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Progress report on geologic study

of Crosby and Ironton area of the Cuyuna Range,

Crow Wing County, Minnesota

by

Robert Gordon 1924-
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R. G. Schmidt and C. E. Dutton, 1904-

This report and accompanying illustrations are preliminary and have not been edited or reviewed for conformity with U. S. Geological Survey standards and nomenclature.

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by

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Introduction

The detailed geology of part of the Cuyuna manganiferous iron-ore district was mapped during the summer and autumn of 1951. The only exposures of bedrock in or near this area are in the open-pit and underground mines where two or more layers of iron-formation and associated clastic sediments have been deformed into a complex fold system and have been intruded by large dikes. The accompanying maps and sections show the distribution of the several rock types exposed, brief descriptions of these materials, and data on the geologic structure. For the most part this structural and lithologic information has been generalized from much more detailed maps prepared in the field on scales of 30, 40, or 50 feet equal to one inch.

The Cuyuna district lies in central Minnesota and extends from the vicinity of Randall, in Morrison County for 62 miles northeastward through Crow Wing County to a point about 15 miles east-northeast of Aitkin in Aitkin County. Maximum width of the district is about 20 miles near its center.

The currently and recently active part of the district is concentrated in about 6 square miles in the vicinity of Crosby, Ironton and Riverton in Crow Wing County and is the only part examined thus far in the investigation (pl. 1).

The average annual production of iron-ore and manganiferous iron-ore from the district during 1940-1950 was slightly more than three million tons, and production in 1951 was three and one half million tons.

The cordiality and helpfulness of the personnel of mining companies and of many other interested individuals has been sincerely appreciated, and the cooperation of the mining companies in providing base maps is especially and gratefully acknowledged.

Description of rocks

The bedrock in the part of the Cuyuna district being discussed may be subdivided into three general types: (1) iron-bearing strata, (2) shale, slate, siltstone, and quartzite, and (3) igneous intrusives. The maps and sections present much information concerning these materials, and some additional descriptions of characteristics follow.

The iron-bearing strata have been divided into two general lithologic types that may be useful in further stratigraphic studies in the district; these have been tentatively called "laminated" or "banded" iron-bearing rock, but some exposures have not been differentiated.

Both oxidized and unoxidized laminated material are exposed in the mines. The unoxidized rock is gray or gray-green, is finely layered, and consists of fine-grained iron carbonate with different amounts of minnesotaite, stilpnomelane, magnetite, and quartz. The layers are produced by variations in mineral composition and usually do not exceed one-quarter inch in thickness. The magnetite is apparently restricted to a few feet in stratigraphic range, but correlation with definite strata has not been made. Some of the unoxidized laminated material in the Mahnomen No. 4 and Arko mines is strongly magnetic. Many of the limonitic laminated ores in the mines are weakly magnetic.

Oxidized laminated iron-bearing rock is usually readily distinguishable because it tends to retain the finely layered structure. Notable exceptions are the "gnarled" materials in which contraction that accompanied silica leaching has produced many small shrinkage cracks; these cracks finely divided the rock and obliterated the original structure. This type of oxidized material does not seem to form from the banded iron-bearing rocks, however, so it does not interfere with differentiation.

In parts of the Arko, Alstead, and Portsmouth mines, laminated iron-bearing rock contains interbedded layers and lenses of chert. These cherts are generally 1 to 3 inches in thickness and are spaced at intervals of about 3 inches to several feet. Some widespread lenses in the Alstead mine are up to 6 inches thick, and a single bed of pale-greenish chert constitutes the lower few feet of the iron-formation. This material is not mottled and consequently is distinguished from the chert of the material described below.

