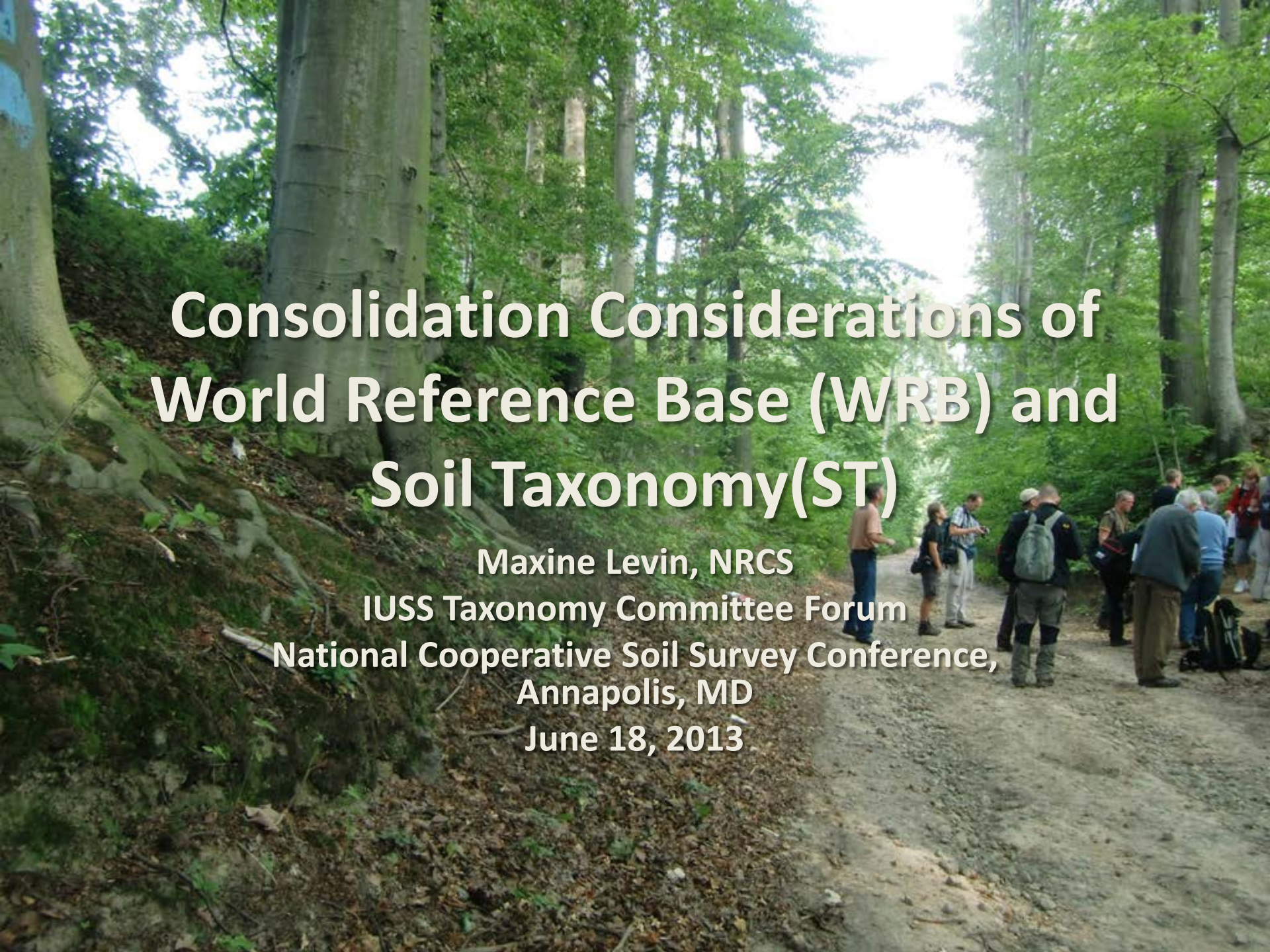

Consolidation Considerations of World Reference Base (WRB) and Soil Taxonomy(ST)

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IUSS Taxonomy Committee Forum

National Cooperative Soil Survey Conference, Annapolis, MD

June 18, 2013

The World Reference Base for Soil Resources (WRB)

- **The international standard taxonomic** soil classification system endorsed by the International Union of Soil Sciences (IUSS). It was developed by an international collaboration coordinated by the International Soil Reference and Information Centre (ISRIC) and sponsored by the IUSS and the FAO via its Land & Water Development Division. It replaces the previous FAO soil classification.

