A MAGNETOMETER SURVEY

NEAR HOUSE SPRINGS, MISSOURI

by

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In recent years a great deal of geophysical exploration research has been conducted by students at Saint Louis University. Most of the work has been done in various areas surrounding the City of Saint Louis, Missouri in the hope of acquiring a comprehensive geophysical picture of the region and also to supplement the geological knowledge of this area.

With this purpose in mind, Dr. Ross R. Heinrich of Saint Louis University suggested to this author several promising regions about which such knowledge was lacking. For this investigation the author selected the area around House Springs, Missouri, which is located approximately 25 miles southwest of Saint Louis, Missouri. The total investigation covered a region of Approximately 75 square miles.

In addition to providing general geophysical and geological information, several more specific reasons were present which warranted this particular area being chosen for investigation. These were: whether a genetic relationship existed between the Eureka anticline, the House Springs fold, and the Valmeyer anticline; what influence, if any, did this region have on the course of the Missouri River; whether there was any continuation of structure or magnetic trends found by J. Fox, who investigated the adjoining region to the west and northwest of the House Springs Area.

Because of the ruggedness of the terrain, the extent of the area to be investigated, and the good results obtained in other

surveys, the magnetic method of geophysical exploration was chosen as the most feasible to use. Readings of the vertical magnetic intensity were first taken solely to give adequate coverage of the entire region, but as the investigation progressed and definite magnetic trends were indicated, additional stations were set up in those particular areas and sufficient readings taken to completely outline the anomaly or feature.

An entire chapter was devoted to the geology of the House Springs Area, with emphasis on structure and stratigraphy. Most of this information was obtained from the literature, but every attempt was made by the author to familiarize himself with the local geology as much as the available time allowed.

Also included was a brief survey of geomagnetism. This consisted of a discussion of the basic principles involved, with a short section on the properties of rocks with which the geophysicist using the magnetic method is primarily concerned. The Earth's magnetic field was also considered; how it originated, the various quantities associated with measurements of terrestrial magnetism, and how these magnetic elements fluctuate with time. Also in this section, the fundamental terms in geomagnetism were defined and some simple relationships set forth. Finally, there was a discussion of the Schmidt-type magnetic field balance, which was the instrument used in the survey.

A chapter was next devoted to magnetic interpretation theory. The general aspects of the theory behind the interpretation of magnetic data were briefly covered; however, the major emphasis was placed on those concepts which were directly related to this investigation. In several instances, the actual derivation of the formulas used in the computations were given.

The actual survey consisted in setting up a main base station to which all readings subsequently obtained could be referred. Each field day a secondary base station was used and at the conclusion of the day's work, this secondary base was tied in as closely as possible with the main base. As a result, at the conclusion of the survey, each station could be tied in with every other station provided the necessary corrections had been made.

The corrected readings were then plotted on a map of the area. Lines were drawn connecting points with equal values, and the result was a contour map showing lines of equal vertical magnetic intensity. At this point, the observed data was ready for interpretation.

The magnetic contour map revealed the presence of two main magnetic anomalies. These anomalies were two sets of parallel contour lines trending east-west and located in the south central portion of the map, and a northeast-southwest trending elliptical high located in the west central part of the magnetic contour map. There were also several minor features present, but these were not defined well enough for interpretation.

In order to determine the structure or structures responsible for the observed anomalies, several methods were attempted. Good results were finally obtained for the interpretation of the two sets of parallel lines by using the method in which a certain structure is assumed, and its dimensions and characteristics varied until the computed curve matches the observed curve. These curves are profiles taken perpendicular to the strike of the structures. A perfect match between the two curves was obtained when a graben-like structure was assumed to cause the observed anomaly. The structure was found to be approximately at 2900 feet below the surface, with the throw of each bordering fault approximately 450 feet.

The elliptical-shaped high was found to be the result of a ridge at the basement level trending NE-SW, with very steep edges to the NW, SW, and SE and grading down gently to the NE. A method originated by Peters, which gives a direct determination of basement structure, was used in this phase of the interpretation.

Several definite conclusions were made. These were: 1) the existence of an important northeast-southwest structural trend in Missouri, 2) evidence of relative uplift in a direction which might have caused the Missouri River to be diverted, 3) that the Eureka anticline, the House Springs fold, and the Valmeyer anticline were not expressions of the same structure. Because of the very high susceptibilities (.012 c.g.s. units) required in all cases to obtain good results, it was also concluded that this section of

Missouri may have some unknown structural oddities, but how these were related to the high susceptibilities could not be determined with the available information.