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Geology of the Menominee Range Dickinson County

By

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PROGRESS REPORT

A PRELIMINARY GEOLOGIC SURVEY OF PART OF THE MENOMINEE IRON RANGE, MICHIGAN

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INTRODUCTION

Detailed work by the Michigan Geological Survey in various parts of the Menominee iron range in Dickinson County prior to the summer of 1939 indicated that a revision of the existing geologic maps of the district might well be undertaken. An area extending from Norway to Quinnesec was selected as one likely to demonstrate the general nature of structural and stratigraphical conditions differing from those shown on the older maps and one which might be typical of the entire district. Within this area, outcrops are reasonably numerous toward the east and west ends, but are entirely absent for more than a mile in the central part.

The methods employed consisted of (1) stratigraphic studies to determine distinctive features and proper sequence of formations; (2) mapping of outcrops and such structural features as strike, dip, folds, faults, etc.; (3) taking dip needle readings at intervals of 40 feet along a grid of north-south and east-west traverse lines one-eighth mile apart; and (4) compiling data from such mine maps and drill records as were available.

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In order to establish as accurately as possible the meaning of dip needle readings, there was conducted a study of observations made on outcrops and in areas in which the underlying formations were known from drill records or mine maps.

The geologic interpretation shown on the accompanying preliminary map represents those relations which seem to agree best with geologic and magnetic data. It is the opinion of the writers that it represents the general type of structure of the area, although it is realized that it may not be correct in all details. It is presented as being a reasonable explanation of the general conditions which have been indicated by available information.

DISTRIBUTION AND STRUCTURE OF FORMATIONS

As shown by the accompanying map, the general strike of the formations in this area is north of west, and the general dip is southward. The oldest formation, the Randville dolomite, occupies the northernmost position and is succeeded southward by progressively younger formations. However, both the general strike of the formations and their succession are interrupted by variations in structure, giving rise to local distributions which depart from the general one.

Although it is obvious that the rocks of the area have been disturbed by folding, which is an important factor in their regional distribution, nevertheless this preliminary map, like its predecessors, of parts of the area resulting from a restudy of the Menominee region, indicates that the local distribution of formations is more the result of faults

than of folds. In this respect the present interpretation agrees well with the geologic structure and distribution shown on subsurface maps of operating mines in the vicinity, although it differs from former interpretations.

One interesting feature of the general fault pattern is the systematic orientation of the faults. Those with northeast-southwest trends constitute the most conspicuous system in the pattern. Other systems embrace those trending (1) northwest-southeast, (2) nearly north-south, and (3) approximately east-west. It will be noted that repetition and overlap are caused chiefly by faults trending northeast-southwest and northwest-southeast.

The position of most faults has been determined by such geologic evidence as abrupt termination of beds, offset of beds with gap or overlap, severely brecciated zones, and slickensided surfaces. Additional evidence of faulting was obtained from abrupt offset or termination of trends in dip needle readings, especially the trends of "highs;" from drill records; and from mine maps.

Only faults of major displacement have been shown on the map and it is likely that more such faults exist than have been indicated by available information. For example, if the "Footwall"° formation is present south of the Curry iron formation in the vicinity of Norway and Quinnesec, as may well be the case, this relationship has undoubtedly resulted from faulting. However, because of the present uncertainty, the boundary

°Footwall slates of L. M. Scofield

between these formations is shown on the map not as a fault contact but as one probably involving faulting in part.

Again, the area between the Few mine in Section 6 (T.39N.,R.29W.) and the Bryngelson shaft in Section 2 (T.39N., R.30W.) is another example. In this area dip needle observations indicate the presence of only one iron formation, the trend of which leads into the Few mine and the Munro mine, where material with the characteristics of the Traders iron formation was observed. However, both Traders and Curry iron formations apparently are present to the east and west of this gap, and the absence of the Curry iron formation in this part of the area is believed to be a result of faulting.

