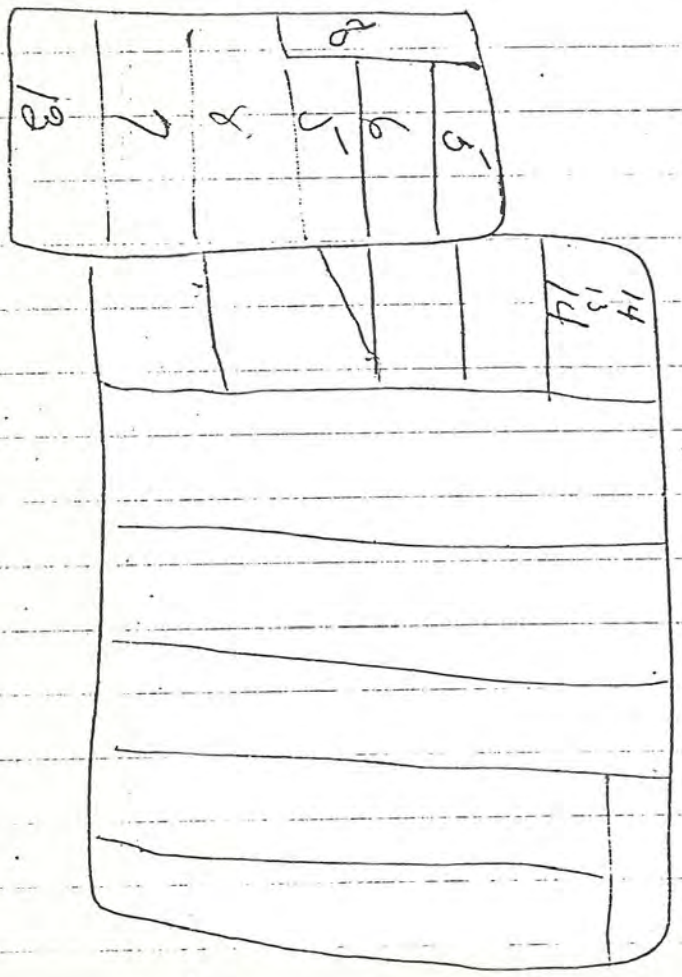
MR 69-4

Gypsum Deposits of Wyoming



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Gypsum Deposits of Wyoming

Definition of Material and Forms

Standard specifications (American Society for Testing Materials Designation C 22-39) require that a material must exhibit purity of 79% $CaSO_4 \cdot 2H_2O$ in order to qualify as the mineral, gypsum. Gypsum occurs in the following forms (Hayward, 1960, p. 471; Burton, 1918, p. 412):

Rock gypsum - Massive rock gypsum is the only primary form of commercial significance. This soft, granular variety ranging in color from white to shades of gray, pink, yellow, and brown occurs interbedded with other sedimentary rocks including shale, limestone, and dolostone.

Alabaster - Alabaster is fine-grained, white, slightly translucent rock gypsum suitable for use in sculpture.

Gypsite - Gypsite, a soft earthy, impure, noncoherent to slightly consolidated form, exists as small gypsum crystals of a solution - redeposition origin scattered through a clay or sandy loam matrix. A considerable volume of this earthy gypsum may warrant its economic exploitation.

Selenite - Selenite is a coarsely-crystalline secondary form dispersed as flat, transparent, flexible foliated plates through clays, in surface rugs, and in veins.

Satin spar - Satin spar is a fine, silky, fibrous variety of secondary origin characterized by a perpendicular orientation of crystalline fibers to the host vein or joint.

Properties

Pure gypsum may be broken down into its constituents in the following manner:

Gypsum ($CaSO_4 \cdot 2H_2O$)

- Calcium sulphate ($CaSO_4$) — 79.1 percent
  - Lime (CaO) — 32.5 percent
  - Sulphur trioxide (SO_3) — 46.6 percent
- Water (H_2O) — 20.9 percent

Pure colorless to white gypsum is discolored to various shades of gray, brown, red, and pink by the presence of impurities. Gypsum is characteristically soft as reflected in its hardness of 2 on the Mohs scale. Pure specific gravity

consideration (2.32 for pure gypsum), rock gypsum weighs approximately 144.77 pounds per cubic foot. Gypsum crystallizes in the monoclinic system with refractive indices of 1.521, 1.522, and 1.530. The compressive strength, as determined by the Bureau of Standards on 6-inch cubes of Virginia gypsum, is:

3,324 lb. per sq. in. when dry and loaded on bed faces.

2,314 lb. per sq. in. when wet and loaded on bed faces.

2,617 lb. per sq. in. when dry and loaded parallel to bed faces.

Gypsum is slightly soluble in water, soluble in dilute hydrochloric acid, and insoluble in sulphuric acid. Its solubility in water is increased considerably by the presence of sodium or magnesium chloride. (Moyer, 1939, p. 2-3)

Calcination of gypsum results in the following transforms:

raw gypsum ($CaSO_4 \cdot 2H_2O$) $\xrightarrow[235°-260°F]{115°-125°C}$ hemihydrate ($CaSO_4 \cdot \frac{1}{2}H_2O$) $\xrightarrow[390°-395°F]{175°-195°C}$ soluble anhydrite ($CaSO_4$) $\xrightarrow{200°C\ 392°F}$ insoluble anhydrite ($CaSO_4$)

The importance of gypsum lies in its ability to lose three-fourths of its combined water upon application of moderate heat to form hemihydrate. Hemihydrite, the chief constituent of first-settle plaster, recombines readily with water and "sets." Soluble anhydrite, the main ingredient in second-settle plaster, is an unstable, hygroscopic form which reverts rapidly to hemihydrate. The inability of insoluble anhydrite or dead-burned gypsum to recombine readily with water and set within reasonable time limits serves as a severe restriction for its large-scale commercial utilization. Keene's cement is dead-burned gypsum to which the property of quick setting of unusually hard finish has been restored by using certain salts. (Moyer, 1939, p. 3; Barton, 1905, p. 413)

First and second-settle calcined gypsum set in the presence of water with evolution of heat and slight expansion of 0.1 to 0.2 percent. The theory of setting is that the unstable hemihydrate dissolves in the mixing water to produce a supersaturated solution from which the stable hydrated gypsum is precipitated in typical needlelike crystals. These crystals interfinger as they grow larger and bind themselves together to form a solid, relatively hard mass. [illegible] The hemihydrate may also first form a gel or adsorption complex with the mixing water which is followed by the formation of gypsum crystals [illegible] resulting in set plaster. [illegible] (Moyer, 1939, p. 3-4)

Geologic Disposition and Occurrence

Commercial rock gypsum occurs within sedimentary successions either as continuous units of wide lateral extent, or as irregular, massive, lenses interbedded with limestone, dolostone, shale, siltstone, sand, and clay. Loci of selenite crystallization are either dispersed throughout any

[illegible] fibrous, or [illegible] restricted to vein fillings. Satin spar is found as [illegible] fracture fillings in rock immediately adjacent to a gypsum unit of significant thickness. Gypsite is generally associated with Quaternary alluvium in basins pervaded by gypsiferous units. Minor amounts of gypsum are also present as gangue minerals in metallic mineral veins.

Most gypsum and anhydrite deposits are considered to be chemical precipitates formed from saturated marine or saline lake waters. The "modified bar hypothesis" suggests that calcium sulfate was precipitated in seacoast lagoons where evaporation took place rapidly. (Branson, 1915, p. 223-230) The lagoons permitted heavy saline concentrations and yet the ocean replenished the lagoons occasionally and thus provided additional supplies of salts to maintain a prolonged and balanced condition. Return of dense brine to the open sea offers an explanation for removal of sodium chlorids from the basin, which was necessary to account for great thicknesses of nearly pure calcium sulfate. (King, 1947, p. 470)

Geochemical considerations relative to saline deposition suggest a strong dependence upon temperature variations in the aqueous media. When a solution of pure calcium sulphate in water is evaporated at a temperature below 66°C. gypsum is deposited; above 66°C., anhydrite is deposited. The presence of other soluble salts, particularly sodium and magnesium chlorides and sulphates, in the solution lowers this critical temperature so that in the evaporation of sea water, the lower temperature limit of anhydrite deposition is 32°C. As this temperature is well within the reach of surface water in semiarid climates during periods of intense evaporation, it is probable that most of the calcium sulphate deposits were originally laid down as anhydrite. However gypsum, not anhydrite, is the stable form of calcium sulphate at atmospheric pressure and temperature and in the presence of moisture. Consequently there is a slow change from the original anhydrite to gypsum by hydration of the deposits lying at shallow depths in the zone of circulating ground water. This condition has been found in numerous localities and has led to the establishment of three vertical zones applicable to gypsum deposits derived from the hydration of anhydrite. Theoretically, the upper zone would contain only gypsum, the intermediate or transition zone, an intimate mixture of anhydrite and gypsum in which hydration is active, and the lowest zone, only anhydrite. (Moyer, 1939, p. 5)

