Soil Development and its Relation to the Ages of Morphostratigraphic Units in Horry County, South Carolina

U.S. GEOLOGICAL SURVEY BULLETIN 1589–B

Prepared in Cooperation with the U.S. Department of Agriculture, Soil Conservation Service

Chapter B

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By H. W. Markewich, M. J. Pavich, M. J. Mausbach,
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Soil profiles developed in 200-ka and 2.5- to 3.0-Ma barrier and back-barrier deposits have been analyzed texturally, mineralogically, and chemically to identify processes active in weathering and pedogenic alteration of parent material

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PREFACE

Some geologic investigations of Quaternary deposits, especially in the conterminous United States, have attempted to use relative degrees of weathering and soil formation to establish chronosequences of glacial and (or) fluvial landforms. Most studies have been in the glacial terrane of the midcontinent and the Western United States. Few such studies have been conducted in the Eastern United States, especially in the unglaciated Middle Atlantic and Southeastern States.

From 1979 to 1984, the U.S. Geological Survey and the U.S. Department of Agriculture's Soil Conservation Service conducted cooperative regional studies of the relations between soils and geology in the Middle Atlantic and Southeastern States. The primary goal of these studies was to determine if soil properties could be used to estimate ages of associated landforms. Deposits associated with marine and fluvial terraces for this study and for previous geologic investigations were sampled for age determinations by isotopic analyses; these ages were then related to biostratigraphy and regional rock-stratigraphic correlations. Specific site investigations were conducted on Pliocene to Holocene marine and fluvial terraces in the Atlantic and eastern Gulf Coastal Plains and the Appalachian Plateau. Soils on granite, schist, and quartzite parent rocks of the Appalachian Piedmont were sampled to test the use of soil properties as indicators of soil age. Each chapter of this bulletin series examines the relation of soils to geology in a specific geographic area.

The cooperative study involved research scientists from both agencies and field personnel from State offices of the Soil Conservation Service. Responsibility for sample analysis was divided between the Department of Agriculture's National Soil Survey Laboratory in Lincoln, Nebr., and the U.S. Geological Survey in Reston, Va. This report was prepared by scientists from both agencies who participated in specific site investigations or in studies of pedogenic processes.

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Soil Development and Its Relation to the Ages of Morphostratigraphic Units in Horry County, South Carolina

By H. W. Markewich,[1] M. J. Pavich,[2] M. J. Mausbach,[3] B. N. Stuckey,[4] R. G. Johnson,[2] *and* Virginia Gonzalez[2]

Abstract

Soils of the lower Coastal Plain in Horry County, South Carolina, were sampled to determine whether their chemical, mineralogical, and morphological properties are related to soil age. These soils have developed on marine barrier and back-barrier deposits that paleontological data indicate are 200 ka (Conway and Jaluco barrier systems) and 2.5 to 3.0 Ma (Horry barrier system). These three barrier systems are the major morphostratigraphic units of barrier systems present on the southern limb of the Cape Fear Arch, which has affected deposition and deformation of Coastal Plain sediments at least since the Cretaceous. The late Cenozoic tectonic history of the arch is not known in detail, but previous studies have suggested regional uplift throughout the Neogene. The present topographic positions of barriers and back barriers are due to either eustatic changes in sea level, regional uplift, or a combination of the two.

Barrier deposits consist predominantly of well-sorted, fine-grained and very fine grained quartzose sand; interbeds of sandy clay and clay range from less than 1 to 5 m thick. Barriers of the Horry system have crest heights of 30 to 40 m, the Conway barrier reaches a maximum altitude of 17 m, and the Jaluco barriers have heights up to 12 m. The preserved topography is similar on all barriers. The Horry barrier system is somewhat more dissected and is more deeply incised than the Conway or the Jaluco barrier systems. Carolina bays are ubiquitous on the sandy surfaces of the barrier systems. Humates (or spodic horizons) are present within many of the barrier sands and are almost always associated with Carolina bays.

Field descriptions of Horry back-barrier soils indicate argillic horizon thicknesses ranging from 60 to 90+ cm. Textural and microfabric data indicate that many of these soils have argillic horizons thicker than 150 cm. These soils are therefore considered to be Paleudults, whereas soils on the Conway and Jaluco back barriers are Hapludults. Well-drained barrier soils of the Horry, Conway, and Jaluco systems all classify as Hapludults. Soils developed on the 200-ka Conway and Jaluco systems are similar both physically and chemically to those developed on the 2.5- to 3.0-Ma Horry barrier system. Data indicate that soils on the Horry barrier system have bisequal development; our samples were from the surface horizons only and do not represent the full profile.

Two sample sites were near or on the rims of Carolina bays on terraces of the Little Pee Dee River. The differences in dominant grain size and sorting of the parent material preclude a direct comparison of soils developed on barriers with those developed on Carolina bays. The characteristics of Carolina bay soils, however, appear to be more like those of the Conway and Jaluco barrier soils than the Horry barrier soils. By inference, then, soils associated with the Carolina bays are apparently nearer 200 ka than 2.5 to 3.0 Ma.

All the soils developed on the Horry, Conway, and Jaluco barrier systems and on Carolina bays have an accumulation of low-charge hydroxyinterlayer dioctahedral vermiculite in the upper parts of their profiles; kaolinite dominates the lower horizons and the parent material. Gibbsite and goethite as well as quartz are present in the clay-sized fractions. Halloysite is present in soils of each age that have significant Bt horizons. Although halloysite appears to be an indicator of in situ development of clay, its presence or absence seems to be associated more with drainage conditions than with the ages of sola.

Only a few pedogenic parameters were found to be useful for estimating soil and surface ages. The position of Bh or spodic horizons within the profile may indicate differences in profile ages, but not enough is known about the origin of spodic horizons to allow their use for age determination. The thicknesses of sola and argillic horizons and the mineralogies of the <2-μm fractions all show trends with increasing age, but they also are related to drainage, as the soils containing high percentages of medium-grained to very coarse grained sand illustrate. The lack of thick argillic horizons in the barrier sands may be the combined result of excessive drainage, little inherited clay, and a small percentage of weatherable minerals. Microfabric analysis of back-barrier profiles proved to be the most reliable indicator of the depth and degree of sand, silt, and clay translocation and may prove reliable for estimating soil age.

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INTRODUCTION

Purpose and Scope

Soils and weathering profiles in Horry County, South Carolina, were studied as part of a regional investigation of the relations between geomorphic surfaces of late Cenozoic age and associated soils and weathering profiles in the Southeastern United States. The lower Coastal Plain of South Carolina (fig. 1) was selected as an initial study area because sufficient stratigraphic data are available to establish the ages of the marine-barrier and back-barrier deposits on which study sites were located. Soils were sampled from 200-ka and 2.5- to 3.0-Ma barrier systems. Two study sites were on the rim area of Carolina bays developed on a terrace of the Little Pee Dee River. The ages of Carolina bays have not been determined, but evidence suggests that they may be between 60 and 120 ka (Markewich, 1985).

Soil horizon designations and descriptive terminology used in this report follow the Soil Survey Manual (Soil Survey Staff, 1981). Microfabric terminology follows Brewer (1976).

The goal of this project was to assess the usefulness of soil- and weathering-profile data (both physical and chemical) in establishing the ages of land surfaces in the Southeastern United States. Specific objectives in Horry County included comparing barrier and back-barrier deposits to gain a more complete understanding of processes involved in soil formation. Of particular interest was the study of pedogenic processes active in soil formation in very sandy siliceous parent material in humid-temperate to subtropical environments. The effects of poor internal drainage on pedogenic processes were also studied.

Physical and chemical analyses of the soil and weathering profiles are presented in tables 3 through 16. These data are compared with published data from Horry County and from sediments of similar age in southeastern Virginia to determine if such data can be used to estimate ages of constructional landforms in the Southeastern United States. We suggest that the texture of parent material and the position of the local water table determine the course of soil development, and we discuss the evidence for in situ development of clay from alteration of aluminosilicate minerals and from authigenesis within argillic horizons.

Previous Work

The late Cenozoic history of the Coastal Plain of North and South Carolina in the area of the Cape Fear Arch has been of interest to researchers since the late 1800's. Dall and Harris (1892) contributed to the stratigraphic framework of upper Miocene and Pliocene units in the Atlantic Coastal Plain. Most of the investigations in this region after 1940 were concerned with bivalve biostratigraphy of the Pliocene and Pleistocene marine beds. Results of paleontological investigations have been presented by DuBar and Chaplin (1963), DuBar and Howard (1963), DuBar (1971), DuBar and others (1974a, b, 1980), Ward and others (1978), and Blackwelder and Ward (1979). Hazel (1971, 1977, 1983) and Cronin and Hazel (1980) determined ages and correlation of the Pliocene and lower Pleistocene of Virginia and North Carolina by using ostracode biostratigraphy. Cronin (1980) and Cronin and others (1984) summarized the correlation of Pleistocene marine deposits and sea levels of the Southeastern United States by using ostracode taxa and concurrent ranges and published planktic, paleomagnetic, and radiometric data. Oaks and DuBar (1974) tentatively correlated all post-Miocene units in the Atlantic Coastal Plain south of Virginia. Mixon and others (1982) evaluated the uranium series dating of mollusks and corals in the Chesapeake Bay region; their observations are applicable to other isotope ages from the Atlantic Coastal Plain.

MacNeil (1950) referred to Flint's (1940) excellent summary of the work by "McGee, Darton, Shattuck, Salisbury and Knapp, Wentworth, Campbell, and Cooke" on Pleistocene sediments of the Atlantic Coastal Plain. Cooke (1930, 1931, 1936, 1937, 1945; Cooke and MacNeil, 1952) can be credited with establishing the terrace concept of mapping the Pliocene and Pleistocene deposits of the Atlantic Coastal Plain. His model of seven terraces, each corresponding to a high stand of sea level, has dominated geologic investigations in this region for more than half a century. Cooke was opposed by many, but the most direct rebuttal came in 1940 from Flint, who claimed that there were only two or three recognizable marine scarps in the lower Coastal Plain and therefore only two or three terraces. Flint did not actually accept the concept of terraces, which he felt were not mappable with any degree of certainty by using concordant altitudes. Cooke thought that Flint's definition was too rigid, and he added a possible eighth terrace to his model (Cooke, 1945). Doering (1960) revised Cooke's model and brought some gulf coast terminology into the Atlantic Coastal Plain. Many of Doering's ideas, especially concerning age and correlation of the highest terraces, influence present work in the region.

Despite differences in the number and origin of terraces on the Atlantic Coastal Plain, each investigation considered terraces to correspond to high stands of sea level during interglacial periods. Explanations for the association of increased altitude with increased terrace age varied between successively lower sea-levels stands, continual uniform regional uplift of the southeastern Atlantic coast during the Pliocene and Pleistocene, or a combination of both. Doering (1960), Daniels and others (1966), Thom (1967a, 1970), Daniels and Gamble (1974, 1978), Harris and others (1979), and, more recently, Cronin (1981), Soller (1983), and Markewich (1985) all discussed the geomorphology and late Cenozoic tectonics of the Coastal Plain in the area of the Cape Fear Arch, but most of the areas of interest were in the middle and upper Coastal Plain of North Carolina. Only

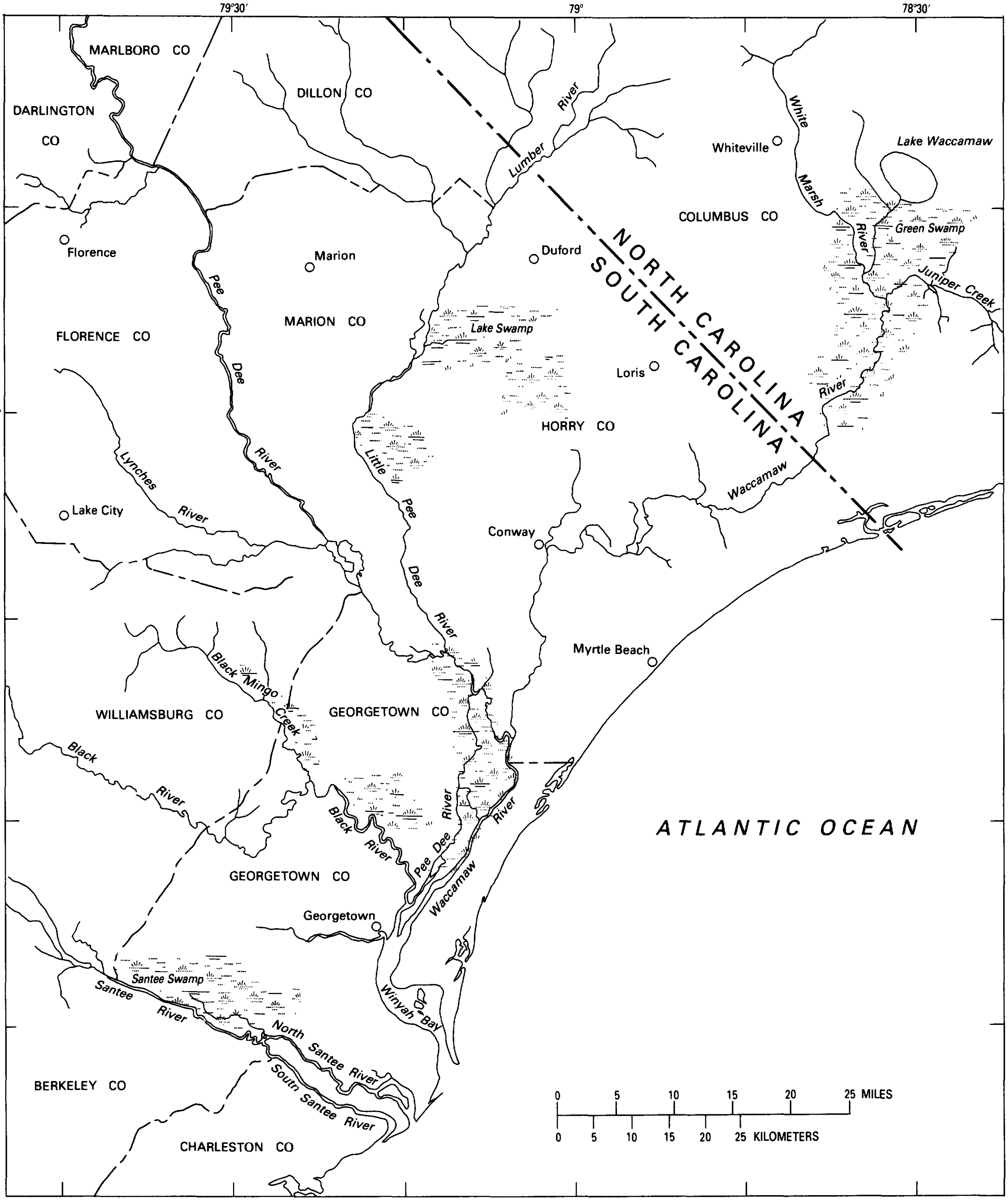


Figure 1. Horry County, South Carolina, study area.

Johnson and DuBar (1964) and Thom (1967a, 1970) were interested in the geomorphology of Horry County and other areas on the southern limb of the Cape Fear Arch. No data on late Cenozoic tectonic activity are available for the area in and around Horry County, but Winker and Howard (1977) suggested that the Cape Fear Arch has been an active

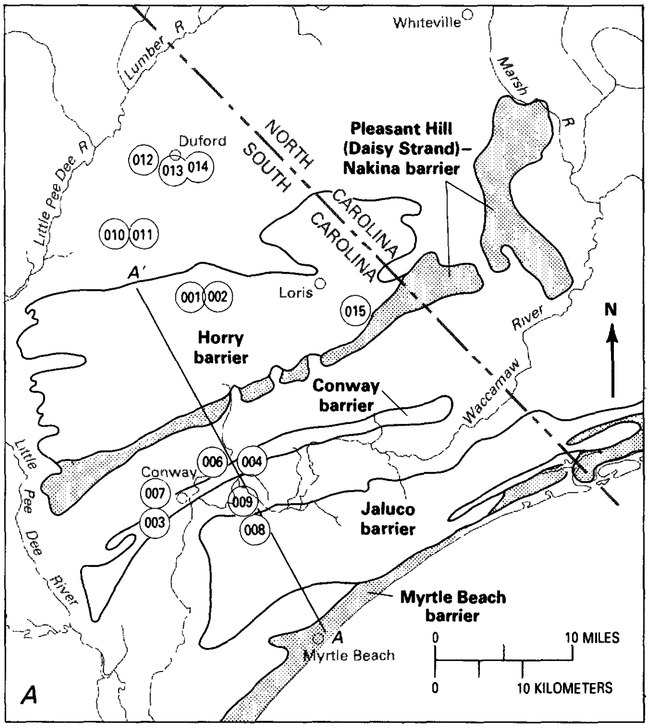


Figure 2*A*. Morphostratigraphic units of Horry County, South Carolina (modified from DuBar, 1971, p. 6). Site locations are identified by the last three digits of their pedon numbers. Location of cross section on figure 2*B* is shown by line A–A′.

feature throughout the Pliocene and Pleistocene and that all but the youngest marine terraces are warped upward in the area of the arch.

Thom (1967a, 1970) discussed the geomorphology of fluvial and marine features in Horry and Marion Counties, South Carolina, and of the ubiquitous Carolina bays. Thom's (1967a) report is particularly relevant to this study. His data on the age and depth of weathering of the fluvial and marine units of Horry County, coupled with the stratigraphic control provided by DuBar and others (1980) and by the unpublished data of J. P. Owens, provided the geologic framework necessary to attempt an investigation into the variations in degree and type of weathering and soil development within this region.

Daniels and others (1971, 1978b) first suggested that marine and (or) fluvial surfaces in the North Carolina Coastal Plain have remained essentially unmodified since their formation. For many of the surfaces, the time intervals involved are 3 to 5 Ma. Many of the soils on these surfaces have developed without interruption over these time intervals. Gamble (1965) and Gamble and others (1970) investigated the origin of the sandy surficial horizons associated with many of the upper and middle Coastal Plain soils in North Carolina. These soils, which occur throughout the Coastal Plain of the Atlantic and Gulf Coast States, are developed on parent material estimated to be as young as middle Pliocene and have surface horizons 1 to 3 m thick. Thom (1967a) suggested that soil profiles developed in barrier sands as young as late Pleistocene in age can have 0.5- to 1.0-m-thick sandy surface horizons that contain micropodzolic or bisequal profiles.

Although there is a great deal of literature on the processes involved in podzolization and the formation of Ultisols, very little data are available on soil chemistry, soil physics, clay mineralogy, or soil genesis of the Ultisols in the Coastal Plain of South Carolina (Coleman and Jackson, 1945; McCollum and McCaleb, 1954). Ingram and others (1959) discussed the clay mineral assemblage found in some of the Carolina bays. Bryant (1965) provided detailed descriptions and some analyses of soils associated with Carolina bays in Scotland County, North Carolina, about 80 km northwest of Horry County, South Carolina. Malcolm (1964) investigated the interactions between mobile soil organic matter, clay minerals, and sequioxides in several Carolina soils. Swanson and Palacas (1965) analyzed humate in the coastal sands of northwestern Florida, and Daniels and others (1976) studied humate within the zone of pedogenic modification in the Coastal Plain of North Carolina. Thom (1967b) discussed the relations between humate and coastal geomorphology of northeastern South Carolina. He concluded that the elliptical features called Carolina bays that are ubiquitous on the land surface of Horry and Marion Counties, South Carolina, formed where humate had developed, but he did not present any data on age(s) or origin of humates or on the chemical processes involved in their formation.

Geographic Setting

Horry County (fig. 1) is the northeasternmost county in South Carolina and is bordered on the east by the Atlantic Ocean, on the north by North Carolina, and on the west and south by the Little Pee Dee and the Pee Dee Rivers. Thom (1967a) has discussed in detail the agricultural and botanical history of the area, which was first settled in the early 1700's and has been agriculturally active ever since. Horry County is in the Coastal Plain physiographic province of Fenneman (1938) and in the "lower Coastal Plain" physiographic subprovince as defined by Colquhoun (1969, p. 3), "a surface that is dominantly one of primary topography." Altitudes in the county range from sea level to about 33 m. Maximum relief is 15 m. Most of the constructional landforms are marine in origin and were formed when relative sea level was higher than it is at present. The majority of ancient barriers, spits, and back-barrier flats are parallel or subparallel to the present coast (fig. 2) and have been modified only slightly by erosion.

Geologic Setting

Horry County is located on the southwestern limb of the Cape Fear Arch (or the Carolina Arch as defined by Dall

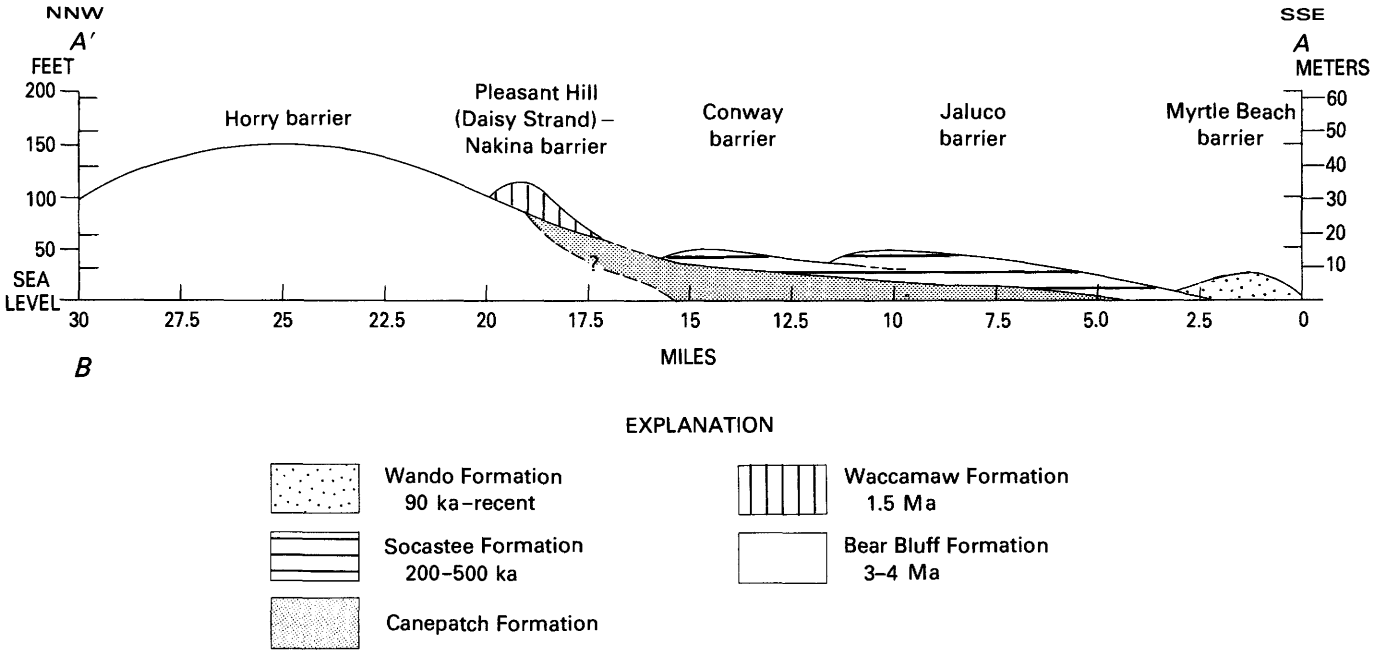


Figure 2*B*. Cross section through the morphostratigraphic units of Horry County, South Carolina.

and Harris (1892)). The surface deposits are early Pliocene in age or younger. Morphologically, the sediments comprise a series of barrier and back-barrier complexes or systems. The Horry barrier system (2.5–3.0 Ma) is the oldest morphostratigraphic feature that has recognizable constructional landforms. The Horry and Jaluco barrier–back-barrier system and the Conway back barrier are underlain by a coarsening-upward sequence of marine clay, silty clay, and sand (Thom, 1967a, b). The surface layer of fine- to medium-grained sand in the barrier complexes is rarely more than 5 m thick and is usually less than 3 m thick. The barriers are composite and form a broad multiridge area several kilometers wide. Unlike the Horry and Jaluco barriers, the Conway barrier is composed entirely of sand and is only one ridge wide. Maximum width of the Conway barrier is about 2 km.

All post-middle Miocene strata in the South Carolina Coastal Plain consist of unconsolidated sand and beds of fossiliferous clay, marl, limestone, and lenses of partially indurated sandstone. Gravels are present as lenses and (or) thin beds throughout the section. Each formation ranges from 9 to 15 m thick, except for narrow channel fills in excess of 30 m thick. McCartan and others (1982) showed that, on the basis of biostratigraphy and (or) isotope or amino acid chronology, three or four major marine transgressions onto the mid-Atlantic Coastal Plain occurred during the Pleistocene. In Horry County, sediments are preserved from at least two of these transgressions and from one transgression considered to be Pliocene in age. Age determinations of the Pliocene and Pleistocene marine deposits are based largely on paleontological evidence, as the section entitled "Previous Work" notes.

Table 1 shows several interpretations of Pliocene and Pleistocene stratigraphy on the southwestern limb of the Cape Fear Arch. Included in this table is J. P. Owens' (oral communication, 1984) current interpretation, which is based on recent geologic mapping of the Florence $1°\times 2°$ quadrangle. This work is still being revised as paleontologic, lithostratigraphic, and radiometric data are generated. Two differences between DuBar and others' (1980) interpretation and that of Owens are (1) Owens' association of the Horry barrier system with the Bear Bluff Formation (middle Pliocene) rather than with the Waccamaw Formation (lower Pleistocene) and (2) the fact that Owens considered the Jaluco barrier system to be the seaward extension of the Conway barrier system (as originally proposed by Thom, 1967a).

Acknowledgments

We would like to express our appreciation to J. P. Owens, R. B. Mixon, and J. T. Hack of the U.S. Geological Survey and R. A. Daniels and Klaus Flach of the U.S. Department of Agriculture's Soil Conservation Service for their initiative in suggesting a cooperative project between the two agencies and for their encouragement throughout the study period. We also extend our thanks for the assistance of Soil Conservation Service field personnel in sampling the study profiles. Travis Dudley and Don Hallbick helped to select and describe the field sites.

METHODS

To compare soil and weathering profiles on the Pliocene and Pleistocene age barriers and back barriers, 12 profiles were sampled from the least-modified positions on the barrier crests and in the back-barrier flats. These barrier systems range in age from 200 ka to 3 Ma. The ages of two profiles from rims of Carolina bays have not been determined, but the bays are considered to be no older than 200 ka (Markewich, 1985). Table 2*A* lists the profile numbers and their associated morphostratigraphic units. All soil pedons were described and sampled by the authors and local Soil Conservation Service (SCS) personnel. Pedon numbers are SCS standard notation, which gives the year, the state abbreviation, the county number, and the pedon number in the county (for example, S80SC–051–001). Pedons discussed in this report are referred to by the last three digits of their complete pedon numbers. (Note that there is no pedon 005.) Horizon designations and descriptions follow the format used in the Soil Survey Manual (Soil Survey Staff, 1981). Samples were sent to the SCS National Soil Survey Laboratory (NSSL) in Lincoln, Nebr., where they were split; one set was then sent to the U.S. Geological Survey (USGS) laboratories in Reston, Va., and the other was retained by NSSL. Analyses conducted at the NSSL (table 2*B*) include textural analyses, cation exchange capacity, pH, and base saturation. The USGS laboratories performed X-ray diffraction on the <2-μm fraction (glycolated, 350 °C, 500 °C; slurry mount on glass slide), bulk chemistry of the whole sample (and, in some cases, the <63-μm fraction) by X-ray fluorescence, and oxalate extraction and atomic absorption of iron and aluminum. Diffraction patterns presented in this report represent untreated clay in an oriented mount.

X-ray fluorescence analyses of soil samples were performed on a Diano 8600 spectrometer[5] after samples had been fused with lithium tetraborate. Major-element concentrations were then determined by comparing unknown intensities for each element with calibration curves prepared from USGS silicate rock standards (Flanagan, 1976), a method that usually results in relative errors of less than 5 percent. In the present study, many of the <63-μm fractions were predominately quartz sand containing more than 90 percent SiO_2 and thus exceeded the range of validity of the calibration curves. Samples high in SiO_2 consequently were diluted by a factor of two with a low-silica standard, BHVO–1. This extra step decreased the relative precision of the determinations by 5 to 10 percent. Therefore, the chemical data presented for most of the horizons are semiquantitative at best. Despite high uncertainties, the analyses show trends of the major constituents from top to base of each pedon. Analytical data are presented in tables 3*B*–3*D* through 16*B*–16*D* and are arranged roughly from oldest to youngest. Those data that are considered useful in establishing a relative and (or) absolute soil chronology are presented graphically later in this report (figs. 18–21). Data that characterize other soil properties such as water content or water retention are included in the tables but are not presented graphically or discussed in the text.

[5]The use of brand names is for descriptive purposes only and does not imply endorsement by the U.S. Geological Survey.

