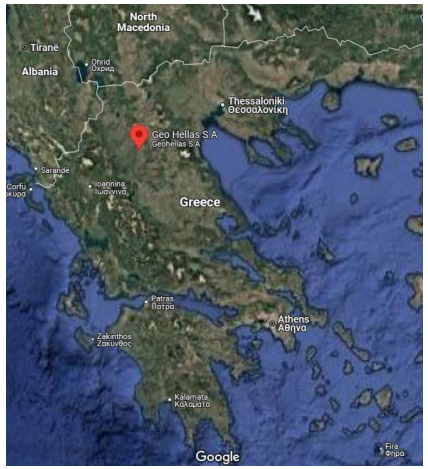
Grevena

Surface Quarry Site



CRM: Magnesium

Overview | CRM – Mg | Location
VE | Criticality Matrix | VEs Map
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Overview

General Information

GeoHellas utilizes the CRM of Mg contained in the attapulgite and by-products in terms of a sustainable environmental management plan. Click

Geohellas is an industrial minerals company whose abundant resources are complemented by professional strength in depth. Featuring an expert, dedicated R&D department and leading-edge manufacturing facilities, Geohellas delivers an expanding portfolio of superior technical clay products that enhance product quality and performance for clients in various business sectors.

Innovation R&D

According to Schumpeter's definition, Innovation is characterized by new (re)combinations of products, processes, services, markets & organizations. The Geohellas team fosters new ideas for products and services, encourages teamwork, inculcates staff with a greater sense of involvement, and allows the organization to find competitive advantages in the marketplace. R&D department explores new uses of our materials and creates new solutions and applications in constant effort to improve the performance, efficiency, and output of the customers' products.

The current 360 panoramas demonstrate the mining geology of primary product extraction that contains CRM of Mg. Moreover, emphasis is given to the environmental uses of Mg contained in attapulgite and its by-product in both the concrete industry and environmental management actions.

Primary and Secondary Products' Mg Environmental Uses	Role of the CRMs contained in the primary product. Adsorption of Heavy Metals from AMD	Role of the CRMs contained in the by-product. Reuse as Building Material

Primary & Secondary Product contained CRM (Mg) – Environmental Management

XRF analysis of attapulgite.

Constituent	% (m/m)	
	Raw attapulgite	Spent attapulgite
Na_2O	0.1360	0.1097
MgO	11.4291	10.2545
Al_2O_3	9.9103	9.6366
SiO_2	68.4193	69.5454
SO_3	0.1705	0.4781
K_2O	0.5849	0.6068
CaO	4.1893	3.8992
TiO_2	0.4840	0.4925
MnO	0.0640	0.1099
Fe_2O_3	4.0880	4.5587
Co_2O_3	0.0028	0.0181
NiO	0.0115	0.0220
CuO	0.0033	0.0151

The primary product's CRM (Mg) is utilized in adsorption of heavy or toxic metals from hazardous waste, especially from AMD (i.e. tailings-acid mine drainage), minimizing the volume of waste and their negative environmental impact, conforming with the 4Rs policy (and especially the waste volume reduction) of the Green Deal.

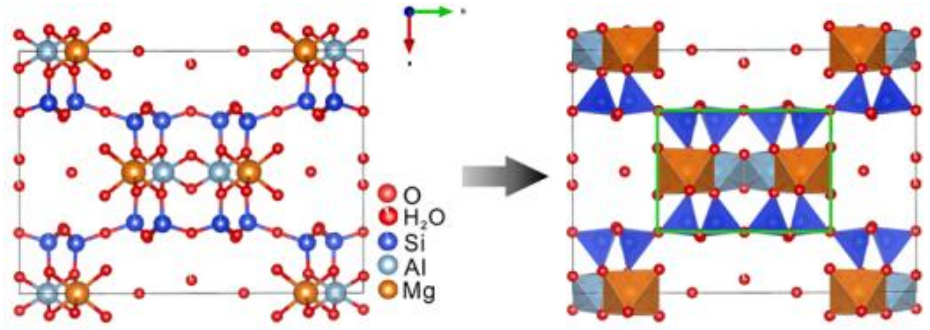
CRM (Mg) that could be utilized from the by-product in the concrete industry as a structural raw material is the Magnesium oxide. Mg is contained in the by-product, at the optimal concentration for the concrete mix (according to the ASTM C114). Therefore, by-product is directly reused in the cement industry. The reuse of the by-product, which contains the optimal concentration in CRM, complies with the 4Rs policy (and especially the reuse task) expressed through the Green Deal.

