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SEARCHING FOR GOLD IN WYOMING

by
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Information Pamphlet 9

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Front cover: The Red Mask mine, circa 1955, is located a short distance west of Libby Flat overlook in the Snowy Range, Medicine Bow Mountains, Wyoming. This mine probably produced minor amounts of gold. Pencil sketch by W. Dan Hausel, 2002.

Introduction

When summer arrives in Wyoming, one usually sees an increase in prospectors and rock hounds searching for gold. Even though there are many types of gold deposits in a geologic sense, prospectors often refer to two general types of gold deposits, placer and lode (Hausel, 2001). Some famous placer deposits include the Nome and Flat placers in Alaska. Examples of lode deposits include the Mother Lode in California and Homestake in South Dakota.

Unfortunately, it is not always possible to make a clear distinction between these two types of gold deposits. For instance, the great Witwatersrand gold deposits in South Africa, which have been the most productive in the world, are classified geologically as paleoplacers. Because these are formed of brittle, consolidated rock (mined to depths of greater than 12,000 feet), most prospectors would consider them to be lode deposits. However, geologists classify these as fossil (paleo) placers, since the gold was deposited in streams more than 2.5 billion years ago.

Another not so clear distinction may arise with eluvial deposits (**Figure 1**). Eluvial deposits are essentially composed of detrital material weathered in place from a nearby (often underlying) source. Gold from an eluvial deposit would show little or no evidence of transportation. Since eluvial deposits are unconsolidated, some prospectors would consider them placers, even though they may directly overlie a lode.

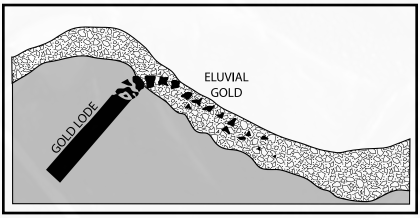

Figure 1. Schematic diagram showing eluvial mineralization caused by weathering and erosion of a hidden vein.

Placer deposits

Placer gold deposits consist of detrital gold and other material transported in streams or by wave action and concentrated with other heavy minerals known as black sands. Black sands primarily consist of dark opaque minerals with greater than average specific gravity, which may include magnetite, pyroxene, amphibole, ilmenite, garnet, sphene, chromite, and monazite, as well as some rare light-colored minerals with relatively high specific gravity such as cassiterite and scheelite.

Other minerals of potential economic interest with relatively high specific gravity that may occur in gold placers include ruby, sapphire, diamond, platinum, and palladium. For example, while prospecting for diamonds in the Laramie Mountains in southeastern Wyoming, we recovered several samples containing trace amounts of ruby and sapphire (Hausel and others, 1988; Hausel, 1998). These are thought to have been derived from nearby mica schists and gneisses.

Upon erosion of bedrock and other parent materials, these heavy minerals are mixed with abundant light-colored, glassy, transparent to opaque minerals with low to average specific gravity such as quartz, apatite, feldspar, and mica. Along with these lighter minerals, minerals with high specific gravity are slowly moved in streams with moderate to high water velocity. The sediment carrying capacity of a stream diminishes with decreased velocity. The heavy minerals concentrate by settling out where diminished velocity occurs; such areas are marked by a distinct increase in black sands. Heavy minerals tend to concentrate at the bottom of a stream along the leading edge of stream meanders, behind obstructions (i.e., rocks, cracks in bedrock) and at waterfalls. Since many streams lack sufficient velocity to carry gold for any great distance, much of the gold in these streams (particularly where it is concentrated in pay streaks) is probably transported during flash flooding events or during heavy spring runoff.

The distances heavy minerals can be transported are not known with any accuracy. Some minerals can be transported great distances. For example, because diamond is 6000 to 8000 times harder than any other mineral and is not very heavy (specific gravity of 3.52 compared to 2.87 for quartz), there are cases where transport distances for diamonds has exceeded 600 miles.

Such great transportation distances for gold are not possible. Gold is too heavy (specific gravity of 15 to 19.3), so when found in streams it is thought to have been derived from a nearby source. In some unusual cases, gold may be transported greater than normal distances while in solution. In Alaska, geologist Paul Graff showed me evidence of gold crystallizing in nuggets downstream but relatively near some lode sources. Maximum transportation distances for gold in solution is unknown, but could be relatively great.

