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Biofacies and Lithofacies of the Upper Pottsville Formation, Black Warrior Basin

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The Mississippi Mineral Resources Institute
University, Mississippi 38677

BIOFACIES AND LITHOFACIES OF THE UPPER POTTSVILLE FORMATION, BLACK WARRIOR BASIN.

FINAL REPORT

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Institution: Mississippi State University

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ABSTRACT

The third phase of research involving the Carboniferous palaeontology of the Black Warrior Basin focused on a lateral study of the depositional couplet model in the upper Pottsville Formation.

Outcrop sections in Walker County, Alabama were investigated from the interval in the upper Pottsville between the Black Creek and the Cobb Coal Groups. The intention was to examine biofacies and lithofacies distributions in laterally correlable outcrops in order to further understand the nature of depositional cycles in the Pottsville. Due to outcrop distributions, the study focused on outcrops that straddled the Mary Lee and Pratt Depostional Couplets, but also extended up to the Cobb and down to the Black Creek Coal Groups.

The study confirmed that biofacies in the upper Pottsville occur in recognisable assemblages, and also revealed that these assemblages appear to show distinct zones of occurrence within the upper Pottsville. The changes in biofacies composition and distribution through the upper Pottsville may reflect subtle changes in the overall depositional environments in the Black Warrior Basin during Morrowan time.

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INTRODUCTION

I. General Remarks

This study focuses on the biofacies of the upper Pottsville in northern Alabama. As such it forms a part of the Black Warrior Research Program currently being conducted at Mississippi State University.

The Black Warrior Research Program is concerned with the application of palaeontological, sedimentological and stratigraphic data to an understanding of hydrocarbon distribution within the basin.

The program has been divided into two main themes: Firstly the program is concerned with ostracode palaeoecology and biostratigraphy of Mississippian strata within the basin. This aspect of the research has been addressed in grants 86-2F (Dewey, 1986), 87-5F (Dewey, 1987) and has been the subject of two master's level theses (Devery, 1987; Puckett, 1987). The results of this part of the program are aimed toward the search for oil and gas reserves. Secondly, the program is concerned with the biofacies and lithofacies distributions in the Pennsylvanian strata within the basin. This aspect of the research has been addressed in grants 86-2F (Dewey, 1986), 88-4F (herein) and has also been the subject of two master's level theses (Pody, 1987, Garbisch, in prepn.) This theme of research is applied toward a better understanding of coal forming environments and their distribution within the basin.

The study profile for the Black Warrior Research Program (fig.l), provides an outline of the component projects for each of the main themes of the program. This report therefore forms part of the second stage in the development of the Pottsville biofacies and lithofacies study. A continuation of this work, which is xamining core materials from Mississippi is currently underway (grant 89-4F).

II. Location of Study Area

The study area was located within the outcrop belt of upper Pottsville strata in Alabama. Outcrop locations were studied in Walker County, Alabama (fig.2). The study area is traversed by a number of Alabama State Highways as well a network of lesser county roads. The main towns in Walker County are Carbon Hill and Jasper.

III. Physiography

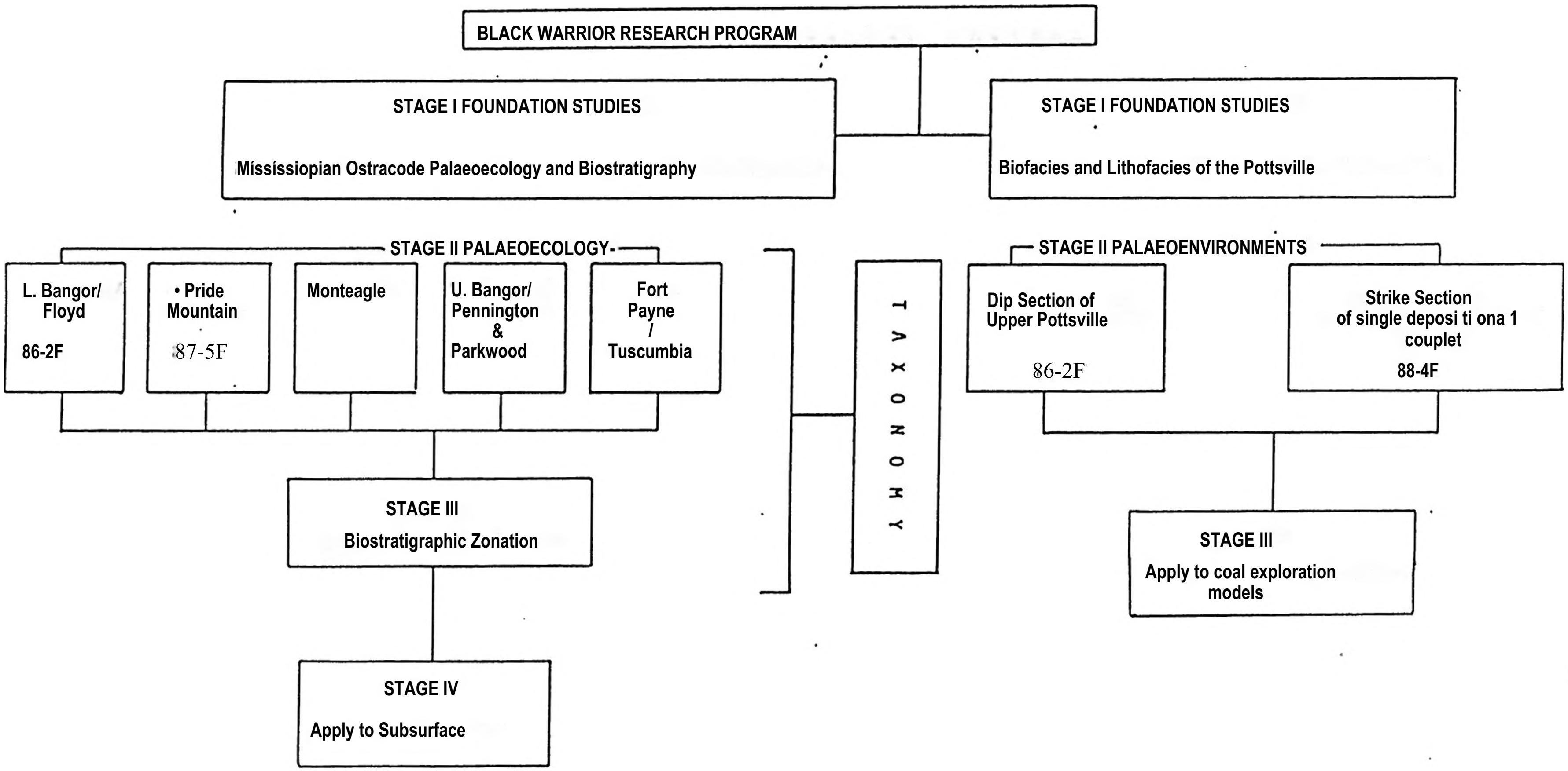


Figure 1: Components of the Black Warrior Research Program

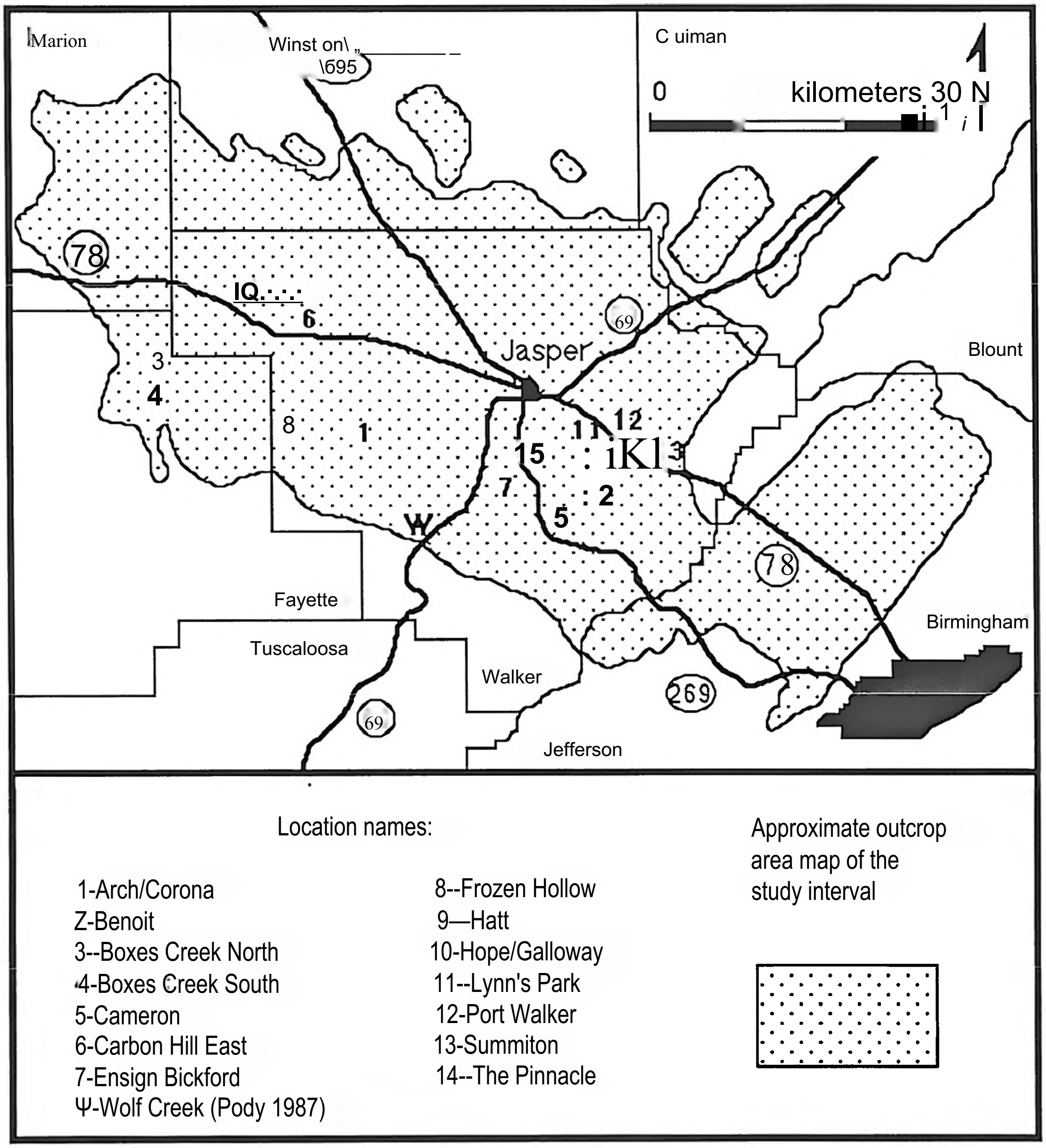


Figure 2: Location of study area

Outcrops of the upper Pottsville in Walker County, Alabama occur within the Warrior Basin District, which forms the southernmost part of the Cumberland Plateau Section (Sapp and Emplaincourt, 1975). The Warrior Basin is bounded to the southeast by the Alabama Valley and Ridge Section and to the southwest by the Fall Line Hills District of the East Gulf Coastal Plain Section.

The Warrior Basin includes exposed Carboniferous strata which dip gently to the southwest by about 0.5 degrees. In the field area, the Pottsville strata young to the south and form a series of generally east-west trending ridges which are capped by resistant sandstones. Relief in the area does not exceed about 100 metres. The study area is drained by the Mulberry Fork of the Black Warrior River.

For a detailed discussion of the physiography of this region refer to Fenneman (1938) and Sapp and Emplaincourt (1975).

PREVIOUS INVESTIGATIONS

The Black Warrior Basin (fig.3) is a triangular region of about 89,600 sq. kms. (Mellen, 1947). The northern border is defined by the Ozark and Nashville Domes. The southeastern and southwestern boundaries are defined by the Appalachian and Ouachita structural fronts respectively.

The Carboniferous stratigraphy of the basin can be subdivided into three main intervals:

i) early Mississippian cherts and carbonates
ii) late Mississippian platformai carbonates and progradational clastic wedges
iii) Pennsylvanian progradational clastic wedges.

The late Mississippian through Pennsylvanian strata were deposited in a foreland basin which received sediment from both Ouachita and Appalachian sources (Thomas, 1974; Horsey, 1981). This report is concerned solely with the deposition and distribution of the upper Pottsville sediments of lower Pennsylvanian (Morrowan) age.

Pottsville sediments in Alabama attain a total thickness of about 3000 metres, and consist primarily of shales, sandstones and coals. McCalley (1900) was the first to recognise that these strata could be subdivided into the lower “barren" and upper "productive coal measures" portions.

The lower Pottsville is a massive, conglomeratic orthoquartzite with thin grey shale interbeds and minor discontinuous coals (Horsey, 1981).

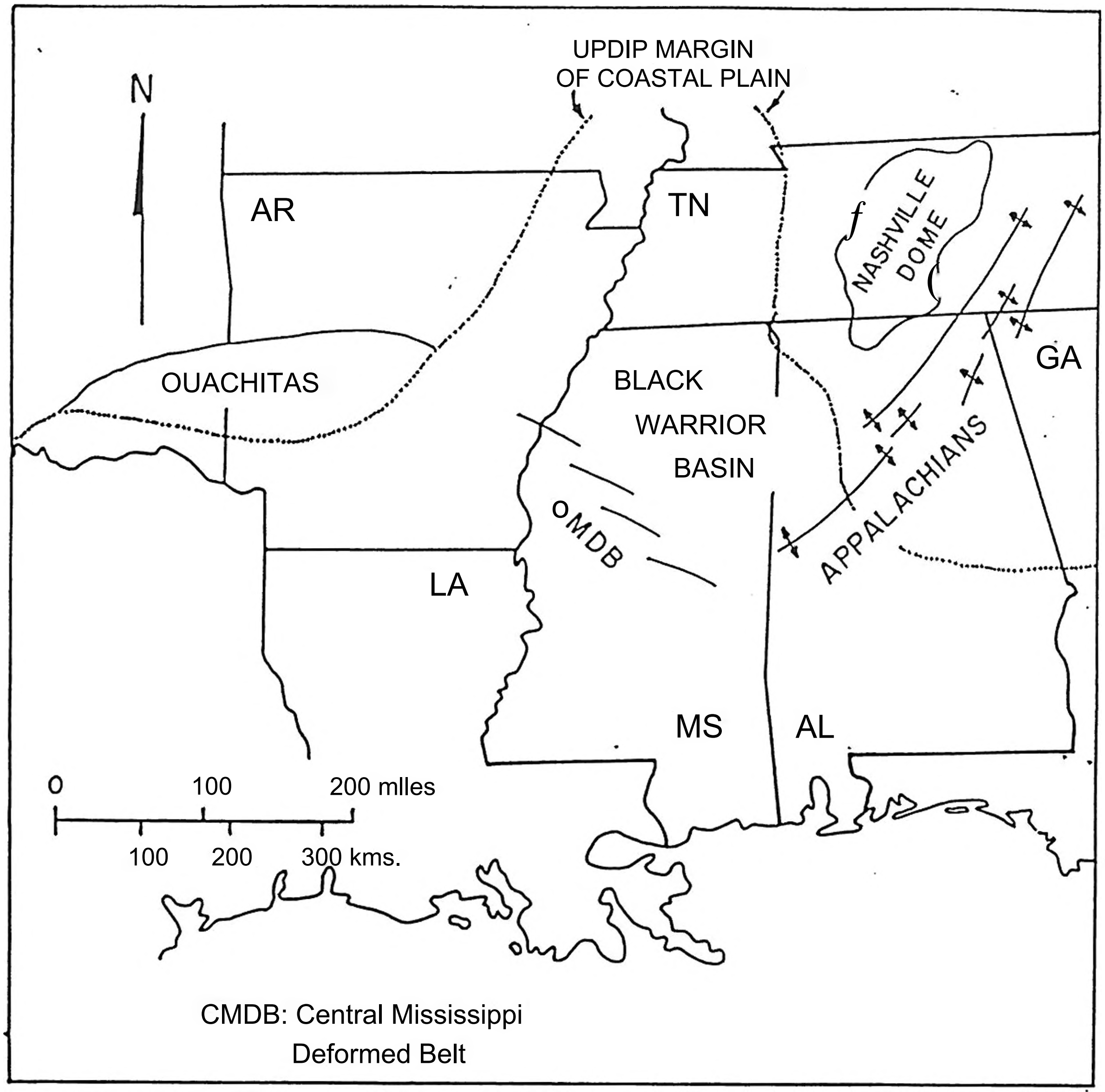


Figure 3: Black Warrior Basin

The upper Pottsville (fig.4) by contrast, consists of seven coal groups (McCalley, 1900; Culbertson, 1964) with associated sandstones and shales, separated by thick intervals of shale and siltstone. Metzger (1965) provided an informal scheme of subdivisons for the entire Pottsville by using the most laterally persistent coal in each coal group to define interval boundaries. The subdivisions erected by Metzger (1965) were the first to include both coal group and inter-coal group lithologies. Pody (1987) developed a subdivision of the upper Pottsville based upon internally complete depositional couplets (fig.5). According to the depositional couplet model, each couplet consists of a lower fine clastic portion and an upper coarse clastic unit which contains coal group lithologies. Each couplet was named from the coal group that it contained in the upper portion. In this model each couplet can be envisaged as a single prograding depositional cycle.

Depositional environments of the upper Pottsville have been the subject of intense study by a number of authors. Butts (1926) suggested that the coal deposits within the Pottsville had been produced by the lithification of marsh peats, and that the Pottsville was deposited under paralic conditions associated with a few brief marine transgressions.

Metzger (1965) suggested that sandstones within the Pottsville were of fluvial or deltaic origin and that the presence of marine faunas in some intervals suggested the occurrence of short-lived transgressive events. Shaley intervals within the Pottsville were considered to be of both marine and non-marine origin.

Ferm and Ehrlich (1967) applied Walther's Law to the upper Mississippian-lower Pennsylvanian section in Alabama. They suggested that the Bangor-Pennington-Pottsville sequence represented a transition from open bay through barrier island to lagoonal and deltaic environments (fig.6). Whilst there is some support that these environments were characteristic of the units discussed, there is little direct evidence to suggest that time lines within the sequence were steep enough to allow lateral correlation of the Bangor with the upper Pottsville.

McKee (1975) was one of the first authors to consider the relationships between sediments and fossils of the Pottsville. This work focussed upon the sediment associations, grain size and inferred hydrodynamics of the depositional systems, but did not evaluate the ecological significance of the fossil elements within the framework of Pottsville depositional environments.

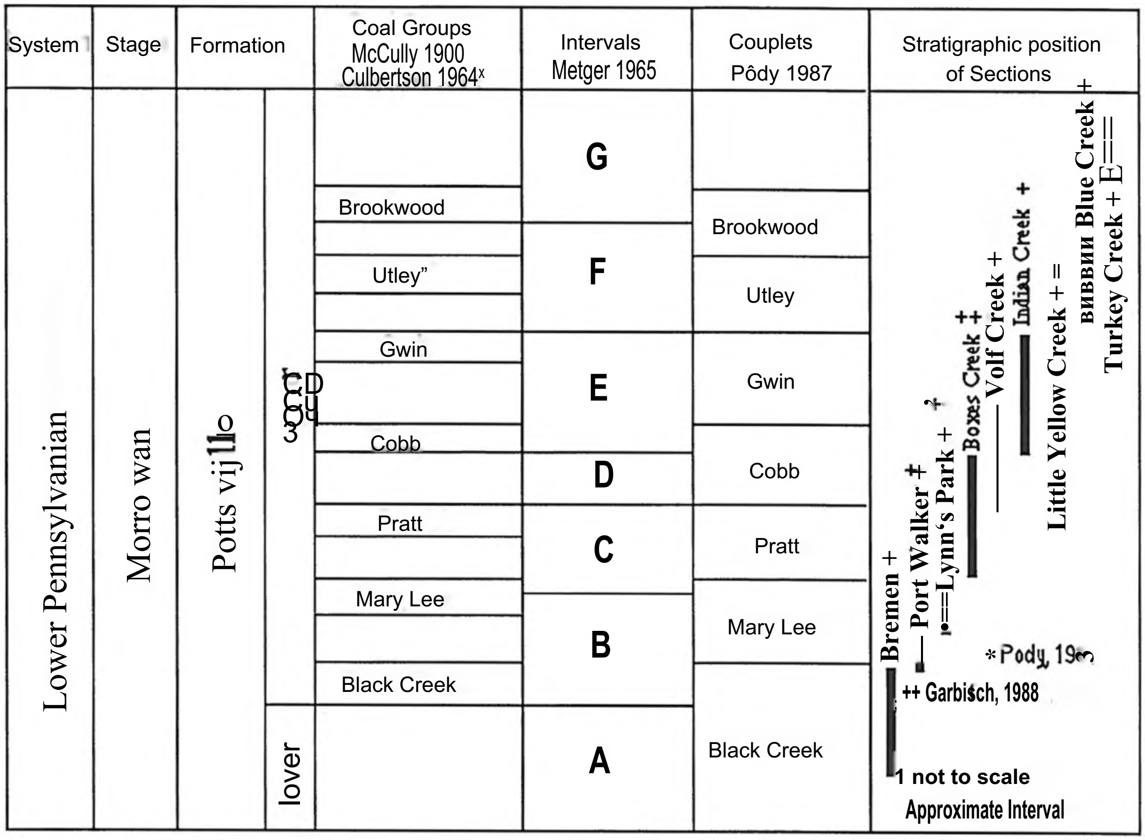
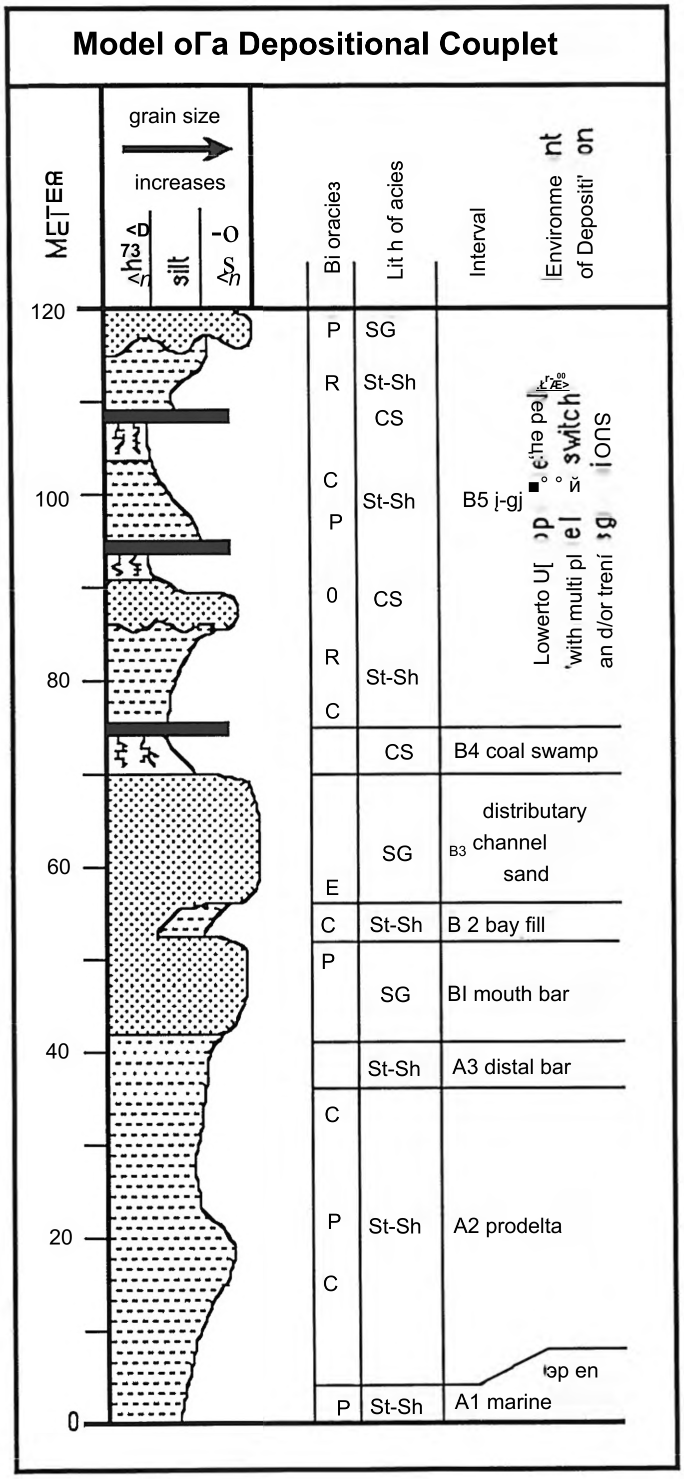


Figure 4: Stratigraphy of the Pottsville Formation



Key to Symbols

Symbols Lithofacies

St-Sh	Siltstone-Shale
BSh	Black Shale
SG	Subgreywacke Sand Stone
QS	Quartzitic Sandstone
CS	Coal-Seatearth
R	Rooted Shale and Siltstone

Symbol Biofacies

P	Productid Assemblage
C	Chonetid Assemblage
0	Orbiculoid Assemblage
E	Exogenous Assemblage

Figure 5: Generalised model of a depositional couplet

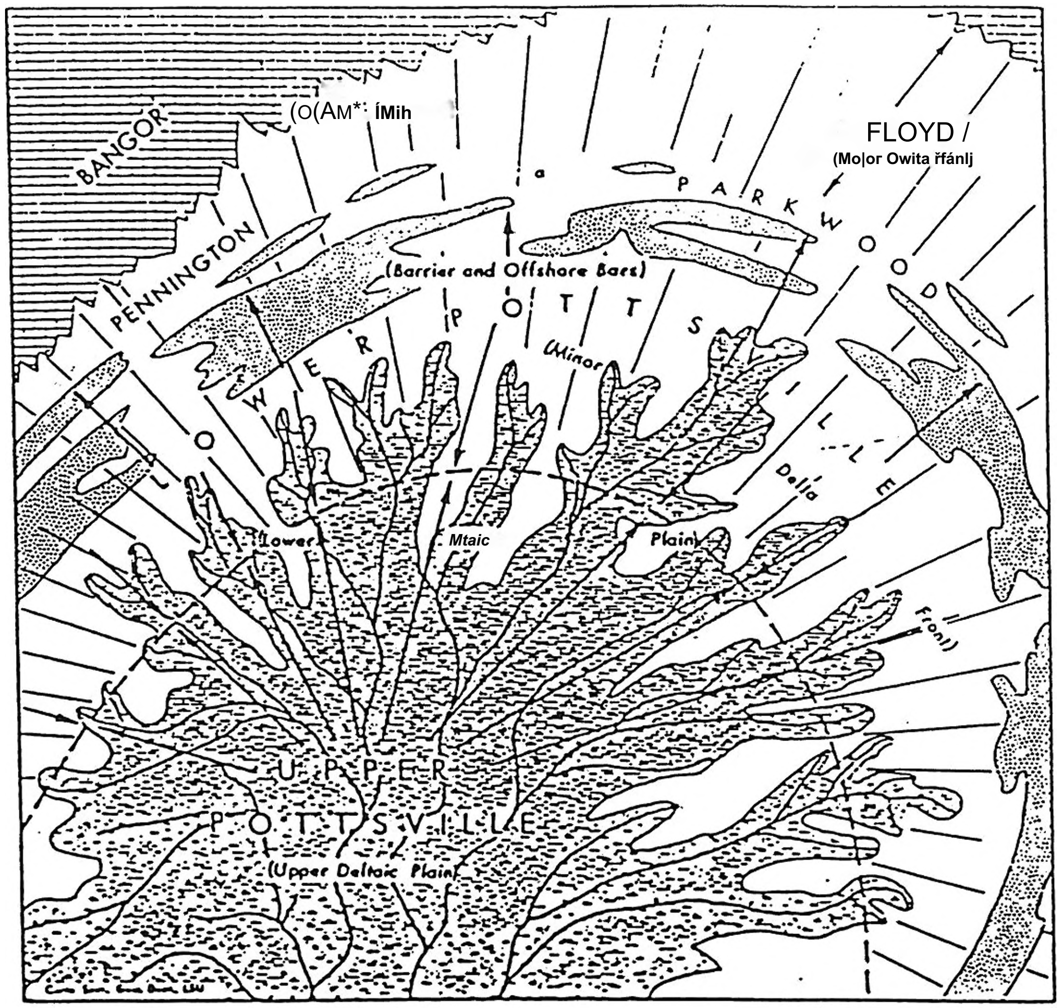


Figure 6: Plan view of a Pottsville Delta (from Ferm and Ehrlich, 1967)

Using core and log data supplimented by outcrop studies. Horsey (1981) considered the depositional environments of the Pottsville. The lower Pottsville was considered to be dominated by barrier island and lagoonal environments, whereas the upper Pottsville was thought to have been deposited in lower delta plain, distributary bay and barrier bar environments. Cyclicity in the upper Pottville was thought to be caused by lobe switching within the delta.

