Metallurgy of the Spanish Mountain Bulk-Tonnage Gold Deposit

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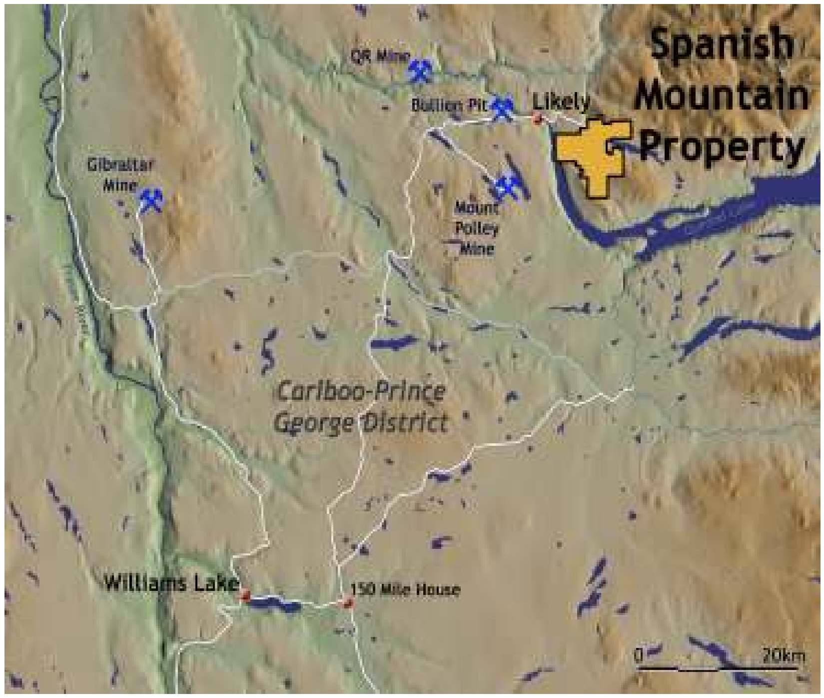
1.0 Introduction

The Spanish Mountain Deposit is located in the Cariboo region of central British Columbia, 6 kilometres east of the village of Likely, and 66 km northeast of the City of Williams Lake. The site can be reached from Williams Lake via a paved secondary road which leaves Highway 97 at 150 Mile House, approximately 16 km south of Williams Lake, and continues for 87 km to the village of Likely. From Likely, the site is accessed from a forest service road.

The project is located in a mining district with both the Mt Polley Mine and QR Mine being visible from the deposit area.



Spanish Mountain Gold Ltd. has been drilling on the Property since 2005. Diamond drilling has identified gold mineralization at Spanish Mountain in an area that extends approximately 1,300 m by 800 m. From drill hole data, elevated gold assay results are observed to be laterally continuous along several stratigraphic sequences, designated primarily as argillite and tuff/greywacke.

The development of a flowsheet for the recovery of gold has been carried out on a number of samples taken from across the deposit. A flowsheet incorporating gravity concentration, flotation and cyanidation of the resulting concentrates has been developed to provide an average gold recovery of 90%.

2.0 Mineralogy (Geology)

Geologically, the Spanish Mountain Property lies within the central part of the Quesnel Terrane, which in the area of the deposit consists of a sedimentary package of black, graphitic argillites, phyllitic siltstones, sandstones, limestones and banded tuffs of the Late Triassic Nicola Group. The sedimentary rocks have been metamorphosed to subgreenschist grade, and are locally intruded by plagioclase-quartz-hornblende sills and dykes.

The Spanish Mountain gold deposit is a bulk-tonnage, gold system of finely disseminated gold within black argillites and siltstones as well as in local high-grade, gold-bearing quartz veins within siltstones, greywackes and tuff. The largest zone carrying significant gold mineralization is called the Main Zone, which has been traced by drilling over a length of approximately 900 metres north-south and a width of 800 metres. The stratigraphy of the North Zone is less well understood, but consists of argillites, siltstones and lesser mafic volcanic dykes and sills, covering an area of about 400 m north-south, with similar width as the Main Zone.

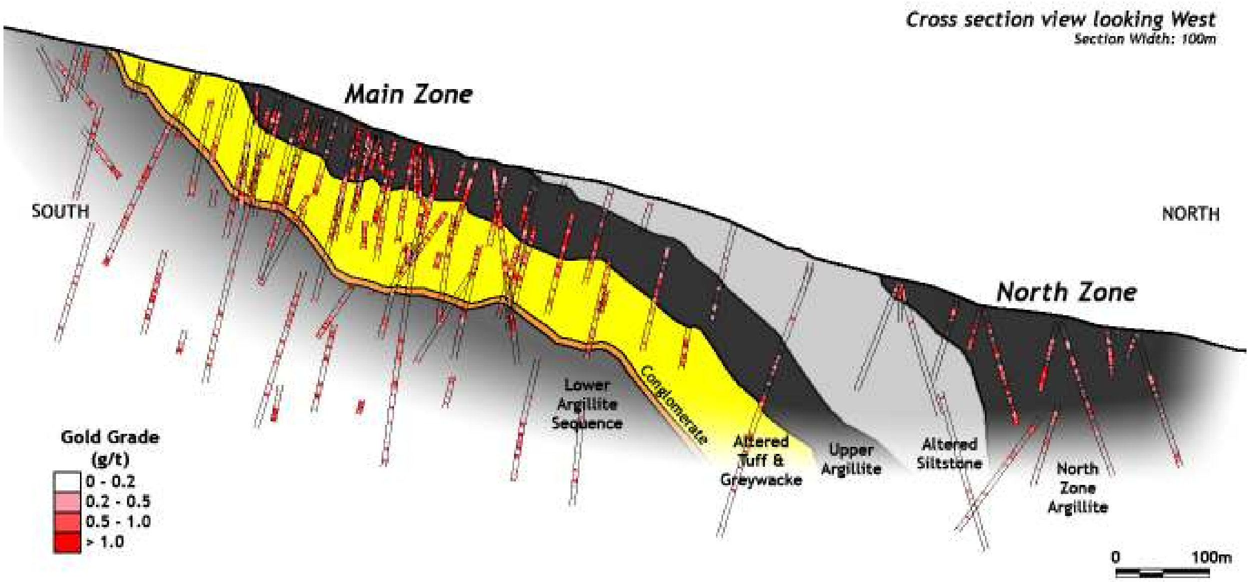
The Spanish Mountain gold deposit is classified as a sediment hosted vein ("SHV") deposit. Key characteristics of SHV deposits include the following:

