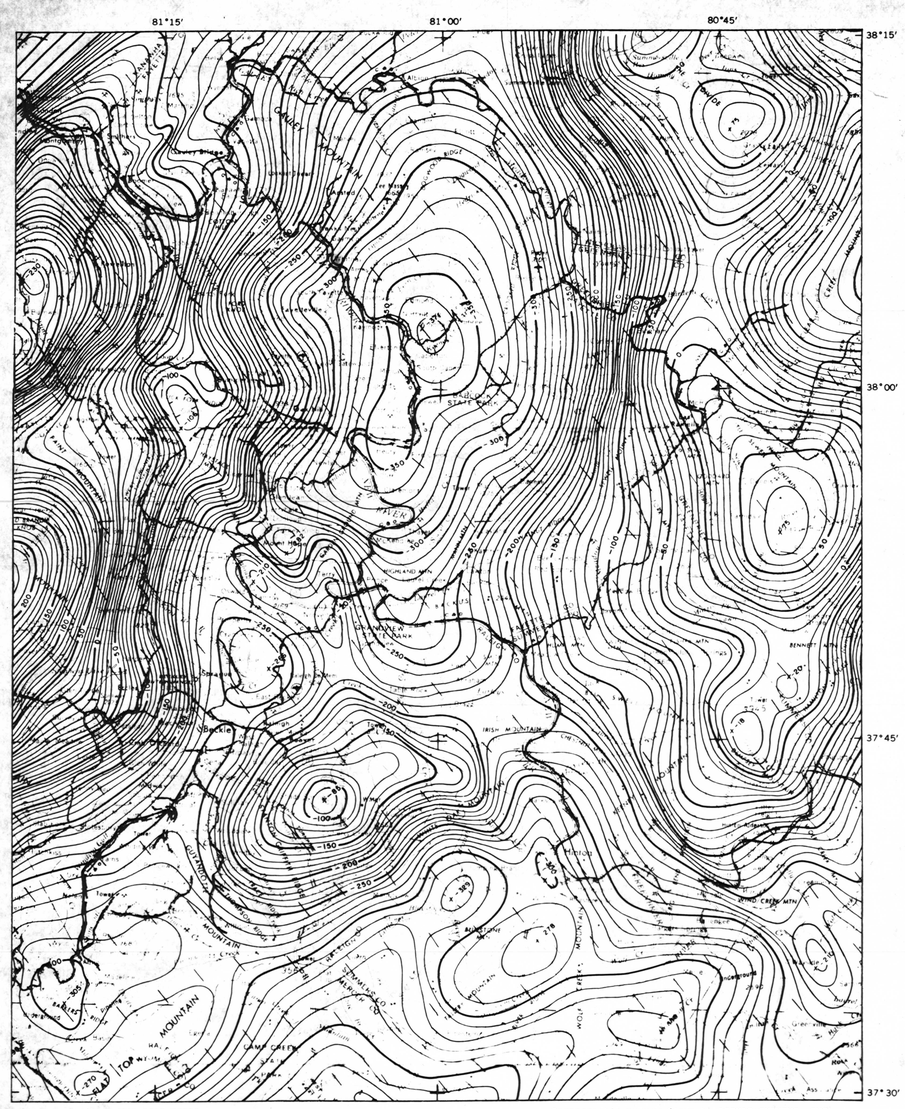
DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

OPEN-FILE REPORT OF 77-76 MAP--D
Mineral resource, geological, and geophysical maps of the New River Gorge area, Fayette, Raleigh and Summers Counties, West Virginia



PRINCIPAL FACTS OF THE IGRF FIELD
Inclination 69°40'N
Declination 5°32'W
Total intensity 56385 Gammas
Gradient East -1.8° Gammas/Mile
Gradient North 6.6° Gammas/Mile.

