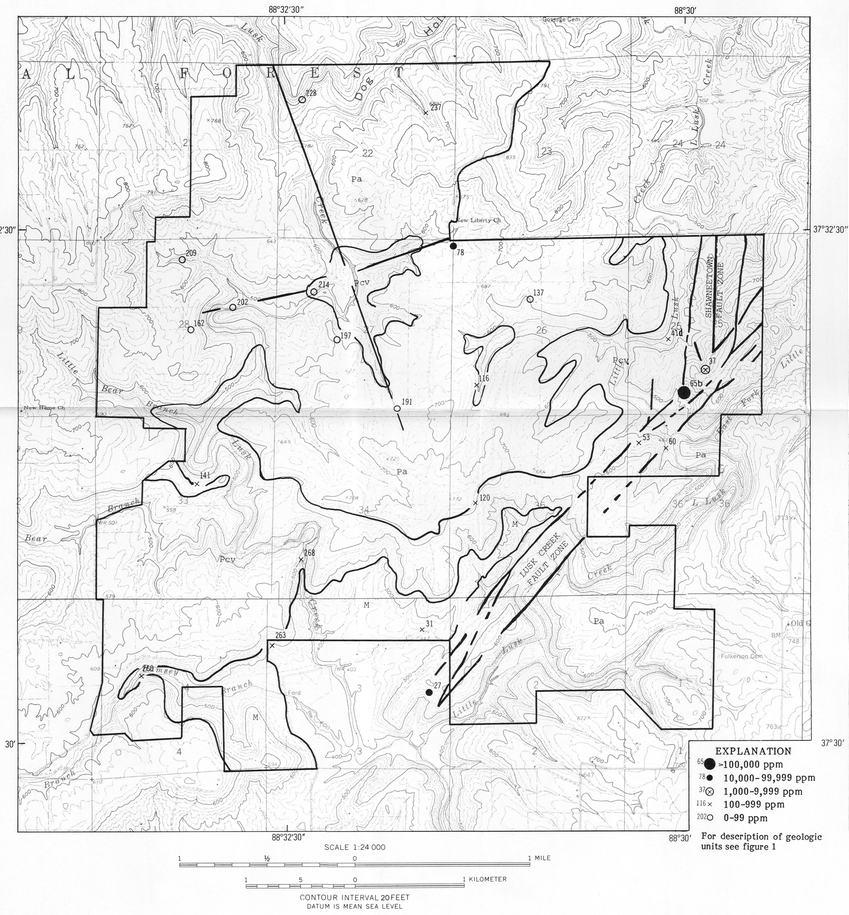


Figure 3A.—Fluorine in bedrock samples.

