Figure 1. Soil resource areas of Mississippi
Expansive Soils of Mississippi

Introduction

Expansive soils in Mississippi were recognized in the mid-19th century by E. W. Hilgard (1860), who is acknowledged as one of the founders of soil science. He observed that certain clayey soils had a tendency to crack in dry seasons and form large surface cracks 2 to 3 inches wide, which were injurious to vegetation and buildings. Hilgard commented that most brick and stone buildings in Jackson, not secured by wall anchors or concrete foundations, developed cracks in all directions over time.

Expansive soils swell when wet and shrink when dry, causing major problems for foundations, roads, sidewalks, pipelines, excavations, and industrial and agricultural operations. Expansive soils are widely distributed in Mississippi, create severe economic damages, and pose a continued threat.

Various names have evolved to describe the expansive, clayey soils, including gumbo soils, buckshot soils, and black cotton soils. Expansive soils are commonly referred to as “self-mulching” because of movement of surface soil into the open cracks.

In some areas, the expansive soils have a characteristic topography. Hilgard (1860) referred to the surface topography in the prairie region of Smith County as “hogback” or “hogswallow” to describe the microrelief produced by the swelling soils. He proposed that the uneven, hummocky surface was due to the clayey soils bulging upward after soil material crumbled into open cracks preventing crack closure upon wetting.

Gilgai, an Australian Aborigine term referring to seasonal water accumulation in lower parts of microrelief forms, is currently used to describe the landscape microrelief (Prescott, 1931; USDA, 1975). Microhigh and microlow terms are also used to describe the microrelief of expansive soils (Bartelli and McCormack, 1976). Modern explanations of the microrelief (Lynn and Williams, 1992; Ahmad, 1983) differ little from Hilgard’s proposal in 1860.

This bulletin describes the types, distribution, and extent of clayey, expansive soils in Mississippi and presents physical, chemical, and mineralogical data of representative soils.

Methods and Materials

Soils were considered expansive based on shrink-swell properties, classification, and severe/moderate limitations for dwellings with and without basements, small commercial buildings, roads, and streets. Data on the extent and types of expansive soils were obtained from published soil surveys and surveys in progress but not published, representing about 80% of the total state acreage. Representative expansive soils were selected after field transect investigations and auger surveys.

Soils were described and sampled in pits using standard methods (Soil Survey Staff, 1984). Samples taken for laboratory analysis were air-dried and sieved to remove coarse fragments. Particle size distribution was determined by the hydrometer method and sieving (Day, 1965). Soil pH was measured in a 1:1 soil/water suspension. Organic matter was determined by wet combustion (Peech et al., 1947). Extractable acidity was determined by the BaCl2-triethanolamine method (Peech, 1965). Exchangeable cations were extracted by 1M NH4OAC (pH 7.0) and determined by atomic absorption spectrophotometry. KCl-exchangeable Al was determined by the method of Yuan (1959).

Clay fractions of selected soils were separated by centrifugal sedimentation. They were analyzed by x-ray diffraction (Jackson, 1956) with a Norelco Geiger counter spectrophotometer using Cu Kα radiation and a Ni filter. Mineral type and content were estimated from basal spacings and x-ray peak intensity. Microscopic examinations were made of soil peds using conventional light microscopy. Coefficient of linear extensibility (COLE) was determined on <2mm extruded soil paste (Schafer and Singer, 1976; Simon, et al., 1987) where

\[
\text{COLE} = \frac{\text{length wet} - \text{length dry}}{\text{length dry}}
\]

Results and Discussion

Occurrence and Extent

Expansive, clayey soils occur in all major soil resource areas of the state (Figure 1) and comprise more than 18% of the total state acreage (Table 1). The largest acreage of expansive soils occurs in the Delta (Southern Mississippi Valley Alluvium) and Blackland Prairie regions of the state (Table 1). These two regions contain about 72% of the expansive soil acreage in the state.

Clayey soils comprise the dominant acreage in the Delta counties. For example, expansive soils comprise more than 89% of Sharkey County. In contrast, expans-
Table 2. Soil series, classification, and approximate acreage of expansive soils of Mississippi.

