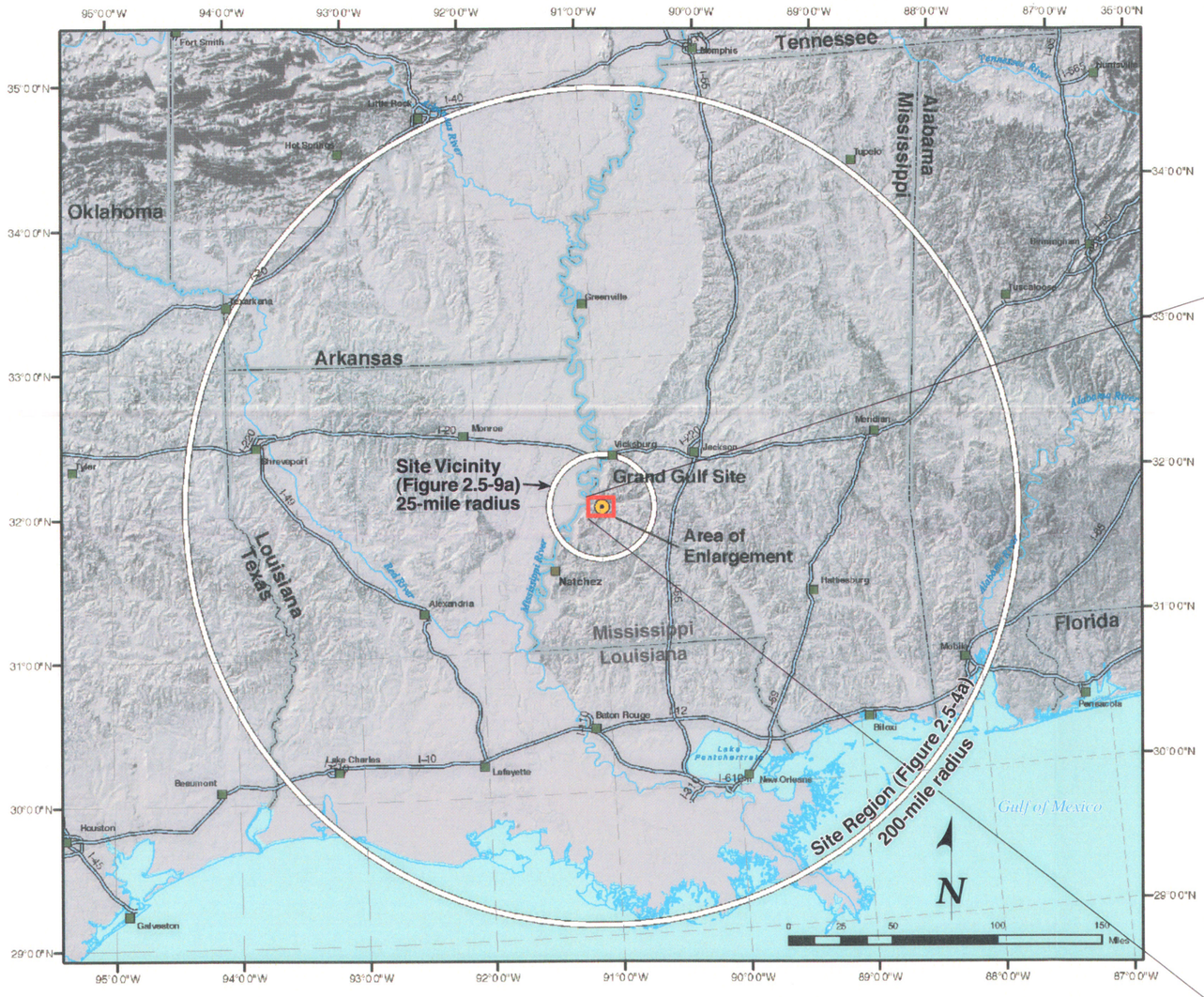
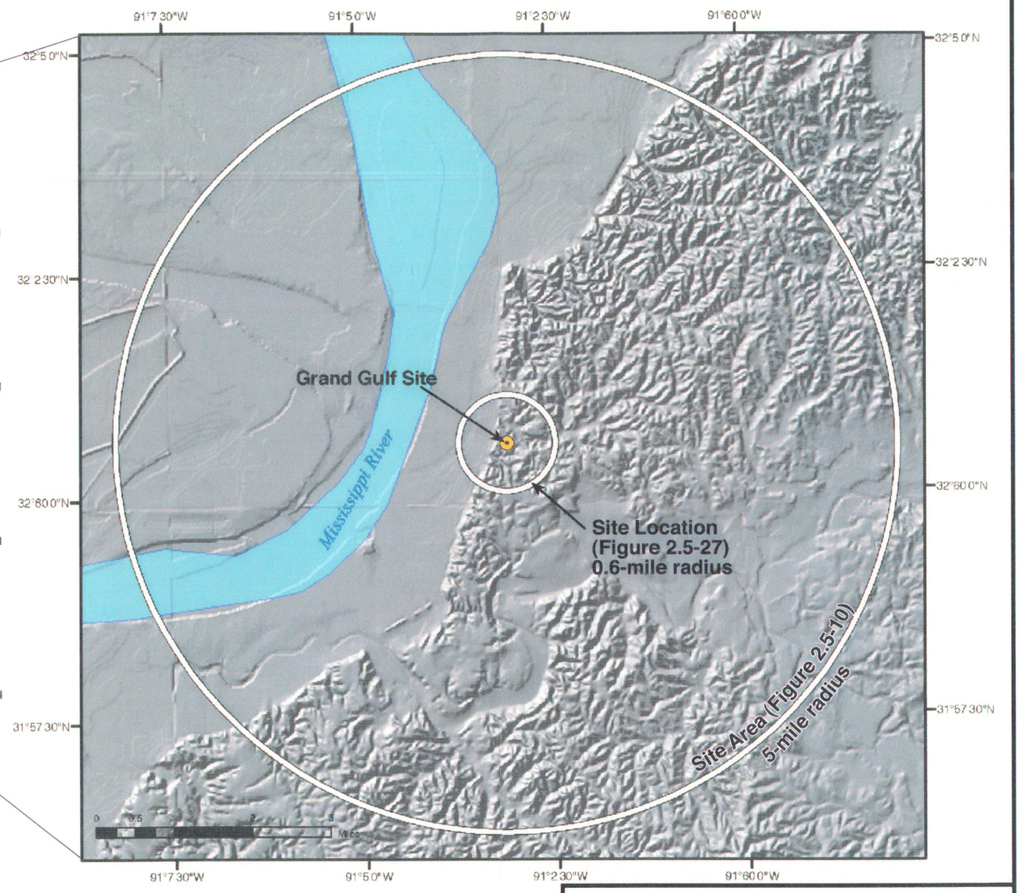
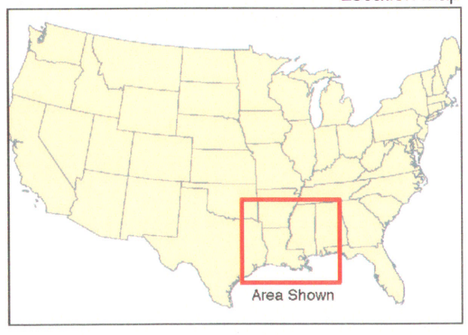




Location Map



Explanation

- Grand Gulf Site
- Major city
- Major river
- Interstate highway
- State boundary

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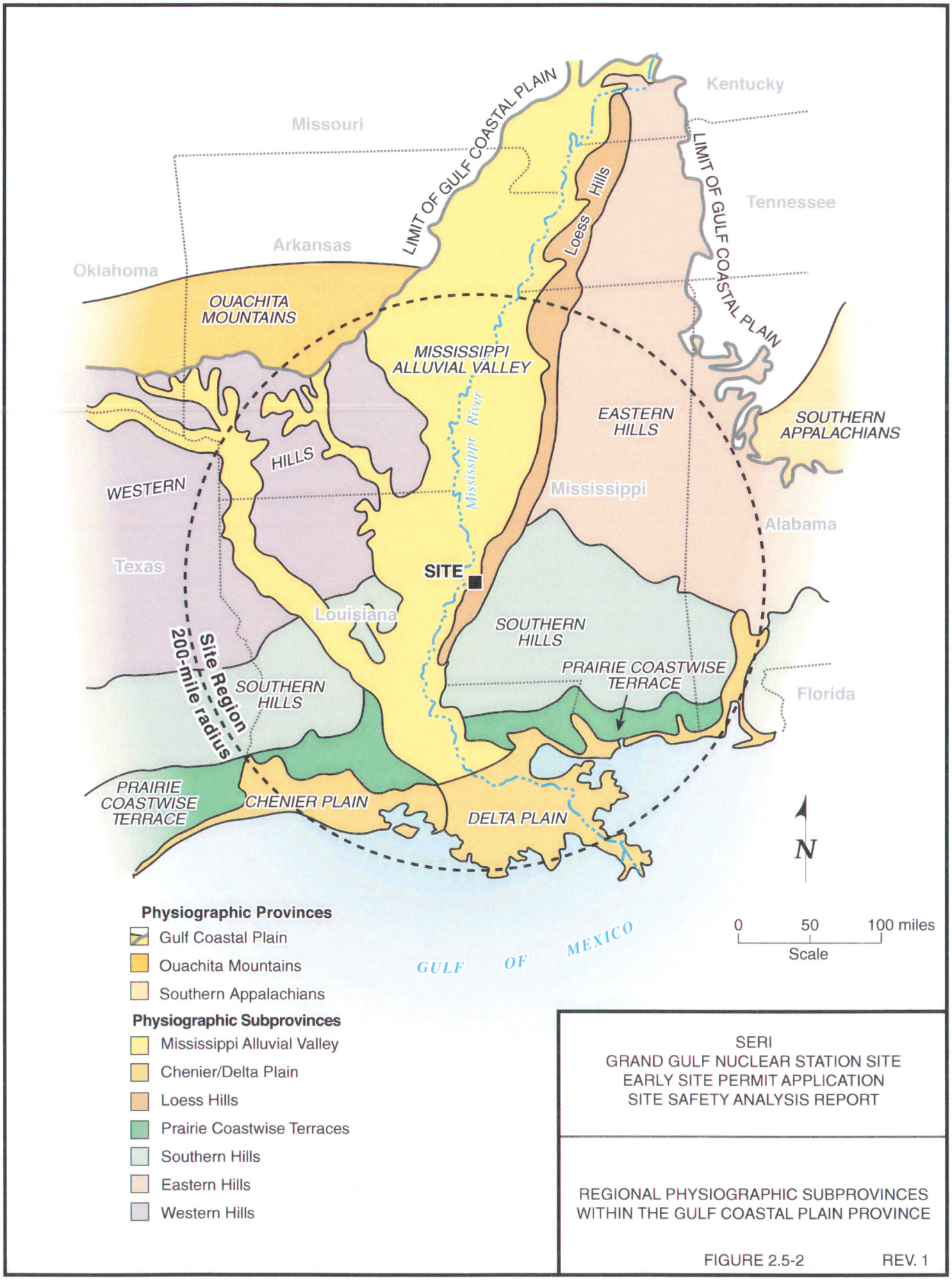
GRAND GULF NUCLEAR STATION SITE
EARLY SITE PERMIT APPLICATION
SITE SAFETY ANALYSIS REPORT

