

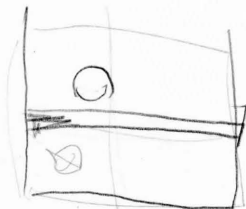
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**A Geologic Assessment of NURE Preferred Uranium Anomalies
in the Illinois Region of the Paducah Quadrangle: Southern Illinois**

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**A Geologic Assessment of NURE Preferred Uranium Anomalies
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Executive Summary

The NURE survey of the Paducah Quadrangle identified 18 "preferred uranium anomalies" in southern Illinois which may be related to geologic factors. The airborne survey used indirect atmospheric gamma spectral data to determine uranium concentrations in geologic materials. Such factors as ground saturation, atmospheric inversions and topography affected the instrumentation, making the reliability of the data questionable. The survey was flown along east-west flight lines spaced 6 miles apart and north-south tie lines spaced 18 miles apart. The width of investigation along each flight line was approximately 600 feet, resulting in areal coverage of about 2 percent. Because of the rapid attenuation of gamma rays by geologic materials, the maximum depth of investigation is about 18 inches. Therefore, except in areas of bedrock outcrop, the survey measured responses to surficial materials only. Possible causes of the 18 anomalies are: a) cultural features not identified by the NURE contractor; b) atmospheric inversions that distort the distribution of terrestrial gamma radiation; c) difficult altitude correction over areas of rugged terrain; d) shale and coal outcrops or shale and coal occurrence in the very shallow subsurface; e) faulting and mineralization associated with Hick's Dome.

Because radon occurs in the decay series measured in the NURE survey, it is possible that the "preferred uranium anomalies" are related to increased levels of radon in soil gas. This is why these anomalies have been presented to the public as "radon hot spots," although no relationship has ever been rigorously demonstrated. The 18 anomalies range in size from 600 to 3,700 feet along the flight lines. According to topographic maps, occupied houses are present in 4 of the anomalous areas and are within 1/2 mile of 17 of the anomalies. Two of the areas in which houses are present are also relatively strong anomalies, meaning that the NURE data show relatively high concentrations of equivalent uranium. These two anomalies are given first priority for ground verification surveys.

This report presents a characterization of 18 "Preferred Uranium Anomalies" identified in the southern Illinois region of the NURE report for the Paducah Quadrangle. The 18 anomalies are located in the counties of Alexander, Franklin, Hamilton, Hardin, Jackson, Johnson, Pope, Saline, Union, and Williamson. The anomalies were identified as part of a nationwide aerial gamma ray spectral survey for uranium resource exploration.

The 18 anomalies range in size from 600 feet to 3,700 feet in length along the flight lines of the aircraft. At the altitude flown, the width of detection is approximately 600 feet. Obviously, the actual detection area varies with the strength of the anomaly and its position relative to the flight line. Therefore, the exact areal extent of each anomaly cannot be determined from the NURE data.

In order to ground check the NURE anomalies, it is important to know their locations accurately. Aircraft location was reported by the contractor to the nearest ten-thousandth of a degree of latitude and longitude. This is a very high level of precision and implies that the location is correct to within about 20 feet. This information was used to plot the anomalies on 7.5-minute topographic maps. The accuracy of the locations is another question; however, and we are at the mercy of the contractor. Although the contractor describes the method and instrumentation used to determine location, there are no accuracy limits placed on the location data. The aircraft was guided by a Bendix automatic pilot and an ^{inertial} ~~initial~~ navigation system. A 35 mm tracking camera provided a photographic record at the center of each 1.0 second counting interval.

For the specified aircraft speed of 140 mph the 1.0 second record period represents a 220 foot strip of terrain along the flight path. Although the tracking camera photographed the center of each 1.0 second sample interval,

the 35 mm tracking film record was used to precisely locate the position of the aircraft at 10 mile intervals, "except when terrain characteristics warranted picking points at closer intervals." The specified nominal terrain clearance along flight lines was 400 feet. Terrain clearance was maintained by the pilot monitoring a radar altimeter. ✓

The spectral data were gathered by a ^{thallium} thallium activated sodium-chloride ^{iodide} crystal system mounted on a DC-3 aircraft. For the Paducah Quadrangle, gamma-^ary spectral data were gathered on east-west traverse lines at six mile spacings and on north-south tie lines at 36-mile intervals. Because of the rapid attenuation of gamma rays by solids, the measurement recorded by the airborne spectrometer ^f is representative of only the upper 12 to 18 inches of geologic materials. The spectral data were processed for uranium resource exploration. This was done by examining abundances and abundance ratios for uranium (U-238), thorium (Th-232), and radioactive potassium (K-40). ✓

In the airborne spectrometer survey, K-40 is directly measured by a single clear peak at 1.46 MeV (million electron volts). By ^Dcontract, Th-232 and U-238 do not have ~~clear~~ distinct gamma radiation peaks. The abundance of these isotopes ¹⁵ are interpreted by measuring peaks for the daughter nuclides ⁵ Bismuth 214 (for U-238) and Thallium-208 (for Th-232). The Bismuth 214 (Bi-214) peak is at 1.75 MeV and the Thallium-208 (Th-208) peaks at 2.615 MeV. A fundamental assumption in calculating the abundance of uranium and thorium is that a state of equilibrium exists between parent and daughter nuclides. The U-238 and Th-232 decay series are shown in figures 1 and 2. ✓

In processing the gamma spectral data, the contractor used specific criteria for designating uranium anomalies. Measurements were considered anomalous if the values of eU (equivalent uranium measured by bismuth-214), eU/eTh (ratio of eU to eTh, equivalent thorium measured by thallium-208), and

eU/K (the ratio of eU to K, potassium measured by potassium-40) were significantly higher than the mean value for the geologic unit in which the measurement is located. The ratios eU/eTh and eU/K are considered important because uranium is commonly enriched with respect to thorium and potassium in known uranium occurrences. An anomaly could be based either on a small number² (or even one) ^{of high measurements} very high measurement) or a larger number of successive measurements of lower value. The minimum requirements for designation as an anomaly are:

<u># of Measurements Supporting Anomaly</u>	<u>Minimum Deviation (above mean for geologic unit)</u>
1	4.00 standard deviations
2	2.54 standard deviations
3	1.87 standard deviations
4	1.45 standard deviations

Anomalies meeting these requirements for eU, eU/eTh, and eU/K were designated as first-priority by the contractor. Second-priority anomalies had only two of the three measurements meeting the above criteria. The 18 anomalies considered in this report are all first-priority anomalies.

After defining the anomalies as described above, the contractor attempted to relate the anomalies to nearby geology or cultural features. Any anomalies which the contractor attributed to cultural features were eliminated from consideration in this report, leaving only those anomalies which may have a geologic source.

Because the anomalies are based on levels of eU, eTh, and K relative to the mean of those parameters for each geologic unit, the accuracy^g of the geologic maps used by the contractor is extremely important in determining the validity of the anomalies. The contractor used a geologic map prepared by Trollinger Geological Associates Inc., but Trollinger's source of information

is not stated. The quality of the geologic mapping may not be of importance in this area, however. As can be seen from Table 1, the radioactivity levels for all the geologic materials in the area are very low and there is not a great deal of variation among the different materials. For example, the eU concentration varies by a factor of less than 3 for all the mapped geologic units. There are three possible explanations for this:

- 1) the concentrations of U, Th, and K are in fact low and show little variation among the geologic materials in southern Illinois.
- 2) the actual radioactivity levels are masked by a thin layer of surficial material (recall that the aerial survey has a maximum depth of investigation of about 18 inches). *thin deposits*
The surficial geologic material over much of Southern Illinois are loess (windblown silts) or reworked loess deposits in slope wash and alluvial deposits.
- 3) the geologic mapping is incorrect and real differences between geologic units have been averaged out in the processing of the gamma spectral data.