RESULTS

Barrier Soils

Samples from profiles S80SC–051–001 and S80SC–051–002 are from the Horry barrier, samples from profiles S80SC–051–003 and S80SC–051–004 are from the Conway barrier, and samples from profile S81SC–051–008 are from the Jaluco barrier. Where it was sampled, fine-grained sand constitutes approximately 60 to 80 percent of the surface sediments of the Horry barrier; total sand comprises about 80 to 95 percent (tables 3*B*, 4*B*). Fine- and medium-grained sand are the dominant size fractions in the barrier sediments of the Conway barrier system (tables 5*B*, 6*B*). In the barrier sediments, these size fractions comprise 80 to 90+ percent of the total sediment (60+ percent fine-grained sand, 25+ percent medium-grained sand) (tables 5*B*, 6*B*). The Jaluco barrier sediments are about 90 percent sand. The fine-grained sand fraction comprises about 30 percent, the medium-grained sand about 45 percent, and the coarse-grained sand about 15 percent (table 9*B*).

Several of the barrier soils have humates or spodic horizons (pedons 003 and 008) (see tables 5*A*–5*D*, 9*A*–9*D*). The spodic horizons all have more than 85 percent sand and less than 5 percent clay. Bulk chemistry of the spodic horizons is variable, and accurate values were difficult to obtain because of the organic matter and water content. Most totals sum to less than 90 percent (tables 5*D*, 9*D*). In pedons 003 and 008, SiO_2 values are anomalously low in all horizons except the Bh3 (see tables 5*D*, 9*D*). Anomalous values for SiO_2 and Al_2O_3 are most likely due to difficulties in preparing samples that are dominantly quartz sand. Fusion with lithium tetraborate may leave SiO_2 in the crucibles. Results will therefore give anomalously low values for SiO_2. Future work on silica-rich pedons should result in more rigorous procedures for determining the elemental chemistry of these horizons.

To completely characterize pedons, both dry and moist bulk density values must be obtained for each sample collected. The bulk density data are not complete owing to the difficulties in obtaining clods in material composed of more than 95 percent uncemented quartz sand. For the samples measured, bulk density values of spodic horizons range between 1.6 and 1.7 g/cm^3 (oven dry) (see tables 5*C*, 9*C*). This range is apparently more narrow than the ranges of other horizons within the same sola, but a greater data base is needed for accurate comparisons. The argillic horizons have bulk densities of 1.6 to 1.8 g/cm^3 (oven dry); values for the A horizons are 1 to 1.6 g/cm^3 (oven dry). Values for both the A and the argillic horizons are typical of Coastal

Plain soils; it is also common for the surface and subsurface horizons in sandy Coastal Plain soils to have similar bulk density values.

Barrier soils contain only a few percent weatherable minerals, mostly potassium feldspar or muscovite in the light fraction. Although a few grains of hornblende and epidote are present, the heavy fraction is composed predominantly of minerals considered to be nonweatherable, particularly zircon and rutile. Quartz constitutes most of the sand- and silt-sized fractions.

Soils developed on barriers of different ages appear to be similar, although both physical and chemical data suggest that soils developed on the Horry barriers may be bisequal and that the data presented represent only the upper parts of the profiles. Figure 3 shows horizon thicknesses and particle size distributions (clay-free base) of soil profiles for the five barrier soils that were sampled. Weight percent clay is superposed on the same plots. Solum thicknesses of soils developed on barriers range from 80 to 145 cm. Variation in weight percent clay in the B horizons is so great and nonsystematic that weight percent clay and (or) clay mass cannot be used as parameters for age determinations. For Horry barrier soils, these variations are from 12 to 16 percent (001) and 4 to 5 percent (002); for Conway barrier soils, 8.5 to 12.5 percent (003) and 6 to 10.5 percent (004); and, for Jaluco barrier soil, 2 to 3.5 percent (008). Clay-mass data (grams of clay per square centimeter integrated through thickness of solum) show little relation to age in barrier soils: for Horry barrier soils, 5 (002) to 18 g/cm^2 (001); for Conway barrier soils, 9 (003) to 12 g/cm^2 (004); and, for Jaluco barrier soil, 3 g/cm^2 (008). Values for cation exchange capacity divided by weight percent clay (CEC/clay) are the same (0.2–0.5) for both Horry and Conway barrier soils; the use of CEC data as an indicator of age is thus limited. (CEC data for the Jaluco barrier soil are anomalous and cannot be used for comparison (table 8*C*).)

Microfabric analysis (using Brewer's (1976) terminology) of the argillic and C horizons of the barrier soils shows that quartz dominates the skeleton grains in all the sola. In pedon 003 from the Conway barrier, the basic structure in the Bt2 (73–91 cm), the A'2 (91–105 cm), and the Bh21 (126–146 cm) horizons is granular. In the Bt2, clay films are both coating and bridging, and an opaque material is coating the clay. Skeleton grains in the A'2 horizon are also coated with this opaque material. In the Bh21, horizon, grains are only partially coated. In pedon 004, also from the Conway barrier, the basic structure of the Bt horizon (61–95 cm) is agglomeroplasmic, and the plasmic structure is skelsepic. Grains are coated with clay, and some have clay bridges. Clay is coated with an opaque substance. The C horizon (138–169 cm) in pedon 004 has 3.6 percent clay, a granular basic structure, and some clay bridging between grains, all of which suggests that there has been translocation of clay into the C horizon.

Basic structure of the Bt1 horizon (74–98 cm) in pedon 001 from the Horry barrier system is agglomeroplasmic and has insepic plasmic structure. Basic structure of the C horizon (141–177 cm) is granular. The presence of some thin discontinuous clay bridges in the C horizon suggests that there has been translocation of clay at least to 177 cm, the maximum depth sampled. Basic structure of the Bt horizon (48–69 cm) from pedon 002, also from the Horry barrier system, is granular and has skelsepic plasmic structure. The C2 horizon (120–136 cm) of pedon 002 has only 0.8 percent clay and a granular basic structure. Skeleton grains of quartz are almost perfectly clean. The C3 horizon (136–173 cm) from pedon 002 has agglomeroplasmic basic structure and skelsepic plasmic structure. There is some clay bridging, which is obscured by opaque coats on clay. Almost all skeleton grains are coated. No microfabric data are available for pedon 008 from the Jaluco barrier.

Hydroxyinterlayer dioctahedral vermiculite (also referred to as HIV), kaolinite, and gibbsite are the predominant phases in the clay fractions of the barrier soil horizons as observed in other soils of the Eastern United States (figs. 4–7) (Douglas, 1977; Karathanasis and others, 1983). Halloysite is also present as a major component of the Bt horizons. Pedons 001 and 004 show that peak intensities of vermiculite and halloysite are inversely related and that halloysite is better developed in the lower parts of textural B horizons. Vermiculite is better developed in more permeable sandy A horizons. Quartz is present at various depths in the clay fraction and does not show a consistently stronger intensity in the uppermost A horizons. HIV (14.2 A) is present even in barrier soils containing less than 5 percent clay in the solum (fig. 5). Possible explanations for its presence are discussed later.

Back-Barrier Soils

Samples from pedons S81SC–051–006 and S81SC–051–007 are from the Conway back barrier; samples from pedon S81SC–051–009 are from the Jaluco back barrier; and samples from pedons S81SC–051–012, S81SC–051–013, S81SC–051–014, and S81SC–051–015 are from the Horry back barrier. Very fine grained and fine-grained sand are the dominant size fractions in the back-barrier soils of the Horry barrier system (50 to 80 percent of total sediment) (tables 13*B*, 14*B*, 15*B*, 16*B*). In the Conway back-barrier sediments, the percentage of total sand varies from 4 to 70. Fine-grained sand is dominant, up to 47 percent; very fine grained sand and medium-grained sand range from 1.5 to 15 percent (tables 7*B*, 8*B*). The Jaluco back-barrier sediments show a fining-upward sequence from medium- to fine-grained sand (from 85 to 65 percent total sand) from the C horizon to the surface (table 10*B*).

Back-barrier soils are significantly different from barrier soils in that they are dominantly silty clay loams. Figure 8 shows the clay-free texture of back-barrier soils. The

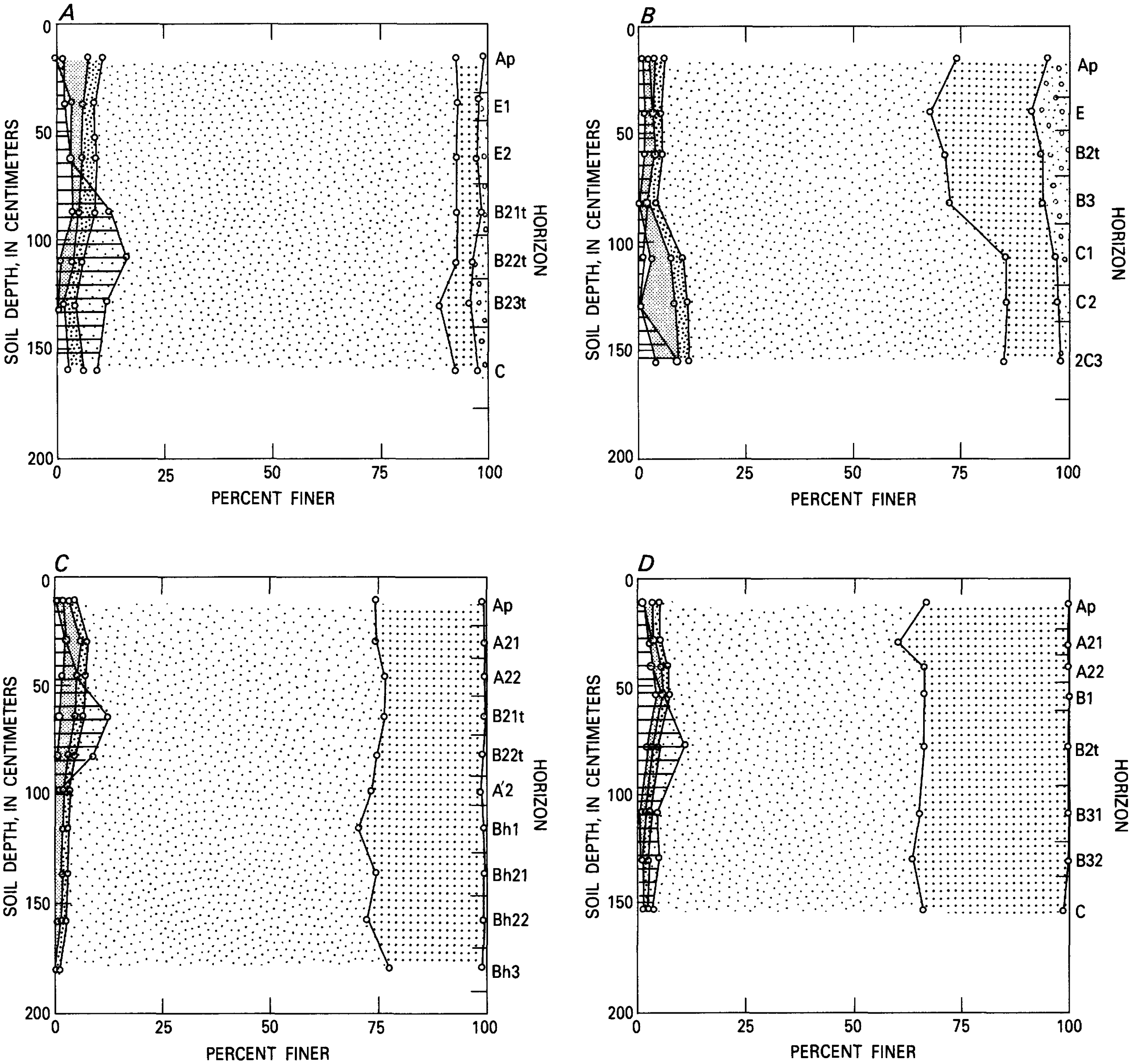


Figure 3. Weight percent clay and weight percents of silt and sand on a clay-free base for barrier pedons 001 (*A*), 002 (*B*), 003 (*C*), 004 (*D*), and 008 (*E*). Horizontal lines show weight percent of clay (<2 μm) for each horizon. Vertical lines denote percent finer than 20, 50, 100, 250, 500, and 2,000 μm on a clay-free base. Clay-free texture of each horizon is calculated by subtracting weight percent of clay; weight percents of coarser fractions are summed, and that sum is used as the denominator in recalculating the percentages of each silt and sand fraction.

weight percent of clay by horizon is also plotted. Solum thicknesses range from 135 to 200+ cm for the Horry back-barrier soils and from 104 to 170+ cm for the Conway back-barrier soils and are as much as 180 cm for the Jaluco back-barrier soil. Thicknesses of the argillic horizons as described in the field range from 46 to 90 cm for the Horry back-barrier soils and from 50 to 80 cm for the Conway back-barrier soils and are as much as 112 cm for the Jaluco back-barrier soil (tables 7*A*, 8*A*, 10*A*, 13*A*, 14*A*, 15*A*, 16*A*). CEC/clay percent values for the same soils are 0.2 to 0.4 for the Horry, 0.2 to 0.5 for the Conway, and 0.2 to 0.3 for the Jaluco (tables 7*C*, 8*C*, 10*C*, 13*C*, 14*C*, 15*C*, 16*C*). Clay-mass data are 44 to 60 g/cm^2 for the Horry, 68 to 76 g/cm^2 for the Conway, and 123 g/cm^2 for the Jaluco. No age trends are evident in these data, except for thicknesses of argillic horizons.

If we assume that the clay curves shown in figure 8 are representative of Horry back-barrier soils and ignore

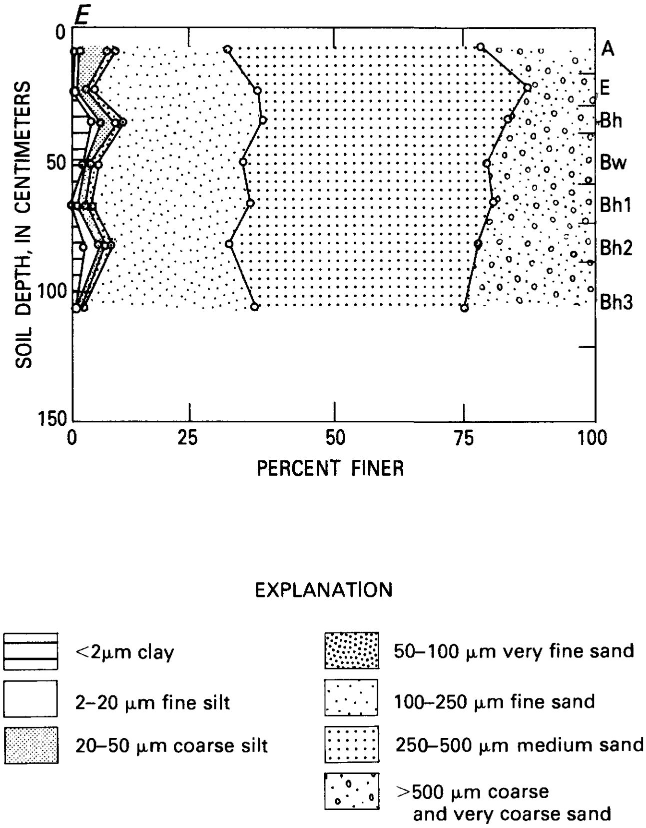


Figure 3.—Continued.

field-designated horizons, then Horry back-barrier soils appear to have argillic horizons greater than 150 cm thick (for example, pedon 013 would have an argillic horizon 161 cm thick) (see table 14*B*). Conway and Jaluco back-barrier soils have argillic horizons less than 120 cm thick. Thin-section analyses indicating that thick clay skins developed in the lower horizons of soils in Horry back-barrier sediments support the assertion that we have not sampled the entire argillic horizon of these pedons.

Microfabric study of pedon 006, developed in back-barrier sediments of the Conway barrier system, shows a vughy porphyroskelic basic structure and mosepic plasmic structure (terminology from Brewer (1976)) in the Bt horizons. The Cg1 horizon shows an agglomeroplasmic basic structure and the same mosepic plasmic structure of the overlying Bt horizons. The Cg2 and Cg3 horizons have agglomeroplasmic basic and vosepic plasmic structures. The Bt horizon of the Jaluco back-barrier soil (pedon 009) shows the same vughy porphyroskelic and mosepic structures as the Bt horizons of the Conway barrier system. The BC horizon has agglomeroplasmic basic and vosepic plasmic structures, whereas the 2C has granular structure. The basic structure of the Bt and BC horizons in pedons 012, 013, and 014 developed in Horry back-barrier sediments is agglomeroplasmic, and the plasmic structure is mosepic, except for the moskelsepic structure of the Bt2 horizon in pedon 013.

Microfabric studies show that quartz dominates the skeleton grains in all back-barrier and barrier profiles. Clay, clay-silt, silt, and sand flows are characteristic of C horizons in all back-barrier profiles. In Bt and C1 horizons of the back-barrier soils, the quartz grains appear to be pitted and in some cases highly fractured. Both the degree of fracturing and the number of pitted surfaces appear to decrease downward from the Bt to the C1 to the C2 and underlying horizons. The presence of a few labile minerals was noted. A few feldspar grains were observed in the Cg2 horizon (152–193 cm) of pedon 006, developed in Conway back-barrier sediments, and in the BCg horizon (134–180 cm) of pedon 009, developed in Jaluco back-barrier sediments. Numerous hornblende grains were observed in the 2C horizon (196–243 cm) of pedon 013, developed in Horry back-barrier sediments.

The Bt1 and Bt2 horizons of back-barrier soils have nearly continuous clay skins in pores and (or) channels. Probably the most striking feature recognized from microfabric studies in the Bt3, BC, and C horizons of back-barrier soils is the thick, dark-red areas of oriented clay masses that

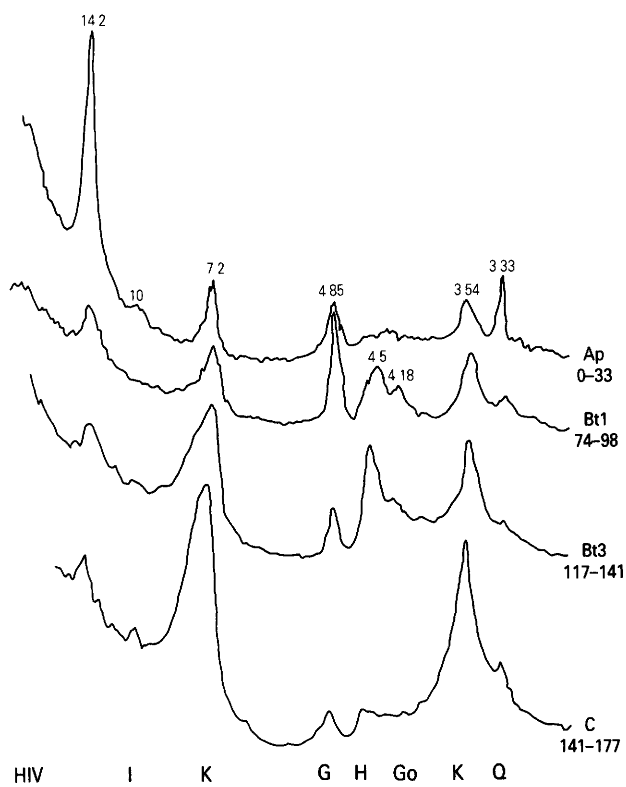


Figure 4. X-ray diffraction patterns for untreated samples from pedon 001. This profile shows upward increases in the peak intensities of vermiculite (HIV), gibbsite (G), and quartz (Q) and decreases in the peak intensities of kaolinite (K) and halloysite (H) above the Bt3. Illite (I) and goethite (Go) are also present. Peaks are measured in angstroms. Depths of horizons are in centimeters.

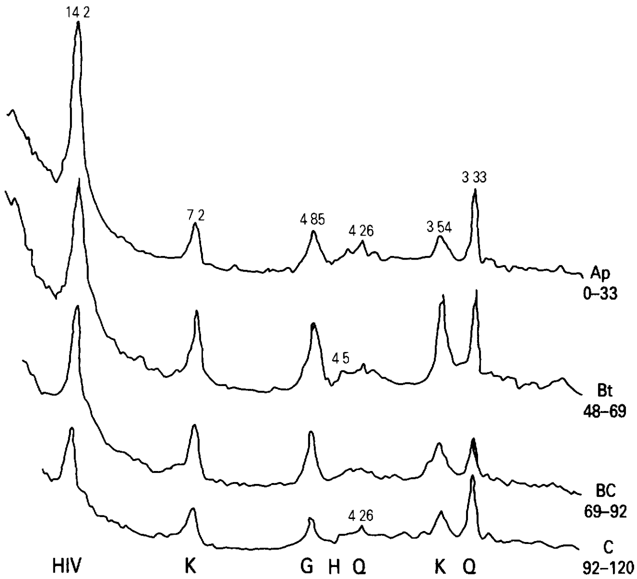


Figure 5. X-ray diffraction patterns of untreated samples from pedon 002. This profile shows upward increases in the peak intensities of vermiculite (HIV) and gibbsite (G). Kaolinite (K) and halloysite (H) intensities are strongest in the Bt horizon. Quartz (Q) peak intensity is strong in all but the BC horizon. Peaks are measured in angstroms. Depths of horizons are in centimeters.

appear to be disrupted clay-filled pores. These zones of oriented clay are highly contaminated with silt.

Clay mineralogy of the back-barrier sediments is dominantly kaolinite and gibbsite and lesser amounts of quartz, goethite, or other iron-oxide and mixed layer illite/smectite (see figs. 9–15). Pedogenic HIV (14.2 A) increases toward the surface in all profiles except 007, which contains expandable illite/smectite to the surface. Data given in table 17 suggest that the peak height ratio of 14.2 A (HIV) to 7.2 A (kaolinite) +4.85 A (gibbsite) tends to increase toward the surface in all back-barrier soils. A plot of clay ratio versus KCl extractable aluminum for pedons 012, 014, 003, and 004 (see fig. 21) shows a decreasing amount of extractable aluminum and an increase in the clay ratio in the back-barrier profiles 012 and 014. This plot can be tentatively interpreted to mean that increased aluminum interlayering in HIV reduces the available extractable aluminum. This same trend is not seen in the barrier profiles (003 and 004). (In agricultural areas, a decrease in extractable aluminum upward in the profile can also be related to liming.)

Carolina Bay Soils

Pedons S81SC–051–010 and S81SC–051–011 are developed on the rims of Carolina bays formed in the surface sediments of a terrace of the Little Pee Dee River. These soils appear to be less developed than any of the barrier or back-barrier soils, in agreement with their estimated age of less than 200 ka (see fig. 16 for plot of texture on clay-free basis). Parent material of the bay rim soils is dominantly medium- and coarse-grained sand-sized quartz (tables 11*B*, 12*B*). For pedon 010, medium-grained sand comprises 40 to 50 percent, coarse-grained sand comprises 21 to 36 percent, and fine-grained sand comprises 8 to 13 percent of the sample by weight percent. In pedon 011, medium-grained sand is 40 to 53 percent, coarse-grained sand is 14 to 19 percent, and fine-grained sand is 14 to 17 percent of the sample. Pedon 011 has up to 21 percent silt in the solum below the A horizon. Pedon 010 has a maximum of 14.5 percent silt in the Bt horizon (63–96 cm) but less than 10 percent in the other horizons. One striking characteristic of pedon 011 is the high silt content (40 percent) in the first 18 cm below the land surface, a fourfold increase from the 10-percent silt in the subjacent E1 horizon (18–33 cm). The variation in silt content throughout the solum and parent material suggests that silt is an artifact of deposition and not the result of pedogenic processes. Possible explanations include the possibility that pedon 011 developed in a localized depression on a bay rim that has a "cap" of silt-sized loess and (or) colluvium. The origin of the silt in the Bt horizon of pedon 010 is also not easy to surmise, but the existence of such a fine-grained, 30-cm-thick depositional layer may have facilitated the formation of an argillic horizon where it would not have developed otherwise.

We did not prepare thin sections of any samples from Carolina bay soils. X-ray diffraction patterns show that vermiculite, kaolinite, and gibbsite are all present in pedon 010 (see fig. 17). Unlike the barrier soils (for example, pedon 004) (fig. 7), pedon 010 shows vermiculite at a maximum in the Bt horizon, where quartz peak intensity is also at a maximum. Both HIV and quartz peak intensities decrease above and below the Bt horizon.

DISCUSSION

The soil and weathering profiles developed on the barriers and back barriers of Horry County are representative of the lower Coastal Plain of the southeastern coastal States and include Hapludults, Paleudults, Aquults, and Aquods (Soil Survey Staff, 1975). Hapludults and Paleudults (Red-Yellow Podzolics of the old classification system) are restricted to the better drained areas, usually at the dissected margin of a barrier, on a fluvial terrace several meters or more above local base level, or on the interfluves within the back-barrier part of the barrier–back-barrier system. The Horry back-barrier soils are within the Pale-Great Group of the Ultisol Order and have argillic horizons greater than 150 cm thick, whereas soils on the Conway and Jaluco back-barrier deposits are in the Hapl-Great Group and have argillic horizons less than 120 cm thick. As sampled, all well-drained barrier soils, regardless of age, classify as

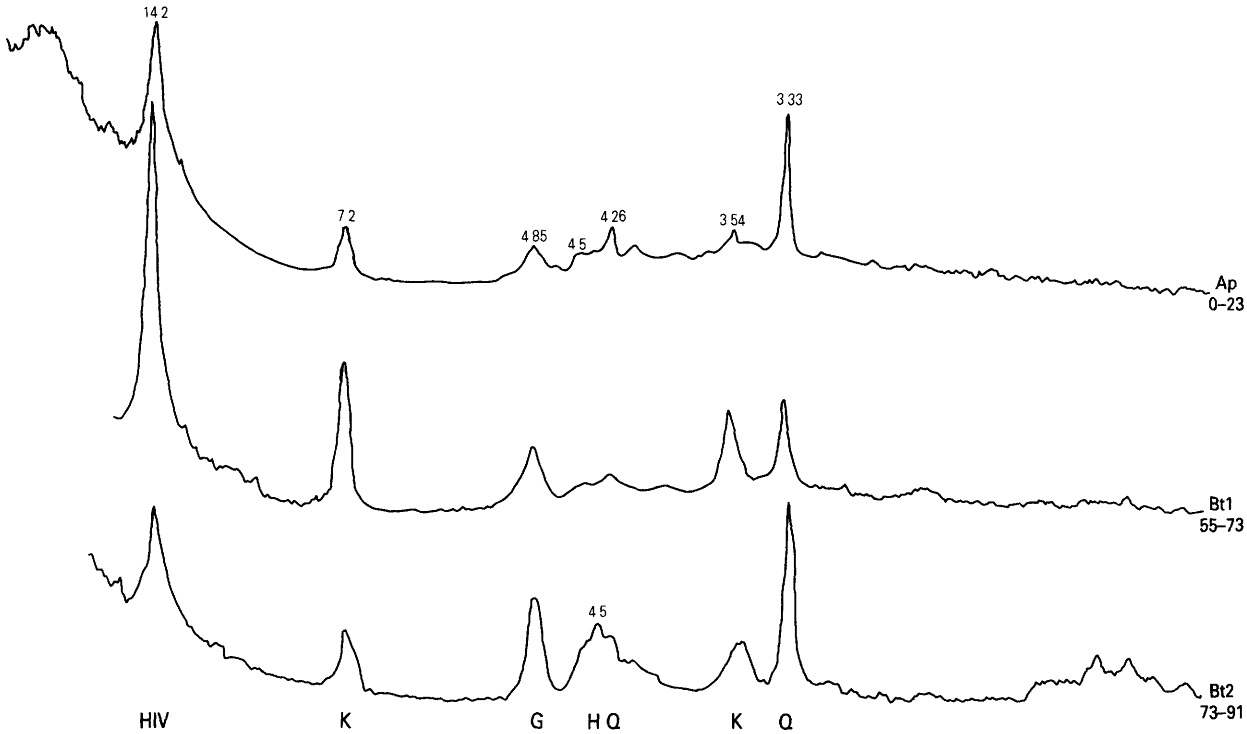


Figure 6. X-ray diffraction patterns of untreated samples from pedon 003. This profile shows an upward increase in the peak intensity of vermiculite (HIV) and upward decreases in the peak intensities of gibbsite (G) and halloysite (H). Kaolinite (K) peak intensity is greatest in the Bt1 horizon. Quartz (Q) is present throughout and does not show an upward increase in peak intensity. Peaks are measured in angstroms. Depths of horizons are in centimeters.

Hapludults. If the Horry barrier soils had been sampled to greater depths, the data probably would have shown them to have bisequal development and to be thick enough to be within the Pale-Great Group.

Aquults and Aquods have developed locally where water has ponded above a bed of sandy clay or clay. These soils are also characteristic of Carolina bays. Thom (1970) thought that Carolina bays formed where sand cemented by disseminated organic matter had formed a relatively impervious substrata (humate or spodic horizon).

Jenny (1941) listed several factors in his formula for soil formation: climate, topography, parent material, biota, and time. Delcourt and Delcourt (1979) suggested that the vegetation assemblage of the coastal region of South and North Carolina alternated between boreal and temperate forest throughout the late Pleistocene. They found short periods of cooler, but not cold, climate. The factors of climate and vegetation are thus considered constant for the purposes of this study. We therefore focus our discussion on the remaining variables in Jenny's equation: parent material, topography (drainage), and time.