DEFINITION OF SITE INVESTIGATION AREAS

FIGURE 2.5-1 REV. 1



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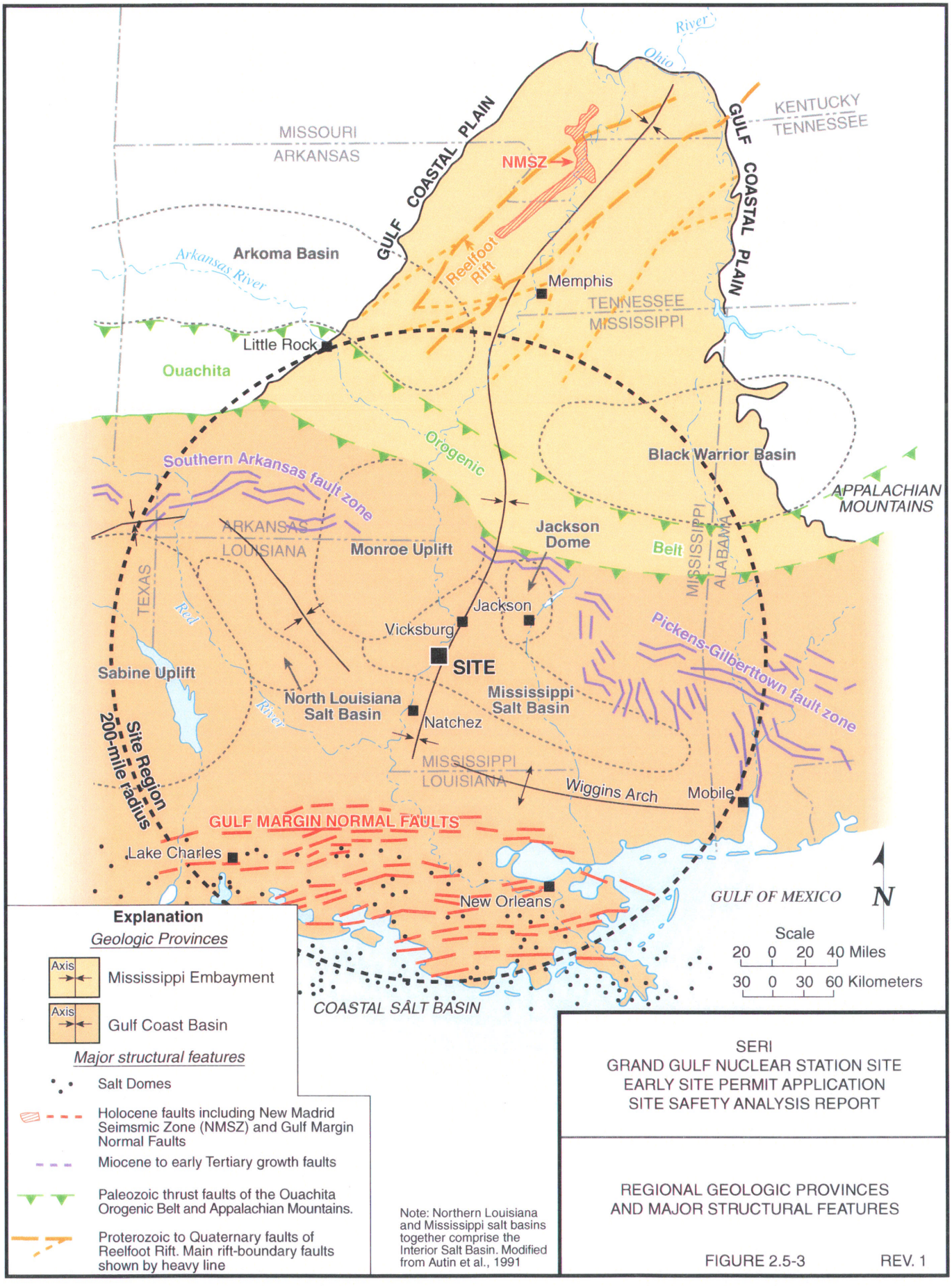
REGIONAL PHYSIOGRAPHIC SUBPROVINCES
WITHIN THE GULF COASTAL PLAIN PROVINCE

FIGURE 2.5-2 REV. 1



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REGIONAL GEOLOGIC PROVINCES AND MAJOR STRUCTURAL FEATURES

FIGURE 2.5-3 REV. 1

Explanation

- Salt dome
- Grand Gulf Site
- Major city
- Major river
- Interstate highway
- State boundary
- Syncline
- Anticline
- A A' Cross section

Map units are described on Figure 2.5-4b

Geology from Schruben, P.G., Arndt, R.E., Bawiec, W.J., digital representation of King, P.B., and Beikman, H.M., 1974, Geology of the conterminous United States at 1:2,500,00 scale, Digital Data Series II, release 2.

Cross-sections are plotted to show respective locations only. Cross-sections A and B are from Reference 16. Cross-section C is from Louisiana Geological Survey (1984).

N

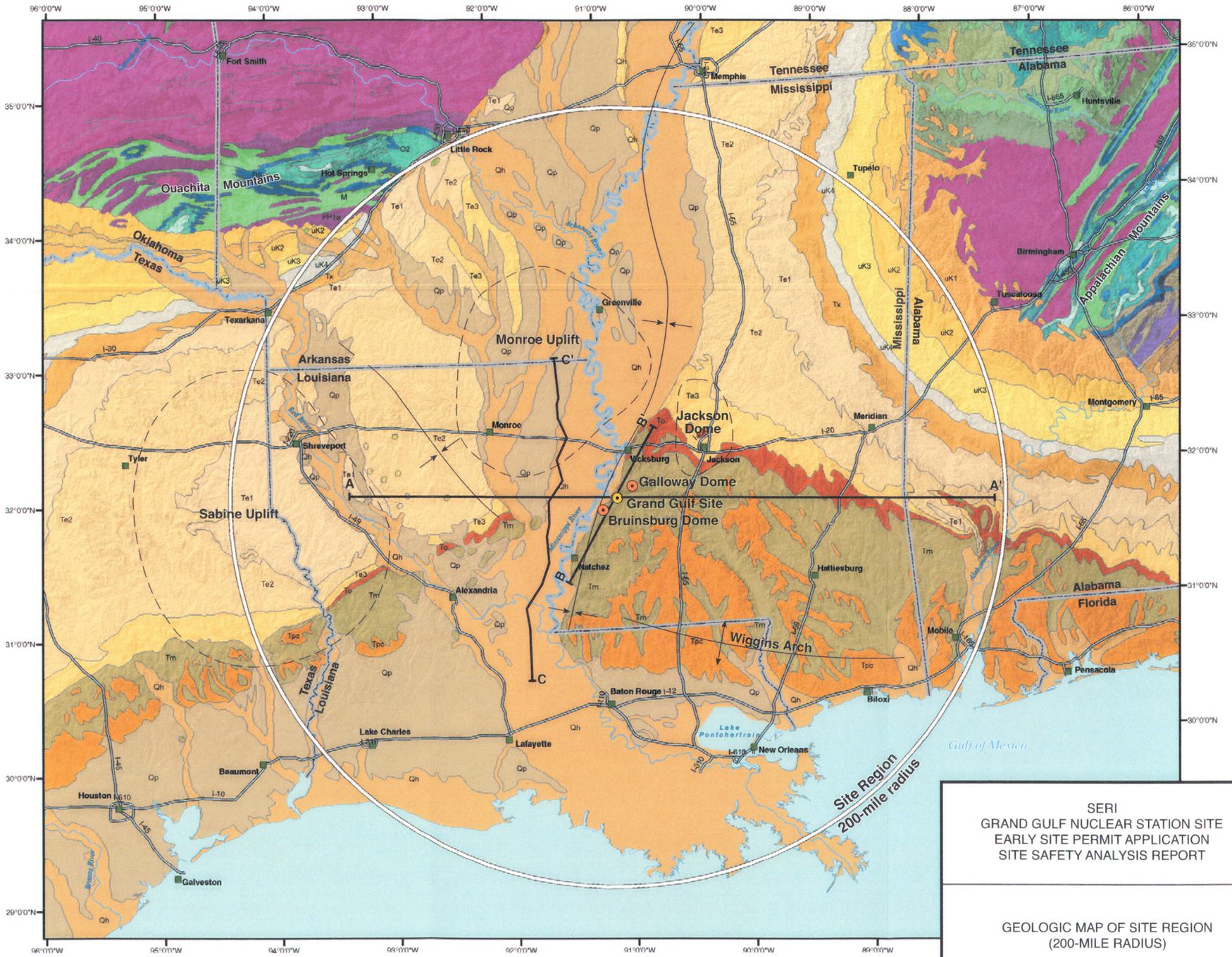
0 25 50 100 Miles

0 25 50 100 Kilometers

1" = 250,000'

Scale

Location Map



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GEOLOGIC MAP OF SITE REGION
(200-MILE RADIUS)

FIGURE 2.5-4a REV. 1

Explanation

Qh, Holocene; includes loess, alluvial, deltaic, beach, backswamp, and Mississippi River meander belt deposits.

Qp, Pleistocene; includes loess, terrace, Praire Complex, Intermediate Complex, Upland Complex (Lafayette and Citronelle gravels), and Deweyville Terrace deposits.

Tpc, Pliocene; Upland Complex (Lafayette and Citronelle gravels).

Tm, Miocene; includes Catahoula, Pascagoula, Hattiesburg, and Flemming Formations.

To, Oligocene; includes Forest Hill formation and Vicksburg Group (Bucatunna, Byram Marl, Glendon Limestone, and Mint Springs formations).

Te3, Eocene; Jackson Group (Yazoo Clay and Moody's Branch formations).

Te2, Eocene; Claiborne Group (undifferentiated).

Te1, Eocene; Wilcox Group.

Tx, Paleocene; Midway Group (Porters Creek Clay and Clayton formation).

Uk4, Upper Cretaceous; Navarro Group, Arkadelphia Marl, and Nacatoch Sand.

Uk3, Upper Cretaceous; Taylor Group, and Selma Group

Uk2, Upper Cretaceous; Austin and Eagle Ford Groups, Tuscaloosa Formation, and Eutaw Formation.

Uk1, Upper Cretaceous; undifferentiated.

Ki, Cretaceous; intrusive rocks.

PP1a, Pennsylvanian; undifferentiated.

M, Mississippian; undifferentiated.

DS, Devonian and Silurian; undifferentiated.

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GEOLOGIC MAP UNIT DESCRIPTIONS
FOR GEOLOGIC MAP OF SITE REGION

FIGURE 2.5-4b REV. 1

Explanation

- Grand Gulf Site
- Major city
- Major river
- State boundary

Fault Zones

- Quaternary/Holocene
- Possible Quaternary
- Miocene
- Cretaceous
- Mississippian/Pennsylvanian
- Proterozoic
- Undifferentiated
  - likely Paleozoic in North
  - likely Miocene-Pliocene in South

Seismic Activity (1627 - 1984)
Magnitude (Mb)

- 0.00 - 1.99
- 2.00 - 2.99
- 3.00 - 3.99
- 4.00 - 4.99
- 5.00 - 7.99

Seismic Activity (1985 - 2004)
Magnitude (Mb)

- 0.00 - 1.99
- 2.00 - 2.99
- 3.00 - 3.99
- 4.00 - 4.99
- 5.00 - 7.99

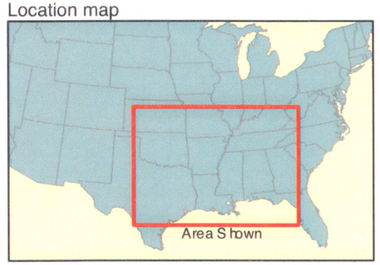
Pre-1985 seismicity from EPRI (1986) catalog and post-1984 seismicity from ANSS-CNSS (2004) composite catalog.