Aeromagnetic survey flown by AIRMAG SURVEYS, INC. and compiled by G_X GEOPHYSICAL EXPLORATION CORPORATION
Flown at 1000 feet ground clearance. 1973

SCALE 1:250 000

5 0 5 10 15 20 25 30 35 40 45 KILOMETRES

5 0 5 10 15 20 25 MILES

EXPLANATION

Magnetic Contours

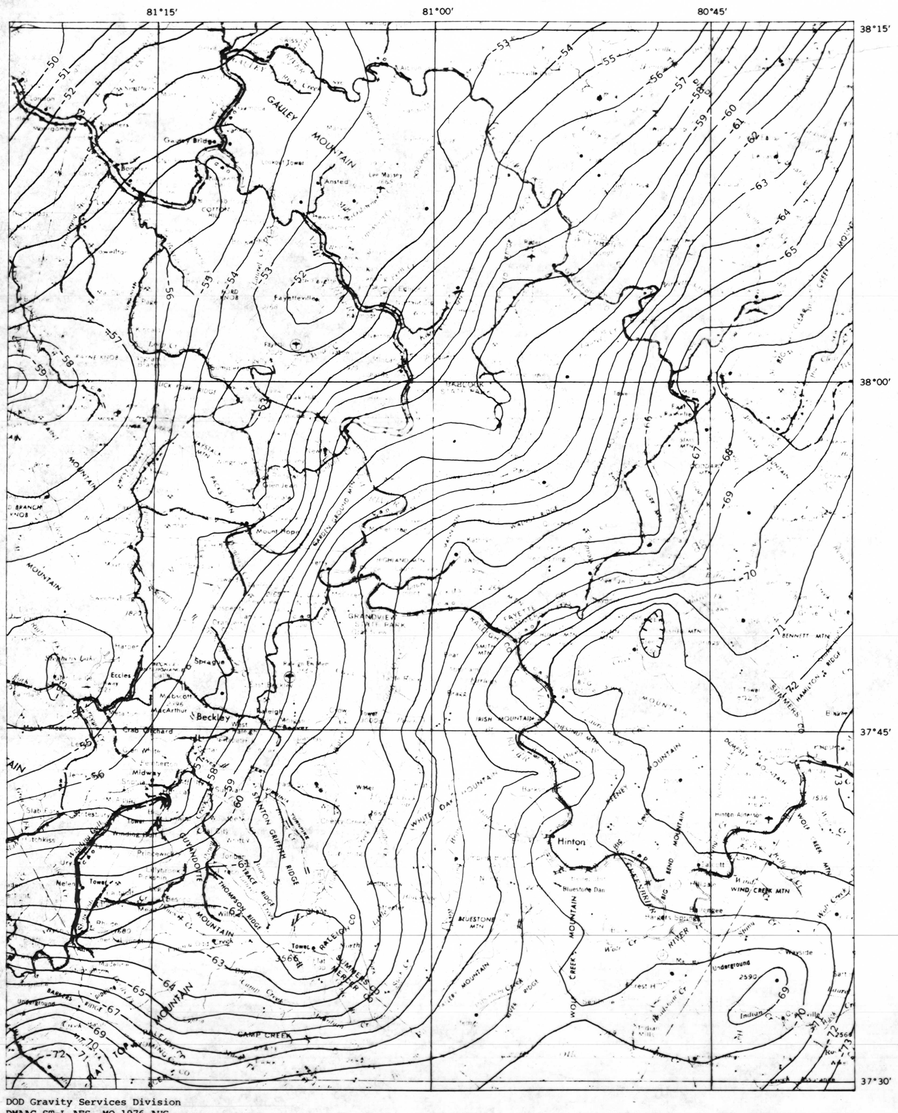
Contours show the reduced total magnetic field intensity derived from the total magnetic field with the Epoch 1965.0 international geomagnetic reference field (Ref "Grid Values of Total Magnetic intensity IGRF--1965" by E. B. Fabiano and N. W. Peddie, Coast and Geodetic Survey Technical Report No. 38, 55 p., 1969) removed. Hachured to indicate closed areas of lower magnetic intensity. Contour intervals 10 and 50 gammas.

Location of measured maximum or minimum intensity within closed high or closed low

Flight path

Showing location and spacing of data

AEROMAGNETIC MAP OF NEW RIVER GORGE AREA,W.VA.



DOD Gravity Services Division
DMAAC ST-L AFS. MO 1976 AUG
Contour Int. = 1 mgal

SCALE 1:250 000

5 0 5 10 15 20 25 30 35 40 45 KILOMETRES

5 0 5 10 15 20 25 MILES

EXPLANATION

Contours in milligals, hachured to indicate closed lows.