<table>
<thead>
<tr>
<th>Series</th>
<th>Classification</th>
<th>Approximate Acreage</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Blackland Prairie</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brooksville</td>
<td>fine, montmorillonitic, thermic Aquic Hapludolls</td>
<td>66,123</td>
</tr>
<tr>
<td>Catalpa</td>
<td>fine, montmorillonitic, thermic Fluvaquentic Hapludolls</td>
<td>57,554</td>
</tr>
<tr>
<td>Eutaw</td>
<td>very-fine, montmorillonitic, thermic Eutic Pelludolls</td>
<td>10,966</td>
</tr>
<tr>
<td>Loutch</td>
<td>fine, montmorillonitic, thermic Aquic Hapludolls</td>
<td>15,888</td>
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<tr>
<td>Griffith</td>
<td>fine, montmorillonitic, thermic Vertic Hapludolls</td>
<td>18,994</td>
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<tr>
<td>Houka</td>
<td>fine, montmorillonitic, acid, thermic Vertic Hapludolls</td>
<td>18,902</td>
</tr>
<tr>
<td>Houston</td>
<td>very-fine, montmorillonitic, thermic Typic Chromudolls</td>
<td>34,334</td>
</tr>
<tr>
<td>Kipling</td>
<td>fine, montmorillonitic, thermic, Vertic Hapludolls</td>
<td>212,980</td>
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<tr>
<td>Lecor</td>
<td>fine, montmorillonitic, nonacid, thermic Vertic Hapludolls</td>
<td>176,464</td>
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<tr>
<td>Okolona</td>
<td>fine, montmorillonitic, thermic Typic Chromudolls</td>
<td>45,373</td>
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<td>Oktibbeha</td>
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<td>108,162</td>
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<td>Pelsahatchie</td>
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<td>4,466</td>
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<td>Sessums</td>
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<td>Sumter</td>
<td>fine-silty, carbonatic, thermic Rendolic Eutrochrepts</td>
<td>79,783</td>
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<td>Tuscaluba</td>
<td>fine, mixed, nonacid, thermic Vertic Hapludolls</td>
<td>10,414</td>
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<tr>
<td>Una</td>
<td>fine, mixed, acid, thermic Typic Hapludolls</td>
<td>14,648</td>
</tr>
<tr>
<td>Urbo</td>
<td>fine, mixed, acid, thermic, Aquic Hapludolls</td>
<td>105,874</td>
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<td>Vaiden</td>
<td>very-fine, montmorillonitic, thermic Vertic Hapludolls</td>
<td>221,554</td>
</tr>
<tr>
<td><strong>Interior Flatwoods</strong></td>
<td></td>
<td></td>
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<tr>
<td>Falkner</td>
<td>fine-silty, siliceous, thermic Aquic Paleudafs</td>
<td>187,175</td>
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<tr>
<td>Maybesh</td>
<td>fine-montmorillonitic, thermic Vertic Ochraqualfs</td>
<td>34,181</td>
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<td>Wilcox</td>
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<tr>
<td><strong>Delta</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alligator</td>
