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PALEOSOLS IN PENNSYLVANIA

by

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INTRODUCTION

In recent years, the study of paleosols has accelerated both in the fields of Soil Science and Geology. Thus, it is appropriate at this time to present a brief introductory report on the occurrence of paleosols in Pennsylvania.

DISCUSSION

Definition

The word paleosol is derived from Greek (palaio-ancient) and Latin (solum-soil) roots (Ruhe, 1965) and literally means ancient soil. Ruhe's (1965, 1975) definition of the term paleosol and its three types (relict, buried and exhumed) is most often cited as the standard definition. Although this is the case, some parts of his definition are vague and the rewording of his definition by Hawley and Parsons (1980) is more acceptable. This definition is as follows: A paleosol is a soil that formed on a landscape of the past with distinctive morphological features resulting from a soil-forming environment that no longer exists at the site. The former pedogenic process was either altered because of external environmental change or interrupted by burial. A paleosol may be classed as:

(a) A relict paleosol if it has persisted on a land-surface without major alteration of its morphology by processes of the prevailing pedogenic environment (climate, vegetation, topography).

(b) A buried paleosol if it has been covered by materials such as loess, glacial till, alluvium, or colluvium.

(c) An exhumed paleosol if it was buried and has been re-exposed by erosion of the covering mantle.

Most paleosols have been affected to some degree by modification of their horizon morphology and/or by profile truncation. Paleosols can vary in age

from Pre-Cambrian (3.1 billion years B.P.) to Holocene (<10,000 years B.P.) (Retallack, 1986). They also can be unconsolidated or lithified. Lithified paleosols are usually fairly old and have gone through deep burial and diagenesis.

According to Ruellan (1971), not all old soils are paleosols. He contends that an old soil is not a paleosol if all of its characteristics are the result of soil formation which has taken place in the same type of environment that exists at the site today. In a more radical approach, Fenwick (1985) would limit the concept of a paleosol to soils isolated from the present pedogenic processes by reason of burial. Fenwick takes this position for all except recent soils because he argues that climatic change has imparted characteristics to soils from older different climates that no longer exist at the soil site today.

In this presentation, Ruhe's concept of paleosols as modified by Hawley and Parsons (1980) will be used. Although this will be the case, Fenwick's concerns on the recognition and interpretation of relict paleosols are well taken.

Occurrence

Exhumed Paleosols

To the authors' knowledge, there are no significant areas of unconsolidated exhumed paleosols in Pennsylvania. This statement is more difficult to make for lithified paleosols. In this case, the lithified paleosols as they become disaggregated, contribute to the new soil forming on the landscape, but their effect is difficult to sort from present pedogenetic properties. An exception to this statement may be the large area of underclays found beneath coals which Gardner et al. (1988a) have interpreted as paleosols.

Buried Paleosols

Table 1 gives the occurrence of various kinds of buried paleosols in Pennsylvania, and Figure 1 gives their location. These buried paleosols vary from Ordovician (Retallack, 1986) to Holocene (Bilzi and Ciolkosz, 1977) in age, and can provide significant information on the past climates and possible geomorphic history of Pennsylvania. In this paper no attempt will be made to evaluate this situation. This effort will be deferred to a future discussion of Pennsylvania paleosols, with the exception of the following comment. It may not be appropriate to call all buried soils paleosols. In particular, buried soils on recent floodplains. These soils are usually within the present soil forming environment; although, a case can be made that the A horizon is no longer accumulating organic matter, thus the organic matter is not in environmental equilibrium.

Relict Paleosols

These type of paleosols are difficult to identify. If we accept that the last interglacial period (Sangamonian) was much warmer and drier than today (Flint, 1971), then all soils older than Wisconsinan are probably relict paleosols. This assumption presents an interesting situation, that requires an evaluation of what soils in Pennsylvania are Pre-Wisconsinan in age. This issue is made even more challenging with the recent report by Eyles and Westgate (1987) which indicates that no Altonian (early Wisconsinan) glacial ice entered Pennsylvania. Thus, the benchmark Altonian soil development report by Levine and Ciolkosz (1982) may be in error, and their Altonian age soils may be of Pre-Wisconsinan age. This subject is also beyond the scope of this paper, and will be deferred to a future presentation.

Table 1. Location and References for Pennsylvania Buried Paleosols (See Figure 1 for general location).

