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Tittel KOLSVIK, AN EVALUATION OF SAMPLED MATERIAL AND ASSAY RESULTS				
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Kommune Bindal	Fylke Nordland	Bergdistrikt	1: 50 000 kartblad 18252	1: 250 000 kartblad Mosjoen
Fagområde Malmberegning	Dokument type		Forekomster Kolsvik	
Råstoffgruppe Malm/metall	Råstofftype Au			
Sammendrag / innholdsfortegnelse Rapporten omhandler malmpotensiale og Au gehalter for følgende soner: A) Total zone B) Central zone				

KOLSVIK. AN EVALUATION OF SAMPLED MATERIAL AND ASSAY RESULTS

Based on geological information such as fractures, alteration, quartz arsenopyrite and gold mineralization coupled with assays a geological potential of mineralized rock at Kolsvik has been outlined as follows:

A) Total zone (T)	1.7 mill. tons
B) Central zone (C)	1.2 mill. tons

The large majority of the assayed material is split core samples (together with chip samples of variable size). A number of samples in the weight range 1 - 100 kg have also been collected for assaying. The mineralization at Kolsvik is characterized by nuggets and concentrations of smaller grains of free gold in an irregular distribution. Under such conditions a split core sample which only represents 1/800 part of a ton will only have a minimal chance of being representative.

The accumulated assay data shows a great variation diverting strongly from a normal distribution and thereby not amending itself to statistical methods such as "kriging". This lack of statistical relationship means that an increase in the sample population (i.e. more core samples from more drilling) will not have a marked effect on the arithmetic means of the total population. Despite this unfavourable situation created by small samples the arithmetic means of the core samples (plus some chip samples) for the zones of geological potential are as follows:

T.	2.49	gAu/t.
C.	3.20	gAu/t.

In order to try and achieve some kind of statistical evaluation from the assay material, samples have been classified into three groups according to weight with the following results:

GEOLOGICAL POTENTIAL T.

Class.	Sample weight kg	n	$\bar{x}$	$\bar{x}$ T
1	0 - 1	823	2.49	
2	1 - 20	591	6.33	4.3 g/t
3	20 - 100	27	14.87	

GEOLOGICAL POTENTIAL C.

Class.	Sample weight kg	n	$\bar{x}$	$\bar{x}$ C
1	0 - 1	585	3.20	
2	1 - 20	372	9.95	6.0 g/t
3	20 - 100	27	14.87	

As can be seen, the gold grades increase with increasing sampling size. The larger samples also show a better reproducibility (samples of approx. the same size from the same area give similar results). These observations can indicate that nugget effects, and effects of irregular distribution decrease with an increase in sample size.

The arithmetic means for the two data groups are  $\bar{x}_T = 4.3$  g/t and  $\bar{x}_C = 6.0$  g/t. In the calculation of these mean values, equal weight is placed upon all samples. However, experience indicates that this is not the most correct method when evaluating gold deposits of an irregular nature. Examples from other deposits indicate that small samples can give a systematic under-estimate and that gold grade under production can be several factors higher than the gold grade indicated by drill cores. (The Kolsvik data shows that the mean grade for the large samples is approx. 5 times greater than the mean for the core samples. Although the number of large samples is too small to draw concise conclusions, there is some indication that the Kolsvik data reflects the trend found in other deposits). Nugget effects, uneven distribution and other irregularities are factors that can be observed but are difficult to calculate and predict, and in an evaluation of these aspects various assumptions and simplifications must be made.

Based on the available observations and data, the problem of "statistically" trying to indicate an expected grade has been approached by attempting to compensate both for variation in the number of samples within the various classes and also for variation in sample size.

A normal accepted statistical approach to this problem is to weigh the various data against each other. It can be shown for an idealized deposit (i.e. even distribution of gold and no nugget effect) that the variation in the sample results is inversely proportional to the sample size. In such a situation a factor is chosen which is inversely proportional to the standard deviation, as this gives the same variance for all the data sets which are the basis for the calculation of the mean value.

This means that for the idealized deposit, factors are chosen that are proportional to the square root of the sample size.

Assuming that the Kolsvik deposit was idealized and using the mean weight for the above mentioned sample classes we get the following factors:

Class.	Mean weight kg		Factor
1	0.5 (x1.4)	=	1.0 V1
2	10.5	=	4.5 V2
3	60	=	11.0 V2

Using the following equation

$$\frac{(N1 \cdot \bar{x}_1 \cdot V1) + (N2 \cdot \bar{x}_2 \cdot V2) + (N3 \cdot \bar{x}_3 \cdot V3)}{(N1 \cdot V1) + (N2 \cdot V2) + (N3 \cdot V3)}$$

gives the following results:

$$\bar{x}_T = 6.16 \text{ g/t}$$

Although it is not realistic to use these factors for the Kolsvik - indeed it is difficult to find concise factors for a deposit with nugget effect - experience would indicate that a factor should be used and that the arithmetic means of unweighted data can at best be assumed to be a minimum value.

(If one chooses factors of 1 · 2 · 3 for the data, the resulting  $\bar{x}_T$  and  $\bar{x}_C$  are 5.14 and 7.43 respectively).

In the above mentioned data-material there is an obvious variation in the number of samples within the various classes and with the chosen factors class No. 2 will strongly influence the results, with the largest samples - despite the high factor - having only little influence.

In order to try to some degree to compensate for the variation in class population, we can assume that  $N_1 = N_2 = N_3$  which would give

$$\begin{aligned} \bar{x}_T &= 11.70 \text{ g/t} \quad (9.96 \text{ for factors } 1 \cdot 2 \cdot 3) \\ \bar{x}_C &= 12.77 \text{ g/t} \quad (11.28 \quad " \quad " \quad " \quad " \quad " \end{aligned}$$

A fairer assumption would be  $N \approx N_2 + N_3$  which gives:

$$\begin{aligned} \bar{x}_T &= 6.37 \text{ g/t} \quad (5.43 \text{ for factors } 1 \cdot 2 \cdot 3) \\ \bar{x}_C &= 9.43 \text{ g/t} \quad (8.07 \quad " \quad " \quad " \quad " \quad " \end{aligned}$$

Both in the literature and via pers. com. there are several case histories which indicate that production grades are often 2 - 5 times higher than assay results from drill holes would indicate.

As the following table shows, the assay data from Kolsvik also indicates a similar trend.

TOTAL GEOLOGICAL POTENTIAL

Class.	N	"Grade"	Factor
	823	2.49	
2	591	6.33	$\frac{6.70}{2.49} = 2.7$
3	27	14.87	

CENTRAL GEOLOGICAL POTENTIAL

Class.	N	"Grade"	Factor
1	585	3.20	
2	372	9.95	$\frac{10.28}{3.20} = 3.21$
3	27	14.87	

This case would indicate the following grades:

$$\begin{aligned} T &= 2.49 \times 2.7 = 6.72 \\ C &= 3.2 \times 3.21 = 10.27 \end{aligned}$$

Taking these various "cases" and other facts into consideration, there does seem to be some good indications that the Kolsvik mineralization despite its irregular and erratic nature, will have a grade higher than the straight arithmetic means calculated from the available data.

However, only bulk sampling on a large scale will prove or disprove this assumption.