United States
Department of Agriculture

Keys to Soil Taxonomy

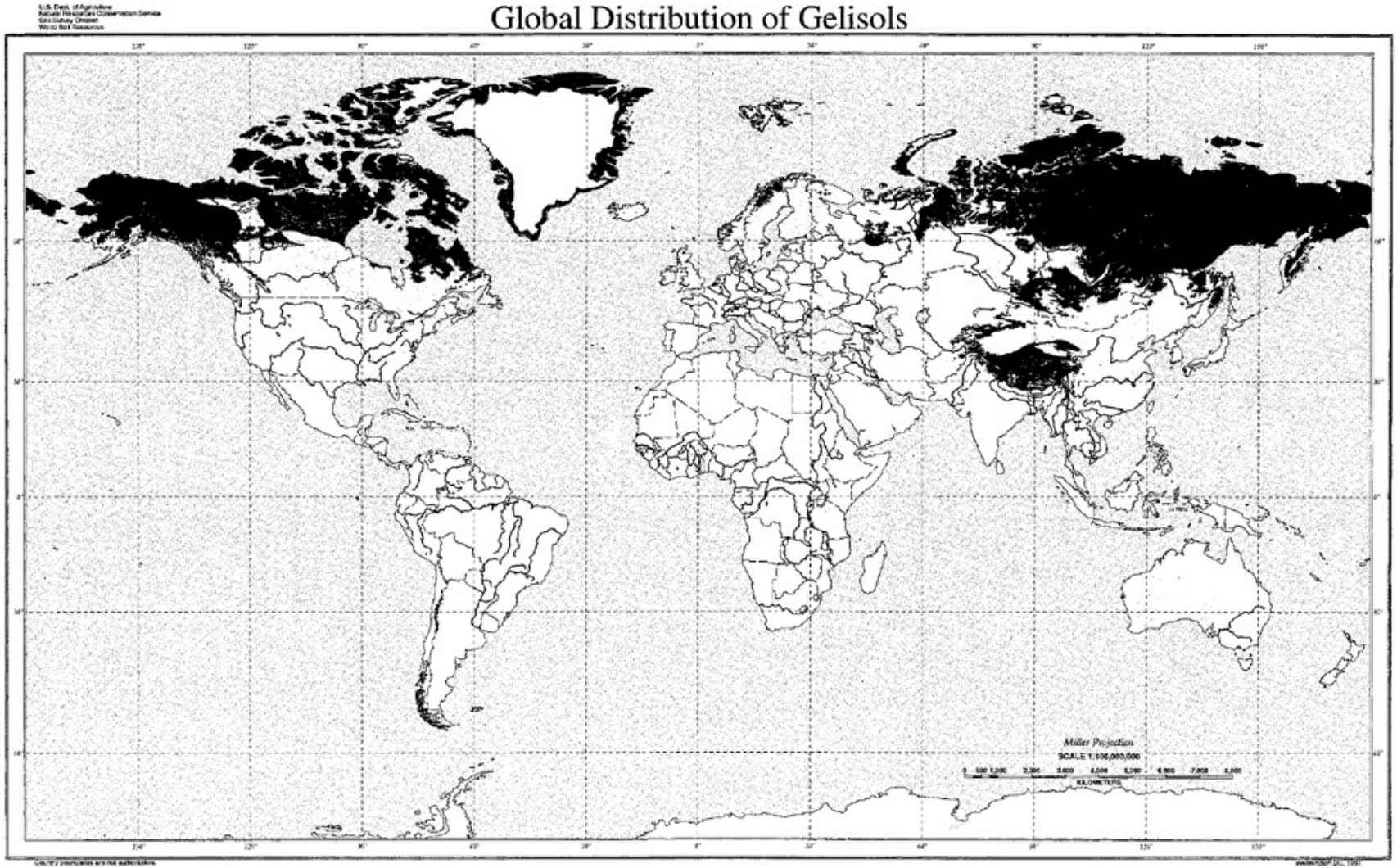
Ninth Edition, 2003

Major Diagnostic Features		Soil Order
Soils with permafrost within 100 cm or cryoturbation and permafrost within 200 cm	Yes →	Gelisols
No ↓		
Soils with organic soil materials extending down to an impermeable layer or with an organic layer that is more than 40 cm thick and without andic properties	Yes →	Histosols
No ↓		
Soils with a spodic horizon within 2 m of soil surface and without andic properties	Yes →	Spodosols
No ↓		
Soils with andic properties (low density, glass, pumice, short-range order minerals)	Yes →	Andisols
No ↓		
Soils with an oxic horizon within 150 cm of soil surface	Yes →	Oxisols
No ↓		
Soils with 30% or more clay to a depth of 50 cm and shrinking/swelling properties	Yes →	Vertisols
No ↓		
Soils with an aridic soil moisture regime and some B horizon development or a salic horizon	Yes →	Aridisols
No ↓		
Soils with an argillic or kandic horizon or fragipan and a base saturation of <35% at 2 m depth or 75 cm below a fragipan	Yes →	Ultisols
No ↓		
Soils with a mollic epipedon and a base saturation of >50% to an impermeable layer or at 1.8 m from soil surface	Yes →	Mollisols
No ↓		
Soils with an argillic, kandic or natric horizon or a fragipan with clay skins	Yes →	Alfisols
No ↓		
Soils with a cambic, sulfuric, calcic, gypsic, petrocalcic, or petrogypsic horizon, or with a mollic, umbric, or histic epipedon, or with an exchangeable sodium percentage (ESP) of >15%, or a fragipan	Yes →	Inceptisols
No ↓		
Other soils	Yes →	Entisols

GELISOLS

Young Soils with little profile development

Form in the presence of Permafrost and frost churning



Key to Soil Orders

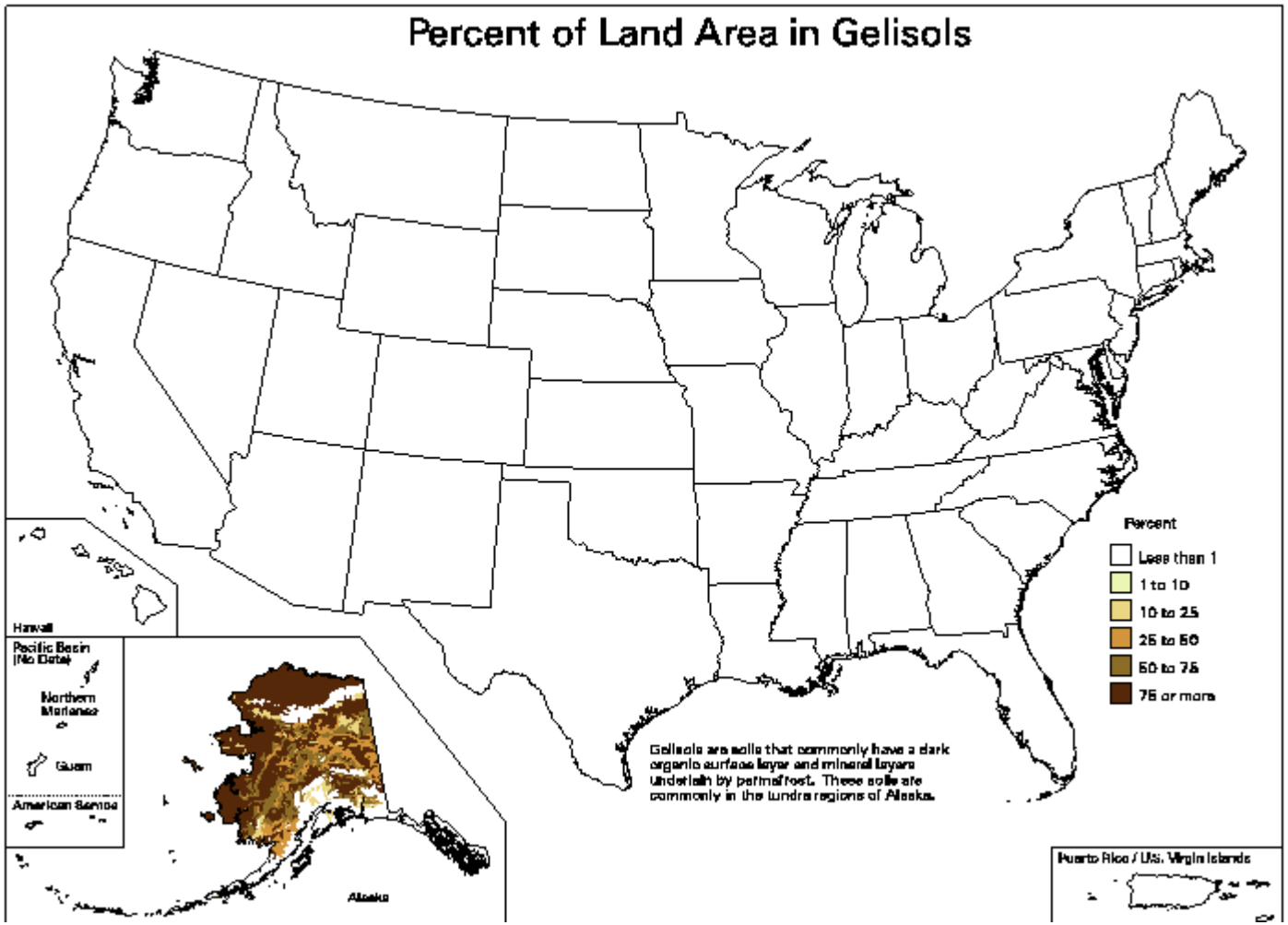
A. Soils that have:

1. Permafrost within 100 cm of the soil surface; *or*

2. Gelic materials within 100 cm of the soil surface and permafrost within 200 cm of the soil surface.

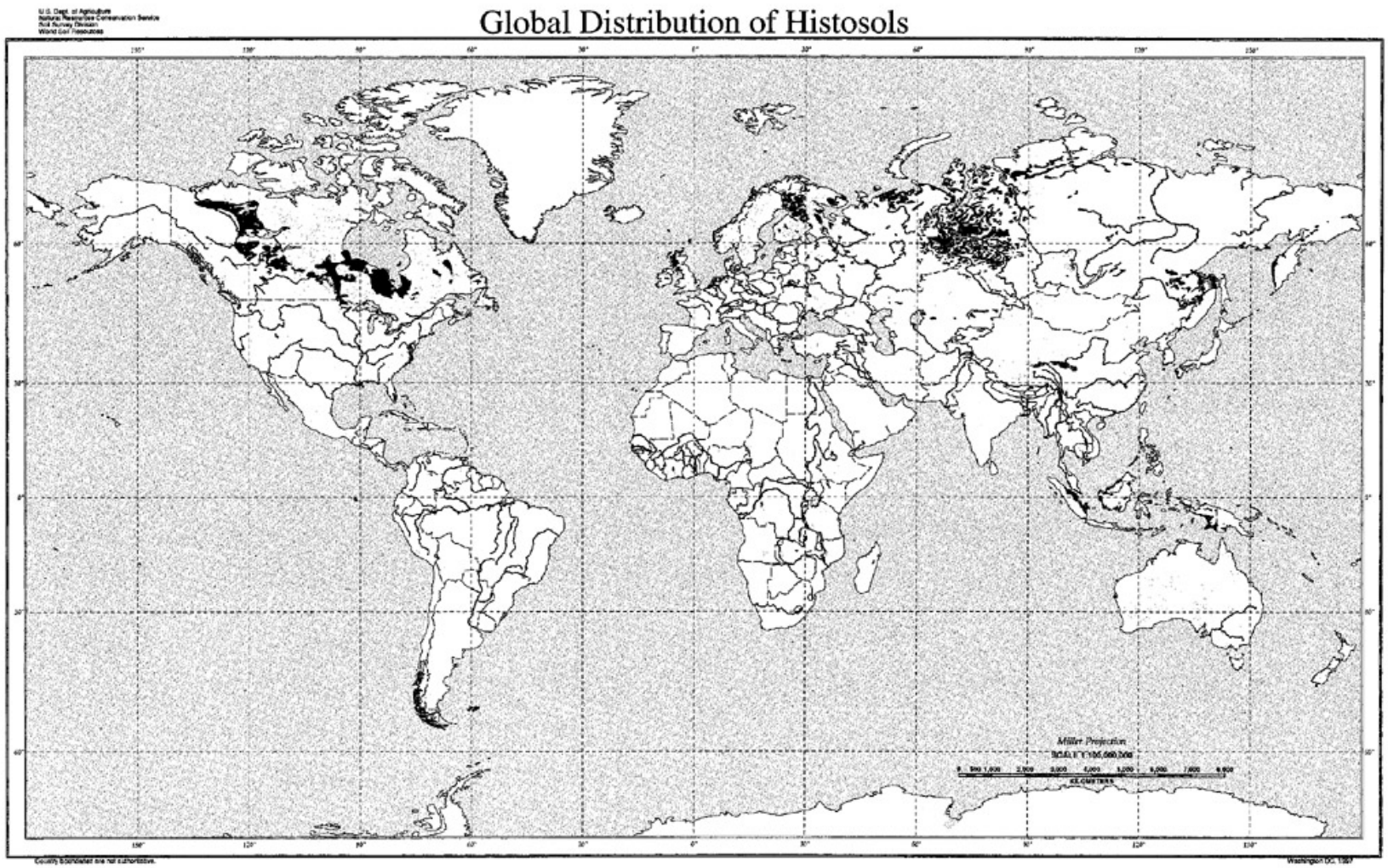
Gelisols, p. 445

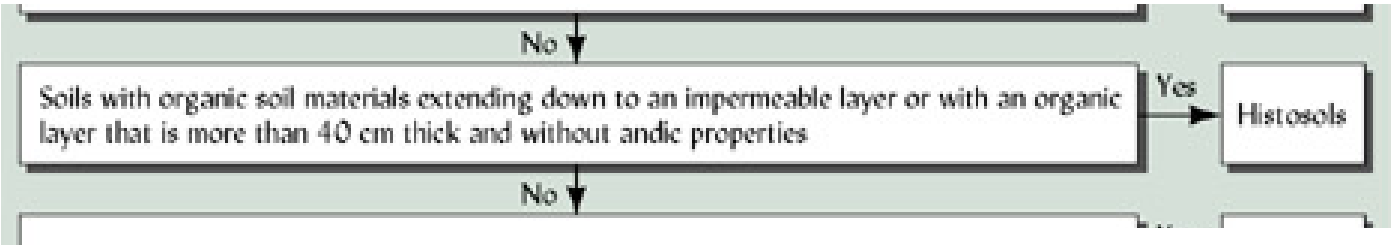
Gelic = frost churning (cryoturbation)