Location of gravity measurement

BOUGUER GRAVITY MAP OF NEW RIVER GORGE AREA, W.VA.

The Aeromagnetic Map

The aeromagnetic map presented here of the New River Gorge area and vicinity is part of the recently completed aeromagnetic survey of West Virginia (U.S. Geological Survey, 1974). The aeromagnetic survey was performed as a joint project of the Geological and Economic Survey of West Virginia and the U.S. Geological Survey in order to obtain a better understanding of the basement rocks underlying the Paleozoic sedimentary rocks of the Appalachian Plateau of West Virginia.

The aeromagnetic survey consisted of a series of profiles flown along northwest-southeast flight lines spaced two miles apart. The aircraft maintained an average altitude of 1000 feet above the terrane. The earth's main magnetic field, the International Geomagnetic Reference Field or IGRF (Fabiano and Peddie, 1969) has been subtracted and the residual magnetic data have been contoured at intervals of 10 and 50 gammas. The part of the resulting magnetic map covering the study area and surrounding region is presented here. The area of the map is shown on the accompanying location map.

The magnetic anomalies on the map are smooth and broad, indicating that they are caused by rocks at considerable depth, since the steepness of the magnetic gradient bears a direct relationship to the depth of the source of the anomaly. Sedimentary rocks rarely contribute significantly to the magnetic relief because of their low magnetite content, in contrast to that of the crystalline rocks of the basement. These latter igneous and metamorphic rocks contain magnetite in amounts that vary with their lithology, usually with higher concentrations in the more mafic rocks, which characteristically give the largest magnetic anomalies. Nothing is known directly about the basement rocks of the New River Gorge area, as there are no drill holes that reach basement in this area. There are only half a dozen drill holes to basement in the entire state, the nearest being over 50 miles to the west, where basement is found at over 18,000 feet below sea level.

A study of the magnetic map of the state as a whole, now underway, has revealed a throughgoing magnetic lineament which crosses the state from southwest to northeast. This lineament can be traced along strike with very little deviation both to the northeast and to the southwest under the sediments of the Appalachian basin. The lineament, which has been named the New York-Alabama lineament by King and Zietz (1977), marks a profound break in the basement rocks and probably existed long before the sedimentary rocks were deposited. The lineament consists of a series of northeast-trending linear gradients. The magnetic patterns on either side indicated that sharply contrasting lithologic units of basement rocks are present on either side of a linear boundary. This boundary passes across the extreme northwest corner of the map of the New River Gorge area. The nature and origin of this boundary are not known, but it could be an old plate boundary, a major fault with predominant strike-slip displacement, or a possible suture. The correlation of the magnetic lineament with regional gravity data is very good. The lineament lies along the west flank of the large gravity low which is apparently associated with the Appalachian basin and separates a region of northeast-trending gravity contours on the southeast from the large, predominantly north-trending gravity anomalies of the continental interior. The boundary defined by this geophysical lineament appears to mark the southeast side of a stable block which bounds major Appalachian deformation with the bulge formed by the tightly folded rocks of Pennsylvania and the arcuate thrust slides of Tennessee forming tectonic salients tangential to it. Most of West Virginia, including the New River Gorge study area, lies in the recess between these two salients.

The New River Gorge is located in a broad, north-trending magnetic low, which is terminated on the north by a narrow magnetic ridge that is part of the New York-Alabama lineament. The low is bounded on the west by a group of large highs which delineate an area of strongly magnetic rocks in the basement. The east side of the low is formed by a north-south-trending pair of highs only a third as high as those on the west. The lower amplitude indicates that it is caused by rocks which have a lower magnetite content. Preliminary depth analyses indicate a slightly greater depth for the eastern unit, but the difference, 2000 feet at the most, is not enough to account for more than a fraction of the smaller anomaly amplitude. Consequently, the lower amplitude is probably accounted for primarily by a different kind of rock.

