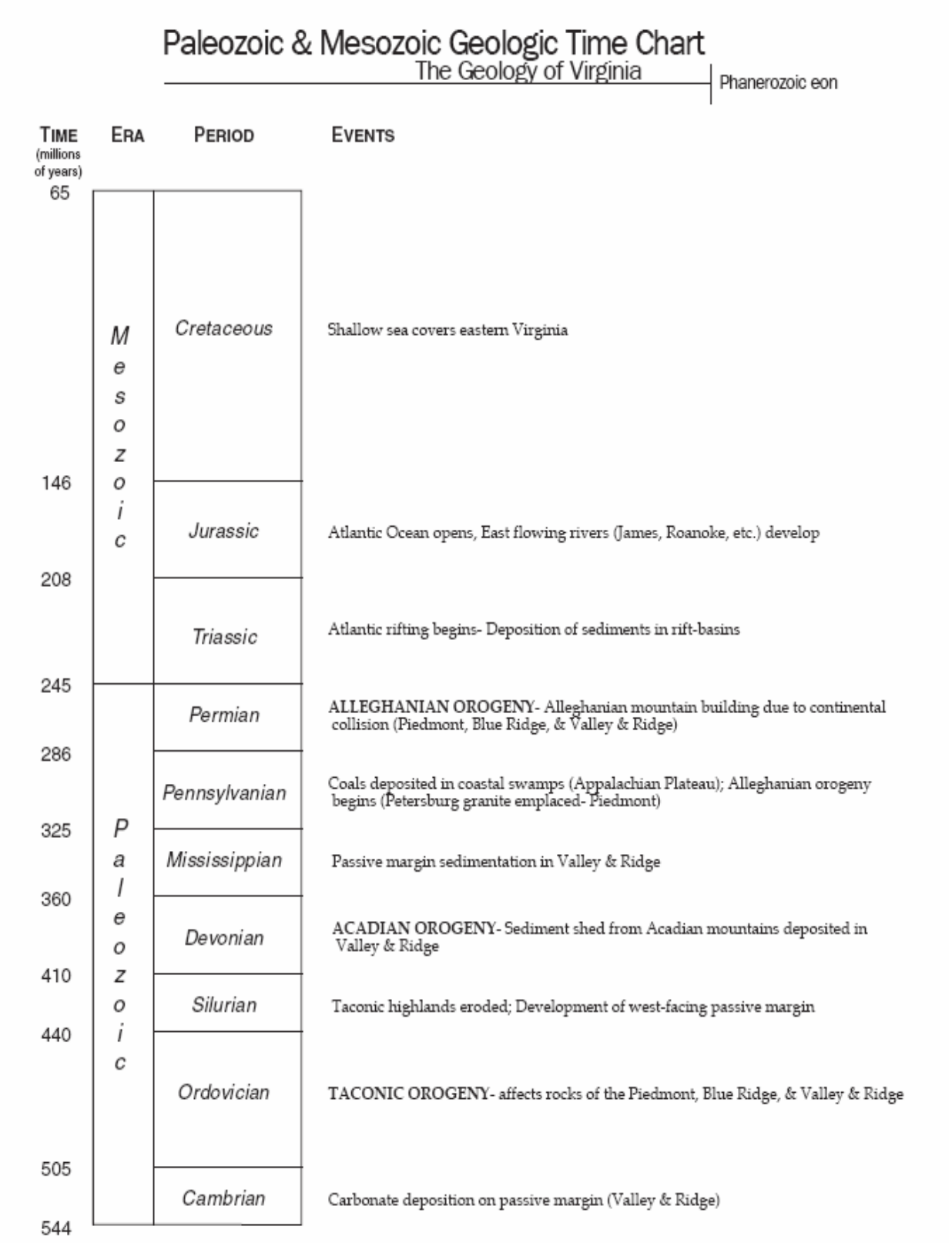

Figure 7. Paleozoic and Mesozoic geologic time chart. Provided by the College of William and Mary, 1999.