HISTOSOLS

All organic soils (peats, mucks, etc.)
At least 20-30% organic matter





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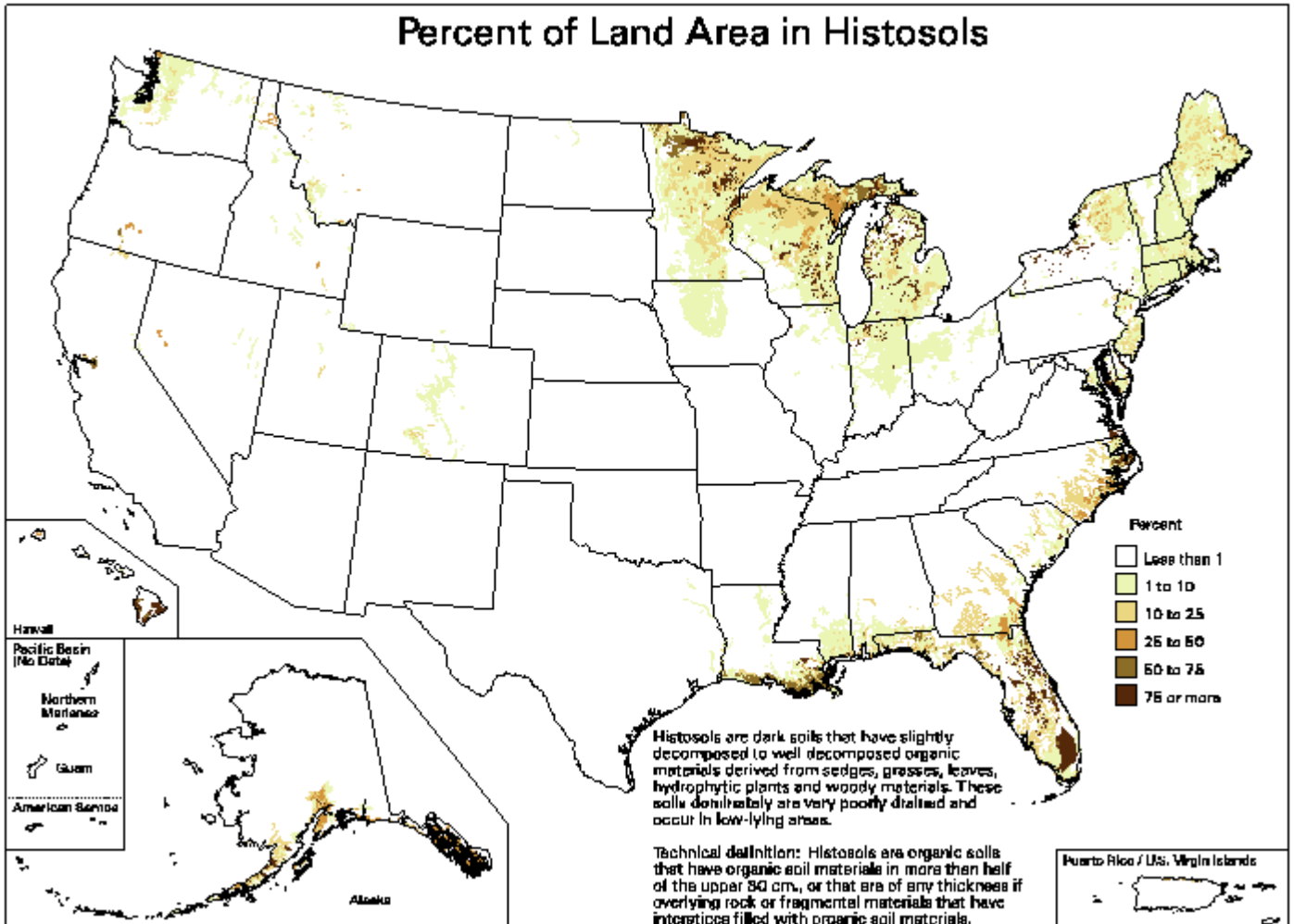
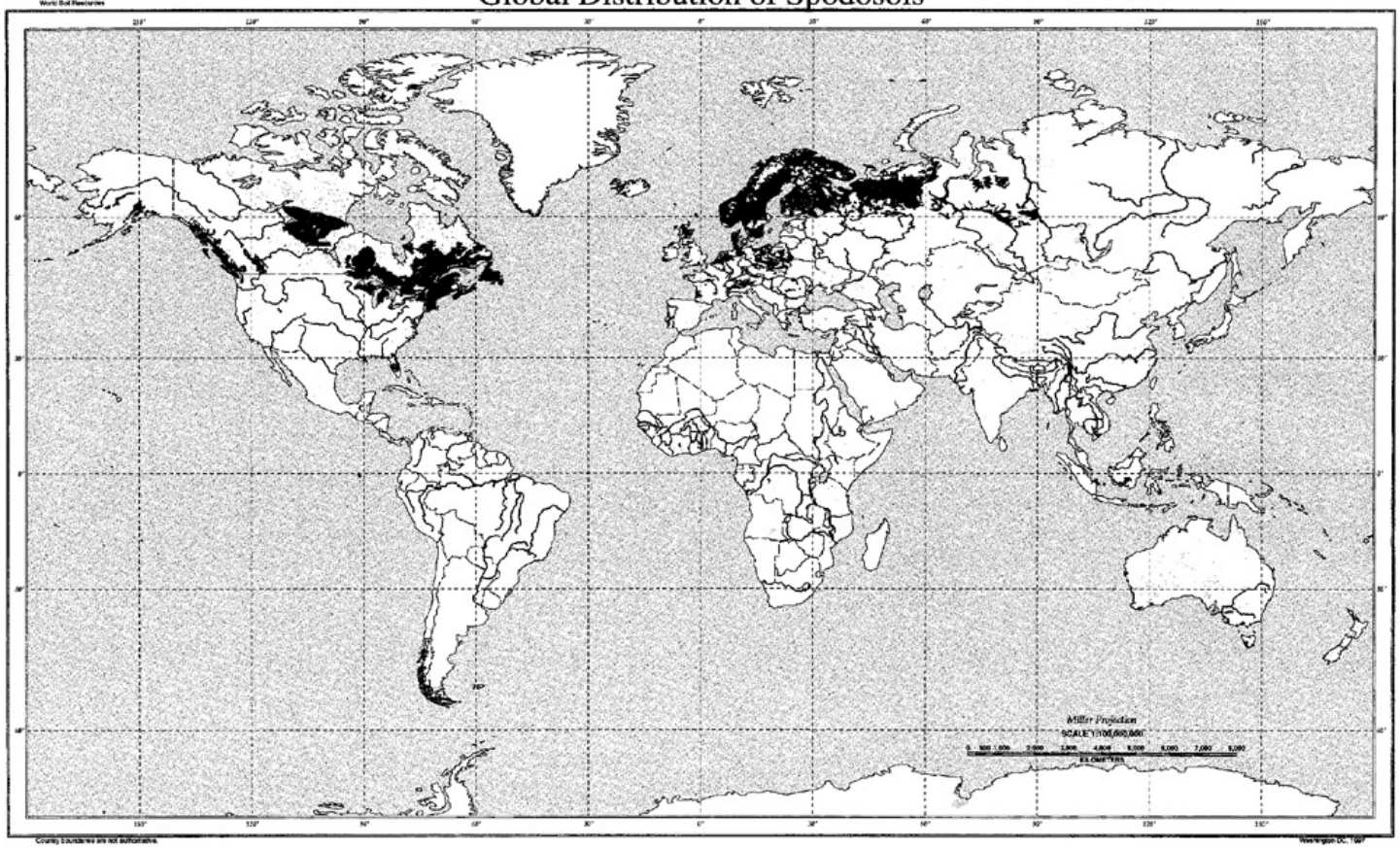


