National Cooperative Soil Survey Newsletter

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Issue 20

NCSS Newsletter

In This Issue—

Editor's Note

Issues of this newsletter are available on the World Wide Web (www.statlab.iastate.edu/soils/soildiv). Click on NCSS and then on the desired issue number of the NCSS Newsletter.

You are invited to submit stories for future issues of this newsletter to Stanley Anderson, National Soil Survey Center, Lincoln, Nebraska. Phone–402-437-5357; FAX–402-437-5336; email–stan.anderson@nssc.nrcs.usda.gov.

Notes on Kandic Properties

During the South Regional Work Planning Conference in Savannah, Georgia (June 3–6, 2002), the kandic horizon and its place in Soil Taxonomy was a topic of discussion. A committee was formed to look into how it can be better applied to landforms in the Southeast. Dr. Stan Buol, North Carolina State University, who was involved early in the development of the concept, was not in attendance. Responding to a request by Marc Crouch, however, he did provide the following history as he knows it.

It is hot and dry in Raleigh, and I am getting ready to catch and eat walleyes and northerns next week in Canada, so this morning I am nostalgic about the kandic horizon. Evidently, the apparent CEC_7/kg clay is the issue. That issue goes back to about 1966, when all the present Udults were Ochrults (7th Approximation) and became Normudults (1964 draft changes to the 7th). At a southern regional soil classification workshop in Ft. Worth, the issue was up for discussion and the proposals were for splitting the Normudults into Hapludults and Tropudults. McCracken was concerned that no provisions were made to separate coastal plain Udults from piedmont Udults, so he asked me to look into the issue. He had become department head, and I had arrived from Arizona with a total lack of experience in Ultisols. Dr. Roy Simonson had forcefully, and correctly, pointed out that criteria for classification had to be from within the pedon classified and could not be based on properties below the soil, i.e., 2 m. Within the proposed Tropudults (iso soil temperature regime criteria), but not in the Hapludults, an Oxic subgroup had been proposed and defined as not having "more than 24 meq/100g clay in the major part of the argillic horizon" (Second Supplement, October 1966).

Armed with all the data I could find and with McCracken's blessing, I set off for Ft. Worth to propose the following:

1) Pedons that did not have a clay content decrease of more than 20%, relative to maximum clay content of the argillic, within 150 cm of the surface would be Pachyudults (thick Udults), and those with a clay decrease of more than 20% within 150 cm would be Hapludults.

2) All Udults would have Oxic subgroups if they had CEC_7/100 g clay less than 24 meq.

The first proposal met with resounding success, but the name Pachyudults was changed to Paleudults to reflect a bias toward genesis (old soils on the older coastal plain surfaces rather than "Pachy," from "pachyderm," meaning thick). The data I had showed that this would separate most Udults on coastal plains from Udults on the piedmont without having to have weatherable mineral data. The state soil scientists liked it because it required less lab data and because the clay content with depth could be determined in the field. As a sidelight Bartelli sent me to my room in the middle of the afternoon to clean up a few sentences in my proposal, by 5 p.m. the group accepted the proposal, and at happy hour the concept of "Pale" based on clay content decrease with depth was being touted for Alfisols, Mollisols, and even Aridisols. The second proposal, Oxic subgroups in all Udults, was soundly shouted down by the group. It required too much lab data, and available data indicated that it would affect a large number of existing series in the Southern region. When the proposal reached Guy Smith, he liked both the “Pale” and the “Oxic” proposals, but the state soil scientists were strongly against the “Oxic” subgroups, so it remained only in the Tropudults and thus was not of concern in most of the Southern region.

After Guy retired and was in Venezuela, the question of “Oxic” subgroups continued to arise. We were then in the beginnings of the ICOM’s with the International Committee on Low Activity Clays. The most pressing issue was the volume of clay skins needed (>1%) to distinguish an argillic horizon from an oxic horizon and seemed to be an insoluble problem. In soils that have few weatherable minerals from which to form “new” clay, few clay skins are present (Rebertus and Buol, 1985. Intermittency of illuviation in Dystrochrepts and Hapludults from the piedmont and Blue Ridge provinces of North Carolina. *Geoderma* 36: 277-291). During the time Guy was in Venezuela, we had several exchanges of letters relative to Ultisols. I well remember and retain those letters, in which Guy was so convinced that the Southern States would not accept the low clay CEC criteria that he wanted to retain the Tropudults, based only on the iso STR criteria, and recognize Oxic subgroups only in “Trop” great groups so as not to upset the Southern region. I wanted to abandon “Trop” as a great group because it was redundant to the family criteria, and I argued, “Low CEC was low CEC regardless of whether it was in the tropics or in the temperate zone.” In one exchange of letters, I sent Guy a postage stamp from the U.S. that outlined the tropics, temperate, and boreal latitudes and asked the very pointed question of whether he thought we should use a great group formative element on criteria that could be mapped on a postage stamp. Feeling a bit guilty about being so abrupt with an elder I so respected, I was hesitant when his letter arrived a couple of weeks latter. To my surprise his first sentences were, “Now I am going to surprise you. I agree with you.” Guy’s concern for low activity clay criteria in the Southern region is shown on page 240 of the Guy Smith interviews.

