Montana Sapphires

Montana Geology 2013

January

Su	Mo	Tu	We	Th	Fr	Sa
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

February

Su	Mo	Tu	We	Th	Fr	Sa
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28		

March

Su	Mo	Tu	We	Th	Fr	Sa
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

April

Su	Mo	Tu	We	Th	Fr	Sa
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30				

May

Su	Mo	Tu	We	Th	Fr	Sa
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

June

Su	Mo	Tu	We	Th	Fr	Sa
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30						

July

Su	Mo	Tu	We	Th	Fr	Sa
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

August

Su	Mo	Tu	We	Th	Fr	Sa
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

September

Su	Mo	Tu	We	Th	Fr	Sa
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30					

October

Su	Mo	Tu	We	Th	Fr	Sa
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

November

Su	Mo	Tu	We	Th	Fr	Sa
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30

December

Su	Mo	Tu	We	Th	Fr	Sa
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

Butte Office
1300 W. Park Street
Butte, Montana 59701-8997
406-496-4180

Montana Bureau of Mines and Geology

Billings Office
1300 North 27th Street
Billings, Montana 59101
406-657-2938

Introduction

The first reported discovery of sapphires in the U.S. was in 1865, by miners seeking gold in gravel deposits along the Missouri River near Helena—but there was no "sapphire rush." Early miners recognized that the stones were unusual, but with no obvious market they continued to focus on gold. More sapphires were soon discovered in other gravel deposits in southwestern Montana. The most famous Montana deposit was discovered when sapphires found in gravel were traced to the igneous dike at Yogo, in central Montana, in 1895. From about 1900 until the late 1930s, Montana developed sapphire mines that produced tons of sapphires. These were used mainly for watch bearings, with lesser production for the gemstone market. Mining production dropped when synthetic sapphires came into widespread industrial use. Today the three primary areas still in production are Rock Creek, the Missouri River, and Yogo. The Yogo deposit is mined for the gemstone market, producing rare and highly valued gems, and the other two are mined for the direct sale of gemstones and to produce sapphire-bearing gravel for tourists to sieve. Montana designated the sapphire as an official state gemstone in 1969.

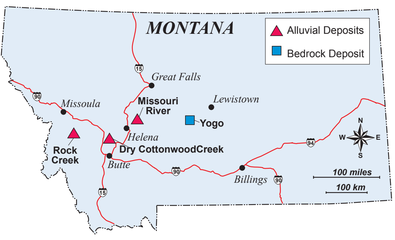

Figure 1. Locations of primary sapphire production areas in Montana.

Sapphires and rubies are both gem varieties of the mineral corundum (Al_2O_3). Rubies are red. Most people probably think of sapphires as blue, but the term is used to cover all colors of gem-quality corundum other than red.Corundum's light-transmitting properties and hardness of 9, ranking next to diamond, make it a durable and very attractive gemstone.

The actual color of a sapphire depends on trace-metal impurities, and can be changed by heat treatment. Worldwide, most of the natural sapphires today are heat-treated. As with all gemstones, color, weight, clarity, and cut are the primary factors determining price. Blue, orange, and pink are the most desirable colors for sapphires.

Rock Creek District

This very large sapphire district, extending over 19 square miles, is in the Sapphire Range of southwestern Montana. Recent work indicates the sapphires were probably carried to the surface by lava flows and volcanic ash about 50 million years ago. Weathering liberated the sapphires from the volcanic host rock, and stream transport combined with the relatively high density of sapphires concentrated them in alluvial gravels.

Sapphires were discovered here in 1892, and substantial production through both ground sluicing and hydraulic sluicing continued through 1928. Estimated total historic production is 65 tons, with an additional 5 tons of reported reserves. After the introduction of synthetic sapphires, production was slow until the early 1980s, when various operators offered the opportunity for the public to dig or sieve sapphire concentrate for a fee.

Sapphires from this district show a large range of colors, mostly pale green to pale blue, but also yellow, purple, and pink, with rarer sapphires that have orange cores. Rubies are extremely rare. Most of the sapphires from the Rock Creek deposit are too pale in color to be desirable as gemstones without heat treatment. Sapphires from this district typically have a rounded appearance, but some are tablet-shaped and others retain the prismatic form. The circle of gems in the front photo were all harvested from Rock Creek.

Because of its large area, tremendous past production, and the high percentage of sapphires that are amenable to color enhancement by heat treatment, the Rock Creek district has the greatest potential of any Montana alluvial district for significant future production.

