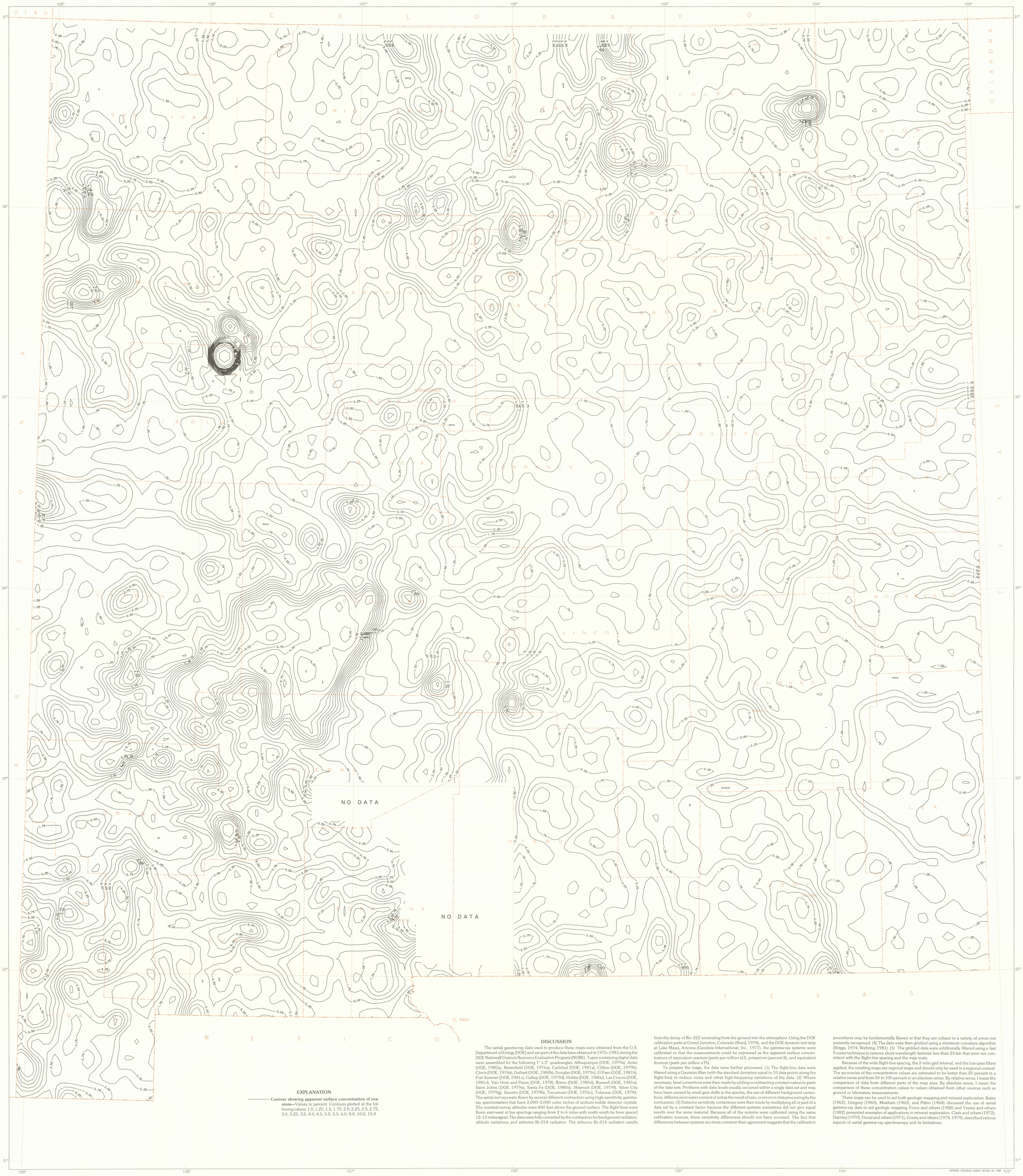

EXPLANATION

Contour showing apparent surface concentration of uranium—Values in percent. Contours plotted at the following values: 1.0, 1.25, 1.5, 1.75, 2.0, 2.25, 2.5, 2.75, 3.0, 3.25, 3.5, 4.0, 4.5, 5.0, 5.5, 6.0, 8.0, 10.0, 15.0

