830586

MEMORANDUM

VANCOUVER

February 14, 1979

To: K. A. MacLean

From: M. D. Kierans

Specific Gravity - Grade Correlation "A" Vein

The original proposal included preparation of an S.G. contour map in the plane of the "A" vein at Chappelle property of Du Pont. That will be done later and a separate memo submitted.

For various practical reasons it is advisable now to prepare a separate memo on the statistical regression analysis of S.G. and grade data for samples selected from dry powdered "pulps" of the split core from diamond drilling of the "A" vein.

The list of samples selected by the writer from logs is shown in Table I. There are sixty samples. The specific gravity results were given to me by K.A. MacLean from laboratory determinations made here in Vancouver. The details of the method used will not be discussed here. Apparently, judging from the statistical regression results, the work was well done. For example, the mean of the S.G.'s for grades above 3 oz of silver per ton is 2.7433. This compares with the specific gravity of a composite sample from a metallurgical test of 2.74. However, at some future time it may be advisable to send one or two pulps for testing at another laboratory for corroboration.

Figure I shows a plot of silver grade (as X) and S.G. (as Y). It is immediately obvious that for pulps under 3 grams that there is no apparent correlation of these variables. However, for pulps over 3 oz/t Ag there is an apparent correlation. The two standard errors of estimates lines and the regression linear correlation line are shown. It should be pointed out that a better correlation would be obtained from averages or means of samples within a small range of grade. However, results actually obtained here are good evidence that a correlation of grades and S.G.'s of dry pulps exists. The grade must be over 3 oz/t of Ag as noted above. In Table I the samples used for the correlation study are checked off. Fifteen data points were used.

cont....

Figure 2 shows the correlation data as a plot of the 95% confidence level estimates and the actual linear regression line. Tests were made for 3 other regression "curve-fits". These were power, logarithmic and exponential regression tests. The linear test gave the highest correlation coefficient. The practical importance of the result is that if an S.G. test on a dried piece of core were made in the field - a relatively simple procedure - and a result 2.75 obtained say, then using a graph plot similar to Figure 2 one gets a grade of 67 oz/t Ag. In addition to this useful result Figure 3 shows the linear regression correlation of silver and gold assays. The correlation coefficient is a very good 0.95815. From this graph plot one gets a grade of 2.1 oz/t Au. The precision limits in both graphs are fairly wide however. Still as a field expedient these relations would be useful. There seem little doubt, as additional data is accumulated that the precision limits will narrow and the correlation coefficients for both plots increase. It must be emphasized though, that the field geologist must have some evidence that the silver content of the material tested is above 3 oz/t Ag, for example, visible argentite or a higher than normal content of pyrite and/or ohaloopyrite.

Tests for gold grade (as X) and S.G. (as Y) were also made. The best test was linear. See page 2 of attached tables. However, the C.C. was lower than for silver so the silver correlation to S.G. is more useful.

Page 4 of the attached tables shows a "silver equivalent" test. The correlation coeffioient here too was less than for silver alone. The C.C. was 0.57377 as compared to 0.60580 for silver alone. The mean grade of the samples used was 1.897 Au/oz/t and 56.292 Ag/oz/t. The mean S.G. was 2.7433.

<u>Tonnage Factor</u>

Page 3 of the attached table shows the data points used to correlate tonnage factor and silver grade. The T.F.'s were calculated using the formula T.F. = 2000 ÷ (S.G. x 62.4). Figure 4 shows the result in graphical form. The linear C.C. was 0.601891 with 2 SY·X 0.4125 and 2 SX·Y 178.522. These last numbers are a measure of the variance at the 95% level of confidence. The limits are rather wide. However, additional data points should increase precision. Meantime, I believe for tonnage reserve computation a more useful procedure would be to use the T.F. regression line rather than a simple mean. See memo to be prepared on this at a later date. Figure 5 needs considerable explanation as it is an important graph for in situ tonnage reserve computation.

cont....

Attached is a photocopy of a Lefax data sheet. It shows a plot which gives the relation of density, porosity and moisture to specific volumes of ores. Attached also is a page which shows assays, S.G.S. and T.F.'s for a metallurgical composite of the "A" vein head samples. There is no data available for computing T.F.'s from experimental porosity and moisture determinations. However, one can get a rough approximation by"working backwards" on the Lefax plot and making certain assumptions.

First of all, at 2.7433 as mean S.G. from our pulps (which I assume were dry pulps) we get a T.F. (short tons) of 11.25 from the chart at a moisture content of 13% and porosity of 10%. The metallurgical report gave a T.F. of 11.7 at S.G. of 2.74. From the chart one gets a moisture content of 9% and a porosity of 10% with these values for S.G. and T.F. K.A. MacLean told me that from his observations of core there were vugs, voids etc. A very rough test (using the chart) of mineral moisture of saturation gives about 3%. This leaves 6% for voids.

Using Figures 2 and 4 2.7433 S.G. gives 11.7 T.F. (uncorrected for moisture and porosity). Using the correction chart and above assumptions and relations gives a T.F. of 11.33 at 10% porosity and 8% moisture. Using this point and the known slope of the regression line we get Figure 5. Obviously the in situ ore must have some measure of porosity and <u>some</u> water content. Some correction <u>should</u> be applied. The writer made a rough calculation of the increase in tonnage for the thickest and highest grade block using figure 5. The result was an increase from about 9,000 tons to about 9,300 tons - an increase of 3.3%. At a total reserve of 55,000 tons this means a reserve increase of <u>about</u> 2,000 tons - a very approximate figure.

Experimental data on porosity and moisture content should be carried out on split core samples at the mine site, but at present I see no reason why a graduated T.F. for grade should not be used in calculation of reserves. It should also be pointed out that T.F.'s are regionalized variables and should be "kriged" just as grade accumulation and thickness of veins are "kriged". The effect will be to smooth out the T.F.'s for all blocks as well as give a variance or precision measure.

Finally I note that the average or mean sulphur content of the ore in the head samples is 3.23%. One could expect a variation in the ore of say 1 to 5% sulphur - which translates to a variation of pyrite content of say 1 to 10%. This is an assumption, but this variation in pyrite content could explain the variation in specific gravity. Iron pyrite has an S.G. of about 4.5.

cont....

If possible or feasible it would be a reasonable idea to order sulphur assays for the pulps checked off in Table 1. If there is a correlation of sulphur content of the pulps and silver grade then all the above is placed on a sounder physical or mineralogical basis. More metalographic and mineralographic data could increase the confidence in the relations outlined above.

M. D. Kierans

MDK/tjs