Vegetation Communities on Gypsiferous soils, White Sands Missile Range, New Mexico

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Abstract

Gypsiferous soils are extensive in the mid and northern portions of the Tularosa Basin of southern New Mexico. Factors such as landform, percent gypsum, depth to gypsum, and gypsum form can affect vegetation. Plant communities associated with these factors will be examined.

Landforms with gypsiferous soils on White Sands Missile Range include:

- Pleistocene lake shorelines (playa dunes, lunettes)
- Relict lakebeds
- Complex drainageways
- Alluvial flats
- Active and stabilized gypsum dunes
- Limestone-capped gypsum hills

The amount of gypsum and the depth at which it occurs in the soils can range from only minor amounts occurring two or three feet below the surface to nearly 100 percent throughout the soil profile. The form in which gypsum occurs varies from hard indurated petrogypsic horizons to soft flour-like gypsum. The combination of these factors helps to ultimately determine plant community composition.

New ecological sites are being developed to accommodate this diverse land area. However, additional research and documentation is needed to better define these soil-landscape-plant community relationships.

Introduction and Background

Gypsum was formed in the Tularosa Basin of southern New Mexico from an inland sea which covered the area 250 million years ago. A giant dome was uplifted 70 million years ago when the Rocky mountains were formed. When the dome collapsed about 10 million years ago, the Tularosa Basin was formed. The original sides of the collapsed dome form what is now the Sacramento mountains and the San Andres mountains (Figure 1).

Figure 1. Satellite photo of Tularosa Basin (center) with San Andres Mtns to the west (left) and Sacramento Mtns to the east (right). Courtesy of the National Park Service, U.S. Dept. of Interior.

Rain and snow that fall in the surrounding mountains of the Tularosa Basin dissolve gypsum from the rocks of the Yeso formation and carry it by surface and subsurface flow to the basin floor. The Tularosa Basin is a closed basin without drainage outlets, therefore, gypsum and other soluable salts have accumulated within the basin.

As the gypsum enriched water decends from the mountains, it pools into low spots or percolates into local aquifers. As the water evaporates, a crystalline form of gypsum called selenite is often left behind (Figure 2). Eventually through weathering, these crystals are broken down into sand-sized particles light enough to be moved by the wind. These particles are what contribute to the formation of the gypsum dunes and also other landforms influenced by gypsum in the Tularosa Basin (Figure 3).

Figure 2. Selenite crystals

Figure 3. Gypsum dunes

Results and Discussion

Landform, amount of gypsum, depth to gypsum, and form or type of gypsum are factors that contribute to the determination of plant production and community composition (Table 1). This poster will briefly examine three different soils that occur on the White Sands Missile Range.

Bomber Soils

Ecological Site: Salty Bottomland (Run-in position)

Classification: Coarse-loamy, gypsic, thermic Ustic Torrifluvent

Figure 4. Profile of Bomber soil

Figure 5. Landscape overview of Bomber soil

Figure 6. Flour gypsum of Bomber soils

Bomber soils are in drainageways that receive run-in water and have much of their sediment washed in (Figures 4 and 5). The high amount of gypsum in these soils (>70%) occurs within 15 cm of the soil surface (Table 1). This gypsum is powder-like, with crystals that cannot be seen without the aid of a10X hand lens. The local term for this gypsum is "flour gyp" (Figure 6).

Talos soils

Ecological Site: Loamy (Neutral position)

Classification: Fine, mixed, superactive, thermic Calcic Argigypsids

Figure 7. Profile of Talos soil

Figure 8. Landscape overview of Talos soil

Figure 9. Selenite crystals of Talos soil

Talos soils occur on alluvial flats, with depth to gypsum occurring at approx. 60 cm (Table 1, Figure 7). These soils are in a neutral position and do not receive additional run-in water (Figure 8). The percent of gypsum in Talos soils is approximately 40% (Table 1). The gypsum type is unweathered selenite crystals (Figure 9).

Peligro Soils

Ecological Site: Gyp Hills (Run-off position)

Classification: Coarse-loamy, gypsic, thermic Leptic Haplogypsids

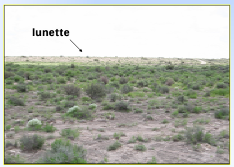

Figure 10. Landscape overview of Peligro soil with lunette in background.

Figure 11. Profile of Peligro soil

Figure 12. Sand gypsum of Peligro soils

Peligro soils occur as raised crescentic mounds of gypsum (playa dunes, lunettes) which were formed from eolian deposits on the leeward side of deflating Pleistocene lakes (Figure 10). Peligro soils contain high amounts (>70%) of gypsum (Table 1). The gypsum occurs within 5 cm of the soil surface and is a crystalline form locally termed "sand gyp" (Figure 11). The crystals of this type of gypsum are visible without the aid of a 10X hand lens. Crystals located on the surface of the soil can form a hardened crust (Figure 12) which limits infiltration and seedling establishment.

Tabular Results

Table 1. Properties of High Gypsum Soils, White Sands Missile Range

Soil Name	Landform	Percent Gypsum	Depth to Gypsum	Type of Gypsum	pH	EC (dS/m)	Annual Production	Dominant Species
Peligro	Playa Dune (Lunette)	>70%	≈5 cm.	Fine sand-size crystalline gyp with hardened surface crust	7.8-8.1	2-2.9	168 kg/ha	hairy crinklemat/gyp dropseed *Tiquilia hispidissima/Sporobolous nealleyi*
Bomber	Drainageway	>70%	≈15 cm.	Soft flour-like gyp crystals not visible with naked eye	7.7-8.5	8.5-21.6	2800 kg/ha	alkali Sacaton *Sporobolous airoides*
Talos	Alluvial Flat	<40%	≈60 cm.	Selenite crystals 2-4mm diam.	7.5-7.9	0.5-3	560 kg/ha	honey mesquite/tobosa *Prosopis glandulosa/Pleuraphis mutica*

Conclusions

1. Soil factors such as landform, percent gypsum, depth to gypsum, and the type or form of gypsum affect plant production and composition of native plant species found on gypsiferous soils.
2. Gypsiferous soils are found on a variety of landforms on White Sands Missile Range.
3. Drainage-ways and broad alluvial flats that receive additional run-in water exhibit highest production. Playa dunes (lunettes) and other landforms where water is lost to runoff show little production.
4. The amount or percent of gypsum present in the soil is important in the determination of plant composition. Generally as the gypsum content increases plant composition shifts to species with high tolerance to gypsum such as gyp dropseed, alkali sacaton, hairy crinklemat, and fourwing saltbush.
5. Soils where high concentrations of gypsum (>35%) occur at depths greater than 10 inches can sustain herbaceous plants that tend to be similar to non-gypsiferous soils with similar surface textures. The deeper rooted shrub component, however, consists of species that demonstrate high gyp tolerance (i.e. fourwing saltbush, Torrey's jointfir).
6. Type or form of gypsum appears to be especially important in determining plant production and composition. Soft flour-like gypsum seems to be most favorable to plant production. Conversely, indurated gypsum favors low production.
7. Soils with a hardened surface crust (Peligro) limit infiltration and exhibit minimal production, with scattered gyp grama and hairy crinklemat occurring as the dominant plants.

Acknowledgements

http://www.nps.gov/archive/whsa/pphtml/subnaturalfeatures12.html. Accessed May 29, 2007.

http://www2.nature.nps.gov/geology/parks/whsa/. Accessed September 28, 2007.

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