ERM Case Studies

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Velocity Minerals

Rozino, Southeast Bulgaria

Background

Velocity is a Canadian-based exploration company focused on developing an emerging gold district in SE Bulgaria with its joint venture partner, Gorubso Kardzhali A.D., an established gold producer. The partner's strategy envisions multiple gold projects and an existing central processing plant for production of doré.

Our Role

In 2019, our team was requested to deliver the Rozino PFS, building on our successful 2018 PEA. This required careful review of the client's data involving several disciplines that contributed to site layout planning, mine plan refinement and ore variability investigation. ERM principally authored the NI 43-101 Technical Report and worked closely with Halyard Inc to supply plant design, develop cost estimates, and manage an array of Qualified Persons across the PFS. ERM's primary role was to provide in-depth experience and expertise to a complex project consisting of three ore types (oxide, transitional and sulphide) and develop a mine plan to maximize economic return while minimizing environmental impact.

Solutions Included

Delivery of a geometallurgical model based on visual logging of the ISRM weathering code that explained variation in metallurgical recovery performance to state of weathering of the rock and head grade.

A study of process path variations to examine the use of gravity and flotation in combination with off-site processing of the concentrates.

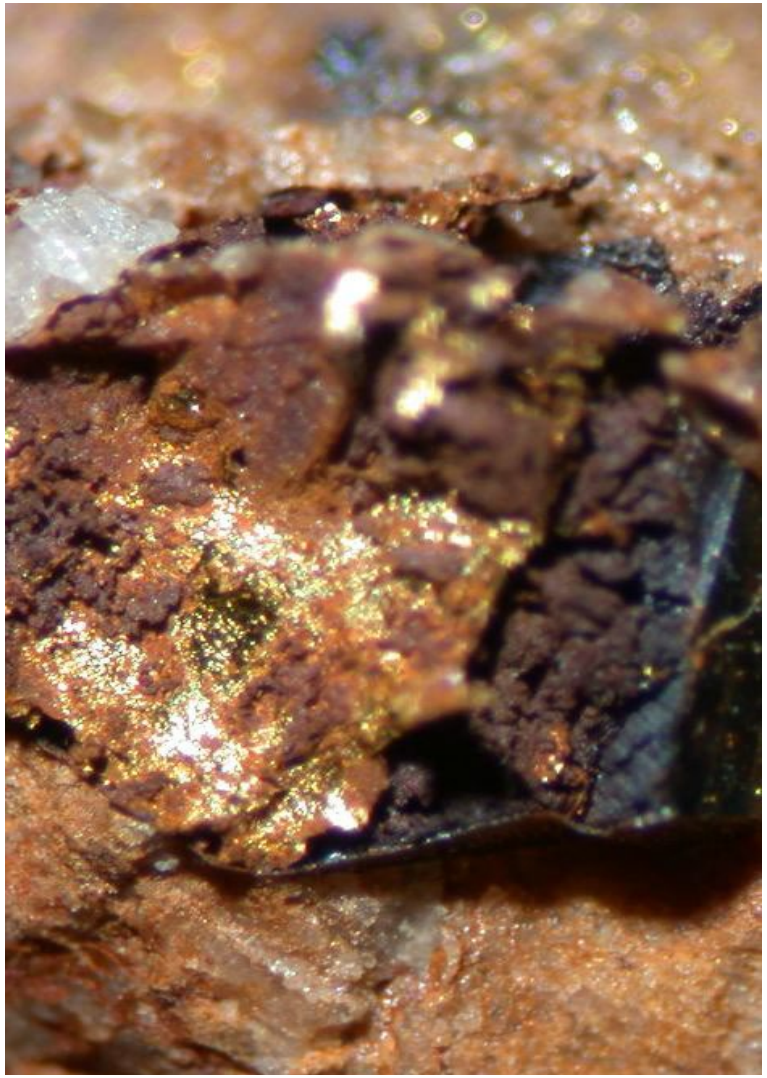
Development of several mine plans to find the smallest environmental footprint with the highest rate of return on investment.

