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A COMPILATION OF MINERAL OCCURRENCES AND THE RELATIONSHIP OF OCCURRENCES TO STRUCTURAL ELEMENTS OF THE KENTUCKY AND TENNESSEE REGION

by

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1.0 INTRODUCTION

A very prominent magnetic anomaly measured by Magsat over the eastern mid-continent of the United States was inferred to have a source region beneath Kentucky and Tennessee (Mayhew and Galliher, 1982). Mayhew et al (1982) noted that prominent aeromagnetic and gravity anomalies are associated with the inferred source region. They constructed a crustal model to fit these anomalies, and interpreted the complex as a large mafic plutonic intrusion of Precambrian age. The complex was named the "Kentucky body". It was noticed that the Jessamine Dome, which is a locus of intense faulting and mineralization, occurs near the northern end of the Kentucky body, and that more generally there seemed to be a spatial relationship between mineral occurrence and the body. This study involved obtaining source material from the U.S. Geological Survey and elsewhere on mineral occurrence in Kentucky and Tennessee, and investigating further whether the distribution of deposits is related in some way to the Kentucky body. A compilation of mineral occurrences in the region, classified according to type and age, is presented in the figures of the report.

1.1 Mineral Deposits

Material in this section is synthesized principally from Lawrence (1968), Jolly and Heyl (1964), Kyle (1976), McKnight et al (1962a,b), Worl et al (1974), Brobst and Hobbs (1968), Wedow et al (1968), and Van Alstine and Sweeney (1968). Four mineral commodities are of interest to this study; they are barite, fluorite, lead, and zinc. These occur together in various proportions over a wide geographic area, and are geneticaly related. They occupy two principal stratigraphic positions in the lower Paleozoic carbonate sequence, mainly in the upper part of the Knox Group of early Ordovician age, and secondarily in the early Cambrian Shady Dolomite, although in places the deposits have also been found in higher stratigraphic levels. The principal (Ordovician) deposits probably formed in a karst terrain developed on the post-early Ordovician unconformity (Lawrence, 1968). Thus they are found concentrated as vein and cavity fillings and residual deposits derived from these, and in breccia zones resulting from collapse related to carbonate solution. Where faults and fracture zones are present, notably in the Jessamine (or Lexington) dome, these commonly have formed pathways for mineralizing solutions.

The mineral distributions and types are summarized in tabular form in Table 1 and in the map of Figure 1. The small dots in Figure 1 indicate the distribution of significant fluorite deposits which include important concentrations of lead, zinc, and barite. Areas a and b enclosed by dashed lines contain many small deposits of lead-zinc-barite-fluorite, and are associated with the Jessamine and Nashville domes, respectively. Locations 1 and 2 represent other significant deposits. Deposits indicated by location 3 are associated with the Elliott County kimberlite (which occurs within the Rome Trough), and are genetically unrelated to the others.

The carbonate-hosted deposits are considered to be of "Mississippi Valley" type, much like those further to the west, and thus the site of deposition may be far from the original, presumably magmatic, source. On the other hand, Jolly and Heyl (1964) presented arguments for a local, deep-seated magmatic body beneath the Jessamine Dome as both the source of the mineralizing fluids and the cause of the intense fracturing. In any case, the age of the mineralization is much less than (perhaps one third) that of the plutonic complex making up the Kentucky body.

1.2 Relation to Large-Scale Structures

The lead-zinc-barite-fluorite mineralization in Kentucky and Tennessee is clearly related to the Cincinnati Arch (Figures 1 and 3), a broad linear domal feature which experienced recurrent vertical movement throughout the Paleozoic. The up-arching of the mineralized stratigraphic levels over the Arch and exposure by erosion explains the association. A sag in the structure occurs where the eastern extension of the Rough Creek Graben

(Soderberg and Keller, 1981) continues into the Rome Trough (Ammerman and Keller, 1979) and crosses the Arch, separating it along its length into the Jessamine and Nashville domes. This explains the association of zones a and b of Figure 1 with the two domes.

Although a direct genetic relationship between the mineral deposits and the Kentucky body seems unlikely because of the great age difference, there does seem to be a close geographic relationship between the Kentucky body and the Cincinnati Arch. The most direct explanation for this is that there has been differential vertical movement between the two due to the anomalously large density of the Kentucky body.

