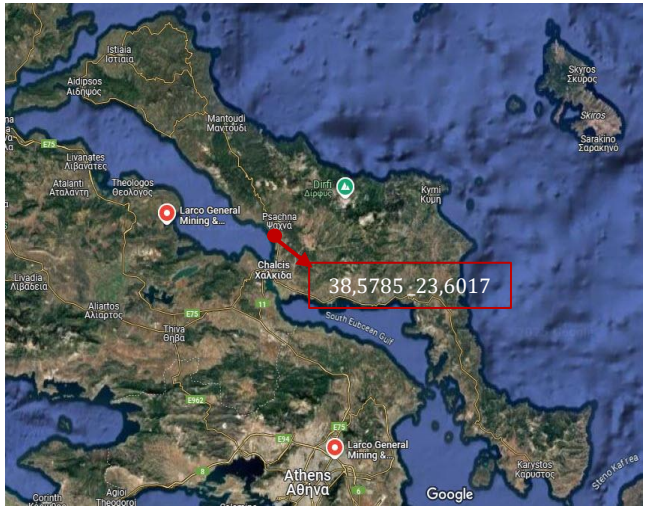
LARCO GMMSA Closed Mining Site



Processing-Conveyor

Overview | CRM Ni | Location

Work Layout Info | VEs Map | Processing VE

Disclaimer

Funded by the European Union

Erasmus+
Enriching lives, opening minds.

IMMERSE
Immersive Virtual Tours on Critical Minerals for Clean Energy Transition

TECHNICAL UNIVERSITY OF CRETE

NA | DAAD
Nationale Agentur für Erasmus+ Hochschulzusammenarbeit
Deutscher Akademischer Austauschdienst
German Academic Exchange Service

Overview

General Information

LARCO is a temporary, under special corporate management regime, mining company. Until 2022, LARCO GMMSA mining company was recognized as one of the world's top 10 ferronickel producers and was a highly trusted brand. The mining company was an entirely export industry and the unique ferronickel producer in Europe using domestic ore.

It operated continuously from 1966 until 2022. Most major stainless steel manufacturers in Europe were successfully using LARCO granulated ferronickel in their facilities.

Specific Information

Surface mining in the Euboea mines referred to an average nickel concentration of approximately 1.01%, and an average annual production of 1.3 Million Tonnes. 63.016.879 tonnes of FeNi have been extracted from 1969 to 2022. Removal of the waste material is estimated at 612.391.167 tonnes for the same time. The stripping ratio (waste/FeNi)equals 9,7/1 w/w, while the average FeNi concentration was approximately 1,017%.

The 360 panoramas in the current VE refer to the most significant processing part of transporting the beneficial Ferronickel material (Fe-Ni) from the first grinding process step to the local company's port. Then, the raw material containing Nickel is transferred to the beneficiation unit in Larymna for further purification through the delivery boat.

***All the information provided by this VE is strictly confidential. It is legally forbidden to share any company-related item without prior official permission from the company administration.**

Info from active sites

Mining Ore Information

LOM Flowchart

Info from Active Sites

Products from Mining Extraction

1. Homogenized – Ferro-Nickel Ore, in quantity of all the Euboea Mines of LARCO G.M.M.S.A., 1,300,000 tonnes per year and dry content Ni: 1.00%, Fe: 35 – 29%, SiO_2: 28-32% which is sent to the Larymna Metallurgical Plant for the production of the main final product, for sale.
2. Limestone waste: Products of the disclosure, part of which can be utilized in the production of aggregates for Civil Engineering projects.

Site	Production (Tonne/Year)		Land & Rehabilitation (m^2*1000/Year)	
	Laterite/FeNi	Waste/Slag	Land Occupation	Number of Plants
Euboea Mines	1.300.000	16.000.000	9.880	4.600
Agios Ioannis Mines	600.000	5.900.000	2.130	8.800
Kastoria Mines	400.000	6.000.000	1.300	15.900
Larymna Factory	17.500	1.650.000	-	-

Mining Ore Information

Mining Extraction to Transportation for Shipping to the final Beneficiation Unit

1. The primary extractive mining ore is transferred to the primary grinding and size classification unit in Vyra
2. Then, using the conveyor belt, the beneficial mining ore is transferred to the local company's port for shipping.
3. The primarily beneficial mining ore is guided to the Larymna Beneficiation unit to be purified in Nickel.

