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INTRODUCTION

As a result of intensive field and laboratory work being conducted in specific key areas in South Australia need for improvements and modifications to Soil Taxonomy have become obvious to several soil scientists. This report proposes some changes to the 1990 Keys to Soil Taxonomy (Soil Survey Staff, 1990) in order to provide more suitable categories for some soils in South Australia. These improvements were also identified and improved upon by several workers during a series of three Soil Taxonomy workshops held in South Australia during September and October, 1991. These workshops have led to the formation of an informal South Australian Soil Classificaion Working Group comprising interested workers from the CSIRO Division of Soils, University of Adelaide, and South Australian Department of Agriculture. Several members of the working group presented the following series of poster papers at the National Soil Science Society of Australia Conference in Adelaide in April, 1992, outlining several proposed changes to Soil Taxonomy:

- *Proposed Changes to Soil Taxonomy: I Thick sandy epipedons, carbonate and sodium enriched soils.* Maschmedt D. J., W. H. Hudnall, D. J. Chittleborough, R. W. Fitzpatrick, and R. H. Merry.
- *Proposed Changes to Soil Taxonomy: II Aquic conditions and soils with iron-rich nodules.* R. W. Fitzpatrick, W. H. Hudnall, I.D. Hollingsworth, D. J. Chittleborough, D. J. Maschmedt and R. H. Merry.
- *Proposed Changes to Soil Taxonomy: III Spodosols.* Merry R. H., W. H. Hudnall, R. W. Fitzpatrick, D. J. Maschmedt and D. J. Chittleborough.
- *Proposed Changes to Soil Taxonomy: IV Andisols.* Lowe D. J., Merry R. H., W. H.Hudnall and R. W. Fitzpatrick.

Abstracts of the above four papers are given in Appendix 1.

The Australian Soil Conservation Council have passed a resolution that agreed to maintain recognition of Soil Taxonomy in publication and international communication as an adjunct to the new Australian System. Moreover, a recently formed project entitled "The Australian Collaborative Land Evaluation Program" (ACLEP) have proposed that Rob Fitzpatrick coordinate information regarding Soil Taxonomy in Australia (see Appendix for extract from the first ACLEP newsletter). The major part of this report is in a format that provides modified keys to several soil orders in the 1990 Keys to Soil Taxonomy (Soil Survey Staff, 1990). We propose to send a copy of this report together with more detailed supporting documents (e.g. Fitzpatrick, 1992; Lowe, 1992) to the Soil Taxonomy headquarters at USDA in Lincoln, Nebraska, for their consideration and further input. These modified keys should then be tested further and modified on the basis of such input.

It is anticipated that some of the information gained from new proposals to modify Soil Taxonomy to Australian soils will also enable further improvement and development of the new Australian Soil Classification System (Isbell, 1992). For example, the recent study of a range of Andisols near Mt. Gambier (Lowe,1992) has led to the introduction of an Andic great group in the new system. Similarly, we think that important atributes featured in the new Australian system such as the sodic (ESP of 6 or more) and magnesic (Ca/Mg ratio of less than 0.1) horizons should seriously be considered for inclusion in Soil Taxonomy as possible new subgroups.

In many parts of Australia it common to find soils with high amounts of ferruginous nodules (glaebules or gravels). The presence of high amounts of ferruginous nodules in soils has the effect of reducing rooting volume, altering water flow and nutrient availability as well as having high wear rates on plough shares (Fitzpatrick *et al.* 1992). Hence, there is a great need to include this characteristic, as well as modify unsuitable existing criteria that attempts to accommodate this, in both Soil Taxonomy and the new Australian system. For example, to accommodate Xeralfs with high amounts of ferruginous nodules (i.e. contain more than 10 percent by volume ranging 2 mm to 30 cm diameter throughout the upper 100 cm of the soil) we have proposed a new great group called **Ferrixeralfs;** as well, a new **ferritic** subgroup is proposed that contains within a minimum thickness of 15 cm, 10 percent or more by volume ferruginous nodules, 2 mm to 30 cm in diameter, within the *upper 50 cm* of the soil. We would suggest that the new Australian Soil Classification System maintains the use of **Ferric** which at present must contain > 20% ferruginous nodules within a minumim thickness of 25 cm and considers adopting a similar definition to the one we have proposed above for the ferritic subgroup.