Delivery of two-phase pit and ore stockpile strategy enabling a 25% reduction in footprint.

Design of waste dump and low-grade stockpiles that enable the closure of the mine at any time, thereby reducing closure risk.

Results & Benefit to Client

The PFS establishes the Rozino deposit as supporting an economic open pit mine operation with gold recovery by a combination of on-site concentration and off-site processing. The area of disturbance has been kept compact which facilitates future reclamation and closure. The PFS establishes Rozino as the first spoke in Velocity's district development strategy. Overall, ERM was able to complete the Pre-Feasibility Study and create a mine plan that minimized the environmental footprint while maximizing cash flow.



Myanmar Metals, Bawdwin Joint Venture

Myanmar

Background

The Mont Sorcier and Lac Doré Projects, owned by Vanadium One and VanadiumCorp respectively, are vanadiferous titano-magnetite (VTM) deposits located within the Lac Doré Complex, Québec and situated approximately 20 km apart.

Both projects had historical data dating back to the 1960s that required validation with new data. This validation, combined with improved geological models, allowed for estimation of Mineral Resources on both Projects.

Our Role

Both clients engaged ERM to access our technical expertise and global experience working with similar deposits. We helped improve understanding of the geological context of mineralization to guide exploration and develop a geological model. This model was then used to support Mineral Resource estimation.

Our team visited the project sites to guide exploration work, review and validate drilling and sampling processes, and interpret the geology. ERM performed statistical comparisons of data to verify the validity and use of the historical data and developed appropriate geostatistical methods to estimate the in-situ grade, the amount of VTM concentrate recoverable by magnetic processing methods, and the grade of the VTM concentrate.

Results & Benefit to Client

ERM was able to bring their expertise and global experience on similar deposits to the Projects, ensuring optimized data acquisition, validation of historical data, and robust geological models. ERM was also able to use their data and geostatistical expertise to the Mineral Resource estimation. This enabled both Vanadium One and VanadiumCorp to cost-effectively advance their projects, and ERM completed a Preliminary Economic Assessment for Vanadium One in early 2020, while VanadiumCorp are advancing metallurgical understanding on their project. Our team was able to bring benefits to two independent clients through the synergies resulting from similar projects in the same geological domain.

ERM was able to illustrate the usefulness of historical data, resulting in a financial saving by not having to re-acquire the data (drillholes and assay samples).

Vanadium One Iron Corp; Vanadium Corp Resource Inc

Quebec, Canada

Background

In the 1930's, Bawdwin was one of the richest mines on the planet. Since 2016, ERM has worked with Myanmar Metals in due diligence and acquisition of the project and with the Bawdwin JV to bring this project to its former glory. ERM played a critical role in advancing the project through study phases to a nearly complete Feasibility Study, managed by Lycopodium, including Mineral Resource estimates, hydrogeological, geotechnical, and mining studies.