In the vicinity of Fumee creek (Section 2, T.39N.,R.30W.), magnetic observations and diamond drill records indicate the presence of faults. Drill records show the presence of sheared and brecciated zones as well as numerous repetitions of like formations. In those instances in which several holes in the same direction but at different angles were drilled from the same set-up, there was much disagreement in the records obtained. The fault relationships are so complex that only the data of the upper holes could be used in the construction of the map. Therefore the map presents only the generalized distribution and trend of formations in this vicinity, with the admitted omission of fault details.

Some evidence of igneous activity was observed within the area mapped. This is indicated by the presence of a few basic dikes cutting the iron formations at the Norway and Cyclops pits and elsewhere, and by the presence of small dikes of granite pegmatite. The latter dikes were

observed at the Vivian pit, at the Millie pit in Iron Mountain (outside of the mapped area), and on the dump of Aragon mine No. 5. They are composed chiefly of quartz, but contain also, among other minerals, some microcline, tourmaline, and mica.

A comparison of structure and distribution of formations shown on this preliminary map and on the map accompanying Monograph 46, United States Geological Survey, reveals certain differences. These are greatest in connection with the interpretation of structure, and less marked in connection with the general distribution of formations. One of the chief differences in distribution of formations will be noted between the Munro mine and Fumee creek, where dip needle readings indicate that the Traders iron formation extends almost to the Bryngelson shaft although the monograph map shows iron formation extending only about half of the distance between these locations.

Also, it will be noted that no geologic formation has been mapped south of the Traders iron formation in that same area. No outcrops occur; dip needle readings furnish no definite information regarding probable formations present; and drill records, if any exist, were not available. Hence it was thought best to show no formation south of the Traders iron formation throughout this distance, as actual conditions are unknown. A second important difference is the fact that, whereas the map in Monograph 52 shows Hanbury slate south of the Curry iron formation throughout the entire area, the accompanying map indicates the presence of formations of variable age and character in that location.

STRATIGRAPHIC PROBLEMS

The chief stratigraphic problems met in geologic mapping in this area involve the separation of the Traders and Curry iron formations, and the correct identification of the various slates. Certain horizons of the iron formations are readily recognized. However, if those horizons are not exposed, much uncertainty regarding proper classification may result. It is believed that this is generally known among workers in this area, and further discussion is not necessary here. The separation of the various slate horizons, however, and particularly the positive separation of "Footwall" and Hanbury formations, is a matter of considerable difficulty and importance.

The Hanbury Problem

The monograph map shows Hanbury slates lying above the Curry iron formation all along the south side of the area under consideration. The present map, however, does not show the Hanbury slates there or any other place in the area. Examination of exposures in the vicinity of Hanbury Lake, at the type locality of the Hanbury, failed to reveal any strata which were distinctly different from those observed in other formations. Indeed, strata examined at the type locality could be matched with material from the Randville formation and from other horizons. Moreover, the rocks of the type locality have been involved in faulting of considerable magnitude which has occurred along the south side of this lake, and it is very probable that part of the exposures there actually are Randville dolomite and slaty phases of the Randville formation.

During the course of field work, the probable succession of strata from Randville dolomite to Curry iron formation had been determined by a study of available exposures. Within the type Hanbury formation, no characteristics were observed which would serve to distinguish it from similar horizons below the Curry iron formation. Moreover, within the area mapped, no rock exposures were observed with characteristics which would exclude them from being correlated with one of the horizons in the succession from Randville dolomite to Curry iron formation. Therefore it seemed inadvisable to consider the type Hanbury as a separate formation, especially in view of the fact that faulting had very probably brought up rocks older than the Curry iron formation at the type Hanbury location.

If the Hanbury formation of the type locality is in reality a complex of several different formations, there arises the problem of reclassifying the type Hanbury and other similar exposures. The identity of the type Hanbury was not an immediate objective of the survey. However, it is recognized that its true identity is a matter of some importance, and that certain ferruginous, quartzitic, and calcareous facies that have been included in the Hanbury formation suggest a close relationship to or identity with horizons of the Randville formation, and possibly also the "Footwall" formation.