As a follow-up to the three Soil Classification workshops held in 1991 it was decided to hold a similar course in September 1992 under the auspices of the Co-operative Research Centre for Soil and Land Management in Adelaide. One of the prime objectives the course was to train people to use Soil Taxonomy, and to test and develop further the proposed changes outlined below.

KEY TO SOIL ORDERS

The key to soil orders should be changed on page 71 so that the sulfuric horizon and sulfidic material should not be permitted in Alfisols. According to the present criteria in Soil Survey Staff (1990), sulfidic material and sulfuric horizons have not been classified in any of the Alfisol suborders. However, we have recently identified degraded Alfisols in areas severely affected by dryland salinization in which sulfidic materials have developed in A and E horizons over the past 50 years. This change is required in order to accommodate Alfisols with recently developed sulfidic materials or sulfuric horizons in the A and E horizons that will logically key out as Entisols (Sulfaquents) or Inceptisols (Sulfaquepts) with argillic horizons (i.e. with Alfic sub-groups).

Modify definition on p. 71 as follows:
1. Have an argillic, kandic or natric horizon but no fragipan, **sulfuric horizon or sulfidic material.**

HISTOSOLS

Saprists that have either a sulfuric horizon or sulfidic material have recently been discovered in mangrove swamp areas along the Gulf of St. Vincent in South Australia.

Saprists p. 237

Add: ADP
Saprists that have a sulfuric horizon that has its upper boundary within 50 cm of the surface.

Sulfosaprists. p.237

Add: ADB
Other Saprists that have a sulfidic materials within 100 cm of the soil surface.

Sulfisaprists. p.237

ALFISOLS

Aqualfs (p. 74).

IAB Natraqualfs p. 80.

Addition of a Sulfaquentic subgroup of Natraqualfs:

IABA. Other Natraqualfs with sulfidic material characteristics with a pH drop of at least one pH unit upon slow oxidation to a pH between 4.0 and 4.5.

Sulfaquentic Natraqualfs (p. 80)

IAC Duraqualfs (p. 77).

Duraqualfs with albic horizons have recently been discovered near Mt Pleasant in the Mt. Lofty Ranges. No subgroups are presently assigned to Duraqualfs and for this reason Albic and Typic subgroups are considered for these soils.

IACA. Other Duraqualfs that have an albic horizon and have less than 15 % saturation with sodium, and have less magnesium and sodium than calcium and extractable acidity, throughout the upper 15 cm of the argillic horizon or in all horizons within 40 cm of the soil surface, whichever is deeper.

Albic Duraqualfs (p. 77)

IACB. Other Duraqualfs.

Typic Duraqualfs

Xeralfs p.119

Natrixeralfs p.125

IDBA. Aquic Natrixeralfs
change chroma of 2 or less to: chroma of 3 or less.

Add:

IDBB. Other Natrixeralfs that have a layer, starting at the mineral surface, that has a sandy particle-size class and extends to the top of a natric horizon that is more than 100 cm below the soil surface.

Grossarenic Natrixeralfs

IDBC. Other Natrixeralfs that have a layer, starting at the mineral soil surface, that has a sandy particle-size class and extends to the top of a natric horizon that is 50 to 100 cm below the soil surface.

Arenic Natrixeralfs

IDBD. Other Natrixeralfs that have the following characteristics:

1. (Criteria for Vertic subgroups e.g. p 108 and 109.)

Vertic Natrixeralfs

IDBE. Other Natrixeralfs that have within a minimum thickness of 15 cm, 10 percent or more by volume iron-manganese nodules ranging from 2 mm to 30 cm in diameter within the *upper 50 cm* of the soil.

Ferritic Natrixeralfs

IDBF. Other Natrixeralfs that have a calcic horizon that has its upper boundary within 100 cm of the soil surface.

Calcic Natrixeralfs

IDBG. Other Natrixeralfs.