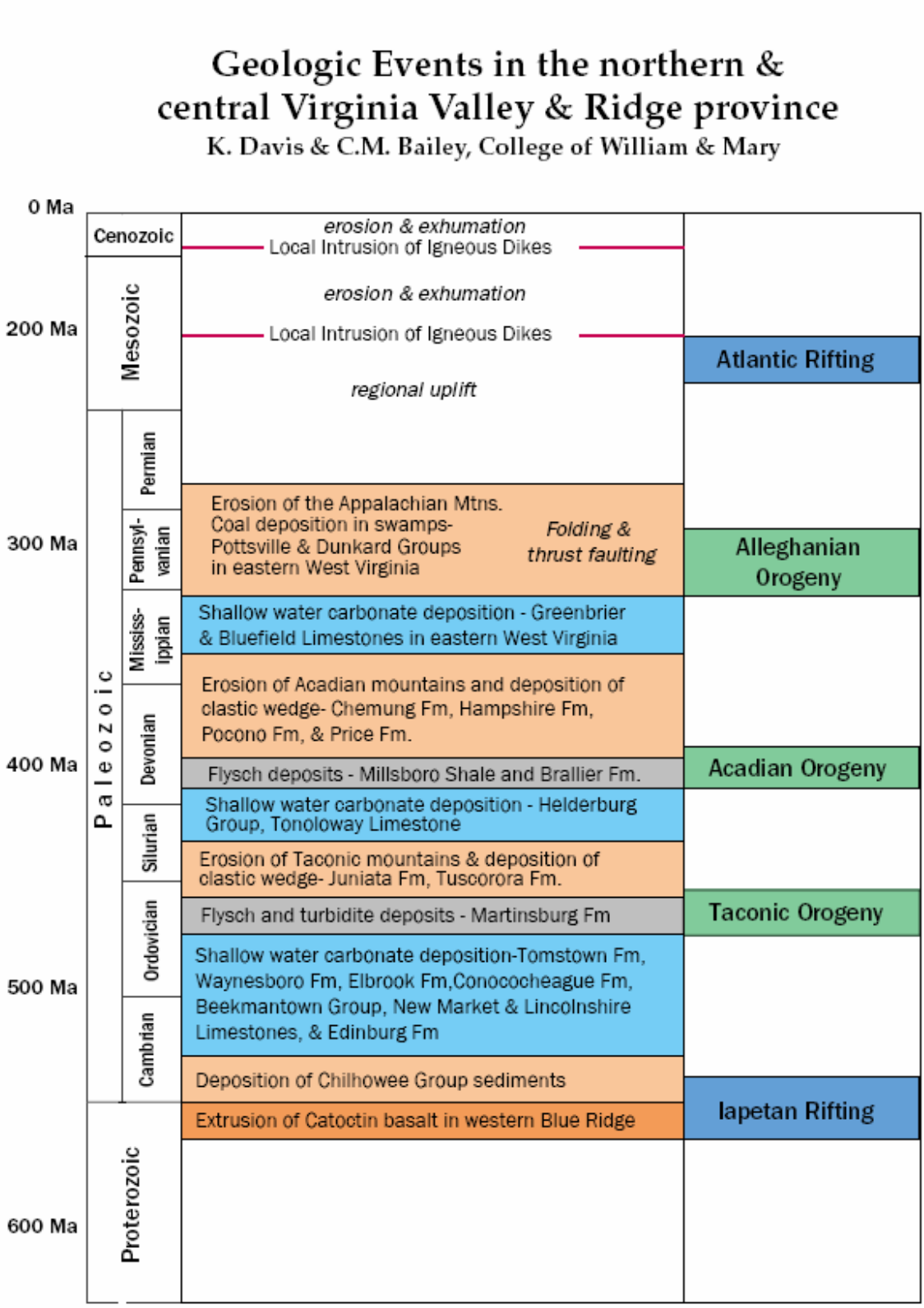

Figure 8. Geologic events in the northern and central Virginia Valley and Ridge province. Provided by the College of William and Mary, 1999.

