DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY
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GEOPHYSICAL INVESTIGATIONS
MAP GP-966

INTRODUCTION

The aerial radiometric data used to produce these maps were obtained from the U.S. Department of Energy (DOE) and are part of the data base obtained during the DOE National Uranium Resource Evaluation Program (NURE). Tapes containing digital data were assembled from the following 2° quadrangles: Canton (DOE, 1980a), Charleston (DOE, 1980c), Cincinnati (DOE, 1981d), Clarksburg (DOE, 1980b), Cleveland (DOE, 1982), Columbus (DOE, 1981h), Fort Wayne (DOE, 1981b), Huntington (DOE, 1981e), Louisville (DOE, 1981c), Marion (DOE, 1981g), Muncie (DOE, 1981a), and Toledo (DOE, 1981f). These data were measured by several different contractors using high-sensitivity gamma-ray spectrometers with 2000–3000 cubic inches of sodium-iodide detector crystals. The nominal survey altitudes were 400 feet above the ground surface. The flight lines were flown east-west at a nominal spacing of 6 miles with north-south tie lines spaced 15 miles apart. The data were fully corrected for background radiation, altitude variations, and airborne Bi-214 radiation. Using the DOE calibration pads at Grand Junction, Colorado (Ward, 1978) and the DOE dynamic test strip at Lake Meade, Arizona (Geodata International, Inc., 1977), the gamma-ray systems were calibrated so that the measurements could be expressed as the apparent surface concentrations of equivalent uranium (ppm eU), equivalent potassium (percent K), and equivalent thorium (ppm eTh).

Prior to preparation of the maps, the data were further processed. The processing steps were: (1) filtering of the flight-line data using a Gaussian filter with a standard deviation of 10 measurement points, (2) level and sensitivity corrections to remove differences between the measurement systems used by different contractors, (3) gridding the data using a minimum curvature algorithm (Briggs, 1974), and (4) low-pass filtering of the gridded data to remove wavelengths less than 25 kilometers. The flight-line data were filtered to reduce noise and high-frequency variations of the data prior to gridding. Level corrections were made by adding or subtracting constant values to limited parts of the data sets. Problems with data levels were usually within a single data set and can be caused by small gain shifts in the spectra, the use of different background corrections, differences in soil water content as the result of rain, and errors in data processing by the contractors. Sensitivity corrections were made by multiplying an entire data set by a constant factor and were made necessary because the different contractor systems sometimes did not give the same results over the same materials. Because the systems were calibrated using the same calibration sources, these sensitivity differences should not occur. The reasons for their occurrence is unknown at this time. The low-pass filtering of the gridded data using a fast Fourier technique was done to remove small-wavelength features that are not consistent with the flight-line spacing and the map scale.

Because of the wide flight-line spacing, the 2-mile-grid interval, and the low-pass filters applied, these maps are regional maps and should only be used in a regional context. The accuracies of the concentration values are estimated to be better than 20 percent in a relative sense and from 50 to 100 percent in an absolute sense. By relative sense I mean the comparison of data from different parts of these maps. By absolute sense I mean the comparison of these concentration values obtained from other sources such as ground or laboratory measurements.

After the final gridded data sets were obtained for each of the three elements—uranium, potassium, and thorium—these data sets were converted to a composite color image using the techniques described by Duval (1983). The individual pixels in the image have side dimensions equal to the 2-mile-grid interval. For this conversion, the data are mapped to a scale of 0–255 such that the first 2 percent of the data (as determined from a cumulative frequency histogram) are assigned a value of 1, the last 2 percent a value of 255. The remaining data are linearly mapped from 2 to 254. Each data set is then transferred to film using a red, green, or blue filter to selectively expose the red-, green-, or blue-sensitive emulsions of a color film. The amount of exposure is proportional to the magnitude of the data. For this particular presentation, uranium was exposed with the red filter, potassium with the green filter, and thorium with the blue filter. Because of the complexities of color combinations, the reader should not, however, attempt to interpret the relative amounts of the elements from the observed colors. The value of this map is to provide a synthesis of the radiometric data that reflects a partial geochemical picture of the surface materials. As such, this map should be interpreted on the basis of color patterns and their correlation with other data such as geologic maps.