Typic Natrixeralfs

Rhodoxeralfs p.127

Add and Change:

IDEB. Other Rhodoxeralfs that have the following characteristics:

1. (Criteria for Vertic subgroups e.g. p 108 and 109)

Vertic Rhodoxeralfs

Change:

IDEB to IDEC	**Petrocalcic Rhodoxeralfs**
IDEC to IDED	**Calcic Rhodoxeralfs**
IDED to IDEE	**Ochreptic Rhodoxeralfs**
IDEE to IDEF	**Typic Rhodoxeralfs**

Add: **Ferrixeralfs** as IDC, p.119; 121

A new great group is proposed to accommodate Xeralfs with high amounts of ferruginous nodules (i.e. contain more than 10 percent by volume and ranging from 2 mm to 30 cm diameter throughout the upper 100 cm of the soil). We propose to call these soils **Ferrixeralfs**. The presence of high amounts of ferruginous nodules (glaebules or gravels) in soils has the effect of reducing rooting volume, altering water flow and nutrient availability as well as having high wear rates on plough shares (Fitzpatrick *et al.* 1990). Aquic, Oxyaquic, Natric, Petroferric, Kandic, Calcic, and Typic subgroups are considered for these soils.

In the Mount Lofty Ranges and on Kangaroo Island in South Australia it is common to find soils with high concentrations of ferruginous nodules in A horizons and at the E-B horizon boundaries which may occur on either valley-bottom, mid- and foot-slope positions. In these regions the hilltops consist of so-called lateritic materials (i.e. weathered zones rich in kaolin and associated ferricrete) that have resulted from strong *in situ* weathering of iron-rich parent materials (i.e. those containing either pyrite or primary iron silicate minerals such as biotite, augites, and olivines) since the Mesozoic. The source of iron, which has resulted in the formation of ferricrete, was derived from rocks which consisted of fine-grained metasediments with interbedded siltstones, sandstones and pegmatitic dykes with pyritic and/or biotitic siltstone seams. The ferricrete materials outcropping on the hilltops as well as the *in situ* ferruginised pegmatitic seams are the primary sources of colluvial ferruginous nodules or gravel which concentrates in these soils.

In the drier Mallee region, the ferruginous soils occupy broad flats between sand dunes. It is presumed that these flats were once reduced tidal flats. When the flats were exposed, the pyritic sediments were oxidised forming discrete ferruginous nodules throughout most of the sediments. With time, an argillic horizon has formed under Eucalyptus Mallee vegetation. These soils usually have a thin ochric epipedon and a thin E horizon.

As well, **ferritic** subgroups are proposed and these are soils that have within a minimum thickness of 15 cm, 10 percent or more by volume iron-manganese nodules ranging from 2 mm to 30 cm in diameter within the *upper 50 cm* of the soil.

IDB. Natrixeralfs

IDC. Other Xeralfs that have more than 10 percent or more by volume iron-manganese nodules ranging from 2 mm to 30 cm in diameter throughout the upper 100 cm of the soil or above a petroferric horizon if this occurs at less than 100 cm from the surface.

Ferrixeralfs

Ferrixeralfs (p 121).

Keys to subgroups

IDCA. Ferrixeralfs that have redoximorphic features with chroma of 2 (or 3 ?) or less within 100 cm of the surface and the horizons that have redoximorphic features with chroma of 2 or less also have aquic conditions, unless artificially drained.

Aquic Ferrixeralfs

IDCB. Other Ferrixeralfs that are saturated with water, unless artificially drained, for 1 month or longer within 100 cm of the mineral soil surface.

Oxyaquic Ferrixeralfs

IDCC. Other Ferrixeralfs that have exchangeable sodium that is 15 percent or more of the CEC (at pH 8.2) in one or more subhorizons in the argillic horizon.

Natric Ferrixeralfs

IDCD. Other Ferrixeralfs that have a petroferric contact within 125 cm of the soil surface.

Petroferric Ferrixeralfs

IDCE. Other Ferrixeralfs that have properties similar to those indicated for Kandiustalfs on page 106.

Kandic Ferrixeralfs

IDCF. Other Ferrixeralfs that have a calcic horizon that has its upper boundary within the upper 100 cm of soil.

Calcic Ferrixeralfs

IDCG. Other Ferrixeralfs.

Typic Ferrixeralfs

Palexeralfs *p.120*

Change the wording of the definition of the Palexeralfs.

Separate item 3 into: *either* (a) and (b) and put the lithic or paralithic statement first.

IDF. Other Xeralfs that have either:

3. Do *not* have a lithic or paralithic contact within 50 cm of the surface of the soil. Have an argillic horizon that has a clayey particle size class in the upper part and *either*:

(a) an increase of at least 20 percent clay (absolute) within a vertical distance of 7.5 cm at the upper boundary **or**

(b) an increase of at least 15 percent clay (absolute) within a distance of 2.5 cm at the upper boundary.

