EXPLANATORY NOTES

The objective of the *Geological Highway Map* of the Mid-Atlantic Region is to present the general geology of the region in an interesting and colorful manner sufficiently generalized to make it clearly understandable to the general public, but detailed enough to be useful to the science student and professional geologist.

This is the fourth of a series of eleven regional maps being prepared to cover the conterminous states of the United States (see index map). These regional maps may be trimmed and fitted together to cover two or more regions. It is hoped that these publications will be a valuable source of geological information that is easily used by the nonspecialist. They explain the rocks and formations seen in rocks, soils, and landforms. All landforms, such as river valleys, hills, plateaus, canyons, plains, and mountains, result from geological processes and take on new beauty and fascination when they are observed with some understanding of their origin and history.

Each of the illustrations in this publication presents a particular type of geological information, and each is in part related to the other. The *Geological Highway Map* shows, by different colors, the age and outcrop pattern of the surface rocks. The *Generalized Chart of Time and Rock Units* shows the kinds of rocks that comprise the map units and their relative and radiometric ages (determined from decay of radioactive elements in the rocks). The positions of the principal structural features are presented on the *Tectonic Map*. The rocks and structure below the surface are shown on the *Geological Cross Sections*. The principal features are illustrated on the *Physiographic Map*.

All colors on the *Geological Highway Map*, the *Generalized Chart of Time and Rock Units*, and the *Geological Cross Sections* are coordinated: the same color is used for rocks of the same age. The long-established color designations of the United States Geological Survey for the geologic systems of North America rocks have been followed. The darker shades of color within each system represent the older rock units of that system; the lighter shades are the younger units.

Geological information concerning a particular area can be assembled by reference to the various illustrations. For example, if Bridgeport, West Virginia, is the area of interest, the following can be determined:

1. *Geological Highway Map*
Bridgeport is situated on rocks whose age and outcrop area are shown by the light blue color and the letter symbol IPnU.
2. *Generalized Chart of Time and Rock Units*
The light blue color and the letter symbol indicate that these rocks are of the Paleozoic Era, Pennsylvanian System, Missourian Series, the Conemaugh Group, and the lower part of the Upper Pennsylvania Sequence. The letter symbol IPnU also shows that the surface rocks are sandstone, limestone, shale, claystone, and shale and a few beds of coal. The time column places the age of these rocks at approximately 280 million years.
3. *Geological Cross Sections*
Cross section B^-B^' passes through Bridgeport (1,000 feet above sea level). The cross section shows that Bridgeport is located on rocks of the Pennsylvanian System, which are approximately 700 feet thick. These are underlain by rocks of Mississippian, Devonian, Silurian, and Ordovician ages to a depth of 10,000 feet below sea level (the depth to basement rocks at Bridgeport is approximately 18,000 feet below sea level).
4. *Physiographic Map*
Bridgeport is located on the dissected plateau that is west of the Appalachian Mountains.
5. *Tectonic Map*
Bridgeport is located on the western side of the Appalachian Basin in an area of gently folded anticlines and synclines that trend northeast and southwest.

GENERALIZED CHART OF TIME AND ROCK UNITS

Three charts are used to show the kinds of rocks in the Mid-Atlantic Region. The rocks are arranged according to relative age. The approximate ages, in millions of years as determined by radiometric (isotopic) dating methods, appear in the time column (right side of chart). Generalized descriptions of the rocks (where available) with the lithologic symbols representing igneous rocks, igneous or metamorphic basement rocks appear at the bottom of the columnar section. Other igneous rocks are shown in the chart as separate boxes, each placed in the appropriate time subdivision.

All rocks are classified into four major units: Cenozoic, Mesozoic, Paleozoic, and rocks known as Precambrian, the next younger rocks are Paleozoic and Mesozoic, and the most recent rocks are Cenozoic. Rock layers may be classified into units that can be identified at widely separated places. In the usual course of events, these rock units are deposited in succession, one overlying the pile and by other means, the relative ages of these formations are determined and they are combined into time-rock units referred to as *series* (the time-equivalent term of a *series* is an *epoch*). Series are subdivisions of rock *systems* (the time-equivalent term of a *system* is a *period*). Series are subdivisions of *erat* of time. Thus, it may be said that the Newman Formation is part of the Chesterian Series of the Mississippian System of rocks. However, the fossils found in those rocks lived during the Chesterian Epoch of time and the Mississippian Period of time. The subdivisions of the rock sequence into time-rock units of time are based on common fossils (fossils of the same or closely allied genera) and plant life as shown by fossil remains.

