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GRAPHITE IN WYOMING

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Introduction

Graphite, formerly also called plumbago or black lead, is a platy, soft, metallic mineral composed of the element carbon. It is found in metamorphic rocks that were formed from organic or carbonaceous sedimentary rocks.

Natural graphite can be classified into three forms: disseminated flake, crystalline vein, and amorphous. Disseminated flake graphite or flake graphite is found in marble, gneiss, and schist. It is characterized by separate flakes of graphite in the host rock. Crystalline vein graphite is found in well-defined veins or as lenticular or pocket accumulations, usually along the contact of pegmatites with limestones. Amorphous graphite is usually found as microcrystalline particles and masses of microcrystalline grains in slates, shales, or schists. Manufactured graphite is made from petroleum coke in electric furnaces (Graffin, 1983).

Production and economic uses of graphite

Natural graphite was produced in the United States in Texas in 1984 and 1988. Occurrences with past production and/or future production potential are found in Alabama, Alaska, New Mexico, New York, Pennsylvania, Rhode Island, and Texas (Taylor, 1989; Krauss and others, 1988; see also Graffin, 1983). There are a few of occurrences in Montana that may also have production potential.

Natural graphite is used by several hundred manufacturing firms in the United States, most of which are located in the northeastern and Great Lakes states. Graphite (both natural and manufactured) is used in refractory linings (26%), dressings and molds in foundries (15%), lubricants (14%), brake linings (13%), pencils (7%), as a carbon additive in steelmaking (5%), and other uses (20%) (Taylor, 1989).

The demand for graphite is expected to increase, especially since graphite can be used in place of asbestos in brake linings. The price of graphite has generally increased over the past five years (Table 1)

Table 1. Price of graphite, 1984 - 1988 (prices in dollars per short ton).

<u>Year</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>
Flake	509	536	648	712	675
Lump ¹	1,065	790	932	811	758
Amorphous ²	40	50	49	52	44

¹Sri Lanka

²Mexico

The United States imports most of its graphite from Mexico. Other countries from which the U. S. purchases graphite include China, Brazil, Madagascar, and others (including Sri Lanka) (Taylor, 1989).

Graphite occurrences in Wyoming

Graphite occurrences in Wyoming are confined to Precambrian metamorphic rocks. Most of the reported graphite occurrences in the state are in the northern Laramie Mountains and the Hartville uplift. There are no producing graphite mines in Wyoming, although there has been some limited past production. The following is a list, by county, of occurrences in Wyoming. Numbers by each occurrence refer to the index map, Figure 1.

Albany County

1. Halleck Canyon

Sec. 26, T.22N, R.71W

Shue (1909) reported that irregular seams of amorphous graphite are found in Precambrian marbles in a sequence that includes granite and gneiss. Some of the graphite was reported to be of high grade.