Flash flooding events appear to be important in producing pay streaks. Pay streaks, or lenses of gold-enriched gravel, are often found in zones of coarser-grained pebbles and cobbles. The pay streaks may be scattered over one or more intervals in a vertical column of gravel (**Figure 2**).

Where meanders occur in streams, gold may concentrate on the inside of the initial curve in the channel, as well as in the bank (point bar) on the upstream part of the inner meander where gold was deposited in the

Figure 2. The color change (upper arrows) more than 1 foot above the gold pan (circled) marks the site of a pay streak in the drainage. This pay streak was probably produced during a flash flooding event, or during unusually high spring runoff. A second pay streak was found at the base of the open cut near the standing water (lower arrow). Even though this placer was essentially located in a dry drainage when mined, it was immediately downslope from some lode deposits, and provided a favorable site for gold concentration.

past (**Figure 3**). As an example, one of my favorite places to take students in my prospecting courses is in a dry campground adjacent to a historical gold placer. Here the bank gravel contains enough gold to keep the interest of the students.

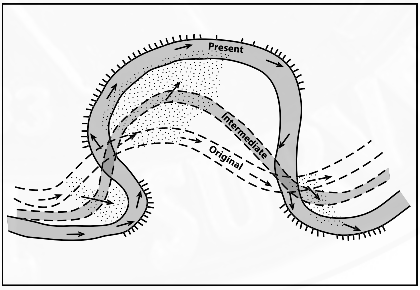

Figure 3. Schematic diagram showing historical development of a meander. Where the stream begins to meander, the water velocity decreases, and minerals with higher specific gravity concentrate there (stippled areas). Through time, the meander may mature, leaving deposits on the inside banks as the stream migrates. Material in the stream as well as the adjacent bank material (which may be high and dry after episodes of flooding and high water) will contain heavy minerals and possibly gold.

In addition to modern placers, some regions contain paleoplacers. Wyoming is famous for abundant paleoplacers scattered over large regions—some have never been prospected, and most have had only limited prospecting. Paleoplacers are simply fossil placers that were deposited by streams or by wave action along prehistoric seas in the geologic past. In most cases, these may not lie anywhere near an active stream or sea today (**Figure 4**); thus, mining would either require transporting water to the paleoplacer, or transporting material from the paleoplacer to water.

Where the paleoplacer consists of relatively unconsolidated gravel, it can be mined in a manner similar to a sand and gravel operation. If the operation is located near a road, the sand and gravel by-product can be used in road construction. Conversely, gold can be extracted as a by-product of sand and gravel operations. For example, gold was found in several sand and gravel operations and placers adjacent to Interstate 80 in southern Wyoming (Hausel and others, 1993). Where paleoplacers are extremely old and well consolidated, such as in the Witwatersrand, the gold is typically mined underground.

Figure 4. This 4- to 6-foot-thick paleoplacer (the gray, bouldery, gravel-capped deposit overlying the lighter bedrock), located along the flank of the Seminoe Mountains, is several hundred feet above and a few miles away from any modern drainage. Note the abundant rounded boulders and cobbles in the fossil drainage.

Lode deposits

One might think of lode deposits as veins or other consolidated rocks that contain anomalously high quantities of metal (e.g., gold). Many lodes occur as distinct quartz veins (**Figure 5**). These may form linear to tabular masses of quartz within country rock. One important characteristic of many productive veins is the presence of sulfides, such as pyrite (fool's gold) or arsenopyrite (arsenic-pyrite).

When pyrite oxidizes, it produces sulfuric acid and rust, resulting in a gossan at the surface and a potential supergene zone (a mineral deposit, or enrichment, formed by descending fluids) a few tens of feet below the surface. Gossans are the oxidized sulfide-rich parts of veins and other mineral deposits that have a distinct, rusty appearance (**Figure 6**). These gossans offer excellent visual guides in the search for gold and other mineral deposits. In any historic mining district, you will often find dozens, if not hundreds, of old prospect pits dug into the rusty rocks. Prospectors learned to recognize these gossans as important guides to ore deposits.

Gossans are good places to search for high-grade gold in lodes. The recognition of gossans in the field can be very helpful to the prospector. For example, gossans produced from the leaching of pyrite are typically very rusty (reddish-brown) in appearance; gossans produced from arsenopyrite are typically greenish-yellow. Gossans are so important

Figure 5. Quartz vein exposed in the mine rib at the Mary Ellen gold mine, South Pass, Wyoming.

that an entire book was written on their different characteristics (Blanchard, 1968).