Deposit

Inclined Road

Sterile Material

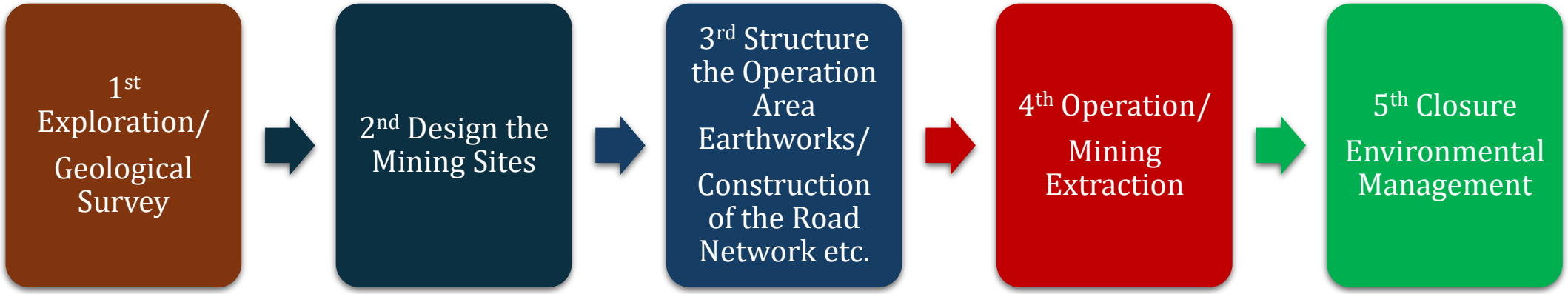
Square and Mining Face

Deposit

Bench

Ore separation from waste (dilution control) and loading onto trucks

Flowchart of LOM (Life of Mine)



(LOM) & Environmental Management

- The Life of Mine (LOM) includes five basic tasks that should be implemented.
- The first task focuses on the geological survey that evaluates a site area as suitable for exploitation.
- The second task refers to the optimization of mining engineering design, including a memorandum of activities that should be accomplished before the actual primary extraction.
- The third task refers to the implementation of design activities.
- The fourth task involves all the working activities and is crucial for the productivity of the mining site. The final task focuses on the optimization of the environmental management action plan depending on the physical conditions of each mining site.
- The environmental management system involves the actions of environmental rehabilitation, planting, creating pit lakes, earthworks, or alternative uses of the produced waste in terms of the Sustainable Mining respecting the 4Rs Policy and regulation of the Circular Economy.

It is essential to mention that closure activities have a significant impact on the brand name of a mining company while enhancing social approval, securing funding, and increasing political support for similar activities.

Work Layout-Info

Primary Extraction to Beneficiation

The entire work layout of the mining activity for the Ferronickel extraction and Nickel beneficiation involves the following working tasks.

1. Primary extraction of the mining ore, including sterile and beneficial material of ferronickel (FeNi).
2. First separation of the coarse sterile material from the coarse beneficial material in the “Vyra” processing unit.
3. Transportation of the coarse and fine beneficial material from the “Vyra” processing unit to the local port of the Larco GMMSA mining company, using the largest conveyor with a length of 7.5 km in Europe. The conveyor belt loads (feeds) the delivered material directly into the specifically designed silos of the transportation boat.
4. The transportation boat delivers the raw material from the Euboea local port to the beneficiation unit of Agios Ioannis in Larymna for further Nickel purification processing. Click to see the shipping
5. The beneficiation unit of the Larco GMMSA company is located on the opposite side of the local company’s port in Politika.

Role of the Conveyor Belt | **Innovation** | **Technical Specifications** | **Operation Flowchart**

Shipping Map

Role of the Conveyor Belt
In Processing, considering the policy of the Green Deal and Sustainable Mining Practices

	Environmental Objective in Environmental Management System (EMS) ISO 14001:2015	Sustainable Mining Practices/Techniques to minimize any potential negative Environmental Side based on Environmental Management System (EMS) ISO 14001:2015
1	Minimization of Energy Consumption	Considering the geomorphology of the area (shown in the first picture) connecting ''Vyra'' processing unit with the local company's port, the conveyor system utilizes gravitational force in the downhill direction. So, while the upper belt rolls, the down belt rolls back.
2	Minimization of needed Energy	Minimization of Energy consumption leads to the least amount of energy needed, which refers to the electricity required only for starting the operation.
3	Minimization of CO_2 emissions	Due to the operation of the conveyor, there is no need for transportation trucks to deliver the raw material to the local company's port.
Environmental Objective in EMS: The goal set for an organization as a whole or for parts of it. The objective is related to the environmental objectives and must be implemented to achieve them.		**Environmental Side in EMS:** It constitutes the basis for highlighting the activities, products, or services of an organization that are related to the environment.