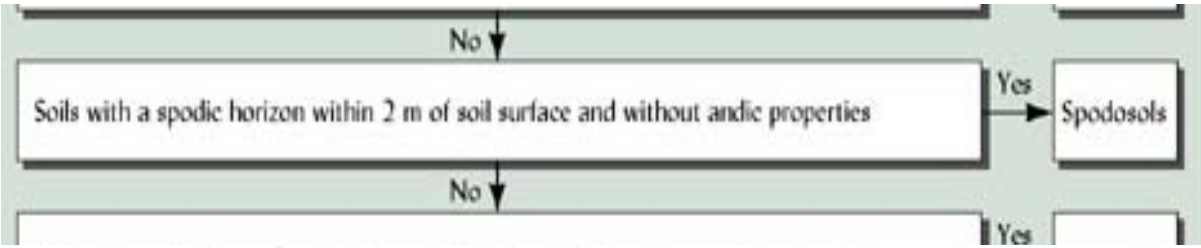
SPODOSOLS

Spodic horizon of illuviated humus, Fe & Al oxides

Common in cool, humid regions on coarse-textured parent materials

Global Distribution of Spodosols





Spodic horizon of illuviated humus, Fe & Al oxides

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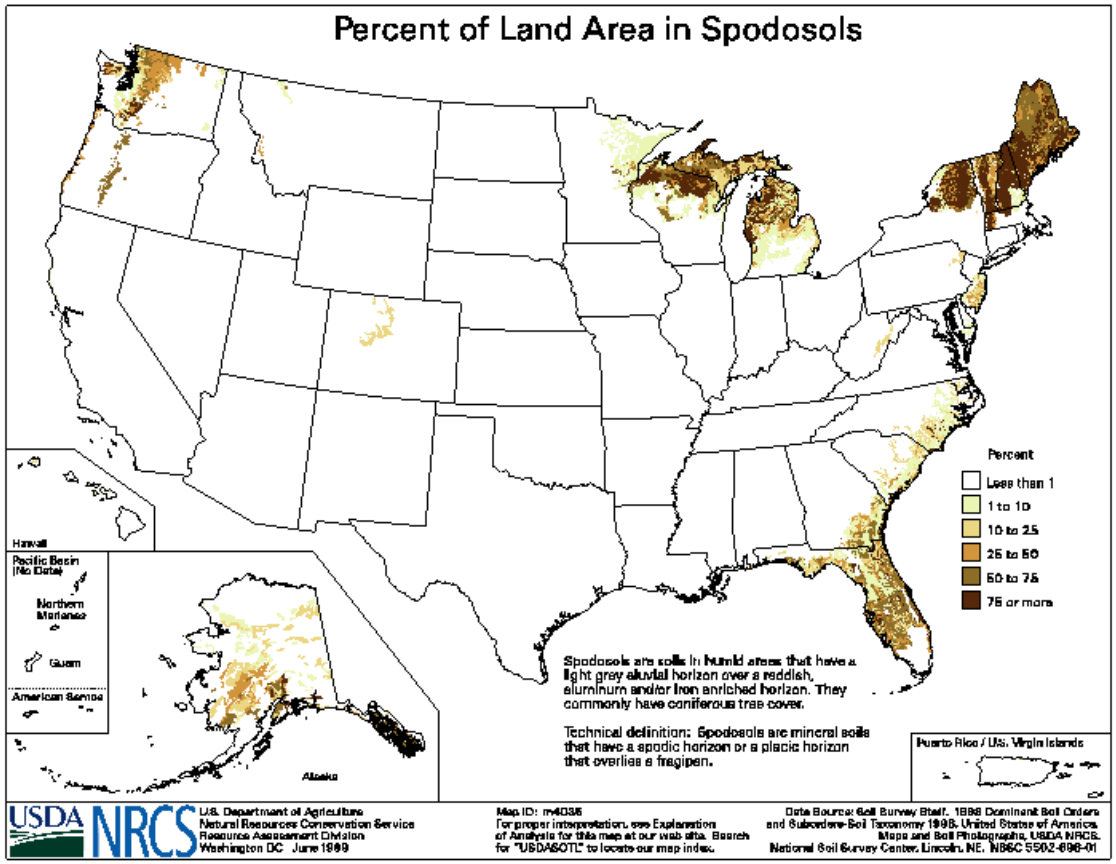
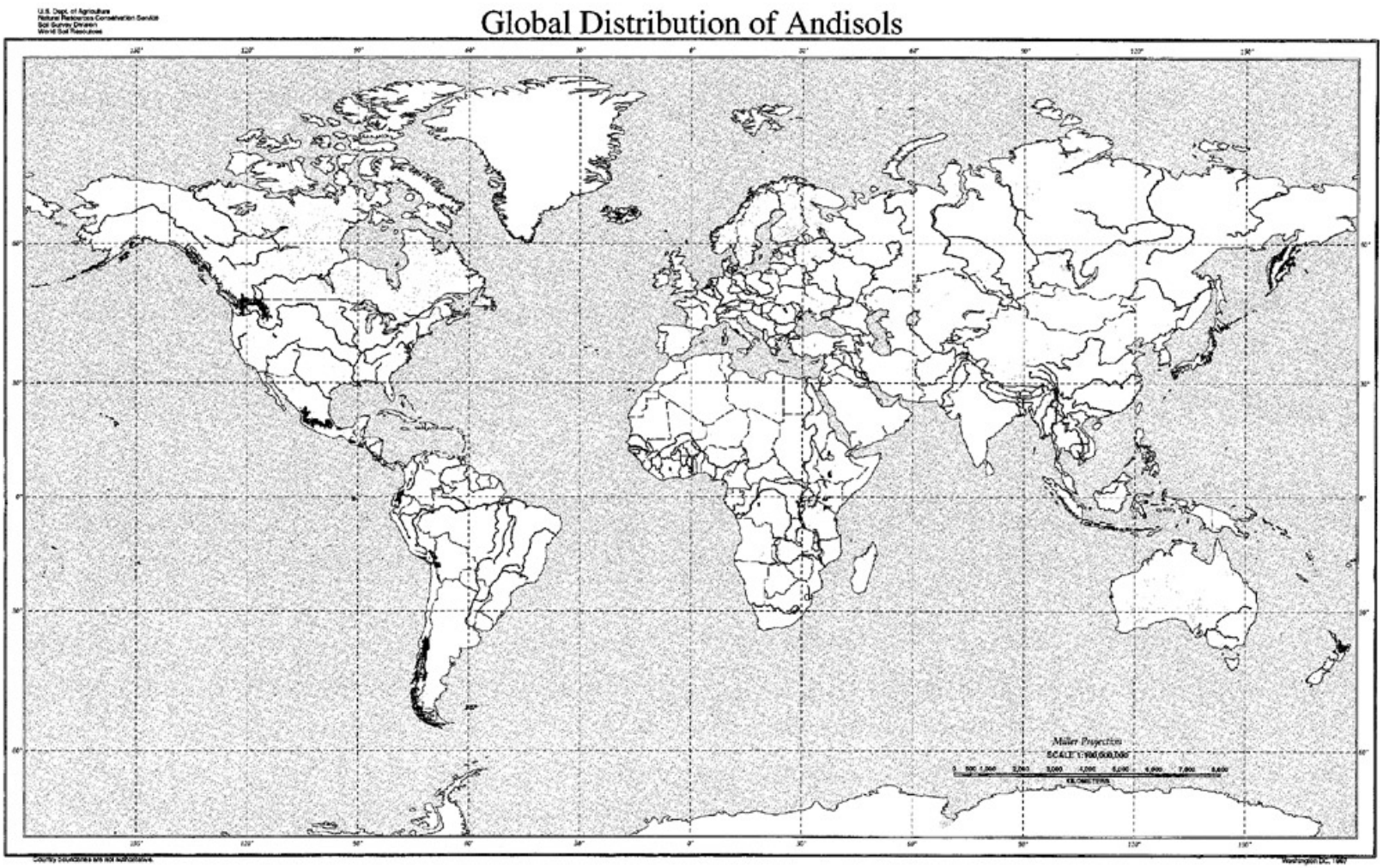
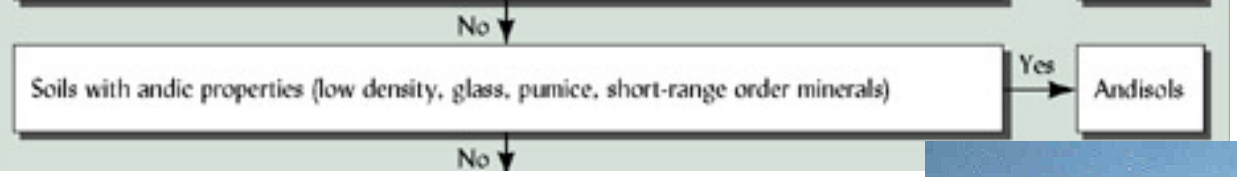


ANDISOL

Volcanic ash parent materials
Mineralogy contains high amount of amorphous materials