2. Bluegrass Creek area

Secs. 35 and 36, T.23N, R.71W

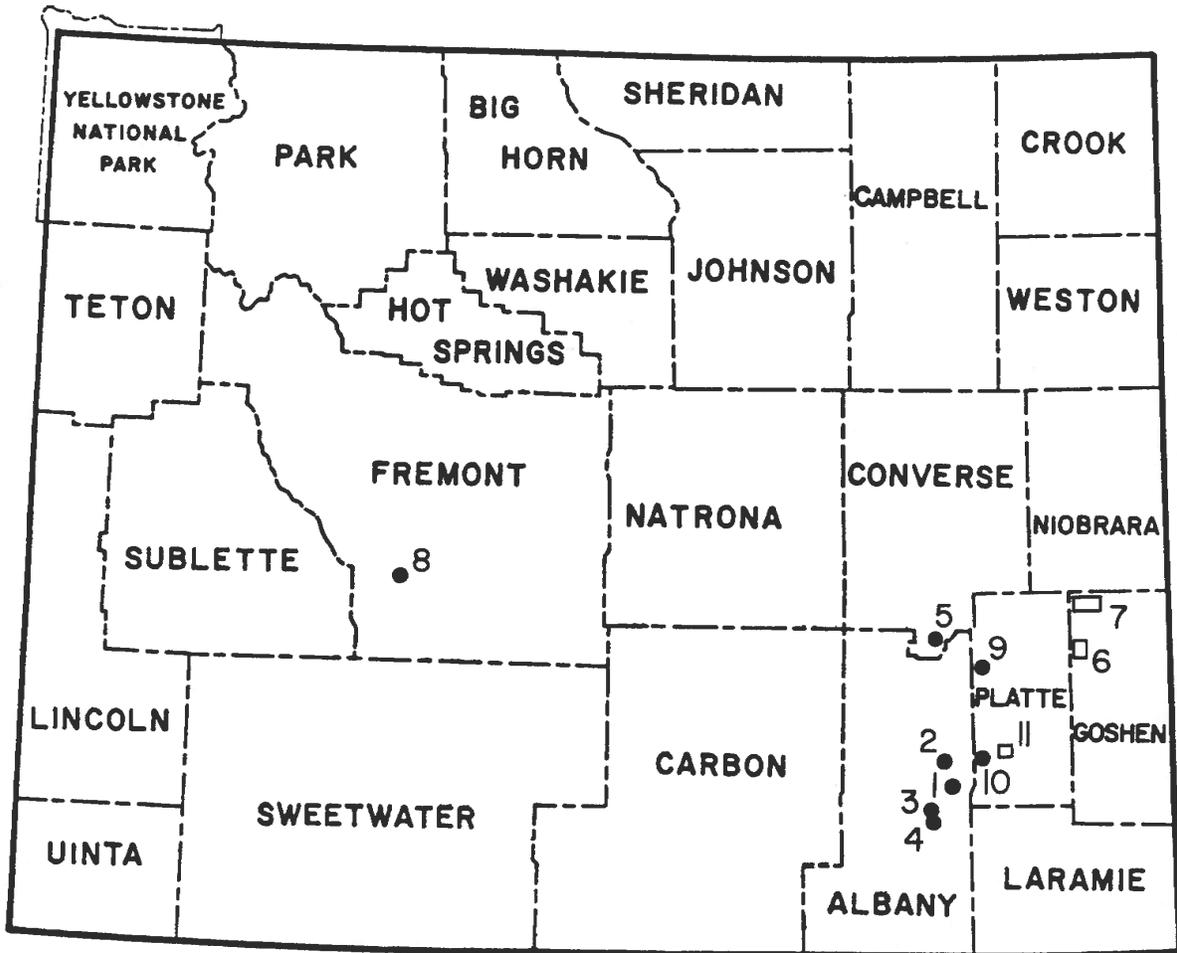


Figure 1. Index map showing graphite locations in Wyoming (numbers refer to occurrences described in text).

Graphite schists 4 to 6 feet wide and up to 30 feet in length are found in quartzites in this area. Smaller bodies are found in the section. These measure 1 to 2 feet wide and 20 feet long or less (Hodge, 1966).

3. Plumbago Creek area

SW corner of T.20N, R.72W

Narrow bands of graphitic schist that contain up to 15 percent graphite are found interbedded with other schists in this area. Graphite is also found in this area in quartzite in thin seams and fracture fillings (Osterwald and others, 1966; also Union Pacific System, 1927). Plumbago Creek was probably named after this occurrence of graphite.

4. Sec. 12, T.19N, R.72W

Crystalline graphite with minor amounts of amorphous graphite is found in this locality, which is just south of the Plumbago Creek location. It occurs in a schist, in a gray marble, and in a porphyritic rock. The graphite averages 12 percent of the rock, with a range of 6 to 16 percent. The graphite occurrence is irregular, averaging 2 to 5 feet thick (Hagner, 1942a) .

Converse County

5. Esterbrook area

East central part of sec. 21, T.28N, R.71W

A graphite-pyrrhotite schist is present in the Maggie Murphy mine at a depth of 107 feet below the surface. This mine was developed in the early years of the twentieth century for copper. No other information on graphite at this location is given (Spencer, 1916).

