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HIGH CALCIUM LIMESTONE DEPOSIT IN THE RATTLER GULCH AREA, GRANITE COUNTY, MONTANA

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John O. Landreth, Mining Geologist,
Northern Pacific Railway Company,
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St. Paul, Minnesota 55101

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MONTANA COLLEGE OF MINERAL SCIENCE AND TECHNOLOGY
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INTRODUCTION AND SUMMARY

Increased demand by Pacific Northwest limestone-consuming industries has precipitated an extensive search for additional high-calcium limestone deposits. In 1966, Northern Pacific Railway Company began a new study of high-calcium limestone deposits in western Montana.

Selection of the Rattler Gulch area near Drummond, Montana, for field examination was based on the following factors: (1) proximity to existing markets, (2) proximity to railroad transportation, and (3) chemical characteristics of material. Suitable limestone units were traced at the surface for 4.5 miles northwest from the Big Horn Calcium Company limestone quarry. These units dip 80° NE to 80° SW. Six chip samples were taken from rock in place; a grab sample across 146 feet of talus was also collected. Analyses of the samples are shown in Table 1; locations of samples are shown on Figure 1. The sample analyses indicate that units containing more than 95 percent $CaCO_3$ average 60 feet in thickness for a distance exceeding 18,000 feet. Reserves to a depth of 100 feet are estimated to be 9 million short tons.

PREVIOUS WORK

Perry (1949) and Chelini (1965), in their comprehensive reports on limestone resources of Montana, included brief descriptions and chemical analyses of the limestone in the Rattler Gulch area. The geology was mapped and described by Kauffman (1963) in a report on the Garnet-Bearmouth area.

ACKNOWLEDGMENTS

Mr. Willis M. Johns, chief geologist, Montana Bureau of Mines and Geology, and Mr. Ernest E. Thurlow, manager, Mineral Development and Eastern Lands, Northern Pacific Railway Company, contributed to planning of the project.

Mr. C. W. Jordan, geologist, and Mr. H. P. Knudsen, field assistant, both of Northern Pacific Railway Company, assisted in the field. The geologic map was prepared and drafted by Mr. C. W. Lindberg, office geologist, Northern Pacific Railway Company. Mr. Layton C. Binon, chief mining geologist, Northern Pacific Railway Company, made many helpful suggestions in the preparation of the manuscript. Chemical analyses were made by Mr. Frank P. Jones, analyst-assayer, Montana Bureau of Mines and Geology.

The American Crystal Sugar Company granted access to its property and gave permission to publish certain chemical data on quarry rock. Big Horn Calcium Company, after purchase of the American Crystal Sugar Company quarry, also agreed to publication.

LOCATION AND ACCESS

The Rattler Gulch area is about 3 miles northwest of Drummond, Granite County, Montana. The mapped area of about 16 square miles lies entirely within T. 11 N., R. 13 W. (index map, Fig. 1).

Good gravel roads along Spring Gulch, Rattler Gulch, and Mulkey Gulch provide access to the high-calcium limestone units from U.S. Highway 10 and from the Northern Pacific Railway on the north side of the Clark Fork River. The Chicago, Milwaukee, St. Paul and Pacific Railroad is on the south side of the river.

DESCRIPTION OF THE RATTLER GULCH LIMESTONE DEPOSIT

High-calcium limestone contains at least 95 percent calcium carbonate ($CaCO_3$) by weight, not more than 2 percent magnesium carbonate ($MgCO_3$), and, in most specifications, less than 3 percent insoluble impurities such as silica, iron oxide, and alumina.