Surface conditions, porosity and permeability of the overburden, and the position of present and past water tables determine these zonal depths and thereby prescribe local variations. Thus, the intermediate zone of

solubility hydration, the stability then of the water table, and surface topography, all generally describe the same vertical profile. The rate of solution may far exceed the rate of hydration and thereby restrict the presence of gypsum to a thin carapace on an anhydrite substrate. Breccia, "chaos", and "pothole" topography in gypsiferous locales are attributed to selective removal of gypsum in solution. (Ward, 1960, p. 472)

Ground water moving through calcium sulfate-bearing strata may take the sulfate into solution and later, under other conditions, redeposit the material in veins or beds or in efflorescent crusts. Gypsite, vein deposits of selenite and satin spar, and disseminated selenite crystals are formed in this manner. (Moyer, 1939, p. 5)

Limestones and lime-bearing minerals may be acted upon by water containing sulphuric acid or another sulfate in solution to form deposits of calcium sulfate. (Moyer, 1939, p. 5)

Calcium sulfate sands, formed by the disintegration of existing gypsum deposits, may undergo eolian transport and reconcentration into drifts and dunes. (Moyer, 1939, p. 5)

Production

Most domestic gypsum is mined by open-pit methods. Open-pit mining is preferred whenever possible to underground mining due to higher efficiencies per man and machine, and lower development and total operating costs. Underground mining is generally confined to deposits where the increased costs are compensated by higher quality ore, or proximity to the market. The mining method selected to develop any particular deposit depends largely on the depth and composition of the overburden and the thickness and attitude of the gypsum deposit. Optimum conditions for the most economic exploitation of a deposit include the absence of overburden, horizontal orientation of gypsiferous units, and a considerable thickness of high-grade gypsum. The maximum stripping ratio of rock to gypsum is about 3:1. (Barton, 1965, p. 13, 41)

To obtain ultimate strength, high bulking aggregate carrying capacity, and other characteristics desirable in wallboard cores and plasters, companies prefer to use ore containing not less than 90 percent gypsum. Ordinarily, a gypsum deposit ~~commercial and most competitive~~ should have minable beds containing at least 70 percent gypsum. Color, density, and other factors also may be considered. Lower grade ores may be upgraded through use of heavy media processes to meet competition from other sources. In certain markets, such as soil conditioning, specifications often permit use of material containing as low as 50 percent calcium sulfate. (Barton, 1965, p. 42)

[illegible] costs from [illegible] $1.50 a ton for unconsolidated [illegible] to $4.00 or more a ton for underground operations. This [illegible] does not always cause a similar [illegible] in the cost of the finished products. On the average, the raw material cost is only about one-ninth of the cost of the finished product. The average value assigned by the Bureau of Mines to crude gypsum mined in the United States in 1963 was $5.07 a ton. The average value of portland-cement retarder was $4.46 a ton; and that of agricultural gypsum, $3.41 a ton. (Bolmer and Biggs, 1965, p. 76)

Uses

The most important, and continually expanding, market for gypsum is the construction industry. Plasters, finish and acoustical plasters, wallboard, lath, sheathing, other board products, and ceiling tiles are the principal forms. Prefabricated forms have been taking a continually increasing share of the construction market from wet plaster but due to market expansion total volume of both varieties has increased.

Three to 5 percent by weight of gypsum or anhydrite is added to cement clinker before it is ground. This quantity of gypsum or anhydrite in finished cement retards the setting. Ground gypsum is used on soils deficient in sulfate sulfur, [illegible]

An important market for calcined gypsum is for making models and patterns in industrial tooling activities. Calcined gypsum is also used for the manufacture of [illegible], dental preparations, and chalk.

Small amounts of calcined gypsum are used in mixtures at an insulating firms between the walls of safes and filing cabinets and coverings for pipes and boilers. Calcined gypsum is used in surgery for orthopedic bandages and for plaster casts. Calcined gypsum with special retardation is employed in making casts of dental work. Ceiling and wall embellishments are made from a mixture of calcined gypsum and hemp fiber. (Barton, 1965, p. 415)

Large quantities of calcined gypsum are used in the manufacture of molds, pastel crayons, chalk, orthopedic bandages, plaster casts, and models in industrial tooling activities. Small amounts of calcined gypsum are used in construction as an insulating filler between the walls of safes and filing cabinets, and as coverings for pipes and boilers. Calcined gypsum with special retardation is employed in making casts of dental work. Ceiling and wall embellishments are made from a mixture of calcined gypsum and hemp fiber. (Barton, 1965, p. 415-416)

Distribution of Gypsum Deposits

Stratigraphic Occurrence

Gypsum deposits in Wyoming are generally restricted to redbed facies of the Permo-Triassic Goose Egg formation (Dinwoody and Phosphoria members of the Embar Group and the Saterka shale), the Triassic Chugwater formation (Spearfish formation), and the Middle Jurassic Gypsum Spring formation. Correlative relationships between gypsiferous redbed sequences are shown below in a portion of the Wyoming stratigraphic nomenclature chart compiled by Burk in 1956:

Producing Deposits and Estimated Reserves

Albany and Carbon Counties

Gypsiferous beds of the Goose Egg formation north of Como Bluff near Medicine Bow satisfy gypsum requirements of the Laramie cement plant which is operated by the Monolith Portland Midwest Company. Production for 1962 and 1963 was 9,018 and 7,128 tons, respectively (Wyoming State Board of Equalization, production figures, 1962-63). Estimation of possible reserves are nonexistent.

Big Horn County

In northeast Bighorn Basin, the lower part of the Gypsum Spring formation is partially composed of a thick-bedded gypsum sequence which varies from 0 to 50 feet in thickness. Although this unit contains interbedded limestone, shale, and claystone, it consists of more than 85% calcium sulfate in common thicknesses of 45 feet which renders it amenable to economic exploitation. Gypsum Products of America is constructing (1966) a gypsum wallboard plant at Hines which will utilize a 52 million ton, near-surface deposit immediately to the southwest on the nose of a northwest-plunging

syncline. It is estimated that wallboard sales will be divided disproportionally among Wyoming (8%), the Pacific Northwest (12%), and Colorado (80%). This plant will cost approximately $3.1 million . . . and will provide 80 long-term jobs. (May, 1965, p. 46-47, 50-51)

Park County

In northwest Bighorn Basin, the lower part of the Gypsum Spring formation contains an alabastrine gypsum bed which ranges in thickness from 0 to 80 feet. Wilson (in press) estimates an outcrop reserve of one million tons for the gypsiferous belt extending 60 miles from the Wyoming-Montana border to Cody. A general southward increase in thickness, and an accompanying decrease in regional dip and overburden enhance economic potential of gypsum deposits in the Cody area (Bullock, 1964, p. 32).

Gypsum is mined at a quarry in Horse Center anticline, 4 miles south of Cody (Ostrowski, et. al., 1966, p. 96). The raw material is processed into plasterboard by the Big Horn Gypsum Company which reported annual productions of 62,585 and 72,908 tons for the years 1962 and

1963, respectively (Wyoming State Board of Equalization, production figures, 1962-63). The plant, costing more than $3 million, is designed to produce 100,000 tons of gypsum products annually. It ultimately will employ about 100 persons and have an annual payroll of $600,000. Production will be marketed in 12 northwestern and midwestern states. (Bolmer and Biggs, 1965, p. 78)

Subsurface reserves, south of this present quarry operation, are approximately 250,000 short tons. This value pertains to a 1½ square mile area where the top of the major gypsum unit does not occur below a depth of 250 feet. (Wilson, in press)

Prospects

Descriptions of all significant gypsum deposits have been compiled from reports of economic investigations and stratigraphic surveys. Individual deposits within any given county are discussed in terms of increasing township number such that each township is held fixed until all appropriate ranges are treated.

(5)

Albany County

2 spaces

Exposures of the Chugwater, Forelle, and Satanka formations reveal all significant gypsum deposits in Albany County. Such exposures display a general linearity or fold pattern along margins of major structural basins. The most important localities are at Red Mountain near the Wyoming - Colorado border and in McGill, Como, and Flat Top anticlines in northwestern Albany County. Gypsite is of local occurrence in alluvium of the Laramie Basin.

single space

Secs. 3, 4, 7-10, T. 12 N., R. 76 W. - Red Mountain

2 spaces

Thick lenticular gypsum beds in the Satanka formation describe a sinuous trace along the base of the north slope of Red Mountain. A measured section displays a maximum thickness of 80 feet distributed in 4 distinct horizons. The most prominent unit reaches a thickness of 67 feet and remains continuous over the entire length of outcrop. (Darton and Siebenthal, 1909, p. 56-57; Siebenthal, 1905, p. 404; Stone, et. al., 1920, p 307)

Sec. 7, T. 13 N., R. 73 W. - Sportsman Lake

A small pit reveals 4 to 5 feet of pure rock gypsum immediately above the Forelle limestone at a location one mile east of Sportsman Lake on 14 miles southwest of Laramie (Darton and Siebenthal, 1909, p. 57; Siebenthal, 1905, p. 404).