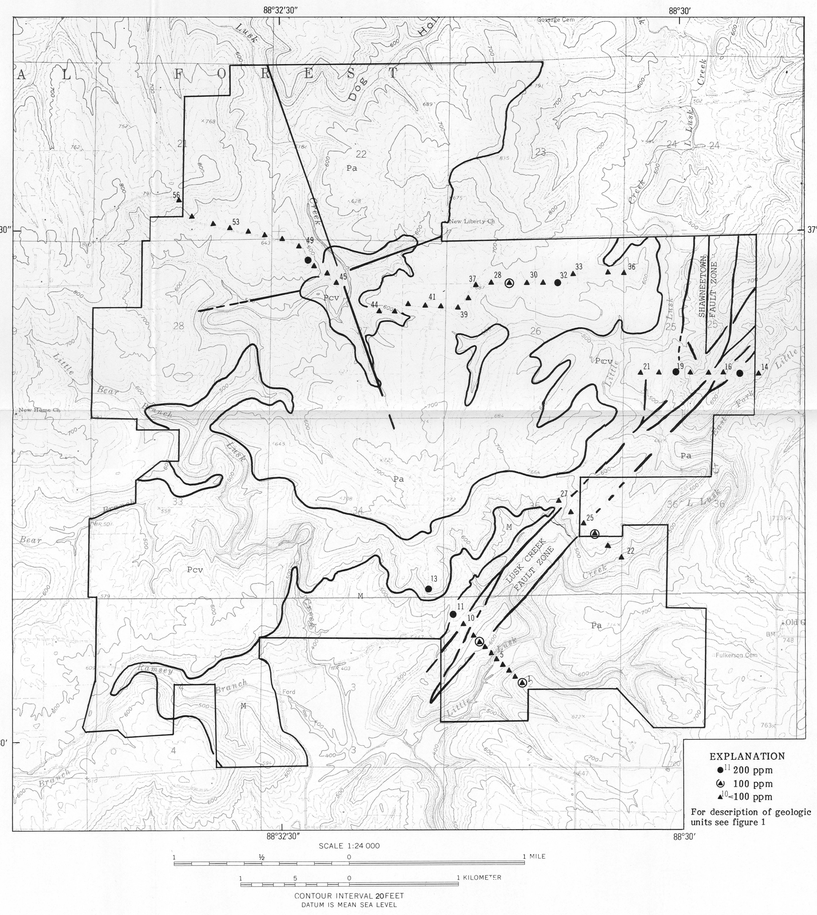


Figure 3B.--Fluorine in soil samples.

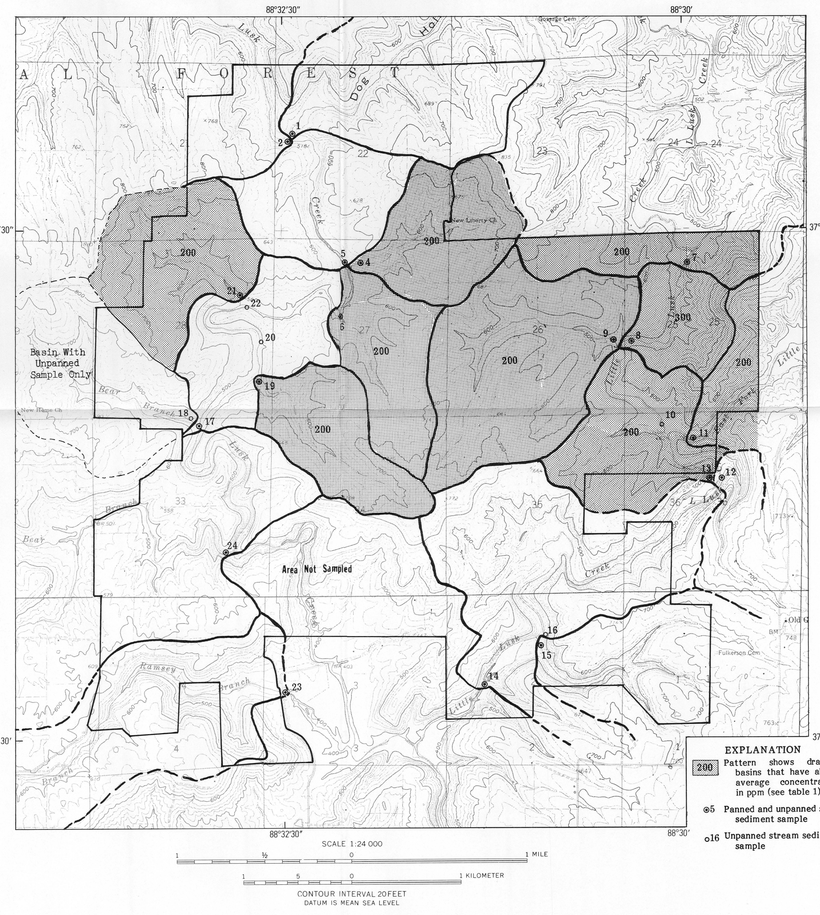


Figure 3C.—Drainage basins sampled for fluorine.

