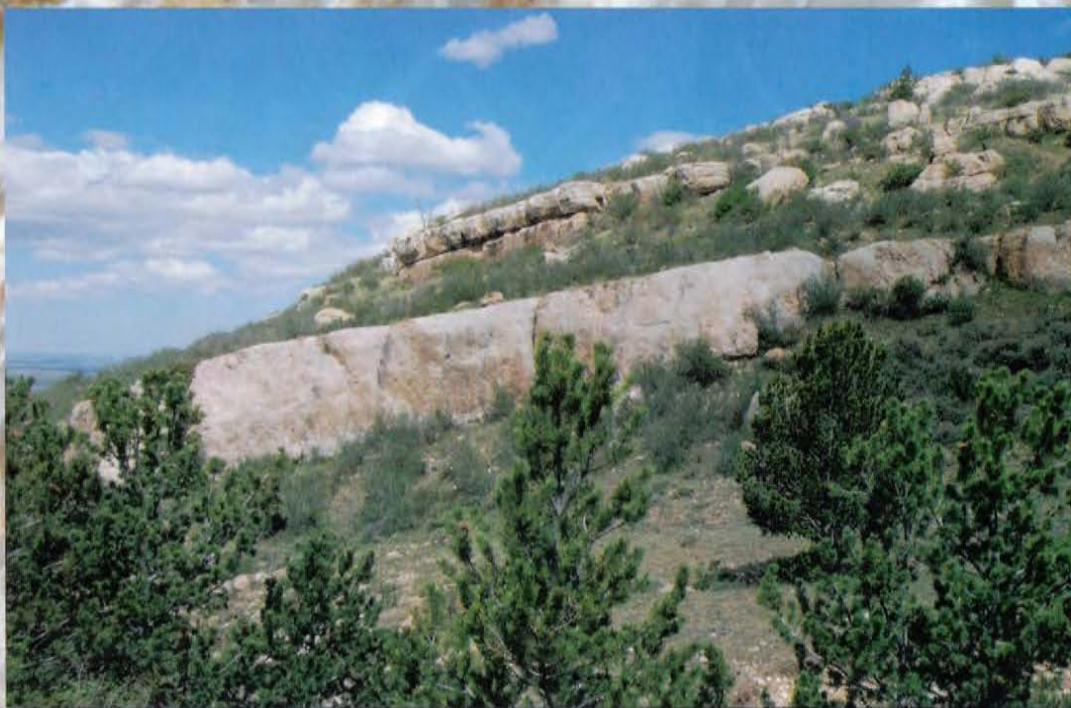




**Wyoming State Geological Survey
Lance Cook, State Geologist**

Decorative stones of southern Wyoming

**by
Ray E. Harris**



**Public Information Circular No. 42
2003
Laramie, Wyoming**

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Front Cover: Outcrop of limestone beds in the Casper Formation (Permian and Pennsylvanian) at the Morris Ranch limestone quarry site (see page 19). The lower beige limestone in center of photograph is 25 to 30 feet thick overlain by 10 to 15 feet of pinkish limestone. This area is about 15 miles north-northeast of Laramie on the west flank of the Laramie Mountains. Background for cover is a polished surface of the Grant Ranch marble (see page 15).

WYOMING STATE GEOLOGICAL SURVEY
Lance Cook, State Geologist

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Ray E. Harris



Laramie, Wyoming
2003

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ABSTRACT

Wyoming's geologic history has produced a wide variety of rocks exposed at the surface today. For this reason, southern Wyoming exhibits a high potential for developing decorative and dimensional stone resources. With the exception of the Medicine Bow Mountains and Sierra Madre, elevations in southern Wyoming range from under 5000 feet in the north-eastern part of this study area to under 9000 feet. At these elevations there are relatively long periods of favorable weather during which stone could be quarried.

Precambrian rocks exposed in the Laramie and Medicine Bow mountains, Sierra Madre, Rawlins uplift, and the Saratoga Valley contain most of the potential decorative stone sites in this report. These rocks are granites and related igneous rocks, marble or dolomitic marble, gneisses and other metamorphic rocks, quartzite, and basalt. Quarry sites in other areas are mostly sedimentary rocks: limestone, sandstone,

and baked and fused shale. The exceptions are volcanic rocks in the Leucite Hills northeast of Rock Springs and in the Horse Mountain area near Baggs.

The study area includes that part of Wyoming south of 42° North latitude and west of 105° West longitude. This report was financed by a grant from Anadarko Petroleum Company; it was initiated by Union Pacific Resources. Anadarko Petroleum bought mineral rights from Union Pacific Resources while the author was performing field work on the grant. Quarry sites identified include not only those where the mineral rights are owned by Anadarko Petroleum, but also sites where the mineral rights are owned by the federal government (administered by both the U.S. Bureau of Land Management and the U.S. Forest Service), the State of Wyoming (administered by the Wyoming Office of State Lands and Investments), and other private mineral owners.

INTRODUCTION

Purpose and scope

The purpose of this report is to describe outcrops of decorative and dimensional stone that could be quarried in southern Wyoming and to promote their economic development. Outcrops were selected on the basis of adequate joint spacing (in the case of dimensional stone), color, access, lack of detrimental minerals, and in some cases, the absence of obvious environmental constraints. The 60 sites included in this study are primarily for dimensional stone, but sites for decorative aggregate, monumental stone, flagstone, and combinations of the above are also included.

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Definitions

Few standard definitions have been established for the dimensional and decorative stone realm. Even within the industry, different regions have their own unique terminology. The following summarizes these definitions and in some cases, attempts to establish definitions applicable to the entire industry.

Stone and product definitions

Dimensional stone is defined as "stone that is finished to specific dimensions and shapes" (Power,

1994), and "Building stone that is quarried and prepared in regularly shaped blocks according to specifications" (Bates and Jackson, 1987). However, there are a variety of definitions used by the stone industry. Some industry groups (particularly the Italian stone industry) restrict the definition of *dimensional stone* to stone that can be quarried into large blocks, usually measuring 10 feet x 5 feet x 5 feet, as opposed to stone that can be quarried only in smaller blocks, which is called *monumental stone* (Alfonso Bertoni, personal communication, 1997). Other related, common usage terms refer to stone cut into blocks of specific dimensions less than 10 feet x 5 feet x 5 feet and not quarried specifically for monuments as *cut-to-size*. In this usage, monumental stone is restricted to stone cut for use in monuments (e.g., gravestones, stone historical monuments, engraved cornerstones, etc.).

As used in this report, *dimensional stone* follows Power's (1994) definition, which includes large blocks and other sizes. *Monumental stone* refers to dimensional stone quarried specifically for use in monuments. *Cut-to-size* includes all types of dimensional stone blocks other than slab or tile, whether sawed into blocks, split, or otherwise fabricated. Curbs, stone trim, ashlar, quoins, keystones, sills, steps, treads, risers, mantles, coping, hearthstone, and other similarly used dimensional stone are all in the category of cut-to-size.

Ashlar is "a rectangular block of hewn stone used for building purposes" (WordNet® 1.6, ©1997 Princeton University) in which the blocks exhibit a significantly greater horizontal than vertical dimension.

Quoins are "Any of the stones used in forming an exterior angle of a wall or other piece of masonry, often being of large size and dressed or arranged so as to form a decorative contrast with the adjoining walls" (Pickett and others, 2000). Other unusual pieces, such as long narrow blocks that are cut to be formed into columns, can come under the term cut-to-size or they can be called specialty blocks.

Slab is stone cut from large blocks into pieces measuring roughly 10 feet x 5 feet x approximately 5/8 inch, and finished either by polishing, honing, or flaming. Slab is usually finished by trimming to rectangular pieces measuring 8 feet x 4 feet x 5/8 inch.

Tile is stone cut to 1 foot x 1 foot x approximately 3/8 inch and finished by polishing, honing, or flaming. Stone is *polished* to desired degrees of shine using

polishing equipment. Stone is *honed* using grinding equipment to produce a dull, slightly rough surface. Honed stone is usually preferred for flooring where traction is desired. Some stone can also be *flamed* to produce a particularly rough surface. Flaming sometimes changes the color of the stone.

Rock type definitions

The rock type definitions used in the stone industry vary (sometimes widely) from the strict geologic definitions. Geologic rock type definitions are available from a number of references (e.g., Thrush and the staff of the Bureau of Mines, 1968; Bates and Jackson, 1987) and will not be presented here.

Granite

In the stone industry, the term *granite* refers to a variety of igneous and metamorphic rocks defined more or less by their hardness. *Granite* includes all rock types considered "hard" other than greenstone, most quartzite, and traprock or basalt. To the stone quarrier or fabricator, hardness is relative, but is related to the types of saws or other equipment necessary to cut and polish the stone.

Marble

In the stone industry, *marble* refers to a variety of rocks again defined more or less by their hardness. *Marble* includes all rock types considered "soft" other than limestone and soapstone (or talc). Serpentine, a siliceous metamorphic rock, is marble to the stone producer. Geologically, marble is calcium carbonate (CaCO_3) with interlocking grains, thought to be formed by metamorphism of limestone.

Sandstone

In the stone producers world, *sandstone* is defined as a "sedimentary rock composed mostly of mineral and rock fragments within the sand size range..." (Power, 1994), which seems to agree with the geologic definition. Sandstones are rarely capable of taking a polish, though some indurated sandstones do. However, sandstones are used as dimensional stone, fieldstone, flagstone, and rubble.

Quartzite

To stone producers, *quartzite* is a rock that can fall within the granite category, but can also be a category by itself. *Quartzite* refers to rocks with a high percentage of quartz, usually over 90%, and can be either sedimentary or metamorphic. Quartzites are

usually extremely hard, sometimes brittle, and require special preparation.

Greenstone

Greenstone is a "...metamorphic rock containing 'one or more of the following minerals: chlorite, epidote, or actinolite' (ASTM designation C119-90). It is derived by metamorphism of basalt, diabase, or other mafic igneous rocks" (Power, 1994).

Traprock or basalt

Basalt is a "...microcrystalline volcanic rock composed of pyroxene and calcic plagioclase. Traprock is a common term for dike rock of the same composition" (Power, 1994). In the stone industry, fine-grained rocks of dark color resembling basalt are called *traprock* or *basalt* regardless of their composition.

Limestone

Limestone is a rock of sedimentary origin composed of calcium carbonate (CaCO_3) (Power, 1994). To the stone industry, *limestone* also includes rocks geologically defined as dolomite. It is distinguished from marble sometimes by its crystallinity: limestones are noncrystalline, while marbles possess a degree of crystallinity. However the differences are slight, and some hard limestones are designated as marble.

Soapstone

Soapstone is a rock composed primarily of the mineral talc. Due to its softness, soapstone is primarily used as a carved ornamental stone.

Quarrying decorative stone

Stone is removed from a deposit by quarrying. There are many methods of quarrying in use, depending on the type of rock, willingness of the operator to invest in equipment, the layout and characteristics of the deposit, and the experience of the operator with a particular method. Dimensional stone quarries are almost always open pit operations; some exceptions include underground marble quarries in Italy and the underground marble quarry in Pitkin County, Colorado.

In all surface methods of quarrying, the removal of waste rock to establish a face or free side from which future blocks may be removed is essential. Quarrying dimensional stone is unlike other mine and quarry operations because each deposit is unique regarding the stone's variability, geometry, fracture and vein spacing and frequency, and the inhomogeneity of the

stone. All of these factors are to be considered by the quarry master in designing the quarry for maximum production. In addition, since large joint-free deposits are uncommon, the orientation of the quarry parallels the primary joint orientation.

The least expensive method of stone quarrying exploits the natural jointing of the rock by driving wedges into the joints, either by hand or by mechanical driving equipment. This method works only on stone with consistent joint spacing that is the desired width, namely joint sets nearly 10 feet apart. A second joint set perpendicular to the first and spaced 5 feet apart, results in blocks 10 feet x 5 feet x 5 feet, or smaller monumental blocks.

Another quarrying method involves drilling fairly wide-spaced holes along the line of the edge of the desired block, adding black powder or other light explosive to the holes, and blasting the block free. This method is often used when one set of favorable jointing is present, but not the second. However, the force of the blast risks inducing fractures into the blocks. A variety of slow-expanding explosive can be used, which lessens the chance of fracturing, but it is more expensive. Only certain kinds of rocks resistant to fracturing are quarried using light explosives. "Soft" rocks like marble, limestone, and sandstone should not be quarried with explosives.

Some large quarries use a method of continuous drilling to remove blocks. A piece of equipment that consists of a number of one-inch-diameter drills spaced one inch apart, traveling on a track, is used to drill a series of holes an inch apart along the edge of the desired block. After completing the desired length of the block, the drill machine is reversed, and it automatically drills out the intervening one-inch of rock not drilled in the first pass, completely freeing the block.

Blocks may be cut from the face of the quarry by a variety of saws. This method works particularly well in marble and limestone but may also be used in harder rocks such as granite. Wireline saws can be routed through drill holes and drawn towards the face, cutting the block out of the face. This method does result in less waste. Other saws include very large chain saws tipped with stonecutting bits which are also used to cut blocks out of the face.

In some quarries, a specially designed torch powered by kerosene or similar fuel is used to cut through the rock. The flame heats the rock and breaks it up by

creating differential expansion of different minerals, flaking the pieces off. It does not work in stone that melts or does not fracture at the point of heating. This method has the drawback of being very noisy. It is most commonly used to trim blocks quarried by other methods.

Recent advances in quarrying technology have produced some innovative methods of quarrying. High-pressure water jets, which create a pressure of 10,000 pounds per square inch at the point of application on the rock, have been used to cut rock from the quarry face. Laser technology has been similarly used, though it has not seen wide application to date, probably due to the cost of laser projecting equipment.

The cost of quarrying is highly variable. One of the most important variables is the amount of waste (locally called grout). Some high-value stones (e.g., blue pearl) can be produced at a total profit even if only 5% of the material leaves the quarry in blocks. Lower-priced material (e.g., beige granite) requires a block-to-waste ratio of 8:2 to be profitable. Blocks can be worth from less than \$100 to more than \$5000 at the quarry mouth, depending on rock type (granites are higher priced than marbles, which are more valuable than limestones) and aesthetics such as color, pleasing texture, sparkle, etc.

Fabricating decorative stone

Fabricating is the process of producing slab, tile, or other items from the quarry blocks. In some cases, fabrication also includes the production of the final product, such as counter tops.

Quarry blocks are usually transported to a fabricating plant nearby. Transportation is expensive—the 2000 average cost was about \$1.10 per ton per mile for a non-contracted hauler in Wyoming (Lock Trucking, Wheatland, Wyoming, personal communication, 2001). The cost is less for company-owned transportation or a contracted hauler. Large quarry blocks weigh 20 tons or more apiece, so the cost to transport one block to a plant just 10 miles away may add \$220 to the cost of production. At some localities, particularly at very large or very small quarries, fabricating plants or portable, temporary operations are constructed at the quarry site.

Dimensional, monumental, and cut-to-size stone is usually sawn into the desired product. Saws include large circular saws, wireline saws (**Figure 1**), and gang saws, which have multiple-bladed saws that can



Figure 1. Wireline saw used at Strid Marble and Granite's fabricating plant in Cheyenne. Note movable trolley. Height of this saw is about 15 feet.

be set to the desired width for the desired product. Single-bladed saws are often mechanically controlled and computer-guided for multiple cuts. Circular saws are movable, and cut a stationary block. Wireline saws are stationary and cut a block on a movable trolley. Gang saws are fixed and cut a block on a movable trolley pushed through the saw.

Fabricating plants also include splitting equipment to split stone into the desired size. Split-face stone is split into a rough or semi-rough surface. These blocks are most often used as facing and trim on structures (**Figure 2**) or interior trim, such as fireplaces.

The product of the sawing operation is rough-cut slab, tile, or other products such as gravestone blanks. Cut material is squared if desired using smaller, often circular saws called trim saws. Some pieces like grave-



Figure 2. The S.H. Knight Geology Building on the campus of the University of Wyoming is faced with split-face stone, some of which was quarried locally; the trim around the windows is Indiana limestone.

stones may be squared by splitting, producing rough edges around the sides.

Cut and sometimes squared pieces go to a polishing, honing, or flaming process to produce the desired surface. Slab is usually polished without being squared. The final product of these plants is usually finished tile, monument blanks, and polished slab. Sometimes slab is cut to final products measuring 4 feet x 8 feet. Finished slab is used on building exterior and interior walls and other items; tile is used on walls, flooring, counters, and other applications; and cut-to-size pieces are prepared for the applications listed above.

Unfinished slab is often sold to wholesalers who sell slab to smaller fabricators, who then produce specific items such as counter tops, tabletops, and other items. Transporting these slabs to the wholesaler increases the cost. The final fabricators use smaller saws or water-jet equipment to cut pieces to customer specifications. Based on 2003 market prices, finished tile and slab retails from \$1.75 per square foot (for low-end limestone flooring, etc.) to over \$120.00 per square foot for the iridescent and rare colors, usually blue, black, and green.

Decorative aggregate production

Decorative aggregate is usually selected because of its color or appearance, though the rock must also meet other specifications including size and dimensional distribution (length to width to height ratio), resistance to wear, specific gravity, and mineralogy (Herrick, 1994). Decorative aggregate is usually crushed stone, but river rock (natural gravel) is also used for decoration. Decorative aggregate has many uses, including landscape rock, roofing granules or particles, and as colored aggregate in concrete

exposed-aggregate facing. Some very finely sized colored rock is used as pigment; for example, fine white marble from Imerys Marble's plant in Wheatland, Wyoming has been used as the coloring agent in PVC pipe.

Decorative aggregate is usually quarried by blasting and sized on site to specifications. Sometimes large pieces from the quarry are shipped to a processing plant for final crushing, sizing, and bagging. Transportation does increase the production costs at the same rates mentioned above for dimensional stone. River rock used as decorative aggregate is sized on site. The sized rock is shipped to wholesalers or retailers, either in bags or bulk.

Other types of decorative stone

Fieldstone is unshaped natural stone gathered from the surface (Power, 1994) that is not used as aggregate. Some types of fieldstone include moss rock and flagstone. Fieldstone is used on exterior or interior walls and trim and on fireplaces.

Flagstone consists of thin slabs of stone used as paving (Power, 1994). Flagstone can be a subclass of fieldstone, but it can also be quarried from a deposit, which is easily split into thin slabs. Flagstone used as paving must meet some specific criteria, such as having a surface variability less than 1/2 inch.

Rubble consists of uncut pieces of broken stone. Most rubble comes from dimensional stone or aggregate waste. It is used primarily for exterior and occasionally interior walls and fireplaces. It is defined as random-shaped pieces of similar or variable size, set into the surface with mortar in random patterns (Power, 1994). Rubble is usually low-cost stone used near the source.

SITE DESCRIPTIONS

This report describes 60 separate decorative stone sites located in five areas and seven counties in southern Wyoming (**Figure 3**). Sites were located using a global positioning system (GPS) unit, and were plotted on the index map as well as on most of the individual site maps using GIS technology. The largest number of sites (31) are in the Laramie Mountains of Albany, Platte, and Laramie counties; six sites are in the Medicine Bow Mountains of Albany and Carbon counties; nine sites are in the Sierra Madre and Saratoga Valley area of Carbon County; and eight sites are in southwestern Wyoming, Sweetwater, Lincoln, and Uinta counties.

Each described site contains a legal location description, land and mineral ownership, the U.S. Geological Survey (USGS) 7 1/2-minute (1:24,000-scale) quadrangle(s) for the site, and a description of the geology and other features. For most sites, topographic maps are included with the quarry sites or primary areas of interest (such as outcrops or occurrences) plotted on them. Where available, a photograph shows the quarry site or area from the ground

and where available, a photograph of a polished section or a hand sample of the rock is provided.

The conventions used in the legal descriptions for parts of a section include NE, NW, SE, or SW for the quarter sections, e.g., SE section 15. Combinations of the above depict further subdivisions of a section, e.g., SW SE section 21 indicates the southwest quarter of the southeast quarter of section 21; and NW SW SE section indicates the northwest quarter of the southwest quarter of the southeast quarter. N, S, E, and W indicate halves of a section or subdivision of a section, e.g., N section 24 indicates the north half of section 24; E W section 32 indicates the east half of the west half of section 32; and N NE SW section 19 indicates the north half of the northeast quarter of the southwest quarter of section 19. C indicates the center of a section or subdivision of a section, e.g., C SE section 32 indicates the center of the southeast quarter of section 32. Land and mineral ownership descriptions follow the same order presented in the legal descriptions but without listing the townships and ranges.