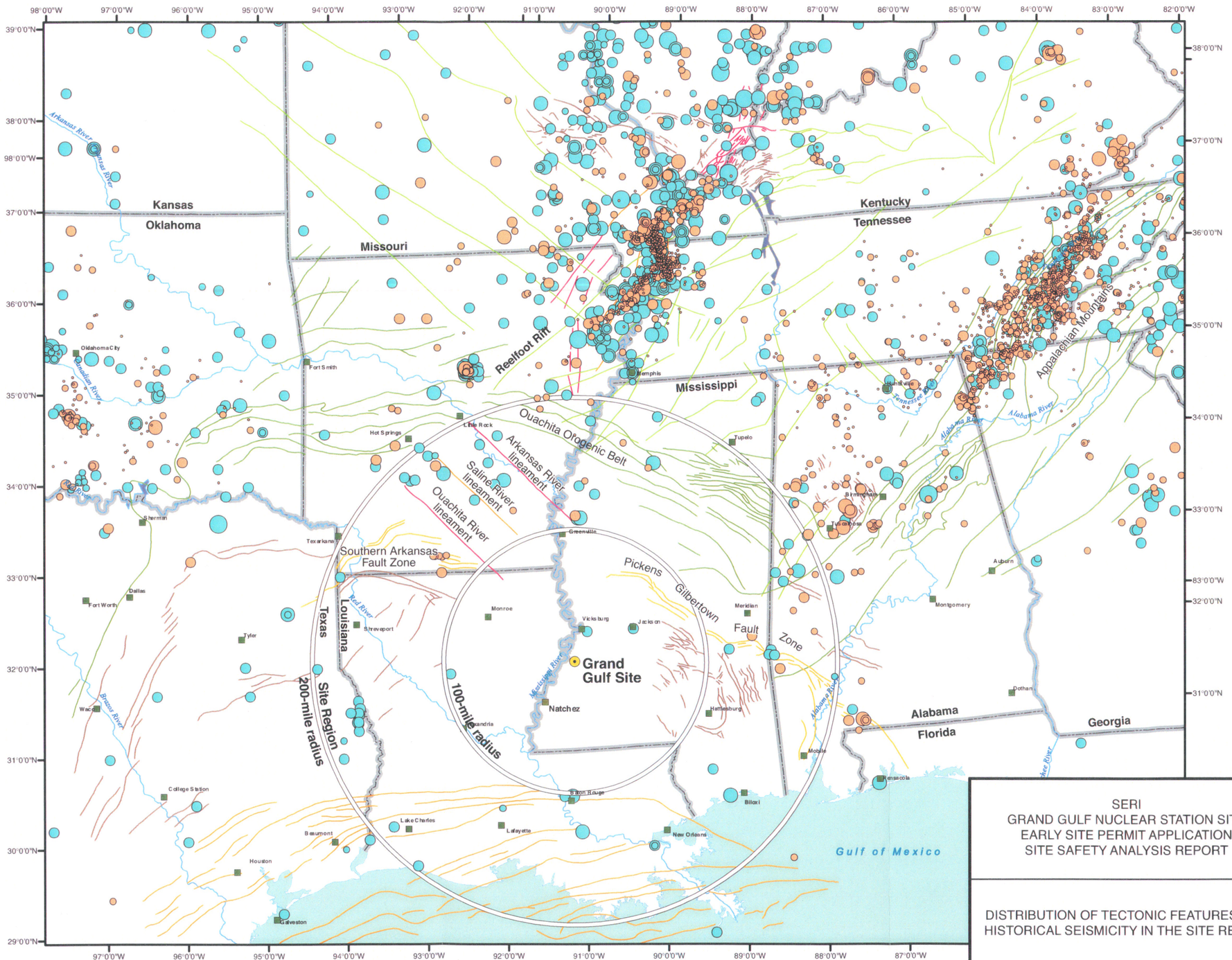
N

0 25 50 100 150 Miles

0 25 50 100 150 Kilometers

Location map





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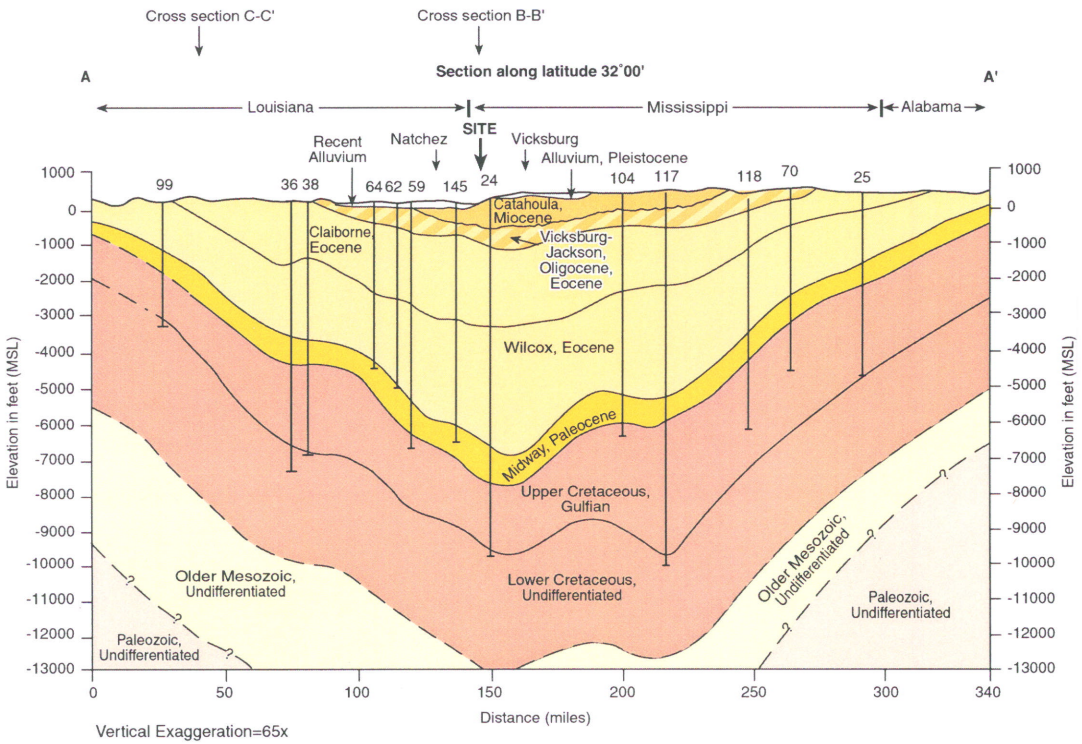
DISTRIBUTION OF TECTONIC FEATURES AND HISTORICAL SEISMICITY IN THE SITE REGION

FIGURE 2.5-5 REV. 1



Location Map

Explanation

Geology

- Recent Alluvium
- M — Miocene
- 0/E — Oligocene/Eocene
- E — Eocene
- P — Paleocene
- K — Cretaceous
- J — Older Mesozoic
- ? — Paleozoic undifferentiated

Symbols

- 99 — Previous boring
- Geologic contact
- Inferred geologic contact
- Queried geologic contact
- Unconformity

References: Fisk, H.N., 1944, Geological investigations of the lower Mississippi River, Mississippi River Commission, Vicksburg Mississippi.

From Figure 2.5-19 of Ref. 16.

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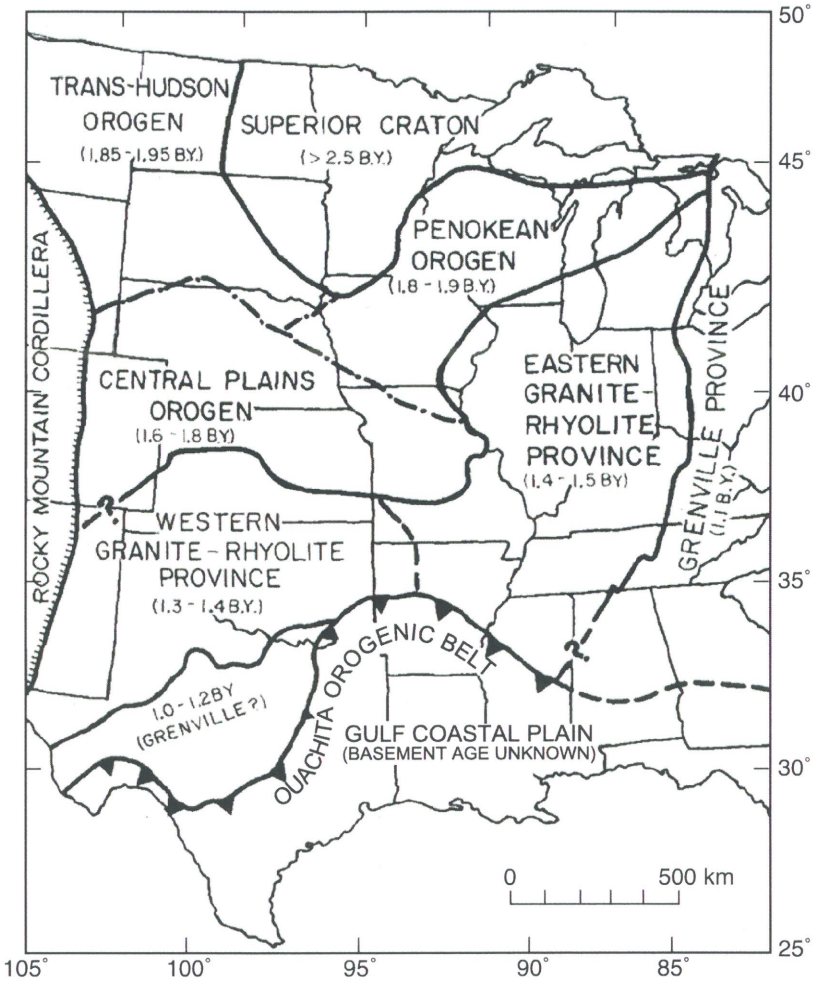
GEOLOGIC SECTION A-A' OF SITE REGION

FIGURE 2.5-6 REV. 1



Age subdivisions of crust in the central U.S. The ages apply to the crystalline basement that is covered by Paleozoic strata over most of the region north of the Ouachita Orogenic Belt and are derived mainly from U-Pb dates on zircon from drill hole samples.

Modified from Johnston and Nava, 1990.

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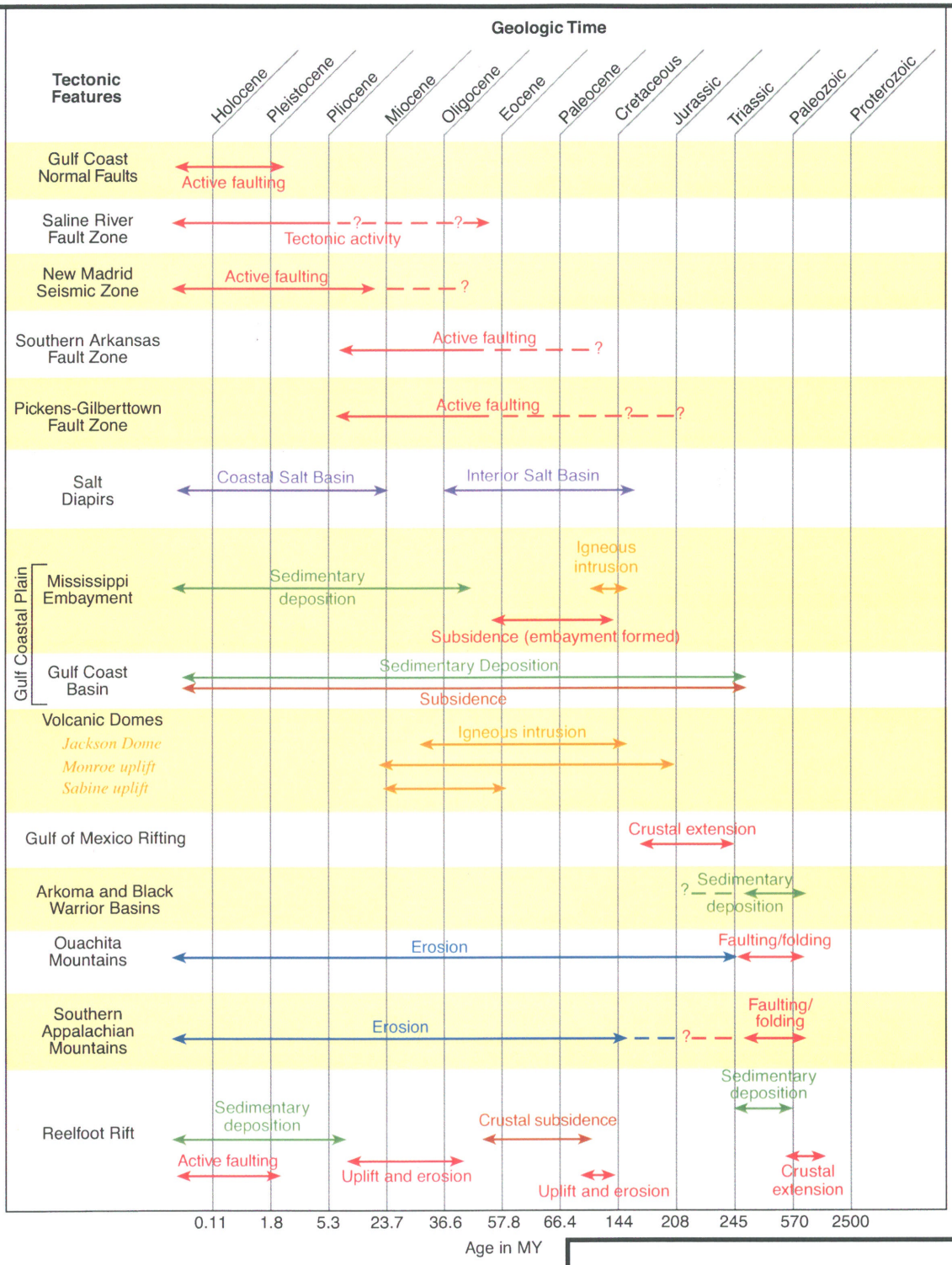
MAJOR CRATONIC FEATURES OF
CENTRAL UNITED STATES