Tectonic Control on Topography and Drainage

One of the more puzzling aspects of the Pliocene and Pleistocene deposits in Horry County and in other parts of the lower Coastal Plain is the remarkable preservation of primary topography associated with deposits that are paleontologically and (or) radiometrically dated as more than 1 Ma. Even where they are deeply incised (12–15 m), 3.0- to 4.5-Ma shallow marine and estuarine deposits of the lower Coastal Plain are represented by relatively unmodified constructional landforms that reach altitudes of more than 80 m (DuBar, 1971; Colquhoun, 1974; Markewich, 1985; J. P. Owens, oral communication, 1984). Cronin (1980, 1981) suggested rates of uplift between 10 and 20 m/Ma during the Pliocene and Pleistocene for the middle and southeastern Atlantic Coastal Plain. Markewich and Soller (1983), Soller (1983), and Markewich (1985) suggested that differential uplift affected the Cape Fear Arch in the area of the Cape Fear River during the Pleistocene. Cinquemani and others (1982) suggested that Holocene transgression south of the Cape Fear Arch was characterized by frequent fluctuations in sea level. R. L. Weems (oral communication, 1984; Weems and Lemon, 1984) has suggested that, during the Pliocene and Pleistocene, the South Carolina Coastal Plain experienced alternating periods of uplift and relative quiescence and an increase in the average rate of uplift from about 350 ka to the present. If the positions of the Horry, Pleasant Hill (Daisy Strand)–Nakina (see fig. 2; unit not sampled), Conway, and Jaluco barriers are plotted against age and if the maximum rates of uplift between periods of

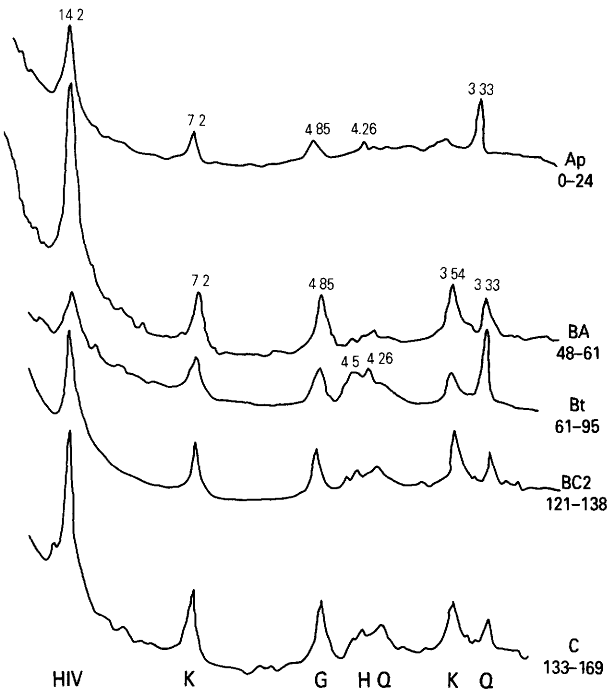


Figure 7. X-ray diffraction patterns of untreated samples from pedon 004. This profile shows upward decreases in peak intensities of halloysite (H) and kaolinite (K). Peak intensities of vermiculite (HIV) and gibbsite (G) increase above and below the Bt horizon. Halloysite peak intensity is greatest in the Bt horizon. The peak intensity of quartz (Q) varies throughout the profile. Peaks are measured in angstroms. Depths of horizons are in centimeters.

deposition are plotted, then the hypothesis of periodic uplift throughout the Pliocene and Pleistocene is supported (table 18). If this hypothesis is correct, then preservation of the morphologic forms of the Horry and younger barrier systems is due in part to periods of relatively slow rates of uplift, dissection, and erosion.

Vertical migration of water, a primary control on soil- and weathering-profile development, is limited by the degree of dissection and incision of an area. This limitation is reflected in the profiles that characterize both the Pliocene and Pleistocene deposits. Well-drained and moderately well drained Hapludults and Paleudults are present only in areas of maximum relief, near the edges of barriers and fluvial terraces, where downward infiltration of water is relatively unimpeded. In less well drained localities, the type of pedogenic alteration and the specific weathering processes are not so easily identified, nor are the soils so easily classified. The edge effect and the problems in mapping and classification produced by that effect have been discussed by Daniels and Gamble (1967), who also presented examples of differences in soil development caused by local changes in parent material. Horry barrier system soil profiles exemplify the problems associated with such sites.

Textural and Stratigraphic Control on Drainage

The Horry and Jaluco barrier systems have subsurface lithologies of thin- to thick-bedded massive sandy clay and clay interbedded with thin- to thick-bedded sand and peat. In general, the sediments are poorly sorted. Surface sand of the Horry and Jaluco barrier systems is commonly less than 3 m thick. Clay beds and discontinuous horizons cemented by disseminated organic matter underlie many of the local swamps, including numerous Carolina bays. In the Horry and Jaluco barriers, water moves rapidly through the surface sand but locally ponds on the underlying clay or cemented sand layers. The Conway barrier is sandier than either the Horry or the Jaluco barrier, and the Conway back barrier is less extensive than either the Horry of the Jaluco back barrier. Water appears to move to depth more easily in the Conway barrier than it does in the clay-rich Jaluco or Horry barrier.

Thom (1967a) reported that the Horry barrier sediments are weathered to depths exceeding 7 m, that the clay is locally weathered to a reddish color, that mottling is prominent, and that illuvial horizons in the Horry barrier sediments extend to depths of 2 to 3 m. In contrast, he showed that weathering in Conway barrier sediments and in sandier parts of the Jaluco barrier sediments extends to 5 m and that illuvial horizon depths range from 3 to 4 m. Our data show the depths of illuvial horizons in the Conway and Jaluco to be somewhat less than those reported by Thom (1967a). Data from both studies indicate significant differences in weathering and pedogenic development between deposits that differ by an order of magnitude in age. Similar results were reported by Markewich and others (in press) for Pleistocene age sediments in the Coastal Plain of Virginia.

Surface drainage in the region parallels the barriers. Dissection and drainage density increase with altitude (gradient), which in Horry County is coincident with an older age of deposit. Both drainage density and depth of incision are most pronounced in the back-barrier part of the Horry barrier system (Thom, 1967a).

Argillic versus Spodic Horizons

Spodic Horizons (Humates)

Two prominent soil-forming processes in the lower Coastal Plain soils of the Southeastern United States are accumulation of clay in argillic horizons and accumulation of organic acids in spodic horizons. In general, water movement plays an important part in podzolization in the middle and lower Coastal Plain (Daniels and others, 1978b). The argillic and spodic horizons are separated areally and in vertical profiles (Daniels and others, 1976). Argillic horizons tend to form in materials having textures finer than loamy sand. Spodic horizons form in sandy sediments where drainage is impeded. As Thom (1967b, 1970) suggested, the spodic horizon can become a further impediment to drainage.

Pedons 003 and 008 have developed in sandy parent materials and are characterized by spodic horizons (or humates) (see tables *5B*, *9B*). The importance of the texture of the parent material to the formation of humate-rich spodic horizons has been observed in the tropics. Leenheer (1980, p. 515) noted that, in the Amazon basin, "a spodic horizon, rich in humic material, is often found above a clay lens, or above clayey parent material which underlies alluvial sands." Leenheer also observed that the lack of clay in alluvial sand is important to the preservation of organic material. He contrasted spodic horizons with clayey latosolic soil horizons over which a thick near-surface organic layer does not form. He stated (Leenheer, 1980, p. 516) that

> ...the lack of this [litter] layer is indicative of more rapid decay processes than those which occur in shallow podzols. Presence of a brown A horizon 5-20 cm thick indicates sorption of soluble humic materials upon the yellow and red clays. Thus, because of more rapid decay and sorption, soluble humic substances do not occur in high concentrations in waters which drain latosols.

Thus, clays in the latosols play an important role in the sorption and decomposition of humic substances. If the soluble humic material is not decomposed near the surface, it can accumulate in a spodic horizon or pass into ground and surface water. Leenheer (1980) suggested that humic substances are relatively stable in the near-surface ground water of sandy podzols because of the lack of nutrients, light, and clay and because of the anaerobic conditions that inhibit oxidation. Near-surface aerobic conditions in a less sandy parent material result in more nutrients and light and greater degrees of sorption and oxidation.

The active movement of organic material from the surface to a spodic horizon at depth appears to be associated with pedons that contain less than 8 percent clay above the spodic horizon (Daniels and others, 1978a; DeConinck, 1980), although it is not unusual for a spodic horizon to be present beneath argillic horizons that contain more than 10 percent clay. One such profile is pedon 003, which has 12.5 percent clay in the argillic horizon above the spodic horizon. It is not common, however, for a spodic horizon to be present beneath an argillic horizon having more than 15 to 18 percent clay, such as Markewich and others (in press) reported in 200,000-yr-old marine sand on the Eastern Shore of Virginia.

In these anomalous cases, soluble organic material has either moved vertically through the profile and accumulated before formation of the argillic horizon or has moved laterally and been deposited by ground water beneath the argillic horizon. In the latter case, lateral movement is always above a lower clay-rich horizon that has impeded downward drainage. This lower boundary is important in the formation of a spodic horizon, regardless of whether the mode of formation is from vertical or horizontal movement of water and humic substances. If there is no lower layer to impede downward migration of water, humic substances may migrate out of the system into the surface water, as the lack of a spodic horizon in pedon 002 shows, even though the Bt horizon of pedon 002 contains less than 8 percent clay. Detailed analysis of ^{14}C activity and organic geochemistry might distinguish between vertically and horizontally transported organic matter.

Because bacteria may be important in converting lignin and other plant tissue to humus, a relatively low density bacterial population may be another factor facilitating the preservation of organic matter during transport. Bacterial population density appears to be limited by the surface area available on the substrata. This surface area would be minimum for a clean, well-sorted sand.

Low initial amounts of iron and aluminum and a parent material of well-sorted sand appear to provide ideal conditions for the accumulation and movement of organic chelators. Humic material in soil and sediments contains a high percentage of aromatic groups (Schnitzer, 1977; Hatcher and others, 1981), which may be most effective as chelators of aluminum and ferric iron owing to their high content of carboxyl groups and phenols (Wright and Schnitzer, 1963; DeConinck, 1980). Although soluble organic acids are continually leached from spodic horizons, the rate of leaching is probably limited by slow water movement at and below the water table. The precipitated organic acids are apparently immobile and chemically stable within the spodic horizon.

The clean barrier sand in which the spodic horizons form provides a parent material in which the chemical clay-producing pedogenic processes are limited. Unlike the argillic horizons observed on finer grained parent material, the spodic horizon is developed with relatively little mass change in the Bh horizon (Markewich and others, in press). There is no evidence for pedogenic loss of mass from the Bh horizon or for eolian input of clay or silt. Limited mass loss is important in preserving the original morphology of the older barriers over very long time periods (that is, greater than 10^6 yr). Transmission of humic material through the Bh horizon is the dominant pedogenic process acting on the landform and results in slight to no modification of the landform, in contrast to the pedogenic processes active in the formation of argillic horizons on less chemically stable parent material, such as the metavolcanic, metasedimentary, and plutonic rocks of the Appalachian Piedmont (Pavich, 1985). In the Piedmont, mass loss by dissolution combines with a relatively high rate of erosion to result in much less stable land surfaces.

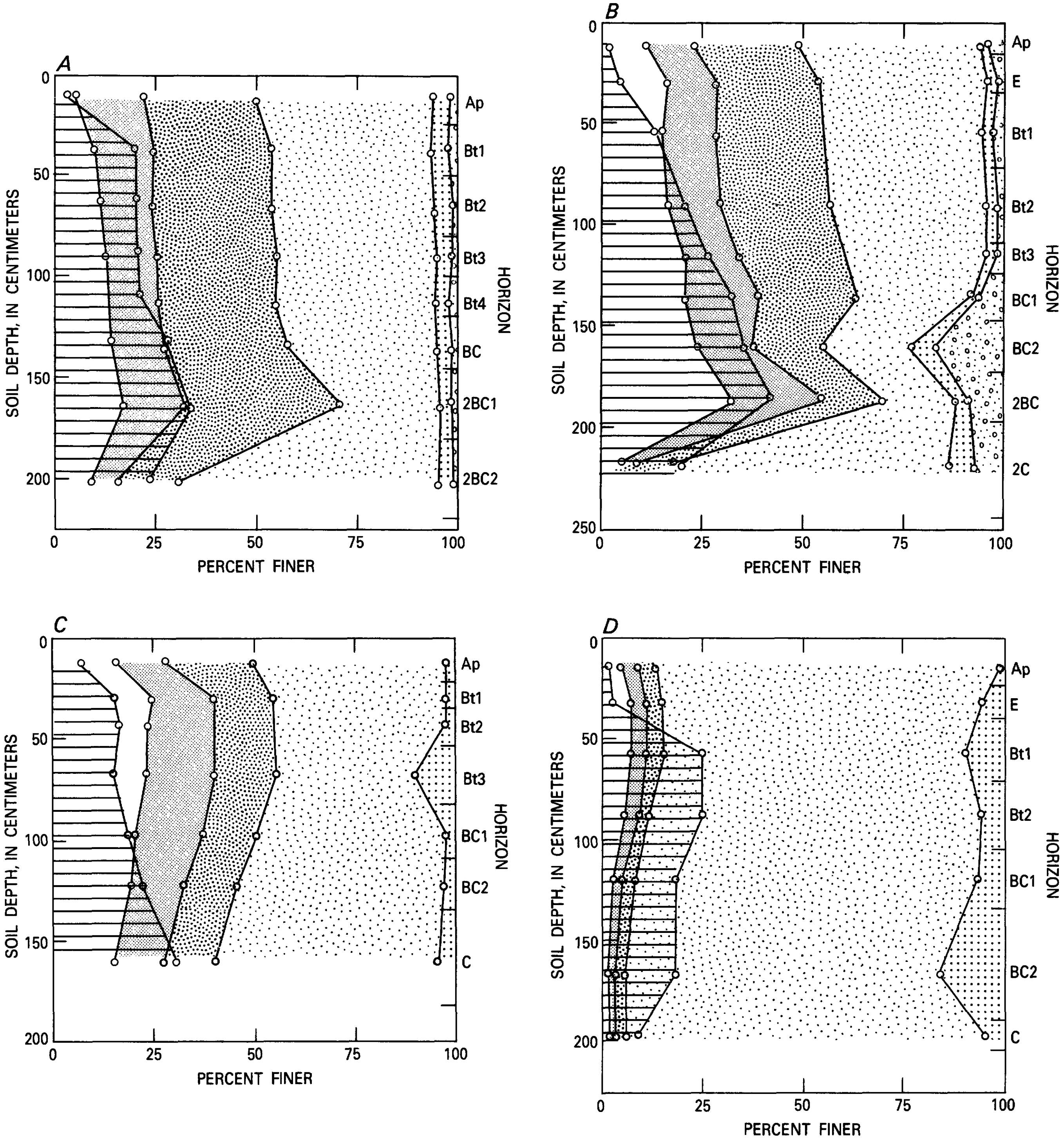


Figure 8. Weight percent clay and weight percents of silt and sand on a clay-free base for back-barrier pedons 012 (*A*), 013 (*B*), 014 (*C*), 015 (*D*), 006 (*E*), 007 (*F*), and 009 (*G*). Horizontal lines show weight percent of clay (<2 μm) for each horizon. Vertical lines denote percent finer than 20, 50, 100, 250, 500, and 2,000 μm on a clay-free base. Clay-free texture of each horizon is calculated by subtracting weight percent of clay; weight percents of coaser fractions are summed, and that sum is used as the denominator in recalculating the percentages of each silt and sand fraction. Patterns are the same as those in figure 3.

Argillic Horizons

For the pedons analyzed in this study, the clay mineralogy of argillic horizons is discussed with respect to variations of drainage conditions within horizons, or soil microenvironments. Soil microenvironments, in general, are determined initially by local drainage conditions and textures of the parent material. Subsequent modifications of microenvironments are the result of changes in drainage

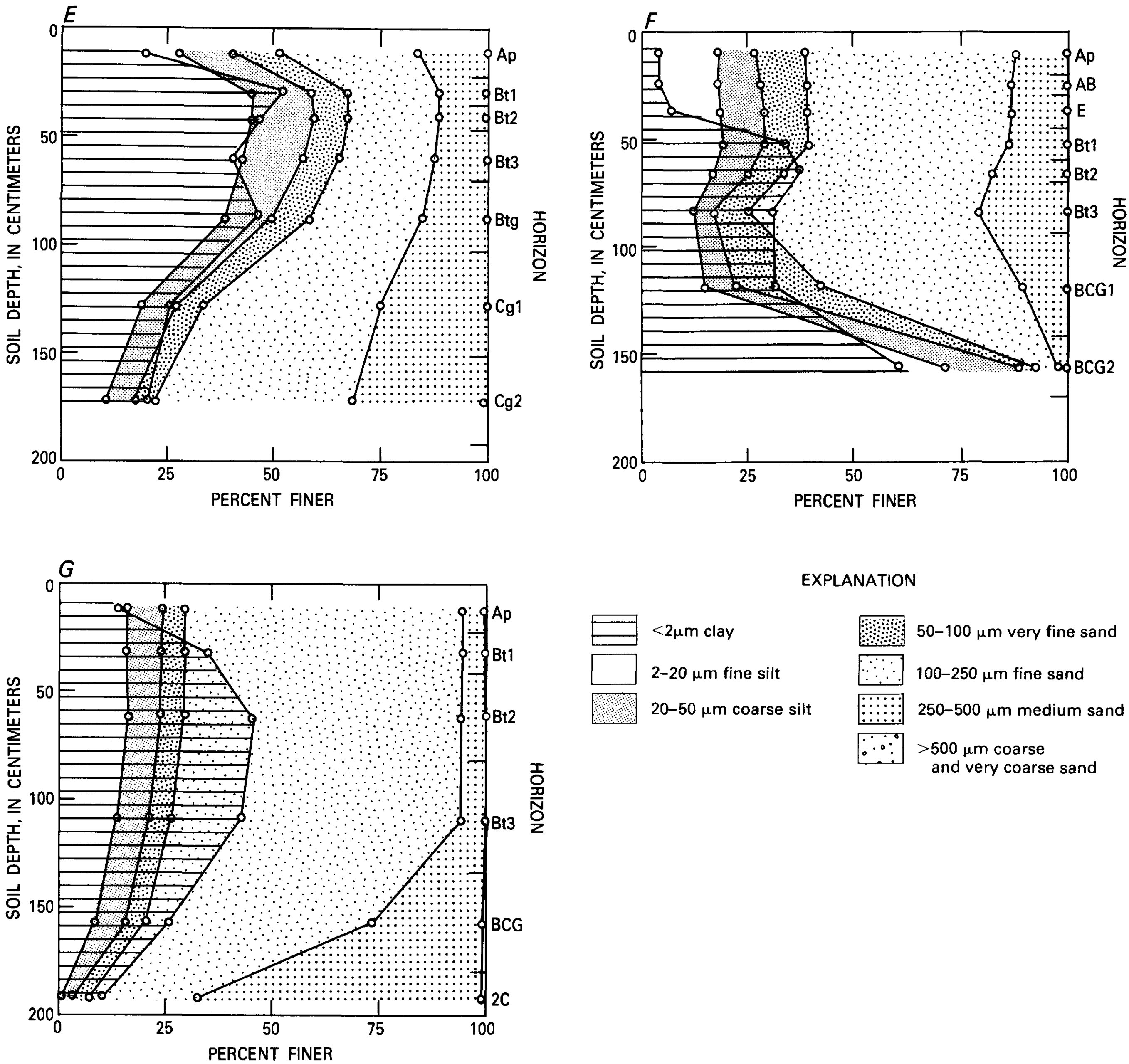


Figure 8.—Continued.

conditions and of physical and chemical alteration of the parent material by pedogenic processes. In the sandy barrier and Carolina bay soils, argillic horizons form as the result of eolian deposition of silt and clay, of textural differences due to primary stratification, or of accumulation of clay-sized grains at the upper surface of a zone cemented by colloidal silica and (or) organic acids.

Carolina Bay and Barrier Soils

Argillic horizons are present in most of the barrier and Carolina bay soils (pedons 001, 002, 003, 004, and 010). The parent material is quartz sand (85–98 percent by weight) (tables *3B*, *4B*, *5B*, *6B*, *11B*). This high percentage of sand and total SiO_2 appears to inhibit formation of clay-rich horizons in barrier and Carolina bay soils. Lack of silt- and sand-sized aluminosilicates prohibits the formation of clay by alteration of original minerals. Colloidal suspensions and allophane are inhibited from forming because water can move freely downward through the solum and parent material, thereby reducing interaction time of soil-water solutions. The lack of allophane and colloid suspensions prohibits the formation of secondary products (clay minerals) through these pathways. Also, any eolian contribution of clay moves easily through the sand instead of experiencing the slow migration from the A horizon through

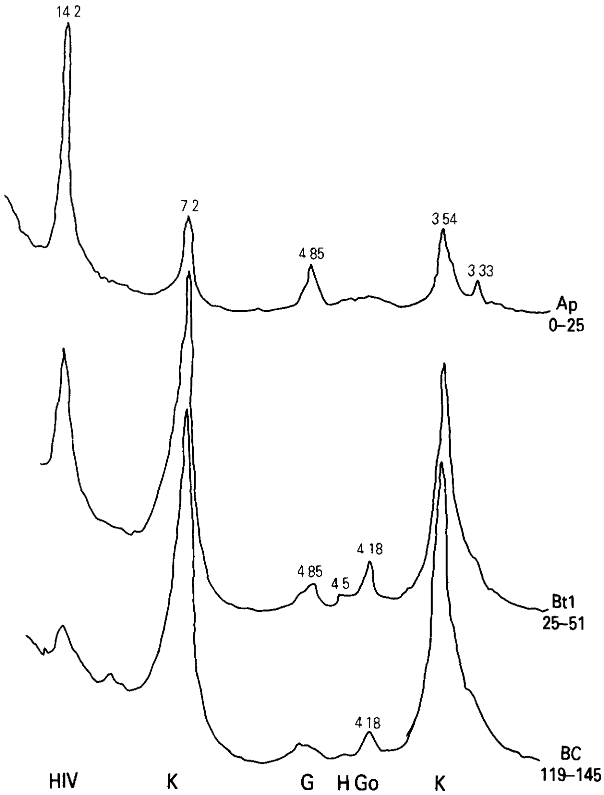


Figure 9. X-ray diffraction patterns of untreated samples from pedon 012. This profile shows upward increases in the peak intensities of vermiculite (HIV) and gibbsite (G). Kaolinite (K) peak intensity decreases above the Bt1 horizon. Halloysite (H) is present in the Bt1 horizon, and goethite (Go) is present in the Bt1 and BC horizons. Quartz (Q) peak intensities in the Ap and Bt1 horizons are weak. Peaks are measured in angstroms. Depths of horizons are in centimeters.

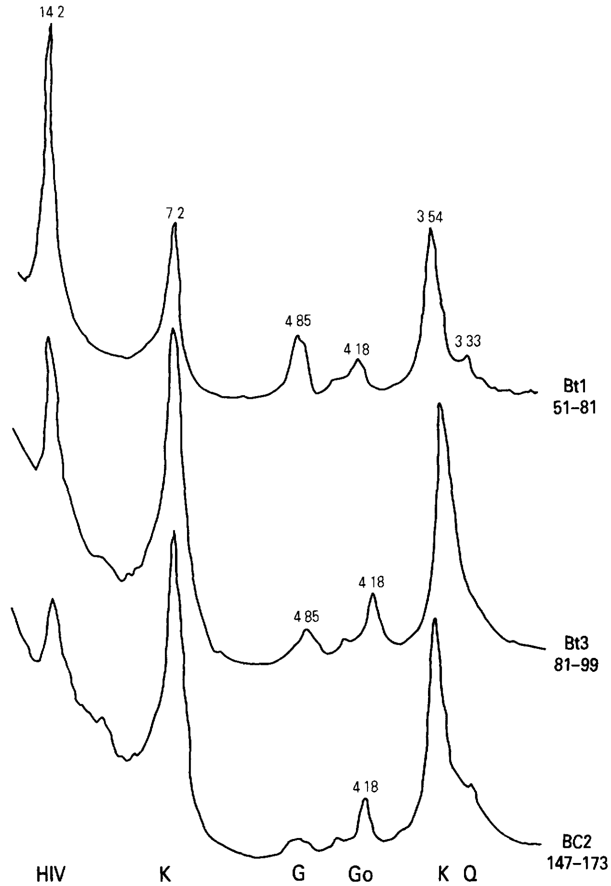


Figure 10. X-ray diffraction patterns of untreated samples from pedon 013. This profile shows upward increases in the peak intensities of vermiculite (HIV) and gibbsite (G). Kaolinite (K) peak intensity is greatest in the Bt3 horizon. Quartz (Q) is present only in the Bt1 horizon. Peaks are measured in angstroms. Depths of horizons are in centimeters.

the E horizon into the underlying B horizon that is typical of most soils.

The result of these limitations on development of argillic horizons is that many stable surfaces mantled with parent material that is predominantly sand may be relatively old and may have undergone extensive weathering. The soils, however, lack argillic horizons thick enough to be classified as Paleudults on the basis of observations to 2 m. The sandy surface sediments of the barriers and bay rims may have extremely thick elluvial horizons in which micropodzols have developed. Thick illuvial horizons underlie many of these surface sands but at sufficient depth that either borrowpit exposures or drilling is necessary to prove their presence, particularly for any morphostratigraphic unit more than 1.0 m.y. old. The following paragraphs describe the argillic horizons from pedons that we sampled in barrier and Carolina bay sediments. The difficulty in classification is particularly evident from the descriptions of pedons 001 and 002 from the Horry barrier system and somewhat evident from the descriptions of pedons 003 and 004 from the Conway barrier.

Carolina bay pedon 010.—Pedon 010 is from the crest of the rim of a Carolina bay that has developed on a terrace of the Little Pee Dee River. The Bt horizon is 33 cm thick and has 6.4 percent clay (3.1 percent more than the underlying Bh1 horizon and 5.2 percent more than the overlying Bw horizon) (table 11*B*). No clay skins are evident. The structure of the Bt horizon is single grain, as is the structure of the overlying Ap, E, and Bw horizons. The clay fraction of the Bt horizon is composed predominantly of vermiculite and quartz and minor amounts of kaolinite, gibbsite, and halloysite. In contrast, vermiculite and quartz are dominant above and below the halloysite-rich Bt horizon in barrier pedon 004. The small percentage of halloysite as a pedogenic phase in the Bt of pedon 010 could be explained by the absence of the labile minerals necessary to form halloysite and (or) the fact that vermiculite and clay-sized quartz are originally wind deposited and subsequently elluviated from the surface into subsurface horizons (fig. 17). The position of the Bt horizon is coincident with a silty

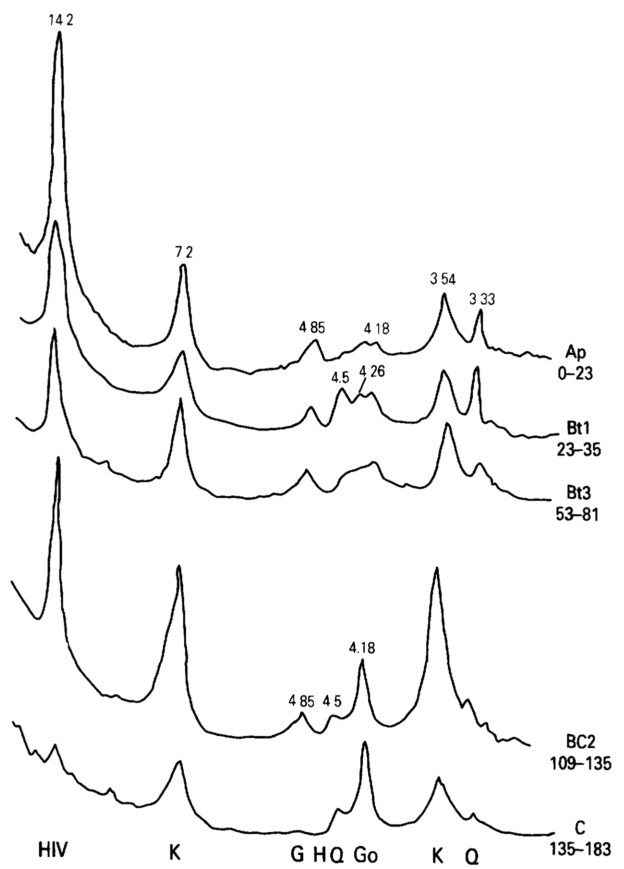


Figure 11. X-ray diffraction patterns of untreated samples from pedon 014. Vermiculite (HIV) peak intensity is greatest above and below the Bt horizons. Peak intensity of halloysite (H) is greatest in the Bt1 horizon. Kaolinite (K) peak intensity is greatest in the BC2 horizon. Peak intensities of gibbsite (G) and quartz (Q) show slight increases upward in the profile. Goethite (Go) is present in the BC2 and C horizons. Peaks are measured in angstroms. Depths of horizons are in centimeters.