DISCUSSION

The aerial gamma-ray data used to produce these maps were obtained from the U.S. Department of Energy (DOE) and are part of the data base obtained in 1975–1983 during the DOE National Uranium Resource Evaluation Program (NURE). Tapes containing digital data were assembled for the following 1° x 2° quadrangles: Albuquerque (DOE, 1979a), Aztec (DOE, 1980a), Brownfield (DOE, 1976a), Carlsbad (DOE, 1981a), Clifton (DOE, 1979b), Clovis (DOE, 1976b), Dalhart (DOE, 1980b), Douglas (DOE, 1979c), El Paso (DOE, 1981b), Fort Sumner (DOE, 1981c), Gallup (DOE, 1979d), Hobbs (DOE, 1980c), Las Cruces (DOE, 1981d), Van Horn and Pecos (DOE, 1978), Raton (DOE, 1980d), Roswell (DOE, 1981e), Saint Johns (DOE, 1979e), Santa Fe (DOE, 1980e), Shiprock (DOE, 1979f), Silver City (DOE, 1979g), Socorro (DOE, 1979h), Tucumcari (DOE, 1976c), Tularosa (DOE, 1979i). The aerial surveys were flown by several different contractors using high-sensitivity gamma-ray spectrometers that have 2,000–3,000 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 line spacings ranging from 2 to 6 miles with north-south tie lines spaced 12–15 miles apart. The data were fully corrected by the contractors for background radiation, altitude variations, and airborne Bi–214 radiation. The airborne Bi–214 radiation results from the decay of Rn–222 emanating from the ground into the atmosphere. Using the DOE calibration pads at Grand Junction, Colorado (Ward, 1978), and the DOE dynamic test strip at Lake Mead, 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 (parts per million eU), potassium (percent K), and equivalent thorium (parts per million eTh).

To prepare the maps, the data were further processed. (1) The flight-line data were filtered using a Gaussian filter (with the standard deviation equal to 10 data points along the flight-line) to reduce noise and other high-frequency variations of the data. (2) Where necessary, level corrections were then made by adding or subtracting constant values to parts of the data sets. Problems with data levels usually occurred within a single data set and may have been caused by small gain shifts in the spectra, the use of different background corrections, differences in water content of soil as the result of rain, or errors in data processing by the contractors. (3) Detector sensitivity corrections were then made by multiplying all or part of a data set by a constant factor because the different systems sometimes did not give equal results over the same material. Because all of the systems were calibrated using the same calibration sources, these sensitivity differences should not have occurred. The fact that differences between systems are more common than agreement suggests that the calibration procedures may be fundamentally flawed or that they are subject to a variety of errors not presently recognized. (4) The data were then gridded using a minimum curvature algorithm (Briggs, 1974; Webring, 1981). (5) The gridded data were additionally filtered using a fast Fourier technique to remove short-wavelength features less than 25 km that were 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, the resulting 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 the map area. By absolute sense, I mean the comparison of these concentration values to values obtained from other sources such as ground or laboratory measurements.

These maps can be used to aid both geologic mapping and mineral exploration. Bates (1962), Gregory (1960), Moxham (1960), and Pitkin (1968) discussed the use of aerial gamma-ray data to aid geologic mapping. Force and others (1982) and Yeates and others (1982) presented examples of applications in mineral exploration. Clark and others (1972), Darnley (1970), Duval and others (1971), Grasty and others (1978, 1979), described various aspects of aerial gamma-ray spectroscopy and its limitations.

Planimetric base from U.S. Geological Survey, 1984
New Mexico state map, 1:500,000

SCALE 1:750 000

25 0 25 50 75 100 MILES

25 0 25 50 75 100 KILOMETERS

INTERIOR—GEOLOGICAL SURVEY, RESTON, VA—1988

Contour map showing regional surface concentrations of uranium

AERIAL GAMMA-RAY CONTOUR MAPS OF REGIONAL SURFACE CONCENTRATIONS OF URANIUM, POTASSIUM, AND THORIUM IN NEW MEXICO

By
Joseph S. Duval

1988

For sale by U.S. Geological Survey, Map Distribution, Box 25286, Federal Center, Denver, CO 80225