Depth Classes
Consider the possibility of another depth class for those soils that have root and water limiting features between 50 and 100 cm. May not be critical for Udic, it is for Ustic and Xeric.

Proposal: **Moderate.** Less than 75 cm but greater than 50 cm. Add similar statements that now appear for shallow.

Consider changing the order of IDFE, IDFF and IDFG. Natric conditions within 100 cm and a surface with a sandy particle size class are more limiting to root growth than a petrocalcic horizon that is at 150 cm. If the petrocalcic horizon is within 100 cm of the surface, it is more important.

Change these three subgroups to read (p. 126):

IDFE. Other Palexeralfs that do *not* have a petrocalcic horizon whose upper boundary is within 100 cm of the soil surface and have a layer, starting at the mineral soil surface that has a sandy particle-size class and extends to the top of an argillic horizon that is more than 50 cm below the soil surface.

Arenic Palexeralfs

IDFF. Other Palexeralfs that do *not* have a petrocalcic horizon whose upper boundary is within 100 cm of the soil surface and have 15 percent or more saturation with sodium in one or more subhorizons within 100 cm of the soil surface.

Natric Palexeralfs

IDFG. Other Palexeralfs that have a petrocalcic horizon whose upper boundary is within 150 cm of the soil surface.

Petrocalcic Palexeralfs

IDFH Other Palexeralfs that have within a minimum thickness of 15 cm, 10 percent or more by volume iron-manganese nodules ranging from 2 mm to 30 cm in diameter within the *upper 50 cm* of the soil.

Ferritic Palexeralfs

IDFJ Other Palexeralfs that have 5 percent or more plinthite (by volume) in one or more sub-horizons within 150 cm of the surface

Plinthic Palexeralfs

Reletter the remaining subgroups appropriately.

Aquic Palexeralf (p. 126).

Chroma limits should be changed from 2 to 3.

IDGH. **Aquic Haploxeralfs**.p. 124.

IDGI. Other Haploxeralfs that:

1. Have, within 75 cm of the soil surface, redoximorphic features with chroma of 2 or less and the horizons that have redoximorphic features with chroma 2 or less also have aquic conditions, unless artificially drained; and

2. Have subhorizons in the upper part of the argillic horizons that have skeletans that:
   a. Have redoximorphic features with moist chroma 2 or less; and

   b. Occupy 5 percent or more of the volume of the subhorizon.

Glossaquic Haploxeralfs

IDGJ. **Natric Haploxeralfs**
IDGK. **Psammentic Haploxeralfs**
IDGL. Other Haploxeralfs that have a layer, starting at the mineral soil surface, that has a sandy particle-size class and extends to the top of an argillic horizon that is 50 to 100 cm below the soil surface.

Arenic Haploxeralfs

IDGM. **Plinthic Haploxeralfs**

ANDISOLS

Xerands p.154

Vitrixerands p. 156 - 157.

Add: Calcic Mollic subgroup as BDAG.

BDAF Alfic Vitrixerands

BDAG Other Vitrixerands that have a calcic horizon or segregations of soft powdery lime within 125 cm of the soil surface.

Calcic Mollic Vitrixerands

BDAH Mollic Vitrixerands (previously BDAG).
BDAI Umbric Vitrixerands.
BDAH Typic Vitrixerands.

The Calcic Mollic subgroup should key out before the Mollic subgroup because it is essentially a modified Mollic subgroup.

Haploxerands *p.154-156*

Add Calcic Vitric subgroup as BDCD

BDCC **Ultic Vitric Haploxerands**

BDCD Other Haploxerands that have both of the following:
1. Less than 30 percent, undried, 1500 kP water retention in some subhorizon that meets the requirements for andic properties and that is at least 25 cm thick within 100 cm of the mineral soil surface; and
2. A calcic horizon or segregations of soft powdery lime within 125 cm of the soil surface.

Calcic Vitric Haploxerands

BDCE **Vitric Haploxerands**
BDCF **Thaptic Haploxerands**
BDCG **Ultic Haploxerands**
BDCH **Argixerollic Haploxerands**
BDCI **Alfic Haploxerands**
BDCJ **Mollic Haploxerands**

Suggest moving Calcic Haploxerands (previously BDCF) to BDCL and change the depth requirement to 150 cm.

