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GARNET IN WYOMING

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Abstract

Garnet is a mineral group used primarily in abrasives, such as garnet-coated paper or cloth or loose grains in airblasted sand. Its use is increasing as the use of free silica (SiO_2) decreases for environmental reasons, especially as airblasted sand. Wyoming contains several occurrences of garnet, though only small amounts of gem quality garnet have been sold. However, a few occurrences of garnet in Wyoming, reported here, may warrant commercial investigations, based on their size and garnet content.

Introduction

Garnets are a group of iron-silicate minerals used priomarily as abrasives. Garnet coated paper and cloth is used in such applications as common sandpaper and optical polishing cloth. Loose grains of garnet are used in airblasting (Austin, 1994). Since silica (SiO_2)-containing minerals are coming under increased regulation because silica dust is a suspected carcinogen, garnet is becoming more popular as an abrasive, especially when used in sandblasting.

Garnets have a cubic crystal structure and a moh's hardness of 6 to 9.0. They generally exhibit no distinct cleavage, but fracture into conchoidal pieces and thin conchoidal flakes. They are heavy minerals, with a specific gravity between 3.5 to 4.2 (Austin, 1994). Varieties of garnet are listed in **Table 1**.

High-grade industrial garnet is usually a mixture of almandine and pyrope garnet which break under pressure into sharp edged plates. These are used as an abrasive powder and in coated abrasives for optical glass polishing and similar uses. Lower quality industrial garnet is used as an airblasting or hydroblasting abrasive and as a filtration agent (Austin, 1994). Garnets are also used in electronic components and in the manufacture of certain types of ceramics and glass products (Austin, 1993). Garnet is also used as a gem when transparent and free from flaws (Austin, 1993).

Table 1 Garnet minerals (after Deer and others, 1966)

Mineral Name	Chemical Formula
Almandine	$Fe_3Al_2Si_3O_{12}$
Andradite	$Ca_3(Fe,Ti)_2Si_3O_{12}$
Grossular(ite)	$Ca_3Al_2Si_3O_{12}$
Hydrogrossular(ite)	$Ca_3Al_2Si_2O_8(SiO_4)_{1-m}(OH)_{4m}$
Pyrope	$Mg_3Al_2Si_3O_{12}$
Spessartine	$Mn_3Al_2Si_3O_{12}$
Uvarovite	$Ca_3Cr_2Si_3O_{12}$

Industrial garnet is produced in the United States at six locations, three in New York, two in Montana, and one in Idaho (Olson, 2002). Other significant occurrences are located in, , Idaho, Maine, Montana, , New Hampshire, North Carolina, , and Oregon (Olson, 2002). This report includes several significant occurrences in Wyoming. Garnet produced in New York is mined from garnet-bearing schists. The Idaho and Montana production is from fluvial placer deposits. Garnet production has been decreasing recently, although production remains higher than the first part of the 1990s (see Austin, 1993). Mined garnet production in the United States is given in table 2.

TABLE 2 ANNUAL UNITED STATES GARNET PRODUCTION 1997 - 2001 (After Olson, 2002) (Data in short tons)

1997	1998	1999	2000	2001
71,500	81,600	66,900	66,400	57,900

Industrial garnet produced in the United States is a graded and sized product. Grading is done according to Government Product Standards (PS8-67 and CS-271-65). These tests do not involve any exact testing method or procedure, but are done qualitatively according to proposed use (Hight, 1983). Garnet bearing rock is mined and crushed, separated from impurities by

screening, tabling, floatation, magnetic separation, or gravity separation, then dried, and heat treated (Austin, 1994).

Garnet production should continue to increase as garnet is substituted for silica-containing abrasives, particularly in airblasting applications. This is a large market as ship-building and -repair facilities use large amounts of airblasted abrasives for cleaning and surface preparation. Another increasing use of garnet is in waterjet cutters. The garnet market faces competition from foreign sources and synthetic abrasives such as silicon carbide, tungsten carbide, boron carbide, boron nitride, fused aluminum oxide, and emery (Olson, 2002, Austin, 1994, Austin, 1993, Hight, 1983).

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Garnet occurrences in Wyoming

There are several occurrences of garnet in Wyoming (**Figure 1**), although there has never been any significant production. The following is an annotated list of known occurrences in Wyoming listed alphabetically by county. The numbers preceding each occurrence refer to the locality map, **Figure 1**. Some localities, listed in order of importance, notably Rock Creek (#5), Cooney Hills Ranch (#18), Two Bar Ranch (#19), Vale Ranch (#3), Lone Tree Creek (#1), and the Garnet Hill area (#s 13, 14, & 15) may warrant commercial testing.

