RESOURCES & TRANSPORTATION:

31st Annual

HIGHWAY GEOLOGY SYMPOSIUM

PROCEEDINGS

Joe C. Thompson Conference Center
The University of Texas at Austin
Austin, Texas

1981

Sponsored by
Bureau of Economic Geology ■ The University of Texas at Austin
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Contents

KARST PROBLEMS ALONG TENNESSEE HIGHWAYS: AN OVERVIEW

by

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INTRODUCTION

Through the years Tennessee highways have been plagued with numerous sinkhole-type collapses and repeated flooding in areas of karst terrain. Some of these collapses have been catastrophic and have presented challenging geotechnical engineering problems which, in some cases, have resulted in unique solutions. These problems have become more acute owing to continued rapid, unplanned commercial and residential expansion into less favorable geologic sites such as active karst areas.

The numerous construction and maintenance problems along Tennessee highways involving collapse and/or flooding of the roadway and adjacent areas are directly attributable to alterations in ground-water flow and surface runoff.

The hydrology of the geologic setting is most instrumental in affecting the surface stability in karst terrain. It is also easily and constantly manipulated by mechanical means. Typically, ground-water flows from one minute fracture to another and eventually to open cavities. A network of solution-enlarged joints and cracks results and it eventually coalesces into caverns of varying dimensions. Surface water enters the ground-water regime by percolating through residual clay soils down into fractures of the underlying bedrock.

Problems that usually occur as a result of changes in the ground-water regime involve (1) development or enlargement of sinkholes, collapse features, and cave entrances; (2) flooding resulting from alteration of both the surface and subsurface drainage systems; and (3) alteration of ground-water levels, spring and well discharge rates, and other problems that are combinations of all the above. In addition, flooding and other drainage problems must be recognized as significant both in litigation that may occur as a result of the flooding damage and in the formulation of remedial concepts.

GEOGRAPHIC DISTRIBUTION OF KARST PROBLEMS

Sinkholes, depressions, sinking creeks, and cave entrances are the surface reflection of rigorous subsurface solution activity. Figure 1 illustrates the geographic distribution of numerous zones of karst-related characteristics across Tennessee.

Karst-related geotechnical engineering problems in Tennessee are confined to three major physiographic provinces: the Valley and Ridge, the Highland Rim, and the Nashville Basin (fig. 2). Within these provinces are disbribution zones that reflect areas of intense solution activity.

In the Valley and Ridge province, karst-related characteristics are zoned into bands reflecting strike belts of carbonate strata such as the Sequatchie Valley.

The next zone that can be delineated is a belt along and parallel to the western Cumberland Plateau escarpment. It is a few miles wide and runs longitudinally from the northern to the southern Tennessee border.

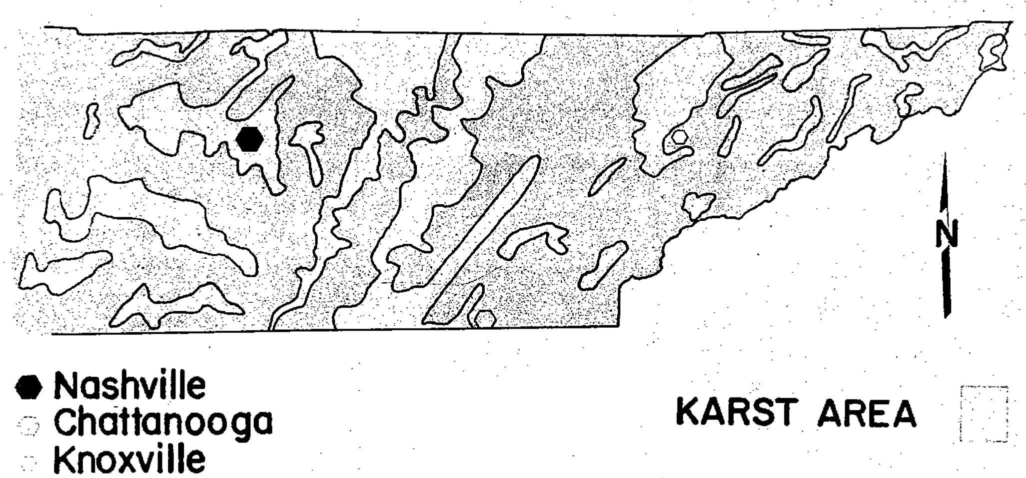

Figure 1. The geographic distribution of karst areas in Tennessee.