- Hosted in extensive belts of shale and siltstone sedimentary rocks of up to thousands of square km
- Rocks originally deposited in sequences along the edges of continents known as passive margin settings
- The sedimentary belts have typically undergone fold/thrust deformation
- Other important tectonic and structural indicators include proximity to continental basement, the presence of cross structures and multiple episodes of alteration
- The presence of quartz and quartz-carbonate veins
- Wide spread regional carbonate alteration is common. The carbonate alteration is typically ankerite, dolomite or siderite, as porphyroblasts and/or as pervasive, fine-grained carbonate
- Widespread sericitic alteration in both argillite and siltstone
- Knots and “nests” of pyrite along with large pyrite cubes and fine-grained disseminated pyrite throughout the host rocks, and in argillites in particular
- They are often simple gold systems. Sometimes trace elements associated with SHV deposits are arsenic (as arsenopyrite), tungsten, bismuth and tellurium. Generally there is a paucity of copper, lead and zinc sulphides, but minor amounts occur in a few deposits
- The deposits can be associated with prolific placer gold fields
- Granitic rocks commonly, but not always, occur in spatial association with the deposit. The timing of granitic intrusion can be before or after mineralization.

SHV deposits are some of the largest in the world with many of the largest located in Asia, especially in Russia. Examples include Muruntau ((>80 million (“M”) ounces ("oz")); Sukhoy Log (>20 M oz); Amantaytau, Olympiada (both >5 M oz) and others. In Australia they include Bendigo (>20 M oz); Ballarat; Fosterville and Stawell. In North America, small to medium deposits occur in the Meguma Terrane of Nova Scotia and in the southern half of the Seward Peninsula in Alaska.

Spanish Mountain shows many of the features common to these deposits, including some of the structural characteristics, regional extent of alteration, alteration mineralogy, mineralization style and gold grade. In addition, the metal chemistry is gold without an association of other trace elements. There is also a lack of significant base metal sulphides.

Gold mineralization occurs predominately as disseminated within the black, graphitic argillite. Gold grain size is typically less than 30 microns, and is often, but not always, associated with pyrite. Gold mineralization also occurs within quartz veins in the siltstone/tuff/greywacke sequences, as free, fine to coarse (visible) gold. Within the veins, it is often associated with sulphides including galena, chalcopyrite and sphalerite. Although the highest grades have come from coarse gold within quartz veins, disseminated gold within the argillite units is by far the most economically important type of mineralization. It has been traced for over 2 km, occurring in multiple stratigraphic horizons. From drill core, elevated gold content has been noted within fault zones as well as quartz veins within fault zones.



Spanish Mountain Gold Resource (at a 0.20 g/t gold cut-off)

Classification	Tonnes	Gold grade (g/t)	Silver grade (g/t)	Gold (ounces)	Silver (ounces)
Measured	29,360,000	0.60	0.67	560,000	630,000
Indicated	186,870,000	0.44	0.69	2,620,000	4,150,000
Measured plus Indicated	**216,220,000**	**0.46**	**0.68**	**3,180,000**	**4,780,000**
Inferred	316,740,000	0.36	0.65	3,650,000	6,620,000

3.0 Grindability

Grindability testwork was carried out on a series of composite samples taken from five drill holes across the deposit. Analysis of the results on the basis of the lithology of the samples indicated a variation in the power requirement for comminution based on rock type. The results that are summarized in Table 3.1 show a significant variation by rocktype.

Table 3.1 Summary of Grindability by Rock Type.

	RWI	BMI	Ai	% 0f Resource
Argillite	13.4	12.8	0.229	67
Tuff	14.7	12.7	0.199	28
Siltstone	15.3	15.4	0.269	<5
Crystal Tuff	16.7	15.6	0.244	tr

The mining schedule is such that both argillite and tuff are being mined at all times with a fairly constant ratio. The average of the combined rod mill and ball mill work indexes over the life of the project is about 13.3.

The target primary grind is 80% passing 184 microns.

4.0 Flowsheet Development

4.1 Cyanidation of Concentrates

While cyanidation is the final step in gold recovery from the deposit, the conditions required for achieving a high gold extraction by cyanidation directed the course of the overall flowsheet development particularly with respect to the control of the graphite (TOC) content of the concentrates.

Figure 4.1 summarizes the results achieved by the cyanidation of a series of flotation concentrates produced from three composite samples. A strong correlation is observed between concentrate TOC content and the gold extraction achieved in these tests following regrinding of the concentrates to about 20 microns.

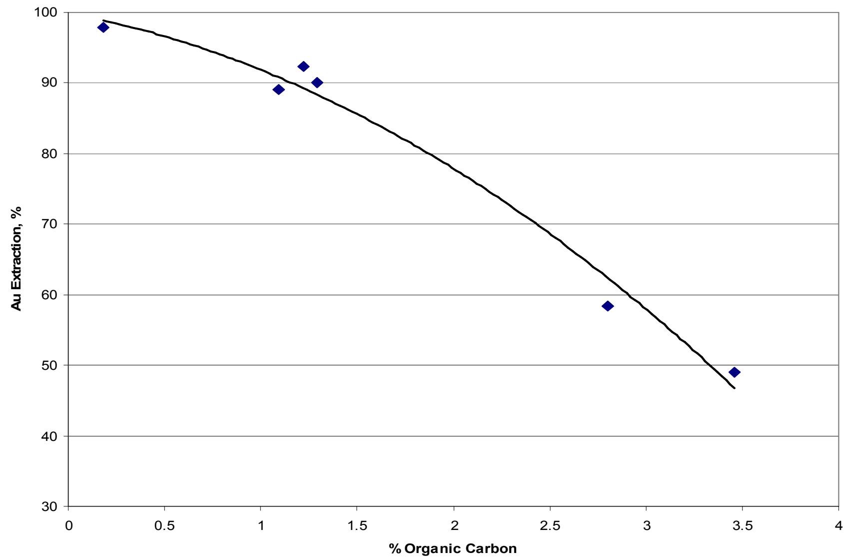


Figure 4.1 Au Extraction versus % Organic Carbon in Cyanidation Feed

Figure 4.2 summarizes the gold extraction achieved by cyanidation of concentrates produced from various composite samples. While the gold extraction achieved for the low TOC gravity concentrates was uniformly high, the extraction from flotation concentrates again decreases fairly linearly with the increase in TOC content of the concentrates. In order to achieve a gold extraction of better than 90% from the flotation concentrate the TOC content needs to be less than 1% and preferably less than 0.5%. Achieving this target was the focus of much of the development work for the flotation circuit.