Rheams and Benson (1982) discussed the stratigraphic, depositional and structural setting of the Pottsville in a field trip guide prepared for the Alabama Geological Society. Within the field guide, Benson (1982) presented an outline of the depositional environments associated with the coal-bearing strata of the Pottsville. In particular he discussed the geometry, sedimentology and fossil content of the various parts of a deltaic sequence from the upper delta plain to the barrier and marine shelf environments.

Gibson (1985) was one of the first authors to investigate the palaeoecological significance of marine faunas in the Pottsville. He defined three assemblages from exposures of the Upper Cliff Coal in the lower Pottsville, but he did not discuss the depositional environments in detai i.

Pody (1987) investigated the sediments and their fossil content in a dip section of the upper Pottsville. The section cut all the main coal groups and also the inter-coal group lithologies. Pody (1987) defined three indigenous and one exogenous macrofaunal assemblage and developed a depositional couplet model that related the coal group lithologies to the inter-coal group lithologies below them. In this manner it was possible to view the deposition of upper Pottsville sediments as a series of depositional cycles that reflected an initial transgression and subsequent progradation, culminating in the development of delta plain environments (fig.5). The study showed that neither lithofacies nor biofacies are independantly diagnostic of environment, and also that fossil occurrences were much more extensive than had previously been reported (Metzger, 1965; McKee, 1975; Gibson, 1985).

In summary, most authors agree that the upper Pottsville strata of the Black Warrior Basin in Alabama reflect depositional events in a series of deltaic environments and that the sequence is associated with periods of marine inundation. The purpose of this report is to supply further evidence concerning the occurrence of marine fossils within the sequence and to test the validity of the depositional couplet model (Pody, 1987), using data from a study of lateral facies variation.

METHODOLOGY

This study has continued field studies begun in Grant 86-2F (Dewey, 1986). Sections were measured from a series of highway, quarry and working mine outcrops. Previous field reconnaisance, established literature and mining company information was used to locate the studied sections.

Most of the localities used in this study are in Walker County, Alabama (fig.2). Outcrops 3 & 4 however, are located in Fayette County, near the easternmost limit of exposed Pottsville in Alabama. A series of USGS and TVA 7.5 minute topographic quadrangle maps were used as locality base maps. Geological Survey of Alabama Map 181H (Ward and Chase, 1981) was used as a base map for the entire project area. The map also provided some of the stratigraphic control for the study. Detailed measured sections were constructed using Brunton, hand level, staff and tape.

Several outcrops were photographed using ASA 400 B&W print film to build photo-mosaics, that aided in following facies changes along the length of an outcrop. ASA 64 colour slide film was used to document individual features in the outcrop.

Fossils and sedimentary structures were collected for analysis and identification. Fossils were photographed using ASA 400 Tri-X Pan B&W film and close-up lenses at xl, x2 and x4 magnifications. Individual specimens were cleaned using dentistry utensils and an ultrasoni câtor to remove debris. Since much of the fossil material was collected from friable shales, it was often necessary to coat samples in the field with a polyurethane varnish to protect them. The varnish could be removed with acetone and a soft brush for laboratory examination.

One of the most important aspects of finding fossils was the degree of weathering of the outcrop. In cases where the fossils are difficult to find and the sediment is badly weathered, it is a temptation to call the outcrop or horizon unfossiiiferous. In such cases, careful excavation of the outcrop often reveals that although the fauna may be sparee, the outcrop is certainly not unfossiliferous. This work is tedious and time consuming, but critical to the correct interpretation of depositional environments.

RESULTS

I. Measured Sections

A total of thirteen measured sections (appendix) have been studied as part of an ongoing MS thesis at M.S.U. (Garbi sch, in prepn.). Measured sections were correlated by reference to major sand and/or identifiable coal units. It was possible to confirm these correlations using a variety of sources including Culbertson (1964), Ward and Chase (1981) and mining company records.

Basic outcrop data are presented in a series of annotated columnar sections (figs. 7-19). The standardized format used throughout this study, indicates lithofacies, biofacies, grainsize and sedimentary structure profile together with descriptive notes for each outcrop unit. The detailed interpretation of these sections is part of an ongoing master's level thesis (Garbisch, in prepn.).

II. Lithofacies

Sediments from the Mary Lee and Pratt depositional couplets were organised into the same lithofacies that were established for studies of the entire upper Pottsville interval (Grant 86-2F and Pody, 1987). A typical depositional couplet consists of two intervals. The lower, A interval is composed mostly of silts and shales deposited on top of the previous couplet. The B interval is composed of sands, silts, shales and coals, that together form the main part of a delta complex. Consequently each lithofacies does show some relationship to position within a couplet, but taken in isolation this information is not characteristic of any particular lithofacies.

Four main lithofacies can be defined as follows:

i) Siltstone-Shale Lithofacies
ii) Subgreywacke Lithofacies
iii) Orthoquartzite Lithofacies
iv) Coal and Seatearth Lithofacies

Each lithofacies is defined according to lithology and sedimentary structures. Lithofacies associations and sequences can also be recognised, although the occurrence of any single lithofacies does not presuppose any particular depositional environment. Subfacies are not defined.

i) Siltstone-Shale Lithofacies.

This lithofacies is the most dominant lithofacies of the present study. Rheams (1982) and Musgrove (1982) indicate that, in terms of overall thickness, the inter-coal group silts and shales account for more than half of the total sequence of sediment present in the upper Pottsville. Despite this fact, these sediments have received the least amount of study (Metzger, 1965; Pody, 1987).

The lithofacies is characterised by variably thick, mostly upward coarsening and rarely upward fining, grey and dark grey, fissile, laminated silstone to shale sequences. Siderite banding is not uncommon in some sections (e.g. Carbon Hill East 8.8-16.2m and Summiton 41.5-48m). Mica flakes and abundant plant debris can also be locally important (e.g. Boxes Creek South 6.8-10.2m).

The lithofacies can contain thin, impersistent to laterally extensive sandstone units (e,g. Hatt 34-35m). It may overlay, or be overlain by the Subgreywacke Lithofacies (e.g. Arch/Corona 14-28m interval). The lithofacies has also been observed to overlay the Coal-seatearth Lithofacies (e.g. Hope/Galloway 8.8m and Port Walker 8.3m)

The Siltstone-shale Lithofacies may contain a variety of fossil materials. The ichnogenus, <u>Helminthopsis</u>, often occurs in this lithofacies as discrete zones, but a generally bioturbated texture is more common. Macro-invertebrate remains are sparcely distributed throughout the lithofacies. In many cases the quality of the outcrop and degree of weathering resulted in very poor fossil recovery. In the silts and shales of the present study, the dominant fossil assemblage is the <u>Aviculopecten</u> Assemblage, whereas in the Siltstone-shale intervals elsewhere in the upper Pottsville (Pody, 1987) the Chonetid Assemblage was more typical.

ii) Subgreywacke Lithofacies

This lithofacies comprises most of the sandstone units encountered in the present study. Typically, the lithofacies is composed of grey and red/grey, massive to cross bedded, fine to medium grained impure sandstones. Frequently the sandstones contain abundant mica and plant debris on parting surfaces. Beds can be of variable thickness and also of variable lateral continuity. Some relatively thin beds can be laterally very persistent, this is especially true of units that occur at the top of the A interval (e.g. Summiton 48m). Massively bedded units often show a mottled, bioturbated texture. Cross-bedded units can show a variety of sedimentary features from low amplitude (less than 1.0cm high) assymmetrical ripples and climbing ripples (e.g. Carbon Hill East 0-6m and Hope/Galioway 0-2.8m) to large trough cross bed which form part of channel structures (e.g. Frozen Hollow 46-50m) and low angle planar cross beds (e.g. Frozen Hollow 42-45m). Lower contacts of the lithofacies are either gradational into the Siltstone-shale Lithofacies (e.g. Port Walker 22-25m) or else they are erosional (e.g. Boxes Creek South 3,5-5.2m). Frequently, the lower contacts are also distorted by soft sediment deformation (e.g. Summi ton 7-14m).

The lithofacies is found intercalated within, and with gradational contact, above, the Siltstone-shale Lithofacies. In interval B, the Subgreywacke Lithofacies often grades upward into the coarser, lower portion of the Coal-Seatearth Lithofacies (e.g. Boxes Creek North 16-18m). Beds of the Subgreywacke Lithofacies are frequently associated with the upper parts of the A interval and most of the B interval in a typical depositional couplet (fig. 5).

Fossil materials found within the Subgreywacke Lithofacies are mostly confined to lag deposits (e.g. Lynn's Park 18-19m) and colonised surfaces (e.g. Port Walker 1m). At both Port Walker and Lynn’s Park the dominant macro-invertebrates are characteristic of the Schizophora Assemblage (Gibson, 1985). Occasionally thin persistant sandstones contain a Productid assemblage (e.g. Boxes Creek North 2-3m). The ichnogenus Zoophycos is also found at Port Walker and shows evidence of having been formed by an organism foraging from the overlying shales into the sand. At the Hope/Galloway section (0-2.8m) unidentifiable, arthropodal(?) trackways are typical on low relief rippled surfaces.

iii) Orthoquartzite Lithofacies

This lithofacies is composed of pale grey, coarse to medium grained, rounded, quartz sandstone. Typically the sandstone contains fairly large muscovite flakes. The sandstone shows large scale trough cross-bedding and an erosional, sole marked, lower contact. The lithofacies occupies a lens shaped geometry, typical of a channel sand. The Orthoquartzite Lithofacies grades upward into the Subgreywacke Lithofacies and is only known from a single outcrop at Frozen Hollow (28.5-31m).

The only fossil materials recovered from this lithofacies were large stems of Calamites which formed a lag at the bottom of the channel.

iv) Coal-seatearth Lithofacies

This lithofacies is the most poorly exposed of the four lithofacies discussed herein. Typically, the lithofacies consists of a lower, rooted underclay and an upper, sulphurous, vitrinitic, bituminous or sub-bituminous coal unit. Coals described from sections in this study can be related to the Mary Lee Coal Group (e.g. Carbon Hill East 7-8m, Hope/Galloway 1.7 & 8.8m, Summiton 41-41m), the Pratt Coal Group (e.g. Arch/Corona 4-5m, Boxes Creek North 16.2-

17.8m and South 6.2-6.5m, Ensign Bickford 0-1.5m, Hatt 3m & 12m) and possibly the Black Creek Coal Group (e.g. Port Walker, 8-9m).

In sections where a coal is exposed, the seatearth fines upward from a unit in the Subgreywacke Lithofacies (e.g. Port Walker 7-8m) or the Siltstone-shale Lithofacies (e.g. Summi ton 38-40m). The upper contact of the coal may be either another unit of the Subgreywacke Lithofacies (e.g. Summiton 41m) or the Siltstone-shale Lithofacies (e.g. Port Walker 8-9m). In places where the seatearth is particularily thick (e.g. Summiton 40m), the lower part of the coal is fissile and more properly referred to as a coal shale. The underlying seatearth also contains recognisable Sigillaria.

III BIOFACIES

The original biofacies used in the depositional couplet model (fig. 5), have proven inadequate to express the data collected in this study. Primarily, sediments from the Mary Lee and Pratt Couplets have a much lower abundance of macro-invertebrate remains, than was recognised in the previous study (Grant 86-2F and Pody, 1987). Secondly, some of the faunal associations that were found in the present study were not described in Pody (1987).

Three distinct assemblages and two associations are described from this study:

i) Aviculopecten Assemblage
ii) Productid Assemblage
i ii) Schizophoria Assemblage
iv) Exogenous Association
v) Helminthopsis Zone

i) Aviculopecten Assemblage

This assemblage is the most widespread, but also the hardest of the assemblages to recognise in outcrop. The assemblage occurs as sparcely distributed remains within the Siltstone-shale Lithofacies. The species diversity and individual abundances are very low and preservation is often very poor. Many specimens occur as molds and impressions on freshly split shale surfaces. It appears as though skeletal calcite is mobilised in the diagenetic process, leaving only thin films of calcite, or external and internal molds.

The assemblage consists of the bivalve Aviculopecten, small orthoconic nauti loi ds, and other bivalves such as Wil kingia. The brachiopod, Chonetes, is noteable by its absence.

The assemblage occurs at Carbon Hill East (10-14m), Ensign Bickford (22m+) and Summiton (42-46m). The nonoccurrence of this assemblage at other localities is not necessarily indicative of barren intervals. In many cases the fact that the assemblage was not found could be related to the degree of weathering of the outcrop. The ichnogenus Helminthopsis shows a similar occurrence to that of the Äviculopecten Assemblage, but is more widespread. It is possible that the traces of Helminthopsis are less susceptible to loss by diagenesis than are the calcite shells of the small macro-invertebrates.

It appears that the Chonetid Assemblage described by Pody (1987), shares several similarities with the Äviculopecten Assemblage of the present study. The lack of chonetids in the present study however suggests that there is a real distinction between the two assemblages. Both assemblages occur exclusively in the Siltstone-shale Lithofacies and show an association with Helminthopsis; both are sparee, low diversity, low abundance faunas. Both are dominated by a single form: either the benthic chonetid brachiopod Eoiissochonetes or the swimming bivalve Äviculopecten.

The lack of chonetids in the present study is not attributed to collection bias. Given the time and methods necessary to find specimens from this assemblage, it is likely that the material found was representative of the collectable fauna. It is suggested that the chonetid and the Äviculopecten Assemblages represent very slightly different palaeoenvironments. It is possible that the lack of chonetids in the Äviculopecten Assemblage, is indicative of conditions that were beyond the tolerance of the chonetid brachiopods. This is especially likely given that the pectenids were vagile benthos and the chonetids were sedentary benthos. It is possible that the environment was too severe for the chonetids, but that occasional vagile organisms could foray into the region.

ii) Productid Assemblage

This assemblage is an abundant, diverse and well preserved fauna that is associated with sandstones of the Subgreywacke Lithofacies. In the present study, the assemblage was not found to be as common or as diverse as in the previous study (Grant 86-2F and Pody 1987). The Productid Assemblage was only found at Boxes Creek North (2-3m). The main components of the fauna are the productid brachiopods Pustula and Composita. According to Pody (1987) the Productid Assemblage is found in the silstone-shale sequences and the upper colonised surfaces of sandstone units in marine and near-marine salinity conditions.

An internal report at the University of Alabama (Holmes, 1977) described a very abundant and diverse macro-invertebrate fauna from within the Mary Lee Coal Group, near

Carbon Hill. The exact locality could not be verified and therefore this locality was not found during the present study.

iii) Schizophoria Assemblage

This assemblage follows the usage developed by Gibson (1985). The assemblage occurs at two localities. At Port Walker (0-2m), the assemblage appears to be mostly in situ, whereas at Lynn's Park (18-19m) the assemblage occurs both as a lag and in situ. The assemblage consists of the brachiopod Schizophoria as the dominant element at Port Walker, together with the orthotetid Derbyia, and the bivalves Wilkingia and Pteronites. Rare gastropods such as Trepospira may also occur.

The assemblage at Port Walker also shows an association with the ichnogenus Zoophycos. It is clear from the highlighted trace that the foraging burrower was active immediately below the colonised zone, but this does not mean that Zoophycos was necessarily contemporaneous with the colonising fauna above it.

The make-up of the assemblages and their associations at Port Walker and at Lynn's Park are very similar to those described by Gibson (1985) for the Upper Cliff Coal of the Lower Pottsville. Given that the Schizophoria Assemblage has not been found higher in the section than the base of the Mary Lee Coal Group, suggests the possibility that the assemblage may be stratigraphically limited within the Pottsville.

iv) Exogenous Association

At Lynn's Park, the Schizophoria Assemblage occurs both in situ and as a lag deposit. It is clear from the unbroken, but jumbled shell material, that the lag deposit has not been transported very far. The lag deposit occurs in a yellow, ferruginous, cross-bedded sand and is composed almost entirely of the brachiopod Derbyia together with plant stems.

v) Helminthopsis Zone

The Helminthopsis Zone is characteristic of much of the Siltstone-shale Lithofacies. It occurs as small, crowded, pale or dark, sinuous, horizontal traces on bedding plane surfaces. It is often associated with, and also shows a wider distribution than, the Aviculopecten Assemblage (e.g. Summi ton 44-50m).

IV DISCUSSIONS

in the initial study (Grant 86-2F and Pody, 1987) a dip section was used to examine the lithofacies and biofacies characteristics of the upper Pottsville. From this study a generalised model emerged (fig. 5) which reinterpreted the upper Pottsville section in terms of depositional couplets. Each couplet consisted of a lower, A interval and an upper, B interval. The A interval represented the flooding of an old delta system and the beginning of progradation, whilst the B interval represented the development of the lower and upper delta plain environments together with lobe switching events.

In the light of this model, biofacies could be linked to the lithofacies in order to interpret the palaeoenvironment. In truly marine salinities, a Productid Biofacies would develop and as conditions deteriorated the fauna would undergo successive attrition and replacement by the Chonetid and Orbiculoid Biofacies respectively (Pody, 1987). Deteriorating environmental conditions could be related to salinity and turbidity changes during progradation.

It was therefore possible to view deposition of the Pottsville strata in the Black Warrior Basin according to a series of internally complete depositional couplets. Each couplet was named from the Coal Group that it contained in its upper portion.

The present study was aimed at evaluating the depositional couplet model, by examining a strike section through a single couplet of the upper Pottsville. In reality, the study has approximated to a study which straddles two couplets. Most mining companies remove overburden from economic reserves and then mine down to the last workable coal in opencast pits. This normally means that coal mine headwalls contain the lower part of an A interval overlying the upper part of the B interval from the couplet below. In order to study one complete couplet, it is therefore necessary to study two coal groups. As a direct consequence, it is almost impossible to find a single section where the A interval of a couplet issoverlain by the B interval of the same couplet.

This project has therefore focussed on the A & B intervals of the Mary Lee Couplet and the A & B intervals of the Pratt Couplet. As a result, the study has straddled an interval from the top of the Black Creek Coal Group to the base of the Cobb Coal Group (fig. 4).

Conclusions that can be drawn from this study are as follows:

i) the lithofacies used to define the depositional couplet model are adequate for application elsewhere in the

Pottsville. Subdivision of the lithofacies would not aid in the general application of the couplet model but would be of use in the detailed examination of individual couplets

ii) the lithofacies in and of themselves are not indicative of any single depositional palaeoenvironment

iii) each couplet probably has its own "depositional signature"

iv) the biofacies used to define the depositional couplet model are inadequate for application elsewhere

v) in general the biofacies may be indicative of a series of deteriorating conditions from the Productid Biofacies through the Chonetid and into the Aviculopecten and Orbiculoid Biofacies. Furthermore, these assemblages may be related to controlling parameters such as substrate type and stability, turbidity and salinity. Oxygen limits within the bottom sediment should not be ruled out as a possible ecological control

vi) the Schizophoria Assemblage is the only biofacies which has thusfar not been found above the Mary Lee interval. This may suggest some stratigraphic control

vii) the Chonetid and Productid Assemblages are more common in the Cobb interval (Pody, 1987) than in either the Mary Lee or the Pratt Couplets. This may suggest differences between the couplets in the equitability of the environments for colonisation.

SUMMARY

It is clear from these discussions that our understanding of the Pottsville is far from complete. In many ways the development of the depositional couplet model has done more to raise questions, rather than answer them. Further study should investigate individual couplets in greater detail, using both surface outcrops and subsurface mines and core data.

It is important to look more closely at the relationships between biofacies and depositional environment. Clearly, the siltstone-shale inter coal group intervals are not barren and although they contain a sparee fauna, it may be telling us much about the conditions of deposition. Subtle changes and relationships between biofacies and lithofacies may be very useful in defining sub-environments within the prograding delta sequence.

Furthermore, the work done so far indicates that each couplet has its own set of characters. Whether this can be translated into a depositional signature or not is uncertain, but could be answered with further investigation.

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Appendix 1 (Measured Sections)

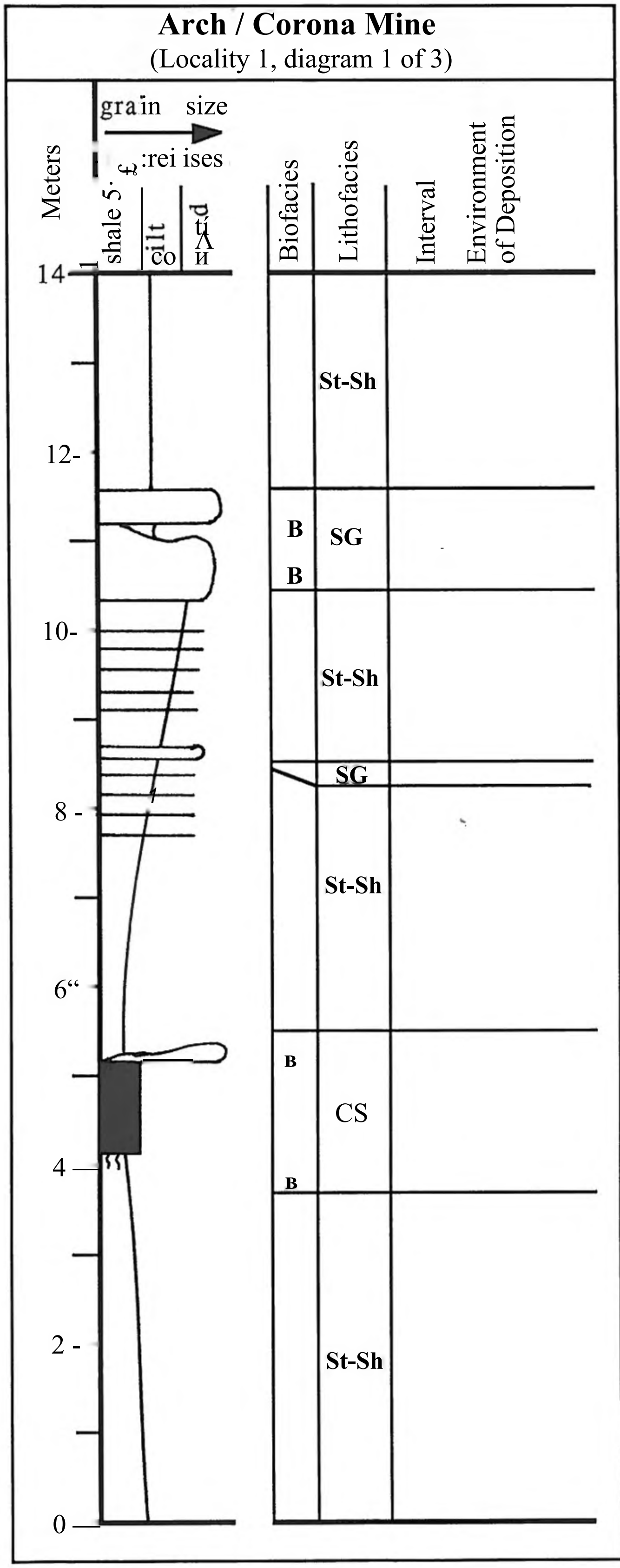
Key to symbols used in section diagrams.