FIGURE 2.5-7 REV. 1



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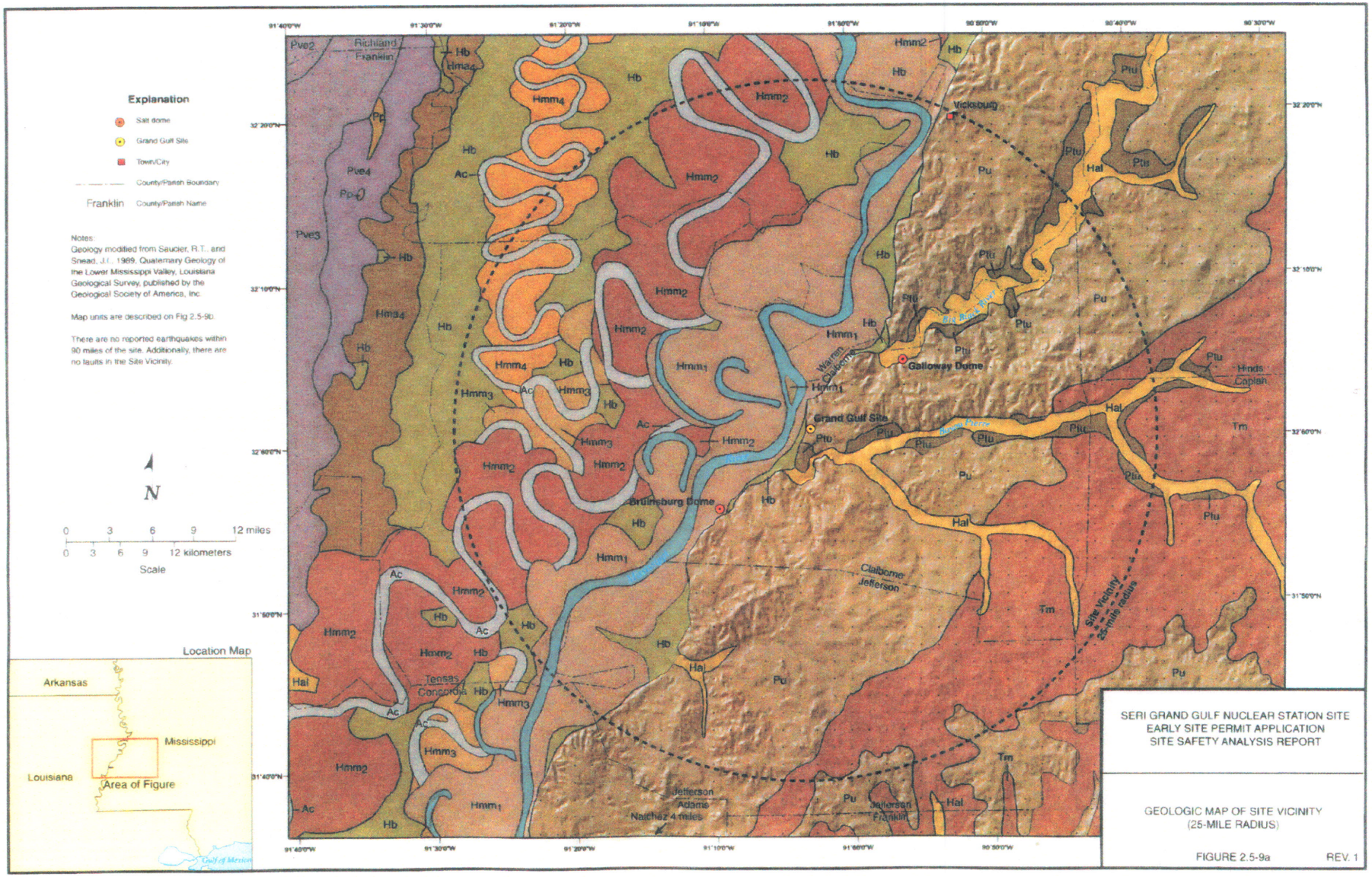
GENERALIZED SEQUENCE OF MAJOR GEOLOGIC EVENTS IN REGION

FIGURE 2.5-8 REV. 1



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SITE SAFETY ANALYSIS REPORT

GEOLOGIC MAP OF SITE VICINITY
(25-MILE RADIUS)

FIGURE 2.5-9a REV. 1

Geologic Map Units	Descriptions
Hal	Alluvium: Undifferentiated on smaller streams.
Hmm1	Mississippi River meander belts: Areas of channel deposition related to lateral migration of past and present river. Final course positions are indicated but abandoned channels (cutoffs) are not delineated.
Hmm2	
Hmm3	
Hmm4	
Ac	Abandoned river course: Last course within each meander belt.
Hma_4	Arkansas River meander belts: Areas of channel deposition related to lateral migration of past Arkansas River courses.
Hb	Backswamp: Areas of overbank deposition not directly affected by meandering channels.
$Pve_{2\text{-}4}$	Valley train of early Wisconsin glaciation: Terraced outwash deposits of braided streams; five levels are recognized. Stippled pattern indicates surficial loess deposits.
Pp	Prairie Complex: A diverse depositional sequence of the Mississippi River, its tributaries, and costal plain streams; includes terraces, fluvial (meander belt and braided stream), colluvial, estuarine, deltaic, and marine units deposited over a considerable part of the late Pleistocene (Wisconsin to Sangamon); three levels are recognized but not mapped.
Ptu	Pleistocene Terrace: Undifferentiated, probably Prairie Complex (Pp) stippled pattern indicates surficial loess deposits.
Pu	Upland complex: Fluvial deposits from both glacial and non-glacial sources. Stippled pattern indicates surficial loess deposits.
Tm	Tertiary and older formations: Undifferentiated. Stippled pattern indicates surficial loess deposits.

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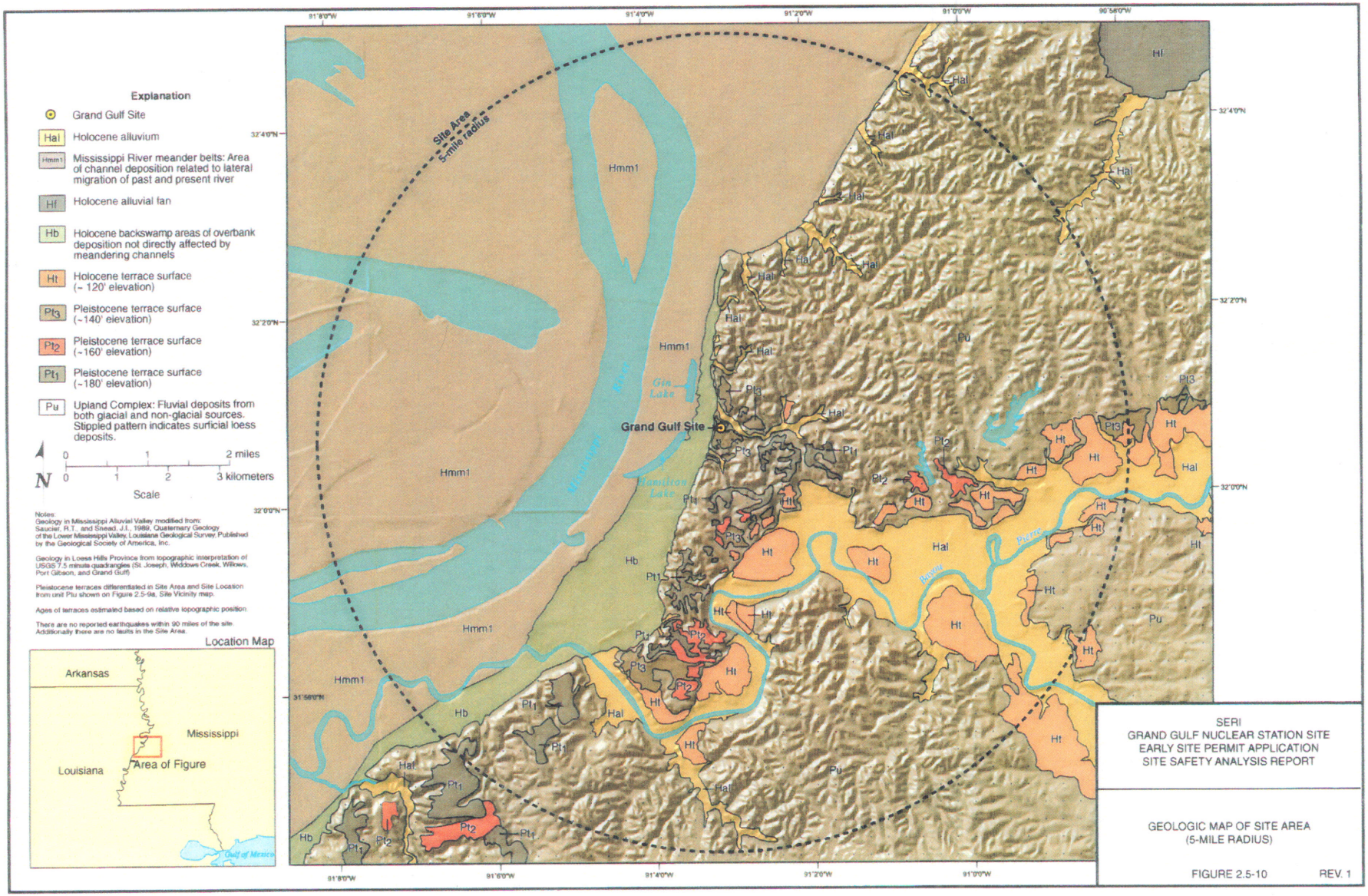
GEOLOGIC MAP UNIT DESCRIPTIONS
FOR GEOLOGIC MAP OF SITE VICINITY

FIGURE 2.5-9b REV. 1



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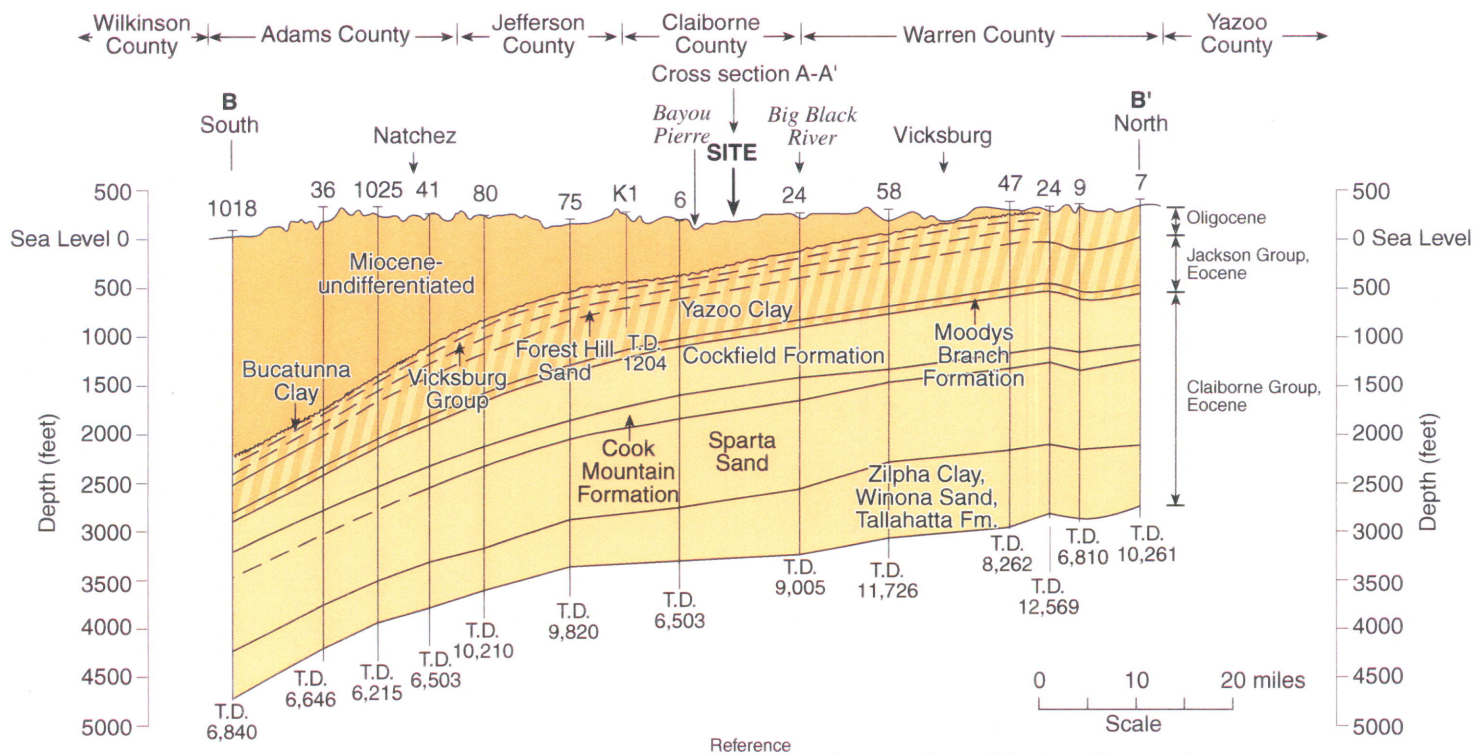
GEOLOGIC MAP OF SITE AREA
(5-MILE RADIUS)

FIGURE 2.5-10 REV. 1



Vertical exaggeration=52.5x

Reference
Callahan, J.A., Skelton, J., Everett, D.R., Harvey, E.J., water Resources of Adams, Claiborne, Jefferson, and Warren Counties, Mississippi, Water Resources Bulletin, 63-1, 1963.

From Figure 2.5-35 of Ref 16.