"Footwall" Slates and Iron Formation

In the area of the accompanying map there are only a few exposures of rock south of the Curry iron formation, each of which was designated Hanbury on the monograph map. The rocks in these exposures are

generally sericitic slates or schists with quartzitic lenses or bands. These characteristics are the ones normally used to identify certain horizons of the "Footwall" slate. Therefore, such exposures are not designated Hanbury on the present map, as it is thought that they probably represent the "Footwall" slates.

Another feature in connection with the mapping of strata south of the Curry iron formation is worthy of special mention. Exploration which was directed southward by cross-cuts and diamond drill holes in the mine workings of Aragon mine No. 5, revealed, south of the Curry iron formation, the presence of layers which were classified on the mine map as "Footwall" material. Among those layers were occurrences of some sort of iron formation. Hence there is a probability that some material previously mapped as Hanbury may be "Footwall" slates with some included iron formation, in fault contact with the Curry iron formation.

The association of lean iron ores with slates which have been classified, previously, as part of the Hanbury formation, can be observed in exposures north of Norway at Iron Hill, and south of Loretto at Turner's exploration. Some investigators have contended that these occurrences of iron formation were to be correlated with the iron formation of Upper Huronian age in the Florence region of Wisconsin. It must be admitted that there are striking similarities in the iron formations and associated slates of the two regions, but if this lean iron formation of the Menominee region is associated with the "Footwall" slates, as has been indicated, it is lower in the succession.

In consequence of such possibilities, several new problems arise. Are these horizons correlatives? If so, is there any liklihood of the "Footwall" slates containing ore bodies similar to those of the Florence region? What is the probable distribution and amount of this material south of the Curry iron formation? These questions cannot be answered without more information.

EXPLORATION POSSIBILITIES

The changes in structure and stratigraphy indicated by the accompanying map should cause a reconsideration of the exploration possibilities of the area. Some of the chief points deserving consideration are here summarized.

The similarity in geologic structure of the rocks of the Aragon location at Norway and the area northwest of Quinnesec is very striking. Overlap by faulting is present in both iron formations at the Aragon mine, but the ore was developed in the Traders horizons. A similar fault pattern at Quinnesec Hill is indicated by the distribution of the Curry iron formation. The survey has not extended far enough to indicate the distribution of the Traders iron formation, but probably it is faulted in the same manner as is the Curry iron formation. If so, the conditions would be similar to those existing at the Aragon property and would be favorable for exploration.

The occurrence of ore bodies only in those parts of the area in which faults have been indicated by geologic and magnetic data suggests

one possible guide in exploratory work. Such a structural relationship may be an important but not an infallible guide, as exploration to date has not indicated high grade ore at the Munro mine and at the locality which was explored by drilling near Fumee creek. It is likely that a combination of factors such as the sequence of faulting, the permeability of the formations, the presence of oxidizing solutions, either cold or hot, or some other relationship have aided in the formation of the ore bodies. The additional factors which determined the location of the high grade ore bodies in some faulted parts of the area are still unknown.

Some general exploration of the Traders iron formation between the Few mine and the Bryngelson shaft might be warranted. There is no faulting shown on the map except near the Bryngelson shaft, but faulting may exist south of the Traders formation, as previously stated. Moreover, faulting may be merely incidental to the formation of ore bodies, and not a necessary part of the process. The conditions in the vicinity of the Bryngelson shaft might prove especially favorable for exploration because of the folding and apparent thickening of the formation.

If ore such as that of the Florence district warrants exploration, then some consideration should be given to the possibilities south of the Curry iron formation in the area shown on the map as possibly containing "Footwall" slate and iron formation.

Although there are no clear indications as to the combination of circumstances which caused the conversion of iron formation into iron ore, the foregoing suggestions have been made in order that they may be considered in attempting exploration of the area.