XI. SAMPLING AND CORING IN PROSPECTING FOR METALLIFEROUS DEPOSITS

H. C. George, University of Oklahoma.

Although the search for outcrops, the examination of stream beds for mineral concentration, the sinking of shafts and the driving of drifts still play a part in the discovery of orebodies, the churn drill and the diamond drill are the usual means by which surface and shallow indications of the presence of ore are checked and tested at greater depths in order to determine whether or not they are of sufficient richness and size to warrant development on a commercial scale. Hence it is of the utmost importance that the cuttings secured in churn drilling and the cores secured in diamond drilling be representative of the orebody penetrated. To accomplish this purpose, the holes drilled must be of sufficient number and so placed that a fairly accurate idea will be secured of the thickness, texture, shape, and position of the orebody, as well as of the amount and character of mineral content.

Diamond drill cores have certain advantages over churn drill cuttings in that they give a much better idea of the physical characteristics of the ore and the form in which the valuable mineral or metal contents occur; whether finely disseminated in the ore, whether in thick sheets or veins or whether in aggregates throughout the ore mass. However, the diamond drill frequently fails to recover core in the loose, soft and friable parts of the orebody. As the major part of the mineral content is frequently found at these places, incomplete or misleading conclusions are often drawn from the results secured from diamond drilling. Furthermore, the diamond drill is unsuited to the testing of formations or orebodies containing chert nodules and fragments, because frequently the chert will cut the metal away from the face of the diamond bit, permitting the loss of the diamonds which form the cutting edge of the bit.

Diamond drill cores secured from an orebody frequently are split lengthwise, one half of the core being assayed and the other half preserved for further reference as to the character of the ore. A reliable estimate of the character of the ore, secured by the physical examination of the cores will be of the greatest value in determining the methods of mining and ore dressing to be used. This information will aid in selecting the best suited type of crushing and screening machinery for the concentrating plant, and may even determine the ore dressing method itself; such as, whether the ore should be concentrated by jigs or by the use of flotation or by a combination of these and other processes.

In churn drilling, careful sampling and good judgment are important factors in the accuracy of estimates of ore reserves, based upon the mineral content of cuttings secured in drilling.

Some of the factors which may be misleading and perhaps disasterous in their results, if not properly interpreted, are::

(1) The case where no metalliferous mineral is shown in the

cuttings, when as a matter of fact the drill has penetrated a thick sheet or vein of it, which upon being broken up by the drill has washed away into open crevices. In numerous cases, later mining operations have shown that this has happened, usually when the open crevices penetrated have served as channels for flowing water. During the prospecting operations this condition may be shown to exist by "shooting" the drill hole at the point where the open crevices occur, but this shooting should not be done until after the prospect drill hole has been completed, because the resulitng shattering of the metalliferous mineral of the walls may "salt" the prospect drill hole at lower levels.

(2) The case where rich metalliferous mineral cuttings are recovered from a prospect drill hole for a considerable thickness, say for 30 or 40 feet, leading one to believe that a thick body of ore had been penetrated. Sometimes results of this character are deceiving, especially when metalliferous mineral is first encountered while drilling through soft and caving formations below the ground water level; the caving into the hole of the formation containing the metalliferous mineral may "salt" the drill hole for many feet below the horizon at which the metalliferous mineral is in place, and thus lead to the logging and assying of 30 to 40 feet of cuttings which show rich assays, when as a matter of fact there may have been only one or two feet of metalliferous containing mineral penetrated in drilling.

This condition may be suspected as existing when large fragments of rock and mineral in the cuttings or of oxidized mineral with unoxidized mineral in the cuttings are found to be present. Also if two metalliferous minerals are present in the cuttings, as for instance sphalerite (Zn S) and marcasite FeS_2), their occurance in the same relative amounts in sample cuttings from different depths, might lead to the conclusion that the prospect drill hole is being salted from upper horizions.

