UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Northeast NTC
CHESTER, PA 19013

SUBJECT: Ground-Penetrating Radar (GPR) Evaluation of Claypans at MSEA Sites

DATE: 22 May 1991

To: Russell C. Mills
State Conservationist
USDA-Soil Conservation Service
555 Vandiver Drive
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Purpose:
To evaluate the potential of using GPR for characterizing the depth to the subsoil in Missouri clasp soils.

Participants:
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Activities:
I departed Chester, Pennsylvania, on 1 May and travelled by to Columbia, Missouri. I arrived in Columbia during the afternoon of 2 May 1991. Field studies were conducted at the MSEA sites near Centralia, and Kingdom City, Missouri, on 3 May 1991. I departed Columbia for Fort Collins, Colorado, on 4 May 1991.

Equipment:
The ground-penetrating radar unit used in this study is the Subsurface Interface Radar (SIR) System-8 manufactured by Geophysical Survey Systems, Inc. [1]. Components of the SIR System-8 used in this study were the model 4800 control unit, ADTEK SR 8004H graphic recorder, ADTEK DT 6000 tape recorder, power distribution unit, transmission cable (30 m), and the models 3205 (500 MHz) and 3110

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1. Use of trade names in this report is for identification purposes only and does not constitute endorsement by the author or SCS.

(120 MHz) antennas. The system was powered by a 12-volt vehicular battery.

Discussion:
Inclement weather and wet field conditions hindered field activities at both sites. The 500 MHz antenna was used at the Centralia site while the 120 MHz was used at the Kingdom City site. The range of the GPR was set at 60 nanoseconds. Soils profiled with the GPR included Adco (fine, montmorillonitic, mesic, Albaquic Hapludalfs) and Mexico (fine, montmorillonitic, mesic, Udollic Ochraqualfs). Assuming a dielectric constant of 19 (for wet, loamy soils), the GPR profiled to an estimated depth of about 2 meters. However, radar imagery was restricted to the upper part of the argillic horizon. Because of rapid rates of signal attenuation, no soil features were apparent below the upper boundary of the argillic horizon.

Despite the limited profiling depth, the GPR can be used to map the depth to the argillic horizon across landscape components. In addition, the GPR techniques can be used to study variations in physical properties across the surface soil/subsoil interface.

The enclosed figures demonstrate how the RADAN software program translate the amplitude values of the reflected signals to color indices. Generally, interfaces which separate soil horizons that are abrupt or strongly contrasting will produce reflected signals having high amplitudes. In the enclosed figures, both the positive and negative pulses have been printed. Signals of higher amplitudes are in shades of blue and green while signals of lesser amplitudes are in shades of yellow and pink. Reflections from the soil surface AND near-surface layers have been identified and labelled in the second figure. The image of the argillic horizon is immediately below the image labelled "near surface reflection".

Recommendations:
The radar successfully mapped the depth to the upper boundary of the subsoil. Participants felt that this study should be continued during a drier time of the year after crops have been harvested (October or November). Grids would be established by EARS personnel across several representative sites and the depth to the argillic horizon mapped with the GPR. In addition, radar profiles would be analyzed with the RADAN software package to assess variations in soil physical properties existing in the surface layers and at the interface of the subsoil. RADAN software enables the analysis of variations in signal amplitudes associated with changes in soil properties. This analysis should be supported by characterization of some physical properties (texture, bulk density, compaction) of the surface layers and the subsoil at selected radar observation sites.

With kind regards.

James A. Doolittle

Soil Specialist

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