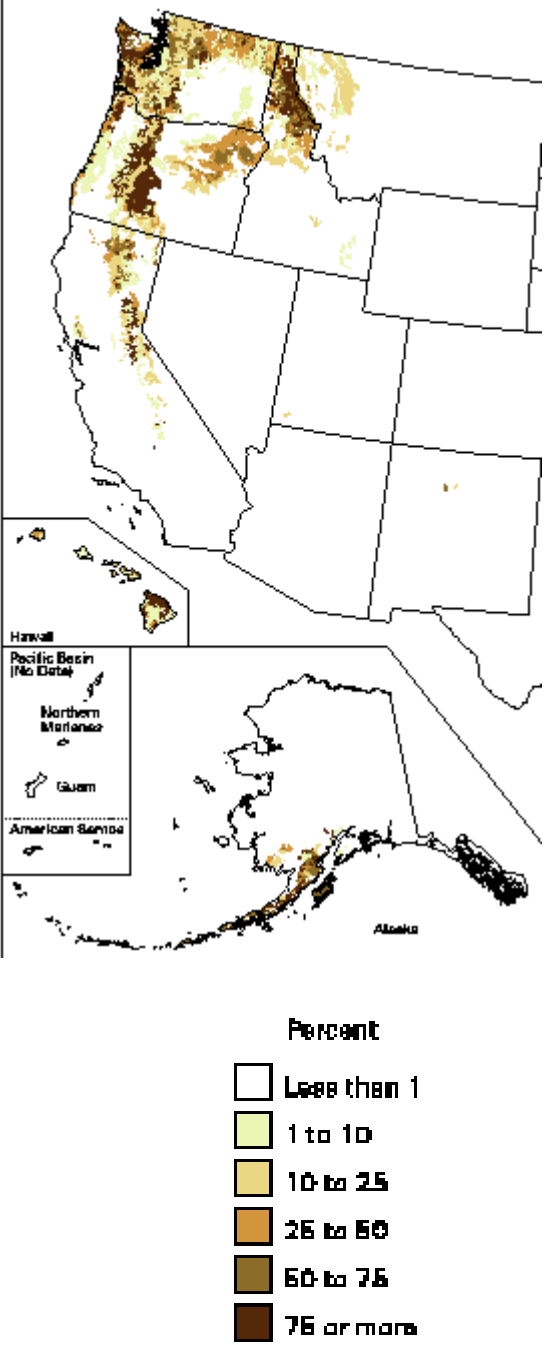
D. Other soils that have andic soil properties in 60 percent or more of the thickness *either*:

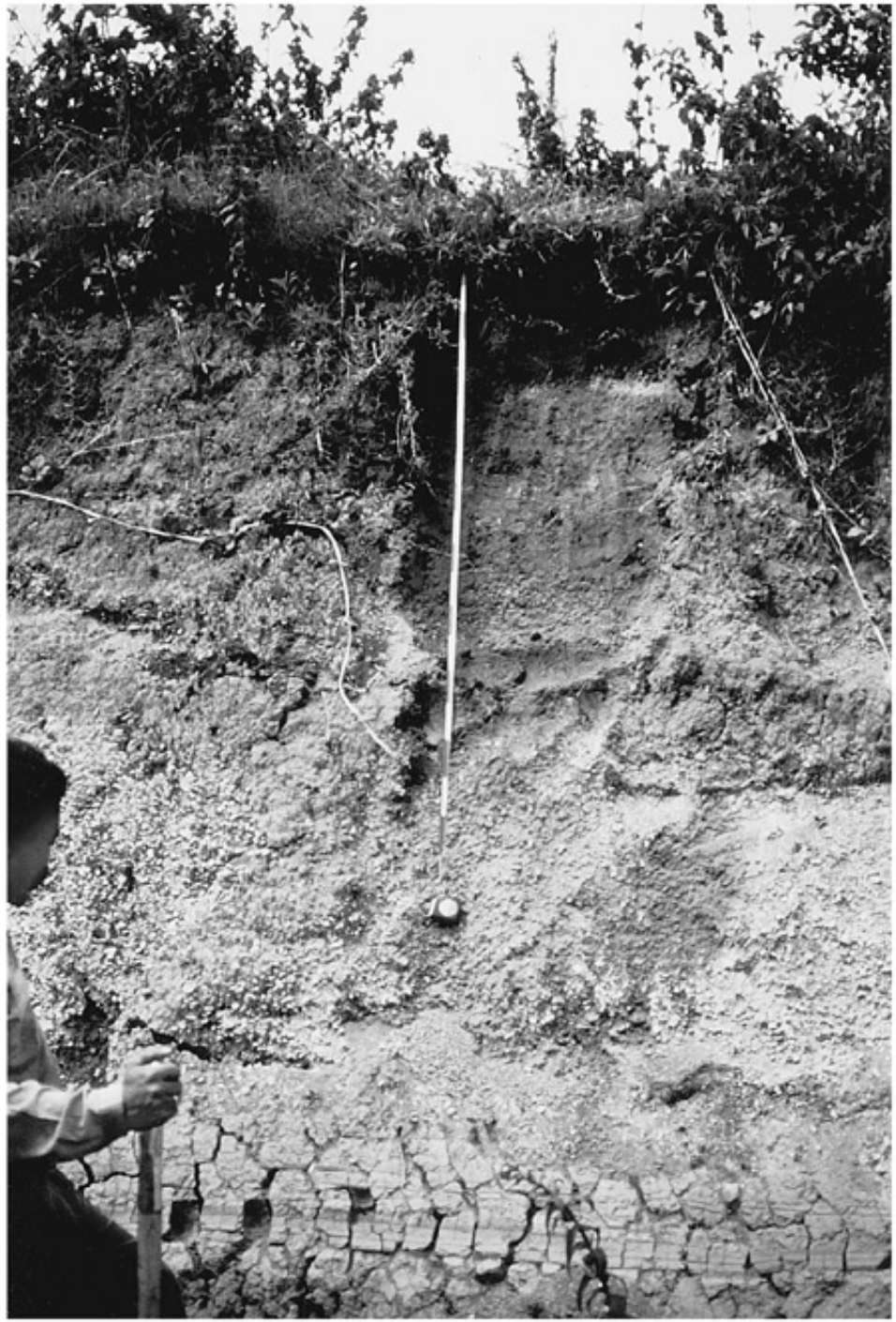
1. Within 60 cm either of the mineral soil surface or of the top of an organic layer with andic soil properties, whichever is shallower, if there is no densic, lithic, or paralithic contact, duripan, or petrocalcic horizon within that depth; *or*

2. Between either the mineral soil surface or the top of an organic layer with andic soil properties, whichever is shallower, and a densic, lithic, or paralithic contact, a duripan, or a petrocalcic horizon.

Andisols, p. 271

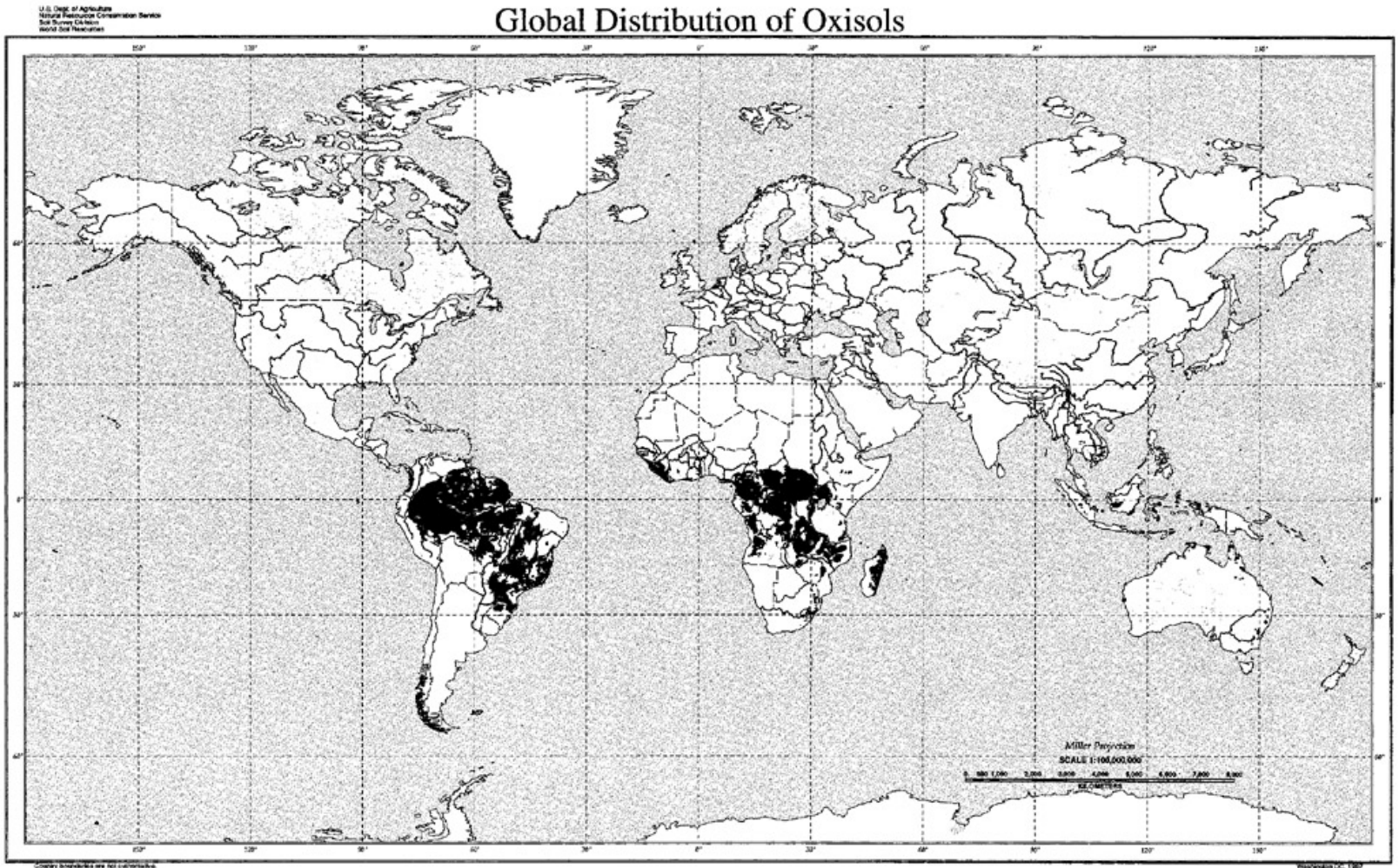
Volcanic ash parent materials
Mineralogy contains high amount of amorphous materials


