West Region NCSS Standards Committee Report

New Proposals for Changes in Soil Taxonomy—2016

1. Proposed Densic Great Groups of Udepts and Aquepts – Mark H. Stolt, Deborah Surabian, Donald Parizek, James Turenne, and Jacob Isleib (PDF; 189 KB)

The committee **approves** the proposal **with modifications**.

Currently, as with other geogenic contacts of physical root restriction, shallow densic soils are recognized at the family level (i.e. soil depth class and particle-size class). If densic contacts are to be further recognized within the Soil Taxonomy classification hierarchy, it is recommended that, like lithic contacts, they are recognized at the subgroup level for Udepts and Aquepts (e.g. Densic Dystrudepts, Densic Endoaquepts).

2. Proposed Changes for Spodosols and Spodic Horizon Designations – Mark H. Stolt and Martin C. Rabenhorst (PDF; 439 KB)

Part 1: The committee **approves** the proposal **with modifications**.

The committee agrees that something needs to be done to make sure that wet Spodosols with low or no iron are included as Aquods. This issue was recognized but never addressed when ICOMOD and ICOMAQ recommendations were incorporated into the fifth edition of *KST* in 1992. However, because aquic conditions are identified by redoximorphic features and measurement of saturation and reduction, the proposal, as written, does not remove the requirement for redoximorphic features (within 50 cm of mineral soil surface) in Spodosols with low or no iron in the spodic horizon (i.e. Alaquods).

The committee recommends the following changes:

One. Add a reaction to IRIS tubes as a redoximorphic feature, similar to what has been done for reaction to an alpha,alpha,dipyridyl solution (*KST page 27*, *item d.*):

d. In soils that have no visible redoximorphic features, a reaction to an alpha,alpha,dipyridyl solution or a reaction to Indicator of Reduction in Soils (IRIS) tubes painted with ferric iron, satisfies the requirement for redoximorphic features.

Two. Add IRIS tube reaction as an option directly into the requirement for Aquods (*KST page 273)*:

CA. Spodosols that have aquic conditions for some time in normal years (or artificial drainage) in one or more horizons within 50 cm of the mineral soil surface and have *one or more* of the following:

1. A histic epipedon; *or*
2. Within 50 cm of the mineral soil surface, redoximorphic features in an albic or spodic horizon; *or*
3. Within 50 cm of the mineral soil surface, a reaction to Indicator of Reduction in Soils (IRIS) tubes painted with ferric iron, in an albic or a spodic horizon.

Aquods, p. 273

Part 2: The committee **does not approve** the proposal as written.

The defining principal behind Spodosols is a spodic horizon which is a translocated accumulation of organic matter and aluminum, with or without iron. Alaquods, which, according to *ST*, occur primarily in the southeastern part of the US, have low iron due to a fluctuating water table which reduces iron and moves it out of the soil profile. Alorthods, which according to *ST*, also, occur primarily in the southeastern part of the US, have low iron due to intensive leaching or low iron parent materials. They also "*have accumulations of aluminum that are relatively high compared to the accumulations of iron" (*second edition, page 712).

The proposal to define the "Al" great groups (Alaquod and Alorthod) on the basis of the Al-to-Fe ratio conceptually makes sense and may offer a workable solution to the current problem. However, the proposal is limited to a study of 11 potential Alaquods from the northeastern part of the US, and does not reference where soil testing took place or provide pedon descriptions for complete diagnostic information.

Further, the proposal does not provide information on other Orthods (Haplorthods) that might qualify as Alorthods if the criteria were changed as proposed.

The committee requests that more information be included in this part of the proposal before considering approval.

Part 3: As it is unclear exactly what is proposed and how it is to be accomplished, the committee **does not approve** the proposal as written

The proposal is to amend and clarify criteria for defining Bh and Bhs horizons but it is not stated how this is to be accomplished or by whom. Is the proposal asking the Standards Committees to amend and clarify the criteria for defining the horizons or are they asking that the committees accept that there is a need to amend and clarify the defining criteria? Further, this part of the proposal needs work to make it easier for the reader to move from text to table. For example, locations for the samples are not indicated in Table 3 forcing the reader to go back to Table 1. Perhaps this part of the proposal should be listed under 'Issues for Discussion and Further Development.'