Large gossans that cover several acres may be situated over giant sulfide-enriched veins or massive sulfide deposits. These may contain gold and/or valuable base metals (copper, zinc, lead, etc). One very large gossan in the Hartville uplift in eastern Wyoming is so distinct that it has been named "Gossan Hill"—it overlies a massive sulfide deposit. One of the better places to look for specimen-grade gold samples is within gossans containing boxworks. Boxworks is a distinct vuggy and rusty rock (**Figure 7**).

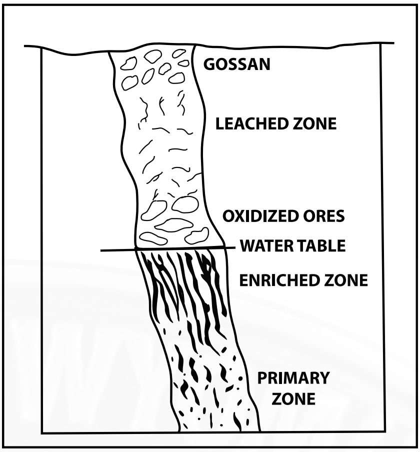

Figure 6. Schematic diagram illustrating the gossan cap overlying a gold-bearing vein.

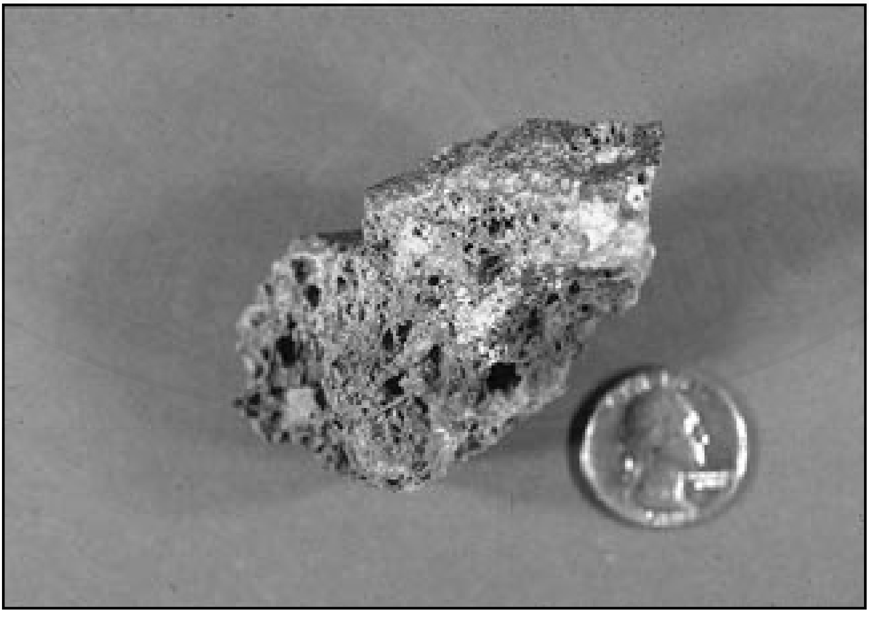

Figure 7. This hand specimen of boxworks exhibits pore spaces that formed where sulfide minerals used to be. The sulfides were leached and removed during the past. Gold, which often is found in the sulfide known as pyrite, is inert, and may remain in place within the boxworks.

Some faults and associated breccias may also be mineralized. Breccias are zones of broken rock containing distinct angular rock clasts. When found, gold may occur in the matrix of the strongly limonite-stained gossan surrounding the rock fragments **(Figure 8)**. Other faults, known as shears, may also be mineralized. These shear zones consist of granulated rock (**Figure 9**). Within many of these shears, gold is often found associated with rust-stained quartz. Many shear zones, particularly those in greenstone belts, have been quite productive for gold. In some gold mining districts in the world, nearly every foot of the exposed shear zone has been prospected at the surface (**Figure 10**).

Ore shoots

Many veins have sporadic gold values with localized ore shoots enriched in gold. Some of these shoots may be enriched 100 to 1000 times the average value of the vein. The challenge given the prospector is how to recognize these shoots.

Ore shoots can be structurally or chemically controlled. Where pressures and/or temperatures dramatically dropped during hydrothermal mineralizing events, structurally controlled ore shoots occur. Chemically controlled ore shoots may occur where there was a chemical reaction between the mineralizing fluids and country rock.