The Mission Canyon Limestone of the Madison Group (Mississippian), the major source of high-calcium limestone in Montana, is well exposed in the Rattler Gulch area. Two quarries in the area, the Hitchcock quarry

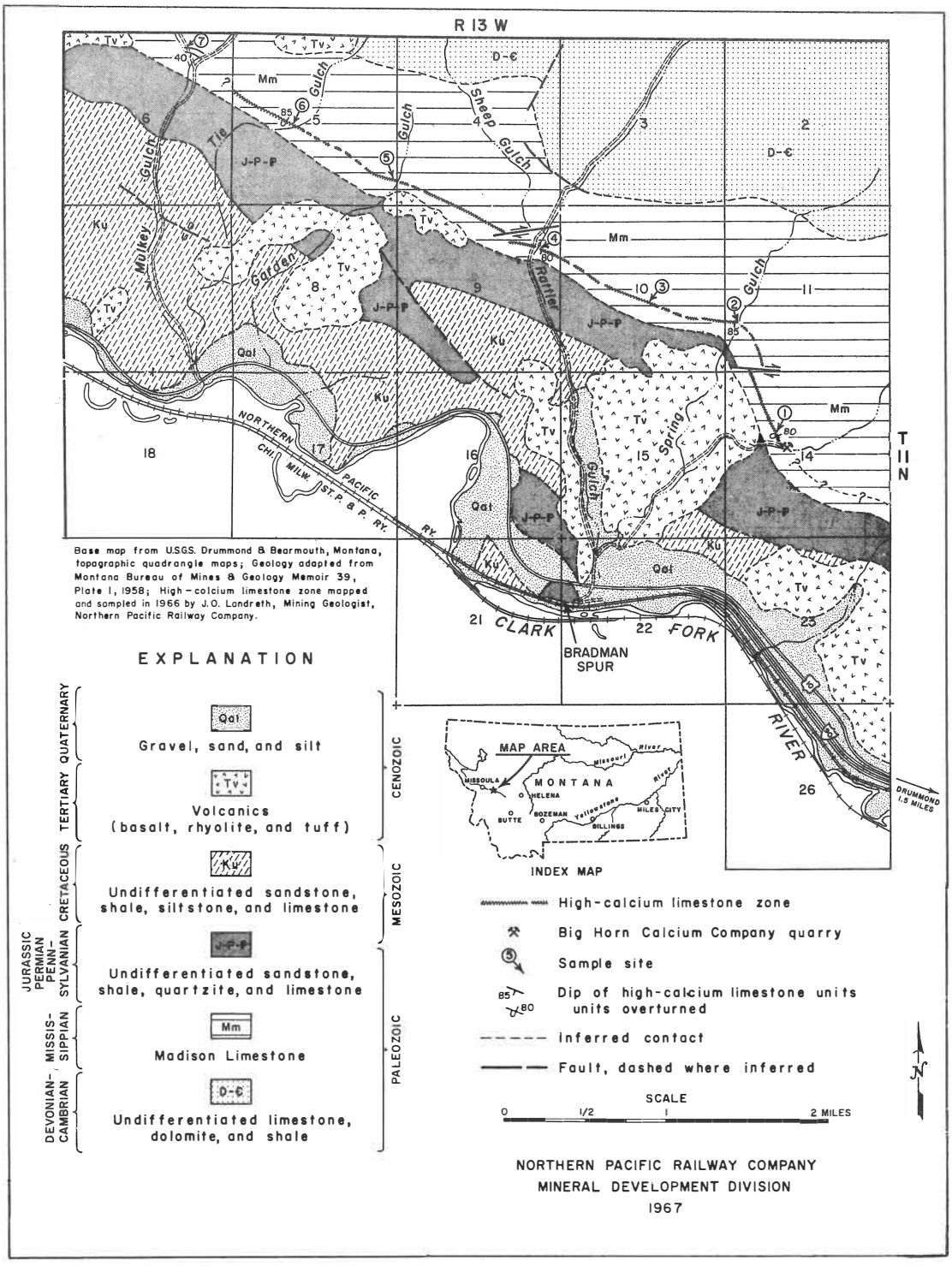

Figure 3. --Geologic map of high-calcium limestone in the Rattler Gulch area, Granite County, Montana.

and the Big Horn Calcium Company quarry, worked essentially the same stratigraphic zone in the upper part of the Mission Canyon Limestone.

Other limestone units in the Paleozoic and Mesozoic rocks in the Rattler Gulch area are too impure to be classed as the high-calcium variety. Several analyses of these limestones are given by Kauffman (1963, p. 30) and Chelini (1965, p. 46, 47, and 51).