3. Proposed Changes in Limnic Horizons and Materials – Ed Tallyn, Thor Thorson, et al.

Part 1: The committee **approves** the proposal as written:

To allow the use of the L master horizon to be used as horizon nomenclature when describing soils that do not classify as Histosols.

Part 2: The committee **approves** the proposal as written:

To allow use of the diatomaceous, marly and coprogenous earth textural modifiers for horizons in soils that are not Histosols.

Part 3: The committee **approves** the proposal as written:

To allow Limnic subgroups for great groups outside of Histosol; particularly, Limnic Cryaquepts.

Part 4: The committee **approves** the proposal as written:

To establish a diatomaceous substitute particle-size class for mineral soils with limnic material. As for the establishment of marl and coprogenous substitute particle-size classes, further evaluation of criteria is needed.

Part 5: The committee **approves** the proposal as written:

To establish an opaline minerology class.

Issues for Discussion and Further Development—2016

1. Surface Mantle Clarifications – Craig Ditzler, Ken Scheffe (PDF; 23 KB)

There are some inconsistencies and errors with this issue for discussion and further development.

First, it is not stated as to which standard the clarification is to be addressed. It should be clear that the changes are to the *Keys to Soil Taxonomy*.

Second, Chapter 1, Page 2 under Buried Soils, it is proposed to add a reference to "chapter 3" to define a surface mantle of new soil material, when, in fact, a definition is not apparent in Chapter 3 for a surface mantle of new soil material.

Third, the paragraphs defining a Surface Mantle of Human Transported Material are somewhat confusing, especially in reference to the presence of buried soil.

Fourth, Diagnostic Surface Horizons: The Epipedon is listed under Chapter 2, Page 7, when, in fact, it is Chapter 3, Page 7.

2. Bedrock, Fragments, and Densic Materials Decision Tree – Wayne Gabriel, Ed Tallyn, et al. (PDF; 128 KB)

The committee agrees that the decision tree is a helpful guide and should be incorporated into the Field Book for Describing and Sampling Soils. Please see Appendix One (below) for comments, questions, and suggestions.

3. Isotic Mineralogy in Sandy Soils – Joe Chiaretti et al., Ken Scheffe, Mike England (PDF; 41 KB)

The title of this issue does not cover the entire document that it's linked to. The linked document encompasses more than the issue of sandy soils false-positively meeting isotic mineralogy criteria. Issues presented in the document are:

- Apparent lack of interpretive value of the isotic class vs. the mixed mineralogy class
- Difficulty in applying the class based on easily observed field correlation guides such as soil parent material, geology, vegetation, landscape position, and soil climate regimes
- Classification and correlation problems of similar soil series separated only by mineralogy class
- Appropriate criteria or critical values for the class (NaF pH and 1500 kPa water/clay ratio)
- Inappropriate inclusion of some soils that have an unreliable 1500 kPa water/clay ratio because it is based on very low clay and 1500 kPa water contents
- Broad application of the class from soils influenced with volcanic ash to soils with high amounts of organo-mineral substances (andic soil materials vs. spodic materials)

The committee agrees that the concept and criteria of the isotic mineralogy class needs to be reevaluated, and would like to see a formal proposal to either revise the current criteria

or remove the class entirely. As it stands, there are members of this committee who would like the class removed.

4. Initiation of Yermic Diagnostic Feature Investigations Project – Ken Scheffe (PDF; 96 KB)

The committee agrees that an investigative project is needed to quantify the features and expression of the vesicular horizon in order to develop meaningful interpretations and pedogenic taxonomic classes. The committee recommends that this project rely heavily on university (e.g. CESU, UC Riverside) and other cooperator participation (e.g. Agriculture Research Service (ARS) Jornada Experimental Range), in conjunction with the NRCS West National Technology Support Center and the National Soil Survey Center, in gathering data and information and synthesizing the interpretative and taxonomic class criteria.

Specific comments and suggestions have been combined in Appendix Two (below).

