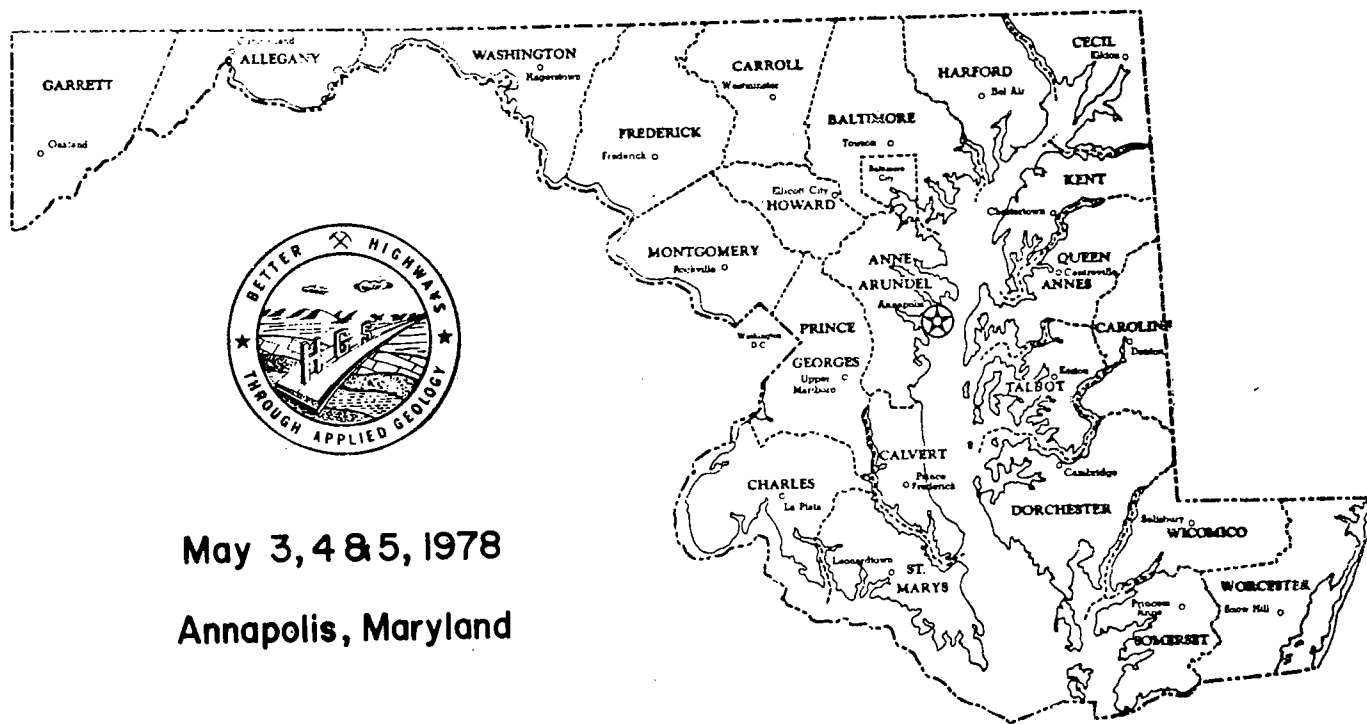


29th Annual  
**Highway Geology  
Symposium**  
**PROCEEDINGS**



May 3, 4 & 5, 1978  
Annapolis, Maryland

**Sponsors:**

Maryland State Highway Administration  
Maryland Geological Survey  
Baltimore-Washington-Harrisburg Section, AEG  
Geotechnical Group, Md. Section, ASCE

TWENTY-NINTH ANNUAL  
HIGHWAY GEOLOGY SYMPOSIUM

Chairmen

Session

- |     |                                       |
|-----|---------------------------------------|
| I   | Michael A. Ozol and Henry W. Janes    |
| II  | Kenneth N. Weaver and Michael A. Ozol |
| III | Henry W. Janes and Emery T. Cleaves   |

## PREFACE

It has been my pleasure to serve as chairman of the Technical Program and Proceedings Committee for the 29th Annual Highway Geology Symposium and, in collaboration with Dr. Kenneth N. Weaver, to review the manuscripts for these Proceedings.

The theme of the Symposium was Urban Geology on the Fall Line. The papers presented here reflect the range of geological circumstances that affect the construction of highways. These include not only the traditional engineering geological perspectives such as slope and grade stability but also the characteristics and availability of the materials for their construction.