<td>very-fine, montmorillonitic, acid, thermic Vertic Hapludolls</td>
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</tr>
<tr>
<td>Bowdre</td>
<td>clayey over loamy, montmorillonitic, thermic Fluvaquentic Hapludolls</td>
<td>32,273</td>
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<tr>
<td>Dowling</td>
<td>very-fine, montmorillonitic, nonacid, thermic Vertic Hapludolls</td>
<td>537,267</td>
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<tr>
<td>Forestdale</td>
<td>fine, montmorillonitic, thermic Typic Ochraqualfs</td>
<td>454,948</td>
</tr>
<tr>
<td>Sharkey</td>
<td>very-fine, montmorillonitic, nonacid, thermic Vertic Hapludolls</td>
<td>862,093</td>
</tr>
<tr>
<td>Tunica</td>
<td>clayey over loamy, montmorillonitic, nonacid, thermic Vertic Hapludolls</td>
<td>123,019</td>
</tr>
<tr>
<td>Tennas</td>
<td>fine, montmorillonitic, thermic Vertic Ochraqualfs</td>
<td>20,800</td>
</tr>
<tr>
<td><strong>Coastal Plain (Upper and Lower)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arundel</td>
<td>clayey, montmorillonitic, thermic Typic Hapludolls</td>
<td>41,932</td>
</tr>
<tr>
<td>Boswell</td>
<td>fine, mixed, thermic Vertic Paleudafs</td>
<td>62,379</td>
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<tr>
<td>Cadeville</td>
<td>fine, mixed, thermic Albaquic Hapludafs</td>
<td>55,312</td>
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<tr>
<td>Chastain</td>
<td>fine, mixed, acid, thermic Typic Fluvaquents</td>
<td>33,766</td>
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<tr>
<td>Falkner</td>
<td>fine-silty, siliceous, thermic Aquic Paleudafs</td>
<td>187,175</td>
</tr>
<tr>
<td>Freest</td>
<td>fine-loamy, siliceous, thermic Aquic Paleudafs</td>
<td>54,548</td>
</tr>
<tr>
<td>Kisatchie</td>
<td>fine, montmorillonitic, thermic Typic Hapludolls</td>
<td>3,575</td>
</tr>
<tr>
<td>Leaf</td>
<td>clayey, mixed, thermic Typic Albaquats</td>
<td>37,080</td>
</tr>
<tr>
<td>Mahon</td>
<td>fine, mixed, thermic Ultic Hapludafs</td>
<td>96,559</td>
</tr>
<tr>
<td>Petal</td>
<td>fine-loamy, siliceous, thermic Typic Paleudafs</td>
<td>54,227</td>
</tr>
<tr>
<td>Siwell</td>
<td>fine-silty, mixed, thermic Typic Hapludolls</td>
<td>12,542</td>
</tr>
<tr>
<td>Susquehanna</td>
<td>fine, montmorillonitic, thermic Vertic Paleudals</td>
<td>192,897</td>
</tr>
<tr>
<td><strong>Loess (Thick and Thin)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Byram</td>
<td>fine-silty, mixed, thermic Typic Fragiudals</td>
<td>29,065</td>
</tr>
<tr>
<td>Kolin</td>
<td>fine-silty, siliceous, thermic Glossaquic Paleudafs</td>
<td>83,973</td>
</tr>
<tr>
<td>Lorman</td>
<td>fine, montmorillonitic, thermic Vertic Hapludolls</td>
<td>107,980</td>
</tr>
<tr>
<td>Siwell</td>
<td>fine-silty, mixed, thermic Typic Hapludolls</td>
<td>18,562</td>
</tr>
<tr>
<td>Tippah</td>
<td>fine-silty, mixed, thermic Aquic Paleudafs</td>
<td>210,882</td>
</tr>
</tbody>
</table>
Table 1. Approximate acreage of expansive soils in soil resource areas of Mississippi.