5. Oxyaquic Subgroup for Fragiudults – Kevin Godsey, Ken Scheffe (PDF; 183 KB)

The committee agrees that the author should be provided feedback as to why the previous request was not approved so that a determination can be made on whether a new proposal is warranted.

Appendix One

Bedrock, Densic Material and Fragment Decision Tree [1, 2] ~~5-07-2015 Approved Draft, SRSS~~

Relatively unaltered
Not pedogenic
Roots can enter only through cracks in material and/or around fragments

FRAGMENTS
Coherent bedrock not present (even if tightly packed). Have cracks < 10 cm apart horizontally that roots can enter

Perform test for cementation

Coherent **LAYERS**
No cracks or the spacing of cracks horizontally apart that roots can enter is >= 10 cm (e.g., coherent layered bedrock present)

- Noncemented
- Slakes after air-drying and then submersion in water for at least 1 hour

Densic fragments

Fragments of dense till, mechanically compacted materials, some mudflows, and lacustrine deposits

Fragments of densic bedrock are present (geologically old);geologic fabric of bedrock still visible

- Yields no rock fragments or pararock fragments
- Designated as C horizon

- Extremely weakly to moderately cemented
- Does not slake, after air-drying and then submersion in water for at least 1 hour

Pararock fragments

- Texture modifiers paragravel, paracobbles, parachanners, paraflagstones, parastones, or paraboulders used with a texture class (e.g., PGR-SL) if fragment volumes are 15 to <90%
- Terms in lieu of texture "paragravel", "paracobbles", "parachanners", "paraflagstones", "parastones", or "paraboulders" (e.g., PG) used and fragment volume is ≥ 90%
- Designated as C horizon

- Strongly cemented to indurated
- Does not slake, after air-drying and then submersion in water for at least 1 hour

Rock fragments

- Texture modifiers gravelly, cobbly, channery, flaggy, stony, or bouldery used with a texture class (e.g., CBV-SCL) and fragment volume is 15 to <90%
- Terms in lieu of texture "gravel", "cobbles", "channers", "flagstones", "stones", or "boulders" (e.g., CB) used and fragment volume is ≥90%
- Skeletal particle-size classes or fragmental substitute class (e.g., fragment volume 35 to <90% or ≥ 90%)

- Noncemented
- Slakes after air-drying and then submersion in water for at least 1 hour

Densic contact over Densic materials

Dense till, mechanically compacted materials, some mudflows, and lacustrine deposits

Geologically old; geologic fabric of bedrock still visible

- Yields no rock fragments or pararock fragments
- Designated as Cd horizon

- Extremely weakly to moderately cemented
- Does not slake, after air-drying and then submersion in water for at least 1 hour

Paralithic contact over Paralithic materials

Geologically old; geologic fabric of bedrock still visible

- Yields pararock fragments to overlying horizons formed in residuum
- Designated as Cr layer

- Strongly cemented to indurated
- Does not slake, after air-drying and then submersion in water for at least 1 hour

Lithic Contact over bedrock

Geologically old; geologic fabric of bedrock still visible

- Yields rock fragments to overlying horizons formed in residuum
- Designated as R layer

Technical Review/Revisions
Oct 21, 2015
WJG/SSR9

1 This key is for fragments and nonpedogenic bedrock, and densic material that is relatively unaltered except for cracks. The key does not work well for fragments that have more than 10 percent air space between fragments or fragments with more than 10 percent fine interstices between fragments.

2 Definitions given on pages 27, 28, 319, 320, 336 337, and 338, of Keys to Soil Taxonomy, 12th edition, 2014; page 173 of the 1993 Soil Survey Manual; and pages 2-62 through 2-64, Field Book for Describing and Sampling Soils V. 3.0.