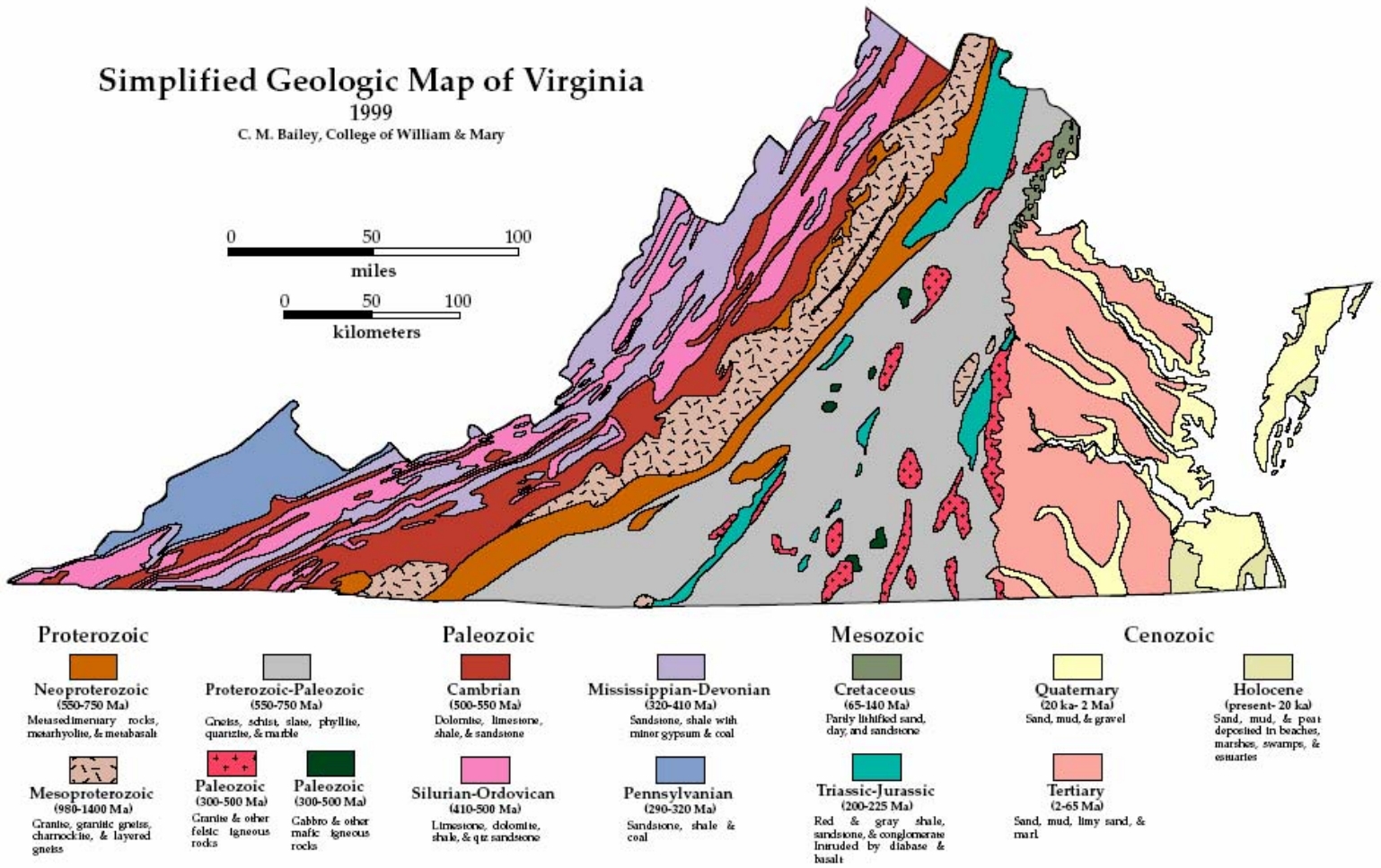

Figure 9. Geologic map of Virginia. Provided by the College of William and Mary, 1999.

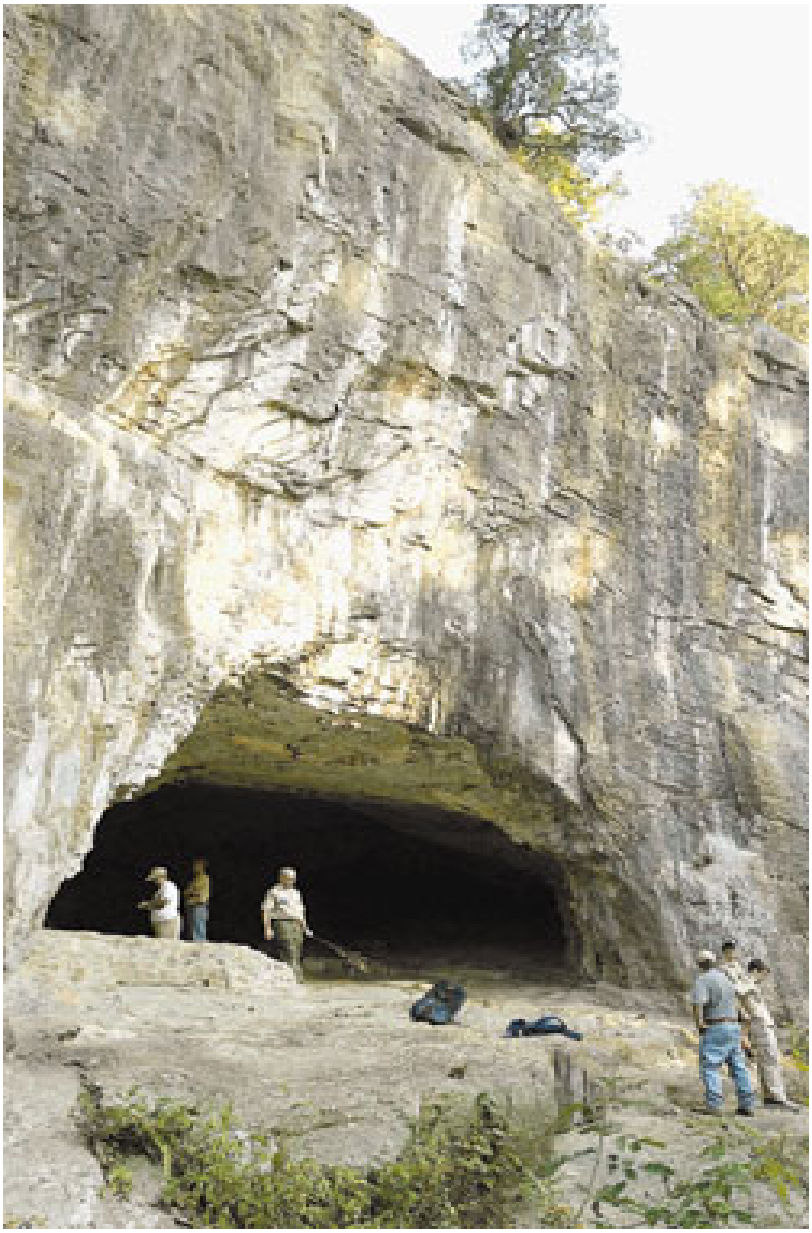

Figure 10. Panther Cave along Cedar Creek. Provided by Rick Foster and the Winchester Star, 2004.