(6)

T. 13 N., R. 74 W. - Sand Creek

Gypsum beds, exhibiting thicknesses of 2 to 4 feet, are found in association with gypsiferous limestone along Sand Creek, 20 miles southwest of Laramie (Darton and Siebenthal, 1909, p. 25

Secs. 20, 21, T. 14 N., R. 73 W. - Red Buttes

At the site of an abandoned plaster mill one mile south of Red Buttes, the Satanka shale contains two gypsum beds of significant thickness. The lower unit is 15 feet thick and is separated from the upper 10-foot horizon by a 25-foot shale sequence. (Darton and Siebenthal, 1909, p. 57)

NE 1/4 sec. 21, T. 14 N., R. 73 W. - Harney Creek

Gypsite, 5 to 6 feet in thickness, is found in the valley of Harney Creek, 1 mile southeast of Red Buttes. It was formerly used with rejected rock gypsum in the production of cement plaster. (Osterwald, et al., 1966, p. 98)

T. 14 N., Rs. 73, 74 W. - Willow Creek

An extensive gypsite bed crops out in the lower 2 miles of Willow Creek valley and extends further north to a point 2 miles below the junction of Willow and Lone Tree Creeks (Darton and Siebenthal, 1909, p. 58; Darton, Blackwelder, and Siebenthal, 1910, p. 14; Siebenthal, 1905, p. 405).

Secs. 33,34, T. 14 N., R. 74 W. - Lone Tree Creek
Scattered exposures of gypsite occur in this area (Osterwald, et. al., 1966, p. 98).

Tps. 14,15 N., R. 77 W. - Centennial Valley
A thin discontinuous gypsiferous limestone bed lies in the upper Fowler on the east side of Centennial Valley (Darton and Siebenthal, 1909, p. 25).

Laramie Area ← no p. even with above left margin and indent following "Sec." to line 2 spaces

Sec. 4, T. 15 N., R. 73 W. - [redacted]
A finely divided gypsite unit is found immediately southeast of Laramie. Its thickness of 9 feet is divisible into an upper 7-foot layer of pure gypsum, an intermediate 5-inch red seam, and a basal unit of white gypsum resting on gravel and red clay. This deposit was worked by a plaster mill operation from 1896 to 1948. (Darton and Siebenthal, 1909, p. 58; Siebenthal, 1905, p. 405 no extra space, as on page 10, under "Hyattville Area"

Secs. 16,17,21, T. 15 N., R. 73 W. - Soldiers Creek
Gypsite (Osterwald, et. al., 1966, p. 98).
no extra space

SW 1/4 sec. 2, T. 16 N., R. 73 W. - [redacted]
The upper part of the Satanka formation contains a 10-foot thick lens of pure gypsum in a prospect pit at the northern base of a

(8)

small hill, 5 miles northeast of Laramie (Darton and Siebenthal 1909, p. 22, 58; Siebenthal, 1905, p. 404). This deposit was worked in 1949 by the Monolith Portland Midwest Company of Laramie.

Secs. 3, H, T. 16 N., R. 73 W. - [redacted]

A thick gypsite bed is found about 5 miles north of Laramie (Birch, 1955, p. 61).

SE 1/4 sec. 28, T. 16 N., R. 73 W.

Gypsite occurs one mile northeast of Laramie (Osterwald, et. al., 1966, p. 98).

end of "Laramie Area"

N 1/2 sec. 35, S 1/2 sec. 26, T. 23 N., R. 77 W. - Como Bluff

Chugwater redbeds contain extensive gypsum deposits of horizontal attitude on the axis of Como Bluff anticline (Dunbar, 1942, p. 34).

T. 20 N., Rs. 75, 76 W. - Marshall Area

The Goose Egg and Chugwater formations contain scattered gypsiferous beds in a region southwest of Marshall (Konkel, 1935, p. 17-18).

Big Horn County

Gypsum deposits of northeast Bighorn Basin

are restricted to redbed facies of the Gypsum Spring, Chugwater, and Goose Egg formations. Gypsum mills have operated at Basin, Kane, and Stucco. (Ostwald, et al., 1966, p. 98)

Massive gypsum, which ranges from 35 to 51 feet in thickness throughout the lower part of the Gypsum Spring formation, constitutes the bulk of exploitable reserves in ... eastern Bighorn Basin. These deposits were formerly considered to lie in the upper part of the Chugwater formation (Maf, 1965, p. 19; Lupton and Condit, 1916, p. 139). Their consistent lateral continuity throughout the area fails along the east-central flank of Little Sheep Mountain and locally along the west flank of the Bighorn Mountains. Potential mining areas include the nose of a broad, northwest-trending syncline immediately southwest of Hines, the eastern flank and southern nose of Sheep Mountain anticline, and a minor west-trending anticline on the northwest flank of Sheep Mountain north of the Bighorn River. (Maf, 1965, p. 19, 46-48)

The Chugwater formation contains primary gypsum in widely separated beds which never exceed one foot in thickness. Relatively pure gypsum in the Goose Egg formation may reach a maximum cumulative thickness of 15 feet. The thinness of these individual gypsum beds and their stratigraphic vertical separation preclude all consideration of their possible exploitation. (Maf, 1965, p. 15-17)

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T. 47 N., R. 88 W. - Tensleep Canyon

The lower Goose Egg formation (Phosphoria) contains 88 feet of gypsum with minor sandstone and shale interbeds (Condit, 1916, p. 265).

Hyattville Area

Sec. 16, T. 49 N., R. 89 W.

Imlay (1956, p. 570) reports a thickness of 43 feet for a prominent gypsum bed in the lower Gypsum Spring formation, 3½ miles southeast of Hyattville.

NW¼ NW¼ sec. 33, T. 49 N., R. 89 W.

Massive gypsum, reaching a total thickness of 43 feet in the lower Gypsum Spring formation, is distributed in 7 beds from 1 to 13 feet thick, 5 miles south of Hyattville (Lupton and Condit, 1916, p. 148).

Sec. 34, T. 49 N., R. 89 W. - Zeisman Ranch

Near the Zeisman Ranch, a number of gypsum layers, 4 to 10 feet thick, are interlayered with red shale, siltstone, and limestone of the Goose Egg formation. Fourteen individual gypsum horizons comprise a cumulative thickness of approximately 42 feet through a 90-foot section. (Lupton and Condit, 1916, p. 151)

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T. 50 N., R. 89 W. - Paintrock Area

The upper Chugwater formation contains a lenticular gypsum bed, averaging 10 feet in thickness along Paintrock Creek (Darton, 1906, p. 39).

Sec. 21, T. 51 N., R. 90 W. - East Fork McDermotts Creek

Massive gypsum attains a thickness of 57 feet in the lower Gypsum Spring formation, 9 miles northwest of Hyattville (Imlay, 1956, p. 569).

Sec. 3, T. 51 N., R. 91 W. - Potato Ridge

Basal massive gypsum of the Gypsum Spring formation exhibits a thickness of 44 feet, 8 miles south of Shell (Imlay, 1956, p. 569).

T. 53 N., R. 91 W. - Shell Creek

At the mouth of Shell Creek Canyon there is a 12-foot gypsum bed in the Chugwater, 24 feet from the base of the formation (Darton, 1906, p. 38-39).

Sheep Mountain Anticline - Stucco

location	formation	thickness (ft.)	source
E½ sec. 10, T. 53 N., R. 94 W.	Gypsum Spring	30'	May, 1965, p. A50
S½ sec. 22, T. 53 N., R. 93 W.	Gypsum Spring	47'	May, 1965, p. A50
T. 53 N., R. 93 W.	Goose Egg	21'	Lupton and Condit, 1916, p. 15
T. 53 N., R. 93 W.	Goose Egg	37'	Condit, 1916, p. 205
SW ¼ sec. 35, T. 54 N., R. 94 W.	Goose Egg	12'	Partridge, 1949, p. 21

Secs. 21, 28, T. 54 N., R. 91 W. - Beaver Creek

Imlay (1956, p. 569) has noted 57 feet of massive gypsum in the lower Gypsum Spring formation, 7 miles northwest of Shell.

Sec. 27, T. 54 N., R. 91 W. - Red Gulch

There are 125 feet of red shales interbedded with gypsum at the base of the Goose Egg formation, 6 miles north of Shell (Birch, 1955, p. C2).