If the first or second explanations are true, then anomalies would show up in the same locations regardless of the accuracy of geologic mapping. However, if the third explanation is correct, then reprocessing of the data based on different geologic mapping could result in anomalies in different locations.

Bismuth-214 is a daughter nuclide of radon-222 (see fig. 1), and therefore, interest has developed in the application of NURE data to identify radon prone areas. There is speculation that the "preferred uranium anomalies" identified in the NURE reports may be localities of higher potential for

Department
indoor radon problems. The Illinois ~~Operation~~ of Nuclear Safety and the Illinois State Geological Survey have selected the Paducah Quadrangle as a region of southern Illinois for investigating the significance of the "uranium anomalies" to indoor radon. One reason for selecting the Paducah Quadrangle is that it includes the region of Hicks Dome, a crypto-explosive structure with associated weak uranium/thorium mineralization.

Table 2 summarizes geologic, topographic, and cultural characteristics of the 18 anomalies. Southern Illinois is a region of relatively rugged terrain. One possible explanation for some of the anomalies is the difficulty of correcting an airborne survey for altitude changes over rugged terrain. It is also possible for atmospheric inversions to create anomalous bismuth levels at the altitude the aircraft was flying. Valleys are especially prone to this phenomenon, and several of the anomalies in southern Illinois appeared over valleys. Several of the anomalies could be caused by cultural features which the DOE contractor failed to identify. Possible geologic causes are the shales and coals of southern Illinois in areas where they occur in outcrop or the very shallow subsurface. One of the survey flight lines passes over Hicks Dome, which because of its associated faulting and mineralization could produce anomalously high radioactivity levels detectable in airborne surveys.

Although southern Illinois is not an area of high population density, there are occupied houses within 1/2 mile of 17 of the anomalies according to USGS topographic maps. There are occupied houses within four of the anomalous areas. Table 3 ranks the relative "strength" of the anomalies based on their size and radioactivity level determined in standard deviations above the norm for the appropriate geologic unit. Combining the information from Tables 2 and 3, it can be seen that two of the highest ranking anomalous areas (26 and 51) include occupied houses. These two anomalies should have the highest

priority for ground verification. Six other anomalies (15, 28, 34, 49, 53, 54) are either highly ranked for "strength" or include occupied houses within their areas of influence. These six anomalies should have second priority for ground survey verification.

The appendix of this report presents a discussion of each of the 18 "preferred uranium anomalies" that were identified by the NURE report in the Illinois portion of the Padacuh Quadrangle. The discussions are keyed to a set of 7.5-minute topographic quadrangles that show the location of each anomaly. The information presented in the appendix ^{is} ~~are~~ intended to assist in the design and performance of a field study of the significance of the anomalies to indoor radon.

Appendix

Description of Anomalies in the Southern Illinois Area of the Paducah Quadrangle

Anomaly No. 5

Rank - Moderate

Location - Christopher Quadrangle 1968
Section 21 and 28, T.6S., R.1E., Franklin County
Anomaly approximately 1,500 feet long on east-west flight line

Cultural Setting - Topographic map shows no houses within anomaly; approximately 15 residences within 1/2 mile. Anomaly is located 3/4 mile northeast of Mulkeytown and 2 miles west of Christopher. A north-south light ~~dirt~~ ^{duty} road crosses the western part of the anomaly. A rural cemetery is located on a knoll 500 feet north of the anomaly.

Physical Setting/Geology - The anomaly is located in a broad, gently rolling lowland area with surface elevations ranging from 450 to 480 feet above sea level.

Regional data predicts that glacial materials are less than 25 feet thick and consist of more than 5 feet of loess over till (Vandalia Member of Glasford Formation). Pennsylvanian bedrock (Upper Modesto Formation) is shale, sandstone, and siltstone with local occurrence of coal, limestone, and black shale.

Possible Explanation - Poor navigation control; flight passed over cemetery.

Anomaly No. 9

Rank - Moderate

Location - Walpole Quadrangle 1963
Sec. 27, T.7S., R.6E., Hamilton County
Anomaly approximately 2,100 feet long on east-west flight line

Cultural Setting - Anomaly is sited over a crude oil storage facility (storage tanks and access roads). Topographic map shows no houses located in the anomaly; approximately 5 houses within 1/2 mile. Anomaly is located 2 1/2 miles southwest of Dale.

Physical Setting/Geology - The anomaly is located in a broad relatively flat lowland area with land surface elevations ranging from 385 to 390 feet above sea level.

Regional data predicts less than 25 feet of glacial materials that consist of less than 5 feet of loess over water-laid sediments (Carmi Member of the Equality Formation). Pennsylvanian bedrock (upper Modesto Formation) is mostly shale, sandstone, and siltstone with local occurrence of coal, limestone and black shale.

laid

Possible Explanation - Anomaly may be related to crude oil storage facility.

Anomaly No. 15

Rank - High

Location - Crab Orchard Quadrangle, photorevised 1978
Sec. 21 and 28, T.9S., R.4E., Williamson County
Anomaly approximately 3,200 feet long on east-west flight line

Cultural Setting - Anomaly located within area of strip mining of coal resources. Topographic map shows no houses within anomaly; approximately 3 houses within 1/2 mile. The anomaly is located 2 miles southeast of Crab Orchard. A dirt road provides access to the western part of the anomaly.

Physical Setting/Geology - Surficial materials^a are spoil from strip-mining. Pennsylvanian bedrock (Carbondale Formation) is mostly shale, sandstone, and siltstone with some coal, limestone, and black shale.

Possible Explanation - Higher radioactivity associated with black shale in spoil material.

Anomaly No. 23

Rank - Moderate to Low

Location - Pamona Quadrangle, photorevised 1978
Section 4 and 9, T.10S., R.2W., Jackson County
Anomaly approximately 1,200 feet long on north-south flight line

Cultural Setting - Topographic map shows no houses within anomaly; approximately 5 houses within 1/2 mile. Main line of Illinois Central Gulf Railroad crosses the anomaly. The village of Etherton is located along the railroad 3/4 mile to the northeast. The Blade Diamond Highway flanks the anomaly 800 feet to the east.

Black

Physical Setting/Geology - Anomaly is located in floodplain of Sugar Creek, with land surface elevations ranging from approximately 375 to 400 feet above sea level. Steep slopes occur immediately north and south of the anomaly along the flight line and elevations greater than 540 feet above sea level occur on uplands 1/2 mile north and south of the anomaly.

drained

Regional data predicts less than 25 feet of glacial deposits consisting of more than 15 feet of loess over bedrock. The soil profile is poorly ~~chained~~ alluvial sediments derived from loess. Bedrock is black shales and coals in the Drury Shale Member of the Pennsylvanian.

Possible Explanation - Railroad ballast; atmospheric ⁱ inversion in valley; poor terrain correction.

Anomaly No. 24

Rank - Moderate to Low

Location - Carbondale Quadrangle; photorevised 1978
Sec. 23, T.10S., R.1W., Jackson County
Anomaly approximately 1,000 feet long on east-west flight line

Cultural Setting - Topographic map shows no houses in anomaly or within 1/2 mile. Anomaly located 6 miles southeast of Carbondale in Shawnee National Forest. An unimproved dirt road flanks the northeastern corner of the anomaly.