The work of ICOMLAC was in full swing, and the clay skin issue would not go away. Frank Moormann did not want to violate the mandate to ICOMLAC to study low activity clay in Ultisols and Alfisols. Both orders required an argillic horizon, but clearly it was often impossible to find clay skins in argillic horizons with low activity clay. A new diagnostic horizon seemed the best way to address the problem, and in 1979, I introduced the “finer textured subsurface horizon (FTSH)” (page 122 in the Excerpts from the Circular Letters of ICOMLAC). After some editing, Frank and I proposed the “finer textured subsoil horizon” that was like the argillic horizon but had low apparent clay CEC and no clay skin requirements (page 125 in the Excerpts from ICOMLAC). Of course, we had to have a better name for the FTSH horizon, and as an aside I proposed “Impic horizon,” derived from “impotent,” but more scientific heads prevailed, and I think Hari Eswaran proposed “Kandic,” derived from kandite, the family name for kaolinites. (I still find that students are more likely to remember what is defined if it is referred to as impotent “Impudults” rather than “Kandiudults.”)

That ended the search for clay skins in argillic-like horizons of low activity clay, but there remained two fundamental questions on how this new diagnostic horizon should be used. First, there was the separation of coastal plains from piedmont areas in the Southern region. I firmly believed that distinction had to be retained and thus saw the necessity of the dual great group name—“Kanhap” for the thinner kandic horizons, mostly in the piedmont, and “Kandi,” i.e., “Pale,” for the thicker kandic horizons of the coastal plain. The second question was more difficult and was a major point of disagreement between Frank and myself. Apparently, the same issue is now in debate. Should the CEC criteria be 16 cmol/kg clay or 24 cmol/kg clay when CEC is determined at pH 7? Frank wanted 24 because it better defined the low activity clay areas in West Africa. I wanted 16 because it better fit the criteria we had been using to separate clayey kaolinitic and clayey mixed families in the Ultisols of the U.S. I also argued that the 16 cmol/kg clay was equivalent to the Oxic horizon and thus the separation of Oxisols from Inceptisols. In some obscure hotel room, Frank and I consumed the mollifying contents of a bottle of Scotch and decided on the phrase “apparent clay CEC at pH 7 of 16 or less <u>OR</u> apparent ECEC of the clay of 12 or less.” By that time we had a number of data sets that determined that an ECEC of 12 cmol/kg clay was nearly equal to an apparent CEC of 20 cmol/kg clay at pH 7. Thus, it would be a compromise between the 24 he wanted and the 16 I wanted, and we would both save face. (Saving face is very necessary in Asian culture, and Frank had spent many years in Viet Nam and Thailand.)

The ICOMLAC proposal went to John Witty in that form. John held a small meeting in Washington to review the proposal. Frank could not attend, but I did. I was armed with a study of existing data and a map made by Joe

Nichols showing that if the higher pH 7 CEC value of 24 cmol/kg clay were accepted, it would move the "kandi" to include parts of Tennessee, Kentucky, and Mississippi, but I do not have the exact map Joe prepared. Anyhow, at that meeting it was argued that the dual criteria of 16 cmol/kg clay or less at pH 7 OR an ECEC of 12 cmol/kg clay or less would require two lab analyses of each sample and it would be better if we settled on one criterion. Thus, the wording was change to AND. The data available clearly showed that if a sample had an apparent CEC of 16 cmol/kg clay at pH 7, it would always meet the 12 or less cmol/kg clay ECEC criterion. I personally feel that the confusion created by including both values in the definition should be eliminated by stating only the apparent CEC at pH 7 criterion, but at the time everyone was more concerned with adhering to the words of the ICOMLAC proposal, even though the application of the criteria had been changed by using AND rather than OR in the definition. Although I clearly favored AND, I refused to vote on the decision out of respect for Frank, who was not able to present his case. After Frank saw the final outcome, he thought I had unduly influenced John. Later, when I visited Frank in the Netherlands, we had dinner and a good bottle of wine, and as I explained what had happened, he forgave me and we parted good and respected friends.

It appears that the 16 vs. 24 apparent clay CEC at pH 7 is again up for debate. From the work Joe Nichols did with data existing at that time, all that changing the kandic limit to 24 cmol/kg clay would do is put the borderline pedons in a different place throughout the Southern region. With introduction of the clay activity family classes, a small range of soils fit as subactive families between "kandi" and 24 cmol/kg clay. One could argue that there is no need to have a 0.16 to 0.24 CEC_7 to % clay ratio subactive activity family class and have the semiactive activity class range from 0.40 down to 0.16 as defined by the kandic.