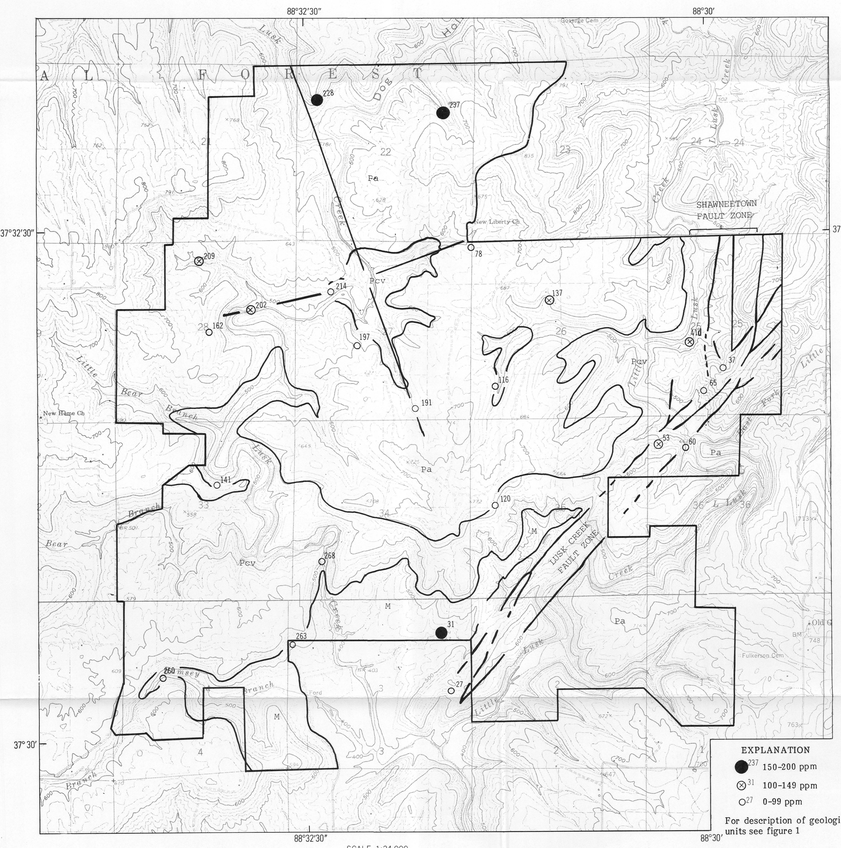


Figure 4A.—Barium in bedrock samples.