Key to Electric Logs

1018 Serio-Punches Oil Co., No. 1 Booze-Fort
36 Callon and Tischener, No. 1 Gousett
1025 Duncan-Taylor and Schumacher, No. 1-A Stanton
41 S.C. and J.S. Callon, No. 1 Abbott
80 Ohio Oil Co., No. 1 Hardtimes Plantation
75 Union Oil Co., of California, No. 1 Wagner
K1 Alcorn College, test hole
6 Serio, Justiss-Mears and Clements, No. 1 Wilson
24 Danciger Oil and Refining Co., No 1 Taylor
58 Union Producing Co., No. 1 Harlin
47 Magnolia Petroleum Co., No. 1 Field Estate
24 California Co., No.1S-1 Anderson-Tully
9 Roy Lee, Trustee, No. 1 Anderson-Tully
7 D.T. Dougherty, No. 1 Hintson

Explanation

Symbols

36 | Previous boring

Geologic contact

Unconformity

Inferred geologic contact

Geology

M Miocene

0/E Oligocene/Eocene

E Eocene

Location Map

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CROSS SECTION B-B' OF SITE VICINITY

FIGURE 2.5-11 REV. 1

C North — Morehouse P.H. — West Carroll P.H. — Richland P.H. — Madison P.H. — Franklin P.H. — Cross-section A-A' — Catahoula P.H. — Concordia P.H. — Avoyelles P.H. — C' South

1 Texas No. 2 Louisville Sec. 36, T.23N., R.8E.
2 Carter No. C-1 Hope Fee Sec. 30, T.22N., R.9E.
3 Gulf No. 1 Whitfield Sec. 17, T.19N., R.9E.
4 Justiss-Mears No. D-1 O'Neal Sec. 16, T.17N., R.10E.
5 Humble No. 1 Moore Sec. 17, T.15N.,R.9E.
6 Jett & El Dorado No. A-1 Chicago Mill Sec. 35, T.14N.,R.9E.
Grand Gulf Site (31 miles east of section line)
7 Duerr & Peterson No. 1 Kimble Sec. 35, T.12N., R.8E.
8 Stanoline No. 1 Jones Sec. 25, T.10N., R.8E.
9 McDaniel No. 1 Crothers Sec. 27, T.9N.,R.8E.
10 Hunt No. 1 Fisher Sec. 25, T.7N., R.8E.
11 Pan Am No. 9 Angelina Sec. 19, T.4N.,R.8E.
12 Pan Am No. 1 Martin Sec. 31, T.3N., R.7E.
13 Pan Am No. 2 Martin Sec. 9, T.1N., R.7E.
14 Moncrief No. 1 Rice Sec. 57, T.25N., R.7E.

Miles → 0 20 40 60 80 100 120 140 160 180 183

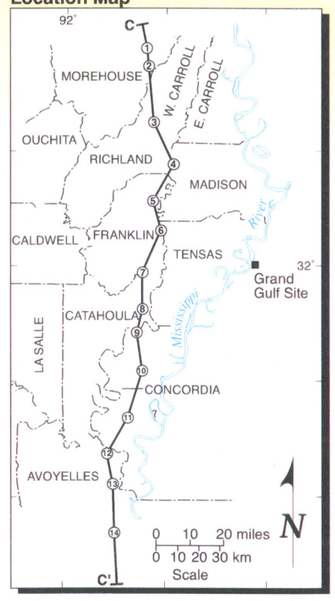
Sea Level

Cook Mountain (E)
Sparta (E)
Cane River (E)
Wilcox (E)
Navarro-Taylor-Austin (K)
Midway (P)
Eagle Ford-Tusc. (K)
Paluxy (J)
Rusk (J)
Mooringsport (J)
Ferry Lake (J)
Rodessa (J)
Pearsall (J)
Sligo-Hosston (J)
Cotton Valley (J)
Haynesville-Buckner (J)
Smackover (J)
Louann Salt (J)
Werner (J)
Cockfield(E)
Anahuac (M)
Frio (M)
Vicksburg-Jackson (O/E)

T.D. 4,916
T.D. 7,494
T.D. 8,300
T.D. 16,420
T.D. 12,500
T.D. 10,500
T.D. 8,110
T.D. 9,237
T.D. 9,224
T.D. 10,310
T.D. 11,450
T.D. 12,165
T.D. 10,253
T.D. 21,500

Elevation (feet)
Sea Level
-5,000
-10,000
-15,000
-20,000

Location Map



Explanation

- Geologic contact
- Inferred geologic contact
- Unconformity
- M Miocene
- 0/E Oligocene/Eocene
- E Eocene
- P Paleocene
- K Cretaceous
- J Jurassic

feet 500 0
2 4 6 8 10 miles
Scale

Vertical exaggeration=20x

Modified from: Eversull, L.G., 1984, Regional Cross Sections, North Louisiana, Louisiana Geological Survey Folio series No. 7, Section J-J'

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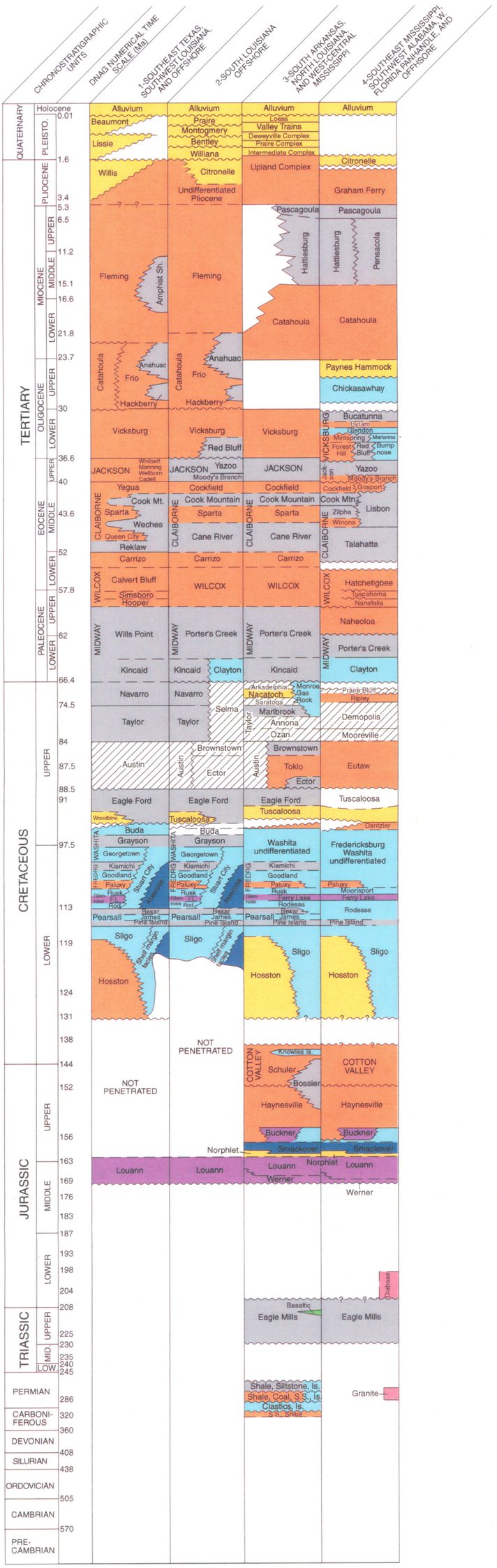
CROSS SECTION C-C' OF SITE VICINITY

FIGURE 2.5-12 REV. 1



Explanation

Dominant lithology

- Predominantly sandstone
- Shale, mudstone, siltstone
- Interbedded sandtone, siltstone, and shale
- Platform and platform-margin carbonates (grain carbonates and reefs)
- Chalk
- Evaporites
- Basinal carbonates, calcic shale, and shale
- Volcanic rocks
- Intrusive-igneous rocks
- Haitus

Contacts

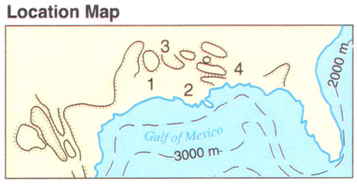
- Conformable
- Unconformable
- Uncertain
- Precise age unknown

FREDRG Fredricksburg
F.L. Ferrylake
R.O.D. Rodessa
ls Limestone
ss Sandstone
sh Shale

Note: Columns showing several laterally-grading units represent, whenever possbile, transition from basin margin on the left to basin center on the right.

From Salvador and Muñeton, 1991

Location Map



Numbers represent stratigraphic column location

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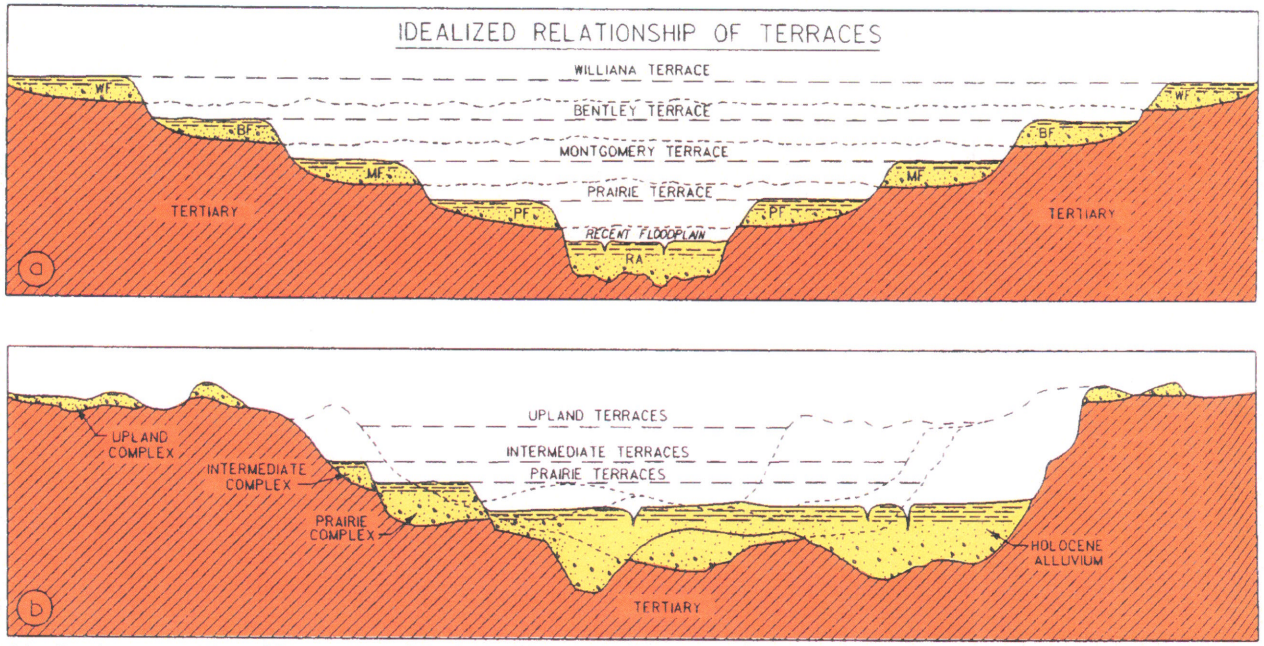
STRATIGRAPHIC COLUMN FOR THE GULF COAST BASIN

FIGURE 2.5-13 REV. 1



Idealized cross section of the southern Mississippi Alluvial Valley comparing: (a) relationships of terraces from Fisk (1944); and (b) relationships of terraces from Autin et al. (1991).

From Autin et al., 1991 and Saucier, 1994.

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COMPARISON OF TERRACE MODELS
ALONG THE MISSISSIPPI ALLUVIAL VALLEY

FIGURE 2.5-14 REV. 1

Explanation

Grand Gulf Site

Contour of top of Glendon Limestone; contour interval = 20 feet

Data source: Figure 2.5-32 of Ref 16.

