

# Marine Gypsum-Seawater's Pure Gift

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## INTRODUCTION

Marine gypsum is a naturally occurring evaporite mineral made of calcium sulphate dihydrate ( $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$ ), which is mostly created when seawater evaporates in confined maritime habitats. It is frequently found in coastal basins, lagoons, and shallow oceans where the climate favors high rates of evaporation relative to precipitation and freshwater influx. Parts of India and other semi-arid and arid regions of the world are home to a large number of gypsum-bearing soils. Geologically speaking, marine gypsum creates large stratified deposits that are incorporated into sedimentary rock formations.

Marine gypsum is essential for sustainable soil management, especially in salt-affected soils (sodic and saline-sodic soils), whether it is added purposefully or by natural weathering. Gypsum's

calcium substitutes exchangeable sodium on soil colloids, resulting in increased aeration, improved infiltration, and improved aggregation. Gypsum may be used in neutral to alkaline soils because, in contrast to lime, it provides calcium without appreciably changing the pH of the soil. Furthermore, secondary plant nutrients like calcium and sulfur, which are necessary for plant development and metabolic activities, may be found in marine gypsum. Gypsum has become more important in contemporary nutrient management techniques due to the rising prevalence of sulfur deficiency in heavily farmed soils. Because of its importance in soil formation, categorization, reclamation, and sustained agricultural production, marine gypsum has a crucial place in soil research.

## FORMATION AND GENESIS OF MARINE GYPSUM

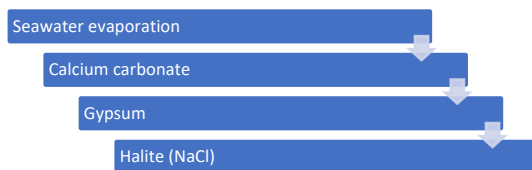
Marine gypsum is formed by a physio-chemical evaporite process that takes place in limited Coastal habitats with certain hydrological and climatic conditions. It is intimately related to the degree of basin limitation, rate of evaporation, and chemical of saltwater.

- Shallow marine basins, lagoons, or inland seas
- Restricted circulation with open oceans
- High evaporation rate exceeding precipitation
- Arid to semi-arid climate
- Limited freshwater inflow

### Environmental conditions required-

#### Precipitation Sequence (Evaporite sequence)-

The concentrated dissolved salts in saltwater precipitate in a certain order called the evaporite sequence when the water evaporates. The sequence is as follows:-



These deposits of gypsum build up as sedimentary rocks with layers. Gypsiferous soils are created when these deposits are broken down over geological time by weathering and soil-forming processes. Gypsum may also develop as a

secondary mineral in some soils when calcium-rich solutions react with sulfate ions. When saltwater is concentrated to around 3.5–4 times, gypsum precipitates.

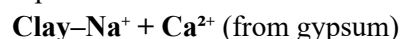
### ROLE OF MARINE GYPSUM IN SOIL RECLAMATION

The restoration of sodic and saline-sodic soils is one of the most significant applications of marine gypsum in soil science. High exchangeable sodium percentages (ESP), which cause clay

particle dispersion and poor soil structure, are characteristics of sodic soils.

#### Mechanism of Sodium replacement

Marine gypsum supplies soluble calcium, which replaces sodium from the soil exchange complex.



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As sodium is leached out with irrigation or rainwater, soil structure improves, resulting in better physical conditions for plant growth.

### EFFECT ON SOIL PROPERTIES

#### Physical Properties-

- Promoting flocculation of clay particles
- Increasing soil aggregation

- Enhancing porosity and permeability
- Improving water infiltration and drainage
- Reducing surface crusting and compaction

#### Chemical Properties-

- Reducing exchangeable sodium percentage (ESP)
- Improving cation balance in soil

- Increasing electrolyte concentration in soil solution, which stabilizes soil structure
- Supplying calcium without significantly altering soil pH

### OTHER IMPORTANCE OF MARINE GYPSUM

#### Nutritional importance-

Marine gypsum serves as a valuable source of essential plant nutrients:

- Calcium (Ca): Important for cell wall formation, root development, and membrane stability

- Sulfur (S): Required for protein synthesis, enzyme activity, and chlorophyll formation  
Sulfur deficiency is increasingly observed in intensively cultivated soils, and gypsum application helps correct this deficiency effectively.

#### Agricultural and Environmental Significance-

Marine gypsum contributes to sustainable agriculture by:

- Improving productivity of salt-affected soils

- Enhancing efficiency of irrigation water, especially when sodium-rich
- Reducing runoff and soil erosion
- Supporting long-term soil health and fertility

### CONCLUSION

Because of its numerous applications in enhancing the physical, chemical, and nutritional qualities of soil, marine gypsum is a crucial mineral in soil research. It is an important resource for sustainable land management because of its ability to restore

sodic soils, enhance soil structure, and deliver vital nutrients. Particularly in dry and semi-arid areas, soil scientists, agronomists, and land-use planners must comprehend the development, occurrence, and roles of marine gypsum.