Thabo Falayi and Ntuli Freeman, 2014. Removal of heavy metals and neutralisation of acid mine drainage with un-activated attapulgite. Journal of Industrial and Engineering Chemistry

Role of Mg for the adsorption of Heavy metals in terms of Waste Management

The crystal structure of the attapulgite and the role of the CRM (Mg) and Si are crucial for the efficiency in environmental uses. The chemical binding chain is structured by Mg, Si, H_2O, and O. The stability of the chemical chain is provided by Si. Greek attapulgite contains Mg, which occurs in oxides. Regarding the environmental management application of attapulgite, the heavy metals contained in acid mine drainage are adsorbed by the attapulgite by substituting for the existing Mg. This chemical mechanism occurs due to the reduction of the magnesium oxidation numbers, while acidic dissolution occurs. Si provides the required stability on the chemical binding chain (maintaining its oxidation number as a non-metallic element) while not reacting with the acidic dissolution occurrence. So, the heavy metals' electronegativity is decreased, heavy metals substitute for Mg in the chemical binding chain, and the phenomenon of adsorption of heavy metals from the attapulgite occurs.

Juan Liu et al., 2021. Preparation, Characterization, Application and Structure Evolution of Attapulgite: From Nanorods to Nanosheets. Applied Surface Science.



Typical Chemical Formula of the Attapulgite

$(Mg, Al)_2Si_4O_{10}(OH)4(H_2O)$

Koukakis et al., 2016. Attapulgite clay of the Ventzia basin, western Macedonia, Greece, as template in synthesizing amorphous carbon nanotubes

Role of Mg, Mn for Construction Activities

Utilization of CRM (Mg), contained in the by-product powder, in limestone Cement Production for Construction Works

Source: **Click** **Click**

The by-product powder, is an indicative cost-effective solution as a reused material in the concrete industry.

The Si element provides stability in the chemical binding while binding with the rest of the metalloids contained in the clinker mix.

The occurrence of Mg provides a well-crystallized stereochemical system that affects the increase of the produced building material's compressive strength.

If the occurrence of Mg exceeds the limit of 2% w/w, then the powder is utilized as a structural material to produce bricks.

Source: **Click** **Click**

CRM-Magnesium (Mg)
Click to see the Criticality Assessment of Mg

CRM	Supply Risk SR	Economic Importance EI	Criticality CR
Magnesium (Mg)	4.1	6.7	27.47
Ranges for SR, EI, CR	0-5	0-9	0-45
Impact on SR, EI, CR (%) (Numerical Value of the CRM) ÷(Maximum Threshold)	$(SR)_{CRM} \div (SR)_{Max}$ 8 2%	$(EI)_{CRM} \div (EI)_{Max}$ 74.4%	$(CR)_{CRM} \div (CR)_{Max}$ 61%