Little Sheep Mountain Anticline - Hines

location	formation	thickness (ft.)	source
sec. 6, T. 54 N., R. 94 W	Gypsum Spring	53'	Imlay, 1956, p. 5[illegible]
NE¼ sec. 6, T. 54 N., R. 94 W	Gypsum Spring	51'	Mat, 1965, p. A43
SE¼ sec. 8, T. 54 N., R. 94 W	Gypsum Spring	46'	Mat, p. A38
W½ sec. 14, T. 54 N., R. 94 W	Gypsum Spring	51'	Mat, p. A25
S½ sec. 16, T. 54 N., R. 94 W.	Gypsum Spring	34'	Mat, p. A36
N½ sec. 15, T. 55 N., R. 94 W.	Gypsum Spring	59'	Mat, p. A19
SW¼ sec. 26, T. 55 N., R. 94 W.	Gypsum Spring	41'	Mat, p. A21
NE¼ sec. 29, T. 55 N., R. 94 W.	Gypsum Spring	52'	Mat, p. A34
N½ sec. 30, T. 55 N., R. 94 W.	Gypsum Spring	40½'	Mat, p. A27
SW¼ sec. 32, T. 55 N., R. 94 W.	Gypsum Spring	20+'	Mat, p. A41
W½ sec. 10, T. 55 N., R. 95 W.	Gypsum Spring	54'	Mat, p. A32
SW¼ sec. 14, T. 55 N., R. 95 W.	Gypsum Spring	49'	Mat, p. A31
E½ sec. 23, T. 55 N., R. 95 W.	Gypsum Spring	47½'	Mat, p. A29
NE¼ sec. 1, T. 56 N., R. 95 W.	Gypsum Spring	48'	Mat, p. A7
W½ sec. 21, T. 56 N., R. 95 W.	Gypsum Spring	37'	Mat, p. A12
SW¼ sec. 22, T. 56 N., R. 95 W.	Gypsum Spring	42'	Mat, p. A5

MORE

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NW¼ sec. 26, T. 56N., R. 95W.	Gypsum Spring	42'	Mat, p. A4
SE¼ sec. 27, T. 56N., R. 95W.	Goose Egg	12½'	Mat, p. A52
S½ sec. 28, T. 56N., R. 95W.	Gypsum Spring	48'	Mat, p. A11
SE¼ sec. 28, T. 56N., R. 95W.	Goose Egg	6½'	Mat, p. A54
NW¼ sec. 28, T. 56N., R. 95W	Goose Egg	16'	Partridge, 1949, p. 23
NW¼ sec. 28, T. 56N., R. 95W	Gypsum Spring	58'	Imlay, 1956, p. 569
SE¼ sec. 33, T. 56N., R. 95W.	Gypsum Spring	49'	Mat, p. A9
NW¼ sec. 34, T. 56N., R. 95W.	Goose Egg	7'	Mat, p. A53
W½ sec. 36, T. 56N., R. 95W.	Gypsum Spring	39'	Mat, p. A2

I hope this table caused you less suffering than it did me!

Three Fork Canyon Area

location	formation	thickness (ft.)	source
SW¼ sec. 18, T. 57N., R. 94W.	Gypsum Spring	48'	Mat, 1965, p. A15
W½ sec. 3, T. 57N., R. 94W.	Gypsum Spring	42'	Mat, p. A13
E½ sec. 2, T. 57N., R. 95W.	Gypsum Spring	48'	Mat, p. A13
NE¼ sec. 12, T. 57N., R. 95W.	Gypsum Spring	55'	Imlay, 1956, p. 569

Sec. 21, T. 58N., R. 95W. - Crooked Creek

Mat (1965, p. A26) reports 46 feet of massive gypsum in the lower Gypsum Spring formation.

NW¼ sec. 22, T. 58N., R. 96W. - Dry Creek

The pronounced, massive gypsum unit of the lower Gypsum Spring formation is 44 feet thick in the Dry Creek area, ½ mile south of the Wyoming - Montana border (Mat, 1965, p. A16).

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Carbon County

Extensive redbed exposures along Flat Top anticline and in the basin between the Freezeout Hills and Shirley Mountains contain major gypsum reserves in Carbon County. Gypsum-bearing formations include the Satanka shale and Chugwater redbeds.

Tps. 19, 20 N., R. 82 W. - Elk Mountain Area

W.C.

Knight (1904, p. 82) reported the probable occurrence of extensive gypsum beds in the Chugwater formation along the west side of Elk Mountain, in faulted terrain north of Bear Butte, and to the southeast and north of Sheep Head Mountain. Tertiary overburden masks lateral continuity of these deposits.

Flat Top Anticline

Sec. 18, T. 23 N., R. 78 W.

The Satanka shale contains 28.7 feet of white gypsum near the middle of the formation on the southwest flank of Flat Top anticline (Osterwald et. al., 1966, p. 99).

Secs. 11-14, T. 23 N., R. 79 W.

L

A section measured at the west end of Flat Top Mountain shows 60 feet of gypsum in 7 layers, 4 to 19 feet thick, in 1000 feet of Chugwater strata (Stone, et. al., 1920, p. 306). W.H. Knight (1944, p. 13-14) describes this gypsum

occurrence as 74.4 feet of brick-red shale and gypsum at the base, 14.5 feet of gray, porous limestone and pink gypsum in the Little Medicine tongue, and 4.8 feet of gray sandy shale and pink gypsum in the Freezeout tongue.

Secs. 11, 14, T. 24 N., R. 79 W. - Freezeout-Seminoe Area

South of Freezeout Mountain, the Chugwater formation contains a 25-foot bed of orange shale and white gypsum, overlain by 25 feet of interstratified shale and gypsum. Both this gypsiferous and the lower 65 feet of the Satanka formation contain good quality gypsum. (Maravich 1940, p. 9-10)

Freezeout Hills

Secs. 15, 16, T. 24 N., R. 80 W.

In the vicinity of Difficulty Post Office, the lower Satanka formation contains about 54 feet of gypsum distributed in three separate beds over a stratigraphic interval of 60 feet (Thomas, 1934, p. 1675).

Secs. 1, 12, T. 25 N., R. 80 W.

In the North Freezeout Hills, gypsite, alabaster, and lesser amounts of selenite and satin spar of commercial quantity and grade occur in the Satanka formation. These deposits are readily accessible and suitable for low-cost excavation. (Bist, 1957, p. 84-85)

Secs. 1, 2, T. 24 N., R 82 W. - Troublesome Creek Basin
The Opeche member of the Satanka formation contains 10 feet of pure gypsum, 20 feet above the top of the Tensleep sandstone (Koenig, 1952, p. C4).

Tps. 24, 25 N., Rs. 80-82 W. - Freezeout-Shirley Area
The Satanka shale forms a sinuous, faulted outcrop pattern across the southern part of the basin between the Freezeout Hills and Shirley Mountains. Numerous gypsum beds of varying thickness, purity, and color are exposed along this trace. (Ferren, 1935, p. 10)

SE¼ sec. 25, T. 25 N., R. 83 W. - Sailor Creek
A fault zone across the Phosphoria and Amsden formations contains pure, white gypsum in lenses ranging from 8 to 10 feet in thickness (Osterwald, et. al., 1966, p. 99).

Converse County
Limited distribution of minor gypsum deposits in the Chugwater and Satanka formations occurs along the northern flank of the Laramie Range in the southern part of Converse County.

(17)

Secs. 4, 5, T. 29 N., R. 72 W. - Manning Ridge
Secs. 14, 30-32, T. 30 N., R. 72 W.
Gypsum is reported at the base of the Chugwater formation (Mort, 1936, p. 78).

T. 31 N., Rs. 71, 72 W. - Wagon Hound and La Bonte Creeks
South of Douglas, "there is considerable gypsum" near the base of the Chugwater formation (Stone, et. al., 1920, p. 305).

T. 32 N., R. 71 W. - Douglas
In the vicinity of Douglas, "There are 100 feet of interbedded gypsum and shale at the base of the Chugwater formation and 75 feet of gypsum in the Satanka redbeds (Lee, 1927, p. 46, and pl. 1).

SE¼ sec. 9, W½ sec. 15, E½ sec. 16, NW¼ sec. 21, T. 32 N., R. 71 W.
- Little Deer Creek
Local massive gypsum lenses, 10 to 20 feet thick, are exposed in the upper Chugwater 9 miles southwest of Glenrock (Berryman, 1942, p. 27).

Crook County

Redbed facies of the Triassic Spearfish, the Permo-Triassic Goose Egg formation, and the Pennsylvanian Minnelusa formation contain significant thicknesses of massive gypsum deposits which are exposed on the western flank of the Black Hills uplift and in the drainage of Belle Fourche River.