The large magnetic low of the New River Gorge area which lies between these highs is evidence of a relatively non-magnetic basement terrane, possibly a north-south trough of metasedimentary rocks. Thus, the general orientation of the Precambrian terrane in this area is predominantly north-south, which may have influenced sedimentation and deformation of the overlying Paleozoic section.

The Gravity Map

The gravity map of the New River Gorge study area, covering the same area as the magnetic map, is based on data placed on file with the Defense Mapping Agency by cooperating investigators who have made gravity measurements in this area (Defense Mapping Agency, 1976). There are too few data points to give a map comparable in detail to the aeromagnetic map, but the gravity map is primarily useful for obtaining regional trends.

Gravity anomalies are produced by variations in the density of the rocks on which the station is located. Significant variations in density occur in the sedimentary section, as well as in the igneous and metamorphic basement, which is the source of the magnetic anomalies discussed in the previous section. When the gravity map is superimposed on the magnetic map, little correspondence in either individual anomalies or trends is found. More closely spaced gravity data might reduce this lack of correlation, but it is more probable that the rock units in the basement, while differing greatly in magnetic properties, have too small variations in density to give easily discernible gravity anomalies.

The prevailing alignment of the gravity contours of the New River Gorge area parallels the northeast regional Appalachian structural trend. There is a gradual slope of the gravity values to the southeast across the map area, which is located on the western flank of the previously mentioned gravity low that extends from Pennsylvania to Tennessee and is associated with the very thick Paleozoic sedimentary section of the Appalachian basin. This slope is partly the effect of a deepening of the basement to the southeast, but may also originate from deepening of the mantle according to some interpretations. Variations in density within the sedimentary rocks, such as from a dominant carbonate composition on the west to a higher content of clastics to the southeast, may also contribute to this gravity gradient. There is one reversal of this gradient where a narrow, northeast-trending high about 5 mgals in amplitude crosses the map area in the vicinity of Fayetteville. There is no counterpart of this anomaly in the magnetic map, which makes it unlikely that it is caused by a denser rock unit in the basement. A lithologic change in the overlying sedimentary rocks is a more probable cause of this gravity high.

Although there is an overall slope of the gravity map to the southeast from the gravity high at Fayetteville, the gradient is not uniform, but drops more rapidly in a 20-mile wide belt running northeast across the middle of the map. The decrease averages 15 mgals and cuts across the nearly north-trending magnetic low that occupies the center of the map area. This locally steeper gravity gradient may reflect a lateral change in lithology of the sediments as they were originally deposited or possibly may be caused by a local deepening of the basement surface, or by some combination of the two, but neither explanation can be verified without more gravity data and better geologic control.

References Cited

Defense Mapping Agency, 1976, Unpublished Bouguer anomaly plots in files of the Defense Mapping Agency, St. Louis, Mo., 1:250,000.

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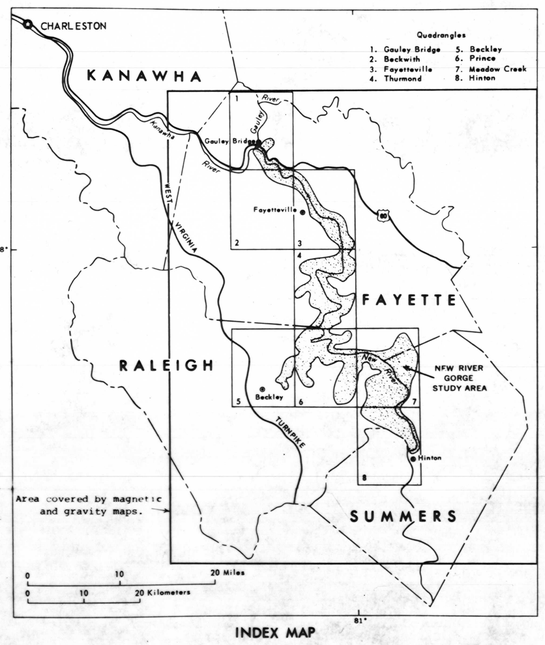

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U.S. Geological Survey

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AEROMAGNETIC AND GRAVITY MAPS, NEW RIVER GORGE AND VICINITY, WEST VIRGINIA

By
Elizabeth R. King

1977

Interior—Geological Survey, Reston, Va.—1977