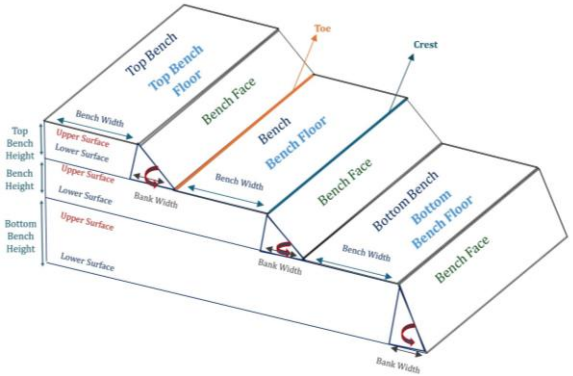
Innovation since 1977

- The conveyor belts were primarily designed and established in 1977 as an alternative to truck transfers for transporting ore from extractive mining operations, aiming to minimize CO_2 emissions and conserve energy.

- LARCO GMMSA consultants adopted an intelligent approach to saving money by constructing the gravitational conveyor instead of an internal road network that utilized the geomorphology of the entire area. Altitude difference (+416-+68 meters).

- Therefore, the specified conveyor belt, which utilizes the gravitational force generated by the steep slopes of the hills, began to operate in an extremely efficient manner.

Operation
Extraction & Processing






Wheeled Excavator | Crawler Excavator | Bulldozer | Dumper

Virgin mine site (natural environment, geochemical background)





Wheeled Excavator | Crawler Excavator | Bulldozer | Compactor | Dumper

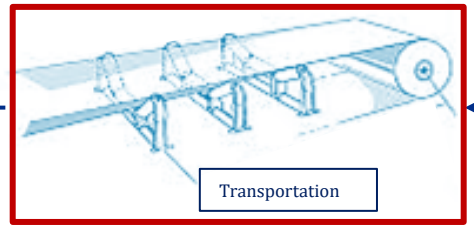
Mining

Top soil, overburden, waste rock and temporary stockpile of ore

Ore

Processing

Tailings
Processing waste

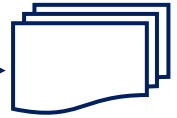


Transportation

Grinding Unit

Shipping

Market product



Beneficiation

Source

Sustainability: A model example of integrating mining logistics with renewable energy concepts.

Innovative Feature

- The conveyor takes advantage of the relative height difference.
- Instead of operating solely as an engine-driven system, it functions simultaneously as an electric generator.
- This design transforms gravitational potential energy into usable electrical power.

This conveyor belt is the largest in all of Europe.

Technical Specifications

Design & Operation

in terms of

Sustainable

Mining

LARCO

Transportation

One of the most Significant Processing Steps of the Fe-Ni mining ore.

The use of a carbon fiber conveyor belt prevents health and safety hazards for personnel operating machinery and reduces diesel costs.

Key Technical Specifications

Length: 7,500 m

Transportation capacity: 1,200 tons/hour

Belt width: 1,000 mm

Belt speed: 4 m/sec

Rated Power: 913 kW

Benefits

Energy efficiency: Diesel-powered land transportation is fully eliminated.

Power generation: Production of electricity

Sustainability

Reduced emissions: Significant decrease in CO_2 footprint.

Cost savings: Lower operational and fuel costs.

CRM – Nickel (Ni)
Click to see Criticality Assessment of Ni

CRM	Supply Risk SR	Economic Importance EI	Criticality CR
Nickel (Ni)	0.5	5.7	2.85
Ranges for SR, EI, CR	0-5	0-9	0-45
Impact on SR, EI, CR (%) (Numerical Value of the CRM) ÷(Maximum Threshold)	$(SR)_{CRM} \div (SR)_{Max}$ 10%	$(EI)_{CRM} \div (EI)_{Max}$ 63.3%	$(CR)_{CRM} \div (CR)_{Max}$ 6.3%

Click to see the uses of Ni

Nickel is a metallic material that is applied in plenty of industrial applications. For instance, nickel is used as a structural material for battery production, in automotive manufacturing, for the construction of energy production units, in stainless steel production, in aerospace engineering, and rarely in the medical industry to produce pharmaceutical products. Despite its low supply risk grade, its economic importance is high. Therefore, according to the European Commission Ni belongs to the critical raw materials and not only a typical base metal.