Tps. 49-51 N., R. 63 W. - Sundance Area

A gypsiferous sequence, which appears near the top of the Spearfish formation, describes an arcuate trace from Inyan Kara Mountain to Rocky Ford Creek. The main gypsum horizon, 5 feet in thickness, encircles Inyan Kara Mountain, Crow Mountain, Gypsum Buttes, and a limestone dome south of Sundance Mountain (Darton, 1905, p. 3; Stone, et. al., 1920, p. 298).

Northeast of Sundance, a deposit contains large slabs of crystalline gypsum (Jamison, 1911, p. 34-35).

Mapel and Bergendahl (1956) noted 5 to 7 feet of massive, white gypsum in the basal portion of a Gypsum Spring exposure, 3 miles southeast of Sundance.

Darton (1909, p. 30) and Richardson (1903, p. 373) reported 8 feet of impure gypsum and 4 feet of massive white gypsum within a vertical interval of 45 feet in the Spearfish formation, one mile northwest of Sundance.

(19

T. 52 N., R. 61 W. - Redwater, Sundance, and Red Canyon Creek

A northwest-trending depositional basin localizes the accumulation of extensive gypsum-anhydrite deposits within the Minnelusa formation in a region southwest of Beulah. Possible economic development of these deposits would be limited to a massive rather discontinuous layer ranging in thickness from a featheredge to 24 feet. (Brady, 1958)

location	thickness (ft.)		number of beds	
	gypsum	gypsum/anhydrite	gypsum	gypsum/anhydrite
SW¼ sec. 4	0	69'	0	6
SE¼ sec. 5	9'	63'	1	3
W½ sec. 9	24'	57'	1	3
S½ sec. 10	8'	150'	1	7
NW¼ sec. 11	10'	18'	1	1
NW¼ sec. 15	16'	67'	1	3
N½ sec. 20	0'	8'	0	1
NW¼ sec. 21	4'	63'	1	3
NW¼ sec. 12	0'	56'	0	3

T. 53 N., R. 61 W. - Beulah Area

Massive, white gypsum beds, 2 and 4 feet thick, are exposed 2 miles northwest of Beulah. Beds averaging 15 feet thick crop out continuously through Government and Redwater valleys. (Stone, et. al., 1920, p. 298)

(20)

Belle Fourche River - Devils Tower - Hulett Area

A basal gypsiferous sequence in the Gypsum Spring formation represent exploitable deposits in redbed facies of Belle Fourche River valley. This gypsum horizon occurs with significant inclusion of reddish brown claystone over an average cumulative thickness of 75 feet. (Mapel and Bergendahl, 1956, p. 84-86 and fig. 2)

location	thickness (ft.)
SW¼ sec. 9, T. 53N., R. 65W. - Lytle Creek	32'
SW¼ sec. 23, T. 53N., R. 65W. - Left Creek	10'
SW¼ sec. 7, T. 54N., R. 64W. - Hulett	30'
NE¼ sec. 34, T. 54N., R. 65W. - Brimmer Ranch	25'
SW¼ sec. 13, T. 55N., R. 64W. - Beaver Creek	28'
SW¼ sec. 32, T. 55N., R. 64W. - Sourdough Creek	22'

Fremont County

Redbed facies of the Wind River Indian Reservation and adjacent areas include significant occurrences of gypsum on the northeast flank of the Wind River Mountains and along the southern margin of the Owl Creek Mountains.

Although considerable gypsum is present in the Chugwater and Dinwoody formations of Triassic age, by far the most extensive and economically significant reserves occur in the overlying Gypsum Springs formation of Jurassic age. The latter formation contains a massive bed of nearly pure gypsum that ranges from 40 to more than 100 feet in thickness over an exposed length of some 100 miles. Widely spaced samples of this massive bed indicate a fairly uniform content of about 96 percent gypsum throughout its exposed length.

The amount of overburden along the outcrop of the massive gypsum bed ranges from virtually none to perhaps a few hundred feet, but may increase rapidly away from the outcrop, particularly where the strata are steeply tilted. Many sections of this bed would be amenable to strip mining for considerable distances down dip from the outcrop. Almost all the remaining reserves above the water table, and possibly to the gypsum-anhydrite contact, could be recovered by underground methods. (Bolmer and Biggs, 1965, p. 70, 71, 75)

The lack of local markets and the cost of transporting the raw material or finished products to potential markets outside the region to date have discouraged the development of these deposits and the establishment of such an industry. (Bolmer and Biggs, 1965, p. 70, 71, 75)

- In July 1961, Vipont Mining Co. of Lander, Wyo., was issued a prospecting permit for gypsum on all tribal lands on the Wind River Indian reservation, excluding wilderness areas. This permit grants the company exclusive rights for 3 years not only to prospect for gypsum but to study the feasibility of constructing and operating a gypsum wallboard and companion products manufacturing plant on or off the reservation. At any time during the term of the permit, or any extensions thereunder, the company may obtain a lease or leases on not more than 50,000 acres of tribal land, provided that it is financially able to develop the project. The royalty rate under such a lease would be $0.10 a ton of gypsum mined, and a minimum annual payment of $3.50 an acre would be required.

Proposed Development. - According to company statements, Vipont ultimately plans to mine gypsum on the reservation for processing in other areas. Mine-run gypsum would be crushed and dried in a mill to be constructed on the reservation, and then shipped by rail to processing and manufacturing plants, possibly at both St. Louis and Seattle.

Company negotiations with the two railroads serving the reservation indicate that they may adopt lower freight rates for trainloads of dried gypsum, particularly if supplied in large-tonnage shipments and in an uninterrupted sequence. Spur lines would have to be extended to the mining areas on the reservation from the main lines of these railroads.

An estimated 5 to 7 years would be needed to get operations up to planned capacity and to develop a daily market for 5,000 tons of gypsum products.

Benefits to Indians. - According to company estimates, about 500 permanent jobs would be created by the proposed gypsum project. Priority would be given to Indian labor not only in the mining and milling operations on the reservation but also in the processing plants under consideration at St. Louis and Seattle. (Bolmer and Biggs, 1965, p. 78-79)

(22)

NW 1/4 sec. 13, T. 31 N., R. 98 W. - Noble Ranch
The massive gypsum unit of the lower Gypsum Spring formation is 45 feet thick (Love, et. al., 1945).

SW 1/4 NE 1/4 sec. 33, T. 32 N., R. 98 W. - Derby Anticline
Compilation of a stratigraphic section in the Blue Ridge area reveals 52 feet of well bedded, sugary gypsum in the lower Gypsum Spring formation (Love, et. al., 1945; 1947, p. 43).

NW 1/2 sec. 18, T. 32 N. R. 98 W.
SW 1/2 sec. 12, T. 32 N., R. 99 W - Dallas Anticline

Love, et. al. (1945) reported 53 feet of massive gypsum in the lower Gypsum Spring formation on the crest of Dallas anticline.

T. 33 N., R. 94 W. - Connant Creek
An isolated occurrence of gypsum is found in undefined redbeds along Conant Creek, 40 miles west of the Rattlesnake Hills (W. C. Knight, 1904, p. 83).

Lander Area
T. 33 N., R. 99 W
Near the Landee Experiment Farm, 40 feet of gypsum are found near the "top of the Chugwater formation" (Jamison, 1911, p. 84).

(23)

NE¼ sec. 27 to SW¼ sec. 23, T. 33N., R. 100W.

The massive gypsum unit of the lower Gypsum Spring formation attains a thickness of 84 feet on Squaw Creek, southwest of Lander (Love, et. al., 1945).

NE¼ sec. 24, T. 2S., R. 1E. to NW¼ sec. 19, T. 2S., R 2E.

A reported gypsum thickness of 62 feet occurs in the lower Gypsum Spring formation on Lander anticline (Love, et. al., 1945; Stone, et. al., 1920, p 307 and Lander sector ↗

SW¼ NW¼ sec. 5, T. 2 S., R. 1 W. - Mill Creek

The lower Gypsum Spring formation includes 92 feet of white gypsum interbedded with 11 feet of dolostone, shale, and siltstone on the south side of Mill Creek (Love, et. al., 1945; 1947, p. 33).

SW¼ sec. 15, T. 1 N., R. 1 W. - Sage Creek Anticline

On the northeast flank of Sage Creek anticline, 50-60 feet of massive gypsum are exposed in the lower Gypsum Spring formation (Love, et. al., 1945; Stone, et. al., 1920, p. 304).

Tps. 1, 2 S., Rs. 1, 2 W. - Wind River Mountain Front
Tps. 1, 2 N., R. 3 W.

The lower gypsum horizon of the Gypsum Spring formation is exposed intermittently for 100 miles along the northeast base of the Wind River Mountains.