Symbols	Sedimentary Structures
	Siderite lenses and nodules
	cross-beds
	Coal
	Rooted horizon
	Scoured base
	soft sediment deformation structure

Symbols	Lithofacies
St-Sh	Siltstone - Shale
SG	Sub greywacke Sandstone
QS	Quartzitic Sandstone
CS	Coal - Seatearth
R	Rooted shale and siltstone

Symbols	Biofacies
P	Productid Assemblage
S	*Schizophoria* Assemblage
A	*Aviculopecten* Assemblage
B	Burrowed and bioturbated zone
E	Exogenous association
H	*Helminthopsis* zone

Name:	**Arch / Corona Mine**
Location Number:	1
Map Location:	SE 1/4, Sec. 1,T15S, R9W Townley, Alabama 7.5 minute quadrangle
Location:	The Corona Mine of the Arch Mining Company is temporarily closed. It is located approximately 6 km (3.5 miles) north of the town of Oakman on an unnamed Walker County Road.
Total Thickness:	31 Meters (100 Feet)
Interval:	The Pratt Coal Group is mined at the Arch/Corona mine with a maximum high wall height of 58m (190 foot), average height is about 30m.
Additional Notes:	The Arch Mining Company is not currently operating any mines in Walker County Alabama. The Corona mine has been closed since January 1988, but all of the mine highwalls are well exposed and unreclaimed.



grey silty shale, very homogeneous in appearance laterally, abundant mica and plant debris, sideritic zones

yellow grey bioturbated medium to coarse grained sandstone, poorly bedded, generally mottled zones to distinct horizontal burrows (2-3mm dia.)

grey silty shale, coarsens upward, abundant mica and plant debris, sideritic zones several thin (2-3cm) silty tabular sandstone beds

grey fine to medium grained silty sandstone bed, 10cm thick

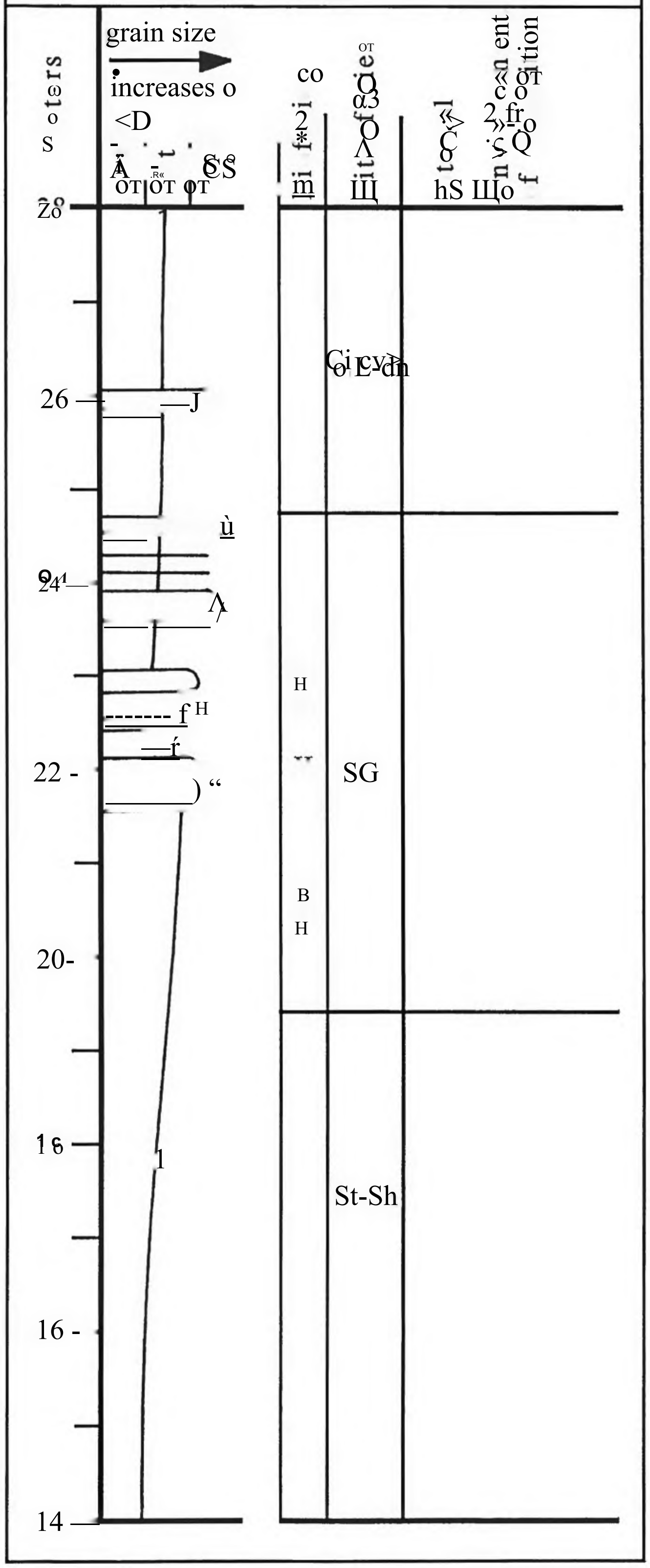
dark grey shale, very flaky laminations, becomes silty upward along with the appearance of sideritic zones are also thin (1-2 cm) fine grained sandstone beds

65 cm vitrinitic coal (uppermost seam of the Pratt Coal Group) lenses of yellow-grey medium grained dirty, well burrowed (2-4mm dia.) lie above the coal seam, with a carbonaceous black shale flaky thinly laminated texture, rooted shale grades downward into the adjacent unit

dark grey silty shale, sideritic zones blocky to wavy laminatec texture very homogeneous and uniform in appearance laterally

Arch / Corona Mine

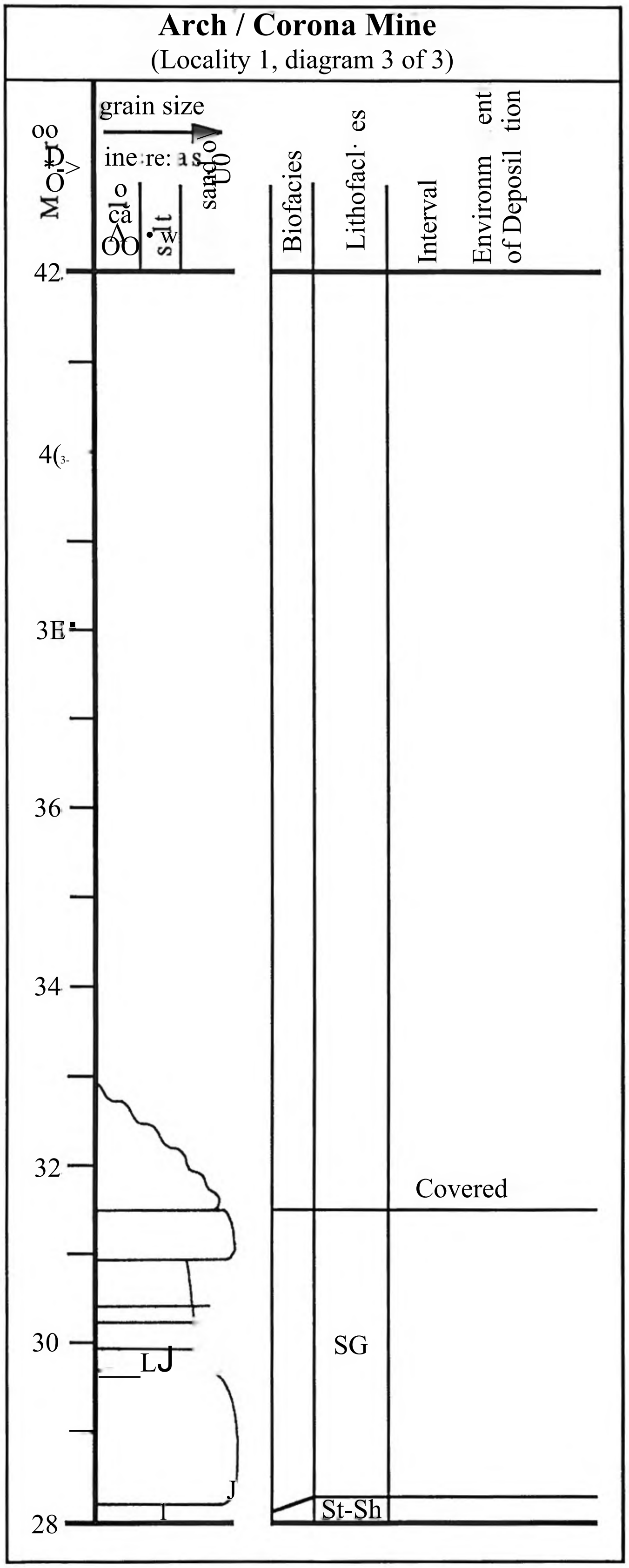
(Locality 1, diagram 2 of 3)



grey to olive silty shale, weathered, finely laminated, abundant mica and plant debris, occasional thin (about 5cm) fine grained silty sandstone beds

grey to olive tan very fine grained silty sandstone and shaley siltstone finely laminated to tabular, laterally continuous siltstone beds with distinct and persistent *Helminthopsis* also some zones of medium grained sandstone containing abundant horizontal burrows, 2-3mm dia. some rippled crossbedding

grey silty shale, silt content increases upward, sideritic zones decrease upward, bedding texture becomes more even and tabular upward from a blocky homogenous texture in the lower portion of this unit, mottled appearance is common



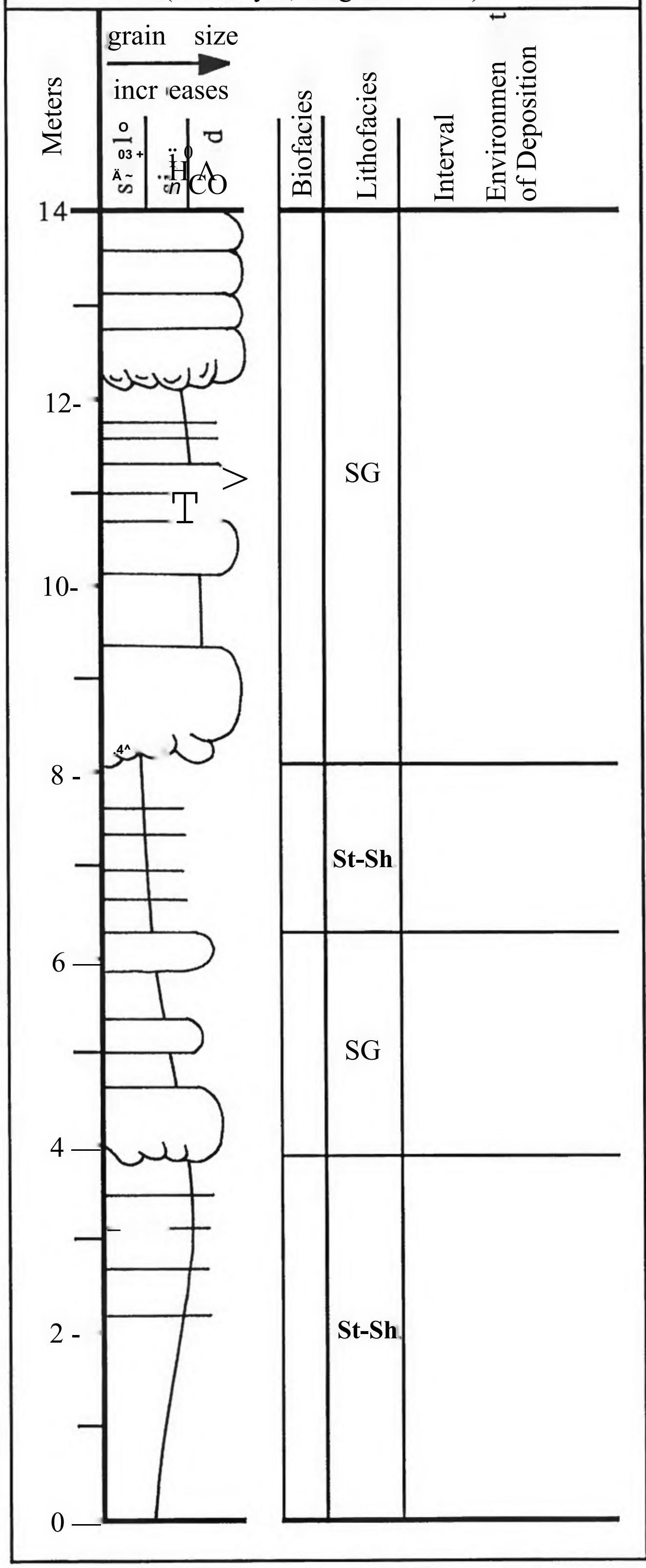
Top of the highwall

very weathered grey fine grained silty sandstone and silty shale

see description below

Name:	**Benoit Roadcut**
Location Number:	2
Map Location:	C, S 1/2, Sec. 11,T15N, R6W Goodsprings, Alabama 7.5 minute quadrangle
Location:	The Benoit roadcut is a large, benched, single roadcut through the crest of a hill approximately 3.2 km (2 miles) southeast of Cordova on an unnamed paved county road.
Total Thickness:	24.5 Meters (80 Feet)
Interval:	The roadcut is a large sand and silt body. This section lies just above several small reclaimed coal mines in the Mary Lee Coal Group which are along the road about 1km and further to the west toward Cordova.

Benoit Roadcut
(Locality 2, diagram 1 of 2)



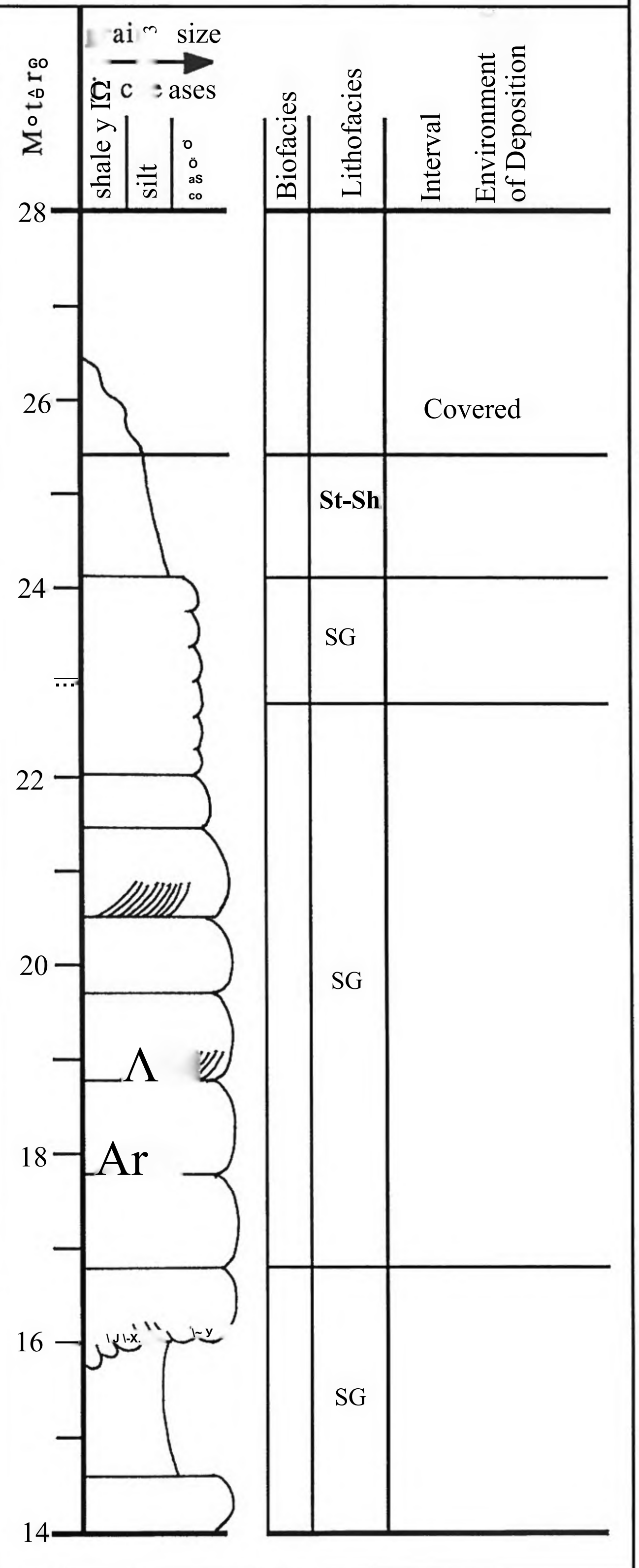
grey and maroon, fine to medium grained silty sandstone, large cross-beds, to ripple cross-beds,basal contacts of sandstone beds often show soft sediment deformation structures over shale beds with blocky laminations, sandstone beds are generally continuous though individual beds often pinch out in less than 10m, mica and fine plant debris on bedding surfaces

grey silty shale, finely laminated to blocky texture, sideritic zones, several thin (1 cm) continuous beds of very fine grained sandstone

grey silty fine grained cross-bedded sandstone, abundant mica and fine plant debris, sharp basal contact with soft sediment deformation structures

grey silty shale, finely laminated to blocky texture, sideritic zones, a few thin (1 cm) continuous layers of very fine grained sandstone, layers of large siderite nodules, laterally continuous

Benoit Roadcut
(Locality 2, diagram 2 of 2)



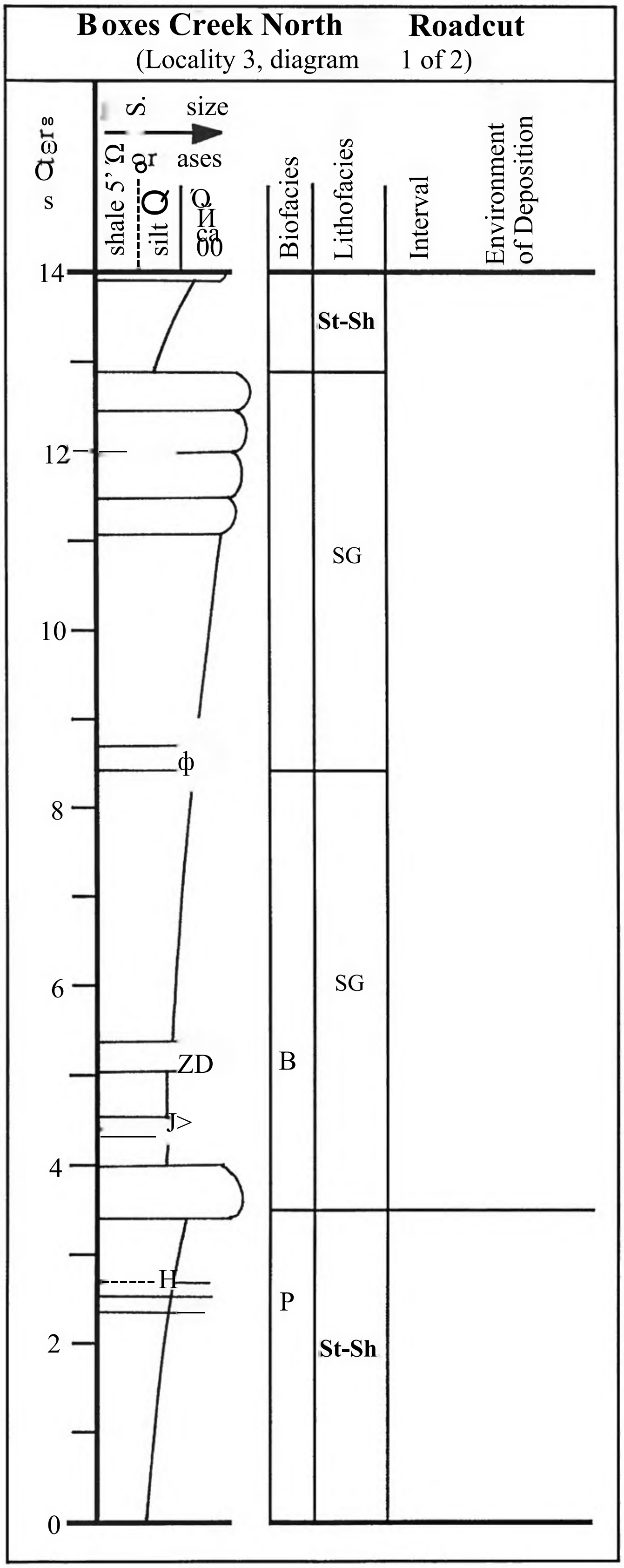
yellow-grey mottled sandy siltstone with clay interbeds very weathered

grey, medium grained, sandstone very weathered

grey and maroon, fine to medium grained silty sandstone, abundant cross beds, individual sandstone beds are tabular and laterally continuous over several meters

see description at the top of the previous page

Name:	**Boxes Creek North Roadcut**
Location Number:	3
Map Location:	W 1/2, NE 1/4, Sec. 1, T14S, R11W Hubbertville, Alabama 7.5 minute quadrangle
Location:	Boxes Creek North roadcut is located where Alabama State Highway 13 cuts the north valley wall of Boxes Creek, it is 6.5 km (4 miles) south of U. S. 78 and 6 km (3.5 miles) north of the intersection of Alabama State Highway 13 and Walker County Road 102.
Total Thickness:	23 Meters (74 Feet)
Interval:	The Boxes Creek North Roadcut contains most of the Pratt Couplet and one of the Pratt Coal Seams (Ward and Chase, 1981) is exposed near the top of the section.



grey fine grained sandstone in thin wavy laminations which coarsen upward and are transitional with the lower unit (continued on the next page)

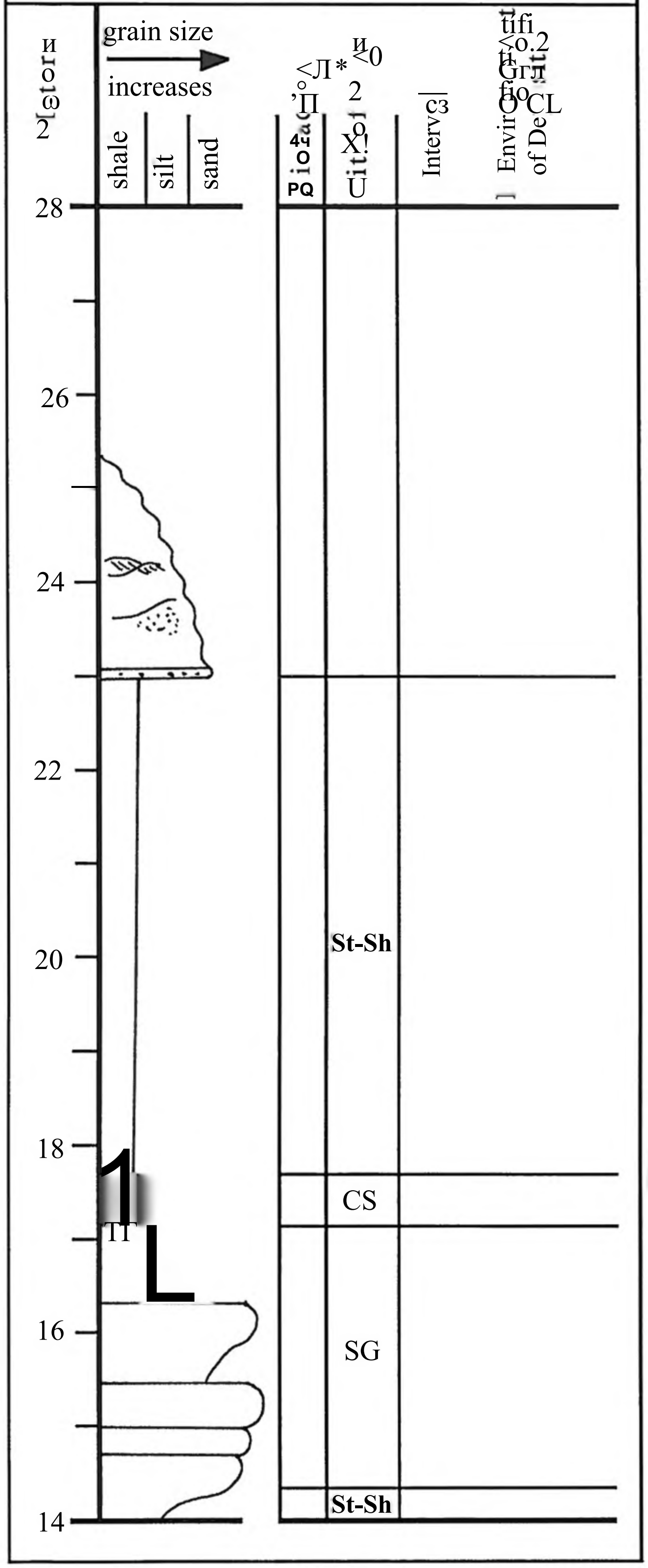
dark grey shale coarsens upward to silty shale.

grey, fine to medium grained silty sandstone with abundant silty layers and ubiquitous ripple crossbeds.
as the upper unit of a coarsening upward sequence starting as grey, sideritic silt and silty sand, discreet ripple bedded sandstone beds increase with frequency upsection. Many sandstone beds have a bioturbated texture.

dark grey, sideritic, silty shale, interbeded with thin laterally continuous beds of silty fine grained sandstone, with undulatory contacts, many of these sandstone beds contain a Productid Assemblage

Boxes Creek North Roadcut

(Locality 3, diagram 2 of 2)



Cretacous cover, lenses of rounded quartz gravel, in a matrix of coarse grained sand with abundant cross beds.