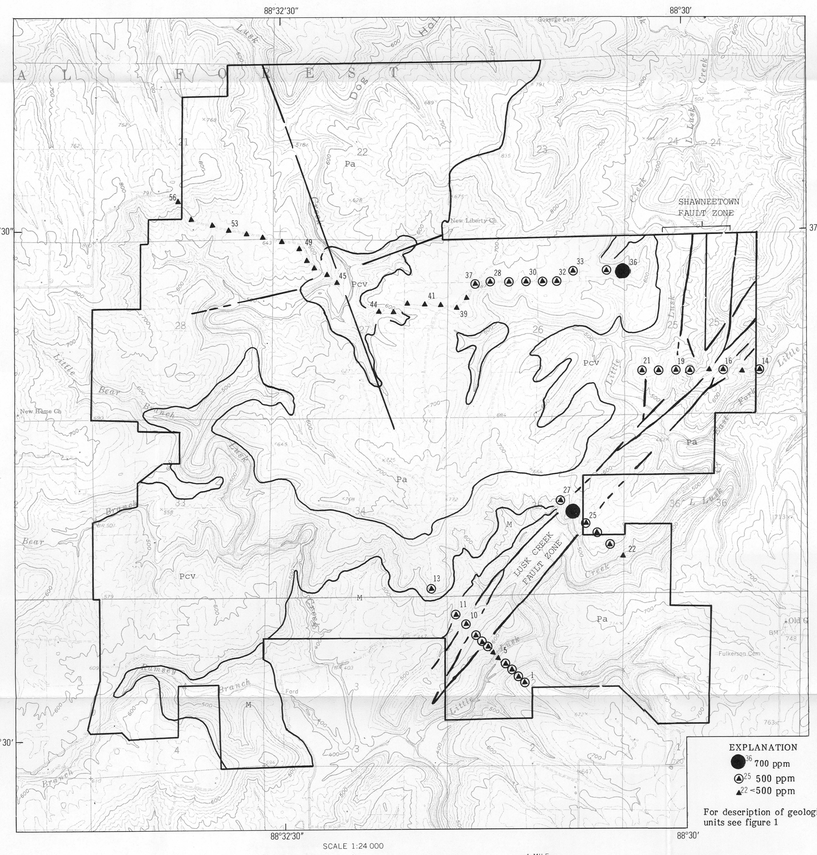


Figure 4B.—Barium in soil samples.

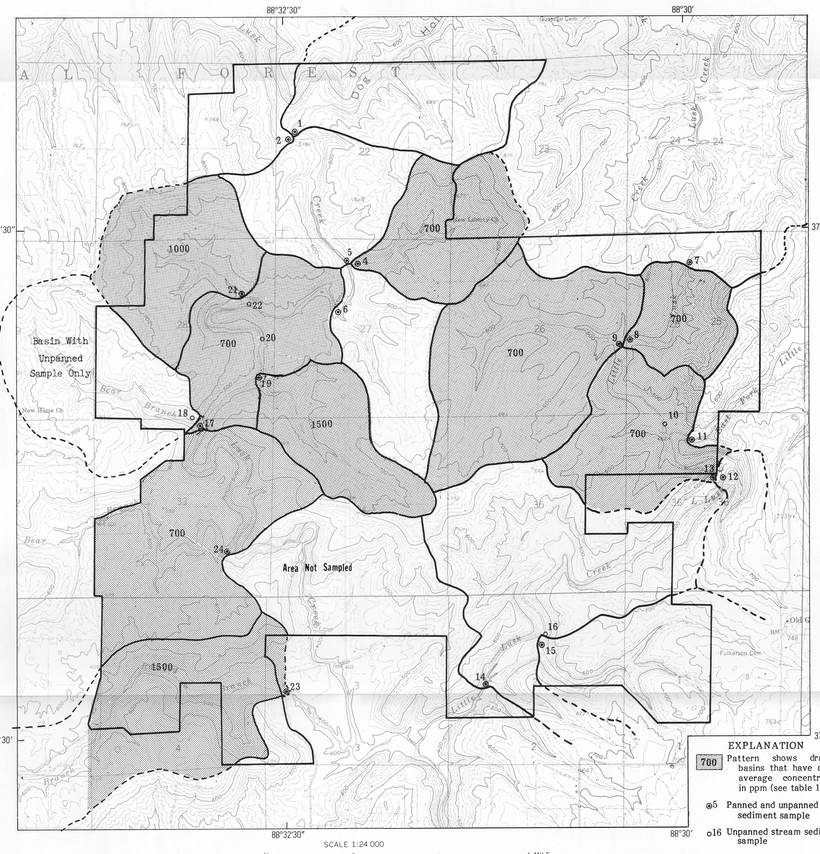


Figure 4C.—Drainage basins sampled for barium.

