The Schwartzwalder Uranium Mine.

By Erik Hunter

Introduction

The Schwartzwalder Uranium mine is located in the Ralston Buttes District of Jefferson County, about 8 miles North of Golden, Colorado. It is the most productive Uranium Mine in the Front Range of Colorado and the "most productive uranium vein deposit in the United States" (Young 1955, p. 16). One of the most interesting aspects of the mine is that it was discovered by an amateur prospector. Fred Schwartzwalder, a janitor at Golden High School, spent a great deal of his free time prospecting for valuable minerals in the Front Range. As it turned out, a friend of his identified one of Fred's samples as high grade pitchblende. In 1949, Fred finally found the original spot where he had taken the sample and proceeded to drive a tunnel using hand steels and blasting powder. It is estimated that it took Fred 5 years to drive a 50 foot tunnel (Brodie p. 5).

A showing of high grade ore at the end of the tunnel persuaded Fred to seek the help of USGS geologists in Denver. They helped him with further exploration, which showed that there was no ore in the level below the first tunnel. At this point, the geologists recommended that Fred sell his claim and run. To make matters worse, in approximately 1954, a man showed up at the workings and informed Fred that he was the rightful owner of the surface and mineral rights. Fred persevered and cut a deal with the owner, Paul White. They agreed to sell the property to the highest bidder. In 1955, Steve Brodie and Charles Parker formed the Denver -Golden Oil and Uranium Corporation and signed a contract to purchase the property and become the operator (Brodie, p. 13). What would follow would be a very profitable venture for everyone involved.

Geology and Mineralogy

The Schwartzwalder mine is located near several other smaller vein-type pitchblende deposits in "Precambrian gneisses and schists of the Idaho Springs formation" (Young 1977, p. 2). The ore zones are entirely fracture-controlled. (Young 1977, p. 9). The ore mineral, pitchblende is found exclusively in "Cymoid" or "S" shaped veins which were created by uranium-rich hydrothermal fluids about 60 million years ago (Wright, p. 84). The Illinois Fault System is the primary zone of economic interest. Notably, though, during the late 1980's, a significant amount of mining took place along the Precambrian West Rogers Reef, according to mine manager Tom Bucholz. A system of fractures within the Illinois Fault System, known as "Horsetail Fractures" are a major source of ore, with veins of pitchblende up to several feet thick. Horsetail fractures are known to structural geologists as a unique feature of strike-slip faults. The force of the fault is distributed through a large volume of rock relative to the volume that the primary fault occupies. This is one of the reasons why this particular mine was so successful. Uranium rich fluids were allowed to mineralize a great deal of rock due to this unique aspect of rock mechanics.

The rock types that have been identified in the mine are as follows: hornblende gneiss, quartz-feldspar gneiss, quartzite, garnet-biotite gneiss, and mica schist. The host rocks for the ore are a "Proterozoic sequence of garnet-biotite gneiss and quartzite that forms a thin transition zone between regionally more extensive units of hornblende gneiss and mica schist" (Wallace and Karlson, p. 1844). The ultimate source of the uranium-rich fluids is not agreed upon. Some geologists claim that it is leached from the Precambrian igneous rocks. Other geologists assert that it was leached from the Paleozoic sedimentary rocks, which unconformably overly the Idaho Springs formation at the mine site. One issue that there is agreement on, however, is the extraordinary amount of uranium in the ore. The shipping grade of ore was nearly 1% uranium oxide. Some individual samples have been assayed at 58% uranium oxide (Paschis, p. 126). To put this in perspective, in 1951, the A.E.C specified a cutoff grade of just 0.10 percent! The ore contains other valuable elements such as molybdenum, thorium, nickel, cobalt, silver, and arsenic (Paschis, p. 126).

Mining Method and Layout

Following the exploratory tunnels, the mining method used initially was shrink stoping. Paschis described this as "shrink stope methods using jacklegs and stopers". He states that the drilling was also done with the aid of " air track mounted down the hole hammers in the steep, wide veins" (p. 128). This mining was done under volume based contracts between Denver-Golden and a "small team of 2 or 3 miners" (Brodie, p. 14). Brodie characterized that type of arrangement as fair and profitable for both labor and management. The early layout consisted of two vertical shafts with levels spaced 125 feet apart as they descended along the steeply dipping orebody (Figure 1). The mining mostly took place on the hangingwall horsetail splays. The ore separated cleanly from the host rock, making the shrinkage stoping method particularly profitable. As the mine ran deeper, different orientations of the orebody were encountered. Wright describes the mining as "room and pillar on flat veins, shrink stope on steep veins, or longhole sub-level blasting on the Illinois" (p.89).