Missouri River District

Sapphires occur in terrace gravels along a 22-mile stretch of the Missouri River northeast of Helena. Following the initial discovery in 1865, at least seven individual deposits, called bars, have been and continue to be mined for gold and sapphires. The largest of these is Eldorado Bar, which has an area of almost 1 square mile. Total estimated production is approximately 3 tons for this district.

Missouri River sapphires are typically blue-green, relatively large, and rounded. They are generally too pale to be sold as gems without heat treatment, but the percentage that responds to treatment is lower than those from Rock Creek. Rare pale blue sapphires have also been found.

Sapphire gravel mined at Eldorado Bar is currently sold for screening by the public. Most of the testing and mining of the Missouri River deposits has been done on Eldorado Bar, but some of the other bars still have sapphire potential. Little work has been done thus far to try to find the bedrock source(s) of these sapphires.

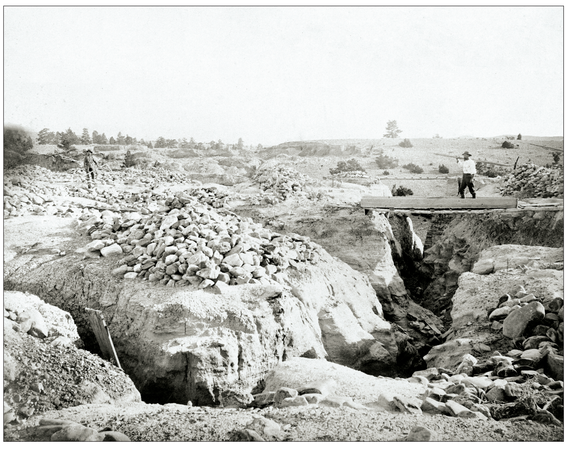

Figure 2. Sapphire mining on Dana Bar on the Missouri River. Photo courtesy of the Montana Historical Society Research Center—Photograph Archives, Helena, Montana.

Front Photo: Middle stone is a Yogo sapphire, 1.17 carats, from The Gem Gallery in Bozeman. The circle is a collection of rough and cut Montana gems from the Rock Creek deposit. The largest faceted stone weighs 0.46 ct and the largest rough crystal weighs 1.86 ct. Photos by Tino Hammid, courtesy of Robert Kane of American Sapphire Company, Beverly Hills, California.

Yogo District

The Yogo district, in central Montana, is the most famous of the Montana sapphire districts. Yogo sapphires are noted for their intense blue coloration, sometimes referred to as cornflower blue; some are even violet. Because of their natural attractive colors, Yogo sapphires do not need heat treatment. They are also generally free from mineral inclusions. Unfortunately most sapphires from this deposit are tabular and typically small, with less than 10 percent of recovered stones weighing more than 1 carat.

According to local legend, in 1895 gold miner Jake Hoover suspected that the blue stones found in his sluice box were of value and gave them to an assayer, who sent them off to Tiffany & Co. in New York City. George F. Kunz, their gemologist and Vice President, promptly sent him a check for $3,750.

Yogo also has the distinction of being the only Montana district where sapphires are mined from bedrock. These sapphires occur in lamprophyre dikes (ouachitite), about 48 million years old, that contain phenocrysts of clinopyroxene and phlogopite in a ground mass of analcime. The recovery of sapphires from the host rock has always been a challenge. More than a hundred years ago the New Mine Syndicate built large wooden platforms where they piled freshly mined ore to let this slightly altered rock soften by weathering, so they could recover the sapphires without significant breakage. In recent years the ore from underground mines has been processed in a washing plant similar to that used for the recovery of placer gold.

Because of limited production of sapphires from this deposit, the retail prices for Yogo sapphires have doubled in recent years. The retail price of a cut, 1-carat Yogo sapphire in Montana in 2012 is around $10,000, with some unusually fine gemstones costing more.

Discovery of a new sapphire-bearing dike by core drilling as recently as 1993 is an indication that this district has not been fully evaluated. Judging from the increase in prices, it appears that the market for these sapphires is far from saturated.

Figure 3. Yogo sapphires. Right, above: a Yogo in place in the bedrock; the gem is 7 mm long. Photo by Dick Berg. Left: Yogo sapphires set in a flower ring, showing their distinctive blue color. Photo courtesy of The Gem Gallery, Bozeman, Montana.