Physical Setting/Geology - Anomaly situated in very rugged terrain on east valley wall of Indian Creek. Land surface elevations range from 460 to 660 feet above sea level.

fragipan ✓
Regional data indicates glacial materials are less than 25 feet thick and consist of loess over bedrock. The soil profile contains a fragipan (fractured) and was formed in loess, colluvium, and residuum from the bedrock. Bedrock is sandstone, siltstone, and shale, with rare coal and black shale in the Lower Tradewater Formation of the Pennsylvanian. There are no known faults.

Possible Explanation - Shale or coal outcrops on steep slope; atmospheric inversion; poor terrain correction along flight line

Anomaly No. 26

Rank - High. This is the highest ranked anomaly of the 18 discussed in the report

Location - Carrier Mills Quadrangle 1961
Sec. 5 and 8, T.9S., R.5E., Saline County
Anomaly approximately 3,000 feet long on north-south flight line

al
Cultured Setting - Topographic map shows 1 house in anomaly; approximately 20 houses within 1/2 mile. Anomaly located 2 miles southwest of Carrier Mills. An east-west secondary road crosses the center of the anomaly.

Physical Setting/Geology - Anomaly is located on gently sloping land in a minor drainageway. Land surface elevations range from 385 to 410 feet above sea level. The area is surrounded by strip mining activity. The soil map shows more extensive strip mining than the topographic map.

thin — Regional data predicts that surficial materials are ~~their~~ deposits of fine-grained lake sediments (Carmi Member of the Equality Formation) over bedrock; the soil profile is somewhat poorly drained and contains a ~~frazipan~~ *frazipan*. Bedrock is shale, sandstone, siltstone, and coal in the Carbondale Formation of the Pennsylvanian.

Possible Explanation - Strip mining activity has reached this site; black shale or coal in the bedrock is at a very shallow depth.

Anomaly No. 28

Rank - High. This the second highest anomaly of the 18 discussed in this report.

Location - Rudement Quadrangle 1959
Sec. 22 and 27, T.10S., R.7E., Saline County
Anomaly approximately 3,700 feet long on east-west flight line

Cultural Setting - Topographic map shows no houses located in anomaly; approximately 3 ^{houses} hours within 1/2 mile. Anomaly is located in Shawnee National Forest 3 1/2 mile east of Rudement. A north-south secondary road crosses the eastern part of the anomaly.

Physical Setting/Geology - Anomaly straddle ^S rugged terrain over the valley of Eagle Creek. Land surface elevation ranges from 400 to 650 feet above sea level.

Surficial geologic materials are thin loess deposits over bedrock and alluvium on bedrock in the narrow floodplain. These may be bedrock exposures on the steep slopes. The soil profile has a frazipan and is developed in loess and the bedrock. Bedrock in the western half of the flight line is mostly sandstone (some shale and siltstone) in the Abbott Formation of the Pennsylvanian. Eastern half of the flight line is mostly shale, siltstone and sandstone (some black shale, rare coals) in the Spoon Formation of the Pennsylvanian.

Frazipan of

Possible Explanation - Shale bedrock in outcrops on steep slope; poor elevation correction for the rugged terrain; local unsaturated condition.

Anomaly No. 34

Rank - Moderate

Location - Lick Creek Quadrangle 1966
Sec. 19 and 20, T.11S., R.2E., Johnson County
Anomaly approximately 1,300 feet long on east-west flight line

Cultural Setting - Topographic map shows 1 structure (cabin?) sited in anomaly; approximately 3 houses within 1/2 mile. A north-south unimproved dirt road crosses through the center of the anomaly. Anomaly is located 1 1/2 mile northwest of Ferne Clyffe State Park.

Physical Setting/Geology - Anomaly is located in rugged terrain straddling a narrow ridge between tributaries to Buck Branch. Land surface elevation ranges from 500 to 630 feet above sea level.

fragipan

Surficial geologic materials are a thin cover of loess over bedrock. The soil profile has a ~~frazipan~~, and is developed in loess and material weathered from bedrock.

Pennsylvanian bedrock is shales (some black) and rare coals in the Drury Shale Member of the Caseyville.

Possible Explanation - Black shales near land surface; poor correction for rugged terrain on flight line; local unsaturated condition.

Anomaly No. 35

Rank - Moderate to Low

Location - Stonefort Quadrangle 1961

Sec. 29, T.11S., R.5E., Pope County

Anomaly approximately 1,300 feet long on north-south flight line

Cultural Setting - Topographic map shows no houses located in anomaly; approximately 5 houses within 1/2 mile. An unimproved dirt road crosses the southwestern part of the anomaly. Location is 1 mile southwest of McCormick in Shawnee National Forest.

Physical Setting/Geology - Anomaly is sited in gently rolling landscape on a ridge top. Land surface elevations range from 710 to 745 feet above sea level.

Regional data predicts that surficial materials are 5 to 10 feet of loess over bedrock. The soil profile contains a frazipan and is developed in loess. Pennsylvanian bedrock and sandstone, siltstone and shale (some black shale, rare coals, and limestone) in the Middle Abbott Formation).

Possible Explanation - Loess cover should ^{mask} make radiation from coal or black shale in shallow bedrock. Poor terrain correction along flight line.

Anomaly No. 36

Rank - Moderate to Low

Location - Herod Quadrangle 1959

Sec. 19 and 20, T.11S., R.7E., Pope County

Anomaly approximately 900 feet long on east-west flight line

91
Cultured Setting - Topographic map shows no houses sited in anomaly; approximately 5 houses within 1/2 mile. A light dirt road approaches within 500 feet of the northwest corner of the anomaly. Location is 5 miles west of Hicks.

Physical Setting/Geology - Anomaly is sited within a valley *large on a saddle that forms* on the drainage divide *is* between Little Lude Creek to the south and Hart Creek to the north. Land surface ranges from 520 to 560 feet above sea level. Land surface elevations greater than 700 feet above sea level occur 1 mile to the west and 1 mile to the east along the flight line. *Just*

of
Surficial materials are thin sand deposits over bedrock. The soil profile is well drained, contains a frazilpan, and is developed in alluvial deposits and weathered bedrock. Pennsylvanian bedrock is sandstone, siltstone, and some shale and rare coals in the Abbott Formation. Anomaly is located 1/4 mile east of Herod Fault Zone and 1/4 mile east-southeast of a known igneous intrusion.

Possible Explanation - Shale or coal in the shallow bedrock; possible extension of igneous body; poor terrain correction along flight line; atmospheric inversion.

Anomaly No. 37

Rank - Moderate to Low

Location - Sec. 21 and 22, T.11S., R.7E., Pope County
Anomaly approximately 1,100 feet long on east-west flight line

91
Cultured Setting - Topographic map shows no houses sited in the anomaly; approximately 5 houses within 1/2 mile. An unimproved dirt road reaches the northwest corner of the anomaly. Location is 3 miles west of Hicks.

Physical Setting/Geology - Anomaly is sited in relatively flat landscape immediately west of the ? valley of Grand Pierre Creek. Land surface elevations range from 460 to 500 feet above sea level.
incised

Surficial materials are thin loess deposits over bedrock. The soil profile contains a frazipan and is developed in loess and weathered bedrock. The anomaly is cut by a northeast *arcuate* fault on the west side of Hicks Dome. Bedrock is Menard Limestone (west of fault) and Waltersburg Sandstone/Vienna Limestone (east of fault).

Possible Explanation - Rugged terrain along flight line; related to faulting associated with Hicks Dome.

Anomaly No. 38 west, 38 east

Rank - Moderate to Low

Location - Herod Quadrangle 1959

Sec. 24, T.11S., R.7E., Hardin County.