Code#	USGS 7 1/2' Quadrangle* and/or General Location	Source or Reference and Remarks
Colluvium		
C-1	Port Matilda*; 1/4 mile E of US 322 US 220 junction on side slope of Bald Eagle Mt.	Hoover (1983)
C-2	Centre Hall*; 1 1/2 miles SW of Potters Mills on the sideslope of Tussey Mt.	Hoover (1983)
C-3	Newton Hamilton*; 3/4 mile SW of Airydale on the sideslope of Jacks Mt.	Hoover (1983)
C-4	Rainsburg*; 8 miles SW of Bedford on the side-slope of Wills Mt.	Hoover (1983) soil Pedon 5-31+
C-5	Newton Hamilton*; 5 miles NE of Mill Creek on Pa 655	Cunningham et al. (1974) Murrill soil pedon 31-28+
C-6	Mingoville*; 250 feet NE of Junction of Pa 550 and 64	Cunningham et al. (1974) Murrill soil 14-29+
C-7	Everett East*; 2 1/2 miles N of Everett on Pa 26	Soil Char. Lab (1980) soil pedon 5-30+
C-8	New Enterprise*; 3 miles E of Imler	Soil Char. Lab (1980) soil pedon 5-33+
C-9	Tremont*; 3/4 mile S of Fountain on Highway 53030	Ciolkosz et al. (1979) Meckesville soil pedon 54-8+
C-10	Palmerton*; Borrow pit on Route 39056 in the Lehigh River water gap on the sideslope of Blue Mt.	Ciolkosz (1971)
C-11	Mifflinburg*; 1 1/2 miles NE of Forest Hill, on sideslope of Seven Notch Mountain	Ciolkosz (1987)
C-12	Various locations in North Central Pennsylvania	Waltman (1985)
C-13	Jersey Shore*; 3/4 mile E of McElhattan in the Landfill	Ciolkosz (1981)
C-14	Various locations in North Central Pennsylvania (Potter County)	Denny (1956)

Table 1. Location and References for Pennsylvania Buried Paleosols (See Figure 1 for general location). (cont'd.)

Code#	USGS 7 1/2' Quadrangle* and/or General Location	Source or Reference and Remarks
Drift/Drift		
D-1	Muncy*; 2 miles W of Muncy	Soil Char. Lab (1974a) Lawrenceville soil pedon 41-48+ (same pedon listed under L-3)
Flood plains		
F-1	State College*; 0.5 mile W of Houserville on Spring Creek floodplain	Bilzi and Ciolkosz (1977) Nolin soil
F-2	Centre Hall*; 1 mile W, 0.5 mile S of Potters Potters Mills on Sinking Creek floodplain	Bilzi and Ciolkosz (1977) Philo soil
F-3	Mifflintown*; 1 mile E of Mifflintown on old US 322	Bilzi and Ciolkosz (1977) Rowland soil
F-4	Swatara Hill*; 2 miles E of DeTurksville along Pa 443	Bilzi and Ciolkosz (1977) Atkins soil
F-5	Manheim*; 0.5 mile SE of Masterville (36-33) and 1 mile E of Masterville (36-32) on Brubaker Creek floodplain	Rowland soil pedons 36-32+ and 36-33+
F-6	Port Matilda*; in the village of Port Matilda and numerous locations SW in stream banks on the floodplain of Bald Eagle Creek	Ciolkosz (1980) Pote and Philo soils
Grezes Litees/Grezes Litees (Shale chips)		
G-1	Roaring Springs*; 2 miles N of Claysburg in shale borrow pit	Ciolkosz (1987) et al. (1988b)
G-2	Meadow Grounds*; 2 miles S of Harrisonville on Pa 665	Ciolkosz (1975)
Loess/Drift		
L-1	Muncy*; 2 miles W of Muncy	Soil Char. Lab. (1974a) Duncannon Soil Pedon 41-23+
L-2	Muncy*; 2 miles W of Muncy	Soil Char. Lab. (1974a) Duncannon Soil Pedon 41-19+
L-3	Muncy*; 2 miles W of Muncy	Soil Char. Lab. (1974a) Lawrence-ville Soil Pedon 41-18+ (same Pedon listed under D-1)

Table 1. Location and References for Pennsylvania Buried Paleosols (See Figure 1 for general location). (cont'd.)

Code#	USGS 7 1/2' Quadrangle* and/or General Location	Source or Reference and Remarks
Loess/Drift		
L-4	Jersey Shore*; Adjacent to reservoir within the city of Jersey Shore	Soil Char. Lab. Duncannon Soil Pedon 41-22+
L-5	Slippery Rock*; 3 miles N of Slippery Rock in road cuts	Ciolkosz (1982)
Rock (lithified)		
R-1	Spring Mills*; 2 miles E of Potters Mills on US 322	Retallack (1986) Potters Mills Paleosol
R-2	Palmerton*; N end of Lehigh River water gap	Ratallack (1986) Lehigh Gap Paleosol
R-3	14 locations in central and eastcentral Pennsylvania	Gray and Nickelsen (paper in review)
R-4	Various locations in Central Pennsylvania	Gardner et al. (1988a)
R-5	Various locations in Central Pennsylvania	Williams (1985)
Sand/Drift or Terrace		
S-1	Muncy*; 3 miles N of Watsontown	Soil Char. Lab (1974b) Sandy Allenwood Soil Pedon 49-10+
S-2	Jersey Shore*; 1 mile SE of Jersey Shore	Soil Char. Lab (1974a) Sandy Allenwood Soil Pedon 41-24+
S-3	Northumberland*; 1 1/2 miles S (49-13) and 2 miles N (49-12) of Montandon	Soil Char. Lab (1974b) Plainfield Soil Pedons (49-12, 49-13)

+Pennsylvania State University Soil Characterization Laboratory soil pedon number.