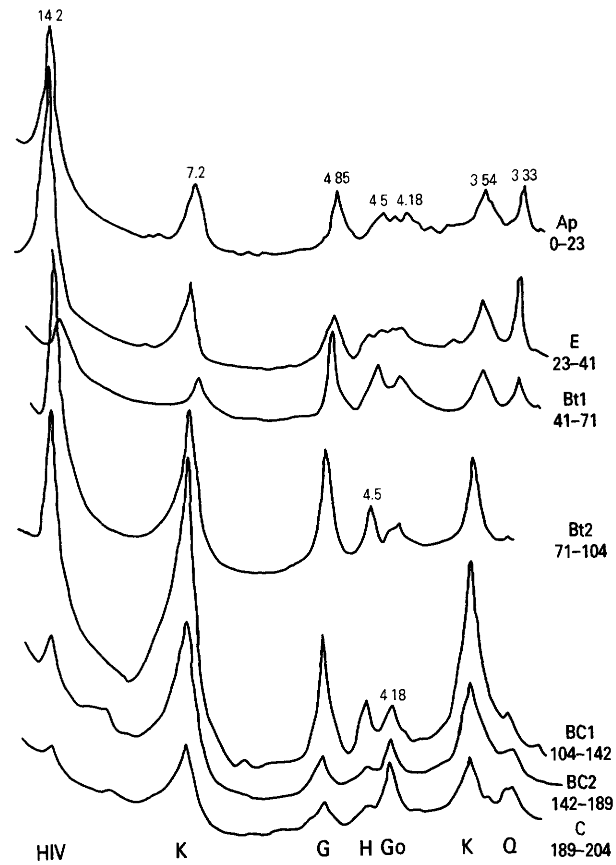


Figure 12. X-ray diffraction patterns of untreated samples from pedon 015. Vermiculite (HIV) peak intensity increases upward relative to kaolinite (K) and gibbsite (G) above the BC2 horizon. Maximum gibbsite peak intensity occurs in the Bt1 horizon, but it is also a major component of the Bt2 and BC1 horizons. Goethite (Go) intensity increases downward below the Bt1 horizon. Quartz (Q) is present in the upper three horizons. Peaks are measured in angstroms. Depths of horizons are in centimeters.

horizon that could be the result of either original stratification and (or) eolian deposition. Both silt and clay could be accumulating above the relatively impervious spodic horizon.

Jaluco barrier profiles.—Although the field description of pedon 008 from the Jaluco barrier system does not include an argillic horizon, particle size data indicate a 30-cm-thick horizon that has six to eight times more clay than either the overlying or the underlying horizons (table 9*B*). This 30-cm-thick zone of clay maxima includes the Bh (31–41 cm) horizon and the Bw horizon (41–61 cm), which contain 3.4 and 2.4 percent clay, respectively. (The values of weight percent clay throughout the profile, however, are within laboratory precision for sandy soils having relatively high contents of organic matter.) The Bh horizon exhibits a subangular blocky structure, which is in contrast to the single-grain structure of the A and E horizons and the massive structure of the Bw and the underlying Bh horizons. Despite the presence of 3.4 percent clay, no crystalline material was identified on X-ray diffraction patterns. Clay was either masked by the organic matter or not present.

Conway barrier profiles.—On the Conway barrier, pedons 003 and 004 show similar thicknesses of Bt horizons (36 and 34 cm, respectively) and maximum clay percentages (12.5 and 10.5 percent, respectively) (tables 5*B*, 6*B*). Pedon 003 has Bh horizons below the argillic horizon, whereas pedon 004 has BC and C horizons below the argillic horizon. They show only minor differences in original texture and mineralogy of parent material, and the surface slope at both sample sites is 0 to 1 percent. The resulting profiles are similar in physical and chemical parameters and in clay mineralogy (see tables 5*A*–5*D*, 6*A*–6*D*; figs. 6, 7).

The Bh horizons (105–190+ cm) in pedon 003 have ratios of fine-grained sand to medium-grained sand of 3:1 and 4:1 in comparison to the 2:1 ratio in the BC horizons

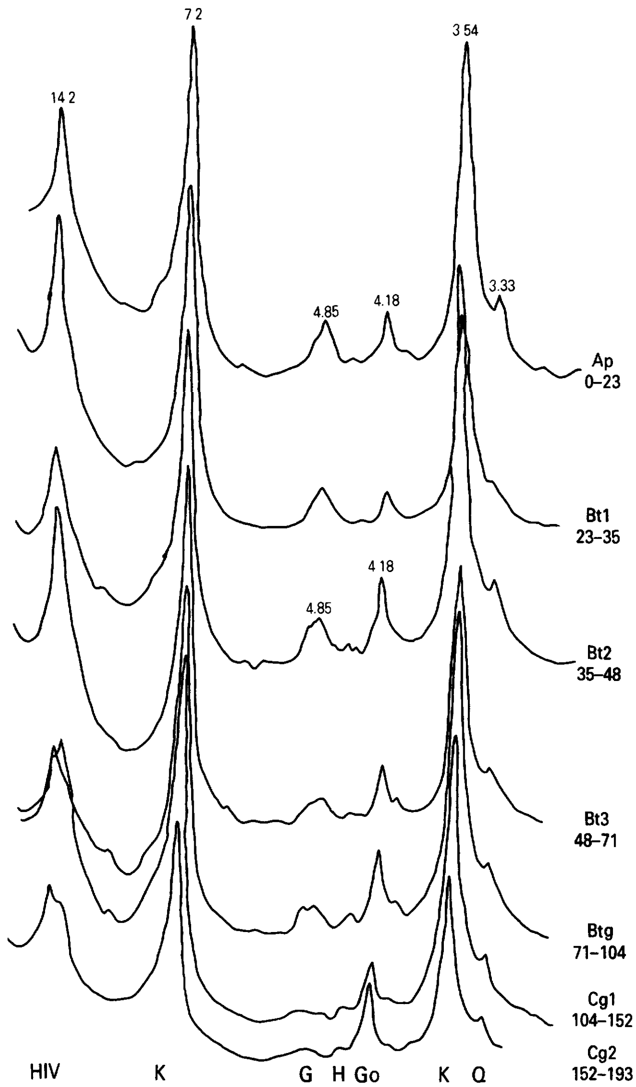


Figure 13. X-ray diffraction patterns of untreated samples from pedon 006. Kaolinite (K) and vermiculite (HIV) are the predominant clay phases. Vermiculite increases in intensity upward from the Cg2 horizon to the Bt1 horizon but decreases relative to kaolinite in the Ap horizon. Gibbsite (G) is a minor phase and increases in intensity upward above the Btg horizon. Goethite (Go) is present throughout and reaches a maximum intensity in the Cg2 horizon. Peaks are measured in angstroms. Depths of horizons are in centimeters.

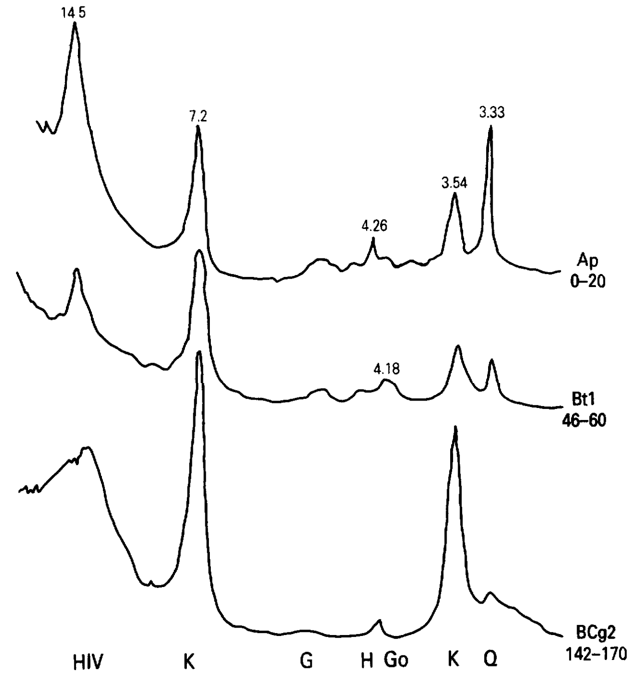


Figure 14. X-ray diffraction patterns of untreated samples from pedon 007. Kaolinite (K) is predominant throughout the profile. Vermiculite (HIV) and quartz (Q) show increasing peak intensities above the Bt1 horizons. Minor amounts of gibbsite (G), halloysite (H), and goethite (Go) are present in the Ap and Bt1 horizons. Peaks are measured in angstroms. Depths of horizons are in centimeters.

(95–138 cm) and the C horizon (138–169+ cm) of pedon 004. In the Bt horizons (61–95 cm) of pedon 003, the ratio of fine-grained sand to medium-grained sand is 3:1; in the Bt horizon (61–95 cm) of pedon 004, the ratio is only 2:1. Pedon 003 shows no measurable fine-grained silt in the Bt2 horizon or in the underlying Bh horizons. The Bt1 horizon shows a ratio of fine-grained silt to coarse-grained silt of 1:3. Pedon 004 shows a ratio of fine-grained silt to coarse-grained silt of 2:1 throughout much of the solum. Similarly, pedon 003 has no measurable fine-grained clay in the profile, whereas pedon 004 has 0.8 to 4.0 percent fine-grained clay distributed throughout the profile. The BC2 and C horizons of pedon 004 have no measurable coarse-grained silt (tables 5*B*, 6*B*).

The clay phases present in the argillic horizons in pedons 003 and 004 are similar in that both have strong halloysite and HIV peaks, and kaolinite and clay-sized quartz are present in both pedons (figs. 6, 7). Thin sections show clay coats on all skeleton grains and some bridging between grains in the C horizon (138–169 cm) of pedon 004, an indication that clay has been translocated below the BC2–C boundary at 138 cm. The top of the Bt horizon is at 61 cm; therefore, if the clay distribution curves are accepted as criteria, the argillic horizon in pedon 004 is between 90 and 150 cm thick.

Horry barrier profiles.—Although the following paragraphs discuss pedons developed in Horry barrier sands, the data suggest that the horizons sampled are not completely representative of an Horry barrier soil or weathering profile. Thom (1967a) indicated that the contact between the elluvial and illuvial horizons in Horry barrier soils was between 3 and 5 ft (1–2 m), that the illuvial horizons extended from 5 to 9 ft (2–3 m) deep, and that micropodzolic bisequa were not uncommon. One interpretation of the data presented herein supports Thom's observations of deep weathering and elluvial-illuvial contacts in the Horry barrier

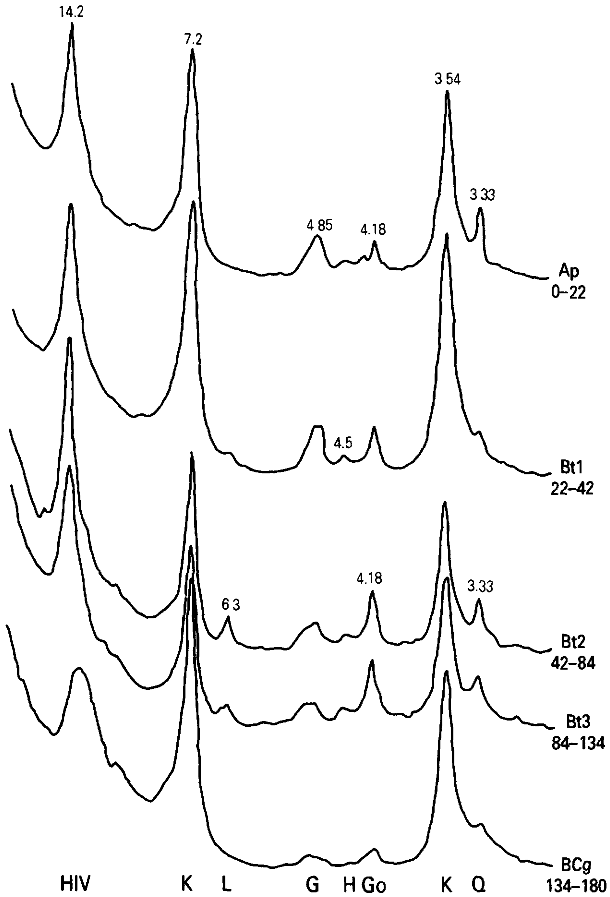


Figure 15. X-ray diffraction patterns of untreated samples from pedon 009. Vermiculite (HIV) and kaolinite (K) are predominant throughout the profile. Vermiculite shows decreasing peak intensities relative to kaolinite above the Bt2 horizon. Gibbsite (G) shows an increase in peak intensity toward the surface. Quartz (Q) is present throughout and does not show an increase toward the surface. Lepidocrocite (L) is present in the Bt2 horizon, and goethite (Go) is present throughout the profile. Peaks are measured in angstroms. Depths of horizons are in centimeters.

sediments. If this interpretation is true, then our data could represent the upper part of a thick bisequal profile. The possibility of 3- to 8-m-thick bisequal soils on 10^{6+}-yr-old deposits should be considered in future work.

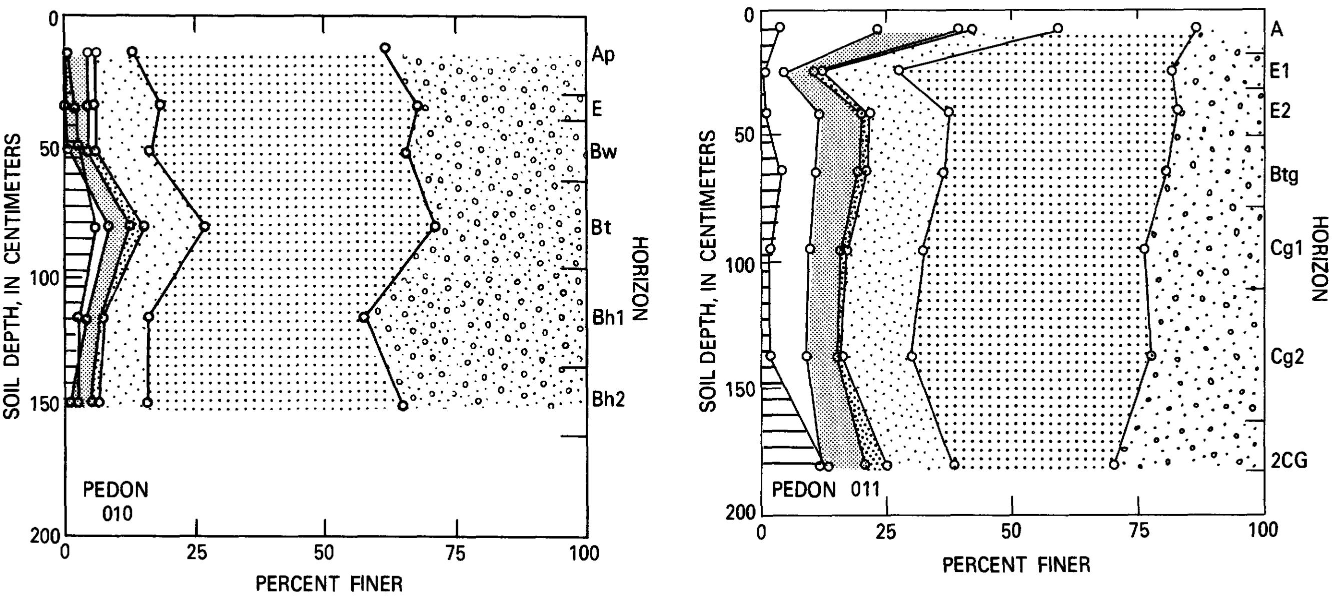
There is a strong contrast between pedons 001 and 002 on the Horry barrier. The major difference between the two is in situ development of clay in the argillic horizon of pedon 001. Both gibbsite and halloysite are present in the Bt horizon of pedon 001 but not in the Bt horizon of pedon 002. The Bt1 and Bt3 horizons of pedon 001 show a strong 4.5-A reflection (fig. 4), interpreted to be a reflection from halloysite. This same peak was documented by Brindley and others (1963) and appears in the halloysite-rich horizons of weathering profiles from the Coastal Plain of the Middle Atlantic States investigated by Owens and others (1983). Because of the peak intensity of halloysite in the Bt3 horizon relative to intensities higher in the profile, we interpret halloysite to be the result of in situ alteration of feldspar.

Owens and others (1983) did not find halloysite in the clay fraction of the Parsonsburg Sand, which they interpreted as eolian. D. R. Soller (oral communication, 1984) found halloysite at moderate depths (5–10 m) in weathered Coastal Plain sediments, but he did not find halloysite in clay fractions of eolian dunes adjacent to the Cape Fear River on the North Carolina Coastal Plain. Thus, the presence of halloysite in Horry County soils is taken as evidence for in situ clay formation (alteration of kaolinite) and not as an indicator of eolian activity. In the Horry and Conway barrier profiles, the intensity of the 4.5-A halloysite peak increases with increasing clay content in the Bt horizon rather than with the age of the solum. The low percentage of clay in pedon 002 and the lack of halloysite and gibbsite in pedon 002 (fig. 5) are apparently due to differences in argillic development in pedons 001 and 002.

The argillic horizon of pedon 002 was described in the field as 21 cm thick. This Bt horizon has 4.8 percent clay, only 0.4 percent greater than the overlying E horizon and 2.8 percent greater than the underlying BC horizon. Quartz grains in the Bt horizon are coated with an opaque substance, probably iron, and have no bridging clay skins. Even if the E and BC horizons were considered to be part of the argillic horizon, the total thickness of that horizon would be only 60 cm, much less than the 100+-cm-thick argillic horizon of pedon 001 (tables *3B*, *4B*).

Data indicate that local variations in the texture of parent material and (or) local drainage conditions (pedon 001, 0 percent slope; pedon 002, 10 percent slope) are the dominant influences on pedogenic development and therefore on argillic horizon development. There is 13 to 15 times as much fine-grained sand as there is medium-grained sand in the solum and in the underlying parent material in pedon 001. In comparison, the ratio of fine-grained sand to medium-grained sand is 3:1 in the solum and 7:1 in the parent material of pedon 002. There is more than 10 percent fine-grained clay in the Bt2 horizon of pedon 001 and less than 1.0 percent in the Bt horizon of pedon 002 (tables *3B*, *4B*). Weaver (1975) suggested that fine-grained and very fine grained sand was the most reactive grain-size fraction coarser than 2 μm. His data suggested that, in the humid tropics, silt was less significant as a source of dissolved silica than the fine-grained and very fine grained sand fractions were. Although the ratio of fine-grained silt to coarse-grained silt varies in the C horizons of the two pedons, the ratio in the argillic horizons is the same (1.4:1), an apparent corroboration of Weaver's (1975) findings. The 10-percent surface slope at the site of pedon 002 could be significant enough to enhance removal of dissolved silica and therefore impede development of pedogenic halloysite.

In all of the well-drained and moderately well drained soils of the southeastern Coastal Plain and Piedmont, the



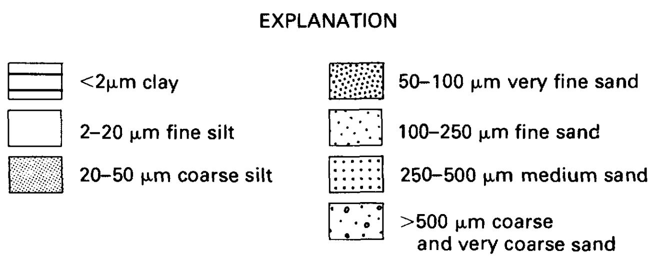


Figure 16. Weight percent clay and weight percents of silt and sand on a clay-free base for Carolina bay pedons 010 and 011. Horizontal lines show weight percent of clay (<2 μm) for each horizon. Vertical lines denote percent finer than 20, 50, 100, 250, 500, and 2,000 μm on a clay-free base. Clay-free texture of each horizon is calculated by subtracting weight percent of clay; weight percents of coarser fractions are summed, and that sum is used as the denominator in recalculating the percentages of each silt and sand fraction.

increase in clay mass in the argillic horizons is associated with the increase in clay-sized quartz, which is a direct result of dissolution of the larger silt-sized and very fine grained sand-sized particles within the argillic horizon (Vita-Finzi and Smalley, 1970; Moss and Green, 1975; M. J. Pavich, H. W. Markewich, and E. J. Dwornik, manuscript in preparation, 1986). As Thom (1967b), Adams and Thom (1968), and Thom and others (1972) noted, our data also show an increase of 14.2-A HIV toward the surface and a corresponding decrease in kaolinite. Perhaps when bases are recycled through the biota, silica and alumina are released by dissolution of the very fine grained sand- and silt-sized fraction in the solum, and kaolinite is transformed to the low-charge vermiculite. The frequency of wetting and drying cycles and the increase of solute activities due to drying may also favor the formation of vermiculite (Markewich and others, in press).

Back-Barrier Soils

The dominant clay minerals in back-barrier sola are kaolinite and HIV and lesser amounts of gibbsite and halloysite. In general, HIV peak intensities increase toward the surface. There is little development of halloysite in the back-barrier soils except in pedons 014 (fig. 11) and 015 (fig. 12), where halloysite does appear in the Bt horizons. Goethite is also a significant component of the B and C horizons in the back-barrier profiles. In contrast to HIV peak intensity, goethite peak intensity generally increases downward beneath the upper Bt horizons. The goethite may be related to repeated oxidation-reduction cycles within the poorly drained lower horizons. In the Conway back-barrier pedons, there is very little evidence for mineral alteration, as the lack of halloysite development and the presence of feldspar in the B horizon indicate (pedons 007 and 009) (figs. 14, 15). Some potassium feldspar was identified petrographically in the very fine grained sand fraction of the BCg1 horizon of pedon 007.

Argillic horizons developed in soils on back-barrier sediments of the Horry, Conway, and Jaluco barrier systems range in thickness from 20 to 110 cm. Field descriptions indicate no apparent correlation between the thicknesses of the argillic horizon as described in the field and the ages of soils or of the parent material. Particle size data, plotted on clay distribution curves (tables 7*B*, 8*B*, 10*B*, 13*B*, 14*B*, 15*B*, 16*B*) (see fig. 8), and microfabric analysis suggest that argillic horizons are thicker than field observations indicate (>150 cm).

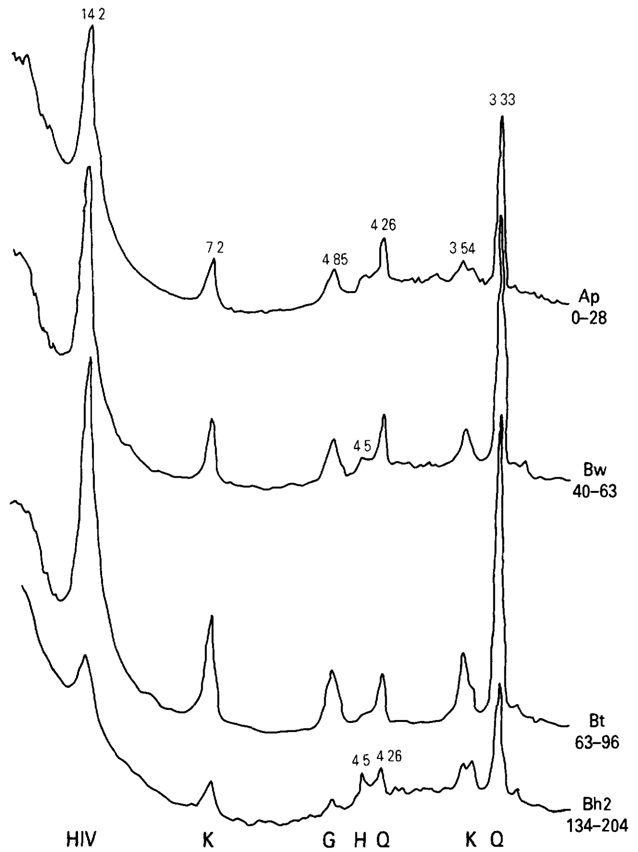


Figure 17. X-ray diffraction patterns of untreated samples from pedon 010. Vermiculite (HIV), kaolinite (K), gibbsite (G), and quartz (Q) are present throughout the profile. Peak intensities of vermiculite and quartz are greatest in the Bt horizon. Intensities of all peaks decrease toward the surface. Halloysite (H) is not present in the profile. Peaks are measured in angstroms. Depths of horizons are in centimeters.

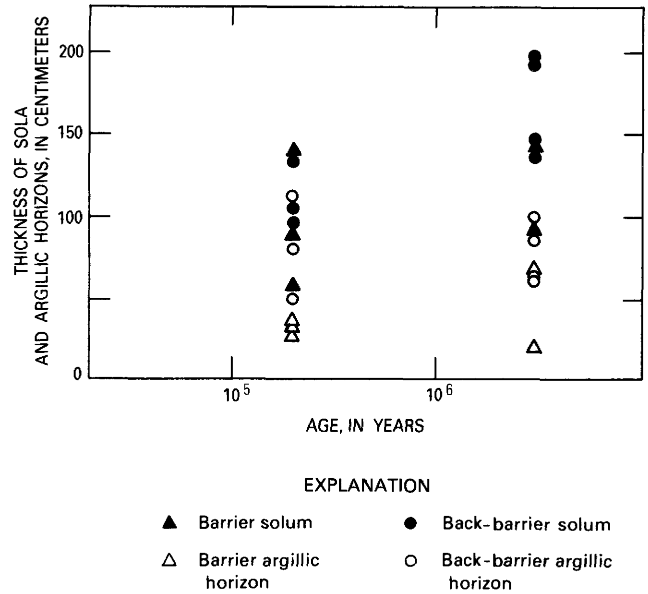


Figure 18. Thicknesses of sola and argillic horizons for Jaluco, Conway, and Horry barrier and back-barrier sites.

The problem with the clay distribution curves (thick argillics) of Horry back-barrier soils is the difficulty in differentiating pedogenic clay from detrital clay. In most cases, the lower horizons containing more clay also show a sand distribution different than that of the overlying horizons (fig. 8). The presence of clay films in thin section can be misleading, because the finer sediments tend to stop the downward movement of clay and thus facilitate the formation of clay films. However, thin sections showed that the colors of thick clay skins in the lowermost horizons are commonly different than those of thick clay skins in the shallower Bt horizons, the suggestion being that they formed and were oxidized in the Bt horizon at a time before translocation.

Textural and microfabric analyses show that the minimum scatter of solum thickness is in the 200-ka back-barrier soils and that sola of the 2.5- to 3.0-Ma back-barrier soils are substantially thicker than the 200-ka sola, even though field descriptions suggest little to no correlation between age and thickness of argillic horizons or sola (see fig. 18). Increasing argillic horizon thickness probably results from the translocation of clay and silt downward through the profile, which, in turn, explains the lesser value of clay mass for the Horry back-barrier pedons in comparison with the values for the Conway and Jaluco back-barrier pedons (see fig. 20).

Tables 13*B* and 15*B* show the apparent effect of downward translocation of clay in pedons 012 and 014 developed in Horry back-barrier sediments. It is probable that the horizons labeled as BC, CB, and C are, in fact, part of the argillic horizon and should be designated as Bt horizons. The solum thickness of the Horry back-barrier soils would then be much greater than the 3 to 6 m sampled and probably deeper than standard backhoe excavation can reach. Therefore, the soils developed on the back-barrier sediments of the 2.5- to 3.0-Ma Horry barrier system appear to be correctly placed in the Pale-Great Group and are characterized by certain parameters that are significantly different from those that characterize the 200-ka soils developed on the Conway and Jaluco back-barrier sediments.

The back-barrier soils of the Horry and Conway barrier systems show a 10-percent increase in fine-grained sand in the upper 20 to 47 cm of the sola. Although this surface layer is generally described in the field as an A and (or) E horizon, this sandy surface could be eolian in origin, or the sand could be residual from eolian activity that has removed the intervening fines. Daniels and others (1969) referred to windblown sands associated with Coastal Plain river valleys. This dunal material associated with the rivers and Carolina bays of the lower Coastal Plain are evidence enough to suggest that loose sand, silt, and clay at the surface have been subjected to eolian processes either con-

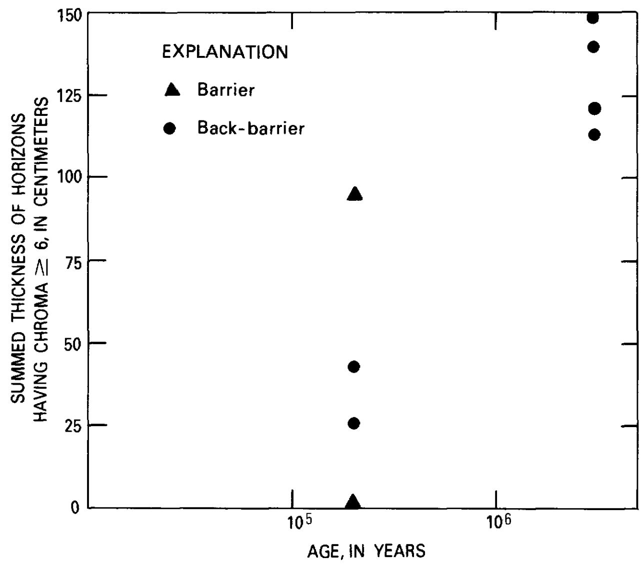


Figure 19. Thicknesses of Bt, BC, CB, and C horizons having chroma greater than six versus age of solum.