This is a double anomaly along an east-west flight line; western part is approximately 1,460 feet long and the eastern part is approximately 900 feet long. The two anomalies are approximately 1,500 feet apart.

a)
Cultured Setting - Topographic map shows no houses located in the anomalies; approximately 25 houses are located within 1/2 mile. Anomaly 38 ~~feet~~ is located within 1/4 mile of Hicks. A light dirt road crosses between the two anomalies. *East*

g
Physical Setting/Geology - Anomaly 38 west straddles an intermittent tributary to Hicks Branch. Land surface elevation ranges from 480 to 540 feet above sea level. Surficial materials are thin loess deposits on weathered bedrock. The soil profile contains a frazipan and is developed in loess and cherty deposits weathered from the bedrock. Bedrock is probably the dark basinal facies of the Salem Limestone to the west and the Ullia Limestone (crinoid-bryozoan grainstone) to the east. Outcrops are poor and there may be unmapped faults.

g
Anomaly 38 east is located on a ridge top with land surface elevations ranging from 560 to 620 feet above sea level. Surficial materials are thin loess deposits over chert bedrock. The soil profile contains a frazipan. Bedrock is chert of the Fort Payne Formation. This anomaly is in close proximity to Hicks Dome and unmapped faults and/or igneous intrusions may be present.

Possible Explanation - These anomalies have a weak signature and were possibly designated as anomalies because of known weak uranium/thorium mineralization at Hicks Dome; poor terrain correction.

Anomaly No. 48

Rank - Moderate to Low

Location - Waltersburg Quadrangle 1962
Sec. 20, T.12S., R.6E., Pope County
Anomaly approximately 2,000 feet long on east-west flight line

^{al} Cultured Setting - Topographic map shows no houses located in anomaly; approximately 5 houses within 1/2 mile. Location is 2 1/2 mile south of Eddyville. The closest approach to the anomaly is a light dirt road located 1/2 mile to the west.

Physical Setting/Geology - Anomaly is situated on relatively flat uplands 1/4 mile west of the valley of Susk Creek. Land surface elevations range from 480 to 520 feet above sea level.

Surficial materials are thin loess deposits over bedrock. The soil profile contains a frazipan and formed in loess and weathered bedrock. Bedrock is the Palestine Sandstone that contains some black shale. A northeast trending fault may intersect the southwest corner of the anomaly. *of*

Possible Explanation - Local occurrence of black shales in the Palestine Sandstone.

Anomaly No. 49

Rank - Low

Location - Shetlerville Quadrangle, photorevised 1978
Sec. 24, T.12S., R.7E., Hardin County
Anomaly approximately 1,000 feet long on east-west flight line

al
Cultured Setting - Topographic map shows 1 house located in anomaly and 1 house sited within 100 feet to the west of the anomaly; approximately 12 houses (the community of Humm Wye) are located within 1/2 mile to the west. State Route 146 trends east-west through the center of the anomaly.

Physical Setting/Geology - The anomaly is located in rugged landscape over a tributary to Wallace Branch. Land surface elevations range from approximately 380 to 470 feet above sea level.

colluvium - Surficial deposits are 5 to 10 feet of loess and colluvium (principally derived from loess) over bedrock. The soil profile has a frazipan. Bedrock is upper St. Genevieve Limestone and/or Aux Vases Sandstone. Anomaly is in an area of a mapped NNE trending fault. *of*

Possible Explanation - Roadfill; effect of faulting (however, note that other fault intersections west on this line are not reflected by anomalies). Highway is used for truck transport of coal, *anomaly may be due* to coal spillage on the road shoulder; poor terrain correction.

Anomaly may be due ...

Anomaly No 50

Rank - Low

Location - Rosiclare Quadrangle 1959
Sec. 20 and 21, T.12S., R.8E., Hardin County
Anomaly approximately 800 feet long on east-west flight line

Cultural Setting - Topographic map shows no houses located in anomaly; approximately 25 houses within 1/2 mile. The community of Stone Church is located 1/2 mile to the southwest. The closest access to the anomaly is a light dirt road 1/4 mile to the west.

Physical Setting/Geology - The anomaly is sited on the nose of a narrow ridge in very rugged landscape. Land surface elevation varies from 330 to 420 feet above sea level. There is a very steep slope in the east side of the anomaly.

Surficial geologic materials are thin loess deposits (0-10 feet) over bedrock. The soil profile contains a frazipan and is developed in loess and weathered bedrock. The bedrock is Palestine Sandstone in a fault bounded block.

Possible Explanation - Poor flight correction for rugged terrain; black shale in Palestine Sandstone; atmospheric inversion; local unsaturated condition.

Anomaly No. 51

Rank - High

Location - Jonesboro Quadrangle 1948

Sec. 9, T.13S., R.2W., Union County

Anomaly approximately 2,000 feet long on north-south flight line

91
Cultured Setting - Topographic map shows 1 house sited in anomaly; approximately 10 houses within 1/2 mile. Jonesboro is located 4 miles to the southwest. An unimproved dirt road reaches the southwestern corner of the anomaly. The anomaly is located in Shawnee National Forest.

Physical Setting/Geology - The anomaly is located over the floodplain of a tributary to Harrison Creek. Land surface elevations range from 420 feet in the floodplain to 600 feet above sea level in the valley wall. There are significantly higher elevations along the flight line to the north of the anomaly (800 feet).

Surficial geologic materials are loess from 0 to greater than 20 feet over bedrock and Cahokia Alluvium (possibly greater than 20 feet thick over bedrock) in creek bottoms. The soil profile is developed in the loess, alluvium and weathered bedrock. Bedrock is limestone in the upper valley walls. Bedrock in the lower valley walls and bottomland is Orchard Creek Shale (Devonian).

Possible Explanation - Shale bedrock; poor terrain correction along flight line; atmospheric inversion.

Anomaly No. 53

Rank - High. Fourth highest ranked anomaly of the 18 in this report.

Location - Mill Creek Quadrangle, photorevised 1978

Sec. 16 and 21, T.14S., R.2W., Alexander County

Anomaly approximately 2,600 feet long on north-south flight line

(a)
Cultured Setting - Topographic map shows no houses in anomaly; approximately 10 houses within 1/2 mile. A light dirt road approaches within 500 feet of the southeast corner of the anomaly; however, Sandy Creek lies between the road and the anomaly. The community of Eleo is located 3 1/2 miles to the northeast.

Physical Setting/Geology - The anomaly is located on a rugged ridge between Sandy Creek and a tributary to Sexton Creek. Land surface elevations range from 510 to 640 feet above sea level.

Surficial materials are 0 to greater than 20 feet of loess over bedrock. The soil profile is developed in loess and weathered bedrock. Bedrock is the Clear Creek Chert of Devonian Age. Tripoli deposits are known to occur in the region of the anomaly. There may be concealed faults in the bedrock.

Possible Explanation - Bedrock exposures on steep slopes; poor terrain correction along the rugged flight line; local unsaturated condition; atmospheric inversion.

Anomaly No. 54

Rank - High. Third highest ranked anomaly of the 18 in this report.

Location - Mill Creek Quadrangle, photorevised 1978
Sec. 28 and 33, T.14S., R.2W., Alexander County
Anomaly approximately 2,800 feet long and located 1 1/2 mile south of anomaly No. 53.

Cultural Setting - Topographic map shows no houses located in anomaly; approximately 10 houses are located within 1/2 mile. The community of Tatumville is located 2 3/4 miles to the east. A light dirt road approaches within 2,000 feet of the southwest corner of the anomaly.