(3) The case where the prospect drill hole shows a considerable thickness of metalliferous mineral of about the same character and quantity in all samples of cuttings. This condition instead of indicating the presence of disseminated metalliferoues mineral may be caused by the drill hole following vertical crevices or joint planes along which a thin sheet of ore, perhaps not more than half an inch thick has been deposited. If this condition is suspected of being present, the drilling of one or more prospect drill holes within ten or fifteen feet of the prospect drill hole showing the mineral in the cuttings will usually give a satisfactory check which will show the conditions actually present.

(4) The case where the quantity of cuttings recovered is small. A series of tests made by the writer in one mining district found that five quarts of cuttings should be secured for each foot drilled with a six inch bit. A smaller recovery of cuttings than this may be caused by their loss in a crevice or opening encountered during drilling, by the penetration in drilling of a cavity or opening of sufficient size to produce a sufficient void to decrease the quantity of cuttings which would be expected, or by the metalliferous mineral occuring in soft

shale or clay which goes into suspension in the water in the prospect drill hole leaving a larger relative quantity of metalliferous mineral in the cuttings than exists in a true section of the formation penetrated.

The following example from a prospect drill hole in a zinc ore body containing both sphalerite (ZnS) and marcasite (FeS_2) illustrates from the zinc and iron assays the variations secured by comparing the average of all assays for the total depth, with assay of the composite sample of the same cuttings.

Depth (feet)	Zinc Assay (Per cent)	Iron Assay (Per cent)
126-129	3.1	2.3
129-132	20.7	4.5
132-135	42.8	3.2
135-138	4.5	6.2
138-141	2.4	5.4
141-144	2.1	5.2
144-147	1.9	3.6
Average 21 feet	11.1	4.4
Composite 21 feet	10.6	4.0

In this case all of the samples of cuttings were about the same size so that the composite assay checked the average assay within half of one per cent. If the rich assayys had been from small samples, the composite asssay would have been much less than the average assay; and conversely if the poor assays had been from small samples, the composite assay would have been much higher than the average of assays. If the composite assay shows values less than the average of assays, then it is considered good practice to use the composite assay in preference to the average of assays.

(5) The case where the amount of water present in the prospect drill hole affects the rcovery of metalliferous mineral in the cuttings. In an experiment the writer took three samples of fifteen pounds each of zinc concentrates assaying 48.9 per cent zinc and 8.3 per cent iron and dropped one sample into each of three prospect drill holes drilling above the point of metalliferous mineralization (a) in the prospect hole containing only sufficient water for drilling purposes 10.6 per cent zinc and 2.9 per cent iron; (b) in the prospect drill hole containing aconsiderablehead of water but turbid in character, 8.9 per cent zinc and 2.1 per cent iron, and (c) in the prospect drill hole that contained clear, strong water, 6.9 per cent zinc and 2.0 per cent iron.

The amount of water in the prospect drill hole sometimes has a relation to the quantity of cuttings recovered as in the case (4), there usually being a less quantity of cuttings with a greater amount of water.

(6) In the case where in prospect drilling small amounts of metalliferous mineral held in suspension in water as a rich vein or bed being penetrated, gradually settles and becomes a part of the next deeper sample of cuttings taken. As in case (5) the next two feet drilled after taking the samples which were assayed showed in (a) 2.5 per cent zinc and 1.7 per cent iron, in (b) 1.6 per cent zinc and1.2 per cent iron, and in (c) 2.2 per cent zinc and 1.2 per cent iron. In churn drilling some engineers consider it good practice to eliminate

all assays of 2 per cent or less of metalliferous mineral content because even when truly representative of actual conditions they do not represent recoverable mineral in commercial mining and milling opoperations.

Most mining companies check-up the prospect drilling results by sinking shafts and driving development drifts before permanent mining and milling equipment is installed, thus preventing some costly mistakes.

Some mining companies use both the diamond drill and the churn drill in developing the same orebody so that a closer check can be secured on the metalliferous mineral content. A mine developed by the combination of these two systems of drilling is the Mascot Zinc Mine of the American Zinc, Lead & Smelting Company at Mascot, Tennessee.