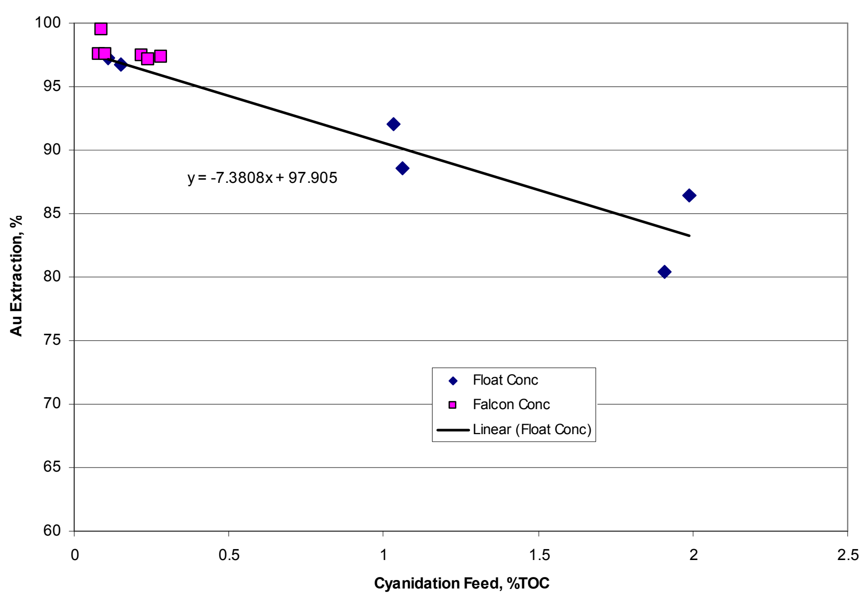


Figure 4.2 Cyanidation Results for Concentrates.

4.2 Gravity Concentration

Testwork that was carried out early on in the project development demonstrated that the fine nature of the gold together with the presence of active graphite would eliminate the use of a whole ore cyanide leach. The association of much of the gold with pyrite suggested that the use of flotation to produce a concentrate for further processing was a possible process route. Furthermore, gravity concentration testwork indicated that there was a significant component of the gold that was recoverable by this means.

Over the course of the program, tests were carried out with both Knelson and Falcon concentrators with no discernable differences in the results achieved. Current test procedures include hand panning of the concentrates from batch tests to further increase the ratio of concentration to results predicted for a commercial circuit. The gold recovery through this procedure is greater than the gravity recovery of 22% predicted by modelling of the GRG results.

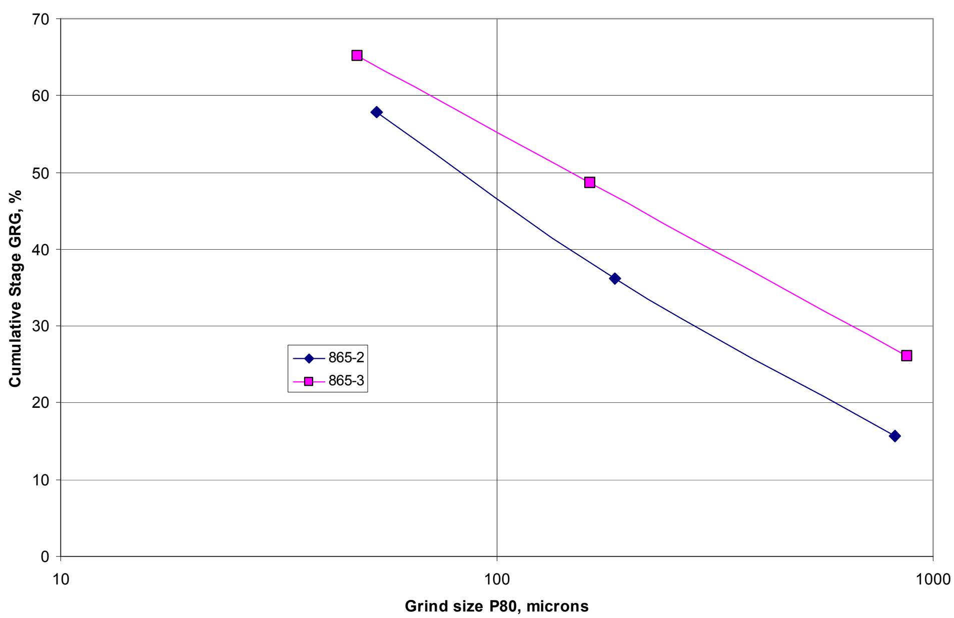


Figure 4.3 Gravity Recoverable Gold from Knelson Testwork

The TOC content of the gravity concentrate is proportional to the TOC content of the feed as summarized in Figure 4.4. As discussed later in this paper, the average feed concentration of TOC is expected to be less than 1%.