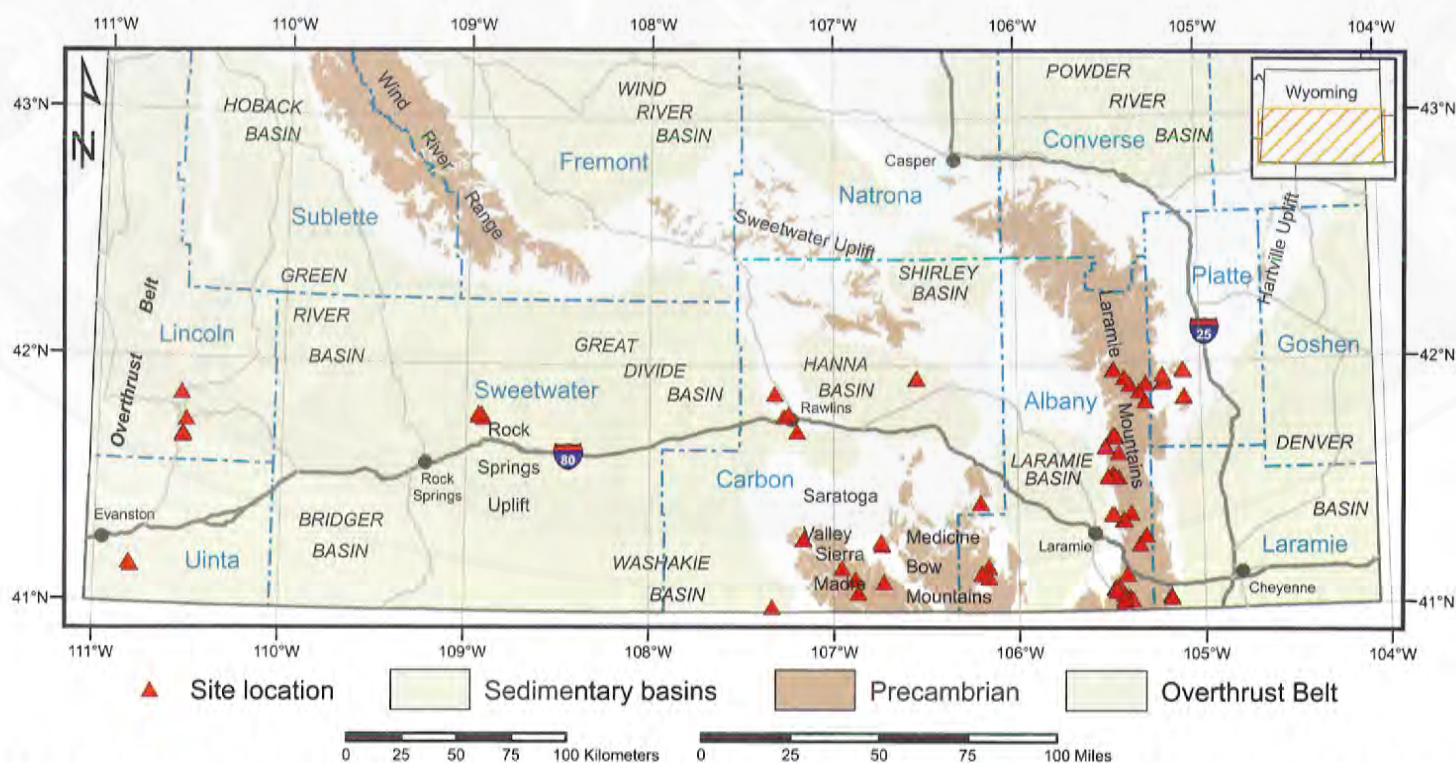


Figure 3. Index map to decorative stone sites in southern Wyoming in relation to major geologic features. Symbol for site locations may represent more than one site. Index map modified from De Bruin, 2002.

Laramie Mountains area



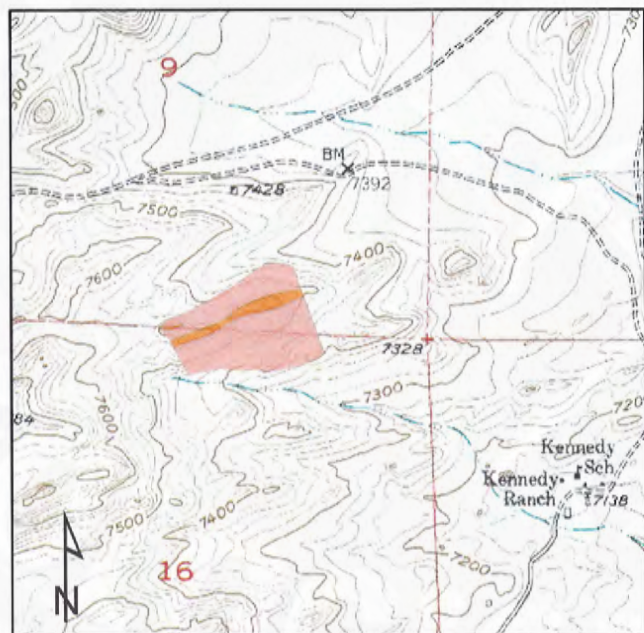
Raven Quarries–Wyoming Raven®

Location: SW SE section 9, NW NE section 16, T23N, R72W, Albany County, Wyoming (**Figure 4**).

USGS 7 1/2-minute Quadrangle(s): Bull Camp Peak.

Land and mineral ownership/status: Federal minerals, private surface (section 9); state surface and minerals (section 16). Leased to Raven Quarries, LLC.

Description: This was an active quarry (**Figure 5**) from 1998 to 2003 that produced both Wyoming Raven® and Mirage® (described below). Raven Quarries, LLC., ceased operations in February, 2003. Wyoming Raven® is a black granite (Figure 6), geologically an amphibolite.



Mirage®
 Wyoming Raven®

0 0.25 0.5 0.75 1 Mile

0 0.25 0.5 0.75 1 Kilometer

Figure 4. Location map of quarry that was operated by Raven Quarries, LLC., where both Wyoming Raven® and Mirage® were produced.



Figure 5. Formerly active quarry for Wyoming Raven®. Person in center of photograph for scale.



Figure 6. Polished 24 inch by 12 inch "slab" of Wyoming Raven®. Engineering scale is about 12 inches long.

Raven Quarries–Mirage®

Location: SW SE section 9, NW NE section 16, T23N, R72W, Albany County, Wyoming (**Figure 4**).

USGS 7 1/2-minute Quadrangle(s): Bull Camp Peak.

Land and mineral ownership/status: Federal minerals, private surface (section 9); state surface and minerals (section 16). Leased to Raven Quarries, LLC.



Figure 7. Formerly active quarry for Mirage® granite. These blocks were cut into slab and polished.

Description: This is a formerly active quarry (**Figure 7**), where both Wyoming Raven® and Mirage® were produced. Mirage® is a swirled and patterned variable granite (**Figure 8**), geologically a migmatite. More Mirage® has been quarried from this site than the black Wyoming Raven®.



Figure 8. Polished slab of Mirage® from Raven Quarries, LLC. This slab is 5 feet high, 10 feet long, and 5/8 inch thick.

Elmers Rock foliated gneissic granite

Location: W NE and E NW section 25, T23N, R72W, Albany County, Wyoming (**Figure 9**).

USGS 7 1/2-minute Quadrangle(s): Bull Camp Peak.

Land and mineral ownership/status: SE NW section 25 is federal [administered by the U.S. Bureau of Land Management (BLM)] surface and minerals. Remainder of site is private surface and minerals.

Description: Massive beige gneissic granite outcrops with joint spacing in excess of 10 feet (**Figure 10**) are found in this area. Locally, exfoliation joints (parallel to exposed surfaces) are spaced less than 10 feet. The rock is slightly foliated, but does exhibit differences depending on the orientation of the cut. The color is warm beige (**Figure 11**) and the site is adjacent to Tunnel Road, maintained by Albany County.

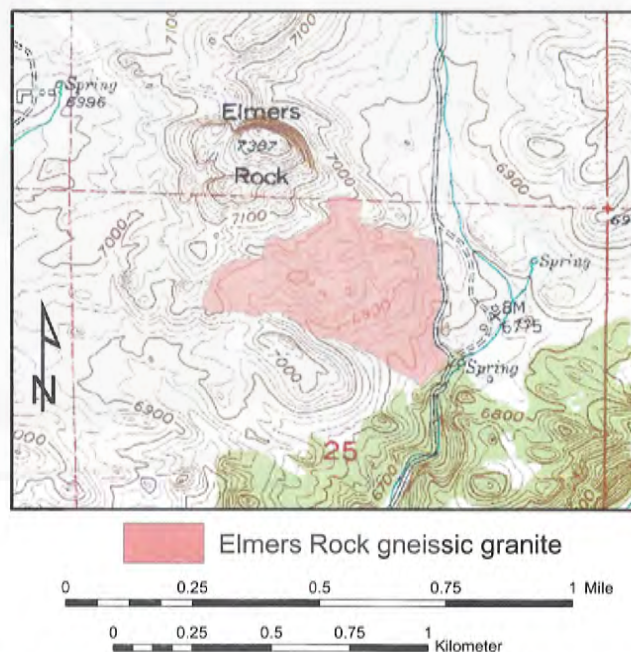


Figure 9. Location map of Elmers Rock gneissic granite quarry site. Road on east side of site is the Tunnel Road.



Figure 10. An outcrop of Elmers Rock gneissic granite along Tunnel Road.

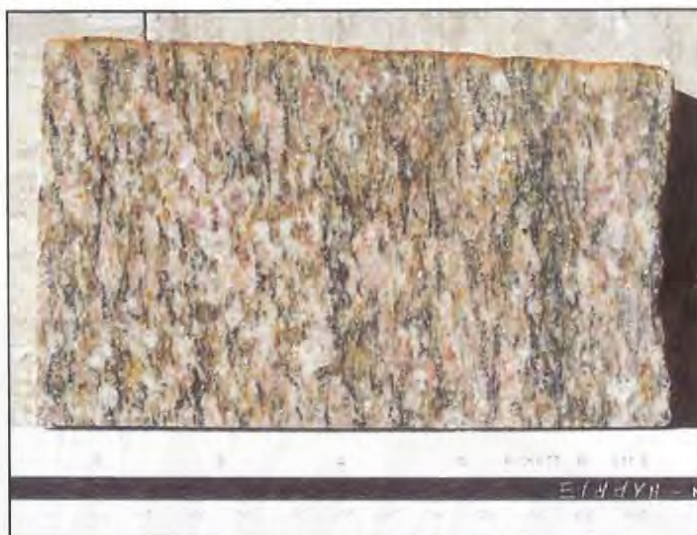


Figure 11. Polished sample of Elmers Rock gneissic granite showing foliation. Upper scale is inches, lower scale is centimeters.



Tunnel Road green quartzite flagstone

Location: SW SE section 36, T23N, R71W, Albany County, Wyoming (**Figure 12**).

USGS 7 1/2-minute Quadrangle(s): Moonshine Peak.

Land and mineral ownership/status: State surface and minerals.

Description: This bright green quartzite that breaks into flagstone (**Figure 13**) crops out in a narrow band trending northeast to southwest (**Figure 12**) and dips northwest nearly vertical. The resource is small but useful for applications such as flagstone for interior trim and fireplaces. The rock on either side of the green quartzite outcrop is a light silvery micaceous quartzite flagstone.

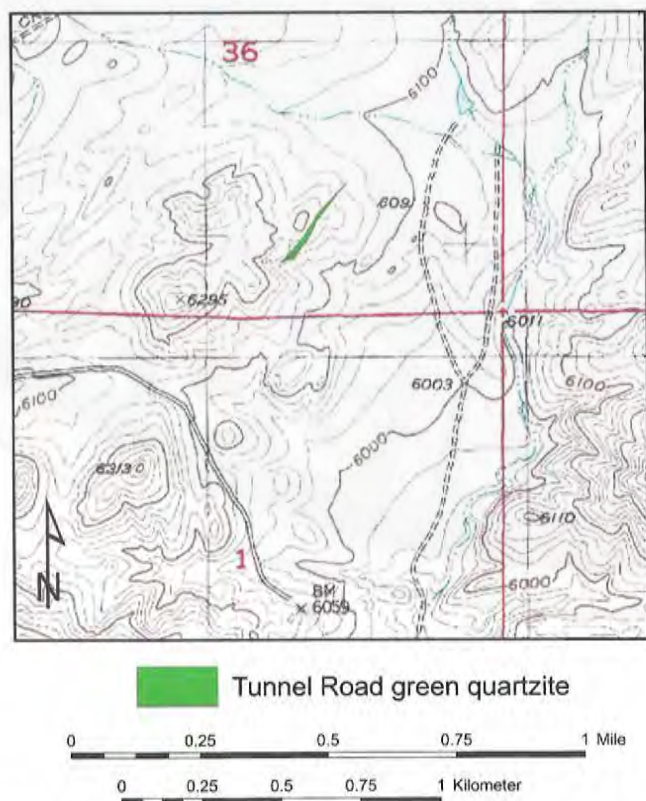


Figure 12. Location map of green quartzite outcrop near Tunnel Road.



Figure 13. Polished sample of Tunnel Road green quartzite (scale in inches).

Picnic Rock pink granite

Location: Mostly in SW NE and NW SE section 23, T23N, R70W, Platte County, Wyoming (**Figure 14**).

USGS 7 1/2-minute Quadrangle(s): Squaw Rock.

Land and mineral ownership/status: Private surface and minerals.

Description: This site contains massive outcrops of a medium-grained pink and gray granite with 1/4 to 3/4 inch-diameter pink feldspar phenocrysts. Joints are spaced 10 feet apart in an east-west direction, and greater than 40 feet apart in a north-south direction. The site is accessible by primitive two track roads; some road development will be needed to utilize this site. No photographs of the outcrop or polished samples were available for this site.

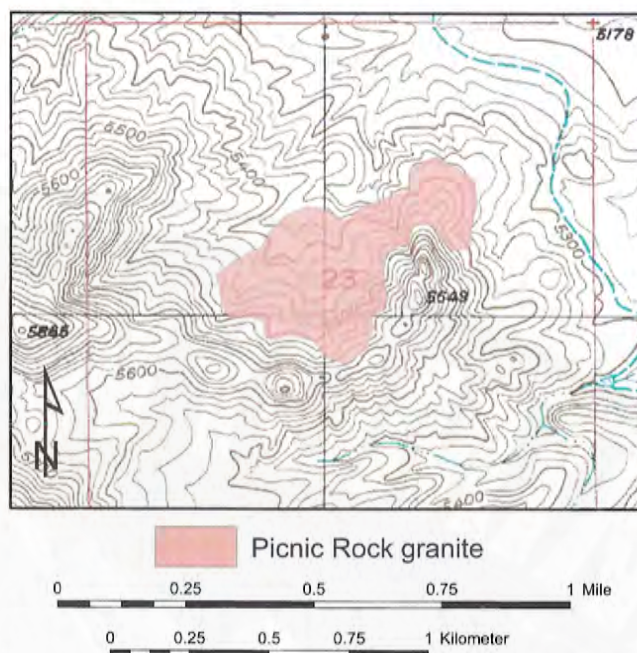


Figure 14. Location map of the Picnic Rock granite site.

Squaw Mountain granite

Location: N, NE SW, and W NW SE section 35; W NW section 36, T23N, R70W, Platte County, Wyoming (**Figure 15**).

USGS 7 1/2-minute Quadrangle(s): Squaw Rock.

Land and mineral ownership/status: Private surface, private and federal minerals (section 35); state surface and minerals (section 36).

Description: This area is underlain by a beige to gray, medium-grained granite containing grayish feldspar phenocrysts from 1/4 to 1 inch across (**Figure 16**). Three separate quarry sites are identified in this area (**Figure 15**). Quarry site 1 (**Figure 17**) has no joints and only infrequent quartz-feldspar veins 1/16 inch or less in width. Quarry site 2 (**Figure 18**) has joints varying from 5 to 8 feet apart. Quarry site 3 (not shown) has widely spaced jointing from 5 to 10 feet, but the area is less exposed than sites 1 and 2.

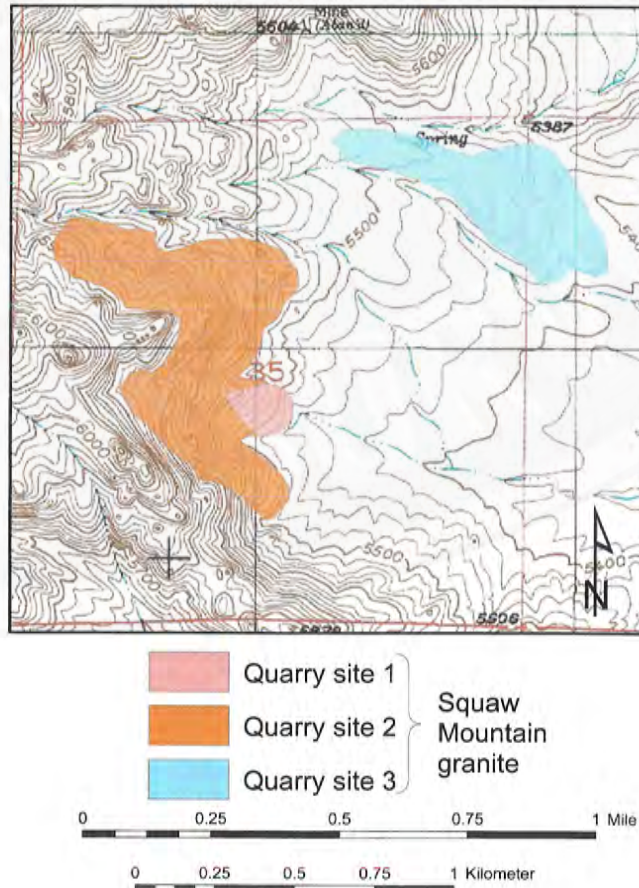


Figure 15. (Right) Location map of three quarry sites for the Squaw Mountain granite.

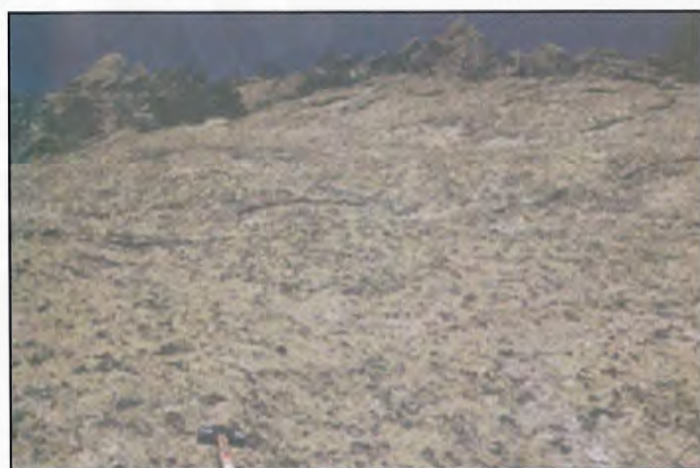
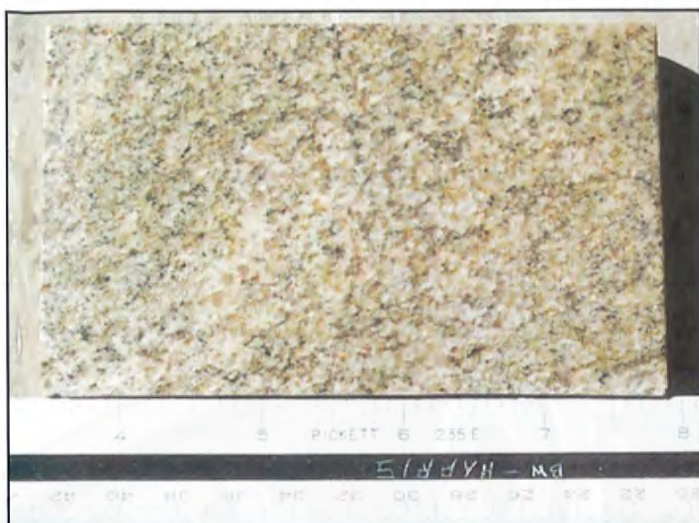


Figure 16. (Upper left) Polished sample of the Squaw Mountain granite. Sample is typical of all three described quarry sites. Upper scale is inches, lower scale is centimeters.

Figure 17. (Left) Quarry site 1 for the Squaw Mountain granite.

Figure 18. (Above) Quarry site 2 for the Squaw Mountain granite.

Two Bar beige granite

Location: SW section 11; NW, NE SW, and NW SE section 14, T23N, R69W, Platte County, Wyoming (**Figure 19**).

USGS 7 1/2-minute Quadrangle(s): Natwick.

Land and mineral ownership/status: Private surface and minerals (S SW section 11; NE NW, NE SW, and NW SE section 14); State surface and minerals (W NW and SE NW section 14).

Description: Medium-grained, grayish granite with a yellowish tint, which produces a beige granite (**Figure 20**). The quarry site in C section 14 contains joint spacing from 3 to 6 feet at the surface and has been permitted for aggregate. There are also widely spaced vertical mafic dikes in the area, comprising approximately 2% of the outcrop area.

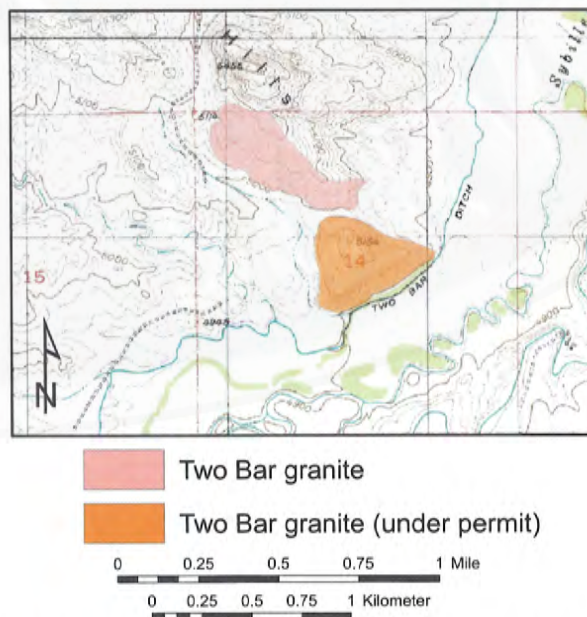


Figure 19. Location map of the Two Bar beige granite with a proposed quarry site and a permitted aggregate site.

