Kandic and Palic Diagnostic Properties in MLRAs 133A and 153A in Two Southeastern Georgia Soil Surveys

Southern Region Cooperative Soil Survey Conference

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Why class limit of ? 16 cmol(+) kg $^{-1}$
(Kimble, Buol, and Witty, Soil Survey Horizons)

- Selected for Oxisols, and eventually same for kandic horizon
- intensely weathered soil material
- 2:1 clays, mainly vermiculite and montmorillonite, should be absent or present in small amounts

Why class limit of ? 16 cmol(+) kg^{-1}

- However, soils form a continuum in nature
- Hence, how much 2:1 clay can be allowed in the concept
- Given limits of quantification, about 10% was selected

Limit of ? 16 cmol(+) kg $^{-1}$ derived

- Kaolinite considered to have a CEC_7 of 7 cmol(+) kg $^{-1}$ clay
- 2:1 vermiculite & mont. to have a CEC_7 of 100 cmol(+) kg $^{-1}$ clay

Limit of ? 16 cmol(+) kg $^{-1}$ derived

- Smectites have class limits of <10% for kaolinitic mineralogy
- If soil clay mix contains 10% 2:1 clay, it contributes 10 cmol charge to the mix (10% of 100 cmol)
- Thus, if the other 90% is 1:1 kaolinite clay at 7 cmol kg $^{-1}$, it contributes 6.3 cmol (90% of 7 cmol)

Limit of ? 16 cmol(+) kg $^{-1}$ derived

- 10 + 6.3 equals 16.3 cmol kg $^{-1}$
- = 16 cmol kg $^{-1}$

Testing these limits

- 19,600 pedons at NSSL in 1992
- Selected all horizons with >8% clay
- Eliminated samples with 1,500 kPa water content to clay ratio of >0.6 to eliminate soils high in organic matter or amorphous material
- 36,070 horizons met requirements

Testing these limits

- Selected all samples that had CEC_7 of 16 or less
- 1,369 horizons met CEC_7
- 95% of these also had ECEC of ?12

Testing these limits

- Reversing the test, extracted all horizons with ECEC of 12 or less
- 2,225 samples met ECEC
- But, 36% of these had CEC_7 of > 16

Testing these limits

- CEC_7 <16 predicts ECEC <12
- Reverse relationship does not work

Georgia Study

- Kandiudult, Kanhapludult, Paleudult, and Hapludult soil series have been mapped and correlated contiguously and intermingled on the landscapes in Georgia and other states, a result of:

Georgia Study

- using whatever soil series were available and traditionally used, and
- more concern with fitting the interpretations regardless of taxonomic classification

Georgia Study

- A study was initiated to help understand:
- the clay activity in these soils,
- the depth of illuviation of clay, and
- the relationship of the soils on the landscape

Georgia Study

- 2 surveys; Ware County, Effingham & Screvens Counties
- 55 pedons total; 12 sites, 3-5 pedons in a transect at each site
- Sampled and described from auger borings with particle-size and kandic control sections and palic great groups in mind

Georgia Study

- Classified each pedon with field description, lab data and 8th Edition of Keys to Taxonomy

Results

- 48 of the 55 pedons display a palic clay curve
- Older, stable positions on these slightly dissected flats
- This is supported in studies by Cady and Daniels and Gamble and Daniels that place the older Paleudults on summits and younger Hapludults on side slopes (“young valley sides slopes”)

Results

Table 2: Clay activity based on the 8th Edition, Soil Taxonomy

Requirements	Total Pedons	Kandic	Sub-active	Semi-active	Active
Current criteria: CEC **and** ECEC	55	25 (45%)	23 (42%)	6 (11%)	1 (2%)

Results

Table 3: Clay Activity Relative to Survey Area

Requirements	Total Pedons	Kandic	Sub-active	Semi-active	Active
Ware County	27	18	7	2	0
Effingham and Screven Counties	28	7	16	4	1