N

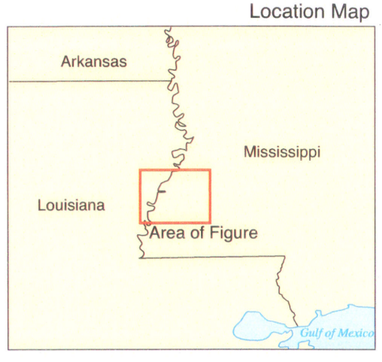
0 1.25 2.5 5 7.5 10 Miles

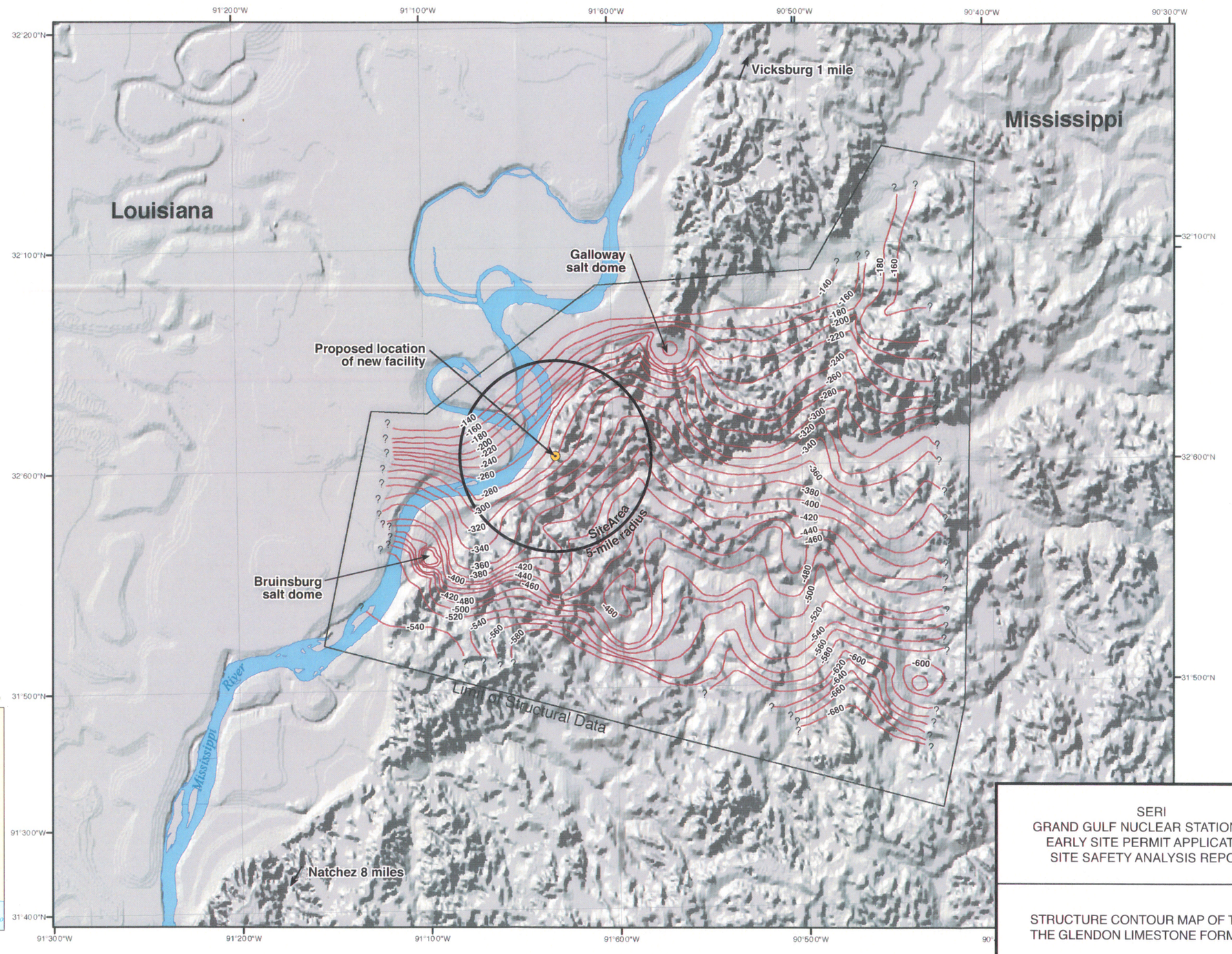
0 1.5 3 6 9 12 Kilometers

1" = 25,000

Scale

Location Map





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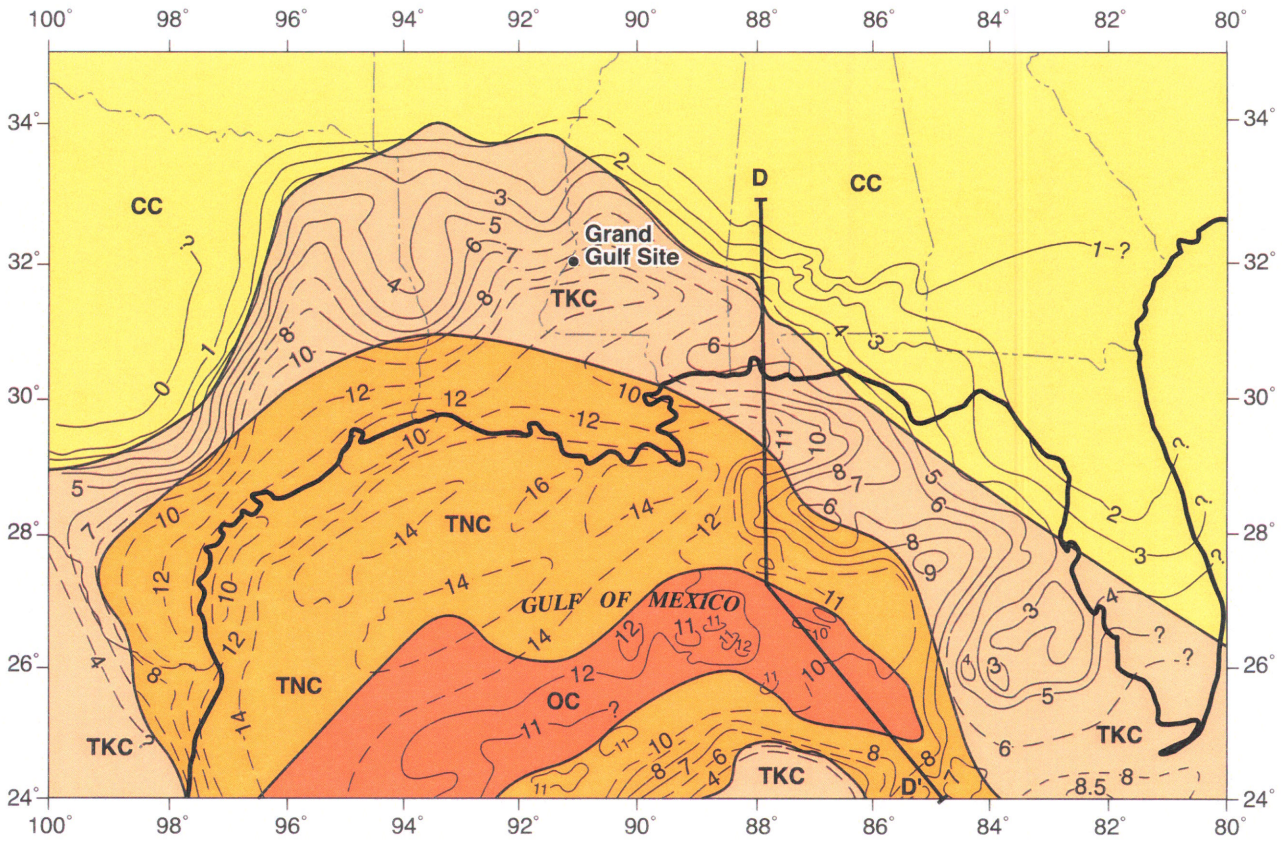
STRUCTURE CONTOUR MAP OF TOP OF THE GLENDON LIMESTONE FORMATION

FIGURE 2.5-15 REV. 1



Explanation

- Continental crust
- Thick transitional crust
- Thin transitional crust
- Oceanic crust

Note: to convert depths from kilometers to miles, multiply depth shown by 0.6. Modified from Sawyer et al., 1991

N

0 200 400 km

Scale

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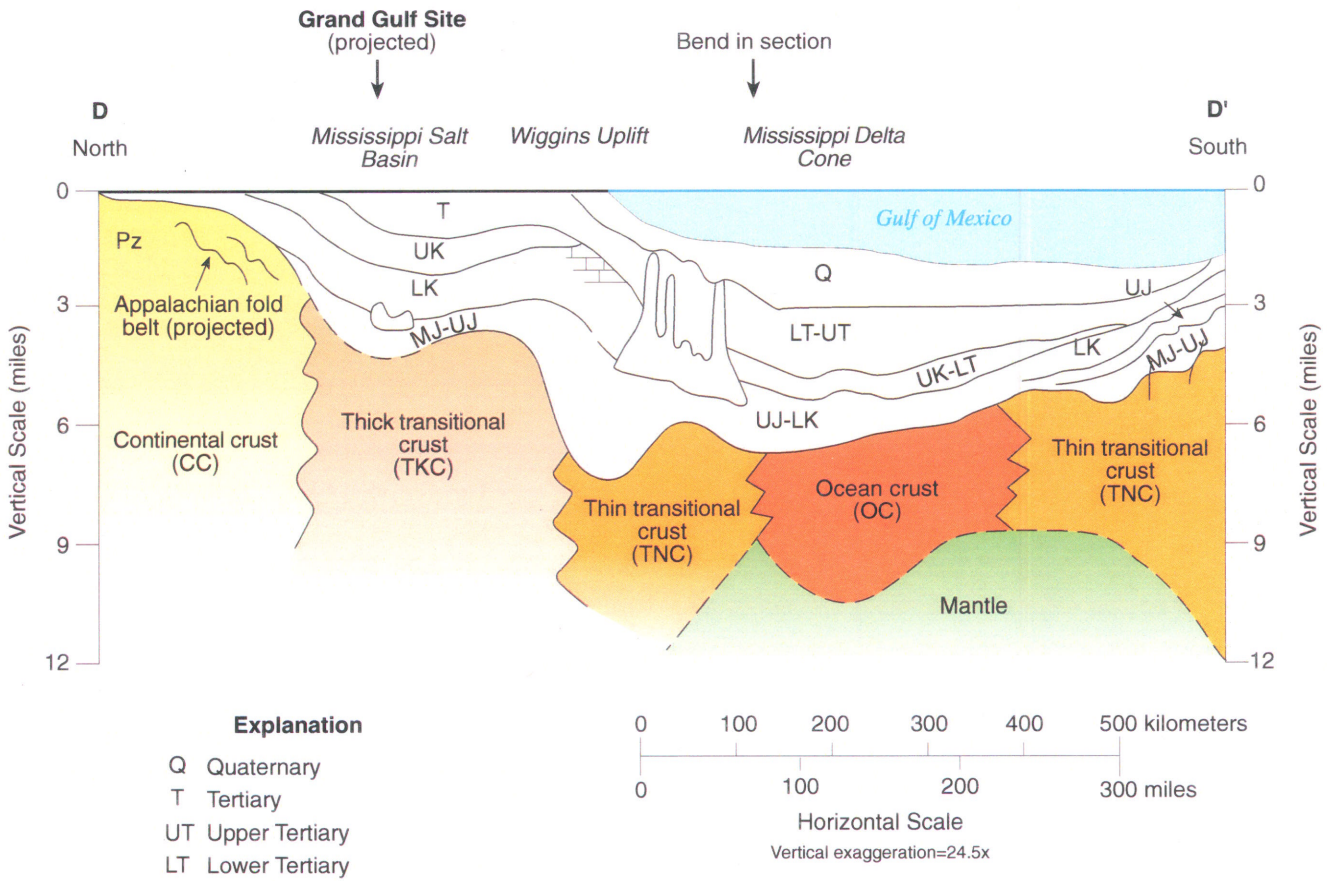
DEPTH TO BASEMENT AND CRUSTAL TYPES, GULF COAST BASIN

FIGURE 2.5-16a REV. 1



Note:
Modified from Sawyer et al., 1991

Depth to basement beneath Grand Gulf Site Location is 5.4 miles (9.0km)