White clay with red mottling under an undulating bed of ferruginous claystone near the 23 meter mark

Dark grey/blue shale with red mottling, some sideritic zones and siderite nodules, the lower portion above the coal has rare plant debris

30 cm coal, (Pratt Coal Group) with a 20cm rooted underclay, which grades into shale and the silty shale about 1m below the coal, just above the coal is a 10 cm zone of white clay with carbonaceous partings

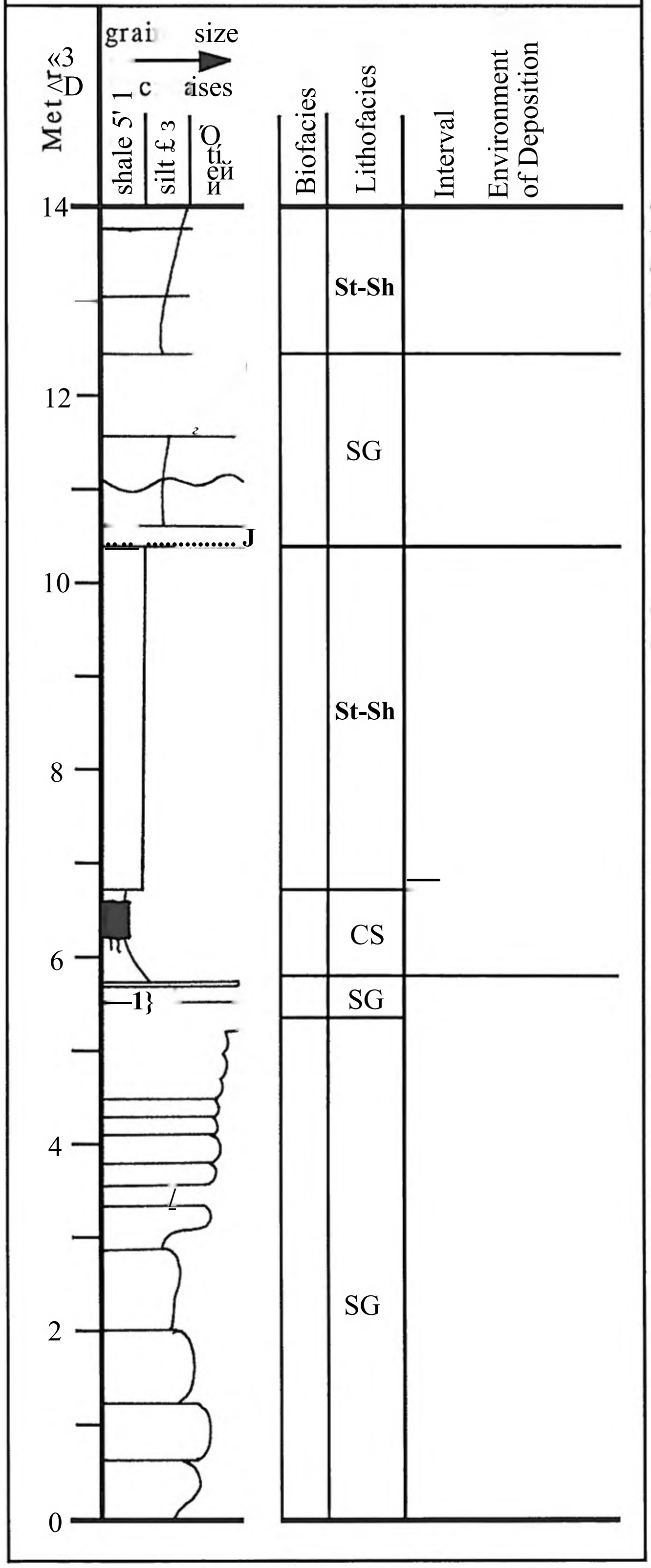
Light grey, fine to medium grained quartz sand, with abundant mica and plant debris, upper portion is massive with no obvious sedimentary features, the lower portion has ripple crossbeds with clay partings between each bed.

(See top of last page)

Name:	**Boxes Creek South Roadcut**
Location Number:	4
Map Location:	W 1/2, E 1/2, Sec. 33, T14S, R11W Hubbertville , Alabama 7.5 minute quadrangle
Location:	Boxes Creek South roadcut is located where Alabama State Highway 13 cuts the south valley wall of Boxes Creek, 11 km (7 miles) south of U. S. 78 and 2 km (1 mile) north of the intersection of Alabama State Highway 13 and Walker County Road 102. There is a continuous outcrop from valley floor to the hill crest where the Pennsylvanian / Cretaceous unconformity is exposed. Nearby is a recently drilled oil/gas well with the well head at the level of the coal exposed in the road cut.
Total Thickness:	41.3 Meters (135.5 Feet)
Interval:	Much of the A interval of the Pratt Couplet is exposed as well as all of the B interval topped with a single Pratt Coal Seam, and a portion of the A interval of the Cobb Couplet.

Boxes Creek South Roadcut

(Locality 4, diagram 1 of 3)



dark grey silty shale in regular wavy laminations, with occasional thin(l-2cm) beds of siltstone (continued on next the next diagram).

grey fine grained silty sandstone beds, laterally continuous, wavy contacts which contain sole, tool marks, and some obscure traces, interbedded with dark grey laminated shale beds.

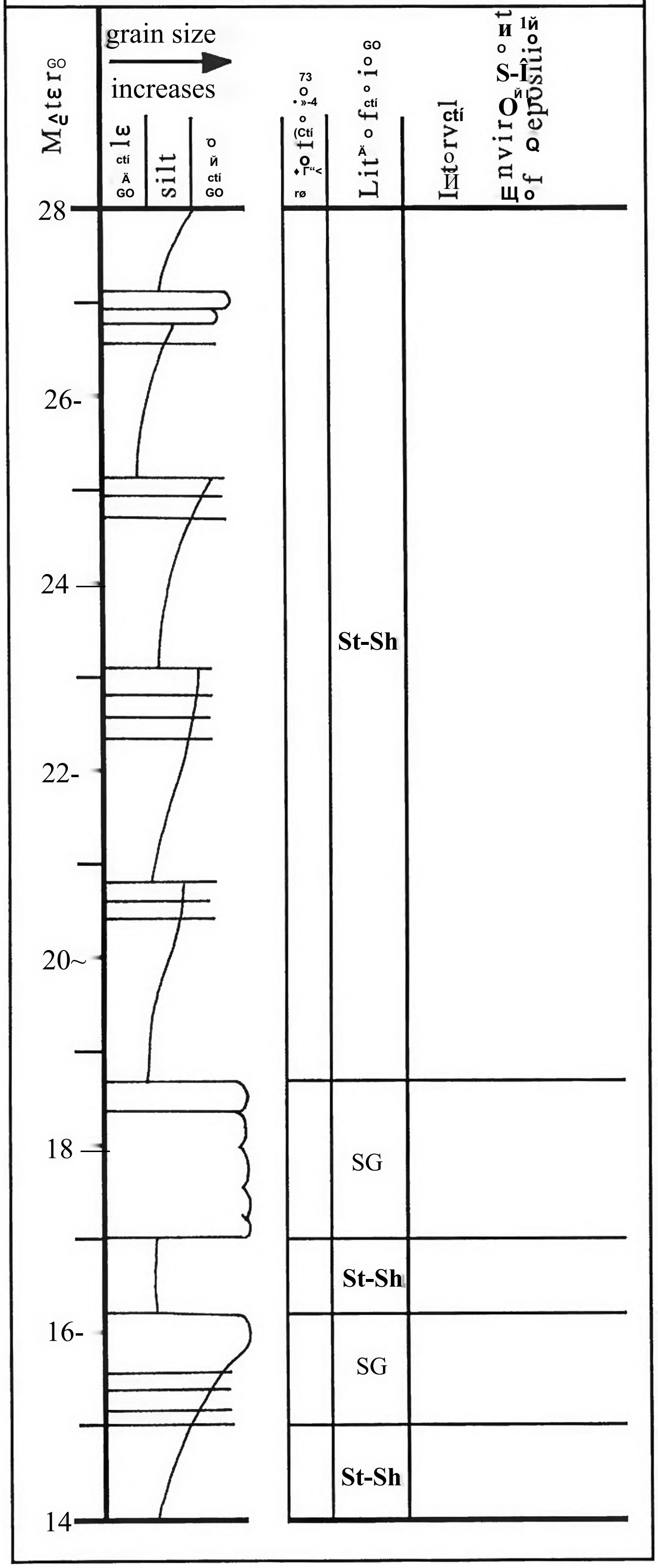
dark grey shale with occasional sideritic horizons or bands; abundant mica and plant debris

20 cm coal, (Pratt Coal Group) with a 20 cm carbonaceous overclay a 60 cm rooted underclay which grades down to a silty shale

grey fine to medium grained silty sandstone, laterally continuous, abundant cross-bedding, wavy erosional bases are present on many beds top a coarsening upward sequence starting as grey to dark grey, interbedded siltstone and silty shale beds, occasional silty fine grained sandstone beds, laterally continuous and ripple cross-bedded, grain size and bed thickness increases upward, abundant mica and plant debris.

Boxes Creek South Roadcut

(Locality 4, diagram 2 of 3)

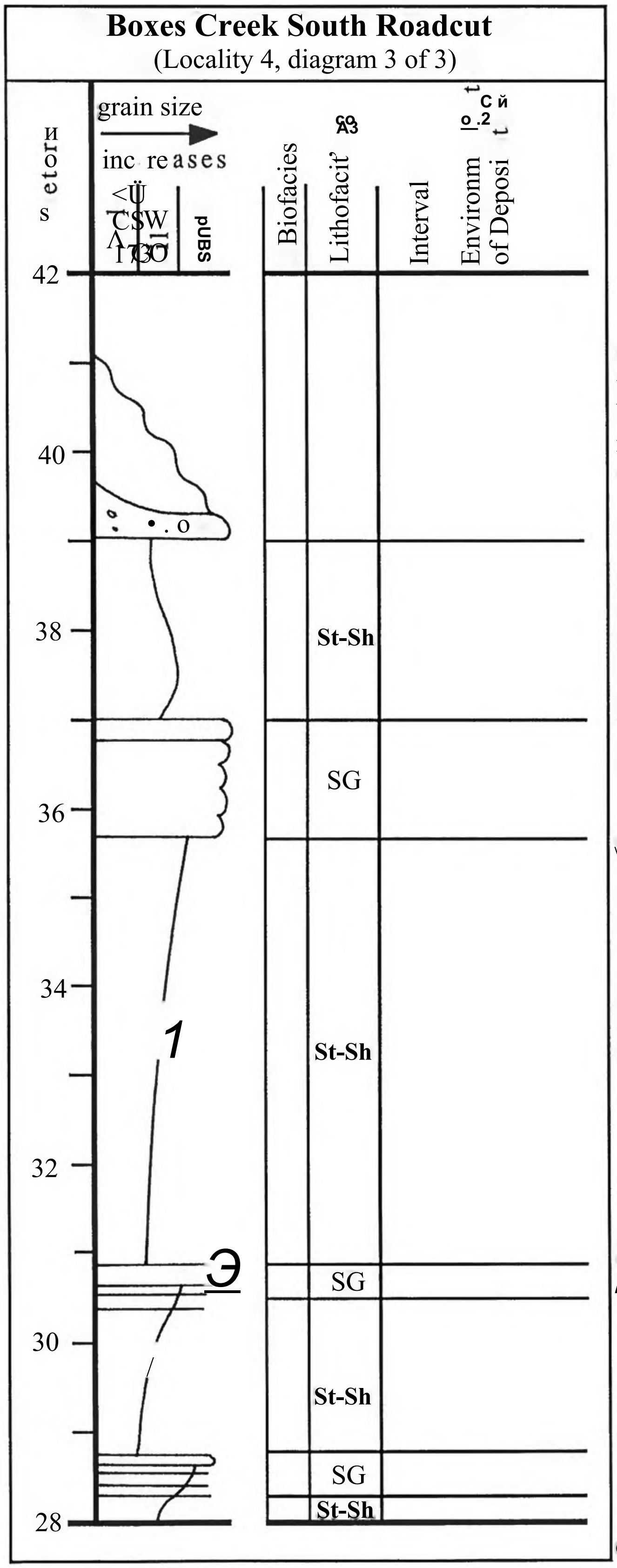


grey, fine grained, silty sandstone, massive laterally continuous beds, thin shaley interbeds, abundant mica and plant debris.

dark grey shale, fine even laminations

grey, silty, fine grained silty sandstone, large scale, low angle, planar cross-beds

dark grey silty shale, regular wavy laminations,several thin (2cm) beds of silt and sandstone grain size coarsens upward



Cretaceous sand and gravel and thin lenses of white clay, the base is an iron cemented rounded quartz pebble conglomerate.

dark grey fine grained silty sandstone, occasional ripple crossbedding, some portions are evenly laminated into thin graded 1 and 2 cm beds with mica and carbonaceous partings between them,

grey, fine grained, silty sandstone in thin (5 -10 cm) laterally continuous beds, with abundant mica and plant debris on the bedding planes

dark grey, silty shale, and very fine grained sandstone, very shaley in the lower portion, grain size and the amount and size of the plant debris increase upward

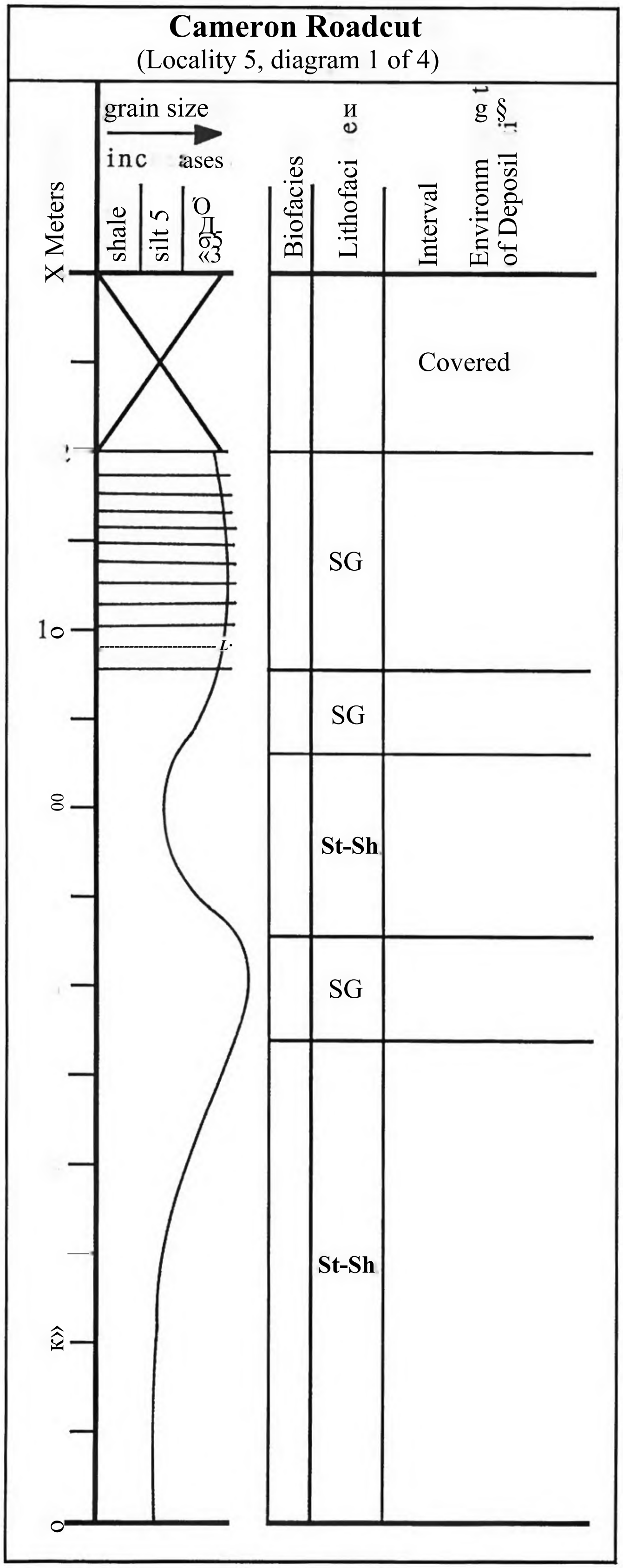
grey, fine grained, silty sandstone, abundant mica and plant debris

dark grey, silty shale, and very fine grained silty sandstone, abundant mica and plant debris.

grey, fine grained silty sandstone, several 4-7 cm beds, finely laminated silty shale interbeds

described on the previous page

Name:	**Cameron Roadcut**
Location Number:	5
Map Location:	SW 1/4, NE 1/4, Sec. 33, T14S, R7W Jasper Alabama, 7.5 minute quadrangle
Location:	The Cameron roadcut is composed of a series of low roadcuts along Alabama State Highway 269, starting 2 km (1.5 miles) south of the city of Jasper and 4.8 km (3 miles) north of the town of Parrish.
Total Thickness:	47 Meters (155 Feet)
Interval:	These are the silts, shales and sandstones above the Mary Lee Coal Group and form the A interval of the Pratt Couplet.
Additional Notes:	This section is a composite of several small exposures. Total measured thickness of this section may be suspect or unreliable due to local variations in dip and the possibility of small local faults.



grey, silty shale with thin interbedded fine grained silty sandstone beds

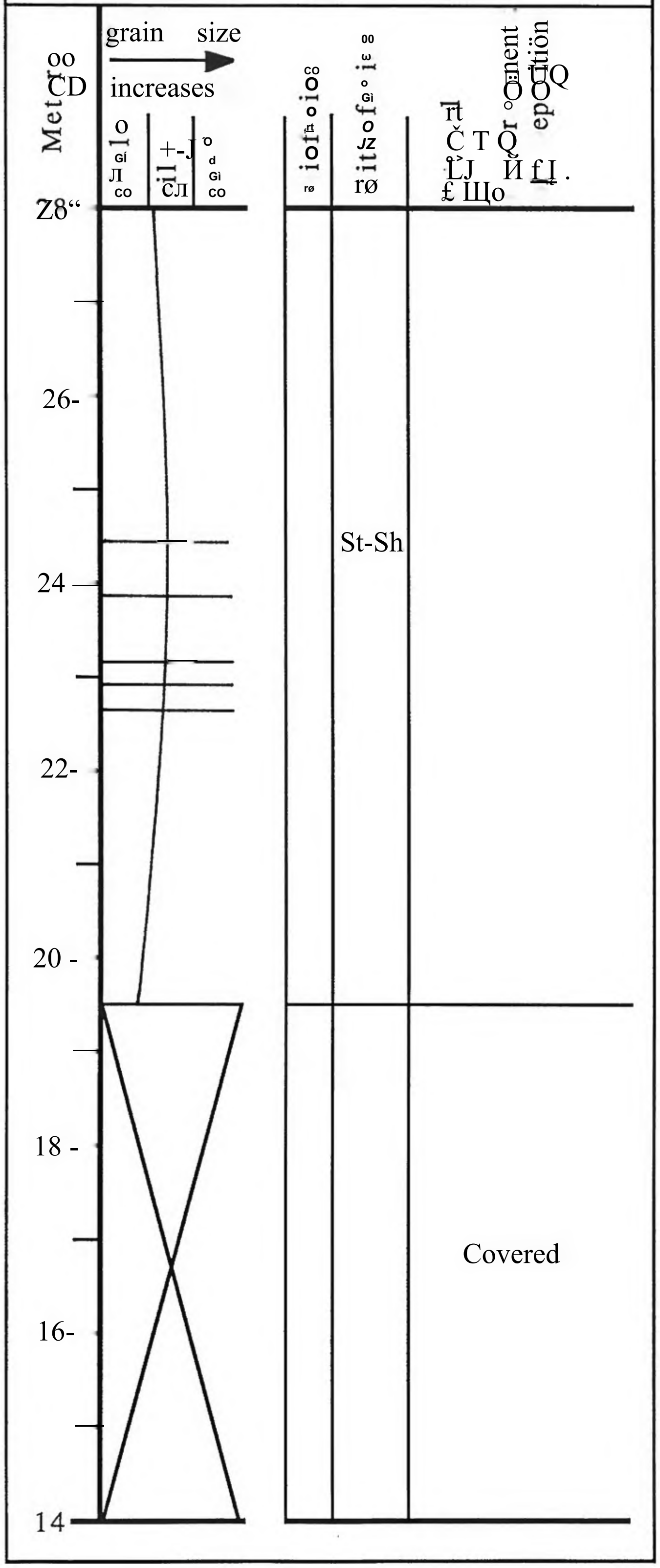
grey, fine grained sandstone, thin uneven beds abundant ripple cross bedding

grey silty shale, finely laminated in thin tabular to wavy beds

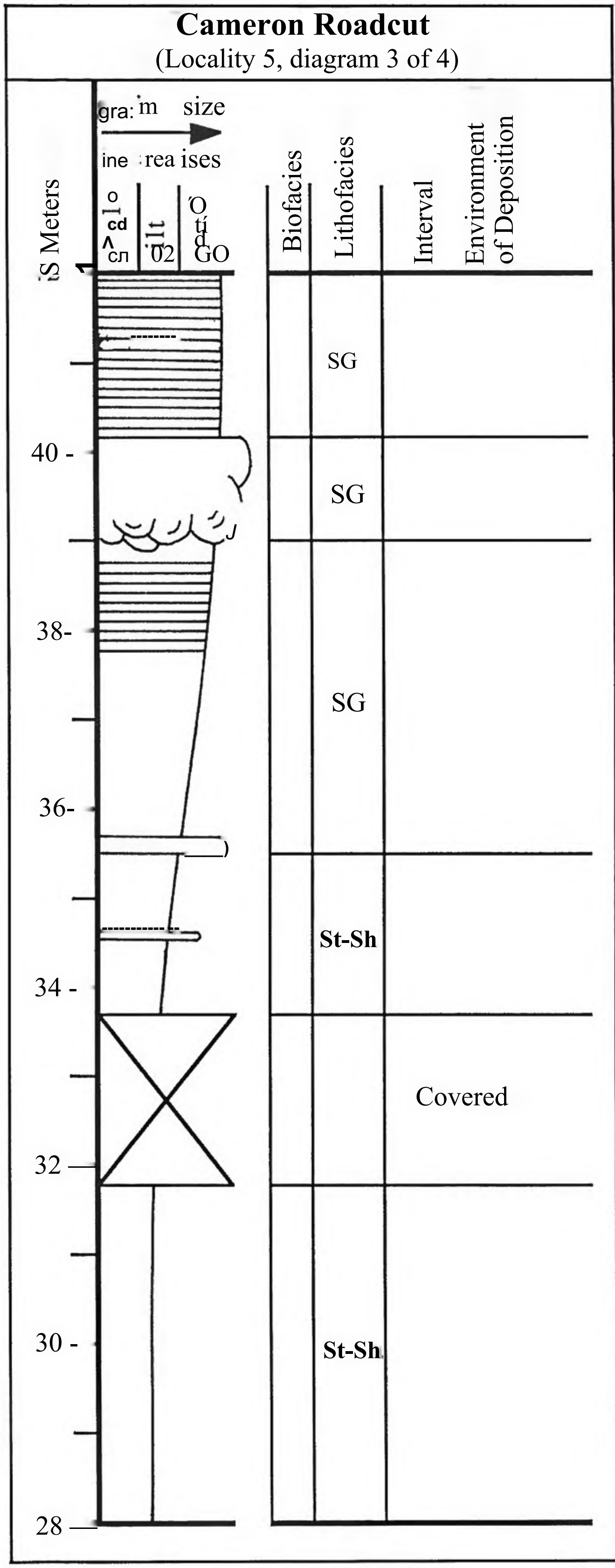
yellow-grey fine grained silty sandstone, abundant mica and plant debris

grey silty shale, sideritic zones sequence coarsens upward

Cameron Roadcut
(Locality 5, diagram 2 of 4)



grey silty shale, sideritic banding, becomes siltier upward, occasional thin (1cm) very fine grained silty sanstone beds, overall blocky laminated texture, abundant mica and plant debris



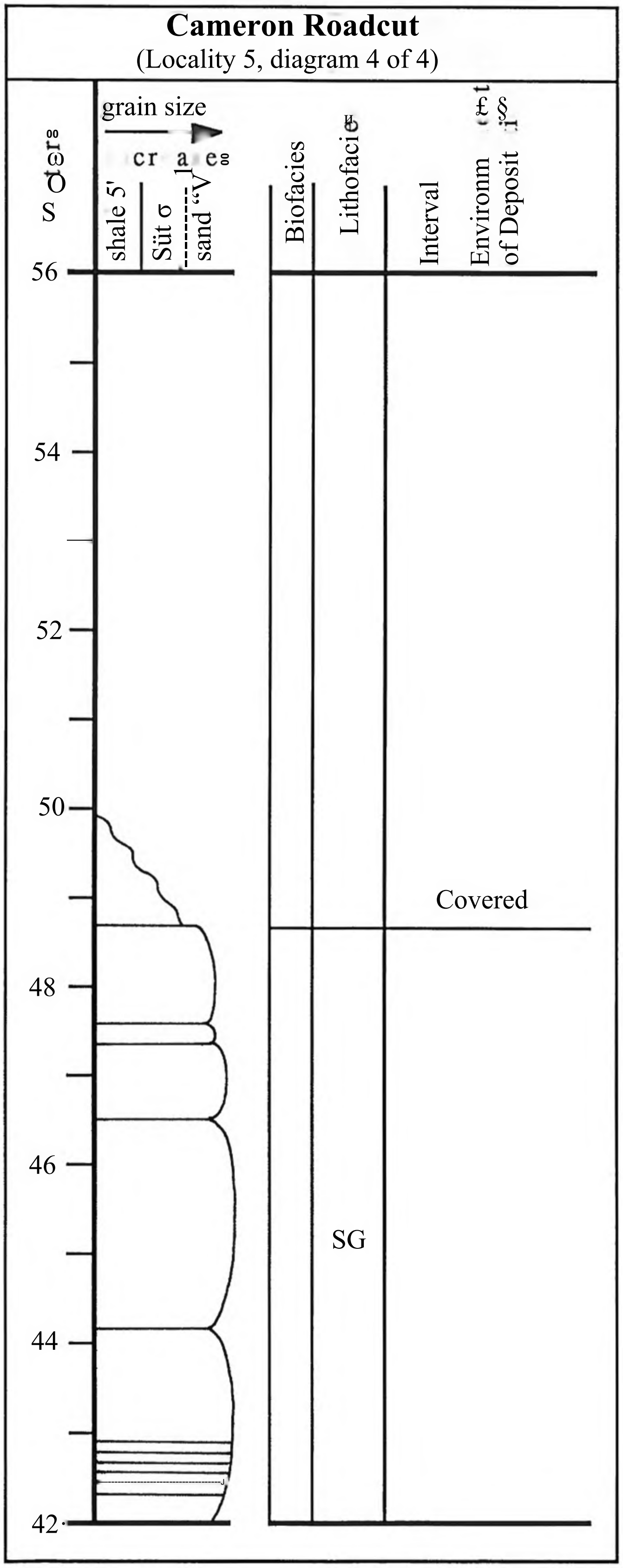
grey, fine grained silty sandstone, very tabular regular bedding, sideritic shaley partings

grey, massive, sideritic silty medium to coarse grained sandstone, very laterally continous throughout the roadcut, large ball and pillow structures and soft sediment deformation is common in the basal portion of the bed

grey, fine grained silty sandstone, tabular bedding, sideritic shaley partings, coarsens upward from silty shale in the lower portion of the unit, several short 2-3cm vertical burrows, (1cm dia.)