The types of rocks in the various map units are shown in the columnar section by lithologic symbols which indicate the type of rock-forming material, and its appearance. The outcrop area of the map unit appears at the base of each chart. No map unit on the geological map has the same lithology in all places on the map, and the rock sequence is not everywhere the same. For example, the Bordon Formation of the Kinderhookian-Osagian Series (dark green color) consists of shale in the Mississippian System of rocks in shale in Kentucky, whereas the equivalent age rocks in Tennessee, the Fe Payne Formation, are chiefly limestone. The many variations of this kind in the Mid-Atlantic Region emphasize the need for including three localized charts of time and rock units. Some rock units are easily recognizable across hundreds of miles because of their lithologic character and appearance within relatively short distances. In the outcrop columnar section, the lithology presented is that of the type locality—the place at which the rocks of the particular unit are typically exposed and from which the unit was named.

GEOLOGICAL HIGHWAY MAP

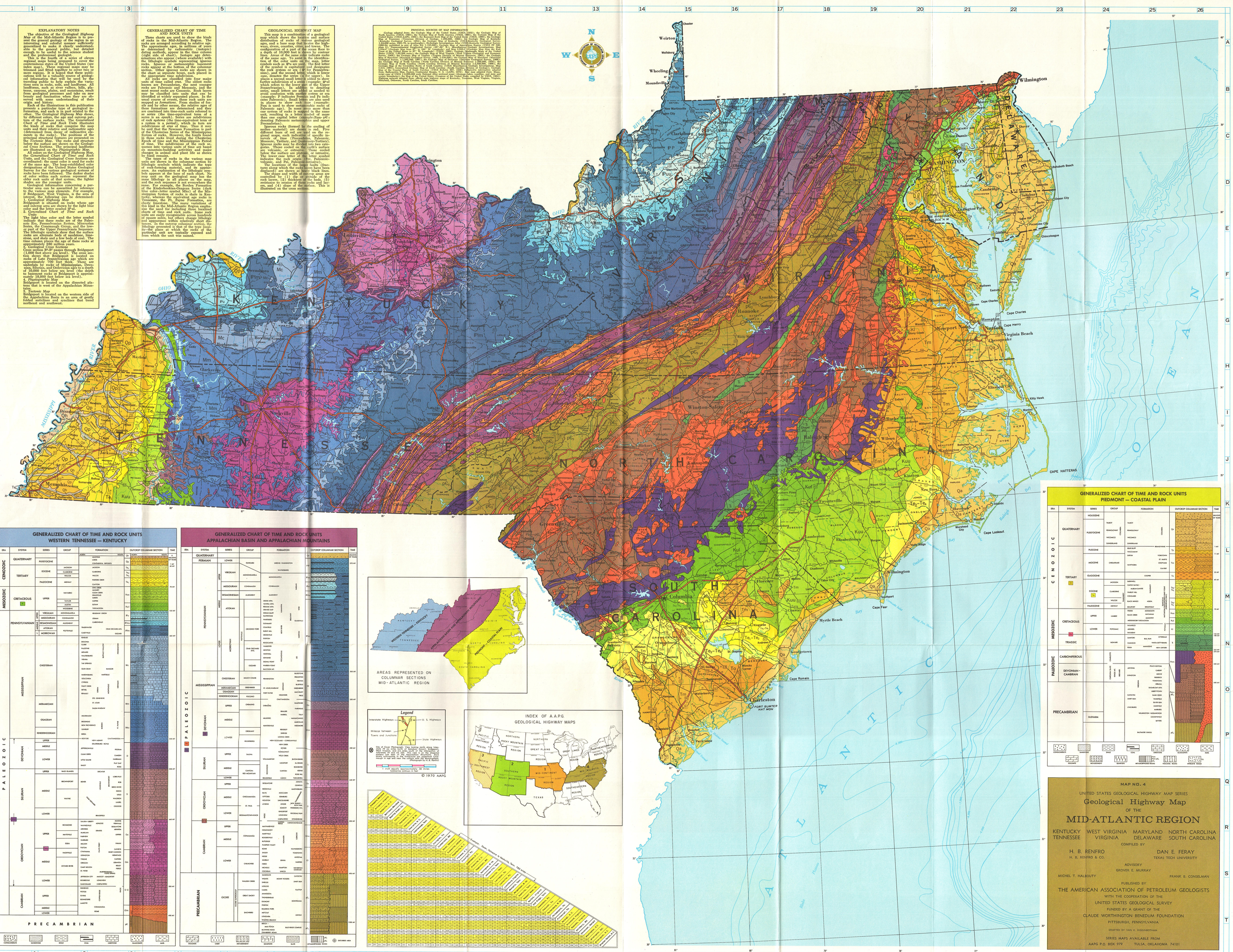
This map is a combination of a geological map which shows the location and surface distribution of rocks of various geological ages, and a base map that locates the highways, rivers, counties, cities, and towns. The configuration of a part of the ocean floor to a depth of 10,000 feet is shown by contour lines. Areas of the continental shelf are shown by a light blue color. To assist in the identification of the color units on the map, letter symbols such as IPn are used. The first letter of the symbol is capitalized and designates the rock system or era (I for Pennsylvanian), and the second letter, which is lower case, denotes the series (n for upper). In places a second small letter is added to show subdivisions of the series (u for upper, m for which refers to the lower part of the Upper Pennsylvanian). In addition to denoting series, small letters are added as needed to avoid confusion with another system or era (example: P indicates Permian and Pz indicates Paleozoic). Small letters are also used to denote igneous rocks (example: Pzm is used to show metamorphic rocks of Paleozoic age). In some areas more than one system of rocks is mapped in the same unit, resulting in a letter symbol of more than one capital letter (example: Pzm-pC denoting Paleozoic metamorphics and upper Precambrian).