There are three reasons I personally would not like to see the kandic horizon criteria raised to less than 24 cmol/kg clay. First, my most selfish reason is that the rules for identifying soils with expansive clays for the purpose of permitting standard septic systems is in the process of being defined at 16 cmol/kg apparent clay CEC determined at pH 7 in North Carolina. This is what I have been doing for about 30 years when septic system questions and samples with more than 35% clay come to my lab. I have tested this criterion against x-ray traces of the clay and believe that it more clearly defines the limit of more or less than 10% 2:1 clay minerals in a sample than I can obtain from x-ray (Kimble, Buol, and Witty. 1993. Rationale for using ECEC and CEC in defining the Oxic and Kandic horizons. *Soil Survey Horizons*. 34: 39-44). It is a lot easier to do, more easily reproduced, and looks better than x-ray traces in a courtroom when decisions of the Health Department and consultants come up for litigation.

Joe Kleiss (1994. Relationship between geomorphic surfaces and low activity clay on the North Carolina coastal plain. *Soil Science* 157: 373-378) has helped to establish a geomorphic relationship that can be used, at least in North Carolina, to define the extent of the kandic horizon on the coastal plain. We have not formally tested limits in the piedmont, but in working with sanitarians and consultants, we have found a good relationship between the 16 limit and other morphological features of the pedons that these people can recognize in the field and use to make their septic system recommendations.

There always is a gray area at the "on ground" boundary between any taxonomic criteria definition of any natural entity. Soils are no more problematic in this respect than rocks or minerals. Within a limited geographic area, it is usually possible to find some taxonomic criterion that fits a geographic boundary, but as that geographic area is expanded and more pedons are examined, we always find that there is no taxonomic criterion that satisfactorily "fits" with "natural" geographic boundaries of soils in all areas.

I was personally very concerned when the kandic criterion was established because I knew the line would be difficult to establish within "my own backyard," but we do the best we can. If the limit is increased, it will only push the decisions to another "backyard," i.e., younger geomorphic surfaces and more poorly drained soils on the coastal plains (see the Kleiss reference) and soils with greater inclusions of basic parent material and/or loess in other areas.

Secondly, we should remember that Soil Taxonomy attempts to classify all soils in the world. In the Southern region we are on the "fringe" of the kandic horizon and do not find the extremely low CEC soils defined as the Acrudoxic Kandiudults (ECEC of 1.5 cmol/kg clay or less) and the various "Acr" great groups of Oxisols. Increasing the "kandic" limit will enlarge the range of clay activity identified by the kandic horizon and needs to be tested in many other places, especially where "Kandi" Ultisols and Alfisols are in geographic association with Oxisols.

Finally, I like 16 cmol/kg clay limit for the kandic horizon because apparent CEC_7 of the clay is most often spatially related to parent material. Having one limit that separates Oxisols and "Kandi" great groups from Inceptisols and "nonkandic" great groups is desirable when map units (often associations of great groups) are named on small-scale generalized maps. I think it is desirable to have some degree of uniformity within Soil Taxonomy. As Guy Smith once said, "Have sympathy for the students." If we identify low activity clay at 16 for the oxic horizon and 24 for the kandic horizon, persons looking at the description of these diagnostic horizons in *Soil Taxonomy* (on page 43 of the 2nd edition, we say the kandic CEC is comparable to that of Oxisols) may wonder if soil scientists really know what they mean by low activity clay. ■

A Note on Erosion in the Lewis and Clark Journals

By Stanley P. Anderson, Editor, NRCS, National Soil Survey Center, Lincoln, Nebraska.

The Journals of the Lewis and Clark Expedition (Gary E. Moulton, ed., University of Nebraska Press, 1987) include William Clark's description of wave erosion near a Tillamook village along the Pacific, January 8, 1806:

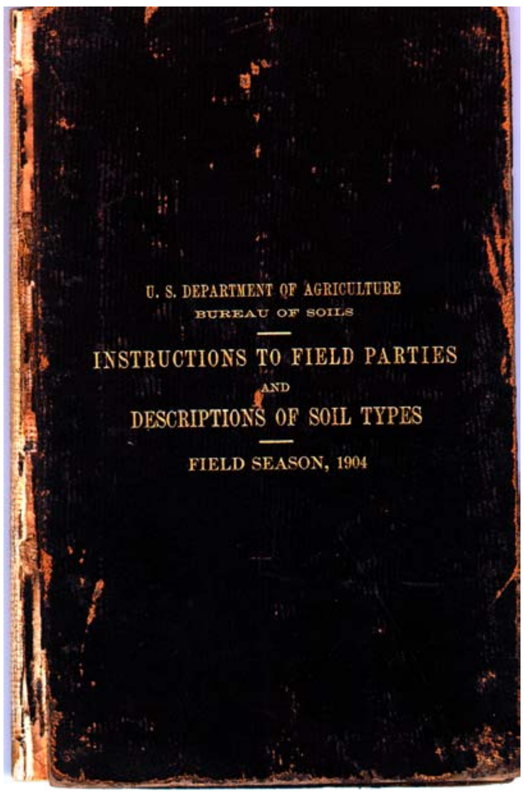
> The Coast in the neighbourhood of this old village is slipping from the Sides of the high hills, in emence masses; fifty or a hundred acres at a time give way and a great proportion of an instant precipitated into the Ocean. those hills and mountains are principally composed of a yellow Clay; their Slipping off or Spliting assunder at this time is no doubt Caused by the incessant rains which has fallen the last two months (vol. 6, pp. 182-183). ■

1904 Guidance on the Form and Content of Soil Survey Reports

By Stanley P. Anderson, Editor, NRCS, National Soil Survey Center, Lincoln, Nebraska.