More and more the engineering problems of urban transportation and construction are coming to extend beyond the basic of design and construction. These problems now involve the consideration of environmental effects, availability and deliverability of aggregates and other materials, control of noise and vibration, monitoring of ground water and the avoidance of conditions leading to deterioration of ground-water supply and quality.

The common thread connecting these topics is geological science, whether in its classical form or in the specialized areas of geotechnics, geophysics, environmental geoscience, hydrology, and other subdisciplines. This group of papers illustrates the range of subjects that now concern the professional engineering geologist involved in highway and related construction in and near large areas of the eastern United States.

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# GEOLOGIC CONTRASTS ACROSS THE FALL ZONE

by

Emery T. Cleaves

Maryland Geological Survey

The theme of the 29th Annual Highway Geology Symposium was "Urban Geology on the Fall Line". In the initial paper of the volume I will emphasize the "Geology" of the theme, and attempt to sketch a general picture of the geology that borders the Fall Line, or Fall Zone, as I prefer to call it. The Fall Zone (Figure 1) separates the unconsolidated to semi-consolidated sediments of the Coastal Plain Province, from the metamorphosed crystalline rocks of the Piedmont Province.

The Piedmont Province is characterized by rolling uplands dissected by narrow steep-wall valleys. The gorges cut by the Potomac and Susquehanna rivers are spectacular examples. The terrain is underlain by Precambrian and Paleozoic crystalline rocks. Gneiss domes, cored by Precambrian Baltimore Gneiss are overlain by the Setters Formation, and Cockeysville Marble. Mafic rocks like amphibolite and gabbro are present as well as serpentinites such as those at Soldiers Delight and Hunting Hill (Figure 1). The Hunting Hill Serpentinite has a certain notoriety, due to concern about asbestos and environmental health. Felsic schists, gneisses, and phyllites comprise most of the remaining terrain in the eastern Piedmont.

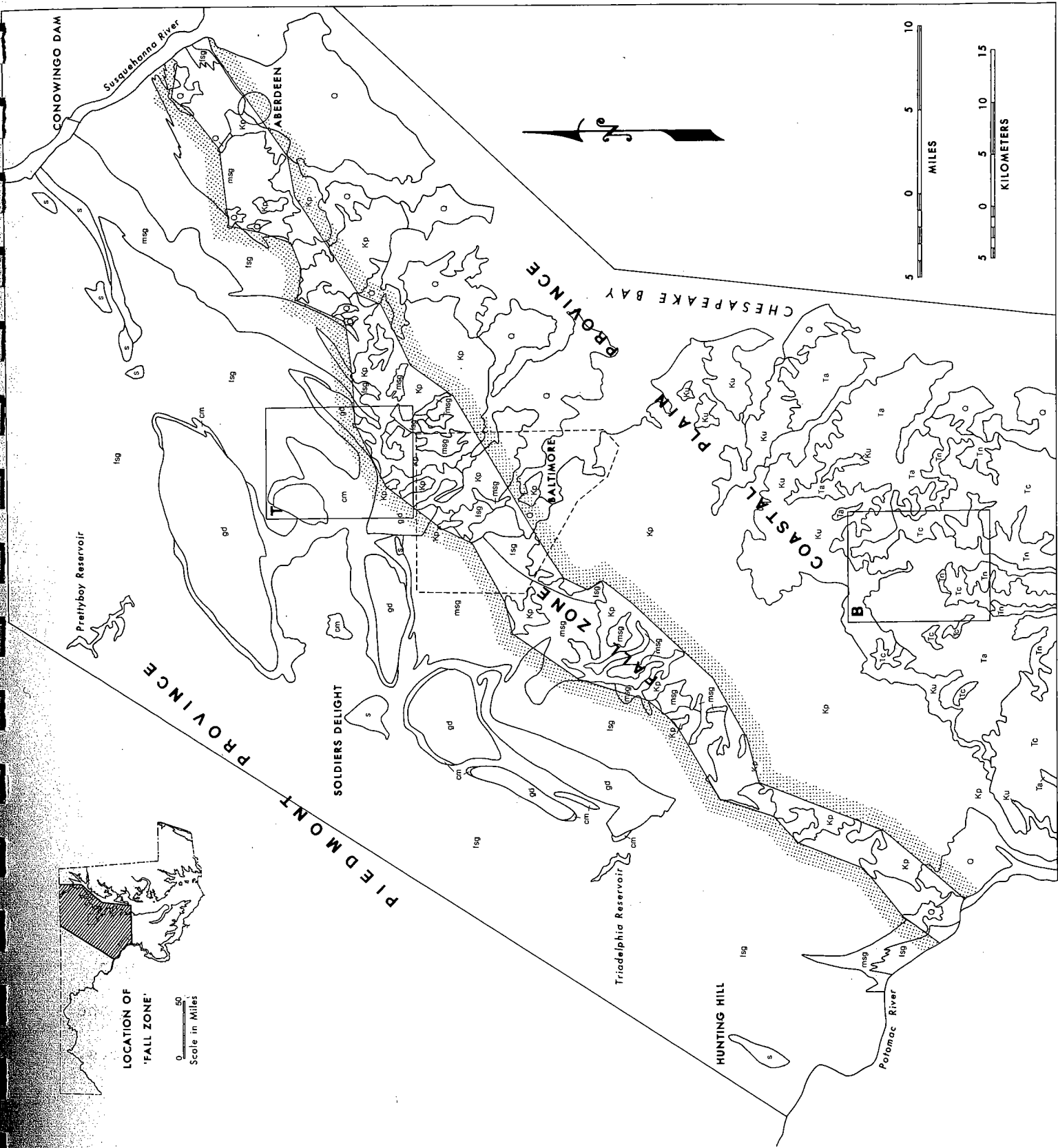
These hard crystalline metamorphosed rocks contrast strikingly with the unconsolidated to semi-consolidated gently dipping Coastal Plain formations composed of gravels, sands, silts, and clays. The Coastal Plain Province south and east of the Fall Zone is characterized by broadly rolling to dissected plains cut by tidal rivers and estuaries which extend back to the Fall Zone. Coastal Plain rocks include those of the Cretaceous Potomac Group which is a fluvial-deltaic complex of gravels, sands, silts, and