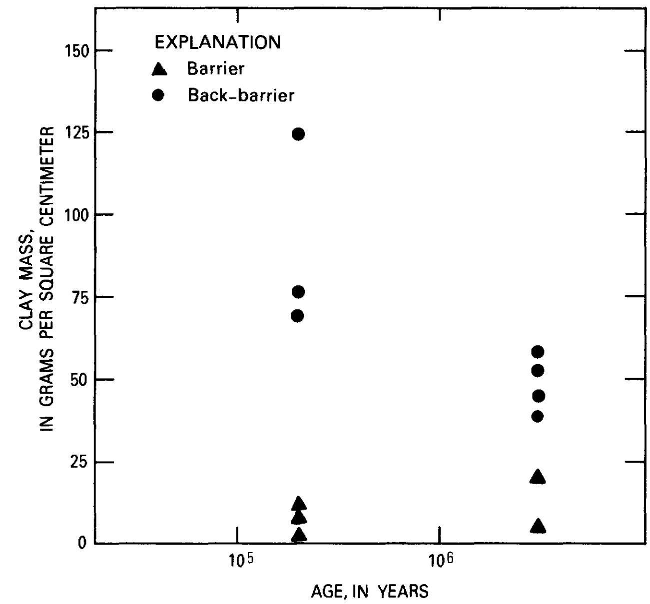


Figure 20. Clay mass versus age of solum for Horry, Conway, and Jaluco barrier and back-barrier profiles. Barrier sites show no increase of clay mass with age. Back-barrier sites show a decrease of clay mass with age.

tinuously or at periodic intervals since deposition (tables *7B*, *8B*, *13B*, *14B*, *15B*, *16B*).

Age Estimates

One of the primary purposes of this study was to determine if soil parameters could help bracket the ages of constructional landforms and their associated sediments on the Coastal Plain of the Atlantic Coast States. Data from the Eastern Shore and the Rappahannock River terraces of southeastern Virginia (Markewich and others, in press) indicated that, for constructional landforms up to several hundred thousand years old, soil parameters such as chroma, thickness of sola, thickness of argillic horizons, clay mass, and (or) depth and degree of clay translocation could be used to estimate ages. The most apparent differences are between soils that vary in age by an order of magnitude. Data from Horry County, South Carolina, also indicate that there are significant differences between soils that are several hundred thousand years old versus soils that are more than 1 Ma (figs. 18, 19, 20, 21). These differences are similar to those seen in the Coastal Plain of Virginia and result from time-progressive postdepositional modification of the parent material. Pye (1983) summarized the near-surface modification of Pleistocene and Holocene dune sands of Queensland, Australia, which included reduction in mean grain size, poorer sediment sorting, reduction in voids ratio, reduction in porosity and permeability, and increased interparticle cohesion.

Data from Horry County suggest that near-surface diagenetic processes in sandy siliceous Coastal Plain sediments of the middle and Southeastern United States produce characteristics similar to those described by Pye (1983). Figure 19 shows that older (more than 1.0 m.y.) back-barrier pedons exhibit a greater total thickness of horizons having chroma greater than or equal to six, probably because of deeper oxidation in the back-barrier sites through time. Data are not sufficient to show a trend in pedons on barrier sites. The increase in high chroma is only one of the criteria for identifying increasing solum thickness with increasing age in the back barriers (fig. 18). Textural data show no obvious trends in age for soils developed on the Conway and Jaluco barrier systems (figs. 8, 18, 20, 21). Figure 21 shows, however, that soils of different ages cluster when we plot the ratio of sand textures against thicknesses of argillic horizons. Although the data are too few to establish the usefulness of this plot, future studies in this region may provide the data necessary to evaluate its usefulness.

Although this study could not establish any particular association between clay mineralogy and age of deposit, D. R. Soller (oral communication, 1984) provided evidence that quartz, gibbsite, and vermiculite are clay-sized eolian components of both the Holocene dunes and sand sheets associated with the youngest Cape Fear River terraces and the >40-ka dunes and Carolina bay rims present on older fluvial and marine terraces in the lower Coastal Plain of North Carolina. HIV, gibbsite, and clay-sized quartz form in situ in the B horizons of Pleistocene and Pliocene soils in both Coastal Plain and Piedmont soils of South and North Carolina. These soils are therefore the most probable source for the eolian HIV and clay-sized quartz encountered in

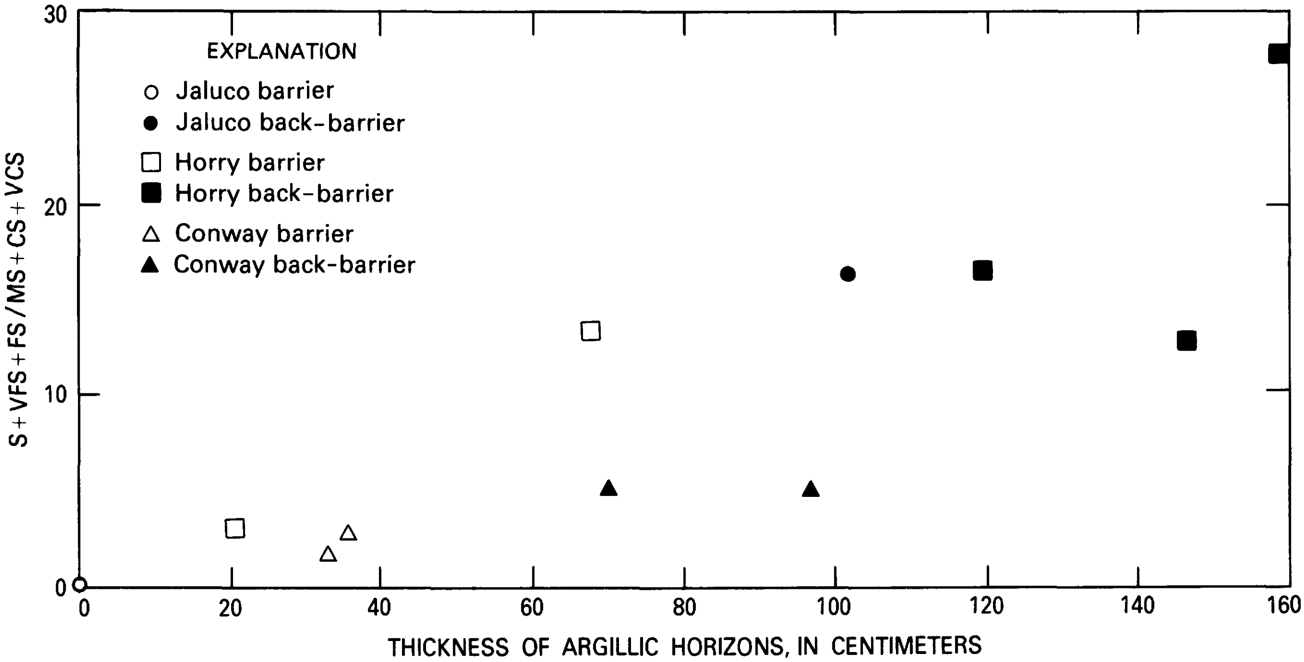


Figure 21. Ratio of silt (S) plus very fine grained sand (VFS) plus fine-grained sand (FS) to medium-grained sand (MS) plus coarse-grained sand (CS) plus very coarse grained sand (VCS) versus the thicknesses of argillic horizons for Horry, Conway, and Jaluco barrier and back-barrier profiles.

many of the dunes. Athough these minerals may be able to form in situ in the soils associated with the Carolina bays on higher terraces of the Cape Fear River, the very young age (5,700–7,700 yr B.P.) (USGS Radiocarbon Laboratory, Reston, Va., sample numbers W–5141 and W–5157, cited by Soller (1983)) for the dunes on the lowest terrace of the lower Cape Fear River suggests that these minerals were formed elsewhere and blown into the sandy dunal material. X-ray diffraction patterns that show strong HIV and quartz peaks in the upper 20 cm of Horry County soils suggest a similar origin for the material above the Bt horizons in this region (figs. 4–7).

In Horry County, South Carolina, and in southeastern Virginia (Markewich and others, in press) where landforms are older than 500 ka and where there has been minimal dissection of the terrane, many of the sola have thicknesses in excess of 4 m; thus, sampling from core or from man-made exposures is required. Without core or large exposures, data such as those presented in this report from the Horry barrier system probably reflect only the near-surface aspects of profiles having bisequal development. Data also indicate that in all cases, but particularly in those where quartz sand and silt comprise more than 95 percent of the parent material, complete soil characterization is needed to identify those parameters related to microenvironments and those related to age of sola (time). Microenvironments include microdrainage differences, local differences in mineralogy, and bisequal pedogenic development.

The work of Thom (1967a, b, 1970; Thom and others, 1972) in Horry County and the work of Soller (1983, in press) on the terraces of the Cape Fear River in North Carolina suggest that depth of weathering and depth of oxidation can be used to estimate the age(s) of the surface of constructional landforms. Thom (1967a) showed progressive differences in depth of sola and degree of oxidation with increasing age of barriers. Adams and Thom (1968) and Thom and others (1977) showed a progressive increase in fine-grained material with increasing age of barrier. (Markewich and others (in press) showed a similar trend of increasing fine-grained material with increasing age for terrace sediments along the lower Rappahannock River in southeastern Virginia.)

Thom (1967a) suggested that depth of oxidation varied from 1 m in the <30-ka terrace deposits (Thom's Terrace I) to 1.5 to 2.5 m in the >36-ka Dune Sand II, Myrtle Beach Barrier, and Terrace II to about 5 m in the 200- to 500-ka Jaluco and Conway barriers (considered to be 200 ka in this report) to more than 7 m in the 2.0- to 3.5-Ma Horry barrier system. Similar observations on increasing depth of oxidation with increasing age have been made for 100-ka to 4.5-Ma fluvial and marine deposits in the valleys of the Cape Fear and Little Pee Dee Rivers in North and South Carolina (J. P. Owens and D. R. Soller, oral communication, 1983; Soller, 1983, in press; H. W. Markewich, unpublished data, 1982–1984).

Depth of oxidation is probably the easiest usable value to obtain in the field for comparing thicknesses of weathering profiles. Comparing depths of oxidation can provide a relative chronology for units in terranes where increasingly older deposits are encountered with increased altitude and degree of dissection. Since depth of oxidation is directly related to depth to the water table and degree of internal drainage, depth of oxidation should be measured only in areas of maximum relief and (or) drainage density such as margins of barriers and (or) terraces. In areas such as the lower Coastal Plain of South Carolina, which has been only slightly modified by dissection and in which the depths to which streams are incised vary greatly, the limited number of acceptable sample localities would restrict the size of the data set and thus affect the accuracy of estimates on surface ages. Other data that could be collected to determine the depth and degree of weathering include information on heavy and light minerals, mineral trends from depth toward the surface for the clay, silt, and very fine grained sand and fine-grained sand fractions (see Owens and others (1983) for an example of this type of analysis), and the degree of SiO_2 dissolution determined by bulk chemical analyses (a reflection of the mineral trends).

CONCLUSIONS

Several factors have contributed greatly to the successful correlation of soils and surfaces of similar ages: (1) a climate that has been relatively uniform over much of the Pliocene and Pleistocene (allowing for catastrophic events producing features such as the Carolina bays); (2) similar topographic positions of marine deposits of a given age; (3) similar vegetation assemblages through the Pliocene and Pleistocene; and (4) similar composition and sorting of parent material. Similar degrees of dissection and drainage conditions in units of different ages work against such correlations, because the degree of dissection and the development of soil and weathering profiles are greatly dependent on local gradient. If there are no significant differences in gradient, it becomes difficult to determine the differences in soil and weathering profiles, even though they have developed on surfaces that differ greatly in age.

Conclusions drawn from pedogenic studies in Horry County, South Carolina, can be divided into two categories: (1) those related to pedogenesis and (2) those related to using soil characteristics for estimating the age of a constructional landform (surface age determined by age of solum).

One conclusion that belongs in neither category but is nevertheless an important logistical consideration concerns sampling needs for soil and weathering profiles developed in the humid temperate climate of the Atlantic Coastal Plain. If landforms older than 10^6 yr are to be sampled, one of the following must be used: (1) several 6-in core holes placed within a few inches of one another, (2) undisturbed shelby tube samples arrayed like the 6-in core, or (3) successively deeper backhoe trenches. Depths that can be excavated by standard backhoe are not adequate because of the 3- to 8-m thicknesses of the sola. If the thicknesses of the sola and associated weathering profiles are considered, depths of 9 to 15 m would not be uncommon. Several core or shelby tube holes would be needed to obtain the volume of sample needed for complete analyses of any horizon.

Pedogenesis

Physical alteration of the parent material appears to be greater than and not necessarily the result of chemical alteration in most of the barrier and back-barrier profiles. There is little evidence of pedogenic chemical alteration at sites that are either excessively well drained (pedon 002) or poorly drained (back-barrier pedons 012, 013, 014, and 015).

The bulk of the evidence for physical alteration is found in back-barrier pedons. For several periods, clay movement resulted in cutans of different hue and chroma. Also, weatherable minerals present in back-barrier sediments are not found in the sola, whereas, in the barrier sands, no weatherable minerals were identified in the parent material or in the sola. Finally, significant reorientation of clay has taken place in the argillic horizons.

X-ray diffraction data indicate that the presence or absence of clay minerals is related more to microenvironments, drainage conditions, and texture than it is to the age of the solum or to minor differences in the original compositions of parent material. Examples include the associations between halloysite and weight percent clay and between goethite and mottles (suggestive of cyclic alteration of oxidation-reduction conditions in the zone of fluctuating water table).

Data suggest that halloysite is an indicator of pedogenic clay development and not of indigenous clay content or eolian contribution.

The increase in the peak height ratio of 14.2 A (HIV) to 7.2 A (kaolinite)+4.85 A (gibbsite) minerals toward the surface corresponds to a decrease in extractable aluminum toward the surface and suggests that HIV is incorporating aluminum into interlayer positions.

Pedologic development proceeded along two pathways. Soils developed in parent material characterized by low clay content and impeded drainage developed spodic horizons (or humate) at or slightly above the seasonal water table. Soils developed mostly in fine-grained or poorly sorted sediment accumulated more clay during weathering and have argillic horizons.

Humate development can occur by translocation of organic material downward through a sandy solum containing little clay or by lateral migration of soluble organic material in ground water above a confining layer.

Humates contain variable amounts of iron and (or) aluminum and very little clay. Characterization of the organic content of humates and (or) isotope chemistry may help define the processes involved in the development of humates.

Locally, soil drainage conditions appear to be dominant over time in determining the development of argillic horizons. That is, the influence of topography is apparently greater than that of time in the development of the sola in certain parts of the landscape. This conclusion may prove incorrect if further investigations show substantially thicker profiles on the Horry barrier system or on any sandy siliceous marine sediments of equivalent age in the region.

Age Determinations

Data are insufficient to differentiate soils of the Jaluco and Conway barrier systems. This conclusion is in agreement with the mapping of Thom (1967a) and J. P. Owens (oral communication, 1984), which placed the Conway and Jaluco barrier systems in the same map unit and considered them to be equivalent in age. Although our data suggest that there has been only a minimal degree of pedogenic alteration in the Jaluco and Conway barrier systems of Horry County, Soller (1983, in press) showed that up to 10 percent of the fine-grained sand fraction of terrace sediments in the lower Cape Fear River valley consists of feldspathic or other weatherable aluminosilicate minerals. J. P. Owens (oral communication, 1984) suggested a similar subsurface composition for the Horry barrier sediments. The lack of these labile components in near-surface sediments of the Jaluco, Conway, and Horry barrier systems suggests that leaching of weatherable minerals may be the first step in the pedogenic alteration of these deposits. If this hypothesis is true, then evidence of pedogenic development may not be recognizable for several thousand years after subaerial exposure. A logical next step in research would be quantitative analyses of weathering and pedogenic alteration with respect to mass loss from these 10^{6+}-yr-old landforms.

Differences in thicknesses of argillic horizons can be used to separate soils that differ in age by an order of magnitude. Back-barrier soils of the 200-ka Conway and Jaluco barrier systems have argillic horizons and sola that are thinner than back-barrier soils developed in the Horry barrier systems.

Thicknesses of the argillic horizons support placement of the Horry back-barrier soils in the Pale-Great Group and are consistent with the Pliocene age presently assigned to the underlying Bear Bluff Formation. Barrier soils of the Horry barrier system are not sufficiently well developed to classify as Paleudults.

For most areas of the lower Atlantic Coastal Plain, relief is great enough to allow simple comparisons of oxidation depths, percentages of labile minerals, and ratios of heavy minerals to be used in determining the relative age of landforms. Caution is needed, because these factors more directly measure differences in relief and (or) dissection between the units rather than differences specifically related to weathering and (or) soil formation. If refinement of ages is necessary, complete pedogenic analyses are probably unavoidable, and sampling techniques are critical because of the depth of the sola.

The back-barrier part of a barrier system may be the source of the HIV and quartz eolian contribution to barrier sands. Such a system would result in depletion of back-barrier surface fines and preservation of barrier forms by accretion. More detailed mineralogical characterizations are necessary to support or dispute this hypothesis.

Three parameters that could be used to estimate ages of surfaces in other parts of the lower Coastal Plain in the Southeastern United States are as follows:

1. The thicknesses of the solum and of the argillic horizon, determined from textural and microfabric data, appear to be acceptable indicators of soil age when soils several hundred thousand years old are compared with those over a million years old, if the entire profile has been sampled. Profile thicknesses estimated from field descriptions do not appear to be reliable for soils developed in barrier and back-barrier units, or at least not where field descriptions are limited to within 3 m of the surface. (The ratios of fine-grained particles (clay plus fine-grained silt plus coarse-grained silt plus very fine grained sand) to coarse-grained particles plotted against the thicknesses of argillic horizons (fig. 21) cluster for individual morphostratigraphic units. This treatment of the data suggests a method of providing age estimates, but it must be tested on many more sites of known age before its usefulness can be determined.)
2. Clay, silt and clay, silt, and sand flows appear to indicate an age of at least 10^5 yr for sola developed in back-barrier sediments of the lower Coastal Plain. Several periods of translocation, indicated by the presence of both red-brown and brown cutans and by the layering of cutans around skeletal grains, are characteristic of sola developed in back-barrier sediments more than 10^6 yr old. More work is needed before microfabric analyses can be used for estimating age, but the technique may prove useful.
3. As an adjunct to microfabric analysis, clay mass may be useful in differentiating units that differ in age by an order of magnitude. Back-barrier soils more than 10^6 yr old begin to lose clay mass in the upper part of the solum as clay is translocated downward.

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Tables 1–18

Table 1. Correlation of upper Tertiary formations with morphostratigraphic units on the southwestern limb of the Cape Fear Arch
[--, unit not cited]

Thom (1967a)		DuBar (1971), DuBar and others (1980)		J. P. Owens (oral communication, 1984)		
Barrier–back-barrier system	Associated glacial and interglacial stage	Barrier–back-barrier system	Formation	Barrier–back-barrier system	Formation	Age
Recent -------	Unnamed	Recent	Unnamed	Recent	Unnamed	0–33 ka
Myrtle -------	Sangamon	Myrtle Beach	Socastee or Canepatch.	Not recognized.	Wando (if present)	70 ka
Jaluco --------	Yarmouth or Aftonian.	Jaluco-Cainhoy	Canepatch	Jaluco	Socastee	200 ka
Conway ------	Yarmouth or Aftonian.	Conway	Canepatch	Conway	Socastee	200 ka
--	--	--	--	Conway back-barrier flat.	Socastee	200 ka
--	--	Pleasant Hill–Nakina.	Waccamaw	Daisy Strand–Nakina.	Penholoway	800 ka
Horry --------	Aftonian or pre-Pleistocene.	Horry	Waccamaw	Horry	Bear Bluff	2.5–3.0 Ma
		Lakeview-Orrum.	Bear Bluff	--	--	

Table 2A. Correlation of pedon number with morphostratigraphic unit and topographic position

Pedon number	Morphostratigraphic unit	Topographic position
S80SC–051–001---	Horry barrier system	Barrier
S80SC–051–002---	Horry barrier system	Barrier
S80SC–051–003---	Conway barrier system	Barrier
S80SC–051–004---	Conway barrier system	Barrier
S81SC–051–006---	Conway barrier system	Back barrier
S81SC–051–007---	Conway barrier system	Back barrier
S81SC–051–008---	Jaluco barrier system	Barrier
S81SC–051–009---	Jaluco barrier system	Back barrier
S81SC–051–010---	Pee Dee fluvial terrace	Rim of Carolina bay.
S81SC–051–011---	Pee Dee fluvial terrace	Rim of Carolina bay.
S81SC–051–012---	Horry barrier system	Back barrier
S81SC–051–013---	Horry barrier system	Back barrier
S81SC–051–014---	Horry barrier system	Back barrier
S81SC–051–015---	Horry barrier system	Back barrier

Table 2*B*. Analytical methods and units of expression for analyses conducted at the Soil Conservation Service National Soil Survey Laboratory, Lincoln, Nebr.

Analysis	Method code[1]	Unit of expression
Particle size	3A1	Weight percent <2 mm material.
Organic carbon	6A1C	Weight percent <2 mm material.
Dithionite-citrate	6C2A	Weight percent <2 mm material.
Iron	6C2B	Weight percent <2 mm material.
Aluminum	6G7A	Weight percent <2 mm material.
Manganese	6D2A	Weight percent <2 mm material.
Bulk density	4A1D	g/cm^3 <2 mm material
COLE[2]	4D1	cm/cm whole soil
15-bar tension	4B2A	Weight percent <2 mm material.
WRD[3]	4C1	cm/cm whole soil
Extractable bases	5B5A	meq/100 g <2 mm material.
Cation exchange capacity (CEC):		
Sum of cations	5A3A	meq/100 g <2 mm material.
NH_4OAC	5A8B	meq/100 g <2 mm material.
Al + bases[4]	5A3B	meq/100 g <2 mm material.
Base saturation:		
Sum of cations	5C3	Percent
NH_4OAC	5C1	Percent
pH:		
$CaCl_2$	8C1E	Negative $\log_{10}$
H_2O	8C1A	Negative $\log_{10}$

[1]Method codes from Soil Survey Staff (1972).

[2]Coefficient of linear extensibility.

[3]Water-retention difference.

[4]Aluminum precipitates from solution at pH 4.5 to 4.8. For pH ≥ 5, extractable aluminum is not measured.

Table 3A. Field description of pedon S80SC-051-001

[Location: 18.3 km north of Conway, Horry County, South Carolina; 34°02′ N., 79°05′ W. Temperature: 17 °C mean annual, 26 °C mean summer. Elevation: 30 m above mean sea level. Physiography: Barrier bar. Geomorphic position: Crest of interfluve. Slope and aspect: 0 percent plane. Precipitation: 137 cm, udic moisture regime. Drainage: Moderately well drained. Land use: Cropland. Parent material: Moderately weathered marine sand and clay. No entry indicates no data]

Depth (cm)	Horizon	Moist color[1]	Texture[2]	Structure[3]	Clay skins	Roots[4]	Boundary[5]
0–33	Ap	10YR4/2	ls	1fgr		mf	as
33–45	E1	10YR7/6	ls	1msbk		mf	gs
45–74	E2	10YR7/6	ls	1msbk		fm	cs
74–98	Bt1	10YR5/8	sl	1m + csbk		cm	gs
98–117	Bt2	10YR7/1	sl	1csbk		ff	gw
117–141	Bt3	10YR7/1	sl	1csbk			ci
141–177	C	10YR7/2	ls	SG			

[1]Munsell notation.

[2]sl, sandy loam; ls, loamy sand.

[3]1, weak; f, fine; m, medium; c, coarse; gr, granular; sbk, subangular blocky; SG, single grain.

[4]ff, few fine; fm, few medium; mf, many fine; cm, common medium.

[5]cs, clear smooth; as, abrupt smooth; gs, gradual smooth; gw, gradual wavy; ci, clear irregular.

Table 3B. Textural analysis of pedon S80SC-051-001

[Grain sizes in millimeters; all other values in weight percent. VF, very fine; F, fine; M, medium; C, coarse; VC, very coarse; TR, trace; —, analyzed but below detectable limits]

		Total			Clay	Silt		Sand				
Depth (cm)	Horizon	Clay (<.002)	Silt (.002–.05)	Sand (.05–2)	F (<.0002)	F (.002–.02)	C (.02–.05)	VF (.05–.10)	F (.10–.25)	M (.25–.50)	C (.5–1)	VC (1–2)
0–33	Ap	1.6	6.8	91.6	—	—	6.8	3.4	81.1	6.1	1.0	TR
33–45	E1	2.0	5.8	92.2	1.2	3.6	2.2	3.4	81.8	5.7	1.2	0.1
45–74	E2	2.8	6.1	91.1	1.2	3.6	2.5	3.4	80.5	5.9	1.3	TR
74–98	Bt1	12.5	4.4	83.1	8.9	2.8	1.6	2.8	74.3	5.1	.9	TR
98–117	Bt2	16.1	2.7	81.2	10.5	.8	1.9	2.5	72.4	4.7	1.5	.1
117–141	Bt3	12.1	1.2	86.7	7.7	—	1.2	2.5	74.0	6.8	3.3	.1
141–177	C	9.2	2.4	88.4	4.8	—	2.4	3.4	78.0	5.0	1.8	.2

Table 3C. Physical and chemical analyses of pedon S80SC–051–001

[Units of measure for all values given in table 2B. —, not detected; no entry, not analyzed; TR, trace]

Depth (cm)	Horizon	Organic C	Total N	Extractable P	Total S	Dithionite-citrate Extractable Fe	Dithionite-citrate Extractable Al	Dithionite-citrate Extractable Mn	Ratio clay CEC[1]	Ratio clay 15 bar[2]
0–33	Ap	0.69	0.033			0.1			1.50	0.88
33–45	E1	.24	.015			.1			.45	.55
45–74	E2	.13	.012			.2			.25	.50
74–98	Bt1	.16	.020			.9			.18	.42
98–117	Bt2	.10				.5			.19	.40
117–141	Bt3	.05				.1			.21	.40
141–177	C	.05				.1			.24	.41

Depth (cm)	Horizon	Bulk density Field moist	Bulk density 1/3 bar	Bulk density Oven dry	COLE[3]	Water content Field moist	Water content 1/3 bar	Water content 15 bar[2]	WRD[4]	pH $CaCl_2$ (.01M) 1:2	pH H_2O 1:1
0–33	Ap		1.57	1.57	—		6.7	1.4	0.08	4.9	5.6
33–45	E1		1.60					1.1		4.8	5.4
45–74	E2		1.67	1.67	—		7.2	1.4		4.4	4.8
74–98	Bt1		1.55	1.56	0.002		8.4	5.2	.10	4.0	4.3
98–117	Bt2		1.66	1.66	—		9.5	6.5	.05	4.0	4.5
117–141	Bt3		1.67	1.69	.004		7.2	4.8	.04	4.2	4.8
141–177	C		1.67	1.68	.004		6.2	3.8	.04	4.2	4.8

Depth (cm)	Horizon	NH_4OAC extractable bases Ca	Mg	Na	K	Sum of bases	Acidity	Extractable Al	CEC[1] Sum of cations	CEC[1] NH_4 OAC	CEC[1] NH_4Cl	Base saturation Sum	Base saturation NH_4OAC
0–33	Ap	0.9	0.2	—	0.1	1.2	1.2	0.1	2.4	2.4	1.6	50	50
33–45	E1	.1	.1	—	TR	.2	1.0	.2	1.2	.9	.9	17	22
45–74	E2	.1	.1	—	TR	.2	.2	.3	.4	.7	.7	50	29
74–98	Bt1	.1	.1	TR	.2	.4	3.3	1.1	3.7	2.2	1.6	11	18
98–117	Bt2	.4	.3	TR	.2	.9	3.1	1.4	4.0	3.0	2.4	23	30
117–141	Bt3	.9	.2	TR	.1	1.2	1.6	.7	2.8	2.5	2.4	43	48
141–177	C	.6	.1	TR	TR	.7	1.4	.9	2.1	2.2	1.9	33	32

[1]Cation exchange capacity.
[2]Water content at 15-bar pressure.
[3]Coefficient of linear extensibility.
[4]Water-retention difference.

Table 3D. Bulk chemistry of pedon S80SC–051–001

Major oxide	Horizon Ap	A21	A22	Bt1	Bt2	Bt3	C
SiO_2	97.4	99.8	97.5	92.3	90.4	93.4	97.4
Al_2O_3	1.6	.7	2.0	5.7	7.2	5.5	4.4
Fe_2O_3	<.01	<.01	<.01	1.12	.58	<.01	<.01
MnO	<.01	<.01	<.01	<.01	<.01	<.01	<.01
TiO_2	.3	.3	.4	.5	.4	.2	.2
CaO	.20	.16	.16	.16	.17	.18	.18
K_2O	.10	.09	.10	.14	.12	.09	.13
Na_2O	<.1	<.1	<.1	<.1	<.1	<.1	<.1
MgO	<.1	<.1	<.1	<.1	<.1	<.1	<.1
Total	99.6	101.0	100.1	99.9	98.8	99.3	102.3

Table 4A. Field description of pedon S80SC-051-002

[Location: 18.3 km north of Conway, Horry County, South Carolina. Location: 34°02′ N., 79°02′ W. Temperature: 17 °C mean annual, 26 °C mean summer. Elevation: 33 m above mean sea level. Physiography: Barrier bar. Geomorphic position: Crest of interfluve. Slope and aspect: 10 percent plane. Precipitation: 137 cm, udic moisture regime. Drainage: Well drained. Land use: Cropland. Parent material: Moderately weathered marine sand and clay. No entry indicates no data]

Depth (cm)	Horizon	Moist color[1]	Texture[2]	Structure[3]	Clay skins	Roots[4]	Boundary[5]
0–33	Ap	10YR4/2	ls	1fgr		mf	as
33–48	E	10YR5/6	ls	1msbk		cm	cs
48–69	Bt	10YR5/6	sl	1msbk		fm	cs
69–92	BC	10YR5/8	ls	1csbk		ff	gs
92–120	C1	10YR7/3	ls				
120–136	C2	10YR8/3	ls	1csbk			
136–173	C3	10YR4/4	sl	MA			

[1]Munsell notation.
[2]ls, loamy sand; sl, sandy loam.
[3]1, weak; f, fine; m, medium; c, coarse; gr, granular; sbk, subangular blocky; MA, massive.
[4]ff, few fine; mf, many fine; fm, few medium; cm, common medium.
[5]cs, clear smooth; as, abrupt smooth; gs, gradual smooth.