Production

Early production figures on the Schwartzwalder Mine are difficult to find, although Steve Brodie estimates the daily production as "several" 25 ton truckloads (Brodie p.7). In 1965, the Cotter Corporation acquired the property, and continued the mining process at a rapid rate. In 1980, Wright estimated the production at 600 tons per day.

Grade Control

Even though the vein deposit had a very distinct visual appearance, careful mining methods and planning were necessary to ensure that the shipping grade of the ore was relatively high for two reasons. First, the haulage to the mill was far. At first, it had to be trucked to Grand Junction, then later to the Cotter mill in Canon City. Secondly, the Cotter Corporation, which was purchased by Commonwealth Edison in 1974, was required to supply the uranium to ComEd for less than market value. One of the most interesting features of the Schwartzwalder Mine was its advanced on site ore handling facility, installed in the late 1970's (Figure 2). This system exploited the relationship between gamma radiation emanation form the ore and the size of the ore particles. A photoelectric eye and scintillometer were interfaced by means of a computer. Ore pieces traveling along a belt were individually analyzed by this system and are separated by means of compressed air blast onto two different conveyor belts. Wright reports that the system rejected pieces that would have assayed at .02% or less uranium oxide (p. 90). The average grade of the ore delivered to the Canon City mill in 1977 was about 0.6% uranium oxide (Wright p. iii).

Haulage

Haulage from the face to the surface raises was reported by Paschis to be "moved by slushers, trackless loaders and youngbuggies. Muck transfer is done in part by 1 yard front end loaders to ore and waste raises then hoisted to the surface" (p. 128). Wright describes this process as "rather costly" in the offset shaft circuit (p. 89).

Ventilation

Paschis describes the ventilation system as moving 250,000 cfm into the mine with 75 horsepower fans (p. 126). He states that "An 8 foot diameter raise bore was completed in 1977 to exhaust the lower levels of the mine. As the deeper levels are developed, they will be connected to this ventilation borehole, located away from the ore trend" (p. 126)

Ore Analysis by Author

A sample of the Schwartzwalder ore was gathered personally by the author. Gamma ray analysis was performed on the sample (Figure 3). The instrument used was a Berkeley Nucleonics SAM-905 gamma ray spectrometer. The gamma emitting isotopes found by the SAM-905 were as follows: Bismuth 207, Radium 226, Thallium 208, and Bismuth

214 (Figure 5). Radium 226 and Bismuth 214 are decay products of uranium 238. The presence of Bismuth 207 is most likely a misidentification by the Sam-905, as Bismuth 207 is an artificially produced element. The presence of Thallium 208 is notable because it is in the Thorium 232 decay series, and has a half-life of only 183 seconds. This ore sample is remarkably similar to the Ascension Mine, located about 6 miles to the south along Golden Gate Canyon Road. The ore from the Ascension mine was found with the Sam-905 to contain Bismuth 207, Radium 226, Bismuth 214, and Potassium 40. More detailed analysis should be formed with a more sophisticated germanium detector to resolve the Bismuth 207 issue.

References:

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Wallace, Alan and Karlson, Richard. "The Schwartzwalder Uranium Deposit, I: Geology and Structural Controls on Mineralization." Economic Geology v. 80 (1985): pp. 1842-1857

Wright, John "Economic Geology of the Schwartzwalder Mine." Colorado School of Mines Uranium Resource Technology Seminar III. Colorado School of Mines Press. (1980) pp. 73-92

Young, E.J. "Geologic, radiometric, and mineralogic maps and underground workings of the Schwartzwalder uranium mine and area, Jefferson County, Colorado. USGS Open File Report 77-725. Washington, USGS 1977.