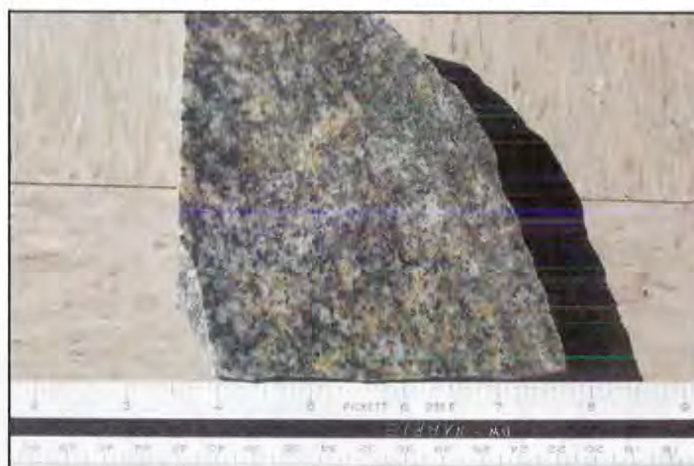


Figure 20. (Left) Polished sample of the Two Bar beige granite. Upper scale is inches, lower scale is centimeters.



Bluegrass blue-gray marble

Location: NW NW section 5, NE NE section 6, T22N, R71W, Albany County, Wyoming (**Figure 21**).

USGS 7 1/2-minute Quadrangle(s): Bull Camp Peak.

Land and mineral ownership/status: Private surface (Bluegrass Ranch), federal minerals.

Description: Light bluish-gray marble crops out in an irregular pattern in this area (**Figure 22**). Fracture spacing at the surface is 4 feet or less, and most marbles in this area exhibit closely spaced fractures at the surface due to weathering. The marbles are fractureless at depth. This marble is quite attractive when polished (**Figure 23**).

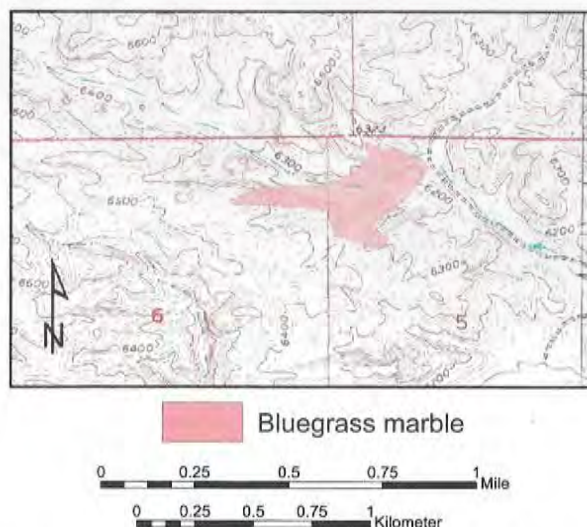


Figure 21. Location map of Bluegrass marble outcrops.



Figure 22. Outcrop area of Bluegrass marble. The marble occurs in the light-colored area in the center of photograph.



Figure 23. Polished sample of Bluegrass marble. Upper scale is inches, lower scale is centimeters.

Flying X green quartzite

Location: NW NW NE section 15, T22N, R71W, Albany County, Wyoming (**Figure 24**).

USGS 7 1/2-minute Quadrangle(s): Moonshine Peak.

Land and mineral ownership/status: Private surface and minerals (Flying X Ranch).

Description: Bright green micaceous quartzite crops out in this location (**Figure 25**), and it has been quarried in the past. The green color is due to the chrome mica mineral known as fuchsite, which is distributed throughout the quartz matrix. The rock is fractured and folded, and the quartzite is suitable for smaller applications like desk sets or jewelry (**Figure 26**). It is the same rock as the Tunnel Road green quartzite (above) but does not split into flagstone.



Figure 25. Outcrop of Flying X green quartzite.

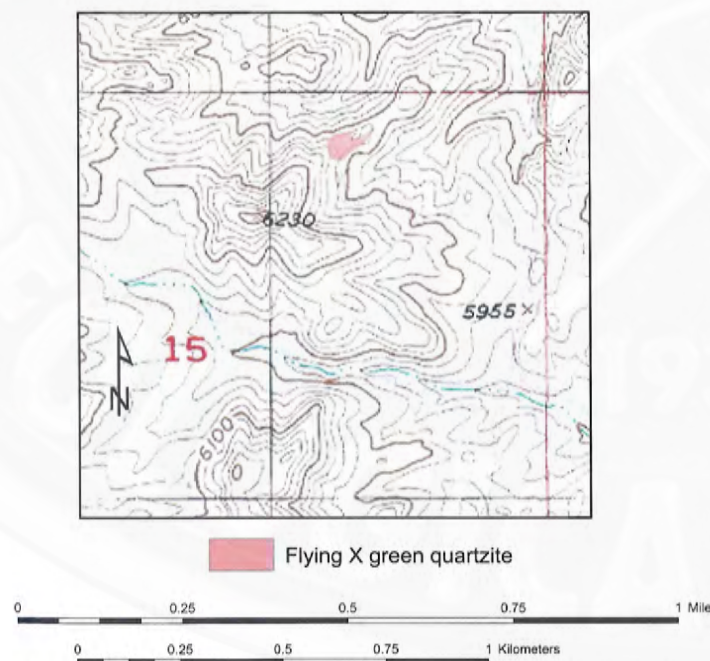


Figure 24. Location map of the Flying X green quartzite.



Figure 26. Polished sample of Flying X green quartzite. Upper scale is inches, lower scale is centimeters.



Red Mountain granite

Location: S section 25, NW and NW NE section 36, T22N, R71W, Albany County, Wyoming (**Figure 27**).

USGS 7 1/2-minute Quadrangle(s): Poe Mountain.

Land and mineral ownership/status: Private surface, federal minerals (section 25); state surface and minerals (section 36).

Description: Reddish-brown, medium-grained granite comprises most of the surface outcrop area (**Figure 28**). There are local areas in the northern part of the exposure where gray, medium-grained granite crops out. Joint spacings vary in the outcrop, ranging from 2 to 20 feet, with zones of closer-spaced joints. This granite exhibits a relatively homogeneous texture in polished hand specimens (**Figure 29**).

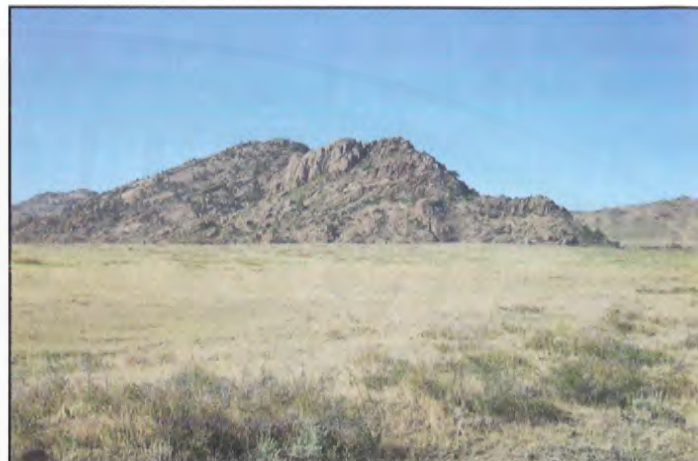


Figure 28. The Red Mountain granite quarry site.

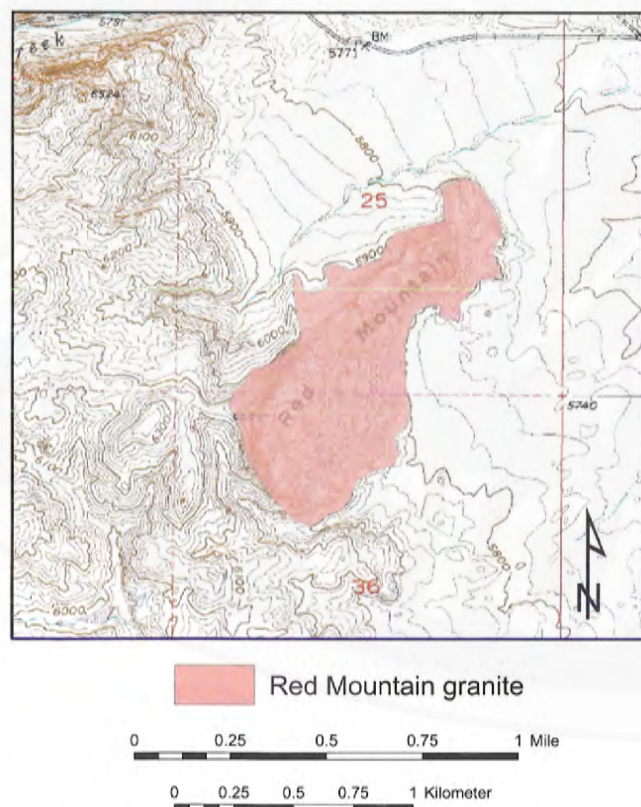


Figure 27. Location map of the Red Mountain granite quarry site and outcrop area.



Figure 29. Polished sample of Red Mountain granite. Upper scale is inches, lower scale is centimeters.



Grant Ranch marble

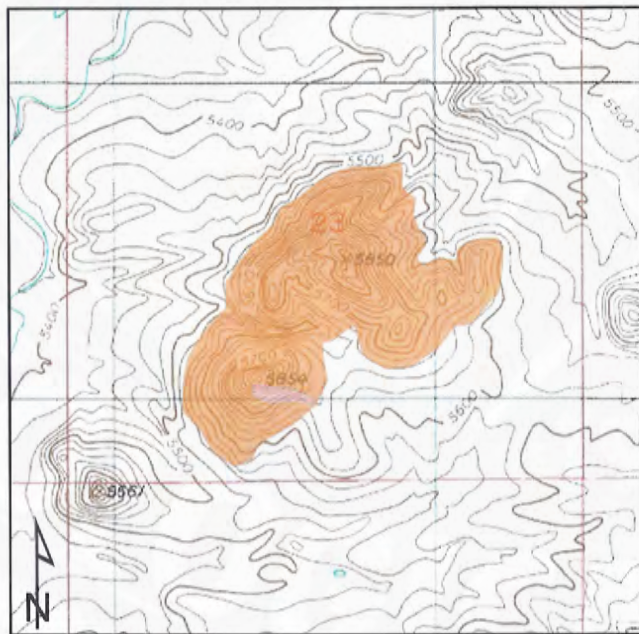
Location: W SE, NE SE, E SW, and SW NE section 23, T22N, R69W, Platte County, Wyoming (**Figure 30**).

USGS 7 1/2-minute Quadrangle(s): Richeau Hills.

Land and mineral ownership/status: Private surface (Grant Ranch), federal minerals.

Description: A large resource of marble crops out over a large area (**Figure 31**). The predominant color is a bluish-gray (**Figure 32** and **cover**), with some zones of pink. There is a small area of brown marble breccia in the southeastern area (**Figure 30**) of the outcrop. The bluish-gray marble is

brecciated in places and often contains a network of calcite veins. The surface weathering has produced 2-foot-spaced fractures and joints—some drilling may be necessary to determine joint spacing for quarrying. Part of this outcrop is under lease for the production of bluish-gray marble aggregate.



Brown marble breccia
 Light blue-gray marble

0 0.25 0.5 0.75 1 Mile
 0 0.25 0.5 0.75 1 Kilometer

Figure 30. Location map of Grant Ranch marble outcrops and areas of breccia.



Figure 31. Outcrop of the Grant Ranch marble.



Figure 32. Polished sample of the Grant Ranch marble; scale is inches.

Sybill Canyon Ubatuba

Location: W section 16, E section 17, T20N, R72W, Albany County, Wyoming (**Figure 33**).

USGS 7 1/2-minute Quadrangle(s): Sheep Rock.

Land and mineral ownership/status: State surface and minerals (section 16); private surface, Anadarko minerals (section 17).

Description: This area is underlain by a dark-colored syenite (with green, silver, and golden reflections) (**Figure 34**) that resembles some varieties of the Brazilian Ubatuba stone. In this area, the rock is fractured and weathered (**Figure 35**). However, four areas of outcrop where the fractures are less frequent have been identified as quarry sites 1

through 4 (**Figure 33**). In these areas, horizontal fractures are spaced from 4 to 5 feet at the surface and the spacing increases with depth. High angle fractures are spaced between 10 and 20 feet at the surface. The weathered horizon extends to 5 to 10 feet in depth in certain areas.

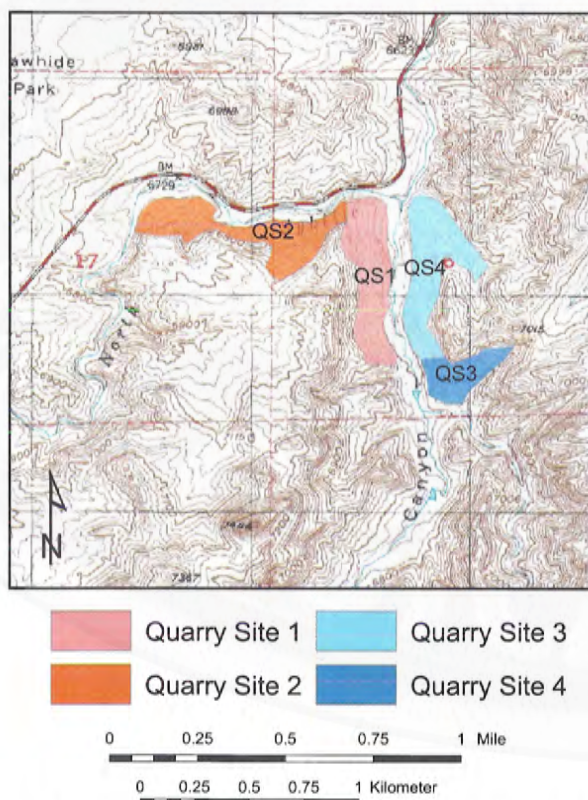


Figure 33. Location map of the Sybill Canyon Ubatuba quarry sites.



Figure 34. Polished sample of dark syenite, typical of that found in any of the four Sybill Canyon quarry sites.



Figure 35. Close up view of the Sybill Canyon Ubatuba syenite showing horizontal fracturing.

Plumbago Creek limestone

Location: E SE and SE NE section 36, T20N, R73W, Albany County, Wyoming (**Figure 36**).

USGS 7 1/2-minute Quadrangle(s): Sybille Springs.

Land and mineral ownership/status: State surface and minerals except for SE SE section 36. State land is leased to MKB Corporation (as of 2003). SE SE section 36 is privately owned surface and minerals. There is a sublease to VA Resources for limestone aggregate. VA has opened a quarry under a 10-acre mining permit in S NE SE section 36 (**Figure 36**).

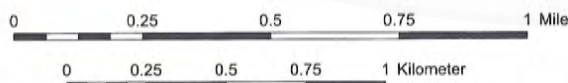
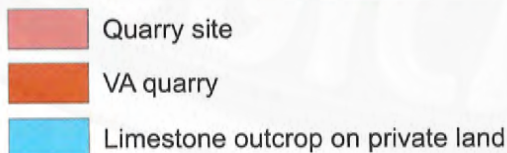
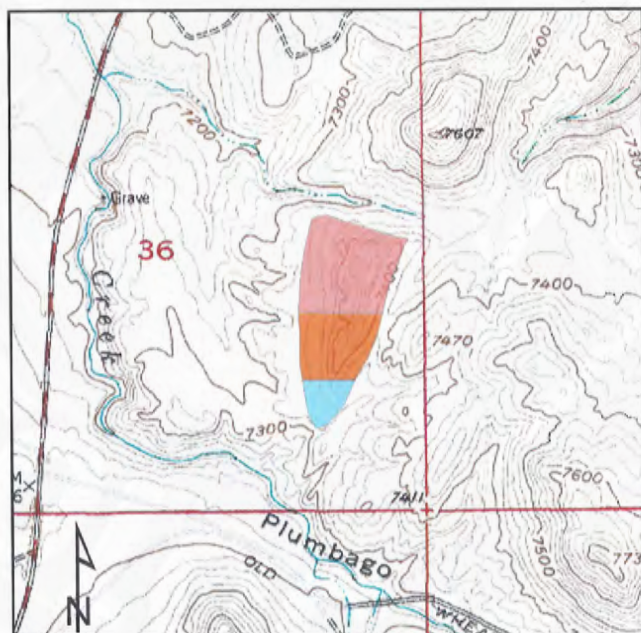


Figure 36. Location map and quarry sites for the Plumbago Creek limestone.

Description: The Plumbago Creek limestone is the lower limestone in the Permian-Pennsylvanian Casper Formation (**Figure 37**). The rock is a beige limestone containing orange-red veinlets (**Figure 38**).



Figure 37. Outcrop of the Plumbago Creek limestone.



Figure 38. Polished sample of veined limestone from Plumbago Creek. Sample is about 8 inches by 5 inches.

Road 12 anorthosite

Location: N and N S section 10, T19N, R72W, Albany County, Wyoming (**Figure 39**).

USGS 7 1/2-minute Quadrangle(s): Sheep Rock.

Land and mineral ownership/status: Federal (BLM) surface and minerals (N NW, NE NE, and NW SE section 10); remainder is private surface, federal minerals.

Description: This area (**Figure 40**) is underlain by a coarse-grained, medium-gray anorthosite (**Figure 41**). The fracture spacing is 4 feet both vertically and horizontally at the surface, greater than other areas in the anorthosite complex. Albany County Road 12 passes through the locality.



Figure 40. Outcrop of the Road 12 anorthosite.

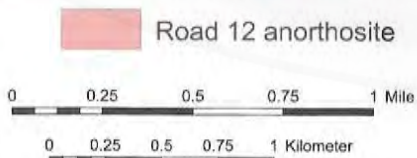
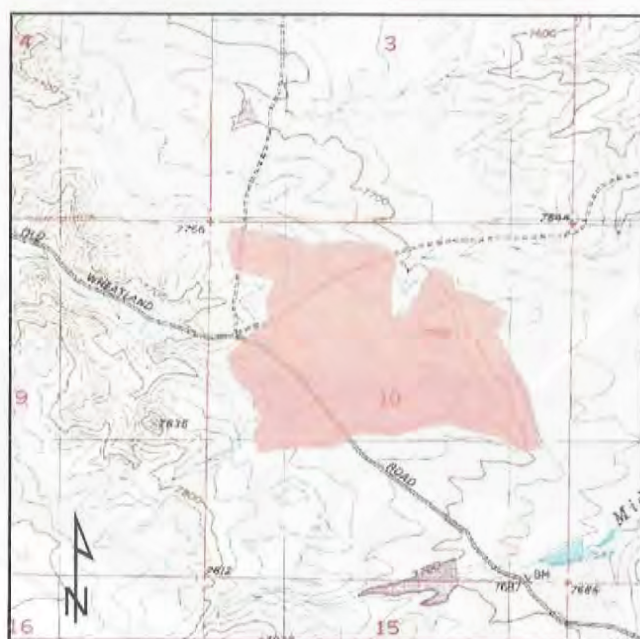


Figure 39. Location map of the Road 12 anorthosite quarry site.

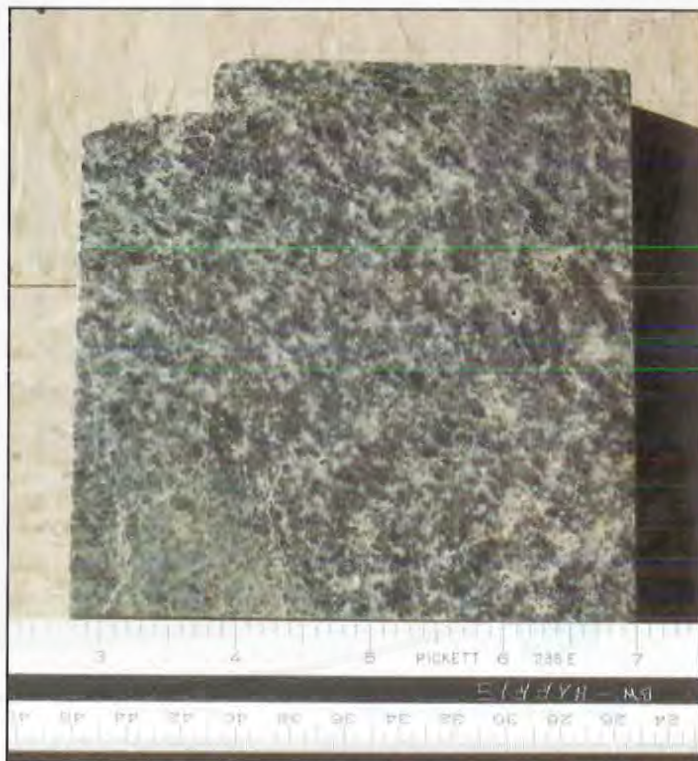


Figure 41. Polished sample of the Road 12 anorthosite. Upper scale is inches, lower scale is centimeters.

Morris Ranch limestone

Location: Western two-thirds of sections 7 and 18, T18N, R72W, Albany County, Wyoming (**Figure 42**).

USGS 7 1/2-minute Quadrangle(s): Bosler SE.

