ALTITUDE OF BASEMENT SURFACE IN THE CENTRAL COASTAL PLAIN AREA OF NORTH CAROLINA

By William L. Lyke and M. D. Winner, Jr.

ABSTRACT

The altitude of the basement surface in the central Coastal Plain of North Carolina ranges from 140 feet above sea level in Wayne County near the Fall Line to 2,400 feet below sea level near the coast in Beaufort County. The slope increases toward the east from about 20 feet per mile at the fall line to about 70 feet per mile at the eastern edge of the study area.

The altitude of the basement surface map in this report may be used to determine the depth to the basement surface and the thickness of the overlying unconsolidated aquifer system as well as the altitude of the surface. The concentration of well data in Wilson, Wayne, and Edgecombe Counties, along with the protruding granite-gneiss rock body near Fountain in Pitt County, demonstrates that the basement surface is irregular rather than smooth as suggested by the contours further to the east.

Basement-rock types in this study area include granite, granite gneiss, metavolcanic, and metasedimentary rocks of Precambrian to Paleozoic age.

INTRODUCTION

This is one of a series of reports resulting from an investigation of the principal water-supply aquifer system of the central Coastal Plain of North Carolina (fig. 1). The purpose of this report is: (1) to describe the configuration and altitude of the basement surface which underlies the unconsolidated sands and clays and partly consolidated limestone rocks that make up the central Coastal Plain aquifers, (2) to discuss features of the basement surface, and (3) to show the basement-rock types that have been identified. The basement rocks are composed of metamorphosed sediments and intrusive rocks whose water-bearing capability is much lower than that of the unconsolidated aquifers overlying them. Therefore, the basement surface forms a natural geohydrologic boundary, and in the study of the unconsolidated aquifers, the basement surface is the lower boundary of the unconsolidated aquifer system (fig. 2). Knowledge of the altitude of basement surface and the thickness of the overlying unconsolidated aquifer system will be useful in hydrologic studies, such as modeling of aquifer systems, and in planning the construction of both water wells and test holes.

This study is being conducted in cooperation with the North Carolina Department of Natural Resources and Community Development; the cities and towns of Ayden, Farmville, Kinston, La Grange, New Bern, Pinetops, Snow Hill, and Stantonsburg; Greene County; Greenville Utilities; and North Lenoir Water Corporation.

PREVIOUS WORK

The map showing the altitude of the basement surface (fig. 3) is taken primarily from Brown and others (1972, pl. 5). Map contours from Brown and others (1972) were used in figure 3 where new data were not available or where the new data did not indicate a contouring change. Other interpretations of the basement surface in the central Coastal Plain study area were prepared for Pitt County (Sumsion, 1970, fig.5), Wilson County (Winner, 1976, fig. 32), and a multi-county area by Narkunas (1980, fig. 18). Values of basement-surface altitudes for exploratory oil-test holes in the North Carolina Coastal Plain were published by the North Carolina Department of Natural and Economic Resources (1977).

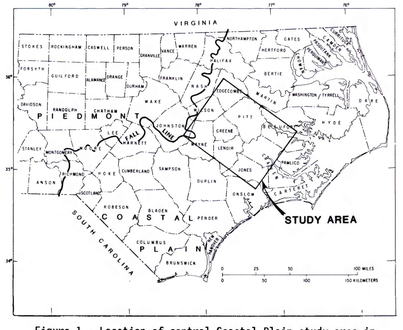

Figure 1.--Location of central Coastal Plain study area in eastern North Carolina.

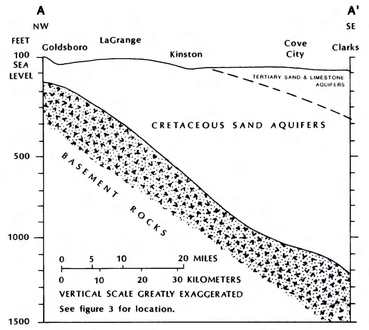

Figure 2.--A cross section of the eastward-dipping basement surface and overlying Coastal Plain aquifer systems.

DATA BASE

The basement-surface map for the central Coastal Plain area (fig.3) was constructed using published and unpublished records of 70 wells from the files of the Groundwater Section of the North Carolina Department of Natural Resources and Community Development (NRCD) and the U. S. Geological Survey. These data are summarized in table 1 and include seven test holes drilled to the basement surface by NRCD as part of their statewide ground-water research station program.

