Correlation of Geologic and Geophysical Data in the Iron Mountain Area, Albany County, Wyoming.

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Upon recommendations of the United States Geological Survey, the Geology Department of the Union Pacific Railway conducted a detailed reconnaissance of the titaniferous iron ore deposits in the Iron Mountain area of Albany County, Wyoming. One of these recommendations called for a magnetic survey in certain specific areas: each of these areas were to have 1) a reconnaissance magnetic survey, and 2) a detailed grid based on the findings of the reconnaissance survey.

The reconnaissance survey sonsisted of magnetic readings spaced at intervals of 200 feet East-West and 100 feet North-South. A detail grid of 50 feet interval spacing was then laid upon areas where the magnetometer showed either positive or high negative readings. Among the areas found to be possible ore producing areas was Grid 1, consisting of an area approximately 3/4 mile square. This area was located on top of a large, rugged mountainous mass of anorthosite, and had numerous large deposits of magnetite.

This area, typical of the surrounding areas, consists of country rock of anorthosite with outcroppings of titaniferous iron ore and interjected dikes. The titaniferous iron ore is believed to be formed by magmatic segregation, and in the area under study, it was found by drilling that there is a gradation between the anorthosite and the iron deposits indicating that they are of the same approximate age. The interjected dikes have sharp margins with the anorthosite and magnetite and were obviously injected after crystallization of the country rock.

These dikes consist of two types: graphic granite and grano-diorite. The graphic granite is of a classic nature with a few exceptions. The writer has found one dike of graphic granite in which there were widely separated inclusions of magnetite and quartz up to six inches in diameter. These granite dikes are large, tabular and protude above the surrounding country rock.

The dikes of grano-diorite are very deeply weathered and disintegrate with the blow of a hammer. They are for the most part buried under the mantle, or lie at depth under the surface. The dark minerals of these dikes are for the most part magnetite, with varying amounts of biotite and hornblende.

Chapter II.

I. Magnetometer computation:

1) Rock masses and rock types differ from one another in their magnetic permeability.

2) The local anomaly values of magnetic intensity are chiefly attributed to:

   a) the amount of magnetite in the rocks.

   b) structural deformation.

3) The magnetic anomaly contour lines in an ideal case without structural or magnetic interference are interpreted similarly to those of topographic contours. This is not meant to imply, however, that the two correspond in interpretation, i.e. a magnetic anomaly dip may be opposite to and cross a topographic slope.

II. Magnetometer readings and actions:

1) The vertical magnetometer(1) is set up so that the vertical plane in which the the magnetic needle of the instrument lies will be perpendicular to the magnetic meridian.

2) The magnetic readings are in gammas:

a) A gamma is 1/100,000 of a gauss.

i) A gauss is the intensity of a magnetic field that will act on a unit magnetic pole with a force of 1 dyne.

) A unit magnetic pole will act on an equal pole with a force of 1 dyne at a distance of 1 cm.

III. Normal Polarization of Magnetic Bodies:

1) This will give a positive reading on the magnetometer.

IV. Reverse Polarity of Magnetic Bodies (rare):

1) Reverse polarity may be due to:

a) Large current intensities in lightning discharge produce strong magnetic fields capable of reversing the polarity of an exposed magnetic body.

b) Position of magnetic ore body: "If the magnetic body strikes magnetic east-west, and dips against the earth's magnetic field at an angle very slightly greater than the earth's field, the body will show reverse polarity."(2)

c) Reverse polarity may be due to bodies that have been overturned.

Chapter III.

Diamond drilling was started in the Grid 1 area before the magnetometer work was finished. As a result, much time and money was wasted.

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(1) As used on survey.
(2) C. H. Wilson.

The surface geologists at first tended to disregard and belittle the accuracy of the magnetometer findings. The first four diamond drill holes were essentially "dry". These holes were based on surface data accumulated by the geologists. The joint patterns of the magnetite-illmanite ore, and the typical jumbled pile of ore outcroppings were such as to confuse the observable data. From DDH no. 5 on, the holes were spotted by coordinating surface and subsurface geology.

Diamond Drill Hole No. 1 at C.5-8.4 was the first hole drilled in this area, and the first of four drilled before complete computation of magnetic data. It was drilled in a south-westerly direction so as to intersect the long, thin tabular body, C.7-F.9, which, according to surface data, dipped to the east. Subsequent magnetometer readins showed that this outcropping was not of major significance and was definitely not a major ore body.