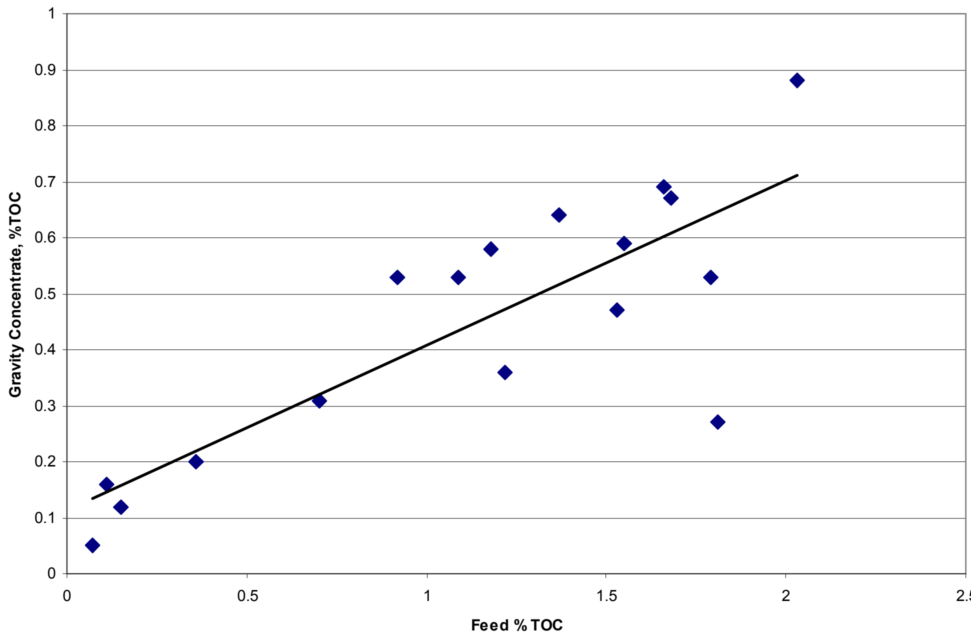


Figure 4.4 TOC content of Gravity Concentrates as a Function of Feed TOC Content.

A secondary gravity concentration stage is currently included in the flowsheet to scavenge gold from the prefloat concentrate and the flotation cleaner tails. The results in Tables 4.1 and 4.2 indicate that about 40% of the gold contained in these streams can be recovered by this means and thereby avoid the recirculation of high TOC products within the flotation circuit.

Table 4.1 Gravity Scavenging of Prefloat Concentrates.

Product	Wt. %	Au g/t	S %	TOC %	Distribution, %		
					Au	S	TOC
Feed	100	0.93	0.65	2.71			
Conc	1.6	26.6	4.81	1.25	45.2	11.7	0.7
Tails	98.4	0.52	0.59	2.73	54.8	88.3	99.3

Table 4.2 Gravity Scavenging of Cleaner Flotation Tailing.

Product	Wt. %	Au g/t	S %	TOC %	Distribution, %		
					Au	S	TOC
Feed	100	1.56	4.44	0.82			
Conc	5.2	13.2	23.8	0.66	44.6	28.1	4.2
Tails	94.8	0.91	3.37	0.83	55.4	71.9	95.8

4.3 Flotation

The flotation process consists of a graphite prefloat followed by a bulk sulphide float. The rougher bulk concentrates is cleaned twice to produce a final flotation concentrate.

The prefloat consists of flotation with the addition of MIBC. The removal of TOC and associated gold loss as a function of prefloat time is summarized in Figure 4.5. At about 10 minutes the removal of TOC starts to level off and this has been adopted as the residence time for the prefloat.

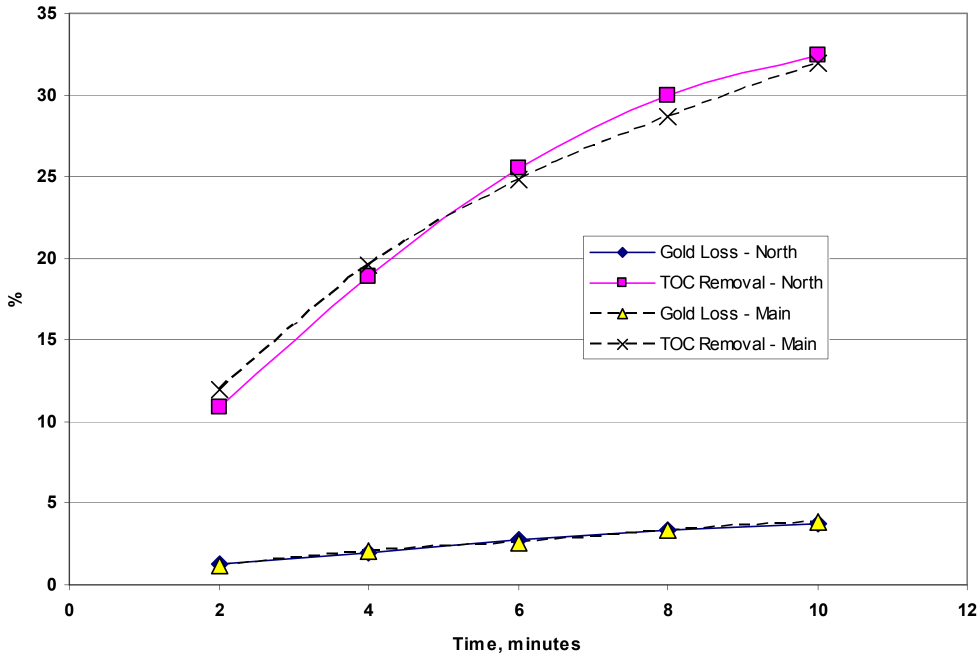


Figure 4.5 Removal of TOC and Loss of Gold During the Prefloat

Following the prefloat the sulphides are floated with an addition of PAX, MIBC and CMC. It was discovered during the testwork that the TOC content of the concentrate could be effectively controlled through the addition of CMC to the rougher and cleaner stages as summarized in Figure 4.6.

