

GY 302: Crystallography and Mineralogy

Assignment 7: Assessing the Economic Potential of Ore Deposits

Your Task: One of the important jobs that economic geologists do when employed with mining companies or government geological surveys like the USGS is to assess the economic potential of new ore deposits. Once the limits of the ore body have been delineated, it is up to the project geologists to determine if a profit can be made in establishing a mine at the site. Numerous factors need to be considered. How much ore is there? What is its grade? What rate of extraction/processing can be done? How long can the mine operate? What is the cost of processing? There are also startup costs. Last year, you could have easily borrowed money from a bank to get started. In today's economy, even profitable mine sites are difficult to develop because of lack of funds (i.e., banks will not loan money).

This exercise will introduce you the economic realities of mineralogy. Consider the diagram on the next page. It shows the extent of a copper ore deposit located in an isolated area of Papua New Guinea. You have been contacted by a local investment firm that is considering helping to fund the development of a small pit mine at the deposit. The junior mining company that found the deposit is a small Australian exploration firm (AusCo). They don't normally produce the deposits they find (i.e., they are not a mining firm), but would like to work this one if it is profitable. If the deposit is not worth them mining it, they would be willing to sell their interests in the property to mining giants Rio Tinto or BHP. AusCo is looking to cut a deal with an investment bank

Assaying data has shown that the deposit consists of 2 zones. Both zones are essentially rectangular in extent. Zone 1, the rich interval, contains on average, 2 wt% digenite, 1 wt% chalcocite and 5 wt% chalcopyrite. Zone 2 contains 0.5 wt% chalcocite and 2 wt% chalcopyrite. The average specific gravity of the ore in zone 1 is 3.45 g/cm³ (3450 kg/m³). The average specific gravity of the ore in zone 2 is 3.12 g/cm³ (3120 kg/m³). The plan is to extract the rich ore zone first and then, if economically feasible, expand the open pit into zone 2.

In Papua New Guinea, average extraction/processing costs are reasonable (\$US 195.00/tonne), but the infrastructure is poor. Consequently, start up costs for even a relatively small extraction operation (2,000 m³/month) will be in the order of \$US 20 million dollars. The deal that AusCo would like to make with investment bank is to get an interest free loan payable in full within 3 years. In return for the loan, the investment firm gets 7% of the profits from year 3 onwards until the mine is closed.

At current copper prices¹, and considering the processing/extraction and shipping costs as well as reasonable operational expenses², how much money can AusCo expect to make from the high grade deposit per year? How long will they be able to mine it before the high grade deposit runs out? Can they pay off the loan within 3 years?

Is zone 2 currently economical? If so, how much money will AusCo make per year and how long will this deposit last? If it isn't currently economical, what price of copper will be needed to make

¹ That means today: check a commodities site on the internet for the most recent copper prices.

² AusCo is a 3 person operation; 2 geologists and a secretary. Salary expenses are estimated to be \$150K per year. Also budget an additional \$25K per year for assaying and personal travel expenses.

it so? Assume extraction/processing costs remain the same for the foreseeable future. Ultimately, would you recommend that the investment firm write AusCo a check for \$US 20,000,000.00?

Due Date: See calendar or website for due dates.