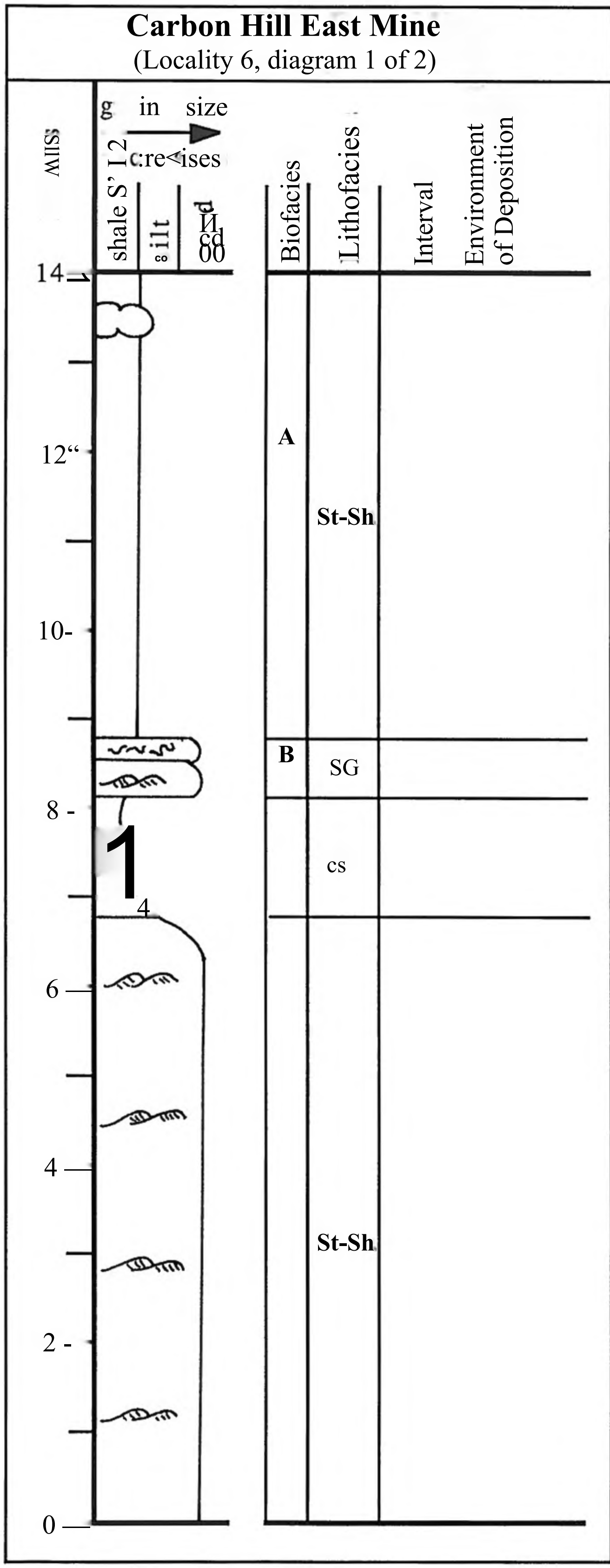
grey silty shale, thin (2-3cm) sandstone beds, wavy laminated texture coarsens upward

grey silty shale, wavy laminated texture, sideritic banding, coarsens upward



grey fine grained silty sandstone and sandy siltstone sideritic banding, bedding becomes less regular upward, abundant mica and plant debris upper 3m are very weathered and vegetated silty sandstone

Name:	**Carbon Hill East Mine**
Location Number:	6
Map Location:	N 1/2, SW 1/4, Sec. 28, T13S, R9W Nauvoo, Alabama 7.5 minute quadrangle
Location:	The Carbon Hill East mine is an old (abouti 5+ years) reclaimed coal mine, parallel to and about 0.5 km north of U. S. 78, the weathered high-wall is about 2 km long, running roughly east to west, the west end is visible from an unnamed Walker County Road.
Total Thickness:	25+ Meters (80+ Feet)
Interval:	The Mary Lee Coal Group crops out at the base of the high-wall.

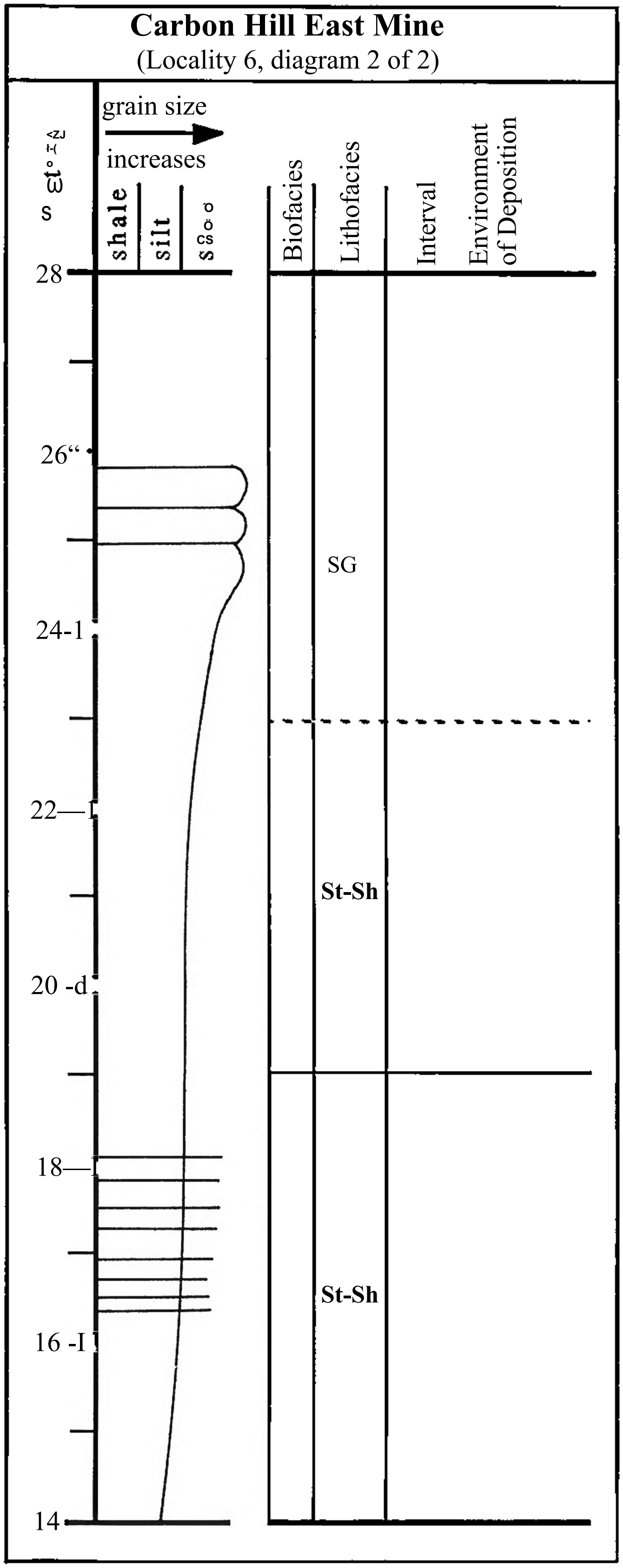


dark grey to black shale, sideritic banding siltier upward

yellow grey medium grained silty sandstone, isolated lenses of ripple bedded sandstone, shaley partings, top 10cm bed is heavily burrowed with 2-3mm horizontal burrows

20cm Vitrinitic coal (possibly the "New Castle" Seam of the Mary Lee Coal Group) carbonaceous 10cm overclay rooted silty sandstone beneath the coal

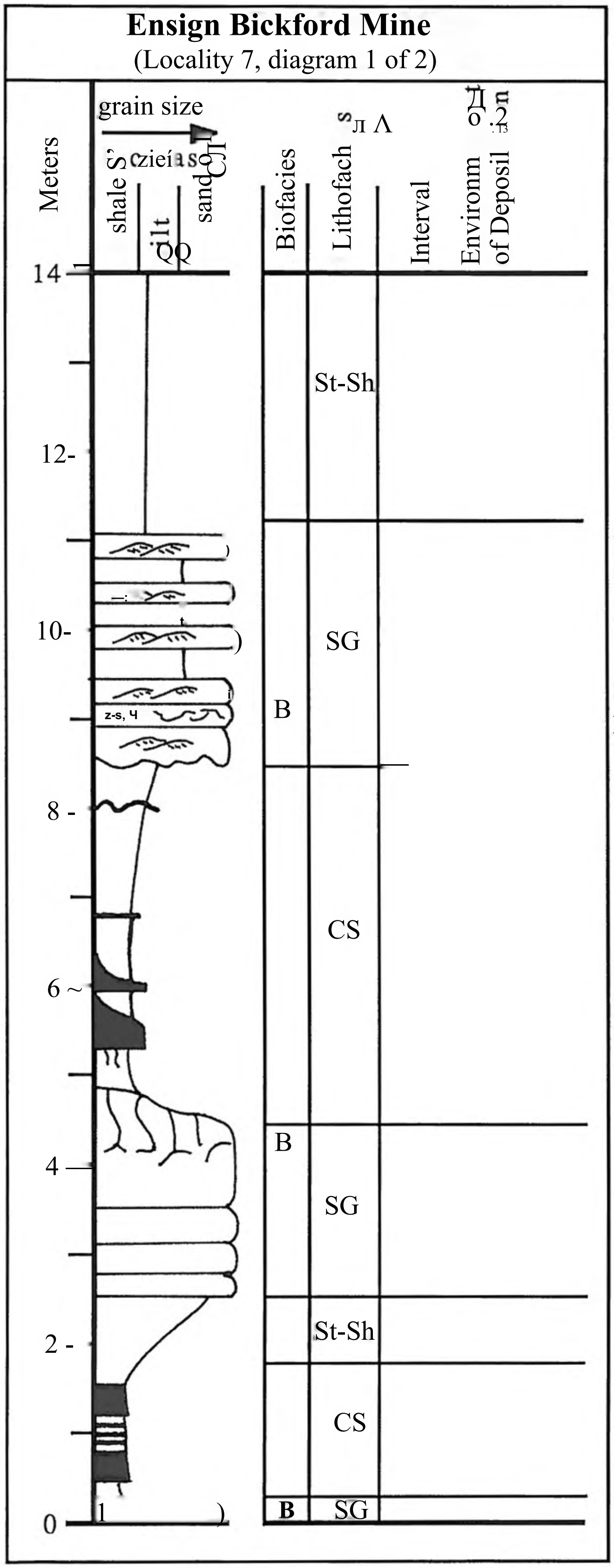
light grey fine to medium grained silty sandstone, abundant ripple cross-bedding throughout, very homogeneous and laterally persistent over 2 km+ of mine highwall, becomes siltier above 6m



Note: above 19m the section appears to coarsen to sandstone at about 25m but due to the vertical highwall face it is extremely difficult to reach

grey silty shale, sideritic banding, very uniform finely laminated texture becomes more tabular as the silt content increases upward, rare fossils between 12m and 16m, 4 specimens were collected, an unidentified brachiopod, the bivalve Wilkingia and two shell fragments

Name:	**Ensign Bickford Mine**
Location Number:	7
Map Location:	NE 1/4, NE 1/4, Sec. 25, T15S, R8W Parrish, Alabama 7.5 minute quadrangle
Location:	The Ensign Bickford Section is located in a reclaimed mine just south of a Walker County Road which runs between The town of Parrish and the town of Oakman. The access road is 3 km (2 miles) east of Oakman, and 6 km (3.5 miles) west of Parrish.
Total Thickness:	20+ Meters (70+Feet)
Interval:	The Pratt Coal Group crops out at the base of the high-wall.
Additional Notes:	The Ensign Bickford Mine is a recently reclaimed mine with intact high-walls which is currently leased by the Ensign Bickford Explosives company as a storage area.



grey silty shale, regular siderite zones, evenly laminated, mottled (bioturbated) beds with are a lumpy texture are common

yellow grey fine grained sandstone, ripple crossbeds, alternating with finely laminated silty shale, the upper 10 cm of the lowest bed is intensely bioturbated the lowest portion contains starved ripples with carbonaceous shale drapes

top coal seam of the Pratt group mostly carbonaceos shale, thin 1-5 cm discontinuous coals are common, the lowest coal is generally persistent but varies between 10 cm to 1m thick, and does pinch out for short (l-5m) distances, at the base is a 30cm rooted underclay

yellow grey, fine to medium grained silty sandstone, well cross-bedded, upper 65 cm contains vertical 1-2 cm dia. sideritic burrows

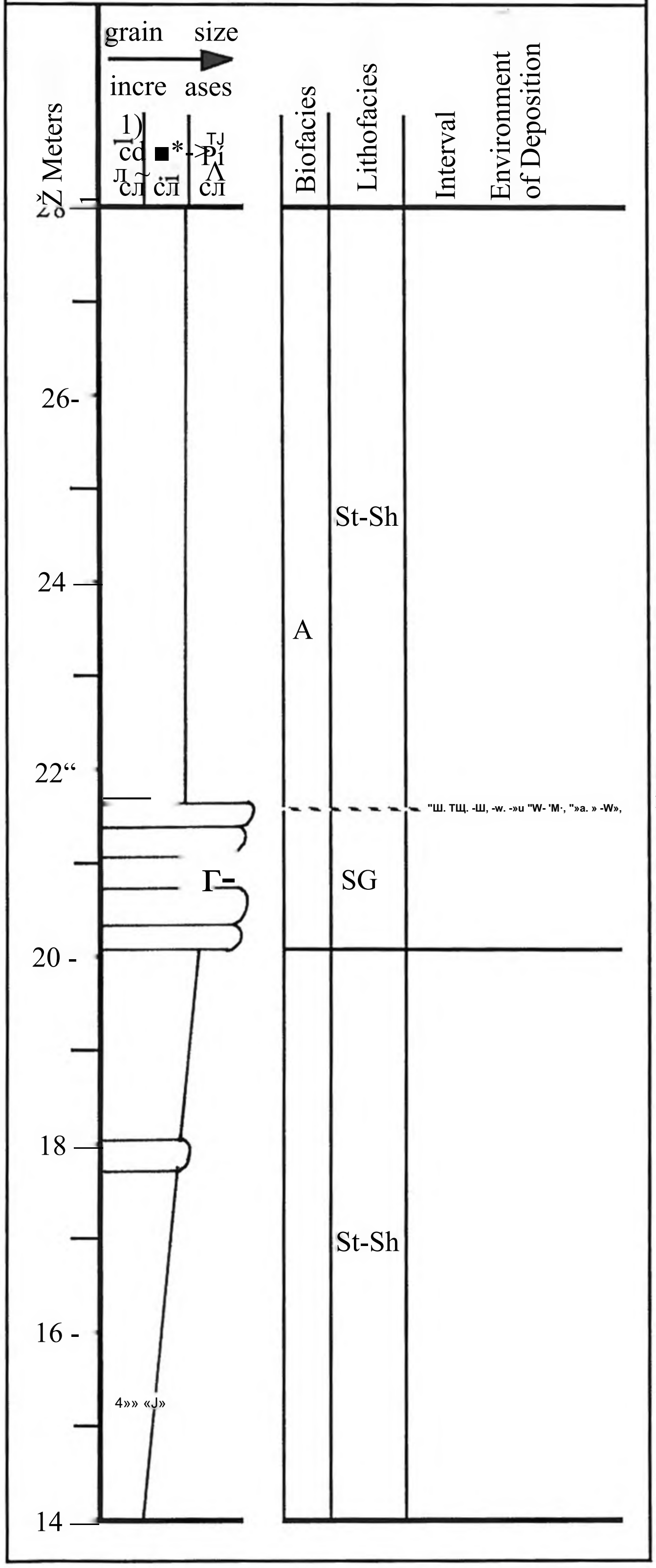
grey, very shaley, silty shale, finely laminated, sideritic zones

finely laminated 20 cm coal, a coal shale, another laminated coal and a 30 cm rooted underclay

yellow-green, laminated fine to medium grained silty sandstone

Ensign Bickford Mine

(Locality 7, diagram 2 of 2)



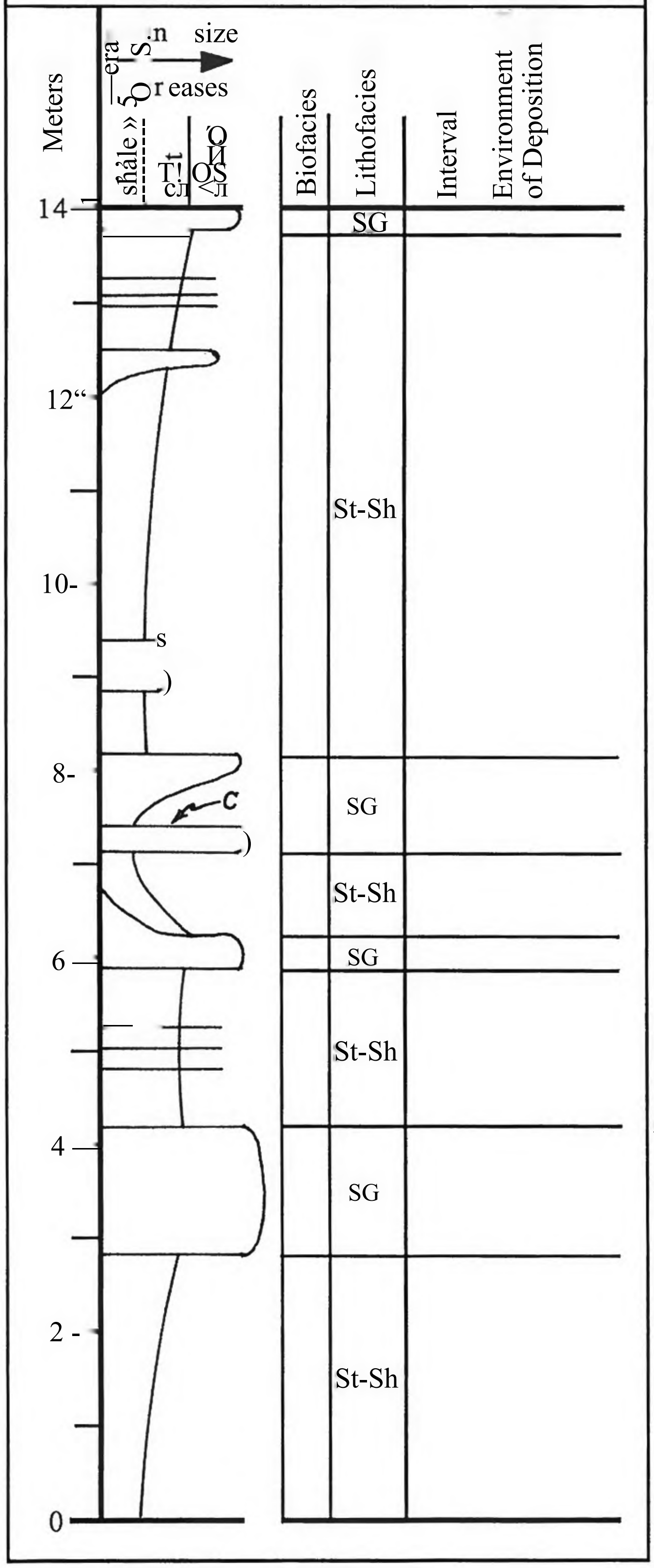
Note: the highwall above 23m is difficult to climb, but it appears to remain grey silty shale for several meters, above 23m several specimens of the bivalve <u>Aviculopectin</u> were found and one <u>Wilkingia</u> as well as many shell fragments

grey, massively bedded, fine to medium grained silty sandstone, abundant mica and fine plant debris, laterally continuous along most of the remaining highwall

grey, silty shale, grain size coarsens upward from about 12m, siltier zones increase in regularity and a mottled texture is less common up section

Name:	**Frozen Hollow Roadcut**
Location Number:	8
Map Location:	SW1/4, SW1/4, Sec.31, T14S, R9W and NW1/4, NW1/4, Sec. 6, T15S, R9W Howard, Alabama, 7.5 minute quadrangle.
Location:	The Frozen Hollow roadcut is on the east valley wall along the road to the Wolf Creek Wildlife Management Area office, just to the south of the Walker County Highway 102 / Wolf Creek crossing.
Total Thickness:	64 Meters (210 Feet)
Interval:	The Pratt seam is exposed along Walker County Highway 102 just below the base of the section. The section it self has no exposed coals, the owner of the land adjacent to the section reports a thick 30-60 cm seam near the crest of the hill several meters above the top of the section, probably a coal in the Cobb Coal Group.
Additional Notes:	This section is highly weathered and heavily vegetated during the summer months. Which may explain the absence of a macro-invertebrate fauna in such a thick section.