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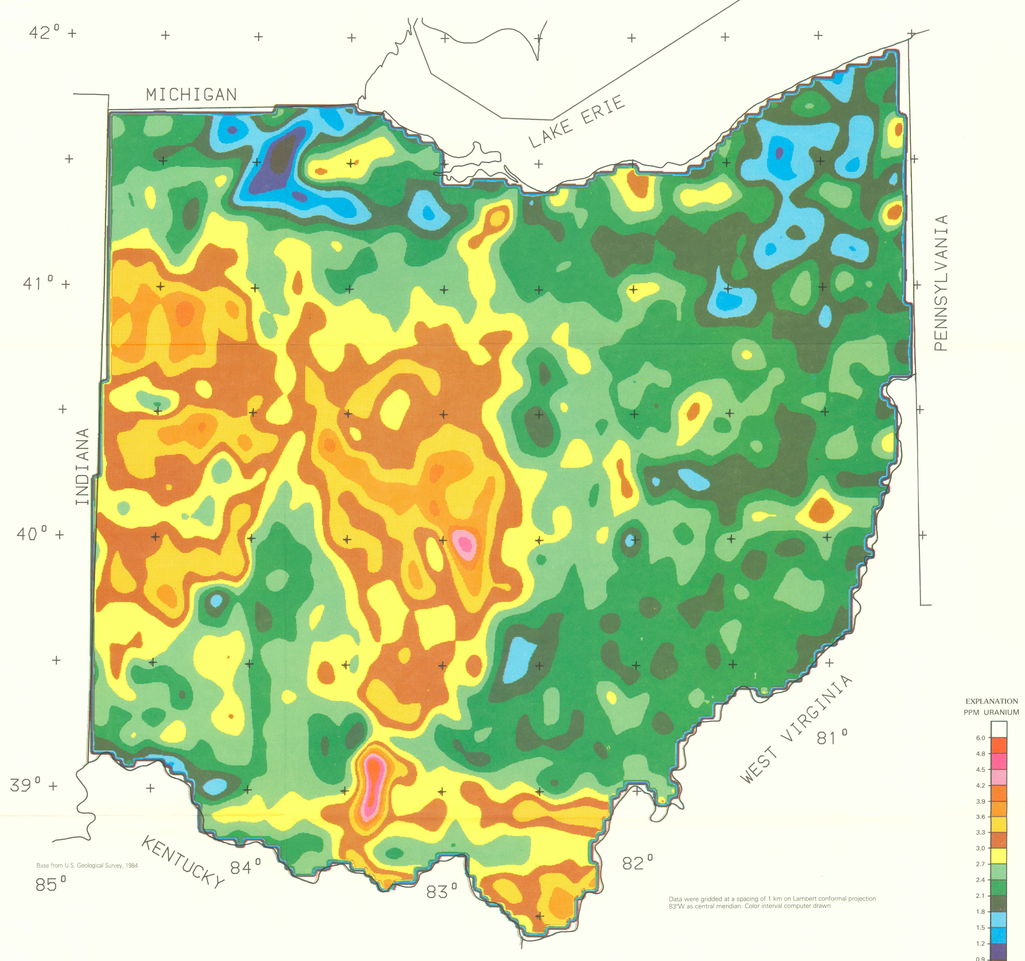
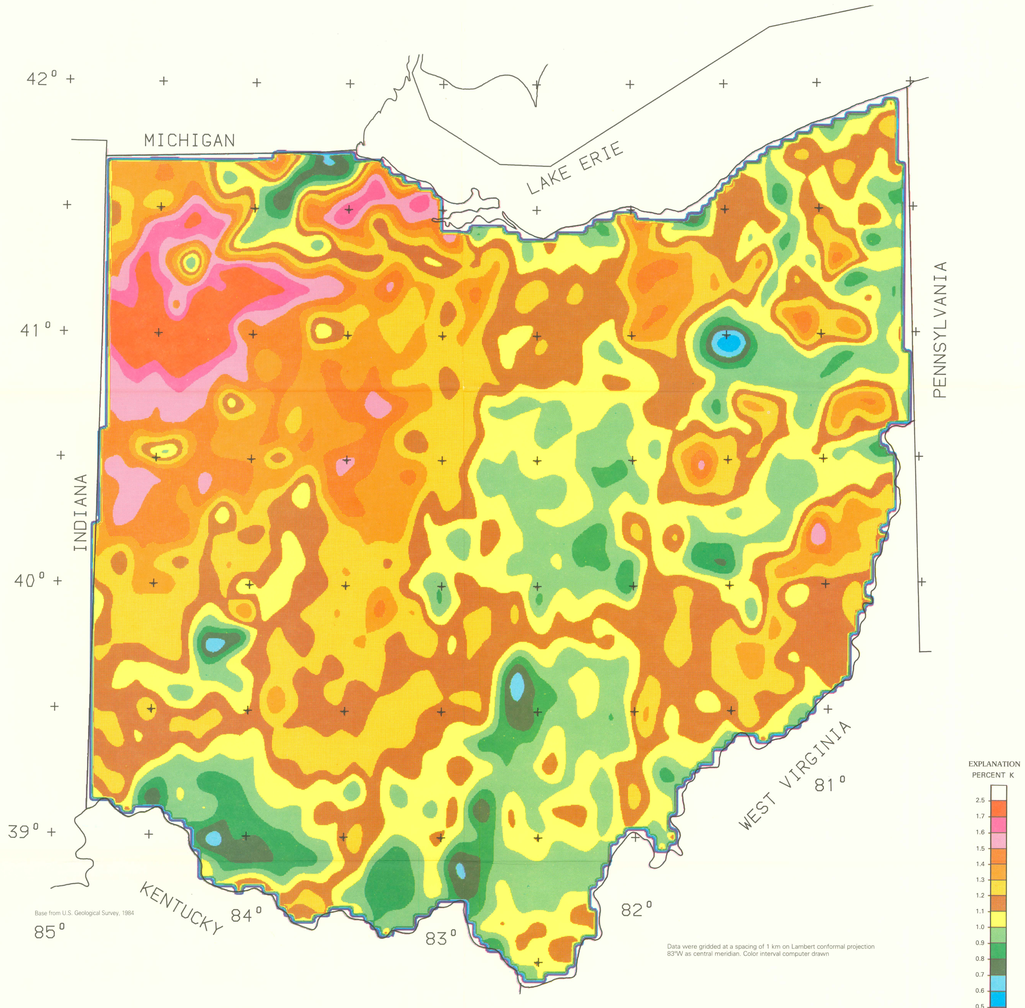
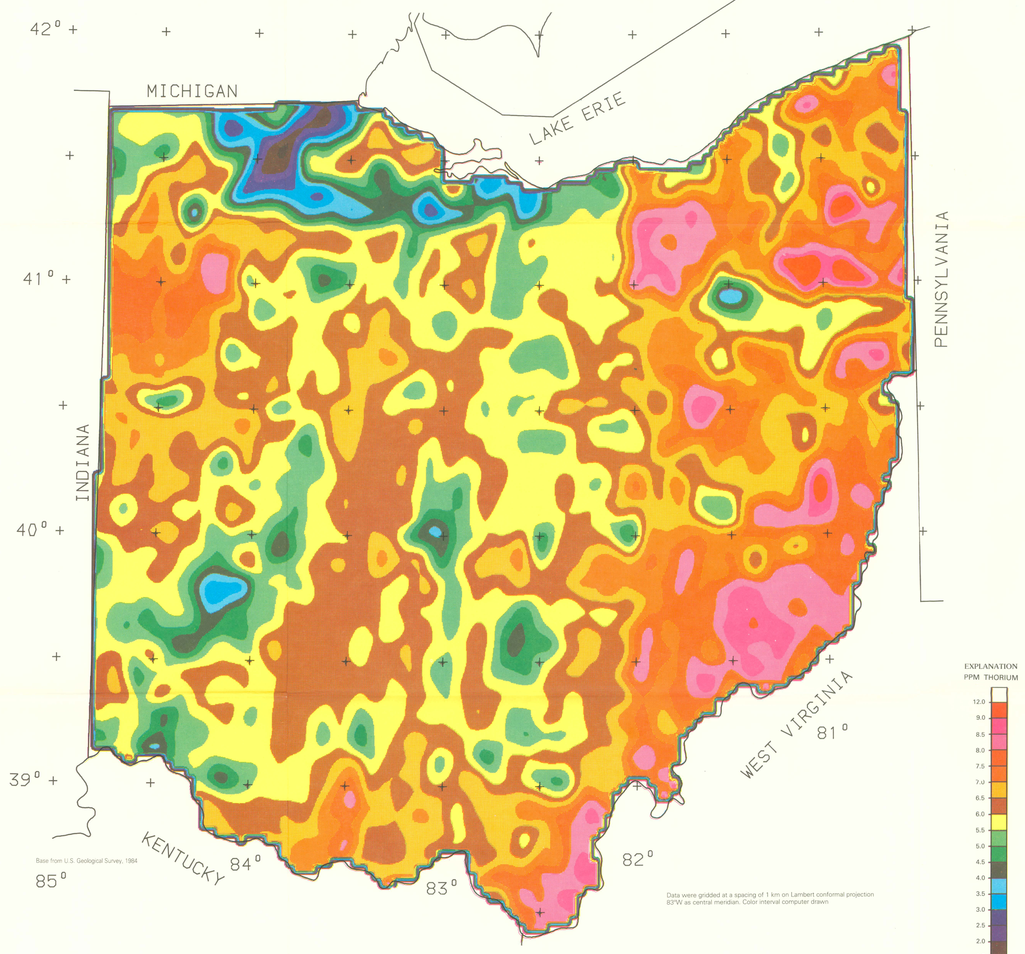