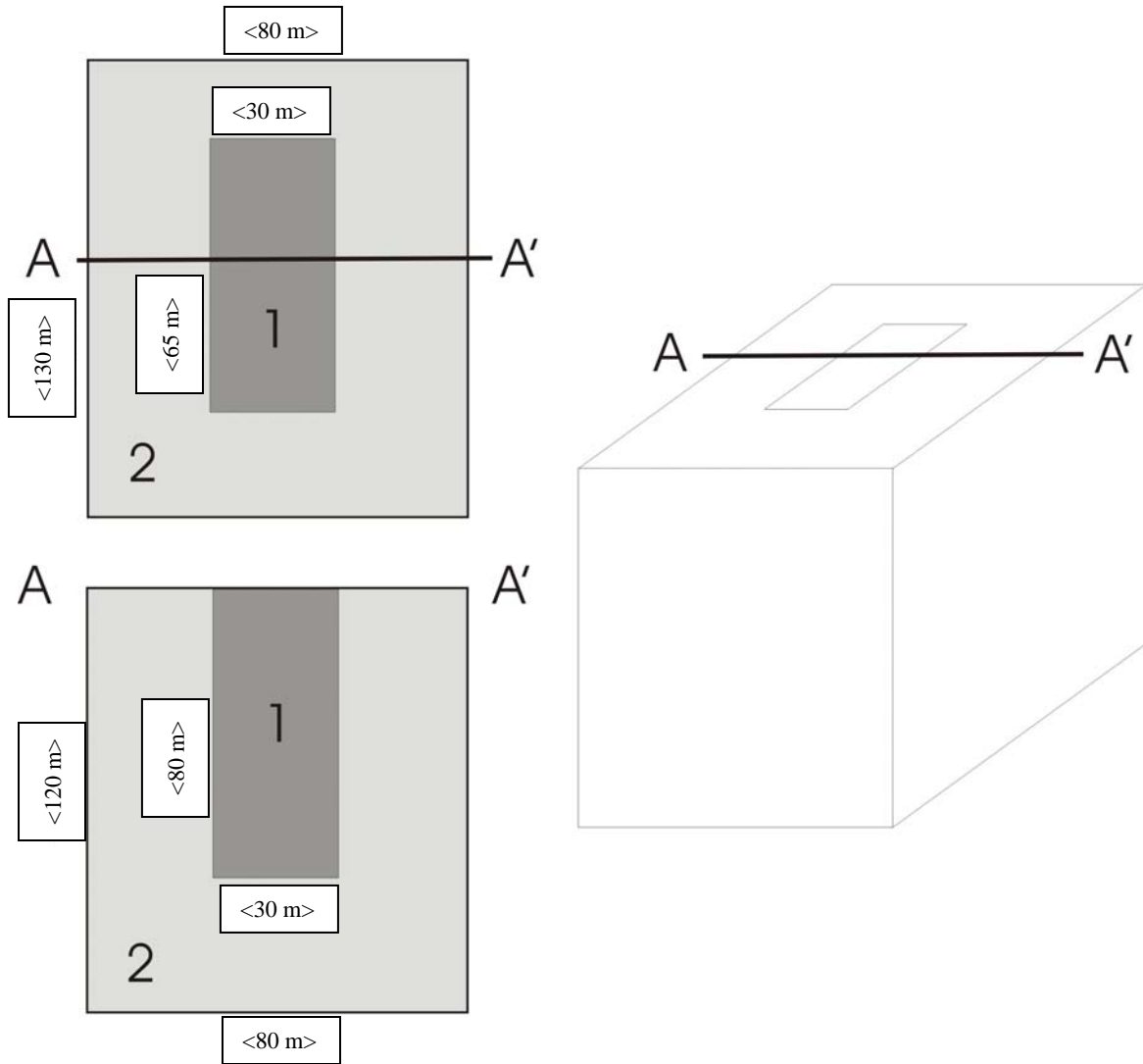


Table 1: Worksheet for estimating copper production/gross revenue for the Zone 1 mine site.

| Mineral | Zone 1 (3450 kg/m³) | | | | | | |
|---|---------------------------------------|-------------------------|--------------------------|------------------|--|--------------------------------------|-----------------------------|
| | Mol. Wt. | Wt% Cu in mineral | Wt% mineral in ore | Wt% Cu in ore | Total wt Cu per m ³ ore | \$US gross per m ³ ore | \$US gross per tonne ore |
| Digenite Cu ₉ S ₅ | 732.24 | | 2 | | | | |
| Chalcocite Cu ₂ S | 159.16 | | 1 | | | | |
| Chalcopyrite CuFeS ₂ | 183.53 | | 5 | | | | |
| Total Gross | | | | | | | |
| Less production costs | | | | | | | |
| Less transportation charges | | | | | | | |
| Less other expenses | | | | | | | |
| Net Profit | | | | | | | |

Table 2: Worksheet for estimating copper production/gross revenue for the Zone 2 mine site.

| Mineral | Zone 2 (3120 kg/m³) | | | | | | |
|---|---------------------------------------|-------------------------|--------------------------|------------------|--|--------------------------------------|-----------------------------|
| | Mol. Wt. | Wt% Cu in mineral | Wt% mineral in ore | Wt% Cu in ore | Total wt Cu per m ³ ore | \$US gross per m ³ ore | \$US gross per tonne ore |
| Digenite Cu ₉ S ₅ | 732.24 | | 0 | | | | |
| Chalcocite Cu ₂ S | 159.16 | | 0.5 | | | | |
| Chalcopyrite CuFeS ₂ | 183.53 | | 3 | | | | |
| Total Gross | | | | | | | |
| Less production costs | | | | | | | |
| Less transportation charges | | | | | | | |
| Less other expenses | | | | | | | |
| Net Profit | | | | | | | |