The following guidelines are from pages 40 and 41 of *Instructions to Field Parties and Descriptions of Soil Types* published by the United States Department of Agriculture, Bureau of Soils, in 1904. Note the restrictions on the length of the various sections in soil survey reports. Sentenced to a 30-year term of hard labor as an editor of the much more lengthy modern soil survey reports, I say that the early years of the soil survey program were the good old days.

> **Form of a soil survey report**.—Owing to the large amount of data being collected by soil-survey parties, it will be necessary to confine the report from each party to about 50 typewritten pages of 250 words each, or 25 printed pages of 500 words each for the Western Division and to about 15 or 20 printed pages for the Eastern Division. The material for the report should be collected and written up, so far as possible, before the party leaves the field.
>
> An outline of the chapters is given as a guide in the arrangement of the report, and should be followed as closely as circumstances will permit. The number of words to be given in each chapter will be a guide in the preparation of the material and is given as the result of experience in former reports. It is understood of course that the headings will necessarily have to be changed somewhat in different districts, and the relative importance of the different chapters will vary with the locality. This is intended, therefore, simply as a guide in the preparation of the reports, and the number of words should be taken as the maximum to be used except in the case of matters of special importance, which may need fuller treatment.



The matter should be presented in a terse style, and no more words used than are absolutely necessary to convey the meaning, being careful, however, to treat each subject so that all important phases may be brought out and clearly stated. In order to attain this, the different chapters should be revised several times if necessary, so that all important matters may be considered and all unnecessary words eliminated. A careful consideration of this matter of style in writing is enjoined upon all members of the division charged with the preparation of reports.

Outline of soil survey report.—The outline of chapters referred to is as follows:

I. Location and Boundaries of the Area (100 words).
II. History of Settlement and Agricultural Development (500 words).
 Date or dates of county organization.
 Principal source of population.
 Agricultural development.
III. Climate.
IV. Physiography and Geology (500 words).[a]
V. Soils (500 words to each type).[b]
 Name, description, depth, and color of soil and subsoil.[c]
 Location of soil in area.
 Topographic features.
 Drainage features.
 Origin of soil and processes of formation.
 Mineral or chemical features. Alkali salts.
 Unusual or characteristic crops to which adapted.
 Crops crown and average yields.
VI. Special Soil Problems, such as Hardpan, Acid Soils, Reclamation of Swamp and Worn-out lands (100 words).
VII. Water Supply for Irrigation, Amount and Character (250 words).
VIII. Underground and Seepage Waters, Drainage of Soils (250 words).
IX. Alkali in Soils (1,000 words).[b]
 Location of alkali areas.
 Origin of alkali.
 Chemical composition of alkali.
 Distribution in soil.
 Reclamation of alkali lands.
X. Agricultural Methods in Use as Adapted to the Soils and Conditions of the Area.
XI. Agricultural Conditions in the Area (1,500 words).[b]
 General prosperity of farming class.
 Tenure of farms.
 General size of farms.
 Character of labor.
 Character of principal products.
 Recognition of adaptation of soils to crops.
 Transportation facilities.
 Markets.

[a] The physiography should be described in some detail; the geology should be briefly treated, only those features having a direct or important bearing on the soils being considered. Authorities for statements made should be cited wherever possible.

[b] In preparing chapters V, IX, and XI write in the subtopics and discuss each in the order given. This will aid in securing uniformity in the reports, and prevent the omission of matter important in making comparisons of the soils and conditions in different areas.

[c] The greatest care should be taken to make the descriptions of the soils, while full enough to be clear, concise and explicit.

It would be difficult to improve upon the advice concerning brevity and clarity given in the third paragraph. In fact, this paragraph is repeated virtually verbatim in the bureau's *Instructions to Field Parties* published in 1914 (page 113). The only differences are that the word "division" is changed to "bureau" in sentence 3 and the word "terse" is changed to "direct" in sentence 1. "Terse" is better. ■

Allan G. Giencke

2002 National Cooperative Soil Survey Soil Scientist Achievement Award

Allan G. Giencke, Soil Data Quality Specialist, St. Paul, Minnesota, Natural Resources Conservation Service, has been selected as the winner of the 2002 National Cooperative Soil Survey (NCSS) Soil Scientist Achievement Award. This award will be presented at the Soil Science Society of America National Meeting in Indianapolis, Indiana, during the week of November 10–15, 2002. Winners are selected from nominations submitted by all NCSS cooperators from across the Nation.