Figure 8. Breccia with angular clasts of country rock in a limonite-rich matrix.

Figure 9. Platinum- and gold-enriched shear zone in the Centennial Ridge district, Wyoming.

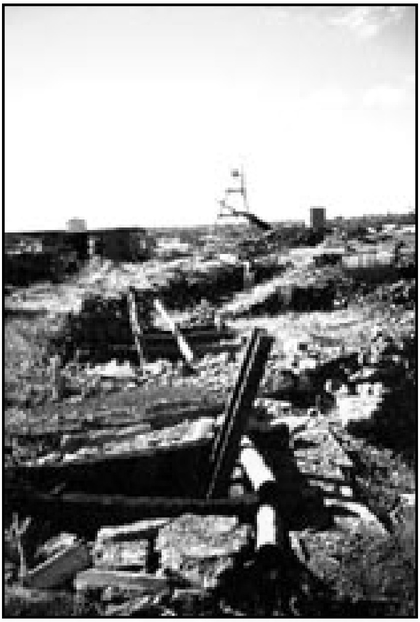

Figure 10. Intensely prospected auriferous shear zone in the Southern Cross district, Australia.

When searching for structurally controlled ore shoots, it is necessary to look for places where one would expect the pressure to have decreased along vein systems. Some structurally controlled ore shoots are found in folds (**Figure 11**). Many fold closures in gold-bearing veins will be enriched in gold. Another type of structurally controlled ore shoot includes vein intersections (**Figure 12**). Some intersections of gold-bearing veins have been dramatically enriched in gold.

There are many other types of structurally and chemically controlled ore shoots. For example, while prospecting in the Gold Hill district in the Medicine Bow Mountains of Wyoming, I noted that gold was almost exclusively found in veins adjacent to amphibolite. Veins in quartzite were unproductive. Additional information on ore shoots can be found in various books on economic geology and ore deposits (see Earll and others, 1976; Evans, 1980; and Peters, 1978).

Conclusions

The search for productive gold deposits requires a good background in prospecting and economic geology as well as some luck. There are still many placer and lode deposits to be found, although the discovery of entirely new mining districts is rare. In all my years as an exploration