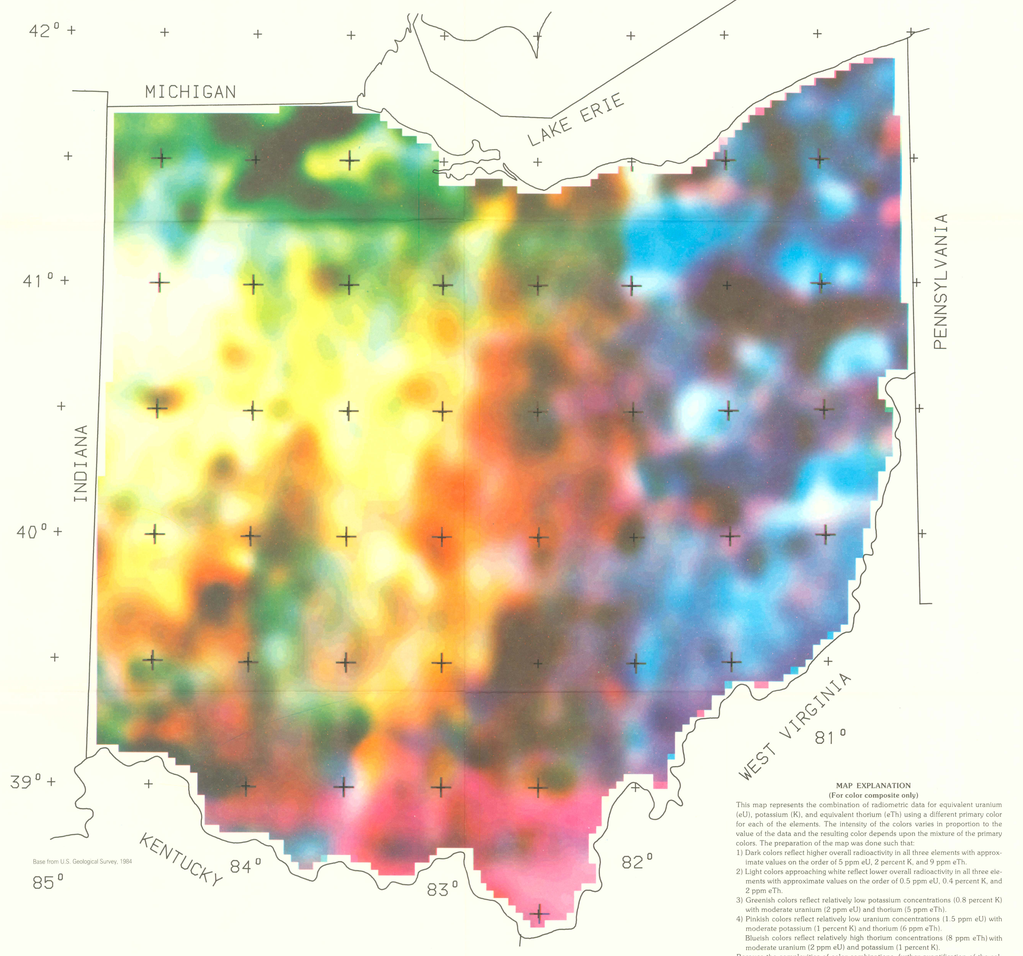
Map A.—Uranium (ppm eU)