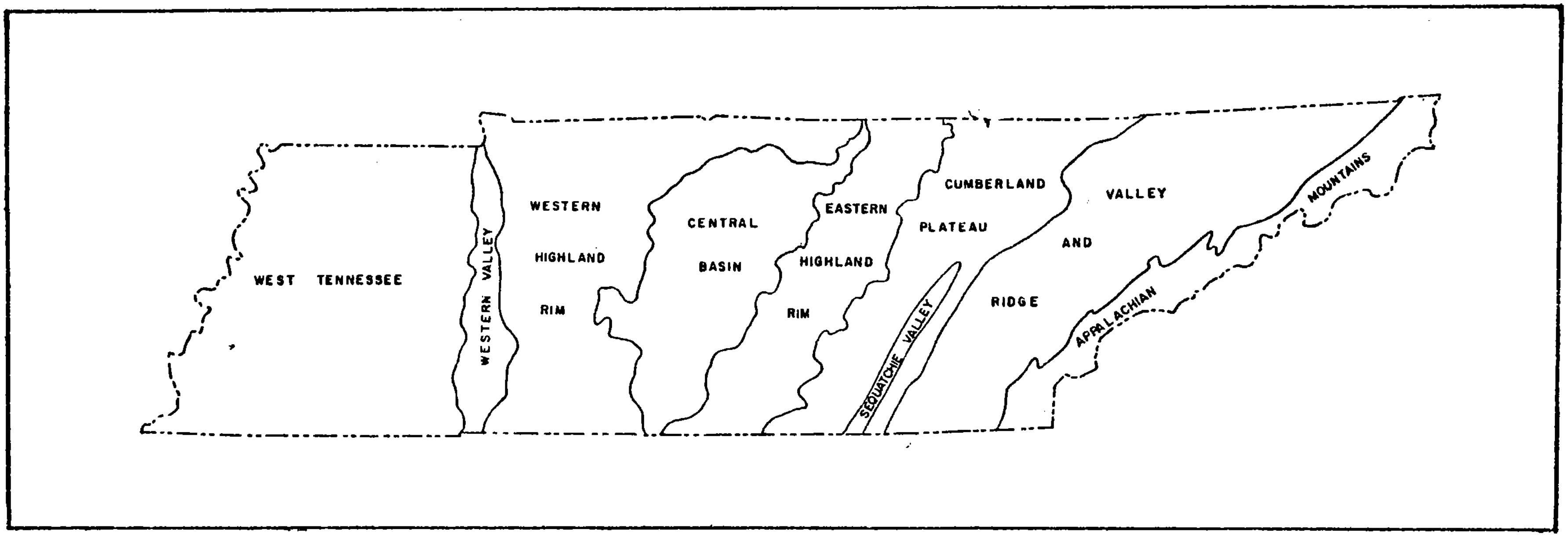

Figure 2. Illustrated above are the physiographic provinces of Tennessee. The major karst areas of Tennessee extend from the Western Highland Rim through the Ridge and Valley Province. (After Hershey and Maher, 1963).

Another zone of intense karst activity characterized by numerous caves is along the eastern Highland Rim escarpment where it joins the Nashville Basin. This area is parallel to the karst zone along the western Cumberland Plateau escarpment.

The karst area to the west, which encompasses the Nashville Basin and western Highland Rim, is arranged in belts coinciding with the drainage areas of the Cumberland, Duck, and Elk Rivers. The location of these karst belts may be related directly to the general joint system of the Nashville Dome.

Generally, there is a geographic distribution of karst-type problems and characteristics that correspond to specific topographic features across Tennessee.

GEOLOGIC DISTRIBUTION OF KARST PROBLEMS

In addition to geographic distribution, karst problems also have a geologic distribution across Tennessee. Certain geologic formations contain more caves, sinkholes, depressions, and other karst characteristics than do other geologic formations.

In areas of karst development, cave systems are the focus of intense solution activity and are reliable indicators of areas prone to karst-type geotechnical engineering problems. Using cave location data from Barr (1961), Matthews (1971), and Moore (1973), a calculation can be made of the geologic distribution of caves. Given a total of 1002 cave locations, the Monteagle Formation contains 23.2 percent of the known caves in Tennessee (fig. 3). Following the Monteagle Formation are the Knox Group (8.9 percent), Bigby-Cannon Formation (8.2 percent), Catheys Formation (7.7 percent), Bangor Formation (7.1 percent), Warsaw Formation (6.3 percent), and the Saint Louis Formation (5.3 percent). Small percentages are found in a number of other formations.

GEOLOGIC AGE	FORMATION	VALLEY & RIDGE	HIGHLAND RIM	NASHVILLE BASIN	% OF KNOWN CAVES
Mississippian	Bangor		X		7.1
	Monteagle		X		23.2
	St. Louis		X		5.3
	Warsaw		X		6.3
	Ft. Payne		X		3.7
	Lepiers			X	2.0
	Catheys			X	7.7
Ordovician	Bigby-Cannon			X	8.2
	Ridley			X	2.3
	Knox GP.				8.9
Cambrian	Copper Ridge	X			2.9
Pre-Cambrian Through Mississippian	(32 other formations)	X	X	X	22.4

Figure 3. General geologic distribution of caves in Tennessee. Karst problems involving highways and other types of construction can be expected when working in the strata of these formations.