

Predicting Sulfide Mineral Abundances from Drill Core to Smelter Feed: Impact on the Olympic Dam Value Chain

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ABSTRACT

Geologists recognised a distinct zonation of iron and copper±iron sulfide minerals (pyrite-py, chalcopyrite-cp, bornite-bn, chalcocite-cc) across Olympic Dam a few years after deposit discovery in 1975. From the deposit margins progressing upwards and inwards:

py→cp→bn→cc

Each sulfide can occur also as binary pairs with the sulfide either immediately before or after in the above sequence (py+cp, cp+bn, bn+cc). However, py+bn, py+cc, cp+cc do not occur.

Even though chalcopyrite is the dominant Cu-sulfide mineral across the deposit, sufficient tonnes of low sulfur bearing sulfides (bornite and chalcocite) occur permitting the use of single-stage smelting technology at Olympic Dam. However, at some time in the future, as bornite and chalcocite-rich ores are gradually depleted, the existing smelter will require replacement.

Ore extraction is planned and scheduled based primarily on Cu grade and Cu:S ratio (proxy for the relative abundances of the sulfide minerals). The copper grade of sulfide concentrate produced during flotation is a function of the mill feed Cu:S ratio, not mill feed Cu grade. The tonnes of concentrate produced, smelter throughput, off-gas handling, slag make, and the final tonnes of Cu-cathode produced are related to mill feed Cu grade and Cu:S ratio.

Visual estimation of sulfide mineral abundances during geological logging of drill core does not have a precision of sufficient quality, even when conducted by experienced geologists, to be useful for mine planning purposes. Drill core assaying alone yields a Cu:S ratio with high precision, but not sulfide mineral abundances.

Based on the deposit wide sulfide zonation (i.e. geological observations) and routine drill core assays, regressions were developed which predict the absolute abundances of sulfide minerals and link the sulfide mineralogy to Cu:S ratio from drill core through smelting. This was transformational for our business because Cu metal output, hence revenue, can be predicted based on drill core assays.