Supply Risk: Risk Grade of the material resources
Economic Importance: Grade of the material's price value to the market
Criticality: Grade of material's impact on the Market

Source: European Commission: Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs, Grohol, M. and Veeh, C., *Study on the critical raw materials for the EU 2023 – Final report*, Publications Office of the European Union, 2023, **https://data.europa.eu/doi/10.2873/725585**

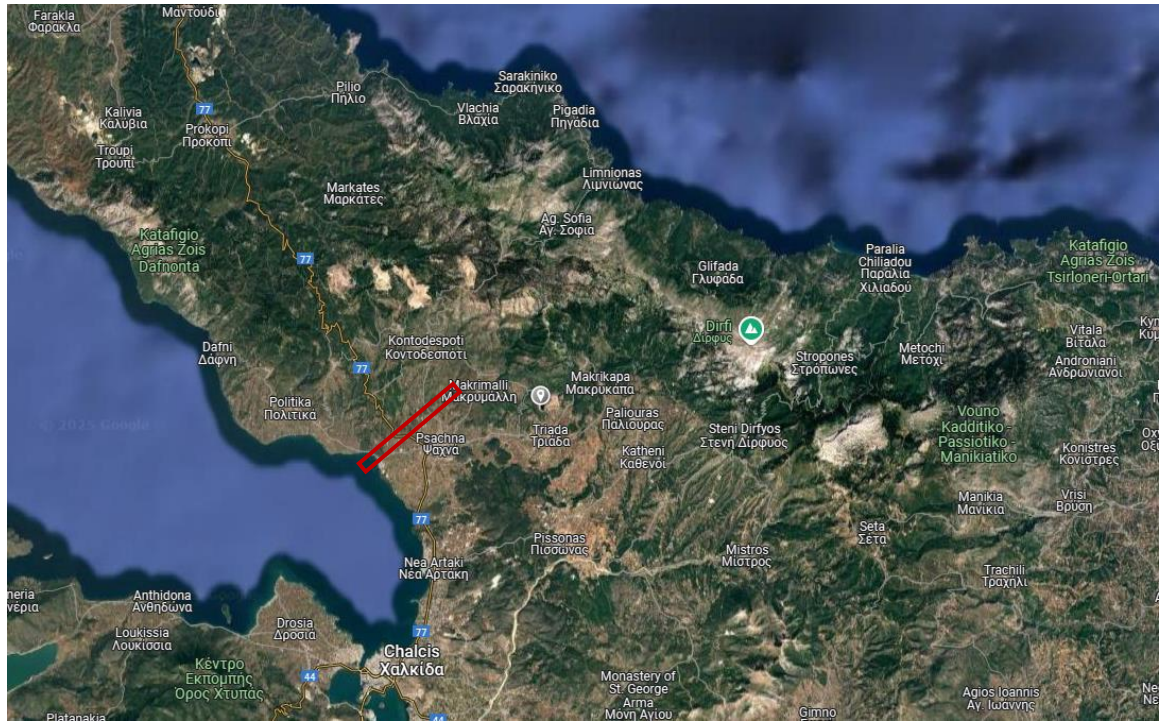
Criticality Matrix

Criticality Matrix		Supply Risk (SR)				
		1	2	3	4	5
(CR)=(EI)*(SR)						
Economic Importance (EI)	1	1	2 **(Ni=2.85)**	3	4	5
	2	2 **(Ni=2.85)**	4	6	8	10
	3	3	6	9	12	15
	4	4	8	12	16	20
	5	5	10	15	20	25
	6	6	12	18	24	30
	7	7	14	21	28	35
	8	8	16	24	32	40
	9	9	18	27	36	45

- The **Criticality Matrix** displays a quantitative assessment of the Criticality grade for each examined raw material, based on the information contained in the European Study on CRMs, as shown below on this slide.
- The **Supply Risk (SR)** and **Economic Importance (EI)** refer to variable parameters that depends on the entire resources of raw materials and their configured price values according to their demand, respectively. i.e. the SR of a raw material could fluctuate within a period. Therefore, depending on the global resources data and industrial needs, the corresponding Study for CRMs could be updated, including the existing SR and EI indices for raw materials.
- The **Criticality (CR)** is configured by the multiplication of EI and SR grades. The CR index shows the criticality grade of each examined raw material.

Source: European Commission: Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs, Grohol, M. and Veeh, C., *Study on the critical raw materials for the EU 2023 – Final report*, Publications Office of the European Union, 2023, **https://data.europa.eu/doi/10.2873/725585**

Map of the Virtual Excursion



LARCO GMMSA_Conveyor Belt
Start Point: Latitude_38°57’85’’ Longitude_23°60’17’’
End Point: Latitude_38°57’24’’ Longitude_23°59’46’’

Disclaimer

Co-funded by
the European Union

The creation of these resources has been funded by the ERASMUS+ grant program of the European Union under grant no. 2023-1-DE01-KA220-HED-000165332.