Figure 1. Geologic Map of the Fall Zone in Maryland

Geology generalized from "Geologic Map of Maryland" (Cleaves, and others, 1968).

Geologic symbols: Q, Quaternary; Tc, Calvert Formation; Tn, Nanjemoy Formation (includes Marlboro Clay); Ta, Aquia Formation; Ku, Monmouth, Matawan, and Magothy Formations; Kp, Potomac Group; fsg, felsic schists and gneisses; msg, mafic schists, gneisses, and amphibolites; s, serpentinite; cm, Cockeysville Marble; gd, gneiss domes including Setters Formation and Baltimore Gneiss.

Other symbols: T, Towson Quadrangle; B, Bowie Quadrangle.



clays. Southeast of the Potomac Group marginal marine and marine formations are exposed such as the sandy Magothy Formation, the glauconitic, sandy Aquia and Nanjemoy Formations, and the famous Miocene, highly fossiliferous silts and clays of the Calvert, Choptank, and St. Marys Formations.

The geologic contrasts carry through to the mineral resources. In the Coastal Plain, sand and gravel for the construction industry constitutes the major resource. Until recently clay was extensively exploited, and bog iron ores were very important in the 1850's. In the Piedmont, crushed stone, derived from marble, gabbro, serpetinite, and gneiss is presently the major product. Formerly, chrome, copper, feldspar, slate, and dimension stone were major resources.

Of all the resources, water is by far the most important. In the Piedmont, surface water reservoirs such as Prettyboy and Triadelphia (Figure 1) are required to provide the major urban areas with adequate water. Ground-water from wells in the crystalline rock provides the water supply for individual homes, small industries, and some smaller communities beyond the reach of the Baltimore and Washington distribution systems. In the Coastal Plain wells tap sedimentary aquifers and provide water for individual homes, industry, and cities such as Annapolis. The contrasting geology of the two Provinces underlies the difference in water-supply sources.

In addition, more detailed examples further illustrate contrasts between the Coastal Plain and Piedmont. Two recently published atlases of the Maryland Geological Survey provide examples — the Bowie Quadrangle (Glaser, and others, 1973) located beside the Patuxent River in the Coastal Plain, and the Towson Quadrangle (Cleaves, and others, 1974) located just north of Baltimore City,

in the Piedmont Province (labelled B and T, respectively on Figure 1). Considering the Bowie Quad first, the Quadrangle Geologic Map (Figure 2a) displays a typical Coastal Plain situation, gently dipping, unconsolidated to semi-consolidated sediments consisting of gravel, sand, silt, or clay, with the exact lithologies varying in each geologic unit. The formations range in age from the Aquia Formation of Paleocene Age to the Marlboro Clay of Eocene Age (a thin plastic clay with silt partings) to Pleistocene Age terrace deposits along the Patuxent River, and alluvial deposits of Holocene Age along the rivers and streams.