Each well was plotted on the most recent U. S. Geological Survey 7.5-minute quadrangle topographic map (scale 1:24,000) from which land-surface altitude was estimated. Data was then transferred to North Carolina Department of Transportation County Highway maps, which were modified as base maps. Drillers'-log or geophysical-log datum points were assumed to begin at land surface. Land-surface altitude values at some well sites may differ in this study from previously published data because newer or larger scale topographic maps, or more accurate location information, were not available during previous studies. Published data from outside the study area were used to help construct the altitude of basement surface map (fig. 3). Contour lines from Brown and others (1972) were used in figure 3 where new data were not available or where new data did not indicate a contouring change.

BASEMENT SURFACE

The basement surface exhibits three prominent features of which a homoclinal eastward dip is the most obvious (fig. 3). The eastward dip and thickening of the overlying unconsolidated aquifers reflect this homoclinal feature. The basement surface in the central Coastal Plain study area dips eastward at a progressively increasing rate from about 20 feet per mile in the west, in northern Wayne County, to nearly 70 feet per mile in the east near Bath in Beaufort County. The altitude of the basement surface ranges from 140 feet above sea level in northwestern Wayne County to about 2,400 feet below sea level just east of Bath.

Another prominent feature on the basement surface is the small granite-gneiss body at a quarry near the Town of Fountain in Pitt County that protrudes through the overlying unconsolidated aquifers to land surface more than 400 feet above the surrounding basement surface (fig. 3). Because the aquifers are missing, ground-water flow is interrupted and must flow around this basement feature. The areal extent of the rock body is partially defined by two deep wells, one three-fourths of a mile to the west and the other about one-half mile to the north of the quarry that do not reach the basement surface at depths of 213 and 225 feet below land surface, respectively. Whether this granite-gneiss prominence is an erosional remnant or whether it is related to some other structural feature is not known.

A relatively large-scale feature is seen in figure 3 as a broad north-eastward trending nose on the basement surface south of the Neuse River in Craven County. This is also shown as a decrease in the basement-surface slope near Cove City in the cross-section (fig. 2). The origin of this feature is unknown; some have postulated basement faulting as a cause. Gibson (1967) mentions an unnamed positive structure roughly parallel to the lower Neuse River, and Harris and Baum (1979) mention basement faults occurring in this general area. It is possible that varying local relief of the basement surface may have created the appearance of a broad ridge where one may not exist. However, there are too few wells in this area for the local relief of the basement surface to be determined. Although basement-surface relief can not be described in detail in the eastern portion of the study area because of the scarcity of well data, it can be expected to be similar to the basement-surface relief to the west.

Table 1: Summary of well records which show the altitude of the basement surface.