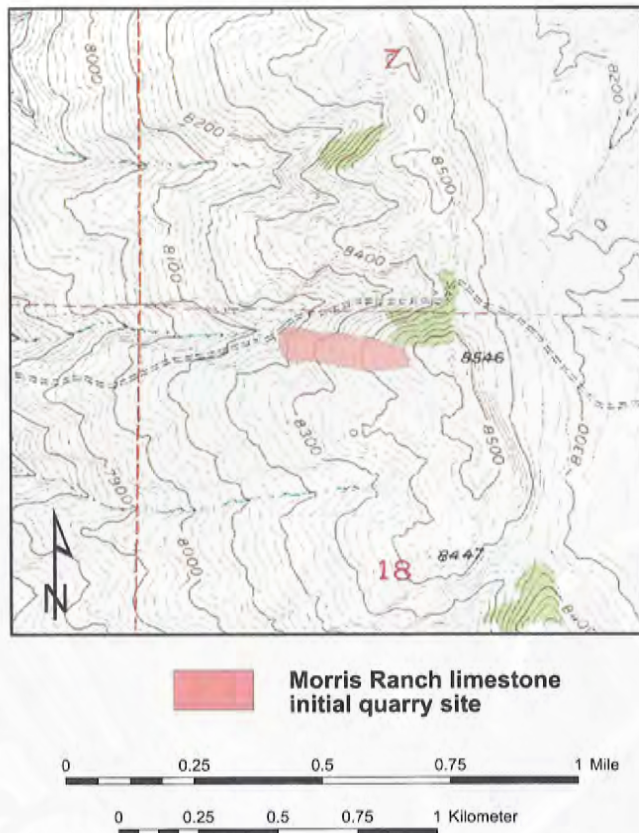


Figure 42. Location map of initial quarry site for the Morris Ranch limestone.

Land and mineral ownership/status: Private surface (Morris Ranch), Anadarko minerals (section 7); private surface (Morris Ranch), federal minerals (N section 18); federal (BLM) surface and minerals (S section 18).

Description: Limestone in the same zone of the Permian-Pennsylvanian Casper Formation at the Roger Canyon and Horse Creek sites (below) crops out extensively in this area (**Figure 43**). The most accessible site for quarrying is found in the N section 18, accessible by a graded private road. The site consists of an upper 10 to 15 feet of pinkish limestone underlain by 25 to 30 feet of light beige limestone. No polished or other samples were available.



Figure 43. Outcrop of the limestone bed in the Casper Formation at Morris Ranch limestone quarry site.

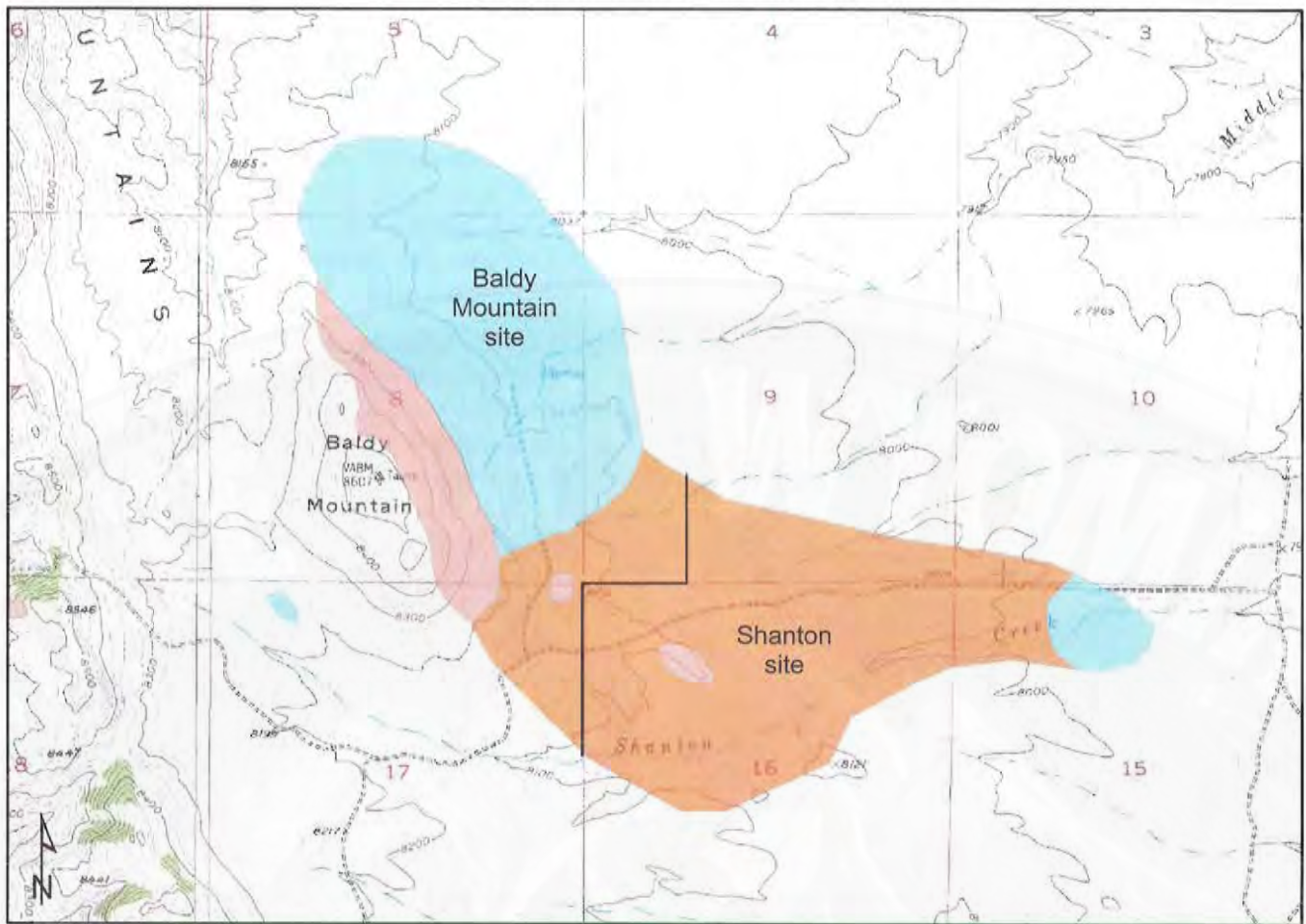
Baldy Mountain blue eyes anorthosite

Location: E section 8, S SE section 5, and NE section 17, T18N, R72W, Albany County, Wyoming (**Figure 44**).

USGS 7 1/2-minute Quadrangle(s): Baldy Mountain and Bosler SE.

Land and mineral ownership/status: Private surface (Morris Ranch), federal minerals under claims since the 1960s by the Twin Buttes Corporation (section 8); private surface (Morris Ranch), Anadarko minerals (sections 5 and 17).

Description: This extensive area is underlain by mostly gray anorthosite containing bright blue labradorite (**Figure 45**). The grain size varies between 1/4 and 3 inches. Some areas consist of dark anorthosite containing the blue labradorite, and have been dubbed "blubatuba" since the background resembles the Brazilian Ubatuba. See the close-up photograph of the blue anorthosite at the Shanton site, below. The joint spacing cannot be determined at the surface due to weathering and low relief, so a drilling program is necessary to determine whether or not the rock can be quarried.



- Interlayered blue eyes and red anorthosite
- Areas of possible blue eyes under cover
- Outcrop of blue eyes

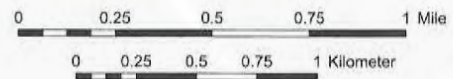


Figure 44. Location map of the Baldy Mountain and Shanton blue eyes anorthosite quarry sites.



Figure 45. Outcrop of the Baldy Mountain blue eyes anorthosite.



Shanton blue eyes anorthosite

Location: S SE and SE SW section 9; S SW SW section 10; N NW section 15; N, N SW, and NW NW SE section 16, T18N, R72W, Albany County, Wyoming (**Figure 44**).

USGS 7 1/2-minute Quadrangle(s): Baldy Mountain and Bosler SE.

Land and mineral ownership/status: Private surface, Anadarko minerals (section 9); private surface and minerals (section 10); private surface (Morris

Ranch), Anadarko minerals (section 15); State surface and minerals leased to Mike and Irene Bintner as of 2003 (section 16).

Description: An outcrop of coarse-grained, labradorite-bearing anorthosite (**Figures 46** and **47**) is found in section 15, with joints in excess of 20 feet and only minor exfoliation. Float and some small outcrops extend to the northwest and west. This outcrop may be continuous with the Baldy Mountain blue eyes area.



Figure 46. Outcrop of blue eyes anorthosite at the Shanton quarry site.



Figure 47. Close-up of the blue labradorite at the Shanton quarry site.



University Casper sandstone quarry

Location: NW NW section 5, T16N, R72W, Albany County, Wyoming (**Figure 48**).

USGS 7 1/2-minute Quadrangle(s): Howell and King Mountain.

Land and mineral ownership/status: Private surface (partly controlled by UW), Anadarko minerals.

Description: This is the quarry from which some of the sandstone used on buildings at the University of Wyoming (UW) was taken (see **Figure 2**). From the early 1930s to the early 1960s, a closely matching sandstone from the Weber Quarry

near Ogden, Utah was used at UW. The UW quarry closed in the late 1960s but some of the equipment remained on site into the early 1980s (**Figures 49** and **50**). Coincidentally, one of the last buildings on the UW campus to use this Casper sandstone was the Dan Miller Building (Wyoming State Geological Survey), completed in 1976. The rock is a limy sandstone in the Permian-Pennsylvanian Casper Formation. The sandstone consists of nearly 50% calcium carbonate and 50% sand grains, mostly quartz. This rock is also found along strike north of the quarry site on private land.

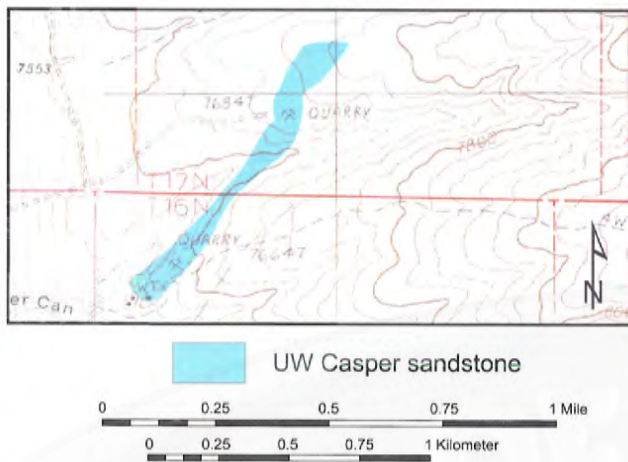


Figure 48. Location map of the University of Wyoming's Casper sandstone quarry.



Figure 49. The University of Wyoming's quarry in the Casper Formation, circa 1982. The equipment and buildings have since been removed.



Figure 50. The quarry face at the University of Wyoming's Casper sandstone quarry. Each lift is about 6 feet high.



Roger Canyon limestone

Location: NW SW section 4, T16N, R72W, Albany County, Wyoming (**Figure 51**).

USGS 7 1/2-minute Quadrangle(s): King Mountain.

Land and mineral ownership/status: Federal (BLM) surface and minerals.

Description: About 25 feet of light beige limestone overlain by 15 feet of pinkish limestone crops out on the south side of Ninth Street Road in Roger Canyon (**Figure 52**). Due to its occurrence in a popular recreational area (**Figure 53**), efforts to establish a quarry here were thwarted by the BLM. The company decided to move its interest to the Horse Creek site.

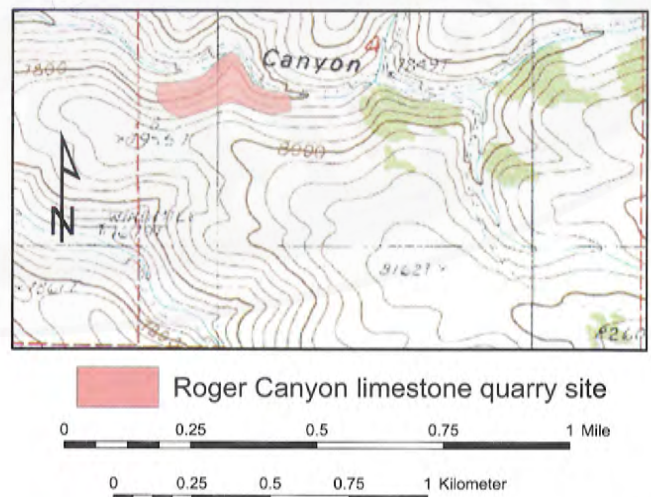


Figure 51. Location map of the Roger Canyon limestone quarry site.

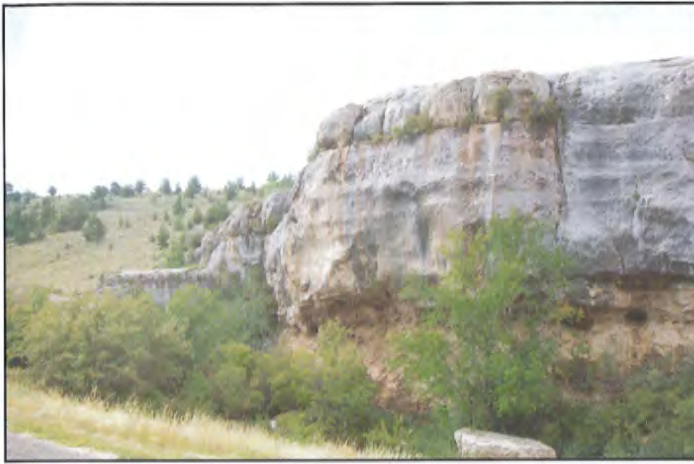


Figure 52. Outcrop of limestone in the Casper Formation in Roger Canyon. Exposed rock face is about 40 feet high.



Figure 53. Exposures of the Casper Formation in Roger Canyon. Prominent unit is the Roger Canyon limestone.



Sherman Hill anorthosite

Location: NE section 5, N section 6, T16N, R71W; S S section 31, T17N, R71W, Albany County, Wyoming (**Figure 54**).

USGS 7 1/2-minute Quadrangle(s): King Mountain.

Land and mineral ownership/status: Private surface, Anadarko minerals (sections 5 and 31); private surface and minerals (section 6).

Description: Medium-gray to bluish-gray anorthosite crops out at this location (**Figure 55**) with joint spacing between 5 and 10 feet, and some exfoliation perpendicular to the jointing. The outcrop is covered in places by a thin layer of alluvium, and some drilling may be necessary to prove the joint spacing and color consistency. This site and the Road 12 site (above) are the best locations of gray anorthosite observed in the Laramie Anorthosite Complex.

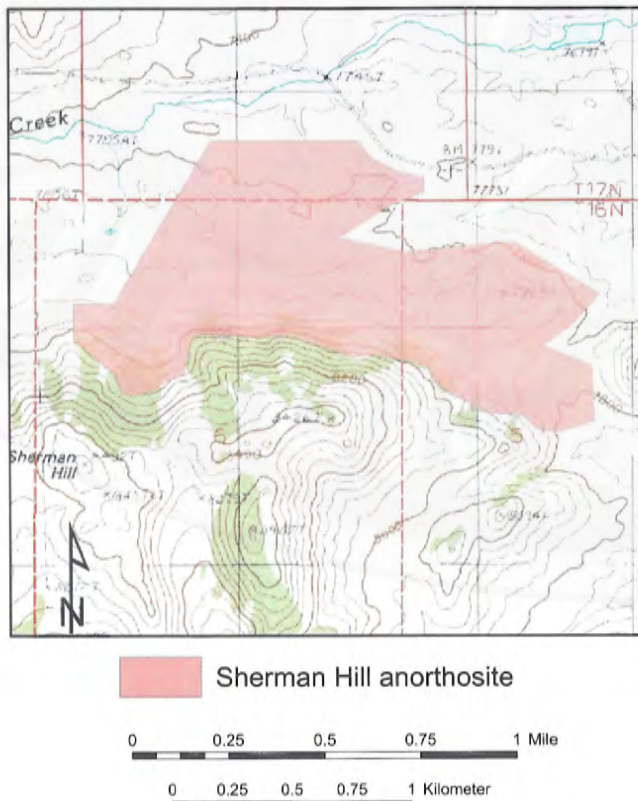


Figure 54. Location map of the Sherman Hill anorthosite.



Figure 55. Outcrop and quarry site for the Sherman Hill anorthosite, center middle distance.



Horse Creek limestone

Location: S section 11, E NW and NE section 14, T16N, R72W, Albany County, Wyoming (**Figure 56**).

USGS 7 1/2-minute Quadrangle(s): Pilot Hill.

Land and mineral ownership/status: Private surface, Anadarko minerals (section 11), federal (BLM) surface and minerals (section 14).

Description: Permian-Pennsylvanian limestone of the Casper Formation crops out in a north-south trending escarpment at the eastern edge of this area (**Figure 57**). It dips to the west at 5 to 10°, forming a dip slope. The upper 15 feet of the limestone is pinkish-beige, while the lower 35 feet is beige. The dip slope is a good place for a quarry. Wyoming Dimensional Stone applied to BLM for a sale of limestone in section 14. However, the area is surrounded by private land and the company was not able to reach an agreement with the landowner regarding access routes. Nevertheless, the area is still a candidate for a quarry site.

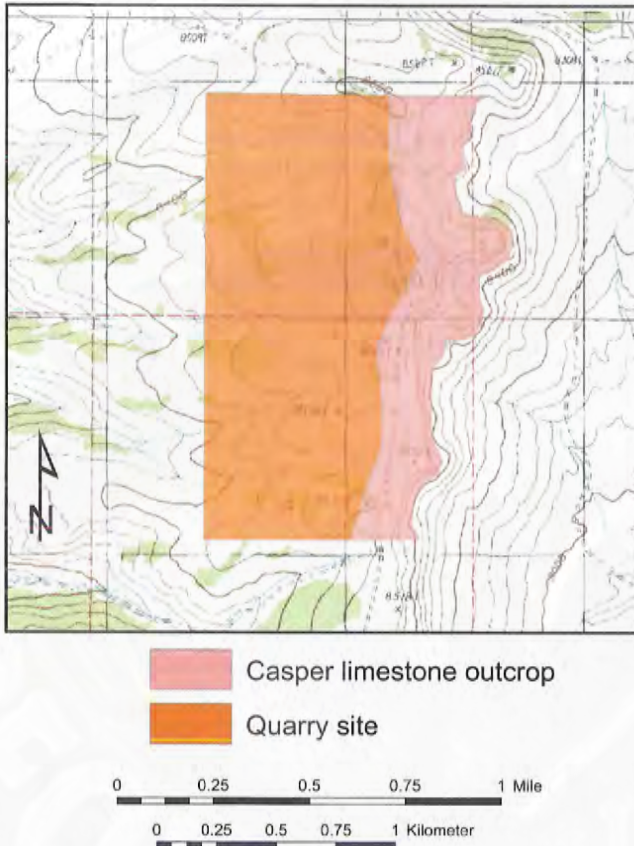


Figure 56. Location map of the Horse Creek limestone outcrop and quarry site.



Figure 57. Outcrop of limestone in the Casper Formation at the Horse Creek site. View is to the north along strike and the 35-foot-thick vertical rock face of limestone dips to the left.



McKechnie pink granite

Location: NW section 1, NE section 2, T15N, R71W; SE section 35, T16N, R71W, Albany County, Wyoming (**Figure 58**).

USGS 7 1/2-minute Quadrangle(s): Green Top Mountain.

Land and mineral ownership/status: Federal [U.S. Forest Service (USFS), Medicine Bow National

Forest] surface and minerals (sections 1 and 2); private surface, Anadarko minerals (section 35).

Description: Coarse-grained pink granite that is slightly lighter in color than that at the No Name Rock site (below) crops out in this area (**Figure 59**) and extends beyond the quarry sites. Joints are vertical, oriented north-northeast to south-southwest and spaced 20 feet apart.

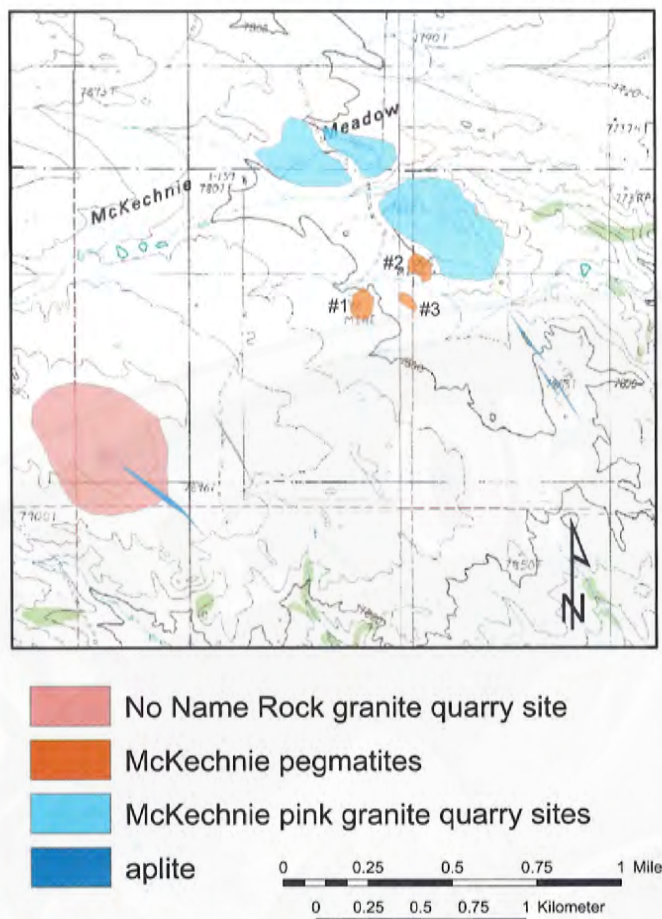


Figure 58. (Left) Location map of the McKechnie pink granite quarry sites, the McKechnie pegmatites, and the No Name Rock pink granite quarry site.



Figure 59. Outcrop of pink granite at a McKechnie quarry site.

McKechnie pegmatites

Location: Pegmatite #1 in SW SE NE section 2, T15N, R71W; pegmatite #2 in SW SW NW NW section 1, T15N, R71W; pegmatite #3 in SE SE NE section 2, T15N, R71W, Albany County, Wyoming (**Figure 58**).

