Modeling Spodosol Distribution along Environmental Gradients in Northern Idaho

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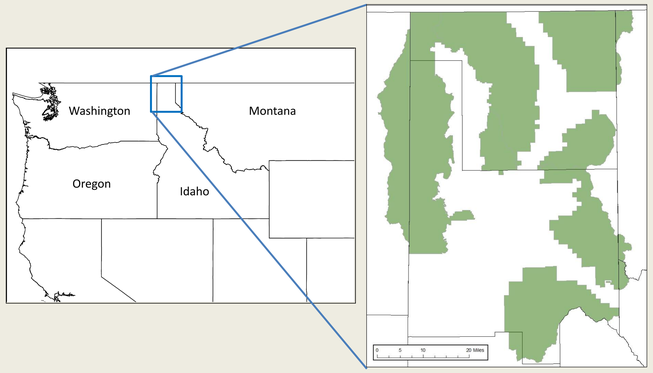
Introduction

- Spodosols not currently mapped in the Kaniksu National Forest (below)
- Previous studies over small areas found Spodosols at mid- to high-elevation landscapes (Houston, 1988; McDaniel et al., 1993, 1994)
- Spodosol distribution tied mainly to elevation and aspect
  - Spodosols found > 1100 m on north-facing slopes
  - Spodosols found > 1500 m on south-facing slopes



Objectives

- Improve understanding of factors controlling podzolization in the region
- Create a terrain-attribute based model explaining the occurrence of Spodosols
- Use model to develop a map of the likely distribution of Spodosols

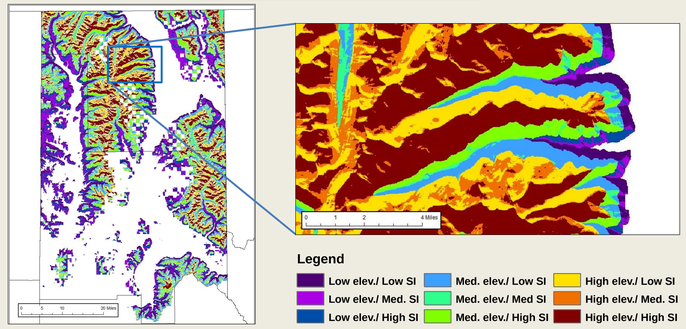
Geologic Setting

- The region has been subjected to continental and alpine glaciation
- Soils within the region are capped by up to 70 cm of volcanic ash from Mt. Mazama, Oregon
- A thin (1-5 mm) layer of Mt. St. Helens ash (1800 A.D.) lies beneath litter layer at undisturbed sites; this can complicate field identification of E horizons
- Two bedrock types underlie the region
  - Metasedimentary belt rocks (fine textured)
  - Kaniksu Batholith granitics (coarse textured)

Methods

- A stratified random sampling scheme was developed to include most public land in the northern Idaho panhandle
- The area above 825 m was divided into sampling categories based on elevation and solar insolation (SI)
  - 3 equal-area categories of elevation were created: low (825 – 1141 m), medium (1142 – 1485 m), high (> 1484 m)
  - 3 equal-area categories of solar insolation were created: low, medium, high
  - A matrix of nine sampling categories was created
- Sampling categories were buffered around roads to increase sampling efficiency
- Polygons were numbered and randomly selected; 73 of these polygons were visited during summer 2010
- Soil morphological properties, vegetation, and site properties were described
- Laboratory analysis is ongoing, but includes pH (1:1, soil:H_2O) and selective dissolution with ammonium oxalate

Sampling Categories



Map showing distribution of the nine sampling categories across the study area (left) and across several mountain valleys (right)

Elevation Gradient Effects

pH	Al+0.5 Fe	
--	--	Oe
3.6	0.3 %	E
3.7	1.8 %	Bhs
3.9	2.0 %	Bs
4.2	1.6 %	Bw1
4.2	1.3 %	Bw2
4.2	1.3 %	Bw3
4.1	0.9 %	2BC

Elevation: 1850 m
Aspect: SE

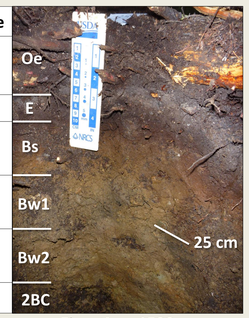
pH	Al+0.5 Fe	
--	--	Oe
4.6	2.9 %	Bw1
4.8	2.5 %	Bw2
4.5	0.8 %	2Bw3

Elevation: 1204 m
Aspect: SE

Two soils on southeast-facing slopes exhibit very different morphologies. The higher-elevation soil exhibits a well-developed albic and spodic horizon, whereas the lower-elevation soil does not. Albic and spodic horizons are very strongly acid and exhibit high extractable Al and Fe.

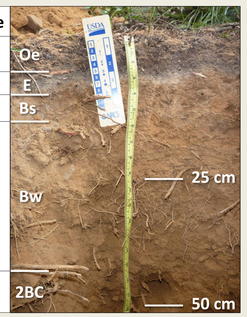
Solar Insolation Gradient Effects

pH	Al+0.5 Fe	
--	--	Oe
3.1	0.2 %	E
3.8	3.2 %	Bs
4.1	1.5 %	Bw1
4.2	1.2 %	Bw2
4.2	0.8 %	2BC



Elevation: 1520 m
Aspect: N

pH	Al+0.5 Fe	
--	--	Oe
4.6	0.3 %	E
4.7	0.8 %	Bs
4.6	0.6 %	Bw
4.5	0.3 %	2BC



Elevation: 1579 m
Aspect: W

These soils both formed at similar elevations, but receive different solar energy inputs. The north-facing soil has very well-developed albic and spodic horizons, while the west-facing soil has very limited expression. Coarser textures also tend to promote spodic expression.

Sampling Matrix

- Expression of podzolization increases with increasing elevation
- Spodic expression generally decreases with increasing solar insolation

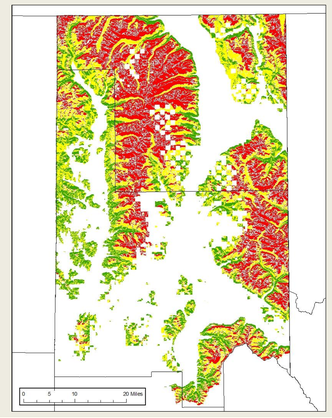
Elevation \ Solar Insolation	L	M	H
H	89	75	88
M	63	50	56
L	25	43	0

Spodic morphology is dominant (> 70% of sampled pedons)
Spodic morphology is present (30 – 70% of sampled pedons)
Spodic morphology is minor or absent (< 30% of sampled pedons)

Matrix illustrating the percentage of sampled pedons within each category that exhibit spodic morphology

Spatial Model

- Using the above matrix, a map was created showing the expected distribution of spodic expression
- Using the minimum percentages of the three categories, roughly 460,000 acres (185,000 ha) of soils expressing spodic morphology occur within the region



Conclusions

- The degree of podzolization generally increases with increasing elevation and decreasing solar insolation
- Preliminary maps indicate that soils expressing spodic morphology cover a substantial portion of the Kaniksu NF
- Textural differences, which are related to the underlying geology, affect the extent of podzolization

References

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Acknowledgements

This project is funded by USDA-NRCS. The authors would like to acknowledge Thomas Staples and Eric Robertson for their assistance with field work, and Anita Falen for her assistance with laboratory procedures.