C = Colluvium; D = Drift; F = Floodplain; G = Grezes Litees (shale chip deposit); L = Loess; R = Rock (lithified); S - Sand.

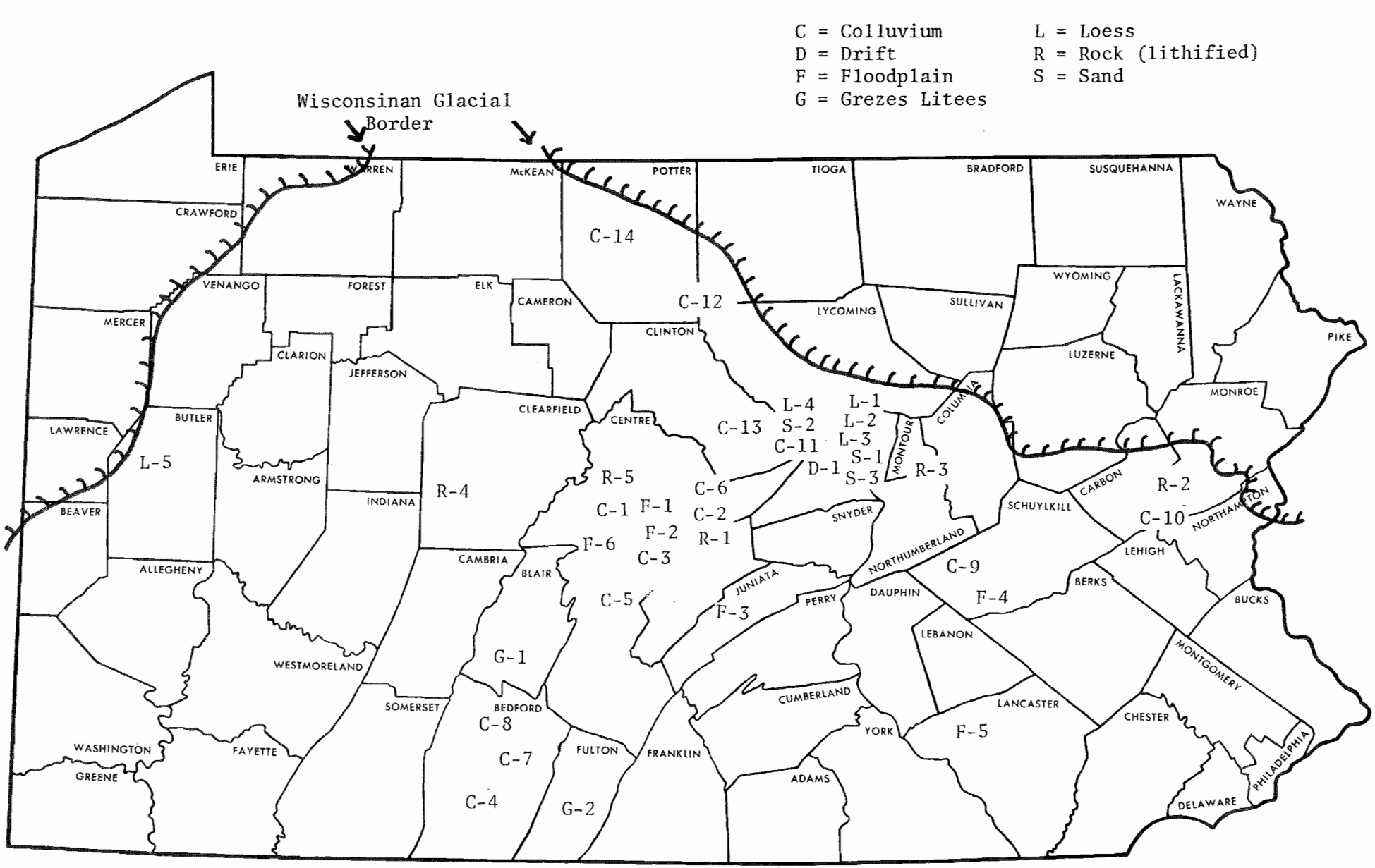

Figure 1. General location map of buried paleosols in Pennsylvania (see Table 1 for additional location information).

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