USGS 7 1/2-minute Quadrangle(s): Green Top Mountain.

Land and mineral ownership/status: Federal (USFS, Medicine Bow National Forest) surface and minerals.

Description: Pegmatite #1 and pegmatite #2, were mined in the pre-1960s for feldspar (**Figure 60**). Pegmatite #3 is unmined. Resources remain for potential decorative aggregate production of light salmon-colored feldspar and light gray quartz. Small amounts of transparent blue quartz are also found at pegmatite #1.



Figure 60. Mined area at the McKechnie pegmatite #1. Dead tree on left horizon is about 10 feet tall.

No Name Rock pink granite

Location: SW SW section 2, E SE section 3, N NW section 11, T15N, R71W, Albany County, Wyoming (**Figure 58**).

USGS 7 1/2-minute Quadrangle(s): Green Top Mountain.



Figure 61. Polished sample of pink granite from the No Name Rock site. Scale is inches. Field of view is about 5 inches wide and 4 inches high.

Land and mineral ownership/status: Federal (USFS, Medicine Bow National Forest) surface and minerals.

Description: Pink, coarse-grained granite (**Figure 61**) crops out at this locality (**Figure 62**). Joints are vertical, oriented north-northeast to south-southwest, and spaced 5 to 20 feet apart. Exfoliation joints 3 to 4 feet at the surface should increase in spacing or disappear completely at depth.



Figure 62. Outcrop at the No Name Rock pink granite site.

Telephone Road pink granite

Location: NW SW section 15, T15N, R71W, Albany County, Wyoming (**Figure 63**).

USGS 7 1/2-minute Quadrangle(s): Green Top Mountain.

Land and mineral ownership/status: Federal (USFS, Medicine Bow National Forest) surface and minerals.

Description: Coarse-grained pink granite crops out at this locality (**Figure 64**). Northwest-southeast trending joints spaced 20 feet apart or greater are present. Exfoliation fracturing is 4 feet or greater at the surface.

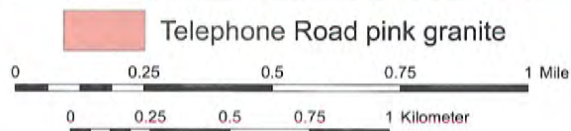


Figure 63. (Right) Location map of the Telephone Road pink granite.



Figure 64. The Telephone Road pink granite site.

Ames Monument granite

Location: NE section 36, T14N, R72W, Albany County, Wyoming (**Figure 65**).

USGS 7 1/2-minute Quadrangle(s): Sherman Mountains West.

Land and mineral ownership/status: State surface and minerals.

Description: Pink, coarse-grained granite crops out in several areas (**Figure 66**). Surface fractures trend northeast-southwest at 10 to 20 foot spacing. In 2000, there was a new house constructed in section 25, north of the north section line of section 36 and about 0.2 mile from the closest part of the proposed quarry site.

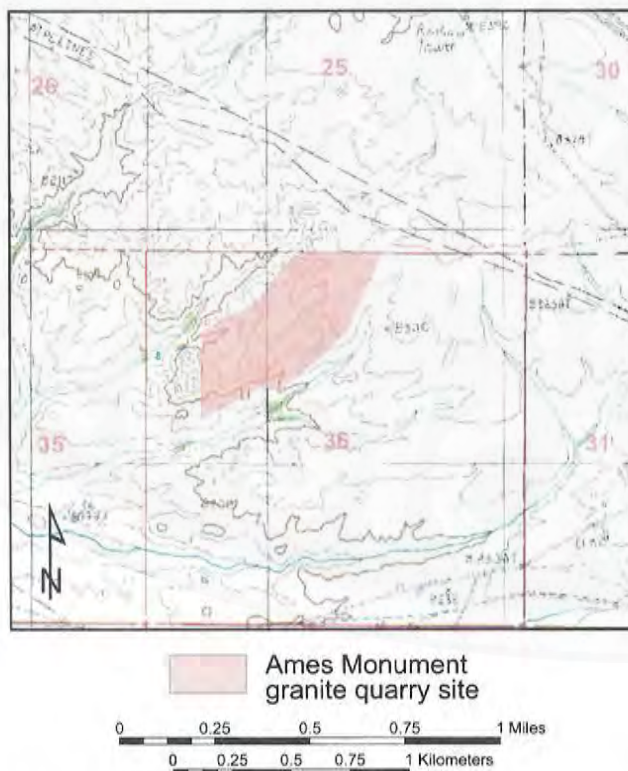


Figure 65. Location map of the Ames Monument granite quarry site.



Figure 66. The Ames Monument quarry site with exposed pink granite.

Hermosa granite

Location: W W section 15; section 16; E, E W, and NW NW section 17; NE section 20; section 21; and W W section 22, T13N, R72W, Albany County, Wyoming (**Figure 67**).

USGS 7 1/2-minute Quadrangle(s): Dale Creek.

Land and mineral ownership/status: Private surface, Anadarko Minerals (section 15); State surface and minerals (section 16); Union Pacific (UP) surface, Anadarko minerals (section 17); private surface and minerals (section 20); UP surface and minerals (not included in the sale of UP mineral rights to Anadarko) (section 21); private surface and minerals (section 22).

Description: Several phases of the Sherman Granite are found in this area, including pink, dark, and mahogany granite. The most prevalent is a coarse-grained, pink granite similar to that found at Ames Monument (**Figures 68 and 69**). To the east, an area in the southern part of section 16 is underlain by a coarse-grained, reddish granite containing about 50% dark minerals (**Figures 70 and 71**). The coarse-grained mahogany phase (**Figure 72**) is exposed at the west portal of the Hermosa Tunnel and has been encountered in the shallow subsurface about 0.25 mile south of the portal in section 21. Two quarry sites have been identified, one in the S SE section 17 and NE section 20; the other in the W W section 15 and E section 16, T13N, R72W.

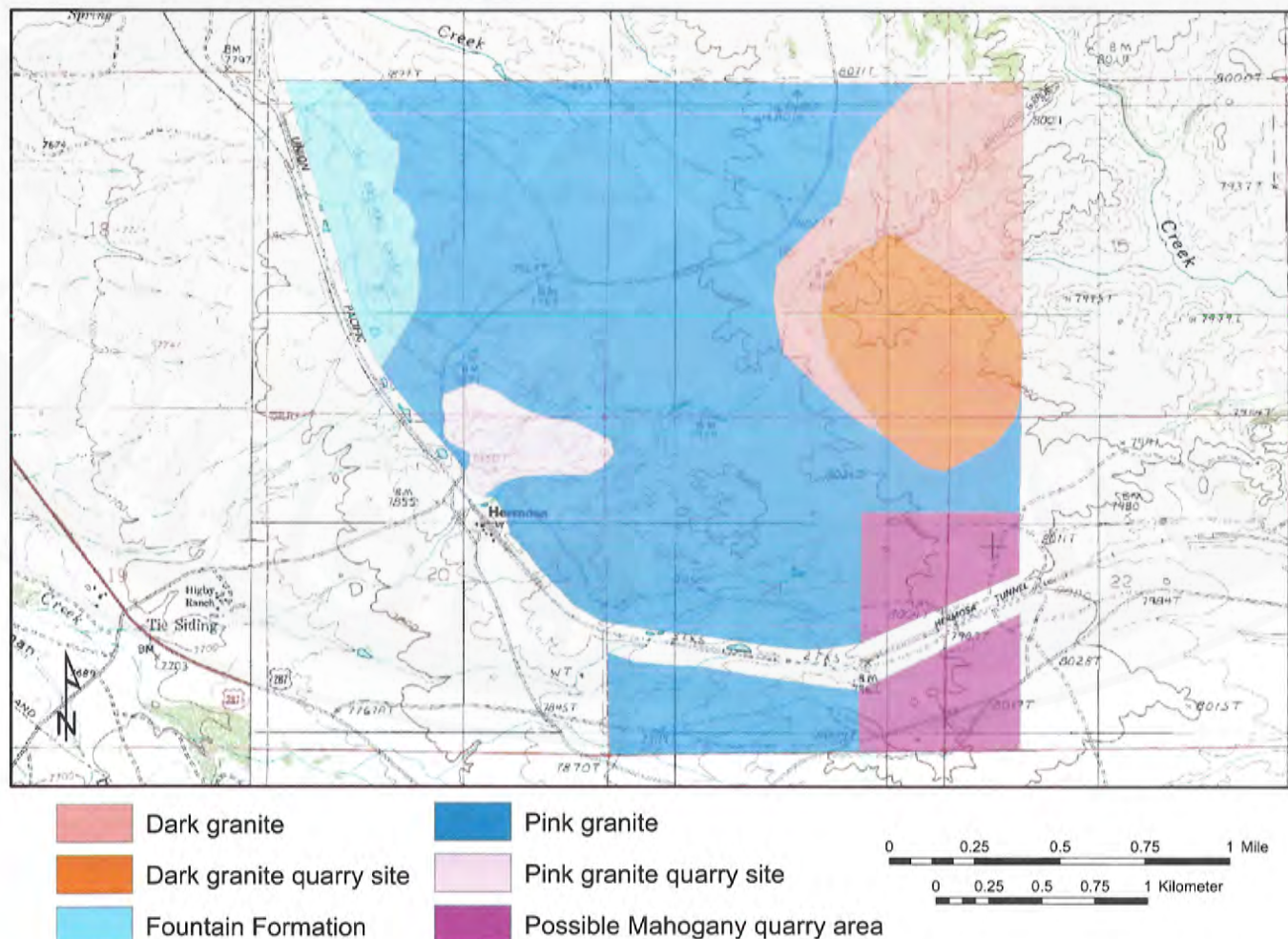


Figure 67. Location map of Hermosa granite quarry sites.



Figure 68. Outcrop and quarry site of the Hermosa pink granite. Exposure is about 20 feet high.



Figure 71. Outcrop and quarry site of the Hermosa dark granite in abandoned railroad cut.



Figure 69. Cut and polished sample of the Hermosa pink granite.

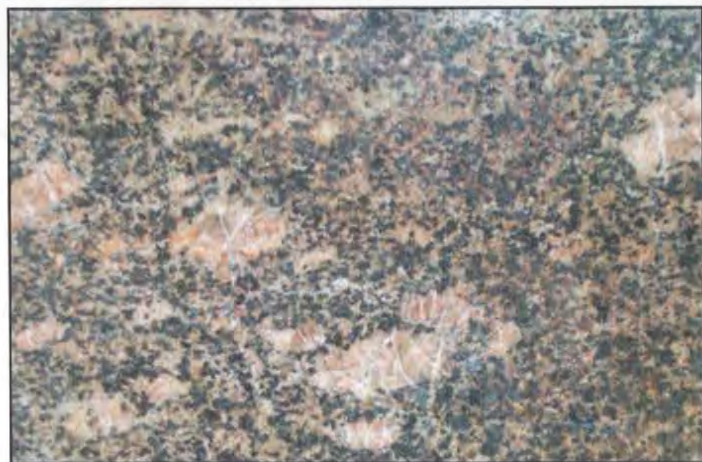


Figure 70. Cut and polished sample of Hermosa dark granite. Field of view is about 5 inches wide and 4 inches high.

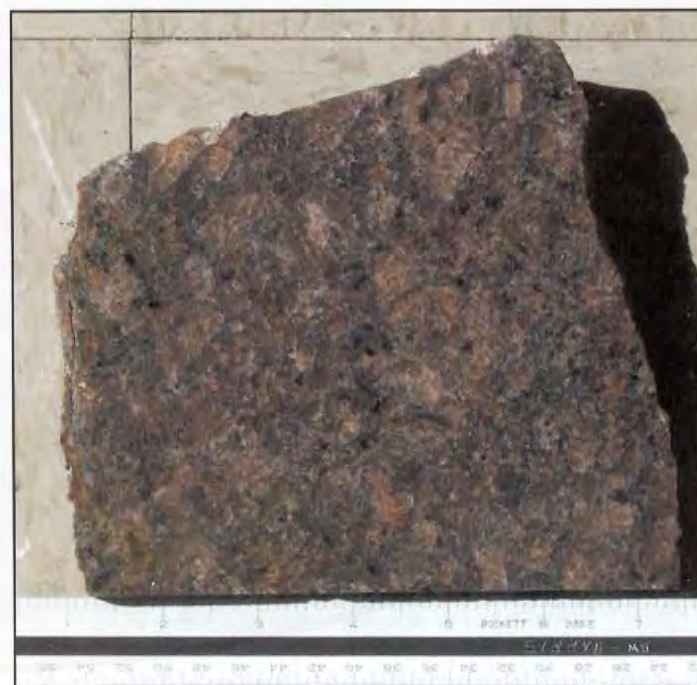


Figure 72. Cut and polished sample of the Hermosa mahogany phase granite. Upper scale is inches, lower scale is centimeters.

Punkin Vine pegmatites

Location: #1 in SE SW section 26, T13N, R72W; #2 in SE NE NW section 2, T12N, R72W; #3 in SE SE SW section 2, T12N, R72W; #4 in SE NE SE section 36, T13N, R72W; and #5 in SW SW NE section 6, T12N, R71W, Albany County, Wyoming (**Figure 73**).

USGS 7 1/2-minute Quadrangle(s): Dale Creek.

Land and mineral ownership/status: Pegmatites #1, 2, 3, and 5, private surface and minerals; # 4, State surface and minerals.

Description: This is a group of zoned pegmatites with light-gray quartz cores surrounded by light-orange feldspar with an outer zone of biotite-feldspar along with other minerals. The feldspar in these pegmatites was mined from the 1930s to the 1950s (**Figure 74**). Reserves of quartz and feldspar remain for decorative aggregate. Pegmatite #5 is currently being quarried for decorative aggregate.

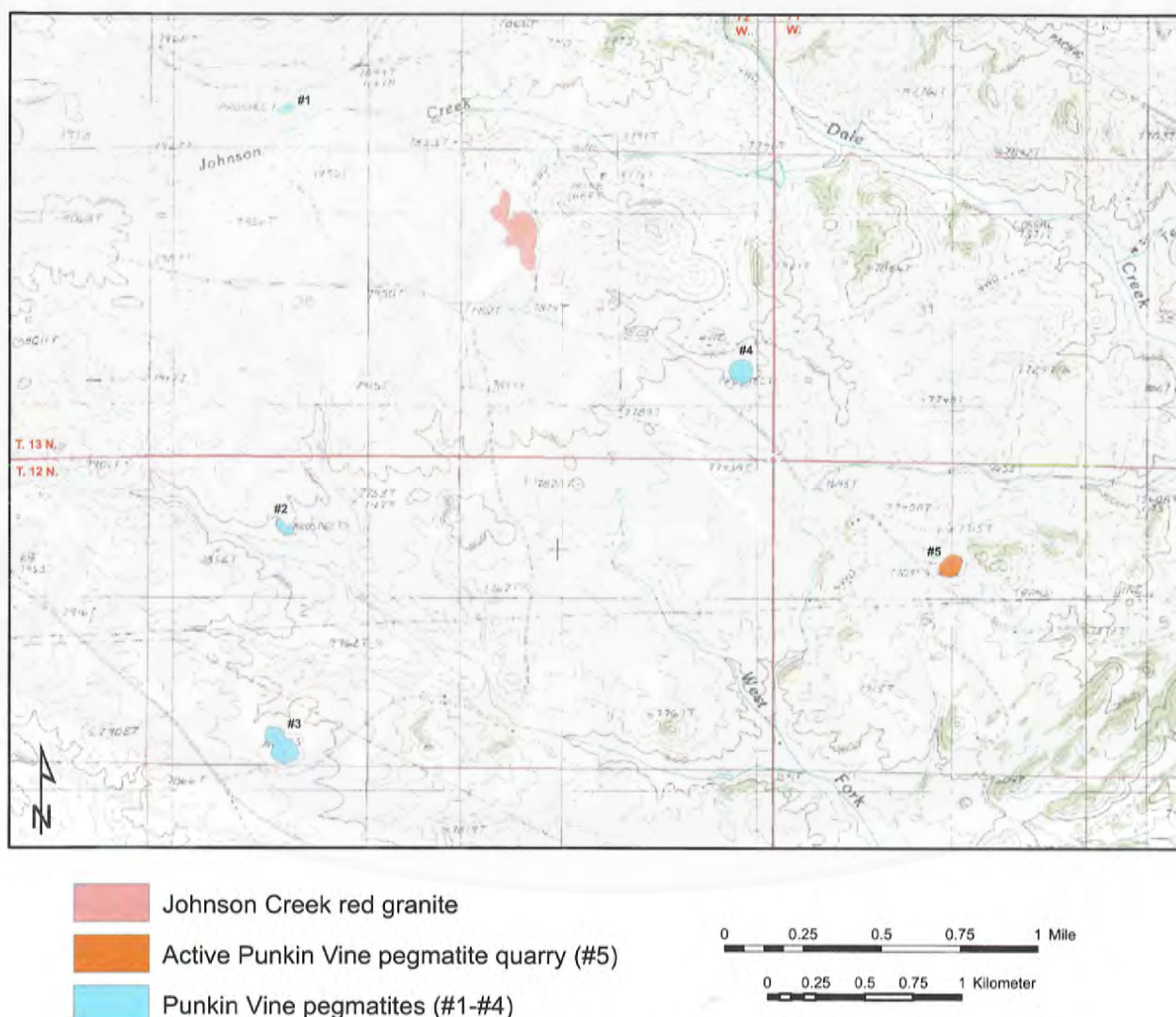


Figure 73. Location map of the Punkin Vine pegmatites and the Johnson Creek red granite.



Figure 74. Inactive quarry at Punkin Vine pegmatite #4.



Johnson Creek granite

Location: NW section 36, T13N, R72W, Albany County, Wyoming (**Figures 73 and 75**).

USGS 7 1/2-minute Quadrangle(s): Dale Creek.

Land and mineral ownership/status: State surface and minerals.

Description: This site contains light red granite (**Figures 76 and 77**). Surface fracturing is spaced at approximately 5 feet, exfoliation fractures are spaced from 3 to 4 feet. The site will require drill testing for determining fracture density at depths of 20 feet or more.

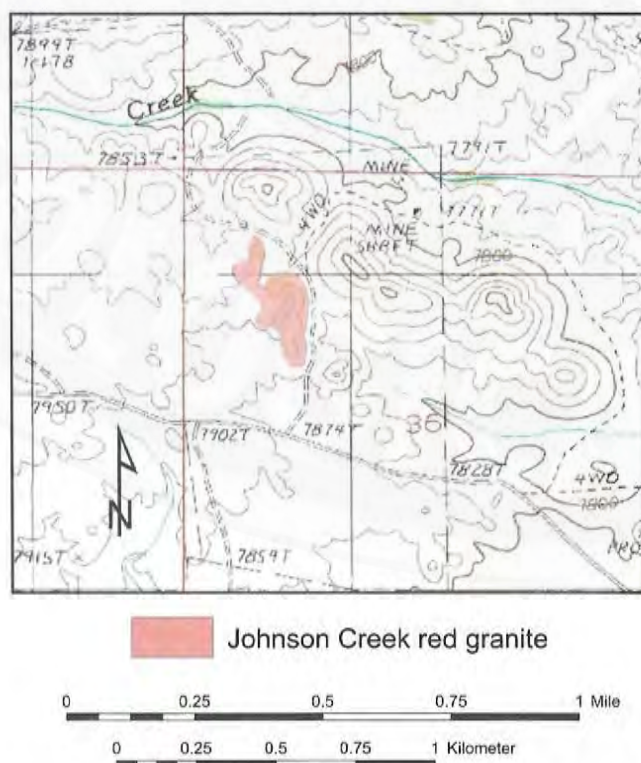


Figure 75. Location map of the Johnson Creek red granite.



Figure 76. Outcrop of the Johnson Creek red granite.

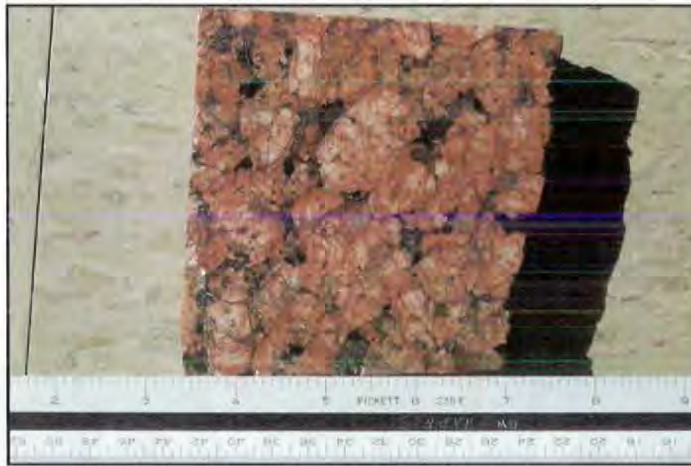


Figure 77. Cut and polished sample of the Johnson Creek red granite. Upper scale is inches, lower scale is centimeters.



Harriman gneiss

Location: Section 16, T12N, R70W, Laramie County, Wyoming (**Figure 78**).

USGS 7 1/2-minute Quadrangle(s): Granite.

Land and mineral ownership/status: State surface and minerals.

Description: This site consists of brownish and pinkish foliated quartzofeldspathic gneiss (**Figure 79**). The variable and swirled mostly brownish gneiss contains infrequent grayish bands. Vertical joints are parallel with the banding, non-continuous on the surface, and spaced from 4 to 6 feet apart.