BDCK **Umbric Haploxerands**
BDCL Other Haploxerands that have a calcic horizon within 150 cm of the soil surface.
Calcic Haploxerands

BDCM **Typic Haploxerands** (previously BDCL)

The reasoning is that soils with Ultic properties, Argillic or Kandic horizon and a Mollic or Umbric epipedon should be keyed before those soils with a calcic horizon because they require more intensive or specialized use and management. The Calcic Vitric subgroup should come out before the Vitric subgroup because it is essentially a modified Vitric subgroup.

ARIDISOLS

Haplargids p. 163

Add: Natric subgroups as FAEH, p. 165

FAEG **Borollic Haplargids**
FAEH Other Haplargids that have a SAR of 13 or more (or 15 percent or more exchangeable sodium saturation at pH 8.2) in some subhorizon within 150 cm of the soil surface.
Natric Haplargids

Reletter the remaining subgroups appropriately.

INCEPTISOLS

Other Halaquepts (p. 244) that have a petrocalcic horizon within 50 cm of the soil surface.

Add:

JACA **Petrocalcic Halaquepts**

Xerochrepts p.260

JDED **Lithic Xerochrepts**

JDEE Other Xerochrepts that have, within 100 cm of the soil surface, one or more horizons with one or both of the following:

1. ESP (at pH 8.2) of 15 or more; or
2. SAR of 13 or more

Sodic Xerochrepts

JDEG **Vertic Xerochrepts**
JDEH **Andic Xerochrepts**
JDEI **Vitrandic Xerochrepts**
JDEJ **Gypsic Xerochrepts**
JDEK **Aquic Dystric Xerochrepts**
JDEL **Aquic Xerochrepts**
JDEM **Dystric Fluventic Xerochrepts**
JDEN **Fluventic Xerochrepts**
JDEO **Dystric Xerochrepts**
JDEP Other Xerochrepts that have a sandy particle size class from a mineral soil surface to a depth of 100 cm or more and have segregations of soft powdery lime within 125 cm of the soil surface.

Calcic Psammentic Xerochrepts

JDEQ Other Xerochrepts that have a calcic horizon within 150 cm of the soil surface.

Calcic Xerochrepts

JDER Other Xerochrepts that have soft powdery lime within a depth of 150 cm if the weighted average particle-size class from depths of 25 to 100 cm is sandy or to a lithic or paralithic contract if one is shallower than 100 cm, or within a depth of 110 cm if the weighted average particle-size class is loamy, or within a depth of 90 cm if it is clayey.

Entic Xerochrepts

JDES **Typic Xerochrepts**

Calcic Psammentic and Calcic Xerochrepts replace Calcixerollic Xerochrepts.
We assume that Tropepts will be eliminated as that concept has for the other orders. It would be good to provide suborder consistent with the other orders, i.e. Ustepts, Udepts, Torrepts and Xerepts. The introduction of these suborders would certainly be supported in Australia. We are willing to assist in formulating and writing the definitions for the Xerepts. The following great groups are possibilities:

Natrixerepts
Calcixerepts
Haploxerepts

This introduction of Xerepts would separate dissimilar Xerochrepts into smaller groups of soils that are similar and would follow the concepts used in other orders.

MOLLISOLS

Calcixerolls p. 323

HDDA **Lithic Calcixerolls**

HDDB Other Calcixerolls that have, within 100 cm of the soil surface, one or more horizon with one or both of the following:
1. ESP (at pH 8.2) of 15 or more; or
2. SAR of 13 or more.

Sodic Calcixerolls

Haploxerolls p. 327

HDFE Vitritorrandic Haploxerolls

HDFG Other Haploxerolls that:
1. Have a calcic horizon or soft powdery lime within 150 cm of the soil surface;

and

2. Have throughout a cumulative thickness of 18 cm of more and within a depth of 75 cm, and the 0.02 to 2.0 mm fraction constitutes at least 30 percent of the less than 2 mm fraction, at leaast 5 percent volcanic glass and acid-oxalate-extractable aluminium plus 1/2 acid -oxalate-extractable iron of 0.40 percent or more.

Calcic Vitrandic Haploxerolls

HDFG Vitrandic Haploxerolls

Reletter remaining subgroups until Vermic Haploxerolls (p 330)

HDFY **Vermic Haploxerolls**
HDFZ Other Haploxerolls that have, within 100 cm of the soil surface, one or more horizons with on or both of the following:
1. ESP (at pH 8.2) of 15 or more; or
2. SAR of 13 or more.