Potential mineral resources are confined to the Pleistocene Age sand and gravel terrace deposits located along the Patuxent River and the Marlboro Clay (Figure 2b). The sand and gravel has been, and is, being extensively excavated and used by the local construction industry. Sand and gravel reserves are still available. However, their exploitation is influenced not only by the need for the material but also by regulations pertaining to sediment pollution, wetlands, and local zoning. In contrast, the clay deposits have not been exploited. Although suitable for face brick and structural tile, it seems unlikely that the clay will be developed due, in great part, to the value of the land for farming and housing developments.

In the Bowie Quadrangle, some geologic factors which affect general construction conditions are specific to coastal plain sedimentary terrain. One such factor is the occurrence of the Marlboro Clay (Unit 1, Figure 2c). The clay is essentially impermeable. During wet periods water movement along the top of the clay creates conditions favorable for slope failure and landsliding, both in the natural state and when modified by construction activities. On the other hand, flood plains (Unit 2, Figure 2c) are a geologic factor

Figure 2. Bowie Quadrangle Maps (adapted from Glaser, and others, 1973).

(a) Geologic:

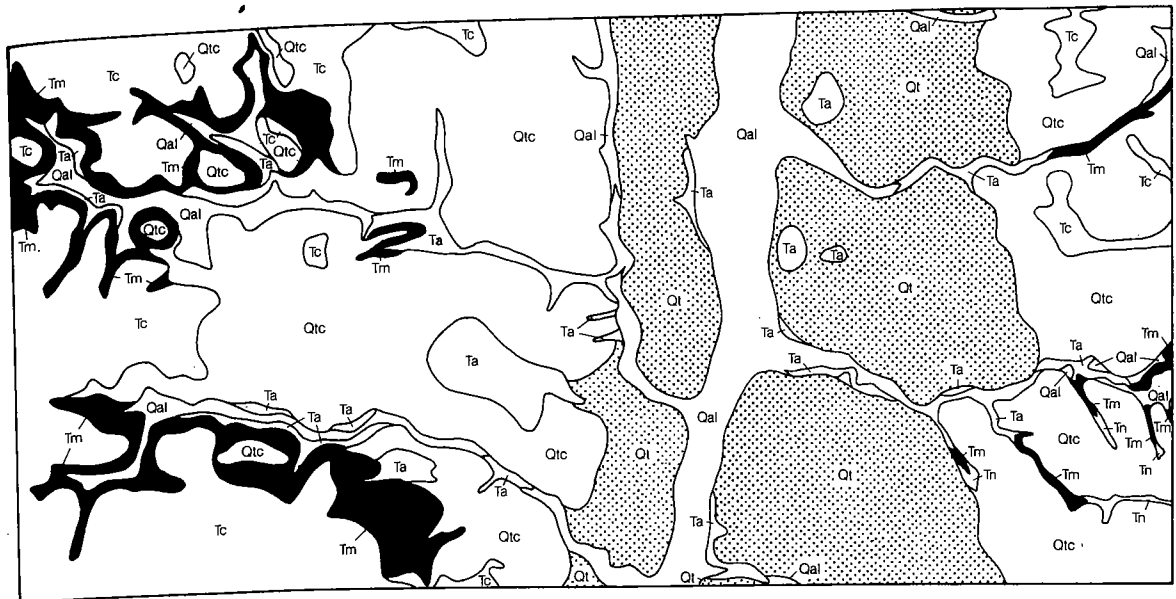
Qal: poorly sorted sand, silt, clay and gravel; Qtc: sand and silt, minor clay and gravel; Qt: sand, gravel, silt, and clay (stipple); Tc: Calvert Formation, fine-grained sand, silt, and diatomaceous silt; Tn: Nanjemoy Formation, poorly-sorted clayey glauconitic sand; Tm: Marlboro Clay, plastic clay with silt partings (black); Ta: Aquia Formation, well-sorted glauconitic sand