Igneous rocks named by the color of the predominant mineral are shown in red. Five different hues of red are used on the regional maps, each indicative of specific intervals of time (Precambrian, Paleozoic, Mesozoic, Tertiary, and Quaternary-Tertiary). Igneous rocks may be divided into two categories. Those cooled on the earth's surface are called volcanic rocks, and those cooled below the surface are plutonic, or intrusive. The lower case letter of the letter symbol indicates the rock origin (v, Paleozoic-volcanic, and Pzi, Paleozoic-intrusive).

The locations of the larger faults (fractures along which the rocks layers have been displaced) are shown on the map. The symbol appears at the base of each chart. No map unit on the geological map has the same lithology in all places on the map, and the rock sequence is not everywhere the same. For example, the Bordon Formation of the Kinderhookian-Osagian Series (dark green color) consists of shale in the Mississippian System of rocks in shale in Kentucky, whereas the equivalent age rocks in Tennessee, the Fe Payne Formation, are chiefly limestone. The many variations of this kind in the Mid-Atlantic Region emphasize the need for including three localized charts of time and rock units. Some rock units are easily recognizable across hundreds of miles because of their lithologic character and appearance within relatively short distances. In the outcrop columnar section, the lithology presented is that of the type locality—the place at which the rocks of the particular unit are typically exposed and from which the unit was named.

PRINCIPAL SOURCES OF MAP INFORMATION

Geology adapted from the Geologic Map of the United States (USGS 1932); the Geologic Map of Northeastern United States (USGS-AMS, 1955); the Geologic Map of Southeastern United States (USGS-AMS, 1955); the Geologic Map of the United States (USGS, 1965); the Bedrock Geologic Map of Tennessee (Division of Geology, 1:250,000, 1966); the Geologic Map of Kentucky (Kentucky Geological Survey, 1:250,000, 1968); the Geologic Map of Virginia (Division of Mineral Resources, 1:250,000 series, 1963-76, in quadrangles); Hydrologic Investigations Atlas (USGS-Kentucky Geological Survey, 1968-84, published in part of Atlas HA 1:125,000); Geologic Map of Appalachian Region (USGS PP 560, 1968); the Geologic Map of Pennsylvania (Pennsylvania Geological Survey, 1:250,000, 1958); Geologic Map (USGS I-554-C, Geologic Map from the East Coast of North America to the Mid-Atlantic Ridge, 1:5,000,000, 1968); the Geologic Map of West Virginia (USGS, 1:62,500 series); the Geologic Map of West Virginia (West Virginia Geological and Economic Survey, 1:250,000, 1968); the Geologic Map of Maryland (Maryland Geological Survey, 1968, 1:250,000); the Geologic Map of Maryland (Maryland Geological Survey, 1:1,584,000, 1907); the Geologic Map of Delaware (Delaware Geological Survey, 1968); the Geologic Map of North Carolina (North Carolina Division of Mineral Resources 1:250,000, 1963); the Geologic Map of South Carolina (South Carolina Division of Mineral Resources 1:500,000, 1964); the Geologic Map of the Crystalline Rocks of South Carolina (USGS Miscellaneous Geologic Investigations, Map I-416, 1964); the Geologic Map of the Coastal Plain of South Carolina (USGS Bulletin 867, 1936); Aeromagnetic information adapted from Aeromagnetic Map of the United States (USGS, 1:5,000,000, 1963); Aeromagnetic information adapted from aeromagnetic maps of Virginia (USGS, 1:250,000, 1963); Aeromagnetic information adapted from aeromagnetic maps of Kentucky, Tennessee, West Virginia, Virginia, Maryland, Delaware, North Carolina, South Carolina.



GENERALIZED CHART OF TIME AND ROCK UNITS
WESTERN TENNESSEE — KENTUCKY

GENERALIZED CHART OF TIME AND ROCK UNITS
APPALACHIAN BASIN AND APPALACHIAN MOUNTAINS

AREAS REPRESENTED ON COLUMNAR SECTIONS MID-ATLANTIC REGION

GENERALIZED CHART OF TIME AND ROCK UNITS
PIEDMONT — COASTAL PLAIN

MAP NO. 4

UNITED STATES GEOLOGICAL HIGHWAY MAP SERIES

Geological Highway Map OF THE MID-ATLANTIC REGION

KENTUCKY TENNESSEE WEST VIRGINIA VIRGINIA MARYLAND DELAWARE NORTH CAROLINA SOUTH CAROLINA

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