

CHARACTERIZATION OF SOILS IN YELLOWSTONE NATIONAL PARK

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Objectives

This is a continuation of a project initiated in 1980 to characterize the major soils of Yellowstone National Park. It has entailed the integration of existing resource data, such as the Yellowstone National Park geologic map (U.S.G.S. 1972), surficial geological map (U.S.G.S. 1972) and the vegetative habitat map (Despain, 1980), with detailed soils characterization data.

The objectives of this study are:

1. Describe and classify the soils in the major habitat and geological regions according to Soil Taxonomy (Soil Survey Staff, 1975).
2. Sample the dominant soils in the major vegetative habitat and geological regions for detailed soils characterization analyses.
3. Prepare an interpretations and analyses report.
4. Develop an initial soils legend for the major soils of the Park.

Methods

The field operations for this study have utilized the Park geologic map, surficial geological maps and the vegetative habitat map for identifying and investigating the major soil areas of the Park. A total of 67 soils have been sampled for complete characterization analyses, resulting in the collection of 265 soil horizon samples. The soils sampled are representative of the major soils occurring throughout the Park.

Laboratory analyses are being performed according to U.S.D.A. Soil Conservation Service standard procedures (Soil Survey Staff, 1972). The analyses include complete chemical and physical characterizations for each soil sample. Analyses are complete for 39 pedons with the remainder to be completed by early 1982.

Results and Discussion

Sixty-seven pedons have been sampled and described in the Park. These

pedons are representative of soils derived from rhyolitic rock, andesitic rock, detritus and hydrothermal activities. Soils derived from rhyolite are relatively coarse textured and infertile. The textures of the sola range from sandy loam at the surface to loamy sands in the substratum. The sum of exchangeable bases range from 1 to 10 miliequivalents per 100 grams of soil throughout the sola. Soils derived from rhyolitic glacial till material typically have in excess of 40% coarse fragments in the C horizon. Table 1 presents select chemical analyses for a representative pedon derived from rhyolitic till. These soils are acid throughout the sola with the majority of the extractable bases occurring in the surface horizon. The vegetative habitats on these soils are dominated by seral stages of lodgepole pine forests within the Subalpine fir/grouse whortleberry-grouse whortleberry phase (Abies lasiocarpa/Vaccinium scoparium - V. scoparium) habitat type.

In contrast, the soils derived from andesitic material are generally dark colored, have in excess of 10 percent clay throughout the sola, usually have an argillic horizon, and have a high amount of extractable bases. Table 2 presents select chemical and physical analyses for a representative pedon sampled in andesitic till. These soils are fine textured, have a good moisture holding capacity and have in excess of 75 percent base saturation. The cation exchange capacity of these soils is also high indicating that these soils can retain significant amounts of nutrients for plant consumption. Vegetation on these soils is typically the Subalpine fir/globe huckleberry - globe huckleberry phase (Abies lasiocarpa/Vaccinium globulare - V. globulare) habitat type.

The parent material, precipitation and vegetation are important in the genesis of the soils of Yellowstone National Park. The classification (Soil Survey Staff, 1975) reflects these influences and can be used as a diagnostic tool for their interpretations. Table 3 presents a cross tabulation of the soil taxa, geological units and vegetative habitat units, for the 39 pedons completed to date. From this data it is evident that the soils derived from rhyolitic material support drought tolerant habitat types and have weakly developed soils, primarily in the Entisol soil order. Soils derived from andesitic material support a more lush forested habitat and have resulted in well developed soil profiles in the Mollisol and Alfisol soil orders. It should also be noted that the soils in the Park have a cold temperature regime, below 8°C, resulting in Cryic great group classification for all soils.

Summary

This study is providing a comprehensive data base on the nature and properties of the major soils of Yellowstone National Park. The results integrate soil characterization analyses with geological and vegetative data. The resulting data base with the associated interpretations will provide a significant tool for recreation management, wildlife management, ecological relationships and provide basic soils data for use in other research projects.

Table 1. Select chemical parameters from a soil representing Rhyolitic Plateau Till.

Horizon	pH CaCl ₂	Ca	Mg	Extractable			Acidity Soil	AL	CEC	Base Percent	Carbon
				Na ---MEQ/100 gm	K	gm					
A ₁	4.0	5.1	0.7	TR	0.6	24.1	1.7	22.6	28	10.20	
B ₂₁	4.2	1.0	0.1	TR	0.1	6.5	2.2	6.2	18	0.67	
B ₂₂	4.5	1.0	0.1	TR	0.1	4.4	1.1	4.1	29	0.26	
B ₃	4.5	0.5	0.1	TR	.1	2.2	0.6	2.0	35	0.11	
C	4.5	1.1	0.3	TR	0.1	1.7	0.6	3.2	47	0.05	

Table 2. Select chemical and physical parameters from a soil representing Andesitic Till.

Horizon	Depth cm	Sand -----Percent-----	Silt	Clay	Ca -----	Mg -----meq/100 gm-----	K	CEC -----
A ₁₁	0 - 5	29.6	53.5	16.9	14.0	4.6	2.8	39.4
A ₂₁	5 - 15	30.6	50.7	18.7	16.3	4.0	2.2	26.4
A ₂₂	15 - 27	32.8	49.0	18.2	16.4	4.7	2.1	28.2
B _{21t}	27 - 49	33.7	39.0	27.3	24.7	8.1	1.9	36.0
B _{22t}	49 - 77	35.7	39.0	25.3	24.0	9.5	1.8	35.1

Table 3. Cross tabulation of soil taxa and habitat units by geological unit.

Geological Unit	Common Soil Taxa (Sub Group)	Common Vegetative Units (Habitat Type)
Rhyolitic Plateau Flows	Dystric Cryochrepts Typic Cryochrepts	2LL, 2L3, 3H0
Rhyolitic Welded Ash Flows	Dystric Cryochrepts	2LL, 2G0
Rhyolitic Detritus	Typic Cryohemists Typic Cryaquents Aquic Cryorthents Typic Cryochrepts Typic Cryorthents	FD DW KF TFG 2LL, 4P0
Andesitic Till and Colluvium	Mollic Cryoboralfs Pachic Cryoborolls Typic Cryoboralfs Typic Cryumbrepts	5N0, 2F0 TFG, FN 2EE 2EE
Andesitic Detritus	Terric Cryohemists Typic Cryorthents Typic Cryoborolls	FD TFG TFG
Hydrothermally Altered Soils	Typic Cryorthents	2LL

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