Physical Setting/Geology - Anomaly is located in a rugged landscape on a ridge between Sandy Creek and a tributary to Sandy Creek. Land surface elevation range from 460 to 620 feet above sea level.

Surficial geologic materials are 0 to greater than 20 feet of loess on bedrock. The soil profile is developed in loess and weathered bedrock. Bedrock is the Grassy Knob Chert. There may be concealed faults in the bedrock.

Possible Explanation - Bedrock exposures on steep slope; poor terrain correction along rugged fight line; local unsaturated condition; atmospheric inversion.

MEMORANDUM

TO: Morris W. Leighton
FROM: Robert H. Gilkeson
COPIES TO: Myrna Killey, Rich Cahill, Steve McFadden, Jim Baxter,
Russ Jacobson, Bob Griffin, Jim Eidel, and Keros Cartwright
DATE: August 18, 1986
SUBJECT: NURE Survey/Paducah Sheet

Jim Baxter and Russ Jacobson have completed their geological characterization of the NURE uranium resource anomalies present on the Illinois portion of the Paducah Sheet. Their focus is principally on bedrock and more information is necessary on the surficial geologic materials. I have asked Myrna Killey to coordinate the characterization of the Quaternary Materials on these anomalies.

I have written a summary report about the location, size, landscape setting, geology and cultural features of each anomaly. It will be easy to incorporate additional information on surficial materials into the report. Steve McFadden has screened the microfiche information to determine the "strength" of the anomalies and has established a ranking from high, moderate, to low.

MEMORANDUM

TO: Morris W. Leighton
FROM: Robert H. Gilkeson
COPIES TO: Rich Cahill, Steve McFadden, Keros Cartwright and Bob Griffin
DATE: August 11, 1986
SUBJECT: NURE URANIUM ANOMALIES, 1. PADUCAH QUAD., 2. REGION OF NORTHWEST MUNICIPAL CONFERENCE IN NORTHEASTERN ILLINOIS

1. PADUCAH QUADRANGLE

There are 18 NURE "uranium resource anomalies" in the Illinois region of the Paducah Quadrangle. Steve McFadden has accurately located the anomalies on 7.5-minute topo. sheets. The locations were determined by latitude/longitude coordinates listed on microfiche records included in the appendices of the NURE report for the Paducah Quadrangle. Copies of the 7.5-minute topo sheets showing locations of anomalies were delivered to the Coal Section and Industrial Minerals Section for geologic appraisal. Russ Jacobson has completed the geologic characterization of the anomalies that are underlain by Pennsylvanian strata. Jim Baxter will complete geologic characterization of the remaining anomalies within the next week.

Steve McFadden and myself held a meeting with D.N.S. personnel (Hamel, Flynn and Crouch) on Thursday, August 8. A set of 7.5-minute maps showing the anomaly locations were provided to D.N.S. so they may initiate planning of the field survey.

The 18 anomalies impact a very small area of the Illinois region of the Paducah Quadrangle. Most are located in rugged uninhabited localities. The maps show five residences located within anomalies and approximately a dozen in close proximity. At face value, the NURE "uranium anomalies" on the Paducah Quadrangle have no application to assessment of indoor radon in this region of Illinois. Nevertheless, a careful field survey will be performed to further investigate the significance of the anomalies.

2. REGION OF NORTHWEST MUNICIPAL CONFERENCE IN NORTHEASTERN ILLINOIS

A meeting with the Health Directors of Northwest Municipal Conference is scheduled for August 21, 1986 in Arlington Heights. Steve McFadden and myself will attend this meeting to explain the contents of the NURE Reports for this region. I have informed D.N.S. of this meeting and invited them to send a representative.

Rich Colwell

NATIONAL URANIUM RESOURCE EVALUATION

reports covering Illinois

- GJBX-26: Aerial radiometric and magnetic survey, St. Louis National Topographic Map, Illinois/Missouri : final report / prepared by Geodata International, Inc. for U.S. Department of Energy, Grand Junction Office, 1981.
- date acquired: Oct. 18, 1982
18 eTh anomalies; 34 eU anomalies; 66 eU/eTh anomalies
- GJBX-27: Aerial radiometric and magnetic survey, Quincy National Topographic Map, Illinois/Missouri : final report / prepared by Geodata International, Inc. for U.S. Department of Energy, Grand Junction Office, 1981.
- date acquired: Oct. 18, 1982
4 eTh anomalies; 45 eU anomalies; 78 eU/eTh anomalies
- GJBX-28: Aerial radiometric and magnetic survey, Burlington National Topographic Map, Illinois/Iowa/Missouri : final report / prepared by Geodata International, Inc. for U.S. Department of Energy, Grand Junction Office, 1981.
- date acquired: Oct. 18, 1982
4 eTh anomalies; 23 eU anomalies; 66 eU/eTh anomalies
- GJBX-31: Aerial gamma ray and magnetic survey, Chicago quadrangle, Indiana, Illinois, and Michigan / prepared by EG&G geoMetrics for U.S. Department of Energy, Grand Junction Office, December 1980.
- date acquired: Feb. 2, 1981
34 anomalies identified of which 10 are in Illinois
- GJBX-41: Aerial radiometric and magnetic reconnaissance survey of portions of Arkansas, Illinois, Indiana, Kentucky, Missouri, and Tennessee : Dyersburg, Paducah, Poplar Bluff and Rolla Quadrangles : final report, vol. I and vol. 2B: Paducah Quadrangle / prepared by Texas Instruments, Inc. for U.S. Department of Energy, Grand Junction Office, December 1979.
- date acquired: unknown
"... 33 uranium anomalies worthy of field-checking as possible uranium prospects. The survey confirms the high radioactivity of Hicks Dome in the east-central portion of the quadrangle. The survey also indicates possible subsurface uranium/thorium concentrations that are evidenced by anomalies in close proximity to faults that flank this structure."
- GJBX-48: Aerial gamma ray and magnetic survey, Danville Quadrangle, Indiana and Illinois : final report / prepared by EG&G geoMetrics for U.S. Department of Energy, Grand Junction Office, January 1981.
- date acquired: unknown
"... (67) uranium anomalies were detected and are discussed briefly in this report. None were considered significant and all appear to be related to cultural features."

GJBX-59: Aerial gamma ray and magnetic survey, Davenport Quadrangle, Iowa and Illinois : final report / prepared by EG&G geoMetrics for U.S. Department of Energy, Grand Junction Office, February 1981.

date acquired: unknown

"A total of 88 uranium anomalies were defined according to the standard interpretation procedures. None of these anomalies were considered significant and all relate to cultural features."

GJBX-64: Aerial gamma ray and magnetic survey, Dubuque Quadrangle, Iowa, Illinois and Wisconsin : final report / prepared by EG&G geoMetrics for U.S. Department of Energy, Grand Junction Office, February 1981.

date acquired: unknown

"... (79) anomalies were detected and briefly described. None are significant and all relate to cultural features."

GJBX-95: Aerial gamma ray and magnetic survey, Vincennes Quadrangle, Indiana, Illinois, and Kentucky : final report / prepared by EG&G geoMetrics for U.S. Department of Energy, Grand Junction Office, March 1981.

date acquired: July 20, 1981

"... (88) uranium anomalies were detected and are discussed briefly in this report. The average concentrations of potassium, uranium, and thorium are moderate at best. All anomalies appear culturally induced, and none appear to represent significant concentrations of uranium."

GJBX-97: Aerial gamma ray and magnetic survey, Indianapolis Quadrangle, Indiana and Illinois : final report / prepared by EG&G geoMetrics for U.S. Department of Energy, Grand Junction Office, March 1981.

date acquired: July 20, 1981

"Though 99 anomalies were defined by the interpretation process, all appeared to be culturally induced. One small group of anomalies overlying strip mines in Pennsylvanian coal deposits have unusually high uranium concentration levels and are thus noteworthy."