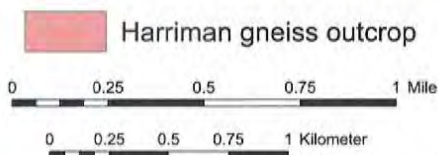
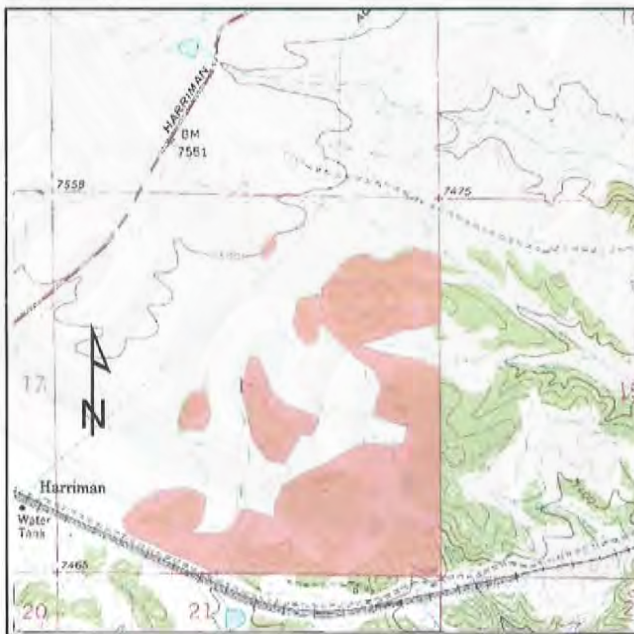


Figure 78. Location map showing outcrops of Harriman gneiss.



Figure 79. Outcrop of the Harriman gneiss shows vertical and subhorizontal jointing.



Goose Creek limestone

Location: E section 36, T13N, R70W, Laramie County, Wyoming (**Figure 80**).

USGS 7 1/2-minute Quadrangle(s): Granite.

Land and mineral ownership/status: State surface and minerals.

Description: The Goose Creek limestone occurs in the Permian-Pennsylvanian Casper Formation (**Figure 81a**). Most of the limestone is buff in color, with some pinkish layers near the top of the

unit (**Figure 81b**). The limestone is 30 to 40 feet thick. Colorado Lien operated an aggregate quarry in this unit in the southeastern corner of section 36 (**Figure 80**). Obtaining a mining permit for the area where Goose Creek cuts through the Casper Formation (**Figure 81a**) is probably not possible.

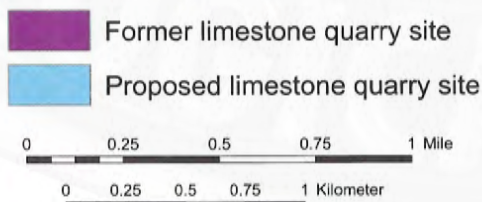
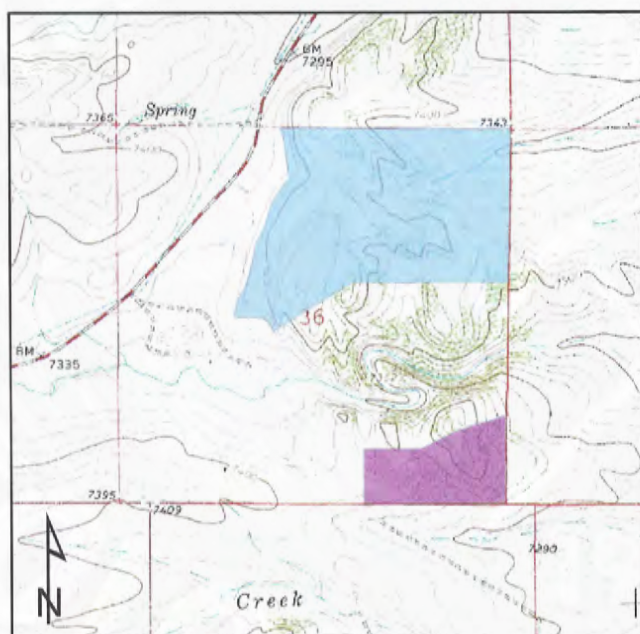


Figure 80. Location map of former and proposed quarry sites for the Goose Creek limestone.



Figure 81a. Outcrop of limestone at the proposed Goose Creek quarry site.



Figure 81b. Cut and polished sample of the Goose Creek limestone.

Rawlins area sites

Ninemile Point limestone

Location: Parts of sections 9, 10, 11, 14, and 15, T22N, R88W, Carbon County, Wyoming (**Figure 82**).

USGS 7 1/2-minute Quadrangle(s): Rendle Hill.

Land and mineral ownership/status: UP surface, Anadarko minerals (sections 9, 11, and 15); federal surface and minerals (sections 10 and 14).

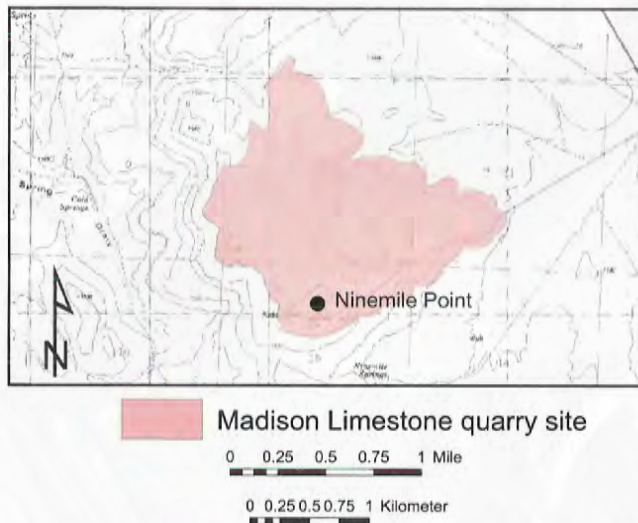


Figure 82. Location map of the Ninemile Point limestone quarry site.

Description: This decorative stone site is in a 30-foot-thick gray limestone bed in the Madison Limestone. The Madison forms an eastward-dipping slope along the Rawlins uplift. Cherty zones in the upper part of the section are not included in thickness estimation. There is minimal overburden at this site (**Figure 83**).



Figure 83. Outcrop of the Ninemile Point limestone.

Rawlins red granite aggregate site

Location: NW section 18, T21N, R87W, Carbon County, Wyoming (**Figure 84**).

USGS 7 1/2-minute Quadrangle(s): Rawlins Peak.

Land and mineral ownership/status: Federal (BLM) surface and minerals.

Description: Red, medium-grained granite crops out at this locality (**Figure 85**). Jointing at the surface is in several directions and spaced at 18 inches or less. The fracturing at this site indicates that this granite, although a medium to dark red, is suitable only for decorative aggregate.

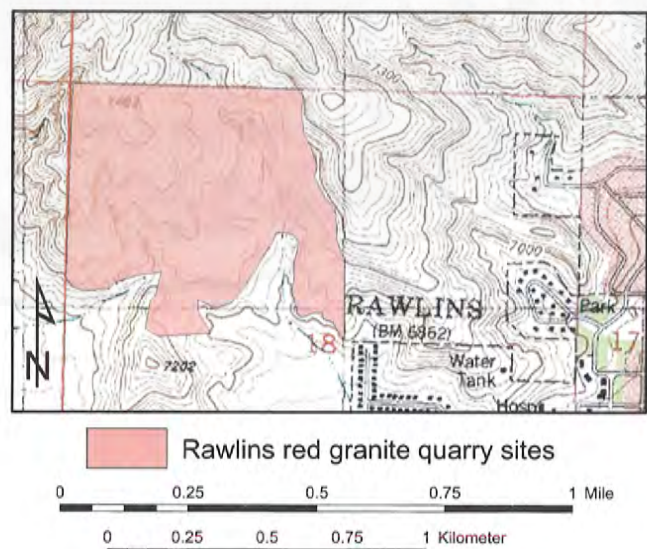


Figure 84. (Right) Location map of the Rawlins red granite quarry sites.



Figure 85. (Left) Outcrop of Rawlins red granite shows a large amount of fracturing along closely spaced joints. Exposure is about 400 feet high. Horizontally bedded rock near top of hill is Flathead Sandstone (Cambrian) overlain by Madison Limestone (Mississippian) on skyline.



Rawlins Flathead Sandstone quarries

Location: SE SW SW section 8, T21N, R87W, Carbon County, Wyoming (**Figure 86**).

USGS 7 1/2-minute Quadrangle(s): Rawlins.

Land and mineral ownership/status: Private surface and minerals.

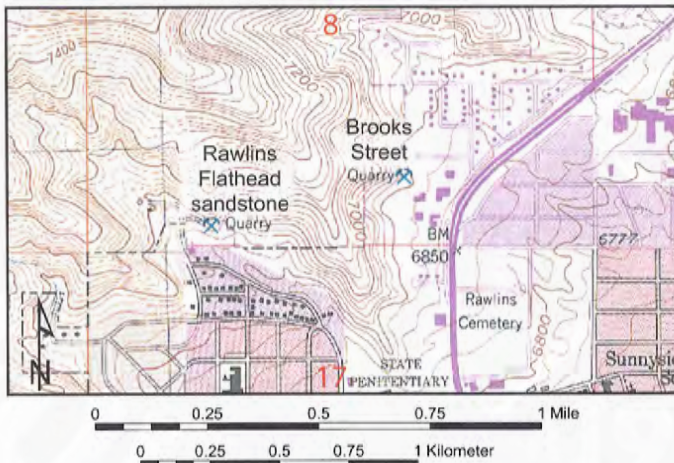


Figure 86. Location map of the Rawlins Flathead Sandstone and Brooks Street quarry sites.



Brooks Street quarry

Location: NW SW SE section 8, T21N, R87W, Carbon County, Wyoming (**Figure 86**).

USGS 7 1/2-minute Quadrangle(s): Rawlins.

Land and mineral ownership/status: Private surface, federal minerals.

Description: Coarse-grained sandstone with zones of pebble conglomerate in the Cambrian Flathead Sandstone was quarried at this locality. The sand-

Description: Coarse-grained sandstone with zones of pebble conglomerate in the Cambrian Flathead Sandstone was quarried at this locality (**Figure 87**). The sandstone is beige in color, and some of the coarser sand grains are orange chert. The material was used in Rawlins for curbs and trim on buildings. The presence of houses 100 feet from the quarry probably precludes development.



Figure 87. Rawlins Flathead Sandstone quarry site immediately north of Rawlins. Exposed face above grass-covered line (center) is about 20 feet high.

stone is beige in color, and some of the coarser grains are orange chert (**Figure 88**). The material was also used for curbs and trim on buildings in Rawlins. This former quarry site is in an industrial area; Pacific Power and Light has a shop adjacent to the quarry property. Since this area is zoned for commercial use, permitting a quarry at this site should be easier than at the Rawlins Flathead Sandstone quarry sites described above.



Figure 88. (Left) Outcrop of Flathead Sandstone at the Brooks Street quarry.

Rawlins sandstone quarries

Location: NW section 4, T20N, R87W (historic quarry locality); W section 2, section 3, section 5, section 9, NW section 10, and section 16, T20N, R87W; and SW SW section 34, T21N, R87W, Carbon County, Wyoming (**Figure 89**).

USGS 7 1/2-minute Quadrangle(s): Smith Draw West.

Land and mineral ownership/status: Federal surface and minerals (sections 2 and 10; SE, S SW, and NE section 4); UP surface, Anadarko minerals (sections 3, 5, and 9); State surface and minerals (section 16). Private surface and minerals [NW and NW NE section 4 (section 4 is not a full square mile)] at the historic quarries.

Description: Sandstone from these quarries was used in the construction of several buildings around Wyoming and Utah, notably the Wyoming State Capitol, the UP railroad depot in Ogden, Utah, and Merica Hall on the UW campus in Laramie. This grayish-tan sandstone is uniform in color and texture (**Figure 90**). It is in the Upper Cretaceous Mesaverde Formation. The shortest access to the quarries at present involves going through the Wyoming state prison (for permission, check at the north gate). If a quarry is reopened, roads could be constructed to avoid the prison.

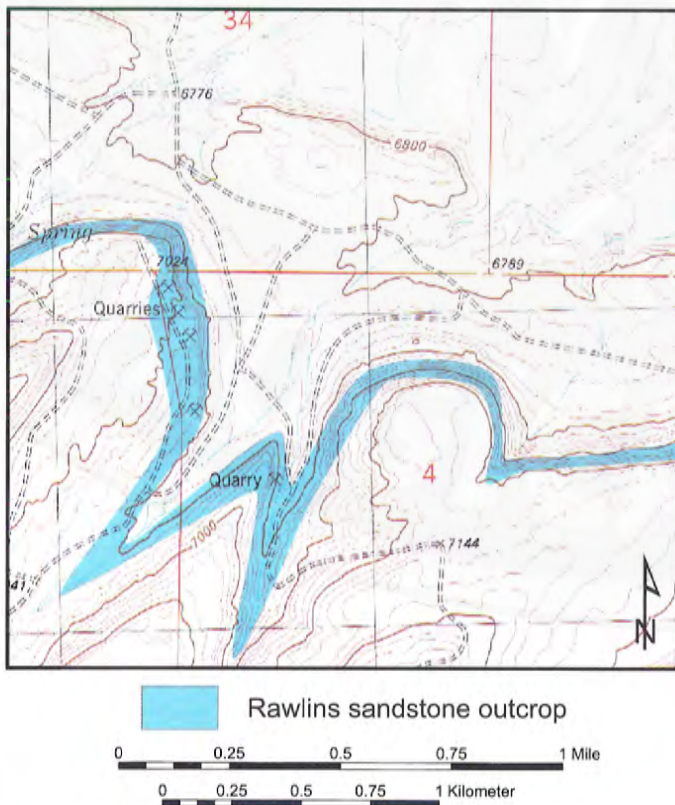


Figure 89. Location map of the Rawlins sandstone outcrop (Mesaverde Formation) and quarries.



Figure 90. Quarry site and outcrop of the Rawlins sandstone.

Red Hill clinker aggregate site

Location: Section 20, T23N, R81W, Carbon County, Wyoming (**Figure 91**).

USGS 7 1/2-minute Quadrangle(s): Elmo.

Land and mineral ownership/status: Federal surface and minerals.

Description: The largest outcrop of red clinker is located on top of Red Hill (**Figure 92**), which is adjacent to the Seminole #2 coal mine reclamation site. Clinker is baked and fused rock caused by the natural burning of coal beds. Its red color is from oxidation of iron in the rocks. The host rock for the clinker is the Hanna Formation (Paleocene and Eocene) of the Hanna Basin.

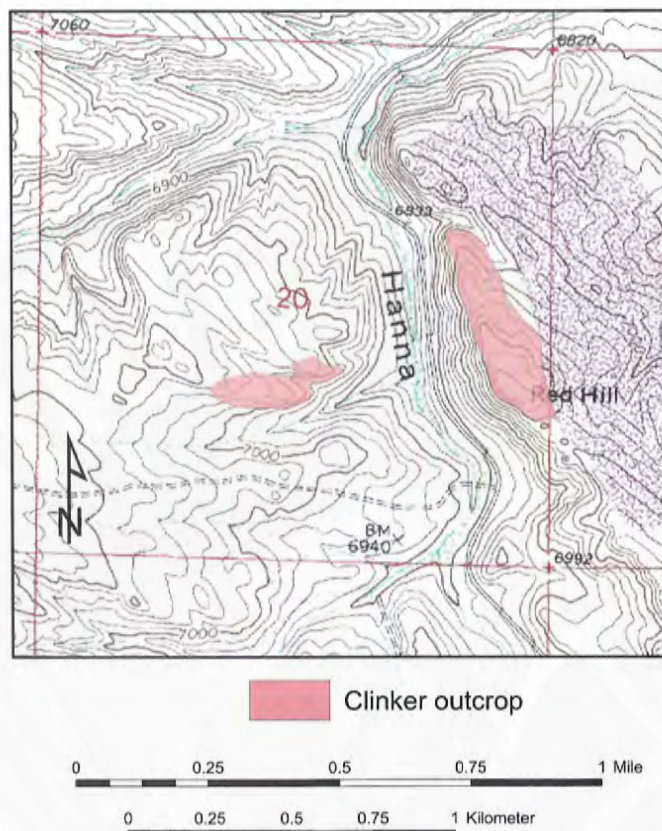


Figure 91. Location map of the Red Hill clinker aggregate site and other outcrops of red clinker.

Figure 92. The Red Hill clinker aggregate site occurs at the top of the hill on the near skyline.

Medicine Bow Mountains sites

Rock Creek light blue/green quartzite aggregate

Location: NE NE section 1, T16N, R78W; N section 31, T17N, R78W, Carbon County, Wyoming (**Figure 93**).

USGS 7 1/2-minute Quadrangle(s): Morgan.

Land and mineral ownership/status: Federal (USFS, Medicine Bow National Forest) surface and minerals.

Description: This locality consists of outcrops and talus of the Precambrian Medicine Peak Quartzite (**Figure 94**). The rock is hard but brittle and is primarily suitable for decorative aggregate. Most of the rock is light blue, although some zones are light green. The blue is produced by finely divided kyanite, while the green is caused by finely divided chrome mica.

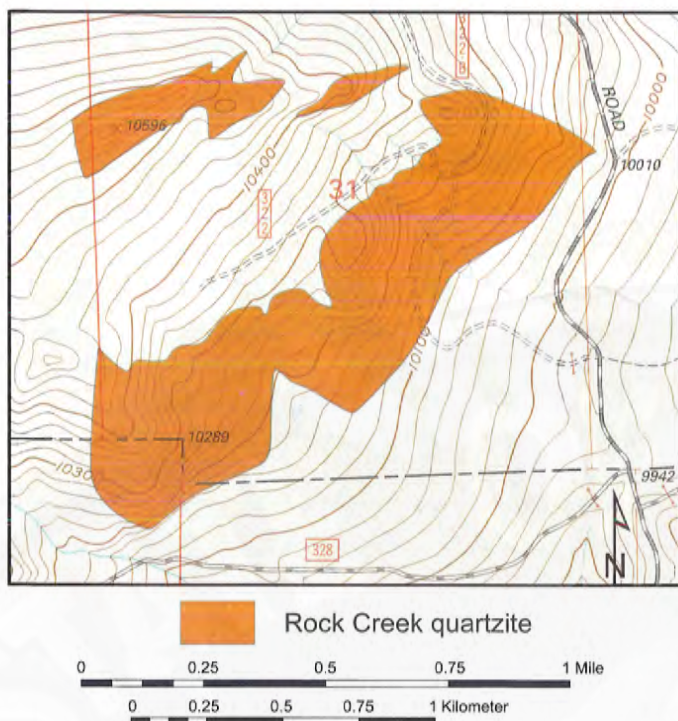
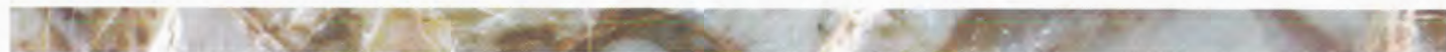


Figure 93. Location map of the Rock Creek quartzite quarry sites.



Figure 94. Outcrop of the Medicine Peak Quartzite at the Rock Creek quarry site.



Albany pink granite

Location: SE SE section 8, SW SW section 9, and NW NW section 16, T14N, R78W, Albany County, Wyoming (**Figure 95**).

USGS 7 1/2-minute Quadrangle(s): Albany.

Land and mineral ownership/status: Federal (USFS, Medicine Bow National Forest) surface and minerals.

Description: Coarse-grained pink granite crops out in a partially reclaimed quarry (**Figure 96**). Large boulders of quarried granite are also located on site (**Figure 97**). This material was quarried as rip-rap (large-sized aggregate) for use in construction of the Cheyenne water pipeline. No determination of surface joint spacing was possible. However, the presence of boulders in excess of 10 feet in diameter indicates that the joint spacing is suitable for the quarrying of large blocks.

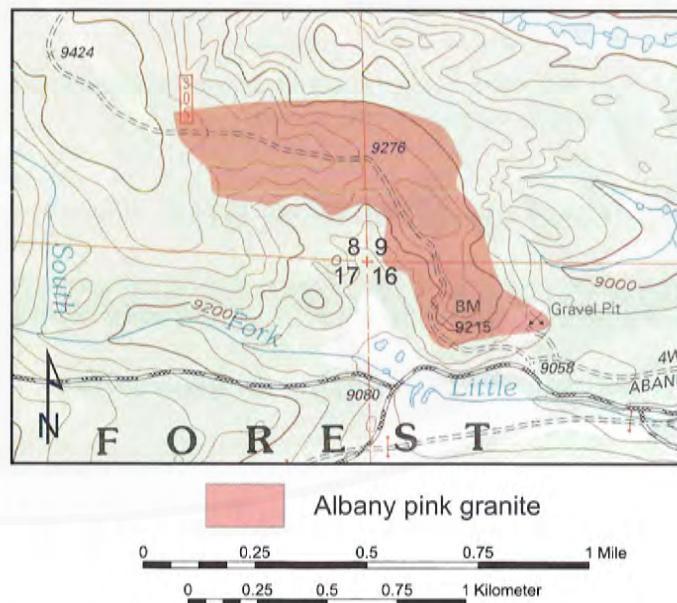


Figure 95. Location map of outcrops and quarry sites for the Albany pink granite.



Figure 96. Partially reclaimed quarry for Albany pink granite.



Figure 97. Boulders of Albany pink granite.



Albany red granite

Location: E section 15, T14N, R78W, Albany County, Wyoming (**Figure 98**).

USGS 7 1/2-minute Quadrangle(s): Albany.

Land and mineral ownership/status: Federal (USFS, Medicine Bow National Forest) surface and minerals.