The NCSS Soil Scientist Achievement Award nationally recognizes exceptional achievement by outstanding soil scientists who are working in the production phase of soil survey under the auspices of the National Cooperative Soil Survey Program. The first award was presented in 1999 as part of the Soil Survey Centennial Celebration. Nominees must have a minimum of 10 years (cumulative) service in the production phase of soil survey and must be currently working in project soil survey work or technical soil services. An individual may receive this award only once during his or her career.

Allan Giencke has enjoyed a long and successful career with USDA, Soil Conservation Service (SCS) and Natural Resources Conservation Service (NRCS). He has been employed for 30 years as a soil survey project leader, assistant state soil scientist, and area resource soil scientist. In Minnesota, Al has used outstanding technical and communication skills to ensure a superior soils program for both the National and Minnesota Cooperative Soil Surveys. He has coordinated soil survey activities in eight states throughout the upper Midwest. He plays a leading role in creating electronic soil surveys in this region.

Al was selected as Soil Scientist of the Year by the Minnesota Association of Professional Soil Scientists in December of 2001. He is a licensed professional soil scientist with the State of Minnesota.

Al is married and has two children. In his spare time, he is involved with volunteer activities, including PREPARE, Junior Achievement, Cub Scouts, Boy Scouts, Habitat for Humanity, Science Fair, and Kids Computer Club. ■

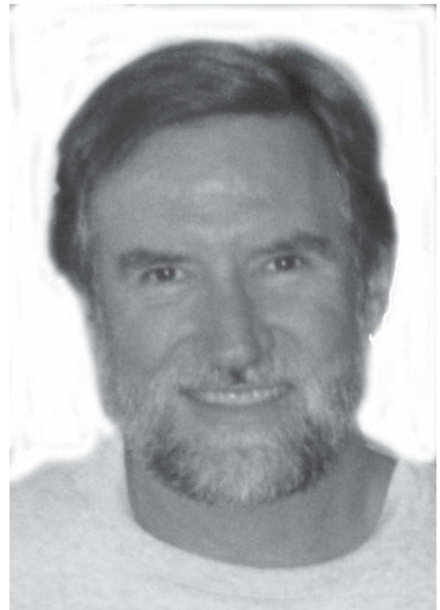
2002 National Cooperative Soil Survey Soil Scientist of the Year Award

David Roberts, Area Resource Soil Scientist, Madison, Wisconsin, Natural Resources Conservation Service, has been selected as the winner of the 2002 National Cooperative Soil Survey (NCSS) Soil Scientist of the Year Award. This award will be presented at the North-Central Regional NCSS Conference in Madison, Wisconsin, during the week of June 24–28, 2002. Winners are selected from nominations submitted by all NCSS cooperators from across the Nation.

The NCSS Soil Scientist of the Year Award nationally recognizes "exceptional achievement by NRCS soil scientists who are working in the production phase of the soil survey program." The first award was presented in 1999 as part of the Soil Survey Centennial Celebration and is now granted annually to outstanding soil scientists at the GS–12 level and below. Nominees must have a minimum of 3 years service in the production phase of soil survey. An individual may receive this award only once during his or her career.

David Roberts has enjoyed a long and successful career with USDA, Soil Conservation Service (SCS) and Natural Resources Conservation Service (NRCS). He has been employed for over 30 years as a project soil scientist, soil survey project leader, and resource soil scientist. Dave has always been forward thinking and innovative in his approach to soil survey work.

One of the contacts that Dave has maintained in his work as a resource soil scientist in southeastern Wisconsin is with the Geography Department at University of Wisconsin in Madison. In late 1997, Dave discovered some research of Professor Axing Zhu that related to computer modeling of soil survey information. For a number of years, Dr. Zhu had been working on a concept that could potentially automate the soil survey process using digital elevation models and fuzzy logic for soil membership. The concept, coined SoLIM, has evolved into a very successful research project and partnership between NRCS and the University of Wisconsin. The evolution of this concept was brought about by Dave's recognition that SoLIM could be a new and innovative means of doing soil survey work that would improve accuracy, increase production, and provide more usable soil survey information in a much more timely fashion. His insistence with management that this concept can produce a more efficient and accurate method of portraying soil survey information has brought us to the point we are at today in the application of the SoLIM technology. Currently, SoLIM is being used to produce soil maps in Wisconsin and Tennessee. Also, Arizona is exploring the possibility of using SoLIM to map some inaccessible lands on a military reservation. The work with the SoLIM concept has proven to be highly successful in Wisconsin, where the project is now in a full production mode.