Map B.—Potassium (percent K)



Map C.—Thorium (ppm eTh)



Map D.—Composite

SCALE 1:1 000 000
25 0 25 50 75 MILES
25 0 25 50 75 100 125 KILOMETERS

MAP EXPLANATION
(For color composite only)

This map represents the combination of radiometric data for equivalent uranium (eU), potassium (K), and equivalent thorium (eTh) using a different primary color for each of the elements. The intensity of the colors varies in proportion to the value of the data and the resulting color depends upon the mixture of the primary colors. The preparation of the map was done such that:

1) Dark colors reflect higher overall radioactivity in all three elements with approximate values on the order of 5 ppm eU, 2 percent K, and 9 ppm eTh.
2) Light colors approaching white reflect lower overall radioactivity in all three elements with approximate values on the order of 0.5 ppm eU, 0.4 percent K, and 2 ppm eTh.
3) Greenish colors reflect relatively low potassium concentrations (0.8 percent K) with moderate uranium (2 ppm eU) and thorium (5 ppm eTh).
4) Pinkish colors reflect relatively low uranium concentrations (1.5 ppm eU) with moderate potassium (1 percent K) and thorium (6 ppm eTh).
   Blueish colors reflect relatively high thorium concentrations (8 ppm eTh) with moderate uranium (2 ppm eU) and potassium (1 percent K).

Because the complexities of color combinations, further quantification of the colors is not practical. The reader should use this map to define areas of similar colors or color patterns as a reflection of the radiometric character of a given surface material.

AERIAL RADIOMETRIC COLOR CONTOUR MAPS AND COMPOSITE COLOR MAP OF REGIONAL SURFACE CONCENTRATIONS OF URANIUM, POTASSIUM, AND THORIUM IN OHIO

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