Our Role

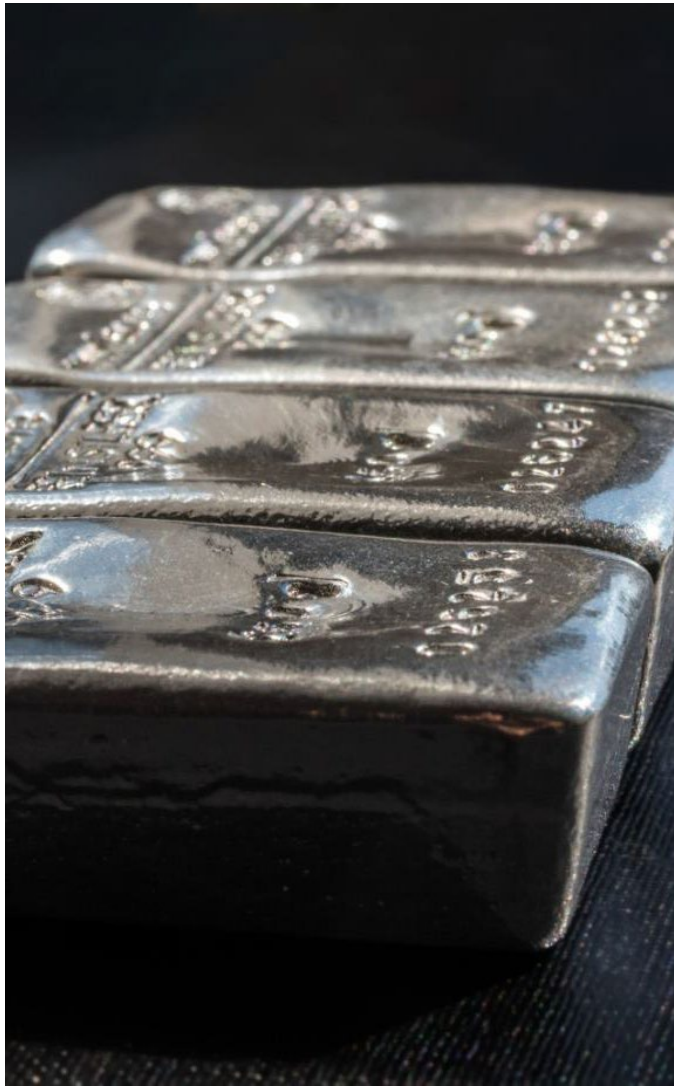
Bawdwin is a structurally-controlled polymetallic Ag-Pb-Zn-Cu-Ni-Co deposit with complex multistage sulphide and alteration mineralogy, and the added complication of an irregularly distributed supergene overprint. Developing a strong geological and geometallurgical understanding and model was essential to support Mineral Resource estimation, to guide metallurgical testwork and quantitative mineralogy, and to bring recovery parameters into the Ore Reserve block model, as well as contributing to geotechnical models and waste characterization.

ERM used its geological, geochemical and geometallurgical expertise to integrate geology, multivariate analysis of multi-element geochemical data, hyperspectral data, and mineralogy into a geometallurgical model to inform comminution and flotation parameters, working closely with the study metallurgists. This was supported by detailed mapping and logging of structure, alteration and oxidation.

Results & Benefit to Client

- ERM was able to bring their expertise and global experience on similar deposits to the Projects, ensuring optimized data acquisition, validation of historical data, and robust geological models.
- Improved Pb, Zn and Ag sulphide and non-sulphide deportment models for interpolation of robust recovery parameters into the Ore Reserve block model to inform financial modelling, mine design and scheduling, prioritizing high recovery material.
- Correlation of geomet domains with blasting performance and potential cost impacts.
- Correlation with the rock-mass quality geotechnical model which can improve geotechnical domain modelling.
- Use of the entire lithogeochemical dataset to support more accurate waste classification to reduce the risk of unexpected changes in waste characteristics during operation.

The nearly completed Feasibility Study benefits from greatly improved understanding of the geometallurgical characteristics of the Bawdwin deposit. This has significant implications for continued mining and processing.



Teck

Elkford, British Columbia

Background

Teck required a 484-bed temporary worker accommodation (Elk Valley Lodge) to house external contractors necessary for the construction of critical projects across the Elk Valley. ERM was contracted to undertake a social impact assessment (SIA) process that included conducting community engagement for the identification of potential socio-economic impacts of the Lodge and to propose mitigation measures.

Our Role

ERM conducted socio-economic baseline research to understand the conditions in Elkford. Next, an impact assessment was undertaken to identify potential impacts to social and economic values, identify appropriate mitigation (or enhancement) measures, and describe management plans and monitoring activities. As part of the SIA, Teck and ERM conducted several forms of engagement to gain the essential information including:

- Key informant interviews
- Interactive open houses
- Presentations to District of Elkford Council and residents
- Presentations to the Ktunaxa Nation Council

Results & Benefit to Client

The SIA process allowed Teck to proactively identify and address potential impacts of the Lodge, as well as implement measures to enhance potential benefits, such as business opportunities. Through the engagement, Teck earned the support of the local government and residents of Elkford. As a direct example of actions leading to desired results, input received from the public during open houses has been implemented and residents see that their suggestions were incorporated leading to their increased support. Currently, Teck facilitates a Community Effects Advisory Committee to undertake ongoing review of the effectiveness of the mitigation measures.

