

Mining in the 21st Century

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Old and new technology drives the minerals sector. As we increasingly search at greater depths for mineral resources we require the “old” technology of detailed geological mapping combined with tools that allow us to sense the presence of mineral deposits at depth and image subsurface geology. Incremental improvements in electromagnetic geophysical tools provide better direct sensing of some types of mineral deposits. Higher quality regional geophysical data, such as aeromagnetism and airborne gravity, combined with computationally intensive inversions allow for the construction of 3D images of the subsurface that can be even more robust with the addition of seismic or magnetotelluric data. Though not currently widely utilized, directional drilling technologies from the petroleum sector will probably be increasingly important for mineral resource delineation.

Mining in the 21st century will become increasingly autonomous for health, safety, and economic reasons. Rapid and cost effective elemental analysis during mining and milling will dramatically impact production techniques. Largely for societal acceptance and environmental quality, mining in the future will probably largely be conducted underground. The large open pits of the late 20th century will give way to more autonomous underground operations. Increasing attention will be given to waste reduction or utilization of wastes for economic benefit. Bulk tonnage, low grade deposits may increasingly be produced via in-situ recovery (ISR) which is currently utilized for a limited number of commodities (U, K, Cu). Advancements, especially in biotechnology, should allow for more effective leaching of wider range of elements. Key to ISR will be better geotechnical methods for enhancing and managing subsurface fluid movement. Information on hydrofracking from the petroleum industry will provide the basis for this future revolution.

Application of advances in geology, especially structural geology, geophysics, geochemistry, hydrology, biochemistry, materials science, robotics, and computing provide a wide range of exciting avenues for young professionals to meaningfully contribute to the mineral resources industry of the future.