Map Number	Well Name	Latitude/Longitude	Altitude of Land Surface (feet)	Altitude of Basement Surface (feet)	Remarks [1]
Craven County					
1	NRCD Cove City Research Station	35°10'19"N/77°18'41"W	46	-1,043	R23x3x.
2	Peter Havfich	35°10'18"N/77°23'32"W	60	-998	R24n5.
3	NRCD Clarks Research Station	35°08'16"N/77°10'18"W	28	-1,257	S22j6a.
4	Graham Merrit	35°13'19"N/77°25'33"W	55	-925	R25j1, CR-T1-79.
Edgecombe County					
5	City of Tarboro	35°53'34"N/77°32'18"W	50	-299	Ed-74, J26h.
6	Town of Macclesfield	35°45'03"N/77°40'22"W	102	-140	Ed-119; green and red slate.
7	Town of Pinetops	35°47'24"N/77°38'22"W	104	-196	K27r1, Ed-123, granite gneiss.
8	C. A. Powell	35°51'15"N/77°41'15"W	110	-140	Ed-114; amphibolitic schist.
9	G. W. Bradley	35°56'46"N/77°43'10"W	100	-20	Ed-58; granite.
10	West Edgecombe School	35°54'15"N/77°44'12"W	112	47	Ed-81; granite.
Greene County					
11	NRCD Maury Research Station	35°28'40"N/77°35'55"W	78	-487	Q27j4.
12	Town of Walstonburg #2	35°35'42"N/77°42'12"W	119	-277	M28w1, Gr-55.
Jones County					
13	NRCD Beaver Creek Res. Station	35°08'20"N/77°31'50"W	55	-785	S26i2x; granite.
14	P. Henderson-Hoffman Forest #1	34°56'15"N/77°24'30"W	52	-1,163	JON-OT-4; metagraywacke.
Lenoir County					
15	Town of La Grange	35°17'15"N/77°45'10"W	102	-304	Q29k3, LEN-P-15.
16	Town of La Grange	35°18'35"N/77°47'05"W	110	-300	Q29h2, Lenoir Co. #1; weathered brown granite.
17	NRCD Kinston Yard Res. Station	35°16'09"N/77°37'06"W	44	-629	Q27r5; fine-grained granite.
18	NRCD Graingers Res. Station	35°19'30"N/77°28'45"W	67	-733	Q25d1ix; red phyllite.
Onslow County					
19	Seay-Hoffman Forest #1	34°54'00"N/77°23'45"W	50	-1,319	ON-OT-11.
Pitt County					
20	NRCD Chicod Res. Station	35°27'49"N/77°16'31"W	42	-1,042	O23l1; gray schist.
21	City of Greenville	35°36'15"N/77°22'37"W	49	-705	M24r1.
22	Town of Farmville	35°36'28"N/77°35'46"W	80	-423	M26y1, Pi-219.
23	Town of Farmville	35°35'15"N/77°36'00"W	85	-399	Pi-P-9.
24	Superior Stone Quarry	35°40'08"N/77°37'46"W	105	85	Pi-43; granite gneiss.
25	Town of Fountain	35°40'18"N/77°38'46"W	108	---	Pi-40, L27x1; bedrock not reached, bottom of well (-162') used as control point.
26	NRCD Bethel Research Station	35°44'57"N/77°21'55"W	55	-635	L24b3.
27	Town of Bethel	35°48'41"N/77°22'46"W	65	-458	K24h1.
28	J. L. Jefferson	35°40'44"N/77°37'43"W	92	---	Pi-44; bedrock not reached, bottom of well (-133') used as control point.
Wayne County					
29	Cliffs of Neuse State Park	35°14'30"N/77°53'15"W	105	-258	R30d2, WAY-P-9.
30	Seymour Johnston A.F.B.	35°22'32"N/77°57'26"W	104	-57	P31m.
31	Seymour Johnston A.F.B. #1	35°21'00"N/77°57'45"W	75	-61	Wa-49, WAY-T-8; red weathered schist overlying chlorite schist.
32	Seymour Johnston A.F.B. #2	35°20'08"N/77°59'08"W	64	-92	P31y, Wa-50.
33	Town of Eureka	35°32'22"N/77°52'21"W	130	-85	N30m3.
34	Town of Eureka	35°32'22"N/77°52'30"W	126	-69	Wa-119; blue slate.
35	Town of Saulston	35°26'20"N/77°33'55"W	128	-96	O30q1, weathered granite.
36	NRCD Saulston Research Station	35°28'12"N/77°31'03"W	97	-119	O30i2x; micaceous green rock (schist?).
37	Wells Realty Company	35°18'43"N/78°01'57"W	135	-66	Q32i1.
38	Isaac Daes	35°33'40"N/78°06'21"W	139	1	Wa-8, N31i; blue slate.
39	Mark K. Jones	35°29'51"N/78°05'11"W	154	62	Wa-13; blue slate.
40	Clarence Bunn	35°28'31"N/78°05'22"W	126	56	Wa-14; blue slate.
41	W. A. Taylor	35°28'35"N/78°02'23"W	135	94	Wa-15; blue slate.
42	Barnes School	35°25'02"N/78°05'02"W	123	-17	Wa-18; slate.
43	Robert E. McHerney	35°26'00"N/77°59'55"W	130	-35	Wa-25; slate.
44	Wayne Auger Hole #3	35°30'50"N/78°03'58"W	138	85	Green slate.
45	City of Goldsboro Test Well	35°24'11"N/78°00'42"W	75	-18	Wayne Co. #1; green schist.
46	Town of Fremont #3	35°32'28"N/77°59'09"W	142	62	Wa-5; chlorite schist.
47	Wayne Hooks	35°33'37"N/78°00'41"W	136	76	Wa-3; slate.
48	Robert Waddell	35°33'45"N/78°04'06"W	150	140	Wa-1; slate and granite.
49	Town of Pikeville	35°29'47"N/77°59'06"W	145	45	Wa-150; slate.
Wilson County					
50	Bruce Foods, Inc.	35°41'44"N/77°53'54"W	110	34	L30q1.
51	Town of Elm City	35°48'16"N/77°51'48"W	137	63	W1-8; blue granite.
52	Wilson County Prison Camp	35°42'32"N/77°55'47"W	133	36	W1-100.
53	Dr. A. F. Williams Estate	35°43'52"N/77°44'25"W	121	-124	W1-133, L28f1. shale.
54	Town of Stantonsburg	35°36'01"N/77°48'57"W	75	-87	W1-409.
55	Wayne Tippette	35°50'38"N/77°48'27"W	137	62	W1-400; slate.
56	Benson Hog Farm	35°46'42"N/77°49'10"W	97	-23	W1-403; granite and slate.
57	Walter Parham	35°46'14"N/77°50'27"W	118	28	W1-15, K30t1; slate.
58	William Cherry	35°48'58"N/77°46'20"W	122	-28	W1-11.
59	Mrs. Edward Eason	35°46'55"N/77°46'18"W	112	---	W1-13; basement not reached, bottom of well (-53') used as control point.
60	David Rose	35°48'29"N/77°45'03"W	106	-41	W1-375; slate.
61	Mrs. Elsie Williford	35°45'57"N/77°45'29"W	122	-96	W1-405; slate and granite.
62	Barney Pittman	35°46'18"N/77°48'25"W	122	-25	W1-404; slate and granite.
63	Town of Lucama	35°38'23"N/78°00'20"W	135	90	W1-334; gray granite.
64	Lee-Woodard High School	35°38'25"N/77°56'14"W	122	64	W1-159, M31i; granite.
65	Town of Black Creek	35°38'02"N/77°55'43"W	124	51	W1-332; gray granite.
66	Daniels Chapel Water Assoc.	35°39'05"N/77°55'00"W	111	61	W1-335; gray and pink granite.
67	Harry Lamm	35°43'02"N/77°52'49"W	120	65	W1-385; granite.
68	Hyland Park	35°39'33"N/77°56'11"W	127	57	W1-337; pink granite.
69	W. H. Gurganis	35°41'40"N/77°56'35"W	112	89	W1-94; red granite.
70	Marvin Boswell	35°40'38"N/77°58'36"W	133	92	W1-369; graywacke-metasedimentary rock.