Table 4B. Textural analysis of pedon S80SC-051-002

[Grain sizes in millimeters; all other values in weight percent. VF, very fine; F, fine; M, medium; C, coarse; VC, very coarse; --, analyzed but below detectable limits]

		Total			Clay	Silt		Sand				
Depth (cm)	Horizon	Clay (<.002)	Silt (.002–.05)	Sand (.05–2)	F (<.0002)	F (.002–.02)	C (.02–.05)	VF (.05–.10)	F (.10–.25)	M (.25–.50)	C (.5–1)	VC (1–2)
0–33	Ap	2.0	5.0	93.0	--	1.6	3.4	1.9	65.7	20.8	4.5	0.1
33–48	E	4.4	3.9	91.7	1.6	2.0	1.9	1.4	61.2	22.6	6.4	.1
48–69	Bt	4.8	3.8	91.4	.8	1.6	2.2	1.3	62.7	21.3	6.0	.1
69–92	BC	2.0	2.6	95.4	1.2	--	2.6	1.7	66.9	20.9	5.8	.1
92–120	C1	1.6	7.6	90.8	.8	3.2	4.4	3.5	74.4	11.1	1.6	.2
120–136	C2	.8	8.3	90.9	--	--	8.3	3.4	73.9	11.8	1.7	.1
136–173	C3	8.4	8.9	82.7	.4	4.4	4.5	2.2	66.6	11.7	2.0	.2

Table 4*C*. Physical and chemical analyses of pedon S80SC–051–002

[Units of measure for all values given in table 2*B*. —, not detected; no entry, not analyzed; TR, trace]

Depth (cm)	Horizon	Organic C	Total N	Extractable P	Total S	Dithionite-citrate Extractable Fe	Dithionite-citrate Extractable Al	Dithionite-citrate Extractable Mn	Ratio clay CEC[1]	Ratio clay 15 bar[2]
0–33	Ap	0.79	0.040			0.2		—	1.25	0.75
33–48	A2	.23	.016			.3		—	.30	.45
48–69	Bt2	.22	.018			.4		—	.39	.44
69–92	B3	.10	.007			.2		—	.20	.45
92–120	C1	.08				.1		—	.19	.38
120–136	C2	.07				.1		TR	.25	.50
136–173	2C3	.12				.7		TR	.20	.42

Depth (cm)	Horizon	Bulk density Field moist	Bulk density 1/3 bar	Bulk density Oven dry	COLE[3]	Water content Field moist	Water content 1/3 bar	Water content 15 bar[2]	WRD[4]	pH $CaCl_2$ (.01M) 1:2	pH H_2O 1:1
0–33	Ap		1.58	1.59	0.002		5.1	1.5	0.06	4.8	5.4
33–48	A2		1.81	1.82	.002		1.7	2.0		4.6	5.2
48–69	Bt2		1.59	1.60	.002		6.1	2.1	.06	4.2	4.8
69–92	B3		1.55	1.57	.004		4.3	.9	.05	4.3	4.7
92–120	C1		1.60					.6		4.6	4.9
120–136	C2		1.68	1.68	—		3.7	.4	.06	4.7	5.1
136–173	2C3		1.79	1.79	—		6.4	3.5	.05	4.2	4.8

Depth (cm)	Horizon	NH_4OAC extractable bases Ca	Mg	Na	K	Sum of bases	Acidity	Extractable Al	CEC[1] Sum of cations	CEC[1] NH_4 OAC	CEC[1] NH_4Cl	Base saturation Sum	Base saturation NH_4OAC
0–33	Ap	0.9	0.3	—	—	1.2	2.2	0.3	3.4	2.5	1.8	35	48
33–48	A2	.1	.3	TR	—	0.4	.7	.4	1.1	1.3	1.1	36	31
48–69	Bt2	—	.2	—	—	0.2	.8	.6	1.0	1.4	1.7	20	14
69–92	B3	—	TR	—	—	—	—	.3		.4	.9		5
92–120	C1	—	TR	—	—	—	—	.2		.3	.6		7
120–136	C2	—	TR	—	—	—	—	.1		.2	.4		10
136–173	2C3	—	.1	—	TR	.1	.1	.7		1.7	1.3		6

[1]Cation exchange capacity.
[2]Water content at 15-bar pressure.
[3]Coefficient of linear extensibility.
[4]Water-retention difference.

Table 4*D*. Bulk chemistry of pedon S80SC–051–002

Major oxide	Horizon Ap	A2	B2t	B3[1]
SiO_2	99.7	98.90	98.70	99.50
Al_2O_3	.36	1.78	2.06	1.35
Fe_2O_3	<.01	<.01	.12	<.01
MnO	<.01	<.01	<.01	<.01
TiO_2	.33	.39	.37	.37
CaO	.18	.17	.16	.16
K_2O	.06	.08	.09	.05
Na_2O	<.10	<.10	<.10	<.10
MgO	<.10	<.10	<.10	<.10
Total	100.6	101.3	101.5	101.4

[1]Analysis of <63-μm fraction.

Table 5A. Field description of pedon S80SC–051–003

[Location: 8 km southwest of Conway, Horry County, South Carolina. Location: 33°48′ N., 79°06′ W. Temperature: 17 °C mean annual, 26 °C mean summer. Elevation: 14 m above mean sea level. Physiography: Barrier bar. Geomorphic position: Crest of interfluve. Aspect and slope: 1 percent plane. Precipitation: 137 cm, udic moisture regime. Drainage: Moderately well drained. Land use: Cropland. Parent material: Moderately weathered marine sand and clay. No entry indicates no data]

Depth (cm)	Horizon	Moist color[1]	Texture[2]	Structure[3]	Clay skins	Roots[4]	Boundary[5]
0–23	Ap	10YR4/1	ls	SG		cf	cs
23–37	A21	10YR6/4	fs	SG		cf	cs
37–55	A22	10YR7/4	ls	SG		ff	cs
55–73	Bt1	10YR6/4	ls	1csbk		ff	cs
73–91	Bt2	10YR6/4	ls	1csbk		ff	cs
91–105	A′2	10YR4/3	s	SG		cf	cs
105–126	Bh1	7.5YR3/4	s	MA		ff	cw
126–169	Bh2	10YR2/1	s	MA			gs
169–190	Bh3	10YR2/2	s	MA			

[1]Munsell notation.
[2]sl, sandy loam; ls, loamy sand; s, sand; fs, fine sand.
[3]1, weak; c, coarse; sbk, subangular blocky; SG, single grain; MA, massive.
[4]ff, few fine; cf, common fine.
[5]cs, clear smooth; cw, clear wavy; gs, gradual smooth.

Table 5B. Textural analysis of pedon S80SC–051–003

[Grain sizes in millimeters; all other values in weight percent. VF, very fine; F, fine; M, medium; C, coarse; VC, very coarse; TR, trace; —, analyzed but below detectable limits]

		Total			Clay	Silt		Sand				
Depth (cm)	Horizon	Clay (<.002)	Silt (.002–.05)	Sand (.05–2)	F (<.0002)	F (.002–.02)	C (.02–.05)	VF (.05–.10)	F (.10–.25)	M (.25–.50)	C (.5–1)	VC (1–2)
0–23	Ap	2.4	3.6	94.0		0.8	2.8	1.1	68.5	23.2	1.2	TR
23–37	A21	2.4	6.3	91.3		2.8	3.5	.9	65.6	23.6	1.2	—
37–55	A22	4.8	5.2	90.0		2.0	3.2	1.2	66.5	21.1	1.2	TR
55–73	Bt1	12.5	4.4	83.1		1.2	3.2	1.2	61.1	19.8	1.0	—
73–91	Bt2	8.5	3.1	88.4		—	3.1	1.1	64.4	21.8	1.0	0.1
91–105	A′2	1.6	2.4	96.0		—	2.4	.6	69.8	24.7	.9	—
105–126	Bh1	—	2.4	97.6		—	2.4	.4	67.7	27.9	1.6	TR
126–146	Bh21	—	2.1	97.9	—	—	2.1	.5	72.2	24.1	1.1	TR
146–169	Bh22	.8	1.4	97.8	0.8	.8	.6	.4	70.5	26.3	.6	TR
169–190	Bh3	—	1.3	98.7	—	—	1.3	.4	76.6	19.2	2.5	—

Table 5D. Bulk chemistry of pedon S80SC–051–003

	Horizon				
Major oxide	Bt1	Bt2	A′2[1]	Bh21[2]	Bh3[1]
SiO_2	52.40	48.80	42.75	31.22	97.93
Al_2O_3	16.88	17.51	14.88	19.50	.22
Fe_2O_3	6.47	9.42	9.90	1.18	.62
MnO	.05	.06	.05	.05	.01
TiO_2	1.45	1.43	1.70	1.77	.05
CaO	.37	.31	.37	.49	<.10
K_2O	.51	.44	.37	.63	.05
Na_2O	.20	.23	.30	.30	<.20
MgO	.62	.25	<.10	<.10	<.10
Total	78.9	78.4	70.3	55.1	99.3

[1]Analysis of <63-μm fraction.

Table 5C. Physical and chemical analyses of pedon S80SC–051–003

[Units of measure for all values given in table 2B. —, not detected; no entry, not analyzed; TR, trace]

Depth (cm)	Horizon	Organic C	Total N	Extractable P	Total S	Dithionite-citrate Extractable Fe	Dithionite-citrate Extractable Al	Dithionite-citrate Extractable Mn	Ratio clay CEC[1]	Ratio clay 15 bar[2]
0–23	Ap	0.73	0.045			0.1	0.1	—	0.92	0.58
23–37	A21	.23	.018			.2	.1	—	.46	.58
37–55	A22	.17	.014			.2	.1	—	.23	.33
55–73	Bt1	.24	.024			.7	.3	—	.19	.37
73–91	Bt2	.18	.018			.6	.2	—	.18	.39
91–105	A'2	.36	.020			.3	.2	—	.81	.81
105–126	Bh1	.34	.011			.1	.2	—		
126–146	Bh21	.68	.016			.1	.3	—		
146–169	Bh22	.68	.022			TR	.2	—	2.38	1.38
169–190	Bh3	.39	.008			—	.1	—		

Depth (cm)	Horizon	Bulk density Field moist	Bulk density 1/3 bar	Bulk density Oven dry	COLE[3]	Water content Field moist	Water content 1/3 bar	Water content 15 bar[2]	WRD[4]	pH $CaCl_2$ (.01M) 1:2	pH H_2O 1:1
0–23	Ap		1.60					1.4		4.1	4.4
23–37	A21		1.63	1.64	0.002		4.7	1.4	0.05	4.3	4.6
37–55	A22		1.55	1.55	—		5.6	1.6	.06	4.2	4.6
55–73	B21t		1.57	1.57	—		7.4	4.6	.04	4.1	4.6
73–91	B22t		1.60					3.3		4.3	4.7
91–105	A'2		1.68	1.68	—		3.8	1.3	.04	4.8	5.2
105–126	Bh1		1.70					.8		5.0	5.4
126–146	Bh21		1.70	1.75	.001		4.3	1.2	.05	4.9	5.4
146–169	Bh22		1.67	1.67	—		3.7	1.1	.04	4.9	5.3
169–190	Bh3		1.67	1.67	—		4.0	.7	.06	4.9	5.3

Depth (cm)	Horizon	NH_4OAC extractable bases Ca	Mg	Na	K	Sum of bases	Acidity	Extractable Al	CEC[1] Sum of cations	CEC[1] NH_4 OAC	CEC[1] Bases +Al	Al saturation	Base saturation Sum	Base saturation NH_4OAC
0–23	Ap	0.3	0.1	—	0.1	0.5	1.4	0.5	1.9	2.2	1.0	50	26	23
23–37	A21	.1	TR	TR	TR	.1	1.1	.5	1.2	1.1	.6	83	8	9
37–55	A22	.1	TR	—	TR	.1	1.3	.6	1.4	1.1	.7	86	7	9
55–73	B21t	TR	.1	—	.1	.2	3.5	1.3	3.7	2.4	1.5	87	5	8
73–91	B22t	—	TR	—	TR	TR	1.9	.9	1.9	1.5	.9	100		1
91–105	A'2	TR	TR	—	—	TR	3.5	.4	3.5	1.3	.4	100		2
105–126	Bh1	.1	TR	—	—	.1	2.7	.3	2.8	1.0	.4	75	4	10
126–146	Bh21	TR	TR	—	—	TR	5.9	.4	5.9	2.0	.4	100		1
146–169	Bh22	—	—	—	—	—	5.5	.4	5.5	1.9	.4	100		1
169–190	Bh3	TR	TR	—	—	TR	3.3	.3	3.3	1.0	.3	100		2

[1]Cation exchange capacity.
[2]Water content at 15-bar pressure.
[3]Coefficient of linear extensibility.
[4]Water-retention difference.

Table 6A. Field description of pedon S80SC–051–004

[Location: 17.6 km northeast of Conway, Horry County, South Carolina; 33°52′ N., 78°57′ W. Temperature: 17 °C mean annual, 26 °C mean summer. Elevation: 14 m above mean sea level. Physiography: Barrier bar. Geomorphic position: Crest of interfluve. Aspect and slope: 10 percent plane. Precipitation: 137 cm, udic moisture regime. Water table: 169 cm. Drainage: Moderately well drained. Land use: Cropland. Parent material: Moderately weathered marine sand and clay. No entry indicates no data]

Depth (cm)	Horizon	Moist color[1]	Texture[2]	Structure[3]	Clay skins	Roots[4]	Boundary[5]
0–24	Ap	10YR4/2	ls	1m+cgr		cf	as
24–35	E1	10YR6/4	ls	SG		cf	cs
35–48	E2	10YR7/4	ls	SG		cf	cs
48–61	BA	10YR7/6	ls	1fsbk		cf	gs
61–95	Bt	10YR5/8	sl	1f+msbk		ff	cs
95–121	BC1	10YR6/8	ls	MA			cs
121–138	BC2	10YR6/6	ls	MA			cs
138–169	C	10YR6/6	s	MA			

[1]Munsell notation.

[2]sl, sandy loam; ls, loamy sand; s, sand.

[3]1, weak; f, fine; m, medium; c, coarse; gr, granular; sbk, subangular blocky; SG, single grain; MA, massive.

[4]ff, few fine; cf, common fine.

[5]cs, clear smooth; as, abrupt smooth; gs, gradual smooth.

Table 6B. Textural analysis of pedon S80SC–051–004

[Grain sizes in millimeters; all other values in weight percent. VF, very fine; F, fine; M, medium; C, coarse; VC, very coarse; —, analyzed but below detectable limits]

		Total			Clay	Silt		Sand				
Depth (cm)	Horizon	Clay (<.002)	Silt (.002–.05)	Sand (.05–2)	F (<.0002)	F (.002–.02)	C (.02–.05)	VF (.05–.10)	F (.10–.25)	M (.25–.50)	C (.5–1)	VC (1–2)
0–24	Ap	1.6	3.4	95.0	1.2	1.2	2.2	1.1	61.4	29.5	2.9	0.1
24–35	E1	3.6	3.4	93.0	.8	2.4	1.0	.9	54.2	33.6	4.2	.1
35–48	E2	2.8	5.0	92.2	.8	3.2	1.8	1.0	58.3	29.9	2.9	.1
48–61	BA	6.0	4.9	89.1	2.8	4.0	.9	1.2	56.7	28.1	2.9	.2
61–95	Bt	10.5	2.9	89.6	4.0	2.0	.9	.9	56.1	26.6	2.8	.2
95–121	BC1	4.0	2.0	94.0	2.0	.8	1.2	.8	60.4	30.0	2.6	.2
121–138	BC2	4.8	1.2	94.0	2.4	1.2	—	.5	58.3	31.8	3.3	.1
138–169	C	3.6	1.5	94.0	1.6	1.5	—	.6	62.2	29.3	2.8	—

Table 6C. Physical and chemical analyses of pedon S80SC–051–004
[Units of measure for all values given in table 2*B*. --, not detected; no entry, not analyzed; TR, trace]

Depth (cm)	Horizon	Organic C	Total N	Extractable P	Total S	Dithionite-citrate: Extractable Fe	Extractable Al	Extractable Mn	Ratio clay: CEC[1]	15 bar[2]
0–24	Ap	0.74	0.047			0.1		—	1.31	0.81
24–35	E1	.27	.018			.2		—	.22	.31
35–48	E2	.16	.013			.2		—	.25	.39
48–61	BA	.14	.013			.4		—	.17	.30
61–95	Bt	.14	.017			.7		TR	.18	.35
95–121	BC1	.06				.5		—	.18	.43
121–138	BC2	.07				.7		—	.08	.40
138–169	C	.06				.4		—	.08	.39

Depth (cm)	Horizon	Bulk density: Field moist	1/3 bar	Oven dry	COLE[3]	Water content: Field moist	1/3 bar	15 bar[2]	WRD[4]	pH: $CaCl_2$ (.01M) 1:2	H_2O 1:1
0–24	Ap		1.60					1.3		4.2	4.5
24–35	E1		1.60					1.1		4.3	4.3
35–48	E2		1.60					1.1		4.3	4.4
48–61	BA		1.61	1.64	0.006		4.8	1.8	0.05	4.2	4.4
61–95	Bt		1.70	1.70	—		5.4	3.7	.03	4.3	4.8
95–121	BC1		1.62	1.65	.006		3.4	1.7	.03	4.8	5.3
121–138	BC2		1.73	1.74	.002		6.4	1.9	.08	4.9	5.3
138–169	C		1.70					1.4		4.9	5.3

Depth (cm)	Horizon	NH_4OAC extractable bases: Ca	Mg	Na	K	Sum of bases	Acidity	Extractable Al	CEC[1]: Sum of cations	NH_4 OAC	NH_4Cl	Base saturation: Sum	NH_4OAC
0–24	Ap	0.8	0.3	—	TR	1.1	2.0	0.3	3.1	2.1	1.6	35	52
24–35	E1	TR	.1	—	—	.1	1.0	.5	1.1	.8	.7	9	12
35–48	E2	—	TR	—	—	TR	.7	.4	.7	.7	.5		8
48–61	BA	.1	.1	TR	—	.2	1.2	.5	1.4	1.0	1.1	14	20
61–95	Bt	.3	.2	TR	0.3	.8	2.4	.7	3.2	1.9	1.6	25	42
95–121	BC1	.2	.1	—	.2	.5	.4	.1	.9	.7	.8	56	71
121–138	BC2	.1	.1	—	.2	.4	—	—	.4	.4	.5	100	100
138–169	C	.1	TR	—	.2	.3	.1	—	.4	.3	.5	75	100

[1]Cation exchange capacity.
[2]Water content at 15-bar pressure.
[3]Coefficient of linear extensibility.
[4]Water-retention difference.

Table 6D. Bulk chemistry of pedon S80SC–051–004

Major oxide	Horizon: B1[1]	Bt2	B31[1]	B31[1]
SiO_2	96.13	92.29	92.17	91.27
Al_2O_3	1.34	2.60	2.02	1.10
Fe_2O_3	1.46	1.96	1.48	1.56
MnO	.01	.01	.01	.01
TiO_2	.70	.64	.72	.42
CaO	.09	.01	.03	.03
K_2O	.09	.11	.07	.07
Na_2O	<.20	<.20	<.20	<.20
MgO	<.10	<.10	<.10	<.10
Total	99.8	97.6	96.5	94.4

[1]Analysis of <63-μm fraction.

Table 7A. Field description of pedon S81SC-051-006

[Location: 4.8 km northeast of Conway, Horry County, South Carolina; 35°52'30" N., 79°05'56" W. Temperature: 17 °C mean annual, 26 °C mean summer. Elevation: 11 m above mean sea level. Physiography: Back-barrier flat. Geomorphic position: Interfluve summit. Slope and aspect: 1 percent plane. Precipitation: 137 cm, udic moisture regime. Drainage: Moderately well drained. Land use: Cropland. Parent material: Weathered marine sand and clay. No entry indicates no data]

Depth (cm)	Horizon	Moist color[1]	Texture[2]	Structure[3]	Clay skins	Boundary[4]
0–23	Ap	10YR4/3	fsl	1fgr		as
23–35	Bt1	7.5YR5/6	cl	1msbk		cs
35–48	Bt2	7.5YR5/6	cl	2msbk	Common, thin, patchy	cs
48–71	Bt3	10YR5/4	c	3msbk	Common, thin, patchy	cw
71–104	Btg	10YR5/2	c	3csbk	Common, thin, patchy	gs
104–152	Cg1	10YR5/2	c	MA		gw
152–193	Cg2	10YR6/2	sc	MA		

[1]Munsell notation.

[2]fsl, fine sandy loam; cl, clay loam; c, clay; sc, sandy clay.

[3]1, weak; 2, moderate; 3, strong; f, fine; m, medium; c, coarse; gr, granular; sbk, subangular blocky; MA, massive.

[4]cs, clear smooth; as, abrupt smooth; cw, clear wavy; gs, gradual smooth.

Table 7B. Textural analysis of pedon S81SC-051-006

[Grain sizes in millimeters; all other values in weight percent. VF, very fine; F, fine; M, medium; C, coarse; VC, very coarse; --, analyzed but below detectable limits]

		Total			Clay	Silt		Sand				
Depth (cm)	Horizon	Clay (<.002)	Silt (.002–.05)	Sand (.05–2)	F (<.0002)	F (.002–.02)	C (.02–.05)	VF (.05–.10)	F (.10–.25)	M (.25–.50)	C (.5–1)	VC (1–2)
0–23	Ap	17.3	33.8	48.9	11.1	22.6	11.2	8.9	26.1	8.9	3.9	1.1
23–35	Bt1	52.7	27.7	19.6	34.6	21.4	6.3	4.3	10.1	3.4	1.3	.5
35–48	Bt2	46.7	31.8	21.5	27.5	24.2	7.6	4.3	11.1	3.9	1.6	.6
48–71	Bt3	40.4	33.9	25.7	24.1	25.7	8.2	5.3	13.1	4.4	2.2	.7
71–104	Btg	46.3	26.8	26.9	26.2	20.9	5.9	4.4	14.6	5.3	2.1	.5
104–152	Cg1	25.1	20.1	54.8	16.6	14.2	5.9	5.3	30.9	11.7	5.4	1.5
152–193	Cg2	24.3	13.3	62.4	18.2	8.9	4.4	4.2	34.2	15.0	7.1	1.9
152–193	Cg3	21.4	15.4	63.2	12.9	10.5	4.9	4.8	35.4	14.5	6.4	2.1

Table 7C. Physical and chemical analyses of pedon S81SC–051–006

[Units of measure for all values given in table 2*B*. —, not detected; no entry, not analyzed; TR, trace]

Depth (cm)	Horizon	Organic C	Total N	Extractable P	Total S	Dithionite-citrate: Extractable Fe	Dithionite-citrate: Extractable Al	Dithionite-citrate: Extractable Mn	Ratio clay: CEC[1]	Ratio clay: 15 bar[2]
0–23	Ap	1.09	0.069			1.2			0.23	0.45
23–35	Bt1	.47	.039			3.8			.21	.40
35–48	Bt2	.35	.034			3.5			.20	.41
48–71	Bt3	.26	.022			3.4			.23	.43
71–104	Btg	.27				4.9			.24	.43
104–152	Cg1	.12				1.5			.28	.39
152–193	Cg2	.10				.2			.29	.37
152–193	Cg3	.10				1.9			.27	.42

Depth (cm)	Horizon	Bulk density: Field moist	Bulk density: 1/3 bar	Bulk density: Oven dry	COLE[3]	Water content: Field moist	Water content: 1/3 bar	Water content: 15 bar[2]	WRD[4]	pH: $CaCl_2$ (.01M) 1:2	pH: H_2O 1:1
0–23	Ap	1.76	1.39	1.44	0.012	5.1	15.3	7.8	0.10	5.0	5.7
23–35	Bt1		1.50					21.1		4.1	4.6
35–48	Bt2	1.61	1.50	1.59	.020	14.0	23.7	19.3	.07	4.2	4.6
48–71	Bt3		1.50					17.4		4.3	4.7
71–104	Btg	1.72	1.58	1.69	.023	10.2	22.4	19.8	.04	4.3	4.6
104–152	Cg1		1.60					9.9		4.1	4.6
152–193	Cg2	1.83	1.72	1.77	.010	7.6	13.8	9.1	.08	3.9	4.6
152–193	Cg3		1.70					8.9		3.9	4.7

Depth (cm)	Horizon	NH_4OAC extractable bases: Ca	Mg	Na	K	Sum of bases	Acidity	Extractable Al	CEC[1]: Sum of cations	CEC[1]: NH_4 OAC	Al saturation	Base saturation: Sum	Base saturation: NH_4OAC
0–23	Ap	2.9	1.2	TR	0.3	4.4	6.2		10.6	4.0		42	100
23–35	Bt1	2.6	1.3	0.6	.1	4.6	13.9	3.6	18.5	10.8	44	25	43
35–48	Bt2	1.7	.9	TR	.1	2.7	12.5	4.0	15.2	9.2	60	18	29
48–71	Bt3	.6	.7	.1	TR	1.4	12.7	5.0	14.1	9.4	78	10	15
71–104	Btg	.5	.8	.1	.1	1.5	15.2	7.5	16.7	11.3	83	9	13
104–152	Cg1	.3	.4	TR	TR	.7	8.8	4.8	9.5	7.0	87	7	10
152–193	Cg2	.4	.4	TR	TR	.8	8.9	5.2	9.7	7.0	87	8	11
152–193	Cg3	.4	.3	TR	TR	.7	7.4	4.0	8.1	5.7	85	9	12

[1]Cation exchange capacity.
[2]Water content at 15-bar pressure.
[3]Coefficient of linear extensibility.
[4]Water-retention difference.

Table 7D. Bulk chemistry of pedon S81SC–051–006

Major oxide	Horizon: Bt1	Bt2	Bt3	Btg
SiO_2	63.38	67.17	71.79	61.92
Al_2O_3	18.40	16.15	14.50	17.69
Fe_2O_3	8.76	7.80	7.60	11.40
MnO	.01	.01	.01	.01
TiO_2	1.54	1.64	1.65	1.48
CaO	.36	.34	.31	.30
K_2O	.65	.62	.62	.68
Na_2O	<.20	<.20	<.20	<.20
MgO	.18	.10	.10	.10
Total	93.2	93.8	96.5	93.5

Table 8A. Field description of pedon S81SC–051–007

[Location: 1.6 km west of Conway, Horry County, South Carolina; 33°50′ N., 79°05′30″ W. Temperature: 17 °C mean annual, 26 °C mean summer. Elevation: 10 m above mean sea level. Physiography: Back-barrier flat. Geomorphic position: Interfluve summit. Slope and aspect: 1 percent plane. Precipitation: 137 cm, udic moisture regime. Drainage: Moderately well drained. Land use: Cropland. Parent material: Weathered marine sand and clay. No entry indicates no data]

Depth (cm)	Horizon	Moist color[1]	Texture[2]	Structure[3]	Clay skins	Boundary[4]
0–20	Ap	10YR3/1	lfs	1fgr		aw
20–29	AB	10YR4/4	fsl	1fgr		cs
29–46	E	10YR6/6	fsl	1fgr		cs
46–60	Bt1	10YR5/6	scl	1msbk	Common, thin, patchy	cs
60–71	Bt2	10YR5/8	scl	2msbk	Common, thin, patchy	cs
71–96	Bt3	10YR6/1	scl	2msbk	Common, thin, patchy	cw
96–142	BCg1	10YR6/1	scl	1cpr-1msbk		gw
142–170	BCg2	10YR6/1	c	1cpr		

[1]Munsell notation.

[2]fsl, fine sandy loam; scl, sandy clay loam; lfs, loamy fine sand; c, clay.

[3]1, weak; 2, moderate; f, fine; m, medium; gr, granular; sbk, subangular blocky; pr, prismatic.

[4]cs, clear smooth; cw, clear wavy; aw, abrupt wavy; gw, gradual wavy.