Table 1

Symbol	Location	Description
• a 1	Central Kentucky District	Barite, fluorite, sphalerite, and galena in fissure veins in Ordovician limestones.
2	Cumberland River Area, Kentucky	Sphalerite, galena, barite, and calcite fissure veins similar to those of Central Kentucky and Central Tennessee districts.
b	Central Tennessee District	Barite, fluorite, sphalerite, galena and calcite fissure veins in Lower and Middle Ordovician limestones. Very large manto and breccia deposits of fluorite, barite, and sphalerite in Lower Ordovician dolomites extending up into Middle Ordovician limestones.
3	Elliott County kimberlites	Fluorite-bearing igneous breccia and tactite zones of Pennsylvanian or Permian age.

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FIGURE CAPTIONS

Figure 1. Tectonic elements and mineral localities in Kentucky and Tennessee. Heavy line is -30 mgal gravity contour outlining Kentucky body (KYB). Light broken line is one contour line selected from aeromagnetic map of Zietz (1982). Cincinnati Arch delineated by zero level structure contour (dot-dash line) on top of Trenton (USGS and AAPG, 1962). Short dashed lines are generalized faults delineating Rough Creek Graben of Soderberg and Keller (1981) and Rome Trough (Ammerman and Keller, 1979). Symbols 1, 2, 3, a, b refer to Table 1. Modified from Mayhew et al (1984).

Figure 2. Locations of cross sections shown in Figure 3.

Figure 3. Latitudinal and longitudinal cross sections constructed from map of Harris (1975) showing basement surface faults cutting it. Chicken-track symbol in sections 4, 5, C, and D indicates inferred position of top of "Kentucky body" (Mayhew et al, 1984).