Appendix Two

*********DRAFT PROJECT PROPOSAL OUTLINE FOR VESICULAR HORIZON INTEGRATION********

Integration of the Vesicular (Yermic) Horizon into the Soil Survey Program

A project proposal by

Ken Scheffe, National Soil Classification Specialist
NSSC, Lincoln, NE

Background

The presence of a near surface pedogenic soil feature with a dominance of vesicular pores and a morphology different than most A horizons, but common in desert landscapes has been known and described for years in the US and other countries. The basic morphology is a layer at or near the soil surface with platy to massive structure with a predominance of easily observed vesicular pores. It is often overlain by desert pavement or a platy surface crust and has been observed to be up to 10 cm thick. The feature reduces the infiltration and restricts germination and establishment of vegetation. This feature is described as having 'Yermic properties' in the 2014 WRB (IUSS Working Group WRB. 2014), and has was described as a vesicular horizon by pedologists in the US for more than 50 years (Springer, M.E. 1958). A proposal to formalize the recognition of this important feature was developed and submitted for consideration by Judith Turk, Carrie-Ann Houdeshell, and Bob Graham in 2010 at the West Regional NCSS Conference (Turk, et al, 2010). After additional review and refinement, and submission to the National NCSS conference in 2013, this important feature was accepted by the Soil Science Division as the Vesicular master horizon, designated by a capital 'V' in February of 2014.

Quantification of the Vesicular Horizon

The vesicular master horizon can be identified and used in the horizon nomenclature based simply upon the presence of the vesicular pores and associated morphology. However, this morphology also imparts physical properties important to the use and management and ecological functions which need integration into the soil survey program. These impacts need recognized and quantified in order to develop soil interpretations and determine whether the feature is to be recognized as a diagnostic feature in Soil Taxonomy.

An investigative project is needed in order to quantify the features and expression of the vesicular horizon in order to develop meaningful interpretations and pedogenic taxonomic classes. Within the US, the dominant expression is found in the arid areas of the West Region. The project will rely upon soil scientist and vegetative specialists in the soil survey offices regional offices in gathering data and information and synthesizing the interpretative and taxonomic class criteria needed, as needed. The study by Turk, et al (2010) will be used to assist in locating study sites and identifying soil features and their significance upon the landscape. Soil descriptions in NASIS and Laboratory data from existing KSSL pedons can likely be gleaned, however, the vesicular surface would likely not have been described and sampled separately from the bulk of the A horizon, nor persisted through sample preparations.

The following are among the features and conditions needing investigated in soils with vesicular surface horizons:

1. Thickness (minimum requirements?)
2. Lateral continuity (pedon or polypedon requirements)
3. Soil Texture (any exclusions)
4. Soil Structure (forms, morphologic covariates, and expression)
5. Consistence (strength, resilience)
6. Hydrology and Ks
7. Chemistry (OM (humus and active carbon), salinity/sodicity/carbonates/gypsum)
8. Plant communities and Ecological Sites of occurrence (ecological state and associated plant community)
9. Climate regimes (moisture and temperature)
10. Geographic distribution in the US (Chihuahuan, Sonoran, Mohave, Great Basin regions)

Events to be Planned and Scheduled

1. Development review, and distribution of Vesicular Horizon Integration Project Plan (Anticipate ~3 years to complete project from approval until completed integration into soil survey standards).
2. Identification of analytical methods and procedures (laboratory analyses, morphology/fabric, sample design).
3. Concurrence to undertake and commitment to fund by Agency Leadership.
4. Conduct teleconferences outlining activities and schedules with SSO and SSRO staffs participating.
5. Initial field exploration and investigations by SSO staff.
6. Field review/assists scheduled with survey and regional staffs to review discuss findings and recommendations. (Possibly 2 – Chihuahuan/Sonoran, Mohave, outlying areas of Great Basin and intermountain west).
7. Modification and synthesis of soil interpretations for soil having vesicular horizons.
8. Evaluation of the occurrence of vesicular horizons upon ecological sites and ESDs.
9. Evaluation and synthesis of diagnostic criteria (if needed) in the development of diagnostic features, criteria, and taxonomic classes.
10. Review and vetting of new standards regarding vesicular horizons
11. Develop or CESU/Initiative funded field tour(s) for NSSC partners and stakeholders in western/southwestern US (is there a corresponding international soils event in the US?)
12. Integration of vesicular horizon feature into all standards documents and release of new documents (SSM, NSSH, and Soil Taxonomy) and publication/presentation of results (i.e. – SSSA, IUSS, WCSS, etc.)

Timetable of Activities

It is estimated about 18 month would be required to conduct the project once fully initiated. This is timetable is based in part upon the following considerations:

- Time needed to cycle through two seasons of field work (primarily Chihuahuan, Sonoran, and Mohave Deserts, and Great Basin).