[1] The remarks column contains published and unpublished identification numbers for wells, and a description of basement rock where available.

ESTIMATING ALTITUDE AND DEPTH OF BASEMENT SURFACE

An estimated altitude of the basement surface may be read directly from figure 3 at any location. Depth to the basement surface may be estimated using the basement altitude map along with the land-surface altitudes in figure 3. Where the altitude of the basement surface is less than 0 feet (a negative value), then the depth to the basement surface is the sum of the basement-surface altitude (the absolute value) plus the land-surface altitude. Where the altitude of the basement surface is greater than 0 feet (a positive value), then the depth to basement surface is estimated by subtracting the basement-surface altitude from the land-surface altitude. It should be remembered, however, that the basement surface can be very irregular as demonstrated by the granite-gneiss body near the Town of Fountain. Land-surface altitudes presented in figure 3 are approximate and should be used only as a guide. More accurate values for land-surface altitude may be obtained from U.S. Geological Survey 7.5-minute quadrangle topographic maps.

SUMMARY

The basement surface is an irregular, eastward-dipping homoclinal structure that ranges in altitude from 140 feet above sea level in Wayne County to 2,400 feet below sea level in Beaufort County. The irregular nature of the basement surface is demonstrated by: (1) the variable altitudes of the basement surface in the western portion of the study area; (2) the protruding granite/gneiss rock body at a quarry near the Town of Fountain, Pitt County; and (3) the flattening of the basement-surface slope observed near the Jones County and Craven County border. Knowledge of the altitude and depth of the basement surface will be helpful in hydrologic studies and in planning water wells and test holes.

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METRIC CONVERSION FACTORS

The inch-pound system of units is used in this report. For readers who prefer the International System of Units (SI), the conversion factors for the terms in this report are listed below:

Multiply inch-pound unit	By	To obtain SI unit
	Length	
foot	0.3048	meter
mile	1.6093	kilometer
foot per mile	0.1894	meter per kilometer

National Geodetic Vertical Datum of 1929 (NGVD of 1929): A geodetic datum derived from a general adjustment of the first-order level nets of both the United States and Canada, formerly called mean sea level, is referred to as sea level in this report.

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