World Reference Base(WRB)
Time line:

- **1971-1981** Soil Map of the World Project, FAO
- **1980-1981** Basic principles for WRB
- **1982-1992** ISSS Subgroup Meetings -FAO World System of Classification 1988
- **1992** In Montpellier, France, no justification for completely new classification system different from the FAO Revised Legend (1988)
- **1994** Progress of the WRB at 15th Congress of the ISSS at Acapulco, Mexico
- **1998** The first official version of the World Reference Base for Soil Resources (WRB) 16th World Congress of Soil Science at Montpellier
- **1998** The WRB text was then adopted by the International Society of Soil Science (ISSS) Council, as the officially recommended terminology to name and classify soils. It also endorsed and adopted as the system for soil correlation and international communication of the International Union of Soil Sciences (IUSS).

ST :How did we get here?

- **1951** US Soil Taxonomy system with Guy Smith, SCS USDA
- **1960** US 7th approximation of US Soil Taxonomy System
- **1967** Supplement to 7th Approximation
- **1975** Agricultural handbook 436 A Basic System for soil classification for making and interpreting soil surveys
- **1979-1990** Soil Management Support Services (SMSS) Hari Eswaran soil classification workshops and World Benchmark Soils Project (WBSP)
- **1983** 1st Edition of Keys to Soil Taxonomy
- **1985-1998** Keys to Soil Taxonomy Editions 2-8
- **1999** Soil Taxonomy 2nd Edition – Expansion of Soil Taxonomy (finalized draft for World Soil Congress Montpelier, France 1998)
- **2000-2010** Focus Soil Survey Program on accelerated mapping and Digital soil survey products (very limited staff at NSSC for Soil Taxonomy-- Bob Engel, Craig Ditzler, Bob Ahrens to continue international input through WRB)
- **2003, 2006, 2010** Keys to Soil Taxonomy 9th, 10th, 11th Editions aligning with World Soil Congresses
- **2010** Micheal Golden proposal for Universal Soil Taxonomy at World Soil Congress Brisbane AU

World Reference Base(WRB)
Time line continued:

- **1998-2005** WRB field tours, and organized conferences and WRB summer schools and support from FAO for publishing cooperation and logistic support of the IUSS, the International Soil Reference and Information Centre (ISRIC) and the Food and Agriculture Organization of the United Nations (FAO)
- **A major effort was undertaken to harmonize nomenclature with the soil taxonomy of the United States Department of Agriculture (USDA) and other major national soil classification systems.**
- **2006** 2nd Edition of WRB IUSS Working Group World reference base for soil resources 2006. World Soil Resources Reports No. 103. FAO, Rome Erika Michéli (Chair),
- **2010** Guidelines for constructing small-scale map legends using the WRB were published as addendum to WRB 2nd edition (adds more information to 2nd tier qualifiers for map unit definition Peter Schad & Otto Spaargaren (Chairs)
- **2014 (World Congress in Korea)**—will be 3rd Edition launch of WRB Peter Schad (Chair)

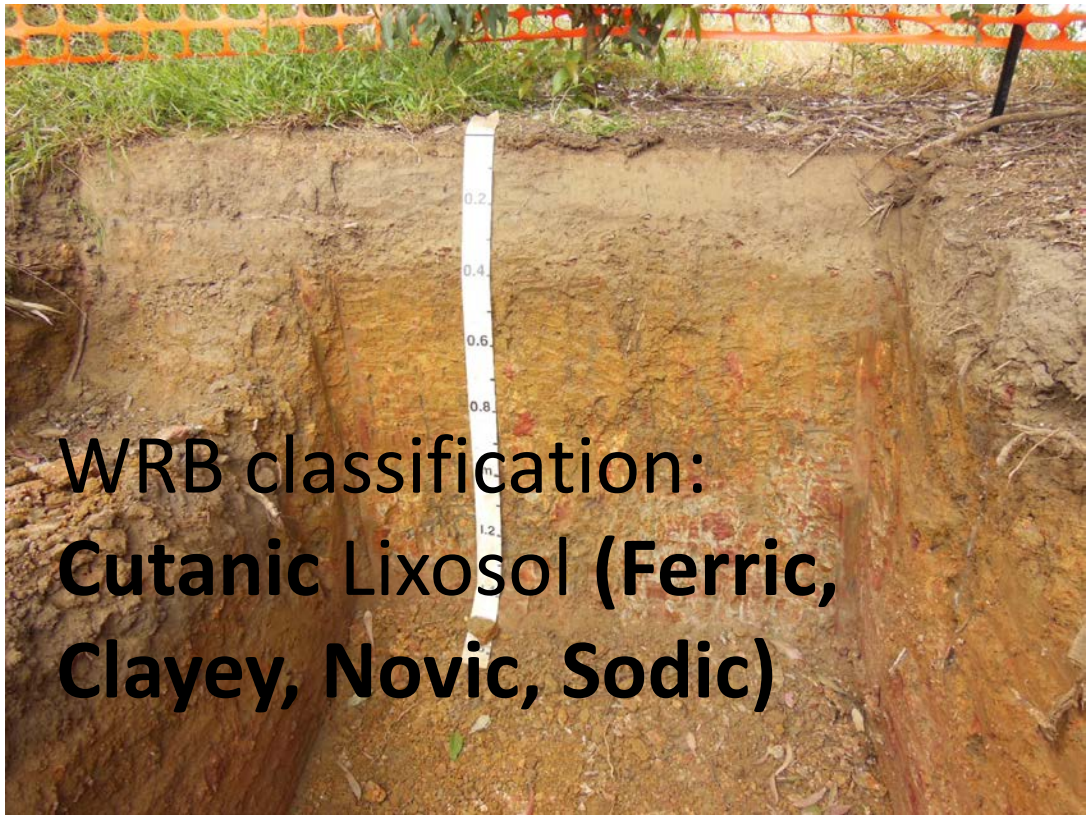
General Classification Principles of WRB:

- The classification of soils is based on soil properties defined in terms of diagnostic horizons, properties and materials, which should be measurable and observable in the field.
- The selection of diagnostic characteristics takes into account their relationship with soil forming processes. They should not, as such, be used as differentiating criteria.
- To the extent possible at a high level of generalization, diagnostic features are selected that are of significance for soil management.
- Climate parameters are not applied in the classification of soils. It is fully realized that they should be used for interpretation purposes, in dynamic combination with soil properties, but they should not form part of soil definitions.

Key to the WRB reference soil groups (2006)

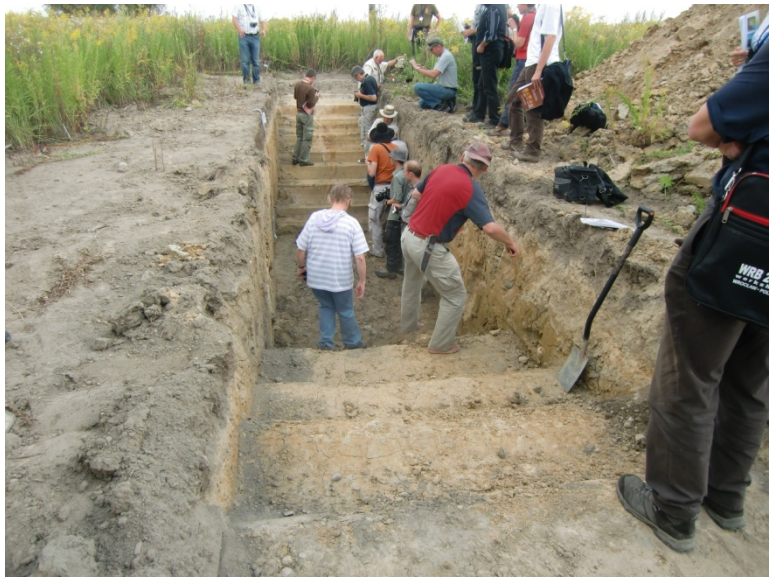
Identification key to the Tier 1--32 reference soil groups(RSBs):

1. **Soils with thick organic layers:** Histosols (HS)
2. **Soils with strong human influence**
   - Soils with long and intensive agricultural use: Anthrosols (AT)
   - Soils containing many artefacts: Technosols (TC)
3. **Soils with limited rooting due to shallow permafrost or stoniness**
   - Ice-affected soils: Cryosols (CR)
   - Shallow or extremely gravelly soils: Leptosols (LP)
4. **Soils influenced by water**
   - Alternating wet-dry conditions, rich in swelling clays: Vertisols (VR)
   - Floodplains, tidal marshes: Fluvisols (FL)
   - Alkaline soils: Solonetz (SN)
   - Salt enrichment upon evaporation: Solonchaks (SC)
   - Groundwater affected soils: Gleysols (GL)
5. **Soils set by Fe/Al chemistry**
   - Allophanes or Al-humus complexes: Andosols (AN)
   - Cheluviation and chilluviation: Podzols (PZ)
   - Accumulation of Fe under hydromorphic conditions: Plinthosols (PT)
   - Low-activity clay, P fixation, strongly structured: Nitisols (NT)
   - Dominance of kaolinite and sesquioxides: Ferralsols (FR)
6. **Soils with stagnating water**
   - Abrupt textural discontinuity: Planosols (PL)
   - Structural or moderate textural discontinuity: Stagnosols (ST)
7. **Accumulation of organic matter, high base status**
   - Typically mollic: Chernozems (CH)
   - Transition to drier climate: Kastanozems (KS)
   - Transition to more humid climate: Phaeozems (PH)
8. **Accumulation of less soluble salts or non-saline substances**
   - Gypsum: Gypsisols (GY)
   - Silica: Durisols (DU)
   - Calcium carbonate: Calcisols (CL)
9. **Soils with a clay-enriched subsoil**
   - Albeluvic tonguing: Albeluvisols (AB)
   - Low base status, high-activity clay: Alisols (AL)
   - Low base status, low-activity clay: Acrisols (AC)
   - High base status, high-activity clay: Luvisols (LV)
   - High base status, low-activity clay: Lixisols (LX)
10. **Relatively young soils or soils with little or no profile development**
    - With an acidic dark topsoil: Umbrisols (UM)
    - Sandy soils: Arenosols (AR)
    - Moderately developed soils: Cambisols (CM)
    - Soils with no significant profile development: Regosols (RG



