Exploring for Ore

Dan Wood*

WH Bryan Mining & Geology Research Centre, University of Queensland, Australia

*E-mail, danwood3844@hotmail.com

So-called "technical successes" in exploration have no economic value, but it is impossible when starting an exploration program to predetermine whether mineralization, if discovered, will become an orebody or be consigned to being just another "technical success." Mineralization only becomes ore by successfully completing a feasibility study which applies geotechnical, mining, metallurgical, economic, and social filters to mining and processing the discovered mineralization and its associated waste.

Orebodies are discovered by exploration geologists, occasionally by mine geologists, and almost never by mining engineers and metallurgists, let alone by accountants and environmental and social scientists. Yet all of these non-exploration disciplines have determining roles in converting mineralization into ore and, often, data from one of these disciplines will play a crucial role in deciding the economic feasibility of developing a mine. Much of the data these disciplines use is collected from drilling directed by exploration and resource definition geologists, and infrequently by metallurgists and geotechnical engineers.

As the chance of discovering a large near-surface orebody falls, the depth of discovery increases, and the cost of exploration escalates, exploration geologists need to have an expanded understanding of what is required to turn discovered mineralization into ore, to prevent it from becoming just another technical success—it is no longer a matter solely of relying on metal grade and thickness. Moreover, this understanding needs to be applied in planning and executing an exploration program. An ore-finding exploration geologist has to identify and consider potentially project-destroying mining factors in deciding to commit to an exploration program, and during its progress. Cancelling or aborting the program may be a necessary action.

These factors will not all be geological, but studies on the performance of mines once developed suggest the bulk of new mines never achieve feasibility study prediction and the reasons for this are predominantly geological. A sizeable inventory presently exists of large porphyry copper deposits, for example, which were discovered decades ago but remain in feasibility study stage. These are technical successes, nothing else; some may never become an orebody and the money invested in discovering this mineralization will have been wasted.

These deposits are caught in a feasibility study time warp and can only become orebodies when either the long-term price of copper supports mine development or favorable geological characteristics are used to produce an economic mine design. A possible example of the latter is the large Frieda River copper-gold porphyry deposit in Papua New Guinea, where mine development may finally proceed after more than 40 years of exploration and mining studies by taking advantage of the favorable alteration characteristics of shallower mineralization to enable lower-cost mining and ore processing. The presence of gypsum rather than anhydrite, which occurs deeper in the Frieda deposit, significantly influences the possibility of developing a mine on this mineralization. High rock temperatures, on the other hand, are challenging the development of the deep porphyry deposits at Resolution and Far Southeast.