Goshen County

6. Haystack Hills area

Secs 14, 15, 22, 24, 25, 26, 27, 34, 35, and 36, T.28N. R.65W and sec. 1, T.27N, R.65W

Graphite schists are found in Precambrian metamorphic rocks in this area. These graphite occurrences have been known since 1881, when the Senteniel claim was located by Lauck & Stein, early settlers and prospectors in the region (Ball, 1907). Since the early part of the twentieth century, there has been little interest in the area's graphite resources. Recently, there has been some interest in these occurrences as possible indicators or hosts for base or precious metal deposits. Some of the larger occurrences in this area are listed below.

In sec. 26 T.28N, R.65W, 2,000 feet east of the summit of McCann Pass, on the north side of the notch, is the largest exposure of graphite in the Haystack Hills, according to Ball (1907). Here, the graphite schist forms two zones each 4 feet wide separated by 2 feet of muscovite schist. The graphite body extends for at least 2,000 feet along strike, though it is covered by Quaternary sediments for part of this length (Ball, 1907). It is truncated on the west by a Precambrian intrusive granite. The graphite schist is truncated on the east side by the McCann fault (Millgate, 1965).

Other graphite-bearing schists are found north of McCann Pass. These zones are less than 2 feet thick, and the graphite content is not great (Millgate, 1965). Most of the carbon is amorphous graphite, rather than the flake variety.

Ball (1907) reported that a band of graphitic schist 2 feet wide is found on the south side of the gap in the center of the NE 1/4 sec.1, T.27N, R.65W. The graphitic schist strikes N70°E, and is vertical. Contorted bodies of quartz lie along the foliation planes of this schist.

High-grade graphitic schist is present in a prospect pit in the center of the W 1/2 sec. 14, T.28N, R.65W, according to Ball (1907). An examination of this area by the author shows several graphite locations in the west 1/2 of this section. These occurrences are associated with yellow and red iron oxides and some

malachite and azurite mineralization. The graphite content of these rocks is not large but the occurrences of graphite measure several hundred feet in diameter.

Graphite is also found in the north-central part of the NE 1/4 sec. 26, the NE corner of sec. 27, the center of the SW 1/4, SE 1/4 sec. 23 and the northwest corner of sec. 26, all in T.28N, R.65W (Ball, 1907). In sec. 26, a 40-foot-deep shaft connected with a tunnel about 80 feet long was developed by a Mr. Vaughn in a schist that contains graphite with plumbojarosite [$\text{PbFe}_6(\text{OH})_{12}(\text{SO}_4)$] and red iron oxide (Hagner, 1943a). The dump from this prospect was oxidizing and contributing hydrogen sulfide gas to the atmosphere and sulfur compounds to surface runoff in 1986. In 1989, this prospect was razed and reclaimed. No relic of the dump or underground material now remains at the surface.

7. Rawhide Buttes area and the Wildcat Hills

T.30N, R.64 and 65W

Graphite is present in Precambrian schist in this area. The schist is equivalent to the graphite-bearing schist in the Haystack Hills area to the south (Snyder, 1980). Most of the graphite occurrences in this area were discovered by prospectors searching for base and precious metal deposits. The following are specific graphite-bearing locations in this area.

Osterwald and others (1966, reference 662) report that at least three graphitic schist layers crop out in Muskrat Canyon in the NW1/4 sec. 19 and NW 1/4, NW 1/4 sec. 30, T.30N, R.64W and the SE 1/4, SE 1/4 sec. 24, T.30N, R.65W. The layers are 1 to 10 feet thick, black, fine-grained, and soft, and show much variation in thickness along strike. The strike length may be as great as 600 feet; however, due to their softness, these schists are usually covered with talus and debris from overlying rocks. They are interlayered with dolomite and hematitic schist. One sample of graphitic schist from a copper prospect assayed 5.0 percent carbon.

In the NE 1/4, NE 1/4 sec. 11, T.30N, R.64W, a 2- to 2 1/2-foot-thick, soft, fine-grained, graphite schist is exposed in a small prospect pit. The schist zone is contorted and brecciated (Osterwald and others, 1966, reference 662).