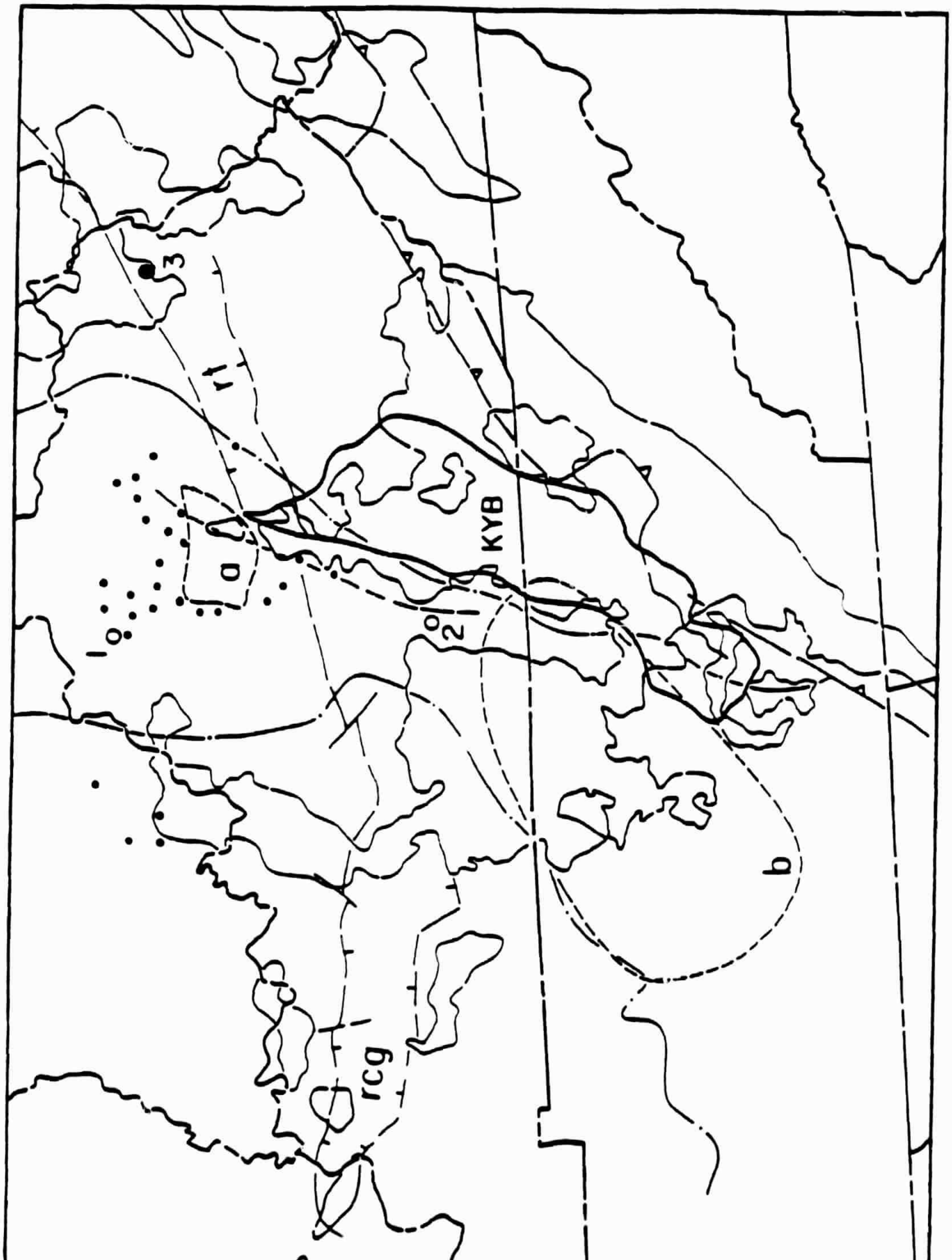

Figure 1

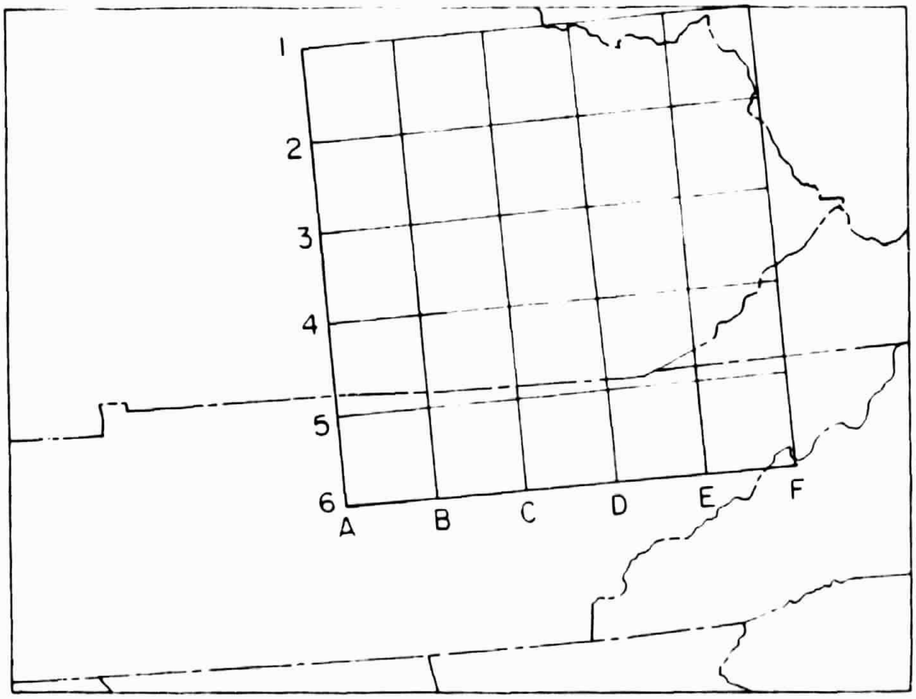

Figure 2