Results

Table 5: Clay Activity Relative to Survey Area and Elevation

Requirements	Total Pedons	Kandic	Sub-active	Semi-active	Active
Effingham and Screven: ? 125 feet	14	1	9	3	1
Effingham and Screven: ?125 feet	14	6	7	1	0
Ware: ? 125 feet	-	-	-	-	-
Ware: ?125 feet	27	18	7	2	0

Results

Table 6: Clay Activity Relative to Hillslope Position

Requirements	Total Pedons	Kandic	Sub-active	Semi-active	Active
Summit (talf)	19	5	13	1	0
Shoulder (talf/rise)	14	8	5	1	0
Backslope (talf/rise)	11	10	0	1	0
Footslope (dip)	7	1	2	3	1
Toeslope (dip)	4	1	3	0	0

Results

Table 10: CEC based on greater than 50% of the 100cm Kandic horizon control section; percentage of this dataset that would meet criteria if CEC requirement is set at different levels. (placement independent of ECEC).

	? 16	? 18	? 20	? 22	? 24	= 24	Other
% (cumulative)	55%	64%	82%	89%	93%	95%	100%
# (cumulative)	30	35	45	49	51	52	55

Results

Table 12: Kandic horizon CEC based on activity class family control section; percentage of this dataset that would meet criteria if CEC requirement is set at different levels. (placement independent of ECEC).

	? 16	? 18	? 20	? 22	? 24	= 24	? 26	Other
% (cumulative)	42%	55%	73%	87%	87%	91%	95%	100%
# (cumulative)	23	30	40	48	48	50	52	55

Table 14: Comparison of different criteria and class limits for classification based on clay activity

Requirements	**Total Pedons**	**Kandic**	**Subactive**	**Semiactive**	**Active**
1. Current criteria: CEC **and** ECEC	55	25 (45%)	23 (42%)	6 (11%)	1 (2%)
2. Change criteria: use same control section as base saturation for Ultisols, 125 from clay increase or 180 from surface…	55	29 (53%)	20 (36%)	5 (9%)	1 (2%)
3. Current limits: CEC **or** ECEC	55	34 (62%)	15 (27%)	5 (9%)	1 (2%)
4. Change limits: CEC: <24 cmol/kg clay, ECEC unchanged, 50% or more of 100cm…,CEC and ECEC	55	30 (55%)	18 (29%)	6 (11%)	1 (2%)

Table 14: Comparison of different criteria and class limits for classification based on clay activity

5. Change limits: **CEC <24 cmol/kg clay and ECEC ? 16 cmol/kg clay**, 50% or more of 100cm…,CEC **and** ECEC	55	**51 (93%)**	0 (0%)	3 (5%)	1 (2%)
6. Change limits: **CEC <24 cmol/kg clay and ECEC ? 16 cmol/kg clay**, 50% or more of 100cm …,CEC **or** ECEC	55	**52 (94%)**	0 (0%)	2 (4%)	1 (2%)
7. Currents limits: activity class control sections, CEC and ECEC	55	20 (36%)	28 (51%)	6 (11%)	1 (2%)
8. Currents limits: activity class control sections, CEC or ECEC	55	26 (47%)	22 (40%)	6 (11%)	1 (2%)
9. Change criteria: **no Kandic horizon in Taxonomy**, activity class control sections as currently defined for families	55	---	**48 (87%)**	6 (11%)	1 (2%)

Clay activity in relation to pedon

- 27 pedons inconclusive
  - single horizon sampled
  - increase/decrease within 1-2 meq
- 25 pedons show decrease with depth
- 3 pedons show increase with depth

Table 14: Comparison of different criteria and class limits for classification based on clay activity

10. Same criteria with 150 cm control section, 50% or more…	55	29 (53%)	19 (34%)	6 (5%)	1 (2%)

Interpolated last horizon sampled to total thickness of 150.
Gained 5 Kandic pedons.
Lost one Kandic because ECEC of last horizon is 14.
Net gain of 4 pedons.