See Figure 2.5-16a for cross-section location

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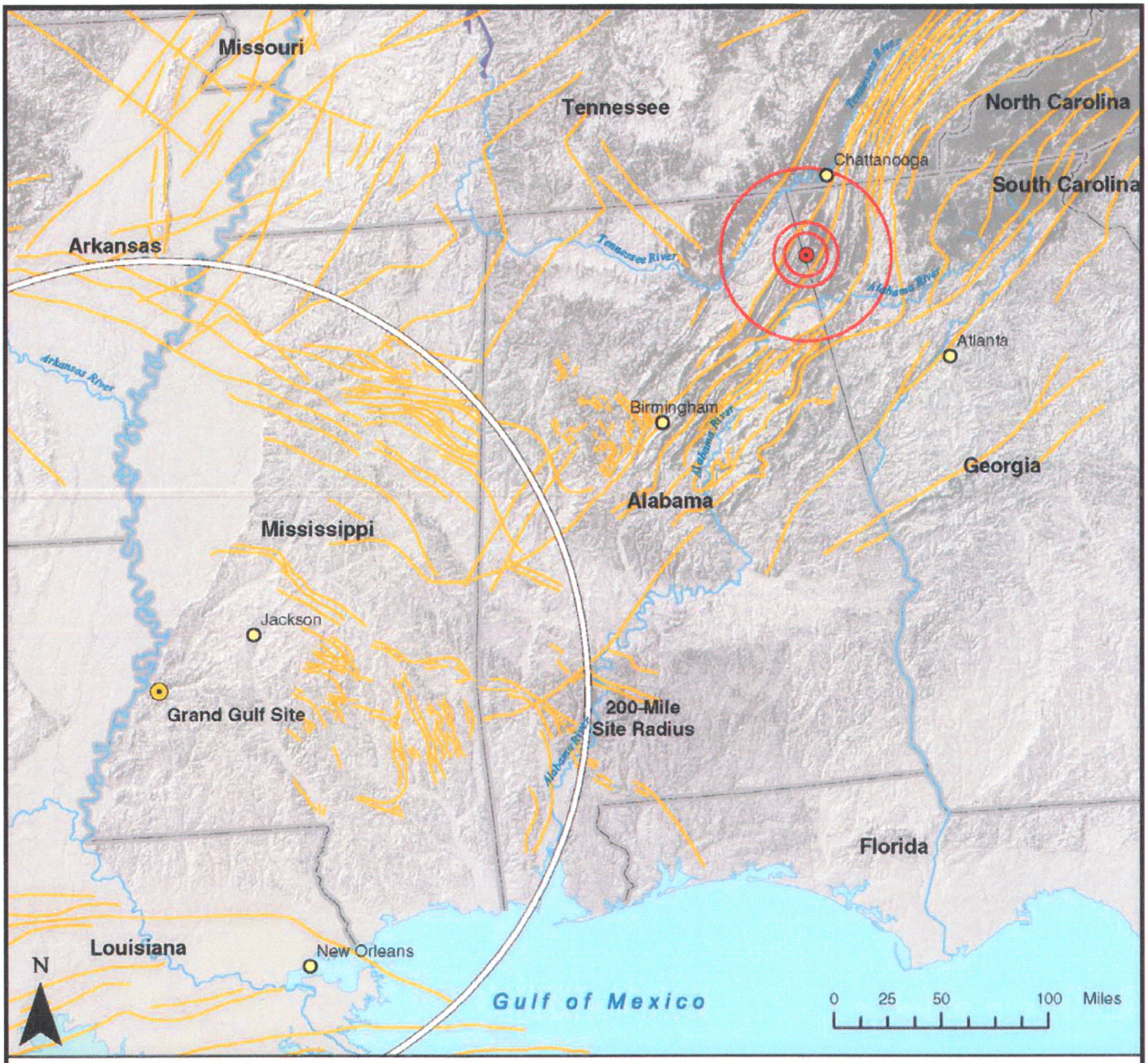
GEOLOGIC SECTION D-D'

FIGURE 2.5-16b REV. 1



Explanation

Faults

Cities

Fort Payne Alabama earthquake, Tuesday April 29, 2003, 08:59:36. Magnitude = Mw = 4.9. Depth = 5 km. Location 34.55N, 85.50W.

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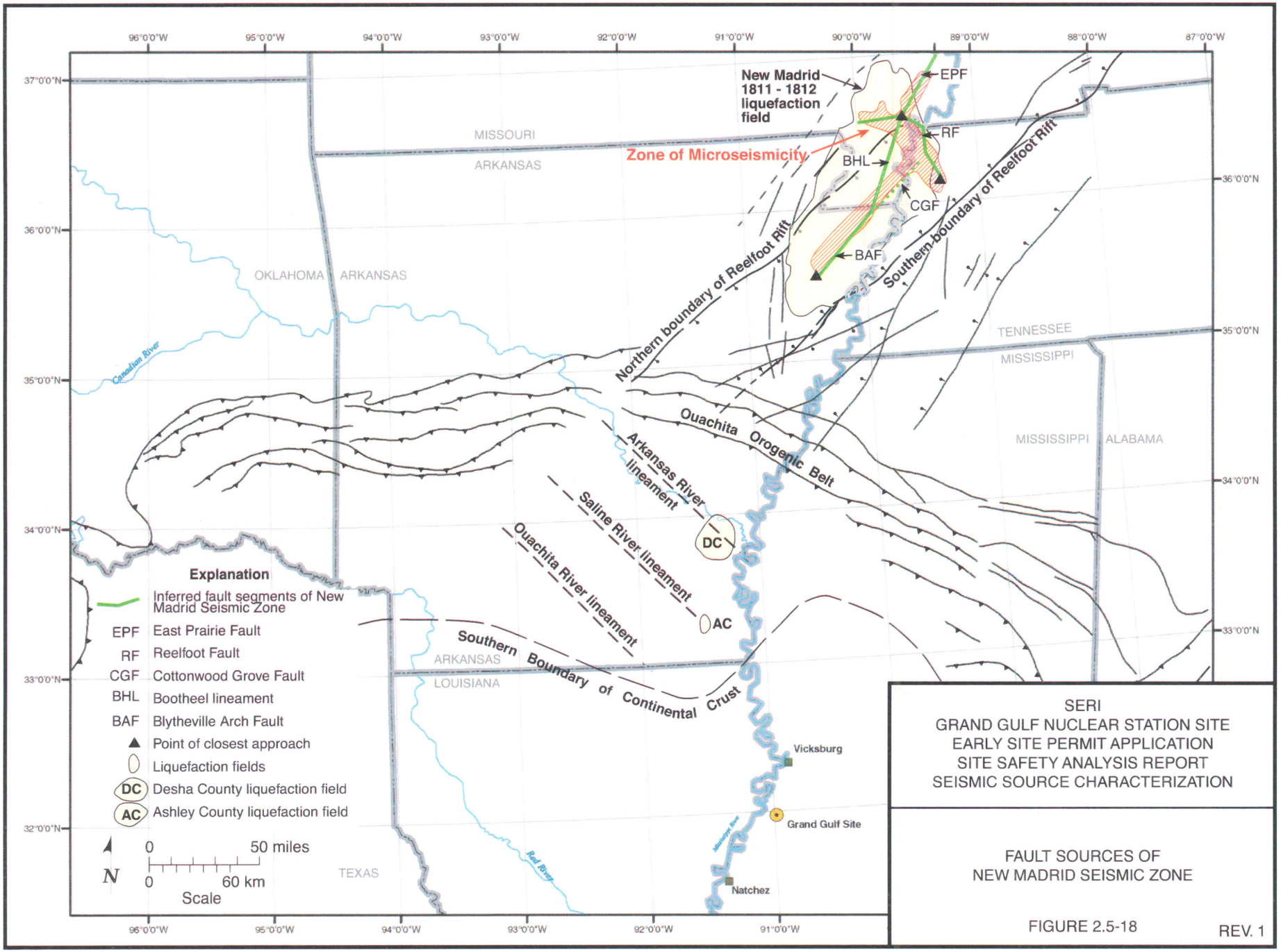
MAP SHOWING LOCATION OF
FORT PAYNE, ALABAMA
EARTHQUAKE, APRIL 29, 2003

FIGURE 2.5-17 REV. 1



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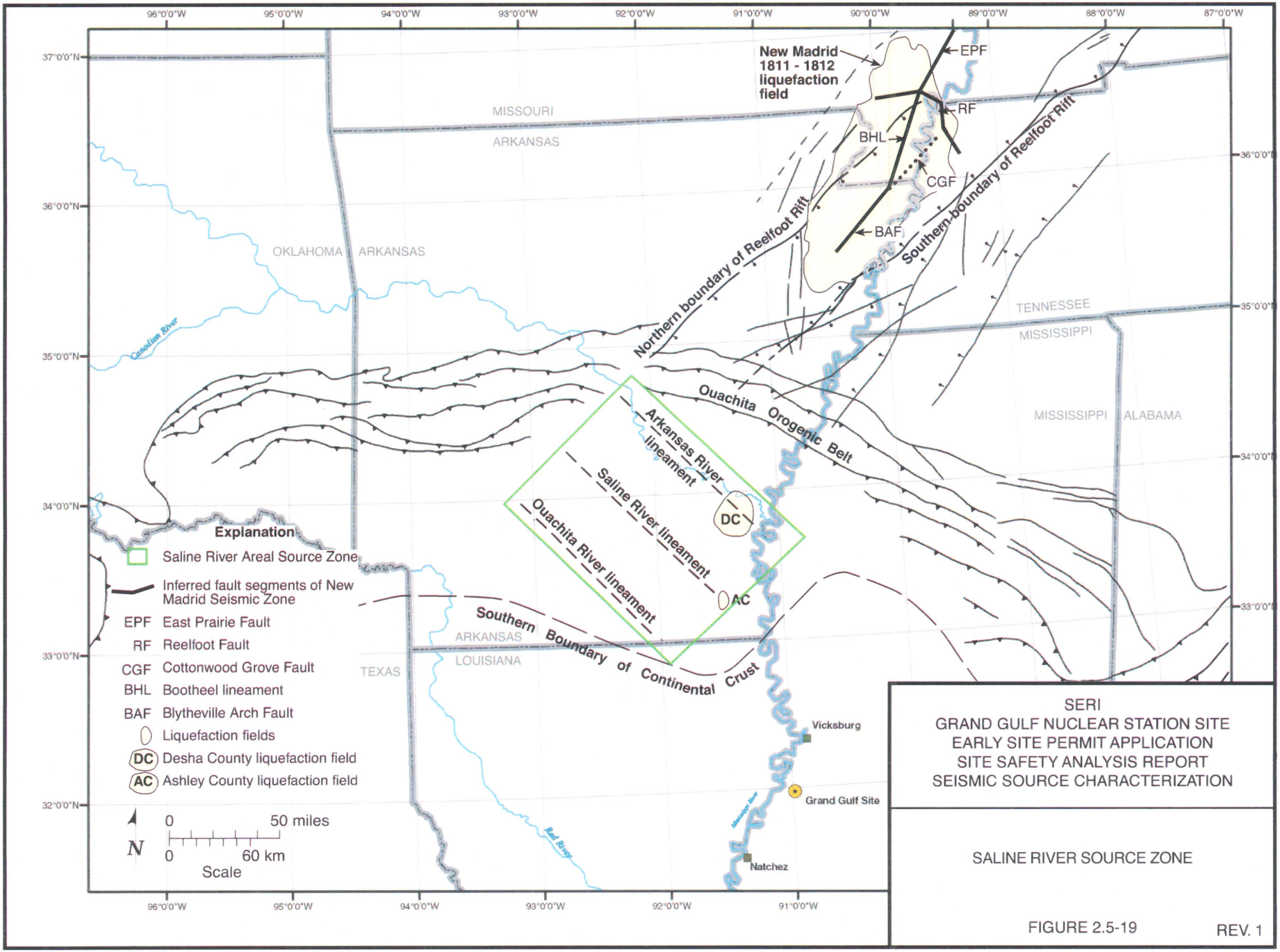
SEISMIC SOURCE CHARACTERIZATION