Frozen Hollow Roadcut
(Locality 8, diagram 1 of 5)



grey fine grained dirty sandstone beds with wavy contacts and silty shale beds inbetween, abundant mica and plant debris

grey, silty shale, abundant mica and plant debris, several very shaly zones, several thin (1-2 cm) sandstone beds.

grey fine grained micaceous dirty sandstone, thin planar layers of sand and silty shale, marked as "C" is a thin (0.5cm) zone of plant debris, and a white clay layer (5cm) above it.

grey silty shale, wavy laminations, mica and plant debris in the partings

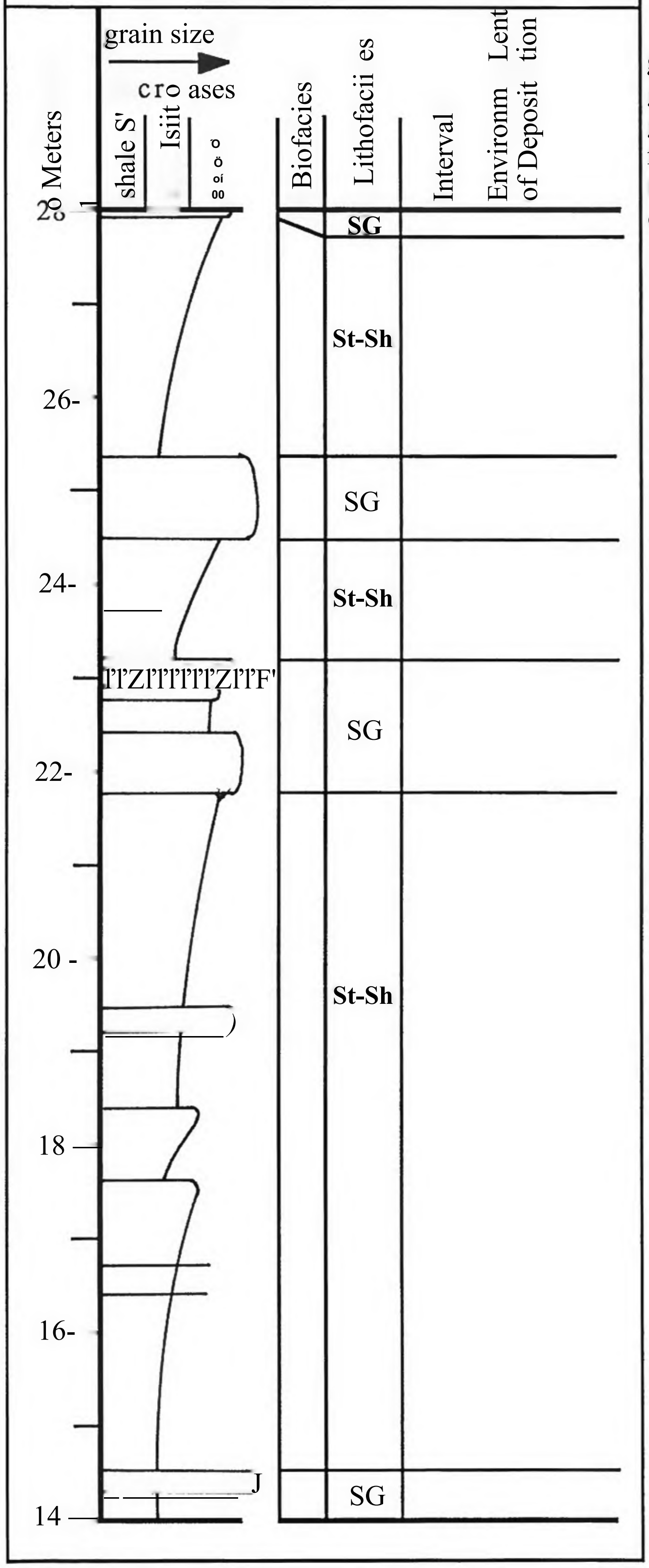
grey fine grained micaceous dirty sandstone, plant debris

grey silty shale, fine wavy laminations, mica and plant debris in partings, several thin (1 cm) fine grained sand stone beds, laterally extensive

grey, fine grained, silty sandstone, abundant mica and plant debris

Very weathered shale with some zones of silty shale

Frozen Hollow Roadcut
(Locality 8, diagram 2 of 5)



grey silty fine to medium grained sand stone, subrounded grains abundant large (1-2 mm) mica flakes, abundant large scale low angle planar cross-beds

grey silty shale, coarsens upward into fine grained silty sandstone. Sand grains are more rounded and the sandstone is less dirty than sand bodies below this point

grey fine grained dirty sandstone, planar laminations

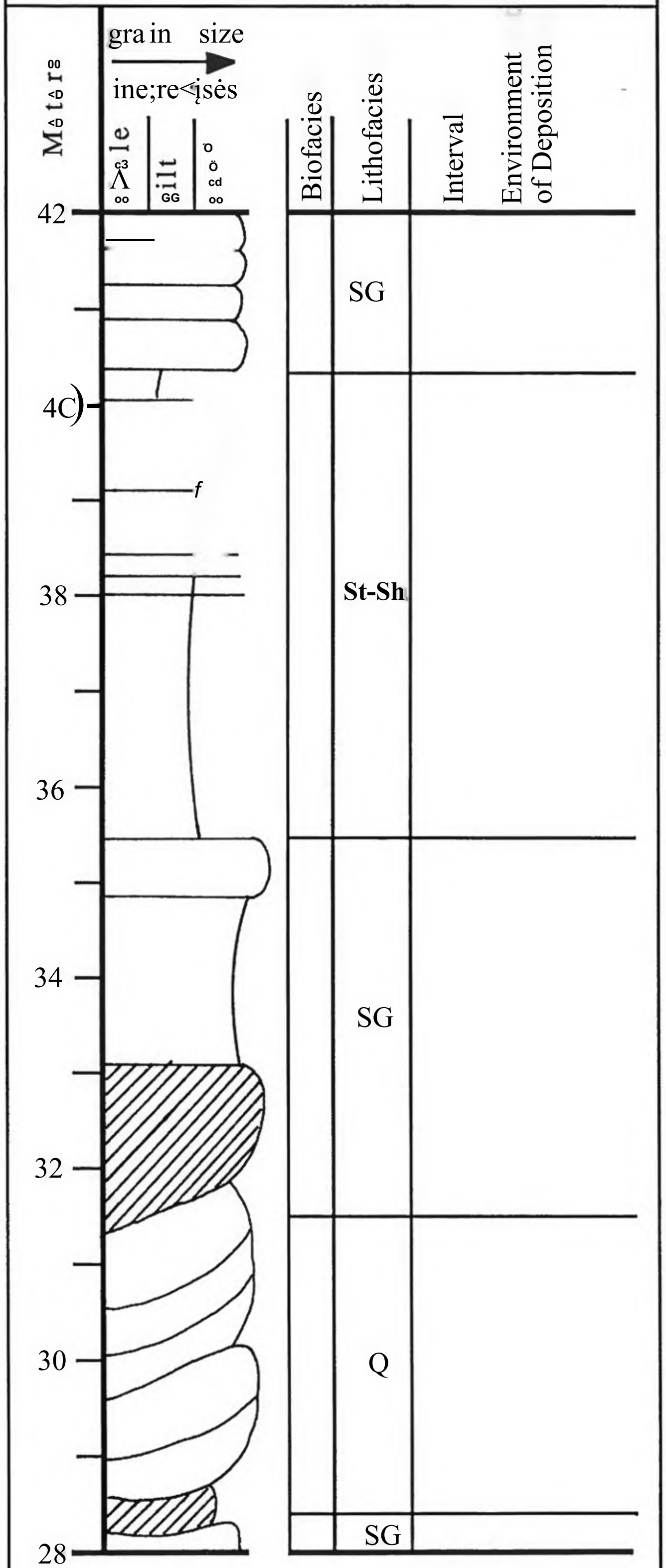
grey finely laminated silty shale

grey fine grained dirty sandstone , abundant mica and plant debris, beds have sharp wavy contacts, with silty shale between

grey silty shale, occasional beds of grey dirty sandstone abundant mica and plant debris shaley portions occur in very fine laminations and sandstone beds often have sharp contacts sandy zones have a mottled bioturbated texture, this portion of the section is composed of several coarsening upward sequences

See top of last page.

Frozen Hollow Roadcut
(Locality 8, diagram 3 of 5)



grey fine grained dirty sandstone, abundant mica and plant debris, obscure horizontal traces on contact surfaces

grey shaley siltstone and very fine grained sandstone, abundant mica and large plant fragments (1-3 cm), wavy bedding

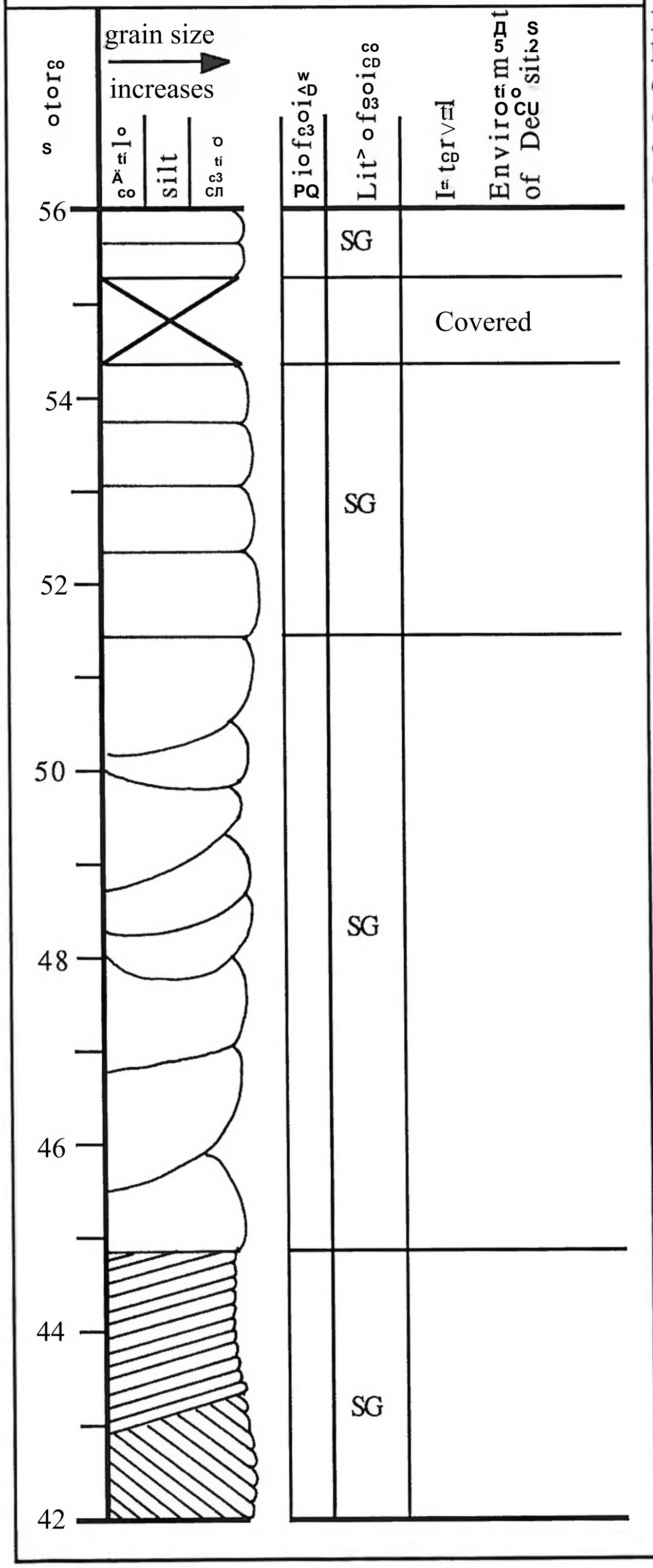
Grey silty sandstone fine to medium, subrounded grains, micaceous, large planar cross-beds, lense shaped zones of fine wavy silt beds, with ripple laminations

light grey quartzitic sandstone medium to coarse, subrounded quartz grains, large (l-2mm) mica flakes, occurs as a lense shaped sandstone body with abundant cross-bedding and an erosional base with sole marks and large plant fossils

See top of the previous page.

Frozen Hollow Roadcut

(Locality 8, diagram 4 of 5)



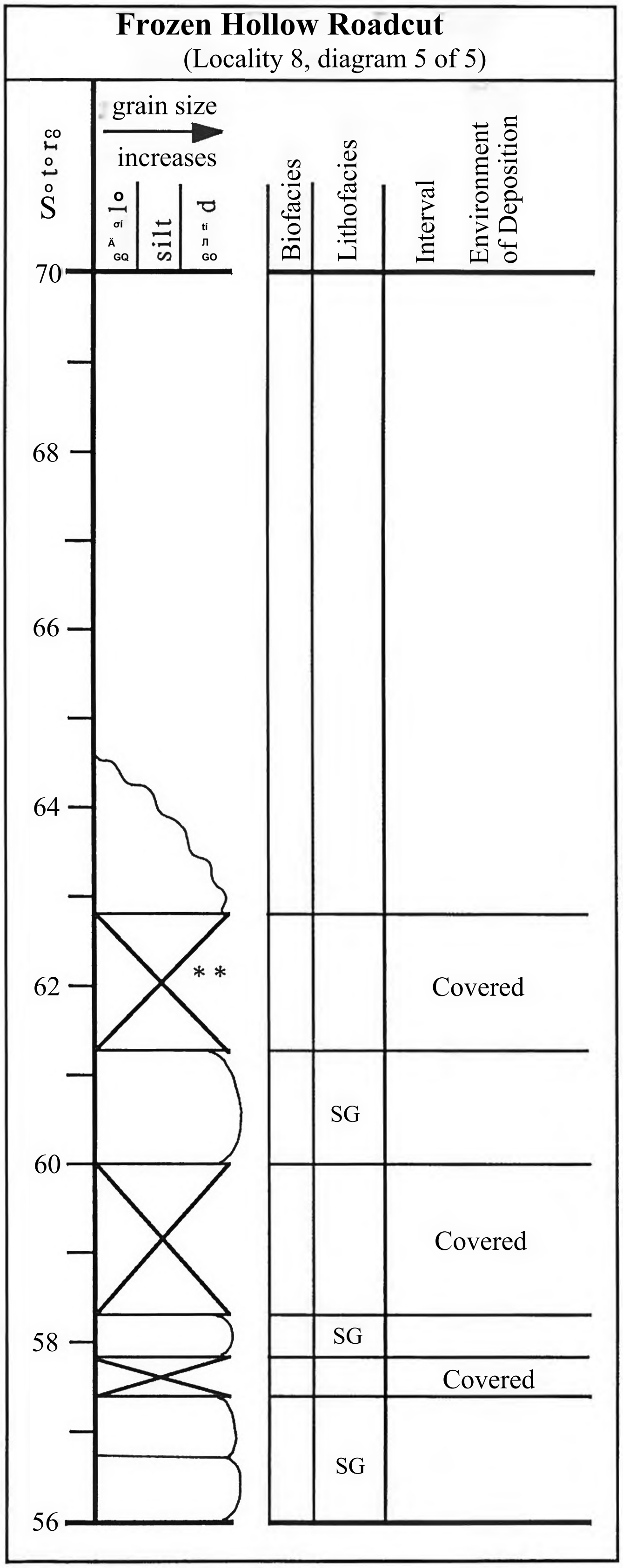
Note: the outcrop above 51m is heavily vegetated and mostly covered, the remaining described section is a composit of many low, weathered, outcrops

see next page

grey fine to medium grained, subrounded quartz sandstone, small silt fraction, abundant mica and dark sand grains

grey fine to medium grained, subrounded quartz sandstone, long low angle crossbeds, the top of this set of sandstone beds crops out with great regularity along both sides of the Frozen Hollow valley

grey fine to medium grained subrounded quartz sandstone, in large scale, low angle planar cross-bedding, cross-sets 2-4 cm thick

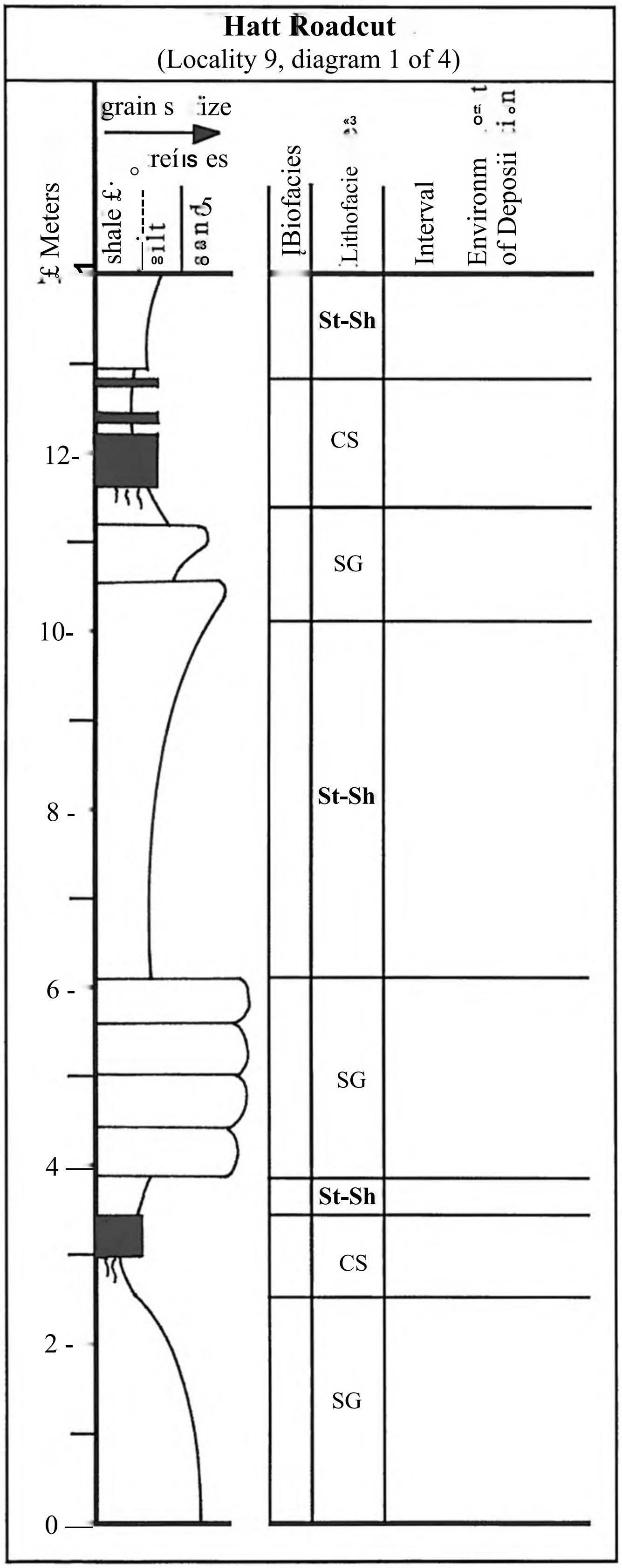


top of the outcrop is weathered pink, sandy siltstone.

**Note: The owner of the land adjacent to the roadcut reports a coal seam several 10's of cm thick at approximately 62m which was exposed during the excavation for the footing of his house, and more recently when a garage was built

grey, fine to medium grained micaceous sandstone, subrounded quartz grains with some horizontal laminations present

Name:	**Hatt Roadcut**
Location Number:	9
Map Location:	NE1/4, SE1/4, & Sl/2, NW1/4, Sec27, T15S, R7W Parrish, Alabama 7.5 minute quadrangle.
Location:	A collection of several road cuts along Alabama State Highway 269, Just north of the town of Hatt, and about 3 km (2 miles) south of the town of Parrish.
Total Thickness:	55 Meters (180 Feet)
Interval:	Two Pratt Coal Group seams are present near the base of the northern Roadcut.
Additional Notes:	The lowest coal seam in the following description could not be located in the actual road cut but was measured in the shallow excavations of an adjacent timber storage area.



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60cm vitrinitic coal, (probably a seam in the Pratt Coal Group) silty carbonaceous overclay, with many thin 1-2cm lenses of coal, white rooted underclay grades downward into silty shale

grey fine to medium grained silty sandstone, as the top of coarsening upward sequences

grey silty shale, well laminated to blocky texture,

Note: 5m -10m portion is heavily vegetated

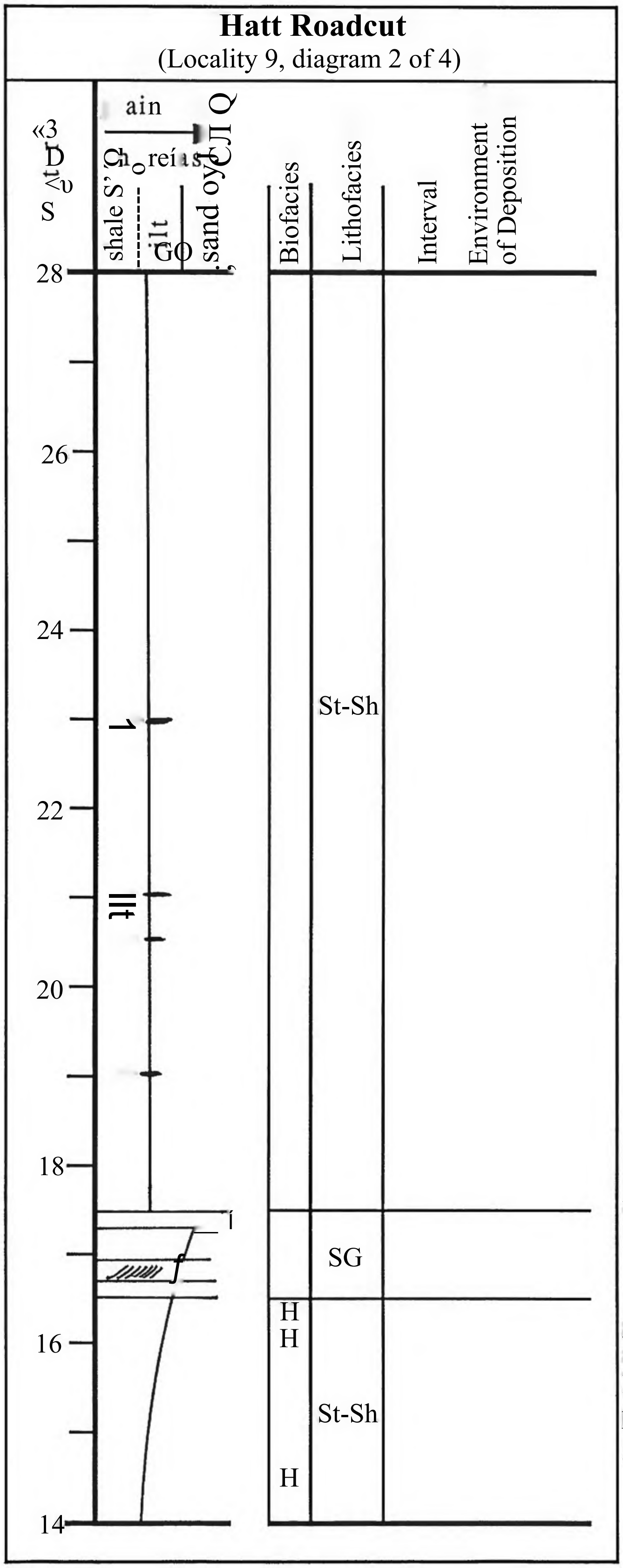
grey medium to coarse grained silty sandstone, massively bedded laterally continuous body, weathered and heavily vegetated

grey silty shale, blocky texture

40 cm weathered coal, probably a seam in the Pratt Coal Group 50cm rooted underclay grades into silty sand

very silty sandstone, very weathered and leached

Note: 0m -17m are described from the northern portion of the Hatt roadcut.

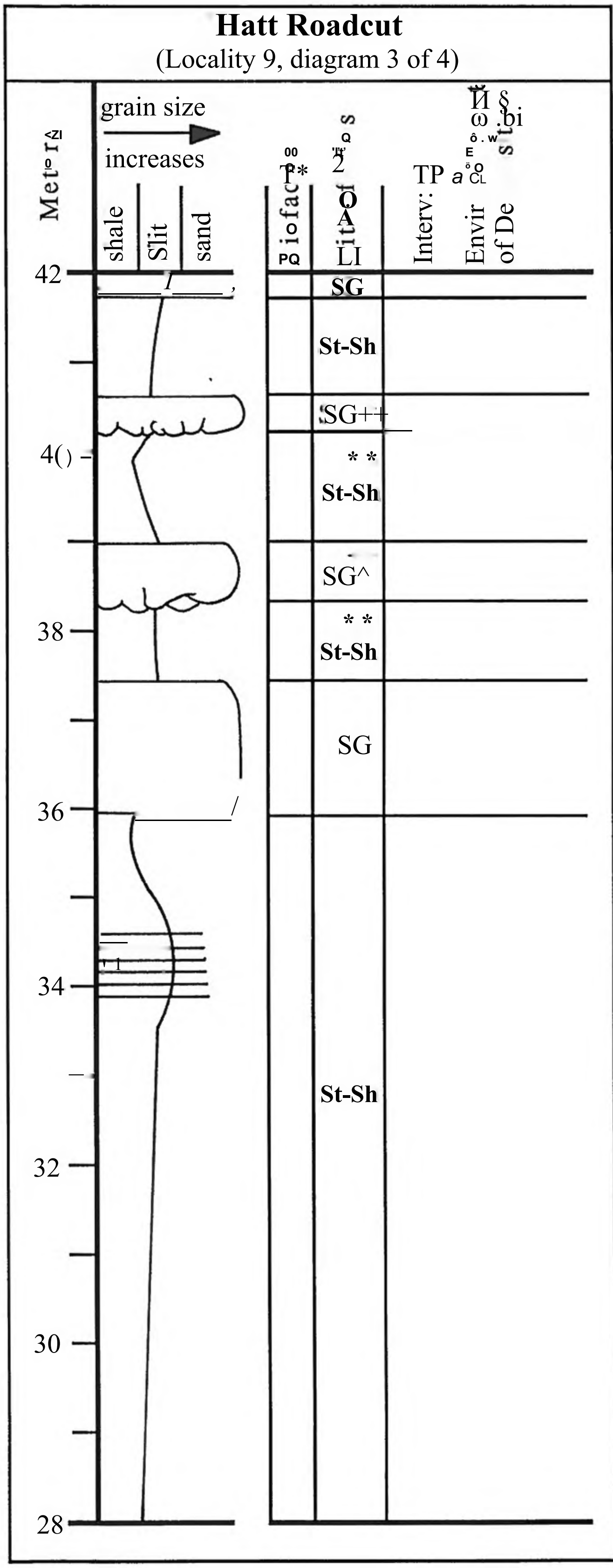


grey, silty shale, very uniform blocky to wavy laminations, regular evenly spaced sideritic zones are comon through out this portion of the section, upward coarsening

Note: 17m and above are described from the southern portion of the roadcut.

grey fine to medium grained silty sandstone, interbedded with silty shale with a blocky laminated texture

grey silty shale, abundant mica and plant debris, blocky to well laminated texture, several persistent zones of Helminthopsis



Note: see bottom of next page

grey silty shale, thin even laminations, mottled (bioturbated) texture

++ (same as marked SG)

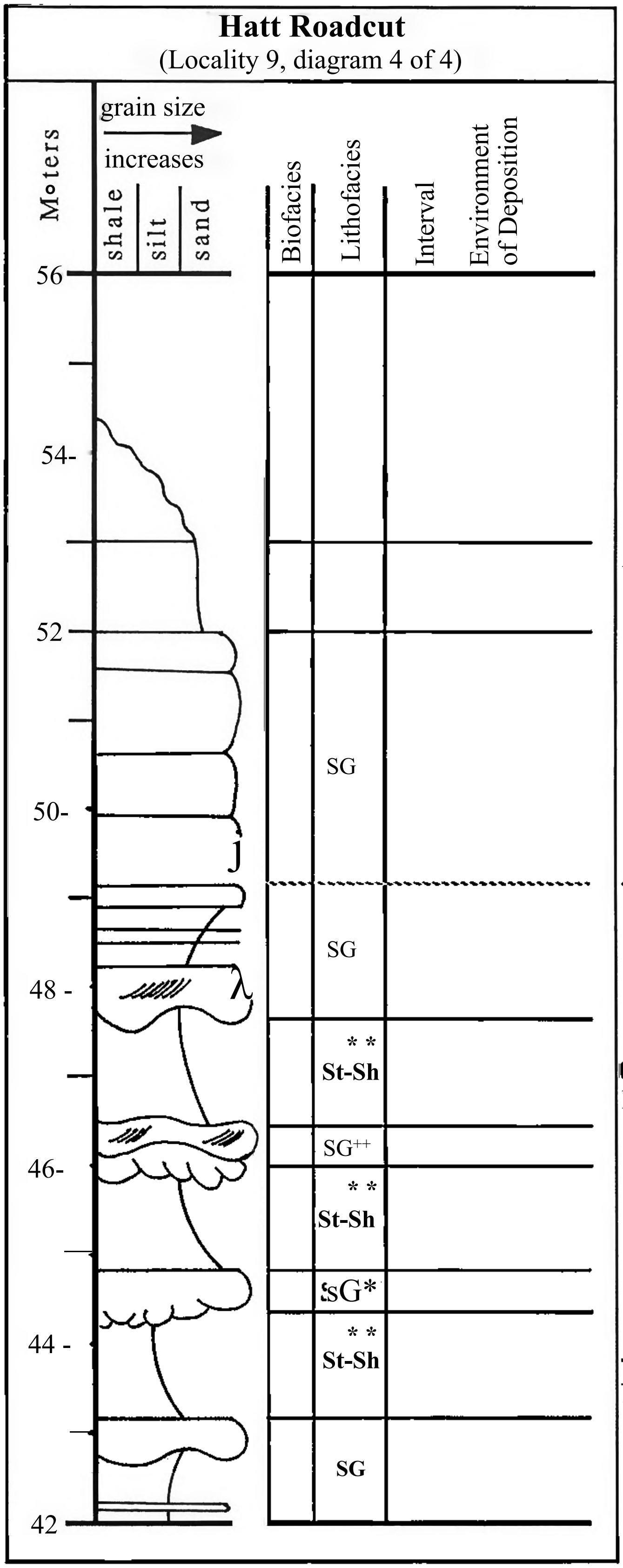
** (same as marked St-Sh)