Sodic Haploxerolls

Reletter remaining subgroups HDFZ a-b-c-d-e.

The Calcic Vitrandic Haploxeroll subgroup should key out before the Vitrandic subgroup because it is essentially a modified Vitrandic Subgroup. The subgroup accommodates soils which just fail to qualify for Vitrixerands (insufficient glass content) and Calcixerolls (not calcareous in all parts of upper horizons and\or just fail calcic horizon) yet contain abundant $CaCO_3$.

ENTISOLS

The 1990 Keys to Soil Taxonomy do not provide categories for aquic soils with sulfidic material (Sulfaquents) that have within 100 cm of the soil surface either one or more of the following horizons:
Argillic or Natric (i.e. Aqualfs with sulfidic material), Petrocalcic, Salic horizons or Sodic material. Hence, it is proposed to add Petrocalcic Salic or Sodic, Alfic Salic or Sodic, and Mollic subgroups to Sulfaquents. These new soils have formed due to recent soil development in the A

and E horizons of Alfisols (Mollic Natraqualfs) that have become waterlogged and saline due to rising saline sulfate-rich groundwaters.

Sulfaquents p. 202.

KAAA Sulfaquents that have within 100 cm of the soil surface both of the following:
1. Salic horizon, and
2. Petrocalcic horizon

Petrocalcic Salic Sulfaquents

KAAB Other Sulfaquents that have within 100 cm of the soil surface both of the following:
1. Salic horizon, and
2. Argillic horizon

Alfic Salic Sulfaquents

KAAC Other Sulfaquents that have within 100 cm of the soil surface both of the following:
1. ESP (at pH 8.2) of 15 (or more), or SAR of 13 (or more), and
2. Petrocalcic horizon

Petrocalcic Sodic Sulfaquents

KAAD Other Sulfaquents that have within 100 cm of the soil surface both of the following:
1. ESP (at pH 8.2) of 15 (or more), or SAR of 13 (or more), and
2. Argillic horizon

Alfic Sodic Sulfaquents

KAAE Other Sulfaquents that have sulfidic materials at a depth of 30 cm or more and an n value of less than 1.

Haplic Sulfaquents

KAAF Other Sulfaquents that have an A horizon that, throughout its upper 10 cm, has a color value, moist, of 3 or less and contains 0.7 % or more organic carbon, or have an Ap horizon that has a color value, moist, of 3 or less and contains 0.7 % or more organic carbon.

Mollic Sulfaquents

KAAG Other Sulfaquents.

Typic Sulfaquents

SPODOSOLS

Australian Spodosols have not been characterised well as a group, at least in Soil Taxonomy terms. There are deficiencies in morphological and chemical description. Some of these matters are being addressed, but it will take some time to cover the possible range of subgroups.

For agronomic reasons and to be consistent with other Orders, the introduction of ustic and xeric differentia could be useful. Does the Spodosol committe agree with this? Most Spodosols in Australia have developed on sandy, siliceous materials, frequently in aquic eironments, so that provision of Aquic, Arenic and Grossarenic subgroups would often be appropriate (e. g. see Merry et al., 1992).

Discussions have been held with the aim of more systematically collating data on Spodosols and broadening the base in support of modifications.

ACKNOWLEDGMENT

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APPENDIX 1.

Abstracts of four posters presented at the Australian Society of Soil Science National Soils Conference in Adelaide in April, 1992, outlining several proposed changes to Soil Taxonomy and extract from the ACLEP newsletter

Maschmedt D. J., W. H Hudnall, R. W. Fitzpatrick, D. J. Chittleborough and R. H. Merry (1992). Proposed Changes to Soil Taxonomy: I Thick sandy epipedons, carbonate and sodium enriched soils. Paper delivered at the National Soils Conference, Australian Society of Soil Science, Adelaide 1992. Book of Abstracts p.4.

PROPOSED CHANGES TO SOIL TAXONOMY: I. THICK SANDY EPIPEDONS, CARBONATE AND SODIUM ENRICHED SOILS

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The purpose of this poster is to show the relevance of Soil Taxonomy for Australian soils within the Xeric soil moisture regime and how Soil Taxonomy may be modified to accept soils for which no taxa are provided and to discuss proposed additions to accommodate Xeric soils that have a thick sandy particle-size class; secondary carbonate, exchangeable sodium or both.