Hawaii
Pacific Basin (No Data)
Northern Marianas
Guam
American Samoa
Alaska
Percent
Less than 1
1 to 10
10 to 25
25 to 50
50 to 75
75 or more

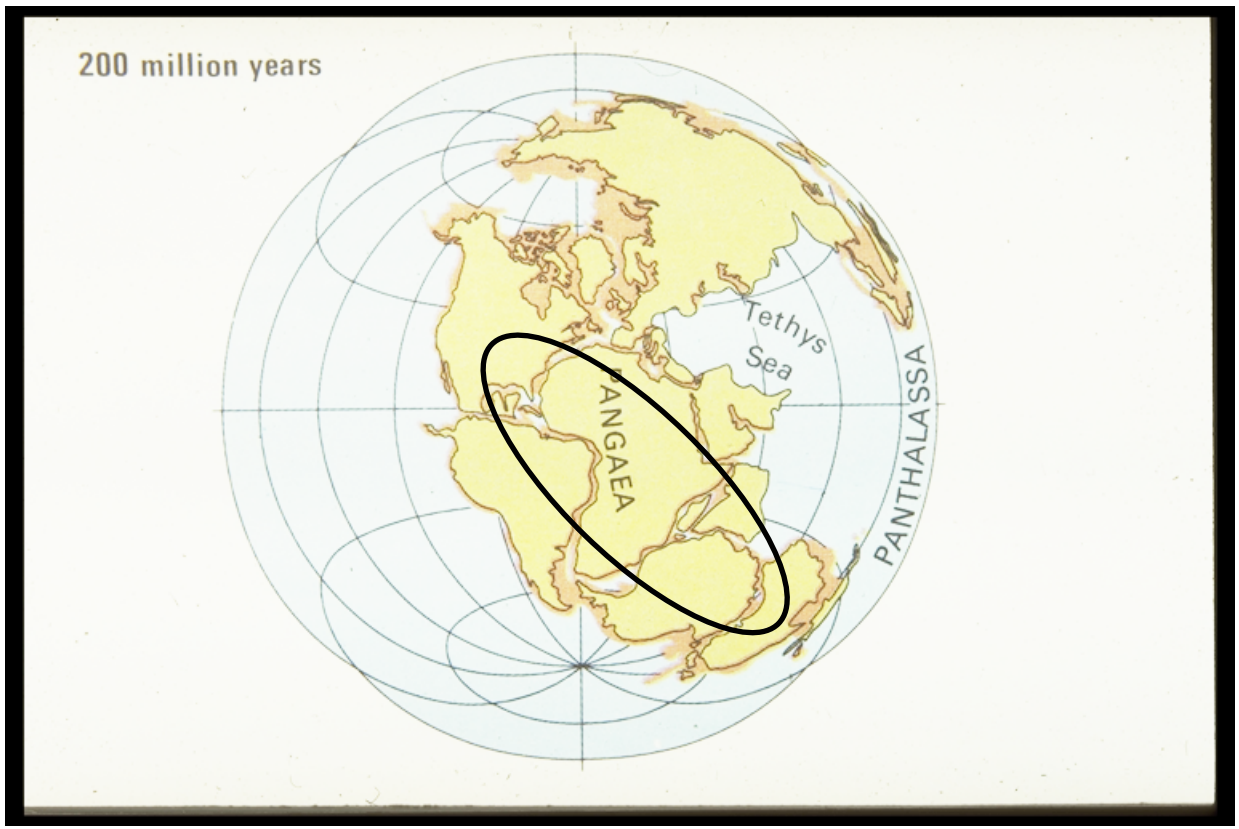

Melanic Epipedon
Pumice layer
Weathered layers of volcanic ash and pumice
Buried A horizon
Oldest layers of volcanic pumice
Underlying layer of expanding clay

OXISOLS

- Common in hot, humid climates with intense weathering and leaching
- Dominant minerals: quartz, Fe & Al oxides, kaolinite
- Commonly infertile



The region inside the black oval was the continental interior of Pangaea 200 million years ago



