Tennessee Valley Authority, 1101 Market Street, LP 5A, Chattanooga, Tennessee 37402-2801

October 3, 2008

10 CFR 52.79

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, D.C. 20555

In the Matter of) Docket No. 52-014 and 52-015
Tennessee Valley Authority)

BELLEFONTE COMBINED LICENSE APPLICATION – RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION – BASIC GEOLOGIC AND SEISMIC INFORMATION

Reference: Letter from Joseph Sebrosky (NRC) to Andrea L. Sterdis (TVA), Request for Additional Information Letter No. 123 Related to SRP Section 02.05.01 for the Bellefonte Units 3 and 4 Combined License Application, dated September 4, 2008

This letter provides the Tennessee Valley Authority's (TVA) response to the Nuclear Regulatory Commission's (NRC) request for additional information (RAI) items included in the reference letter.

A response to each NRC request in the subject letter is addressed in the enclosure which also identifies any associated changes that will be made in a future revision of the BLN application.

If you should have any questions, please contact Phillip Ray at 1101 Market Street, LP5A, Chattanooga, Tennessee 37402-2801, by telephone at (423) 751-7030, or via email at pmray@tva.gov.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on this 3rd day of Oct, 2008.

Andrea L. Sterdis
Manager, New Nuclear Licensing and Industry Affairs
Nuclear Generation Development & Construction

Enclosure
cc: See Page 2

D085
NRO

cc: (w/ Enclosures)
J. P. Berger, EDF
J. M. Sebrosky, NRC/HQ
E. Cummins, Westinghouse
S. P. Frantz, Morgan Lewis
M. W. Gettler, FP&L
R. Grumbir, NuStart
P. S. Hastings, NuStart
P. Hinnenkamp, Entergy
M. C. Kray, NuStart
D. Lindgren, Westinghouse
G. D. Miller, PG&N
M. C. Nolan, Duke Energy
N. T. Simms, Duke Energy
K. N. Slays, NuStart
G. A. Zinke, NuStart

cc: (w/o Enclosure)
B. C. Anderson, NRC/HQ
M. M. Comar, NRC/HQ
B. Hughes/NRC/HQ
R. G. Joshi, NRC/HQ
R. H. Kitchen, PGN
M. C. Kray, NuStart
A. M. Monroe, SCE&G
C. R. Pierce, SNC
R. Reister, DOE/PM
L. Reyes, NRC/RII
T. Simms, NRC/HQ

Enclosure
TVA letter dated October 3, 2008
RAI Response

Responses to NRC Request for Additional Information letter No. 123 dated September 4, 2008
(10 pages, including this list)

Subject: Basic geologic and seismic information in the Final Safety Analysis Report

RAI Number	Date of TVA Response
02.05.01-01	This letter – see following pages
02.05.01-02	This letter – see following pages
02.05.01-03	This letter – see following pages
02.05.01-04	This letter – see following pages

Associated Additional Attachments / Enclosures	Pages Included
Attachment 2.5.1-01A	2
Attachment 2.5.1-01B	3
Attachment 2.5.1-03A	3
Attachment 2.5.1-04A	4

NRC Letter Dated: September 4, 2008

NRC Review of Final Safety Analysis Report

NRC RAI NUMBER: 02.05.01-01

FSAR 2.5.1.1.3.2 describes sub-vertical, upward-widening features in a soil exposure and states that they "resemble non-tectonic soil weathering features (cutans) …." Please present observations, measurements, or analyses, and figures, photographs, or other illustrations that demonstrate whether or not these features could be seismically induced.

BLN RAI ID: 1517

BLN RESPONSE:

Consistent with statements in the FSAR, the features are found to be non-tectonic soil weathering features. The discussion below further supports this conclusion, and a new FSAR Figure is added as shown in Attachment 02.05.01-01A.

Field location KH-9 is located in Gadsden, Alabama in an abandoned excavation or old borrow pit near the intersection of Highway 278 and Armstrong Street. The excavation exposes three subvertical cuts, 4 to 9 feet high, made into early to middle Pleistocene fluvial sediments of the Coosa River. The excavation is on the crest of a low hill at elevation 620 ft. based on the USGS topographic map, approximately 120 feet above the level of the Coosa River, which flows 0.8 mi. north of the excavation. As stated in the FSAR, the age of the deposits is not known, but based on the regional denudation rate (100 ft./my) (FSAR Reference 220) and the strong soil development, it is likely that the terraces are on the order of hundreds of thousands to a million years old.

The exposures at KH-9 reveal terrace sediments consisting of sandy gravels and gravelly sands capped with up to 5 ft of fine sand and silt. The sands and gravels exhibit the cross-bedding typical of fluvial sediments. The material is highly weathered with bright red and yellowish red colors, and the upper few meters host a partially eroded mature soil profile.

The Natural Resources Conservation Service (NRCS) maps the soil as belonging to the Holston soil series (Reference 1). Holston soils are classified as Paleudults, highly weathered soils, leached of the elements calcium, sodium, magnesium, and potassium, that have a horizon of translocated clay, or *argillic horizon*. They form on very old, stable land surfaces with gentle slopes and commonly have a small amount of *plinthite*, an iron cementation, at depth (Reference 2). The soils observed in the excavations at KH-9 are consistent with this description.

The most complete soil profile, observed in the easternmost cut, consists of a partially eroded, leached horizon, of light yellowish brown silt loam, capping an argillic horizon of yellowish red and brown mottled silty clay loam, with distinct clay films. At 3 ft. depth, the argillic horizon grades downward into an iron-rich, or plinthite horizon, with dark red and light gray mottling indicating iron mobilization and accumulation. At 4.5 ft. the mottled silty clay loam abruptly terminates at the upper contact of a gravelly sand layer. The iron cementation continues downward into this gravelly sand, giving the sandy matrix a dark red color. In this and other exposures in this excavation, mottling is more pronounced in the finer textured sediments and may be absent in the coarse sediments.

The sub-vertical features are found in the iron-rich horizons of the western and central cut faces, in either the mottled or unmottled horizons. The features appear as sub-vertical veins 0.5 to 2 in. wide, lighter in color than the surrounding soil matrix (FSAR Figure 2.5-209 panels a and b). They are similar to the light colored mottles within the iron-cemented horizon. The veins are seen to occasionally branch upward or downward, and may be part of a group of parallel veins. Vein width is fairly constant with depth, though examples can be found that pinch out with depth or widen near the surface. Some end abruptly at a bedding contact. The edges of the veins are typically lined with reddish iron cementation.

The veins pass through stratigraphic contacts without offsetting or disturbing them. FSAR Figure 2.5-209 Panel A shows several veins passing through a gravel lens bounded by mottled silty clay loam. The gravel is not displaced, and gravel clasts occur within the vein where it passes through the lens.

Veins such as these are documented in the pedology literature, and are referred to as *bleached fractures* (Reference 3). They form from the cracking of a partially cemented or brittle soil horizon during seasonal drying, followed by infiltration of fresh rainwater along the crack, mobilizing free iron and translocating silt and clay into the crack from the upper soil horizons. Water is drawn into the partially cemented block on the margins of the fracture; iron is then precipitated from the water in the walls of the fractures as the soil dries again, forming the red borders adjacent to the fracture. The fracture becomes a preferred pathway for the infiltration of water and for root penetration, and over time takes on a bleached appearance. In plan view the fractures form a rough polygonal pattern about blocks of more cemented soil (Reference 3). Abbott and others (FSAR Reference 227) describe similar features in Tertiary coastal plain sediments in South Carolina, which they also attribute to advanced soil weathering.