Building a Common Understanding of Mining Terminology Workshops

Nunavik, Quebec, Canada

Background

Raglan Mine is a Glencore company and operator of high-grade nickel mines in Nunavik, Quebec. Under the Raglan Agreement, Raglan Mine is a member of the Raglan Committee, along with five Inuit parties: the Makivik Corporation, the two Inuit communities of Salluit and Kangiqsujuaq, and their respective landholding corporations. Although the mine is expected to continue to operate for at least 20 years, through its work with the Raglan Committee, Committee members had concerns around mine closure. To address these concerns, they established a Mine Closure Subcommittee. One of the key responsibilities of Subcommittee members is to ensure Inuit voices are reflected and addressed in the Raglan Mine Closure Plan and to report back to communities to ensure they are informed on mine closure planning.

Our Role

To support the Subcommittee's review of the next Closure Plan, Raglan Mine asked Stratos to plan and facilitate a series of multi-stakeholder workshops to find appropriate terms and descriptions in Inuktitut for key terms used in the closure planning process. In August 2022, we worked with Raglan Mine to plan the workshops. In September 2022, we facilitated the workshop with the Mine Closure Subcommittee, who developed the first iteration of Inuktitut words for the terms. Following this first workshop, we facilitated two additional workshops in Salluit and Kangiqsujuaq, to validate and challenge the work of the Mine Closure Subcommittee with Elders who are experts in Inuktitut.

Results & Benefit to the Client

The overall objective of these workshops was for participants to reach a common understanding of how to describe common mining and closure terms in both plain language English and Inuktitut. With our support, the three Terminology workshops completed in 2022 have:

- Produced and validated Inuktitut terms and descriptions for twenty-four (24) terms
- Improved participant understanding of both mining and the Inuktitut language
- Supported cross-cultural learning and team building

BHP

Saskatchewan, Canada

Background

BHP is advancing its plans to develop the Jansen Potash Project in Saskatchewan, Canada. This conventional underground potash mine stands to be the largest in the world with an expected mine life of about 70 years. The project was subject to Canadian and provincial environmental acts and regulations governing the development of industrial projects. BHP contracted ERM to undertake the Environmental Impact Assessment (EIA) to gain regulatory approval for the project.

ERM's Role

The EIA commenced with the collection of comprehensive baseline environmental and socio-economic data required for project planning and development. The project then progressed to implementing the assessment of environmental and social aspects of the project including habitat compensation planning, wildlife pre-clearing surveys, toad relocation, and construction environmental monitoring.

ERM's work at the Jansen Potash Project includes:

- Full suite of environmental and social baseline studies
- Linear Features (water, power, rail) baseline studies
- Prepare Environmental Impact Statement, and steward through review process to approval
- Updates to EIS based on Project design changes
- Design and execute environmental monitoring programs
- Design and execute habitat compensation program

Value to the Client

Government approval of the project was received six months after submitting the comprehensive EIA document.

ERM has a long and successful history of working with BHP on the Jansen Potash Project with over 10 years at the project and over 30 years with BHP globally.

Seabridge Gold

Canada

ERM completed and delivered comprehensive environmental assessment and permit applications for large remote mining project which was successfully approved under the BC and Canadian Environmental Assessment Acts.

Background

The Project is one of the world's largest undeveloped gold-copper project by reserves. ERM was contracted as the primary environmental consultant to develop and conduct comprehensive environmental consulting services for the project, including coordinating the preparation and approval of the provincial Application for Environmental Assessment Certificate under the BC Environmental Assessment Act and the federal Comprehensive Study under the Canadian Environmental Assessment Act.

ERM's Role

Multiple ERM teams collaborated on the project's main areas of study: atmospheric and climate, integrated water management, aquatic and fisheries, soils/ecosystems/vegetation, geochemical, terrestrial wildlife assessment, archaeological survey, and social-economic assessment.
ERM completed multidiscipline baseline studies to support the submission of the Application/EIS, as well as applications for federal and provincial permits. We conducted the first Economic, Social and Cultural Impact Assessment (ESCIA) and managed the tracking and reporting of all public consultation and engagement activities, maintained a consultation database, facilitated open houses, and created outreach materials.