DESCRIPTION OF QUARRY PROPERTIES

The Hitchcock quarry (sample site 4) mentioned by Chelini (1965, p. 46) is in Rattler Gulch in the NE$\frac{1}{4}$ sec. 9, T. 11 N., R. 13 W. This is probably the quarry described by Perry (1949, p. 36):

> "In 1939 a quarry was opened . . . four miles west of Drummond. Rock was taken from about 50 feet of strata in the upper part of the Madison Limestone, and the pit has been extended about 150 feet . . . The limestone is reported to average 98 percent calcium carbonate."

Limestone from this quarry was used at the American Crystal Sugar Company beet-sugar plant in Missoula, but the quarry is now inactive. More recently American Crystal Sugar Company obtained high-calcium limestone from its own quarry in the NW$\frac{1}{4}$ sec. 14, T. 11 N., R. 13 W., about 2 miles southeast of the Hitchcock quarry. The American Crystal Sugar Company quarry is 500 feet long and 48 feet wide at the southeast working face, widening to 55 feet at the northwest working face. Both working faces are more than 150 feet high. Quarried rock was crushed and hauled by truck about 1$\frac{1}{2}$ miles by gravel road to the Bradman Spur on the Northern Pacific Railway for shipment to Missoula. In 1966 the American Crystal Sugar Company closed its Missoula beet-sugar plant and has since sold the quarry and loading facilities to Big Horn Calcium Company. Hereinafter this quarry will be referred to as the Big Horn Calcium Company quarry.

HIGH-CALCIUM LIMESTONE ZONE INVESTIGATION

A preliminary inspection of limestone units within the Mission Canyon Limestone indicated that the units quarried in the Hitchcock and Big Horn Calcium Company quarries were the most likely to contain high-calcium limestone. This judgment was based on Mills' (1962, p. 6-10) description of field characteristics for identification of high-calcium limestone. Detailed investigation was restricted to the limestone units developed at these quarries. Owners of the various properties containing the high-calcium limestone zone are listed in Appendix B.

Lithology

The high-calcium limestone zone ranges from 47 to 82 feet in thickness and in most places consists of two resistant units separated by a unit having less resistance. At sample site 3, however, five units were identified within the zone. Under stereoscopic examination of aerial photographs, this zone is easily traced for a distance of about 4 miles.

The units within the zone consist of dark- to medium-gray, fine- to coarse-grained, locally fossiliferous or oolitic, thick-bedded to massive limestone. The units of less resistance are almost everywhere extensively fractured. Lithologies at each sample location are described in Appendix A.

Sampling Method

The limestone units were sampled at sites $\frac{1}{2}$ to 1 mile apart between the Big Horn Calcium Company quarry in sec. 14, T. 11 N., R. 13 W., and Mulkey Gulch in sec. 6, T. 11 N., R. 13 W. For easier sampling, sites were selected in dry drainages where the units crop out in bold relief.

The sampling procedure used at sites 1 through 6 was very similar to the chip-sampling method described by Chelini (1965, p. 3). Specimens approximately 3 inches in diameter were collected at 4-inch intervals perpendicular to the strike of the bedding in the limestone. Each piece was then trimmed to approximately $1\frac{1}{2}$ inches in diameter to insure removal of all weathered parts.

Sample 7 is a grab sample collected across a talus slope below a prominent nearly vertical limestone outcrop. At this location, specimens about $1\frac{1}{2}$ inches in diameter were collected at 1-foot intervals, but no attempt was made to remove weathered surfaces.

Chemical Analyses of Samples

Analyses of the seven samples collected during this investigation are in Table 1.

The chemical quality of samples 1 through 5 is remarkably consistent, and these samples represent high-calcium limestone.

Because it contains more than 2 percent $MgCO_3$, sample 6 does not fit the specifications for high-calcium limestone, but it indicates the limestone is satisfactory for some high-calcium uses.

Sample 7 does not meet the requirements for high-calcium limestone, because it contains 6.06 percent $MgCO_3$. Had the weathered surfaces been removed from the sample, however, the magnesium content might have been less.

Table 1. --Analyses of limestone in the Rattler Gulch area.