GJBX-181: Airborne gamma-ray spectrometer and magnetometer survey, Rockford Quadrangle, Aurora Quadrangle (IL), Madison Quadrangle (WI) : final report / prepared by High Life Helicopters, Inc./QEB, Inc. for U.S. Department of Energy, 1981.

date acquired: Nov. 17, 1981

23 anomalies - Aurora Quadrangle

11 total anomalies - Rockford Quadrangle of which 9 are in Illinois

GJBX-237: Aerial gamma ray and magnetic survey, Racine and Grand Rapids Quadrangles, Michigan, Wisconsin and Illinois : final report / prepared by EG&G geoMetrics for U.S. Department of Energy, Grand Junction Office, July 1981.

date acquired: Nov. 17, 1981

"...83 uranium anomalies were detected... All appear to have cultural and/or locally unsaturated associations, and none appear to contain significant measured quantities of uranium"

GJBX-241: Airborne gamma-ray spectrometer and magnetometer survey, Peoria Quadrangle (IL), Belleville Quadrangle (IL), Decater (IL) : final report / prepared by High Life Helicopters, Inc./QEB, Inc. for U.S. Department of Energy, Grand Junction Office, 1981.

date acquired: Nov. 17, 1981

23 uranium anomalies - Peoria Quadrangle

42 uranium anomalies - Belleville Quadrangle

38 uranium anomalies - Decater Quadrangle

Table 2. Summary of NURE Preferred Uranium Anomalies.

Anomaly #	Surficial Geology (IGSG)	NURE Unit	Topography	*Proximity to Occupied Houses	**Possible Explanation
5	loess	Pm/Pc	flat	b (15)	flight path near cemetery
9	loess	Qal	flat	b (5)	crude oil faciity
15	spoil	Pca	flat	b (3)	flight path over strip mine
23	loess	Qal	valley/flood plain	b (5)	railroad ballast, 1,2
24	loess/P	Pab	valley wall, steep slopes	-----	shale or coal outcrop, 1,2
26	Ec/Ca	Pca	gently sloping	a (1), b (20)	nearby strip mines, shale, coal
28	loess/Pag	Pab/Ps	rugged, high relief	b (3)	shale outcrop, 2
34	loess/Pcv	Pcv	rugged, high relief	a (1?), b (3)	shale outcrop, 2
35	loess/Pab	Pab	rolling/ridge top	b (5)	shallow coal & shale?, 2
36	Ec/Pab	Pcv	valley	b (5)	shallow shale or coal, 1,2
37	loess/M	M	flat/near valley	b (5)	faulting assoc. with Hicks Dome, 2
38	thin loess	Mvm	sloping/hill top	b (25)	mineralization assoc. with Hicks Dome
48	thin loess	Mcu	flat uplands	b (5)	shallow black shale
49	loess	Mcl	rugged, high relief	a (1), b (1)	road fill, bedrock faulting, 2
50	thin loess	Mcl	rugged, high relief	b (23)	shallow black shale, 2
51	loess/Dock	Du	floodplain/valley wall	a (1), b (10)	shale outcrop, 2
53	Dchert/Tripoli	Du	rugged, high relief	b (10)	bedrock outcrop, 2
54	Dchert/Tripoli	Du	rugged, high relief	b (10)	bedrock outcrop, 2

*a - Occupied houses within anomaly (number of houses)
 b - Occupied houses within 1/2 mile of anomaly (number of houses)
 (based on information from 7 1/2-minute topographic maps)
 **1 - atmospheric B_xi inversion
 2 - rugged terrain, difficult terrain correction

MEMORANDUM

TO: R. H. Gilkeson
FROM: M. M. Killey *MMK*
DATE: August 27, 1986
RE: NURE Survey/Paducah Sheet

Attached is a summary report of Quaternary sediments and soils compiled by Dick Berg and me on the sites of uranium resource anomalies on the Illinois portion of the Paducah 1:250,000-scale map. Without having seen your summary report I am unable to determine how much of our report duplicates parts of your report. I would appreciate seeing a copy of your final report at your convenience.

Please let me know if you need additional information

gm

cc: M.W. Leighton
K. Cartwright

Attachment

SUMMARY REPORT ON QUATERNARY SEDIMENTS ON PADUCAH SHEET
FOR NURE ANOMALY AREAS

Sites 5, 9, and 15 are located in counties for which no soil surveys are immediately available.

Site 5 shows 0-25 feet of drift on drift thickness map, and more than 5 feet of loess over Vandalia Till Member (Glasford Formation) on the Quaternary Deposits map; it is located in a broad lowland area. A generalized soils association map indicates that the soils are generally moderately well to poorly drained with a silty or loamy surface layer and a clayey subsoil.

Site 9 is located on a broad bottomland between two intermittent drainageways; the Quaternary deposits map shows the site as having less than 5 feet of loess and either Vandalia Till Member (Glasford Formation), or Carmi Member (Equality Formation) (probably the latter). Drift thickness is 0-25 feet.

Site 15 is located entirely within strip mined land.

Site 23: Located on bottomlands in proximity to railroad. Drift thickness map: 0-25 feet. Quaternary deposits map: more than 15 feet of loess over bedrock; near (but not on) Vandalia till. Soils are silty alluvial sediments, poorly drained. Alluvium is probably loess-derived silt.

Site 24: Located on slope between uplands and creek. Drift thickness map: 0-25 feet. Quaternary deposits map: 5-10 feet of loess (near the 10-foot contour line) over Vandalia till. Soils are loess or silty colluvium and residuum that weathered from sandstone, siltstone, and shale; soils contain a fragipan (fractured).

Site 26: Straddles broad minor drainageway in driftless area. Quaternary deposits map: strip mined area surrounded by Equality Formation Carmi Member (fine-grained lake sediments) and bedrock; less than 5 feet of loess. Soils contain a fragipan, and are in part somewhat poorly drained, poorly drained loess and silty wash, and strip mined land composed of predominantly shale,

siltstone, and some sandstone and other fragments. Soils map shows that more of this area has been strip mined since publication of the topographic map.

Site 28: Straddles narrow drainageway sloping from upland to creek. In driftless area. Quaternary deposits map: 5-10 feet of loess over bedrock. Soils have a fragipan, in part over material weathered from sandstone, siltstone, and shale, also this type of soil may lack a loess cover. One soil of latter type is on 30-60% slope.

Site 34: On sloping terrain. Quaternary deposits map: 10-15 feet of loess over bedrock. Soils have a fragipan, in part over material weathered from sandstone, siltstone, and shale; also an alluvial soil.

Site 35: Upland site. Quaternary deposits map: 5-10 feet of loess over bedrock. Soil contains a fragipan.

Sites 36, 37, and 38: Sites in a straight east-west line: 36 is on a minor divide between two minor intermittent drainaways; 37 is on a gently sloping upland; 38 West straddles an intermittent drainageway; 38 East is an upland. Quaternary deposits map: 5-10 feet of loess over bedrock. Soils for 36 have a fragipan and a well-drained silty sand that contains gravel and sandstone fragments and occurs in a bottomland. Soils for 37 have a fragipan, in part overlying material weathered from sandstone, siltstone, and shale. Soils for 38 are the same as for 37 and in addition include a loess over a cherty material over limestone (sinkholes) and a silty clayey material mixed with chert; the locality is near Hicks Dome.

