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Development of a Digital Data Base for Reflectance-Related Soil Information

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The soil characteristics in the identification record include (see Table 1)

- 1) taxonomic information,
- 2) sampling site descriptions,
- physical measurements,
- 4) chemical measurements, and
- 5) engineering measurements.

The spectral observation parameters in the identification record include (see Table 2)

- measurement geometry characteristics,
- 2) meteorological conditions,
- 3) instrument parameters.

In addition there are other data base variables that are free to be assigned by the researcher for parameters that are needed for his experiment but are not included in the basic set given in Tables 1 and 2.

The data base allows for a wide range of soil measurements, site information, and spectral observations parameters. However, it is not required that all of the measurements be made for a given observation to 'fill up' the identification record. Also some of the information of the identification record is coded so that it can be used by computer programs. 1

The spectral information in the data base may be that collected by a continuous

scan spectroradiometer or a multiband radiometer. It is possible to include spectral information from the reflective 0.4-2.4 μm , and/or emissive, 4.0-15.0 μm , portions of the electromagnetic spectrum. Generally, the reflective data will be in units of spectral bidirectional reflectance factor and the emissive data, if included, will be in units of spectral radiance.

The initial data included in the data base are spectroradiometric properties and physical, chemical, engineering and site information for 500 soil samples from 39 states of the United States, as well as Brazil, Costa Rica, Sudan, Spain, and Jordon (Table 3). The astericks in Table l indicate the physical, chemical, engineering and site information available for the 500 soil samples. The instrument that was used to collect the spectral data for the soils data base is the Purdue/LARS Exotech 20C circular variable filterwheel spectroradiometer system. The spectral data from the 500 soil samples covers the spectral range from 0.5 to 2.3 μm and was processed into units of spectral bidirectional reflectance factor.

IV. DATA BASE ACCESS

The LARSPEC software system is available for researchers using the Purdue/LARS computer facility to retrieve and manipulate the soils information in the data base.² The software system allows

Table 1. Soil characteristics and descriptions that may be included in the data base.

Taxonomic	Site	Physical
Information	Characteristics	Characteristics
*Order *Suborder *Great group *Subgroup name *Particle size class *Contrasting particle size class *Mineralogy class *Temperature regime *Other modifers	*Soil series name *Horizon designation *Moisture regime *Drainage class *Slope class *Erosion phase *Physiographic position *Parent material *Soil elevation *Natural vegetation or crop *Site location	*Soil moisture tension *Water content Bulk density *Munsell color (moist) *Textural class designation *USDA particle size distribution sand content silt content clay content very coarse sand coarse sand medium sand fine sand very fine sand coarse silt fine silt Electrical conductivity *Erosion factor *Wind erodibility group

1

Table 1. Soil characteristics and descriptions that may be included in the data base (con't.).

Chemical Characteristics	Engineering Characteristics
*Organic carbon	*Liquid limit
Water pH	*Plastic limit
Buffer pH	*Plasticity index
*Extractable bases:	*Activity
calcium	*Liquidity index
magnesium	*Shrinkage limit
sodium	*Shrinkage ratio
potassium	*Volumetric shrinkage
extractable acidity	*Linear shrinkage
cation exchange capacity	*Compression index
base saturation	*ASTM particle size distribution:
*Iron oxide	medium sand
Aluminum oxide	fine sand
Manganese dioxide	fines
Silicon dioxide	*Specific gravity
*Available phosphorus	*AASHO soil classification
*Available potassium	*Unified soil classification

Table 2. Spectral observation parameters that may be included in the data base.

Measurement Geometry Characteristics	Meteorological Conditions	Instrument Parameters
Location name	Air temperature	Instrument name
Latitude	Wet bulb temperature	Scan rate
Longitude	Barometric pressure	Focal distance
Flightline	Relative humidity	Field of view
Illumination source	Cloud cover	Detector name
Irradiance zenith angle	Cloud type	Gain setting
Irradiance azimuth angle	Wind speed	Filter setting
View zenith angle	Wind direction	Facility operating instrument
View azimuth angle Distance to ground Date & time spectral data collected	Visibility	Data quality values

researchers to print, graph, and copy the soil information as the researcher requires.

The identification information may be printed as illustrated in Figure 1. Graphical displays of the spectral curves or functions of the spectral are possible on an electrostatic printer-plotter (Figure 2) or line printer type output devices. Scattergrams of the identification information and/or spectral data and simple correlation analyses allow researchers to initiate statistical analyses of soils data (Figures 3-4). The soil data may also be copied to other storage formats, such as cards, to be used by

other statistical analyses software packages.

The soil information in the data base is also available to researchers who do not have access to the Purdue/LARS computer facility. The Laboratory for Applications of Remote Sensing at Purdue University should be contacted for information about obtaining the data.

Table 3. Distribution of initial soils in data base relative to geographic extent of these soils.

	soil samples in data base		United States extent
Soil order	number	percent of U.S. soils	percent
Mollisol	146	30.4	24.6
Alfisol	80	16.7	13.4
Entisol	78	16.2	7.9
Aridisol	50	10.4	11.5
Ultisol	44	9.2	12.9
Inceptisol	36	7.5	18.2
Spodoso1	30	6.2	5.1
Vertisol	8	1.7	1.0
Histosol	8	1.7	0.5
Oxisol (non-U.S.)	4	-	<0.02
Not specified (non-U.S.)	35	-	-
Total	519		

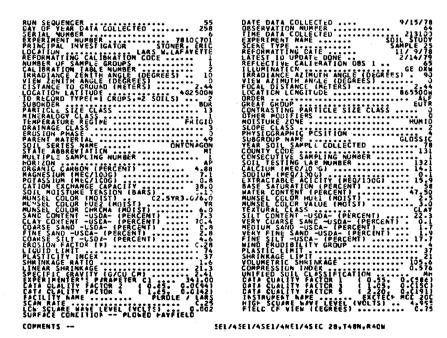


Figure 1. Example of the identification information available for each soil sample.

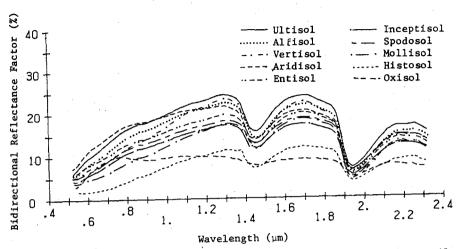


Figure 2. Reflectance spectra of 484 soil samples averaged by soil taxonomic order (see Table 4).

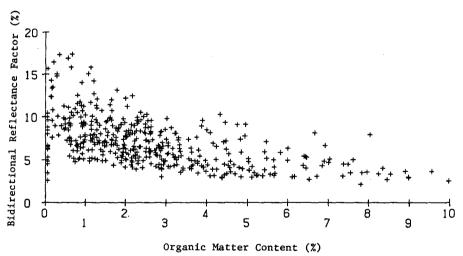


Figure 3. Graphical display of reflectance in the 0.52-0.62 μm wavelength band plotted as a function of organic matter content of 480 U.S. soil samples containing less than 10% organic matter.

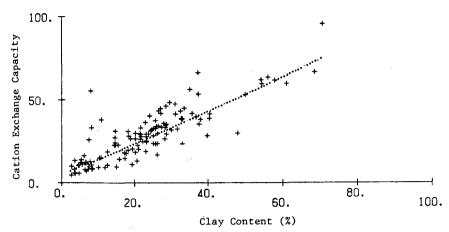


Figure 4. Graphical display of cation exchange capacity plotted as a function of clay content for 128 U.S. soil samples from the subhumid moisture zone.

V. ACKNOWLEDGEMENTS

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