Sample no.	Length (feet)	$CaCO_3$*/	$MgCO_3$*/	CaO	MgO	CO_2	Fe_2O_3	SiO_2	Al_2O_3	S
1	57	98.6	0.90	55.4	0.43	43.2	0.271	0.94	0.002	none
2	47	96.7	1.19	54.3	0.57	43.0	0.200	1.54	0.164	none
3	47	99.1	0.90	55.7	0.43	41.9	0.157	1.62	0.085	none
4	59.5	98.1	1.17	55.1	0.56	42.4	0.143	1.38	0.085	none
5	82	98.3	1.23	55.2	0.59	42.2	0.086	1.24	0.077	none
6	69	96.1	2.45	54.0	1.17	42.8	0.215	1.06	0.098	none
7	146**/	93.4	6.06	52.4	2.90	42.7	0.285	0.82	0.115	none

*/ Calculated
**/Grab sample

A grab sample from the Hitchcock quarry (Chelini, 1965, p. 47) contained 0.063 percent P_2O_5, indicating that the limestone may contain a small amount of apatite or collophanite.

The following weighted chemical analyses for 25,576.45 tons of limestone removed from the Big Horn Calcium Company quarry were obtained from American Crystal Sugar Company:

Iron and aluminum oxides	Calcium carbonate	Magnesium carbonate
0.81%	96.76%	2.42%

Sample 1, collected from a site about 150 feet from the northwest end of the Big Horn Calcium Company quarry, is fairly consistent with the quarry analyses, although the magnesium carbonate percentage is greater in the quarry material.

Chemical requirements differ from plant to plant, but as a general rule limestone represented by samples 1 through 6 can be used for the following industrial purposes: agricultural limestone, chemical and metallurgical lime, construction finishing lime, treatment of pulp and paper, sugar refining, and whiting substitutes.

Size of Deposit

The strike length of the high-calcium limestone zone established by the sampling exceeds 18,000 feet. Measured thicknesses range from 47 to 82 feet, and average about 60 feet. Reserves to a depth of 100 feet are estimated to be 9 million short tons. The Big Horn Calcium Company quarry, however, has been mined to a depth of more than 150 feet although there the thickness averages only 50 feet.

It must be remembered that only the resistant units were sampled; additional quantities of high-calcium limestone may lie adjacent to the resistant zone. The exact thickness of the high-calcium limestone zone could be determined by trenching and drilling.

The lower quality of samples 6 and 7 does not preclude the extension of high-calcium limestone into the northwestern part of the area. At sample site 6, some impure beds may have been included at the top or bottom, and more selective sampling might show acceptable material. At sample site 7, sampling of rock in place may indicate that part of the limestone is of acceptable quality.

The Mission Canyon Limestone southeast of the Big Horn Calcium Company quarry was not studied in this investigation.

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Chelini, J. M., 1965, Limestone, dolomite, and travertine in Montana: Montana Bur. Mines and Geology Bull. 44, 52 p.

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Mills, J. W., 1962, High-calcium limestones of eastern Washington: Washington Division of Mines and Geology Bull. 48.

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APPENDIX A - DESCRIPTION OF SAMPLE SITES

The following units were measured stratigraphically from top to bottom (south to north):

		Feet
	Sample 1	
Location:	NW$\frac{1}{4}$ sec. 14, T. 11 N., R. 13 W. (about 150 feet NW of Big Horn Calcium Company quarry).	
Description:	Limestone, dark gray, coarsely crystalline, thick bedded, resistant.	57
	Total thickness sampled	57
	Sample 2	
Location:	SW$\frac{1}{4}$ sec. 11, T. 11 N., R. 13 W. (NW side of Spring Gulch).	
Description:	Limestone, dark brownish gray, coarsely crystalline, fossiliferous, resistant.	5
	Limestone, dark brownish gray, coarsely crystalline, fossiliferous, fractured.	10
	Limestone, dark brownish gray, coarsely crystalline, fossiliferous, resistant.	32
	Total thickness sampled	47
	Sample 3	
Location:	Near center sec. 10, T. 11 N., R. 13 W. (NW side of unnamed dry gulch).	
Description:	Limestone, gray, fine grained, fossiliferous, resistant.	13
	Cover, dug down 4 feet without reaching bedrock (not sampled). 2	
	Limestone, gray, fractured, covered.	2
	Limestone, gray, coarsely crystalline, fossiliferous, more resistant than beds above and below.	20
	Limestone, gray, coarsely crystalline, fossiliferous, resistant.	12
	Total thickness sampled	47