<table>
<thead>
<tr>
<th>Soil Resource Area</th>
<th>Extent*</th>
<th>Proportion of State</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Acres</td>
<td>%</td>
</tr>
<tr>
<td>Delta</td>
<td>2,668,046</td>
<td>8.8</td>
</tr>
<tr>
<td>Blackland Prairie</td>
<td>1,207,356</td>
<td>4.0</td>
</tr>
<tr>
<td>Coastal Plain</td>
<td>839,682</td>
<td>2.8</td>
</tr>
<tr>
<td>Interior Flatwoods</td>
<td>329,964</td>
<td>1.1</td>
</tr>
<tr>
<td>Loess</td>
<td>391,152</td>
<td>1.3</td>
</tr>
<tr>
<td><strong>TOTALS</strong></td>
<td><strong>5,430,200</strong></td>
<td><strong>18.0</strong></td>
</tr>
</tbody>
</table>

*Based on soil surveys completed 1/92.

Expansive soils comprise about 50% of Noxubee County, 10% of Forrest County, and 1% of Hancock County.

Forty-five soil series comprise most of the expansive soils in Mississippi (Table 2). Sharkey, Alligator, Dowling, and Forestdale are the most extensive expansive soils mapped in the state.

Swelling soils in the state have been classified into six orders of Soil Taxonomy (Table 3). The largest acreage has been classified as Inceptisols and Alfisols. Although the Vertisol Order represents clayey, expansive soils with shrinking and swelling properties, only about 3% of the expansive soils in the state have been classified as Vertisols. Recent research indicates a large acreage of soils previously classified as Inceptisols and Alfisols should be reclassified as Vertisols.

Depth to expansive clay horizons is variable and horizon thickness is also variable. The swelling clay may occur at the surface and/or in the subsoil. For example, Bowdre soils in the Delta have up to 20 inches of expansive clay overlying loamy material; and Tunica soils have 20 to 36 inches of clay over nonswelling, loamy substratum. In contrast, Alligator, Sharkey, and Dowling soils may have expansive clay extending from the surface to depths of 6 feet and greater.

Soils of the Blackland Prairie in the northeastern part of the state are usually underlain by firm chalk at depths of 5 to 6 feet, except for the Sumter soil, which has chalk within 20 to 40 inches. In contrast, soils of the Blackland Prairie in the east central part of the state, commonly known as the Jackson Prairie, are underlain by expansive, calcareous clay ranging in depth from a few feet to more than 500 feet. Soils of the Blackland Prairies have neutral/calcareous and extremely acid expansive clays overlying chalk and calcareous clays. The soils with acid clays are commonly referred to as the "Piney Woods." The thickness of stable nonexpanding soil overlying expansive clay is an important consideration in road construction, building foundations, and domestic waste disposal. Soils like Byram, Siwell, and Kolin have loamy horizons underlain by expansive clay below depths of 20 to 40 inches. Equally important is the thickness of expansive clay over underlying stable rocks. Expansive Arundel and Kisatchie soils are underlain by rock at depths of 20 to 40 inches.

Recognition that expansive clay soils occur adjacent to and intermingled with stable loamy soils in the Coastal Plain is important. Sharp boundaries may occur between stable and expansive soils with little or no topographic indication. Expansive Boswell and Susquehanna soils commonly occur adjacent to stable loamy soils in the Coastal Plain uplands. Failure to recognize the boundaries may result in building foundations being placed on both stable and expansive soils with resultant severe structural damage. Soil maps and on-site investigations can be used to identify expansive soils.

### Soil Swelling

Soil swelling occurs when clayey soils absorb water. If soil moisture is unchanged, the soil volume does not change. Very dry clayey soils with water contents less than 15% easily absorb water and swell (Chen, 1975), and most soil expansion usually has occurred at 30% moisture content. Soil moisture is a function of depth. Allen and Braud (1966) reported most soil water change occurs in the upper 8 inches of the soil. Our research on swelling soils indicates about 80% of the soil moisture variation occurs in the surface 20 inches. Cheng (1991) determined that expansive Okolona and Vaiden soils in Monroe County swelled in winter and shrank in mid-spring and summer. He reported the greatest vertical movement occurred in the upper 20 inches with a maximum of 1.1 inches in Okolona and 0.96 inch in Vaiden.

A common method of estimating swelling potential in soils is the coefficient of linear extensibility (COLE). This parameter is used to classify soils in Soil Taxonomy (Soil Survey Staff, 1975). Clayey soils with COLE values of 0.09 and greater are considered expansive and may be classified as Vertisols or in Vertic subgroups of other orders. These soils usually have severe limitations for buildings, roads, and founda-

Table 2. Acreage and extent of Mississippi expansive, clayey soils in the different orders of soil taxonomy.*

<table>
<thead>
<tr>
<th>Soil Order</th>
<th>Acreage</th>
<th>Percentage of Expansive Soils</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inceptisol</td>
<td>2,578,810</td>
<td>47.49</td>
</tr>
<tr>
<td>Alfisol</td>
<td>2,446,767</td>
<td>45.06</td>
</tr>
<tr>
<td>Vertisol</td>
<td>166,619</td>
<td>3.07</td>
</tr>
<tr>
<td>Mollisol</td>
<td>106,821</td>
<td>2.00</td>
</tr>
<tr>
<td>Ultisol</td>
<td>106,067</td>
<td>1.99</td>
</tr>
<tr>
<td>Entisol</td>
<td>35,766</td>
<td>0.62</td>
</tr>
</tbody>
</table>

*Based upon 80% completion of soil survey of the state.
Table 4. Coefficient of Linear Extensibility (COLE) of selected horizons of representative expansive soils.