Figures

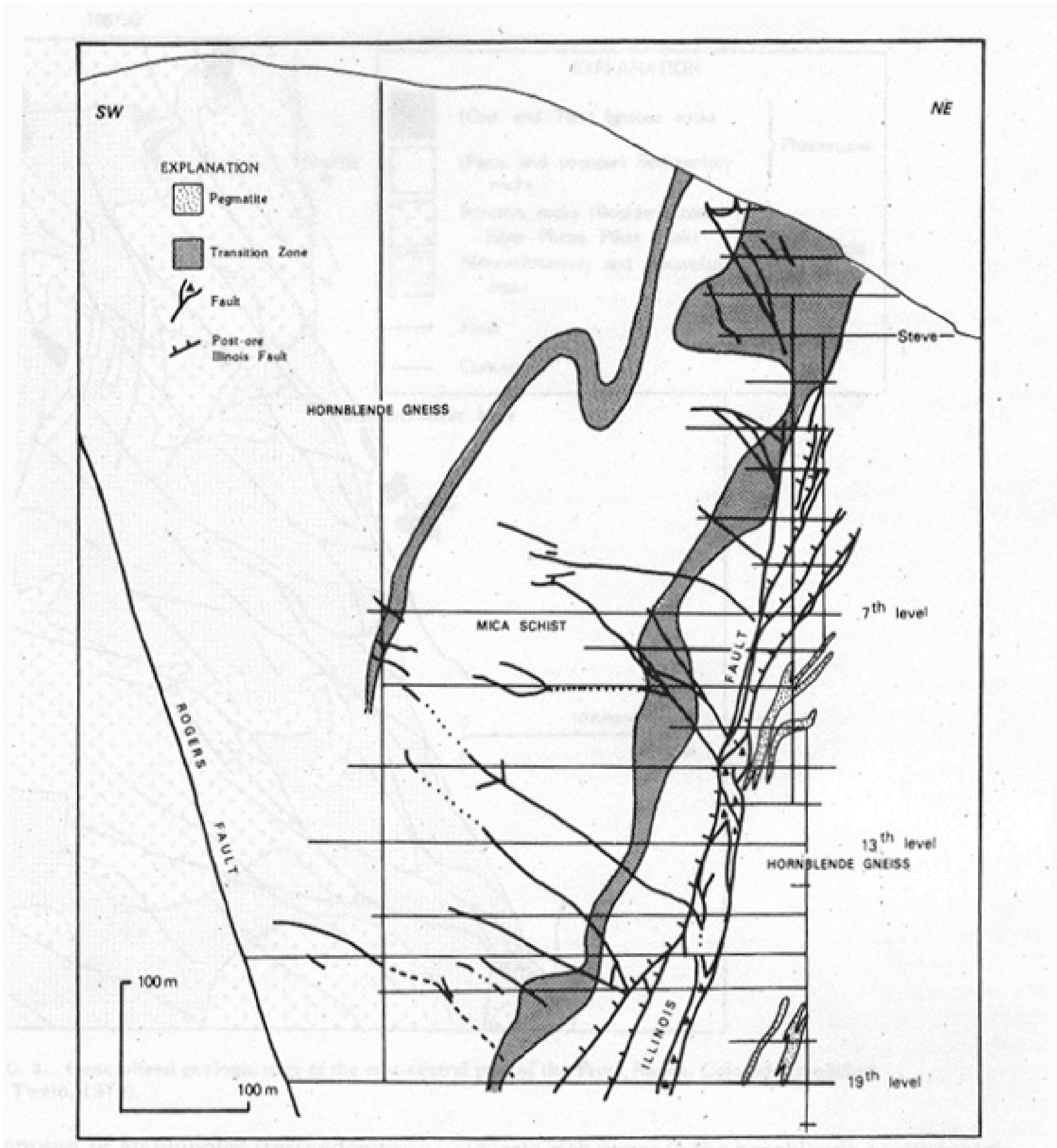


FIG. 2. Cross section of the Schwartzwalder mine, showing mine workings and geology. Stippled area is the transition zone between hornblende gneiss and mica schist.

Figure 1 (Wallace and Karlson p. 1844)