		Feet
	Sample 4	
Location:	NE$\frac{1}{4}$ sec. 9, T. 11 N., R. 13 W. (SE side of Rattler Gulch).	
Description:	Limestone, gray, fine grained, resistant; contains veinlets of white to reddish calcite.	13.5
	Limestone, gray, medium grained, sandy; minor calcite veining.	3
	Limestone, gray, medium grained; minor calcite veining.	43
	Total thickness sampled	59.5
	Sample 5	
Location:	SE$\frac{1}{4}$ sec. 5, T. 11 N., R. 13 W. (NW side of Sawmill Gulch).	
Description:	Limestone, gray, medium to coarse grained, slightly oolitic, resistant; coarse grained part is fossiliferous.	64
	Limestone, gray, medium grained, slabby, fractured.	13
	Limestone, gray, medium grained, massive, resistant.	5
	Total thickness sampled	82
	Sample 6	
Location:	NW$\frac{1}{4}$ sec. 5, T. 11 N., R. 13 W. (NW side of Tie Gulch).	
Description:	Limestone, gray, coarse grained, fossiliferous, resistant.	59
	Limestone, gray, medium grained, oolitic, massive, resistant.	10
	Total thickness sampled	69
	Sample 7	
Location:	NE$\frac{1}{4}$ sec. 6, T. 11 N., R. 13 W. (east side of Dry Mulkey Gulch, about 500 feet above the confluence of Dry Mulkey and Wet Mulkey Gulches).	
Description:	(talus) limestone, dark gray, coarsely crystalline, minor calcite veining along fractures, resistant.	146
	Total thickness sampled	146

APPENDIX B - PROPERTY OWNERSHIP

Location	Owner
Sec. 4, T. 11 N., R. 13 W.	
$S\frac{1}{2}$ $SW\frac{1}{4}$	Harry G. Hitchcock et ux, Butte, Montana
Sec. 5, T. 11 N., R. 13 W.	
$W\frac{1}{2}$	Public domain
$S\frac{1}{2}$ $NE\frac{1}{4}$, $N\frac{1}{2}$ $SE\frac{1}{4}$	Tree Farmers, Inc., Butte, Montana
$S\frac{1}{2}$ $SE\frac{1}{4}$	Elvin M. Baker et ux, Drummond, Montana
Sec. 6, T. 11 N., R. 13 W.	
$W\frac{1}{2}$, $N\frac{1}{2}$ $NE\frac{1}{4}$	Public domain
$S\frac{1}{2}$ $NE\frac{1}{4}$, $SE\frac{1}{4}$	Weggo Lund, Hall, Montana
Sec. 9, T. 11 N., R. 13 W.	
$NW\frac{1}{4}$ $NW\frac{1}{4}$	Elvin M. Baker et ux, Drummond, Montana
$NE\frac{1}{4}$ $NW\frac{1}{4}$, $S\frac{1}{2}$ $N\frac{1}{2}$	Harry G. Hitchcock et ux, Butte, Montana
$NW\frac{1}{4}$ $NE\frac{1}{4}$	Harry G. Hitchcock and Harry Hitchcock, Butte, Montana
$NE\frac{1}{4}$ $NE\frac{1}{4}$	Public domain
Sec. 10, T. 11 N., R. 13 W.	
All	Public domain
Sec. 11, T. 11 N., R. 13 W.	
All	Lyon Ranch Company, Drummond, Montana
Sec. 14, T. 11 N., R. 13 W.	
$N\frac{1}{2}$ $NW\frac{1}{4}$	Carl Nelson Ranch Company, Hall, Montana
$S\frac{1}{2}$ $NW\frac{1}{4}$, $N\frac{1}{2}$ $SW\frac{1}{4}$	Big Horn Calcium Company, Billings, Montana

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