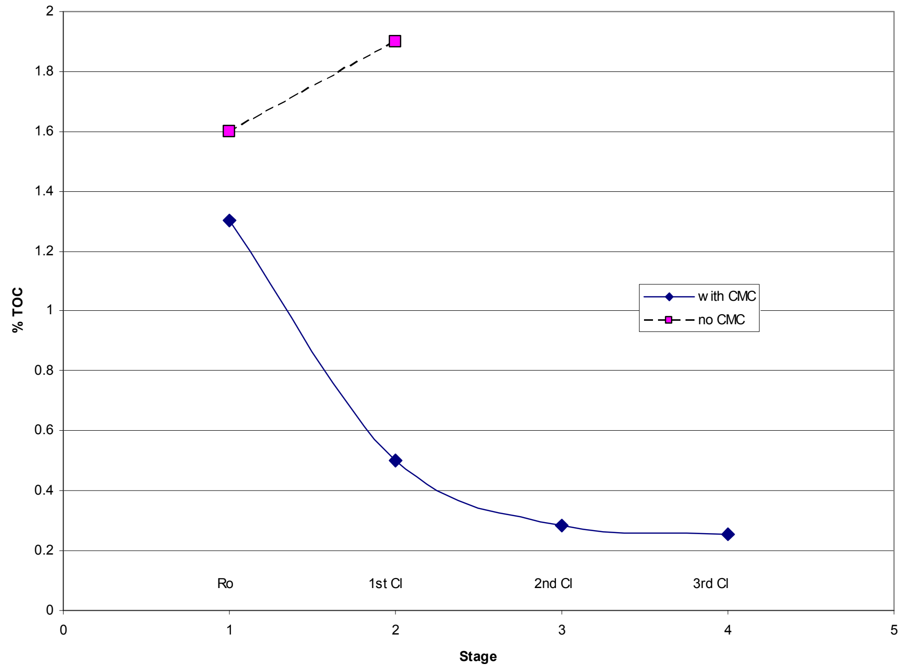


Figure 4.6 TOC content of flotation concentrate from the rougher concentrate through multiple cleaning stages.

The TOC content of the resulting concentrate is proportional to the TOC content of the feed samples as summarized in Figure 4.7. The CMC addition is effective in producing low TOC concentrates across a wide range of feed concentrations.

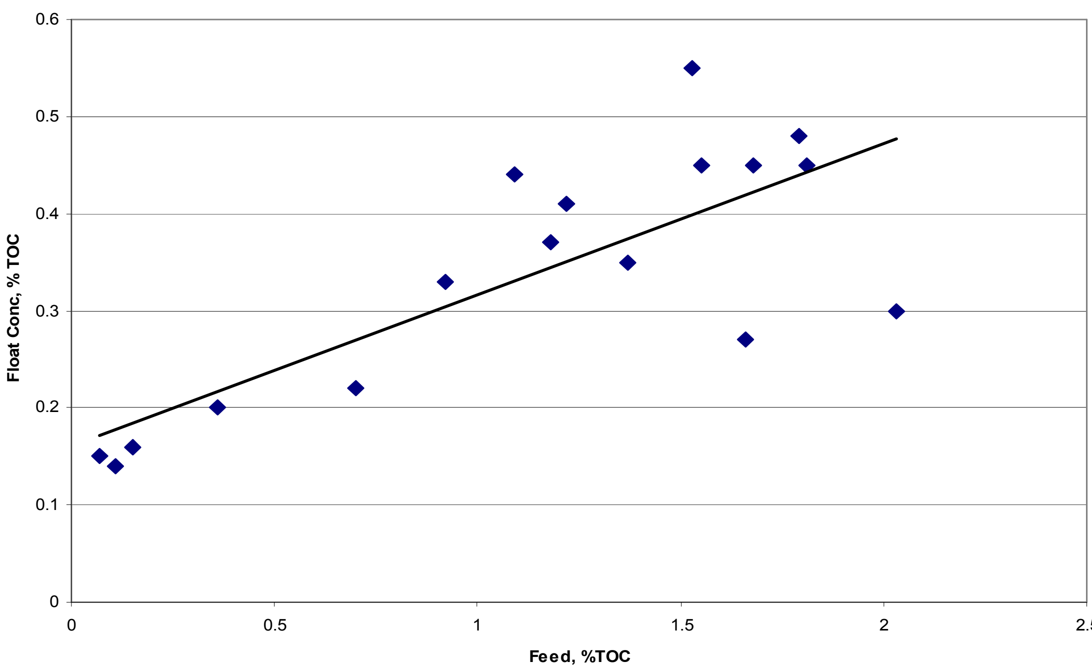


Figure 4.7 TOC Content of Cleaner Flotation Concentrate as a Function of Feed TOC Content.

While all the drill samples from the project have been analyzed for their sulphur content there are no analyses available for TOC content to utilize for the prediction of the plant feed composition. As summarized in Figure 4.8 the feed TOC content is proportional to the feed sulphur content and the expected TOC content of the feed can therefore be estimated utilizing this relationship. Figure 4.9 shows the expected feed concentration of sulphur by year and by bench. It is apparent that the average feed concentration of sulphur will be less than 2% and generally averages about 1/5%. The production of flotation concentrate having a TOC content less than 0.5% will therefore be achievable.