David Roberts

The SoLIM concept has created an excitement in the soil science community that is unprecedented and potentially could revolutionize how soil survey work is accomplished. ■

Integrated Long-Term Soils Study

By Sandy Wilmot, Monitoring Director, Vermont Monitoring Cooperative[1]
(sandy.wilmot@anrmail.anr.state.vt.us)

In 1999, a team[2] of scientists associated with the Vermont Monitoring Cooperative (VMC) proposed establishment of a long-term forest soil monitoring study. The justification for such a study was multi-pronged but focused on the long-term impacts of air pollution on the quality of forest soils. The concerns related to these impacts included the fate of heavy metals (e.g., mercury and lead) deposited from the atmosphere, loss of available nutrients (especially calcium and magnesium) through leaching, and changes in carbon and nitrogen resulting from nitrogen saturation and from climatic changes. The overall goal of this study is to detect human-caused changes in forested soils at two VMC study sites. An additional goal is to provide basic soil characterization data to support VMC monitoring and research.

Updating soil maps for the study sites was the first task of the team and was accomplished by Thom Villars in 1999 and 2000. The study sites straddle four counties (Chittenden, Lamoille, Bennington, and Winham Counties), and seven towns (Underhill, Cambridge, Stowe, Manchester, Sunderland, Winhall, and Stratton).

The soil map update ensured that each area was mapped according to the newest soil standards. The two study sites have been mapped at a 1:20,000 scale, but the specific long-term soil monitoring locations will be mapped at a higher resolution.

Five soil sites have been identified for long-term monitoring. Three of these are at Mount Mansfield, and two are at Lye Brook. An elaborate soil characterization of each site is near completion. Analysis was conducted at the National Soil Survey Laboratory, Natural Resources Conservation Service (NRCS), Lincoln, Nebraska. Initial site characterization has been completed, and the sites have been permanently marked. A sampling design has been established, and the baseline sampling year is expected to be 2002.

Following is a description of the sampling design:

- Sampling will be done over a 200-year period.
- Sampling dates: 0, 5, 10, 20, 50, 100, 150, and 200 years.
- Three sites at Mount Mansfield—northern hardwood forest, transitional forest, and high-elevation spruce/fir forest; two sites at Lye Brook—northern hardwood forest and transitional forest.
- Plot size is 50 x 50 meters with uniform, relatively stone-free soils.
- In each sampling year, 10 1-meter samples per site will be used to collect soil from five horizons.
- Samples will be analyzed against a known forest soil standard.
- Archived samples will be stored at room temperature in 8-ounce jars.

An added bonus to the soil monitoring study is the installation of two Soil Climate Analysis Network (SCAN) stations, one at Mount Mansfield and one at Lye Brook. This NRCS national network provides continuous monitoring of soil temperature and moisture and will be an excellent source of supplemental environmental data in support of the study.

Additional research questions are being addressed at these sites. Don Ross is using the VMC study sites in addition to other locations as part of a regional nitrogen transformation study. Nitrate in rain and snow is transformed in the soil before appearing in streams. Soil micro-organisms are involved in nitrogen cycling processes. Soil disturbance changes transformation rates. This complex process will shed light on the question of nitrogen saturation in soils, both in Vermont and in the region.

A study initiated in 2001 by Linda Pardo of the U.S. Forest Service approaches the nitrogen saturation issue from above ground. An evaluation of tree foliage for delta-N-15 can determine the status of soil nitrogen at a site.

Additional studies are being planned in association with the long-term soil monitoring sites. The subjects of these studies include weathering rates of soils, status of mercury accumulation in soils, calcium transformations over time, rooting depth and density, and carbon flux. In addition, scientists are working with the Soil Science Society of America to establish forest soil reference samples. These samples will provide VMC and others involved in studying the forest ecosystem with a known standard for forest soils and thus will improve laboratory analyses. ■

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[1] The Vermont Monitoring Cooperative (VMC) is a multi-disciplinary program initiated in 1990 as a State, university, and Federal partnership to improve our understanding of forested ecosystems. It was designed to enhance access to data and information from monitoring and research studies. The VMC facilitates this process by providing networking opportunities and data management services.

[2] The Soil Team includes Scott Bailey, U.S. Forest Service; Thom Villars, Natural Resources Conservation Service; Don Ross, University of Vermont; Nancy Burt, Green Mountain National Forest; Deane Wang, University of Vermont; and Sandy Wilmot, Vermont Department of Forests, Parks & Recreation. Tim Scherbatskoy, from University of Vermont, was involved in the initial planning but has now moved on to New York.

Photograph of a landslip by Mary McDonald Pochelon, Soil Conservation Technician, USDA, NRCS, Kalispell, Montana.

Landslips

By Chuck Gordon, State Soil Scientist/ MLRA Leader, USDA, NRCS, Bozeman, Montana.

Landslips result when masses of soil and rock material move downslope under natural conditions. Block glides, slumps, and earth flows are the major types of landslips. Although landslips have many causes, most involve either earth materials with low shear strength or ground-water saturation of materials. Large landslips are most common in areas where shales and other soft sedimentary rocks abound. Landslip deposits have many seeps, springs, and depressions that often contain small ponds or bogs.