Site 48: In a broad bottomlands area. Quaternary deposits map: 5-10 feet of loess over bedrock. Soils have a fragipan, and formed over material weathered from sandstone, siltstone, and shale, and a well-drained silty sand occurring in bottomland areas and containing gravel and sandstone fragments.

Site 49: Located on a saddle between two knobby upland areas and at the head of an very minor drainageway. Quaternary deposits map: 5-10 feet of loess over bedrock. Soils have fragipan and are composed of a poorly drained colluvium.

Site 50: Located on an upland and adjacent steep slope. Quaternary deposits map: 5-10 feet of loess over bedrock. Soils have a fragipan over material weathered from sandstone, siltstone, and shale, a silty loam material mixed with sandone flagstone, and a poorly drained clayey sediment located on terraces.

Site 51: Straddles a tributary to Harrison Creek. Quaternary deposits map: more than 20 feet of loess over bedrock with Cahokia Alluvium in creek bottoms. Soils are loessial, a residuum weathered from cherty limestone, and silty and cherty stream sediments.

Sites 53 and 54: Dissected uplands. Quaternary deposits map: more than 20 feet of loess over bedrock. Soils are composed of loess and silty material over massive beds of chert.

Eight of the sites are in a bottomlands/drainageway situation, three are on slopes, five are on uplands, three are on upland sloping terrain and one is entirely within a strip mined area. From this preliminary evaluation there appears to be no common factor regarding landscape position. Most of the sites, however, have a loess cover in common. We have tried to note nearby features which might have an effect on the anomalies.

Anomaly 23. Pamona Quadrangle SE 1/4 Sec. 4, NE 1/4 Sec 9, T. 10 S., R. 2 W., Jackson County, N-S flight line.

In flood plain of Suger Creek where flight line intersects main-line of Illinois Central Gulf Railroad.

Geology: just south of major extent of the Illinoisan Till Plain, Quaternary alluvium overlying Pennsylvanian Drury Shale Member of the Caseyville and/or older Pennsylvanian Rocks.

Possible Explanations: (1) Black shales or coals in the Drury, (2) railroad ballast.

See ISGS Circular 320.

Anomaly 34. Lick Creek Quadrangle, approximate NE, NE, SW and SE, SE, NE of Section 19, and SE, SE, NW and NW, NW, SW of Section 20, T. 11 S., R. 2 E., Johnson County. E-W flight line.

Geology: underlain by Drury Shale Member of Caseyville.

Possible Explanation: Black shales of coals in the Drury.

See ISGS Bulletin 48.

Anomaly 36. Herod Quadrangle, Section 19, and 20, T. 11 S., R. 7 E., Pope County. E-W flight line.

Geology: Located just east (ca 1/4 mile) of Herod Fault Zone and about 1/4 mile ESE of known igneous intrusion. Area underlain by strata of the Abbott Formation within the interval between the Murry Bluff and Finnie Sandstones.

Possible Expalnation: 1) shales or coal (Delwood) of the Abbott, 2) effect of igneous intrusion or extension of igneous body, 3) related to Herod Fault Zone.

Unnumbered Anomaly. Herod Quadrangle, SW 1/4, Section 21, T. 11 S., R. 7 E., Pope County. E-W flight line.

Geology: Located adjacent to, east of a near northernmost mapped extent of minor fault in Caseyville Formation. Underlain by Abbott Formation (interval between Grinkstaff Sandstone with Reynoldsburg Coal) on the west and uppermost Caseyville (Pounds Sandstone, Drury equivalent shale) to the east

Possible Explanations: 1) related to fault, 2) to black shale and/or coals of the Drury and/or lower Abbott interval.

See ISGS Circular 413.

Anomaly 37. Herod Quadrangle, SE 1/4, Section 21, SW 1/4 Section 22, T. 11 S., R. 7 E., Pope County. E-W flight line.

Geology: Area cut by NE trending portion of arcuate fault on west side of Hicks Dome. Underlain mainly by Menard limestone (west of fault) and Waltersburg sandstone/Vienna limestone (east of fault).

Possible Explanation: Some effect of faulting.

See ISGS Circular 413.

Anomaly 38. Herod Quadrangle, double anomaly in south half of Section 24, T. 11 S., R. 7 E., Hardin County. E-W flight line.

Geology: Easternmost anomaly 1/4 mile west of Hicks underlain by Fort Payne Formation (chert). Proximity to apex of Hicks Dome indicates may be unmapped faults and/or igneous occurrences. Westernmost anomaly probably underlain by dark basinal facies of Salem Limestone to west and crinoid-bryozoan grainstone of Ullia Limestone to east. However, outcrops are poor and there may be unmapped faults. Southwest dipping beds in Fort Payne in gully approx 330' east of area indicates possible fault or intrusive body.

Possible Explanations: Easternmost 1) proximity to known radioactivity at Hicks Dome, 2) effect of shallow or exposed New Albany black shale, 3) unmapped fault or intrusive. Westernmost: unmapped faults or intrusives.

See ISGS Circular 413.

Anomaly 48. W 1/2, Section 20, T. 12 S., R 6 E., Waltersburg Quadrangle, Pope County. E-W flight line.

Geology: Area located on back slope of Palestine Sandstone "Cuesta" about 1 mile west on major faulting of the Lusk Creek Fault Zone. Probable NE trending fault cathe northwest corner of area.

Possible Explanations: 1) effect of faulting, 2) black shales in Palestine?

See current COGOEMAP.

Anomaly 49. Shetlerville Quadrangle, near center, Section 24, T. 12 S., R. 7 E., Hadin County, E-W flight line--on Illinois 146.

Geology: mapped NNE trending fault area underlain by upper Ste. Genevieve Limestone ^{and} Aux Vases Sandstone. ✓

Possible Explanations: 1) effect of faulting, 2) coal spill of truck overload dumpage. Other fault intersections west on this line and on other lines not reflected by anomalies.

Anomaly 50. Rosiclare Quadrangle, near center west line Section 21, T. 12 S., R. 8 E., Hardin County Illinois. ^{E-W} N-S flight line. ✓

Geology: in fault bounded black on Palestine Sandstone.

Possible Explanation: ?

Anomaly 51. Jonesboro Quadrangle, SE 1/4 section 9, T. 13 S., R. 2 W., Union County. N-S flight line along stream gully tributary to Harrison Creek.

Geology: Bailey Limestone (Devonian) and Silurian Limestone mapped in valley walls in Section 9. Portions of valley walls and probably creek bed (Harrison Creek in Section 16) contains underlying Girardeau and Orchard Creek Shale (Ordovician) and Maquoketa probably occurs at or near surface along flight line in Section 9. NNW trending fault has been mapped passing just outside the NE corner of Section 9 and unmapped faults may occur in Section 9. ✓

Possible Explanation: probably related to a darker portion of the Orchard Creek Shale.

Anomaly 53. Mill Creek Quadrangle, Sections 16 and 21, T. 14 S., R. 2 W., Alexander County, approximately 5/6 mile east of Delta Fault as mapped by Wilber and Ekblaw. ^{aw} N-S flight line.

Geology: area underlain by Clear Creek Chert (Devonian). ^{There} May be concealed faulting. ^{Anomaly} ~~for what its worth~~ lies within area of tripoli deposits and occupies a position on northwest flank of aero-magnetic anomaly related to deep seated pluton?

Anomaly 54. Mill Creek Quadrangle, Sections 28 and 33, T. 14 S., R. 2 W.

Geology: underlain by Grassy Knob Chert may be concealed faults.

Possible Explanation 53 and 54: concealed faulting.