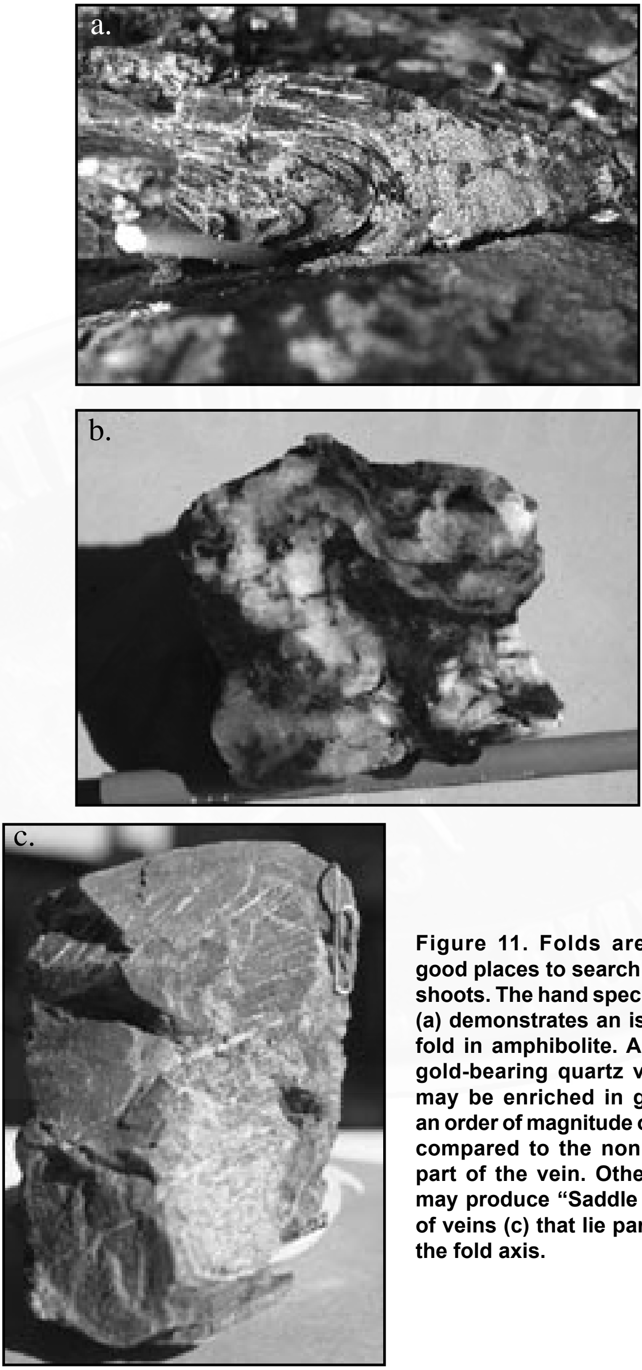

Figure 11. Folds are often good places to search for ore shoots. The hand specimen in (a) demonstrates an isoclinal fold in amphibolite. A folded gold-bearing quartz vein (b) may be enriched in gold by an order of magnitude or more compared to the non-folded part of the vein. Other folds may produce "Saddle Reefs" of veins (c) that lie parallel to the fold axis.

Figure 12. Hand specimen illustrating intersecting quartz veins.

geologist, I have only been able to find one new gold district. However, I have found many gold deposits within known districts.

Some of the better areas to search for gold are historical mining districts (**Figure 13**). In my experience, it is rare that any ore deposit has been completely mined out. Many historical and modern mines still contain workable mineral deposits as well as nearby deposits that have been overlooked. Many well-known giant mining companies of the past were notorious for overlooking significant ore deposits. Thus, one could potentially make a living just following up on the exploration projects of many of these past giants [as well as some projects of present giants].

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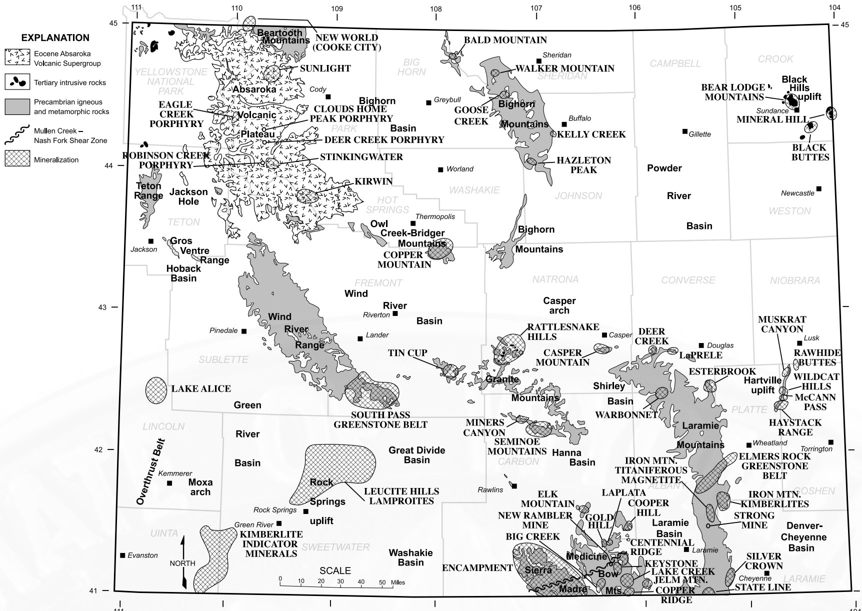

Figure 13. Principal mineralized areas and mining districts in Wyoming (from Hausel and Sutherland, 2000; original modified from Hausel, 1997).

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Recommended publications on gold available from the Wyoming State Geological Survey

Bulletin 66–Minerals and rocks of Wyoming (1986).

Bulletin 68–The geology of Wyoming's precious metal lode and placer deposits (1989).

Bulletin 70–Copper, lead, zinc, molybdenum, and associated metal deposits of Wyoming (1997).

Bulletin 71–Gemstones and other unique minerals and rocks of Wyoming—A field guide for collectors (2000).

Public Information Circular 23–Tour guide to the geology and mining history of the South Pass gold mining district, Fremont County, Wyoming (1984).

Public Information Circular 32–Guide to the geology, mining districts, and ghost towns of the Medicine Bow Mountains and Snowy Range scenic byway (1993).

Report of Investigations 28–Economic geology of the Copper Mountain supracrustal belt, Owl Creek Mountains, Fremont County, Wyoming (1985).

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