Soil Taxonomy was developed to serve the purpose of soil surveys. One of the major purposes of a soil survey is to allow users to make interpretations based upon soils data, the major component being the soil mapping unit. If soil series are not used, taxonomic names may be used. It is upon this premise that Soil Taxonomy was developed and it is these attributes that make it a widely accepted international system. The attributes include: 1. Each taxa should carry the same meaning to each user, 2. The taxa should be concepts of real bodies of soil that are known to occupy geographic areas, 3. Differentiae should be soils properties that can be observed in the field or that can be inferred either from other properties that are observable in the field or from the combined data of soil science and other disciplines, 4. The taxonomy should be capable of modification to fit new knowledge with a minimum of disturbance, 5. The taxonomy must be capable of providing for all soils in a landscape and 6. The taxonomy should provide for all soils that are known. When the Keys to Soil Taxonomy were published, not all the soils in the world were known. Therefore, only the soils that were known were included in Soil Taxonomy. Thus, as new soils are mapped and mapping units are established, new taxa may be added to accommodate those soils. Such is the case for many soils in Australia that have formed under a Xeric soil moisture regime (Mediterranean climate). Ony a few subgroups were provided for the Natrixeralfs. The Xerochrepts do not contain a provision for the thick sandy epipedon nor sodic properties. Also, the Calcixerollic subgroup is too inclusive.

The following proposed taxa of Australian soils result from several known geographical occurrences: 1. A sandy particle-size class from 50 cm to 100 cm and those greater than 100 cm, 2. Secondary accumulation of calcium carbonate and 3. Soils with salts more soluble than gypsum and that have either or both: (i) ESP of 15 (measured at pH 8.2) or more or (ii) SAR of 13 or more within specified depths in the soil, proposed are to be included into Soil Taxonomy. Examples and data are included for: Arenic, Grossarenic and Calcic subgroups in the Natrixeralfs; Psammmentic, Calcic Sodic, Calcic, Entic and Sodic subgroups in the Xerochrepts.

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PROPOSED CHANGES TO SOIL TAXONOMY: II. AQUIC CONDITIONS AND SOILS WITH IRON-RICH NODULES

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This poster is one of several presentations illustrating the relevance of Soil Taxonomy for Australian soils within the Xeric soil moisture regime. Based on new information gained recently we propose to show how Soil Taxonomy may be modified to accept soils for which no taxa are provided and to discuss proposed additions to accommodate Xeric soils that have aquic conditions and contain high amounts of iron-rich nodules.

The 1990 Keys to Soil Taxonomy do not provide categories for aquic soils with sulfidic material (Sulfaquents) that have within 100 cm of the soil surface either one or more of the following horizons:
Argillic or Natric (i.e. Aqualfs with sulfidic material), Petrocalcic or Sodic horizons. Hence, it is proposed to add Petrocalcic Sodic, Alfic Sodic (or Sodalfic?) and Mollic subgroups to Sulfaquents. According to present criteria, sulfidic material may not be classified in any of the Alfisol suborders. However, in order to accommodate Alfisols that have developed sulfidic materials in their A horizons, we propose that the definition of an Alfisol should be altered to specifically exclude sulfidic materials so that they will key out as Entisols (Sulfaquents) but with argillic horizons (Alfic). The poster consists of two soil monoliths demonstrating recent soil development in the A horizon of a sodic duplex soil (Mollic Natraqualf) that has become waterlogged due to rising saline sulfate-rich groundwaters.

Duraqualfs with a Natric horizon have recently discovered near Mt Pleasant in the Mt. Lofty Ranges. No subgroups are presently assigned to Duraqualfs and for this reason Natric and Typic subgroups are considered for these soils.

A new great group is proposed to accommodate Xeralfs with high amounts of iron nodules (i.e. contain more than 10 percent by volume ranging 2 mm to 30 cm diameter throughout the upper 50 cm of the soil). We propose to call these soils Ferrixeralfs. The presence of high amounts of iron nodules in soils has the effect of reducing rooting volume, altering water flow and nutrient availability as well as having high wear rates on plough shares. Aquic, Oxyaquic, Natric, Calcic and Typic subgroups are considered for these soils.