MEMORANDUM

TO: Morris W. Leighton
FROM: Robert H. Gilkeson
COPIES TO: Myrna Killey, Rich Cahill, Steve McFadden, Jim Baxter,
Russ Jacobson, Bob Griffin, Jim Eidel, and Keros Cartwright
DATE: August 18, 1986
SUBJECT: NURE Survey/Paducah Sheet

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ms
Gilkeson, RH

#2

U.S. GEOLOGICAL SURVEY
NATIONAL CENTER 927
RESTON, VIRGINIA 22092
OCTOBER 21, 1986

Mr. Bob Gilkeson
Illinois Geological Survey
434 Natural Resources Building
615 E. Peabody Drive
Champaign, Illinois 61820

Dear Bob:

I am sending you copies of the Aurora NURE data for uranium at a scale of 1:250,000 as well as a map of the combined amplitudes of uranium, eU/K, and eU/eTh. The uranium map has the units of ppm eU and I estimate that the relative accuracy is better than 30 percent but the absolute accuracy could be as bad as 100 percent. The data for the quad really need to be put in the context of the surrounding quads before I can say much more. The units on the other map are arbitrary and actually result from converting the normalized data for eU, eU/K, and eU/eTh to Munsell coordinates. I am beginning to doubt the usefulness of the combined-amplitude map for regional data. It is probably better when the data support a detailed scale. In this case the maps are quite similar although you might be able to test whether some of the uranium highs would have different concentrations of radon in the soil gas that might correlate with the highs on the combined-amplitude map. The concept behind the combined-amplitude map is that high eU combined with high ratios implies the presence of uranium that has been mobilized and therefore likely to have a higher radon emanation power. To properly test the concept we are going to need soil gas measurements and surface gamma-ray data.

As you know the data are flown at a line spacing of 6 miles and do not really support the scale of 1:250,000. I have made the maps at that scale as a matter of convenience. You should be careful about putting too much emphasis on short trends. Given that the geology in Illinois has fairly broad units, trends that extend across several flight lines are probably real. In any case the map cannot be expected to show a very close correlation with geology at the map scale.

The data were gridded with an interval of about 2 miles initially and then regridded to achieve the map scale. The data were also filtered to reduce the effects of flight-line differences that were present in the data. This filtering was achieved using a combination of band-pass and strike filters.

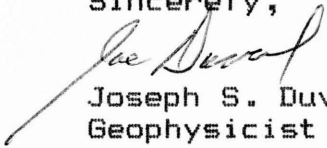
The resulting map is truly a "regional" map and would more appropriately be presented at a scale of 1:1,000,000.

We are in the process of making a map that will show the variation of the data along the flight lines leaving gaps between lines. Unfortunately, we are having problems getting the map plotted because they are in the process of moving the computer and plotter to another location. Because of an unknown delay, I decided to go ahead and send these maps to you so that you can begin to make your plans.

As you can see, the map indicates that the Aurora quad does not have any large areas with uranium concentrations over 3 ppm eU. That suggests to me that you will not encounter any high (greater than 100 picocuries per liter) indoor radon values anywhere in the quad. We do know that porosity and permeability are very important and can result in some unusual radon concentrations. I would still not expect any severe levels to be found.

Let me know how I might be of further help to you. When the other map is ready, I will send you a copy.

Sincerely,


Joseph S. Duval
Geophysicist

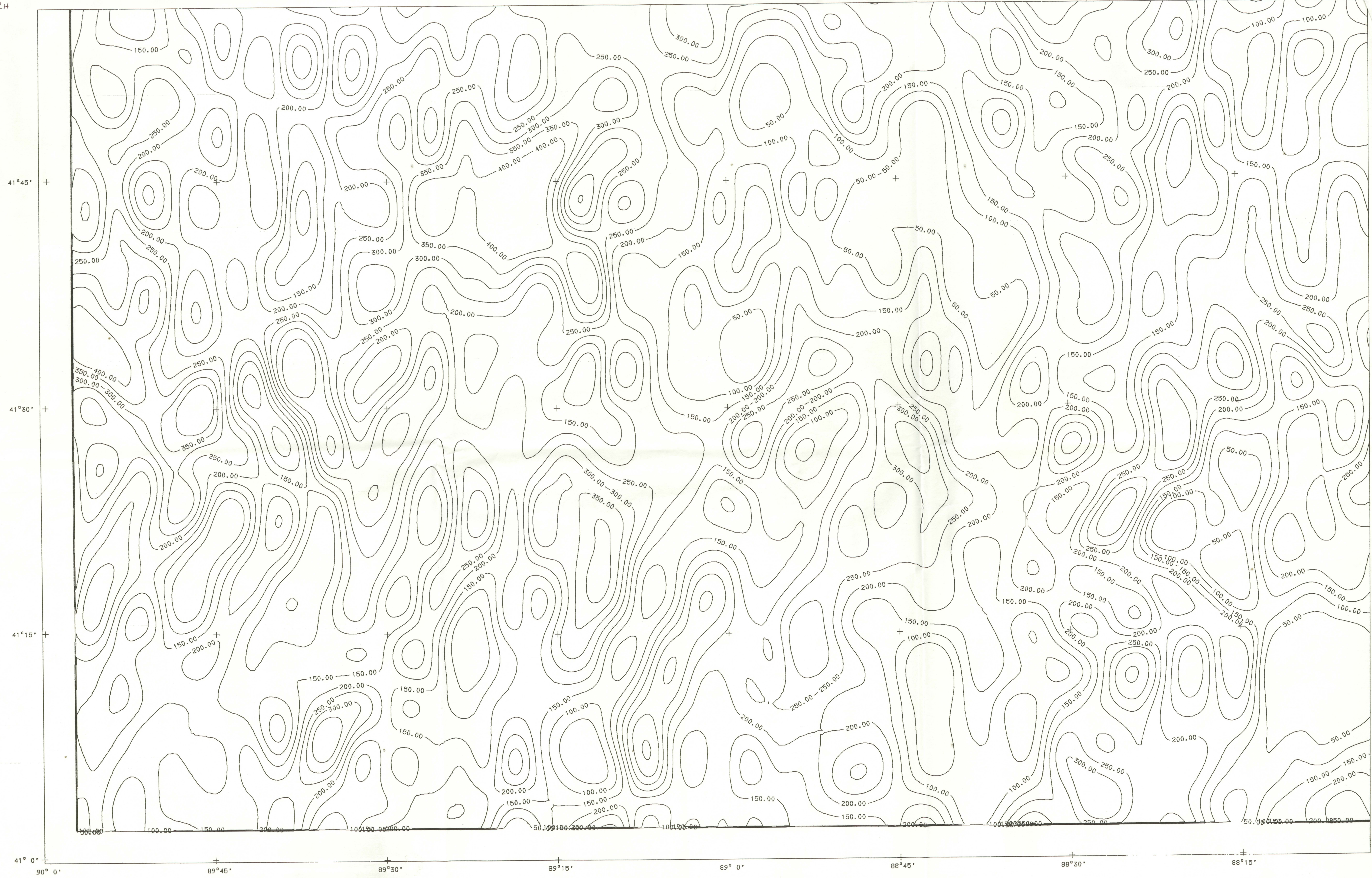
M.S.
Gilkeson, R.H.
#2



AU, U .254 BEGRID
AURORA QUAD, RADIO-METRIC DATA
SCALE = 1:250,000 DATE = 24-SEP-1986

Uranium concentrations (ppm?)

NS
Wilkeson, RH
FZ



ILLINOIS VAL
AURORA QUAD RADIOMETRIC DATA
SCALE = 1:250,000 DATE = 30-SEP-1986

Combined uranium, thorium, potassium concentrations