Table 8B. Textural analysis of pedon S81SC–051–007

[Grain sizes in millimeters; all other values in weight percent. VF, very fine; F, fine; M, medium; C, coarse; VC, very coarse; TR, trace; —, analyzed but below detectable limits]

		Total			Clay	Silt		Sand				
Depth (cm)	Horizon	Clay (<.002)	Silt (.002–.05)	Sand (.05–2)	F (<.0002)	F (.002–.02)	C (.02–.05)	VF (.05–.10)	F (.10–.25)	M (.25–.50)	C (.5–1)	VC (1–2)
0–20	Ap	4.1	25.6	70.3	1.7	17.0	8.6	11.3	47.2	11.6	0.2	TR
20–29	AB	4.1	25.6	69.3	1.6	17.1	9.5	10.9	25.9	12.2	.3	TR
29–46	E	7.3	26.2	66.5	1.6	17.4	8.8	10.2	44.3	11.6	.3	.1
46–60	Bt1	33.8	19.5	46.7	21.2	13.0	6.5	6.8	30.7	9.0	.2	TR
60–71	Bt2	37.6	15.8	46.6	22.5	10.6	5.3	5.1	30.5	10.8	.1	.1
71–96	Bt3	31.3	11.7	57.0	17.9	8.5	3.2	5.7	37.0	14.1	.2	TR
96–142	BCg1	31.7	15.3	53.0	17.9	10.2	5.1	13.6	32.3	7.0	.1	TR
142–170	BCg2	65.5	30.5	4.0	40.7	24.5	6.0	1.5	1.9	.5	.1	TR

Table 8C. Physical and chemical analyses of pedon S81SC–051–007
[Units of measure for all values given in table 2B. —, not detected; no entry, not analyzed; TR, trace]

Depth (cm)	Horizon	Organic C	Total N	Extractable P	Total S	Dithionite-citrate Extractable Fe	Dithionite-citrate Extractable Al	Dithionite-citrate Extractable Mn	Ratio clay CEC[1]	Ratio clay 15 bar[2]
0–20	Ap	1.67	0.072			0.3			1.49	0.80
20–29	AB	.83	.033			.4			.71	.83
29–46	E	.33	.014			.4			.23	.49
46–60	Bt1	.36	.026			2.4			.24	.44
60–71	Bt2	.29				3.6			.25	.41
71–96	Bt3	.24				3.8			.27	.43
96–142	BCg1	.16				4.5			.30	.44
142–170	BCg2	.19				1.8			.30	.38

Depth (cm)	Horizon	Bulk density Field moist	Bulk density 1/3 bar	Bulk density Oven dry	COLE[3]	Water content Field moist	Water content 1/3 bar	Water content 15 bar[2]	WRD[4]	pH $CaCl_2$ (.01M) 1:2	pH H_2O 1:1
0–20	Ap	1.60	1.43	1.44	0.002	4.0	14.0	3.3	0.15	4.4	4.9
20–29	AB		1.50					3.4		4.4	4.9
29–46	E		1.52	1.52	—		12.1	3.6	.13	4.4	5.0
46–60	Bt1		1.60					14.9		4.3	4.6
60–71	Bt2		1.60					15.5		4.2	4.7
71–96	Bt3	1.68	1.62	1.70	.016	14.1	20.2	13.5	.11	4.1	4.7
96–142	BCg1		1.60					14.0		3.9	4.7
142–170	BCg2	1.53	1.23	1.73	.120	23.6	39.6	25.0	.18	4.2	4.5

Depth (cm)	Horizon	NH_4OAC extractable bases Ca	Mg	Na	K	Sum of bases	Acidity	Extractable Al	CEC[1] Sum of cations	CEC[1] NH_4 OAC	CEC[1] Bases +Al	Al saturation	Base saturation Sum	Base saturation NH_4OAC
0–20	Ap	1.6	0.4	—	0.1	2.1	8.1	0.6	10.2	6.1	2.7	22	21	34
20–29	AB	.3	TR	—	TR	.3	7.3	1.0	7.6	2.9	1.3	77	4	10
29–46	E	.2	TR	TR	TR	.2	3.9	.8	4.1	1.7	1.0	80	5	12
46–60	Bt1	1.0	.3	—	.1	1.4	9.9	3.9	11.3	8.2	5.3	74	12	17
60–71	Bt2	50.8	.5	TR	TR	51.3	11.1	5.3	62.4	9.5	56.6	9	82	100
71–96	Bt3	28.7	.3	TR	.1	29.1	10.4	4.7	39.6	8.3	33.9	14	74	100
96–142	BCg1	.8	.7	0.1	.1	1.7	10.3	5.6	12.0	9.4	7.3	77	14	18
142–170	BCg2	3.3	2.4	.2	.3	6.2	22.7	15.2	28.9	24.7	21.4	71	21	25

[1]Cation exchange capacity.
[2]Water content at 15-bar pressure.
[3]Coefficient of linear extensibility.
[4]Water-retention difference.

Table 8D. Bulk chemistry of the <63-μm fraction, pedon S81SC–051–007

Major oxide	Horizon E	Bt1	Bt3	BCg1	BCg2
SiO_2	90.84	67.67	54.75	53.37	62.18
Al_2O_3	5.17	16.58	19.96	17.80	20.25
Fe_2O_3	1.90	8.13	15.95	18.78	7.39
MnO	.02	.02	.02	.02	.01
TiO_2	1.78	1.59	1.33	1.34	1.24
CaO	.30	.33	.32	.32	.40
K_2O	.41	.68	.85	.84	1.15
Na_2O	<.20	<.20	<.20	<.20	<.25
MgO	<.10	.21	.16	.13	.52
Total	100.4	95.2	93.3	92.6	93.1

Table 9A. Field description of pedon S81SC–051–008

[Location: 1.6 km southwest of Conway, Horry County, South Carolina; 33°48′ N., 79°01′ W. Temperature: 17 °C mean annual, 26 °C mean summer. Elevation: 10 m above mean sea level. Physiography: Barrier bar. Geomorphic position: In slight depression. Slope and aspect: 0 percent plane. Precipitation: 137 cm, udic moisture regime. Drainage: Somewhat poorly drained. Land use: Forest, ungrazed. Parent material: Weathered marine sand and clay. No entry indicates no data]

Depth (cm)	Horizon	Moist color[1]	Texture[2]	Structure[3]	Clay skins	Boundary[4]
0–18	A	10YR2/1	s	SG		aw
18–31	E	10YR6/1	s	SG		aw
31–41	Bh	5YR2/1	s	1msbk		cw
41–61	Bw	10YR3/4	s	MA		cw
61–76	Bh1	5YR3/3	s	MA		aw
76–91	Bh2	5YR2/2	s	MA		gw
91–122	Bh3	5YR2/1	s	MA		

[1]Munsell notation.
[2]s, sand.
[3]1, weak; m, medium; sbk, subangular blocky; SG, single grain; MA, massive.
[4]cw, clear wavy; aw, abrupt wavy; gw, gradual wavy.

Table 9B. Textural analysis of pedon S81SC–051–008

[Grain sizes in millimeters; all other values in weight percent. VF, very fine; F, fine; M, medium; C, coarse; VC, very coarse; —, analyzed but below detectable limits]

		Total			Clay	Silt		Sand				
Depth (cm)	Horizon	Clay (<.002)	Silt (.002–.05)	Sand (.05–2)	F (<.0002)	F (.002–.02)	C (.02–.05)	VF (.05–.10)	F (.10–.25)	M (.25–.50)	C (.5–1)	VC (1–2)
0–18	A	0.4	7.8	91.8	—	1.8	6.0	0.4	22.4	48.1	20.6	0.3
18–31	E	.4	3.3	96.3	—	1.6	1.7	.5	32.3	50.9	12.2	.4
31–41	Bh	3.4	9.6	87.0	—	5.9	3.7	.4	28.2	45.3	12.6	.5
41–61	Bw	2.4	3.9	93.7	—	3.2	.7	.6	29.4	45.7	16.9	1.1
61–76	Bh1	.4	3.3	96.3	—	1.6	1.7	.6	30.8	46.4	17.7	.8
76–91	Bh2	2.0	7.6	90.4	—	5.7	1.9	.2	23.0	45.5	21.0	.7
91–122	Bh3	1.2	1.6	97.2	—	1.5	.1	.3	33.6	39.3	20.6	3.4

Table 9C. Physical and chemical analyses of pedon S81SC–051–008
[Units of measure for all values given in table 2B. —, not detected; no entry, not analyzed; TR, trace]

						Dithionite-citrate			Ratio clay	
Depth (cm)	Horizon	Organic C	Total N	Extractable P	Total S	Extractable Fe	Extractable Al	Extractable Mn	CEC[1]	15 bar[2]
0–18	A	5.31	0.122			0.1	TR		41.50	25.50
18–31	E	.30	.006			TR	—		2.75	.50
31–41	Bh	2.62	.154			.1	0.3		3.65	1.62
41–61	Bw	.48	.011			.2	.2		.75	.83
61–76	Bh1	.68	.011			TR	.1		6.00	2.00
76–91	Bh2	1.15	.019			.1	.3		2.05	1.20
91–122	Bh3	1.90	.023			TR	.3		5.25	1.75

		Bulk density				Water content				pH	
Depth (cm)	Horizon	Field moist	1/3 bar	Oven dry	COLE[3]	Field moist	1/3 bar	15 bar[2]	WRD[4]	$CaCl_2$ (.01M) 1:2	H_2O 1:1
0–18	A	1.02	0.67	0.84	0.078	18.3		10.2	0.23	2.8	3.4
18–31	E		1.70					.2		3.4	3.9
31–41	Bh	1.63	1.67	1.68	.002	8.6		5.5	.13	3.4	4.0
41–61	Bw	1.88	1.61	1.61	—	1.0		2.0	.08	4.4	4.7
61–76	Bh1		1.60					.8		3.7	4.0
76–91	Bh2		1.60					2.4		4.2	4.5
91–122	Bh3		1.64	1.66				2.1	.09	4.3	4.6

		NH_4OAC extractable bases							CEC[1]				Base saturation	
Depth (cm)	Horizon	Ca	Mg	Na	K	Sum of bases	Acidity	Extractable Al	Sum of cations	NH_4 OAC	Bases +Al	Al saturation	Sum	NH_4OAC
0–18	A	0.4	1.0	TR	0.2	1.6	20.5	1.2	22.1	16.6	2.8	43	7	10
18–31	E	—	TR	0.1	—	.1	1.3	.1	1.4	1.1	.2	50	7	9
31–41	Bh	.1	TR	.2	—	.3	24.8	5.7	25.1	12.4	6.0	95	1	2
41–61	Bw	—	—	—	—	—	6.6	1.1	6.6	1.8	1.1	100		1
61–76	Bh1	TR	—	.5	—	.5	6.4	1.4	6.9	2.4	1.9	74	7	21
76–91	Bh2	—	—	—	—	—	12.6	1.8	12.6	4.1	1.8	100		TR
91–122	Bh3	—	—	.1	—	.1	15.0	1.6	15.1	6.3	1.7	94	1	2

[1]Cation exchange capacity.
[2]Water content at 15-bar pressure.
[3]Coefficient of linear extensibility.
[4]Water-retention difference.

Table 9D. Bulk chemistry of the <63-μm fraction, pedon S81SC–051–008

	Horizon					
Major oxide	E	Bh	Bw	Bh1	Bh2	Bh3
SiO_2	82.50	72.31	78.04	76.26	78.56	91.69
Al_2O_3	2.27	1.22	7.69	3.72	5.65	<.10
Fe_2O_3	.23	1.04	2.83	<.01	.16	.70
MnO	.05	.03	.02	.05	.01	.01
TiO_2	1.38	.46	1.06	1.03	2.20	.20
CaO	.29	.29	.31	.29	.29	.05
K_2O	.18	.22	.39	.21	.22	.01
Na_2O	<.20	<.20	<.20	<.20	<.20	.70
MgO	<.10	<.10	<.10	<.10	2.41	.50
Total	86.9	75.5	90.3	81.5	89.5	93.8

Table 10*A*. *Field description of pedon S81SC–051–009*

[Location: 4.8 km east of Conway, Horry County, South Carolina; 33°53'30" N., 79°54'40" W. Temperature: 17 °C mean annual, 26 °C mean summer. Elevation: 10 m above mean sea level. Physiography: Back-barrier flat. Geomorphic position: In slight depression. Slope and aspect: 1 percent plane. Precipitation: 137 cm, aquic moisture regime. Drainage: Somewhat poorly drained. Land use: Cropland. Parent material: Weathered marine sand and clay. No entry indicates no data]

Depth (cm)	Horizon	Moist color[1]	Texture[2]	Structure[3]	Clay skins	Roots[4]	Boundary[5]
0–22	Ap	10YR3/2	fsl	1msbk		cvf+f	as
22–42	Bt1	10YR5/2	cl	2fsbk	Common, thin, patchy	ff	cw
42–84	Bt2	10YR4/2	c	2fsbk	Common, thin, patchy	ff	cw
84–134	Bt3	10YR5/8	c	2msbk	Common, thin, patchy	fvf	gs
134–180	BCg	10YR7/2	scl	2msbk			gw
180–204	2C	10YR5/8	sl	MA			

[1]Munsell notation.

[2]sl, sandy loam; scl, sandy clay loam; fsl, fine sandy loam; cl, clay loam; c, clay; s, sand.

[3]1, weak; 2, moderate; f, fine; m, medium; sbk, subangular blocky; MA, massive.

[4]ff, few fine; fvf, few very fine; cvf, common very fine; f, fine.

[5]as, abrupt smooth; cw, clear wavy; gs, gradual smooth; gw, gradual wavy.

Table 10*B*. Textural analysis of pedon S81SC–051–009

[Grain sizes in millimeters; all other values in weight percent. VF, very fine; F, fine; M, medium; C, coarse; VC, very coarse; TR, trace; —, analyzed but below detectable limits]

		Total			Clay	Silt		Sand				
Depth (cm)	Horizon	Clay (<.002)	Silt (.002–.05)	Sand (.05–2)	F (<.0002)	F (.002–.02)	C (.02–.05)	VF (.05–.10)	F (.10–.25)	M (.25–.50)	C (.5–1)	VC (1–2)
0–22	Ap	14.1	20.8	65.1	9.1	13.7	7.1	4.4	56.2	3.4	0.9	0.2
22–42	Bt1	35.2	15.6	49.2	25.4	10.2	5.4	3.3	42.5	2.7	.6	.1
42–84	Bt2	44.7	13.6	41.7	30.8	9.0	4.6	2.8	35.9	2.4	.6	TR
84–134	Bt3	43.0	12.2	44.8	30.4	7.4	4.8	2.8	39.0	2.4	.6	—
134–180	BCg	26.8	11.7	61.5	18.7	6.1	5.6	3.4	38.7	15.9	3.4	.1
180–204	2C	11.3	2.9	85.8	8.5	.4	2.5	3.5	22.7	41.0	7.5	.1

Table 10*C*. Physical and chemical analyses of pedon S81SC–051–009

[Units of measure for all values given in table 2*B*. --, not detected; no entry, not analyzed; TR, trace]

Depth (cm)	Horizon	Organic C	Total N	Extractable P	Total S	Dithionite-citrate Extractable Fe	Dithionite-citrate Extractable Al	Dithionite-citrate Extractable Mn	Ratio clay CEC[1]	Ratio clay 15 bar[2]
0–22	Ap	1.55	0.076			1.0			0.55	0.48
22–42	Bt1	.49	.040			2.3			.25	.41
42–84	Bt2	.46	.042			4.3			.23	.42
84–134	Bt3	.43				4.6			.23	.45
134–180	BCg	.16				.7			.31	.41
180–204	2C	.13				.7			.36	.45

Depth (cm)	Horizon	Bulk density Field moist	Bulk density 1/3 bar	Bulk density Oven dry	COLE[3]	Water content Field moist	Water content 1/3 bar	Water content 15 bar[2]	WRD[4]	pH $CaCl_2$ (.01M) 1:2	pH H_2O 1:1
0–22	Ap	1.50	1.51	1.54	0.007	7.5		6.8	0.11	5.1	5.5
22–42	Bt1		1.40					14.4		4.1	4.4
42–84	Bt2	1.42	1.32	1.456	.057	26.1		18.7	.21	4.2	4.4
84–134	Bt3		1.30					19.2		4.2	4.6
134–180	BCg	1.72	1.71	1.78	.013	13.1		11.0	.07	4.0	4.6
180–204	2C		1.70					5.1		4.0	4.5

Depth (cm)	Horizon	NH_4OAC extractable bases Ca	Mg	Na	K	Sum of bases	Acidity	Extractable Al	CEC[1] Sum of cations	CEC[1] NH_4 OAC	CEC[1] Bases +Al	Al saturation	Base saturation Sum	Base saturation NH_4OAC
0–22	Ap	2.8	1.1	—	0.4	4.3	7.6	0.3	11.9	7.7	4.6	7	36	56
22–42	Bt1	1.3	.6	0.3	.2	2.4	10.2	4.2	12.6	8.9	6.6	64	19	27
42–84	Bt2	1.3	.6	TR	.1	2.0	13.3	5.3	15.3	10.5	7.3	73	13	19
84–134	Bt3	1.5	.7	TR	.1	2.3	12.5	4.2	14.8	10.1	6.5	65	16	23
134–180	BCg	1.1	.4	.1	.1	1.7	8.5	4.9	10.2	8.2	6.6	74	17	21
180–204	2C	1.4	.3	TR	.1	1.8	4.0	1.7	5.8	4.1	3.5	49	31	44

[1]Cation exchange capacity.
[2]Water content at 15-bar pressure.
[3]Coefficient of linear extensibility.
[4]Water-retention difference.

Table 10*D*. Bulk chemistry of pedon S81SC–051–009

Major oxide	Horizon Bt1	Horizon Bt3	Horizon BCg
SiO_2	53.92	58.05	52.38
Al_2O_3	17.54	19.28	17.39
Fe_2O_3	8.96	18.25	5.00
MnO	.03	.01	.02
TiO_2	1.21	1.18	1.18
CaO	.36	.35	.34
K_2O	.46	.58	.82
Na_2O	<.20	.20	1.00
MgO	.24	.10	.10
Total	82.7	98.0	78.2

Table 11A. Field description of pedon S81SC–051–010

[Location: 8 km southwest of Floyds, Horry County, South Carolina; 34°08′10″ N., 79°08′20″ W. Temperature: 17 °C mean annual, 26 °C mean summer. Elevation: 20 m above mean sea level. Physiography: Rim of Carolina bay. Geomorphic position: Interfluve summit. Slope and aspect: 1 percent plane. Precipitation: 137 cm, aquic moisture regime. Drainage: Moderately well drained. Land use: Cropland. Parent material: Weathered marine or fluvial sand and clay. No entry indicates no data]

Depth (cm)	Horizon	Moist color[1]	Texture[2]	Structure[3]	Clay skins	Boundary[4]
0–28	Ap	10YR3/2	s	SG		as
28–40	E	10YR5/3	s	SG		cs
40–63	Bw	10YR5/6	s	SG		gw
63–96	Bt	10YR6/2	ls	SG		gw
96–134	Bh1	5YR3/3	s	MA		gw
134–162	Bh2	10YR3/2	s	MA		

[1]Munsell notation.

[2]ls, loamy sand; s, sand.

[3]SG, single grain; MA, massive.

[4]cs, clear smooth; as, abrupt smooth; gw, gradual wavy.

Table 11B. Textural analysis of pedon S81SC–051–010

[Grain sizes in millimeters; all other values in weight percent. VF, very fine; F, fine; M, medium; C, coarse; VC, very coarse; —, analyzed but below detectable limits]

		Total			Clay	Silt		Sand				
Depth (cm)	Horizon	Clay (<.002)	Silt (.002–.05)	Sand (.05–2)	F (<.0002)	F (.002–.02)	C (.02–.05)	VF (.05–.10)	F (.10–.25)	M (.25–.50)	C (.5–1)	VC (1–2)
0–28	Ap	0.8	4.6	94.6	—	0.8	3.8	0.6	8.3	48.0	35.5	2.2
28–40	E	2.0	4.3	93.7	—	.4	3.9	1.0	13.1	51.2	27.1	1.3
40–63	Bw	1.2	4.2	94.6	—	.8	3.4	1.0	11.6	49.8	30.2	2.0
63–96	Bt	6.4	14.5	79.1	—	9.2	5.3	1.6	13.2	41.1	21.7	1.5
96–134	Bh1	3.3	7.3	89.4	—	3.7	3.6	.7	9.0	43.8	32.3	3.6
134–162	Bh2	2.5	5.7	91.8	—	1.6	4.1	.8	10.0	50.0	28.8	2.2

Table 11*C*. Physical and chemical analyses of pedon S81SC–051–010

[Units of measure for all values given in table 2*B*. --, not detected; no entry, not analyzed; TR, trace]

Depth (cm)	Horizon	Organic C	Total N	Extractable P	Total S	Dithionite-citrate Extractable Fe	Extractable Al	Extractable Mn	Ratio clay CEC[1]	15 bar[2]
0–28	Ap	0.68	0.023			0.1	0.1		2.38	1.25
28–40	E	.20	.006			TR	TR		.20	.40
40–63	Bw	.16	.005			.1	TR		.08	.42
63–96	Bt	.17	.006			.1	.1		.13	.31
96–134	Bh1	.96	.010			TR	.2		.85	.85
134–162	Bh2	1.26	.018			.1	.3		1.80	1.16

Depth (cm)	Horizon	Bulk density Field moist	1/3 bar	Oven dry	COLE[3]	Water content Field moist	1/3 bar	15 bar[2]	WRD[4]	pH $CaCl_2$ (.01M) 1:2	H_2O 1:1
0–28	Ap		1.70					1.0		4.9	5.4
28–40	E		1.70					.8		4.4	4.8
40–63	Bw		1.70					.5		4.4	4.8
63–96	Bt	1.81	1.67	1.67		1.5		2.0	.07	4.3	4.7
96–134	Bh1		1.70					2.8		4.5	4.9
134–162	Bh2	1.49	1.69	1.69		12.5		2.9	.15	4.5	4.8

Depth (cm)	Horizon	NH_4OAC extractable bases Ca	Mg	Na	K	Sum of bases	Acidity	Extractable Al	CEC[1] Sum of cations	NH_4 OAC	Bases +Al	Al saturation	Base saturation Sum	NH_4OAC
0–28	Ap	0.7	0.2	—	0.1	1.0	2.1	0.2	3.1	1.9	1.2	17	32	53
28–40	E	.1	TR	—	TR	.1	1.1	.2	1.2	.4	.3	67	8	25
40–63	Bw	—	—	—	TR	TR	.5	.2	.5	.1	.2	100		20
63–96	Bt	—	TR	—	TR	TR	1.6	.5	1.6	.8	.5	100		2
96–134	Bh1	—	—	—	TR	TR	8.7	.9	8.7	2.8	.9	100		1
134–162	Bh2	—	—	—	TR	TR	12.3	1.1	12.3	4.5	1.1	100		TR

[1]Cation exchange capacity.
[2]Water content at 15-bar pressure.
[3]Coefficient of linear extensibility.
[4]Water-retention difference.

Table 11*D*. Bulk chemistry of pedon S81SC–051–010

Major oxide	Horizon Bw[1]	Bt	Bh1[1]	Bh2[1]
SiO_2	94.55	92.23	78.27	48.63
Al_2O_3	3.27	4.78	8.25	17.79
Fe_2O_3	.60	.40	.17	14.99
MnO	.02	.01	.02	.02
TiO_2	1.42	1.68	2.31	1.10
CaO	.30	.29	.29	.34
K_2O	.26	.27	.30	.49
Na_2O	.20	.22	.34	.30
MgO	.10	.10	<.10	.15
Total	100.7	99.9	89.9	83.8

[1]Analysis of 63-μm fraction.

Table 12A. Field description of pedon S81SC–051–011

[Location: 6.4 km southwest of Floyds, Horry County, South Carolina; 34°08′10″ N., 79°08′20″ W. Temperature: 17 °C mean annual, 26 °C mean summer. Elevation: 21 m above mean sea level. Physiography: Back-barrier flat. Geomorphic position: Interfluve summit. Slope and aspect: 1 percent plane. Precipitation: 137 cm, udic moisture regime. Drainage: Poorly drained. Land use: Forest, ungrazed. Parent material: Weathered marine or fluvial sand and clay. No entry indicates no data]

Depth (cm)	Horizon	Moist color[1]	Texture[2]	Structure[3]	Clay skins	Boundary[4]
0–18	A	5YR2/2	fsl	1fgr		cs
18–33	E1	10YR7/2	s	1msbk		cs
33–51	E2	10YR6/1	s	2msbk		cs
51–79	Btg	10YR4/2	ls	3msbk		cs
79–112	Cg1	10YR4/1	s	3csbk		cs
112–163	Cg2	10YR3/2	s	MA		cs
163–204	2Cg	10YR2/1	sl	MA		

[1]Munsell notation.

[2]sl, sandy loam; ls, loamy sand; fsl, fine sandy loam; s, sand.

[3]1, weak; 2, moderate; 3, strong; f, fine, m, medium; c, coarse; gr, granular; sbk, subangular blocky; MA, massive.

[4]cs, clear smooth.

Table 12B. Textural analysis of pedon S81SC–051–011

[Grain sizes in millimeters; all other values in weight percent. VF, very fine; F, fine; M, medium; C, coarse; VC, very coarse; --, analyzed but below detectable limits]

		Total			Clay	Silt		Sand				
Depth (cm)	Horizon	Clay (<.002)	Silt (.002–.05)	Sand (.05–2)	F (<.0002)	F (.002–.02)	C (.02–.05)	VF (.05–.10)	F (.10–.25)	M (.25–.50)	C (.5–1)	VC (1–2)
0–18	A	3.2	40.2	56.6	—	24.3	15.9	3.5	15.3	27.1	9.6	1.1
18–33	E1	.8	10.7	88.5	—	4.5	6.2	1.1	16.6	52.9	17.0	.9
33–51	E2	1.6	20.9	77.5	—	12.9	8.0	1.8	16.3	43.1	15.4	.9
51–79	Btg	4.0	20.0	76.0	—	12.1	7.9	2.0	16.6	41.8	14.8	.8
79–112	Cg1	2.0	16.4	81.6	—	10.5	5.9	1.5	16.1	45.8	17.3	.9
112–163	Cg2	2.0	16.0	82.0	—	9.7	6.3	.9	14.4	46.2	19.4	1.1
163–204	2Cg	13.3	25.7	61.0	—	15.5	10.3	4.6	15.4	25.6	14.0	1.4

Table 12C. Physical and chemical analyses of pedon S81SC–051–011
[Units of measure for all values given in table 2B. —, not detected; no entry, not analyzed; TR, trace]

Depth (cm)	Horizon	Organic C	Total N	Extractable P	Total S	Dithionite-citrate Extractable Fe	Dithionite-citrate Extractable Al	Dithionite-citrate Extractable Mn	Ratio clay CEC[1]	Ratio clay 15 bar[2]
0–18	A	11.50	0.578			0.1			15.69	6.91
18–33	E1	1.07	.031			TR			2.13	2.25
33–51	E2	.26	.006			TR			.38	.38
51–79	Btg	.53				TR			.36	.33
79–112	Cg1	.39				TR			.45	.40
112–163	Cg2	.55	.006			TR			.60	.55
163–204	2Cg	.21	.141			.1			1.44	.82

Depth (cm)	Horizon	Bulk density Field moist	Bulk density 1/3 bar	Bulk density Oven dry	COLE[3]	Water content Field moist	Water content 1/3 bar	Water content 15 bar[2]	WRD[4]	pH $CaCl_2$ (.01M) 1:2	pH H_2O 1:1
0–18	A		1.00					22.1		4.4	4.4
18–33	E1		1.70					1.8		4.1	4.7
33–51	E2	2.03	1.98	1.98	—	2.0		.6	0.13	4.6	5.1
51–79	Btg	1.99	1.99	1.99	—	5.1		1.3	.15	4.6	5.3
79–112	Cg1		1.70					.8		4.6	5.3
112–163	Cg2		1.70					1.1		4.6	5.3
163–204	2Cg		1.30					10.9		4.9	5.5

Depth (cm)	Horizon	NH_4OAC extractable bases Ca	Mg	Na	K	Sum of bases	Acidity	Extractable Al	CEC[1] Sum of cations	CEC[1] NH_4 OAC	CEC[1] Bases +Al	Al saturation	Base saturation Sum	Base saturation NH_4OAC
0–18	Ap	14.8	0.9	0.2	0.5	16.4	37.6	0.4	54.0	50.2	16.8	2	30	33
18–33	E1	.5	.2	—	TR	.7	2.2	.1	2.9	1.7	.8	12	24	41
33–51	E2	.1	TR	.4	TR	.5	.7	TR	1.2	.6			42	83
51–79	Btg	.4	.1	—	.1	.6	1.4	.2	2.0	1.4	.8	25	30	43
79–112	Cg1	.3	.1	TR	TR	.4	1.1	TR	1.5	.9			27	44
112–163	Cg2	.4	.2	—	TR	.6	1.1	TR	1.7	1.2			35	50
163–204	2Cg	11.3	.4	.2	.2	12.1	16.3	—	28.4	19.2			43	63

[1]Cation exchange capacity.
[2]Water content at 15-bar pressure.
[3]Coefficient of linear extensibility.
[4]Water-retention difference.