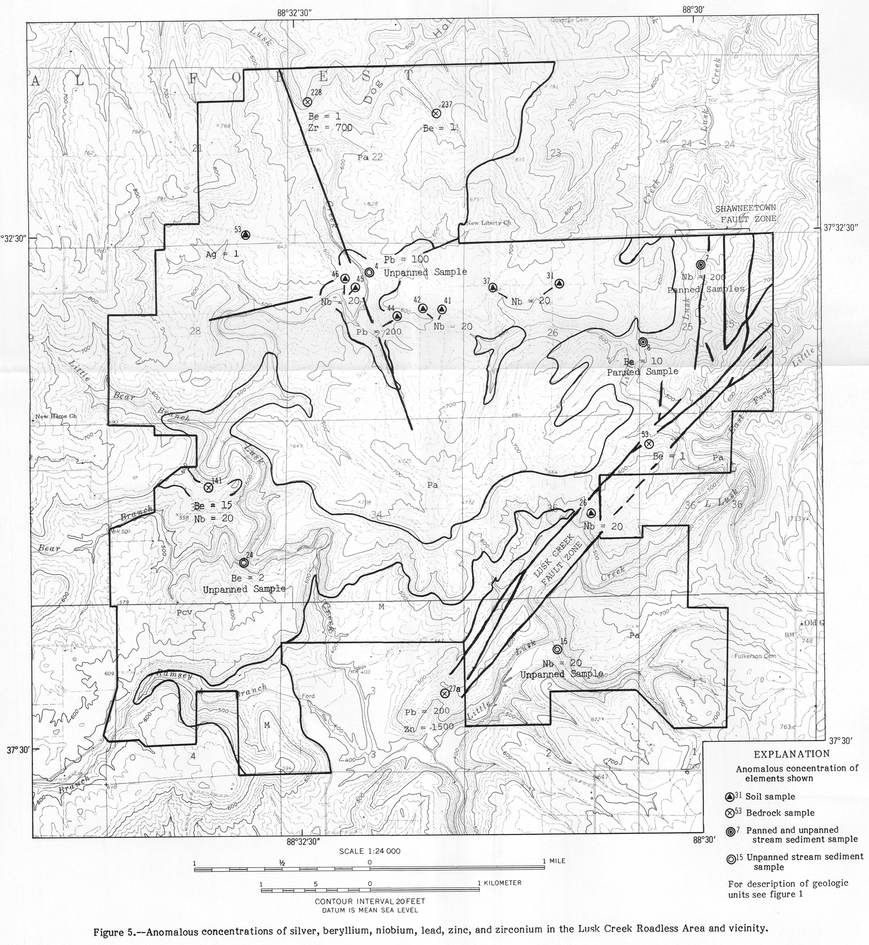


Figure 5.—Anomalous concentrations of silver, beryllium, niobium, lead, zinc, and zirconium in the Lusk Creek Roadless Area and vicinity.

Table 2.--*Description of rock samples selected for geochemical analysis*
Unless otherwise noted all samples are chip samples ranging in size from 2-10 cm.