DDH no. 2 (F.3-6.3) -- The second hole drilled was drilled in a westerly direction towards the large outcropping at F.7-5.3. Surface indications were again so confused that it seemed that the ore body dipped approximately N8OE at a rather shallow dip. Magnetometer calculations show that if a body does exist in this area, it is vertical. The result of drilling was a core of 3 feet of silicate-type(3) ore directly under the outcropping. If the magnetometer work had been consulted before drilling operations began, much time and money would have been saved.

DDH nos. 3 & 4 were drilled in the same manner: outcroppings that looked good on the surface had no vertical extent, as is the case in many of the outcroppings found in this area.

DDH no. 5 was drilled upon a granite dike in an NE direction towards the positive reading in the area G,H-5. The relatively high

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93) Magnetite-illmanite ore with a relatively large percent of hornblende, leucite and norite.

reading on the granite was believed to be from magnetite within the dike. Massive iron ore was encountered between the 6,000 and I4,000 anomaly. This body continued to the other side of the I4,000 anomaly, and then entered anorthosite, directly beneath the surface iron outcrop This would indicate that the ore body dipped to the south under, or parallel to the probably south dipping granite dike.

The large massive ore body mapped at H,L— 3,4 was mapped in the belief that it was such a body. Subsequent magnetic survey showed that only a small part of this area was of commercial value. The rest of this outcrop(?) as mapped is now thought to be either the residual remains of an outcrop located in the same position at a higher level before erosion, or is float from the definite outcrop at points L.5 -- 2

DDH no. 8 was drilled towards the offscale positive reading at an angle of 25°. Ore was encountered approximately at the station of offscale reading. The drill core showed a thickness of 25', which seems to indicate a vertical circular body of relatively great depth. At a point 300' southwest of the offscale positive reading is encountered a high negative reading of fair size, which is thought to be due to either a fair sized body of reverse polarity, or to a buried geologic structure.

At point L,M -- I.5,2.5 the observed outcrop and the magnetic survey correspond. DDH no. IO was drilled towards the point of the 26,000 gamma anomaly at an angle of 45°. The drill hole passed through 147' of massive iron ore, in which iron was first encountered beneath the 6,000 anomaly on the suthwest side and continued to the 8,000 anomaly on the northeast side. This is consistent with the findings of the numerous other drill holes if the magnetic readings are of a substantially high value, I5,000 . The area of 6 -- 8,000 gammas consist of massive ores, and the distance between readings from

6,000 -- 5,000 are usually a silicate type iron ore.

At the point H -- 2.5 an offscale negative reading is encountered next to an iron outcrop believed to be of reverse polarity. I00' south of this reading is a station of 28,000 gammas. As there is no outward sign of structural disturbance, it is assumed that the off-scale negative reading is due to reverse polarity caused by lightning, and the 28,000 anomaly is a separate iron body. The idea of two separate bodies is substantiated by a "0" reading between two magnetic stations.

DDH no. I3 was drilled solely on subsurface observations by the magnetometer, since there were no visible outcrops nearby. The magnetic anomaly contour lines indicated that a possible ore body existed in this area, and the body had a southwest dip. The hole was drilled to a depth of 450' and I73' feet of ore was encountered, of which 43' was massive and I30' was rich silicate type ore. This area, , gives an excellent example of ideal magnetometer interpretation: the outcrop was found to dip proportionally with the dip of the magnetic anomalies. (See attatched cross section.)

DDH #13 is drawn from the relative horizon so as to cross the magnetic anomaly cross-section at the corresponding position underground.

Theoretically, it would be possible to determine the exact shape of the ore body underground by means of one drill hole that completely penetrated the ore body, and an analysis of the drill core to determine the magnetic permeability of the ore. This could probably be done by taking a magnetic anomaly cross-section where the drill hole has penetrated, and subtract or add a correction factor for magnetic permeability of rocks weaker than the strongest magnetic unit. (pure massive magnetite - Ilmenite ore.)

The magnetic anomaly cross-section in the diagram shows the shape of the ore body in the ideal sense — assuming that the ore is homogeneous.