High-Magnesium Dolomites in South-Central New Mexico

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Abstract

Magnesium is an important critical mineral used in a wide range of industrial products and materials. It is used in the manufacture of certain medicines, fertilizers, electronics, and batteries. Magnesium is utilized as an alloying agent of aluminum to improve mechanical capabilities; aluminum-magnesium alloys are useful in airplane and car construction, where strong lightweight materials are critical. China has much of the processing capacity and is the largest global producer of both magnesium compounds and magnesium metal. Demand for magnesium has increased because of use in car parts and batteries. Although magnesium is found in many minerals, dolomite, magnesite, brucite, carnallite, and olivine are of major commercial importance. In New Mexico, magnesium is produced solely for fertilizer as langbeinite from the Carlsbad Potash District. At least one company is considering producing magnesium from dolomite near Deming. In addition to providing significant yields of magnesium, dolomites are also used as crushed rock in construction as a soil additive and iron smelting. In order to consider mining dolomites for magnesium, the dolomites need to be “high-purity”. We define high-purity dolomites as containing at least 15% MgO. We find that certain dolomites in south-central New Mexico, including those within the Florida and San Andres Mountains, contain economically significant grades of magnesium (12-22% MgO). High-purity dolomites exist near Silver City, Deming, and Las Cruces, locations that are feasible for transport and extraction. High-purity dolomite deposits in south-central New Mexico, the mining of which could occur in the future, remain the most plentiful source of magnesium in the state. Research is ongoing as magnesium-rich sites are found and described for any potential future mining activity.

Mg% in Naturally Occurring Sources

Mineral/Material	Chemical formula	Mg wt. %
Brucite	$Mg(OH)_2$	41.68
Olivine	Mg_2SiO_4	34.55
Magnesite	$MgCO_3$	28.8
Serpentine	$Mg_3(Si_2O_5)(OH)_4$	26.31
Dolomite	$CaMg(CO_3)_2$	13.18
Bischofite	$MgCl_2 \cdot 6H2O$	11.96
Langbeinite	$K_2Mg_2(SO_4)_3$	11.71
Carnallite	$KMgCl_3 \cdot 6H2O$	8.75
Brines	Mg^{2+}	~2.5 (variable)
Sea water	Mg^{2+}	0.13

Values retrieved from webmineral.com

Study Goals

- Magnesium is a critical mineral due to its industrial importance and delicate supply chain.
- The US relies heavily on other countries for sufficient supply of Mg to continue production on important products, such as batteries and alloys used in cars and airplanes.
- Supply chain breakdown in source countries such as China, Russia, and Turkey would cause a critical shortage of Mg.
- War, protectionist policies, or a crash in the economy can negatively impact supply chains.
- It is of extreme importance that the US find ways to ensure internal supply chains of Mg to avoid industrial complications in the future.
- Dolomite can be an economically significant mineral due to Mg yield.
- High-purity dolomites sampled for this study are in readily accessible locations in south-central New Mexico.
- The percentages of MgO in these dolomites are high enough that mining operations are economically feasible.

If mining operations are permitted in central NM, it would bolster the supply chain of Mg in the US and soften the potential blow to its critical industries if external supply chains are somehow interrupted.

Industrial Uses of Magnesium

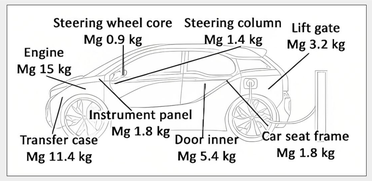

Figure 1. Estimated magnesium content allocated throughout a car (Golroudbary et. al 2023)

Figure 2. Magnesium is being used as a less expensive alternative to lithium in batteries that use magnesium-oxide as a cathode

Figure 3. Map of Sampling Locations For High-Magnesium Dolomites

- Fluorite Ridge
- Snake Hills
- Florida Mtns
- Klondike Hills
- Victorio Mtns
- Lake Valley
- Hillsboro
- Mud Mountain
- San Andres Mtns
- Sacramento Mtns
- Guadalupe Mtns
- Carlsbad

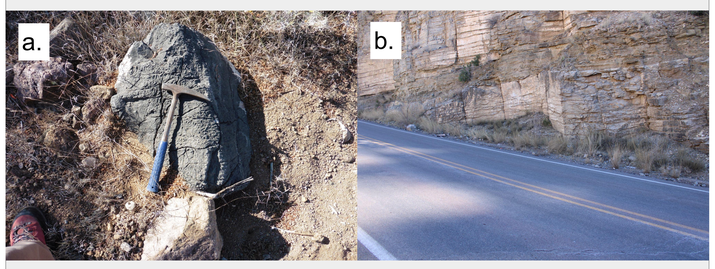

Figure 4. Field photos of sampling locations at the (a.) Florida Mountains and (b.) the Sacramento Mountains.

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Sample Chemistry

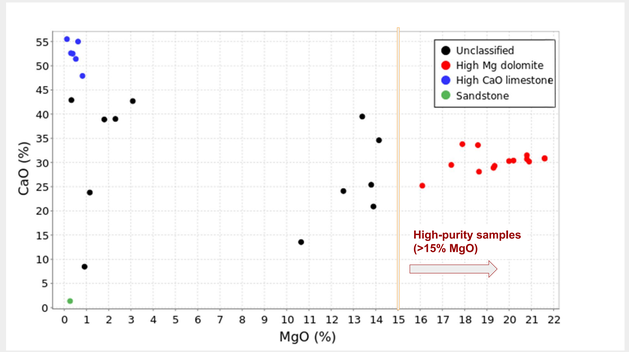

Figure 5. High CaO and MgO samples. High MgO content allows us to distinguish dolomites from limestones. **High MgO dolomites were retrieved from the Victorio Mountains, Snake Hills, Fluorite Ridge, San Andres Mountains, Guadalupe Mountains, and the Florida Mountains.**

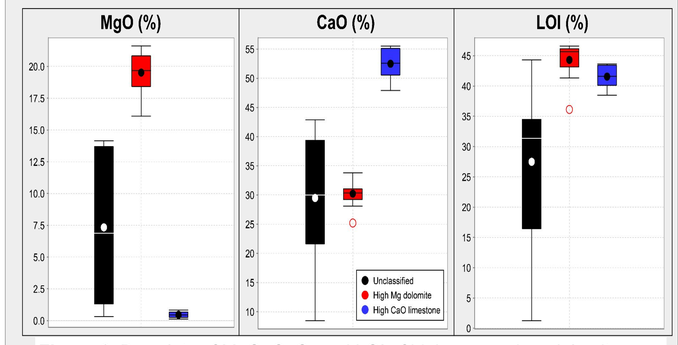

Figure 6. Box plots of MgO, CaO, and LOI of high magnesium dolomites, high calcium limestones, and other rocks. Dolomites show up to 22% MgO, around 30% CaO, and around 45% LOI. High calcium limestones show almost no MgO, up to 55% CaO, and up to 44% LOI. Unclassified rocks are likely dolomitic limestones, calcareous dolomites, or other sediments.

Conclusions

Our findings show that a large percentage of the dolomite samples from some locations such as Mud Mountain, the Sacramentos, and Kingston do not match our definitions for high-purity. **However, samples from the Victorio Mountains, Snake Hills, Fluorite Ridge, San Andres Mountains, Guadalupe Mountains and the Florida Mountains are consistently high purity (>15% MgO) and may contain economically significant amounts of magnesium.** More sampling and results from Luna and Otero Counties are forthcoming.

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