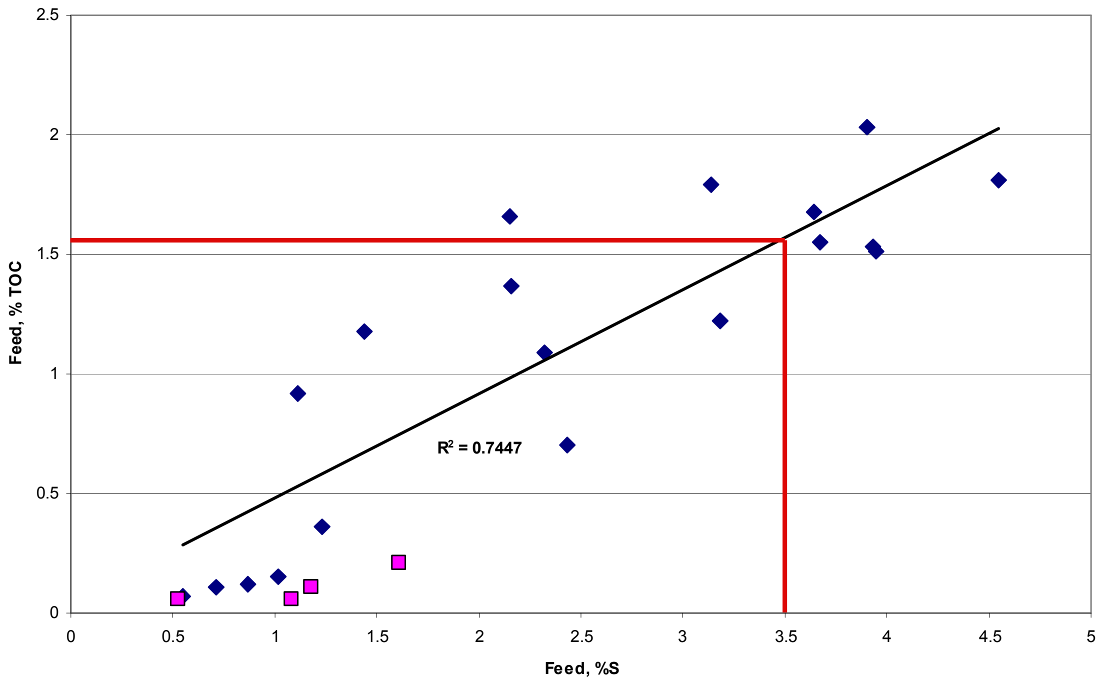


Figure 4.8 Relationship Between Feed TOC Content and Feed S Content.

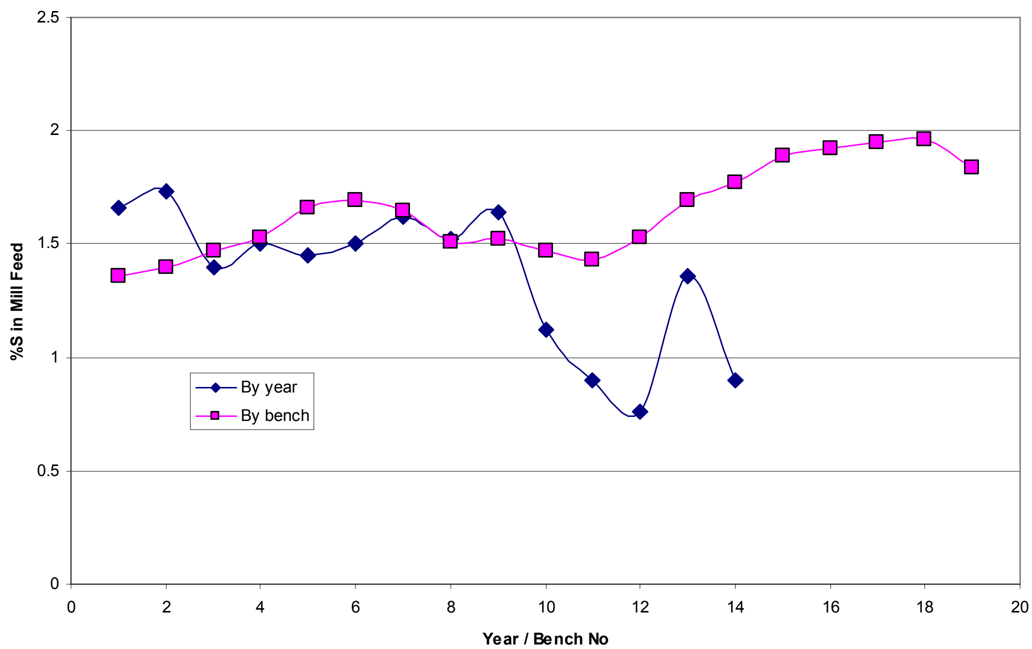


Figure 4.9 Feed Concentration of S by Year and by Bench.

The test results have also been analyzed to determine the conditions under which excessive consumption of PAX might be encountered. Figure 4.10 illustrates that when the TOC plus S content exceeds 5% the tailings assay increases rapidly unless the PAX addition is increased. To achieve a TOC+S content greater than 5% requires a S content greater than 3.5% according to Figure 4.8, a condition that is unlikely to be achieved.

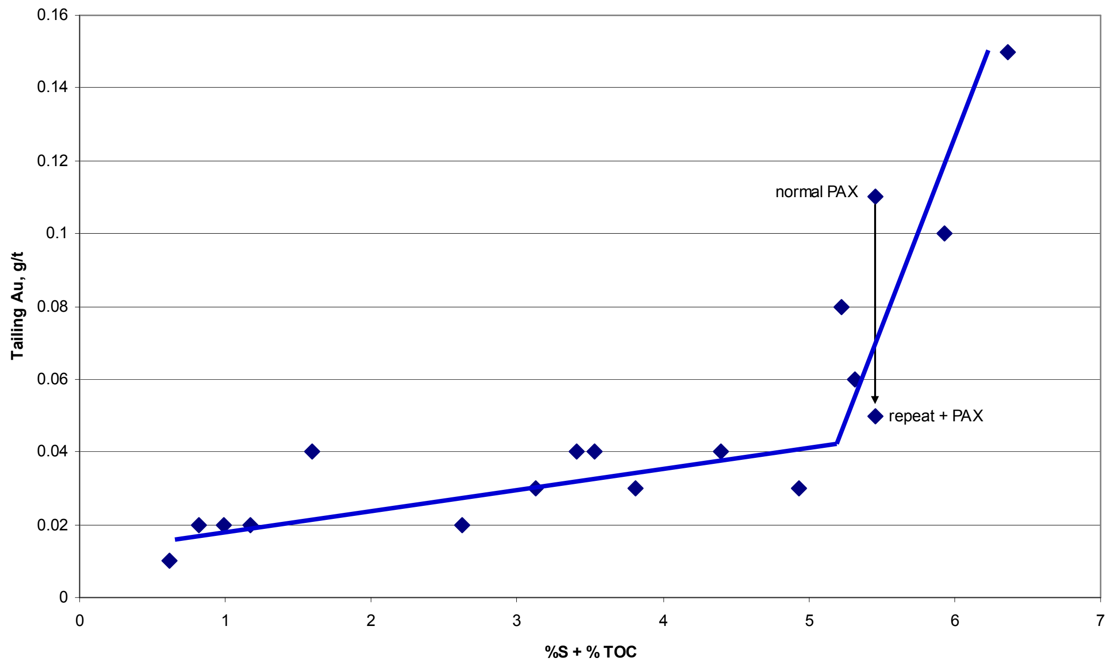


Figure 4.10 Impact of S + TOC Content on Tailings Assay.