Other studies

- H. J. Kleiss, in North Carolina found that:
- Requirements consistently satisfied only in well drained soils on the Upper Coastal Plain
- Middle and Lower Coastal Plain were inconsistent
- Increasing wetness increased activity

Joe Kleiss

- Upper Part of Middle Coastal Plain, using the Coats Scarp at 89 meters (about 292 feet) would serve as guide to separate “kandic” soils

Pedons in NSSL Database
Queried & Classified by Dr. West

Pedons in NSSL Database Queried & Classified by Dr. West

- Pedons from Virginia to Louisiana
- Only Ultisols in Piedmont, Coastal Plain, and Flatwoods retained
- All SND pedons deleted
- OSD for classification-soils as named during sampling
- 205 pedons

Pedons in NSSL Database Queried & Classified by Dr. West

	Total	Kandic	Subactive	Semiactive	Other
All Pedons w/ Kandic	205	65	73	49	18
All Pedons w/o Kandic	205	---	138	49	18

Pedons in NSSL Database Queried & Classified by Dr. West

	Total	Kandic	Subactive	Semiactive	Other
All Pedons	205	65	73	49	18
Piedmont Pedons	44	21	12	11	0
Coastal Plain Pedons	161	44	61	38	18

Pedons in NSSL Database Queried & Classified by Dr. West

	Total	Kandic	Subactive	Semiactive	Other
Aquults	34	1	5	11	17
Udults	171	64	68	38	1

Pedons in NSSL Database Queried & Classified by Dr. West

	Total	Kandic	Subactive	Semiactive	Other
Sandy	4	1	3	0	0
Coarse-loamy	3	0	1	2	0
Fine-loamy + Loamy	103	32	42	25	4
Fine + Very fine	84	26	25	22	11

Stan Buol

- “At the time…developing criteria…I knew this would happen from reviewing existing data. …mappable or natural landscape units are going to have spatially associated pedons from both groups.”

Stan Buol

- “My first impression is that attempting to change criteria will only shift the same problems in mapping to another location.”
- “I don’t think we should take a “head count” and name the map unit according to the majority population. Name the map unit so as to identify the taxonomic population present.”

Larry West

- “I am not sure what the answer is for kandic horizons in the southeast.”
- “There may be differences in morphology and classification that I have not seen in my analysis that could be used to separate kandic from non-kandic soils.”

Larry West

- “I am not sure it is worth the effort to have kandic and non-kandic with similar morphology separated by elevation or…landscape position (backslope vs. footslope).”

Joey Shaw

- “This kandic thing is a real quagmire.”
- “I would suggest that 24 is probably best way to go.”
- I am not in favor of going exclusively to activity classes, I think it’s best to keep kandi at the great group level due to it’s importance.”

A look at agronomic interpretations

- Tried to find paired Kandiudult/Paleudult series
- In same state so that application of interpretations might be coordinated from same guidelines
- Went to Auburn MO

Interpretations

- Actually found a pair in same survey area correlated in 1997 (Macon County): Bama and Orangeburg
- Bama=fine-loamy, siliceous, subactive, thermic Typic Paleudult
- Orangeburg=fine-loamy, kaolinitic, thermic Typic Kandiudult
- Both very deep, well drained, moderately permeable soils in marine sediments

Interpretations

Macon County, Alabama

	Site Index	Volume of fiber
		ft^3/ac
BaA: Bama (Pale) loblolly pine	90	129
OrA: Orangeburg (Kandi) loblolly pine	90	114

Interpretations

Macon County, Alabama

Map symbol and soil name	Land capability	Bahiagrass	Corn
		AUM	Bu
BaA:			
Bama-------- Pale	1	8.50	110.00
OrA:			
Orangeburg-- Kandi	1	9.00	120.00

Interpretations

- Troup
  - Loamy, kaolinitic, thermic Grossarenic Kandiudult
- Wadley
  - Loamy, siliceous, subactive, thermic Grossarenic Paleudult