++ grey, fine grained sandstone, laterally continuous with soft sediment deformation prominent in the basal contact

**grey silty shale, fines upward to a blocky textured shale, from laminated lower portion

grey, silty, fine grained sandstone, in planar beds with sharp contacts with evenly spaced sideritic zones.

grey, silty shale, very uniform blocky to wavy laminations, regular evenly spaced sideritic zones are comon through out this portion of the section, coarsening upward, the occurence of thin ripple cross-bedded sandstone beds becomes more common between 33m to 36m, and increases to a maximum at 35m with a number of laterally continuous thin (1-2 cm) sandstone beds with common ripple cross-bedding, sandy and very silty beds often have a bioturbated mottled appearence



Top of the hill and of the outcrop, heavily vegetated

very weathered pink silty shale

grey, fine to medium grained silty sandstone,poorly preserved cross-bedding

grey, fine to medium grained silty sandstone, discontinuous tabular beds, interbedded finely laminated, silty shale, basal sandstone bed is crossbedded

**grey silty shale, fines upward to a blocky textured shale, from laminated lower portion

++ (plus cross-beds)

**grey silty shale, fines upward to a blocky textured shale, from laminated lower portion

++ (plus cross-beds)

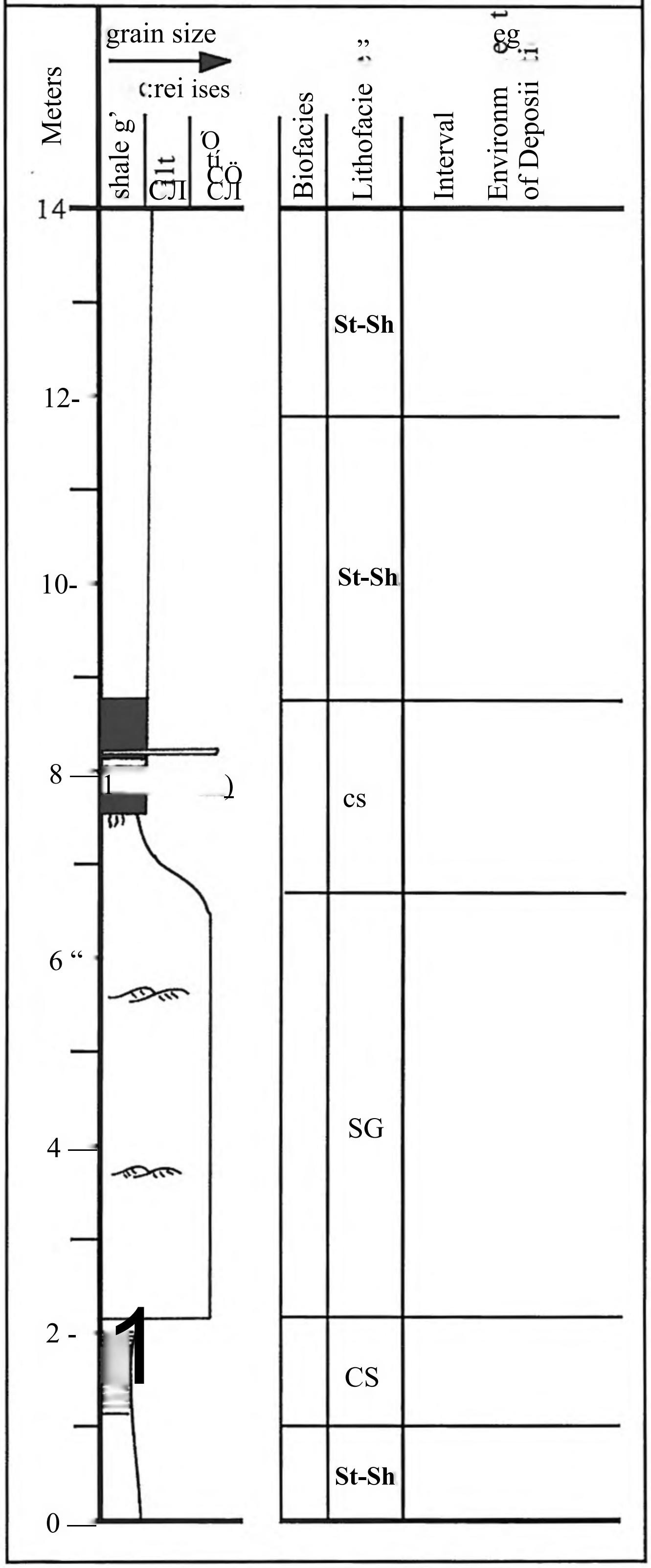
**grey silty shale, fines upward to a blocky textured shale, from laminated lower portion

grey silty, fine grained sandstone beds (l-8cm), interbedded with mottled (bioturbated) silty shale, very persistent laterally

Name:	**Hope / Galloway Mine**
Location Number:	10
Map Location:	s 1/2, NE1/4, Secl4, T13S, R10W Carbon Hill Alabama, 7.5 minute quadrangle
Location:	An active coal Mine just north west of the city Carbon Hill operated by Gateway Malls Inc.
Total Thickness:	40 Meters (130 Feet)
Interval:	Mary Lee Coal Group is mined at the base of the section.
Additional Notes:	The described section is a composit of portions of several highwalls exposed in the Hope / Galloway mine complex north and west of the city of Carbon Hill.

Hope / Galloway Mine

(Locality 10, diagram 1 of 3)



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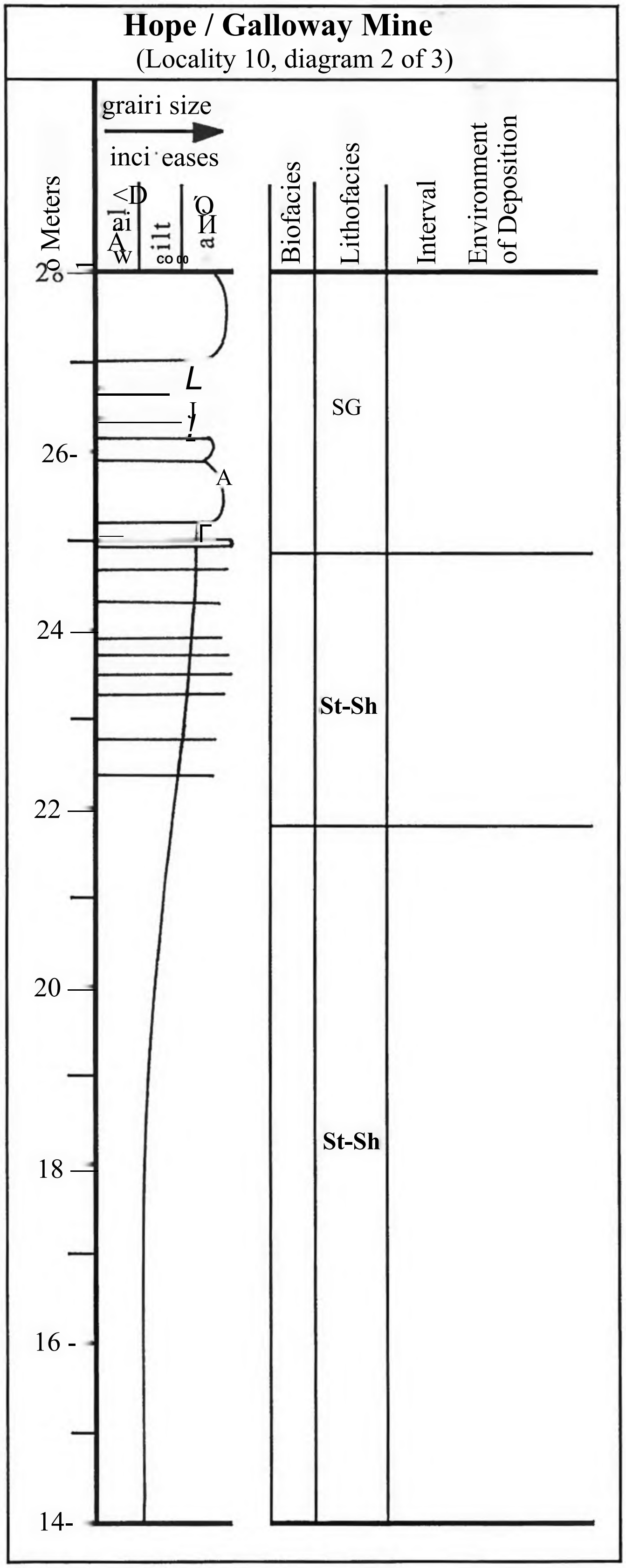
dark grey shale, blocky laminated texture, uniform in appearence along the highwall face

/ 1.8 m interval of vitrinitic coal, (Mary Lee Coal Group) coal shale, and yellow-grey sandstone, the interval undulates in height up to 2m along the highwall, 65cm rooted silty underclay

grey fine to medium grained silty sandstone and silty shale abundant ripple crossbeds, mica and plant debris

/ 30 cm vitrinitic coal (Mary Lee Coal Group), several centimeters of carbonaceous shale above and below the coal

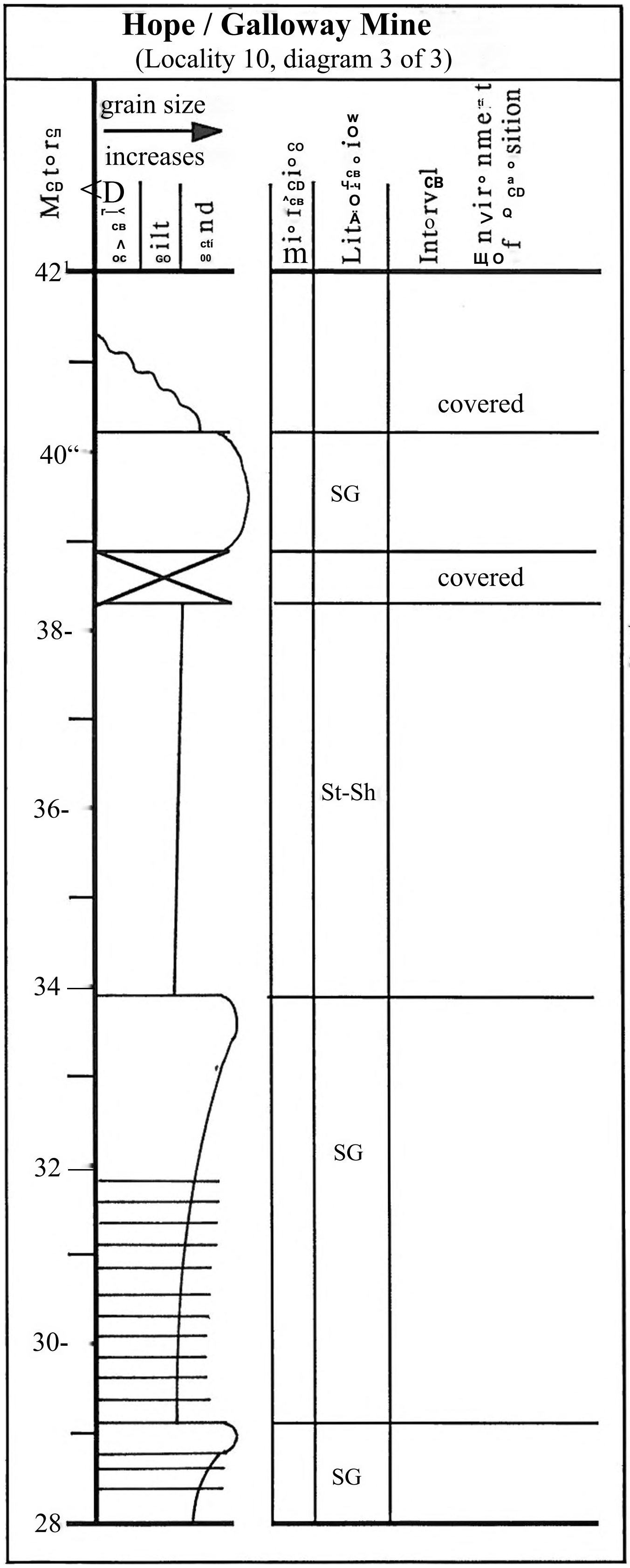
grey silty shale, tabular to wavy beds, sideritic banding



grey fine to medium grained silty sandstone, abundant mica and plant debris, laterally persistent, small scale soft sediment deformation is common

grey silty shale, coarsening upward, wavy to tabular laminations, many thin (2-3cm) fine grained silty sanstone beds

grey silty shale, sideritic banding, very uniform along the highwall, coarsening upward, bedding texture varies from blocky to wavy laminations as the silt content increases upward



top of the highwall

weathered, grey, medium to coarse grained sandstone, massively bedded

very weathered silty shale and sandy silt

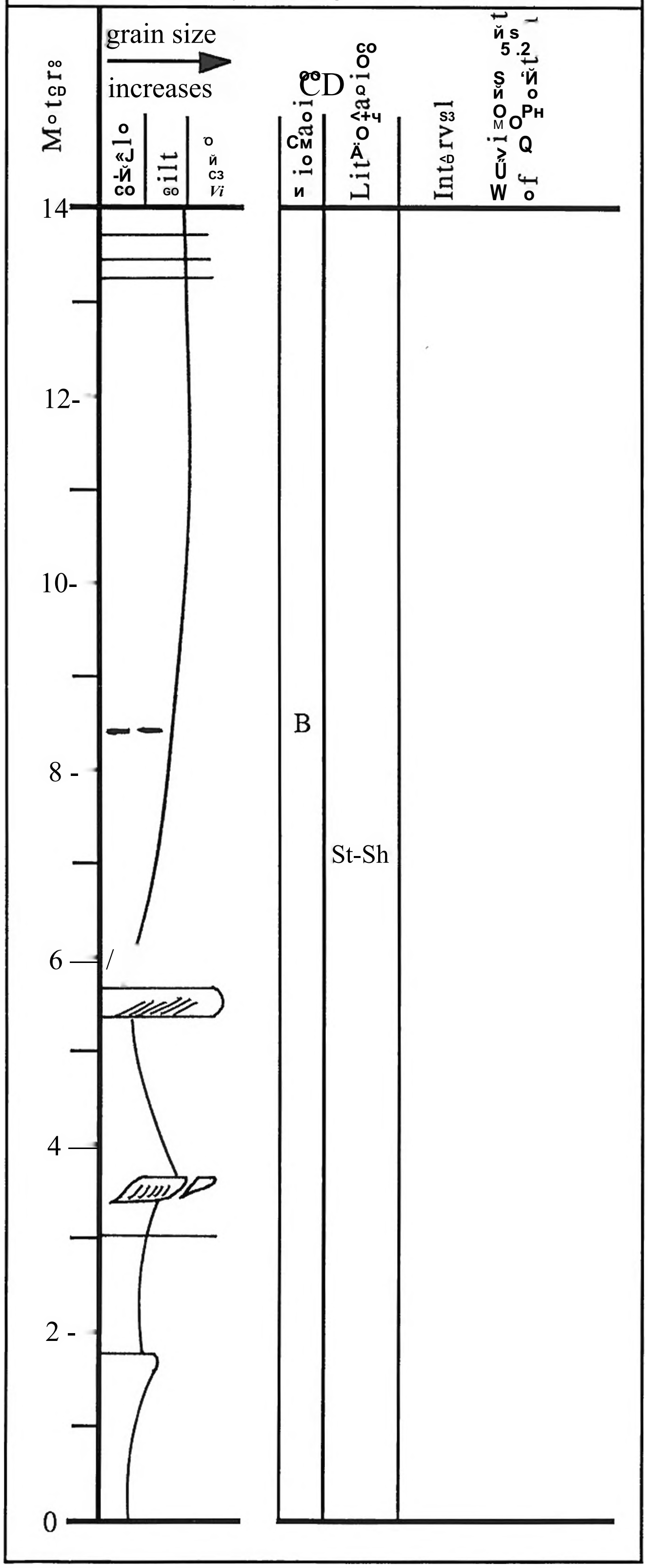
grey, fine grained silty sandstone, coarsens upward from, silty shale with many thin (1-3 cm) wavy to tabular sandstone beds

see top of last page

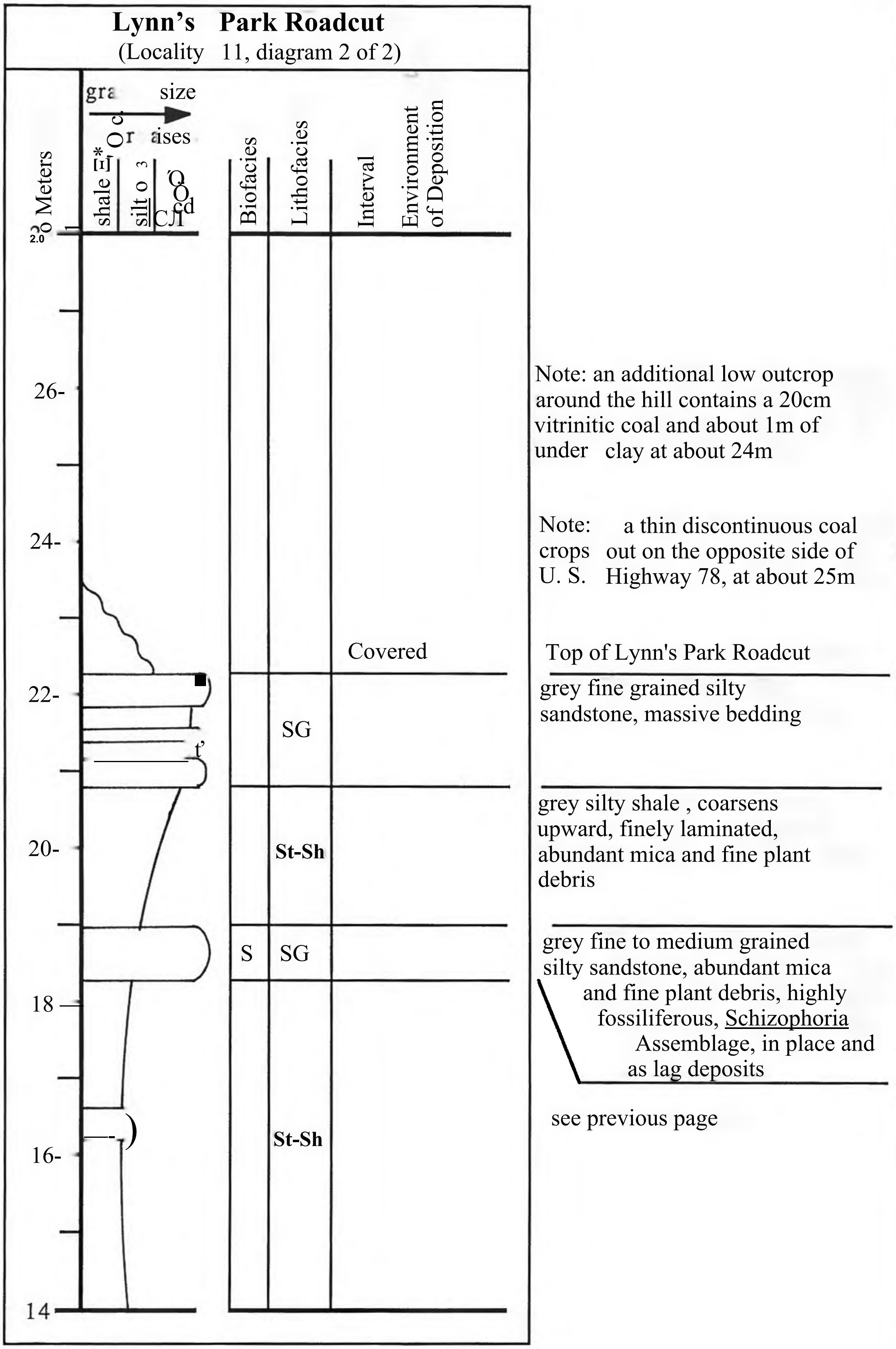
Name:	**Lynn's Park Roadcut**
Location Number:	11
Map Location:	E1/2, NE1/4, Sec.22, T14S, R6W Cordova, Alabama 7.5 minute quadrangle
Location:	A collection of several road cuts along both sides of U. S. 78, in the west valley wall of the Mulberry Fork of the Warrior River.
Total Thickness:	24.1 Meters (79 Feet)
Interval:	The section covers much of the Mary Lee Couplet.
Additional Notes:	Also exposed around the hill from the Lynn's Park Roadcut is a 30 + cm Coal with an thick underclay, located near the crest of the hill is a large abandoned coal mine in the Mary Lee Coal Group, with a thick 60 cm seam exposed at the base of the high wall (Mary Lee Seam).

Lynn's Park Roadcut

(Locality 11, diagram 1 of 2)

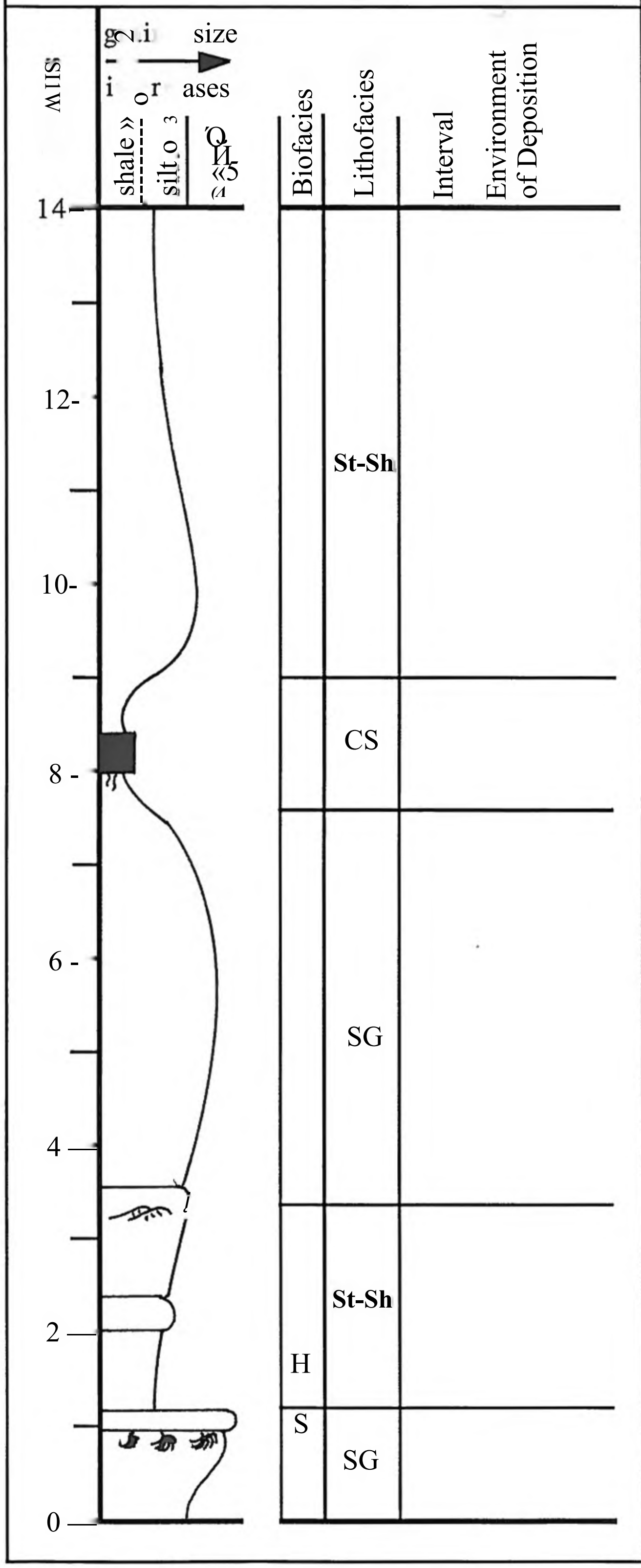


grey shale, grey silty shale and rare thin (1cm) sandstone beds very laterally continuous, some silty beds have a mottled (bioturbated) texture, shaley beds often have a blocky texture which grades to laminar as the silt content increases, evenly spaced sideritic bands are common and a laterally persistent zone of nodular siderite occursat 8.5m, mica and fine plant debris are abundant.