(b) Mineral Resources

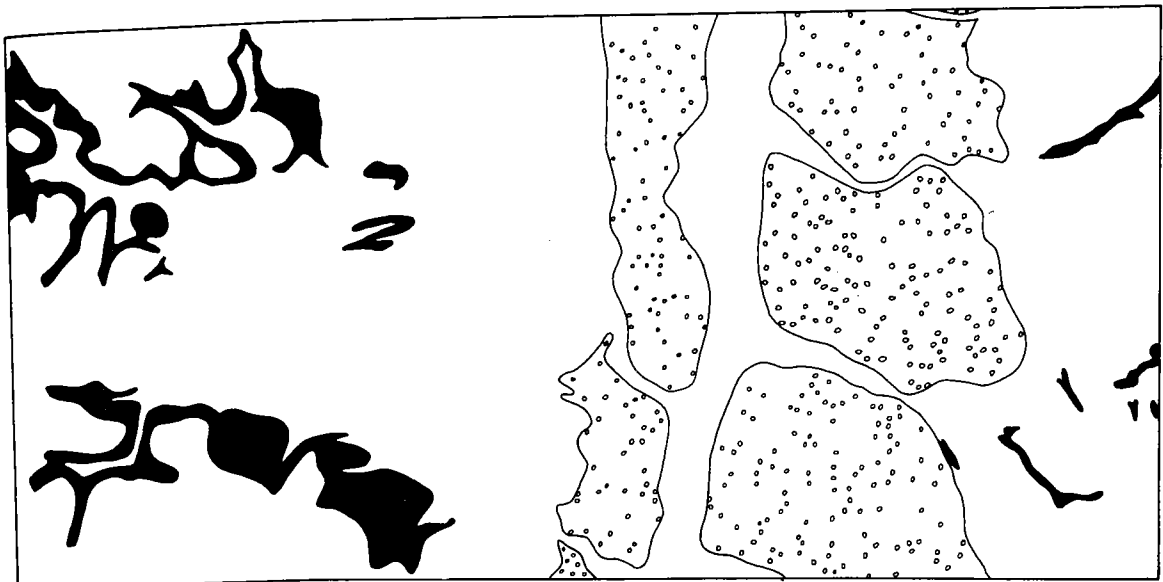
clay (stipple); sand and gravel (open dot)

(c) Geologic Factors Affecting Land Modification

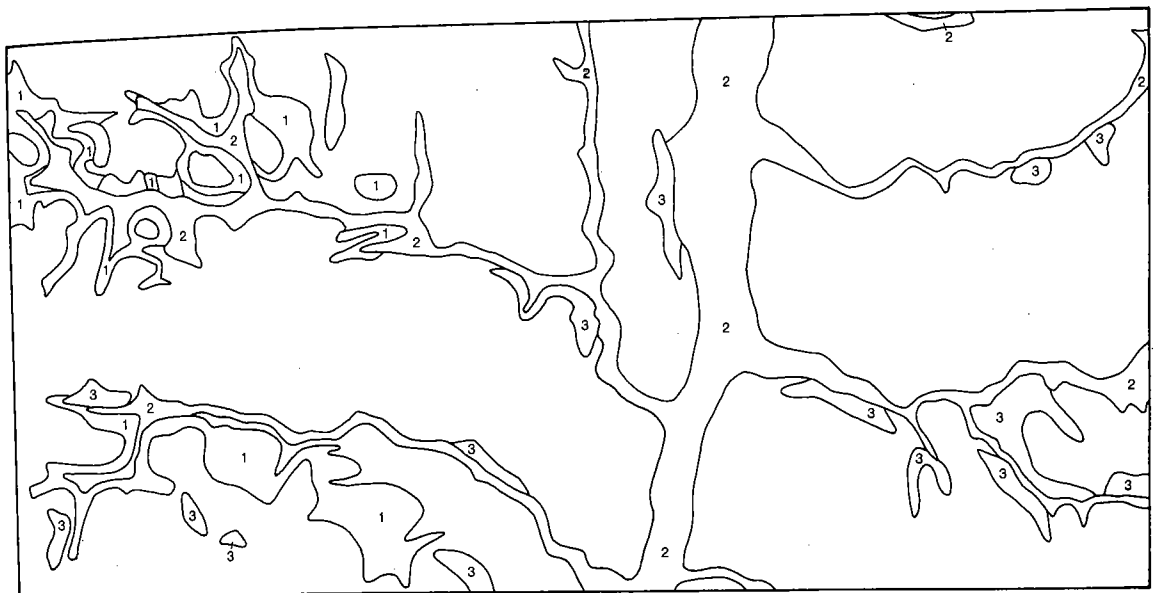
1, Marlboro Clay; 2, flood plain; 3, 15% slope



(a)



(b)



(c)