| Sample No. | Description |
|---|---|
| LB-27a | Grab sample from the Lost 40 mine waste dump; breccia; white, medium to coarse grained, siliceous, mostly fine-grained quartz, slightly calcareous, minor fluorite visible, undifferentiated Mississippian strata along Lusk Creek fault zone |
| LB-27b | Chip sample from country rock near Lost 40 mine; breccia; white, medium-grained, siliceous, mostly fine-grained quartz, undifferentiated Mississippian strata along the Lusk Creek fault zone |
| LB-31 | Siltstone; grayish tan, laminated, flaggy, Degonia Sandstone |
| LB-37 | Chip sample from near Rock Candy mines breccia; white, limonitic and hematitic, yellow-red staining on fractures, 5 mm wide veins of fluorite, undifferentiated Mississippian strata at intersection of Shawneetown and Lusk Creek fault zones |
| LB-410 | Grab sample: sandstone; tan, primarily quartz, Caseyville Formation |
| LB-53 | Chip sample taken from fgliated fault gauge zone along Lusk Creek Fault zone: siltstone; dark gray-brown, micaceous, Abbott Formation |
| LB-60a | Quartz sandstone; gray, numerous limonitic yellow flecks, Abbott Formation |
| LB-65a | Chip sample of country rock from exposed fault within Lusk Creek fault zone: breccia; white, medium- to coarse-grained, siliceous, primarily quartz, undifferentiated Mississippian strata |
| LB-65b | Chip sample of vein rock from exposed fault within Lusk Creek fault zone: vein rock of calcite and fluorite; white and purple, coarse-grained, in undifferentiated Mississippian strata |
| LB-78 | Siltstone; light gray, thinly bedded beds 20 cm thick, Abbott Formation |
| LB-116 | Quartz sandstone; yellowish tan with reddish brown iron banding and reddish brown veneer on joints, minor scattered quartz pebbles, Caseyville Formation |
| LB-120 | Quartz pebble sandstone; reddish yellow primarily quartz, minor clay matrix, Caseyville Formation |
| LB-137 | Quartz sandstone; tan, Abbott Formation |
| LB-141 | Quartz sandstone; reddish to yellowish brown, iron stained, Abbott Formation |
| LB-162 | Quartz sandstone; tan, minor limonitic yellow staining, Abbott Formation |
| LB-191 | Quartz sandstone; tan, micaceous, Abbott Formation |
| LB-197 | Quartz sandstone; dark reddish brown, heavily iron stained, Abbott Formation |
| LB-202 | Quartz sandstone; reddish yellow, iron stained, Abbott Formation |
| LB-209 | Quartz sandstone; tan, micaceous, thin bedded flaggy, Abbott Formation |
| LB-214 | Quartz sandstone; yellowish tan, limonitic, minor quartz pebbles, Caseyville Formation |
| LB-228 | Quartz sandstone; dark brown, dirty micaceous, Abbott Formation |
| LB-237 | Shale; black fissile, Abbott Formation |
| LB-260 | Limestone; dark gray, medium- to fine-grained, crystalline, slightly fossiliferous, Kinkaid Limestone |
| LB-263 | Limestone; gray, micritic, Kinkaid Limestone |
| LB-268 | Siltstone; gray, slightly iron stained, micaceous, Caseyville Formation |

## RESULTS OF GEOCHEMICAL STUDIES

Table 1 provides data on the general background levels of selected elements in bedrock in the study area, and table 2 describes the rock samples selected for analyses. For the most part, background levels are of roughly the same order of magnitude as those given by Turekian and Wedepohl (1961) for the types of rock in the study area. However, table 3 shows elements having higher values than those shown by Turekian and Wedepohl. For example, the average content of fluorine in sandstone is significantly higher than that given in Turekian and Wedepohl, which probably reflects extremely high concentrations of fluorine in fault breccia and mineralized rock along the Lusk Creek fault zone (fig. 4A). Sample 78, a siltstone showing 13,000 ppm fluorine, occurs more than 1 mi west of the Lusk Creek fault zone, and may indicate a local mineralized zone.

Most roads in this region of southern Illinois are graveled, and it is possible that gravel may have come from fluorspar mine dumps, thus causing false anomalies in stream-sediment samples. This does not seem to be the case, however, because most small drainage basins in the area do not have graveled roads crossing them, and several that are crossed by graveled roads outside the area do not have elevated values of elements occurring in fluorspar deposits.

Turekian and Wedepohl give only order-of-magnitude values for barium, manganese, and copper in sandstone; barium and manganese values are in the tens of ppm (parts per million) range and copper is 0-9 ppm. Beryllium values are tenths of ppm for both sandstone and limestone. Table 3 shows that the highest value of barium in sandstone is 150 ppm, and that the average value in limestone is more than three times greater than that given by Turekian and Wedepohl. Beryllium is significantly higher than reported by Turekian and Wedepohl in only one sample (LB-141). Table 3 also shows that some samples of sandstone have anomalously high values of manganese, lead, and zinc relative to those reported by Turekian and Wedepohl.

The terms anomalous, high, and above average used in the following discussion refer to the data given in table 1. Anamalous indicates that a given value is two or more standard deviations above the mean value of the sample population (each sample type—bedrock, soil, and stream sediment—is considered a sample population). A high value indicates it is one to two standard deviations above the mean; above average is larger than the mean but less than one standard deviation. Table 4 shows value ranges for selected elements.