Description: Medium-red granite crops out on a hill immediately west of the town of Albany (**Figure 99**) and is adjacent to graded Forest Service Road 500. Joints are spaced 2 to 4 feet apart, and drilling will be necessary to determine spacing at shallow depth. This site is 1/2 mile west of cabins near the town site of Albany.

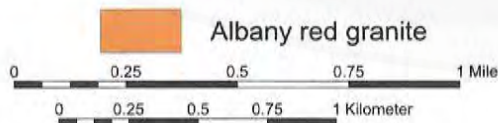


Figure 98. Location map of outcrops and quarry sites for Albany red granite.



Figure 99. Outcrop of Albany red granite.



Albany charcoal-gray granite

Location: SE section 16, T14N, R78W, Albany County, Wyoming (**Figure 100**).

USGS 7 1/2-minute Quadrangle(s): Albany.

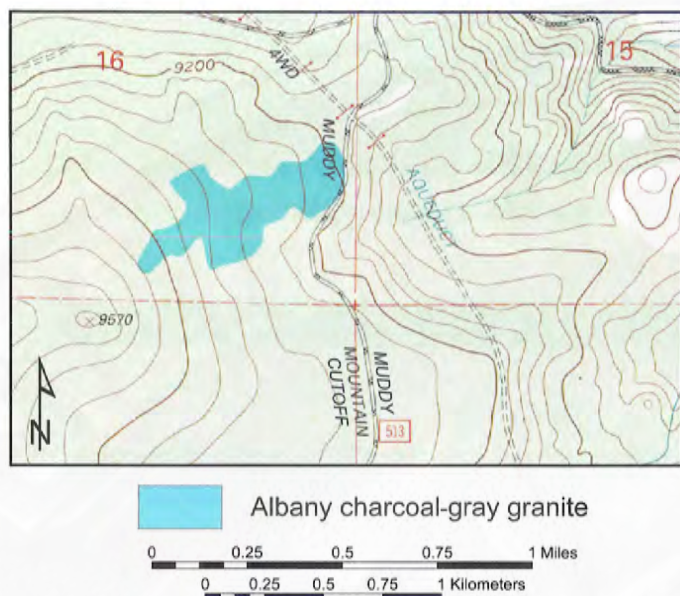


Figure 100. Location map showing outcrops of Albany charcoal-gray granite.

Land and mineral ownership/status: Federal (USFS, Medicine Bow National Forest) surface and minerals.

Description: Fine-grained charcoal-gray granite (geologically an amphibolite) crops out (**Figure 101**) near the Muddy Mountain Cutoff. Joints are spaced 20 feet or greater at the surface.



Figure 101. An outcrop of Albany charcoal-gray granite.



Road 527 dark blue granite

Location: Outcrops in SE NE and NE SE section 29; float in S section 29 and SE section 30, T14N, R78W, Albany County, Wyoming (**Figure 102**).

USGS 7 1/2-minute Quadrangle(s): Albany.

Land and mineral ownership/status: Federal (USFS, Medicine Bow National Forest) surface and minerals.

Description: Dark blue granite (geologically a gabbro) is found as float in this area (**Figure 103**). There are no other rock types in the float, indicating that solid rock is present beneath the float. The largest boulders at the surface are 3 feet in diameter (**Figure 104**). Due to this rock's unique color (**Figure 105**), a drilling program may be valuable to determine its extent and ability to be quarried. Areas of float extend 1/2 mile west of the area shown on **Figure 102**.

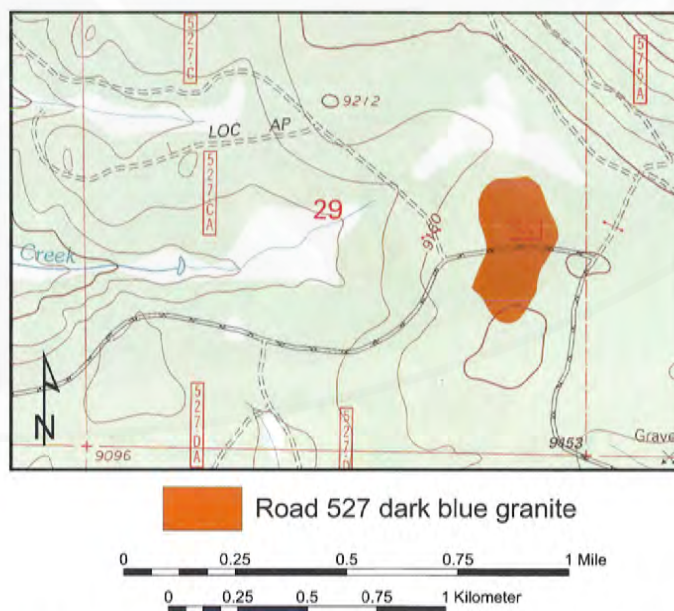


Figure 102. Location map showing outcrop area of Road 527 dark blue granite.



Figure 103. Dark blue granite occurs as float on either side of the road.



Figure 104. Close-up view of a large boulder of dark blue granite found in the outcrop area.



Figure 105. A polished stone paperweight made of Road 527 dark blue granite. Upper scale is inches, lower scale is centimeters.



Foxpark purple granite

Location: SE SW section 33, T14N, R78W, Albany County, Wyoming (**Figure 106**).

USGS 7 1/2-minute Quadrangle(s): Albany.

Land and mineral ownership/status: Federal (USFS, Medicine Bow National Forest) surface and minerals.

Description: Fine-grained, layered granite (geologically an amphibolite) crops out (**Figure 107**) just east of Lake Creek at this site. The rock is variable in color and is primarily suitable for quarrying to make dark purple decorative aggregate.

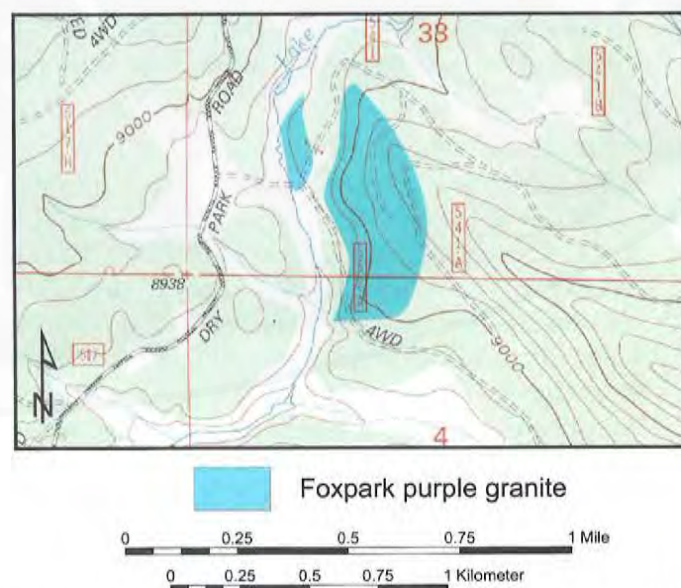


Figure 106. Location map of Foxpark purple granite outcrops and quarry sites.



Figure 107. Outcrop of Foxpark purple granite.

Sierra Madre and Saratoga Valley sites



Divide Peak flagstone

Location: NW SE section 3, T15N, R87W, Carbon County, Wyoming (**Figure 108**).

USGS 7 1/2-minute Quadrangle(s): Divide Peak.

Land and mineral ownership/status: Federal (USFS, Medicine Bow National Forest) surface and minerals.

Description: Light-beige slate with shiny silver- to light gold-colored mica on the parting surfaces crops out at this locality in an area of young pine trees. The parting surfaces are perfectly flat and around 1/4 to 1 inch thick (**Figure 109**). The rock makes an excellent flagstone. The outcrop, from which some of this material has been taken, is about 20 feet in diameter. The extent of the resource is not known due to the cover. However, the direction in which the slate extends is inferred from the orientation of the rock in the outcrop.

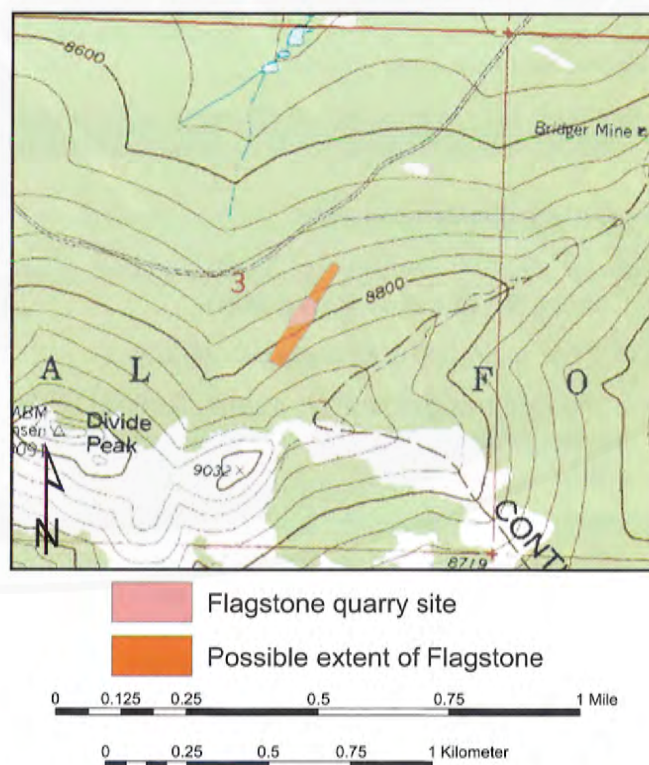


Figure 108. Location map of Divide Peak flagstone showing quarry site and possible extent of the resource.



Figure 109. Outcrop and quarry of Divide Peak flagstone.

Baggot Rocks North gneiss

Location: NE and NE SE section 8, NW NW NW section 9, T15N, R83W, Carbon County, Wyoming (Figure 110).

USGS 7 1/2-minute Quadrangle(s): Cow Creek.

Land and mineral ownership/status: Federal (BLM) surface and minerals.

Description: Pink, light-gray, and beige banded and swirled gneiss. Joints vary between 4 and 10 feet at the surface. Surface samples exhibit minor iron staining along fractures.



Baggot Rocks West gneiss

Location: SW SW SW section 9, NW NW NW section 16, T15N, R83W, Carbon County, Wyoming (Figure 110).

USGS 7 1/2-minute Quadrangle(s): Cow Creek.

Land and mineral ownership/status: Federal (BLM) surface and minerals (section 9); State surface and minerals (section 16).

Description: Black and white banded gneiss. The black bands are discontinuous, appearing as lines of dots, some connected, some not (Figure 111). The surficial 2 to 6 inches are lightly stained with limonite. Joints are 5 to 8 feet apart at the surface.

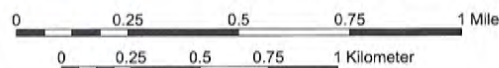
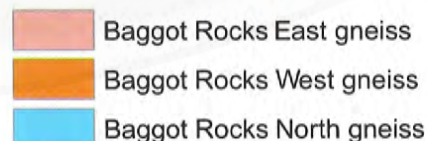
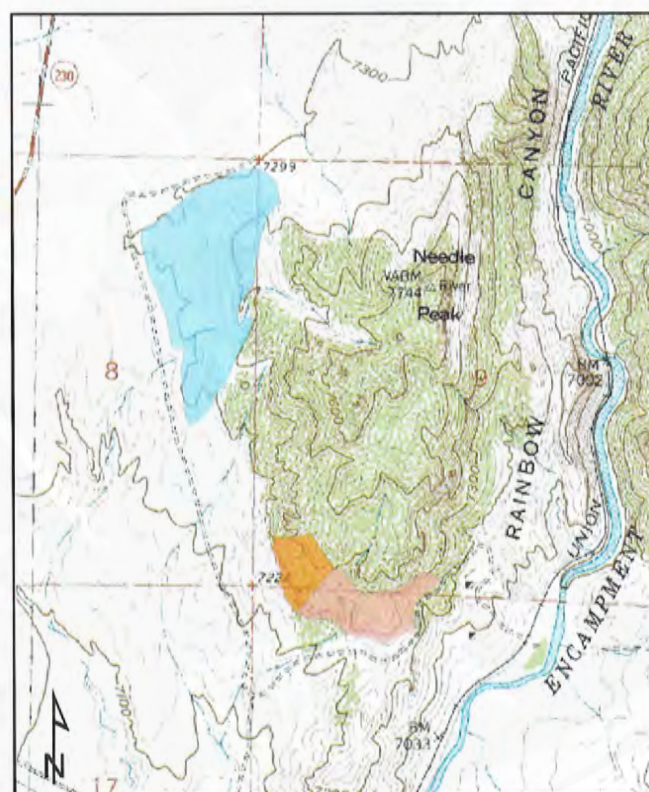


Figure 110. Location map of Baggot Rocks North, West, and East gneiss.

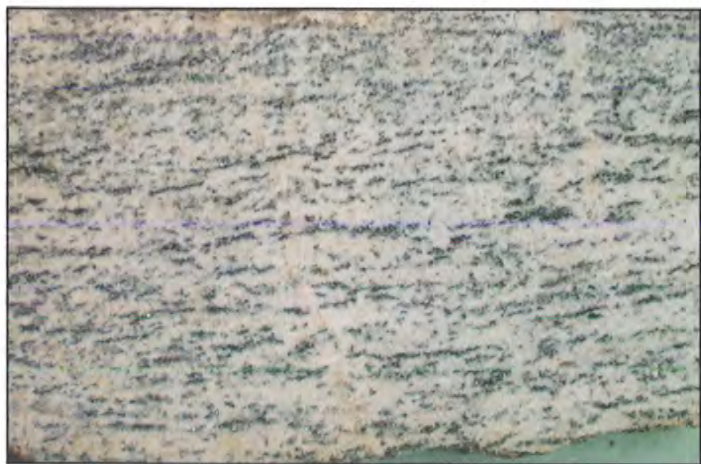


Figure 111. Polished hand sample of the Baggot Rocks West gneiss. Sample is about 8 inches across.



Baggot Rocks East gneiss

Location: S S SW section 9, N N NW section 16, T15N, R83W, Carbon County, Wyoming (**Figure 110**).

USGS 7 1/2-minute Quadrangle(s): Cow Creek.

Land and mineral ownership/status: Federal (BLM) surface and minerals (section 9); State surface and minerals (section 16).

Description: Pink, light-gray, and black banded and swirled gneiss occur at this site. Joints vary between 4 and 10 feet at the surface. Surface samples exhibit minor iron staining along fractures.

Battle Pass red granite

Location: N section 32, T14N, R85W, Carbon County, Wyoming (**Figure 112**).

USGS 7 1/2-minute Quadrangle(s): Red Mountain.

Land and mineral ownership/status: Federal (USFS, Medicine Bow National Forest) surface and minerals.

Description: Bright-red, medium-grained granite (**Figures 113 and 114**) crops out in this area (Houston and Graff, 1995). It is the darkest red granite located to date in southern Wyoming. Exposures are poor so joint spacing cannot be determined, but there are boulders at the surface up to 4 feet in diameter, in an area of extensive weathering on the Continental Divide. This area will need to be tested by drilling. A light-red to pink granite also crops out north of the red granite in S S section 29, T14N, R85W.

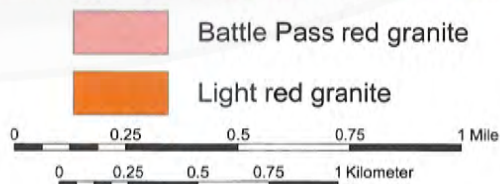
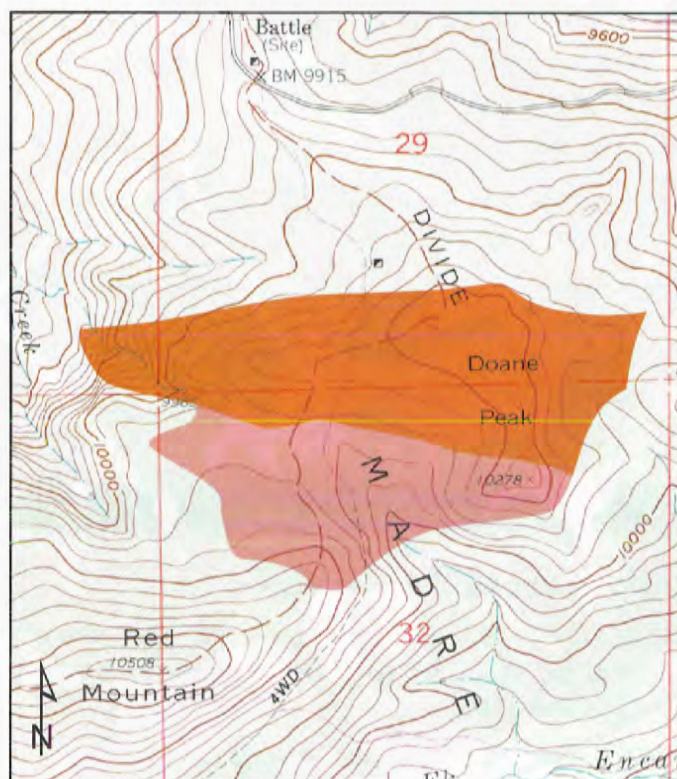


Figure 112. Location map of the Battle Pass red granite (from Houston and Graff, 1995).



Figure 113. Outcrop area of Battle Pass red granite. Boulders in foreground are about 2 feet in diameter.



Figure 114. Polished sample of Battle Pass red granite. Upper scale is inches, lower scale is centimeters.



Dead Horse Park granite

Location: Section 31, T14N, R84W, Carbon County, Wyoming (**Figure 115**).

USGS 7 1/2-minute Quadrangle(s): Blackhall Mountain.

Land and mineral ownership/status: Federal (USFS, Medicine Bow National Forest) surface and minerals.

Description: Light-orange, slightly foliated granite crops out in this area (Houston and Graff, 1995). Vertical and exfoliation joints are spaced 6 to 10 feet apart (**Figure 116**).

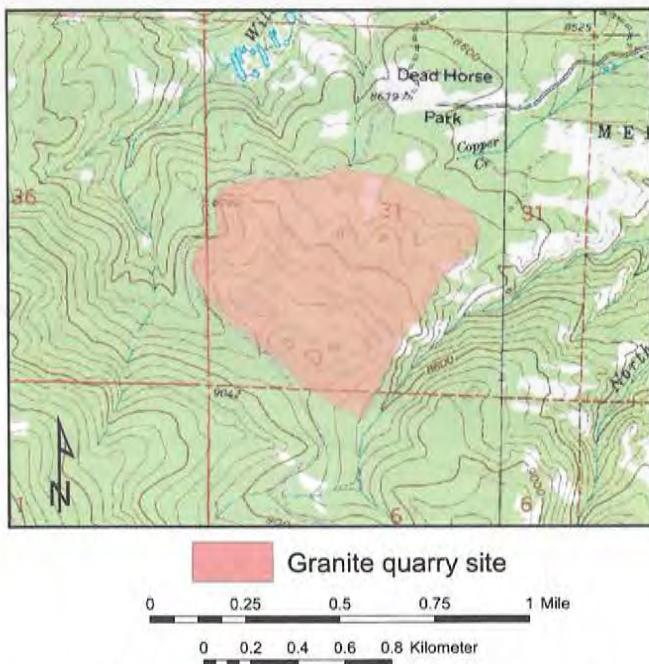


Figure 115. Location of Dead Horse Park granite quarry site. Extent of outcrops is from Houston and Graff (1995).



Figure 116. Typical outcrop of the Dead Horse Park granite showing slight foliation and vertical jointing.

Wood Mountain gneiss

Location: SE section 4, NE section 9, T13N, R83W, Carbon County, Wyoming (**Figure 117**).

USGS 7 1/2-minute Quadrangle(s): Blackhall Mountain.

Land and mineral ownership/status: Federal (USFS, Medicine Bow National Forest) surface and minerals.

Description: Outcrops of a bluish-black and white, banded gneiss occur in this area (**Figure 118**). The outcrops have joints spaced 4 feet apart at the surface. Drilling will be necessary to determine the extent and viability of this stone.

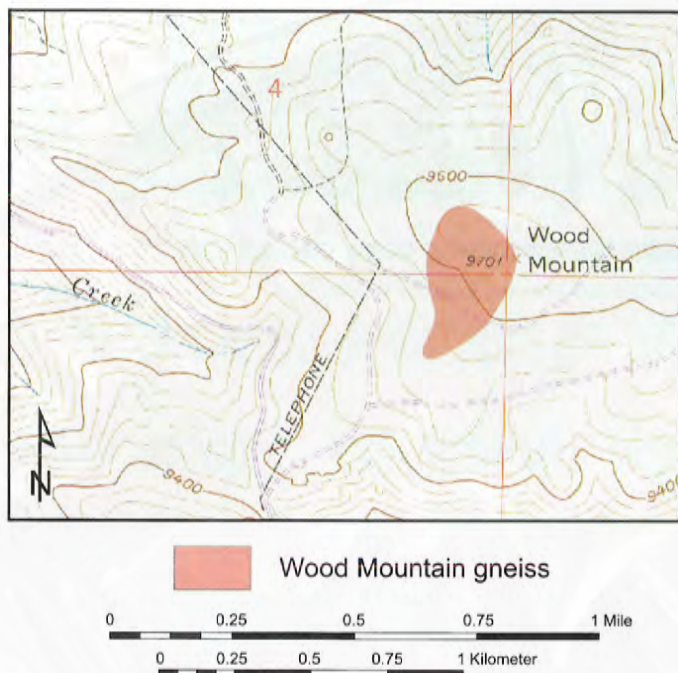


Figure 117. Location map showing outcrops and quarry sites of the Wood Mountain gneiss.



