MAGNETOMETER MAP OF BENNETT AND WASHBAAUGH COUNTIES

by
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INTRODUCTION

The magnetometer survey of Bennett and Washabaugh County was made in August, 1960, as part of the continuing magnetometer program of South Dakota State Geological Survey under the direction of Dr. Allen F. Agnew, State Geologist. Magnetometer maps will eventually cover the entire State.

FIELD WORK

Observations were made with an Askania Vertical Ground Magnetometer at intervals of five miles, with closer spacing in an area northeast of Martin. This network of observations probably outlines the major magnetometric features in the county. In addition to changes in the earth's magnetic field caused by rock types and geologic structures, there is a gradual increase in the magnetic intensity toward the north magnetic pole. In this area the vertical intensity increased about 9 gammas per mile north and 1.2 gammas per mile east (Tullis, 1942). The application of the regional correction to a survey tends to result in a flat magnetic surface. Therefore, any anomaly on this surface is due to a geologic structure.

The diurnal daily variation was taken from repeated observations at a base station and from daily magnetograms supplied by the Tucumcari Magnetic Observatory of the U. S. Coast and Geodetic Survey. All magnetic observations were made in fields and pastures, away from power lines, fences and other possible magnetic objects.

TOPOGRAPHY

Bennett and Washabaugh Counties lie in the Missouri Plateau subdivision of the Northern Great Plains. A large portion of the area is rolling to hilly range land. Buttes and mesas are common. Escarpments are at the edges of the highlands, and vast areas of Impeccable badlands occur in the southern part of the south side of the White River. The maximum topographic relief is 1327 feet, from the top of Eagle River Butte south of Washabaugh, to the valley floor of the White River.

SURFACE GEOLOGY

The area includes the extreme southern tip of the Williston Basin and the northern extension of the Kennedy Basin (Agnew, Gries, 1960). Mesozoic and Cenozoic sedimentary rocks and sediments comprise the surface formations of the area (see Table I). The Cretaceous, Jurassic, Cretaceous, and Mesozoic are present in the area.

The Pierre shale, a marine deposit of Cretaceous age, occurs in the northeastern part of the area along the White River, which constitutes only about ten percent of the area. The remaining ninety percent of Bennett and Washabaugh Counties is made up of Cenozoic formations.

The Cenozoic rocks are present in three areas. The Middle White River group is the northern part and makes up the badlands. The Chadron Formation of the Piocene geologic time in the southern part is the White River. The Chadron Formation at the base is mainly grayish sand in gray-brownish sandstone, siltstone, and shale, with a conglomerate at the base. The Tri-Tong Formation is pinkish-gray to tuffaceous with a sandstone deposit.

The central part of the area contains the Aransas Group (Collins, 1959, 1960). The Shoshone Formation at the base consists of calcareous and clayey sandstone. The Monroe-Creek Formation is well-sorted, massively bedded sandstone. The Harlinville Formation is composed of sands and silts with channel deposits and conglomerates.

The southern part of the area is the Sand Hills region, containing the Ogallala Group (Collins, 1959; Beck, 1960). The Valiance Formation at the base consists of a well-sorted, coarse-grained sandstone and the Chadron Formation is a yellow, silt, and clay deposit. The Chadron Formation at the top is a series of calcareous sandstone, siltstone, and volcanic ash, and is present on the higher altitudes of the uplands.

Table 1---Stratigraphic Classification

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<thead>
<tr>
<th>Era</th>
<th>Series</th>
<th>Group or Formation</th>
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<tbody>
<tr>
<td>Cenozoic</td>
<td>Pliocene</td>
<td>Ogallala</td>
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<td>Ash Hollow</td>
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<td>Valentine</td>
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<td>Miocene</td>
<td>Arksone</td>
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<td>Monroe Creek</td>
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<td>Sharpes</td>
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<tr>
<td>Oligocene</td>
<td>White River</td>
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<td></td>
<td></td>
<td>Scale</td>
</tr>
<tr>
<td>Mesozoic</td>
<td>Cretaceous</td>
<td>Morrow</td>
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</table>

GENERAL STATEMENT

Theoretically the earth itself is a natural magnet. The forces set up between the magnetic and earth's magnetic poles are the cause of the magnetic field. The vertical intensity is determined by the magnetic field emanating from the crust of the earth. These conditions are composed of paramagnetic, diamagnetic, and non-magnetic substances which are in the basement complex, the subsurface sedimentary column, and the ground surface.

The vertical intensity of the terrestrial magnetic field is illustrated by contour lines (isogams) on maps; the lines connect points of equal value. Variations of the intensity are recognized as positive and negative forces commonly known as magnetic highs and lows, or anomalies. The com-}

MAGNETIC ANOMALIES

The present magnetometer survey was added to the survey of Jackson County (Petch and Carmine, 1942; Tullis, 1942), and was continued eastward from the Shannon County Survey (Petch, 1960). The outstanding feature is the extension of the Kyle magnetometer high of Shannon County to the east. This high crosses Bennett County in a southerly direction and appears to terminate near Tullis. A 49-mile long linear feature is located north of Martin, and this high is separated from the remainder of the Kyle high by a sharp low northeast of Martin. A W1 lambda anomaly is located northeast of Tullis.

A large portion of Washabaugh and the northeast part of Bennett County is low magnetically and contains north-south alignment of three magnetometer lows, which turn northwardly into Jackson County. A 100-mile alignment continues southeastward through Coon in southeastern Pennington County, two small highs are located in southwestern Washabaugh County along the White River.

The Southeast magnetics high of Shannon County (Petch, 1960) extends into the area as a larger high with a summit of 172 gamma along a fault line. This high is further separated from the Kyle-Martin high by the Swift-Wick-Percupino magnetometer high of Shannon County (Petch, 1960), which continued southeastward through the James with readings as low as 40 gamma.

GEOLoGIC ANALYSIS

The Kyle magnetometer high is presumed to be caused by differences of rock type in the Precambrian basement. The present survey shows a southeastern extension of the Kyle closure, about 50 miles long and 12 miles wide. The linear alignment indicates a tectonic origin. If it is related to tectonic forces it could be a fault or volcanic ridge as a cause. The magnetic closure could then represent undulations on the structure.

The present survey shows a north-south alignment of three magnetometer highs, which turn northwardly into Jackson County. A 100-mile alignment continues southeastward through the James with readings as low as 40 gamma.

REFERENCES


Peterson, W. D., 1942, Geology of the Spring Creek quadrangle South Dakota. S. Dak. Geol. Survey, map and text.