Value to the Client

The project was successfully approved under the BC Environmental Assessment Act, The Canadian Environmental Assessment Act, Schedule 2 of the Metal and Diamond Mining Effluent Regulations and several Provincial Lands, Environment, and Mining Permits.

De Beers Group

Snap Lake, Victor and Voorspoed Mines, Canada

Strategic Closure, Technical Support and Stakeholder Participation

ERM has been supporting De Beers Group to redefine current closure plans since 2018 for three assets in their portfolio where production has ceased. These sites are being used as case studies supporting a paradigm shift in the overall approach to mine closure referred to as "Reimagining Closure".

ERM has worked with De Beers to establish the business case for change, develop the strategic framework for reimagining, and supported the execution of site specific plans and studies. Key to this work has been taking an unconstrained view of the scope of the closure plans and introducing collaborative design as a tool to better engage regional stakeholders in decision making. ERM continues to support De Beers as they look to apply a 'reimagining lens' to their portfolio of active, closing, and legacy sites more broadly. This work is showing early success by reducing the total cost of closure and establishing conditions where regional value can be created in the post-closure phase.

Lessons Learned

- Acknowledging mine closure as a material business risk.
- Taking a more holistic view of mine closure and its strategic objectives.
- Transition thinking from managing liabilities to creating opportunities.
- Embracing a range of potential outcomes that go beyond demolition and rehabilitation.
- Involving regional stakeholders as active participants and peers in decision making.

Ebbw Vale, United Kingdom

Sustainable Regeneration Program

Ebbw Vale Steelworks, South Wales closed in 2002. The closure precipitated a fundamental change in the local economy, and the Welsh Assembly Government and Blaenau Gwent CBC commenced a programme of reclamation and redevelopment in 2005. ERM was appointed to lead the delivery team, and development is now well advanced, with a new educational campus, a new hospital housing and community facilities at its core.

Value delivered to client

- Leading a multidisciplinary team of some 14 designers and advisors.
- Project management and programming.
- Sustainability visioning, advice, assessment and auditing.
- Environmental Impact Assessment.
- Stakeholder engagement and health impact assessment.
- Strategic advice on sustainable procurement, waste and recycling.
- Transport assessment.
- Carbon footprinting and strategic emissions reduction planning.
- Sustainable Development Management Systems.

The Works' Ebbw Vale has become recognised by the Welsh Assembly Government and the Design Commission for Wales an exemplar of sustainable regeneration. The project is characterised by ERM's holistic approach to sustainability, which places equal emphasis on social and economic aspects as environmental and resource use issues. ERM's team secured outline planning consent for the £350 million development in 14 weeks with only one formal objection submitted.

Horsehead Zinc Smelter, Pa, USA

Demolition Management & Material Recovery

ERM managed a turn key DDD project of the former Horsehead zinc smelting facility and 110 MW George F. Weaton Power Station near Pittsburgh Pennsylvania USA. The client required the demolition prior to property sale to Shell Oil Company for the development of a new multi billion dollar etheyle cracker plant. The scope included the demolition to grade of >80 structures on 260 acres along the Ohio River.

Given the location on the banks of the Ohio River extensive marine protection measures were taken and activities were coordinated with the United States Coast Guard as well as regulators and community. Ancillary features and equipment were taken out of service and demolished while essential operations of the main zinc smelter remained temporarily operational.

Value Delivered to client

- Decontamination, abatement, and demolition of the power plant and associated coal unloading structures and stacks with a 70 calendar day period.
- Recovery and recycling of over 29,000 tons of scrap steel and non ferrous metals to fund the abatement, decontamination and demolition efforts.
- Managing the transportation and off site disposal of over 13,000 tons of friable and non friable asbestos containing material and screening, loading and shipping of over 10,000 tons of zinc dust for reuse.