These features do not have characteristics diagnostic of seismically induced liquefaction features or tectonic faulting. The veins do not consist of liquefiable silt and sand and do not appear to originate from a layer of liquefiable material at depth. They disappear upward into the argillic horizon instead of widening into a surficial deposit of erupted silt and sand. The preservation of stratigraphic textural features through the vein is inconsistent with rapid movement of liquefied material upward through the vein. The lack of offset of the bedding across the veins and their random orientation is inconsistent with a faulting origin.

In summary, the sub-vertical features observed in the Pleistocene terrace sediments at location KH-9 are bleached fractures formed from the cracking due to seasonal drying of partially cemented sediments and the subsequent infiltration of soil water along the fractures. The infiltrating soil water leaches iron from the walls of the fractures and translocates into the fractures small amounts of material from the upper soil horizons. The resulting features appear as light colored veins with reddish borders within the partially iron-cemented horizons of the soil.

References

1. Natural Resources Conservation Service Web Soil Survey 2.0, accessed 9/17/08.
2. Soil Survey Staff, 1999, Soil Taxonomy: a basic system of soil classification for making and interpreting soil surveys: U.S Department of Agriculture, Agriculture Handbook No. 436, revised edition, Chapter 19, Ultisols, pp. 721-781.
3. Soil Survey Staff, 1975, Soil Taxonomy: a basic system of soil classification for making and interpreting soil surveys: U.S Department of Agriculture, Agriculture Handbook No. 436, pp. 42-43.

This response is PLANT SPECIFIC.

ASSOCIATED BLN COL APPLICATION REVISIONS:

1. COLA Part 2, FSAR Chapter 2 figures are modified by replacing Figures 2.5-208 and -209 as follows:

Existing Figure 2.5-208, 25-Mi. Radius Geologic Map, will be renumbered as Figure 2.5-208a (Attachment 2.5.1-01B)

Existing Figure 2.5-209, Explanation of Geologic Map Units and Symbols 25-Mi., will be renumbered as Figure 2.5-208b (Attachment 2.5.1-01B)

A new Figure 2.5-209, Soil Weathering Features in Pleistocene Terrace Deposits, Gadsden, Alabama, is added (Attachment 2.5.1-01A).

2. COLA Part 2, FSAR. Chapter 2, Subsection 2.5.1.1.3.2, last paragraph, from:

At one location in Gadsden (Field Stop KH9, Figure 2.5-208) subvertical features characterized by subvertical bands of alternating red and light brownish gray color were observed in the lower, more clay-rich, strongly mottled part of the soil. The features appeared to flare upward and become less distinct in the upper part of the mottled horizon and could not be traced into the upper 0.6 m (2 ft.) of the soil. The contact between the mottled unit and gravelly sand does not show any apparent vertical displacement across the features. These features resemble non-tectonic soil weathering features (cutans) seen elsewhere in the Coastal Plain region of the southeastern U.S. (Reference 227).

To read:

At an exposure of these high terrace deposits in Gadsden (Field Stop KH9, Figure 2.5-208a) distinct subvertical veins, 0.5 to 2 inches wide, of light brownish gray material, were observed within the yellowish red soil of these old deposits (Figure 2.5-209 panel a). The veins could be traced through a strongly mottled horizon (typically 3 to 5 feet below the surface), through the underlying unmottled partially iron-cemented sediments, to the base of the exposure 6 to 8 feet below the surface. The veins become less distinct in the upper part of the mottled horizon and could not be traced into the upper 0.6 m (2 ft.) of the soil. The veins are seen to occasionally branch upward or downward, and may be part of a group of parallel veins. Vein width is fairly constant with depth, though examples can be found that pinch out with depth or widen near the surface. The edges of the veins are typically lined with reddish iron cementation.

The veins pass through stratigraphic contacts without offsetting or disturbing them. Figure 2.5-209 panel b shows several veins passing through a gravel lens bounded by mottled silty clay loam. The gravel is not displaced, and gravel clasts occur within the vein where it passes through the lens.

Veins such as these are referred to in the pedology literature as *bleached fractures* (Reference 477). They are thought to form from the cracking of a partially cemented or brittle soil horizon during seasonal drying, followed by infiltration of fresh rainwater along the crack, mobilizing free iron and translocating silt and clay into the crack from the upper soil horizons. Water is drawn into the partially cemented block on the margins of the fracture; iron is then precipitated from the water in the walls of the fractures as the soil dries again, forming the red borders adjacent to the fracture. The fracture becomes a preferred pathway for the infiltration of water and for root penetration, and over time takes on a bleached appearance. In plan view the fractures form a rough polygonal pattern about blocks of more cemented soil (Reference 477). Abbott and others (Reference 227) describe similar features in Tertiary coastal plain sediments in South Carolina, which they also attribute to advanced soil weathering.

These features do not have characteristics diagnostic of seismically induced liquefaction features or tectonic faulting. The veins do not consist of liquefiable silt and sand and do not appear to originate from a layer of liquefiable material at depth. They disappear upward into the argillic horizon instead of widening into a surficial deposit of erupted silt and sand. The preservation of stratigraphic textural features through the vein is inconsistent with rapid movement of liquefied material upward through the vein. The lack of offset of the bedding across the veins, and their random orientation is inconsistent with a faulting origin.

3. COLA Part 2, FSAR. Chapter 2, Subsection 2.5.1.1.3.2, third paragraph from:

In northern Alabama, extensive alluvial terrace deposits are mapped in the Coosa River Valley in the Gadsden to Weiss Reservoir area (Etowah and Cherokee Counties) (Reference 224) (Figure 2.5-208). The alluvial and terrace deposits are preserved within a broad valley underlain by the Cambrian Conasauga Formation. Structural cross-sections and maps indicate that the Cambrian unit beneath the valley is a near horizontal thrust sheet, referred to as the Rome thrust (Reference 225) (see discussion in Subsection 2.5.1.1.4.2). The meandering river morphology is prominent where the widest part of the Rome thrust sheet is preserved. Downstream of the confluence of Big Canoe Creek and the Coosa River (about 10-mi. southwest of Gadsden), the valley narrows and the Coosa River takes a sharp bend to the south and cuts across the regional structural grain. Quaternary deposits are not shown on the State Geologic Map of Alabama (Reference 225) (Figures 2.5-208 and 2.5-209) downstream...

To read:

In northern Alabama, extensive alluvial terrace deposits are mapped in the Coosa River Valley in the Gadsden to Weiss Reservoir area (Etowah and Cherokee Counties) (Reference 224) (Figure 2.5-208a). The alluvial and terrace deposits are preserved within a broad valley underlain by the Cambrian Conasauga Formation. Structural cross-sections and maps indicate that the Cambrian unit beneath the valley is a near horizontal thrust sheet, referred to as the Rome thrust (Reference 225) (see discussion in Subsection 2.5.1.1.4.2). The meandering river morphology is prominent where the widest part of the Rome thrust sheet is preserved. Downstream of the confluence of Big Canoe Creek and the Coosa River (about 10-mi. southwest of Gadsden), the valley narrows and the Coosa River takes a sharp bend to the south and cuts across the regional structural grain. Quaternary deposits are not shown on the State Geologic Map of Alabama (Reference 225) (Figures 2.5-208a and 2.5-208b) downstream...