Albany County

1. Lone Tree Creek (Reitz Ranch): SE 1/4 Sec. 11, T. 26N., R. 71W. and the NE 1/4 Sec. 14, T. 26N., R. 71W.

Several abandoned prospect pits on the north side of Lone Tree Creek and the hill to the north in this locality were developed into garnetiferous zones in a biotite gneiss. The gneiss is black to dark red, and consists of biotite and a little feldspar. Garnets are orangish red to dark red, and appear unaltered. They compose as much as 95% of the rock in some zones. Zones consisting of more than 75% garnet vary from a few inches to twenty feet thick and are lentiform in shape. The remainder of the gneiss contains 5% to 75% garnet. The garnets range in size from microscopic to 1/2" in diameter, with the majority being around 1/4". The biotite gneiss underlies an area of more than 160 acres. (REH field notes)

2. Big Chief Mica Mine: Sections 9 & 16, T. 25 N., R. 71 W.

In this area garnet is present in euhedral crystals that vary in size from microscopic to 3/8 inch in diameter (Osterwald, 1947). Garnetiferous zones are present in hornblende schist in three main areas immediately north and northwest of the ranch named by Osterwald (1947) as the Robinson Ranch.

3. Vale Ranch: SW 1/4 NE 1/4 Sec.15, T. 23N., R. 72W.

Dark red almandine garnets are exposed in an isolated hill at the northeast end of the Gene Kennedy (Vale) Ranch airstrip. This exposure measures about 50 feet in diameter, is about 30 feet high, and is surrounded by quaternary alluvium. Exposures approximately 1000 feet on either side of the garnet bearing rock consist primarily of quartzofeldspathic gneiss. The garnets in the outcrop are red to dark orange red, range in size from 1/8 in. to about 1 in., and compose almost 70% of the rock. There is a reaction rim of muscovite and sericite between the garnets and the host rock. The host rock is primarily hornblende gneiss, consisting of hornblende, biotite and a little feldspar. (REH field notes)

4. Many Values Prospect: SE 1/4 Sec. 32, T. 13 N., R. 78W.

Garnet crystals weighing over 2 pounds have been produced in the past from the Many Values mica, beryl, and columbite-tantalite mine. None of these crystals have been found to be gem quality. The garnets occur in biotite schist adjacent to a pegmatite (Rocks and Minerals, 1939). Hanley and others (1950) report that pink and orange subhedral garnets have been found at this locality.This occurrence is reported by Osterwald and others (1966) as the "Ione Prospect".

Carbon County

5. Rock Creek area, NW1/4 Sec.2 to the W 1/2 Sec. 10, T19N, R79W

Dark red almandine garnets are present in a dark grey schist exposed on the west wall of Rock Creek Canyon in Section 2, at an elevation of 8600 to 8800 feet. In Sec. 10, the schists are exposed at the top of the canyon at an elevation of 9000 feet. The garnetiferous zones trend N35°E from Sec. 10 to Sec. 2. Garnet comprises about 55% of the schist. The garnets range in size from 1/8" to 1 1/2' in diameter. There is a very large amount of garnet-bearing rock in this area. Some of the garnets, especially those in the upper zones, appear to be metamict. The area is within the Medicine Bow National Forest. (REH field notes)

6. Encampment area: Sec. 14, T. 14 N., R. 84W

Osterwald and others (1947) report that large perfect crystals of garnet have been found at this location three miles south of Encampment.

Converse County

7. Mormon Canyon: Secs. 11, 12, 13, and 14, T.32N., R.76W

A quartz vein that trends N - S is exposed in outcrops near the common corner of these sections. It is 500 feet long, and varies in width between 30 and 100 feet. The dike contains, in addition to quartz, tremolite, actinolite, glaucophane, grossularite garnet, epidote, scheelite, and molybdenite. (Hagner, 1942a)

Crook County

8. Negro Hill Placers: S1/2 Sec. 21, N. 1/2 Sec. 28, T. 51N., R. 60W

Gold-bearing gravels in this area were reported by Irving and others (1904), to contain "great quantities of tourmaline and cassiterite and innumerable small red garnets...". Negro hill consists of precambrian gneisses and schists intrtuded by Tertiary alkalic igneous rocks (Love and others, 1978). The source of the material in these placers could also be the Tinton Mining District, one half mile east of Negro Hill in South Dakota.

Fremont County

9. Romur claim group: Sec. 22, T. 40 N., R. 93 W

Elongate epidote-zoisite-quartz-garnet rock bodies associated with scheelite occur in an area of about 400 acres in this section. The garnet crystals are dark red, and vary between 1/4" and 2" in diameter (U. S. Bureau of Mines, 1943). No grade or volume estimates are given for garnet.

10. Abernathy Prospect: Unsurveyed Sec. 19, T. 30N., R.100W (Author's location)

A 2' x 4' pit was dug into a metamorphosed quartz vein at this location. The vein contains scheelite, garnet and epidote (Hagner, 1942b).

11. Camp Stambaugh: T. 29N., R. 100W.

Jones (1873), p. 104, reports that numerous outcrops of "garnet-bearing gneiss" are found between this location, near Atlantic City, and the Sweetwater River (Locality#). He notes that the garnet is abundant, "mostly quite small, but occasionally of fair size".

12. Sweetwater River Alluvium: S. 1/2 T.28N., R.101W

Jones (1873), p. 9, noted large amounts of garnet, as well as "slight indications of gold" in the alluvium of the Sweetwater River in this locality, just east of South Pass.