(24)

Specific thicknesses of this important unit are 40 feet from Soral to Trout Creeks, 50 feet on Pevah Creek, 70 feet from South to North Forks Sage Creek, and 125 feet on Bull Lake Creek. (Bolmer and Biggs, 1965, p. 72)

SW 1/4 sec. 2 to NW 1/4 sec. 11, T. 6 N., R. 2 E. - Sheep Creek

White gypsum, interbedded with thin red shale laminae in the lower Gypsum Spring formation, averages 45 feet in thickness along the East Fork of Sheep Creek (Love, et. al., 1945; 1947, p. 23).

T. 6 N., Rs. 3, 4 E. - Sears Ranch

West of Boysen, the lower Gypsum Spring formation contains 35-55 feet of massive gypsum (Bolmer and Biggs, 1965, p. 72).

Secs. 22, 23, 25, 26, 36 T. 6 N., R. 2 W. - Maverick Springs Anticline

The lower Gypsum Spring formation contains 94 feet of massive gypsum in the Maverick Springs area (Love, et. al., 1945). Appreciable reserves of gypsum amenable to strip mining are exposed along the crest of Maverick Springs anticline. Data concerning reserves and amount of overburden in this area are summarized below (Bolmer and Biggs, 1965, p. 73):

(25)

Gypsum amenable to strip mining:
areal extent - 151.2 acres
thickness - 10 to 60 feet
total reserves - 14,333,400 tons
Waste stripping required:
areal extent - 18.1 acres
thickness - 20 to 40 feet
total stripping - 1,806,000 tons
Stripping ratio: 0.13 to 1

Sec. 6, T. 6 N., R. 3 W.
Sec. 1, T. 6 N., R. 4 W.
Sec. 36, T. 7 N., R. 4 W. - Red Creek

Love (1939, p. 43-44; et. al., 1945) and Cooldy (1947, p. 28-29) include 146 feet of white massive gypsum and 35 feet of interstratified limestone, sandstone, and red shale in the Gypsum Spring formation on the east side of Red Creek at the southern margin of the Absaroka Range.

Secs. 6, 7, T. 6 N., R. 2 W.
Sec. 1, T. 6 N., R. 3 W.
Sec. 3, T. 7 N., R. 2 W.
Sec. 36, T. 7 N., R. 3 W - Circle Ridge Anticline

Gentle dips within the Gypsum Spring formation on the northeast flank of Circle Ridge dome expose 123 feet of massive gypsum which is suitable for strip mining (Collier, 1920, p. 157).

T. 7 N., Rs. 3, H E. - Red Canyon Creek

The massive gypsum layer in the Gypsum Spring formation varies in thickness from 30 to 40 feet along Red Canyon Creek, southwest of Minnesela (Bolmer and Biggs, 1965, p. 72).

Sec. 27, T. 8 N., R. 3 E. - Mud Creek

The Gypsum Spring formation exhibits 100 feet of its characteristic gypsum unit on Middle Fork Mud Creek, 15 miles west of Thermopolis (Imlay, 1956, p. 571).

T. 8 N., R. 1 E. - Red Creek

Bolmer and Biggs (1965, p. 72) report a thickness of 30 to 40 feet for the massive gypsum unit at the base of the Gypsum Spring formation along Red Creek on the northern flank of the Owl Creek Mountains.

Sec. 20, T. 42 N., R. 94 W.
Sec. 23, T. 42 N., R. 95 W. - Buffalo Creek

Tourtelot (1952, p. 50) reports a thickness of 40 feet for massive gypsum and interbedded red siltstone in the upper part of the Dinwoody formation along Buffalo Creek between Thermopolis and Minnesela.

(28)

T. 43 N., R. 93 W. - Red Spring Anticline

SW¼ sec. 21

Two gypsum beds in the Gypsum Spring formation crop out on the northern flank of Red Spring anticline, 10 miles east of Thermopolis. The upper unit is 10 feet thick and is separated from the lower 4-foot thick layer by 33 feet of interbedded shale and limestone. (Lupton and Condit, 1916, pl. I)

Secs. 28, 29

Exposures on the northeastern flank of Red Spring anticline reveal 33 feet of impure gypsum in the Dinwoody formation and 65 feet of massive gypsum with minor shale intercalations in the Gypsum Spring formation (Shlemon, 1959, p. 52, 72).

T. 45 N., R. 93 W. - Thermopolis Area

In the vicinity of Thermopolis, the Chugwater formation contains 68 feet of massive gypsum, 8 feet of impure gypsum and sand, and 88 feet of interbedded red sandstone, shale and gypsum; the upper part of the underlying Dinwoody formation includes 17 feet of impure, yellowish gypsum (Collier[2], 1920, p. 66-67; Lee, 1927, pl. 11)

The Soil Sulphaid Distributing Company produced gypsum associated with sulfur from hot springs deposits, 2½ miles west of Thermopolis. Operations

Secs. 29, 32, T. 7 N., R. 1 E. - Phlox Mountain Area

Excellent exposures of the lower Gypsum Spring formation reveal a massive gypsum unit ranging in thickness from 50 to 80 feet. Favorable thickness and attitudes of this deposit are offset by regional isolation and high costs of transportation to a suitable market area. (Long, 1959, p. 24)

Secs. 19, 20, 30. T. 7 N., R. 1 W. - Antelope Ridge Area

An 80-foot bed of relatively pure gypsum near the base of the Gypsum Spring formation could be readily strip-mined in the Bargee area (Bolmer and Biggs, 1965, p 72; Kisling, 1962, p. 41).

T. 7 N., R. 2 W. - Muddy Creek-Red (Antelope) Basin Area

The massive gypsum bed in the Gypsum Spring formation ranges in thickness from 40 feet at the head of Muddy Creek to 78 feet in Red (Antelope) Basin (Bolmer and Biggs, 1965, p. 72).

Hot Springs County

Occurrences of gypsum in Hot Springs County are found in the Gypsum Spring, Chugwater, and Dinwoody formations exposed on the northern flank of the Owl Creek Mountains.

ceased in 1950, following an initial production of 3,015 tons in 1949. (Wyoming State Board of Equalization, production figures, 1948, 1949).

Johnson County

Gypsum deposits of Johnson County are found in exposures of the Chugwater and Goose Egg formations along the southeastern flank of the Bighorn Mountains.

Tps. 41, 42 N., Rs. 83, 84 W. - Buffalo Creek

South of Barnum along the valley of Barnum Creek, there are numerous beds of gypsum (Stone, et. al., 1920).

E½ T. 43 N., R. 84 W.
SE¼ T. 44 N., R. 83 W.
Tps. 43, 44 N., R. 83 W. (V-shaped area) - Red Fork Powder River Area

Gypsum-bearing redbeds of the Goose Egg and lower Chugwater formations describe a sigmoidal pattern from Barnum to Mayoworth in the Red Fork Powder River drainage area (Carlson, 1949, p. 26-27, and pl. 2).

T. 44 N., R. 84 W. - Phillips Ranch

Gypsum outcrops of the Gypsum Spring formation on Phillips Ranch and westward along the base of the main mountain front display an average thickness of 52 feet exclusive of several interstratified shale and limestone horizons (Lupton and Condit, 1916, p. 155 and pl. 11

NW 1/4 T. 45 N., R. 83 W. - North Fork Powder River

Along North Fork Powder River near Welch Ranch the Goose Egg formation contains 40 feet of white and pink banded gypsum interbedded with red shales (Lupton and Condit, 1916, p. 154; Stone, et. al. 1920, p. 300).

T. 46 N., R. 83 W. - South Fork Crazy Woman Creek

Gypsum horizons, including several shale layers, total 90 feet in thickness within the Goose Egg formation, 1/2 mile north of South Fork Crazy Woman Creek (Lupton and Condit, 1916, p. 154, and pl. I; Stone, et. al., 1920, p. 300).

T. 47 N., R. 83 W. - Middle Fork Crazy Woman Creek

One of the thickest gypsum deposits on the east slope of the Bighorns is on the north side of Middle Fork Crazy Woman Creek, 9 miles southeast of Hazelton. The Gypsum Spring formation contains 93 feet of gypsum with insignificant amounts of interbedded shale and limestone. Chugwater gypsum beds are from 25 to 40 feet thick. Individual gypsum layers are fine textured and free of clastic sediment. (Lupton and Condit, 1916, p. 153-154, and pl. I; Stone, et. al., 1920, p. 300).