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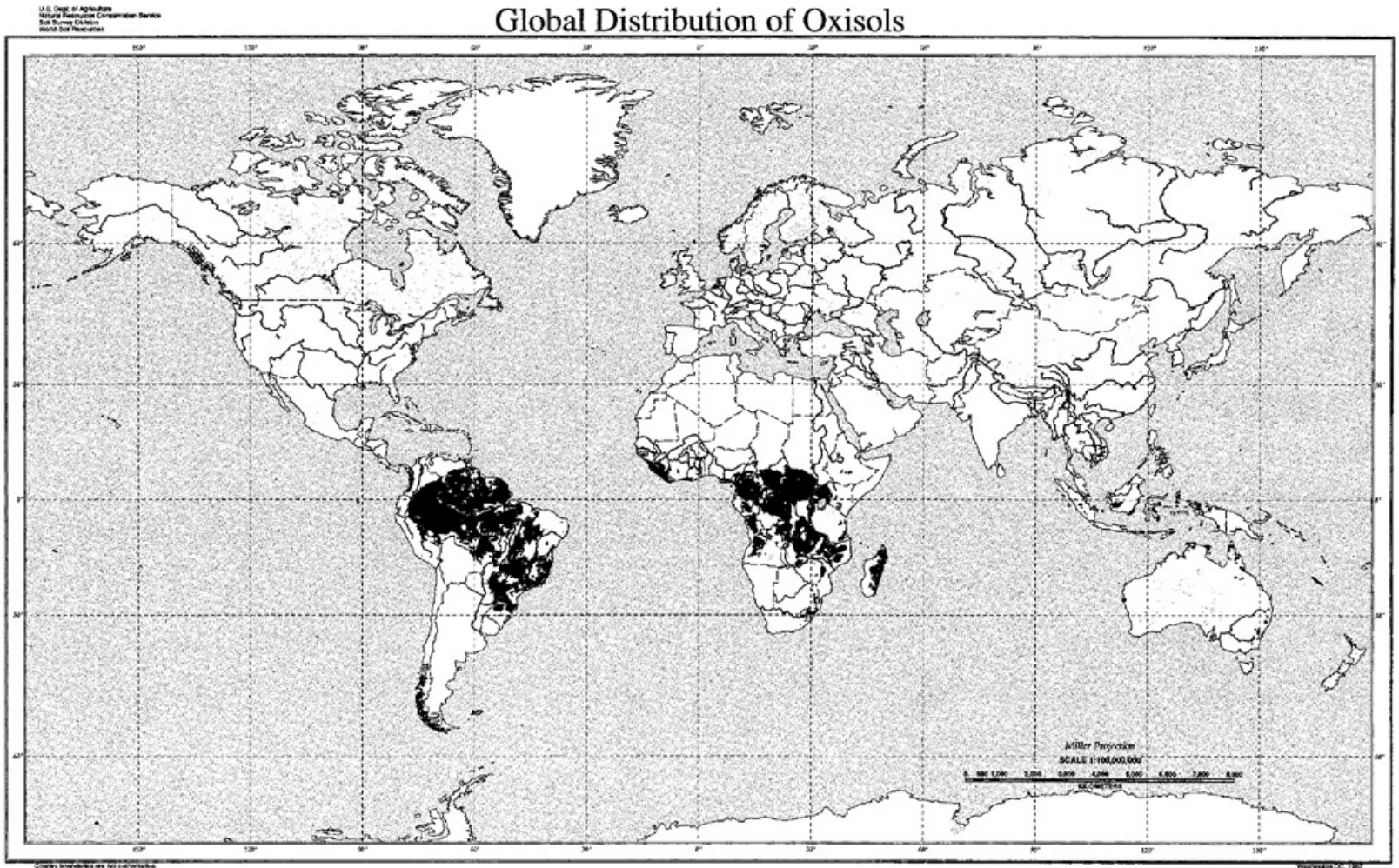
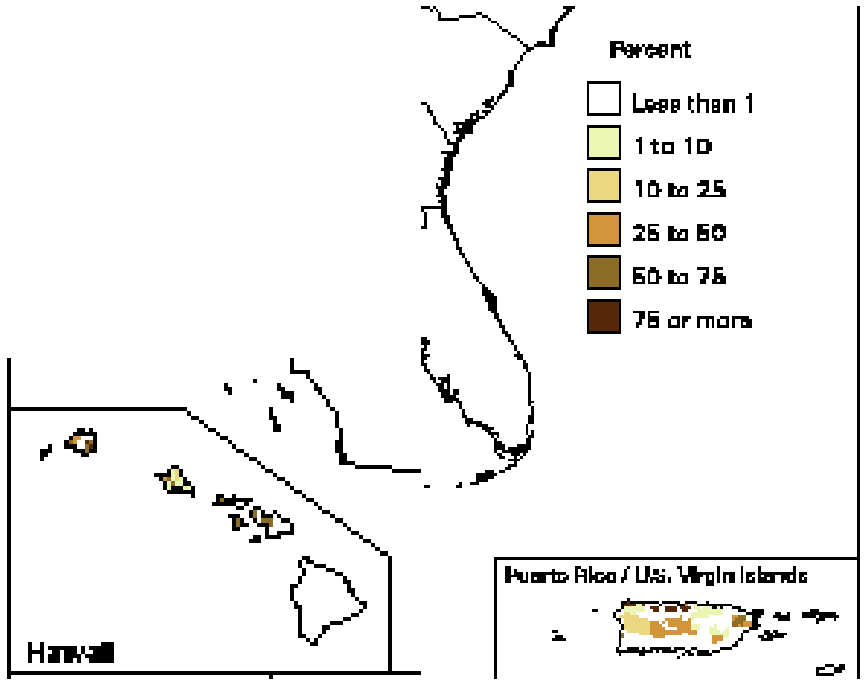


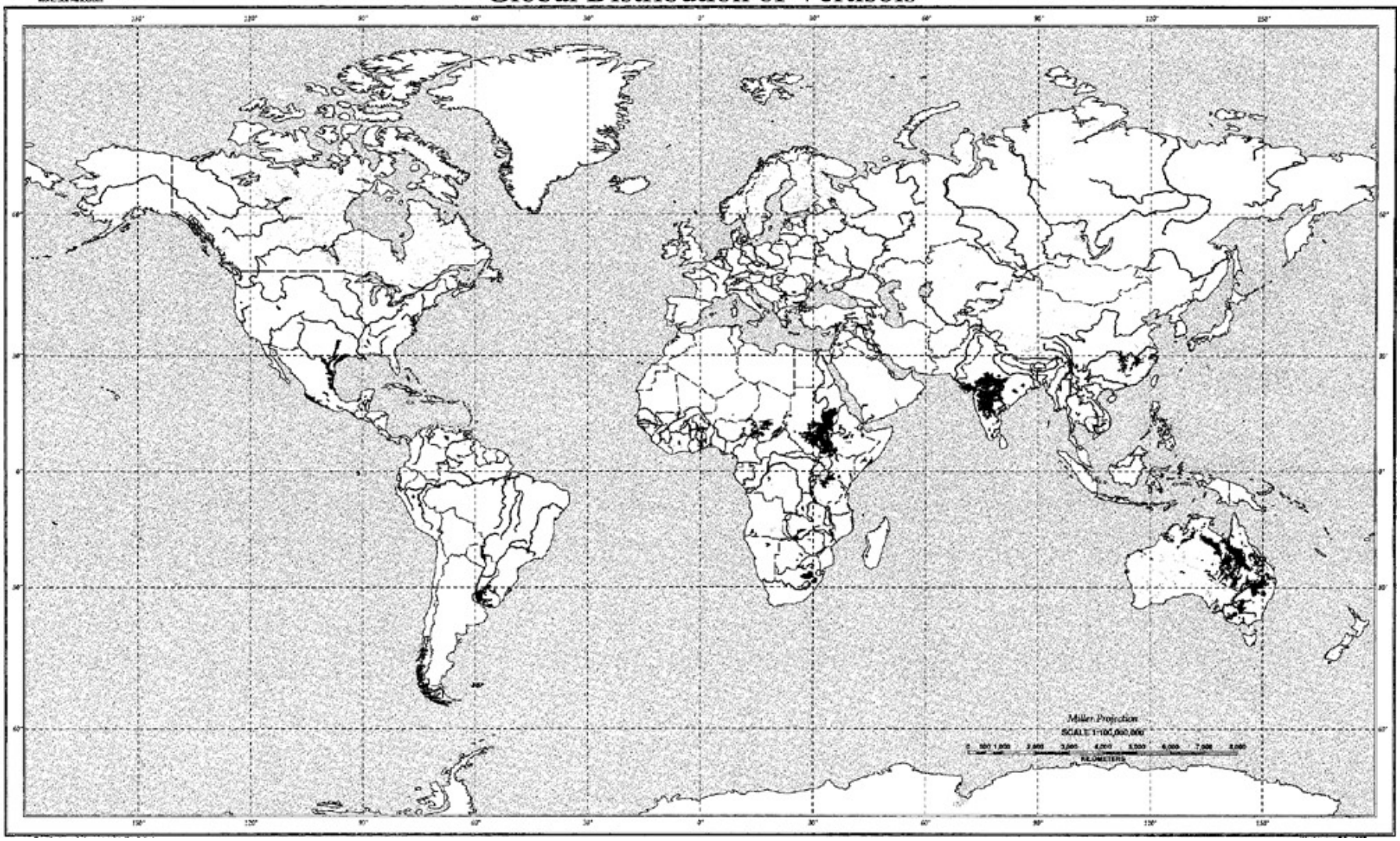


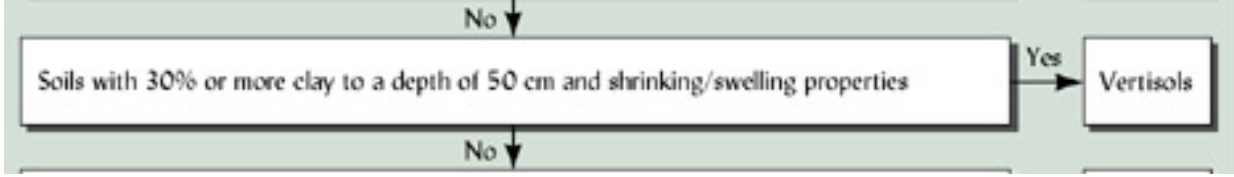
Common in hot, humid climates with intense weathering and leaching
Dominant minerals: quartz, Fe & Al oxides, kaolinite
Commonly infertile