Tier 2: The combination of RSGs with qualifiers, detailing the properties of the RSGs by adding a set of uniquely defined qualifiers.

WRB Workshop and Field Excursion Wroclaw, Poland Aug 30-Sept 3, 2011



Characteristics of diagnostic horizons in US Taxonomy that were more narrow in their definitions than what appeared to be used in the field for WRB.

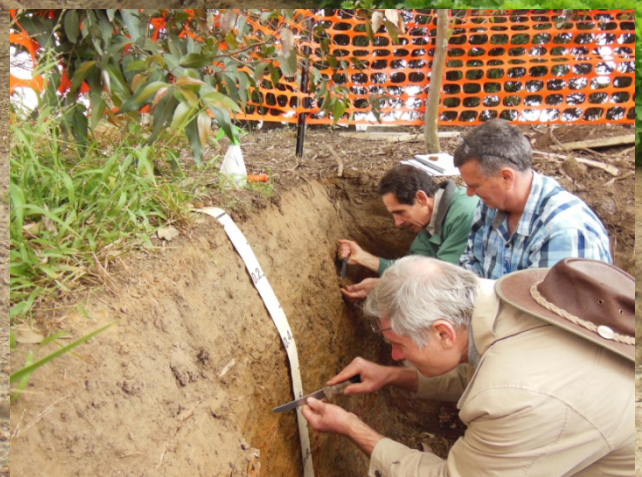
Examples were:

- **Albic -**colors accepted for US taxonomy are grayer and lighter than those recognized in the field in WRB system with higher chroma.
- **Glossic horizon –** eluvial part is dependent on albic colors which are more narrowly defined in US system.
- **Argillic Horizon**- buried argillic horizons are not recognized in keying out US taxonomy. There are restrictions in depths relative to accumulation to satisfy significant changes between eluvial and illuvial parts of profile.

•**Histic epipedons-** difficult measurement to estimate in the field. Borderline situations defer to mollic or umbric epipedon.

•**Mixed Minerology (clay activit**y)-ECEC measurements for WRB tour profiles and were not a 1:1 comparison with CEC (NH4OAc, pH 7 (CEC-7)) for calculation of CEC/Clay ratio for clay activity classes.

Comparison of the Australian (ASC), World Reference Base (WRB), and Soil Taxonomy (ST) classifications for soils seen on Victoria and Tasmania excursions.



Victoria Excursion

Site #	Name	ID
	Land Use	
1	Clyde	GP22
	Cropland (vegetables)	

ASC classification: Ferric-Sodic, Mesotropic, Brown Chromosol

WRB classification: Cutanic Lixosol (Ferric, Clayey, Novic, Sodic)

ST classification: Very-fine, kaolinitic, thermic Plinthic Paleustalfs

Commonalities with Diagnostic criteria

- Strategies for Universal system based on commonalities of WRB & ST with Diagnostic criteria.
- US Taxonomy system would also improve with a field guide that focuses first on collection of all diagnostic features from pit observation and laboratory data.
- Once all the diagnostic features are catalogued and aligned, only then are we really ready for the next edition classification keys in Soil Taxonomy.

Recommendations to the NCSS Soil Taxonomy Classification as it relates to WRB:

1. Provide (as we did with SMSS) initiative 1979-1990) a better mechanism to accept recommendations for world wide applications of Soil Taxonomy with appropriate updates and changes as needed to Keys of Soil Taxonomy Editions.
2. Focus (for universality of the US System) on **diagnostic features** to completely align with WRB in criteria definitions and critical thresholds for definitive applications-this should be the main focus for a Universal Soil Classification system
3. Use WRB field workshops and IUSS Classification Meetings as an opportunity to gather input to update US Classification System for worldwide application
4. Focus on launching an expanded system of US Soil Taxonomy for worldwide use for the UN International Year of the Soil in 2015