The banded iron-bearing rock is characteristically a thick-bedded, cherty, moderately magnetic material with a mottled or granular texture. The beds range from a few inches to several feet in thickness, and may be present in two general forms. The iron and silica may be more or less uniformly distributed through the strata or high-silica and high-iron beds may alternate. Where exposed in the mines, the banded material is partly or completely oxidized. It consists of various amounts of fine-grained quartz, iron carbonate, magnetite, and ferric oxides. Silicates were not observed, though this may be related to the extent of oxidation.

The mottled texture suggests derivation from a rock in which granules have been partly destroyed by recrystallization and oxidation. Distinct granules have been observed in mottled chert from the Arko mine and also from the Algoma mine which lies north of the mapped area.

The iron-bearing strata in the Virginia and Armour No. 2 pits locally contains much graphite.

The stratigraphic position has not been established for all exposures of shale, slate, siltstone, and quartzite; some immediately underlie the iron-bearing strata in anticlinal structures--i.e., Mahnomen No. 1 mine area, pl. 4--and consequently are the oldest rocks of the sequence, but others probably are between units of iron-bearing strata. The shale is commonly light gray or banded light and dark gray; locally, layers contain clay granules and exhibit graded bedding. The slates are generally sericitic and locally siliceous; they may be gray or greenish-gray if unoxidized but otherwise are buff or reddish brown in color. Graphitic slate is exposed in the Huntington, Feigh, Pennington, and Virginia mines. The siltstone is composed of fine quartz, contains less sericite than the slates, and has little or no cleavage. The quartzites are generally interbedded as lenses in slates, but the maximum thickness may be as much as 50 feet. The quartzites are medium grained and are dark gray and gray-green to buff and red-brown.

Chloritic schists are exposed in the mines along the southern edge of the mapped area and in the Maroco mine on the northern edge. These schists crosscut the iron-formation and seem to be thoroughly altered intrusive rocks. The color is usually a gray or greenish-gray when unoxidized, red-brown when oxidized.

Structural geology

The geologic structures of the Cuyuna district are dominantly folds that trend about N 65°E and numerous examples are present in the mapped area. Undulations of many of the fold axes produce opposed plunges to the northeast and southwest and complicate the exposure patterns of the strata.

The northernmost structure exposed in the mapped area is in the Maroco mine where the beds dip southward on the north limb of a large syncline. The general southwestward plunge of this syncline is indicated by the plunges of the several drag folds in this mine. This same fold limb apparently continues southwestward about one mile to the Section 6 mine (sec. 6, T. 46 N., R. 29 W.). beyond the mapped area.

Iron-formation that probably lies on the southeast limb of this same syncline appears in the Joan and Mangan-Stai mines and in the northwest corner of the Arko mine. The general dip of the beds is to the northwest, and the drag folds plunge to the southwest.

Further details of this synclinal area are lacking because the Virginia mine is the only area of exposed bedrock ~~bedrock~~ between the two limbs. The location of the mine in the general synclinal structure described above and the lithology of the iron-bearing rock in the Virginia mine suggest that these exposures of iron-formation are higher in the stratigraphic succession than those in the Maroco, Joan, Mangan-Stai, and Arko mines.

The structure in the area southeast of the Joan, Mangan-Stai, and Arko mines is a series of long parallel synclines and anticlines. These folds are further characterized by local plunges toward the northeast and southwest that cause rocks of various stratigraphic positions to be exposed on the crests of anticlines and in the troughs of synclines.

Along the southern edge of the mapped area a group of mines, from the Huntington to the Thompson, are located on southward-dipping iron-formation, but it has not been clearly shown that these mines are on the same or different layers of iron-bearing rock. The southward-dipping iron-bearing strata and associated slates are overlain and truncated by one or more instrusives that trend more westerly than the adjacent sedimentary rocks.

The iron-bearing strata continue southwestward from the Huntington mine, but in 1951 no bedrock was exposed for a distance of more than 2 miles to the Sagamore mine where the strata also constitute a part of the southern limit of the mapped area. Several large folds are well exposed in the Sagamore mine (pl. 6) and are probably drag folds on a south-dipping major fold limb.

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