4. COLA Part 2, FSAR Chapter 2, Subsection 2.5.7 is modified to add a new reference.

477. Soil Survey Staff, 1975, Soil Taxonomy: a basic system of soil classification for making and interpreting soil surveys: U.S Department of Agriculture, Agriculture Handbook No. 436, pp. 42-43.

ASSOCIATED ATTACHMENTS/ENCLOSURES:

Attachment 02.05.01-01A, New FSAR Figure 2.5-209

Attachment 02.05.01-01B, Renumbered FSAR Figure 2.5-208a and 2.5-208b

NRC Letter Dated: September 4, 2008

NRC Review of Final Safety Analysis Report

NRC RAI NUMBER: 02.05.01-02

FSAR 2.5.1.2.5 describes minor displacement (about 3 inches) that was observed along a "joint" located in the northwest corner of the Unit 1 QA Records Storage Vault. The joint was subsequently investigated. What is the age of the displacement?

BLN RAI ID: 1518

BLN RESPONSE:

The relative age of the Unit 1 QA Records Storage Vault joint is Late Paleozoic. The last paragraph of FSAR Subsection 2.5.1.2.5 Site Structural Geology on page 2.5-43 states that "Joints and fractures in the site area likely formed as a result of the thrusting and mountain building forces that created the Sequatchie anticline in late Paleozoic time." This finding is supported by regional evaluations published by Wiltschko (FSAR Reference 215). It was also a conclusion developed in FSAR Reference 400, page 2 where "...the feature is not a significant fault, but is a joint that received minor shear displacement during the process that developed the entire joint set..." This conclusion was corroborated by an NRC geologist in a site meeting on September 22, 1976. TVA therefore concludes that the age of minor shearing along this joint is contemporaneous with the tectonic forces associated with regional tectonic development that created the joints found throughout the site area during the Late Paleozoic Era.

During the review to respond to this request, an incorrect text reference was identified. This reference is corrected as shown in the Application Revisions section below.

This response is PLANT-SPECIFIC.

ASSOCIATED BLN COL APPLICATION REVISIONS:

COLA Part 2, FSAR. Chapter 2, Subsection 2.5.1.2.5, second paragraph, second sentence will be revised from:

Minor displacement that was observed in the northwest corner of Unit 1 QA Records Storage Vault was investigated by core drilling and recorded by surface mapping (Reference 201).

To read

Minor displacement that was observed in the northwest corner of Unit 1 QA Records Storage Vault was investigated by core drilling and recorded by surface mapping (Reference 400).

ASSOCIATED ATTACHMENTS/ENCLOSURES:

None

NRC Letter Dated: September 4, 2008

NRC Review of Final Safety Analysis Report

NRC RAI NUMBER: 02.05.01-03

Given the uncertainty in locating earthquakes in most network data, especially at distances corresponding to the Eastern Tennessee Seismic Network stations, distance to the nearest station, station density, crustal velocity structure and etc., please discuss the likelihood that some of the earthquakes are located on one or more of the mapped faults shown in FSAR Figures 2.5-294 and 2.5-220.

BLN RAI ID: 1519

BLN RESPONSE:

The locations of earthquakes shown in FSAR Figure 2.5-294 are uncertain in part because the seismograph network within Alabama, Georgia and surrounding states has been sparse since the inception of most networks used to locate the earthquakes. However, as discussed below, location uncertainties for well-constrained earthquakes generated from standard-of-practice hypocentral location techniques provide reasonable estimates of the uncertainty in location and allow the conclusion that it is unlikely the earthquakes shown in Figure 2.5-294 are related to any of the faults shown in FSAR Figure 2.5-220 or Figure 2.5-294.

The standard error estimates for most of the events within the Virginia Tech Seismological Observatory Full Instrumental Catalog (FSAR Reference 407) that are shown in FSAR Figure 2.5-294 are in the form of 68% confidence error ellipsoids derived by the location program Hypoellipse (Reference 1), a widely used hypocentral location program. These ellipsoids show the horizontal and vertical projections of a joint spatial confidence region for the hypocenter under the assumption of normally distributed phase arrival-time reading errors. The reported uncertainties do not take into account bias due to error in the velocity model used to locate the events. Such bias can be significant for focal depth estimates in cases where there are no recording stations within a focal-depth distance of the epicenter. The bias is less significant in the horizontal plane, provided that the event is recorded by at least one station in each azimuthal quadrant surrounding the epicenter. However, the velocity models used for the various hypocenters have generally been developed specifically for the region of the southeastern U.S. including the Bellefonte site (e.g., FSAR Reference 292; Reference 2) and are used by most seismograph network operators within the region.

Figure 1 (Attachment 02.05.01-03A) shows the projections of the 68% hypocenter error ellipsoids in the horizontal plane for instrumentally located earthquakes in the site vicinity. The data are taken from the Southeastern United States Seismic Network Bulletins, 1973-2006 (Reference 3). Most earthquakes within 25 km of the site are located to the northwest of the surface trace of the Sequatchie Valley thrust, of Late Paleozoic age, which dips to the southeast. Figure 1 shows that the epicenter semi-major error ellipse axes (68% confidence) are on the order of 2 km or less for most of these events, suggesting that they are determined with sufficient accuracy to support the interpretation that the majority occurred to the northwest of the Sequatchie Valley fault and therefore, have no relation to that feature.

Earthquakes with computed epicenters to the southeast of the Sequatchie Valley fault trace could be, in principle, associated with that southeast-dipping Paleozoic fault, or other faults to the southeast shown in FSAR Figure 2.5-294. The critical issue in evaluating any potential association between these earthquakes and faults is the focal depth of the earthquakes. Figure 2 (Attachment 02.05.01-03A) shows a histogram of a focal depths for the 19 events shown in Figure 1 that have a 68% confidence vertical error ellipsoid projection of 5 km or less, and were recorded by at least one station within 20 km of the epicenter. These events represent the best-constrained hypocenter locations, and should have minimum bias in the focal depth estimates due to uncertainty in assumed velocity model. Therefore these events are the most appropriate subset to use in judging the depth distribution of earthquakes.

Figure 2 shows that only one of the 19 well-constrained events has an estimated focal depth less than 4 km and that the remainder of the focal depth estimates are between 5 and 22 km. This distribution derived for events in the vicinity of the Bellefonte site is consistent with results for the eastern Tennessee seismic zone as a whole (FSAR Reference 292), showing 90% of the focal depth estimates below 5 km, with a median depth of 16.8 km, in the mid-crust. The crystalline basement with 25 miles of the site is at a depth of approximately 2 to 2.5 km (see FSAR Figure 2.5-220), so the earthquake hypocenters demonstrate that the seismicity shown in FSAR Figure 2.5-294 is almost exclusively within the crystalline basement, thus supporting the conclusion that faults shown in FSAR Figure 2.5-294 are not capable faults.

Of the basement faults shown in FSAR Figure 2.5-220, only one is mapped as within 25 miles of the site. It is not possible to correlate any of the seismicity shown in Figure 2.5-294 to this fault because there are no data constraints on the location of the fault within approximately 30 miles of the site (note the considerable distance between the seismic control points shown on the fault and the site in FSAR Figure 2.5-220). However, as stated in FSAR Subsection 2.5.2.3, a review of the seismicity conducted for the Bellefonte COLA demonstrated that none of the seismicity within the site region can be correlated with a known geologic structure.