<table>
<thead>
<tr>
<th>Soil Series</th>
<th>Horizon</th>
<th>Depth (in.)</th>
<th>COLE*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alligator</td>
<td>A</td>
<td>0-5</td>
<td>0.22 ± 0.008**</td>
</tr>
<tr>
<td>Alligator</td>
<td>Bgge1</td>
<td>21-40</td>
<td>0.19 ± 0.009</td>
</tr>
<tr>
<td>Mayhew</td>
<td>Bgge</td>
<td>20-30</td>
<td>0.18 ± 0.018</td>
</tr>
<tr>
<td>Okolona</td>
<td>A</td>
<td>0-5</td>
<td>0.16 ± 0.009</td>
</tr>
<tr>
<td>Okolona</td>
<td>Bwss1</td>
<td>21-46</td>
<td>0.15 ± 0.009</td>
</tr>
<tr>
<td>Pelahatchie</td>
<td>Bt2</td>
<td>21-29</td>
<td>0.17 ± 0.02</td>
</tr>
<tr>
<td>Pelahatchie</td>
<td>Bt3</td>
<td>29-43</td>
<td>0.21 ± 0.001</td>
</tr>
<tr>
<td>Petal</td>
<td>Bt</td>
<td>48-60</td>
<td>0.11 ± 0.001</td>
</tr>
<tr>
<td>Sharkey</td>
<td>Bgge1</td>
<td>9-19</td>
<td>0.19 ± 0.001</td>
</tr>
<tr>
<td>Sharkey</td>
<td>Bgge2</td>
<td>19-40</td>
<td>0.17 ± 0.02</td>
</tr>
<tr>
<td>Susquehanna</td>
<td>Btg2</td>
<td>27-42</td>
<td>0.18 ± 0.007</td>
</tr>
<tr>
<td>Vaiden</td>
<td>Bt1</td>
<td>4-14</td>
<td>0.14 ± 0.013</td>
</tr>
<tr>
<td>Vaiden</td>
<td>Btsa2</td>
<td>56-69</td>
<td>0.21 ± 0.014</td>
</tr>
<tr>
<td>Wilcox</td>
<td>Bt4</td>
<td>20-35</td>
<td>0.18 ± 0.017</td>
</tr>
<tr>
<td>Wilcox</td>
<td>Cg</td>
<td>35-60</td>
<td>0.18 ± 0.016</td>
</tr>
</tbody>
</table>

*Means of 10 replications  **Standard deviation

Soil Cracking

Expansive, clayey soils crack upon drying as the volume of soil aggregates decrease. Research indicates the size and extent of cracks vary with clay content and mineralogy, soil moisture fluctuations, absorbed cations, precipitation, vegetation, and land use (Smith et al., 1985; Reeve et al., 1980; Franzmeier and Ross, 1968). Cracks that extend from the surface provide for rapid free water movement into the subsoil. Allen and Braud (1966) reported the effect of cracks on infiltration continued after the cracks appeared to swell shut. Vertical free water movement along cracks in unsaturated soil has been described as channeling (Beven, 1981), short-circuiting (Bouma et al., 1981), and bypass flow (Smettem and Trudgill, 1983).

Rain and irrigation waters containing fertilizers can penetrate the subsoil by flowing through the cracks resulting in drought damage and possible nutrient deficiency (Bouma and Dekker, 1978; Germann et al., 1984). Cracks also provide access for herbicides, insecticides, and other pollutants to move deep into the soil in solution or by transport with surface soil (Bouma and Loveday, 1988; Southard and Graham, 1992). The movement of solutes in cracks may impact groundwater (Bronswnik, 1989; Thomas and Phillips, 1979; Coles and Trudgill, 1985). Research on cracking Vertisols in California detected herbicides at depths 50 inches below open cracks (Graham et al., 1992).