Graphite is found in thin seams and films parallel to the foliation of contorted limonite- and hematite-stained quartz-muscovite schists in the NE 1/4, NE 1/4 sec. 11, T.30N, R.64W, according to Osterwald and others (1966, reference 662). This zone is 2 to 4 feet thick and can be traced across a low saddle on the northwest corner of the Rawhide Buttes.

Graphite schist 22.4 feet thick, interlayered with muscovite and biotite schists in a total thickness of 40 feet, is found in the NE 1/4, SE 1/4 and the SE 1/4, NE 1/4 sec. 2, T.30N, R.64W. Carbon assays from shallow prospect pits in this zone range from 3.2 to 11.8 percent (Osterwald and others, 1966, reference 662).

Fifteen feet of dark gray to blue-black, fine-grained, soft, hematite- and limonite-stained graphite-muscovite-quartz schist is exposed in a shallow trench in the SE 1/4, NW 1/4 sec. 2, T.30N, R.64W. A chip sample across this unit contained 2.7 percent carbon (Osterwald and others, 1966, reference 662).

Graphitic schist layers 1/2 to 1 1/2 feet thick are found in the NW 1/4, NW 1/4 sec. 2, T.30N, R.64W, according to Osterwald and others (1966, reference 662). These layers are found interlayered with hematite-stained muscovite-quartz schist.

Fremont County

8. Miners Delight region

Near Atlantic City in T.29 and 30N, R.100W

Dietz (1929) reported "extensive" amorphous graphite occurrences in the Miners Delight region

Platte County

9. Rabbit Creek graphite

Sec. 22 T.26N, R.70W

Perhaps the largest graphite deposit in Wyoming is located in the Rabbit Creek area in Platte County. Hagner (1943b) reported that some graphite was sacked at the mine and hauled to Wheatland by animal team. Patterson (1950) reported that this team eventually made it to Denver with only half its original load, and the shipment did not pay for the trip.

The graphite-bearing schist body strikes N22°W, and dips 90°. It occurs in a shear zone along the axial plane of a non-plunging fold. Country rock in the area includes hornblende schist, magnetite schist, gneiss, "clinozoisite rock", hornblende diabase, and quartz stringers (Patterson, 1950).

The graphite schist body at this locality is 4,720 feet long, averages 4 feet wide, and is 70 feet high. There are 1,321,600 cubic feet of schist in the occurrence. The schist averages 21 percent graphite, which gives an estimated 277,500 cubic feet of graphite in the occurrence (Patterson, 1950). There are 67,525 tons of graphite resources remaining in the occurrence.

10. Collins Graphite

E 1/2 sec. 17, T.23N, R.70W

A body of graphite schist at this locality measures 6 to 8 feet wide and strikes for an estimated one half mile in a northeast-southwest direction. The country rocks in this area are biotite-muscovite-quartz schists. An unspecified type of garnet is found in some of the graphite prospect pits on this body (Hagner, 1942b).

11. Cooney Hills area

W 1/2 T.23N, R.69W and the E 1/2 T.23N, R.70W

Graphite occurs in the Cooney Hills in metamorphic rocks and adjacent to quartz pegmatites or granitic intrusives. The following localities are reported concentrations of graphite in this area

In the SE 1/4, SE 1/4, NE 1/4 sec. 10, T.23N, R.69W, fine-grained massive graphite occurs in a lode 7 feet thick. The graphite is found at the contact of a granitic intrusive and is exposed in several prospect pits once known as the Texan lode (Bothner, 1967).

Bothner (1967) reported poor quality fine-grained graphite in several prospect pits in the NE 1/4, SE 1/4 sec. 19, T.23N, R.69W. The graphite-bearing unit is highly fractured and contains quartz fracture fillings.

In the George Creek area in the NE 1/4, NW 1/4 sec. 17, T.23N, R.70W, Bothner (1967) located small lenses of highly fractured graphite and disseminated graphite in a prospect pit. The graphite occurs with mica schist at this locality.

Graphite schist is exposed in an adit and several prospect pits in the NW 1/4, SW 1/4 sec. 17, T.23N, R.70W. This schist is approximately 10 feet thick and is associated with bull quartz and amphibolite (Bothner, 1967).

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