References

1. Lahr, J. C., 1989, HYPOELLIPSE/Version 2.0: A computer program for determining local earthquakes hypocentral parameters, magnitude, and first-motion pattern, U.S. Geological Survey Open-File Report 89-116, 92 p.
2. Bollinger, G.A., M.C. Chapman and T.P. Moore, 1979.. Central Virginia Regional Seismic network: Crustal Velocity Structure in Central and Southwestern Virginia, NUREG/CR-1217, Division of Reactor Safety Research, U.S. Nuclear Regulatory Commission, Washington, D.C., 187 p.
3. Online source: http://www.geol.vt.edu/outreach/vtso

This response is PLANT-SPECIFIC.

ASSOCIATED BLN COL APPLICATION REVISIONS:

No COLA revisions have been identified associated with this response.

ATTACHMENTS/ENCLOSURES:

Attachment 02.05.01-03A, Figures 1 and 2

NRC Letter Dated: September 4 2008

NRC Review of Final Safety Analysis Report

NRC RAI NUMBER: 02.05.01-04

Please provide evidence that all of the thrust faults shown in FSAR Figure 2.5-294 near the Bellefonte COL site sole out into the Appalachian detachment. Figure 2.5-220 shows subbasement faults with the same general northeast-strike and similar locations as those of Fig. 2.5-294. Given fault location uncertainty, explain whether or not some of the faults shown on these two figures could be the same fault penetrating through the detachment.

BLN RAI ID: 1520

BLN RESPONSE:

The structural model and geologic history are presented in FSAR Subsections 2.5.1.1.4.2.1 and 2.5.1.1.4.2.2. This RAI response provides specific discussion of the relationship between the two types of faults and summarizes much of the current FSAR text. Figures from Thomas and Bayona's more recent paper (FSAR Reference 256) are presented. The new figures and amplified discussion add background and detail to the data presented, but do not change the geologic interpretation

The thrust faults shown on FSAR Figure 2.5-294, along with other thrust faults within the Appalachian thrust belt, are thought to sole into a regional detachment based on interpretation of seismic reflection profiles, deep well data, geologic mapping, and paleomagnetic data. Publications that describe the data and interpret the geometry of the faults in Alabama and Georgia include Thomas (FSAR Reference 245), Thomas and Bayona (FSAR Reference 225), Bayona and others (FSAR Reference 246), and Thomas and Bayona (FSAR Reference 256). The structural model developed in these publications is supported by studies in other parts of the Appalachian Thrust belt, for example Wiltschko (FSAR Reference 215) and Hatcher (FSAR Reference 213).

The seismic reflection and well data used in these studies were generally collected by the petroleum industry. Eighteen parallel seismic reflection profiles, each approximately 50 miles long, cross the thrust belt and four deep wells penetrate the basement (Figure 1 of Attachment 02.05.01-04A). Geologic mapping of the Paleozoic rocks was conducted by a variety of researchers including the authors.

In the Thomas and Bayona model (FSAR References 225, 246, and 256), the basement faults are high-angle normal faults associated with Iapetan rifting that took place in the late Precambrian to early Paleozoic. Mapping of these faults relies on the calculation of the depth to the top of basement along the seismic reflection profiles, supported by basement penetration by the four wells. The top of the Precambrian crystalline basement is nearly horizontal and relatively shallow, estimated to be about 2 km (1.2 miles) below sea level in the vicinity of the BLN site. The planar surface of the basement is broken into blocks by the basement faults, creating a paleotopography on the top of basement (Figure 2 of Attachment 2.5.1-04A). The dominantly NE-SW oriented normal faults are offset by perpendicular transverse faults, breaking the basement into rectangular blocks. The basement faults are the result of extension of the crust during rifting of the Iapetan Ocean in the early Paleozoic.

For most of the Paleozoic era, thick sequences of sedimentary rocks were laid down over this basement surface. These carbonates, sandstones, and shales represent hundreds of millions of years of deposition from the late Cambrian to early Permian time. As a result of compression during the late Paleozoic Alleghanian orogeny, the Paleozoic strata now form a thrust belt of northeast striking, northwest translated thrust sheets (Figure 3 of Attachment 02.05.01-04A). The thrust sheets are detached at a regional décollement near the base of the Paleozoic strata above Precambrian basement rocks. Cambrian shale is thought to be the structurally weak layer that hosts the regional décollement. The geometry of the basement faults is seen to have influenced the geometry and location of ramps in the overlying thrust belt.

Cross sections drawn by Thomas and Bayona (FSAR References 246 and 256) show the interpreted relationship between the thrust faults and the basement faults (Figure 3 of Attachment 02.05.01-04A). The BLN site lies relatively close to cross section line 4 (Figure 1 of Attachment 02.05.01-04A). These two types of faults – the Precambrian basement normal faults and the Paleozoic thrust faults – are different in age, in sense of motion, and in the rocks they displace. Their apparent spatial coincidence is a reflection of the influence that fault-related topography on the basement surface has had on the initiation of the thrust ramps.

The presence, and exact location, of the basement fault shown beneath the Sequatchie Valley thrust ramp near the BLN site (Figure 3 of Attachment 02.05.01-04A) is not well constrained by direct data. The two seismic reflection profiles that image this fault nearest the BLN site are located 33 mi. southwest and 23 mi. northeast of the site (Figure 1 of Attachment 02.05.01-04A). However, the occurrence of a basement fault associated with the Sequatchie Valley fault is inferred by the association of vertical basement faults with thrust faults in areas where direct data do exist, such as along the Wills Valley fault. Geologic reasoning leads to the conclusion that a vertical basement fault is likely to be present near the BLN site, its location bounded by the surface trace of the Sequatchie Valley fault on the northwest, and the eastern edge of the Sequatchie anticline (approximately the western edge of Sand Mountain) on the southeast. Neither the Sequatchie Valley fault nor the underlying basement fault are active, and no seismicity has been directly associated with these structures.

This response is PLANT-SPECIFIC.

ASSOCIATED BLN COL APPLICATION REVISIONS:

No COLA revisions have been identified associated with this response

ASSOCIATED ATTACHMENTS/ENCLOSURES:

Attachment 02.05.01-04A, Figures 1, 2, and 3

Attachment 02.05.01-01A

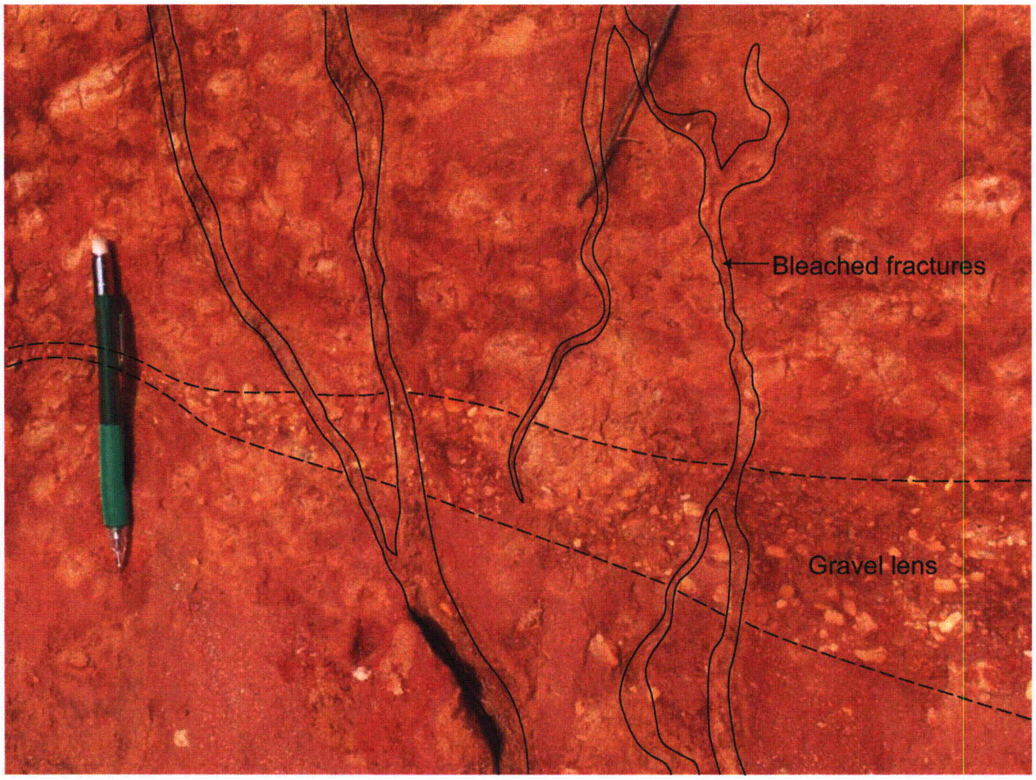
(2 pages including cover)

New Figure 2.5-209

Soil Weathering Features in Pleistocene Terrace Deposits, Gadsden, Alabama

A)

B)



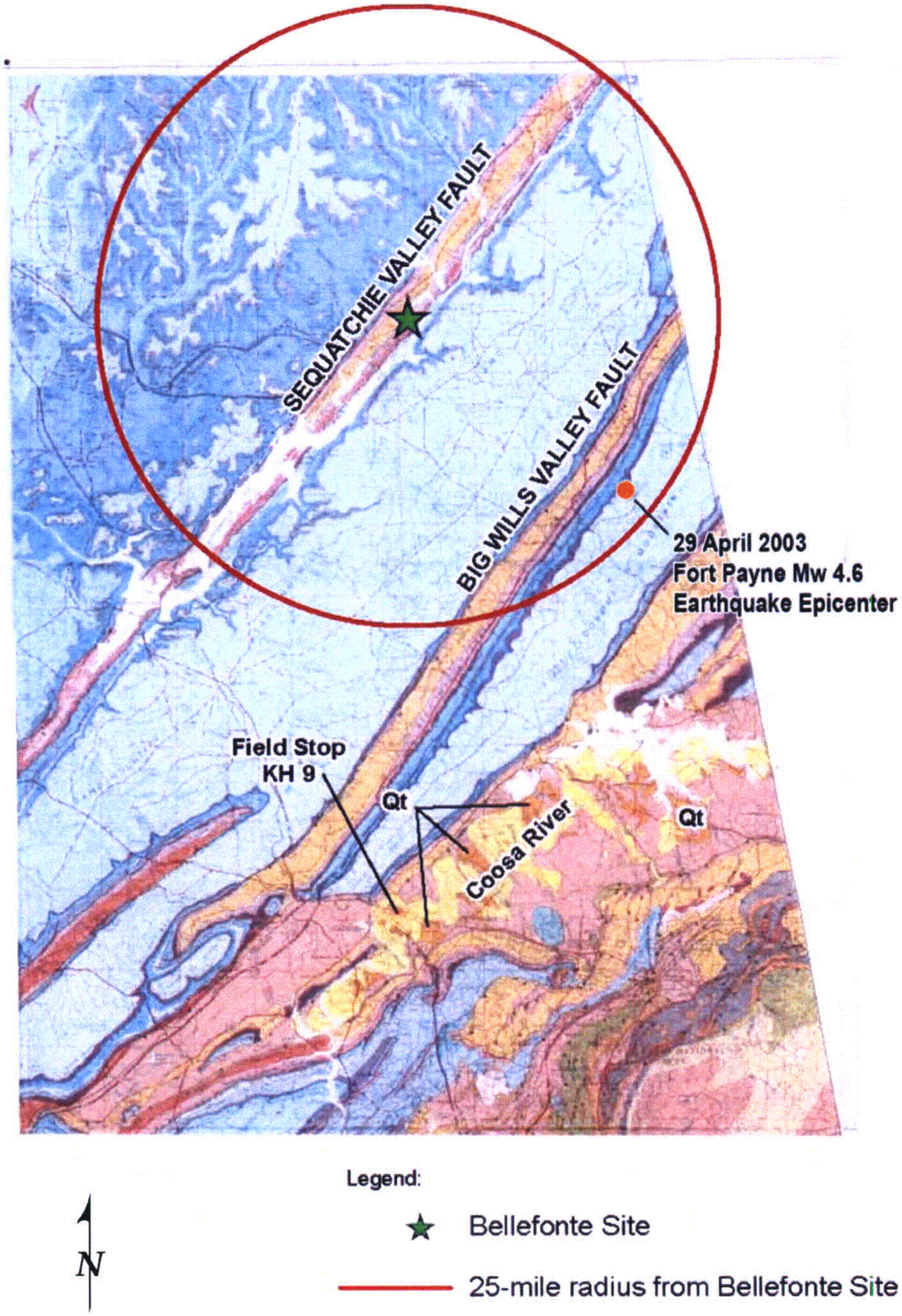
BLN COL 2.5-1

FIGURE 2.5-209
Soil Weathering Features in Pleistocene Terrace Deposits near Gadsden, Alabama

Attachment 02.05.01-01B

(3 pages including cover)