T. 47 N., R. 83 W. - Beaver Creek

In a ravine near Beaver Creek, 12 miles north of Mayoworth, there is a large amount of gypsum above and below the purplish clay member of the Goose Egg formation. Gypsum beds in the Chugwater vary from 25 to 40 feet in thickness. (Lupton and Condit, 1916, p. 154; Stone, et. al., 1920, p. 300)

Secs. 11, 35, T. 48 N., R. 83 W. - Billy Creek Area

All major redbed formations in the Billy Creek area contain significant gypsum deposits. A basal gypsum layer in the Gypsum Spring formation maintains a thickness of 5 feet. The Chugwater formation includes 76.2 feet of gypsum distributed in 6 units which are interstratified with 174.1 feet of limestone, dolostone, gypsiferous siltstone, and shale. The upper 150 feet of the Goose Egg formation consist of [siltstone intercalations and gypsum units ranging from 1 to 20 feet in thickness. (Hose, 195 p. 106, 108)

T. 50 N., R. 83 W. - Sand Creek

Vertical beds reveal 100 feet of gypsum near the head of Sand Creek, southwest of Buffalo (Stone, et. al., 1920).

T. 52 N., R. 82 W. - South Fork Rock Creek

Soft red sandstone containing much impure gypsum is capped by 20 feet of pure gypsum on South Fork Rock Creek northwest of Buffalo (Stone, et. al., 1920).

Natrona County

The southern prong of the Bighorn Mountains, the northeast flank of the Rattlesnake Mountains, the east-west plunging terminations of Casper Mountain, the northwest flank of Muddy Mountain, and the Alcova area are sites of significant gypsum occurrence in the Sundance, Chugwater, and Goose Egg formations of Natrona County.

T. 30 N., R. 83 W. - Alcova Area

Gypsum in the Goose Egg formation occurs in 2 separate beds, 10 and 3 feet thick, which are separated by 132 feet of sandstone, red shale, and sandy gypsiferous limestone (Lee, 1927, p. 52). The lower Chugwater formation contains 55 feet of gypsum and interbedded redshale (Thomas, 1934, p. 1675). Southwest of Alcova near the head of Platte Canyon, gypsum-bearing beds trend northwest for 5 to 6 miles (W. C. Knight, 1904, p. 82).

(33)

Sec. 13, T. 30 N., R. 80 W. - Bates-Corral Creeks Area
Secs. 34, 35, T. 31 N., R. 80 W.

Jenkins (1950, p. 63) found white, finely-crystalline, massive gypsum beds, 4 to 7 feet thick, in the Sundance formation, 18 miles south of Casper. Thick overburden renders these deposits unsuitable for exploitation.

Tp. line, T. 31-32 N., R. 79 W. - Muddy Mountain

Massive deposits of white gypsum, 3 to 8 feet thick, are abundant in the upper Goose Egg formation on the northwest flank of Muddy mountain; in other nearby areas, the Goose Egg is not gypsiferous. Thick overburden prevents economic consideration of a 7-foot gypsum unit in the "lower Sundance". (Schwarberg, 1959, p. 70)

T. 32 N., R. 78 W. - Muddy Creek

At the east end of Casper Mountain on Muddy Creek, there are 8-foot gypsum beds of steep inclination in the upper part of the Chugwater formation (Stone, et. al., 1920, p. 305).

T. 32 N., R. 81 W. - Bessemer Mountain

Near Bessemer Mountain about 15 miles northeast of Alcova, clean, thin-bedded to massive gypsum interbedded with red shale occurs beneath a small amount of overburden (Birch, 1955, p. 64).

T. 32 N., R. 81 W. - Goose Egg

At the west end of Casper Mountain, 86 feet of gypsum occur near the base of the Chugwater formation (Lee, 1927, p. 48). At its type locality (NW¼ sec. 12), the Goose Egg formation contains 98 feet of white, generally dense gypsum, irregularly interbedded with limestone breccia and sandy, red to ocher siltstone and shale (Thomas and Barke, 1956, p. 6).

T. 32 N., Rs. 86, 87 W.
T. 33 N., Rs. 87–89 W.
T. 34 N., Rs. 88, 89 W. - Rattlesnake Hills

Gypsum beds along the northeast base of the Rattlesnake Hills dip 25° to 30° NE and extend along the mountain front for approximately 20 miles (W. C. Knight, 1904, p. 83). The Little Medicine tongue of the Dinwoody formation contains 12 feet of gypsum (Tourtelot, 1952, p. 50).

T. 39 N., R. 86 W. - E-K Creek

Gypsum associated with dolostone and dolomitic siltstone is found along E-K (Ekoy) Creek in thicknesses of 30 feet within the Dinwoody formation and 176 feet within the Phosphoria formation (Tourtelot, 1952, p. 50).

T. 39 N., Rs. 86, 87 W. - Deadman Butte Area

Woodward (1957, p. 228) reported a gypsum - siltstone sequence in the Phosphoria formation along Badwater, Cottonwood, and First Water Creeks north of Deadman Butte

Park County

Major alabastine gypsum reserves of Park County occur in the lower Gypsum Spring formation on the eastern flank of the Absaroka plateau in the vicinity of Cody. Gypsum deposits of Horse Center and Rattlesnake Mountain anticlines average 70 feet in thickness. Further north along the southeastern prong of the Beartooth block, this gypsum horizon reaches its minimum thickness of 16 feet. Gypsum lentils, ranging in thickness from 0 to 12 feet in the middle Gypsum Spring formation, are not laterally continuous over distances greater than 3 miles. Minor amounts of gypsum are found in the Morrison formation. (Bullock, 1964, p. 1-8)

The Interstate Chemical Company, near Cody, produced 1,800 tons of gypsum in 1949 from open pit deposits associated with sulfur. The Wyoming Mineral Products Company produced gypsum from a small hot springs deposit southwest of Cody.

This deposit yielded a total of 1,520 tons of gypsum and sulfur in 1949. (Wyoming State Board of equalization, production figures, 1948, 1949). Neither of these deposits are in current operation (Wilson, personal communication).

The following table lists locations and thicknesses for the massive gypsum member of the Gypsum Spring formation:

location	thickness (ft.)	source
Horse Center Anticline:		
secs. 5,6, T.51 N., R.101W.	80'	Imlay, 1956, p.56
sec. 8, T.51 N., R.101 W.	59'	Bullock, 1964, p3
sec. 25, T.52 N., R.102 W.	69'	Bullock, p.4
sec. 31, T.52 N., R.102 W.	80'	Bullock, p.40
Rattlesnake Mountain Anticline:		
sec. 11, T.52 N., R.102 W.	68'	Bullock, p.49
sec. 13, T.52 N., R.102 W.	67'	Bullock, p.4
sec. 14, T.52 N., R.102 W.	69'	Bullock, p.46
sec. 18, T.52 N., R.103 W.	70'	Bullock, p.45
sec. 7, T.53 N., R.102 W.	67'	Bullock, p.58
sec. 17, T.53 N., R.102 W.	68'	Bullock, p.5
sec. 27, T.53 N., R.102 W.	69'	Andrews, Bullock, p.5
sec. 35, T.53 N., R.102 W.	12'	Pierce and [illegible], 19 Johnson, 1934, p.819
sec. 12, T.53 N., R.103 W.	62'	Bullock, p.60 Imlay, 1956, p.56
sec. 13, T.53 N., R.103 W	63'	Bullock, p.63
sec. 32, T.54 N., R.103 W.	60'	Bullock, p.6

Pat O'Hara Anticline:

sec. 4, T. 54 N., R. 103 W.	39'	Bullock, p. 72
sec. 21, T. 54 N., R. 103 W.	42'	Bullock, p. 69
sec. 24, T. 54 N., R. 104 W.	63'	Bullock, p. 67

Clarks Fork Yellowstone River:

sec. 32, T. 54 N., R. 103 W.	40'	Bullock, p. 74
sec. 5, T. 55 N., R. 103 W.	35'	Bullock, p. 80
sec. 20, T. 55 N., R. 103 W.	36'	Bullock, p. 78
sec. 29, T. 55 N., R. 103 W.	40'	Bullock, p. 76
sec. 17, T. 56 N., R. 103 W.	35'	Bullock, p. 86
sec. 29, T. 56 N., R. 103 W.	16'	Bullock, p. 84
sec. 32, T. 56 N., R. 103 W.	31'	Bullock, p. 8:
sec. 27, T. 58 N., R. 103 W.	27'	Bullock, p. 90
sec. 34, T. 58 N., R. 103 W.	26'	Bullock, p. 89

T. 51 N., R. 101 W. - Horse Center Anticline
Fischer (1906, p. 58) reported 8 feet of gypsum in the Morrison formation.

Platte County

Minor deposits of gypsum in the Permo-Triassic redbeds of Platte County are found on the east flank of the Laramie Range and in the Glendo area.