Geology

Considering the impressive historic and continuing production of Montana sapphires, it is somewhat surprising that more is not known about the geology of these deposits. Although numerous articles describe mineral inclusions and gemological characteristics of the sapphires, with the exception of the Yogo deposit, there are few detailed geologic maps.

Worldwide, most major sapphire production is from alluvial deposits where the sapphires weathered from older rocks, leaving important questions: (a) what were those older rocks, and (b) did the sapphires originate in those older rocks or from some other source? In the Rock Creek district of Montana it appears that volcanic rocks transported them from a deeper and older unexposed source rock. The same may apply to the Missouri River sapphires, but this remains to be established. The Yogo sapphires are hosted in igneous dikes, but there is some evidence that these sapphires formed in the mantle, and the magma that formed the dikes merely served to transport the sapphires. Various techniques, including geochemistry, mineral inclusions, and oxygen isotopes, have been used to investigate the ultimate origin, but none appear to provide unique solutions to this puzzle. Investigations are still ongoing.

Figure 4. Sapphire mining using a sluice, Yogo Creek, 1930. Photo courtesy of the Montana Historical Society Research Center--Photograph Archives, Helena, Montana.

Future

At least 25 purported sapphire occurrences are known in southwestern Montana. It is likely that common minerals such as quartz and feldspar have been incorrectly identified as sapphires at most of these; however, there is no doubt that additional sapphire occurrences will be confirmed. For example, despite several reports of sapphires having been found in alluvium a couple miles west of Butte, it was not until 2004 that these reports were verified with the find of a 6.5-carat sapphire. This was followed by the identification of small sapphires from another gulch approximately 2 miles west of the Montana Tech campus.

An intriguing possibility remains that other Yogo-type deposits may be found in central Montana. In that region, igneous activity has formed numerous dikes that are similar in age and composition to the ouachitite dike that hosts the Yogo sapphires. These dikes are particularly abundant in the area north of the Highwood Mountains of central Montana, approximately 46 miles northwest of the Yogo deposit. Montana's other sapphire districts were discovered by placer miners seeking gold, but with the exception of Pohlod Creek in the Highwood Mountains, there is little evidence of placer mining in this large area. Systematic sampling for sapphires might reveal a new occurrence…and a "sapphire rush" could yet happen.

Acknowledgments

This calendar would not have been possible without the help of the following individuals, who generously donated their images, time, and expertise: Robert E. Kane, President of Fine Gems International, Beverly Hills, California; Don Baide, owner of The Gem Gallery, Bozeman, Montana; Shirley Beck and Dale Siegford, owners of Sapphire Gallery, Philipsburg, Montana; Chris Cooney, owner of Gem Mountain, Philipsburg, Montana; and Chris Van Laer, Asterism Services. Text was written by Dick Berg and Edmond Deal, MBMG; editing and layout by Susan Barth, MBMG. The MBMG has a continuing research program on Montana sapphires.

Montana Bureau of Mines and Geology

Montana Tech of The University of Montana

Scope and Organization

The Montana Bureau of Mines and Geology (MBMG) was established in 1919 as a non-regulatory public service and research agency for the State of Montana, to conduct and publish investigations of Montana geology, including mineral and fuel resources, geologic mapping, and groundwater quality and quantity. In accordance with the enabling act, the MBMG conducts research and provides information.

Contact Us:

Butte Office
1300 W. Park Street
Butte, MT 59701-8997
406-496-4180 Fax: 406-496-4451

Billings Office
1300 North 27th Street
Billings, MT 59101-0108
406-657-2938 Fax: 406-657-2633

http://www.mbmg.mtech.edu

Abandoned and Inactive Mines	496-4606	Groundwater Information Center	496-4336
Analytical Services	496-4767	http://mbmggwic.mtech.edu/	
Coal/Coalbed Methane	657-2702	Groundwater Investigation Program	496-4848
Coalbed Hydrogeology	657-2929	Environmental Hydrogeology	496-4157
Director's Office	496-4180	Mineral Museum	496-4414
Earthquake Studies Office	496-4332	Oil & Gas	657-2702
http://mbmgquake.mtech.edu/		Public Inquiry/Information	496-4174
Economic Geology	496-4171	Publication and Map Sales	496-4174
Geographic Information Systems Laboratory	496-4151	http://www.mbmg.mtech.edu/pubsales	
Geologic Mapping	496-4326	Publications Division	496-4687
Groundwater Assessment Program	496-4306	Research Division	496-4153