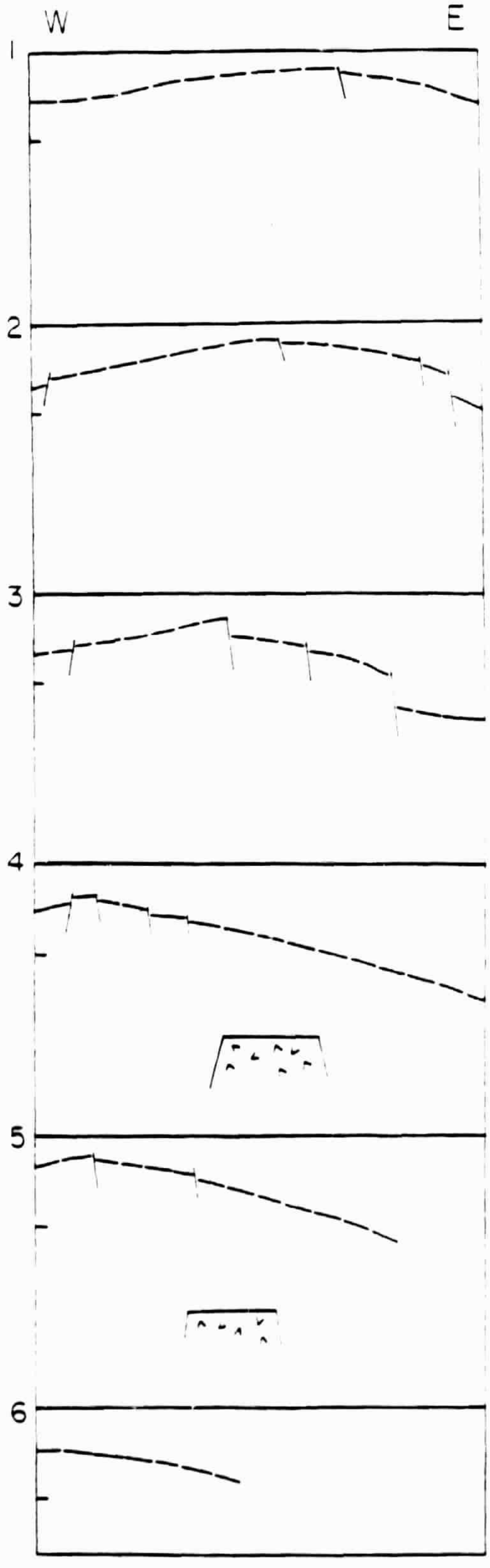

Figure 3a

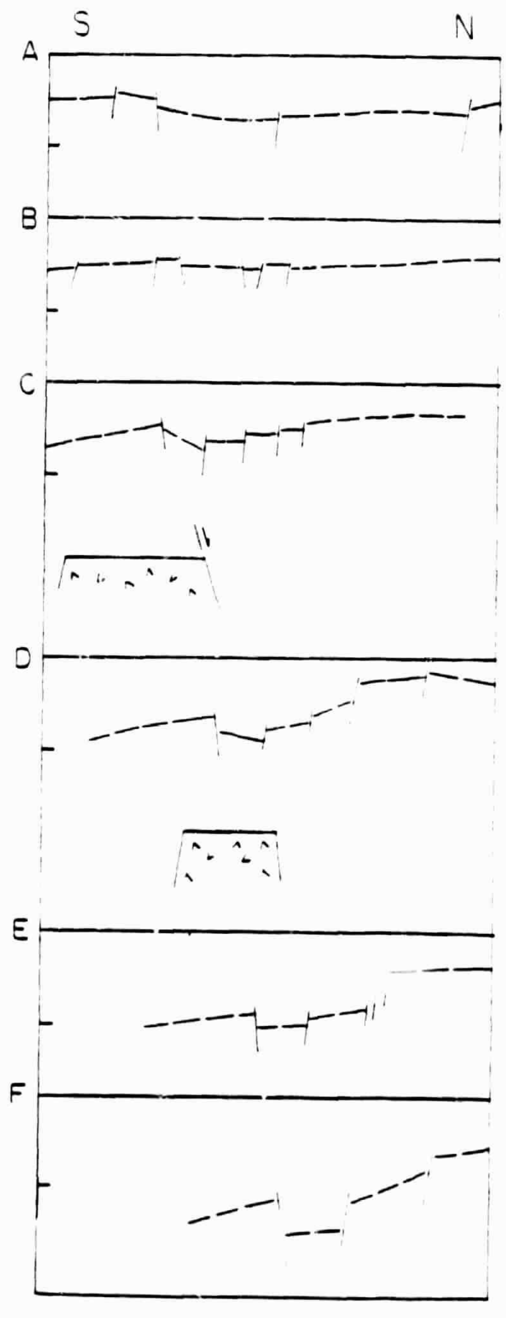

Figure 3b