Table 12D. Bulk chemistry of the <63-μm fraction, pedon S81SC–051–011

Major oxide	Btg horizon
SiO_2	95.15
Al_2O_3	2.44
Fe_2O_3	.05
MnO	<.01
TiO_2	1.59
CaO	.34
K_2O	.49
Na_2O	.40
MgO	<.10
Total	100.4

Table 13A. Field description of pedon S81SC–051–012

[Location: 16 km northwest of Floyds, Horry County, South Carolina; 34°12′20″ N., 79°04′55″ W. Temperature: 17 °C mean annual, 26 °C mean summer. Elevation: 21 m above mean sea level. Physiography: Back-barrier flat. Geomorphic position: Interfluve summit. Slope and aspect: 1 percent plane. Precipitation: 137 cm, udic moisture regime. Drainage: Well drained. Land use: Cropland. Parent material: Weathered marine sand and clay. No entry indicates no data]

Depth (cm)	Horizon	Moist color[1]	Texture[2]	Structure[3]	Clay skins	Boundary[4]
0–25	Ap	10YR4/2	lfs	1fgr		as
25–51	Bt1	10YR5/6	scl	1msbk		gw
51–81	Bt2	10YR5/8	scl	1msbk		gs
81–99	Bt3	10YR5/8	scl	1msbk		cs
99–119	Bt4	10YR5/8	scl	2msbk		cs
119–145	BC	10YR5/8	scl	2msbk		cw
145–180	2BC1	10YR6/1	scl	2msbk		cs
180–219	2BC2	2.5YR4/8	sl	MA		

[1]Munsell notation.

[2]lfs, loamy fine sand; scl, sandy clay loam; sl, sandy loam.

[3]1, weak; 2, moderate; f, fine; m, medium; gr, granular; sbk, subangular blocky; MA, massive.

[4]as, abrupt smooth; gw, gradual wavy; gs, gradual smooth; cs, clear smooth; cw, clear wavy.

Table 13B. Textural analysis of pedon S81SC–051–012

[Grain sizes in millimeters; all other values in weight percent. VF, very fine; F, fine; M, medium; C, coarse; VC, very coarse; —, analyzed but below detectable limits]

		Total			Clay	Silt		Sand				
Depth (cm)	Horizon	Clay (<.002)	Silt (.002–.05)	Sand (.05–2)	F (<.0002)	F (.002–.02)	C (.02–.05)	VF (.05–.10)	F (.10–.25)	M (.25–.50)	C (.5–1)	VC (1–2)
0–25	Ap	2.8	19.2	78.0	0.8	5.7	13.5	28.4	43.2	4.5	1.5	0.4
25–51	Bt1	21.1	19.3	59.6	14.6	7.7	11.6	22.9	31.9	3.0	1.2	.6
51–81	Bt2	20.7	18.7	60.6	15.0	8.9	9.9	23.4	32.5	3.3	1.0	.4
81–99	Bt3	21.0	20.2	58.8	15.0	10.1	10.1	23.3	31.5	2.9	.9	.2
99–119	Bt4	21.1	20.4	58.5	12.2	10.5	9.9	22.7	31.3	3.0	1.0	.5
119–145	BC	27.1	20.3	52.6	19.0	10.5	9.8	22.0	26.9	2.5	.9	.3
145–180	2BC1	36.2	20.9	42.9	21.6	10.6	10.3	24.5	15.7	1.4	.9	.4
180–219	2BC2	23.0	12.5	64.5	14.1	6.5	6.0	11.8	49.4	2.8	0.5	—

Table 13C. Physical and chemical analyses of pedon S81SC–051–012

[Units of measure for all values given in table 2B. --, not detected; no entry, not analyzed; TR, trace]

Depth (cm)	Horizon	Organic C	Total N	Extractable P	Total S	Dithionite-citrate Extractable Fe	Dithionite-citrate Extractable Al	Dithionite-citrate Extractable Mn	Ratio clay CEC[1]	Ratio clay 15 bar[2]
0–25	Ap	0.57	0.027			0.2			0.68	0.57
25–51	Bt1	.30	.024			1.7			.19	.40
51–81	Bt2	.18	.010			1.8			.17	.43
81–99	Bt3	.17				2.1			.18	.46
99–119	Bt4	.18				2.4			.21	.50
119–145	BC	.16				2.6			.23	.49
145–180	2BC1	.16				3.4			.25	.45
180–219	2BC2	.11				1.7			.23	.42

Depth (cm)	Horizon	Bulk density Field moist	Bulk density 1/3 bar	Bulk density Oven dry	COLE[3]	Water content Field moist	Water content 1/3 bar	Water content 15 bar[2]	WRD[4]	pH $CaCl_2$ (.01M) 1:2	pH H_2O 1:1
0–25	Ap		1.70					1.6		4.8	5.3
25–51	Bt1		1.60					8.5		4.6	4.8
51–81	Bt2	1.64	1.64	1.65	0.002	13.6	15.5	8.8	0.11	4.5	4.8
81–99	Bt3		1.60					9.6		4.5	4.7
99–119	Bt4		1.60					10.5		4.5	4.6
119–145	BC	1.62	1.55	1.64	.019	17.6	21.9	13.2	.13	4.2	4.5
145–180	2BC1		1.50					16.4		4.2	4.5
180–219	2BC2		1.60					9.6		4.3	4.5

Depth (cm)	Horizon	NH_4OAC extractable bases Ca	Mg	Na	K	Sum of bases	Acidity	Extractable Al	CEC[1] Sum of cations	CEC[1] NH_4 OAC	CEC[1] Bases +Al	Al saturation	Base saturation Sum	Base saturation NH_4OAC
0–25	Ap	1.1	0.2	—	0.2	1.5	2.0	0.1	3.5	1.9	1.6	6	43	79
25–51	Bt1	1.8	.4	—	.4	2.6	4.7	.6	7.3	4.1	3.2	10	36	63
51–81	Bt2	1.8	.4	—	.2	2.4	4.6	.6	7.0	3.6	3.0	2	34	67
81–99	Bt3	1.7	.4	TR	.1	2.2	4.8	.8	7.0	3.8	3.0	27	31	58
99–119	Bt4	1.6	.5	0.1	.1	2.3	4.8	1.1	7.1	4.5	3.4	32	32	51
119–145	BC	1.4	.6	.2	.1	2.3	6.5	2.6	8.8	6.2	4.9	53	26	37
145–180	2BC1	1.3	.9	.3	.1	2.6	11.7	5.1	14.3	9.1	7.7	66	18	29
180–219	2BC2	.2	.3	.5	.1	1.1	6.8	4.0	7.9	5.2	5.1	78	14	21

[1]Cation exchange capacity.
[2]Water content at 15-bar pressure.
[3]Coefficient of linear extensibility.
[4]Water-retention difference.

Table 13D. Bulk chemistry of the <63-μm fraction, pedon S81SC–051–012

Major oxide	Bt1	Bt2	Bt3	Bt4	BC	2BC1	2BC2
SiO_2	69.18	68.99	69.08	67.67	62.56	61.00	63.93
Al_2O_3	15.08	15.88	15.79	16.47	19.12	20.18	18.52
Fe_2O_3	6.46	7.08	8.05	8.36	9.60	9.93	10.16
MnO	.02	.02	.02	.02	.02	.03	.03
TiO_2	1.82	1.93	1.92	1.93	1.77	1.62	1.35
CaO	.39	.38	.38	.37	.35	.33	.29
K_2O	.41	.34	.36	.40	.50	.72	.84
Na_2O	<.20	<.20	<.20	.30	<.20	.30	<.20
MgO	.10	<.10	<.10	.10	.10	.36	.38
Total	93.4	94.6	95.6	95.6	94.0	94.4	95.5

Table 14*A*. Field description of pedon S81SC–051–013

[Location: 0.8 km north of Floyds, Horry County, South Carolina; 34°12′ N., 79°03′50″ W. Temperature: 17 °C mean annual, 26 °C mean summer. Elevation: 28 m above mean sea level. Physiography: Back-barrier flat. Geomorphic position: Interfluve summit. Slope and aspect: 1 percent plane. Precipitation: 137 cm, udic moisture regime. Drainage: Well drained. Land use: Cropland. Parent material: Weathered marine sand and clay. No entry indicates no data]

Depth (cm)	Horizon	Moist color[1]	Texture[2]	Structure	Clay skins	Boundary[3]
0–23	Ap	10YR4/2	lfs			as
23–35	E	10YR6/4	lfs			cs
35–73	Bt1	10YR5/6	scl			gs
73–109	Bt2	10YR6/8	scl			cw
109–124	Bt3	10YR6/6	cl			cw
124–147	BC1	10YR6/6	cl			gw
147–173	BC2	10YR5/6	cl			cs
173–196	2BC	10YR7/1	s			as
196–243	2C	2.5YR4/6	scl			

[1]Munsell notation.

[2]lfs, loamy fine sand; scl, sandy clay loam; cl, clay loam; s, sand.

[3]as, abrupt smooth; cs, clear smooth; gs, gradual smooth; cw, clear wavy; gw, gradual wavy.

Table 14*B*. Textural analysis of pedon S81SC–051–013

[Grain sizes in millimeters; all other values in weight percent. VF, very fine; F, fine; M, medium; C, coarse; VC, very coarse; —, analyzed but below detectable limits]

		Total			Clay	Silt		Sand				
Depth (cm)	Horizon	Clay (<.002)	Silt (.002–.05)	Sand (.05–2)	F (<.0002)	F (.002–.02)	C (.02–.05)	VF (.05–.10)	F (.10–.25)	M (.25–.50)	C (.5–1)	VC (1–2)
0–23	Ap	1.6	22.6	75.8	1.2	11.3	11.3	27.0	45.0	2.5	1.1	0.2
23–35	E	4.0	27.2	68.8	2.8	16.1	11.6	24.9	40.1	2.2	1.0	.6
35–73	Bt1	16.9	23.3	59.8	11.3	12.5	10.8	21.7	35.4	1.7	.8	.2
73–109	Bt2	20.6	23.3	56.1	14.2	13.0	10.3	21.7	31.3	1.7	.9	.5
109–124	Bt3	26.0	25.2	48.8	16.2	13.0	12.2	19.6	25.8	1.6	1.1	.7
124–147	BC1	32.1	26.7	41.2	18.7	13.8	12.9	16.2	18.1	2.0	3.3	1.6
147–173	BC2	35.3	24.4	40.3	20.3	15.0	9.4	10.6	14.5	3.9	7.9	3.4
173–196	2BC	42.4	32.0	25.6	22.0	19.2	12.8	9.0	9.3	2.7	3.3	1.3
196–243	2C	19.3	7.3	73.4	12.1	4.4	2.9	6.3	55.9	5.5	2.4	3.3

Table 14*C*. Physical and chemical analyses of pedon S81SC–051–013
[Units of measure for all values given in table 2*B*. —, not detected; no entry, not analyzed; TR, trace]

Depth (cm)	Horizon	Organic C	Total N	Extractable P	Total S	Dithionite-citrate Extractable Fe	Extractable Al	Extractable Mn	Ratio clay CEC[1]	15 bar[2]
0–23	Ap	0.69	0.031			0.2			1.31	1.00
23–35	E	.32	.016			.4			.40	.55
35–73	Bt1	.22	.014			1.6			.21	.46
73–109	Bt2	.19				2.3			.23	.50
109–124	Bt3	.20				2.9			.25	.51
124–147	BC1	.18				3.8			.27	.48
147–173	BC2	.20				4.2			.26	.48
173–196	2BC	.19				3.4			.27	.43
196–243	2C	.13				1.0			.26	.42

Depth (cm)	Horizon	Bulk density Field moist	1/3 bar	Oven dry	COLE[3]	Water content Field moist	1/3 bar	15 bar[2]	WRD[4]	pH $CaCl_2$ (.01M) 1:2	H_2O 1:1
0–23	Ap							1.6		4.8	5.3
23–35	E							2.2		4.5	5.0
35–73	Bt1							7.7		4.5	4.9
73–109	Bt2							10.4		4.5	4.7
109–124	Bt3							13.3		4.3	4.6
124–147	BC1							15.5		4.5	4.6
147–173	BC2							16.8		4.4	4.7
173–196	2BC							18.2		4.6	4.6
196–243	2C							8.1		4.2	4.7

Depth (cm)	Horizon	NH_4OAC extractable bases Ca	Mg	Na	K	Sum of bases	Acidity	Extractable Al	CEC[1] Sum of cations	NH_4 OAC	Bases +Al	Al saturation	Base saturation Sum	NH_4OAC
0–23	Ap	0.7	0.2	—	0.2	1.1	3.2	0.2	4.3	2.1	1.3	15	26	52
23–35	E	.5	.1	—	.1	.7	2.1	.4	2.8	1.6	1.1	36	25	44
35–73	Bt1	1.4	.2	0.5	.2	2.3	4.7	.5	7.0	3.5	2.9	21	33	66
73–109	Bt2	1.6	.4	.9	.1	3.0	6.2	1.3	9.2	4.8	4.3	30	33	62
109–124	Bt3	1.4	.6	TR	.1	2.1	8.5	2.6	10.6	6.6	4.7	55	20	32
124–147	BC1	.9	.8	—	.1	1.8	9.7	4.5	11.5	8.7	6.3	71	16	21
147–173	BC2	.9	.7	.3	.1	2.0	11.2	5.5	13.2	9.0	7.5	73	15	22
173–196	2BC	1.0	.8	.2	.2	2.2	12.4	7.6	14.6	11.5	9.8	78	15	19
196–243	2C	.1	.3	TR	.1	.5	6.3	3.4	6.8	5.1	3.9	87	7	10

[1]Cation exchange capacity.
[2]Water content at 15-bar pressure.
[3]Coefficient of linear extensibility.
[4]Water-retention difference.

Table 14*D*. Bulk chemistry of the <63-μm fraction, pedon S81SC–051–013

Major oxide	Horizon Bt1	Bt2	Bt3	BC1	BC2	2BC
SiO_2	74.38	70.39	66.87	65.41	60.69	66.47
Al_2O_3	12.64	14.52	16.21	17.06	17.92	17.93
Fe_2O_3	5.88	7.53	8.85	9.98	12.40	7.37
MnO	.02	.02	.02	.02	.02	.02
TiO_2	1.99	1.94	1.80	1.60	1.34	1.36
CaO	.36	.37	.34	.31	.31	.31
K_2O	.36	.44	.53	.81	.81	.97
Na_2O	<.20	<.20	<.20	<.20	<.20	<.20
MgO	<.10	.10	.10	.10	.10	.30
Total	95.6	95.3	94.7	95.2	93.5	94.7

Table 15*A*. Field description of pedon S81SC–051–014

[Location: 0.8 km south of Floyds, Horry County, South Carolina; 34°11′ N., 79°02′ W. Temperature: 17 °C mean annual, 26 °C mean summer. Elevation: 29 m above mean sea level. Physiography: Back-barrier flat. Geomorphic position: Interfluve summit. Slope and aspect: 1 percent plane. Precipitation: 137 cm, udic moisture regime. Drainage: Moderately well drained. Land use: Cropland. Parent material: Weathered marine sand and clay. No entry indicates no data]

Depth (cm)	Horizon	Moist color[1]	Texture[2]	Structure[3]	Clay skins	Boundary[4]
0–23	Ap	10YR4/2	ls	1fgr		as
23–35	Bt1	10YR5/6	scl	1msbk		cs
35–53	Bt2	10YR5/6	scl	1msbk		gw
53–81	Bt3	10YR5/6	scl	1msbk		cw
81–109	BC1	10YR5/6	scl	1msbk		cw
109–135	BC2	10YR5/6	scl	1msbk		gw
135–183	C	7.5YR5/8	sl	MA		

[1]Munsell notation.

[2]ls, loamy sand; scl, sandy clay loam; sl, sandy loam.

[3]1, weak; f, fine; m, medium; gr, granular; sbk, subangular blocky; MA, massive.

[4]as, abrupt smooth; cs, clear smooth; gw, gradual wavy; cw, clear wavy.

Table 15*B*. Textural analysis of pedon S81SC–051–014

[Grain sizes in millimeters; all other values in weight percent. VF, very fine; F, fine; M, medium; C, coarse; VC, very coarse; TR, trace; —, analyzed but below detectable limits]

		Total			Clay	Silt		Sand				
Depth (cm)	Horizon	Clay (<.002)	Silt (.002–.05)	Sand (.05–2)	F (<.0002)	F (.002–.02)	C (.02–.05)	VF (.05–.10)	F (.10–.25)	M (.25–.50)	C (.5–1)	VC (1–2)
0–23	Ap	6.6	29.8	63.6	4.6	14.5	15.3	15.7	45.5	1.9	0.4	0.1
23–35	Bt1	15.4	33.8	50.8	11.8	20.7	13.1	12.2	36.7	1.4	.4	.1
35–53	Bt2	16.6	33.5	49.9	5.7	19.8	13.7	12.1	35.6	1.7	.4	.1
53–81	Bt3	15.3	33.0	51.7	12.9	18.9	14.1	12.4	27.4	1.5	.4	TR
81–109	BC1	18.6	30.2	51.2	13.0	18.2	12.0	11.6	37.7	1.5	.3	.1
109–135	BC2	22.7	25.4	51.9	15.8	15.0	10.4	10.3	39.6	1.6	.3	.1
135–183	C	31.2	18.8	50.0	17.1	10.5	8.3	9.4	37.7	2.1	.6	.2

Table 15*C*. Physical and chemical analyses of pedon S81SC–051–014

[Units of measure for all values given in table 2*B*. —, not detected; no entry, not analyzed; TR, trace]

Depth (cm)	Horizon	Organic C	Total N	Extractable P	Total S	Dithionite-citrate Extractable Fe	Dithionite-citrate Extractable Al	Dithionite-citrate Extractable Mn	Ratio clay CEC[1]	Ratio clay 15 bar[2]
0–23	Ap	1.66				0.6			0.98	0.70
23–35	Bt1	.34				1.4			.27	.49
35–53	Bt2	.22				1.5			.23	.47
53–81	Bt3	.18				1.3			.22	.49
81–109	BC1	.16				1.7			.19	.49
109–135	BC2	.16				2.5			.20	.50
135–183	C	.12				5.9			.17	.44

Depth (cm)	Horizon	Bulk density Field moist	Bulk density 1/3 bar	Bulk density Oven dry	COLE[3]	Water content Field moist	Water content 1/3 bar	Water content 15 bar[2]	WRD[4]	pH $CaCl_2$ (.01M) 1:2	pH H_2O 1:1
0–23	Ap		1.60					4.6		4.6	4.8
23–35	Bt1	1.57	1.57	1.60	0.006	10.8	16.0	7.6	0.13	4.3	4.6
35–53	Bt2		1.60					7.8		4.2	4.6
53–81	Bt3	1.72	1.71	1.72	.002	11.5	15.4	7.5	.14	4.4	4.7
81–109	BC1		1.70					9.1		4.4	4.7
109–135	BC2	1.63	1.64	1.69	.010	15.1	18.2	11.3	.11	4.3	4.7
135–183	C							13.6		4.4	4.7

Depth (cm)	Horizon	NH_4OAC extractable bases Ca	Mg	Na	K	Sum of bases	Acidity	Extractable Al	CEC[1] Sum of cations	CEC[1] NH_4 OAC	CEC[1] Bases +Al	Al saturation	Base saturation Sum	Base saturation NH_4OAC
0–23	Ap	1.2	0.3	—	0.3	1.8	8.1	1.2	9.9	6.5	3.0	40	18	28
23–35	Bt1	.9	.4	—	.1	1.4	6.0	1.4	7.4	4.2	2.8	50	19	33
35–53	Bt2	1.0	.3	—	TR	1.3	5.5	1.1	6.8	3.8	2.4	46	19	34
53–81	Bt3	.3	.2	—	TR	.5	4.3	1.3	4.8	3.3	1.8	72	10	15
81–109	BC1	.2	.2	—	TR	.4	4.2	1.3	4.6	3.5	1.7	76	9	11
109–135	BC2	.2	.2	TR	TR	.4	5.4	2.0	5.8	4.5	2.4	83	7	9
135–183	C	.2	.3	1.2	TR	1.7	6.8	3.1	8.5	5.4	4.8	65	20	31

[1]Cation exchange capacity.

[2]Water content at 15-bar pressure.

[3]Coefficient of linear extensibility.

[4]Water-retention difference.

Table 15*D*. Bulk chemistry of the <63-μm fraction, pedon S81SC–051–014

Major oxide	Horizon Bt1	Bt2	Bt3	BC1	BC2
SiO_2	80.51	80.07	83.46	81.72	68.41
Al_2O_3	10.21	10.40	9.22	9.40	9.79
Fe_2O_3	4.57	4.99	4.00	4.73	6.15
MnO	.01	.01	.01	.06	<.01
TiO_2	1.66	1.69	1.73	1.73	1.49
CaO	.32	.33	.30	.29	.30
K_2O	.37	.35	.31	.31	.29
Na_2O	<.20	<.20	<.20	<.20	<.20
MgO	.18	.10	<.10	<.10	<.10
Total	97.8	97.9	99.0	98.2	86.4

Table 16A. Field description of pedon S81SC–051–015

[Location: 1.6 km south of Floyds, Horry County, South Carolina; 34°02′50″ N., 78°53′ W. Temperature: 17 °C mean annual, 26 °C mean summer. Elevation: 30 m above mean sea level. Physiography: Back-barrier flat. Geomorphic position: Interfluve summit. Slope and aspect: 1 percent plane. Precipitation: 137 cm, udic moisture regime. Drainage: Well drained. Land use: Cropland. Parent material: Weathered marine sand and clay. No entry indicates no data]

Depth (cm)	Horizon	Moist color[1]	Texture[2]	Structure[3]	Clay skins	Boundary[4]
0–23	Ap	10YR4/2	ls	1fgr		as
23–41	E	10YR5/3	ls	1fgr		cs
41–71	Bt1	10YR5/6	scl	1msbk		gw
71–104	Bt2	10YR6/8	scl	1msbk		gw
104–142	BC1	10YR6/8	sl	1msbk		gw
142–189	BC2	10YR6/8	sl	MA		cs
189–204	C	10YR6/8	ls	MA		

[1]Munsell notation.

[2]ls, loamy sand; scl, sandy clay loam; sl, sandy loam.

[3]1, weak; f, fine; m, medium; gr, granular; sbk, subangular blocky; MA, massive.

[4]as, abrupt smooth; cs, clear smooth; gw, gradual wavy.

Table 16B. Textural analysis of pedon S81SC–051–015

[Grain sizes in millimeters; all other values in weight percent. VF, very fine; F, fine; M, medium; C, coarse; VC, very coarse; —, analyzed but below detectable limits]

		Total			Clay	Silt		Sand				
Depth (cm)	Horizon	Clay (<.002)	Silt (.002–.05)	Sand (.05–2)	F (<.0002)	F (.002–.02)	C (.02–.05)	VF (.05–.10)	F (.10–.25)	M (.25–.50)	C (.5–1)	VC (1–2)
0–23	Ap	2.0	8.0	90.0	—	4.9	3.1	5.2	78.3	4.2	2.0	0.3
23–41	E	2.8	10.4	86.8	0.4	7.2	3.2	4.7	75.2	4.0	2.6	.3
41–71	Bt1	24.8	8.4	66.8	14.6	5.7	2.7	3.6	56.6	3.5	2.6	.5
71–104	Bt2	24.7	7.2	68.1	15.8	4.5	2.7	3.4	59.2	3.3	1.9	.3
104–142	BC1	18.2	3.7	78.1	10.5	2.4	1.3	3.0	69.6	3.5	1.9	.1
142–189	BC2	18.6	2.3	79.1	13.7	1.2	1.1	2.4	62.8	7.1	5.6	1.2
189–204	C	9.3	3.6	87.1	5.6	2.4	1.2	3.3	80.2	2.5	.8	.3

Table 16*C*. Physical and chemical analyses of pedon S81SC–051–015
[Units of measure for all values given in table 2*B*. --, not detected; no entry, not analyzed; TR, trace]

Depth (cm)	Horizon	Organic C	Total N	Extractable P	Total S	Dithionite-citrate: Extractable Fe	Dithionite-citrate: Extractable Al	Dithionite-citrate: Extractable Mn	Ratio clay: CEC[1]	Ratio clay: 15 bar[2]
0–23	Ap	0.63	0.036			0.2			0.90	0.75
23–41	E	.20	.009			.3			.25	.46
41–71	Bt1	.24	.020			2.4			.13	.40
71–104	Bt2	.21	.013			2.6			.11	.42
104–142	BC1	.15				1.8			.13	.47
142–189	BC2	.13				1.8			.15	.46
189–204	C	.14				2.3			.15	.58

Depth (cm)	Horizon	Bulk density: Field moist	Bulk density: 1/3 bar	Bulk density: Oven dry	COLE[3]	Water content: Field moist	Water content: 1/3 bar	Water content: 15 bar[2]	WRD[4]	pH: $CaCl_2$ (.01M) 1:2	pH: H_2O 1:1
0–23	Ap							1.5		4.7	5.1
23–41	E							1.3		4.7	5.2
41–71	Bt1							9.8		5.4	5.7
71–104	Bt2							10.3		5.5	5.8
104–142	BC1							8.6		5.0	5.4
142–189	BC2							8.5		4.4	5.1
189–204	C							5.4		4.5	5.2

Depth (cm)	Horizon	NH_4OAC extractable bases: Ca	Mg	Na	K	Sum of bases	Acidity	Extractable Al	CEC[1]: Sum of cations	CEC[1]: NH_4 OAC	CEC[1]: Bases +Al	Al saturation	Base saturation: Sum	Base saturation: NH_4OAC
0–23	Ap	0.7	0.1	0.1	0.1	1.0	2.1	0.2	3.1	1.8	1.2	17	32	56
23–41	E	.2	TR	TR	.1	.3	.6	.1	.9	.7	.4	25	33	43
41–71	Bt1	1.9	.6	.3	.2	3.0	4.4		7.4	3.3			41	91
71–104	BC2	1.6	.6	.1	.1	2.4	3.9		6.3	2.8			38	86
104–142	BC1	1.2	.5	.1	TR	1.8	2.6	—	4.4	2.4			41	75
142–189	BC2	.8	.6	.3	TR	1.7	3.1	.5	4.8	2.7	2.2	23	35	63
189–204	C	.3	.2	TR	TR	.5	3.0	.1	3.5	1.2	.6	17	14	42

[1]Cation exchange capacity.
[2]Water content at 15-bar pressure.
[3]Coefficient of linear extensibility.
[4]Water-retention difference.

Table 16*D*. Bulk chemistry of the <63-μm fraction, pedon S81SC–051–015

Major oxide	Horizon: E	Bt1	Bt2	BC1	BC2
SiO_2	80.47	39.24	35.08	34.63	34.93
Al_2O_3	4.26	27.29	26.38	26.50	25.84
Fe_2O_3	1.55	10.22	12.50	14.63	16.59
MnO	.01	.08	<.10	.05	.05
TiO_2	1.50	1.58	1.74	1.24	.88
CaO	.33	.41	.41	.40	.37
K_2O	.39	.48	.43	.56	1.02
Na_2O	<.20	<.20	<.20	<.20	<.20
MgO	<.10	<.10	<.10	.47	.50
Total	88.5	79.3	76.5	78.4	80.1

Table 17. Clay mineral trends–peak height ratios: 14.2 A/ 7.2 A+4.85 A for pedons 001, 002, 003, 004, 010, 012, and 014

Pedon	Horizon	Peak height ratio
	Horry barrier	
S80SC–051–001	Ap	1.9
	Bt1	1.1
	Bt2	.2
	C	.2
S80SC–051–002	Ap	2.4
	Bt2	1.2
	BC	.9
	C2	1.0
	2C3	1.6
	Conway barrier	
S80SC–051–003	Ap	1.9
	Bt2	1.5
	Bt3	.7
S80SC–051–004	Ap	1.6
	BA	1.7
	Bt2	.6
	BC	.9
	C	1.2
	Carolina bay	
S81SC–051–010	Ap	2.1
	BA	2.0
	Bt	1.7
	Bh1	1.3
	Horry back barrier	
S81SC–051–012	Ap	1.5
	Bt1	2.5
	Bt2	1.1
	Bt3	1.0
	Bt4	.7
	BC	.4
	2BC1	.1
S81SC–051–014	Ap	1.9
	Bt1	1.4
	Bt3	1.0
	BC2	1.0
	C	.4

Table 18. Altitude, age, and estimated uplift rates for individual barrier systems in Horry County, South Carolina

Barrier system (formation)	Altitude (meters)	Age (years)	Uplift rate (meters/m.y.)	Average altitude difference between units (meters)	Uplift rates in interval between deposition of units (meters/m.y.)		
Horry (Bear Bluff)	33–50	2.5×10^6– 3.0×10^6	13–20 11–17				
					(2.5 Ma)	(3.0 Ma)	
Daisy Strand–Nakina (Penholoway).	27–30	800,000	34–38	10	6.0	4.5	
					(500 ka)	(200 ka)	
				10	33	17	
Conway-Jaluco (Canepatch or Socastee).	17–20	500,000 or 200,000	34–40 85–100				
					(70 ka)	(30 ka)	(10 ka)
				10	25	21	20
					77	59	53
Unnamed (Myrtle Beach of Crisp (1971) or Wando).	3–10	70,000 or 30,000 or 10,000	40–140 100–330 300–1,000				