Renumbered FSAR Figure 2.5-208a and 2.5-208b

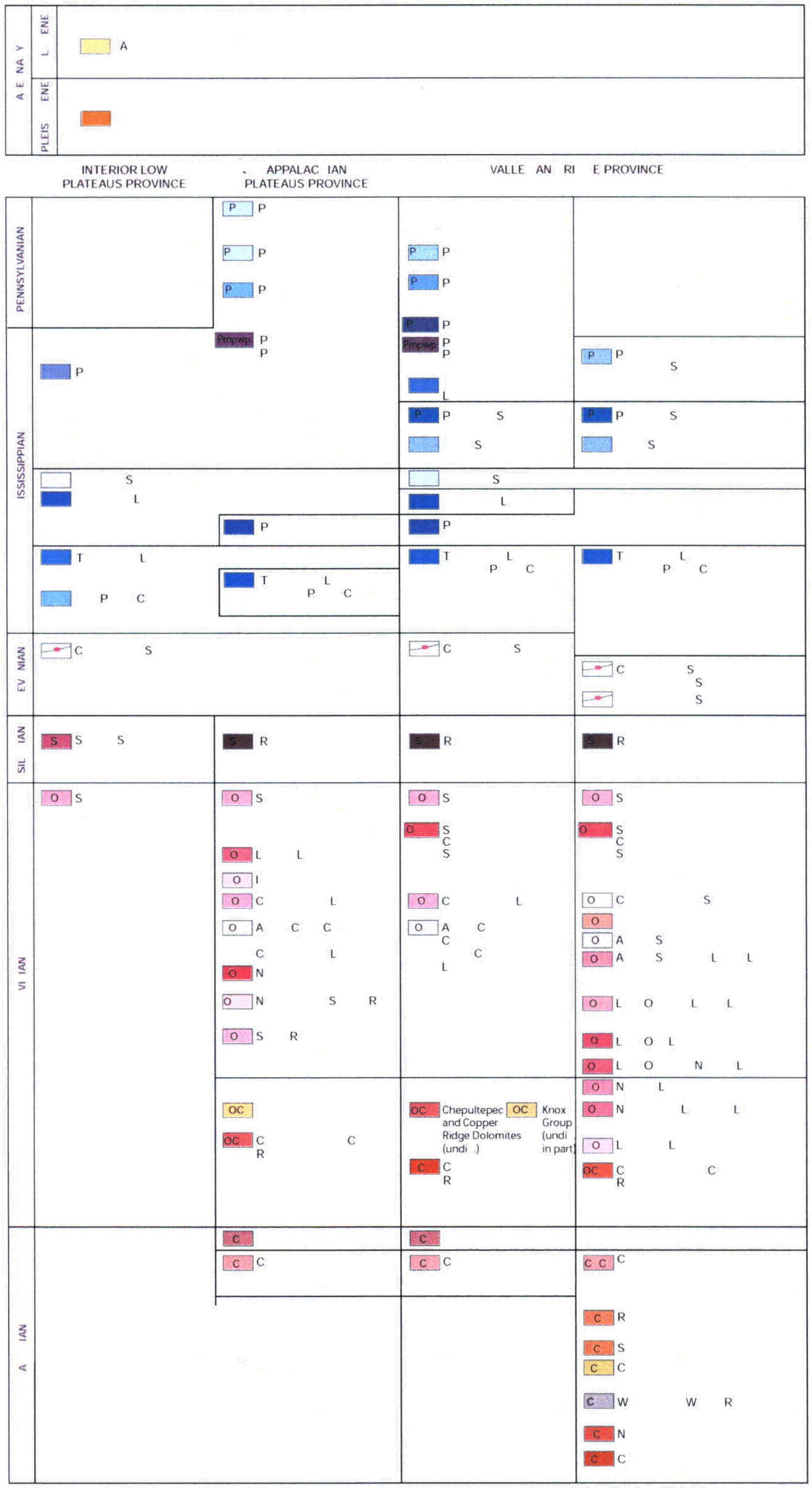


(Reference 224)

FIGURE 2.5-208a
25-Mile Radius Geologic Map

N P U
COL A
P SAR

E



LN COL

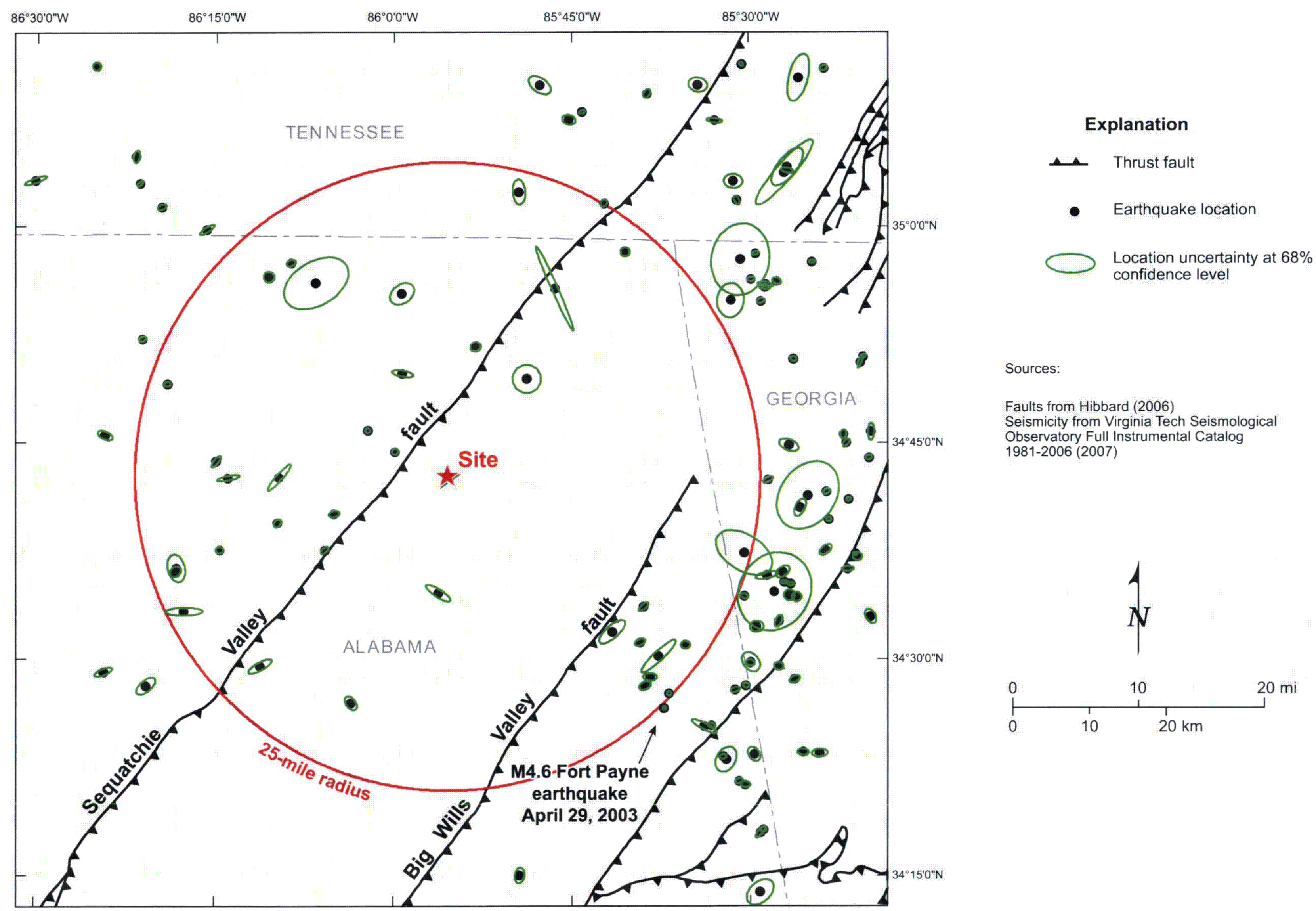
I E

E S

Attachment 02.05.01-03A

(3 pages including cover sheet)

Figures 1 and 2



(Reference 408 and 407)