The anomalously high values of fluorine in bedrock along the Lusk Creek fault zone (fig. 3A) are also reflected in the soil samples. For example, samples 1, 8, and 24 show above-average values, and samples 11, 13, 15, and 19 show anomalous values in soils from near the fault zone (fig. 3B). Furthermore, above-average to anomalous values are found in soils 1 mi west of the fault zone.

Several drainage basins show values of 200 ppm of fluorine in the panned concentrates. The highest, 300 ppm, occurs in the Shawneetown fault zone (fig. 3C). Minus 80 mesh stream-sediment samples, except for sample 2 in the northwest corner of the area, do not show anomalous fluorine values (table 1).

Anomalous, high, and above average values of barium in bedrock, panned stream-sediment, and soil samples are distributed throughout the area (fig. 4A, B, C). High and anomalous values in bedrock (150 and 200 ppm) occur in the northern (samples 228 and 237), and southern (sample 31) parts of the area. Above-average values of barium in bedrock (70-100 ppm) are found along the fault zone as well as in several samples west of the fault zone (fig. 4A). Nearly all soil samples along the fault zone have above-average to anomalous values of barium (500 and 700 ppm) as well as samples 28 through 37 just to the west (fig. 4B). Elsewhere in the area, barium values in soil samples are much lower. Panned concentrates having barium values of 700 ppm or greater are found in much of the area (fig. 4C), and values of 1,000 and 1,500 ppm occur in the western part.

Anomalous values of lead occur in several samples within the study area (fig. 5). In the bedrock samples, the highest lead value (200 ppm) is in sample 27a, taken at the Lost 40 mine. This sample also contains the only anomalous value of zinc (1,500 ppm). Although zinc was not detected in any other bedrock sample, high values of lead occur in both panned concentrates and soil samples (tables 1 and 4). A soil sample with 200 ppm lead at location 44 (fig. 5) is about 10 times the background level of lead in the study area (table 4). Also, high lead values of 100 or 150 ppm occur in panned concentrates from three drainage basins—one which crosses the Shawneetown fault zone (sample 8) and two in the western part of the area (samples 19 and 24; see fig. 2 for localities). Beryllium values of 1.5 ppm were found in several soil samples above the Lusk Creek and Shawneetown fault zones, and in soil samples 29 through 32 from west of the Shawneetown fault zone (fig. 1 and table 1). Bedrock sample 141, from the western part of the area, is anomalous in beryllium (fig. 6). Niobium occurs at 30 ppm or greater in most panned concentrates and it is anomalous in sample 7 (200 ppm), and high in sample 9 (100 ppm). It was also anomalous in bedrock sample 191 near the center of the area. There are also seven soil samples that are anomalous in niobium as shown on figure 5.

The high and anomalous values of fluorine and other elements such as barium, beryllium, lead, and zinc near the Lusk Creek and Shawneetown fault zones reflect the high resource potential of this region. This is substantiated by the presence of observable fluorspar, barite, galena and sphalerite along the faults and the fact that there has been fluorspar-mining activity along the fault zone (Klasner and others, 1983).

Above-average, high, and anomalous values of barium, beryllium, fluorine, and lead in selected samples west of the Lusk Creek and Shawneetown fault zones, especially near the newly mapped faults in the west-central part of the study area, suggest that this region may have significant fluorspar mineralization in the subsurface even though Mississippian strata, in which most fluorspar deposits occur in the Illinois-Kentucky mining district (Grogan and Bradbury, 1967), are buried beneath as much as 747 ft of Pennsylvanian rocks as shown by core data from holes in sec. 14, T. 11 S., R. 6 E. The core data were obtained from the Illinois State Geological Survey.