5.0 Flowsheet

A block diagram of the process flowsheet is shown as Figure 5.1. The primary grind is 80% passing 180 microns. A more detailed block diagram is included below as Figure 5.2 showing the flows for the prefloat concentrate and cleaner tailings. A simplified flowsheet which is the basis for the PEA recently completed for the project is included at the end of this paper.

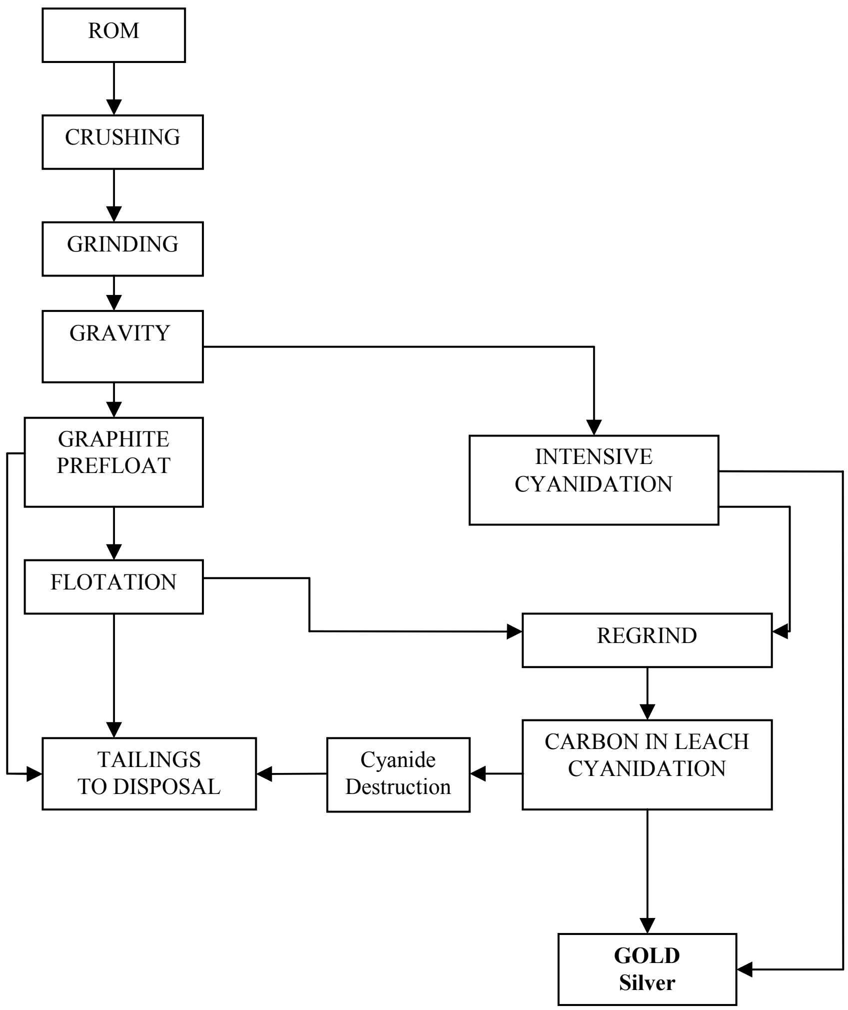


Figure 5.1 Block Diagram of Process Flowsheet.

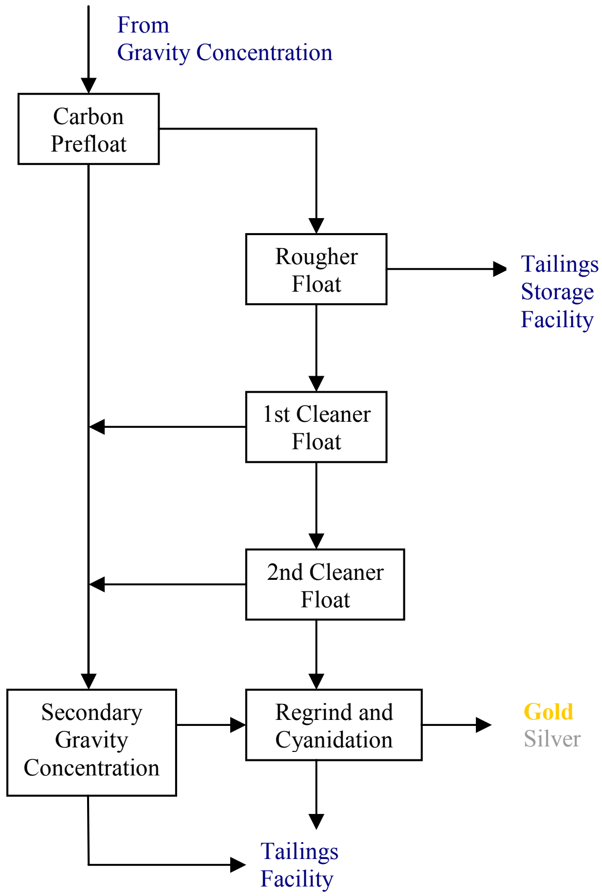


Figure 5.2 Block Diagram of Flotation Circuit.

6.0 Metallurgical Predictions

The gold recovery to concentrates as a function of head grade is summarized in Figure 6.1. An average gold recovery to the concentrates is 94% down to about 0.45 g/t Au and decrease to 90% as the feed grade drops below this value. During the first few years of production the feed grade averages about 0.7 g/t Au and the life of mine average is estimated at 0.48 g/t Au.

Applying the projected cyanidation extraction to the concentrate results in an overall gold recovery of 90% or better down to 0.45 g/t Au and a recovery of 87% below this figure. Further optimization of the process conditions has been commenced and this work is expected to reduce the scatter in the projected results at lower gold grades.