FIGURE 1
Location Uncertainty of Seismicity

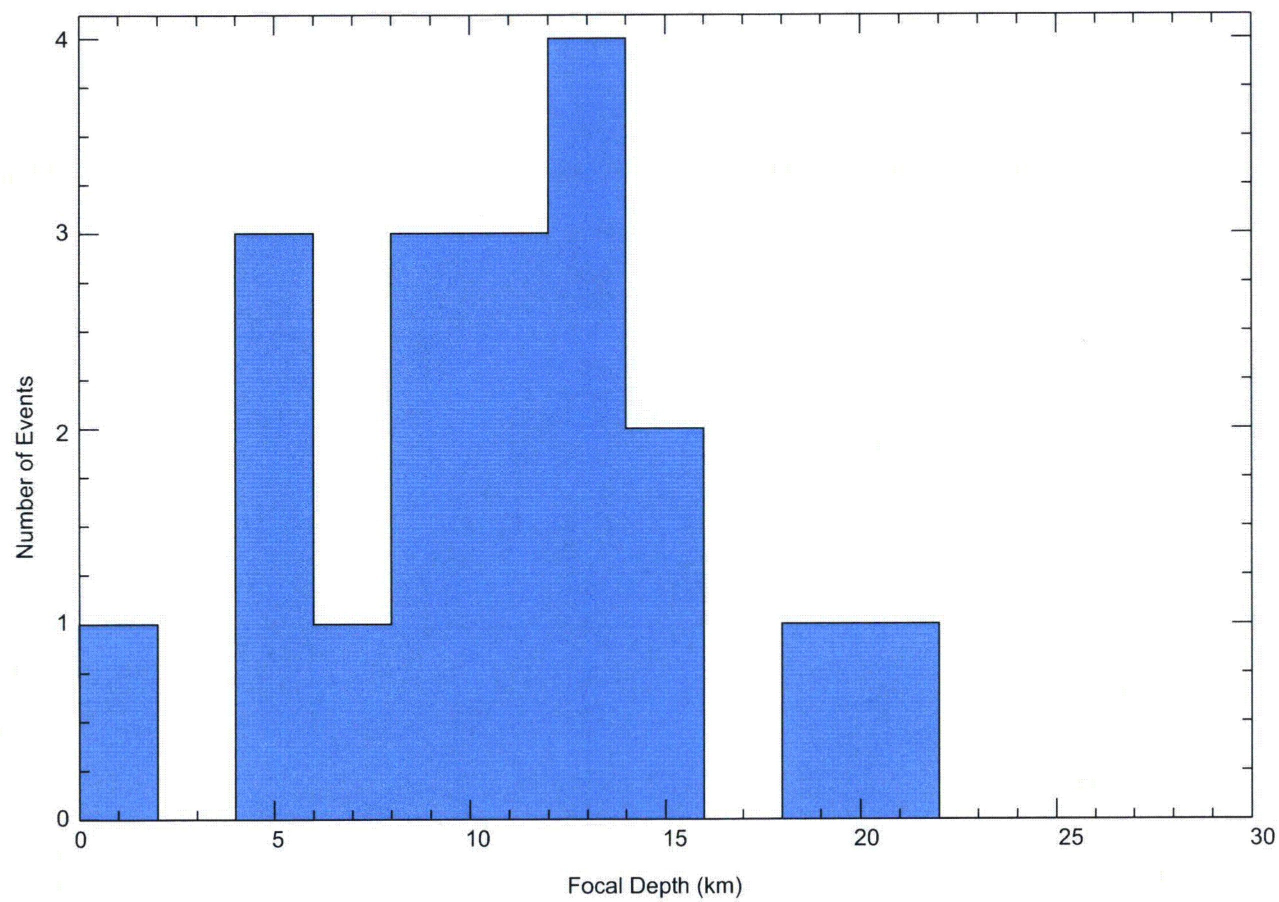


FIGURE 2

Histogram of Focal Depths for Hypocenter Locations with ERZ Less than 5km and with Minimum Station Distance Less Than 20 km

Attachment 02.05.01-04A
TVA letter dated Date 3, 2008
RAI responses

Attachment 02.05.04-04A

(4 pages including cover sheet)

Figures 1, 2, and 3

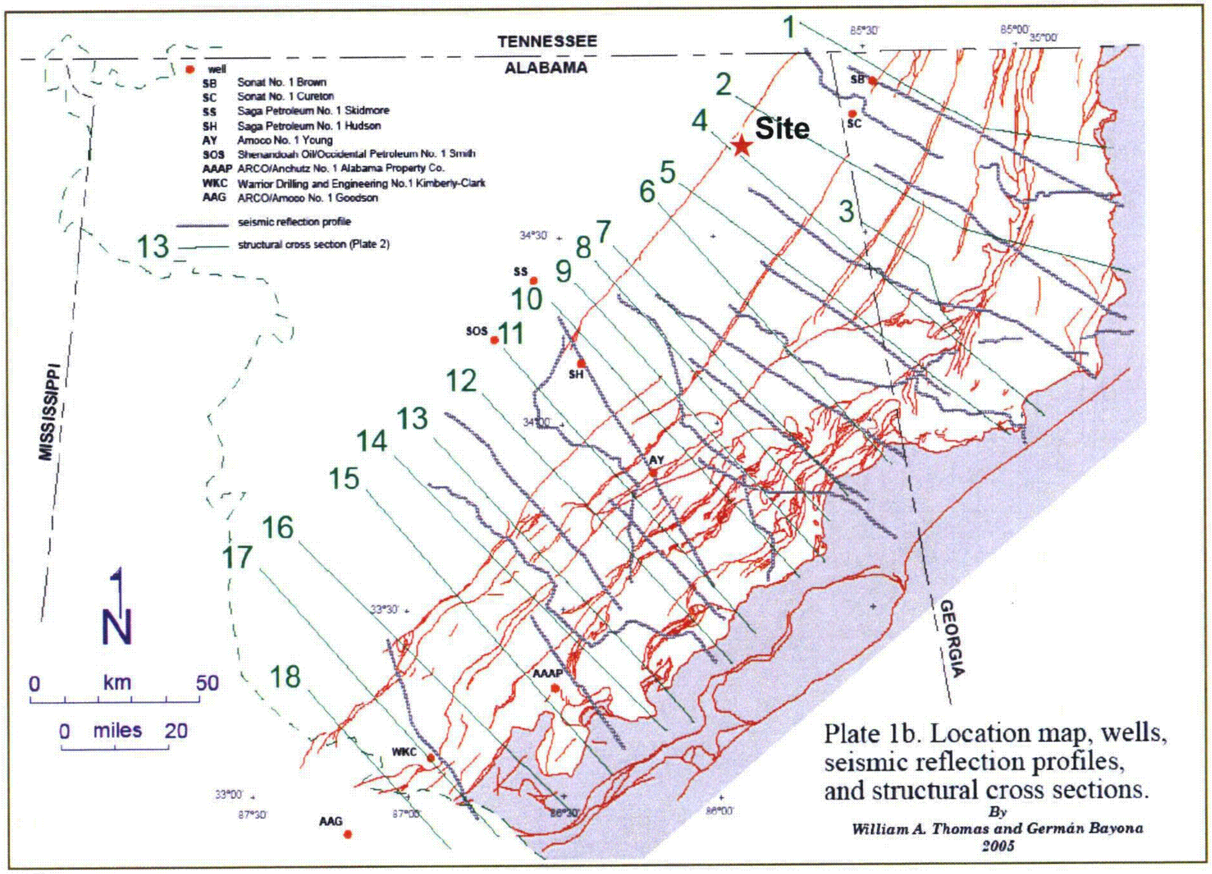


FIGURE 1

Location of Wells (red dots) and Seismic Reflection Profiles (wide gray lines), Used to Constrain the Structure of the Appalachian Thrust Belt. Thomas and Bayona (2005) Combine These Data with Geologic Mapping to Create 18 Structural Cross Sections (Numbered Green Lines)