Interpretations

Butler County: correlated 1996
Choctaw county: correlated 1998

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                     |Site |Volume  |
                     |Index|of fiber|
-------------------------------------
                     |     | ft3 /ac |
WaB: Wadley (Pale) (Choctaw Co., AL |
loblolly pine-------|  80 |   114   |
                     |     |         |
AaB: Troup (Kandi) (Butler Co., AL  |
loblolly pine-------|  80 |   114   |
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Interpretations

Macon County, Alabama

Map symbol and soil name	Land capability	Bahiagrass	Corn
		AUM	Bu
WaB: (Butler County, Alabama)			
Wadley------ Pale	3s	7.20	114.00
AaB: (Choctaw County, Alabama)			
Troup -- Kandi	3s	7.20	114.00

Similar-dissimilar soils

- Have not used CEC as a property for determining if soils are similar or dissimilar
- If we did, these would be in adjacent classes and we would probably not assign values that designate them as automatic dissimilar soils
- All other things equal, we would call a Kandiudult and a subactive Paleudult similar soils and only name one

Existing series in selected supgroups of Paleudults and Kandiudults in MLRA's 133A and 153A

Subgroups	Paleudults	Kandiudults
Arenic Plinthaquic	1	0
Plinthaquic	6	0
Aquic Arenic	1	0
Aquic	14	0
Oxyaquic	0	0
Grossarenic Plinthic	1	0
Arenic Plinthic	2	1
Plinthic	9	4
Grossarenic	7	1
Arenic	7	2
Typic	19	6
Totals	67	14

Decisions

- Correlate their components in these Lower Coastal Plain survey areas as subactive Paleudults, Hapludults, Paleaquults, etc
- Use existing Paleudults and Kandiudults series to the extent possible
- Taxadjunct Paleudults if activity class is not subactive
- Taxadjunct Kandiudults as subactive Paleudults

Decisions

- Keep Kandic great groups somewhere in MLRA 133A, use activity classes in MLRA 153A
- Any proposed series in MLRA 153A are to be classified as subactive Paleudults, with reference to this study for classification
- Provide NASIS text notes for recognizing similar soils with Kandic horizons

Screvens County

- Both MLRA 133A and 153A in county
- Could have same series with two different classifications; in one DMU it is as standard, in another it is a taxadjunct
- Proposal to change NSSH to note such a thing has already been reviewed and approved in an update to taxadjunct criteria

Screvens County

- Dothan - …Plinthic Kandiudult (133A)
- Dothan - …Plinthic Paleudult (153A)
- Mainly to keep things clean and because Dothan concept was established on the Coastal Plain in 133A and is now classified as a Kandiudult

Recommendations

- Amend Taxonomy so that Kandiudults and Kanhapludults Key in similar priority as Paleudults and Hapludults
  - Give moisture regime and saturation same priority as in Paleudults and Halpudults

Key to Subgroups, 8th Edition, Soil Taxomony

Paleudults	**Kandiudults**
Vertic	Arenic plinthaquic
Spodic	Aquic arenic
Arenic plinthaquic	Arenic plinthic
Aquic arenic	Arenic rhodic
Plinthaquic	Arenic
Fragiaquic	Grossarenic plinthic
Aquic	Grossarenic
Anthraquic	Acrudoxic plinthic
Oxyaquic	Acrudoxic
Lamellic	Plinthaquic
Arenic plinthic	Aquandic
Psammentic	Andic
Grossarenic plinthic	Aquic
Plinthic	Plinthic
Arenic rhodic	Ombroaquic
Arenic	Oxyaquic
Grossarenic	Sombric
Fragic	Rhodic
Rhodic	Typic
Typic	

Recommendations

- Need to review transect data to see how extensive Oxyaquic subgroups may actually be in these surveys
- If used Keys with Paleudult priority for subgroups for all Kandiudults and Paleudults, 15 of the 55 pedons are Oxyaquic
  - Based on presence of concentrations and depletions within 100 cm of surface

Discussion???