Figure 2. Surface crack research plot (11 ft²) in an Alligator clay soil in LeFlore County.
A persistent question that arises concerning soil cracks is whether or not they occur at the same place each year. Several researchers reported that cracks redevelop in the same place after each wetting and drying cycle (Blokhuys et al., 1964; Yong and Warkentin, 1975). Sleeman (1963) and Ahmad (1983) suggested cracks form a semi-permanent pattern, which depends on clay orientation and land use. Komas et al. (1991) determined that cracks conducting bypass water form a semi-permanent network of polygons on the soil surface. They determined the sizes of the polygons increase curvilinearly with clay content.

We measured the width and depth of surface cracks of a typical Alligator clay soil for 3 years in a plot of 11 square feet (Figure 2). We traced the cracks on plastic overlay each year and measured the location and volume of cracks. The major cracks (maximum width and depth) occurred at the same location each year. The surface area comprised by the cracks ranged from 12.2 to 23.4% of the plot over the 3-year period (Table 5). There was little variation in the maximum crack width and depth. Wider cracks extended deeper than smaller cracks. Soil moisture contents showed a horizontal and vertical gradient from the exposed crack surface. Average soil moisture increased from 20.8% at the surface crack face to 21.8% directly inside the ped. The crack interface vertical soil moisture gradient increased from 20.8% at the surface to 24.6% at a depth of 12 inches. Surface cracks developed and were evident at soil moisture contents of 28%.

In a related study (Cheng, 1991) of Okolona and Vaiden soils in Monroe County over a 2-year period, maximum cracks were 2.3 inches wide and 24.4 inches deep in Okolona, and 1 inch wide and 20 inches deep in Vaiden.

It is very difficult to accurately measure crack depth because of the circuitous path of the cracks. We determined that measurements from the surface with a metal tape greatly underestimated the maximum crack depth based on subsequent determination from freshly excavated pits in Alligator, Sharkey, Okolona, and Vaiden soils.

We found that crack depth, width, orientation, and volume can be accurately determined by injecting expanding polyurethane into cracks under nitrogen pressure and allowing it to expand and harden before excavating. The three-dimensional excavated mold of the crack system (Figure 3) can be immersed in water to obtain crack volume by water displacement. This technique revealed that many cracks occur in the subsoil that are not visible at the surface. The larger cracks appear to be associated with planar surfaces of prismatic structural units, which were commonly expressed at the surface as a polygonal pattern.

<table>
<thead>
<tr>
<th>Year</th>
<th>Width</th>
<th>Depth</th>
<th>Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>1987</td>
<td>2.8</td>
<td>26</td>
<td>12.2</td>
</tr>
<tr>
<td>1988</td>
<td>3.0</td>
<td>26</td>
<td>23.4</td>
</tr>
<tr>
<td>1989</td>
<td>2.9</td>
<td>27</td>
<td>19.2</td>
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</table>
Landscape Relationships

Expansive soils occur on floodplains, terraces, upland ridges, and sideslopes. The dominant acreage occurs on Mississippi River floodplains and terraces with nearly level topography and slope gradients of 0 to 2%. Most of the acreage of expansive soils has nearly level slopes of 0 to 2%. The Delta soils are mapped in very large delineations. Runoff is very slow because of the nearly level slopes and the poorly defined drainage pattern. The acid, clayey soils comprising the “Post Oak” portions of the Blackland Prairies, including Kipling and Oktibbeha soils, have slopes ranging from 0 to 40%. In contrast, Brooksville, Okolona, and Eutaw soils of the Prairie region have slopes similar to the Delta soils.

Expansive soils in the loessial and coastal plain regions occur on steeper, dissected landscapes with slopes ranging to 40%. Surface drainage is well defined on these steeper soils. The expansive soils on steep slopes have limitations due to the high shrink-swell properties and they are prone to mass movement. Mabon soils with slopes greater than 25% are prone to landslides (Pettrry et al., 1988).