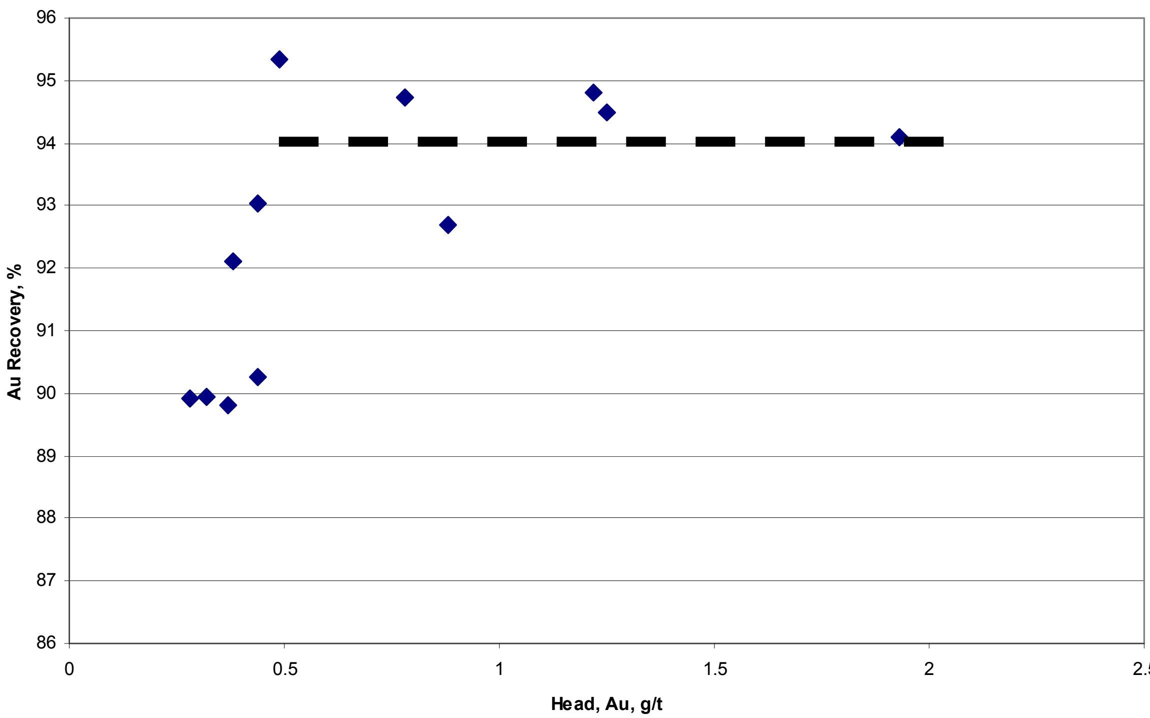
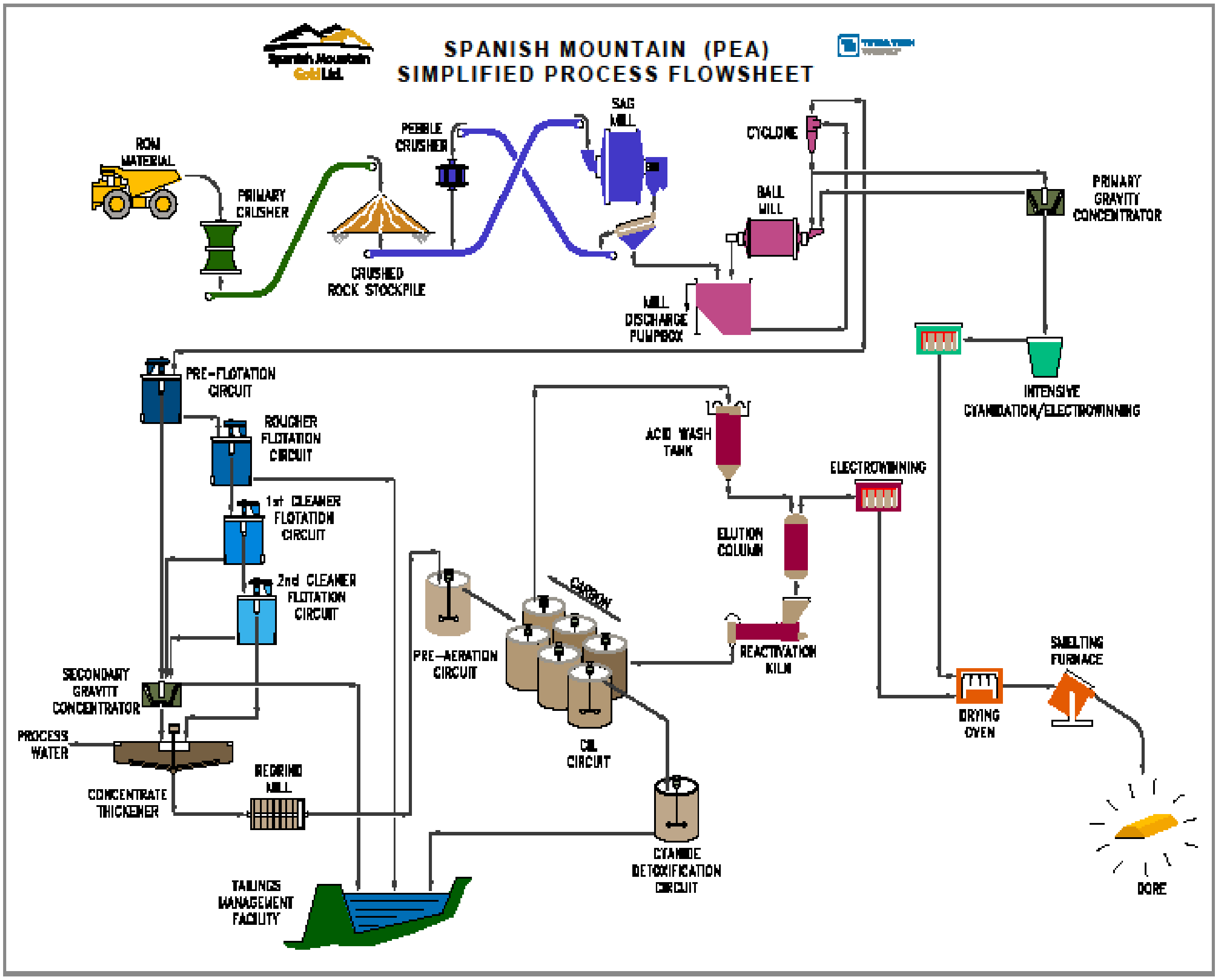


Figure 6.1 Predicted Recovery to Concentrates



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