Landslips are hazardous to life and property both in the landslip itself and in the areas where the landslip material is deposited. Some landslips are stable and unlikely to move again; others remain unstable and can be reactivated by basal undercutting, such as that caused by stream erosion or artificial excavation. Movement can also recur because of increased ground-water pressure, such as that induced by the removal of forest cover or the diversion of drainage water to unusual slope positions. Landslips can by reactivated by some management practices, such as excavation. Excavation for road construction can be particularly hazardous. ■

An area that is subject to the damaging effects of postfire runoff. Photograph by Tasha Gibby, Public Affairs Specialist, USDA, NRCS, Bozeman, Montana.

Postfire Runoff

By Chuck Gordon, State Soil Scientist/ MLRA Leader, USDA, NRCS, Bozeman, Montana.

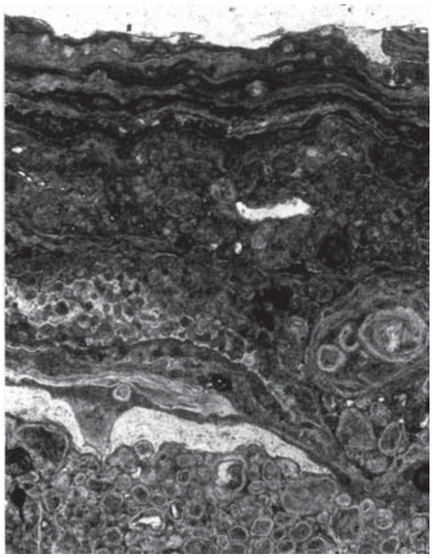
Wildfires are an integral part of nature. They can have many positive effects on plant ecology and wildlife but also can have devastating effects on life and property. Besides the direct effect of the fire itself, postfire runoff problems can occur. Slopes left denuded by forest or range fires are susceptible to accelerated soil erosion, flash flooding, and debris flows because of the absence of vegetation and roots that bind the soil. In addition, very high temperatures can produce hydrophobicity in the soil surface. Hydrophobic soils repel water, reducing the amount of infiltration.

Several recovery techniques can reduce the hazards associated with postfire runoff. Revegetation and structural practices assist in the recovery from the aftermath of a wildfire. Vegetation is one of the most important factors influencing soil erosion. It helps to control erosion by shielding the soil from the impact of raindrops, by maintaining a soil surface capable of absorbing water, and by reducing the amount and velocity of runoff. A few of the structural practices that aid in the recovery process are straw wattles, which stabilize slopes; contour tree felling; mulching; temporary check dams; concrete barriers; and rock-lined channels. ■

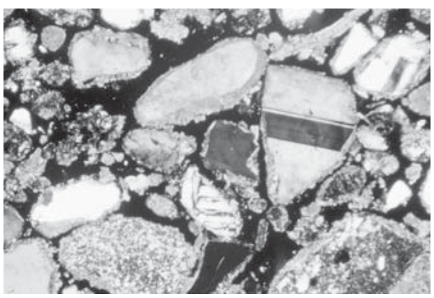
Soil Visualization Through Micromorphology

By Michael Wilson, Research Soil Scientist, NRCS, National Soil Survey Center, Lincoln, Nebraska.

Micromorphology, the microscopic examination of thin slices of undisturbed soil fabric, provides scientific information



Photomicrograph of the 2Bkqm horizon of a pedon from Jefferson County, Oregon. The fabric has an opal and chalcedony laminar cap. Much of the fabric is composed of durinodes (noncrystalline silica) surrounded by moderately oriented silicate clays.



A thin section of the Bk6 horizon from a pedon in Fremont County, Wyoming. This horizon consists mainly of medium (0.25-0.50 mm) and coarse (0.5-1.0 mm) sand-sized grains with surface coatings of calcium carbonate.

that complements analytical soils data. It is the one laboratory technique that preserves the natural arrangement of soil materials in the study of the properties and relationships of soil mineral and organic constituents.

The National Soil Survey Center (NSSC) laboratory in Lincoln, Nebraska, has produced thin sections of soil fabric for many of the pedons being analyzed for chemical, physical, and mineralogical properties. When the thin sections are made, soil material is impregnated with a resin that hardens upon heating and the soil is then sliced to fit a glass slide and ground to a thickness of about 30 micrometers. Particle features, such as arrangement, size, mineralogy, and weathering, can then be examined with a petrographic microscope. Primary soil structural units as well as the shape and continuity of pores are readily visible.

Micromorphology has been instrumental in developing certain criteria of Soil Taxonomy and in elucidating pedogenetic processes, such as argillation, pan formation, and crusting. This science has wide application in such disciplines as soil chemistry, soil physics, land-use management, biology, and archaeology. Photomicrographs of soil fabrics are increasingly used to educate students of all ages and levels (K-12, university, and professional levels).