FAULT SOURCES OF
NEW MADRID SEISMIC ZONE

FIGURE 2.5-18

REV. 1



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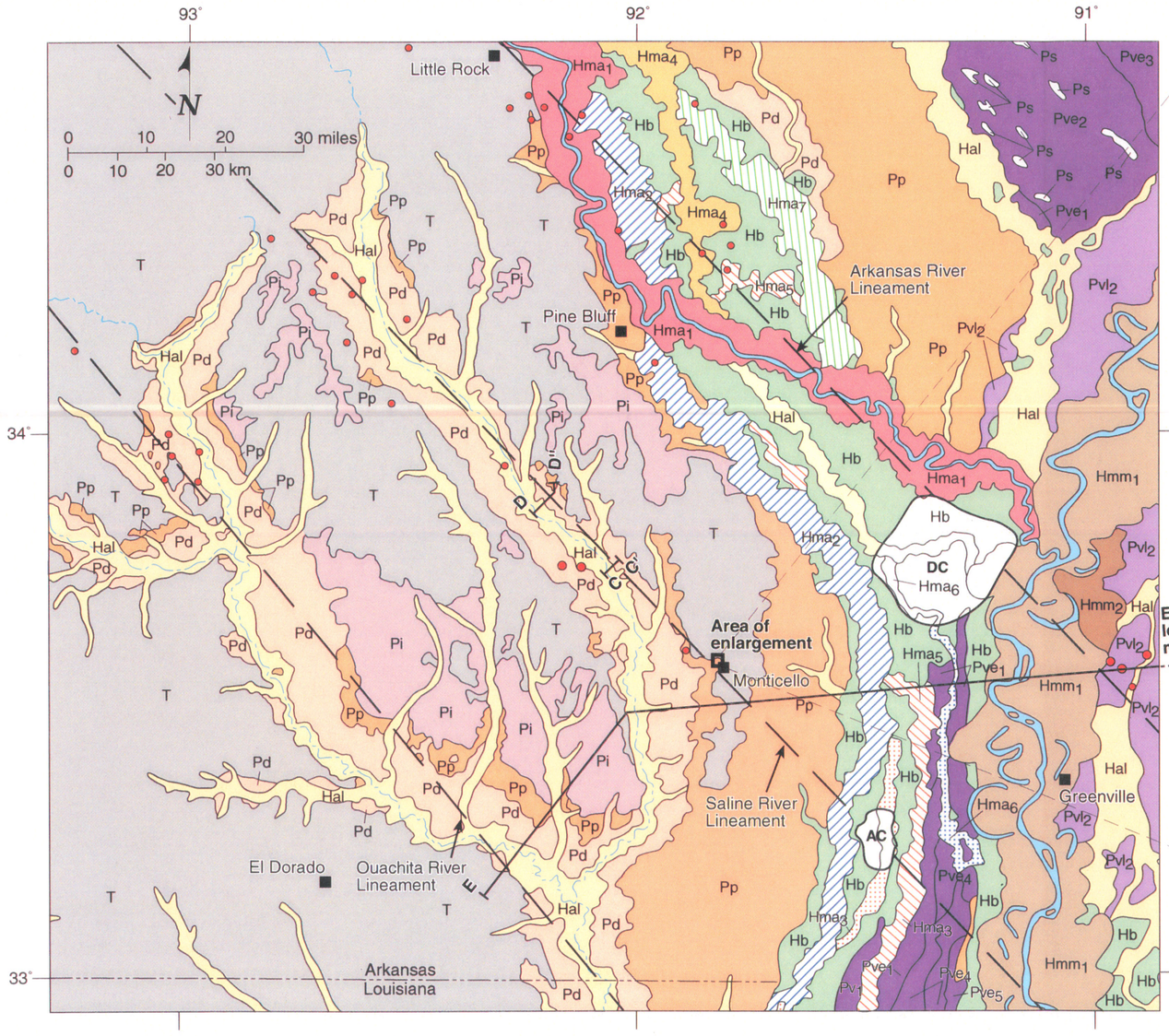
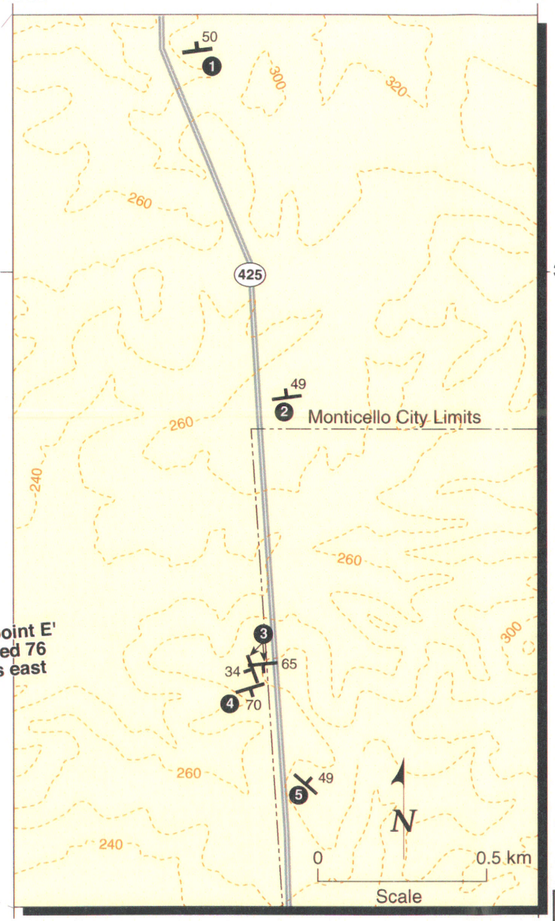
SALINE RIVER SOURCE ZONE

FIGURE 2.5-19 REV. 1





Locations of faults described by reference 152. Circled numbers are trench sites described by Cox et al. and summarized in Table 2.5-4. Figure 2.5-25 shows fault exposure from Site 5.

Note: Cross section E - E' shown on Figure 2.5-21; cross sections C - C' and, D - D'' shown on Figure 2.5-23. Location of cross sections G - G' and H - H'' are approximate. Map modified from Saucier, 1989. Area of enlargement from Reference 151.

Explanation

Symbols

- Seismicity from center for Earthquake Research and Information New Madrid catalog as presented in Reference 152

Areas of liquefaction (Reference 151)

- DC — Desha County liquefaction field
- AC — Ashley County liquefaction field

Explanation

Geologic Units

- Hal — Alluvium: Undifferentiated in smaller streams.
- Hb — Backswamp: Areas of overbank deposition not directly affected by meandering channels.
- $Hmm_{(1,2)}$ — Mississippi River meander belts: Areas of channel deposition related to lateral migration of past and present river. Final course positions are indicated, but abandoned channels (cutoffs) are not delineated.
- $Hma_{(1-7)}$ — Arkansas River meander belts: Areas of channel deposition related to lateral migration of past Arkansas River courses.
- $Pve_{(1-3)}$ — Valley train of early Wisconsin glaciation: Terraced outwash deposits of braided streams; five levels are recognized. Stippled pattern indicates surficial loess deposits.
- Pp — Prairie Complex: A diverse depositional sequence of the Mississippi River, its tributaries, and coastal plain streams; includes terraces, fluvial (meander belt and braided stream), colluvial, estuarine, deltaic, and marine units deposited over a considerable part of the late Pleistocene (Wisconsin to Sangamon); three levels are recognized, but not mapped.
- T — Tertiary and older formations: Undifferentiated. Stippled pattern indicates surficial loess deposits.
- $Pv1_2$ — Pleistocene valley train deposits of late Wisconsin age.
- Pd — Pleistocene Deweyville complex terraces
- Pi — Pleistocene intermediate complex terraces
- 49 — Strike and dip of fault plane observed in trenches of Reference 152

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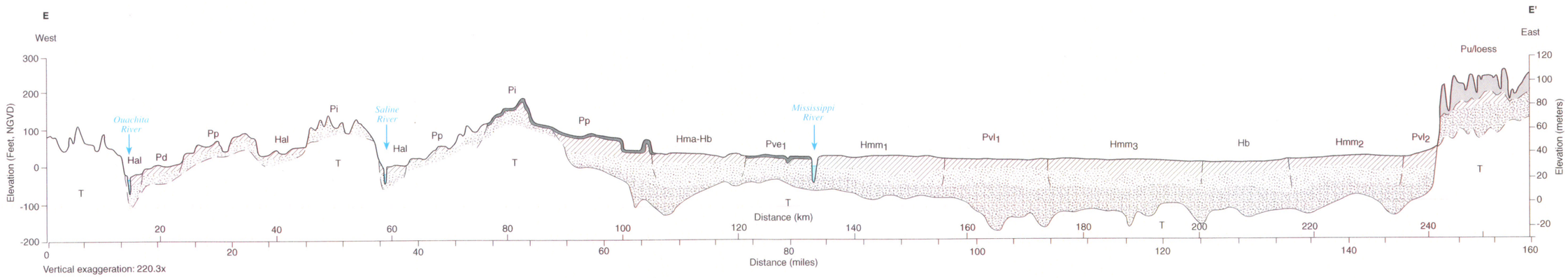
GEOLOGIC MAP IN VICINITY OF SALINE RIVER SHOWING SEISMICITY, LIQUEFACTION, AND FAULTS

FIGURE 2.5-20 REV. 1



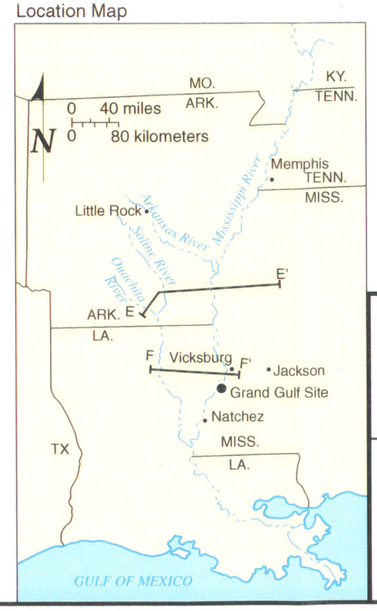
Explanation

Loess veneer	
Loess	
Clay and silt	
Sand	
Sand and gravel	
Tertiary	
Geologic contact	
NGVD	National Geodetic Vertical Datum

Hal	Holocene alluvium undifferentiated
$Hmm_{(1-3)}$	Holocene Mississippi River meander belt
Hma	Holocene Arkansas River meander belt
Hb	Holocene backswamp
Pd	Pleistocene Deweyville Complex
$Pvl_{(1-2)}$	Pleistocene Valley train of late Wisconsin age
Pp	Pleistocene Praire Complex
Pi	Pleistocene Intermediate Complex
Pu	Pleistocene Upland Complex
T	Tertiary undifferentiated

Note:
From Saucier, 1991, Quaternary Nonglacial Geology: Conterminous United States, The Geology of North America, Vol. K-2, Geological Society of America, Plate 7, Lower Mississippi Valley cross section D-D'.

Location Map



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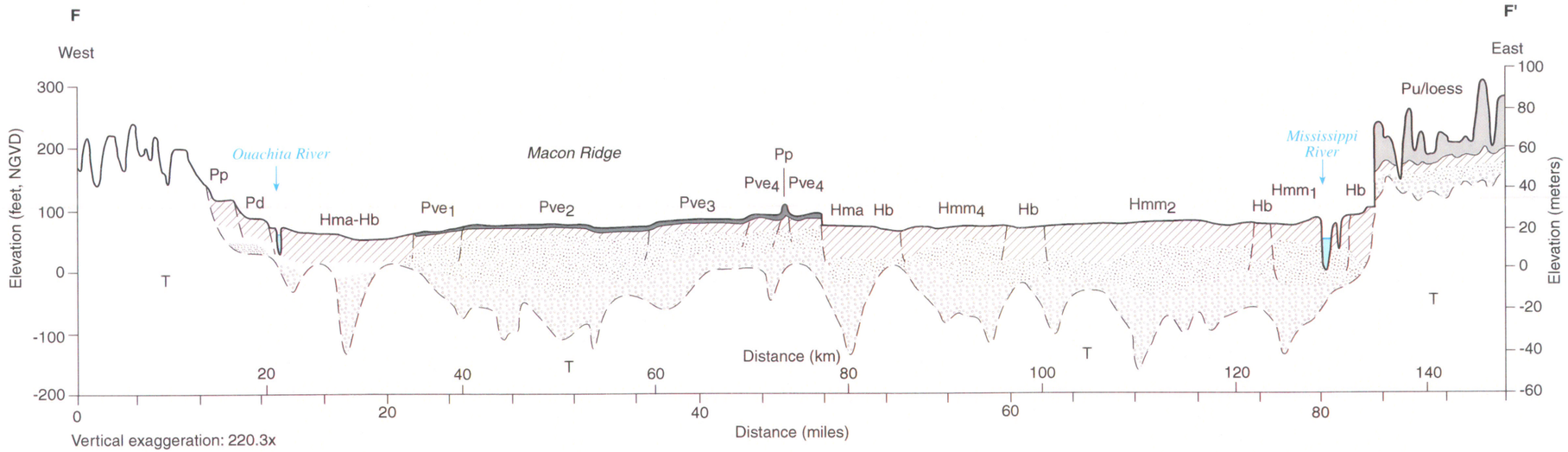
CROSS SECTION E - E'

FIGURE 2.5-21 REV. 1



Explanation

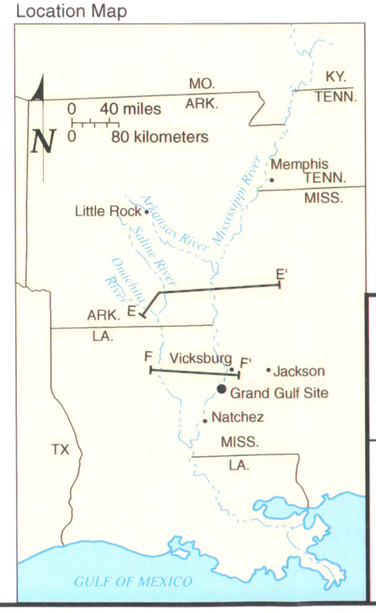
- Loess veneer
- Loess
- Clay and silt
- Sand
- Sand and gravel
- Tertiary
- Geologic contact
- NGVD — National Geodetic Vertical Datum

$Hmm_{(1,2,4)}$	Holocene Mississippi River meander belt
Hma	Holocene Arkansas River meander belt
Hb	Holocene backswamp
Pd	Pleistocene Dewyeville Complex
$Pve_{(1-4)}$	Pleistocene Valley train of early Wisconsin age
Pp	Pleistocene Praire Complex
Pu	Pleistocene Upland Complex
T	Tertiary undifferentiated

Notes:
Ouachita River now occupies the Holocene Arkansas River meander belt. The Arkansas River changed its course through avulsion in late Holocene time.

From Saucier, 1991, Quaternary Nonglacial Geology: Conterminous United States, The Geology of North America, Vol. K-2, Geological Society of America, Plate 7, Lower Mississippi Valley cross section E-E'.

Location Map



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CROSS SECTION F - F'

FIGURE 2.5-22 REV. 1