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**

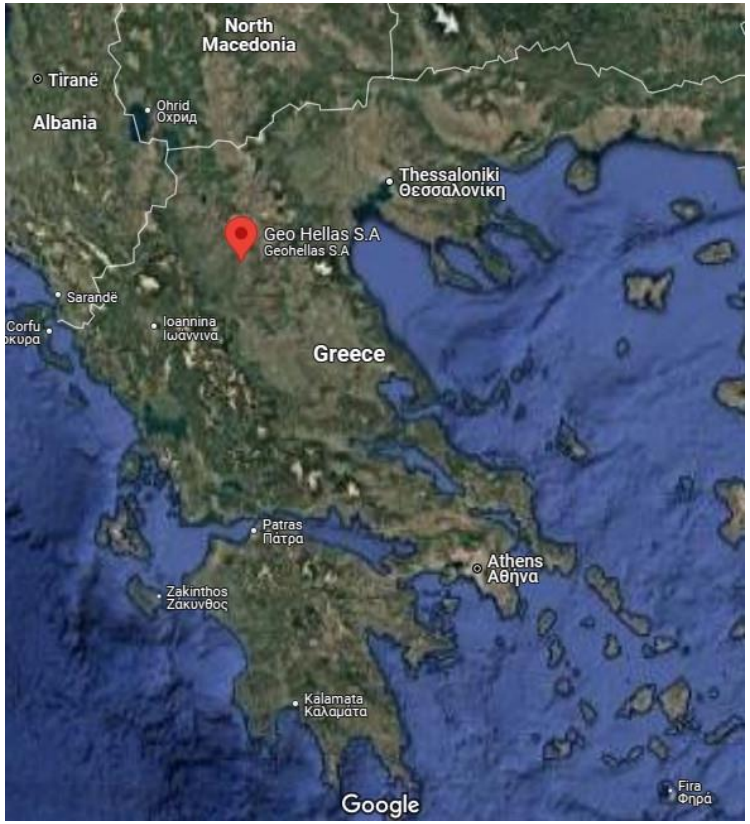
Criticality Matrix

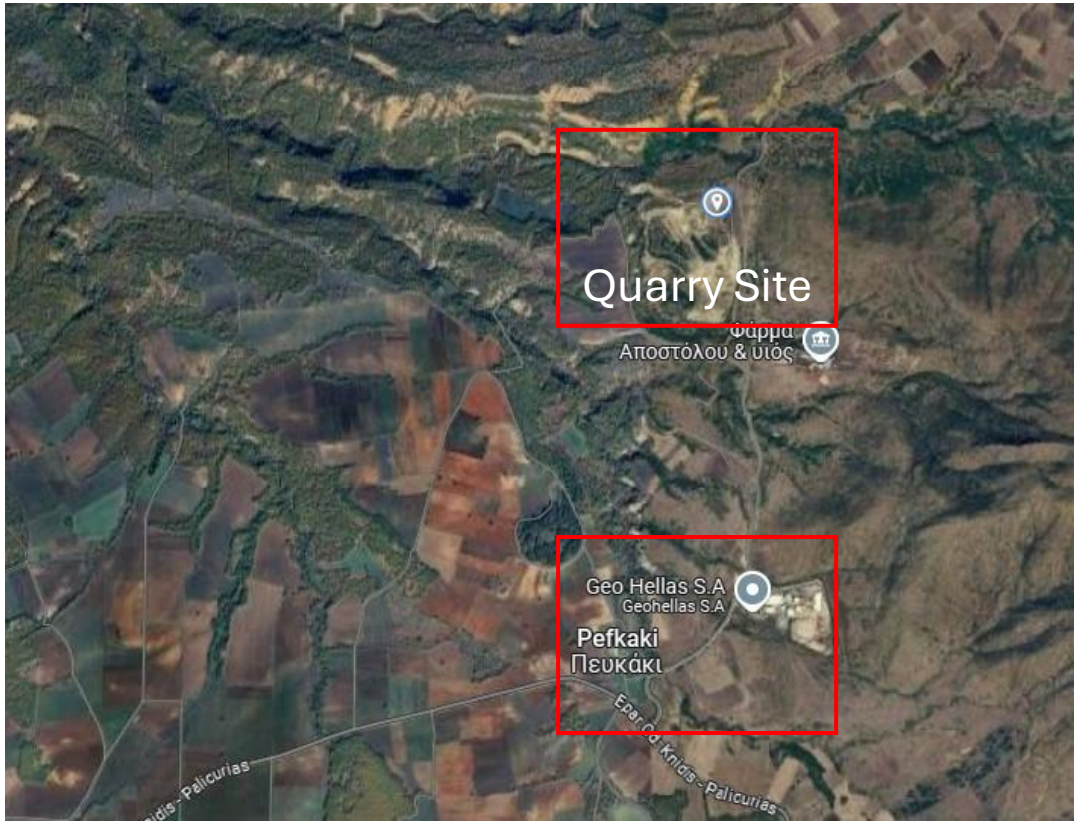
Criticality Matrix		Supply Risk (SR)				
		1	2	3	4	5
(CR)=(EI)*(SR)						
Economic Importance (EI)	1	1	2	3	4	5
	2	2	4	6	8	10
	3	3	6	9	12	15
	4	4	8	12	16	20
	5	5	10	15	20	25
	6	6	12	18	24	30
	7	7	14	21	28	35
	8	8	16	24	32	40
	9	9	18	27 **(Mg=27.47)**	36	45

- 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





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Disclaimer

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