Subsurface horizons typically have stress surfaces on faces of ped in the upper profile, which grade to slickensides in the lower subsoil. Stress surfaces result from shrink-swell action of expanding clay. Slickensides are shear planes caused by soil movement in the profile that creates smooth, slick, shiny planar surfaces. The slickensides are more extensive and better developed in the lower subsoils, and they commonly exhibit a “tongue and groove” or “corrugated” form (Figure 4). The slickensides commonly intersect and they are usually inclined 10° to 40° from the horizontal (Figure 5). We measured slickensides that were 10 feet long and 8 inches wide in Okolona soils in Monroe County. Typically, the slickensides occur deeper in soils with argillic horizons such as Vaiden, Kipling, and Oktibbeha. Research elsewhere indicates slickensides occur below the depth of cracking and at the seasonal wetting depth, with an optimum depth of 150 to 200 cm (Yaalon and Kalmar, 1978). We traced large “corrugated” slickensides to depths of 120 inches and contact with underlying chalk in Vaiden soils in Monroe County. The angle of inclination of the underlying chalk appeared to influence the slickenside inclination.

Morphology

The dominant acreage of clayey, expansive soils (Delta and Blackland Prairie regions) have ochric epipedons and cambic subsurface horizons, except Boudre, Catalpa, and Okolona soils, which have mollic epipedons. The acid, clayey soils of the “Post Oak Prairie,” and the expansive soils of the Loessial, Interior Flatwoods, and Coastal Plain regions exhibit greater pedogenic development with ochric epipedons and subsurface argillic horizons.

Mineralogy

The expansive soils formed in a variety of parent materials including Selma chalk, Yazoo clay, Talla-hatta siltstone, and alluvial and marine clayey sediments. Soils inherited their textural characteristics and mineralogy from the parent materials. The clay fractions do not contain a discrete mineral suite, but a mixture of different phyllosilicates in varying proportions with montmorillonite a dominant mineral. Typically, the clay fractions have montmorillonite > kaolinite > interlayer vermiculite > illite >

Figure 4. Well-developed tongue and groove slickenside from Btss horizon in a Vaiden silty clay loam soil in Monroe County.
quartz. The shrinking and swelling are primarily due to the montmorillonitic clay.

We detected no differences in shrink-swell characteristics between acid and neutral clays. The Al-hydroxy-interlayering in the acid clays does not appear to inhibit expansion as postulated by Franzmeier and Ross (1968). Karathanasis and Hajek (1985) also found no Al-interlayer induced swelling reduction in expansive soils in Alabama.

Acknowledgments

Special thanks are expressed to R.B. Hinton, W.D. Daniels, P. Nichols, Jr., and F.B. Brent of the Soil Conservation Service, USDA. We appreciate the reviews and useful suggestions of K. H. Remy and W. F. Jones, Mississippi Agricultural and Forestry Experiment Station.

References Cited


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APPENDIX

Soil Data Tables
(Tables 6-24)
Units and Conventions Used in Soil Data Tables
(Tables 6-24)

The units used in this publication are the same used in published soil survey reports in Mississippi.

Particle Size Distribution

VCS = very coarse sand (2-1 mm)  VFS = very fine sand (0.10-0.05 mm)
CS = coarse sand (1-0.5 mm)      Silt (0.05 - 0.002 mm)
MS = medium sand (0.5 - 0.25 mm) C = clay (< 0.002 mm)
FS = fine sand (0.5 - 0.25 mm)

Clay Minerals

M = montmorillonite; K = kaolinite; I = Illite; V = hydroxy interlayered vermiculite; Q = quartz; F = feldspar; Cr = cristobolite. Abundance: 1 is > 50%; 2 is 20 to 50%; 3 is 10 to 20%; and 4 is < 10%.

Unit Conversions

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Soil Horizon Symbols

Master Horizons

A = Mineral horizons which have formed at the surface.
E = Mineral horizons which have lost silicate clay, iron, or aluminum, leaving a concentration of sand and silt particles.
B = Mineral horizons which have formed below A or E horizons which have illuvial concentrations of silicate clay, iron, aluminum, humus, carbonates, gypsum, or silica alone or in combination.
C = Horizons or layers, excluding hard bedrock, that are little affected by pedogenic processes.
R = Hard bedrock

Subordinate Distinctions within Master Horizons

g = Strong gleying
k = Accumulation of carbonates
p = Tillage or other disturbance
r = Weathered or soft bedrock

Discontinuities

2 = Arabic numerals are used as prefixes to horizon designations (preceding A, E, B, C, R) to indicate discontinuities.
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27
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