(38)

Tps. 19-22 N., Rs. 69, 70 W. - Deadhead Creek

A narrow strip of Permian redbeds follows the drainage of Deadhead Creek along the east flank of the Laramie Range. Sporadic lenticular gypsum beds up to 20 feet thick are scattered throughout the area. (Haun, 1949, p. 9; Jenkins, 1938, p. 35)

T. 29 N., Rs. 67-69 W. - Glendo Area

Gypsum beds range from a few inches to as much as 40 feet in thickness in the lower part of the Chugwater formation (Love, et.al, 1949). A gypsum layer, varying from 45 to 50 feet in thickness, is exposed along Horseshoe Creek, approximately 6 miles southwest of Glendo (Osterwald, et.al., 1966, p. 102).

Sheridan County

Gypsum in Sheridan County is exposed continuously in the base of the Chugwater formation on the northeastern flank of the Bighorn Mountains from Pass Creek, near the Wyoming - Montana border, south to Little Goose Creek (Stone, et.al., 1920, p. 299). Gypsum was previously mined and milled at Dayton.

T. 56 N., R. 87 W. - Dayton Area

On U.S. Highway 14, approximately 11 miles southwest of Dayton, 18 feet of gypsum are distributed in 3 beds in the lower part of the Chugwater formation (Zapkis, 1950, p. 38-39).

Washakie County

Gypsum deposits of Washakie County are found in exposures of the Gypsum Spring and Goose Egg formations on the northwest flank of the Owl Creek - Bighorn arc.

T. 42 N. R. 88 W. - Nowood Area

The emergence of an unnamed creek from a small canyon, 1½ miles southwest of Nowood, marks the occurrence of a 42-foot gypsum bed in the lower Goose Egg formation (Lupton and Condit, 1916, p. 153). Thickness of this unit decreases to 33 feet at Lone Tree Creek, 4⅓ miles southwest of Nowood (Imlay 1956, p. 571).

The upper Goose Egg formation includes massive beds of white gypsum with interbedded red shale along Nowood Creek, 3 miles northeast of Nowood (Lupton and Condit, 1916, p. 153). This sequence averages a thickness of 190 feet in the vicinity of Mahogany Butte (Tourtelot, 1952, p. 50).

T. 43 N., R. 87 W. - Redbank Area

A 30-foot lenticular gypsum bed overlain by nodular chert is found in the upper Goose Egg formation along the valley of Cherry Creek, 2 miles southwest of Redbank. Beneath this thick gypsum layer are a few thin beds of red shale followed by 8 massive gypsum units, 2 to 4 feet thick, scattered through 50 feet of red shale. (Lupton and Condit, 1916, p. 152, and pl. V; Stone, et al., 1920, p. 301)

The basal gypsum horizon in the Gypsum Spring formation is 27 feet thick, one mile northwest of Redbank school (Imlay, 1956, p. 570).

T. 44 N., Rs. 87, 88 W. - Bigtrails Area

Northwest of Bigtrails, the massive gypsum unit in the lower Gypsum Spring formation ranges in thickness from 44 feet on Canyon Creek to 48 feet at the mouth of Buffalo Creek (Lupton and Condit, p. 149, and pl. V; Stone, et al., 1920, p. 301).

Secs. 4, 8, 9, 14, 16, 17, T. 45 N., R. 87 W. - Otter Creek

Morgan (1951, p. 49) and Imlay (1956, p. 570) reported 32 to 44 feet of gypsum in the lower Gypsum Spring formation and 73 feet of gypsum interbedded with 12 feet of shale at the base of the Goose Egg formation on Otter Creek, 7 miles

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Tps. 47, 48 N., Rs. 88, 89 W. - Tensleep Area

On the north side of Tensleep Canyon near Burke's Ranch, the Goose Egg formation includes 12 beds of gypsum representing a cumulative thickness of 68.5 feet. These deposits are interbedded with 22 feet of red shales. The principal gypsum horizon is 240 feet above the top of the Tensleep sandstone. (Cordet, 1916, p. 265; Darton, 1906, p. 39; Lupton and Cordet, 1916, p. 152, and pl. I; Stone, et. al., 1920, p. 301)

Lupton and Cordet (1916, p. 149, and pl. I) measured 54 feet of massive gypsum overlain by 20 feet of impure gypsum in the Gypsum Spring formation along the west side of Nowood Creek and the north side of the Tensleep - Worland road, 2 miles northwest of Tensleep. The upper Goose Egg formation contains 90 feet of gypsum interlayered with thin red shale beds (Stone, et. al., 1920, p. 301).

Northwest of Tensleep, the massive gypsum unit of the lower Gypsum Spring formation decreases in thickness from 50 feet on Brokenback Creek to 46 feet on Buffalo Creek (Imlay, 1956, p. 570).

Weston County

Gypsum deposits of Weston County are found in exposures of Permo-Triassic redbeds over a distance of 30 miles on the southeast flank of the Black Hills uplift.

Tps. 44-46 N., R. 60 W. - Stockade Beaver Creek-Newcastle Area

There are extensive gypsum deposits in the basal Spearfish formation along Stockade Beaver Creek, southeast, east, and northeast of Newcastle. West of Ferry Peak, 50 feet of gypsum are found interbedded with red shale and clayey sandstone (Darton, 1901, p. 516-518; Richardson, 1903, p. 372). This sequence continues northward and eventually includes another gypsiferous unit which reaches a thickness of 10 to 12 feet in a valley 2 miles southeast of Mt. Pisgah (Darton, 1901, p. 518; Stone, et al., 1920, p. 297). Extensive exposures of gypsum in the middle Spearfish formation are found a short distance northeast of the LAK ranch (Stone, et al. 1920, p. 297).

Tps. 47, 48 N., Rs. 61, 62 W. - Oil Creek Area

A thick bed of gypsum appears at the top of the Spearfish formation in the upper drainage of

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Oil Creek, 5 miles north of the TE Ranch. This unit exhibits an average thickness of 25 feet along Oil Creek and as a capping on Red Butte, and apparently is correlative with a unit of similar thickness, 2 miles southeast of Mt. Pisgah on Stockade Beaver Creek. (Darton, 1905, p. 3)

NW 1/4 SW 1/4 and NW 1/4 NE 1/4 sec. 8, T. 48 N., R. 60 W. - Cold Springs Creek

The Permian Minnekahta limestone is directly overlain by 21 feet of gypsum at the base of the Spearfish formation. This overburden covers reserves estimated at several 10's of million tons. (Darton, 1905, p. 3; Osterwald, et. al., 1966, p. 103)

Purity of Gypsum Deposits

Sample location	CaO	SO_3	$CaSO_4$	H_2O	MnO MgO	Fe_2O_3 Al_2O_3	SiO_2 insoluble residues	Indicated gypsum purity (from SO_3 value)
pure gypsum	32.50	46.60	79.10	20.90	—	—	—	100.00
Albany County								
Red Buttes[1]	32.50	46.30	78.71	20.80	—	.30	.20	99.36
Big Horn County								
Stucco[2]	33.74	43.92	74.66	19.50	.98	.17	.01	94.25
Hyattville (Chugwater)[2]	32.92	45.74	77.76	19.99	.44	.03	.05	98.15
Hyattville (Goose Egg)[2]	32.72	45.18	76.81	20.03	.42	.05	.06	96.95
Hinis[3]	32.90	45.80	78.30	20.00	.10	.10	.90	98.28
Fremont County								
Maverick Springs Anticline[4]	33.00	44.70	77.20	19.80	—	—	.20	95.92
Hot Springs County								
Thermopolis[2]	34.20	45.50	77.35	20.00	—	.10	.25	97.64
Johnson County								
Middle Fork (Crazy Woman Creek)[2]	32.81	45.42	77.21	20.40	—	.11	.07	97.47
Park County								
Horse Center Anticline[5]	32.98	45.95	78.45	20.06	—	.15	.05	98.80
Rattlesnake Mountain[5]	32.91	46.23	78.73	20.28	—	.22	.20	99.40
Clark Fork Anticline Yellowstone River[5]	32.85	46.07	78.57	20.53	—	.20	.22	99.00
Platte County								
Glindo Area[6]								99.61
Weston County								
Cold Springs Creek[7]	32.40	42.10	71.50	15.80	1.00	.50	1.80	92.27

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CaO percentages, in excess of 32.5%, are attributed to minor presence of limestone.

[1] D.B. O'Brine, analyst - U.S.G.S. Bull. 285, p. 405, 1906
[2] W.C. Wheeler, analyst - U.S.G.S. Bull. 640, p. 139-157, 1917.
[3] H. Infanger, analyst - Natural Resources Research Institute, Univ. of Wyoming, 1965
[4] Natural Resources Research Institute, Univ. of Wyoming, 1959.
[5] B. Davis and R. Tremain, analysts - Natural Resources Research Institute, Univ. of Wyoming, 1964.
[6] Osterwald, et. al., 1966, p. 102.
[7] Osterwald, et. al., 1966, p. 103.