Table 3.--*Comparison of elemental abundances in rocks from the Lusk Creek Roadless Area with average crustal abundances of elements as given in Turekian and Wedepohl (1961)*
All figures in parts per million (ppm).

| | Shale | | Sandstone* | | Limestone | |
|---|---|---|---|---|---|---|
| | 1 sample | | 21 samples | | 2 samples | |
| Element | T | H | T | H/A | T | H/A |
| Ba | 580 | 200 | x0.0 | 150/71 | 10 | 70/35 |
| Be | 3 | 1 | 0.x | 15/ 10 | 0.x | 0/0 |
| F | 740 | 100 | 270 | 94,000/10,406 | 330 | 200/150 |
| Cu | 45 | 10 | x.0 | 15/8 | 4 | 5.4<5 |
| Mn | 850 | 20 | x0.0 | 1,000/155 | 1,100 | 1,000/600 |
| Pb | 20 | 10 | 7 | 200/<10 | 9 | 10/<10 |
| Zn | 95 | 0 | 16 | 1,500/71 | 20 | 0/0 |

T - Crustal abundance from Turekian and Wedepohl. The x symbols indicate order of magnitude. For example, x0.0 indicates values in the tens of (ppm) and 0.x indicates values in the tenths of ppm.

H - Highest concentration measured in the study area

A - Average concentration measured in the study area

* - Sandstone samples include breccia from along Lusk Creek fault zone but do not include vein samples.

Table 4.--*Summary of statistical data in selected elements from table 1.*
all results are in parts per million (ppm)

BEDROCK SAMPLES

| Element | Mean | Above Average | High | Anomalous |
|---|---|---|---|---|
| Barium | 68 | 69 - 116 | 117 - 167 | 167+ |
| Beryllium | 0.1 | 0.2 - 0.4 | 0.5 - 0.7 | 0.7+ |
| Fluorine | Not calculated due to wide variability (See table 1) | | | |
| Lead | 10 | 11 - 48 | 49 - 89 | 89+ |
| Niobium | Only detected in sample LB-141 (20 ppm) | | | |
| Zirconium | 176 | 177 - 349 | 350 - 524 | 524+ |

SOIL SAMPLES

| Element | Mean | Above Average | High | Anomalous |
|---|---|---|---|---|
| Barium | 383 | 384 - 538 | 539 - 694 | 694+ |
| Beryllium | 0.9 | 1.0 - 1.3 | 1.4 - 1.9 | 1.9+ |
| Fluorine | 47 | 48 - 108 | 109 - 171 | 171+ |
| Lead | 22 | 23 - 47 | 48 - 74 | 74+ |
| Niobium | 11 | 12 - 14 | 15 - 19 | 19+ |
| Zirconium | 604 | 605 - 822 | 823 - 1,043 | 1,043+ |

PANNED STREAM SEDIMENT SAMPLES

| Element | Mean | Above Average | High | Anomalous |
|---|---|---|---|---|
| Barium | 600 | 601 - 997 | 998 - 1,397 | 1,397+ |
| Beryllium | 6.3 | 6.4 - 7.5 | 7.6 - 8.9 | 8.9+ |
| Fluorine | 144 | 145 - 218 | 219 - 293 | 293+ |
| Lead | 68 | 69 - 109 | 110 - 152 | 152+ |
| Niobium | 57 | 58 - 98 | 99 - 141 | 141+ |
| Zirconium | All samples at 2000+ ppm | | | |

UNPANNED STREAM SEDIMENT SAMPLES

| Element | Mean | Above Average | High | Anomalous |
|---|---|---|---|---|
| Barium | 148 | 149 - 201 | 202 - 256 | 256+ |
| Beryllium | 1.0 | 1.1 - 1.2 | 1.3 - 1.6 | 1.6+ |
| Fluorine | 52 | 53 - 61 | 62 - 73 | 73+ |
| Lead | 26 | 27 - 44 | 45 - 63 | 63+ |
| Niobium | 4 | 5 - 9 | 10 - 16 | 16+ |
| Zirconium | 422 | 423 - 616 | 617 - 812 | 812+ |

# GEOCHEMICAL SURVEY OF THE LUSK CREEK ROADLESS AREA, POPE COUNTY, ILLINOIS

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