PROPOSED CHANGES TO SOIL TAXONOMY: III. SPODOSOLS

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Soil Taxonomy has been developed principally in North America and may not discriminate Australian soils to the same degree as locally developed classifications. Spodosols are widespread in south-western Australia, south-eastern South Australia and western Victoria, Tasmania and in eastern Australia but are frequently mapped as sub-dominant soil types. Criteria have not evolved for Spodosols developed in ustic and xeric soil moisture regimes. This poster attempts to show that modification of Soil Taxonomy will better accommodate some Australian Spodosols and defines additional great groups based on soil moisture regimes.

Changes to Soil Taxonomy could include -

a) provision of a new subgroup of the Duraquods great group,

b) new great groups in the Humods suborder, the Ustihumods and Xerihumods, to follow Fragihumods and precede Haplohumods, and

c) expansion of the suborder Orthods to include Ustorthods and Xerorthods to precede Haplorthods.

Udic moisture regimes are implied for other Haplorthods and are distinct from the seasonally wet ustic and xeric soil moisture regimes.

At the subgroup level of Taxonomy, the following are proposed -

a) an Arenic subgroup to precede Aeric Duraquods,

b) Arenic, Grossarenic, and Alfic subgroups to precede Typic Durorthods,

c) Aquic, Arenic, Grossarenic, Alfic and Typic Ustorthods, and

d) Aquic, Arenic, Grossarenic, Alfic and Typic Xerothods.

These subgroups have been developed with reference to field descriptions and data for a limited number of Australian Spodosols. To institute these changes, supporting evidence is required that better defines the areal extent of the soils as well as soil description and characterization using the recent Soil Taxonomy criteria (ICOMOD Circular 10, March 1991). A clearer definition of regions of Australia with ustic and xeric moisture regimes is also required.

These new taxa have been proposed to separate those Spodosols with deep sandy A horizons, spodic horizons overlying argillic horizons and to identify soils for potential agricultural improvement depending on seasonal rainfall patterns.

PROPOSED CHANGES TO SOIL TAXONOMY: IV. ANDISOLS

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Andisols, a new order in Soil Taxonomy[a], are soils primarily developed in volcanic ash (tephra). The concept of an Andisol is that of a soil which has layers, weathered to give significant amounts of active Al and/or Fe, in the form of allophane, imogolite, ferrihydrite, or Al-humus complexes, that are 35 cm or more thick within the top 60 cm of the pedon[b]. Andisols must also have low bulk density or a specified amount of volcanic glass. We have studied a number of soils developed on Pleistocene and Holocene basaltic ash, lapilli, and scoria, commonly containing limestone and other non-volcanic fragments, in the Mount Gambier area of southeast South Australia, with the aim of classifying them in Soil Taxonomy. The soils have deep, dark, friable topsoils and low bulk densities. They are forming in a xeric moisture regime with moist, cool winters and warm, dry summers. Andisols are rarely described from such environments, allophane being predominantly associated with humid (udic) moisture regimes with strong leaching.

From a total of 14 volcanogenic pedons studied, we have provisionally classified 10 as Andisols, either Vitrixerands or Haploxerands. At the subgroup level, the soils are probably Mollic Vitrixerands or Vitric Haploxerands. However, for three of the soils, these current categories do not adequately express the high contents of $CaCO_3$ in the B horizons (24—38%) and so we propose adding two new subgroup classes to Soil Taxonomy: (1) a Calcic Vitrixerand (or Calcic Mollic Vitrixerand), a Vitrixerand (or special type of Mollic Vitrixerand) with a calcic horizon or soft powdery lime; and (2) a Calcic Vitric Haploxerand, a Haploxerand with a calcic horizon or soft powdery lime. The proposed subgroup (1) would possibly key out between Alfic and Mollic Vitrixerands, and (2) would possibly key out between Ultic Vitric Haploxerands and Vitric Haploxerands, in Keys to Soil Taxonomy[a]. Such changes require full characterization of the soils and must be submitted to the controlling body of Soil Taxonomy using a set procedure.

a Soil Survey Staff 1990. Keys to Soil Taxonomy, 4th ed. *SMSS Technical Monograph* 19.
b Parfitt, R.L.; Clayden, B. 1991. Andisols — the development of a new order in Soil Taxonomy. *Geoderma* 49: 181-198.

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