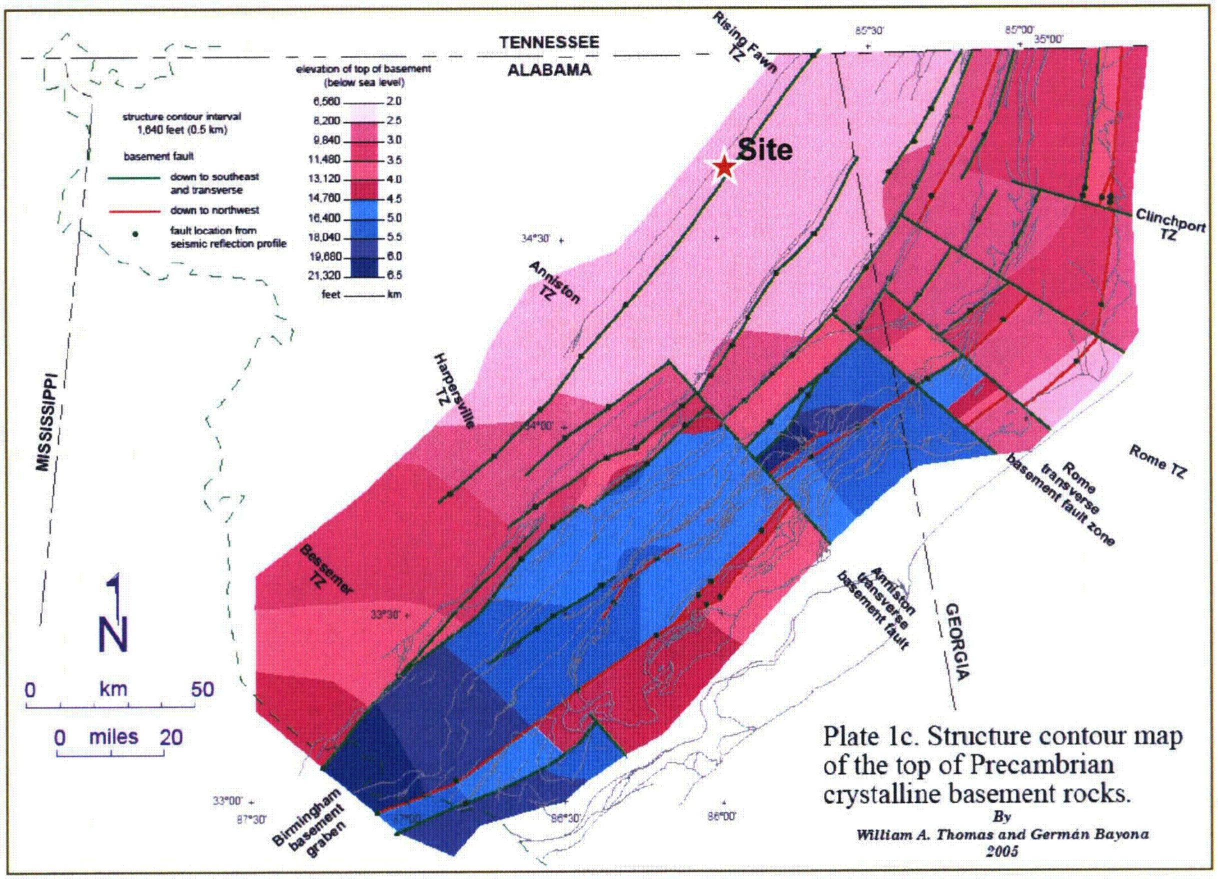


FIGURE 2

Structure Contour Map of the Top of Precambrian Crystalline Basement Rocks, from Seismic Reflection Profiles and Well Data, Interpreted by Thomas and Bayona (2005)

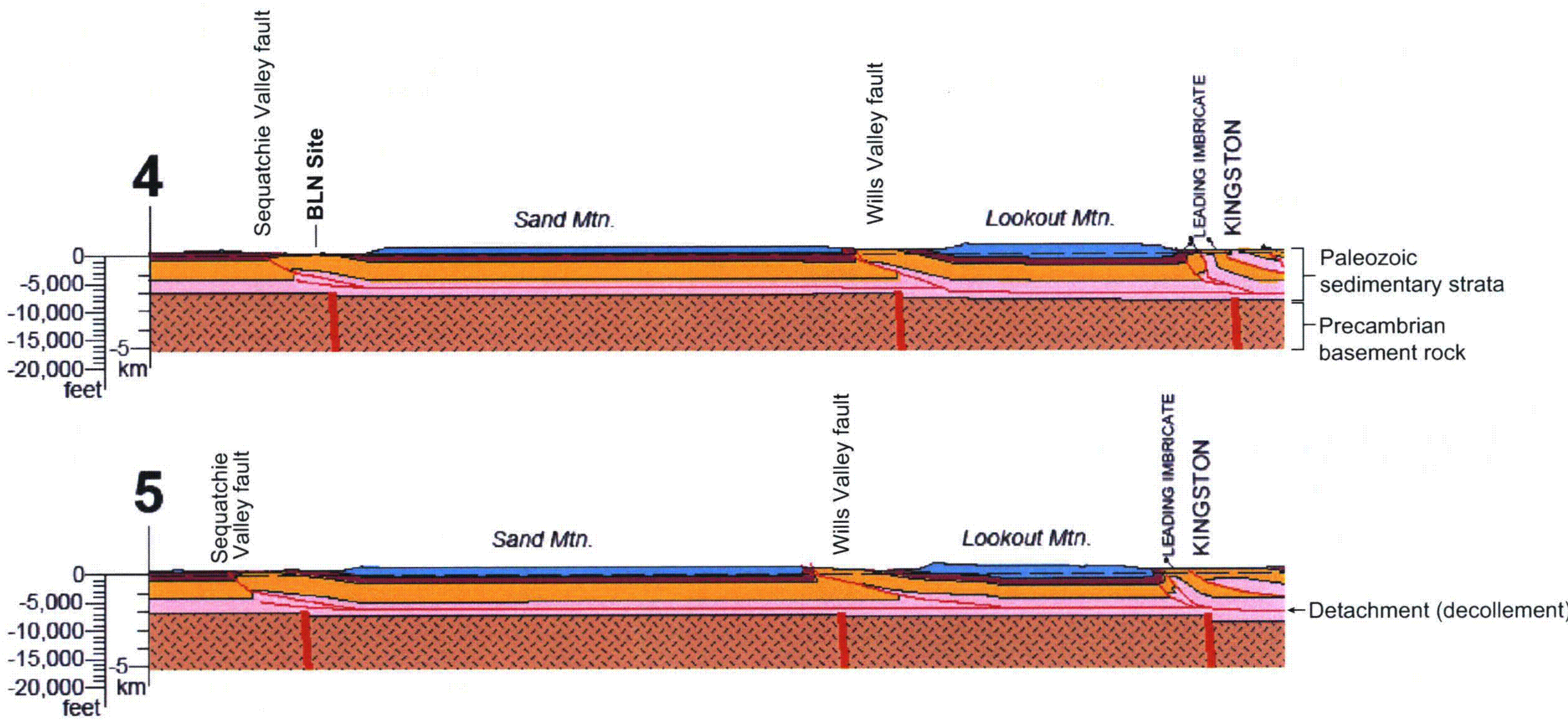


FIGURE 3

Enlarged Portions of Structural Cross Sections from Thomas and Bayona, 2005 (Reference 256), Showing the Relationship Between Vertical Faults of the Precambrian Basement, and Thrust Faults of the Paleozoic Sedimentary Strata. Thrust Faults Sole into a Horizontal Detachment Localized along Weak Beds in the Cambrian Strata (Pink Unit). Similar Cross Sections from Thomas and Bayona 2002 (Reference 225) are Presented in Figure 2.5-217 in the FSAR. The BLN Site is Located on Profile Line 4 (Figure 3) on the East Limb of the Sequatchie Anticline.