These images help soil scientists and others to visualize soil composition and genetic processes. The slide presentation “Soil Under a Microscope” (http://www.nrcs.usda.gov/technical/worldsoils/microscope/) is an example of the educational use of micromorphology. The poster “The Colors of Soil,” in addition to providing information about the science of soils, features an enlarged image of a thin section of soil fabric. ■

Nonagricultural Soil Survey Interpretations

By R.B. Grossman, Research Soil Scientist, NRCS, National Soil Survey Center, Lincoln, Nebraska. From a paper prepared for a conference in Kenya in 1989. Only the part of the paper entitled “1.0 Current USDA System” is given here. A few modifications of the original text have been made.

A few words about the history of nonagricultural soil survey interpretations in the United States may add perspective (Gardner, 1957; Simonson, 1987a, 1987b). In the 1920’s and early 1930’s the Federal Soil Survey was involved in successful cooperative studies with the National Bureau of Roads on characterization of soil as construction material and with the National Bureau of Standards on corrosion (Romanoff, 1957). There was not, however, an encompassing program in nonagricultural interpretations. The present strong, broad program may be traced to the assumption of leadership of the Federal Soil Survey in the Bureau of Soils by C.E. Kellogg in the mid 1930’s. He had been involved while a graduate student at Michigan State University in a program that employed soil survey information for planning road construction (Michigan State Highway Department, 1952). This experience may have been a factor in the emphasis placed on use of soil information for engineering decisions. Kellogg’s assumption of leadership of the Bureau of Soils soil survey coincided with the early period of the New Deal, when there was much effort to improve the infrastructure of the country and large scale social planning was generally accepted. The Soil Conservation Service had its origins in this period. A utilitarian soil survey was begun for soil erosion control by the Soil Conservation Service separate from the one Kellogg headed. The Soil Conservation Service program may have fostered more emphasis on interpretations in the soil survey of the Bureau of Soils headed by Kellogg. During World War II nonagricultural interpretations were made for the military by soil survey personnel associated with the Bureau of Soils. Maps were prepared that estimated suitability of soils for construction and trafficability. After World War II, people who had been involved in the military program had a large influence on the interpretations effort.

In the period 1950-1970 the current comprehensive interpretative program was largely established. A probable reason for the strong emphasis on interpretations as a whole was the placement of all responsibility for soil survey in the Soil Conservation Service with its practical thrust. The "Guide for Interpreting Engineering Uses" (USDA, SCS, 1971) codifies various interpretations for nonagricultural purposes developed in this period and is still a useful reference for current interpretations. This was an important reference for the completion of SCS-SOI-5 forms, which were the bases of the first consistent national system of interpretive quantities and class placements.

Three factors probably favored an emphasis on nonagricultural over agricultural interpretations during the formative 1950-1970 period. First, a concern about agricultural surpluses made it difficult to emphasize agricultural interpretations that would add to the surpluses. Second, strong programs in agricultural interpretations, particularly in soil fertility, existed in the state agricultural experiment stations, whereas there was no other national program for dissemination of nonagricultural soil survey information. The third factor was a rapidly expanding need resulting from prosperity and population growth. This emphasis on nonagricultural interpretations has continued and only recently may be changing with the advent of environmental concern about agriculture and greater awareness of the hazards of erosion.

During 1950-1970, there was a major movement of people to the suburbs related to the general economic improvement and the large increase in birth rate immediately after World War II. Nonagricultural interpretations increasingly emphasized the prediction of soil properties important to construction and maintenance of detached houses on individual lots. The soil survey of Fairfax County, Virginia (Porter et al., 1963; Pettry and Coleman, 1974) pioneered the comprehensive treatment on nonagricultural interpretations with emphasis on sites for detached houses. From 1940-1960 the population of the county increased several fold, leading to a large increase in the need for nonagricultural interpretations which the soil survey attempted to meet.

References

Gardner, D.R. 1957. The National Cooperative Soil Survey of the United States. Ph.D. Thesis, Harvard University, Cambridge, MA.

Michigan State Highway Department. 1952. Field Manual of Soil Engineering. Third edition.

Pettry, D.E., and C.S. Coleman. 1974. Two Decades of Urban Soil Interpretations in Fairfax County, Virginia. Geoderma 10: 27-34.

Porter, H.C., J.F. Derting, J.H. Elder, and E.F. Henry. 1963. Soil Survey of Fairfax County, Virginia. U.S. Dept. of Agriculture, Soil Conservation Service, Washington, D.C.

Romanoff, M. 1957. Underground Corrosion. Nat. Bureau Standards Circ. 579.

Simonson, R.W. 1987a. Historical Aspects of Soil Survey and Soil Classification Part VI. 1951-1960. Soil Survey Horizons 28: 39-46.

Simonson, R.W. 1987b. Historical Aspects of Soil Survey and Soil Classification Part VII. 1961-1970. Soil Survey Horizons 28: 77-84.

United States Department of Agriculture, Soil Conservation Service. 1971. "Guide for Interpreting Engineering Uses." ■