Internet Case Study #19:

Why Include Ore Samples in the Prediction of Minesite-Drainage Chemistry, When Ore is Not Waste?

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Detailed and thorough predictions for minesite-drainage chemistry, acid rock drainage, and metal leaching consider ranges of potential geochemical and mineralogical conditions that may be encountered at a particular minesite. This is an important part of waste-management and water-management planning, for the protection of the environment and water quality. So why would samples of ore be included in a drainage-prediction program, especially when ore represents profits and ore will be milled not wasted? There are many reasons to include ore samples, to the point that not including ore can lead to errors.

Ore-grade samples may provide easiest access to some geochemical ranges, especially early in the assessment when waste-grade samples may be limited due to an early focus on economics and ore. A corollary might be that any geochemical condition found only in ore does not require testing, because the ore would be milled. Again, this argument is not valid for minesite-drainage prediction as explained below.

1) One potential task of a drainage-prediction program is to provide data to the geological/mineralization block model. Such a model interpolates geostatistically between core analyses to estimate information on a block-by-block basis, like rock units and levels of metals or other elements. To improve the accuracy of block modelling, unbiased samples should be used. For example, if only biased ore-grade samples are used in a block model, the model will predict 100% of the rock is ore.

Where a particular geochemical condition correlates very well with ore grade, the absence of ore-grade samples in the block model will lead to incorrect, biased results in ore blocks and in nearby waste blocks. Where geochemical conditions do not correlate very well with ore grades, the absence of ore-grade samples again leads to poor geochemical estimates for waste blocks near ore blocks. In both cases, some waste rock will be poorly modelled and incorrectly characterized by ignoring ore-grade samples, potentially leading to incorrect predictions of drainage chemistry.

2) Throughout the design and operational phases of a minesite, ore grades can change as commodity prices and costs fluctuate. An increase in the ore grade will cause some ore samples to become waste, and the geochemical characteristics of this former ore can be important for proper revision of waste-management plans. A decrease in the ore grade will cause some waste samples to become ore, giving the false impression that time and money were wasted on testing of ore. Also, during operation, periods of "high grading" can arise when only the highest grade ore is milled, while lower grade ore is "stockpiled" or sent to a waste pile. These examples illustrate why a detailed and flexible prediction program should include ore samples and be prepared for changes in ore grade without triggering a new phase in the prediction program.

3) No mining operation is perfect. Waste piles inevitably will include some ore-grade material, and ore will include some waste-grade material. The geochemical characteristics of the ore-grade material in waste could affect drainage chemistry, and there are full-scale case studies of this effect. Thus, the inclusion of ore samples in drainage predictions is important and sometimes critical.

4) At numerous minesites, ore has been stockpiled for future milling, particularly low-grade ore. Years later, problems may arise, such as the rock has oxidized and has become too expensive to mill, or the grade is no longer sufficient, or the operation has simply terminated. This stockpiled ore then becomes an unanticipated part of waste management and perhaps even of water treatment for a long period of time. Pre-existing geochemical characterization of this ore can assist in estimating the long-term costs and benefits of various options to process or manage it.

Even during operation, ore and low-grade-ore stockpiles can lead to additional costs, such as interim water management or treatment. These additional costs during operation can be important to the economics of a mining operation and should be recognized early. This cannot be done if ore samples are not tested.

5) Although the milling of ore may change some of its mineralogy and geochemistry, and additional compounds or minerals may be added or created, the geochemical characterization of ore-grade samples will provide some valuable early information until the mill process is finalized or operating. For example, if sulphide levels are not substantially affected by milling, the Sulphide Acid Potential of tailings can be estimated from ore-grade samples.

Despite good arguments for including ore-grade samples in minesite-drainage prediction programs, we still find some people who express shock or alarm upon hearing about ore samples. We assume this is due to a generic black-and-white view towards ore and waste, which is really a distinction based on human-perceived monetary value and not necessarily on geochemical conditions that can affect minesite-drainage chemistry.