- Time to conduct laboratory analysis, including thin sections (soil fabric) analysis
- Time to synthesize of findings and development and coding of criteria and interpretations
- Formal delivery (workshop, publications, soil survey standards)

I. **Planning Phase -4th Quarter FY-16**
   a. Initial Project Plan development
   b. Preliminary teleconferences, field planning, schedule development,
   c. Identification of investigators/scientist participating

II. **Performance Phase – 1st Qtr. FY-17 thru 2nd Qtr. FY-18**
   a. Exploratory field investigations, sample collection, analysis, testing

III. **Synthesis Phase – 4th Qtr. FY-17 thru 1st Qtr. FY-18**
   a. Development and vetting of diagnostic criteria and interpretations, codifying approved standards into NSSH, SSM, Soil Taxonomy

IV. **Delivery Phase - 2nd Qtr. FY-18 (Winter/Spring workshop 2018)**
   a. University partner hosted workshop in western US

NRCS Soil Survey Regions and Soil Survey Offices Included

- SSR-8 – Phoenix
  - Las Cruces
  - Grants
  - Tucson
  - Glove
  - Flagstaff
  - Globe
  - Victorville
  - Ogden
  - Marfa
- SSR-2 - Davis
  - Elko
  - Minden
  - Sonora
  - Klamath Falls
- SSR-1 and SSR-4 (TBD)
  - Ontario
  - Idaho Falls
  - Price

Questions to be answered (just mine for now, more from others later)

1. Can vesicular horizons be consistently identified, described, and meaningful diagnostic criteria be developed for inclusion in Soil Taxonomy?
2. In loamy Aridisols, is a vesicular (yermic) surface the exception, or the norm?
3. Is vesicular morphology a surface morphology, phase criteria in mapping, dynamic soil property, series criteria, or a feature of a broader 'soil function' system?
4. Are there fundamental differences when it occurs in conjunction with desert pavement and with no surface fragments?
5. Is the vesicular surface a sign of degradation, or a sign of maturity/stasis/instability?
6. Are there indicators of eminent change (thresholds), either in soil, vegetation, or climate which lead to formation, or lead to destabilization and dust evolution?
7. What is the relationship of precipitation (timing and amount) and temperature (regime and freeze-thaw) that leads to vesicular horizon for formation?
8. Do the temperature and moisture regimes of occurrence correspond to taxonomic thresholds for these regimes, or does it split them?

Estimated of Costs

The cost of the Vesicular Horizon Integration, as always, depends upon what we want to put into it. I believe it best to be inclusive as possible with soil survey offices, soil survey regions, and the NCSS partners which will be affected by this project, both in performance and with the resulting changes in soil classification and interpretation. It also needs to be appropriately peer reviewed, vetted, and documented with analytical evidences. Finally, it needs to be officially accepted and released (workshop) and published in peer reviewed journals, etc., as well as codified in Soil Taxonomy and its Keys. With that in mind, I propose the following as a minimum budget for the purposes of initial project planning. The crude estimates below could be as much as 30% lower, or higher, than needed depending upon the level of field verification and support required.

Item	Units	Unit Cost	Total
Salaries of NRCS Staff	300 days	$300/day (S&B)	$ 90,000
Analytical Procedures	15 pedons	$3,000	$ 45,000
Travel (NSSC and Field staff)	200 days	$139/day (+ airfare)	$ 30,000
Agreements (CESU)	1 hosted 3 day workshop	$25,000	$ 25,000
			$ 190,000

References

IUSS Working Group WRB. 2014. World Reference Base for Soil Resources 2014.
International soil classification system for naming soils and creating legends for soil maps.
World Soil Resources Reports No. 106. FAO, Rome.

Judith K. Turk, Carrie-Ann Houdeshell, and Robert C. Graham. A proposed master V horizon for the designation of near-surface horizons with vesicular porosity.

Springer, M.E. 1958. Desert pavement and vesicular layer of some soils of the desert of the Lahontan Basin, Nevada. Soil Sci. Soc. Am. Proc. 22:63-66.