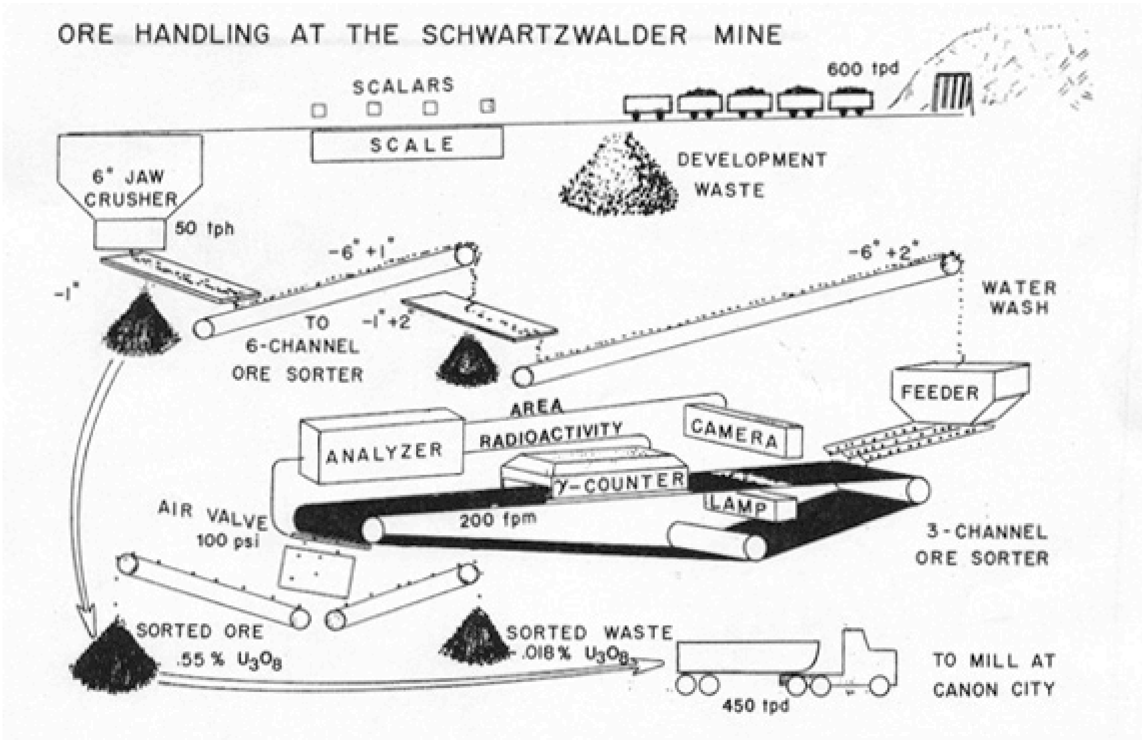


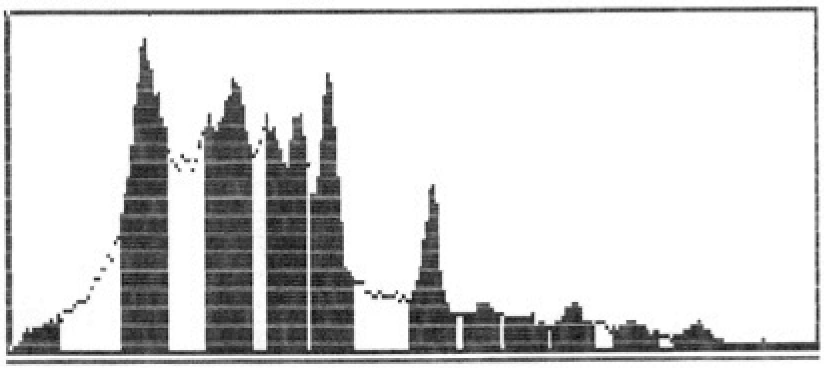
Figure 2 (Paschis p. 128)

Figure 3 (Erik Hunter)

MCA REPORT

DATE:	07-Oct-2002 17:19	BIAS:	927
EN CAL DATE:	01-Oct-2002 20:15	COARSE GAIN:	1
		FINE GAIN:	1.24
BKG DATE:	01-Oct-2002 19:40	LOW DISC:	1.00%
GROSS CPM:	90230	HIGH DISC:	100.05%
NET CPM:	87704	ELAPSED LT:	149.88
GROSS INTEGRAL:	225396	ELAPSED RT:	151.76
NET INTEGRAL:	219086	DEAD TIME:	1.24%

FULL SCALE: 3361



PEAKS FOUND

CHN	ENERGY (keV)	GROSS CPM	AMBIENT CPM	CONTINUUM CPM	NET CPM	UNC %	
9	10.9	1235	38	927	269	q 12.3	
43	78.4	14831	156	9577	5097	q 2.14	Bi207
70	180.4	14651	225	12624	1801	q 6.52	Ra226
91	286.9	11612	253	10736	622	q 16.5	Tl208
101	348.7	9760	262	7156	2341	q 3.88	
133	596.3	5548	240	2434	2873	q 2.21	Bi214
150	758.8	2004	132	1623	247	q 16.9	
163	910.1	1728	138	1504	84	q 49.2	Tl208
177	1086.1	1873	118	1269	485	q 8.32	Bi214
197	1374.3	1318	94	924	299	q 11.7	
217	1713.0	901	46	435	419	q 6.30	Bi207
237	2108.6	228	33	96	98	q 14.3	

Figure 4 (Erik Hunter)