Lynn's Park Roadcut
(Locality 11, diagram 2 of 2)
Meters
shale
silt
size
Biofacies
Lithofacies
Interval
Environment of Deposition
26-
24-
22-
20-
18
16-
14
Covered
SG
St-Sh
S
SG
St-Sh
Note: an additional low outcrop around the hill contains a 20cm vitrinitic coal and about 1m of under clay at about 24m
Note: a thin discontinuous coal crops out on the opposite side of U. S. Highway 78, at about 25m
Top of Lynn's Park Roadcut
grey fine grained silty sandstone, massive bedding
grey silty shale , coarsens upward, finely laminated, abundant mica and fine plant debris
grey fine to medium grained silty sandstone, abundant mica and fine plant debris, highly fossiliferous, Schizophoria Assemblage, in place and as lag deposits
see previous page

Name:	**Port Walker Roadcut & Mine**
Location Number:	12
Map Location:	SE1/4, SW1/4, Sec. 23, T14S, R6W Cordova, Alabama 7.5 minute quadrangle
Location:	A long road cut along the access road to the Port Walker Coal Loading facility just off of U. S. 78 on the East Bank of the Mulberry Fork.
Total Thickness:	25 Meters (82 Feet)
Interval:	The exposed coal may be the lowest seam in the Mary Lee Coal Group or the Lick Creek seam of the Black Creek Coal Group.
Additional Notes:	The section described below is a composit of the section exposed just off of U. S. Highway 78 and the exposures in an abandoned coal mine now used as a coal storage area and port facility. The uncertainty concerning the stratigraphic position of the coal seam is related to the possibility of local faulting.

Port Walker Roadcut & Mine
(Locality 12, diagram 1 of 2)



grey shale, and grey silty shale finely laminated, evenly spaced sideritic zones, shale has a blocky texture and becomes more laminar as the unit coarsens and becomes more silty upward

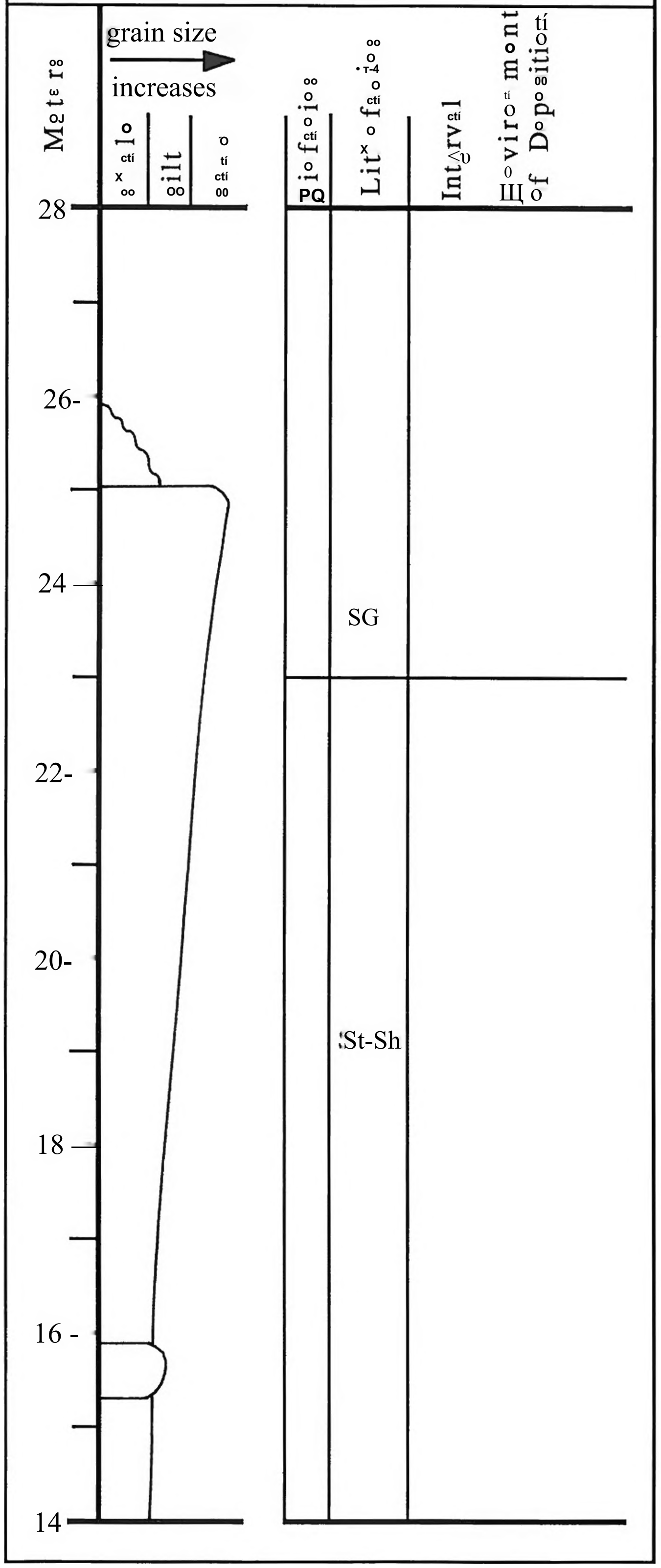
20 cm vitrinitic coal, several cm of coal shale at the base, 20 cm overclay, 100cm underclay both coarsen gradationally coal pinches to the south along the roadcut

grey very fine to fine grained silty sandstone, wavy bedding mottled to distinct burrows, 1) quasiplanar burrows 5mm in diam. 2) inclined burrows 2-3 mm in diam., shaley zones contain sideritic nodules, unit coarsens upward to a medium grained subangular quartz sandstone with about 10% red unidentified grains.

grey silty shale, sideritic zones sandy silt zones show ripple cross-bedding generally well bioturbated, Helminthopsis is often present

grey fine grained silty sandstone, fossils, Schizophoria Assemblage; Brachiopods and Zoophycos, abundant mica and plant debris

Port Walker Roadcut & Mine
(Locality 12, diagram 2 of 2)



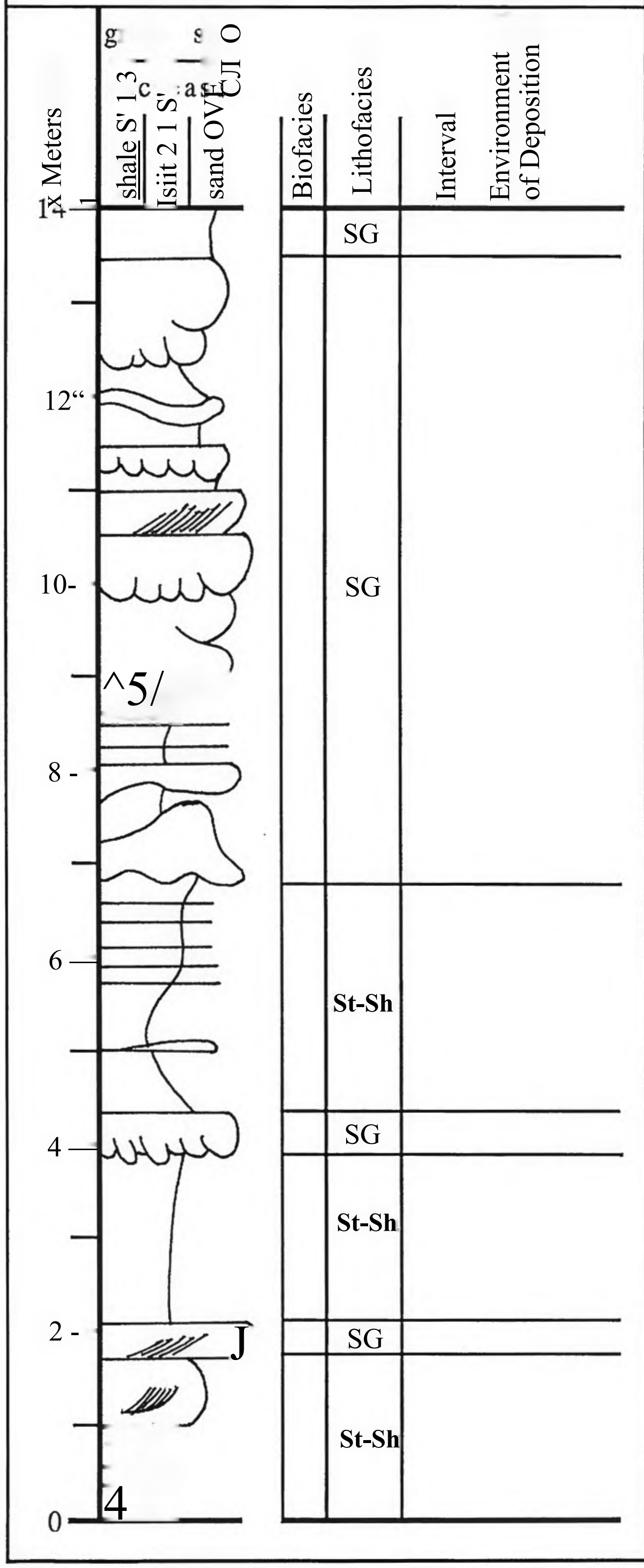
yellow grey, fine grained silty sandstone, abundant mica and fine plant debris, even tabular beds, very weathered and vegetated

grey silty shale, siderite zones moderately weathered, silty beds coarsen and thicken upward

Name:	**Summiton Roadcut**
Location Number:	13
Map Location:	NW1/4, NW1/4, Sec.4, T15S, R5W and SW1/4, SW1/4, Sec. 33, T14S, R5W and SE1/4, SE1/4, Sec. 32, T14S, R5W Sipsey, Alabama 7.5 minute quadrangle
Location:	A collection of several road cuts along both sides of U. S. 78, at the west end of the Summition city limits.
Total Thickness:	67.2 Meters (220 Feet)
Interval:	The Mary Lee Coal is exposed in the middle of the section
Additional Notes:	The section is a composit of several roadcuts. Some ambiguity remains as to the placement and number of coals present. A similar coal is exposed in three seperate areas, each at different elevations of several meters. Two possible explanations are that two or more coals are present but only one is exposed in each area due to the vegetated and heavily weathered nature of the outcrop, or that a small fault has displaced the various segments of outcrop which contain a coal seam.

Summiton Roadcut

(Locality 13, diagram 1 of 5)



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grey fine to medium grained silty sandstone, large cross-beds, to ripple cross-beds, basal contacts of sandstone beds often show soft sediment deformation structures which overlie shale beds with a blocky texture, sandstone beds are generally continuous though individual beds often pinch out in less than 10m, mica and fine plant debris is prevalent on parting surfaces

grey silty shale, finely laminated to blocky texture, sideritic zones, a few thin (1 cm) continuous beds of very fine grained sandstone

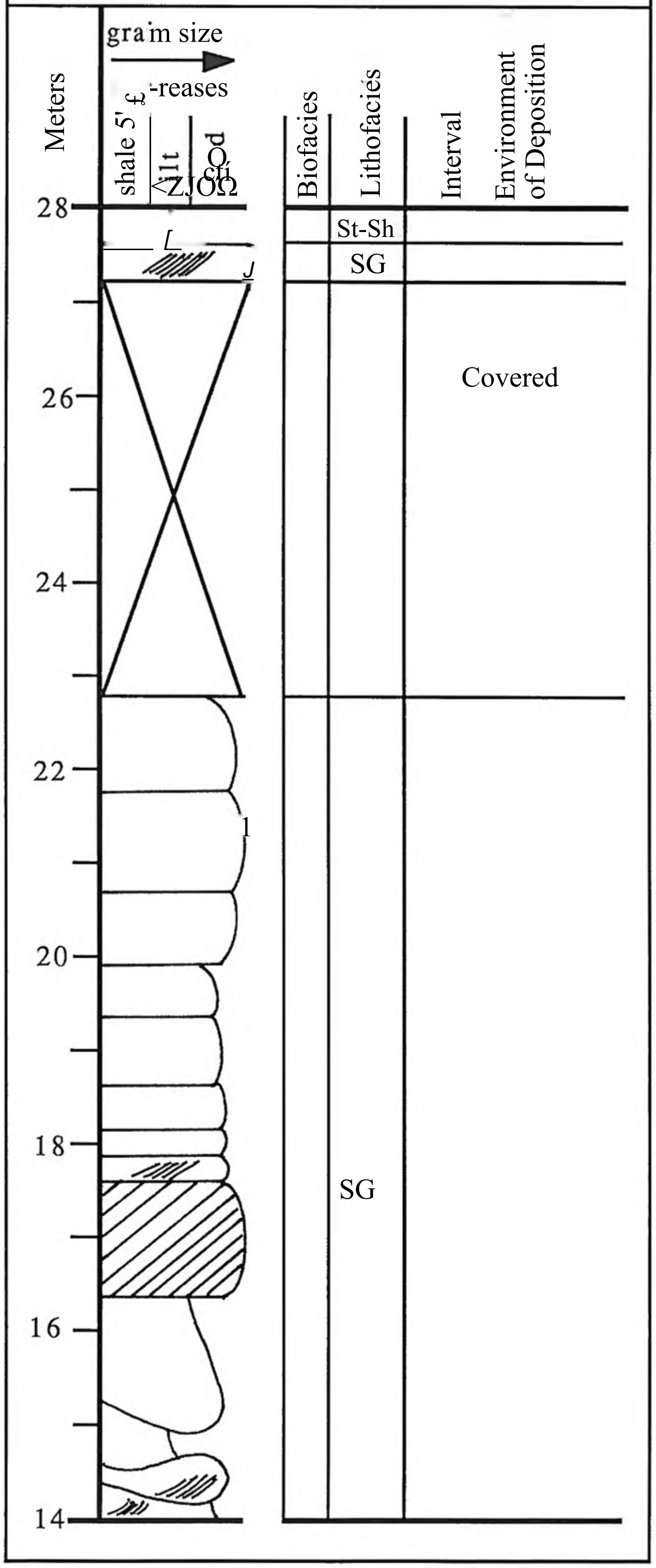
grey silty fine grained cross bedded sandstone, abundant mica and fine plant debris, sharp basal contact with soft sediment deformation structures

grey silty shale, finely laminated to blocky texture, sideritic zones, a few thin (1 cm) continuous of very fine grained sandstone

grey silty, fine grained cross bedded sandstone, abundant mica and fine plant debris

grey silty shale, sideritic zones, some siltstone beds and layers of large siderite nodules, both laterally continuous

Summiton Roadcut
(Locality 13, diagram 2 of 5)



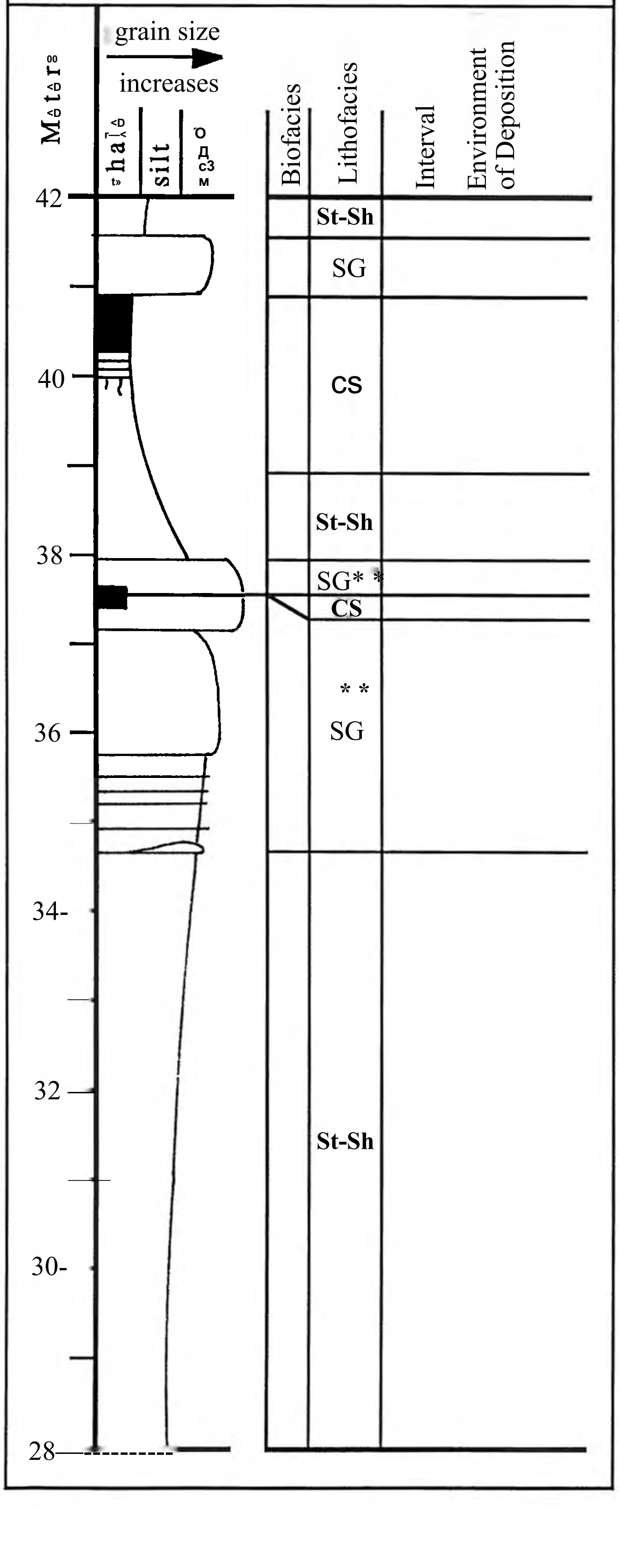
pink grey mottled sandy siltstone with clay interbeds very weathered

grey medium grained, sandstone very weathered

grey, fine to medium grained silty sandstone, abundant cross beds, individual sandstone beds are tabular and laterally continuous
Note: the transition from sandstone beds exihibiting abundant soft sediment deformation structures to the more tabular well crossbeded sandstones above is gradational but distinct.

Summiton Roadcut

(Locality 13, diagram 3 of 5)



weathered silty shale

yellow-grey ripple bedded sandstone with shale interbeds

40 cm vitrinitic coal, (Mary Lee Coal Group) 20 cm laminated coal below it, a heavily rooted underclay with large fragments of Sigillaria

grey silty shale fines upward into a white rooted underclay

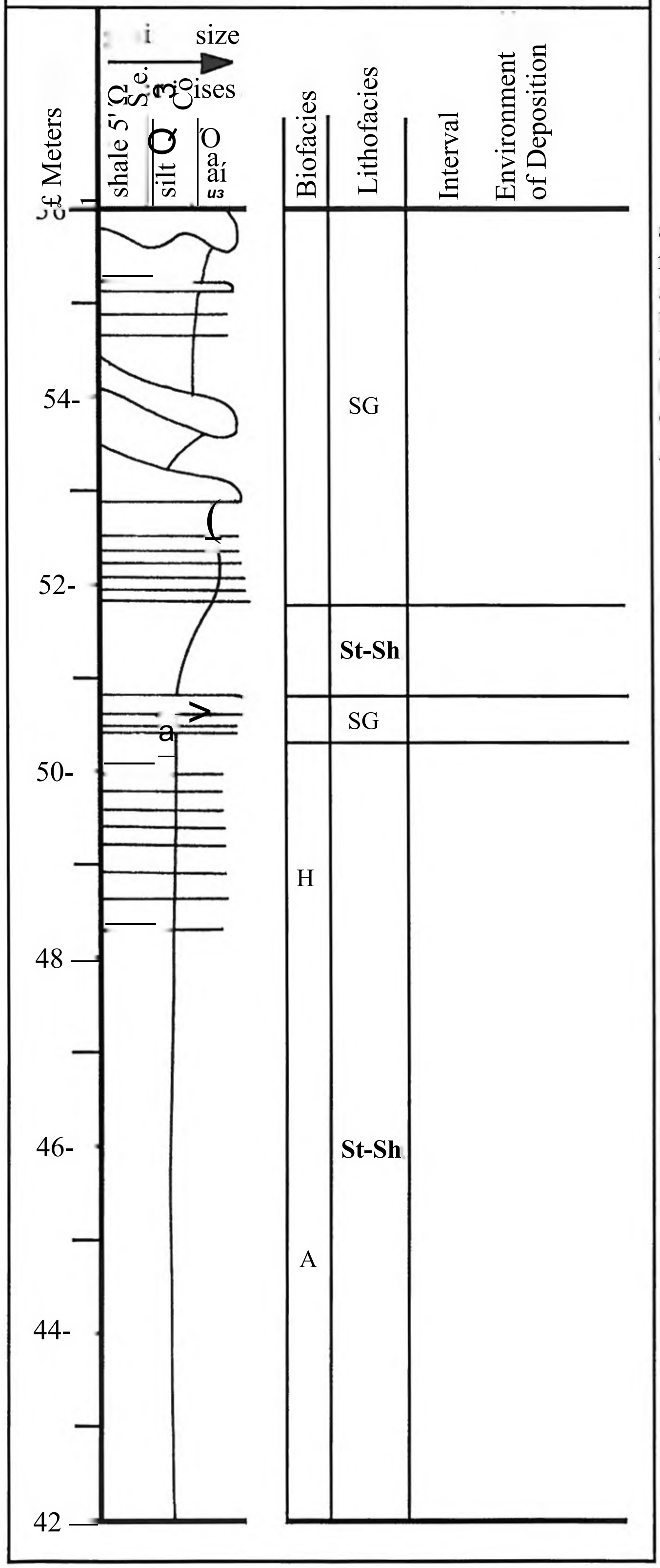
** same sandstone beds

10 cm coal exposed in the ditch on the opposit side of the road sandy siltstone above & below

** grey sandy silt and silty sandstone beds planar horizontal laminations, coarsens upward, very weathered and vegetated

grey, shale, silty shale and shaky siltstone, coarsens upward very weathered and vegetated

Summiton Roadcut
(Locality 13, diagram 4 of 5)

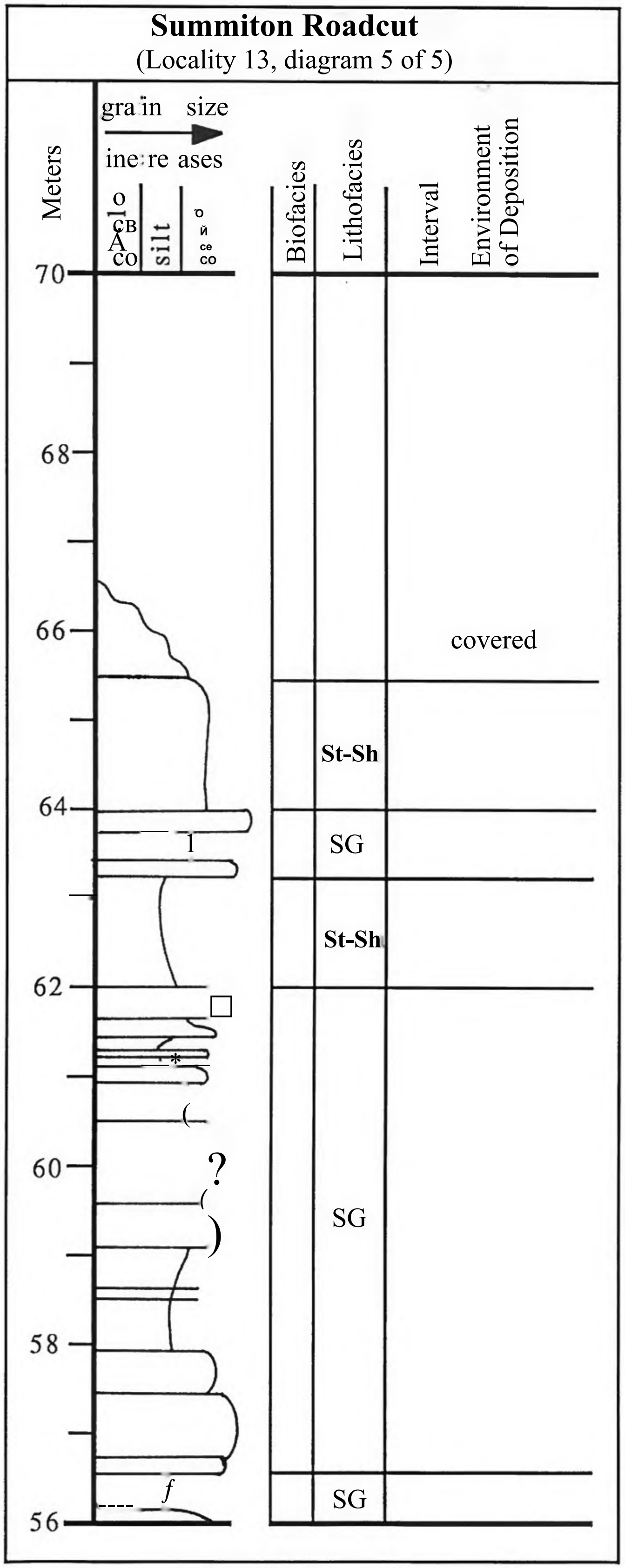


alternating beds of grey fine to medium grained silty sandstone and grey silty shale in finely laminated beds, abundant mica and fine plant debris, several shale beds are present which coarsen upward to a fine grained sandstone

grey shale, blocky texture, sideritic zones

grey silty fine grained sandstone, ripple cross-bedded planar continuous beds

grey silty shale, sideritic zones macro-invertebrate fossils (Brachiopods, Bivalves, Cephalopods), silty beds often have a mottled (bioturbated) texture, Helminthopsis is common in the upper portion (above 48m) of this unit, laterally continuous layers of large siderite nodules are common, coarsens upward



Top of the outcrop

interbedded shaley silt and silty shale in very weathered planar laterally continuous beds

grey silty fine to medium grained sandstone

grey silty shale finely laminated

grey fine to medium grained silty sandstone abundant cross-bedding, mica and fine plant debris, very planar laterally persistent beds with sharp upper and lower contacts sideritic zones are present in the few silty shale beds present

see description on top of previous page