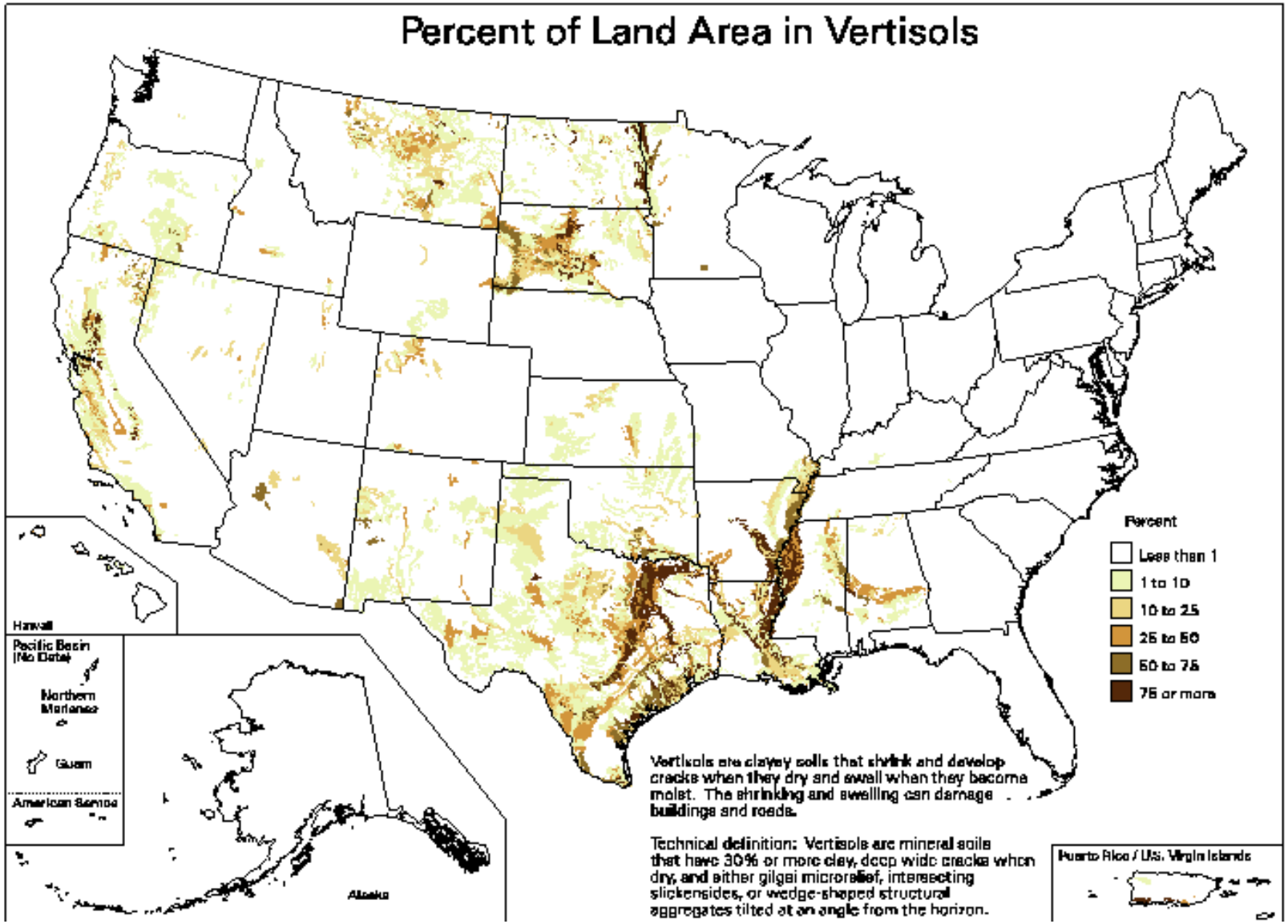
VERTISOLS

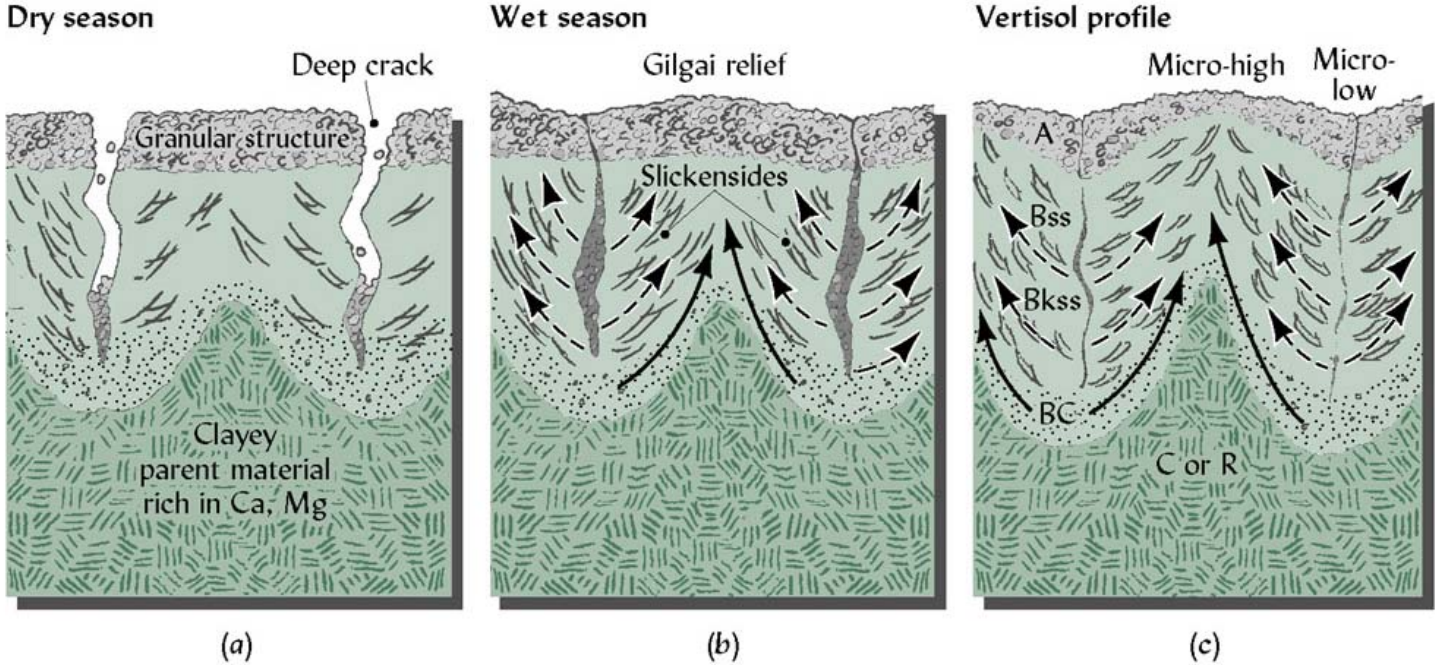
Form in clayey parent material
Shrink-swell behavior
Found in climates dry enough to form wide cracks

Global Distribution of Vertisols




No
Soils with 30% or more clay to a depth of 50 cm and shrinking/swelling properties
Yes
Vertisols
No


Percent of Land Area in Vertisols
Percent
Less than 1
1 to 10
10 to 25
25 to 50
50 to 75
75 or more
Hawaii
Pacific Basin (No Data)
Northern Mariana
Guam
American Samoa
Alaska
Puerto Rico / U.S. Virgin Islands
Vertisols are clayey soils that shrink and develop cracks when they dry and swell when they become moist. The shrinking and swelling can damage buildings and roads.
Technical definition: Vertisols are mineral soils that have 30% or more clay, deep wide cracks when dry, and either gilgai microrelief, intersecting slickensides, or wedge-shaped structural aggregates tilted at an angle from the horizon.


Dry season
Deep crack
Granular structure
Clayey
parent material
rich in Ca, Mg
(a)
Wet season
Gilgai relief
Slickensides
(b)
Vertisol profile
Micro-high
Micro-
low
A
Bss
Bkss
BC
C or R
(c)