Figure 118. Outcrop and potential quarry site of the Wood Mountain gneiss.

Soldier Creek granite

Location: SW section 17, SE section 18, E E section 19, W and SE section 20, NW section 29, T13N, R84W, Carbon County, Wyoming (**Figure 119**).

USGS 7 1/2-minute Quadrangle(s): Dudley Creek.

Land and mineral ownership/status: Federal (USFS, Medicine Bow National Forest) surface and minerals.

Description: Light-orange, slightly foliated granite crops out in this area (Houston and Graff, 1995). Vertical and exfoliation joints are spaced 6 to 10 feet apart. This area of outcrops (**Figure 120**) is more extensive than the site at Dead Horse Park, and there are more choices for quarry sites, but this area is farther from Encampment and will require more road development. The granite at this site (**Figure 121**) is identical to that at Dead Horse Park.



Figure 119. Location map of potential quarry sites for the Soldier Creek granite. Extent of the granite area is based on Houston and Graff (1995).



Figure 120. Outcrop and potential quarry site for the Soldier Creek granite.



Figure 121. Cut and polished sample of the Soldier Creek granite. Upper scale is inches, lower scale is centimeters.



Horse Mountain area basalts

Location: Section 1, T12N, R89W; sections 5, 6, 7, 8, 17, and 18, T12N, R88W, Carbon County, Wyoming (**Figure 122**).

USGS 7 1/2-minute Quadrangle(s): Grieve Reservoir.

Land and mineral ownership/status: Mixture of private and federal (BLM) surface, federal minerals.

Description: Hills in this area are composed of Tertiary intrusive volcanic rocks of basaltic com-

position. These hills include Horse Mountain, Little Horse Mountain, and Sugarloaf Mountain. The much larger Battle Mountain east of these hills (**Figure 123**) is also composed of basalt. However, it is in a remote roadless location. All the basalts are vesicular and dark gray in color (**Figure 124**). The three most accessible sites are Sugarloaf Mountain, the unnamed hill in section 5, and the unnamed hill in section 18.

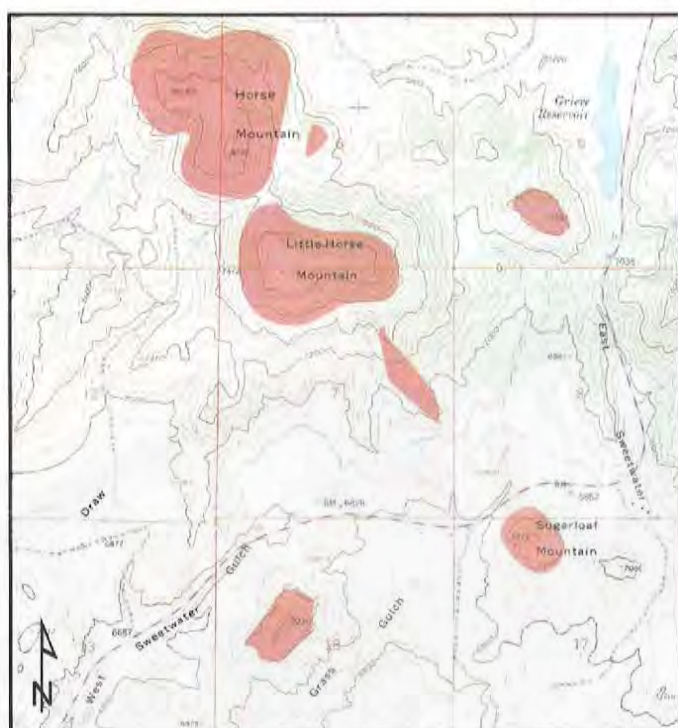


Figure 122. Location map showing outcrop areas of Horse Mountain basalts.



Figure 123. Battle Mountain, on skyline, is capped by basalts related to the Elkhead Mountains volcanic field in Colorado. The smaller Horse Mountain basalts are west of Battle Mountain.



Figure 124. Cut sample of basalt from Horse Mountain area; engineering scale is about 1 foot long.

Southwestern Wyoming sites



Hams Fork sandstone

Location: SW NW and NW SW section 26, NE SE and SE NE section 27, T22N, R116W, Lincoln County, Wyoming (**Figure 125**).

USGS 7 1/2-minute Quadrangle(s): Kemmerer.

Land and mineral ownership/status: Private surface and minerals (NE SE section 27); federal (U.S.

Bureau of Reclamation) surface and minerals (remainder of location).

Description: Sandstone similar to that found at Blazon Gap (below) is present at this site. The sandstone is in the Upper Cretaceous Frontier Formation (**Figure 126**). Wyoming State Highway 233 is adjacent to this site.

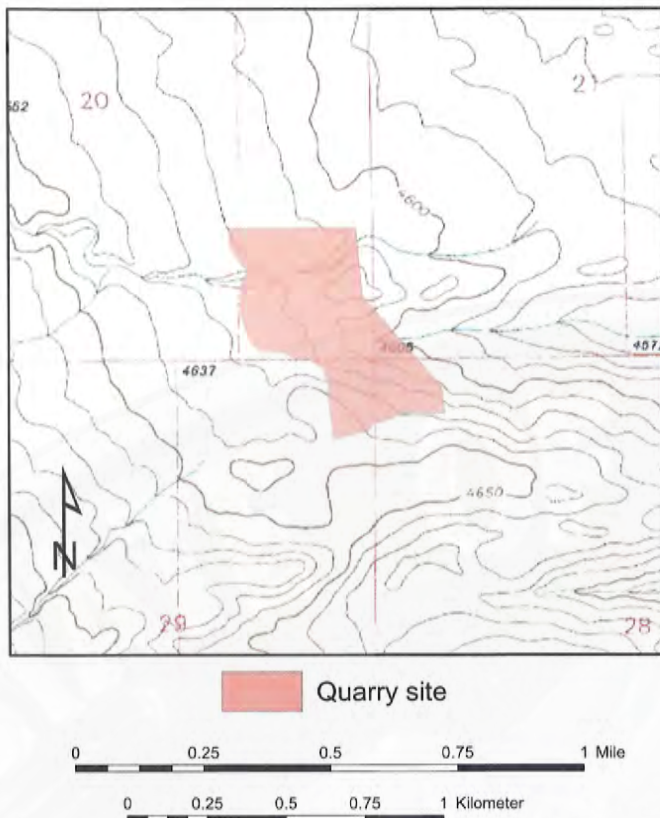


Figure 125. Location map of the Hams Fork sandstone quarry site.



Figure 126. Outcrop of sandstone unit in the Frontier Formation at the Hams Fork quarry site.



Historical Waterfall sandstone quarry site

Location: SW SW SE section 36, T21N, R116W, Lincoln County, Wyoming (**Figure 127**).

USGS 7 1/2-minute Quadrangle(s): Elkol.

Land and mineral ownership/status: Private surface and minerals.

Description: A sandstone bed in the Upper Cretaceous Frontier Formation was quarried at this locality in the late 1800s. This stone was used as facing on the Portland, Oregon, City Hall, and possibly on other structures. The Portland City Hall is undergoing restoration, and the restorers would like to use the stone from the original quarry. However, the quarry site is now adjacent to houses. The sandstone unit quarried crops out along the face of a hogback to the north (**Figure 128**). Small amounts of this sandstone may be removed from this outcrop; however, there is generally too much overburden to allow for a larger quarry.

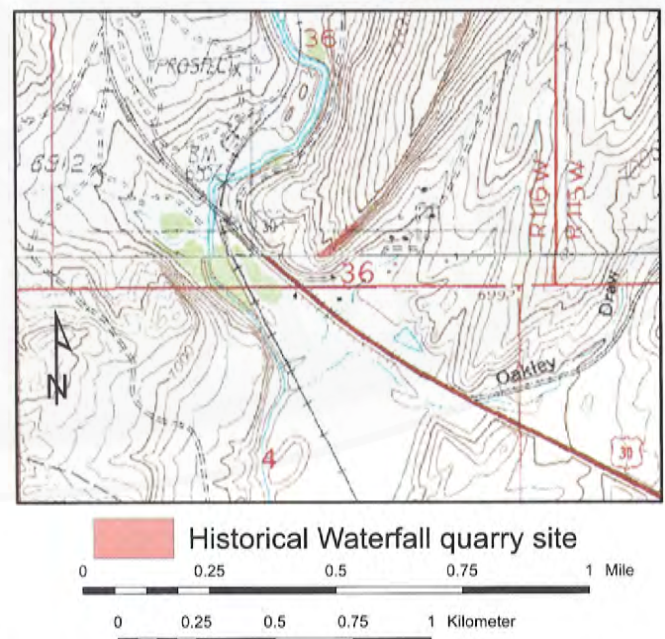


Figure 127. Location map of the historical Waterfall sandstone quarry site.



Figure 128. Outcrop and quarry site for the Waterfall sandstone bed in the Frontier Formation. Note housing development in right center in front of outcrop.



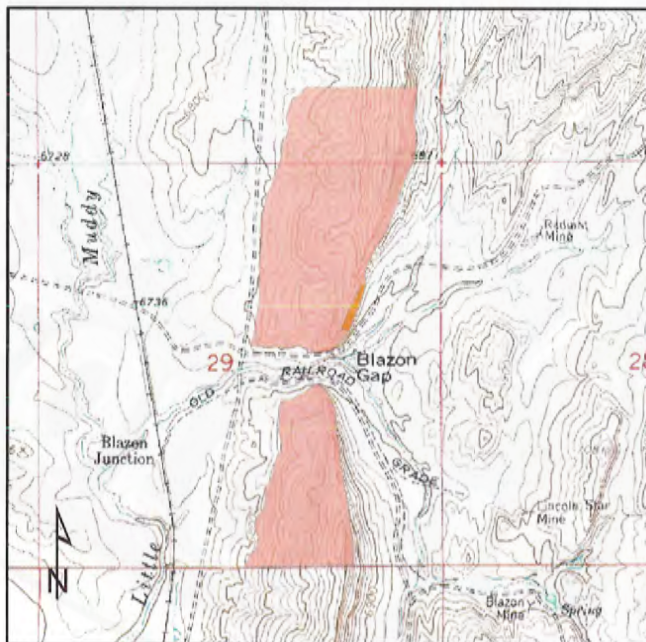
Blazon Gap sandstone

Location: S SE section 20, E section 29, T20N, R116W, Lincoln County, Wyoming (**Figure 129**).

USGS 7 1/2-minute Quadrangle(s): Elkol.

Land and mineral ownership/status: Federal (BLM) surface and minerals (section 20); UP surface, Anadarko minerals (section 29).

Description: Light-beige sandstone of the Upper Cretaceous Frontier Formation crops out in a north-south trending hogback that dips to the west at 30° (**Figure 130**). The sandstone is about 30 feet thick. A recently-operated quarry is present in the W SE NE section 29, T20N, R116W. The sandstone would make a good sawn or split-face stone for facing or trim.



Blazon sandstone quarry area
Existing quarry

0 0.25 0.5 0.75 1 Mile
0 0.25 0.5 0.75 1 Kilometer

Figure 129. Location map of Blazon Gap sandstone outcrop and quarry site.



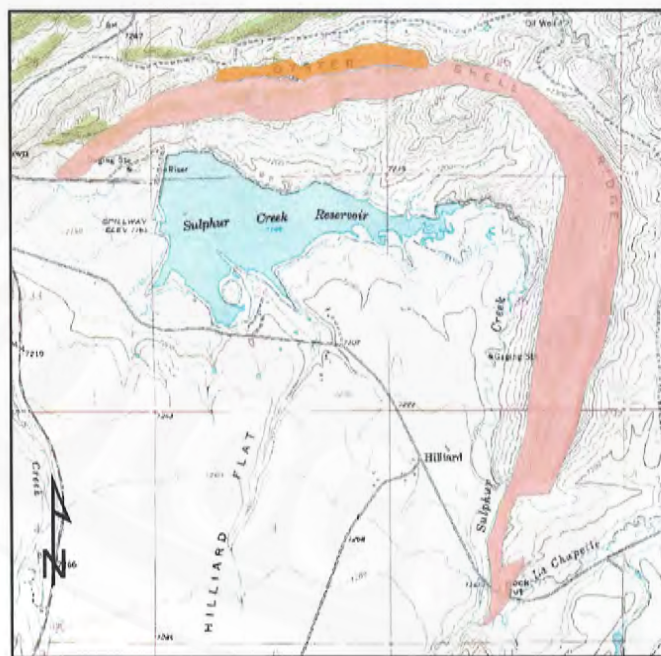
Figure 130. Outcrop and recent quarry for the Blazon Gap sandstone bed in the Frontier Formation.

Oyster Shell Ridge sandstone

Location: C section 2, T13N, R119W; section 26; section 27; SW section 28; section 35, T14N, R119W, Uinta County, Wyoming (**Figure 131**).

USGS 7 1/2-minute Quadrangle(s): Sulphur Creek Reservoir.

Land and mineral ownership/status: Federal (BLM) surface and minerals (NE section 2, T13N, R119W; section 26, N SE section 28, SW NE and NW SE section 35, T14N, R119W). Private surface and minerals (NW and N SE section 2, T13N, R119W); private surface, federal minerals (S SE section 28, T14N, R119W); private surface, Anadarko minerals (section 27 and the remainder of the area in section 35, T14N, R119W). Section 27 may be UP surface.



Oyster Ridge Sandstone Member outcrop
 Quarry site

0 0.25 0.5 0.75 1 Mile
 0 0.25 0.5 0.75 1 Kilometer

Figure 131. Location map of the Oyster Shell Ridge sandstone showing outcrop pattern and possible quarry sites.

Description: Light-beige sandstone containing dark fossil oyster shells (**Figure 132**) is present at this locality. The sandstone is part of the Oyster Ridge Sandstone Member at the top of the Upper Cretaceous Frontier Formation (**Figure 133**). The outcrop forms an arc with dips toward the center, forming part of a syncline with its axis trending northeast to southwest. The sandstone may make an interesting rock for sawn or split blocks used as facing or trim. The proposed quarry site is in SW NW section 26 and C section 27, T14N, R119W.



Figure 132. Close-up view of Oyster Shell Ridge sandstone with preserved oyster fossils (darker areas on the exposed bedding surface).



Figure 133. Outcrop of the Oyster Ridge Sandstone Member of the Frontier Formation near the proposed Oyster Shell Ridge quarry site. Trees on outcrop are about 10 feet tall.

Zirkel Mesa North pumice aggregate

Location: SE SE SE section 10, SW SW SW section 11, NW NW NW section 14, NE NE NE section 15, T21N, R102W, Sweetwater County, Wyoming (**Figure 134**).

USGS 7 1/2-minute Quadrangle(s): South Superior.

Land and mineral ownership/status: Federal (BLM) surface and minerals (sections 10 and 14); UP surface, Anadarko minerals (sections 11 and 15).

Description: Light-tan pumice composes a cinder cone in this area (**Figure 135**). The pumice naturally breaks into rounded pieces 1/2 inch to 1 foot in diameter, which can be screened into size ranges for decorative aggregate. This rock is particularly suitable for landscape rock and is a distinctive color.

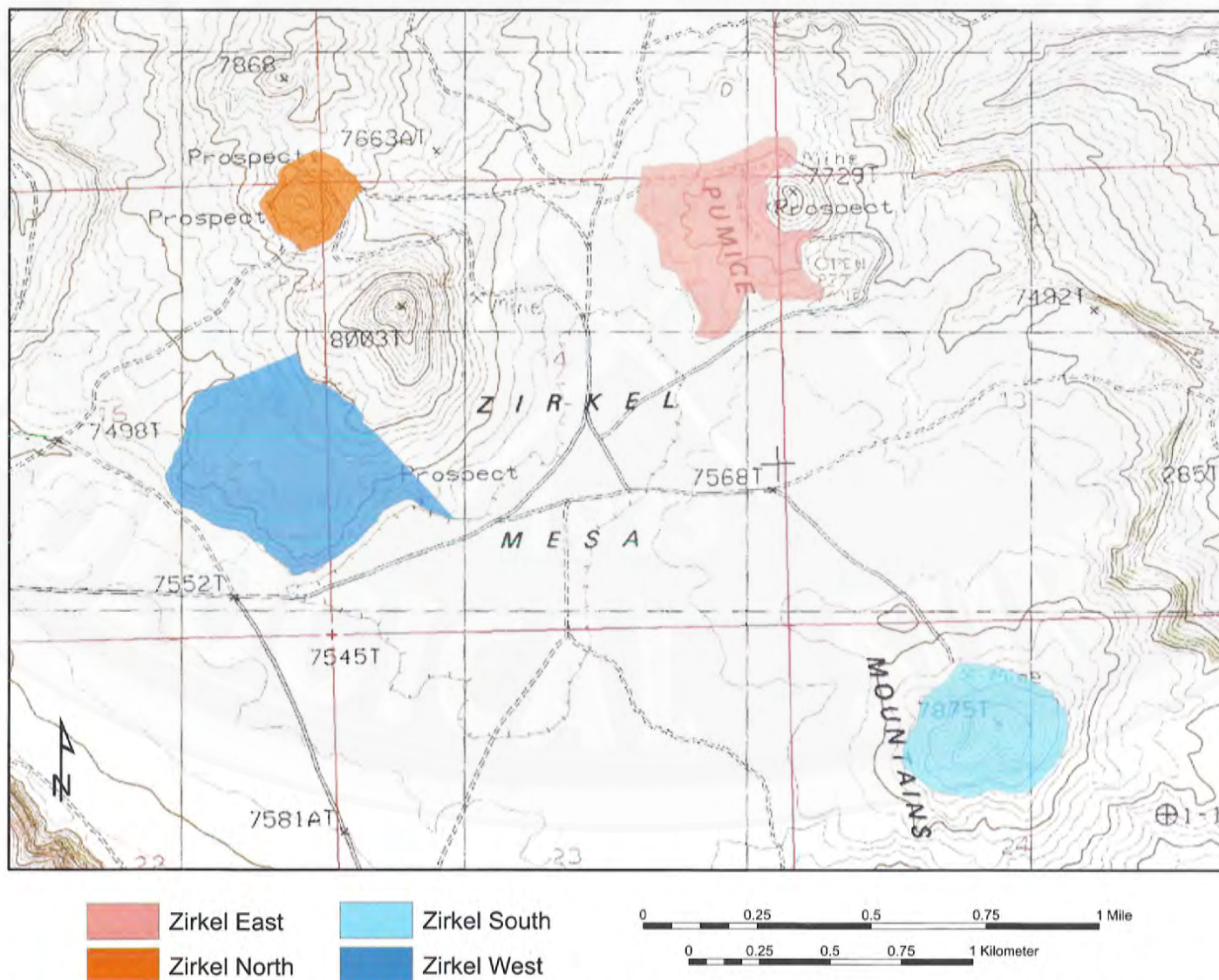


Figure 134. Location map of part of the Leucite Hills volcanic field showing Zirkel Mesa North, East, West, and South quarry sites.



Figure 135. Site of the proposed Zirkel Mesa North pumice aggregate quarry.

Zirkel Mesa East lava

Location: S SE SE section 11, SW SW SW section 12, NW NW NW section 13, NE NE section 14, T21N, R102W, Sweetwater County, Wyoming (**Figure 134**).

USGS 7 1/2-minute Quadrangle(s): South Superior.

Land and mineral ownership/status: Federal (BLM) surface and minerals (sections 12 and 14); UP surface, Anadarko minerals (sections 11 and 13).

Description: The lava flow at this site is similar to Zirkel Mesa West (below), but browner in color. The flow is from 18 to 25 feet thick (**Figure 136**). The phlogopite mica at the site is slightly less distinctive than that at Zirkel Mesa West.



Figure 136. Quaternary lava flow (the nearly horizontal dark band in the middle distance) at the Zirkel Mesa East quarry site.

Zirkel Mesa West lava

Location: W SW and SW SW NW section 14, SE and S SE NE section 15, T21N, R102W, Sweetwater County, Wyoming (**Figure 134**).

USGS 7 1/2-minute Quadrangle(s): South Superior.

Land and mineral ownership/status: Federal (BLM) surface and minerals (section 14); UP surface, Anadarko minerals (section 15).

Description: Uniform gray potassium-rich lava of early Pleistocene age occurs at this locality (**Figure 137**). The rock is vesicular, and contains phlogopite flakes, which create a gold-copper sparkle in sunlight (**Figure 138**). The lava flow is 20 to 22 feet thick with no systematic vertical fractures. One area on the southwest point of the flow has been quarried, probably as a test for the production of potash from the rock.



Figure 137. Outcrop of lava flow at Zirkel Mesa West quarry site. Exposed rock face above vegetation is about 20 feet high.



Figure 138. Close-up view of lava at Zirkel Mesa West site showing the vesicular texture of the rock and phlogopite.



Zirkel Mesa South pumice aggregate

Location: C N section 24, T21N, R102W, Sweetwater County, Wyoming (**Figure 134**).

USGS 7 1/2-minute Quadrangle(s): South Superior.

Land and mineral ownership/status: Federal (BLM) surface and minerals.

Description: Pumice in a cinder cone at this site (**Figure 139**) is similar to Zirkel Mesa North, except grayer in color.

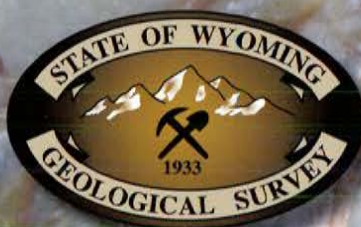


Figure 139. Outcrop of pumice on edge of cinder cone at proposed Zirkel Mesa South pumice aggregate quarry.

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