Goshen County

13. Garnet Hill: NW 1/4 Sec.35 T.28N, R. 65W.

Several zones of garnet schist are found on the west and south slopes of Garnet Hill. The schists are light grey in color and consist of muscovite, almandine garnet, and feldspar. The garnets range in size from microscopic to 1/2 inch in diameter and appear to be unaltered. The schists consist of from 10% to 75% garnet. The shists are soft and can be broken by hand, so the garnets should be easily removed from the rock. (REH field notes)

14. Vaughn Prospect: NE 1/4 SW 1/4 Sec. 35 T.28N., R.65W

Hagner (1943) reported that several hundred gem garnets were mined and sold for $1.00 each from a location three miles south of Sec. 26, T. 28 N., R. 65W. Although this location is just over a mile south of section 26, the author examined a prospect pit in Section 35 on the south side of Garnet Hill that contains small amounts of 1/4 in. diameter dark red transparent garnets and grass green, though translucent, hexagonal beryl crytstals measuring 1/2 inch in diameter and about two inches in length. This occurrence may have given Garnet Hill its name. The prospect is in a quartz-feldspar pegmatite surrounded by quartzofeldspathic gneiss. The prospect was developed by a small pit and

small adit driven into the pegmatite. Only trace amounts of garnet were noted at this locality in 1988.

15. Crystal Palace Mica Mine: SE 1/4 NE 1/4 Sec. 34 T. 28N., R.65W

Sheets of muscovite mica were mined at this location in the early years of the 20th century. An open cut over 600 feet long and about a hundred feet deep was developed to mine the muscovite. The host rock is a pegmatite containing muscovite, feldspar, white quartz, tourmaline, brown garnet, and a little beryl. It strikes N. 60°E. (Sterrett, 1923). In 1994, the dump was partly overgrown, but garnet may constitute as much as 30% of the waste pile. Little, if any, resource remains in the walls or face of the open cut. The garnet is reddish brown, equidimensional, and is found in crystals ranging from 1/4 inch in diameter to two inches in diameter.

Platte County

16. Rabbit Creek area: Secs. 22, 23, 24, 25, and 26, T. 26N., R.70W.

Garnetiferoius hornblende schist is common in this area as mapped by Patterson (1950). These schists contain euhedral almandine garnets up to 1/4 inch in diameter. Garnets are also found in magnetite schist, hornblende diabase, and clinozoisite rock in this location. Patterson (1950) also noted that "Almandine garnet is present as an accessory mineral in the schist at the northwestern end of the graphite body.", and that "Garnets predominate (in the hornblende schist bodies) near the graphitic schist."

17. North Laramie River Canyon: SE 1/4 Sec. 29, T. 26N., R. 70W, and the NE 1/4 Sec. 32, T. 26N., R. 70W.

At this locality, the North Laramie River flows in a deep narrow canyon. Exposed along the walls of this canyon in this area are several garnetiferous muscovite schists and garnet-bearing hornblende schists of Precambrian age. The rocks trend N7°E and dip to the west at angles from 20° to nearly vertical. Garnets compose from 25% to 50% of the schists, in zones from 10 to 30 feet thick. in the center of the SE1/4 of sec. 29, the river makes a sharp bend to the

south, and follows the trend of a garnte schist for about 1/4 mile. The garnets are dark red to dark purplish red, and vary from 1/8" to about 1" in diameter. (REH field notes)

18. Cooney Hills Ranch: NW 1/4 Sec. 11 T. 23N., R. 70W.

At this locality, garnet-bearing gneisses are cut by an irrigation ditch. Large (over two inches in diameter) purplish red garnets are found in the gneiss. The gneisses consist of feldspar and biotite mica, and are strongly foliated, with the trend of the foliation N25°W. Some garnets are free-weathering and are found in the sediments below the ditch cut and beneath the outcrop area of the gneiss. Garnets compose about 15% of the gneiss. The garnet bearing gneiss may extend to the south towards the Two Bar Ranch occurrence (#19, below). (REH field Notes)

19. Two Bar Ranch: NW 1/4 Sec. 24 T.23N., R.70W.

At several localities in this section, large (1/2" to 1") unweathered and unabraded purplish red garnets are found in quaternary terrace gravels and alluvial gravels. A small knoll just west of an irrigation ditch in the NW 1/4 of the NW1/4 of this section is composed of gneiss similar to the Cooney Hills Ranch occurrence (#18 above), contains a few small garnets, and may be an outcrop of the source of these garnets. The garnet-bearing rock may extend between these two occurrences. (REH field notes)

Teton County

20. Central portion of Grand Teton National Park: approximately T. 43 & 44 N., R. 115 & 116 W.

Layered gneiss at relatively low elevation changes to garnet bearing rock at high altitudes in the central portion of the Teton Mountains. Prograde metamorphism involving the mineral reaction biotite + muscovite + quartz <—> K feldspar +almandine + phlogopite + water produced these occurrences of garnet in nebulites and pegmatites (Woodward, 1972). Large amounts of rock in the central part of the Tetons contains garnet. Garnet Lake was named after its occurrence.

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